Annual Groundwater Monitoring Report

Southwestern Electric Power Company

H. W. Pirkey Power Plant

Landfill CCR Management Unit

Hallsville, Texas

January 2021

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SOUTHWESTERN ELECTRIC POWER COMPANY℠

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I. Summary

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), Pirkey 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, 2021.

In general, the following activities were completed:

- Groundwater samples were collected for the wells the landfill groundwater monitoring network in June and November 2020 and analyzed for Appendix III, 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;
- An alternate source for the statistically significant increases (SSIs) over background that caused this unit to transition to assessment monitoring was identified in a report (*Alternative Source Demonstration Report Federal CCR Rule*) on January 7, 2020. As a result, the unit returned to detection monitoring and was in detection monitoring at the beginning of 2020;
- The unit was in detection monitoring at the end of 2020;
- There were no SSIs determined for the 2nd half 2019 groundwater sampling and analysis event;
- SSI over background was determined for fluoride at well AD-34 on October 2, 2020. An alternate source for fluoride exceedance was identified in a report (*Alternative Source Demonstration Report Federal CCR Rule*) on December 31, 2020;
- The November sampling event is undergoing statistical analysis;
- 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 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;

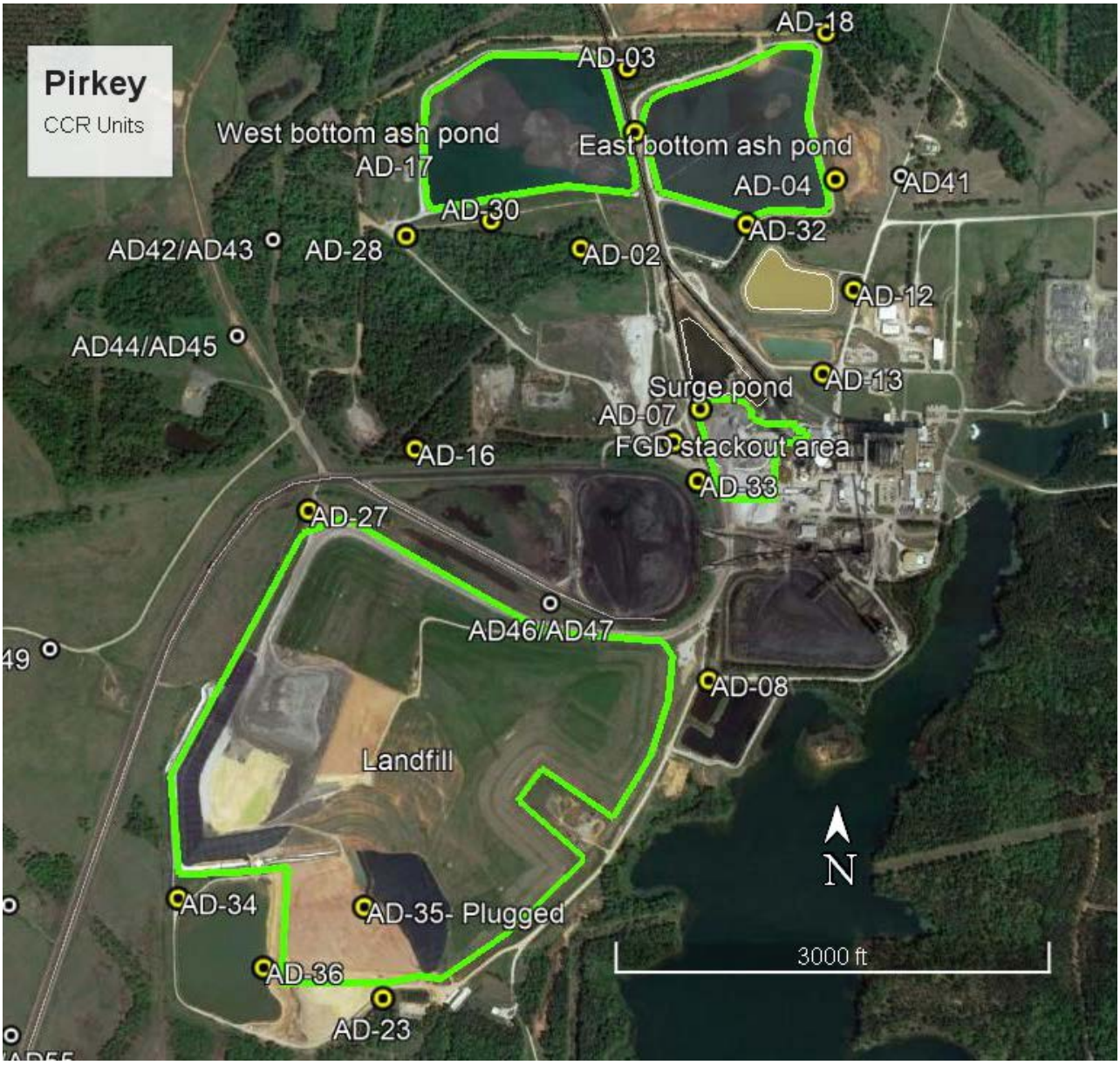
- All of the monitoring data collected, including the rate and direction of groundwater flow, plus a summary showing the number of samples collected per monitoring well, the dates the samples were collected and whether the sample was collected as part of detection monitoring or assessment monitoring 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, if applicable.
- 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.

Landfill Monitoring Wells	
Up Gradient	Down Gradient
AD-8	AD-23
AD-12	AD-34
AD-16	AD-35 (decommissioned 2018)
AD-27	AD-36 (installed 2019)



III. Monitoring Wells Installed or Decommissioned

One monitoring well (AD-7R) was installed to better understand spatial variability of constituents across the site, groundwater flow, and groundwater chemistry. The well installation report can be found in **Appendix IV**.

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.

As required by the detection monitoring rules, 40 CFR 257.94 et seq., two rounds of sampling were conducted in June and November including all Appendix III parameters.

The verification sample after the 2nd half 2019 groundwater sampling event appeared to be consistent with groundwater flow that is normally seen near the landfill (toward the south).

The verification sample after the 1st half 2020 groundwater sampling event appeared to be consistent with groundwater flow that is normally seen near the landfill (toward the south).

Detection monitoring will continue in 2021.

V. Statistical Evaluation of 2020 Events

The three statistical analysis reports available for this reporting period are included in **Appendix II**.

There were no SSIs determined for the 2nd half 2019 groundwater sampling and analysis event.

SSI over background was determined for fluoride at well AD-34 on October 2, 2020.

Data from the events conducted between August 2017 and June 2020, including both initial and verification results, were evaluated for inclusion in the background dataset. Additionally, data from eight background monitoring events at AD-36, which was installed to replace well AD-35 following its decommissioning, were evaluated to establish background concentrations for Appendix III constituent. Documentation for this information can be found in a report dated January 27, 2021 (*STATISTICAL ANALYSIS SUMMARY-Background Update Calculations H.W. Pirkey Power Plant Landfill*).

The November sampling event is undergoing statistical analysis.

VI. Alternate Source Demonstration

An alternate source investigation was conducted for the landfill's SSIs over background. An alternate source for the SSIs over background that caused to unit to transition to assessment

monitoring was identified in a report (*Alternative Source Demonstration Report Federal CCR Rule*) on January 7, 2020. As a result, the unit returned to detection monitoring.

SSI over background was determined for fluoride on October 2, 2020. An alternate source demonstration was identified in a report (*Alternative Source Demonstration Report Federal CCR Rule*) on December 31, 2020.

Documentation supporting these findings are found in **Appendix III**.

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

On April 3, 2018, no alternate source was found for SSIs over background, so the unit transitioned to assessment monitoring. On December 26, 2019, SSLs above GWPS were identified. On March 26, 2019, no alternate sources were identified for the unit, so it transitioned into assessment of corrective measures. On April 22, 2019, an alternate source was identified for the SSLs, so the unit did not continue assessment of corrective measures work and remained in assessment monitoring.

On January 7, 2020, an alternate source was found for the SSIs determined for boron, total dissolved solids (TDS), and sulfate as summarized in *Groundwater Monitoring Statistical Evaluation Report* (1/3/2018), so the unit returned to detection monitoring. The unit remained in detection monitoring during 2020.

Detection monitoring will continue in 2021.

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 2020 and Actions Taken

No problems were encountered this year.

X. A Projection of Key Activities for the Upcoming Year

Key activities for the next year include:

- Detection monitoring sampling will be conducted;

- Evaluation of the detection monitoring results from a statistical analysis viewpoint, looking for any SSIs over background;
- Responding to any new data received in light of CCR rule requirements;
- Preparation of the next 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.

Table 1 - Groundwater Data Summary: AD-8
Pirkey - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/10/2016	Background	1.58	109	9	< 0.083 U	6.1	181	432
7/13/2016	Background	0.775	20.7	13	2	6.2	131	280
9/8/2016	Background	1.04	50.7	12	2	5.1	121	285
10/12/2016	Background	0.793	20.8	13	2	3.7	184	276
11/15/2016	Background	0.769	17.2	13	3	3.7	208	296
1/11/2017	Background	0.734	18.6	13	3	3.6	228	280
2/28/2017	Background	0.777	18.1	10	2	3.7	157	250
4/11/2017	Background	0.779	17.1	12	3	3.9	168	284
8/23/2017	Detection	0.411	19.4	9	0.587 J	3.9	56	110
3/21/2018	Assessment	1.03	56.1	8	1.1987	5.7	140	278
8/20/2018	Assessment	0.714	14.5	18	5.1991	3.7	168	300
2/28/2019	Assessment	1.05	103	6.83	0.40	5.7	175	462
5/21/2019	Assessment	1.11	85.5	4.48	0.33	5.9	127	296
8/13/2019	Detection	0.818	27.6	12.7	3.39	4.6	128	260
6/3/2020	Detection	0.783	74.4	11.5	2.45	5.8	196	396
11/3/2020	Detection	0.822	18.5	15.8	2.50	4.1	119	237

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

Table 1 - Groundwater Data Summary: AD-8
Pirkey - LF
Appendix IV Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/10/2016	Background	< 0.93 U	< 1.05 U	38	1	< 0.07 U	1	1.80288 J	0.9155	< 0.083 U	1.02541 J	< 0.00013 U	0.027	< 0.29 U	15	1.19926 J
7/13/2016	Background	< 0.93 U	1.16508 J	61	7	0.175996 J	1	20	6.75	2	1.46729 J	0.032	0.211	< 0.29 U	< 0.99 U	< 0.86 U
9/8/2016	Background	< 0.93 U	< 1.05 U	48	2	< 0.07 U	0.835837 J	9	1.658	2	< 0.68 U	0.018	0.048	< 0.29 U	3.84567 J	< 0.86 U
10/12/2016	Background	< 0.93 U	1.46586 J	61	6	< 0.07 U	0.74214 J	18	6.72	2	2.30733 J	0.032	0.112	< 0.29 U	2.51464 J	< 0.86 U
11/15/2016	Background	< 0.93 U	< 1.05 U	52	6	0.118693 J	0.805286 J	18	6.14	3	2.85553 J	0.03	0.16	< 0.29 U	< 0.99 U	< 0.86 U
1/11/2017	Background	< 0.93 U	1.53134 J	60	6	0.108717 J	2	18	6.29	3	2.99592 J	0.032	0.157	< 0.29 U	1.4083 J	< 0.86 U
2/28/2017	Background	< 0.93 U	1.68597 J	52	6	0.13889 J	0.633257 J	18	7.64	2	3.26919 J	0.031	0.153	< 0.29 U	1.78549 J	< 0.86 U
4/11/2017	Background	< 0.93 U	< 1.05 U	51	6	0.128137 J	0.887504 J	19	5.56	3	2.44168 J	0.031	0.01068 J	< 0.29 U	< 0.99 U	< 0.86 U
3/21/2018	Assessment	< 0.93 U	< 1.05 U	37.9	2.57	< 0.07 U	< 0.23 U	9.38	2.499	1.1987	0.95 J	0.01503	0.049	< 0.29 U	27.68	< 0.86 U
8/20/2018	Assessment	0.02 J	4.05	33.4	4.55	0.18	0.759	15.9	0.145	5.1991	4.46	0.0221	0.105	0.02 J	9.8	0.083
2/28/2019	Assessment	< 0.4 U	< 0.6 U	46.8	< 0.4 U	< 0.2 U	< 0.8 U	0.8 J	1.066	0.40	< 0.4 U	0.002 J	< 0.005 U	< 8 U	30.8	< 2 U
5/21/2019	Assessment	< 0.4 U	1 J	42.8	1 J	< 0.2 U	< 0.8 U	< 0.4 U	1.786	0.33	< 0.4 U	0.0003 J	0.009 J	< 8 U	23.9	< 0.1 U

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

Table 1 - Groundwater Data Summary: AD-12
Pirkey - LF
Appendix III Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/11/2016	Background	0.03	0.362	5	< 0.083 U	4.4	4	94
7/13/2016	Background	0.03	0.26	6	< 0.083 U	3.1	4	75
9/7/2016	Background	0.04	0.343	6	< 0.083 U	3.9	7	63
10/12/2016	Background	0.03	0.271	7	1	3.4	8	92
11/14/2016	Background	0.04	0.331	8	< 0.083 U	2.6	6	80
1/11/2017	Background	0.03	0.315	7	< 0.083 U	4.8	6	76
2/28/2017	Background	0.04	0.434	5	< 0.083 U	3.6	4	50
4/11/2017	Background	0.05	0.299	6	0.2565 J	4.7	7	72
8/23/2017	Detection	0.0495	0.245	6	0.213 J	4.8	6	52
3/21/2018	Assessment	0.01397	0.269	5	< 0.083 U	4.2	3	< 2 U
8/20/2018	Assessment	0.017	0.338	10	< 0.083 U	4.4	4	94
2/27/2019	Assessment	0.03 J	0.4 J	6.08	0.09	5.2	3.6	36
5/21/2019	Assessment	0.020	0.3 J	6.30	0.09	4.1	4.0	80
8/12/2019	Detection	< 0.02 U	0.278	7.24	0.06 J	4.9	2.6	90
3/10/2020	Detection	0.02 J	0.3 J	6.08	0.10	4.9	3.7	62
6/2/2020	Detection	< 0.02 U	0.2 J	5.63	0.10	4.0	3.9	91
11/2/2020	Detection	0.03 J	0.3 J	4.65	0.08	4.3	3.3	74

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

Table 1 - Groundwater Data Summary: AD-12
Pirkey - LF
Appendix IV Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/11/2016	Background	< 0.93 U	< 1.05 U	26	0.219521 J	< 0.07 U	0.710981 J	1.58207 J	0.2073	< 0.083 U	< 0.68 U	< 0.00013 U	< 0.005 U	< 0.29 U	1.73953 J	< 0.86 U
7/13/2016	Background	< 0.93 U	< 1.05 U	23	0.190337 J	< 0.07 U	0.68835 J	1.29444 J	2.909	< 0.083 U	< 0.68 U	0.008	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
9/7/2016	Background	< 0.93 U	< 1.05 U	30	0.232192 J	< 0.07 U	0.353544 J	1.66591 J	0.881	< 0.083 U	< 0.68 U	0.01	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
10/12/2016	Background	< 0.93 U	< 1.05 U	27	0.149553 J	< 0.07 U	0.529033 J	1.56632 J	0.257	1	< 0.68 U	0.012	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
11/14/2016	Background	< 0.93 U	< 1.05 U	28	0.152375 J	< 0.07 U	0.32826 J	1.47282 J	0.767	< 0.083 U	< 0.68 U	0.013	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
1/11/2017	Background	< 0.93 U	< 1.05 U	23	0.126621 J	< 0.07 U	0.650158 J	1.09495 J	1.536	< 0.083 U	< 0.68 U	0.01	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
2/28/2017	Background	< 0.93 U	< 1.05 U	26	0.149219 J	< 0.07 U	0.325811 J	1.29984 J	0.416	< 0.083 U	< 0.68 U	0.009	< 0.005 U	< 0.29 U	< 0.99 U	0.994913 J
4/11/2017	Background	< 0.93 U	< 1.05 U	24	0.159412 J	< 0.07 U	0.416007 J	1.33344 J	0.3895	0.2565 J	< 0.68 U	0.008	0.01364 J	< 0.29 U	< 0.99 U	< 0.86 U
3/21/2018	Assessment	< 0.93 U	< 1.05 U	25.82	0.16 J	< 0.07 U	1.05	1.49 J	0.784	< 0.083 U	< 0.68 U	0.00722	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
8/20/2018	Assessment	< 0.01 U	0.11	27.8	0.159	0.01 J	0.330	1.72	1.128	< 0.083 U	0.089	0.0143	< 0.005 U	0.04 J	0.1	0.04 J
2/27/2019	Assessment	< 0.4 U	< 0.6 U	22.5	< 0.4 U	< 0.2 U	< 0.8 U	1.37	0.225	0.09	< 0.4 U	0.00688	< 0.005 U	< 8 U	< 0.6 U	< 2 U
5/21/2019	Assessment	< 0.4 U	< 0.6 U	21.7	< 0.4 U	< 0.2 U	< 0.8 U	1.15	0.201	0.09	< 0.4 U	0.00576	< 0.005 U	< 8 U	< 0.6 U	< 0.1 U

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

Table 1 - Groundwater Data Summary: AD-16
Pirkey - LF
Appendix III Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/10/2016	Background	0.02	1.21	8	< 0.083 U	3.9	16	116
7/14/2016	Background	0.03	2	9	< 0.083 U	3.8	45	148
9/8/2016	Background	0.03	1.83	9	< 0.083 U	3.9	33	133
10/13/2016	Background	0.03	1.15	9	< 0.083 U	3.9	16	124
11/14/2016	Background	0.03	1.58	9	< 0.083 U	4.4	23	124
1/12/2017	Background	0.02	1.76	10	< 0.083 U	3.7	43	112
3/1/2017	Background	0.03	1.29	9	< 0.083 U	3.2	22	108
4/10/2017	Background	0.02	1.21	11	< 0.083 U	3.4	24	106
8/24/2017	Detection	0.03648	0.945	12	< 0.083 U	4.3	14	96
3/22/2018	Assessment	0.0171	1.03	14	< 0.083 U	4.0	13	96
8/21/2018	Assessment	0.020	1.17	17	< 0.083 U	4.0	15	128
2/27/2019	Assessment	0.03 J	0.704	20.3	0.07 J	4.1	17.7	76
5/23/2019	Assessment	0.022	1.06	20.8	0.06 J	4.6	26.9	128
8/15/2019	Detection	< 0.02 U	0.874	20.0	0.06 J	5.1	15.4	110
6/3/2020	Detection	< 0.02 U	0.872	21.7	0.11	4.7	13.3	122
11/3/2020	Detection	< 0.02 U	0.817	19.9	0.07	4.4	11.0	105

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

Table 1 - Groundwater Data Summary: AD-16
Pirkey - LF
Appendix IV Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/10/2016	Background	< 0.93 U	1.83497 J	61	0.453643 J	0.0817904 J	1	4.23727 J	1.294	< 0.083 U	< 0.68 U	0.006	0.01506 J	< 0.29 U	2.26113 J	1.3697 J
7/14/2016	Background	< 0.93 U	< 1.05 U	64	0.565692 J	< 0.07 U	1	6	1.438	< 0.083 U	< 0.68 U	0.036	0.02395 J	1.1177 J	< 0.99 U	< 0.86 U
9/8/2016	Background	8	< 1.05 U	70	0.810547 J	0.0926258 J	2	8	1.931	< 0.083 U	< 0.68 U	0.032	0.00753 J	< 0.29 U	< 0.99 U	1.75243 J
10/13/2016	Background	< 0.93 U	1.52475 J	56	0.250902 J	< 0.07 U	1	3.33761 J	1.843	< 0.083 U	< 0.68 U	0.033	< 0.005 U	< 0.29 U	1.70284 J	< 0.86 U
11/14/2016	Background	< 0.93 U	< 1.05 U	55	0.38481 J	< 0.07 U	0.561291 J	4.34297 J	2.123	< 0.083 U	< 0.68 U	0.028	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
1/12/2017	Background	< 0.93 U	< 1.05 U	58	0.70928 J	< 0.07 U	0.406161 J	8	2.629	< 0.083 U	< 0.68 U	0.031	0.01045 J	< 0.29 U	< 0.99 U	< 0.86 U
3/1/2017	Background	< 0.93 U	1.50766 J	76	0.487946 J	< 0.07 U	0.558767 J	5	1.417	< 0.083 U	< 0.68 U	0.021	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
4/10/2017	Background	< 0.93 U	< 1.05 U	77	0.435552 J	< 0.07 U	0.822329 J	5	0.932	< 0.083 U	< 0.68 U	0.019	0.00733 J	< 0.29 U	< 0.99 U	< 0.86 U
3/22/2018	Assessment	< 0.93 U	< 1.05 U	83.66	0.27 J	< 0.07 U	1.59	3.6 J	2.11	< 0.083 U	< 0.68 U	0.02224	0.018 J	< 0.29 U	< 0.99 U	< 0.86 U
8/21/2018	Assessment	0.03 J	0.42	69.0	0.213	0.03	0.211	3.78	1.92	< 0.083 U	0.082	0.0347	0.014 J	< 0.02 U	0.1	0.051
2/27/2019	Assessment	< 0.4 U	7.74	56.2	< 0.4 U	< 0.2 U	< 0.8 U	3.21	0.848	0.07 J	< 0.4 U	0.0154	0.011 J	< 8 U	< 0.6 U	< 2 U
5/23/2019	Assessment	< 0.4 U	5.80	83.4	< 0.4 U	< 0.2 U	< 0.8 U	3.16	1.957	0.06 J	< 0.4 U	0.0227	< 0.005 U	< 8 U	< 0.6 U	< 0.1 U

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

Table 1 - Groundwater Data Summary: AD-23
Pirkey - LF
Appendix III Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/10/2016	Background	0.01	0.535	4	< 0.083 U	4.0	10	72
7/13/2016	Background	0.03	0.317	4	< 0.083 U	2.7	11	59
9/8/2016	Background	0.02	0.26	5	< 0.083 U	3.5	12	64
10/12/2016	Background	0.03	0.321	6	< 0.083 U	3.7	13	68
11/15/2016	Background	0.03	0.249	5	< 0.083 U	3.5	14	100
1/11/2017	Background	0.02	0.319	6	< 0.083 U	3.7	13	60
2/28/2017	Background	0.03	0.217	4	< 0.083 U	4.0	9	48
4/11/2017	Background	0.03	0.543	7	0.2688 J	4.2	11	76
8/23/2017	Detection	0.04021	0.276	6	0.198 J	4.1	11	64
12/21/2017	Detection	0.04498	0.469	--	--	--	--	--
3/21/2018	Assessment	0.01762	0.227	4	< 0.083 U	3.9	10	72
8/20/2018	Assessment	0.017	0.247	9	< 0.083 U	3.8	11	92
2/28/2019	Assessment	0.02 J	0.3 J	6.94	0.04 J	5.1	7.2	70
5/23/2019	Assessment	0.017	0.3 J	6.82	0.04 J	4.8	9.1	54
8/13/2019	Detection	< 0.02 U	0.325	7.12	0.03 J	5.0	7.4	126
1/27/2020	Detection	--	--	--	--	4.3	--	70 J
6/3/2020	Detection	< 0.02 U	0.2 J	7.08	0.07	4.3	8.5	65
11/4/2020	Detection	< 0.02 U	0.2 J	6.97	0.05 J	3.9	7.9	71

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

Table 1 - Groundwater Data Summary: AD-23
Pirkey - LF
Appendix IV Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/10/2016	Background	2.89148 J	1.65098 J	48	0.186855 J	0.0739811 J	2	2.29646 J	6.86	< 0.083 U	< 0.68 U	0.000135818 J	0.01188 J	< 0.29 U	1.91991 J	< 0.86 U
7/13/2016	Background	3.79558 J	< 1.05 U	48	0.192156 J	0.0925427 J	2	2.72879 J	5.69	< 0.083 U	< 0.68 U	0.006	0.01721 J	1.34973 J	2.00038 J	< 0.86 U
9/8/2016	Background	< 0.93 U	< 1.05 U	53	0.20435 J	< 0.07 U	5	2.01019 J	6.68	< 0.083 U	2.23756 J	0.006	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
10/12/2016	Background	1.29835 J	7	120	0.463688 J	0.13648 J	41	3.91303 J	12.89	< 0.083 U	31	1.01	0.095	0.563586 J	2.10924 J	< 0.86 U
11/15/2016	Background	< 0.93 U	< 1.05 U	50	0.129296 J	< 0.07 U	6	1.66943 J	7.54	< 0.083 U	3.21271 J	0.006	0.02438 J	0.403857 J	1.34763 J	< 0.86 U
1/11/2017	Background	< 0.93 U	2.03681 J	73	0.159 J	< 0.07 U	15	2.25934 J	8.06	< 0.083 U	11	0.009	0.092	< 0.29 U	< 0.99 U	< 0.86 U
2/28/2017	Background	1.65681 J	< 1.05 U	41	0.116844 J	< 0.07 U	0.295768 J	1.05228 J	5.74	< 0.083 U	< 0.68 U	0.005	< 0.005 U	< 0.29 U	1.3076 J	< 0.86 U
4/11/2017	Background	< 0.93 U	3.9673 J	86	0.318917 J	0.107977 J	22	2.60853 J	10.31	0.2688 J	15	0.01	0.118	0.31517 J	< 0.99 U	< 0.86 U
3/21/2018	Assessment	< 0.93 U	< 1.05 U	56.1	0.17 J	< 0.07 U	5.7	1.09 J	7.55	< 0.083 U	3.52 J	0.00709	0.02 J	< 0.29 U	< 0.99 U	< 0.86 U
8/20/2018	Assessment	0.03 J	0.87	53.5	0.147	0.01 J	1.77	0.803	11	< 0.083 U	4.79	0.00634	0.025	0.07 J	1.0	0.176
2/28/2019	Assessment	< 0.4 U	1 J	46.9	< 0.4 U	< 0.2 U	4.16	1 J	6.14	0.04 J	3.46	0.00646	0.035	< 8 U	1 J	< 2 U
5/23/2019	Assessment	< 0.4 U	0.7 J	56.4	< 0.4 U	< 0.2 U	3 J	0.7 J	9.66	0.04 J	8.99	0.00537	0.058 J	< 8 U	< 0.6 U	0.2 J

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

Table 1 - Groundwater Data Summary: AD-27
Pirkey - LF
Appendix III Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/11/2016	Background	0.02	4.41	8	0.6176 J	3.9	51	198
7/13/2016	Background	0.03	4.43	8	< 0.083 U	2.7	54	192
9/8/2016	Background	0.03	4.17	8	< 0.083 U	2.9	52	196
10/12/2016	Background	0.03	4.09	8	< 0.083 U	3.0	58	216
11/15/2016	Background	0.03	4.52	8	< 0.083 U	3.5	92	216
1/11/2017	Background	0.02	3.74	9	< 0.083 U	4.1	58	180
3/1/2017	Background	0.03	4.31	8	< 0.083 U	2.8	56	216
4/10/2017	Background	0.03	4.01	9	< 0.083 U	3.3	54	180
8/24/2017	Detection	0.0358	3.58	9	0.197 J	3.7	52	168
3/22/2018	Assessment	0.03901	5.58	11	< 0.083 U	3.9	78	192
8/21/2018	Assessment	0.024	4.58	10	< 0.083 U	3.5	65	196
2/28/2019	Assessment	0.07 J	4.02	11.7	0.20	4.7	52.8	42
5/23/2019	Assessment	0.023	3.89	11.4	0.20	4.4	55.2	204
8/16/2019	Detection	0.02 J	3.94	10.5	0.18	3.9	53.2	198
6/3/2020	Detection	0.03 J	3.55	12.8	0.25	4.2	54.6	219
11/3/2020	Detection	0.03 J	3.45	10.8	0.19	3.6	53.1	196

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

Table 1 - Groundwater Data Summary: AD-27
Pirkey - LF
Appendix IV Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/11/2016	Background	1.20808 J	2.15232 J	43	5	0.431235 J	0.87101 J	20	2.031	0.6176 J	< 0.68 U	0.066	< 0.005 U	< 0.29 U	1.10872 J	< 0.86 U
7/13/2016	Background	0.956365 J	1.27952 J	45	5	0.434627 J	2	21	2.406	< 0.083 U	< 0.68 U	0.097	0.02241 J	0.434679 J	< 0.99 U	< 0.86 U
9/8/2016	Background	< 0.93 U	< 1.05 U	47	6	0.398469 J	2	20	2.71	< 0.083 U	< 0.68 U	0.095	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
10/12/2016	Background	< 0.93 U	2.14429 J	46	5	0.424977 J	2	20	4.43	< 0.083 U	< 0.68 U	0.096	< 0.005 U	< 0.29 U	1.35863 J	< 0.86 U
11/15/2016	Background	< 0.93 U	< 1.05 U	41	5	0.419182 J	2	22	3.69	< 0.083 U	< 0.68 U	0.095	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
1/11/2017	Background	< 0.93 U	1.56781 J	46	5	0.30207 J	1	18	2.62	< 0.083 U	< 0.68 U	0.1	0.00659 J	< 0.29 U	< 0.99 U	< 0.86 U
3/1/2017	Background	< 0.93 U	< 1.05 U	43	5	0.286804 J	2	21	3.48	< 0.083 U	< 0.68 U	0.1	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
4/10/2017	Background	< 0.93 U	< 1.05 U	45	5	0.414787 J	0.954802 J	21	2.58	< 0.083 U	< 0.68 U	0.104	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
3/22/2018	Assessment	< 0.93 U	< 1.05 U	40.53	5.29	0.48 J	3.09	25.63	2.808	< 0.083 U	< 0.68 U	0.108	0.012 J	< 0.29 U	< 0.99 U	< 0.86 U
8/21/2018	Assessment	0.02 J	1.71	39.5	4.90	0.46	1.14	24.6	2.619	< 0.083 U	0.296	0.0921	0.006 J	0.07 J	3.7	0.137
2/28/2019	Assessment	< 0.4 U	1 J	39.5	5.32	0.5 J	< 0.8 U	18.9	2.95	0.20	< 0.4 U	0.0892	< 0.005 U	< 8 U	2 J	< 2 U
5/23/2019	Assessment	< 0.4 U	< 0.6 U	41.0	5.22	0.3 J	< 0.8 U	19.9	3.93	0.20	< 0.4 U	0.0885	< 0.005 U	< 8 U	0.6 J	0.2 J

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

Table 1 - Groundwater Data Summary: AD-34
Pirkey - LF
Appendix III Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/10/2016	Background	0.08	37.8	7	< 0.083 U	4.0	974	1,516
7/13/2016	Background	0.111	33.2	8	< 0.083 U	3.6	837	1,396
9/8/2016	Background	0.09	39.5	8	< 0.083 U	3.3	870	1,520
10/12/2016	Background	0.09	35.8	7	0.6272 J	3.6	1,084	1,464
11/15/2016	Background	0.1	36.3	7	0.9978 J	3.7	1,006	1,428
1/11/2017	Background	0.07	39.9	8	< 0.083 U	3.2	1,334	1,378
2/28/2017	Background	0.08	37	6	< 0.083 U	3.7	993	1,402
4/10/2017	Background	0.09	38.2	8	0.5241 J	3.0	1,016	1,490
8/23/2017	Detection	0.107	36.2	7	0.619 J	3.7	1,231	1,128
12/21/2017	Detection	--	--	8	0.6669 J	--	1,020	1,260
3/21/2018	Assessment	0.171	40.1	6	< 0.083 U	3.7	956	1,424
8/20/2018	Assessment	0.067	37.0	10	< 0.083 U	3.7	1,064	1,462
2/27/2019	Assessment	0.08 J	39.9	7.64	0.86	2.9	970	1,470
5/21/2019	Assessment	0.060	42.0	7.34	0.69	3.3	1,080	1,154
8/13/2019	Detection	0.070	39.8	7.46	1.13	3.7	1,060	1,648
1/27/2020	Detection	--	--	--	0.9	3.6	--	1,550
3/11/2020	Detection	--	--	--	--	3.6	--	--
6/3/2020	Detection	0.058	40.1	7.68	1.22	3.4	1,150	1,620
7/15/2020	Detection	--	--	--	1.39	4.1	--	1,510
11/4/2020	Detection	0.060	39.5	7.10	0.82	3.4	1,090	1,670

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

Table 1 - Groundwater Data Summary: AD-34
Pirkey - LF
Appendix IV Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
5/10/2016	Background	< 0.93 U	12	72	3	6	34	301	9.64	< 0.083 U	12	0.176	0.105	0.688222 J	< 0.99 U	< 0.86 U
7/13/2016	Background	< 0.93 U	25	177	4	6	81	296	7.75	< 0.083 U	39	0.183	0.313	2.11044 J	7	< 0.86 U
9/8/2016	Background	< 0.93 U	9	31	3	8	12	306	7.91	< 0.083 U	1.01746 J	0.158	0.064	< 0.29 U	< 0.99 U	< 0.86 U
10/12/2016	Background	< 0.93 U	10	39	3	5	15	297	10.12	0.6272 J	3.69632 J	0.174	0.036	< 0.29 U	< 0.99 U	< 0.86 U
11/15/2016	Background	< 0.93 U	7	23	2	8	6	292	13.21	0.9978 J	< 0.68 U	0.154	0.025	< 0.29 U	4.50827 J	< 0.86 U
1/11/2017	Background	< 0.93 U	6	29	2	7	8	284	11.9	< 0.083 U	< 0.68 U	0.164	0.032	< 0.29 U	< 0.99 U	< 0.86 U
2/28/2017	Background	< 0.93 U	7	11	2	6	< 0.23 U	294	9.87	< 0.083 U	< 0.68 U	0.158	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
4/10/2017	Background	< 0.93 U	4.49903 J	23	2	11	7	299	2.407	0.5241 J	< 0.68 U	0.167	0.0164 J	< 0.29 U	< 0.99 U	< 0.86 U
3/21/2018	Assessment	< 0.93 U	6.51	10.6	2.24	11.97	< 0.23 U	279	8.85	< 0.083 U	< 0.68 U	0.156	< 0.005 U	< 0.29 U	3.24 J	< 0.86 U
8/20/2018	Assessment	0.01 J	14.4	7.77	1.77	4.34	0.977	249	10.17	< 0.083 U	1.32	0.114	0.005 J	0.03 J	13.0	0.070
2/27/2019	Assessment	< 0.4 U	15.9	9.93	2.42	4.57	0.9 J	260	8.56	0.86	1 J	0.153	0.015 J	< 8 U	14.8	< 2 U
5/21/2019	Assessment	< 0.4 U	12.7	10.5	2.25	4.48	0.8 J	272	10.82	0.69	1 J	0.158	< 0.005 U	< 8 U	4.9	< 0.1 U

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

Table 1 - Groundwater Data Summary: AD-36
Pirkey - LF
Appendix III Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
8/13/2019	Background	0.065	0.240	9.46	0.05 J	4.7	2.2	92
1/27/2020	Background	0.056	0.304	8.65	0.05 J	4.7	3.5	40 J
3/11/2020	Background	0.05 J	0.2 J	8.44	0.06	5.0	3.7	60 J
4/15/2020	Background	0.054	0.2 J	8.40	0.05 J	3.6	3.7	40 J
5/13/2020	Background	0.055	0.2 J	8.56	0.05 J	4.1	3.4	40 J
6/3/2020	Background	0.052	0.2 J	8.52	0.07	4.6	3.3	65
6/16/2020	Background	0.064	0.2 J	8.39	0.05 J	4.6	3.6	50 J
7/1/2020	Background	0.059	0.3 J	--	--	4.9	--	52
7/15/2020	Background	--	--	8.09	0.08	5.0	3.7	--
11/4/2020	Detection	0.068	0.2 J	7.99	0.06 J	4.6	3.1	57

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

Table 1 - Groundwater Data Summary: AD-36
Pirkey - LF
Appendix IV Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
8/13/2019	Background	< 0.02 U	0.15	10.8	0.234	< 0.01 U	0.203	0.901	1.298	0.05 J	< 0.05 U	0.0161	< 0.005 U	< 0.4 U	0.09 J	< 0.1 U
1/27/2020	Background	< 0.02 U	0.14	9.94	0.191	0.01 J	0.09 J	0.762	1.096	0.05 J	< 0.05 U	0.00277	< 0.2 U	< 0.4 U	0.07 J	< 0.1 U
3/11/2020	Background	< 0.02 U	0.09 J	10.2	0.184	< 0.01 U	< 0.04 U	0.760	4.056	0.06	< 0.05 U	0.00246	< 0.002 U	< 0.4 U	0.1 J	< 0.1 U
4/15/2020	Background	< 0.02 U	0.10	10.1	0.179	< 0.01 U	0.1 J	0.770	2.84	0.05 J	< 0.05 U	0.00210	0.003 J	0.8 J	0.09 J	< 0.1 U
5/13/2020	Background	< 0.02 U	0.15	10.2	0.194	< 0.01 U	0.247	0.750	2.346	0.05 J	< 0.05 U	0.00266	0.004 J	< 0.4 U	0.08 J	< 0.1 U
6/3/2020	Background	< 0.02 U	0.11	9.81	0.204	< 0.01 U	0.08 J	0.683	0.692	0.07	< 0.05 U	0.00262	0.005 J	< 0.4 U	0.09 J	< 0.1 U
6/16/2020	Background	< 0.02 U	0.11	9.75	0.173	< 0.01 U	0.214	0.723	0.885	0.05 J	0.08 J	0.00254	0.003 J	1 J	0.1 J	< 0.1 U
7/1/2020	Background	< 0.02 U	0.09 J	9.72	0.179	< 0.01 U	0.09 J	0.681	1.171	--	< 0.05 U	0.00268	0.004 J	< 0.4 U	0.06 J	< 0.1 U
7/15/2020	Background	--	--	--	--	--	--	--	--	0.08	--	--	--	--	--	--

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

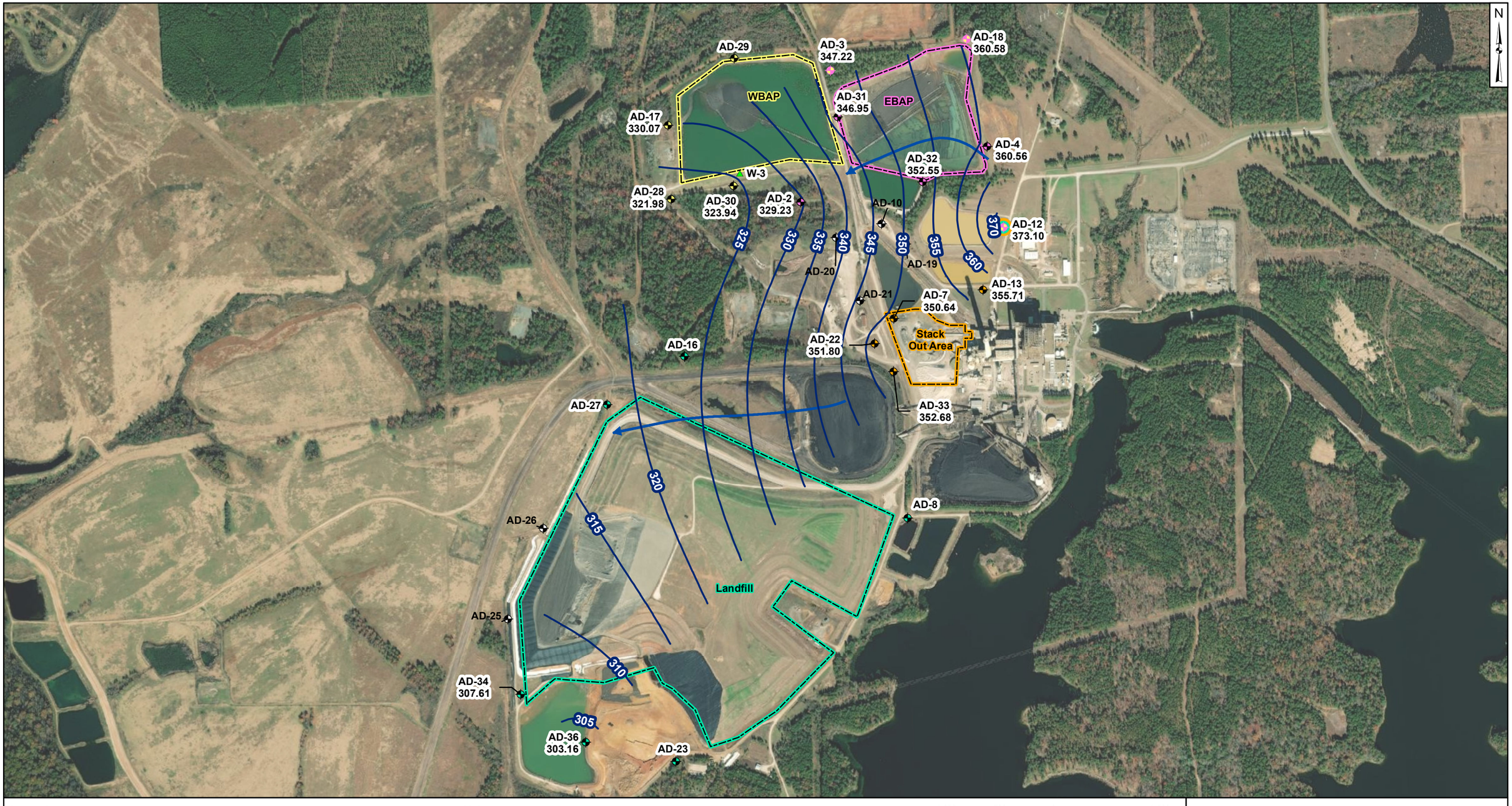
Table 1: Residence Time Calculation Summary
Pirkey Landfill

Geosyntec Consultants, Inc.

CCR Management Unit	Monitoring Well	Well Diameter (inches)	2020-01[3]		2020-03		2020-06	
			Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Landfill	AD-8 [1]	4.0	NC	NC	NC	NC	6.4	19.0
	AD-12 [1]	4.0	NC	NC	35.1	3.5	20.1	6.0
	AD-16 [1]	2.0	NC	NC	NC	NC	24.7	2.5
	AD-23 [2]	2.0	21.3	2.9	NC	NC	17.9	3.4
	AD-27 [1]	2.0	NC	NC	NC	NC	9.8	6.2
	AD-34 [2]	2.0	NC	NC	3.3	18.7	NC	NC
	AD-36 [2]	2.0	21.3	2.9	11.7	5.2	22.6	2.7

CCR Management Unit	Monitoring Well	Well Diameter (inches)	2020-07[3]		2020-11	
			Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Landfill	AD-8 [1]	4.0	NC	NC	7.0	17.4
	AD-12 [1]	4.0	NC	NC	26.9	4.5
	AD-16 [1]	2.0	NC	NC	21.6	2.8
	AD-23 [2]	2.0	NC	NC	14.2	4.3
	AD-27 [1]	2.0	NC	NC	16.6	3.7
	AD-34 [2]	2.0	10.1	6.0	27.3	2.2
	AD-36 [2]	2.0	22.1	2.8	26.0	2.3

Notes:
[1] - Background Well
[2] - Downgradient Well
[3] - Only select wells were gauged as part of two-of-two verification sampling
NC - Not Calculated



Legend

Groundwater Monitoring Wells

- Out of Network
- EBAP
- WBAP
- Landfill
- Stackout Area
- EBAP and WBAP

- All CCR Unit Networks
- Piezometer
- Groundwater Elevation Contour
- Approximate Groundwater Flow Direction

Notes

- Monitoring well coordinates and water level data (collected on March 10-11, 2020) provided by AEP.
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level.
- East and West Bottom Ash Ponds have compacted cohesive soil from elevation 344 to 347 ft. msl (Sargent and Lundy, 1984; AMEC, 2011).
- Clearwater pond base elevation is 344 ft. msl (Sargent and Lundy, 1983).
- W-3, AD-16, AD-27, and AD-29 were not gauged in March 2020.
- AD-34 is an artesian well.
- AD-35 was abandoned November 13, 2018. AD-36 was installed April 24, 2019.

1,000 500 0 1,000 Feet

Potentiometric Contours - Uppermost Aquifer March 2020

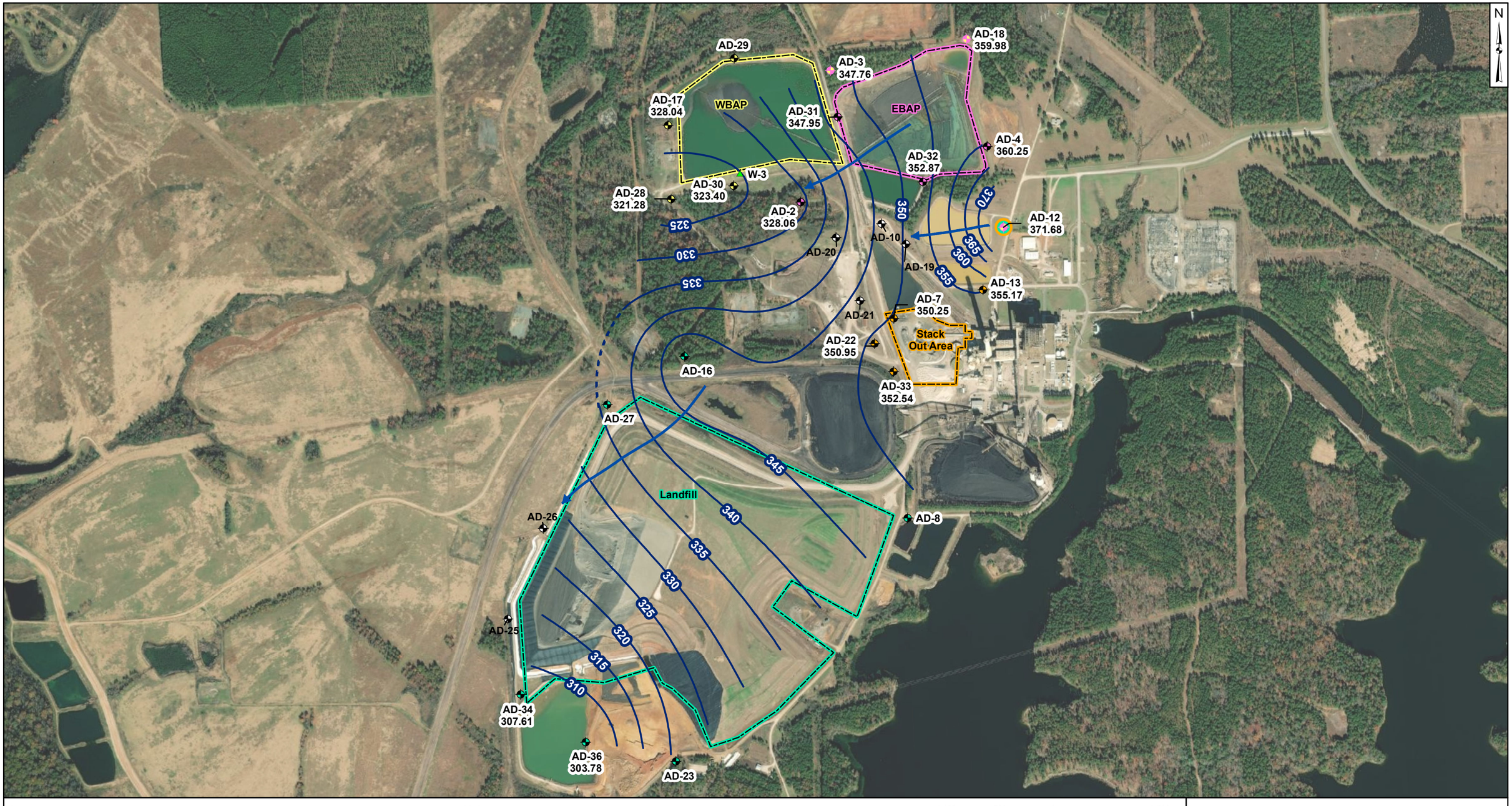
AEP Pirkey Power Plant
Hallsville, Texas

Geosyntec consultants

Columbus, Ohio | 2020/06/12

Figure **1**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Pirkey\2020\AEP-Pirkey_GW_2020-03March.mxd. ARevezzo. 6/12/2020. Project/Phase/Task.



Legend

Groundwater Monitoring Wells

- Out of Network
- EBAP
- WBAP
- Landfill
- Stackout Area
- EBAP and WBAP

- All CCR Unit Networks
- Piezometer
- Approximate Groundwater Flow Direction
- Groundwater Elevation Contour
- Grondwater Elevation Contour (Inferred)

Notes

- Monitoring well coordinates and water level data (collected on June 2 - 3, 2020) provided by AEP.
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level.
- East and West Bottom Ash Ponds have compacted cohesive soil from elevation 344 to 347 ft. msl (Sargent and Lundy, 1984; AMEC, 2011).
- Clearwater pond base elevation is 344 ft. msl (Sargent and Lundy, 1983).
- W-3, AD-8, AD-16, AD-23, AD-27, and AD-29 were not gauged in June 2020.
- AD-34 is an artesian well.
- AD-35 was abandoned November 13, 2018. AD-36 was installed April 24, 2019.

1,000 500 0 1,000 Feet

Potentiometric Contours - Uppermost Aquifer
June 2020

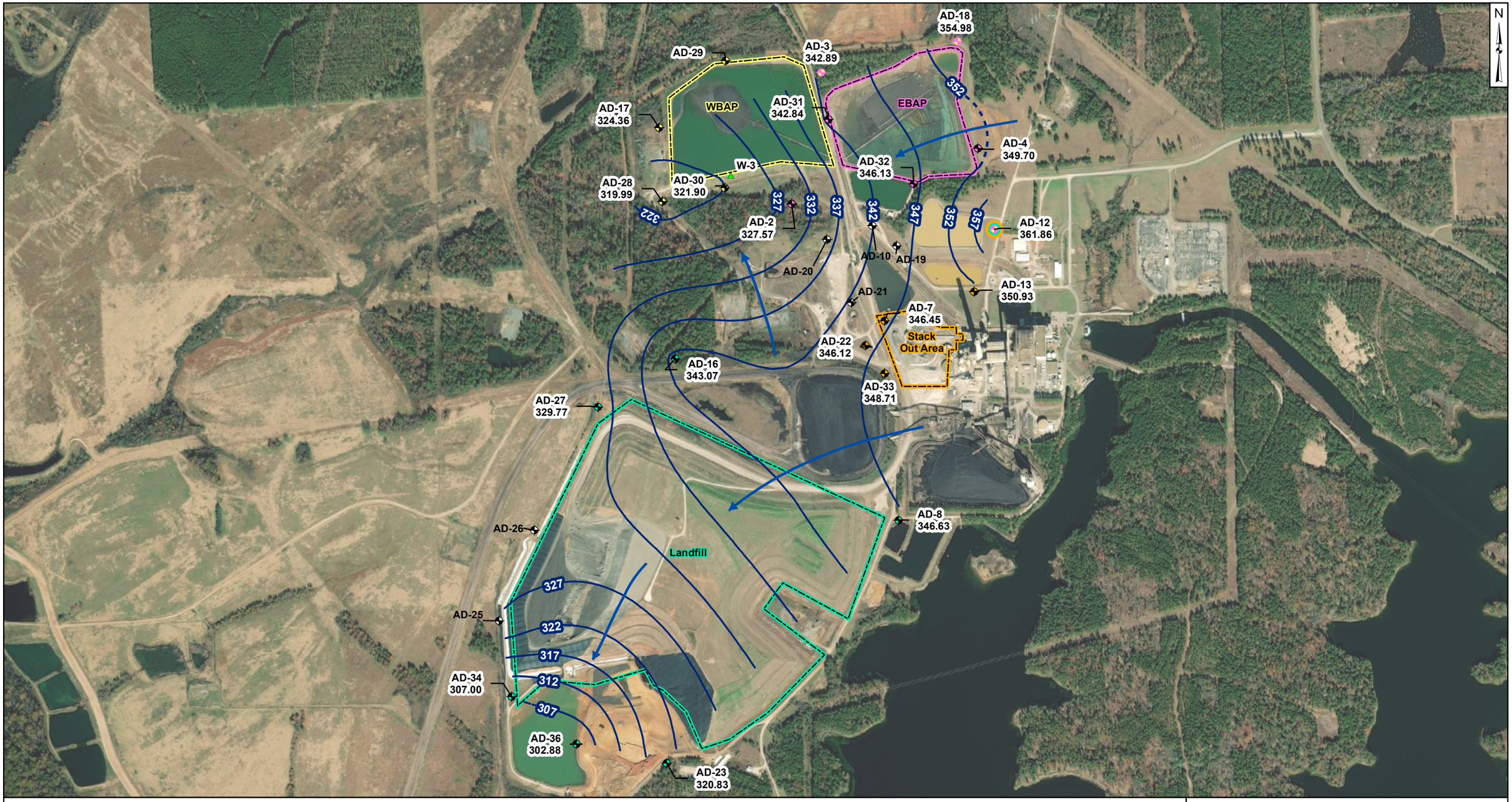
AEP Pirkey Power Plant
Hallsville, Texas

Geosyntec consultants

Columbus, Ohio | 2020/11/13

Figure **2**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Pirkey\2020\AEP-Pirkey_GW_2020-06June.mxd. HDuff. 11/13/2020. Project/Phase/Task.



Legend

Groundwater Monitoring Wells

- Out of Network
- EBAP
- WBAP
- Landfill
- Stackout Area
- EBAP and WBAP

- All CCR Unit Networks
- Piezometer
- Approximate Groundwater Flow Direction
- Groundwater Elevation Contour
- Grondwater Elevation Contour (Inferred)

Notes

- Monitoring well coordinates and water level data (collected on November 2-4, 2020) provided by AEP.
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level.
- East and West Bottom Ash Ponds have compacted cohesive soil from elevation 344 to 347 ft. msl (Sargent and Lundy, 1984; AMEC, 2011).
- Clearwater pond base elevation is 344 ft. msl (Sargent and Lundy, 1983).
- W-3 and AD-29 were not gauged in November 2020.

1,000 500 0 1,000 Feet

Potentiometric Contours - Uppermost Aquifer
November 2020

AEP Pirkey Power Plant
Hallsville, Texas

Geosyntec consultants

Columbus, Ohio | 2021/01/06

Figure **3**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Pirkey\2020\AEP-Pirkey_GW_2020-11November_new.mxd. HDuff. 1/6/2021. Project/Phase/Task.

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.

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Memorandum

Date:	February 7, 2020
To:	David Miller (AEP)
Copies to:	Leslie Fuerschbach (AEP)
From:	Allison Kreinberg (Geosyntec)
Subject:	Evaluation of Detection Monitoring Data at Pirkey Plant's Landfill

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257 Subpart D, "CCR rule"), the second semi-annual detection monitoring event of 2019 at the Landfill, an existing CCR unit at the Pirkey Power Plant located in Hallsville, Texas, was completed on August 13, 2019. Based on the results, a two-of-two verification sampling was completed on January 27, 2020.

Eight background monitoring events were conducted at the Pirkey LF prior to these detection monitoring events, and upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. Lower prediction limits (LPLs) were also calculated for pH. Details on the calculation of these background values are described in Geosyntec's *Statistical Analysis Summary* report, dated January 3, 2018. An alternative source demonstration (ASD) was certified on January 7, 2020 which resulted in a revision from interwell tests to intrawell tests for the pH, sulfate, and TDS prediction limits.

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 (or are below the LPL for pH). In practice, if the initial result did not exceed the UPL, a second sample was not collected or analyzed.

Detection monitoring results and the relevant background values are compared in Table 1. No SSIs were observed at the Pirkey Landfill CCR unit, and as a result the Pirkey Landfill will remain in detection monitoring.

The statistical analysis was conducted within 90 days of completion of sampling and analysis in accordance with 40 CFR 257.93(h)(2). A certification of these statistics by a qualified professional engineer is provided in Attachment A.

Table 1: Detection Monitoring Data Summary
Pirkey - Landfill

Geosyntec Consultants, Inc.

Parameter	Unit	Description	AD-23		AD-34	AD-34
			8/13/2019	1/27/2020	8/13/2019	1/27/2020
Boron	mg/L	Interwell Background Value (UPL)	0.0300		0.120	
		Detection Monitoring Result	0.0200	--	0.0700	--
Calcium	mg/L	Interwell Background Value (UPL)	0.654		42.5	
		Detection Monitoring Result	0.325	--	39.8	--
Chloride	mg/L	Interwell Background Value (UPL)	7.89		9.20	
		Detection Monitoring Result	7.12	--	7.46	--
Fluoride	mg/L	Interwell Background Value (UPL)	1.00		1.00	
		Detection Monitoring Result	0.0300	--	**1.13**	0.90
pH	SU	Intrawell Background Value (UPL)	4.8		4.3	
		Intrawell Background Value (LPL)	2.5		2.7	
		Detection Monitoring Result	**5.0**	4.3	3.7	**--**
Sulfate	mg/L	Interwell Background Value (UPL)	15.8		1390	
		Detection Monitoring Result	7.40	--	1060	--
Total Dissolved Solids	mg/L	Interwell Background Value (UPL)	106		1590	
		Detection Monitoring Result	**126**	70	**1650**	1550

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

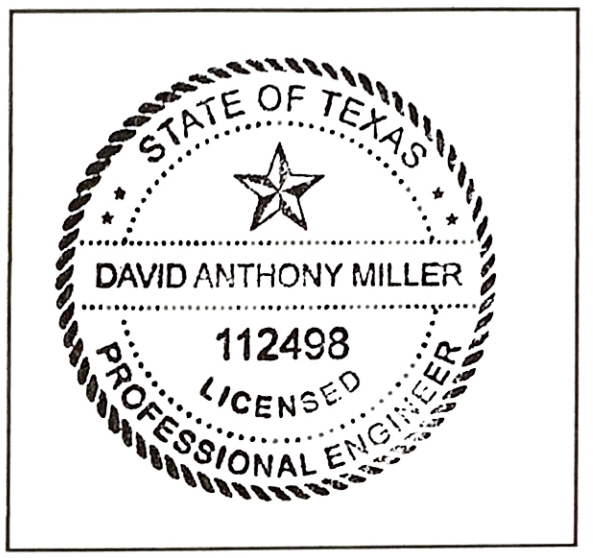
ATTACHMENT A
Certification by Qualified Professional Engineer

CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

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

112498	TEXAS	02.07.2020
License Number	Licensing State	Date

Geosyntec consultants

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Memorandum

Date:	October 2, 2020
To:	David Miller (AEP)
Copies to:	Leslie Fuerschbach (AEP)
From:	Allison Kreinberg (Geosyntec)
Subject:	Evaluation of Detection Monitoring Data at Pirkey Plant's Landfill

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257 Subpart D, "CCR rule"), the first semi-annual detection monitoring event of 2020 at the Landfill, an existing CCR unit at the Pirkey Power Plant located in Hallsville, Texas, was completed on June 3, 2020. Based on the results, a two-of-two verification sampling was completed on July 15, 2020.

Eight background monitoring events were conducted at the Pirkey LF prior to these detection monitoring events, and upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. Lower prediction limits (LPLs) were also calculated for pH. Details on the calculation of these background values are described in Geosyntec's *Statistical Analysis Summary* report, dated January 3, 2018. An alternative source demonstration (ASD) was certified on January 7, 2020 which resulted in a revision from interwell tests to intrawell tests for the pH, sulfate, and TDS prediction limits.

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 (or are below the LPL for pH). In practice, if the initial result did not exceed the UPL, a second sample was not collected or analyzed.

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

- Fluoride concentrations exceeded the intrawell UPL of 1.00 mg/L in both the initial (1.22 mg/L) and second (1.39 mg/L) samples collected at AD-34. Therefore, an SSI over background is concluded for fluoride at AD-34.

In response to the exceedances noted above, the Pirkey LF CCR unit will either transition to assessment monitoring or an alternative source demonstration (ASD) for fluoride will be conducted in accordance with 40 CFR 257.94(e)(2). If the ASD is successful, the Pirkey LF will remain in detection monitoring.

The statistical analysis was conducted within 90 days of completion of sampling and analysis in accordance with 40 CFR 257.93(h)(2). A certification of these statistics by a qualified professional engineer is provided in Attachment A.

Table 1: Detection Monitoring Data Summary
Pirkey Plant - Landfill

Geosyntec Consultants, Inc.

Analyte	Unit	Description	AD-23	AD-34	
			6/3/2020	6/3/2020	7/15/2020
Boron	mg/L	Intrawell Background Value (UPL)	0.030	0.120	
		Analytical Result	0.02	0.058	--
Calcium	mg/L	Intrawell Background Value (UPL)	0.65	42.5	
		Analytical Result	0.2	40.1	--
Chloride	mg/L	Intrawell Background Value (UPL)	7.89	9.20	
		Analytical Result	7.08	7.68	--
Fluoride	mg/L	Intrawell Background Value (UPL)	1.00	1.00	
		Analytical Result	0.07	**1.22**	**1.39**
pH	SU	Intrawell Background Value (UPL)	4.8	4.3	
		Intrawell Background Value (LPL)	2.5	2.7	
		Analytical Result	4.3	3.4	--
Sulfate	mg/L	Intrawell Background Value (UPL)	15.8	1,388	
		Analytical Result	8.5	1,150	--
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	106	1,587	
		Analytical Result	65	**1,620**	1,510

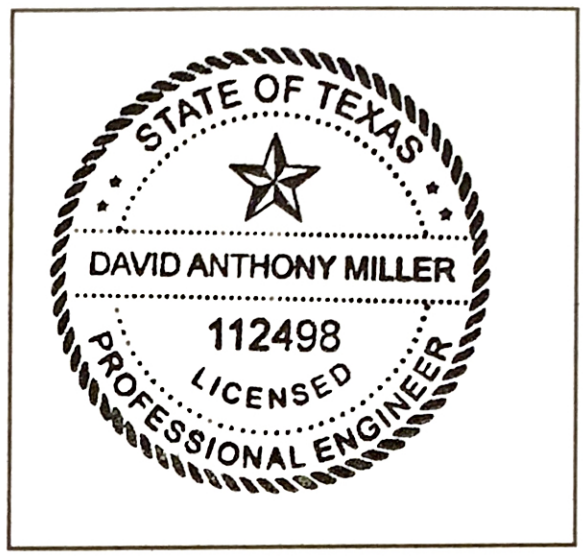
Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
Bold values exceed the background value.
Background values are shaded gray.

ATTACHMENT A

Certification by a Qualified Professional Engineer

CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

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

112498	TEXAS	10.02.2020
License Number	Licensing State	Date

STATISTICAL ANALYSIS SUMMARY
Background Update Calculations
H.W. Pirkey Power Plant
Landfill
Hallsville, Texas

Submitted to

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants
engineers | scientists | innovators

941 Chatham Lane
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Columbus, Ohio 43221

January 27, 2021

CHA8500

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LIST OF ACRONYMS AND ABBREVIATIONS

ANOVA	Analysis of Variance
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Value
CFR	Code of Federal Regulations
LF	Landfill
LFB	Laboratory Fortified Blanks
LPL	Lower Prediction Limit
LRB	Laboratory Reagent Blanks
NELAP	National Environmental Laboratory Accreditation Program
PQL	Practical Quantitation Limit
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
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 Subpart D, "CCR rule"), groundwater monitoring has been conducted at the lined landfill (LF), an existing CCR unit at the H.W. Pirkey Power Plant located in Hallsville, Texas.

Eight monitoring events were completed prior to May 2017 to establish background concentrations for Appendix III and Appendix IV constituents under the CCR rule. A detection monitoring event was conducted in August 2017 with verification samples collected in December 2017. During the August 2017 monitoring event, statistically significant increases (SSIs) for boron, sulfate, and total dissolved solids (TDS) were observed, and the unit transitioned to assessment monitoring. Semiannual assessment monitoring events were conducted between March 2018 and May 2019. An ASD was prepared in 2020 that indicated that:

- Former mining activities in the vicinity of the LF (shown as 'A Area' in Figure 1) were affecting groundwater quality at monitoring well AD-34;
- Interwell statistics were not appropriate for the Pirkey LF; and,
- The unit could return to detection monitoring (Geosyntec, 2020a).

Since returning to detection monitoring, two detection monitoring events have been completed ([1] August 2019 with verification samples collected in January 2020 and [2] June 2020).

Data from the events conducted between August 2017 and June 2020, including both initial and verification results, were evaluated for inclusion in the background dataset. Additionally, data from eight background monitoring events at AD-36, which was installed to replace well AD-35 following its decommissioning, were evaluated to establish background concentrations for Appendix III constituents. Groundwater data underwent several validation tests, including those for completeness, sample tracking accuracy, transcription errors, and consistent use of measurement units. No data quality issues were identified which would impact the usability of the data.

The data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. The compliance data were reviewed for outliers, which were removed (when appropriate) prior to updating prediction limits for Appendix III constituents to represent background values at AD-23 and AD-34 and establishing background at AD-36. Oversight on the use of statistical calculations was provided by Dr. Jim Loftis, senior advisor at GSC. Certification of the selected statistical methods by a qualified professional engineer is documented in Attachment A.

SECTION 2

LANDFILL EVALUATION

2.1 Previous Background Calculations

Eight background monitoring events were completed from May 2016 through April 2017 to establish background concentrations for Appendix III and Appendix IV constituents under the CCR rule. The data were reviewed for outliers and trends prior to calculating UPLs for the Appendix III constituents. A lower prediction limit (LPL) was also established for pH. Interwell prediction limits were selected for pH, sulfate, and TDS, and intrawell prediction limits were selected for boron, calcium, chloride, and fluoride. Both the interwell and intrawell tests used a one-of-two resampling plan. The statistical analyses to establish background levels were previously documented in the February 2018 *Statistical Analysis Summary* report (Geosyntec, 2018).

The Pirkey LF transitioned to assessment monitoring following completion of the August 2017 detection monitoring event. Semiannual assessment monitoring events were completed between March 2018 and May 2019 in accordance with 40 CFR 257.95. Following the collection of additional data in the vicinity of the LF in 2019, the conceptual site model was updated. It was determined that former mining activities in the vicinity of the LF (shown as 'A Area' in Figure 1) were affecting groundwater quality at monitoring well AD-34 (Geosyntec, 2020a). Thus, interwell prediction limits are not appropriate for the detection monitoring. The unit returned to detection monitoring, and intrawell prediction limits were calculated to reflect the variability in the site conditions.

Monitoring well AD-35 was decommissioned in November 2018 due to landfill expansion activities. AD-35 was replaced by a new downgradient monitoring well, AD-36, which was installed in April 2019 and added to the monitoring network. Eight samples were collected between August 2019 and July 2020 to establish Appendix III background values at AD-36 in accordance with the CCR Rule.

2.2 Data Validation & QA/QC

After the last background monitoring event in 2017, three semiannual detection monitoring events and four semiannual assessment monitoring events were conducted at the LF. If the initial results from a detection monitoring event identified possible exceedances, verification sampling was completed on an individual well/constituent basis. Samples were analyzed for the Appendix III constituents during the semiannual assessment monitoring events; thus, a minimum of four samples were collected from each compliance well since the last background update. A summary of data collected at existing wells AD-23 and AD-34 during these detection and assessment monitoring events may be found in Table 1. A summary of the data collected at new well AD-36 during the eight background monitoring events may be found in Table 2.

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

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.6.27 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.

2.3 Statistical Analysis

The data used to conduct the statistical analyses described below are summarized in Table 1 and Table 2. Statistical analyses for the LF were conducted in accordance with the October 2020 *Statistical Analysis Plan* (Geosyntec, 2020b), except where noted below. The complete statistical analysis results are included in Attachment B.

Time series plots of Appendix III constituents are included in Attachment B and were used to evaluate concentrations over time and to provide an initial screening of suspected outliers and trends. Box plots were also compiled to provide visual representation of variations between wells and within individual wells (Attachment B).

2.3.1 Outlier Evaluation

Potential outliers were evaluated 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 $= \tilde{x}_{0.75} - \tilde{x}_{0.25}$

Tukey's outlier test indicated select values for boron and sulfate at upgradient well AD-27 and TDS at upgradient well AD-8 could be considered outliers. Additionally, the August 13, 2019

chloride value at AD-36 and TDS value at AD-23 could be considered outliers. However, these values were not removed from the dataset as they appeared to represent variation in natural groundwater concentrations (Attachment B).

2.3.2 AD-23 and AD-34 Prediction Limit Update

2.3.2.1 Establishment of Updated Background Dataset

Analysis of variance (ANOVA) was conducted during the initial background screening to assist in identifying if intrawell tests are the most appropriate statistical approach for assessing Appendix III constituents. Intrawell tests compare compliance data from a single well to background data within the same well and are most appropriate (1) when upgradient wells exhibit spatial variation; (2) when statistical limits constructed from upgradient wells would not be conservative from a regulatory perspective; or (3) when downgradient water quality is not impacted compared to upgradient water quality for the same constituent. Intrawell tests were used to evaluate potential SSIs for boron, calcium, chloride, and fluoride. Interwell tests were originally used to evaluate potential SSIs for pH, sulfate, and TDS. However, because former mining activities in the vicinity of the LF affect groundwater quality at monitoring well AD-34 (Geosyntec, 2020a), intrawell tests will be used to evaluate potential SSIs for all Appendix III constituents moving forward.

Periodic updating of background statistical limits is necessary as natural systems continuously change due to physical changes to the environment. For intrawell analyses, data for all wells and constituents are re-evaluated when a minimum of four new data points are available. These four (or more) new data points are used to compare against the existing background dataset.

Mann-Whitney (Wilcoxon rank-sum) tests were used to compare the medians of historical data (May 2016 – April 2017) to the new compliance samples (August 2017 – June 2020 [July 2020 for fluoride, TDS, and pH at AD-34]). Results were evaluated to determine if the medians of the two groups were similar at the 99% confidence level. Where no significant difference was found, the new compliance data were added to the background dataset. Where a statistically significant difference was found between the medians of the two groups, the data were reviewed to evaluate the cause of the difference and to determine if adding newer data to the background dataset, replacing the background dataset with the newer data, or continuing to use the existing background dataset was most appropriate. If the differences appeared to have been caused by a release, then the previous background dataset would have continued to be used.

The complete Mann-Whitney test results and a summary of the significant findings can be found in Attachment B. Statistically significant differences were found for calcium in upgradient well AD-16, chloride in upgradient wells AD-16 and AD-27, and pH at upgradient well AD-16. The more recent calcium values at AD-16 are lower than the initial background dataset, whereas the more recent chloride values at AD-16 and AD-27 are slightly higher than the initial background dataset. While the more recent chloride values at AD-16 and AD-27 are slightly higher than the initial background dataset, concentrations at both wells are still low and generally consistent with values at other wells in the network. Because AD-16 and AD-27 are upgradient wells and

represent natural variability upgradient of the unit, the earlier sample results were deselected so that only the most recent eight data points will be used for calcium at AD-16 and chloride at AD-16 and AD-27. For pH at AD-16, the recent concentrations were only slightly higher than the initial dataset and all values were used in the prediction limit calculations. Because intrawell prediction limits are used for all Appendix III constituents, the selection of background datasets at upgradient wells will not affect the calculation of background prediction limits.

2.3.2.2 Updated Prediction Limits

After the revised background dataset was established, a parametric or non-parametric analysis was selected based on the distribution of the data and the frequency of non-detect data. Estimated results less than the 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 B.

Intrawell UPLs were updated using all the historical data through June 2020 to represent background values for all Appendix III constituents at AD-23 and AD-24. The verification sample collected for fluoride, pH, and TDS at AD-34 in July 2020 was also included in the background update. Intrawell LPLs were also updated for pH. The updated prediction limits are summarized in Table 3.

The intrawell 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 the initial result does not exceed the UPL, a second sample will not be collected. The retesting procedures allowed achieving an acceptably high statistical power to detect changes at downgradient wells for constituents evaluated using intrawell prediction limits.

2.3.3 AD-36 Prediction Limit Establishment

As eight groundwater sampling events have been completed at AD-36, which was recently added to the well network, prediction limits were established for Appendix III constituents using those eight events as the background dataset. The same approach outlined in Section 2.3.2.2 was used for the AD-36 dataset. Additionally, trend tests were completed to evaluate if significant trends were present at AD-36. No significant trends were identified for Appendix III constituents at AD-36 (Appendix A).

Intrawell UPLs were calculated using the complete background dataset to represent background values for all Appendix III constituents at AD-36. Intrawell LPLs were also updated for pH. The updated prediction limits are summarized in Table 3. The intrawell UPLs were calculated for a

one-of-two retesting procedure. The retesting procedures allowed achieving an acceptably high statistical power to detect changes at downgradient wells for constituents evaluated using intrawell prediction limits.

2.4 Conclusions

Semiannual detection or assessment monitoring events have been completed at AD-23 and AD-34 in accordance with the CCR Rule since May 2017. Eight background events have been completed at AD-36 in accordance with the CCR Rule since August 2019. The laboratory and field data from these events were reviewed prior to statistical analysis, with no QA/QC issues identified that impacted data usability. At AD-23 and AD-34, Mann-Whitney tests were completed to evaluate whether data from the detection monitoring events could be added to the existing background datasets. The background datasets were updated, and UPLs and LPLs were recalculated using intrawell prediction limits with a one-of-two retesting procedure for all Appendix III constituents. At AD-36, the background dataset was established, and UPLs and LPLs were calculated using intrawell prediction limits with a one-of-two retesting procedure for all Appendix III constituents.

SECTION 3

REFERENCES

Geosyntec Consultants, 2018. Statistical Analysis Summary. Landfill – H.W. Pirkey Plant. February.

Geosyntec Consultants, 2020a. Alternative Source Demonstration Report. Federal CCR Rule – H.W. Pirkey Power Plant Landfill. January.

Geosyntec Consultants, 2020b. Statistical Analysis Plan – Pirkey Plant. October.

TABLES

Table 1: Groundwater Data Summary
H.W. Pirkey Plant - Landfill

Geosyntec Consultants, Inc.

Parameter	Unit	AD-8							AD-12							
		8/23/2017	3/21/2018	8/20/2018	2/28/2019	5/21/2019	8/13/2019	6/3/2020	8/23/2017	3/21/2018	8/20/2018	2/27/2019	5/21/2019	8/12/2019	3/10/2020	6/2/2020
Boron	mg/L	0.411	1.03	0.714	1.05	1.11	0.818	0.783	0.0495	0.01397	0.0170	0.0300 J	0.0200	0.05 U	0.02 J	0.05 U
Calcium	mg/L	19.4	56.1	14.5	103	85.5	27.6	74.4	0.245	0.269	0.338	0.400 J	0.300 J	0.278	0.3 J	0.2 J
Chloride	mg/L	9.00	8.00	18.0	6.83	4.48	12.7	11.5	6.00	5.00	10.0	6.08	6.30	7.24	6.08	5.63
Fluoride	mg/L	0.587 J	1.1987	5.1991	0.400	0.330	3.39	2.45	0.213 J	1 U	1 U	0.0900	0.0900	0.0600 J	0.10	0.10
Sulfate	mg/L	56.0	140	168	175	127	128	196	6.00	3.00	4.00	3.60	4.00	2.60	3.7	3.9
Total Dissolved Solids	mg/L	110	278	300	462	296	260	396	52.0	5 U	94.0	36.0	80.0	90.0	62	91
pH	SU	3.9	5.7	3.7	5.7	5.9	4.6	5.8	4.8	4.2	4.4	5.2	4.1	4.9	4.9	4.0

Parameter	Unit	AD-16							AD-23								
		8/24/2017	3/22/2018	8/21/2018	2/27/2019	5/23/2019	8/15/2019	6/3/2020	8/23/2017	12/21/2017	3/21/2018	8/20/2018	2/28/2019	5/23/2019	8/13/2019	1/27/2020	6/3/2020
Boron	mg/L	0.03648	0.0171	0.0200	0.0300 J	0.0220	0.05 U	0.05 U	0.04021	0.04498	0.01762	0.0170	0.0200 J	0.0170	0.05 U	--	0.05 U
Calcium	mg/L	0.945	1.03	1.17	0.704	1.06	0.874	0.872	0.276	0.469	0.227	0.247	0.300 J	0.300 J	0.325	--	0.2 J
Chloride	mg/L	12.0	14.0	17.0	20.3	20.8	20.0	21.7	6.00	--	4.00	9.00	6.94	6.82	7.12	--	7.08
Fluoride	mg/L	1 U	1 U	1 U	0.0700 J	0.0600 J	0.0600 J	0.11	0.198 J	--	1 U	1 U	0.0400 J	0.0400 J	0.0300 J	--	0.07
Sulfate	mg/L	14.0	13.0	15.0	17.7	26.9	15.4	13.3	11.0	--	10.0	11.0	7.20	9.10	7.40	--	8.5
Total Dissolved Solids	mg/L	96.0	96.0	128	76.0	128	110	122	64.0	--	72.0	92.0	70.0	54.0	126	70.0 J	65
pH	SU	4.3	4.0	4.0	4.1	4.6	5.1	4.7	4.1	--	3.9	3.8	5.1	4.8	5.0	4.3	4.3

Parameter	Unit	AD-27							AD-34										
		8/24/2017	3/22/2018	8/21/2018	2/28/2019	5/23/2019	8/16/2019	6/3/2020	8/23/2017	12/21/2017	3/21/2018	8/20/2018	2/27/2019	5/21/2019	8/13/2019	1/27/2020	3/11/2020	6/3/2020	7/15/2020
Boron	mg/L	0.0358	0.03901	0.0240	0.0700 J	0.0230	0.0200 J	0.03 J	0.107	--	0.171	0.0670	0.0800 J	0.0600	0.0700	--	--	0.058	--
Calcium	mg/L	3.58	5.58	4.58	4.02	3.89	3.94	3.55	36.2	--	40.1	37.0	39.9	42.0	39.8	--	--	40.1	--
Chloride	mg/L	9.00	11.0	10.0	11.7	11.4	10.5	12.8	7.00	8.00	6.00	10.0	7.64	7.34	7.46	--	--	7.68	--
Fluoride	mg/L	0.197 J	1 U	1 U	0.200	0.200	0.180	0.25	0.619 J	0.6669 J	1 U	1 U	0.860	0.690	1.13	0.900	--	1.22	1.39
Sulfate	mg/L	52.0	78.0	65.0	52.8	55.2	53.2	54.6	1,231	1,020	956	1,064	970	1,080	1,060	--	--	1,150	--
Total Dissolved Solids	mg/L	168	192	196	42.0	204	198	219	1,128	1,260	1,424	1,462	1,470	1,154	1,648	1,550	--	1,620	1,510
pH	SU	3.7	3.9	3.5	4.7	4.4	3.9	4.3	3.7	--	3.7	3.7	2.9	3.3	3.7	3.6	3.6	3.4	4.1

Notes:
mg/L: milligrams per liter
SU: standard unit
U: Non-detect value. For statistical analysis, parameters which were not detected were replaced with the reporting limit.
J: Estimated value. Parameter was detected in concentrations below the reporting limit.
--: Not Measured

Table 2: AD-36 Background Groundwater Data Summary
H.W. Pirkey Plant - Landfill

Geosyntec Consultants

Parameter	Unit	8/13/2019	1/27/2020	3/11/2020	4/15/2020	5/13/2020	6/3/2020	6/16/2020	7/1/2020	7/15/2020
Boron	mg/L	0.0650	0.056	0.05 J	0.054	0.055	0.052	0.064	0.059	--
Calcium	mg/L	0.240	0.304	0.2 J	0.2 J	0.2 J	0.2 J	0.2 J	0.3 J	--
Chloride	mg/L	9.46	8.65	8.44	8.40	8.56	8.52	8.39	--	8.09
Fluoride	mg/L	0.0500 J	0.05 J	0.06	0.05 J	0.05 J	0.07	0.05 J	--	0.08
Sulfate	mg/L	2.20	3.5	3.7	3.7	3.4	3.3	3.6	--	3.7
Total Dissolved Solids	mg/L	92.0	40 J	60 J	40 J	40 J	65	50 J	52	--
pH	SU	4.7	4.7	5.0	3.6	4.1	4.6	4.6	4.9	5.0

Notes:
mg/L: milligrams per liter
SU: standard unit
J: Estimated value. Parameter was detected in concentrations below the reporting limit.

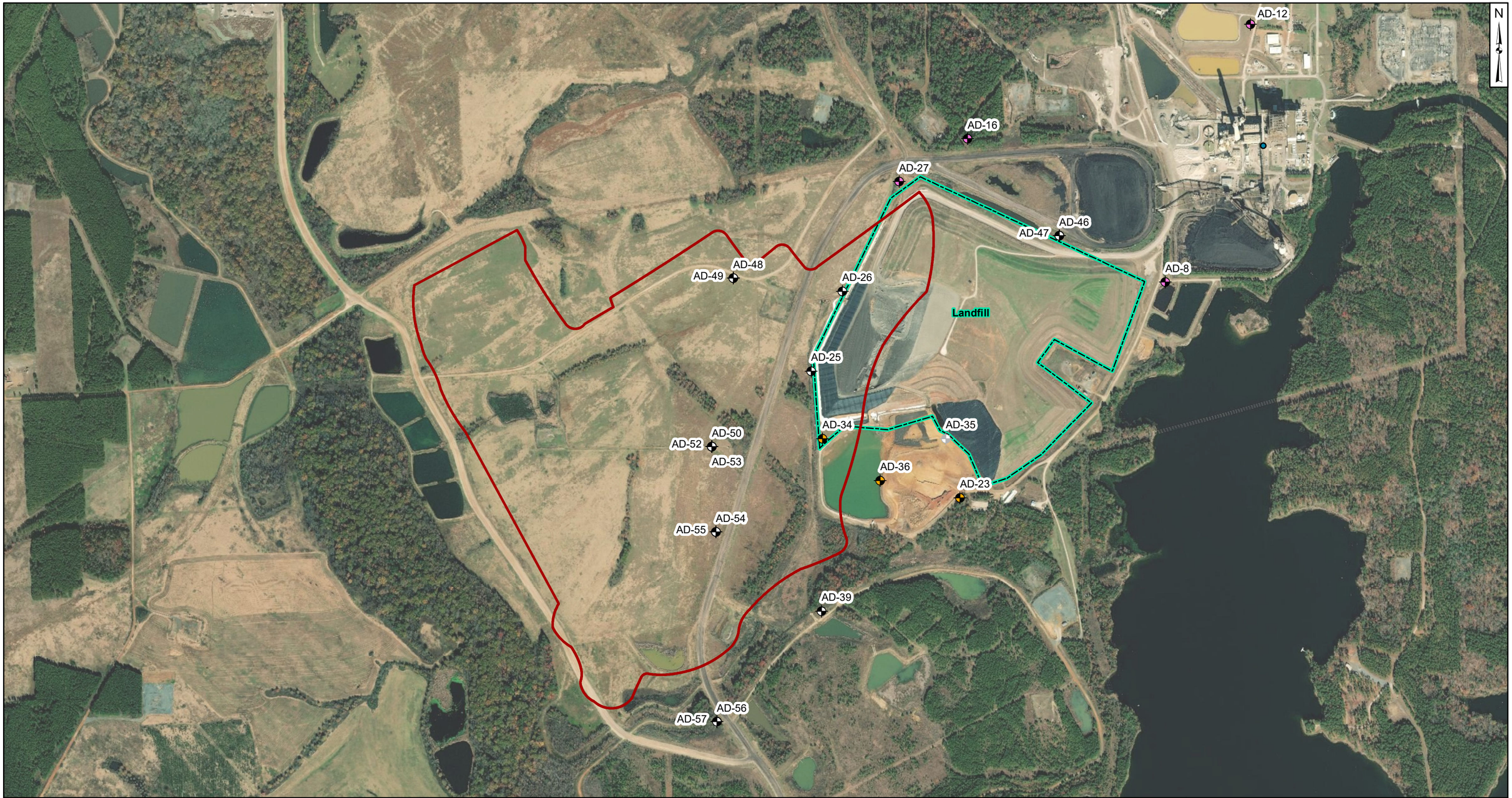
Table 3: Revised Prediction Limit Summary
H.W. Pirkey Plant - Landfill

Geosyntec Consultants, Inc.

Parameter	Unit	Description	AD-23	AD-34	AD-36
Boron	mg/L	Intrawell Background Value (UPL)	0.0433	0.145	0.0702
Calcium	mg/L	Intrawell Background Value (UPL)	0.536	42.8	0.304
Chloride	mg/L	Intrawell Background Value (UPL)	8.88	9.35	9.54
Fluoride	mg/L	Intrawell Background Value (UPL)	1.00	1.29	0.0800
pH	SU	Intrawell Background Value (UPL)	5.2	4.2	5.7
		Intrawell Background Value (LPL)	2.8	2.9	3.5
Sulfate	mg/L	Intrawell Background Value (UPL)	14.5	1,280	4.20
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	111	1,700	98.5

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

FIGURES



Legend

- Upgradient Well
- Downgradient Well
- Out of Network Well
- Abandoned Well
- A Area
- Landfill

Notes

- Monitoring well coordinates, site features, and data provided by AEP.
- A Area is a former lignite (reclaimed) mine.
- AD-35 was abandoned in November 2018 and a new downgradient well, AD-36, was installed in April 2019.
- Aerial imagery provided by DigitalGlobe and dated 12/1/2018.

1,000 500 0 1,000 Feet

Site Layout

AEP Pirkey Power Plant
Hallsville, Texas

Geosyntec consultants

Columbus, Ohio | 2020/01/06

Figure **1**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Pirkey\2019\AEP_Sitelayout_20191224.mxd. ARevezzo. 1/6/2020. Project/Phase/Task.

ATTACHMENT A

Certification by a Qualified Professional Engineer

Certification by a Qualified Professional Engineer

I certify that the selected and above described statistical method is appropriate for evaluating the groundwater monitoring data for the H. W. Pirkey Plant Landfill 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

112498	TEXAS	01.27.2021
License Number	Licensing State	Date

ATTACHMENT B

Statistical Analysis Output

GROUNDWATER STATS CONSULTING

December 4, 2020

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

Re: Pirkey Landfill
Background Update – 2020

Dear Ms. Kreinberg,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the 2020 background update of groundwater data at American Electric Power Company's Pirkey Landfill. This site is in Detection Monitoring and 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 the site for the CCR program in 2016. The monitoring well network, as provided by Geosyntec Consultants, is listed below. Note that downgradient well AD-35 was originally in the well network but has been abandoned and replaced with well AD-36.

- **Upgradient wells:** AD-8, AD-12, AD-16, and AD-27
- **Downgradient wells:** AD-23, AD-34, and AD-36

Data were sent electronically, and the statistical analysis was conducted according to the Statistical Analysis Plan and screening evaluation prepared by GSC and approved by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to GSC. During this analysis, proposed background data from replacement well AD-36 were screened, and data from all other wells were also screened for updating background statistical limits as described below.

The CCR program consists of the following Appendix III constituents:

- boron, calcium, chloride, fluoride, pH, sulfate, and TDS

Time series plots for these parameters at all wells are provided for the purpose of screening data at these wells (Figure A). Additionally, a separate section of box plots is 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. When values in background have been flagged as outliers, they may be seen in a lighter font and as a disconnected symbol on the graphs.

In earlier analyses, 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. Additionally, further studies conducted by Geosyntec Consultants since the original background screening support the use of intrawell methods due to the presence of mine spoils underlying well AD-34.

Power curves are provided to demonstrate that the selected statistical methods for Appendix III parameters comply with the USEPA Unified Guidance. The EPA suggests the selected statistical method should provide at least 55% power at 3 standard deviations or at least 80% power at 4 standard deviations.

Summary of Statistical Methods:

- Intrawell prediction limits, combined with a 1-of-2 resample plan for boron, calcium, chloride, 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. While the false positive rate associated with the parametric limits is based on an annual 10% (5% per semi-annual event) as recommended by the EPA Unified Guidance (2009), the false positive rate associated with the nonparametric limits is dependent upon the available background sample size, number of future comparisons, and verification resample plan. The distribution of data is tested using the Shapiro-Wilk/Shapiro-Francia test for normality. After testing for normality and performing any adjustments as discussed below (US EPA, 2009), data are analyzed using either parametric or non-parametric prediction limits.

- 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.

Natural systems continuously evolve due to physical changes made to the environment. Examples include capping a landfill, paving areas near a well, or lining a drainage channel to prevent erosion. Periodic updating of background statistical limits is necessary to accommodate these types of changes. In the intrawell case, data for all wells and constituents may be re-evaluated when a minimum of 4 new data points are available to determine whether earlier concentrations are representative of present-day groundwater quality. In some cases, the earlier portion of data is deselected prior to construction of limits 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.

Appendix III Background Update Summary – 2020

Prior to updating background data, samples were evaluated using Tukey's outlier test and visual screening through the July 2020 sample event. Tukey's outlier test only noted outliers for boron in upgradient well AD-27, chloride in well AD-36, sulfate in upgradient well AD-27, and TDS in well AD-23 and upgradient well AD-8 among the Appendix III parameters. However, none of the identified values were flagged as outliers since they appear to be representative of natural variation in groundwater quality. A summary of Tukey's test results follows this letter (Figure C).

The Sen's Slope/Mann Kendall trend test was used to evaluate all proposed background data at well AD-36 to identify statistically significant increasing or decreasing trends (Figure D). While trends may be visual, a quantification of the trend and its significance is

needed. 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. The Sen's Slope/Mann Kendall trend test did not identify any statistically significant increasing or decreasing trends. A summary of those results follows this letter.

For all Appendix III parameters at all other wells besides AD-36, the Mann-Whitney (Wilcoxon Rank Sum) test was used to compare the medians of historical data through April 2017 to the new compliance samples at each well through July 2020 (Figure E). The test evaluates whether the groups are statistically different at the 99% confidence level. If no significant difference is found, background data may be updated with compliance data. The following well/constituent pairs had statistically significant higher medians in more recent data:

- Chloride: AD-16 (upgradient) and AD-27 (upgradient)
- ph: AD-16 (upgradient)

The following well/constituent pair had a statistically significant lower median in more recent data when compared to historical data:

- Calcium: AD-16 (upgradient)

Typically, when the test concludes that the medians of the two groups are significantly different, particularly in the downgradient wells, the background data are not updated to include the newer data but will be reconsidered in the future. However, since these differences occurred upgradient of the facility for each of the parameters above and represent natural variation in groundwater quality, the earlier portions of the records were deselected prior to construction of statistical limits so that limits are more representative of present-day water quality conditions. All records for these well/constituent pairs will utilize the most recent 8 measurements beginning from 4/10/2017. One exception is for pH where the most recent concentrations were only slightly higher than the earlier measurements. The test results are included with the Mann Whitney test section at the end of this report.

Intrawell prediction limits using all historical data through July 2020, except for the cases mentioned above which use truncated portions of the most recent data through July 2020, combined with a 1-of-2 resample plan, were constructed, and a summary of the updated limits follows this letter (Figure F).

Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for the Pirkey Landfill. If you have any questions or comments, please feel free to contact us.

For Groundwater Stats Consulting,

Kristina L. Rayner
Groundwater Statistician

Date Ranges

Date: 12/3/2020 12:32 PM

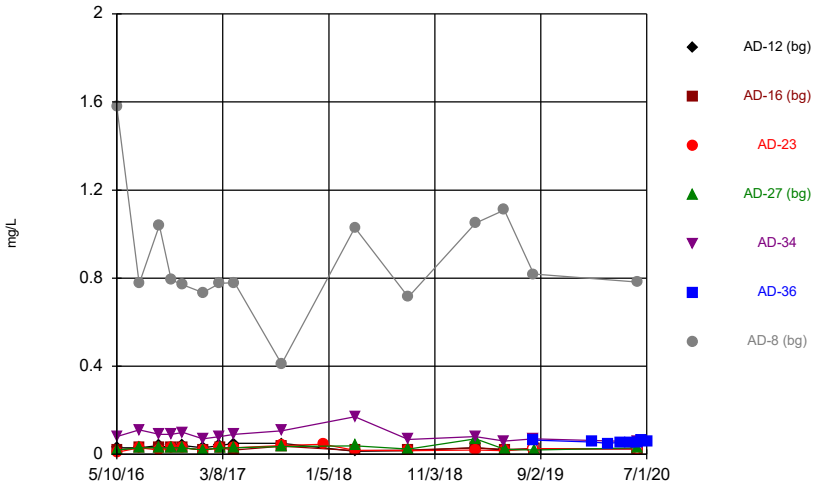
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Calcium, total (mg/L)
- AD-16 background:4/10/2017-6/3/2020

Chloride, total (mg/L)
- AD-16 background:4/10/2017-6/3/2020
- AD-27 background:4/10/2017-6/3/2020

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

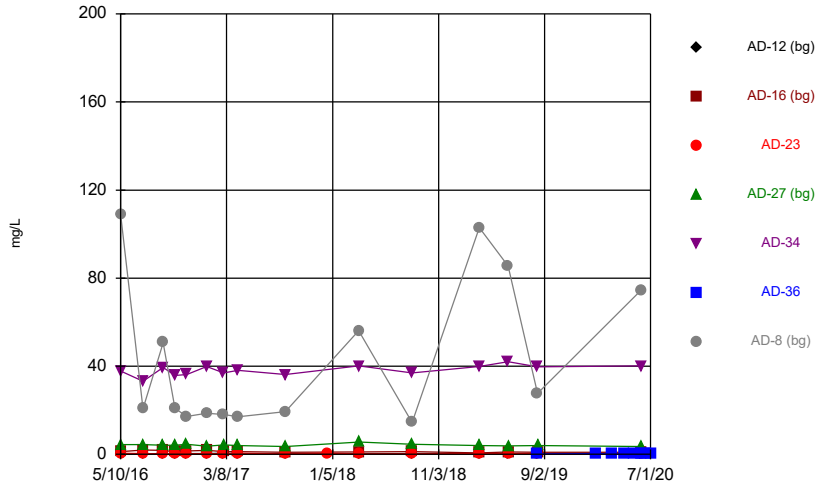
Time Series



Constituent: Boron, total Analysis Run 12/3/2020 12:36 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

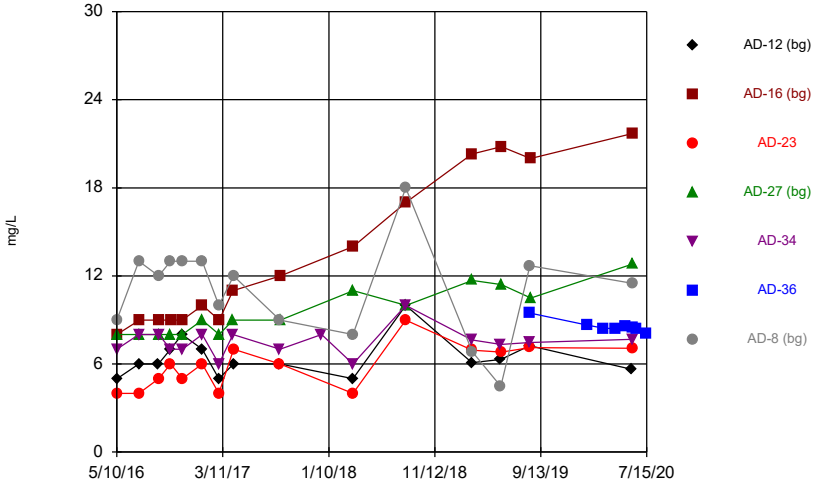
Time Series



Constituent: Calcium, total Analysis Run 12/3/2020 12:36 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

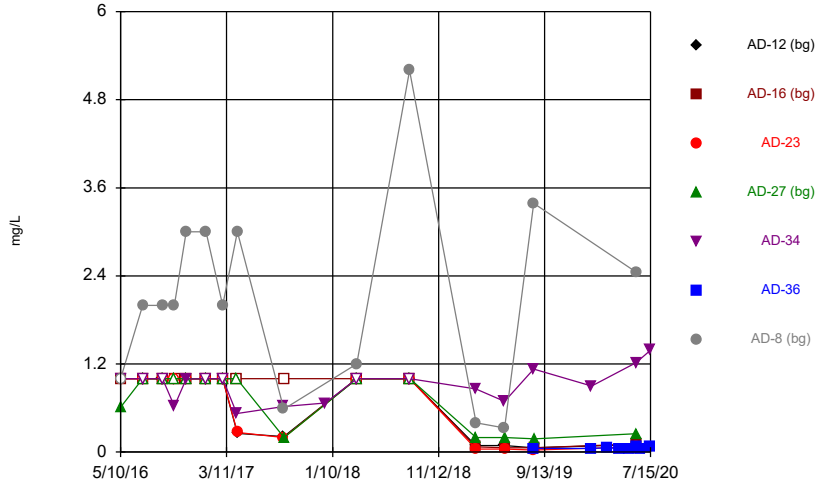
Time Series



Constituent: Chloride, total Analysis Run 12/3/2020 12:36 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

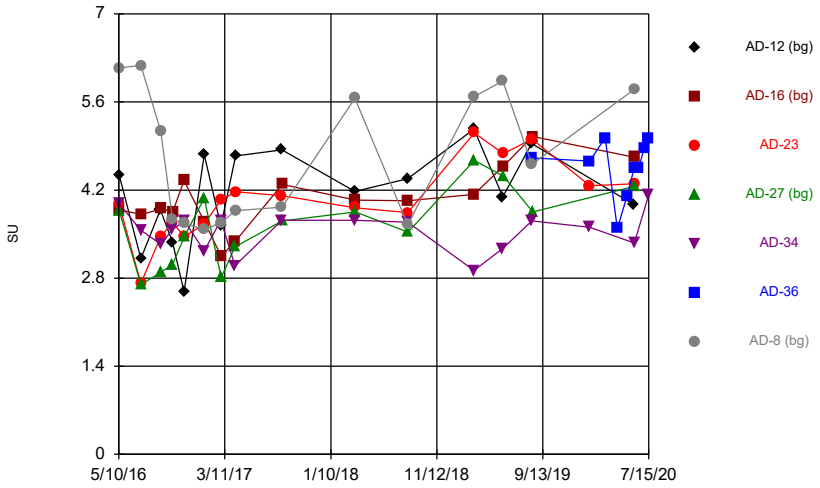
Time Series



Constituent: Fluoride, total Analysis Run 12/3/2020 12:36 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

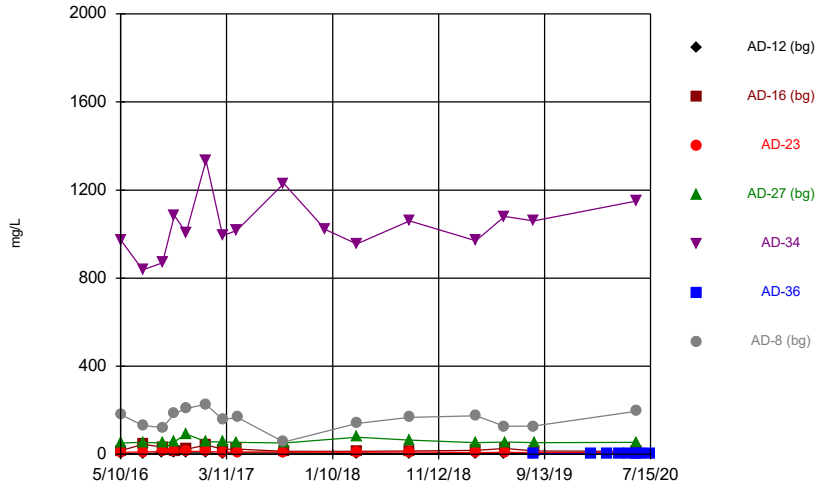
Time Series



Constituent: pH, field Analysis Run 12/3/2020 12:36 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

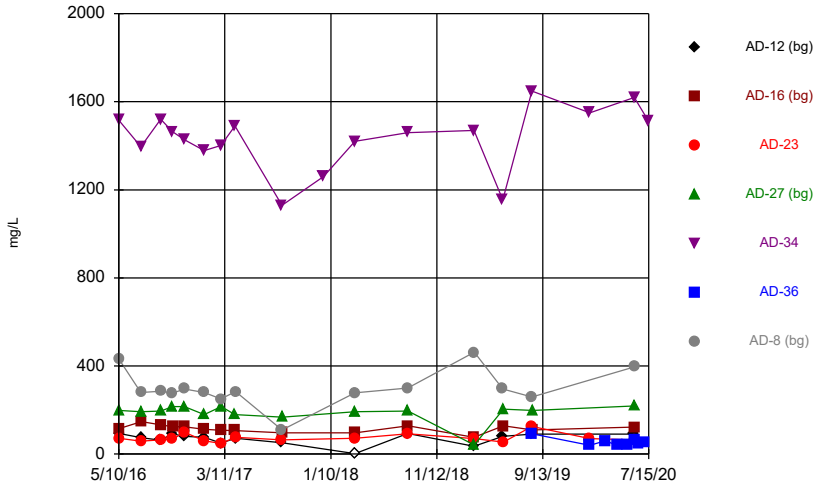
Time Series



Constituent: Sulfate, total Analysis Run 12/3/2020 12:36 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

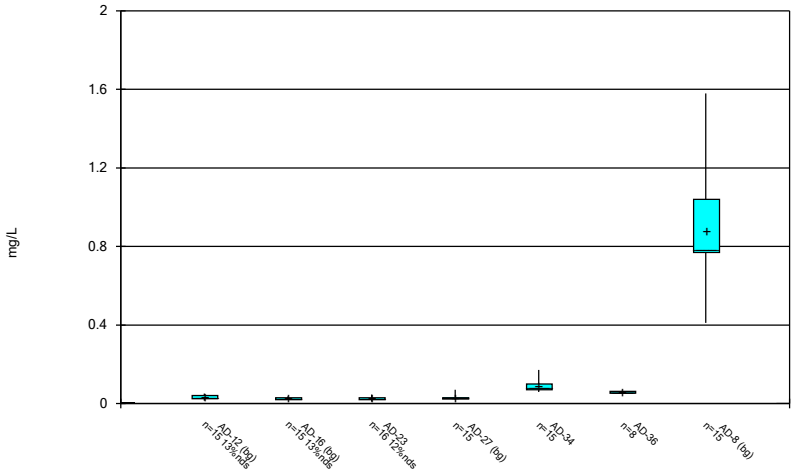
Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



Constituent: Total Dissolved Solids [TDS] Analysis Run 12/3/2020 12:36 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

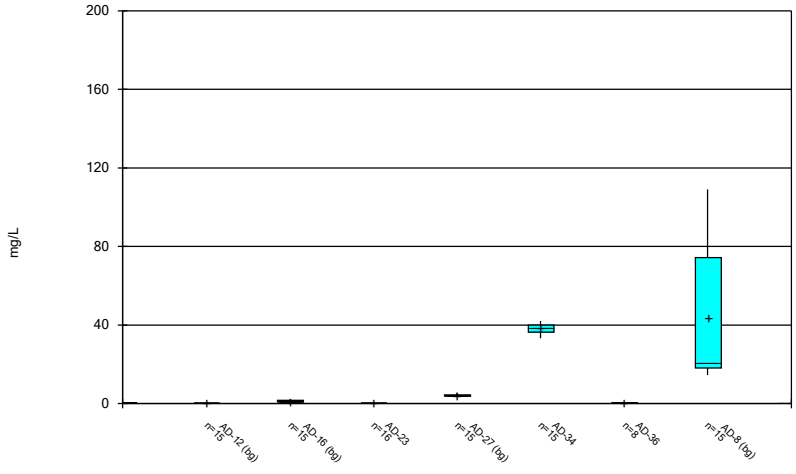
Box & Whiskers Plot



Constituent: Boron, total Analysis Run 12/3/2020 12:37 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

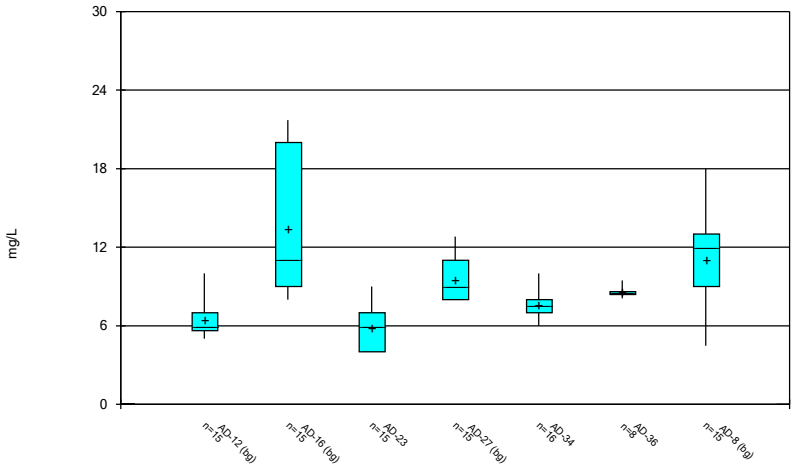
Box & Whiskers Plot



Constituent: Calcium, total Analysis Run 12/3/2020 12:37 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

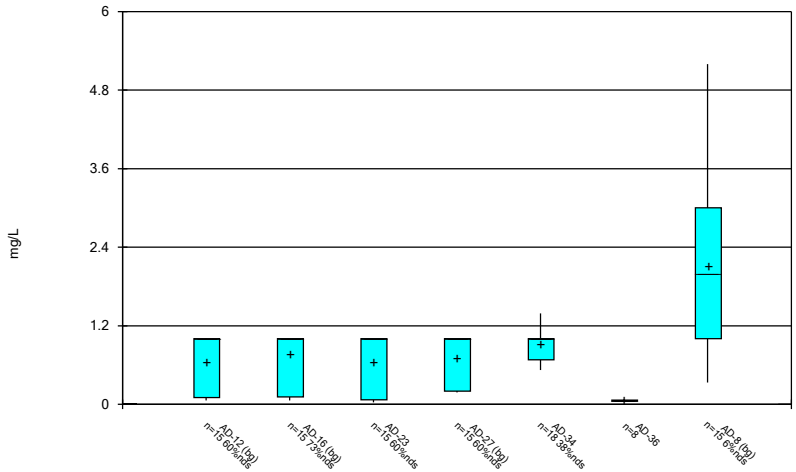
Box & Whiskers Plot



Constituent: Chloride, total Analysis Run 12/3/2020 12:37 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

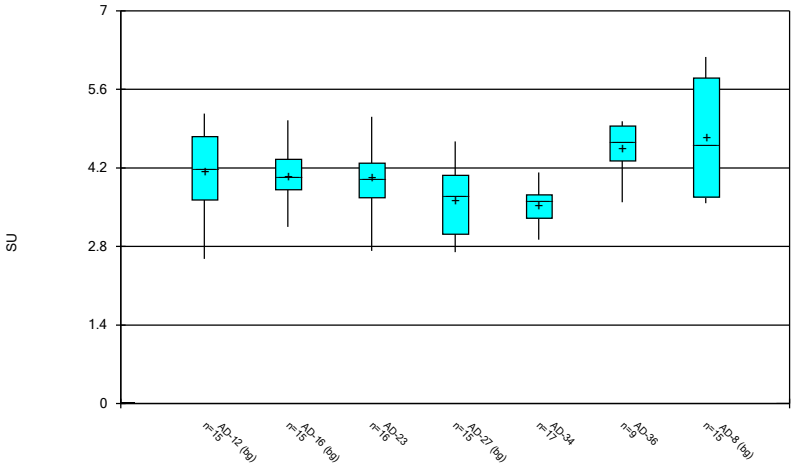
Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot



Constituent: Fluoride, total Analysis Run 12/3/2020 12:37 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

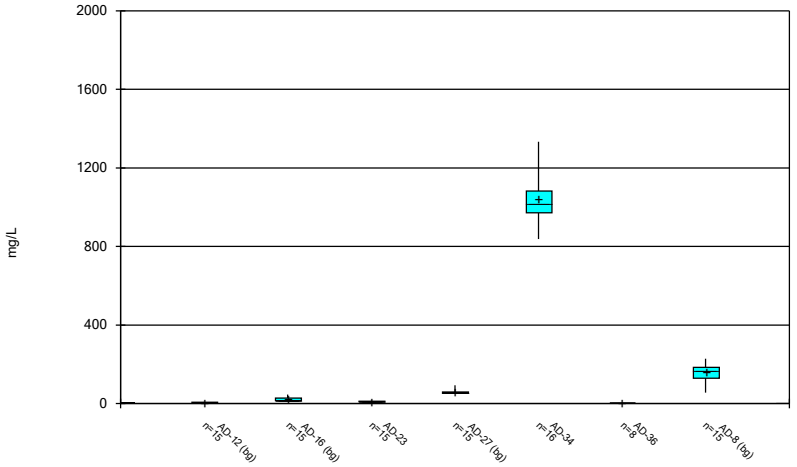
Box & Whiskers Plot



Constituent: pH, field Analysis Run 12/3/2020 12:37 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

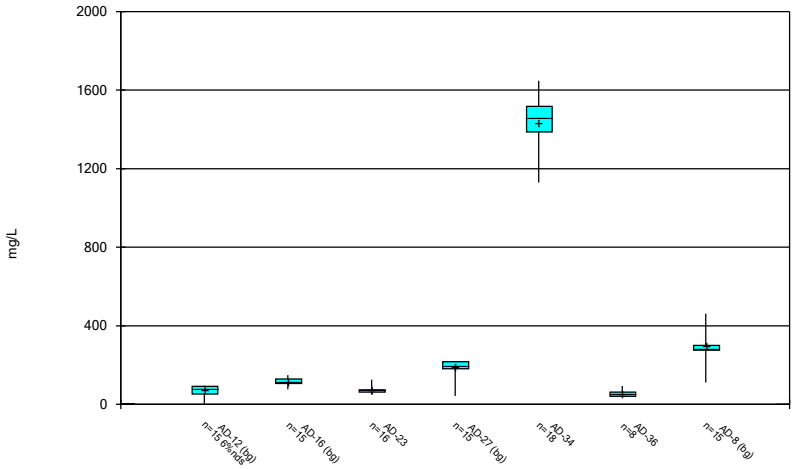
Box & Whiskers Plot



Constituent: Sulfate, total Analysis Run 12/3/2020 12:37 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot



Constituent: Total Dissolved Solids [TDS] Analysis Run 12/3/2020 12:37 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Outlier Summary

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill Printed 12/2/2020, 4:48 PM

No values flagged as outliers.

Outlier Analysis - Significant Results

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill Printed 12/2/2020, 4:59 PM

Constituent	Well	Outlier	Value(s)	Method	N	Mean	Std. Dev.	Distribution	Normality Test
Boron, total (mg/L)	**AD-27 (bg)**	**Yes**	**0.07**	**NP**	**15**	**0.03079**	**0.01222**	**ln(x)**	**ShapiroWilk**
Chloride, total (mg/L)	**AD-36**	**Yes**	**9.46**	**NP**	**8**	**8.564**	**0.3981**	**ln(x)**	**ShapiroWilk**
Sulfate, total (mg/L)	**AD-27 (bg)**	**Yes**	**92,78**	**NP**	**15**	**59.05**	**11.39**	**ln(x)**	**ShapiroWilk**
Total Dissolved Solids [TDS] (mg/L)	**AD-23**	**Yes**	**126**	**NP**	**16**	**72.5**	**19.19**	**ln(x)**	**ShapiroWilk**
Total Dissolved Solids [TDS] (mg/L)	**AD-8 (bg)**	**Yes**	**432,110,462,396**	**NP**	**15**	**299**	**82.57**	**normal**	**ShapiroWilk**

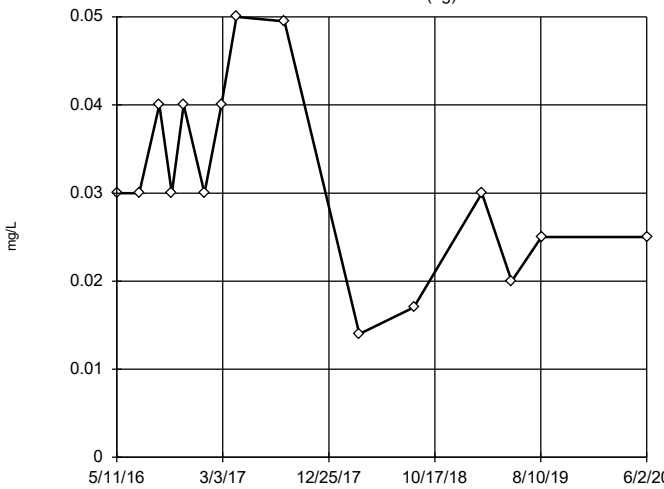
Outlier Analysis - All Results

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill Printed 12/2/2020, 4:59 PM

Constituent	Well	Outlier	Value(s)	Method	N	Mean	Std. Dev.	Distribution	Normality Test
Boron, total (mg/L)	AD-12 (bg)	No	n/a	NP	15	0.03137	0.01078	sqrt(x)	ShapiroWilk
Boron, total (mg/L)	AD-16 (bg)	No	n/a	NP	15	0.02571	0.005645	x^(1/3)	ShapiroWilk
Boron, total (mg/L)	AD-23	No	n/a	NP	16	0.02542	0.009074	x^(1/3)	ShapiroWilk
Boron, total (mg/L)	**AD-27 (bg)**	**Yes**	**0.07**	**NP**	**15**	**0.03079**	**0.01222**	**ln(x)**	**ShapiroWilk**
Boron, total (mg/L)	AD-34	No	n/a	NP	15	0.08827	0.0279	ln(x)	ShapiroWilk
Boron, total (mg/L)	AD-36	No	n/a	NP	8	0.05688	0.00541	ln(x)	ShapiroWilk
Boron, total (mg/L)	AD-8 (bg)	No	n/a	NP	15	0.8775	0.261	x^(1/3)	ShapiroWilk
Calcium, total (mg/L)	AD-12 (bg)	No	n/a	NP	15	0.3097	0.06082	x^(1/3)	ShapiroWilk
Calcium, total (mg/L)	AD-16 (bg)	No	n/a	NP	15	1.246	0.3825	ln(x)	ShapiroWilk
Calcium, total (mg/L)	AD-23	No	n/a	NP	16	0.3191	0.106	ln(x)	ShapiroWilk
Calcium, total (mg/L)	AD-27 (bg)	No	n/a	NP	15	4.188	0.5016	ln(x)	ShapiroWilk
Calcium, total (mg/L)	AD-34	No	n/a	NP	15	38.19	2.285	x^4	ShapiroWilk
Calcium, total (mg/L)	AD-36	No	n/a	NP	8	0.2305	0.04625	ln(x)	ShapiroWilk
Calcium, total (mg/L)	AD-8 (bg)	No	n/a	NP	15	43.51	33.94	ln(x)	ShapiroWilk
Chloride, total (mg/L)	AD-12 (bg)	No	n/a	NP	15	6.417	1.314	ln(x)	ShapiroWilk
Chloride, total (mg/L)	AD-16 (bg)	No	n/a	NP	15	13.32	5.164	ln(x)	ShapiroWilk
Chloride, total (mg/L)	AD-23	No	n/a	NP	15	5.864	1.505	normal	ShapiroWilk
Chloride, total (mg/L)	AD-27 (bg)	No	n/a	NP	15	9.493	1.628	ln(x)	ShapiroWilk
Chloride, total (mg/L)	AD-34	No	n/a	NP	16	7.508	0.9337	ln(x)	ShapiroWilk
Chloride, total (mg/L)	**AD-36**	**Yes**	**9.46**	**NP**	**8**	**8.564**	**0.3981**	**ln(x)**	**ShapiroWilk**
Chloride, total (mg/L)	AD-8 (bg)	No	n/a	NP	15	11.03	3.252	normal	ShapiroWilk
Fluoride, total (mg/L)	AD-12 (bg)	No	n/a	NP	15	0.654	0.4413	ln(x)	ShapiroWilk
Fluoride, total (mg/L)	AD-16 (bg)	No	n/a	NP	15	0.7533	0.4236	ln(x)	ShapiroWilk
Fluoride, total (mg/L)	AD-23	No	n/a	NP	15	0.6431	0.4564	ln(x)	ShapiroWilk
Fluoride, total (mg/L)	AD-27 (bg)	No	n/a	NP	15	0.7096	0.3818	ln(x)	ShapiroWilk
Fluoride, total (mg/L)	AD-34	No	n/a	NP	18	0.9236	0.2249	normal	ShapiroWilk
Fluoride, total (mg/L)	AD-36	No	n/a	NP	8	0.0575	0.01165	ln(x)	ShapiroWilk
Fluoride, total (mg/L)	AD-8 (bg)	No	n/a	NP	15	2.104	1.315	sqrt(x)	ShapiroWilk
pH, field (SU)	AD-12 (bg)	No	n/a	NP	15	4.139	0.7332	x^3	ShapiroWilk
pH, field (SU)	AD-16 (bg)	No	n/a	NP	15	4.058	0.4938	sqrt(x)	ShapiroWilk
pH, field (SU)	AD-23	No	n/a	NP	16	4.033	0.6067	normal	ShapiroWilk
pH, field (SU)	AD-27 (bg)	No	n/a	NP	15	3.628	0.6016	normal	ShapiroWilk
pH, field (SU)	AD-34	No	n/a	NP	17	3.544	0.3201	x^2	ShapiroWilk
pH, field (SU)	AD-36	No	n/a	NP	9	4.566	0.4632	x^6	ShapiroWilk
pH, field (SU)	AD-8 (bg)	No	n/a	NP	15	4.75	1.061	x^2	ShapiroWilk
Sulfate, total (mg/L)	AD-12 (bg)	No	n/a	NP	15	4.873	1.641	ln(x)	ShapiroWilk
Sulfate, total (mg/L)	AD-16 (bg)	No	n/a	NP	15	22.49	10.42	ln(x)	ShapiroWilk
Sulfate, total (mg/L)	AD-23	No	n/a	NP	15	10.48	2.021	normal	ShapiroWilk
Sulfate, total (mg/L)	**AD-27 (bg)**	**Yes**	**92,78**	**NP**	**15**	**59.05**	**11.39**	**ln(x)**	**ShapiroWilk**
Sulfate, total (mg/L)	AD-34	No	n/a	NP	16	1040	123.8	ln(x)	ShapiroWilk
Sulfate, total (mg/L)	AD-36	No	n/a	NP	8	3.388	0.5027	x^6	ShapiroWilk
Sulfate, total (mg/L)	AD-8 (bg)	No	n/a	NP	15	157.9	42.45	x^2	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	AD-12 (bg)	No	n/a	NP	15	69.83	25.67	x^2	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	AD-16 (bg)	No	n/a	NP	15	115.1	17.67	x^2	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	**AD-23**	**Yes**	**126**	**NP**	**16**	**72.5**	**19.19**	**ln(x)**	**ShapiroWilk**
Total Dissolved Solids [TDS] (mg/L)	AD-27 (bg)	No	n/a	NP	15	187.5	42.9	x^5	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	AD-34	No	n/a	NP	18	1434	138.6	x^5	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	AD-36	No	n/a	NP	8	54.88	17.74	ln(x)	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	**AD-8 (bg)**	**Yes**	**432,110,462,396**	**NP**	**15**	**299**	**82.57**	**normal**	**ShapiroWilk**

Tukey's Outlier Screening

AD-12 (bg)



n = 15

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 = 0.1061, low cutoff = 0.001053, based on IQR multiplier of 3.

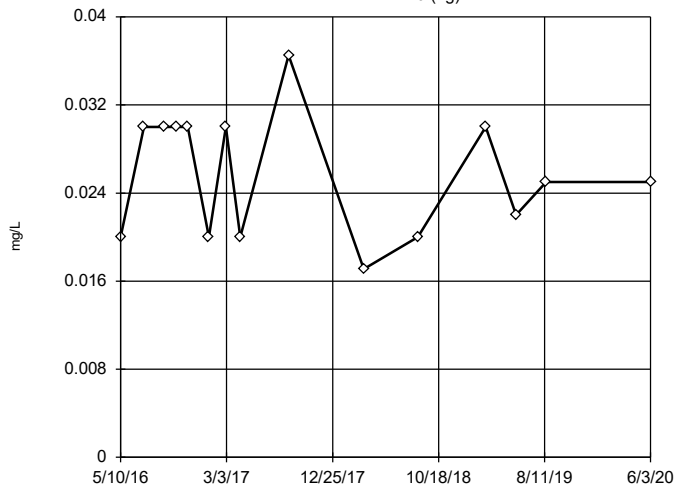
Constituent: Boron, total Analysis Run 12/2/2020 4:54 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-16 (bg)



n = 15

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 = 0.07872, low cutoff = 0.003624, based on IQR multiplier of 3.

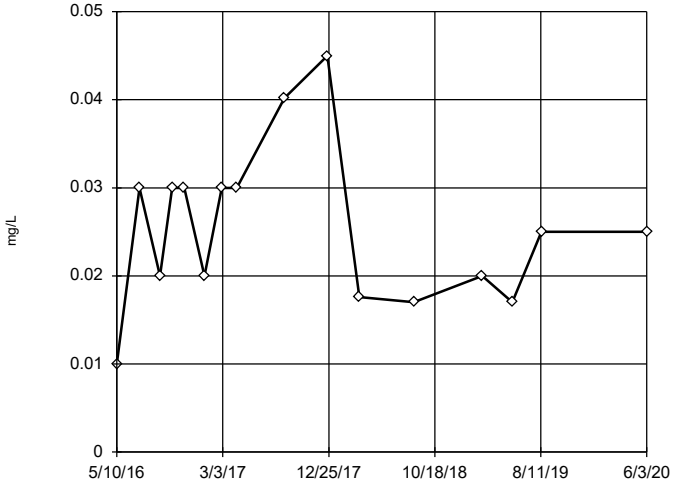
Constituent: Boron, total Analysis Run 12/2/2020 4:54 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-23



n = 16

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 = 0.08845, low cutoff = 0.002246, based on IQR multiplier of 3.

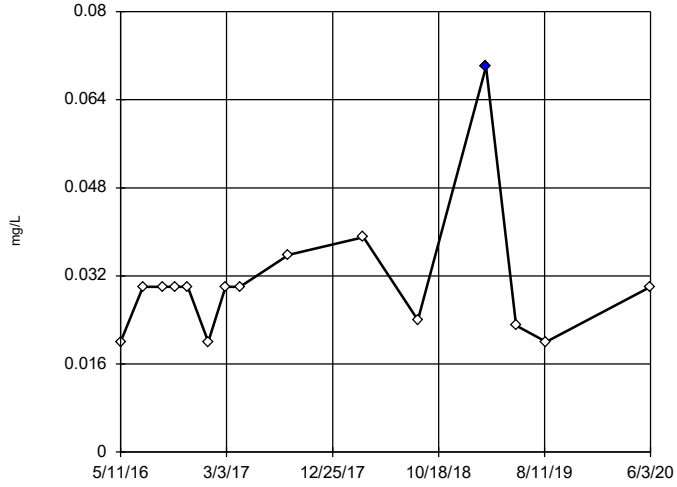
Constituent: Boron, total Analysis Run 12/2/2020 4:54 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-27 (bg)



n = 15

Outlier is drawn as solid. Tukey's method selected by user.

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

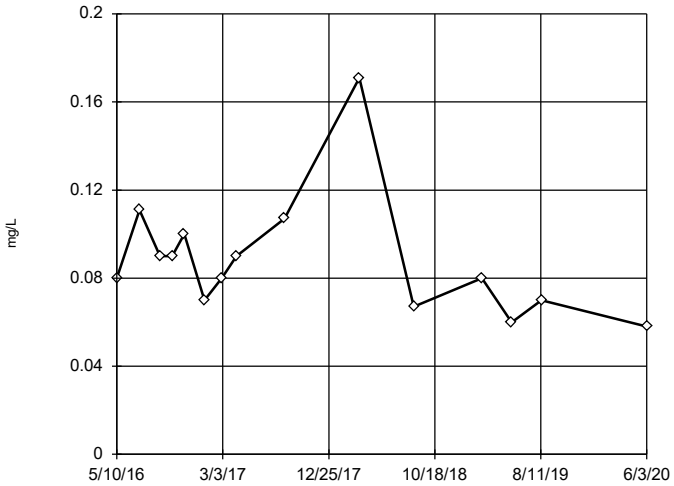
High cutoff = 0.06657, low cutoff = 0.01036, based on IQR multiplier of 3.

Constituent: Boron, total Analysis Run 12/2/2020 4:54 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Tukey's Outlier Screening

AD-34



n = 15

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 = 0.2915, low cutoff = 0.02401, based on IQR multiplier of 3.

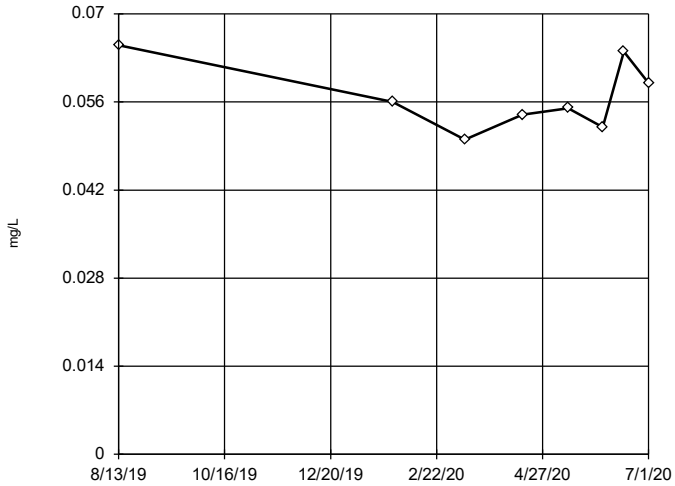
Constituent: Boron, total Analysis Run 12/2/2020 4:54 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-36



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 = 0.09582, low cutoff = 0.03398, based on IQR multiplier of 3.

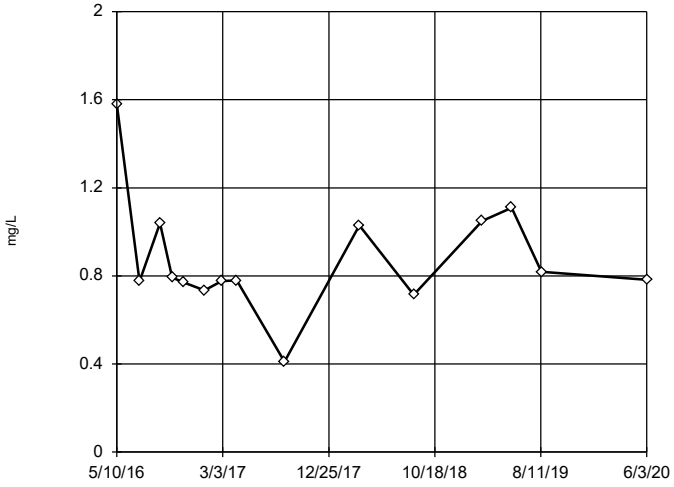
Constituent: Boron, total Analysis Run 12/2/2020 4:54 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-8 (bg)



n = 15

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 = 2.218, low cutoff = 0.2444, based on IQR multiplier of 3.

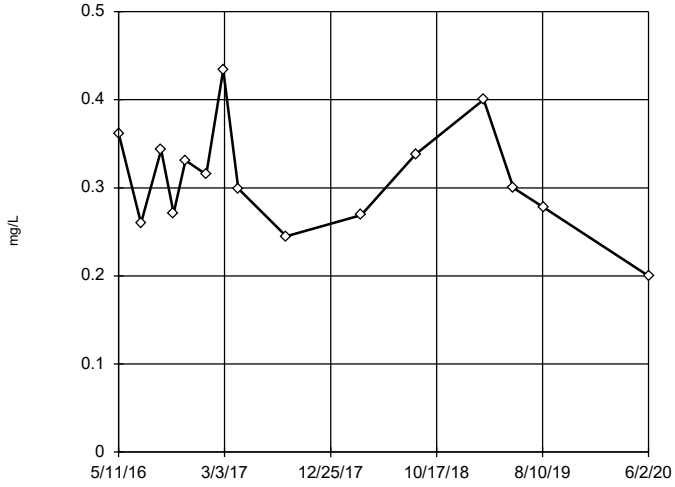
Constituent: Boron, total Analysis Run 12/2/2020 4:54 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-12 (bg)



n = 15

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

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

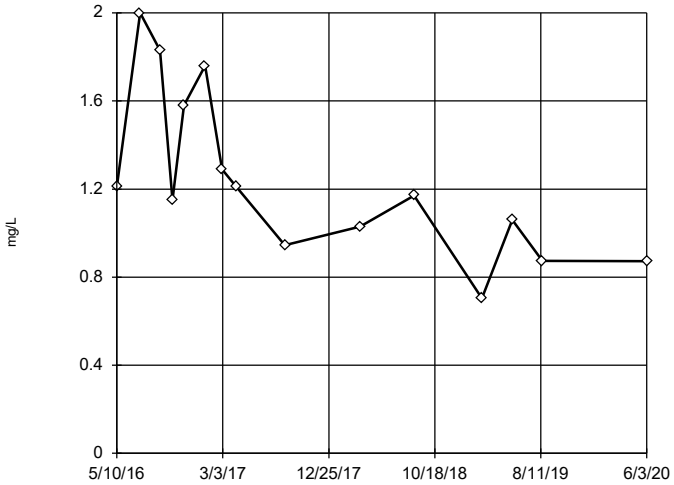
High cutoff = 0.6436, low cutoff = 0.1121, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 12/2/2020 4:54 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Tukey's Outlier Screening

AD-16 (bg)



n = 15

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

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

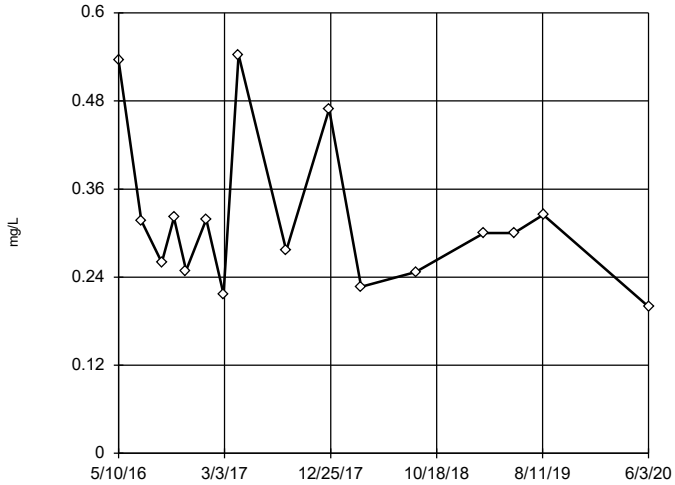
High cutoff = 7.385, low cutoff = 0.2022, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 12/2/2020 4:54 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-23



n = 16

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

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

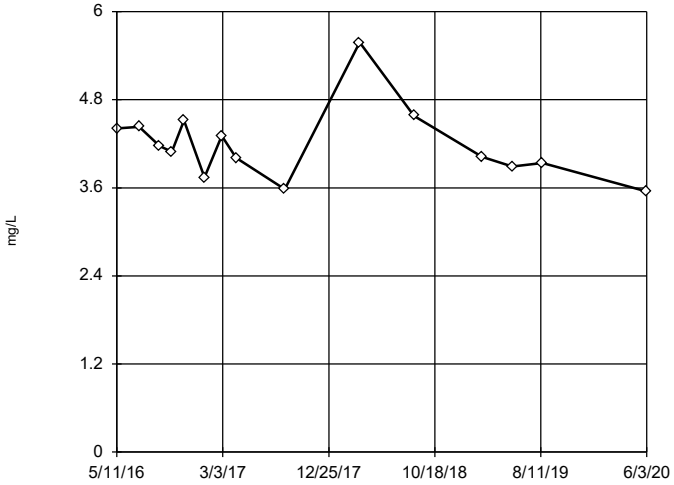
High cutoff = 0.7136, low cutoff = 0.1123, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 12/2/2020 4:54 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-27 (bg)



n = 15

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

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

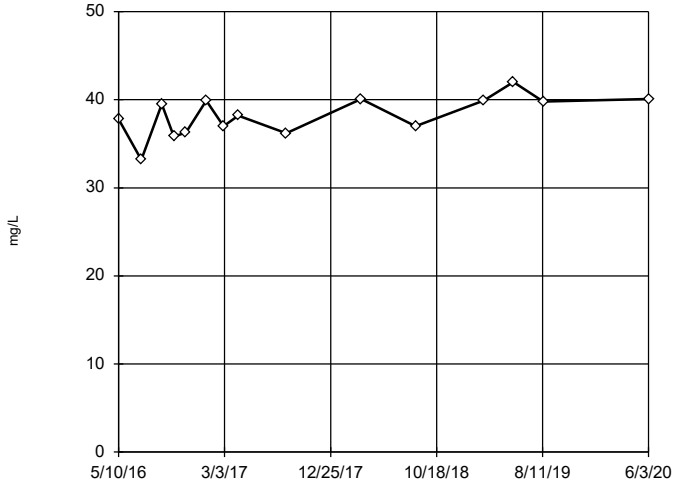
High cutoff = 6.543, low cutoff = 2.634, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 12/2/2020 4:54 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-34



n = 15

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

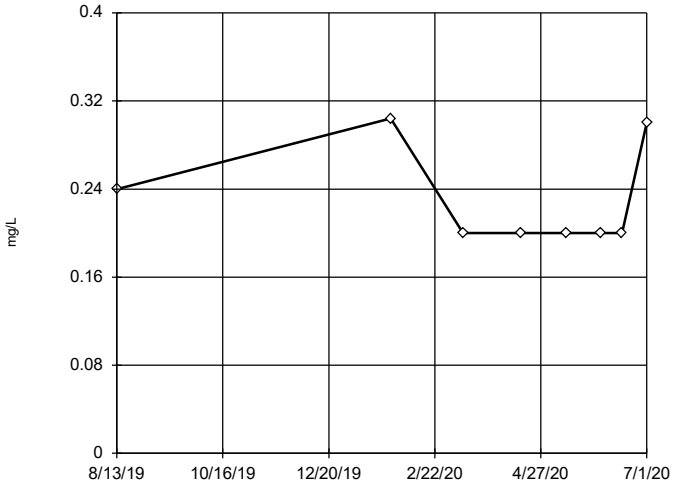
Data were x^4 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 47.12, low cutoff = -28.48, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 12/2/2020 4:54 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Tukey's Outlier Screening

AD-36



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 = 0.648, low cutoff = 0.08282, based on IQR multiplier of 3.

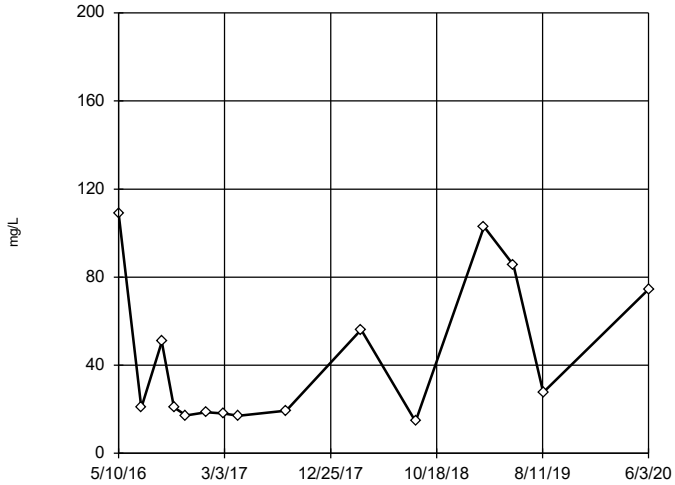
Constituent: Calcium, total Analysis Run 12/2/2020 4:55 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-8 (bg)



n = 15

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 = 5167, low cutoff = 0.2606, based on IQR multiplier of 3.

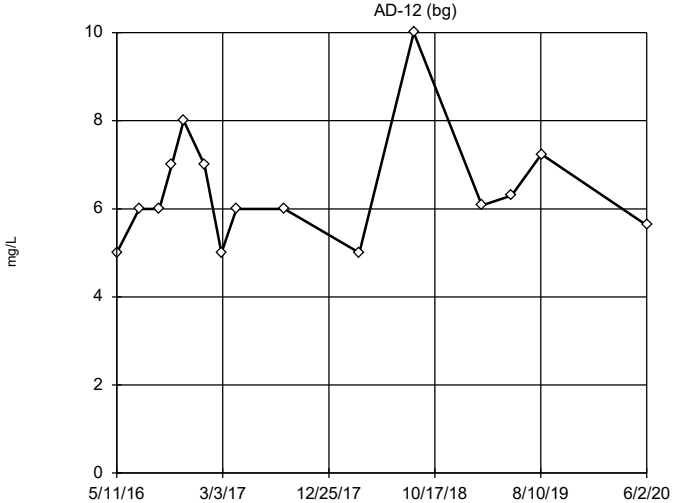
Constituent: Calcium, total Analysis Run 12/2/2020 4:55 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-12 (bg)



n = 15

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 = 13.45, low cutoff = 2.929, based on IQR multiplier of 3.

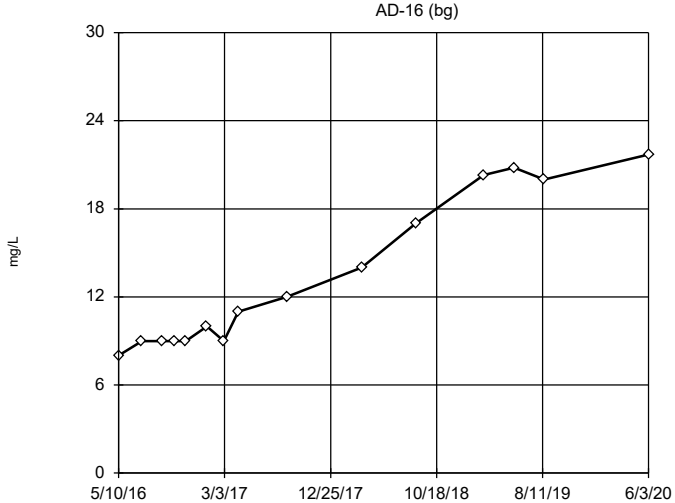
Constituent: Chloride, total Analysis Run 12/2/2020 4:55 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-16 (bg)



n = 15

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

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

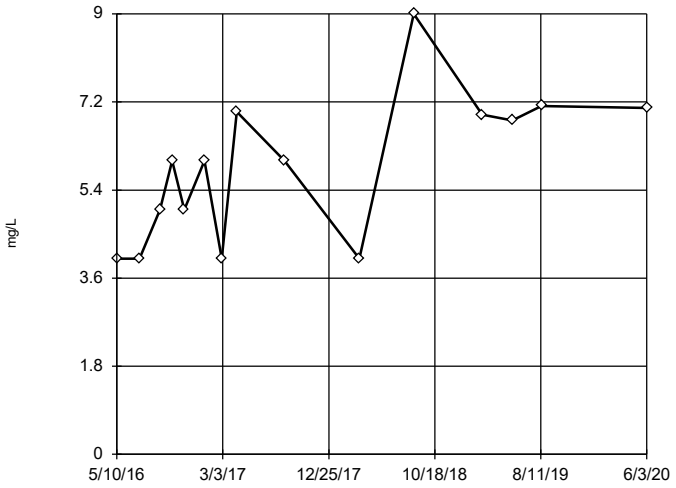
High cutoff = 219.5, low cutoff = 0.8201, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 12/2/2020 4:55 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Tukey's Outlier Screening

AD-23



n = 15

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

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

High cutoff = 16, low cutoff = -5, based on IQR multiplier of 3.

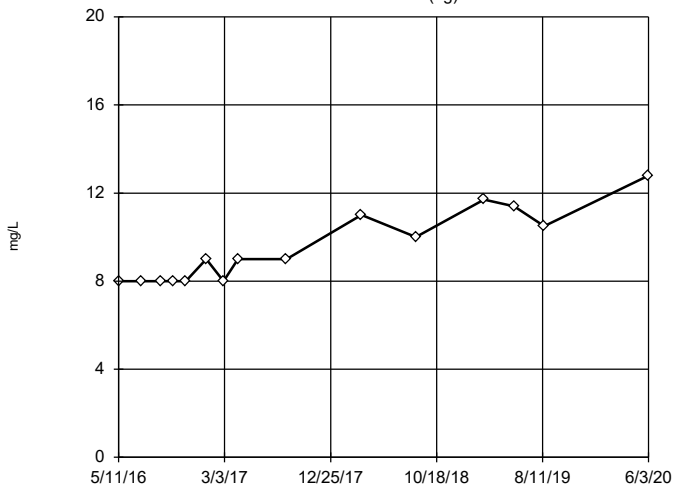
Constituent: Chloride, total Analysis Run 12/2/2020 4:55 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-27 (bg)



n = 15

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 = 28.6, low cutoff = 3.077, based on IQR multiplier of 3.

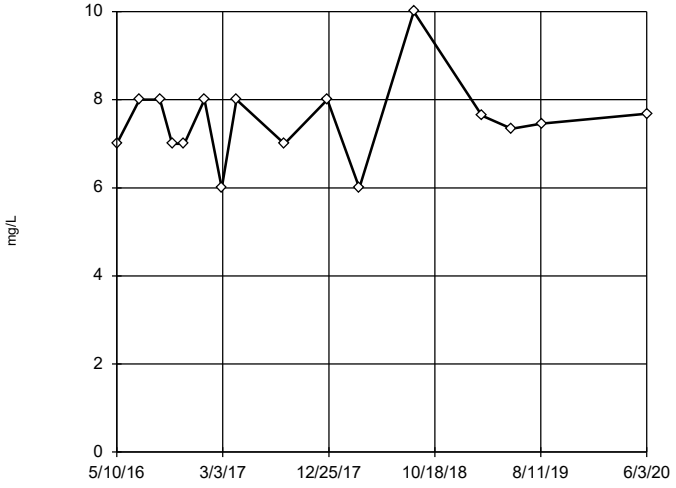
Constituent: Chloride, total Analysis Run 12/2/2020 4:55 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-34



n = 16

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 = 11.94, low cutoff = 4.689, based on IQR multiplier of 3.

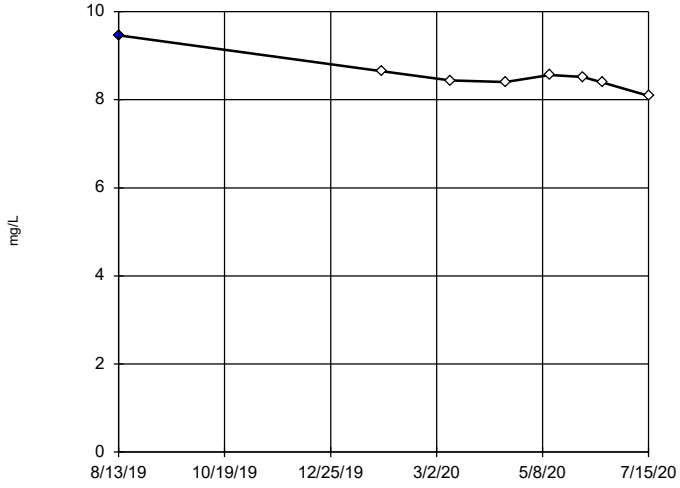
Constituent: Chloride, total Analysis Run 12/2/2020 4:55 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-36



n = 8

Outlier is drawn as solid. Tukey's method selected by user.

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

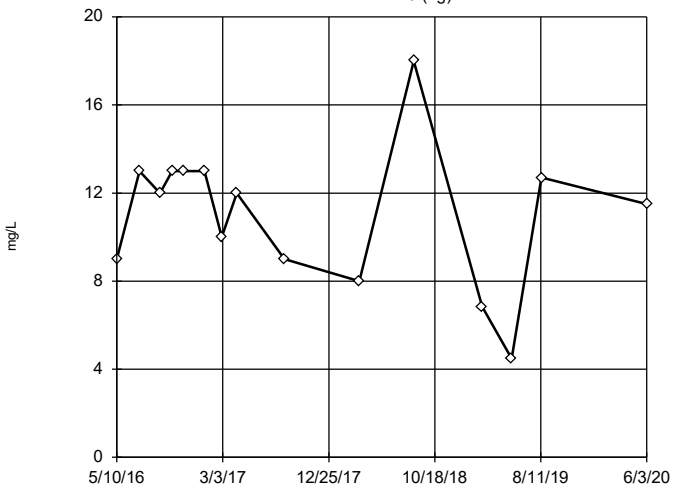
High cutoff = 9.267, low cutoff = 7.796, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 12/2/2020 4:55 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Tukey's Outlier Screening

AD-8 (bg)



n = 15

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

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

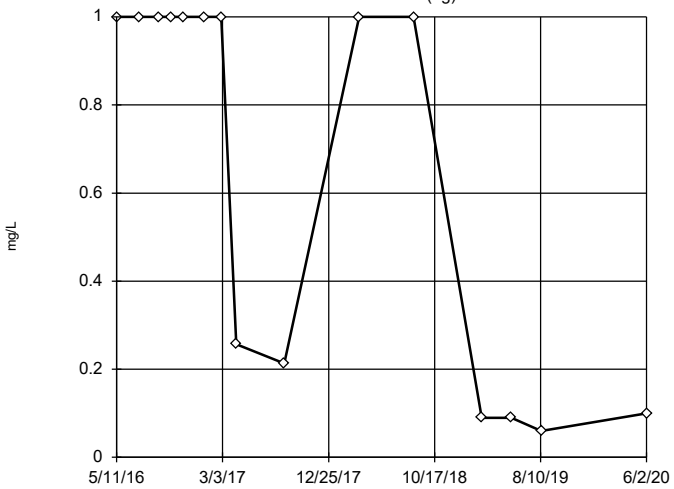
High cutoff = 25, low cutoff = -3, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 12/2/2020 4:55 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-12 (bg)



n = 15

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

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

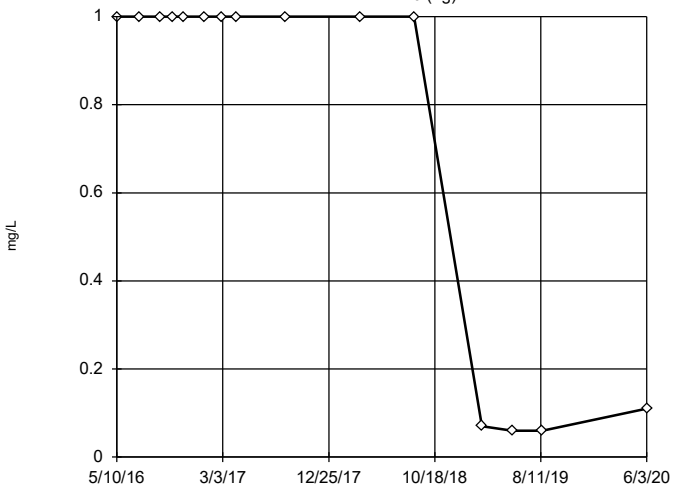
High cutoff = 1000, low cutoff = 0.0001, based on IQR multiplier of 3.

Constituent: Fluoride, total Analysis Run 12/2/2020 4:55 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-16 (bg)



n = 15

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

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

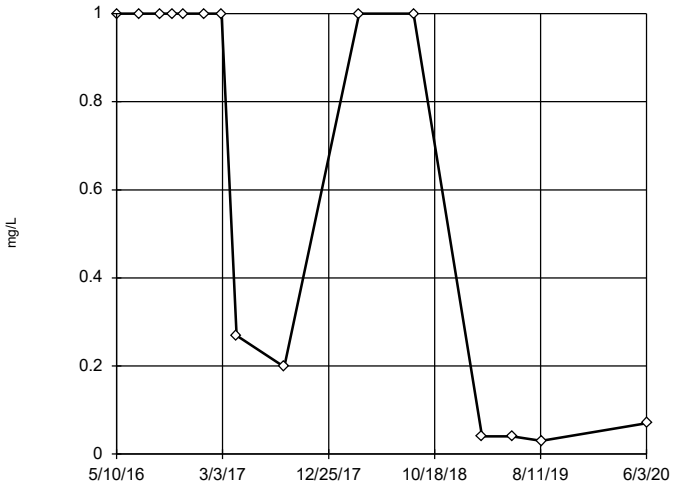
High cutoff = 751.3, low cutoff = 0.0001464, based on IQR multiplier of 3.

Constituent: Fluoride, total Analysis Run 12/2/2020 4:55 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-23



n = 15

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

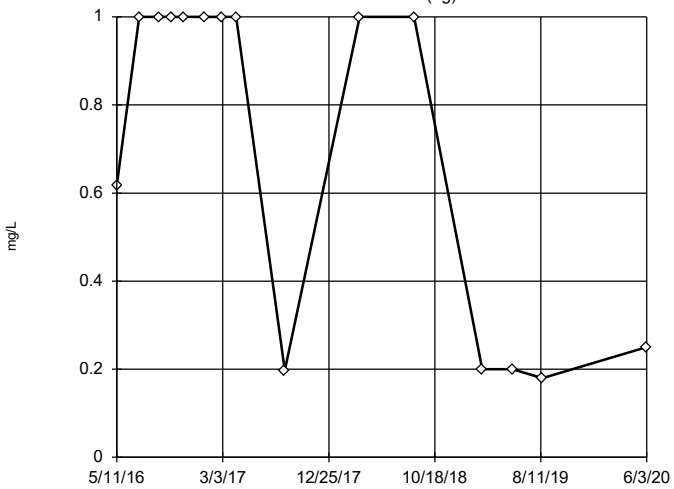
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 2915, low cutoff = 0.00002401, based on IQR multiplier of 3.

Constituent: Fluoride, total Analysis Run 12/2/2020 4:55 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Tukey's Outlier Screening

AD-27 (bg)



n = 15

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

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

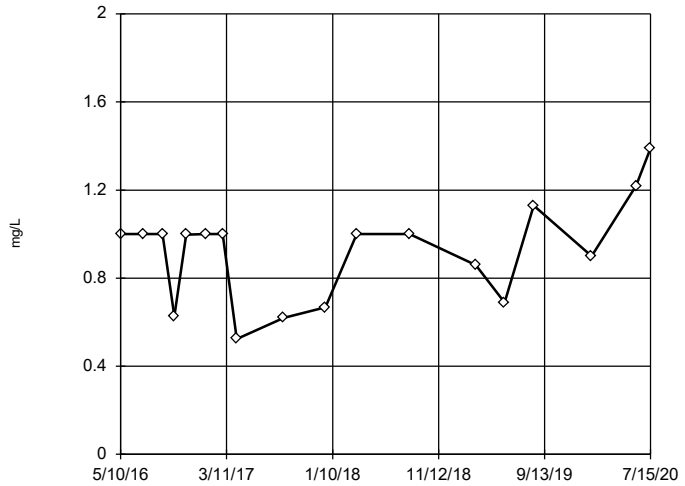
High cutoff = 125, low cutoff = 0.0016, based on IQR multiplier of 3.

Constituent: Fluoride, total Analysis Run 12/2/2020 4:55 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-34



n = 18

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

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

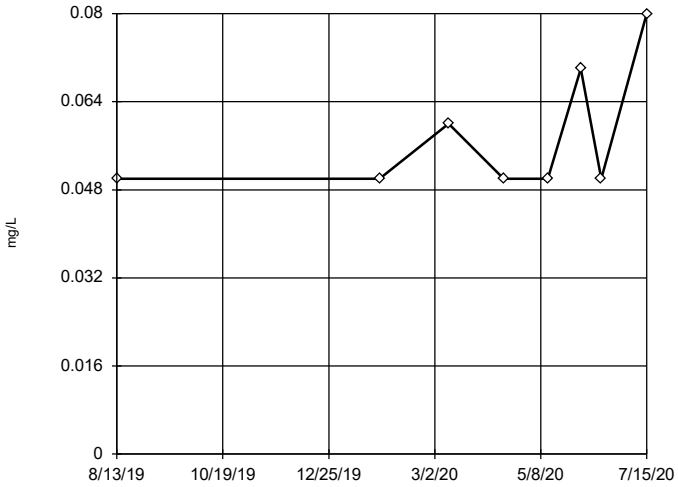
High cutoff = 1.965, low cutoff = -0.2862, based on IQR multiplier of 3.

Constituent: Fluoride, total Analysis Run 12/2/2020 4:55 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-36



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).

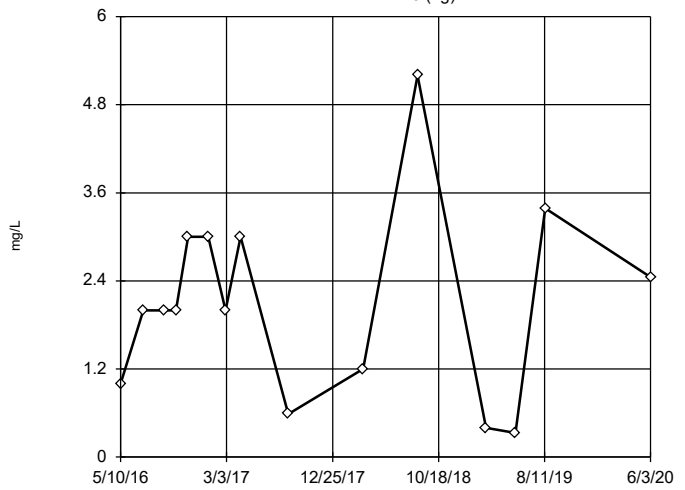
High cutoff = 0.1411, low cutoff = 0.02296, based on IQR multiplier of 3.

Constituent: Fluoride, total Analysis Run 12/2/2020 4:55 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-8 (bg)



n = 15

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

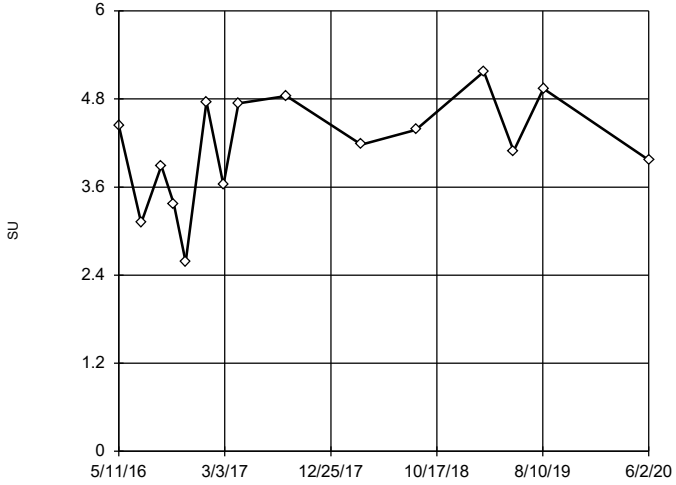
Data were square root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 15.43, low cutoff = -1.431, based on IQR multiplier of 3.

Constituent: Fluoride, total Analysis Run 12/2/2020 4:55 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Tukey's Outlier Screening

AD-12 (bg)



n = 15

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 = 6.603, low cutoff = -5.094, based on IQR multiplier of 3.

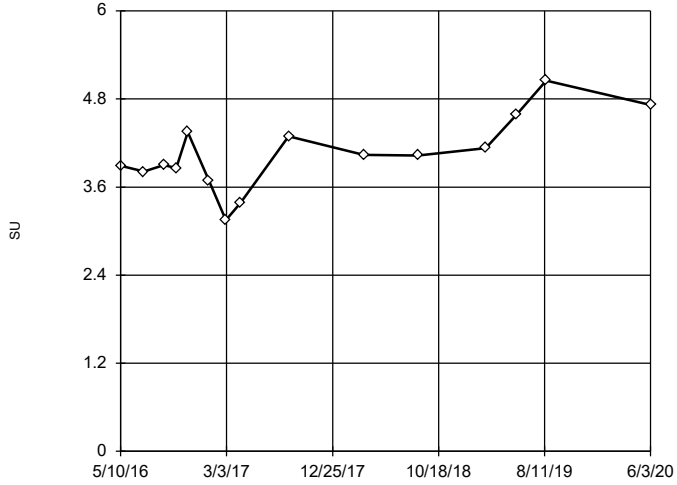
Constituent: pH, field Analysis Run 12/2/2020 4:55 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-16 (bg)



n = 15

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 = 6.185, low cutoff = 2.405, based on IQR multiplier of 3.

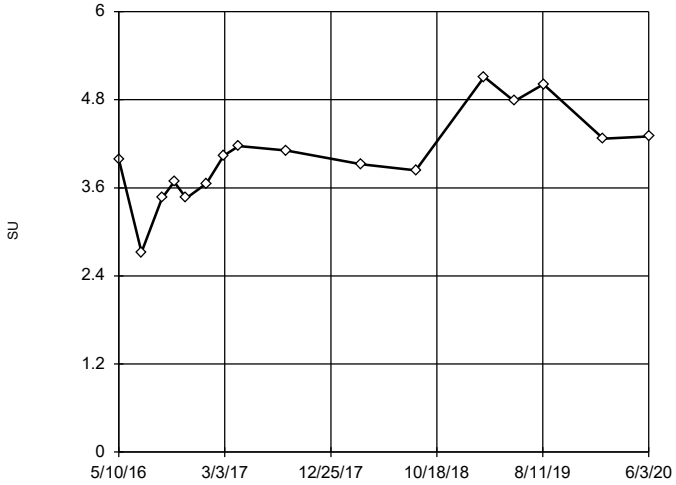
Constituent: pH, field Analysis Run 12/2/2020 4:55 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-23



n = 16

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

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

High cutoff = 6.13, low cutoff = 1.825, based on IQR multiplier of 3.

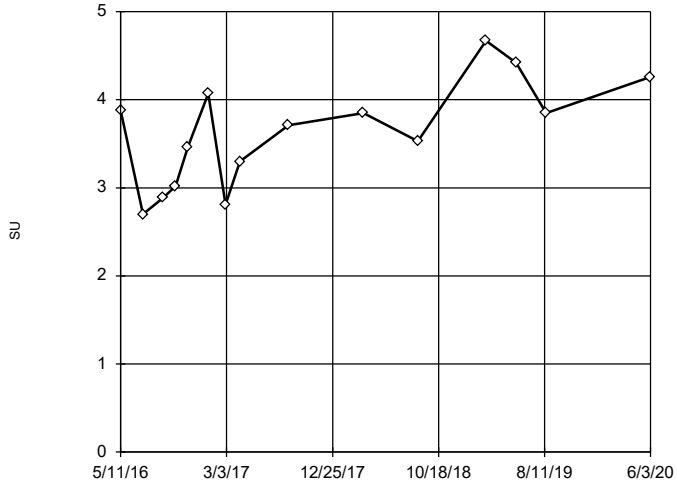
Constituent: pH, field Analysis Run 12/2/2020 4:55 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-27 (bg)



n = 15

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

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

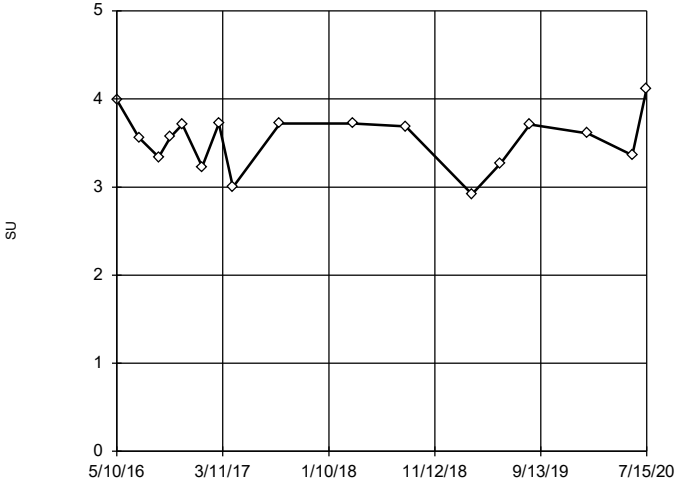
High cutoff = 7.22, low cutoff = -0.13, based on IQR multiplier of 3.

Constituent: pH, field Analysis Run 12/2/2020 4:55 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Tukey's Outlier Screening

AD-34



n = 17

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 = 4.752, low cutoff = 1.477, based on IQR multiplier of 3.

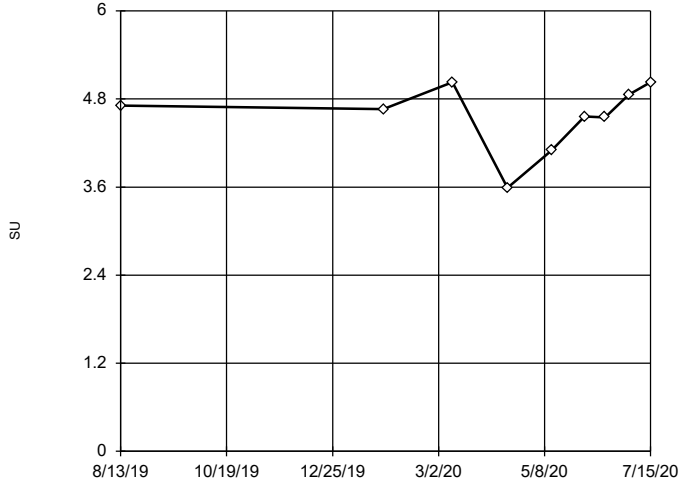
Constituent: pH, field Analysis Run 12/2/2020 4:55 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-36



n = 9

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 = 5.806, low cutoff = -5.061, based on IQR multiplier of 3.

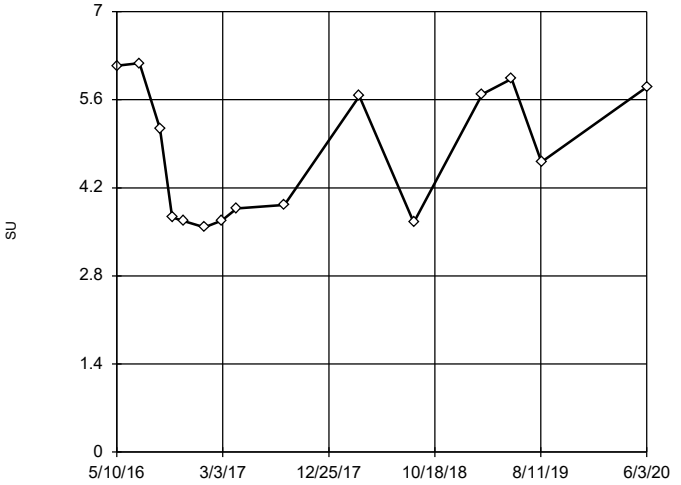
Constituent: pH, field Analysis Run 12/2/2020 4:55 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-8 (bg)



n = 15

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 = 9.692, low cutoff = -6.837, based on IQR multiplier of 3.

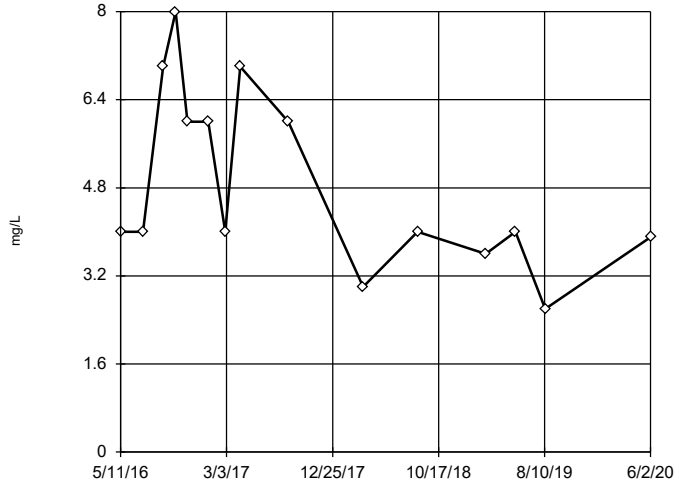
Constituent: pH, field Analysis Run 12/2/2020 4:55 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-12 (bg)



n = 15

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

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

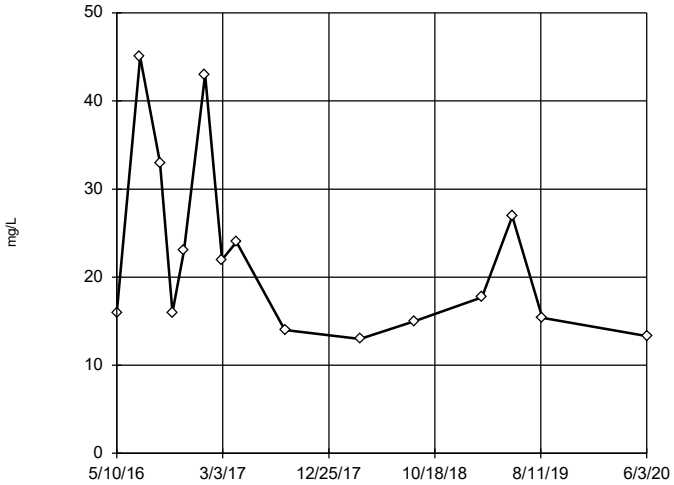
High cutoff = 21.85, low cutoff = 1.071, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 12/2/2020 4:55 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Tukey's Outlier Screening

AD-16 (bg)



n = 15

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

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

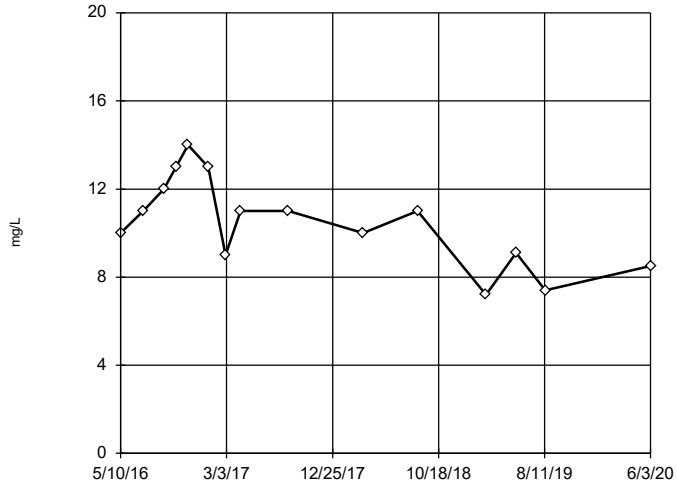
High cutoff = 155.1, low cutoff = 2.601, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 12/2/2020 4:55 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-23



n = 15

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

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

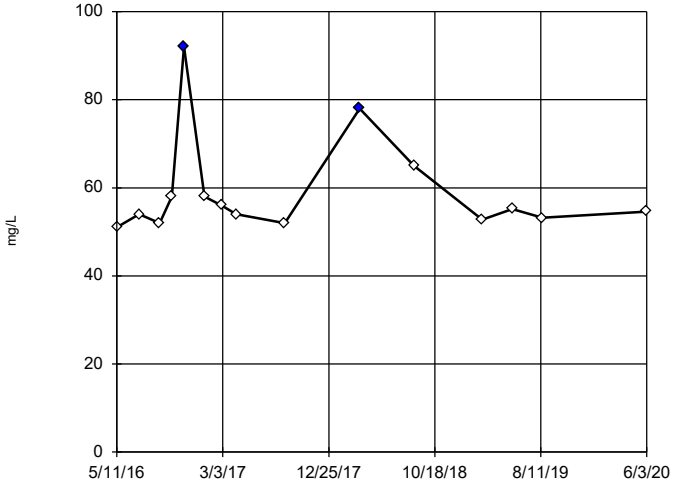
High cutoff = 21, low cutoff = 0, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 12/2/2020 4:55 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-27 (bg)



n = 15

Outliers are drawn as solid.
Tukey's method selected by user.

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

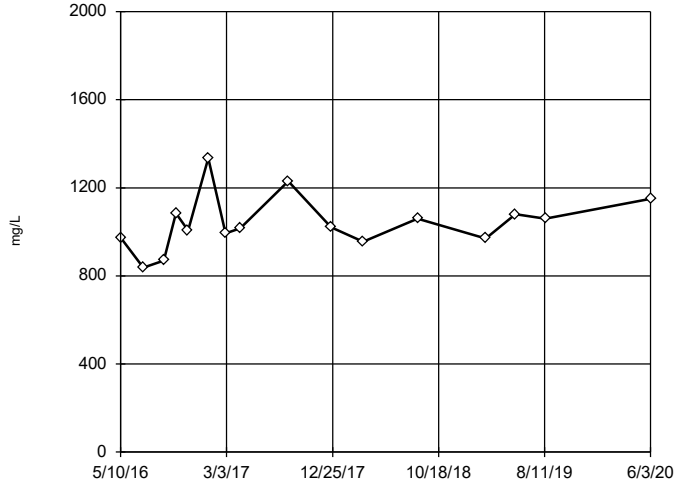
High cutoff = 76.88, low cutoff = 39.83, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 12/2/2020 4:55 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-34



n = 16

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

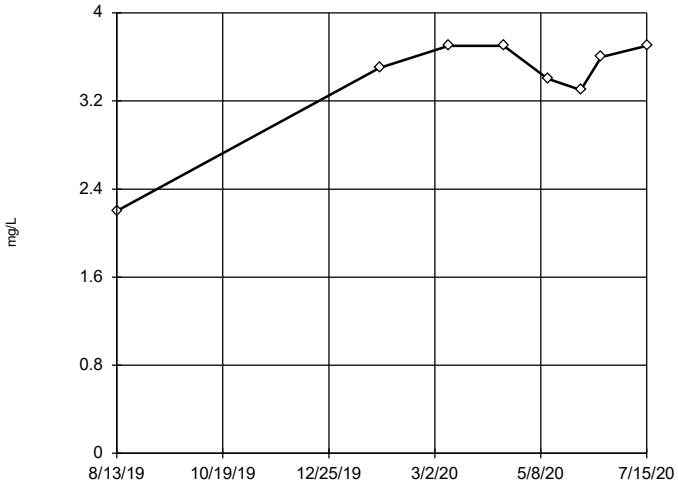
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 1492, low cutoff = 704.7, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 12/2/2020 4:55 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Tukey's Outlier Screening

AD-36



n = 8

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 = 4.264, low cutoff = -3.557, based on IQR multiplier of 3.

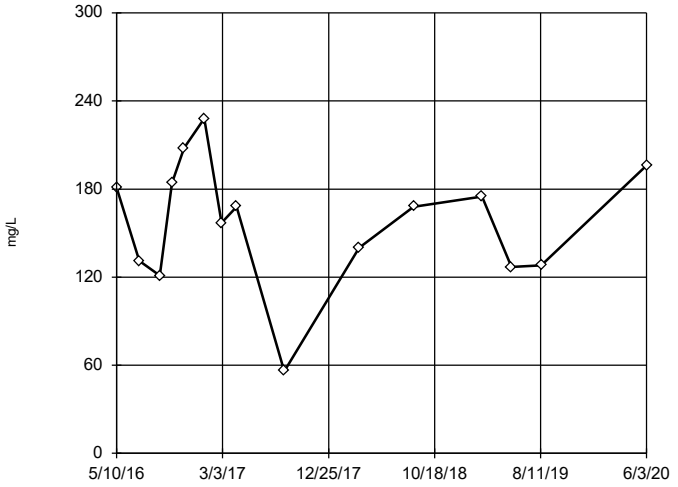
Constituent: Sulfate, total Analysis Run 12/2/2020 4:55 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-8 (bg)



n = 15

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 = 293.7, low cutoff = -189.8, based on IQR multiplier of 3.

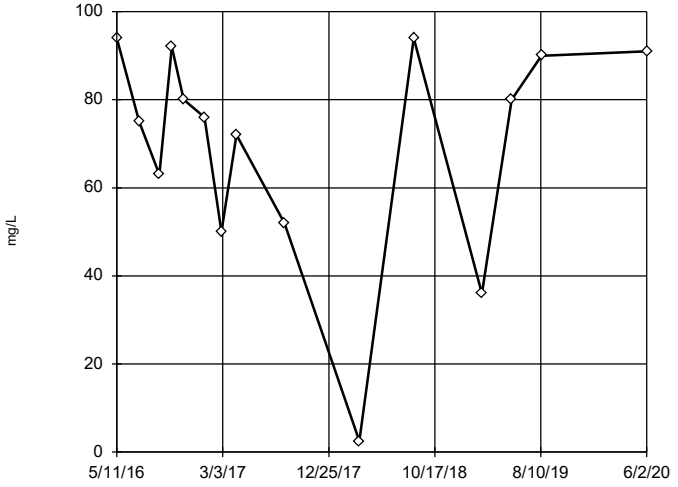
Constituent: Sulfate, total Analysis Run 12/2/2020 4:55 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-12 (bg)



n = 15

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 = 158.2, low cutoff = -118.4, based on IQR multiplier of 3.

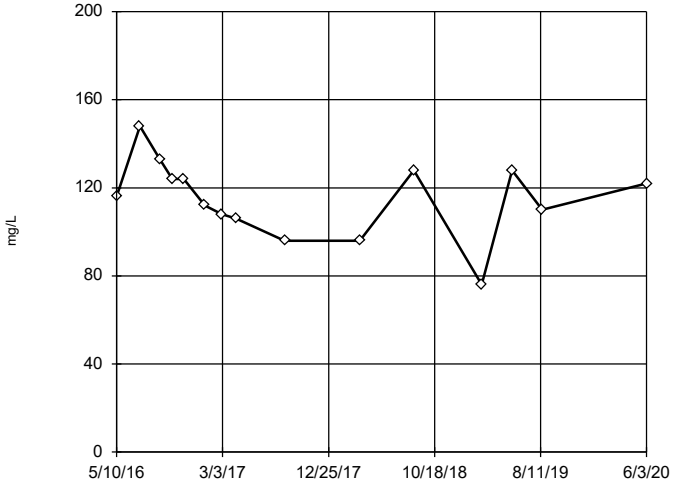
Constituent: Total Dissolved Solids [TDS] Analysis Run 12/2/2020 4:55 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-16 (bg)



n = 15

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

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

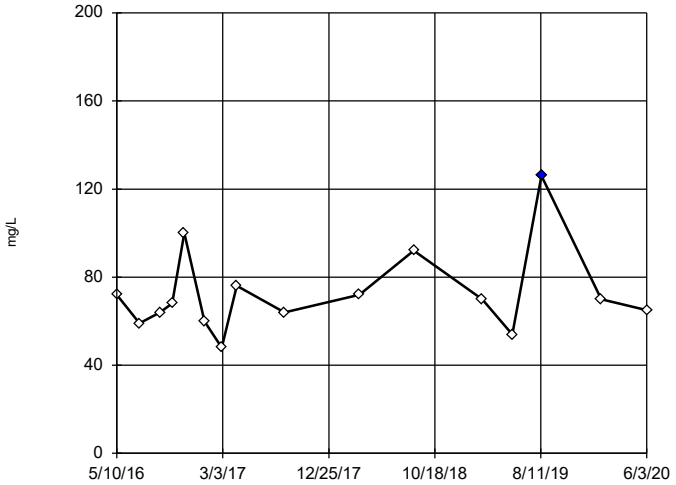
High cutoff = 178.4, low cutoff = -64.87, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids [TDS] Analysis Run 12/2/2020 4:55 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Tukey's Outlier Screening

AD-23



n = 16

Outlier is drawn as solid. Tukey's method selected by user.

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

High cutoff = 125.8, low cutoff = 36.43, based on IQR multiplier of 3.

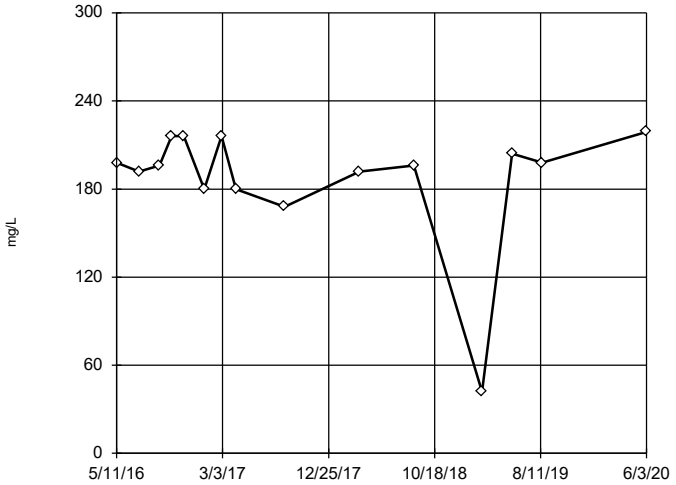
Constituent: Total Dissolved Solids [TDS] Analysis Run 12/2/2020 4:55 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-27 (bg)



n = 15

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

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

High cutoff = 265.3, low cutoff = -230.8, based on IQR multiplier of 3.

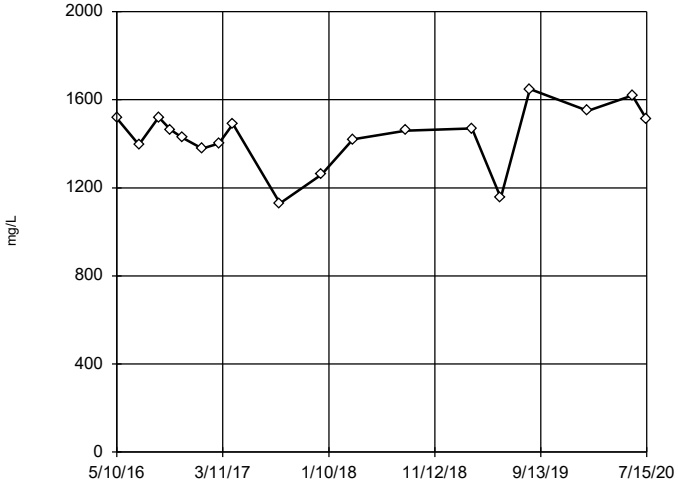
Constituent: Total Dissolved Solids [TDS] Analysis Run 12/2/2020 4:55 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-34



n = 18

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

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

High cutoff = 1759, low cutoff = -1295, based on IQR multiplier of 3.

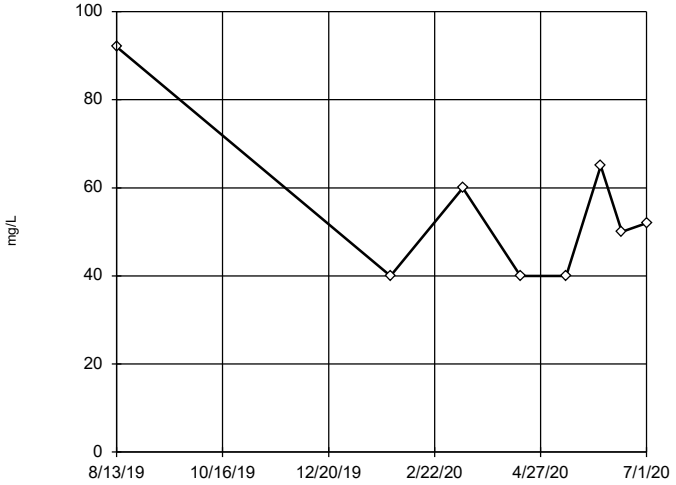
Constituent: Total Dissolved Solids [TDS] Analysis Run 12/2/2020 4:55 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

AD-36



n = 8

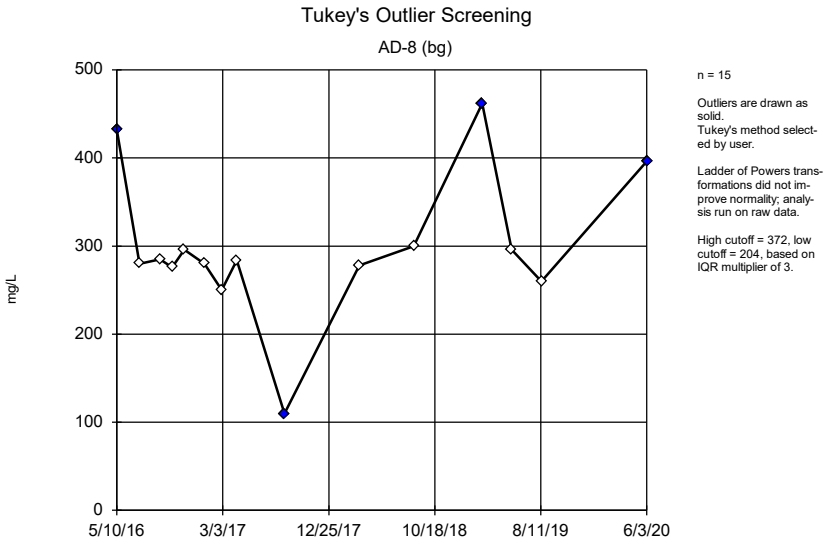
No outliers found. Tukey's method selected by user.

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

High cutoff = 237.7, low cutoff = 10.51, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids [TDS] Analysis Run 12/2/2020 4:55 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill



n = 15

Outliers are drawn as solid.
Tukey's method selected by user.

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

High cutoff = 372, low cutoff = 204, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids [TDS] Analysis Run 12/2/2020 4:55 PM View: Descriptive
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

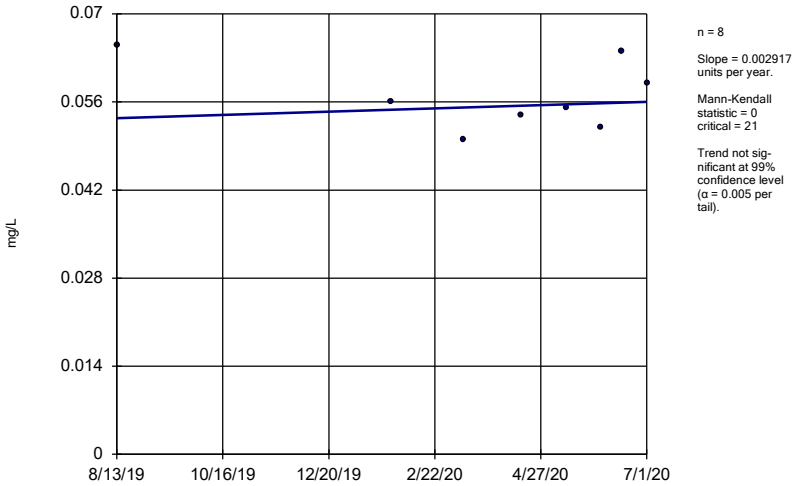
Trend Test Summary - All Results (No Significant)

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill Printed 12/2/2020, 4:32 PM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Boron, total (mg/L)	AD-36	0.002917	0	21	No	8	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	AD-36	0	-4	-21	No	8	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AD-36	-1.181	-20	-21	No	8	0	n/a	n/a	0.01	NP
Fluoride, total (mg/L)	AD-36	0.008649	10	21	No	8	0	n/a	n/a	0.01	NP
pH, field (SU)	AD-36	0.4073	5	25	No	9	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	AD-36	0.6767	7	21	No	8	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	AD-36	0	-1	-21	No	8	0	n/a	n/a	0.01	NP

Sen's Slope Estimator

AD-36



n = 8

Slope = 0.002917 units per year.

Mann-Kendall statistic = 0
critical = 21

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

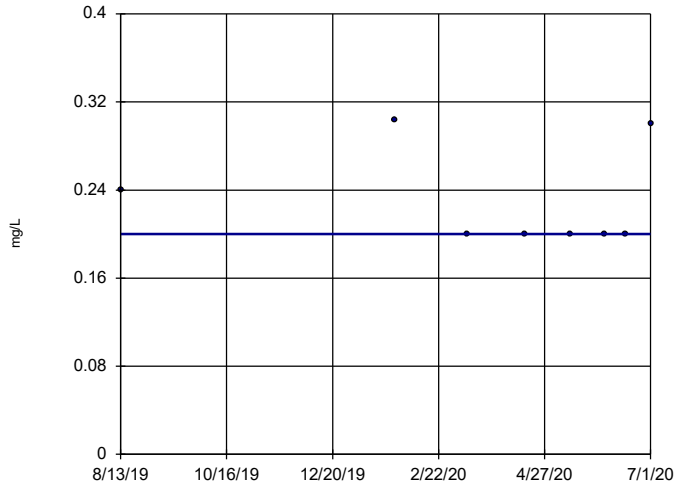
Constituent: Boron, total Analysis Run 12/2/2020 4:31 PM View: AD-36

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-36



n = 8

Slope = 0 units per year.

Mann-Kendall statistic = -4
critical = -21

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

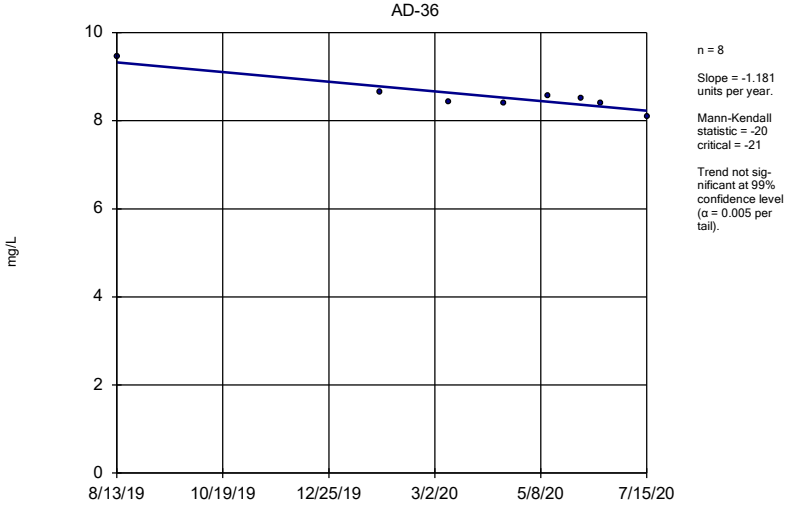
Constituent: Calcium, total Analysis Run 12/2/2020 4:31 PM View: AD-36

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-36



n = 8

Slope = -1.181 units per year.

Mann-Kendall statistic = -20
critical = -21

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

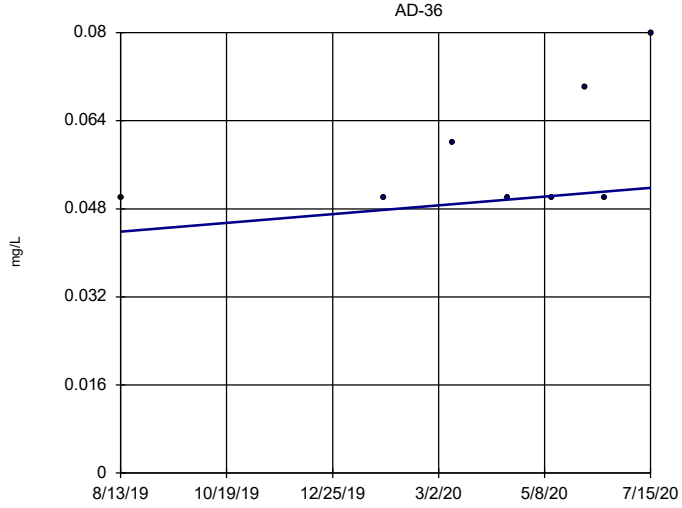
Constituent: Chloride, total Analysis Run 12/2/2020 4:31 PM View: AD-36

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-36



n = 8

Slope = 0.008649 units per year.

Mann-Kendall statistic = 10
critical = 21

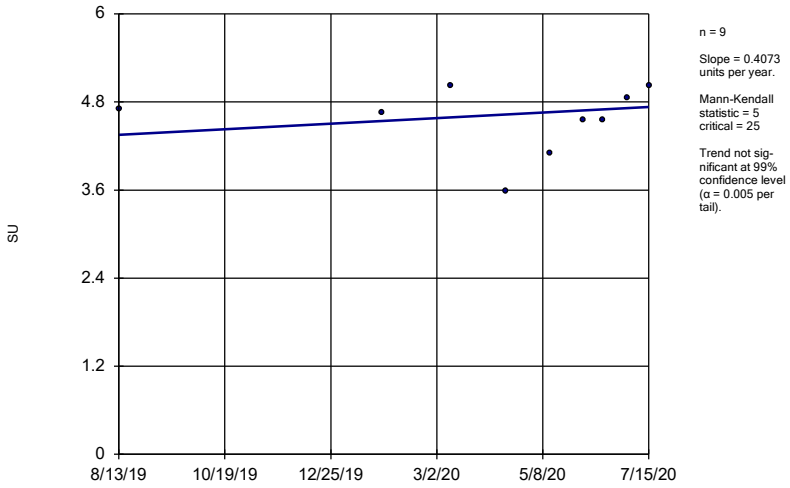
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Fluoride, total Analysis Run 12/2/2020 4:31 PM View: AD-36

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sen's Slope Estimator

AD-36



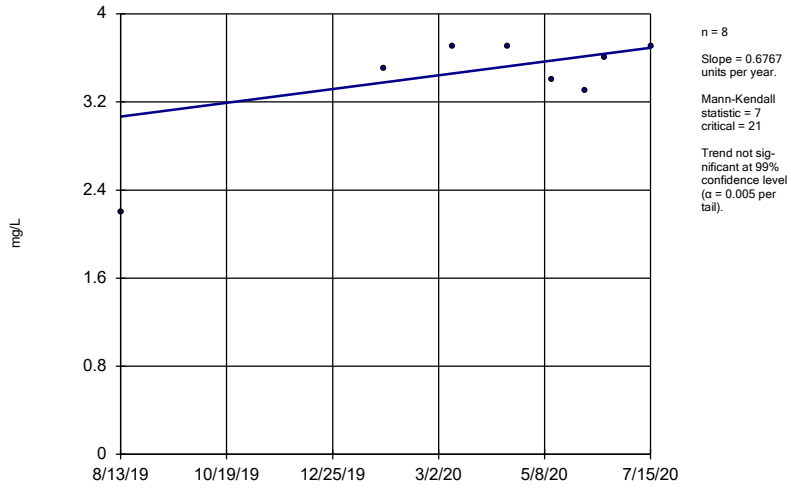
Constituent: pH, field Analysis Run 12/2/2020 4:31 PM View: AD-36

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-36



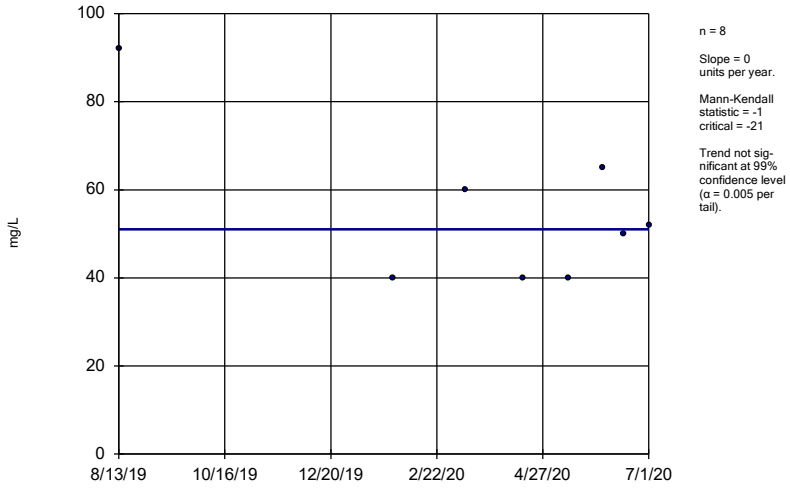
Constituent: Sulfate, total Analysis Run 12/2/2020 4:31 PM View: AD-36

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-36



Constituent: Total Dissolved Solids [TDS] Analysis Run 12/2/2020 4:31 PM View: AD-36

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Mann-Whitney Summary - Significant Results

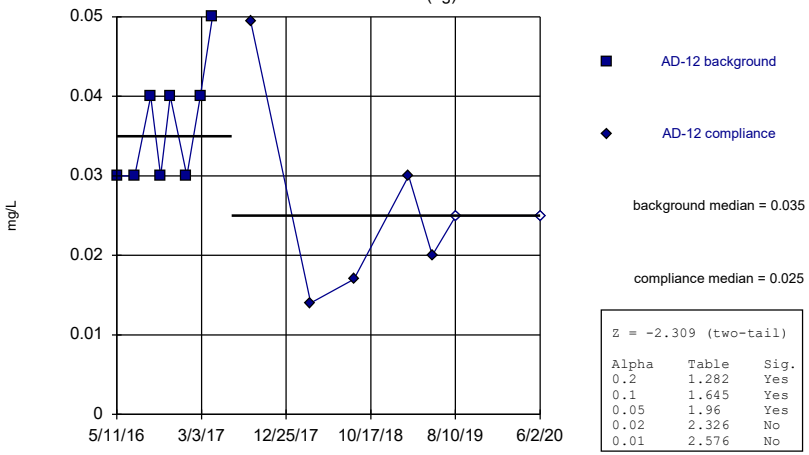
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill Printed 12/3/2020, 11:46 AM

Constituent	Well	Calc.	0.01	Sig.	Method
Calcium, total (mg/L)	**AD-16 (bg)**	**-3.185**	**Yes**	**Yes**	**Mann-W**
Chloride, total (mg/L)	**AD-16 (bg)**	**3.241**	**Yes**	**Yes**	**Mann-W**
Chloride, total (mg/L)	**AD-27 (bg)**	**3.179**	**Yes**	**Yes**	**Mann-W**
pH, field (SU)	**AD-16 (bg)**	**2.72**	**Yes**	**Yes**	**Mann-W**

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

AD-12 (bg)



Z = -2.309 (two-tail)

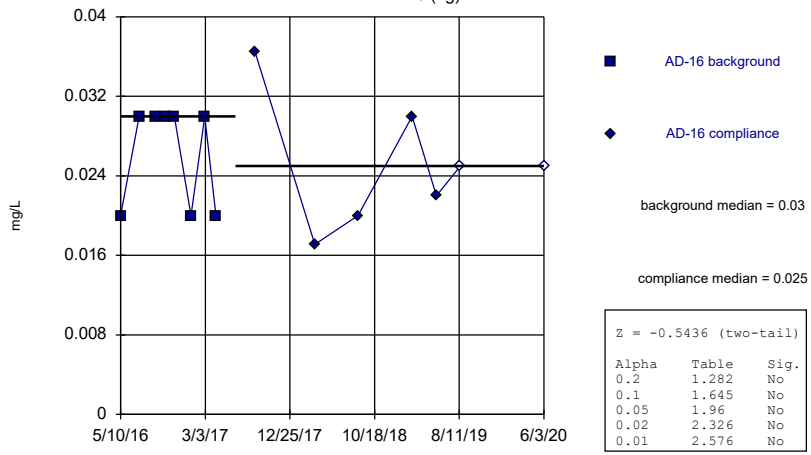
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	Yes
0.02	2.326	No
0.01	2.576	No

Constituent: Boron, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

AD-16 (bg)



Z = -0.5436 (two-tail)

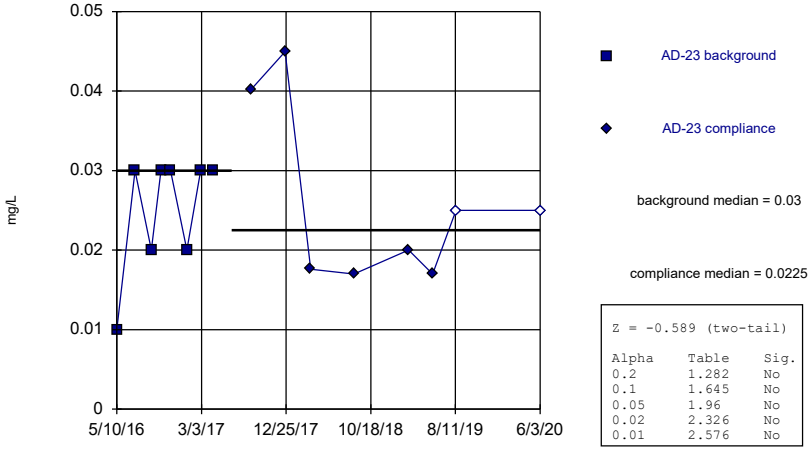
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Boron, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

AD-23



Z = -0.589 (two-tail)

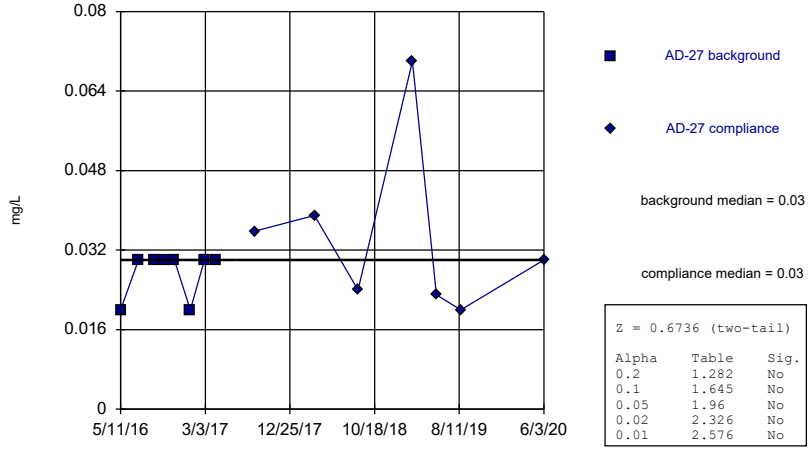
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Boron, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-27 (bg)



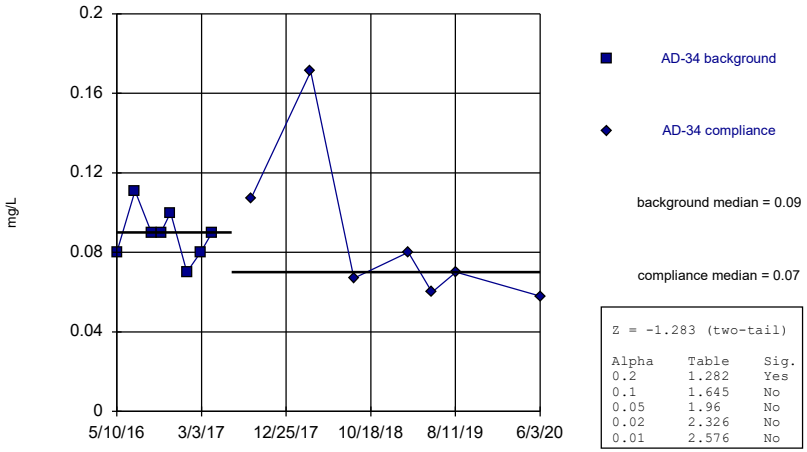
Z = 0.6736 (two-tail)

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

Constituent: Boron, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Mann-Whitney (Wilcoxon Rank Sum)

AD-34



Z = -1.283 (two-tail)

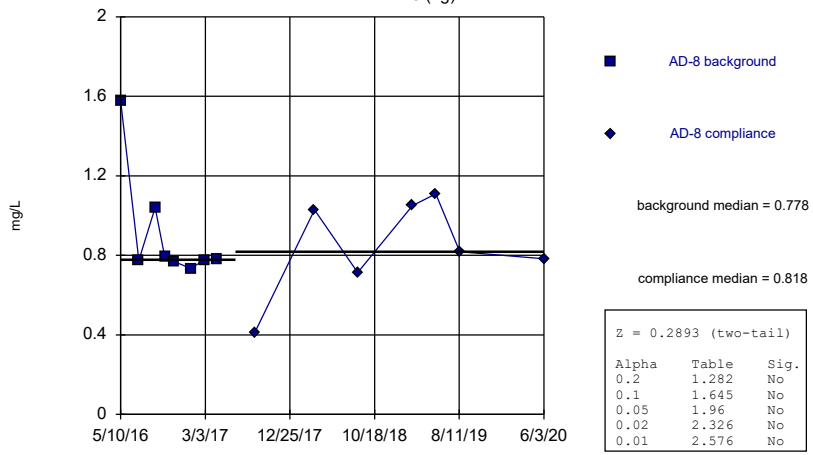
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Boron, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-8 (bg)



Z = 0.2893 (two-tail)

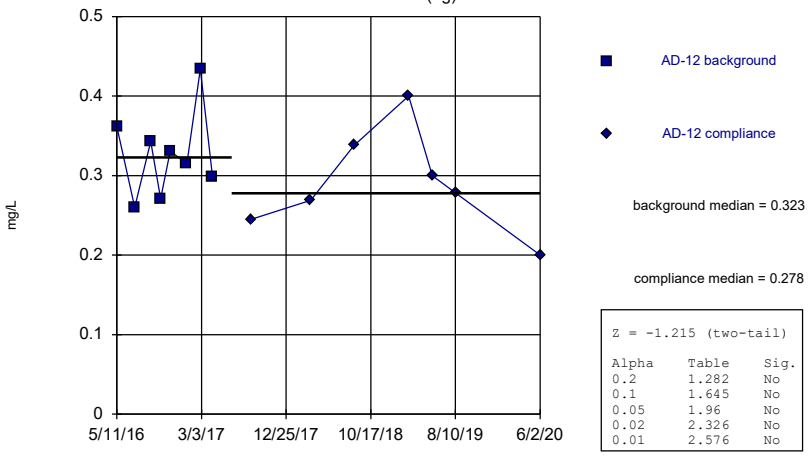
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Boron, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-12 (bg)



Z = -1.215 (two-tail)

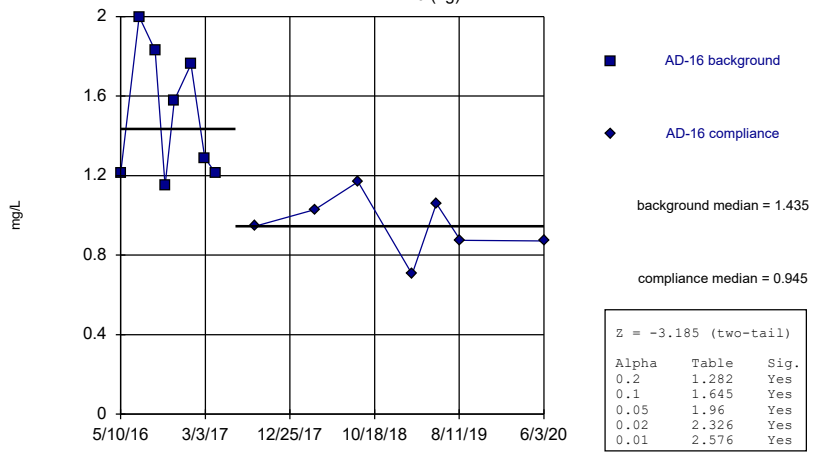
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Calcium, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-16 (bg)



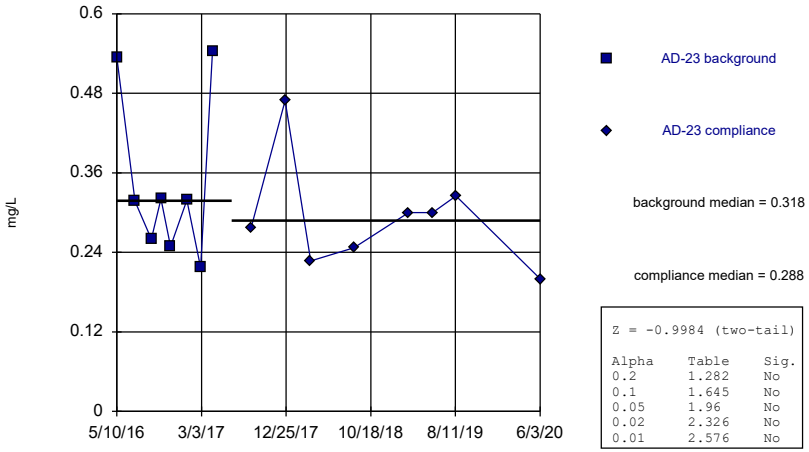
Z = -3.185 (two-tail)

Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	Yes
0.02	2.326	Yes
0.01	2.576	Yes

Constituent: Calcium, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Mann-Whitney (Wilcoxon Rank Sum)

AD-23



Z = -0.9984 (two-tail)

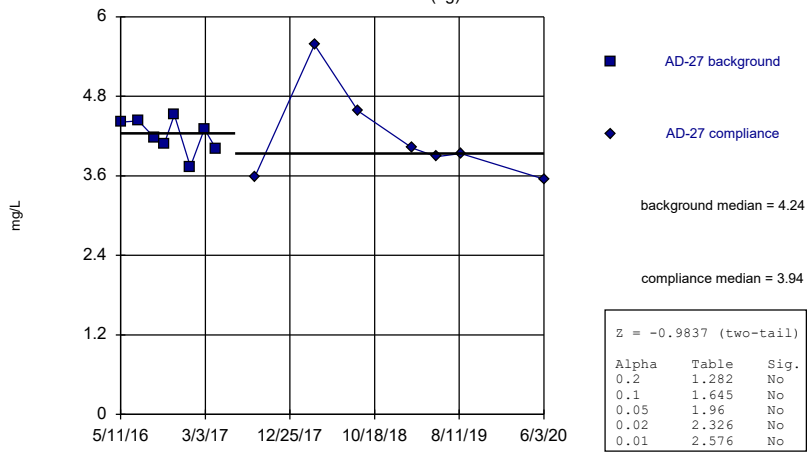
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Calcium, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-27 (bg)



Z = -0.9837 (two-tail)

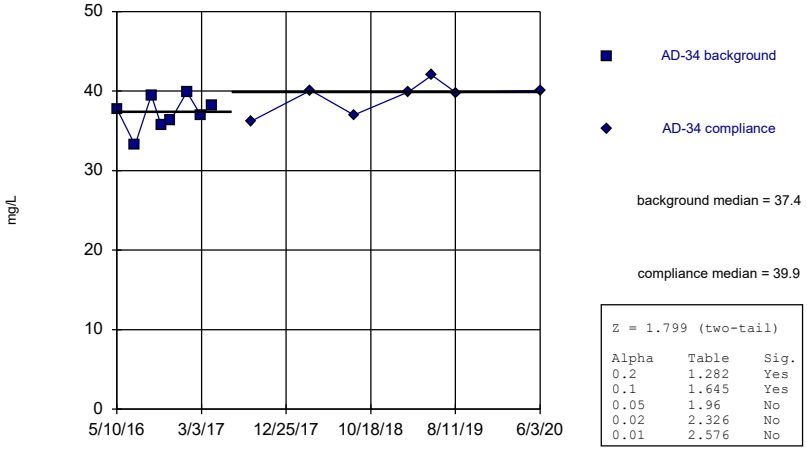
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Calcium, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-34



Z = 1.799 (two-tail)

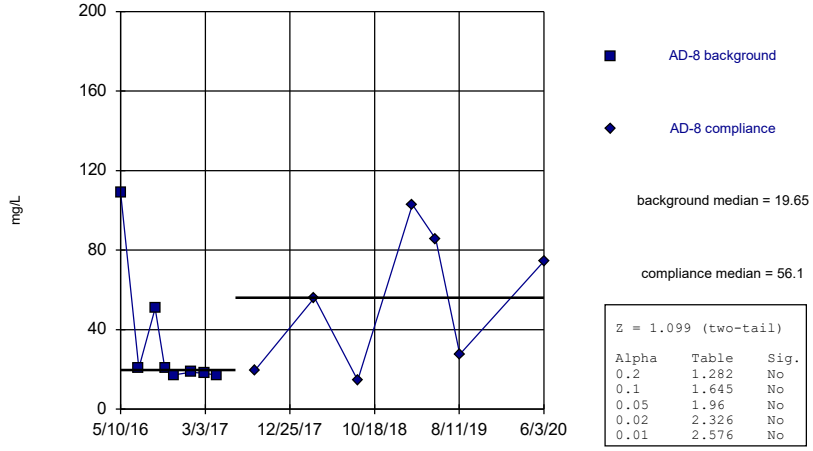
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Calcium, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-8 (bg)



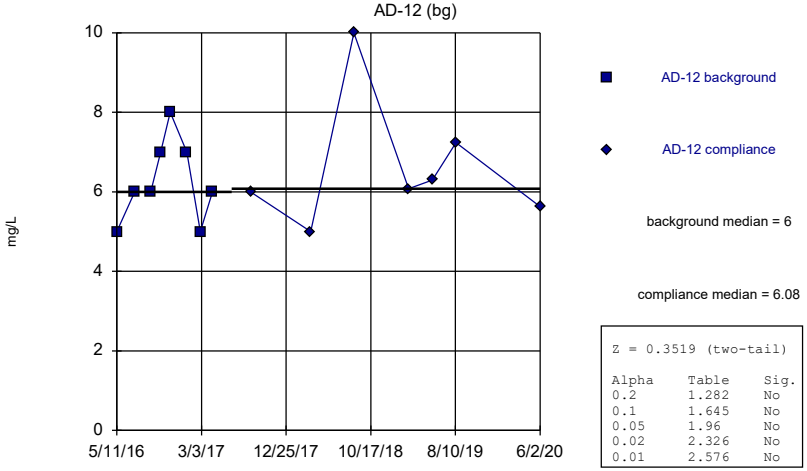
Z = 1.099 (two-tail)

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

Constituent: Calcium, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Mann-Whitney (Wilcoxon Rank Sum)

AD-12 (bg)



Z = 0.3519 (two-tail)

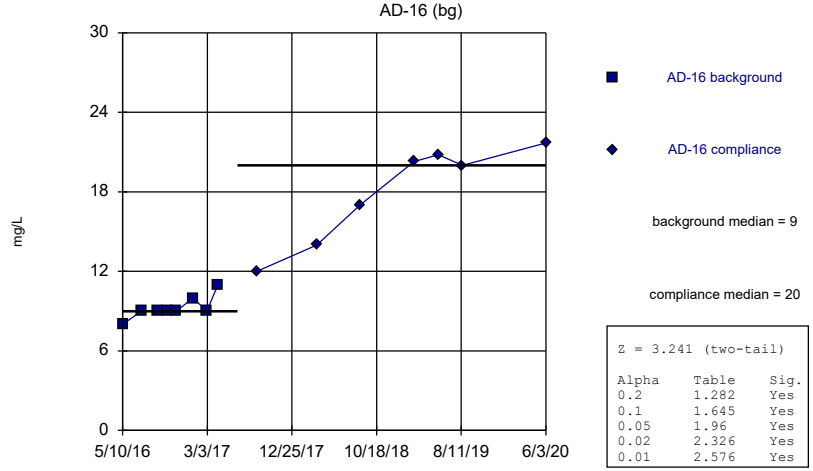
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Chloride, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-16 (bg)



Z = 3.241 (two-tail)

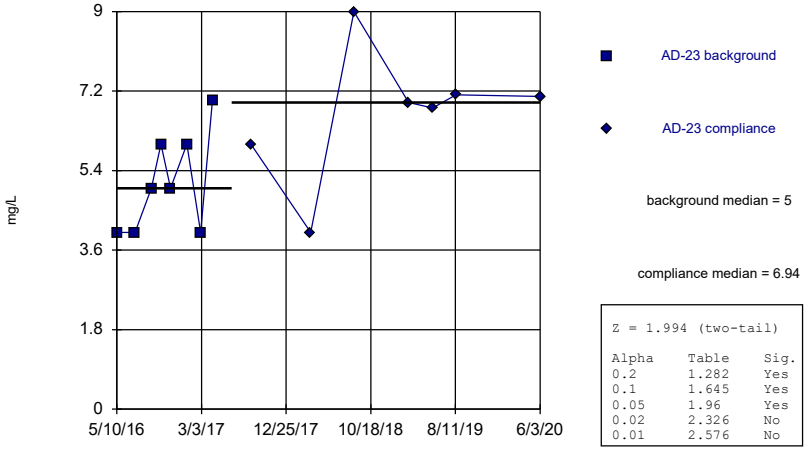
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	Yes
0.02	2.326	Yes
0.01	2.576	Yes

Constituent: Chloride, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-23



Z = 1.994 (two-tail)

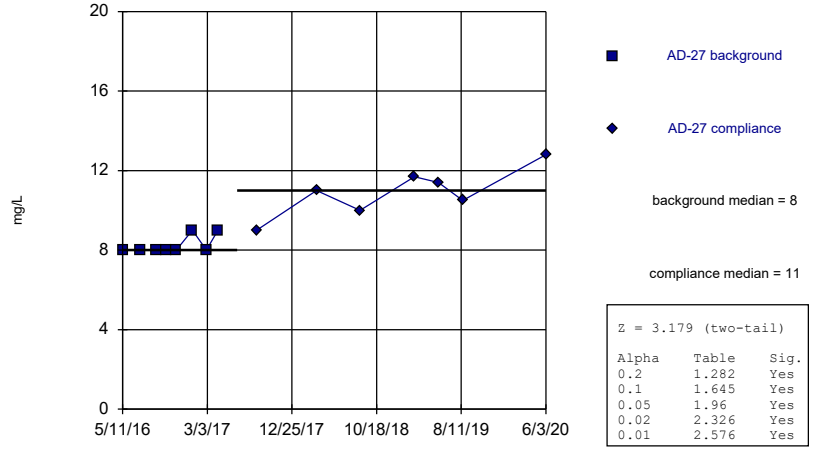
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	Yes
0.02	2.326	No
0.01	2.576	No

Constituent: Chloride, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-27 (bg)



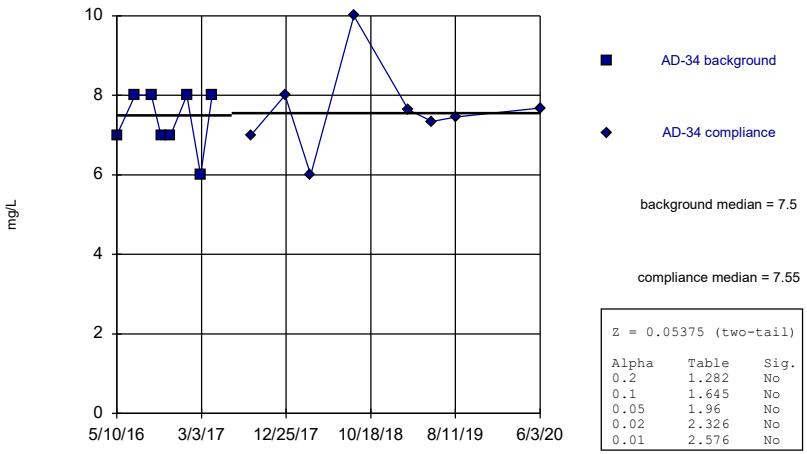
Z = 3.179 (two-tail)

Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	Yes
0.02	2.326	Yes
0.01	2.576	Yes

Constituent: Chloride, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Mann-Whitney (Wilcoxon Rank Sum)

AD-34



Z = 0.05375 (two-tail)

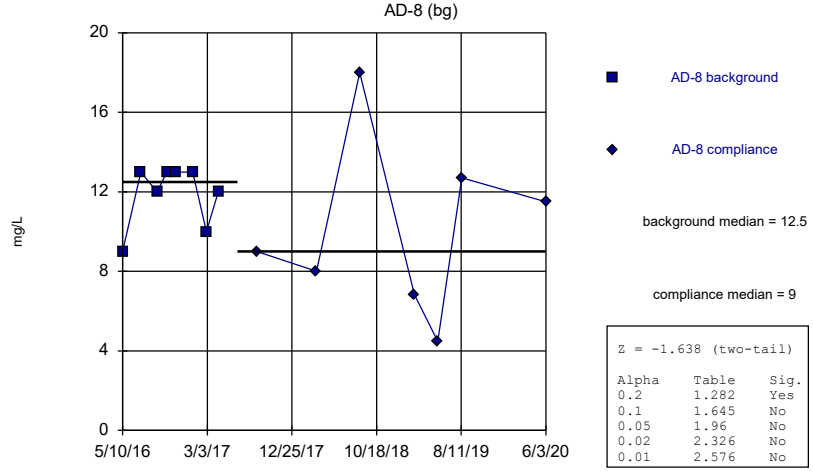
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Chloride, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-8 (bg)



Z = -1.638 (two-tail)

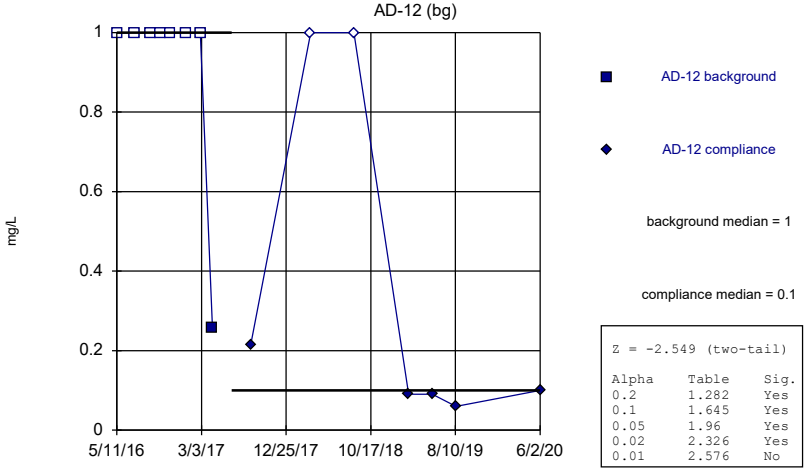
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Chloride, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

AD-12 (bg)



Z = -2.549 (two-tail)

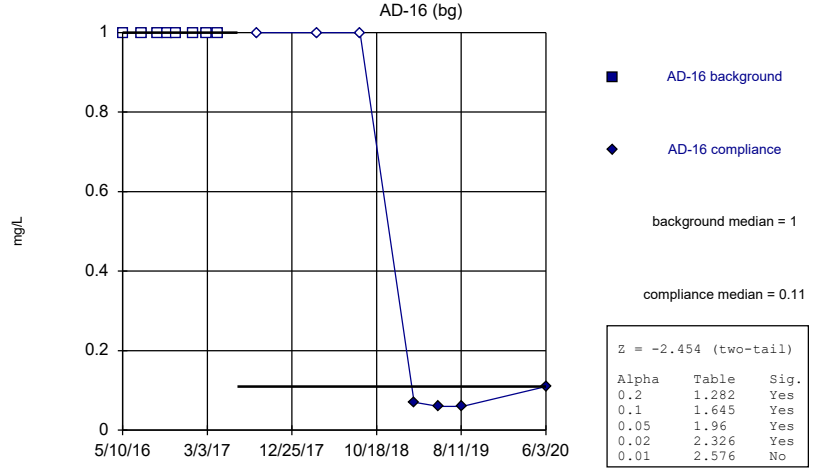
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	Yes
0.02	2.326	Yes
0.01	2.576	No

Constituent: Fluoride, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

AD-16 (bg)



Z = -2.454 (two-tail)

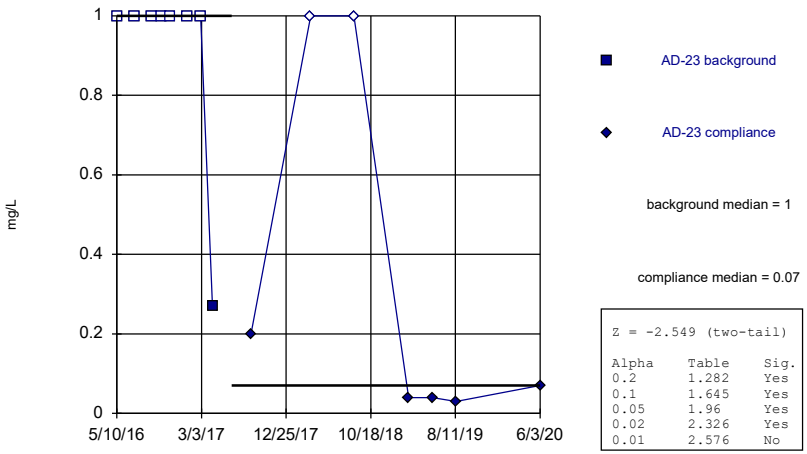
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	Yes
0.02	2.326	Yes
0.01	2.576	No

Constituent: Fluoride, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

AD-23



Z = -2.549 (two-tail)

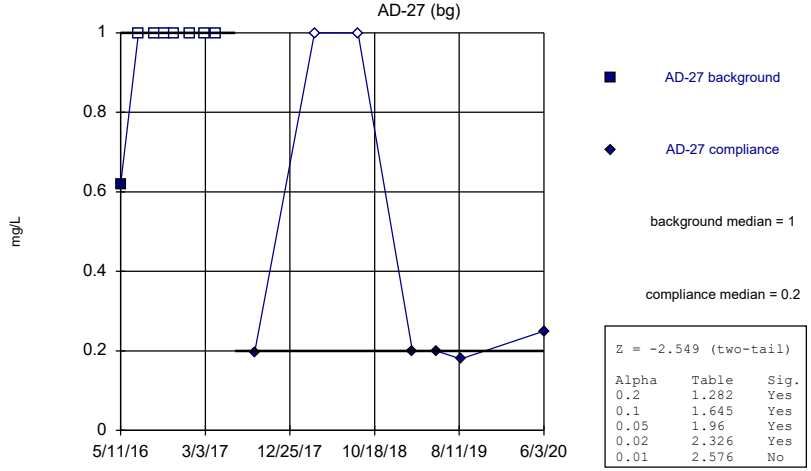
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	Yes
0.02	2.326	Yes
0.01	2.576	No

Constituent: Fluoride, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

AD-27 (bg)



Z = -2.549 (two-tail)

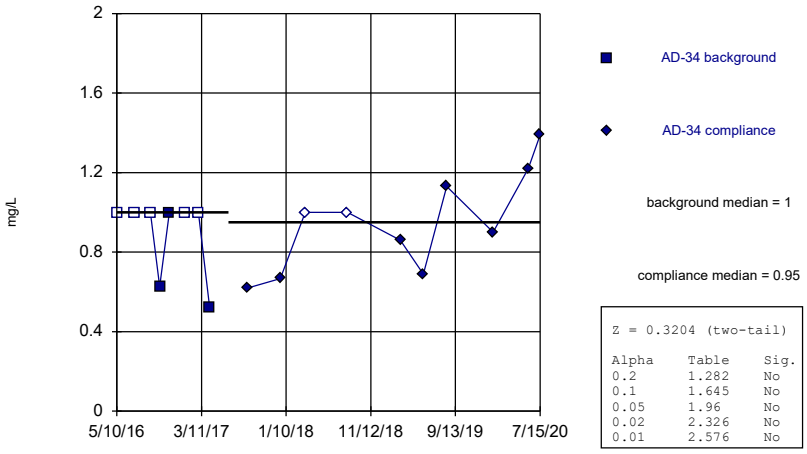
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	Yes
0.02	2.326	Yes
0.01	2.576	No

Constituent: Fluoride, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

AD-34



Z = 0.3204 (two-tail)

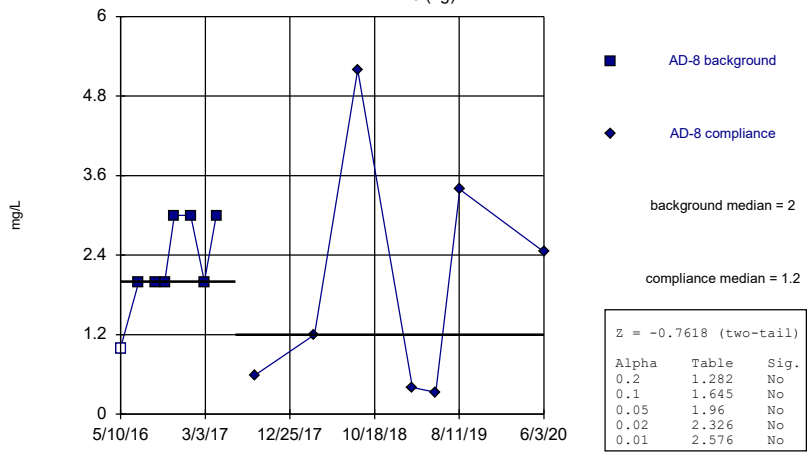
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Fluoride, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

AD-8 (bg)



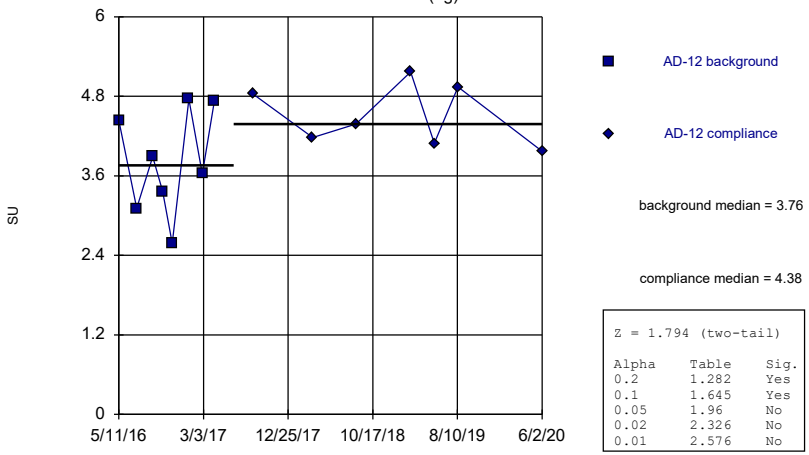
Z = -0.7618 (two-tail)

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

Constituent: Fluoride, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Mann-Whitney (Wilcoxon Rank Sum)

AD-12 (bg)

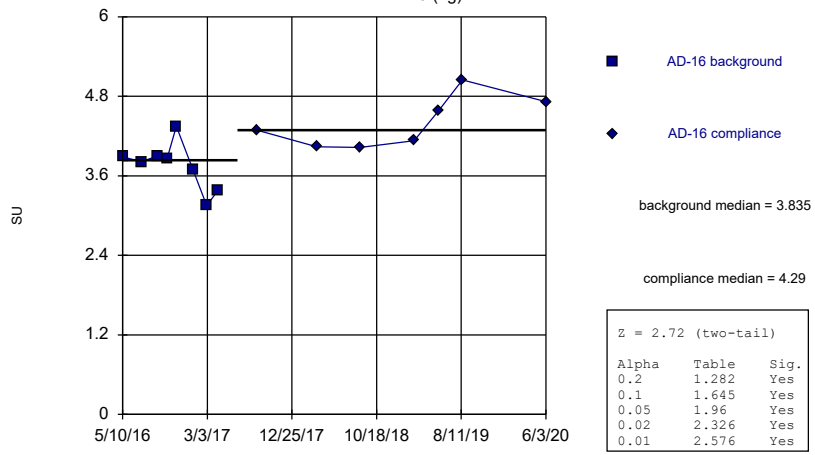


Constituent: pH, field Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-16 (bg)

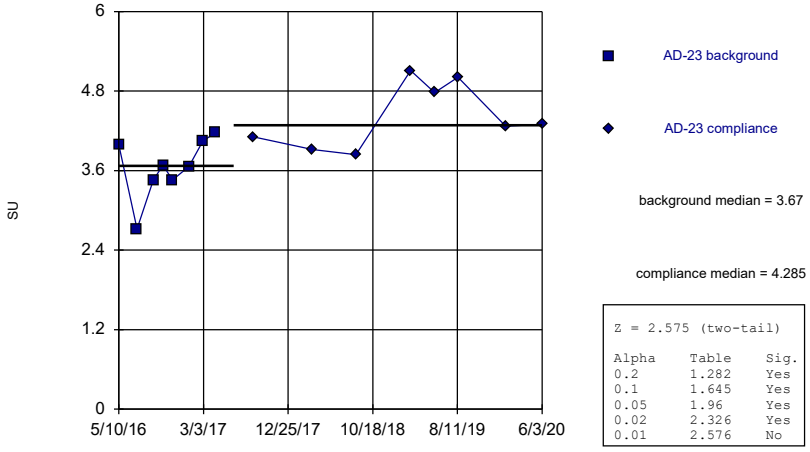


Constituent: pH, field Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-23

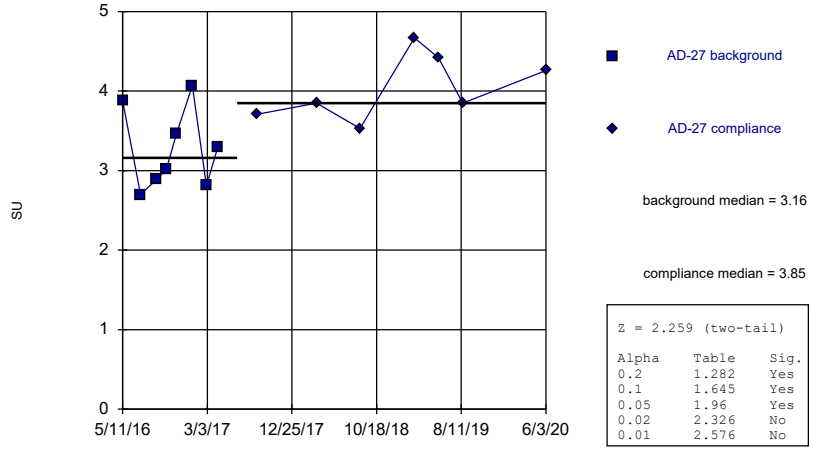


Constituent: pH, field Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

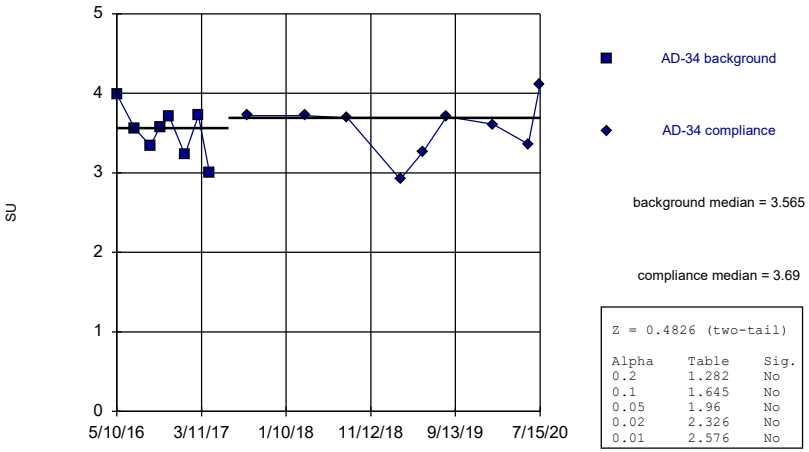
AD-27 (bg)



Constituent: pH, field Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Mann-Whitney (Wilcoxon Rank Sum)

AD-34



Z = 0.4826 (two-tail)

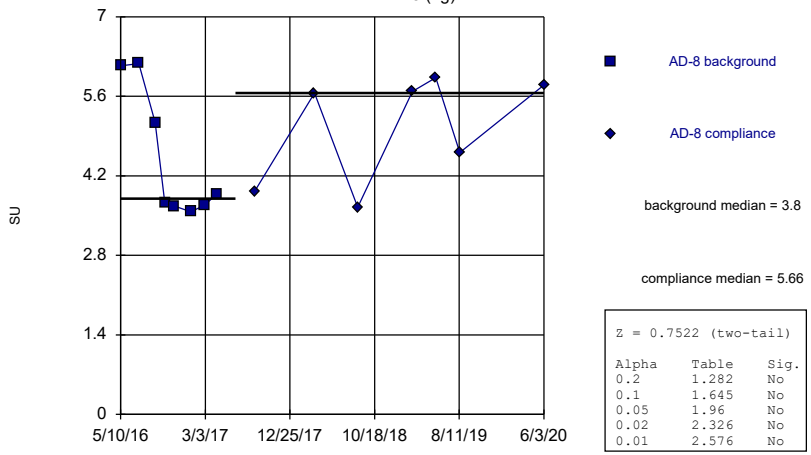
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: pH, field Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-8 (bg)



Z = 0.7522 (two-tail)

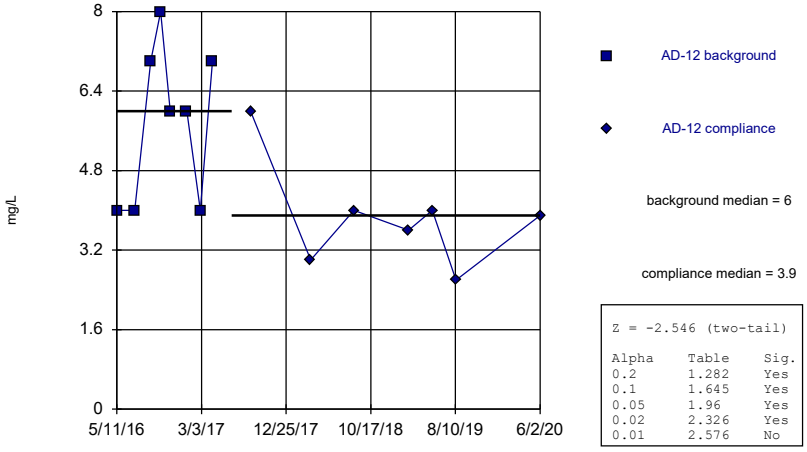
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: pH, field Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-12 (bg)



Z = -2.546 (two-tail)

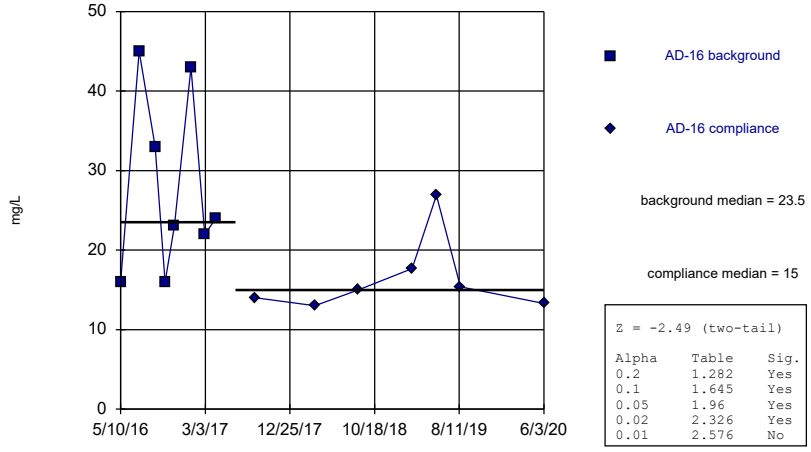
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	Yes
0.02	2.326	Yes
0.01	2.576	No

Constituent: Sulfate, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-16 (bg)



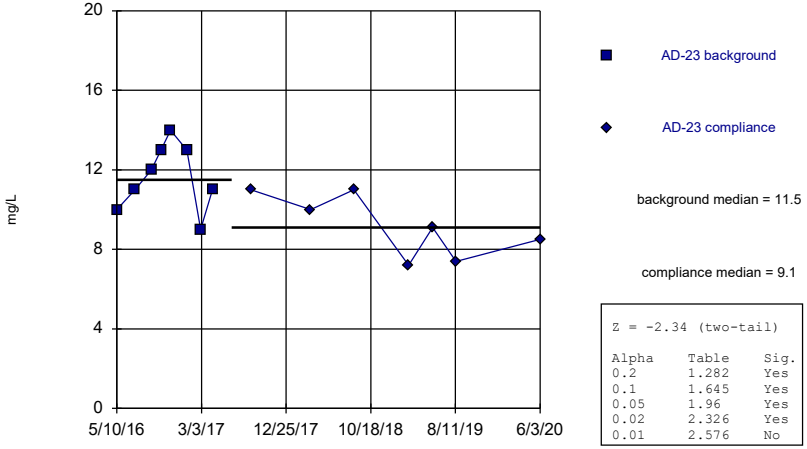
Z = -2.49 (two-tail)

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

Constituent: Sulfate, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Mann-Whitney (Wilcoxon Rank Sum)

AD-23



Z = -2.34 (two-tail)

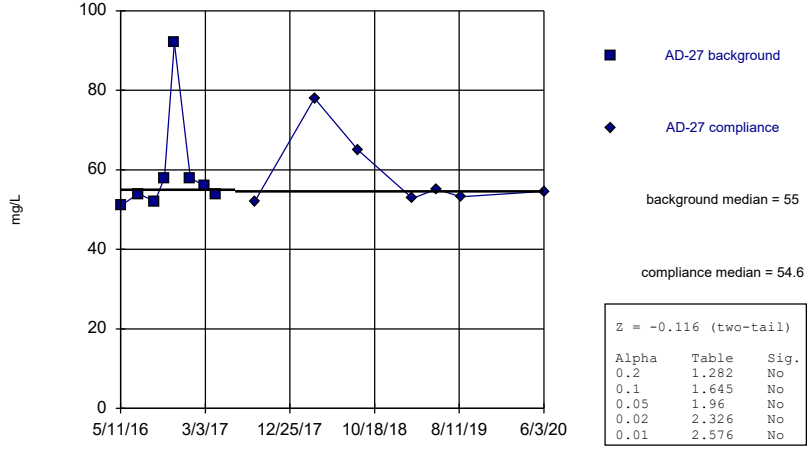
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	Yes
0.02	2.326	Yes
0.01	2.576	No

Constituent: Sulfate, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-27 (bg)



Z = -0.116 (two-tail)

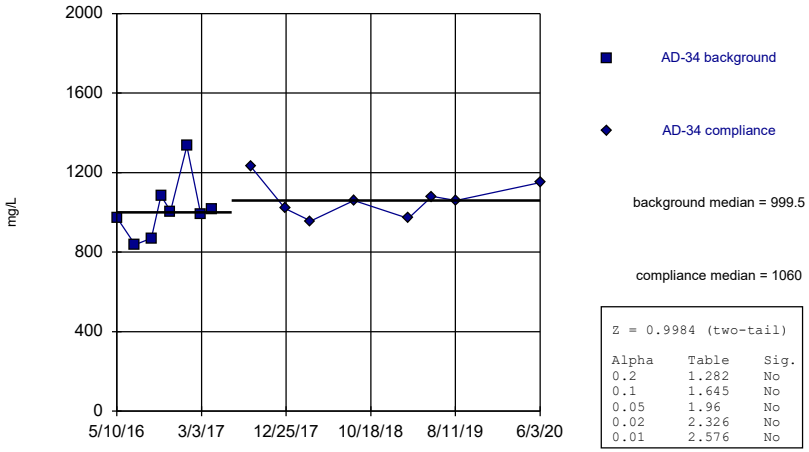
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Sulfate, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-34



Z = 0.9984 (two-tail)

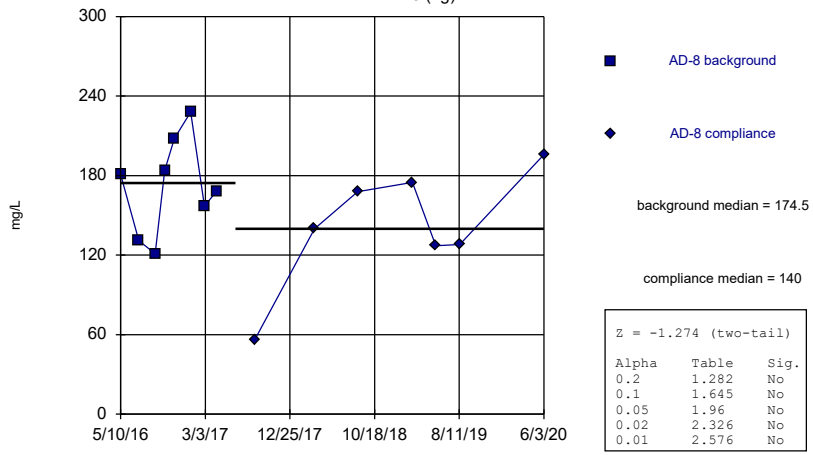
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Sulfate, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-8 (bg)



Z = -1.274 (two-tail)

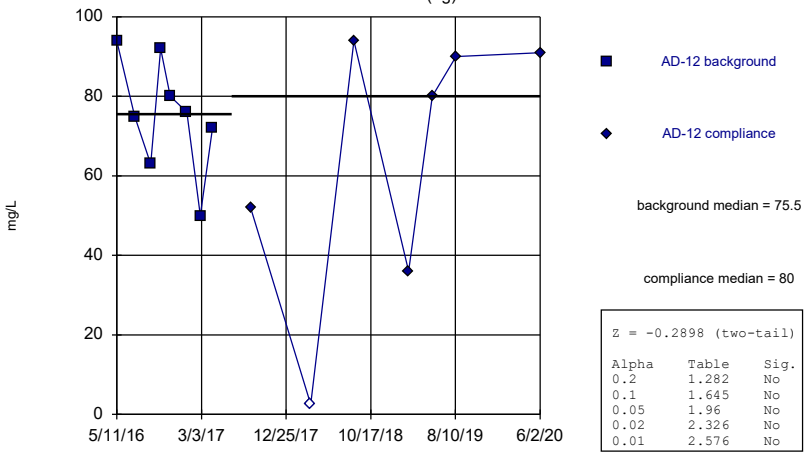
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Sulfate, total Analysis Run 12/3/2020 11:39 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

AD-12 (bg)

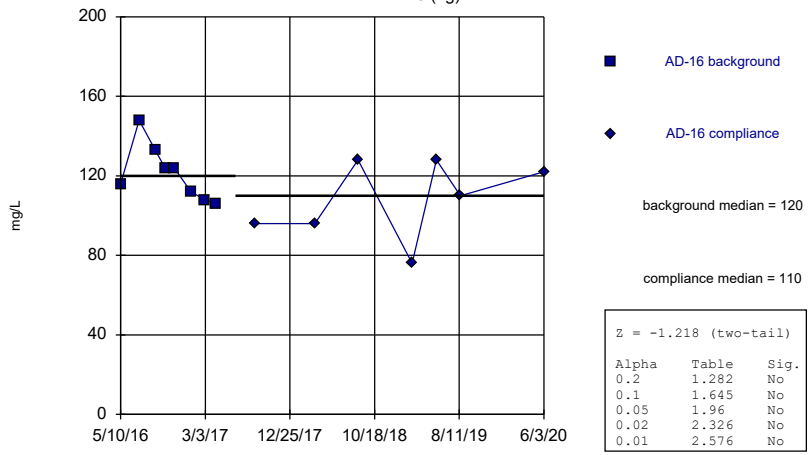


Constituent: Total Dissolved Solids [TDS] Analysis Run 12/3/2020 11:40 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-16 (bg)

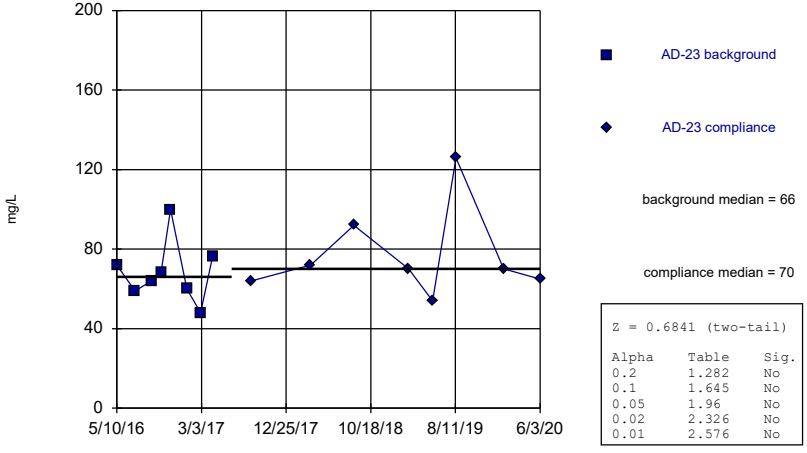


Constituent: Total Dissolved Solids [TDS] Analysis Run 12/3/2020 11:40 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-23

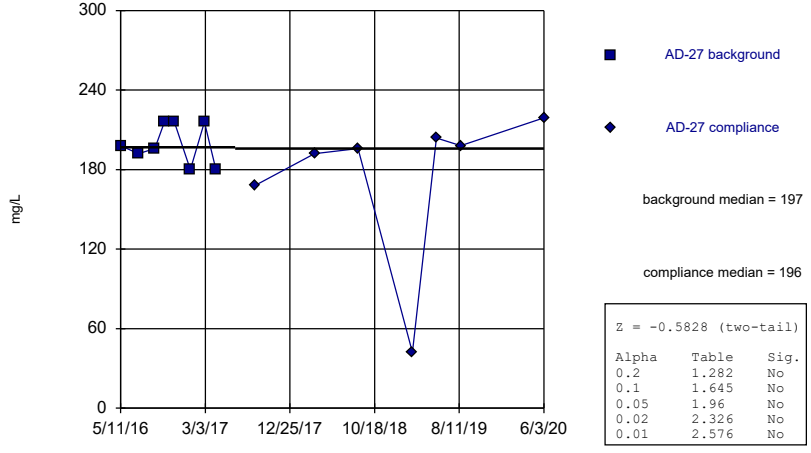


Constituent: Total Dissolved Solids [TDS] Analysis Run 12/3/2020 11:40 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

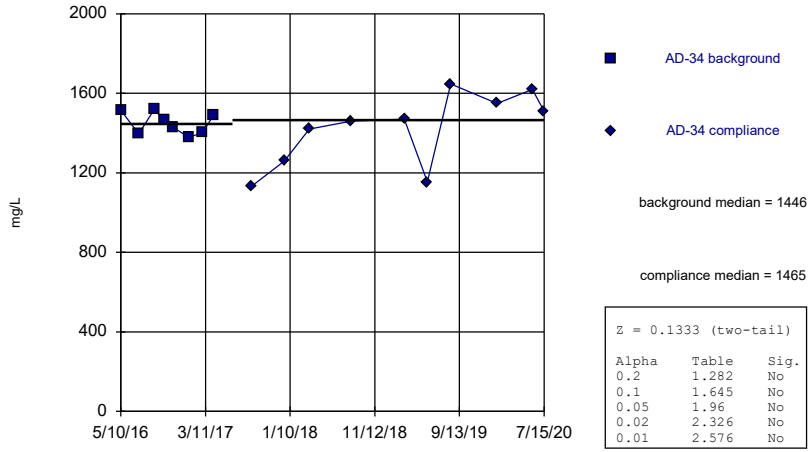
AD-27 (bg)



Constituent: Total Dissolved Solids [TDS] Analysis Run 12/3/2020 11:40 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Mann-Whitney (Wilcoxon Rank Sum)

AD-34



Z = 0.1333 (two-tail)

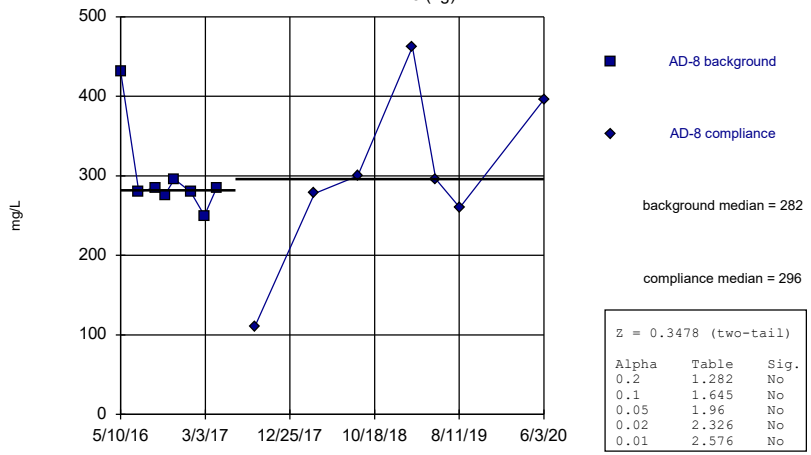
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Total Dissolved Solids [TDS] Analysis Run 12/3/2020 11:40 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-8 (bg)



Z = 0.3478 (two-tail)

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

Constituent: Total Dissolved Solids [TDS] Analysis Run 12/3/2020 11:40 AM View: Mann Whitney
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Intrawell Prediction Limit Summary - All Results

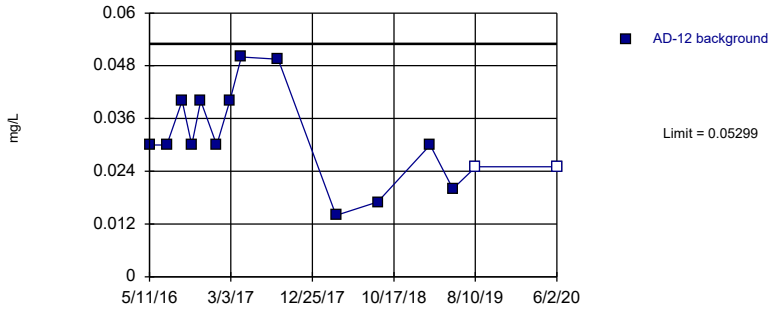
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill Printed 12/3/2020, 12:34 PM

Constituent	Well	Upper Lim.	Lower Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	AD-12	0.05299	n/a	15	0.03137	0.01078	13.33	None	No	0.002505	Param Intra 1 of 2
Boron, total (mg/L)	AD-16	0.03703	n/a	15	0.02571	0.005645	13.33	None	No	0.002505	Param Intra 1 of 2
Boron, total (mg/L)	AD-23	0.0433	n/a	16	0.02542	0.009074	12.5	None	No	0.002505	Param Intra 1 of 2
Boron, total (mg/L)	AD-27	0.05526	n/a	15	-3.534	0.3185	0	None	ln(x)	0.002505	Param Intra 1 of 2
Boron, total (mg/L)	AD-34	0.145	n/a	15	0.2942	0.04317	0	None	sqrt(x)	0.002505	Param Intra 1 of 2
Boron, total (mg/L)	AD-36	0.07017	n/a	8	0.05688	0.00541	0	None	No	0.002505	Param Intra 1 of 2
Boron, total (mg/L)	AD-8	1.401	n/a	15	0.8775	0.261	0	None	No	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	AD-12	0.4316	n/a	15	0.3097	0.06082	0	None	No	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	AD-16	1.397	n/a	8	0.9831	0.1682	0	None	No	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	AD-23	0.536	n/a	16	0.5584	0.08819	0	None	sqrt(x)	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	AD-27	5.194	n/a	15	4.188	0.5016	0	None	No	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	AD-34	42.77	n/a	15	38.19	2.285	0	None	No	0.002505	Param Intra 1 of 2
Calcium, total (mg/L)	AD-36	0.304	n/a	8	n/a	n/a	0	n/a	n/a	0.02144	NP Intra (normality) 1 of 2
Calcium, total (mg/L)	AD-8	147.5	n/a	15	3.504	0.7427	0	None	ln(x)	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AD-12	9.052	n/a	15	6.417	1.314	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AD-16	27.54	n/a	8	17.1	4.248	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AD-23	8.882	n/a	15	5.864	1.505	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AD-27	13.93	n/a	8	10.68	1.325	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AD-34	9.347	n/a	16	7.508	0.9337	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AD-36	9.542	n/a	8	8.564	0.3981	0	None	No	0.002505	Param Intra 1 of 2
Chloride, total (mg/L)	AD-8	17.56	n/a	15	11.03	3.252	0	None	No	0.002505	Param Intra 1 of 2
Fluoride, total (mg/L)	AD-12	1	n/a	15	n/a	n/a	60	n/a	n/a	0.007533	NP Intra (NDs) 1 of 2
Fluoride, total (mg/L)	AD-16	1	n/a	15	n/a	n/a	73.33	n/a	n/a	0.007533	NP Intra (NDs) 1 of 2
Fluoride, total (mg/L)	AD-23	1	n/a	15	n/a	n/a	60	n/a	n/a	0.007533	NP Intra (NDs) 1 of 2
Fluoride, total (mg/L)	AD-27	1	n/a	15	n/a	n/a	60	n/a	n/a	0.007533	NP Intra (NDs) 1 of 2
Fluoride, total (mg/L)	AD-34	1.285	n/a	18	0.8208	0.2404	38.89	Kaplan-Meier	No	0.002505	Param Intra 1 of 2
Fluoride, total (mg/L)	AD-36	0.08	n/a	8	n/a	n/a	0	n/a	n/a	0.02144	NP Intra (normality) 1 of 2
Fluoride, total (mg/L)	AD-8	4.74	n/a	15	2.104	1.315	6.667	None	No	0.002505	Param Intra 1 of 2
pH, field (SU)	AD-12	5.61	2.669	15	4.139	0.7332	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AD-16	5.048	3.068	15	4.058	0.4938	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AD-23	5.228	2.837	16	4.033	0.6067	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AD-27	4.834	2.422	15	3.628	0.6016	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AD-34	4.168	2.919	17	3.544	0.3201	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AD-36	5.653	3.478	9	4.566	0.4632	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AD-8	6.18	3.57	15	n/a	n/a	0	n/a	n/a	0.01507	NP Intra (normality) 1 of 2
Sulfate, total (mg/L)	AD-12	8.164	n/a	15	4.873	1.641	0	None	No	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	AD-16	44.65	n/a	15	4.639	1.019	0	None	sqrt(x)	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	AD-23	14.53	n/a	15	10.48	2.021	0	None	No	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	AD-27	92	n/a	15	n/a	n/a	0	n/a	n/a	0.007533	NP Intra (normality) 1 of 2
Sulfate, total (mg/L)	AD-34	1284	n/a	16	1040	123.8	0	None	No	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	AD-36	4.198	n/a	8	40.92	13.44	0	None	x^3	0.002505	Param Intra 1 of 2
Sulfate, total (mg/L)	AD-8	243	n/a	15	157.9	42.45	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	AD-12	121.3	n/a	15	69.83	25.67	6.667	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	AD-16	150.6	n/a	15	115.1	17.67	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	AD-23	110.9	n/a	16	8.453	1.055	0	None	sqrt(x)	0.002505	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	AD-27	233.2	n/a	15	7363038	2652026	0	None	x^3	0.002505	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	AD-34	1702	n/a	18	1434	138.6	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	AD-36	98.48	n/a	8	54.88	17.74	0	None	No	0.002505	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	AD-8	464.6	n/a	15	299	82.57	0	None	No	0.002505	Param Intra 1 of 2

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, AD-12 (bg)



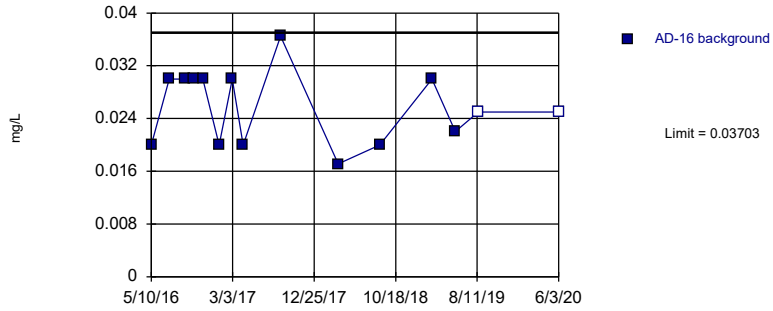
Background Data Summary: Mean=0.03137, Std. Dev.=0.01078, n=15, 13.33% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9405, critical = 0.835. Kappa = 2.006 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Boron, total Analysis Run 12/3/2020 12:32 PM View: PLs
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, AD-16 (bg)



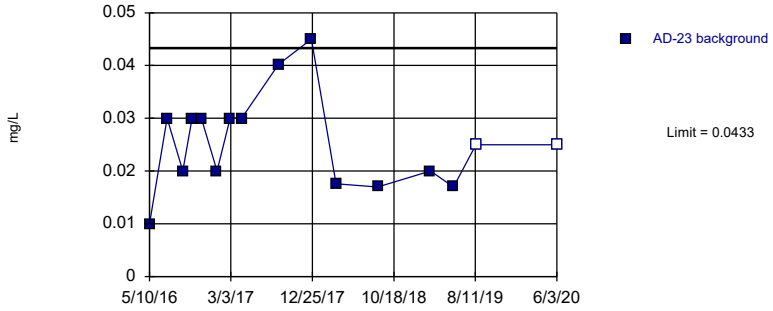
Background Data Summary: Mean=0.02571, Std. Dev.=0.005645, n=15, 13.33% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8915, critical = 0.835. Kappa = 2.006 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Boron, total Analysis Run 12/3/2020 12:32 PM View: PLs
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, AD-23



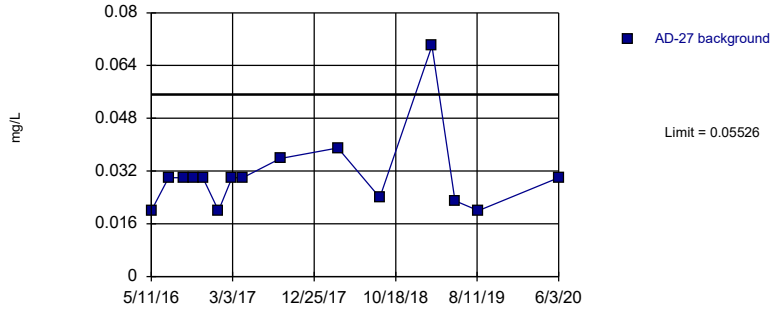
Background Data Summary: Mean=0.02542, Std. Dev.=0.009074, n=16, 12.5% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9384, critical = 0.844. Kappa = 1.97 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Boron, total Analysis Run 12/3/2020 12:32 PM View: PLs
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-27 (bg)

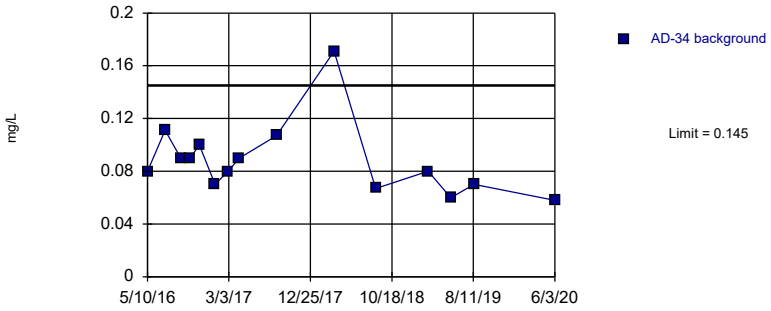


Background Data Summary (based on natural log transformation): Mean=-3.534, Std. Dev.=0.3185, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8388, critical = 0.835. Kappa = 2.006 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Boron, total Analysis Run 12/3/2020 12:32 PM View: PLs
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Prediction Limit

Intrawell Parametric, AD-34



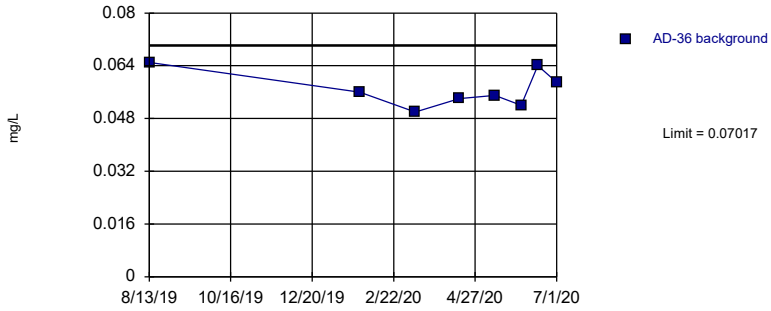
Background Data Summary (based on square root transformation): Mean=0.2942, Std. Dev.=0.04317, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8841, critical = 0.835. Kappa = 2.006 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Boron, total Analysis Run 12/3/2020 12:33 PM View: PLs
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-36



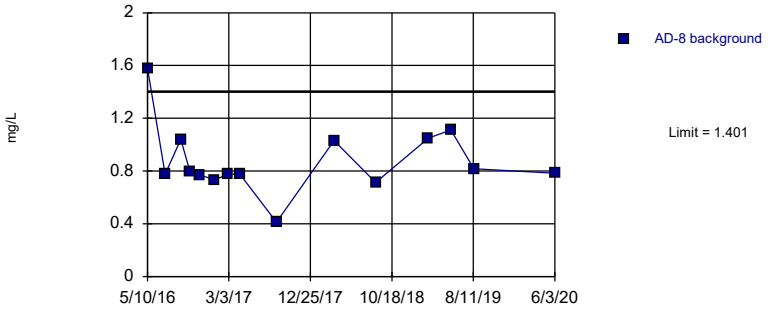
Background Data Summary: Mean=0.05688, Std. Dev.=0.00541, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9299, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Boron, total Analysis Run 12/3/2020 12:33 PM View: PLs
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-8 (bg)



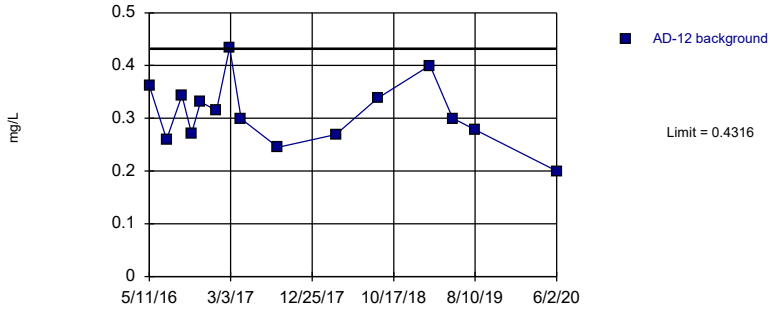
Background Data Summary: Mean=0.8775, Std. Dev.=0.261, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.852, critical = 0.835. Kappa = 2.006 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Boron, total Analysis Run 12/3/2020 12:33 PM View: PLs
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-12 (bg)

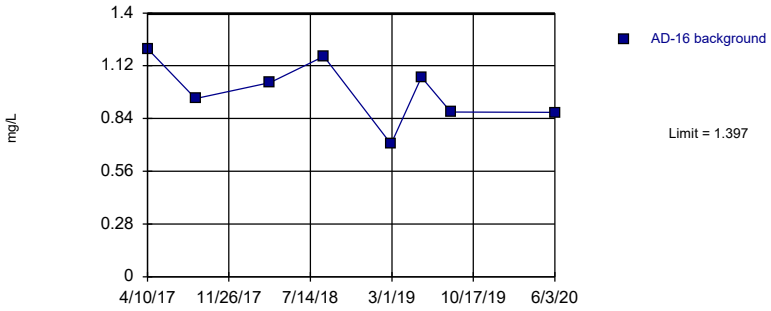


Background Data Summary: Mean=0.3097, Std. Dev.=0.06082, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9821, critical = 0.835. Kappa = 2.006 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium, total Analysis Run 12/3/2020 12:33 PM View: PLs
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Prediction Limit

Intrawell Parametric, AD-16 (bg)



Background Data Summary: Mean=0.9831, Std. Dev.=0.1682, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.967, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

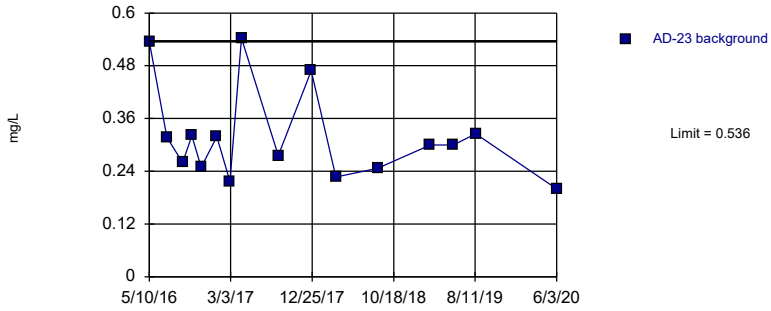
Constituent: Calcium, total Analysis Run 12/3/2020 12:33 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-23



Background Data Summary (based on square root transformation): Mean=0.5584, Std. Dev.=0.08819, n=16. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8672, critical = 0.844. Kappa = 1.97 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

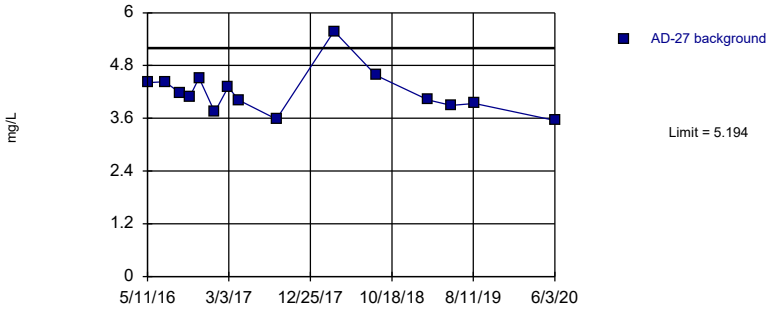
Constituent: Calcium, total Analysis Run 12/3/2020 12:33 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-27 (bg)



Background Data Summary: Mean=4.188, Std. Dev.=0.5016, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8881, critical = 0.835. Kappa = 2.006 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

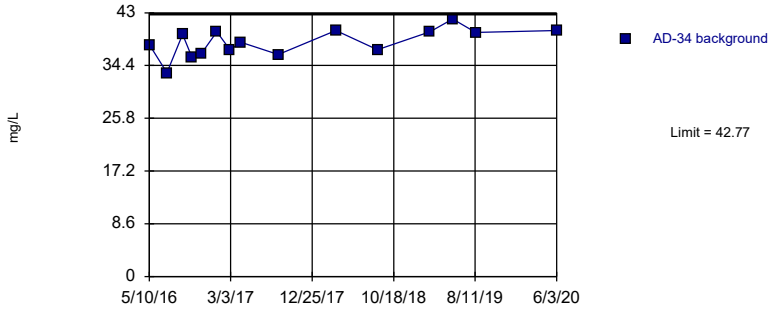
Constituent: Calcium, total Analysis Run 12/3/2020 12:33 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-34



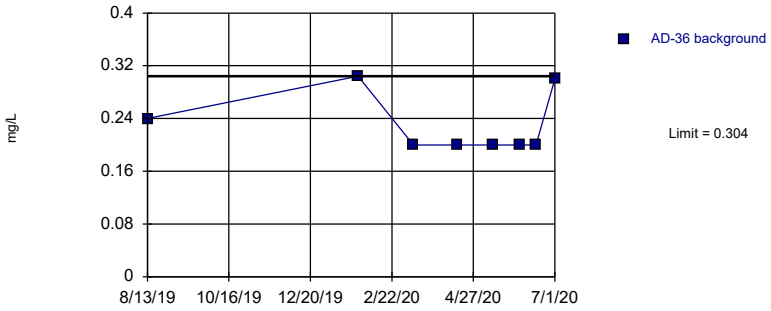
Background Data Summary: Mean=38.19, Std. Dev.=2.285, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9459, critical = 0.835. Kappa = 2.006 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Calcium, total Analysis Run 12/3/2020 12:33 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Prediction Limit

Intrawell Non-parametric, AD-36



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 8 background values. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2). Assumes 1 future value.

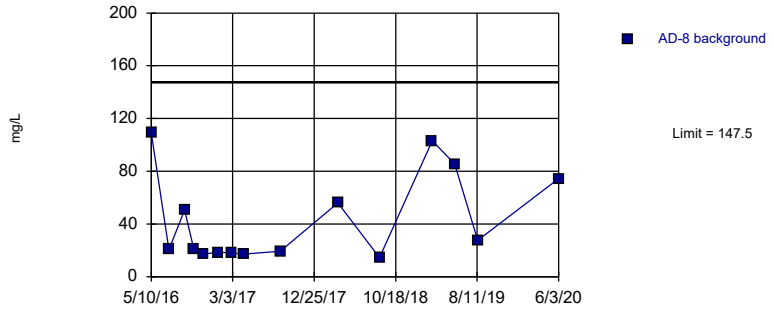
Constituent: Calcium, total Analysis Run 12/3/2020 12:33 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-8 (bg)



Background Data Summary (based on natural log transformation): Mean=3.504, Std. Dev.=0.7427, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8383, critical = 0.835. Kappa = 2.006 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

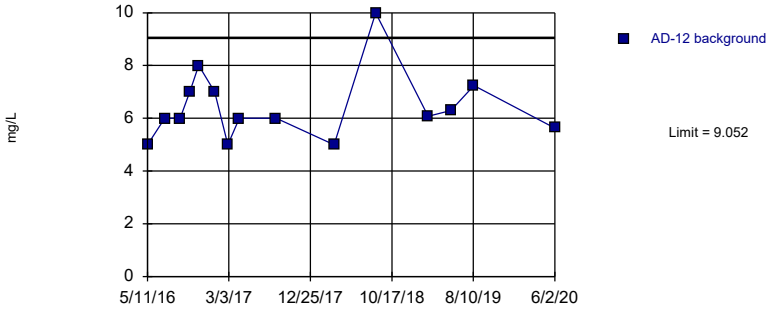
Constituent: Calcium, total Analysis Run 12/3/2020 12:33 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-12 (bg)



Background Data Summary: Mean=6.417, Std. Dev.=1.314, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8559, critical = 0.835. Kappa = 2.006 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

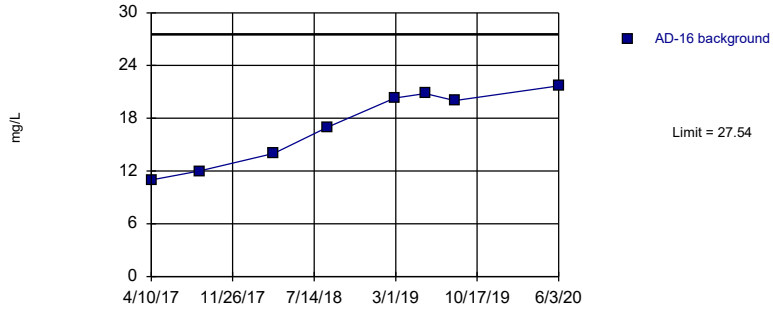
Constituent: Chloride, total Analysis Run 12/3/2020 12:33 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-16 (bg)



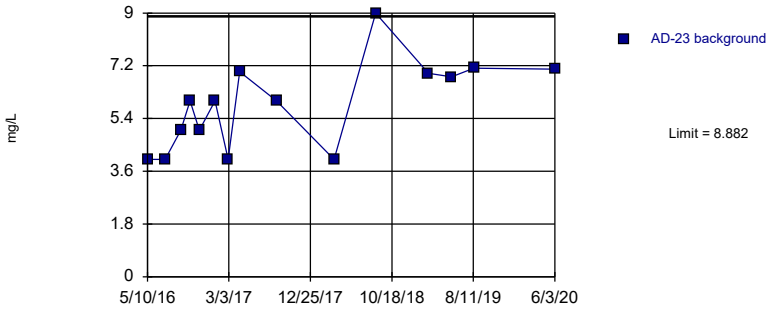
Background Data Summary: Mean=17.1, Std. Dev.=4.248, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.877, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Chloride, total Analysis Run 12/3/2020 12:33 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Prediction Limit

Intrawell Parametric, AD-23



Background Data Summary: Mean=5.864, Std. Dev.=1.505, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9066, critical = 0.835. Kappa = 2.006 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

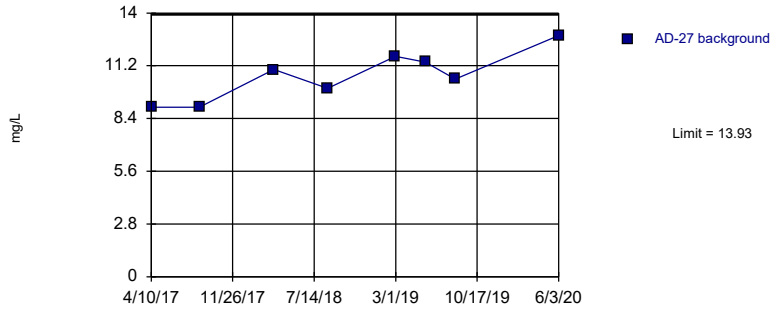
Constituent: Chloride, total Analysis Run 12/3/2020 12:33 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-27 (bg)



Background Data Summary: Mean=10.68, Std. Dev.=1.325, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9547, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

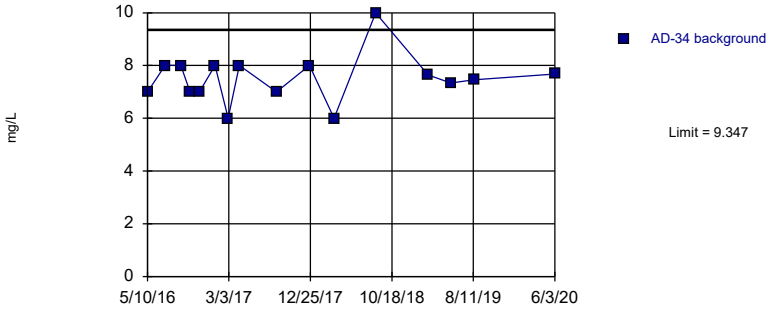
Constituent: Chloride, total Analysis Run 12/3/2020 12:33 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-34



Background Data Summary: Mean=7.508, Std. Dev.=0.9337, n=16. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8815, critical = 0.844. Kappa = 1.97 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

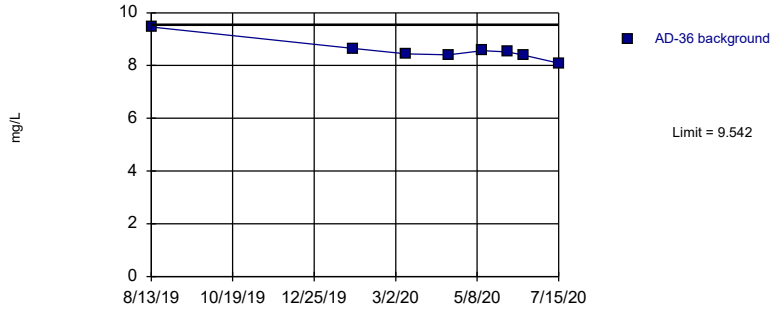
Constituent: Chloride, total Analysis Run 12/3/2020 12:33 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-36



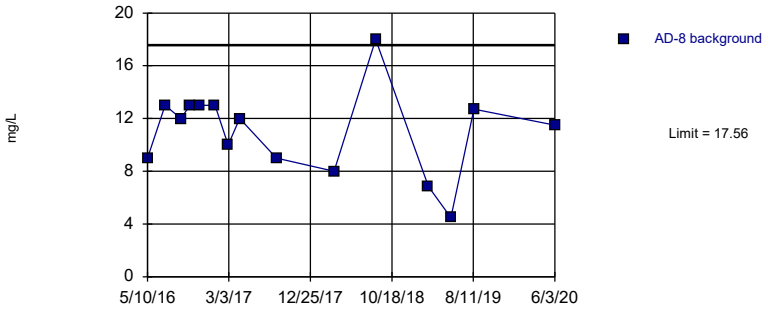
Background Data Summary: Mean=8.564, Std. Dev.=0.3981, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8029, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Chloride, total Analysis Run 12/3/2020 12:33 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Prediction Limit

Intrawell Parametric, AD-8 (bg)



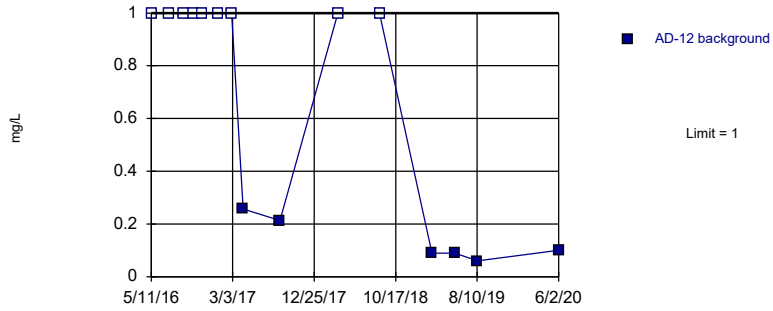
Background Data Summary: Mean=11.03, Std. Dev.=3.252, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.941, critical = 0.835. Kappa = 2.006 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Chloride, total Analysis Run 12/3/2020 12:33 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Prediction Limit

Intrawell Non-parametric, AD-12 (bg)



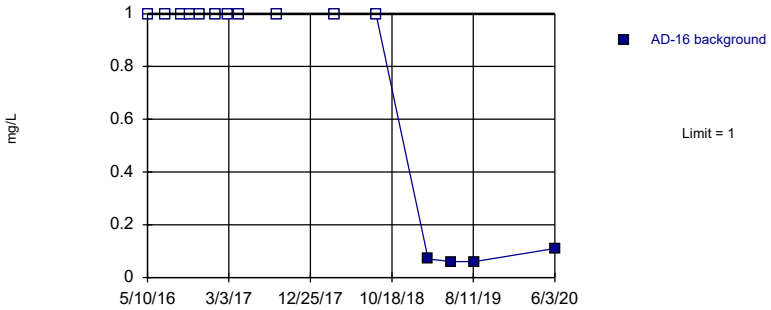
Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 15 background values. 60% NDs. Well-constituent pair annual alpha = 0.01501. Individual comparison alpha = 0.007533 (1 of 2). Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 12/3/2020 12:33 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Prediction Limit

Intrawell Non-parametric, AD-16 (bg)



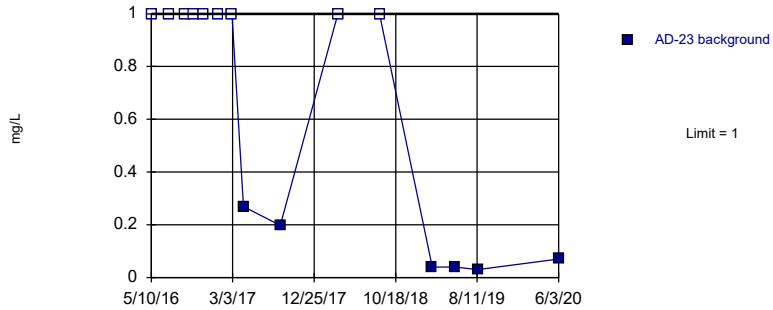
Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 15 background values. 73.33% NDs. Well-constituent pair annual alpha = 0.01501. Individual comparison alpha = 0.007533 (1 of 2). Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 12/3/2020 12:33 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Prediction Limit

Intrawell Non-parametric, AD-23



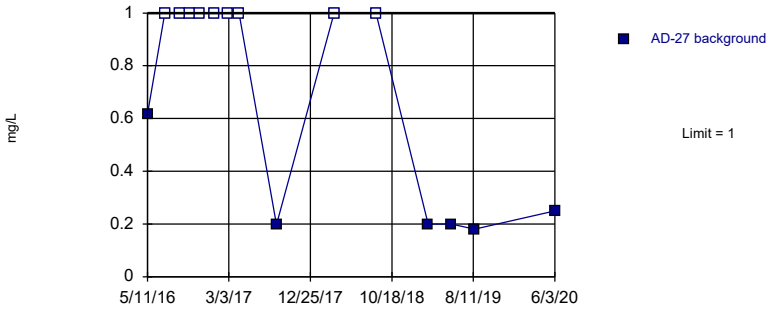
Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 15 background values. 60% NDs. Well-constituent pair annual alpha = 0.01501. Individual comparison alpha = 0.007533 (1 of 2). Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 12/3/2020 12:33 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Prediction Limit

Intrawell Non-parametric, AD-27 (bg)



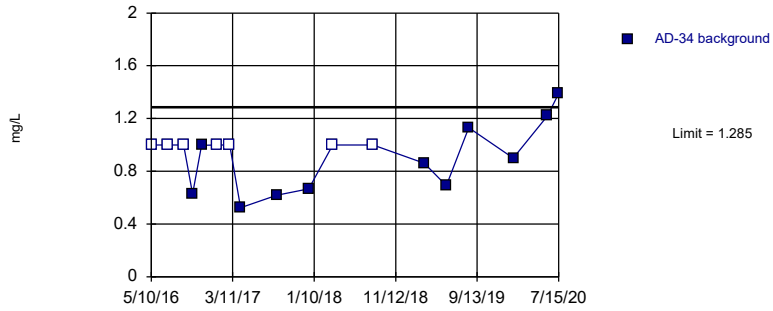
Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 15 background values. 60% NDs. Well-constituent pair annual alpha = 0.01501. Individual comparison alpha = 0.007533 (1 of 2). Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 12/3/2020 12:33 PM View: PLs
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, AD-34



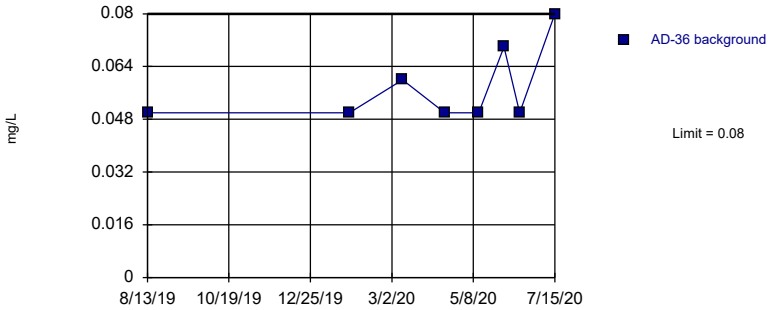
Background Data Summary (after Kaplan-Meier Adjustment): Mean=0.8208, Std. Dev.=0.2404, n=18, 38.89% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9192, critical = 0.858. Kappa = 1.931 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 12/3/2020 12:33 PM View: PLs
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Non-parametric, AD-36



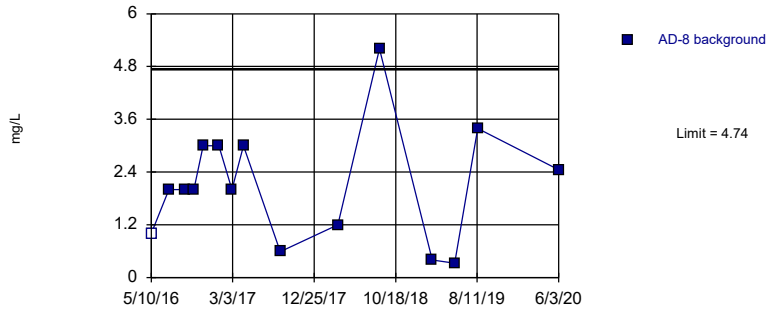
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 8 background values. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2). Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 12/3/2020 12:33 PM View: PLs
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, AD-8 (bg)

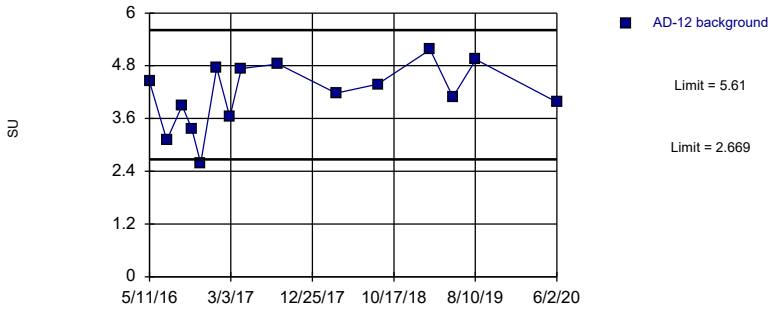


Background Data Summary: Mean=2.104, Std. Dev.=1.315, n=15, 6.667% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9353, critical = 0.835. Kappa = 2.006 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 12/3/2020 12:33 PM View: PLs
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Prediction Limit

Intrawell Parametric, AD-12 (bg)



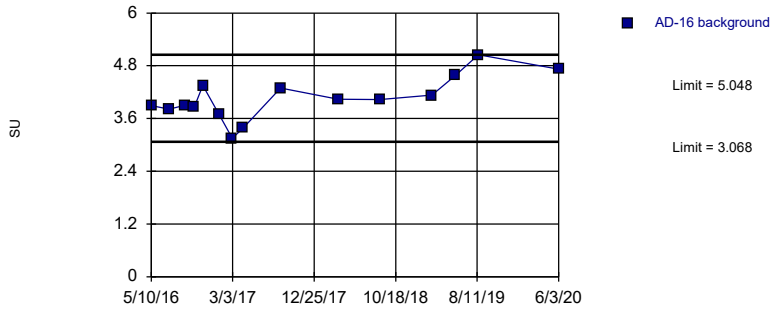
Background Data Summary: Mean=4.139, Std. Dev.=0.7332, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9592, critical = 0.835. Kappa = 2.006 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 12/3/2020 12:33 PM View: PLs
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-16 (bg)



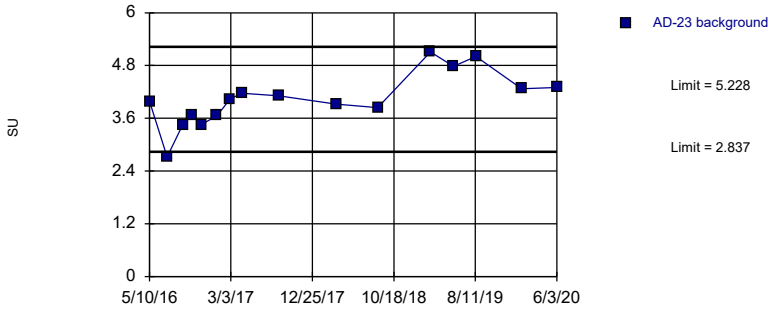
Background Data Summary: Mean=4.058, Std. Dev.=0.4938, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9814, critical = 0.835. Kappa = 2.006 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 12/3/2020 12:33 PM View: PLs
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-23



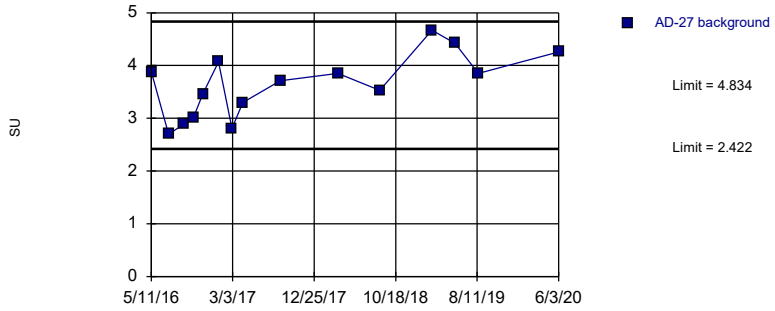
Background Data Summary: Mean=4.033, Std. Dev.=0.6067, n=16. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9632, critical = 0.844. Kappa = 1.97 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 12/3/2020 12:33 PM View: PLs
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-27 (bg)

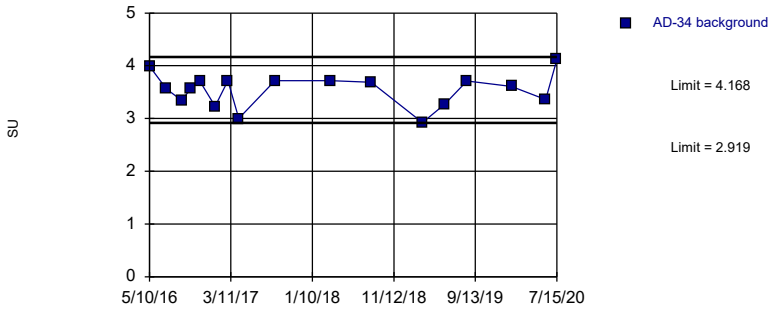


Background Data Summary: Mean=3.628, Std. Dev.=0.6016, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9661, critical = 0.835. Kappa = 2.006 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 12/3/2020 12:33 PM View: PLs
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Prediction Limit

Intrawell Parametric, AD-34



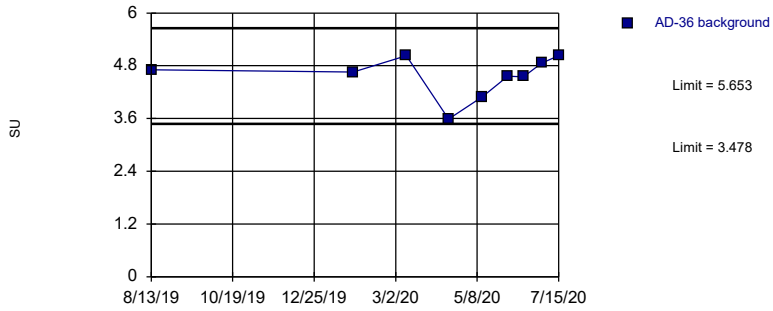
Background Data Summary: Mean=3.544, Std. Dev.=0.3201, n=17. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9468, critical = 0.851. Kappa = 1.951 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 12/3/2020 12:33 PM View: PLs
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-36



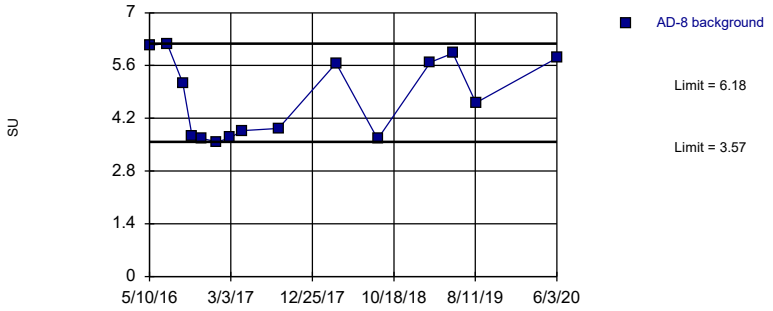
Background Data Summary: Mean=4.566, Std. Dev.=0.4632, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8742, critical = 0.764. Kappa = 2.348 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 12/3/2020 12:33 PM View: PLs
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Non-parametric, AD-8 (bg)



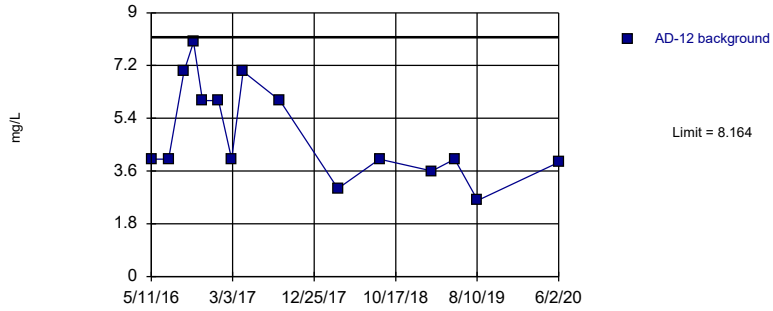
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limits are highest and lowest of 15 background values. Well-constituent pair annual alpha = 0.03002. Individual comparison alpha = 0.01507 (1 of 2). Assumes 1 future value.

Constituent: pH, field Analysis Run 12/3/2020 12:33 PM View: PLs
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-12 (bg)

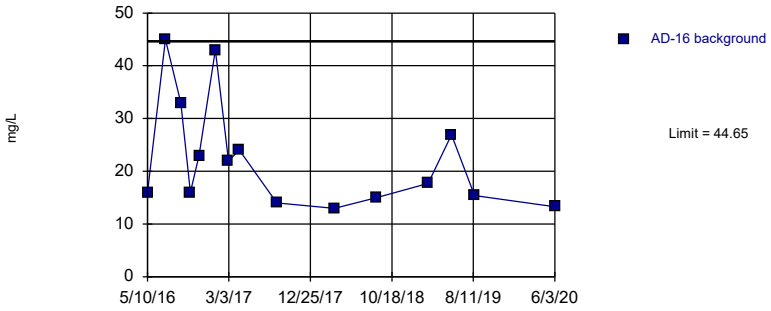


Background Data Summary: Mean=4.873, Std. Dev.=1.641, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8903, critical = 0.835. Kappa = 2.006 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 12/3/2020 12:33 PM View: PLs
Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Prediction Limit

Intrawell Parametric, AD-16 (bg)



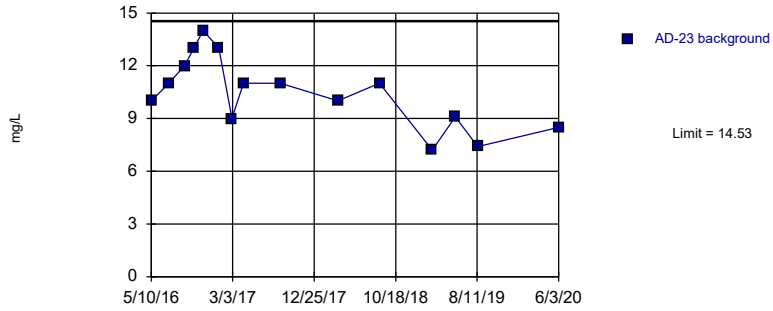
Background Data Summary (based on square root transformation): Mean=4.639, Std. Dev.=1.019, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8612, critical = 0.835. Kappa = 2.006 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 12/3/2020 12:33 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Prediction Limit

Intrawell Parametric, AD-23



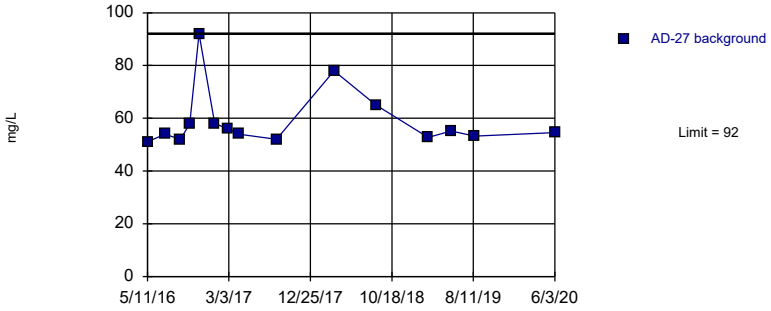
Background Data Summary: Mean=10.48, Std. Dev.=2.021, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9645, critical = 0.835. Kappa = 2.006 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 12/3/2020 12:33 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Prediction Limit

Intrawell Non-parametric, AD-27 (bg)



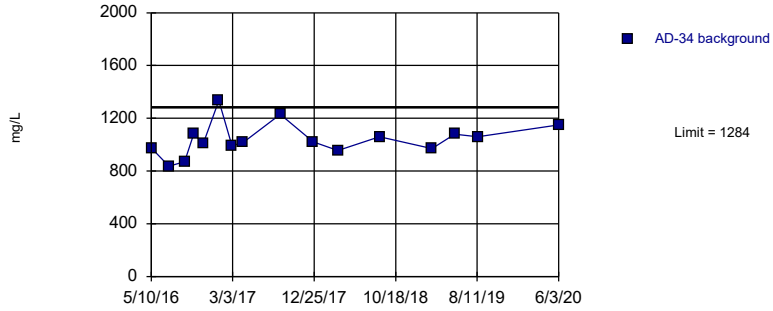
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 15 background values. Well-constituent pair annual alpha = 0.01501. Individual comparison alpha = 0.007533 (1 of 2). Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 12/3/2020 12:33 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Prediction Limit

Intrawell Parametric, AD-34



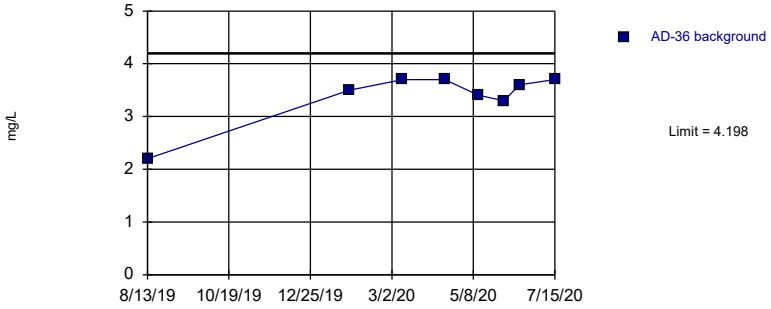
Background Data Summary: Mean=1040, Std. Dev.=123.8, n=16. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9456, critical = 0.844. Kappa = 1.97 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 12/3/2020 12:33 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Prediction Limit

Intrawell Parametric, AD-36



Background Data Summary (based on cube transformation): Mean=40.92, Std. Dev.=13.44, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7626, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

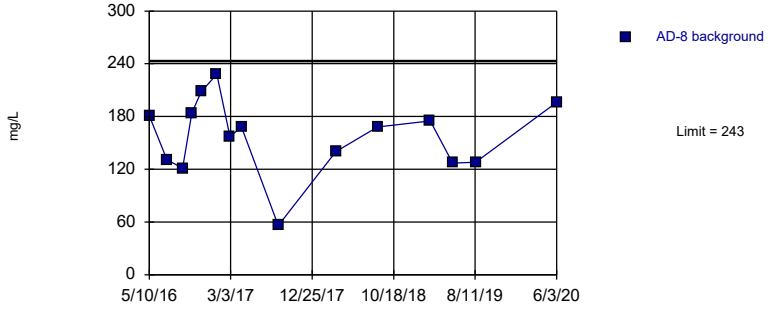
Constituent: Sulfate, total Analysis Run 12/3/2020 12:33 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-8 (bg)



Background Data Summary: Mean=157.9, Std. Dev.=42.45, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9573, critical = 0.835. Kappa = 2.006 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

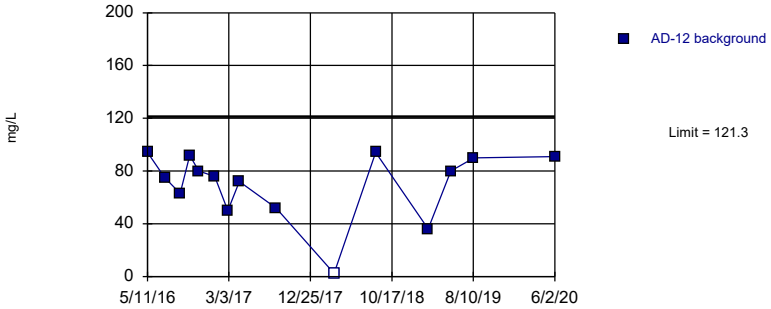
Constituent: Sulfate, total Analysis Run 12/3/2020 12:34 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, AD-12 (bg)



Background Data Summary: Mean=69.83, Std. Dev.=25.67, n=15, 6.667% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8522, critical = 0.835. Kappa = 2.006 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

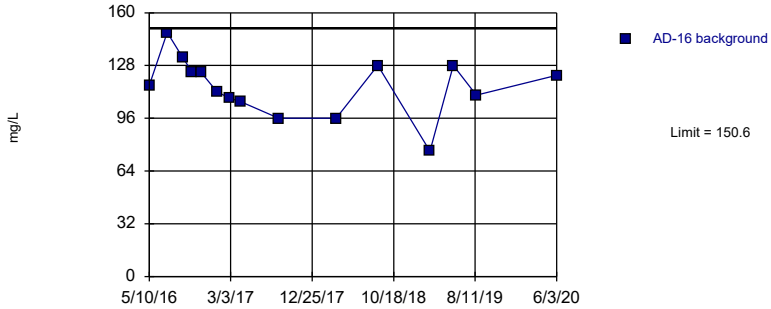
Constituent: Total Dissolved Solids [TDS] Analysis Run 12/3/2020 12:34 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-16 (bg)



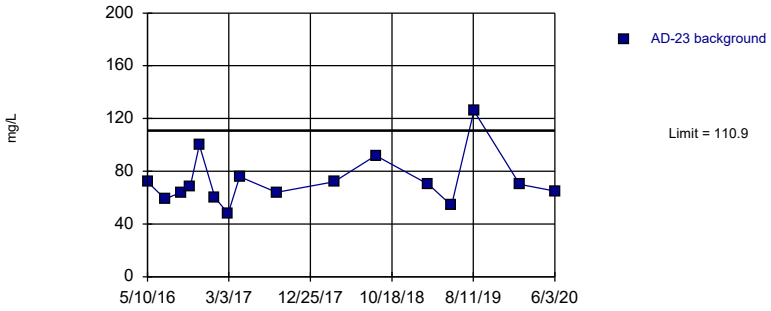
Background Data Summary: Mean=115.1, Std. Dev.=17.67, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9746, critical = 0.835. Kappa = 2.006 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids [TDS] Analysis Run 12/3/2020 12:34 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Prediction Limit

Intrawell Parametric, AD-23



Background Data Summary (based on square root transformation): Mean=8.453, Std. Dev.=1.055, n=16. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8892, critical = 0.844. Kappa = 1.97 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

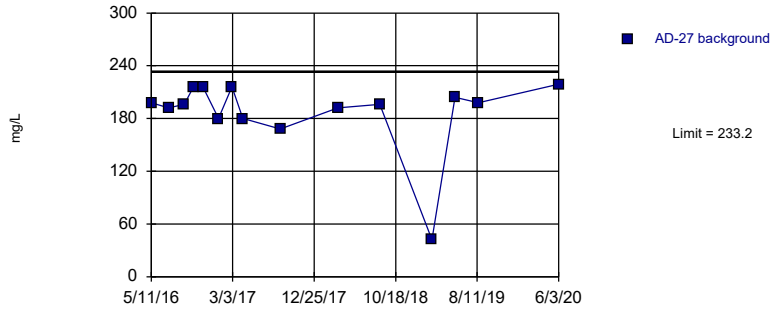
Constituent: Total Dissolved Solids [TDS] Analysis Run 12/3/2020 12:34 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-27 (bg)



Background Data Summary (based on cube transformation): Mean=7363038, Std. Dev.=2652026, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8696, critical = 0.835. Kappa = 2.006 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

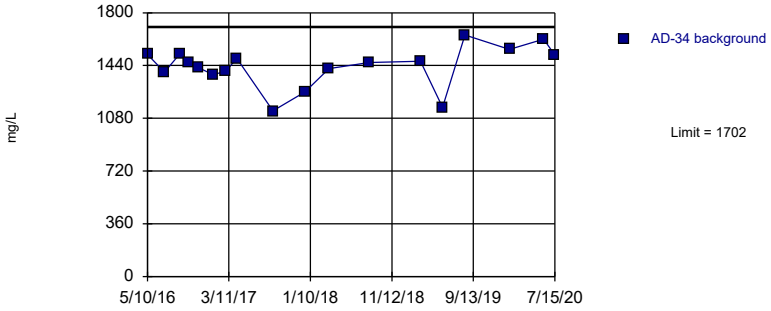
Constituent: Total Dissolved Solids [TDS] Analysis Run 12/3/2020 12:34 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-34



Background Data Summary: Mean=1434, Std. Dev.=138.6, n=18. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9175, critical = 0.858. Kappa = 1.931 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

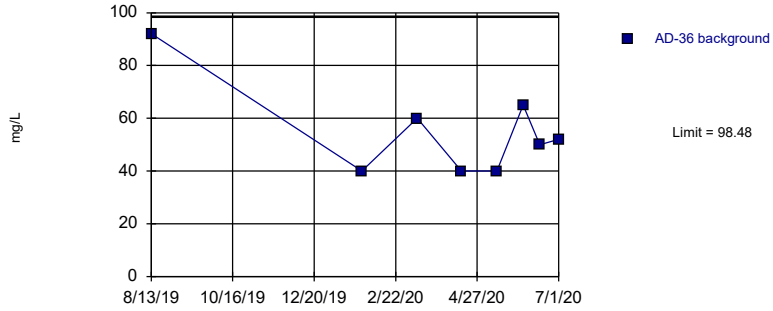
Constituent: Total Dissolved Solids [TDS] Analysis Run 12/3/2020 12:34 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Sanitas™ v.9.6.27 Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-36



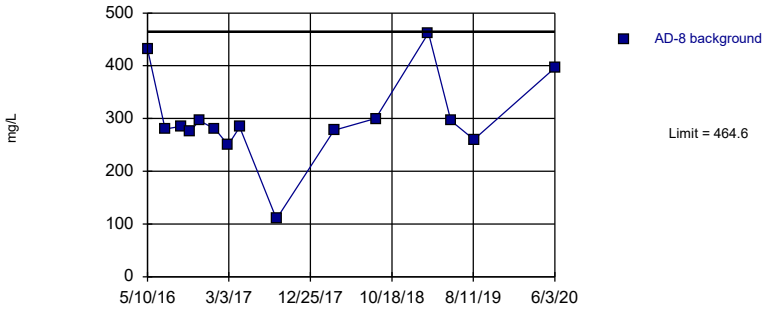
Background Data Summary: Mean=54.88, Std. Dev.=17.74, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8385, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids [TDS] Analysis Run 12/3/2020 12:34 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Prediction Limit

Intrawell Parametric, AD-8 (bg)

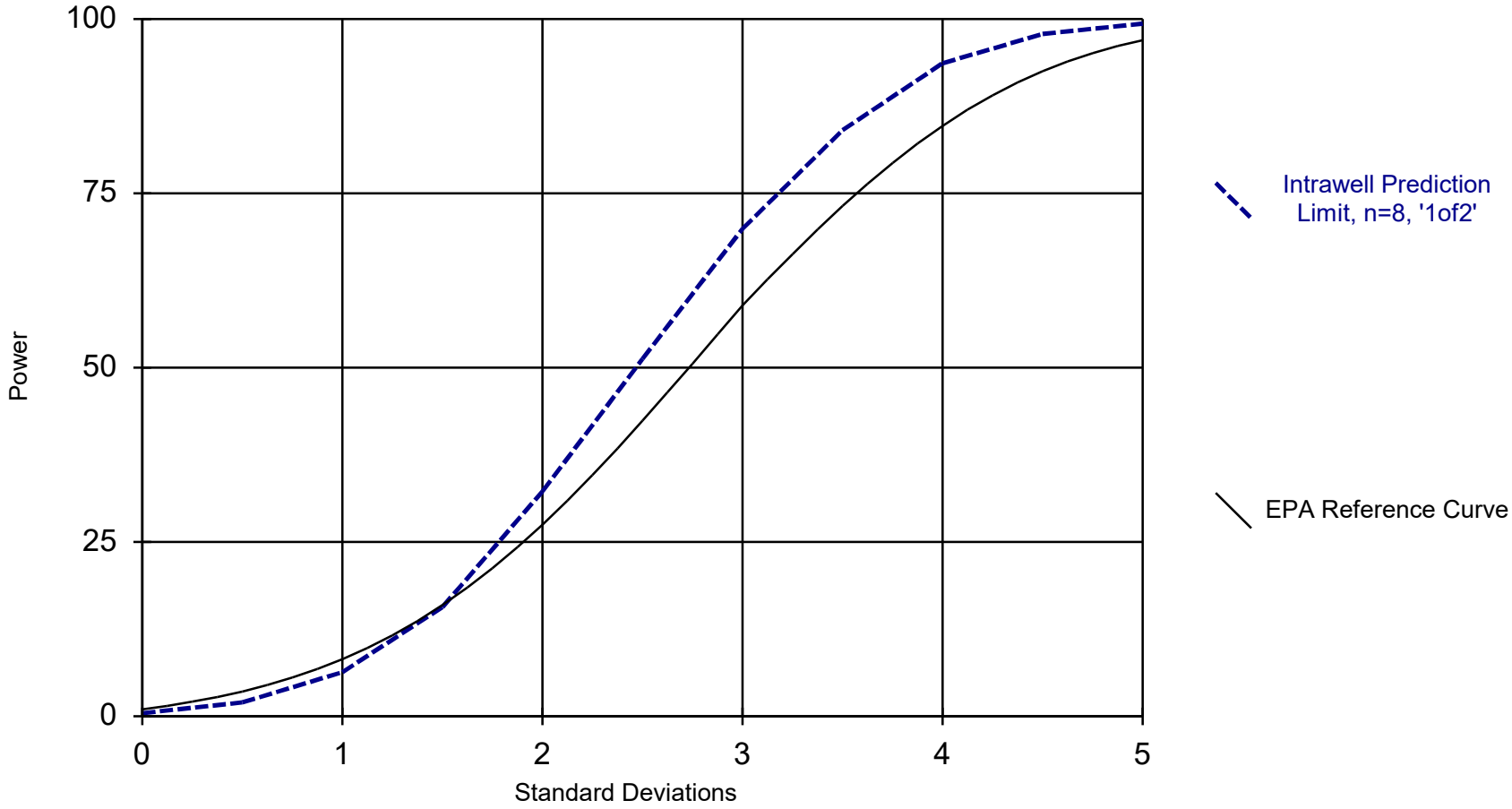


Background Data Summary: Mean=299, Std. Dev.=82.57, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8448, critical = 0.835. Kappa = 2.006 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: Total Dissolved Solids [TDS] Analysis Run 12/3/2020 12:34 PM View: PLs

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

Power Curve



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

Analysis Run 12/3/2020 12:41 PM View: Descriptive

Pirkey Landfill Client: Geosyntec Data: Pirkey Landfill

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

H.W. Pirkey Power Plant Landfill Hallsville, Texas

Submitted to

AMERICAN ELECTRIC POWER

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

941 Chatham Lane
Suite 103
Columbus, OH 43221

December 2020

CHA8495

TABLE OF CONTENTS

TABLES

FIGURES

ATTACHMENTS

LIST OF ACRONYMS

AEP	American Electric Power
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
EPRI	Electric Power Research Institute
GSC	Groundwater Stats Consulting, LLC
LPL	Lower Prediction Limit
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
SU	Standard Unit
TCEQ	Texas Commission on Environmental Quality
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency

SECTION 1

INTRODUCTION AND SUMMARY

This Alternative Source Demonstration (ASD) report has been prepared to address a statistically significant increase (SSI) for fluoride in the groundwater monitoring network at the H.W. Pirkey Power Plant's Landfill, located in Hallsville, Texas, following the first semiannual detection monitoring event of 2020. The Landfill is registered as an ash landfill under Texas Commission on Environmental Quality (TCEQ) Industrial and Hazardous Waste Solid Waste Registration No. 33240. The western side of the Landfill overlies a former lignite mining area, as shown in **Figure 1**.

Background groundwater concentrations for the Landfill were initially calculated in January 2018 with data from at least eight monitoring events (Geosyntec, 2018). Upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. Lower prediction limits (LPLs) were also calculated for pH. An alternative source demonstration (ASD) was certified on January 7, 2020 which resulted in a revision from interwell tests to intrawell tests for pH, sulfate, and TDS prediction limits due to the presence of lignite mine spoils within the screened interval at downgradient well AD-34 (Geosyntec, 2020). Prediction limits were calculated based on a one-of-two retesting procedure to maintain an appropriate site-wide false positive rate (SWFPR). With this procedure, an SSI is concluded only if both samples in a series of two exceed the UPL or, in the case of pH, are below the LPL. In practice, if the initial result did not exceed the UPL, a second sample was not collected or analyzed.

The first semi-annual detection monitoring event of 2020 was performed in June 2020 (initial sampling event), and the results were compared to the calculated prediction limits. Where initial exceedances were identified, verification resampling was completed in July 2020. Following verification resampling, an SSI for fluoride was identified at well AD-34 by intrawell analysis, A summary of the detection monitoring analytical results and the calculated prediction limits to which they were compared is provided in **Table 1**.

1.1 CCR Rule Requirements

USEPA regulations regarding assessment monitoring programs for CCR landfills and surface impoundments provide owners and operators with the option to make an alternative source demonstration when an SSI is identified (40 CFR 257.94(e)(2)). An 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 40 CFR 257.94(e)(2), Geosyntec Consultants, Inc. (Geosyntec) has prepared this Alternative Source Demonstration (ASD) report to document that the SSI identified for fluoride at AD-34 is from a source other than the Landfill.

1.2 Demonstration of Alternative Sources

An evaluation was completed to assess possible alternative sources to which the identified SSI 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 SSI identified for fluoride at AD-34 was based on a Type IV cause and not by a release from the Pirkey Landfill.

SECTION 2

ALTERNATIVE SOURCE DEMONSTRATION

The Federal 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. The methodology used to evaluate the fluoride SSI and the proposed alternative source are described below.

2.1 Proposed Alternative Source – Natural Variation

An initial review of site geochemistry, site historical data, and laboratory quality assurance/quality control (QA/QC) data did not identify ASDs due to Type I (sampling), Type II (laboratory), or Type III (statistical evaluation) issues. Groundwater sampling, laboratory analysis, and statistical evaluations were generally completed in accordance with draft TCEQ guidance for groundwater monitoring (TCEQ, 2020). As described below, the SSI has been attributed to natural variation, which is a Type IV issue.

In February 2019, a Landfill leachate sample was collected for laboratory analysis to support an ASD for cobalt and cadmium (Burns & McDonnell, 2019). The results of this sample found that fluoride was detected at an estimated (J-flagged) concentration of 0.50 milligrams per liter (mg/L). The laboratory analytical report is provided as **Attachment A**. This concentration is below the intrawell UPL of 1.00 mg/L at AD-34, suggesting that the Landfill is not the likely source of the fluoride exceedance.

Fluoride concentrations at the site appear to be highly variable, including at background monitoring locations. Observed concentrations at background well AD-8 are consistently higher than those observed at AD-34 (**Figure 2**). The second semi-annual detection sampling event was conducted on November 4, 2020. The reported fluoride concentration for the sample from well AD-34 was 0.82 mg/L, which is below the calculated UPL (**Figure 3**). Based on recent results at AD-34, including the three samples collected during the 2020 groundwater monitoring events, a statistically significant positive trend is not demonstrated (**Figure 4**). Thus, the observed fluoride concentrations during the first semi-annual event are not considered indicative of a release from the LF and are instead likely due to natural variability in the aquifer.

A cause of the variability of dissolved fluoride concentrations may be associated with former mining activities that took place immediately underlying and downgradient of the Landfill. As has been noted in previous ASDs (Burns & McDonnell, 2019; Geosyntec, 2019; Geosyntec, 2020), AD-34 is screened within lignite mine spoils, which has significantly impacted its groundwater composition. An analysis of lignite in a well core advanced in the Wilcox formation, which is the material formerly mined in Area A, found that fluorine was present in the material at concentrations ranging from approximately 10 to 50 milligrams per kilogram of dry material (mg/kg dry lignite) (Chakrabouti et. al, 1984). It is feasible that fluorine could be mobilized from the mine spoils, resulting in variability in the aqueous fluoride concentrations at AD-34.

An additional line of evidence that the Landfill is likely not affecting groundwater at AD-34 is the lack of increasing concentrations for chloride. Chloride is a conservative constituent which is not significantly attenuated by chemical processes during advective flow. The concentration ratio between chloride and fluoride in groundwater varies between approximately 10:1 and 100:1 at both upgradient and downgradient locations (**Figure 5**). Chloride was detected in the Landfill leachate at 640 mg/L (**Attachment A**), which is approximately two orders of magnitude greater than the concentrations detected at AD-34. The concentration ratio between chloride and fluoride in the Landfill leachate is approximately 1200:1 (**Figure 5**), which suggests that dissolved chloride concentrations at AD-34 would be higher if this location were affected by leachate. As shown in **Figure 6**, the concentration of chloride is consistently around 7 mg/L, which is comparable to upgradient monitoring locations. A trend analysis found no significant increasing trend for chloride at AD-34 (**Figure 7**). Because chloride is a conservative constituent and concentrations are higher in the leachate, if the Landfill were affecting the groundwater composition, we would expect to observe an increasing trend of dissolved chloride at AD-34.

The lack of elevated fluoride in the Landfill leachate, the high concentration of fluoride at upgradient location AD-8, and the presence of fluorine in lignite mined within the footprint of the Landfill all indicate that the Landfill is not the likely source of elevated fluoride at AD-34.

2.2 Sampling Requirements

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

SECTION 3

CONCLUSIONS AND RECOMMENDATIONS

The preceding information serves as the ASD prepared in accordance with 40 CFR 257.94(e)(2) and supports the position that the fluoride SSI at AD-34 identified during the first semiannual detection monitoring event of 2020 was not due to a release from the Landfill. The identified SSI was, instead, attributed to natural variation in the aquifer associated with former mining activities. Therefore, no further action is warranted, and the Pirkey Landfill will remain in the detection monitoring program. Certification of this ASD by a qualified professional engineer is provided in **Attachment B**.

SECTION 4

REFERENCES

AEP, 2017. Statistical Analysis Plan – H.W. Pirkey Power Plant. Hallsville, Texas. January.

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

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TCEQ, 2020. Coal Combustion Residuals Groundwater Monitoring and Corrective Action Draft Technical Guideline No. 32. Topic: Coal Combustion Residuals (CCR) Groundwater Monitoring and Corrective Action. Waste Permits Division. May.

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TABLES

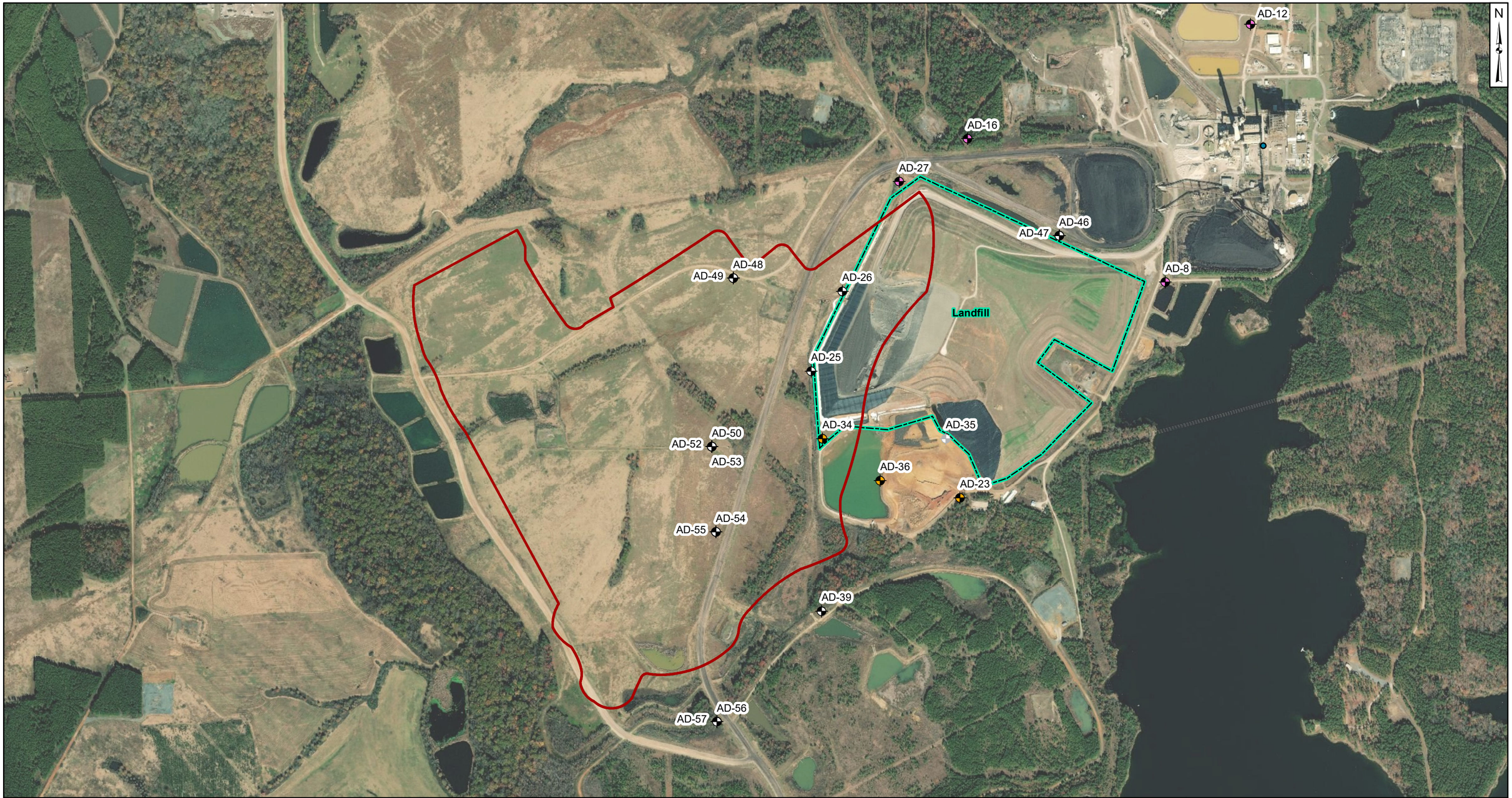
Table 1: Detection Monitoring Data Summary
Pirkey Plant - Landfill

Geosyntec Consultants, Inc.

Analyte	Unit	Description	AD-23	AD-34	
			6/3/2020	6/3/2020	7/15/2020
Boron	mg/L	Intrawell Background Value (UPL)	0.030	0.120	
		Analytical Result	0.02	0.058	--
Calcium	mg/L	Intrawell Background Value (UPL)	0.65	42.5	
		Analytical Result	0.2	40.1	--
Chloride	mg/L	Intrawell Background Value (UPL)	7.89	9.20	
		Analytical Result	7.08	7.68	--
Fluoride	mg/L	Intrawell Background Value (UPL)	1.00	1.00	
		Analytical Result	0.07	**1.22**	**1.39**
pH	SU	Intrawell Background Value (UPL)	4.8	4.3	
		Intrawell Background Value (LPL)	2.5	2.7	
		Analytical Result	4.3	3.4	--
Sulfate	mg/L	Intrawell Background Value (UPL)	15.8	1,388	
		Analytical Result	8.5	1,150	--
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	106	1,587	
		Analytical Result	65	**1,620**	1,510

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

FIGURES



Legend

- Upgradient Well
- Downgradient Well
- Out of Network Well
- Abandoned Well
- A Area
- Landfill

Notes

- Monitoring well coordinates, site features, and data provided by AEP.
- A Area is a former lignite (reclaimed) mine.
- AD-35 was abandoned in November 2018 and a new downgradient well, AD-36, was installed in April 2019.
- Aerial imagery provided by DigitalGlobe and dated 12/1/2018.

1,000 500 0 1,000 Feet

Site Layout

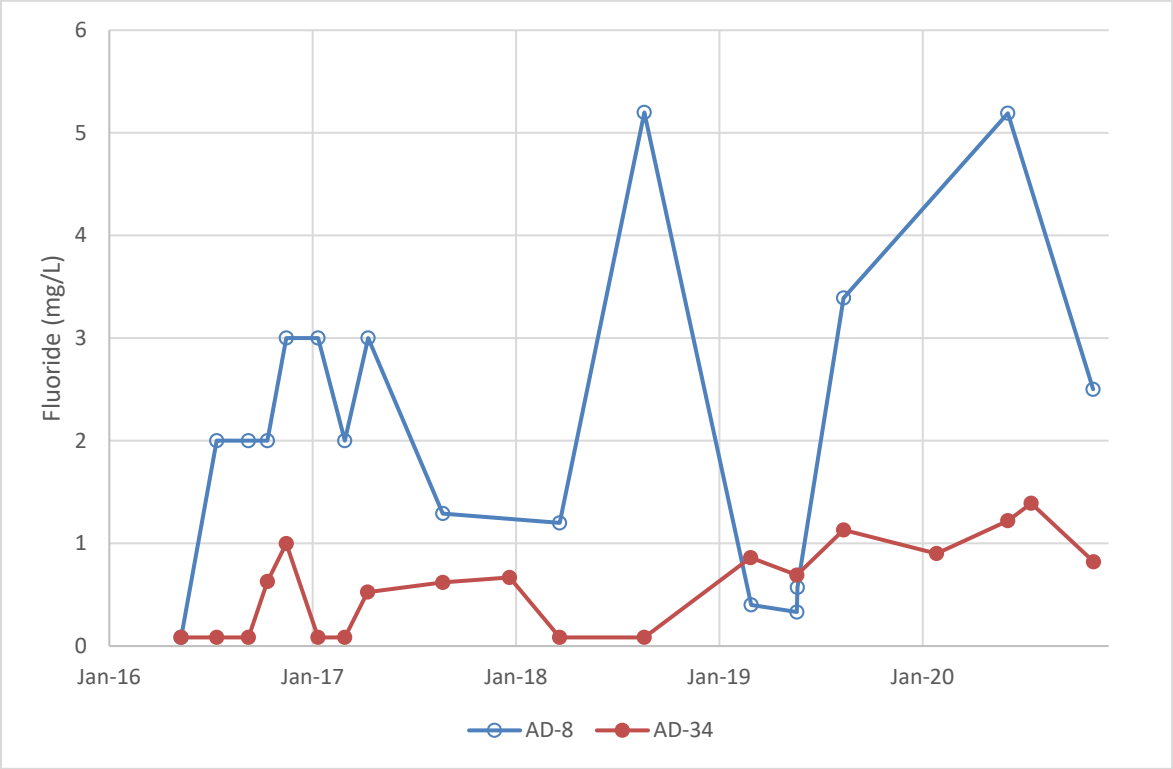
AEP Pirkey Power Plant
Hallsville, Texas

Geosyntec consultants

Columbus, Ohio | 2020/01/06

Figure **1**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Pirkey\2019\AEP_Sitelayout_20191224.mxd. ARevezzo. 1/6/2020. Project/Phase/Task.



Notes: Fluoride concentrations are shown in milligrams per liter (mg/L). AD-8 is shown with hollow symbols because it is an upgradient location.

AD-34 and AD-8 Fluoride Time Series Graph
Pirkey Landfill

Geosyntec consultants

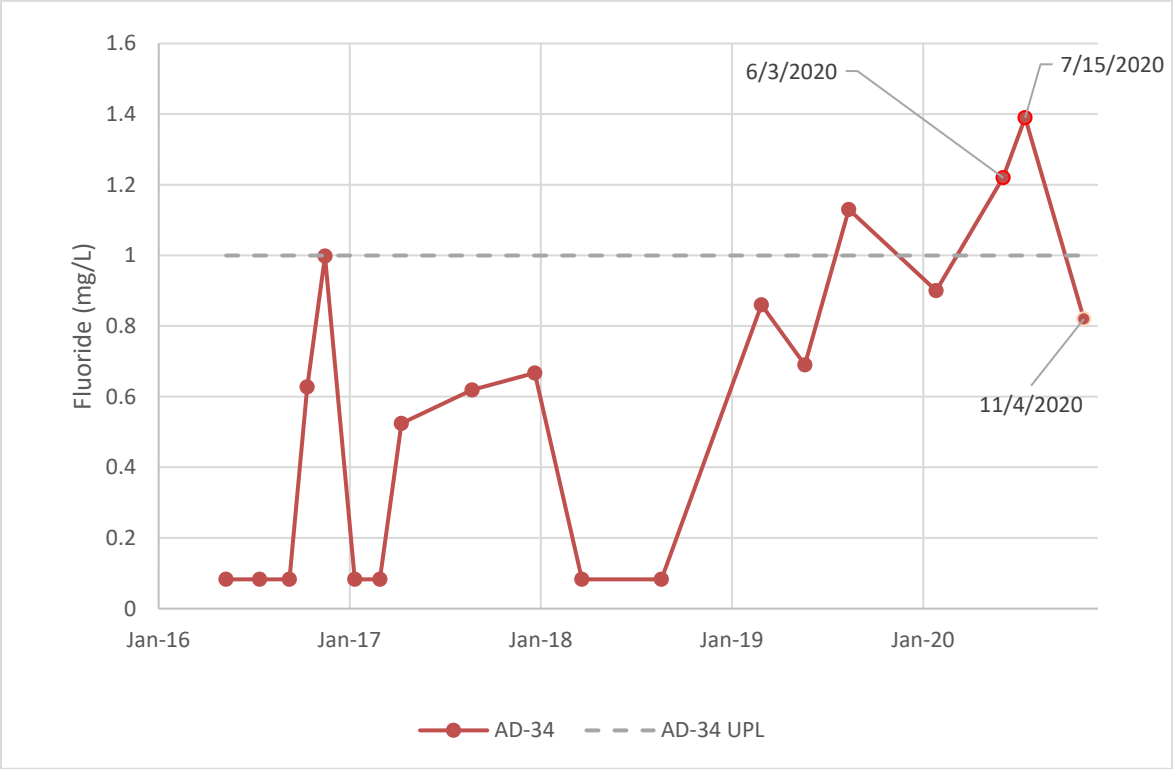
AMERICAN ELECTRIC POWER

Figure 2

Columbus, Ohio

11-Dec-2020

internal info: path, date revised, author



Notes: Initial sampling for the first semi-annual detection monitoring event occurred on 6/3/2020. Verification resampling for the first semi-annual event occurred on 7/15/2020. Initial sampling for the second semi-annual event occurred on 11/4/2020. The upper prediction limit (UPL) was calculated using intrawell analyses.

AD-34 Fluoride Time Series Graph
Pirkey Landfill

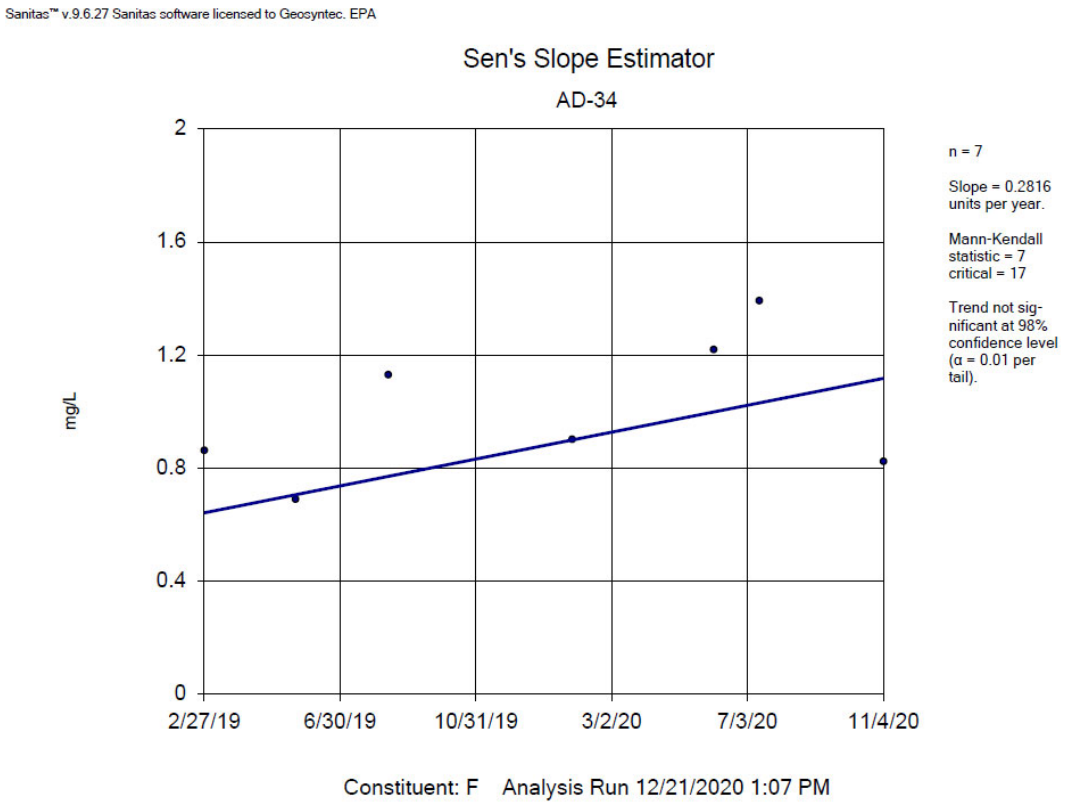
Geosyntec consultants

AMERICAN ELECTRIC POWER

Columbus, Ohio

11-Dec-2020

Figure 3



Notes: Analysis of fluoride concentrations was completed using Sanitas™. No significant increasing trend was identified at 98% confidence level. As fluoride was not detected at AD-34 in 2018, all results collected after 2018 were used.

AD-34 Fluoride Trend Test
Pirkey Landfill

Geosyntec consultants

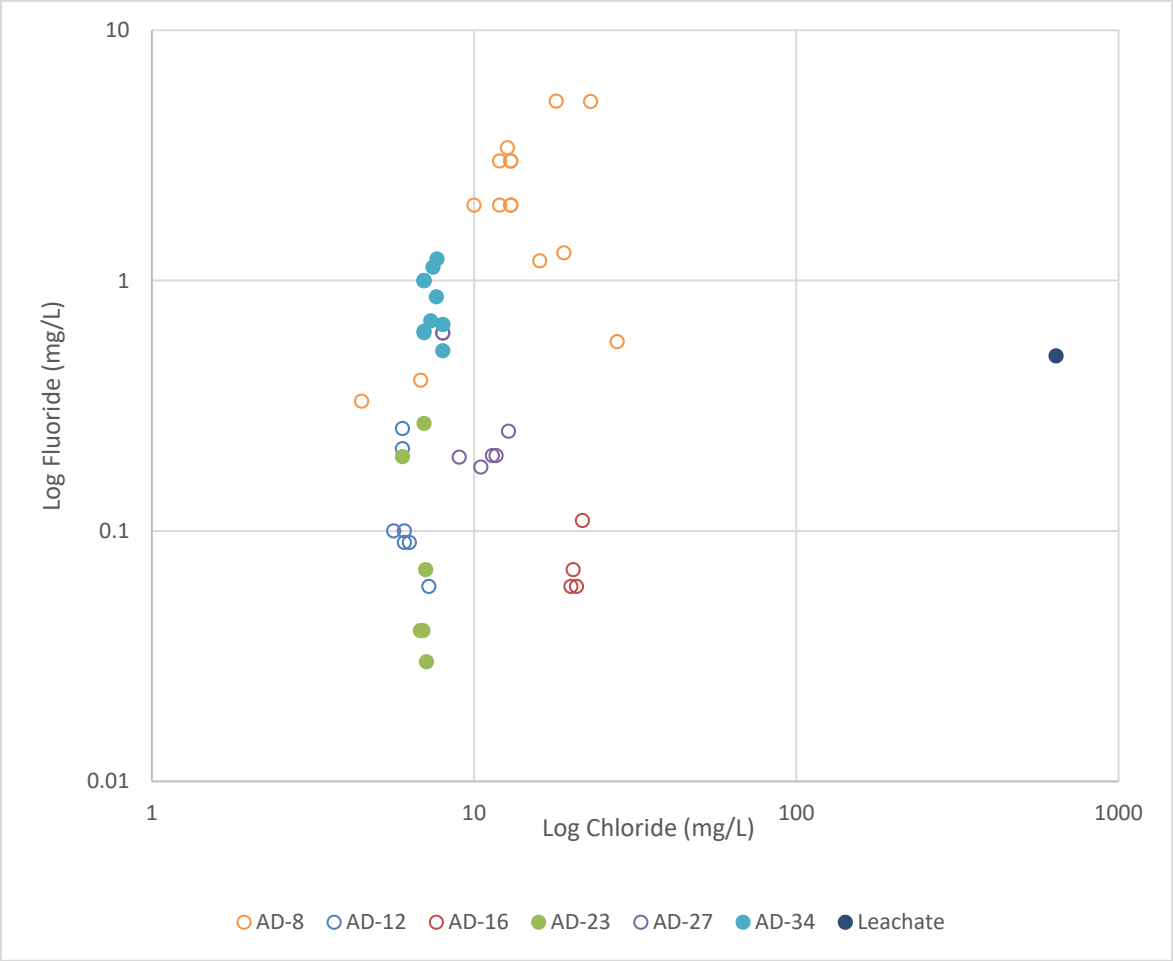
AMERICAN ELECTRIC POWER

Figure
4

Columbus, Ohio

28-Dec -2020

internal info: path, date revised, author



Notes: Chloride and fluoride concentrations are shown in milligrams per liter (mg/L). Upgradient wells are shown with hollow circles. 'Leachate' represents landfill leachate collected in February 2019.

Chloride and Fluoride Concentration Distribution

Pirkey Landfil

Geosyntec consultants

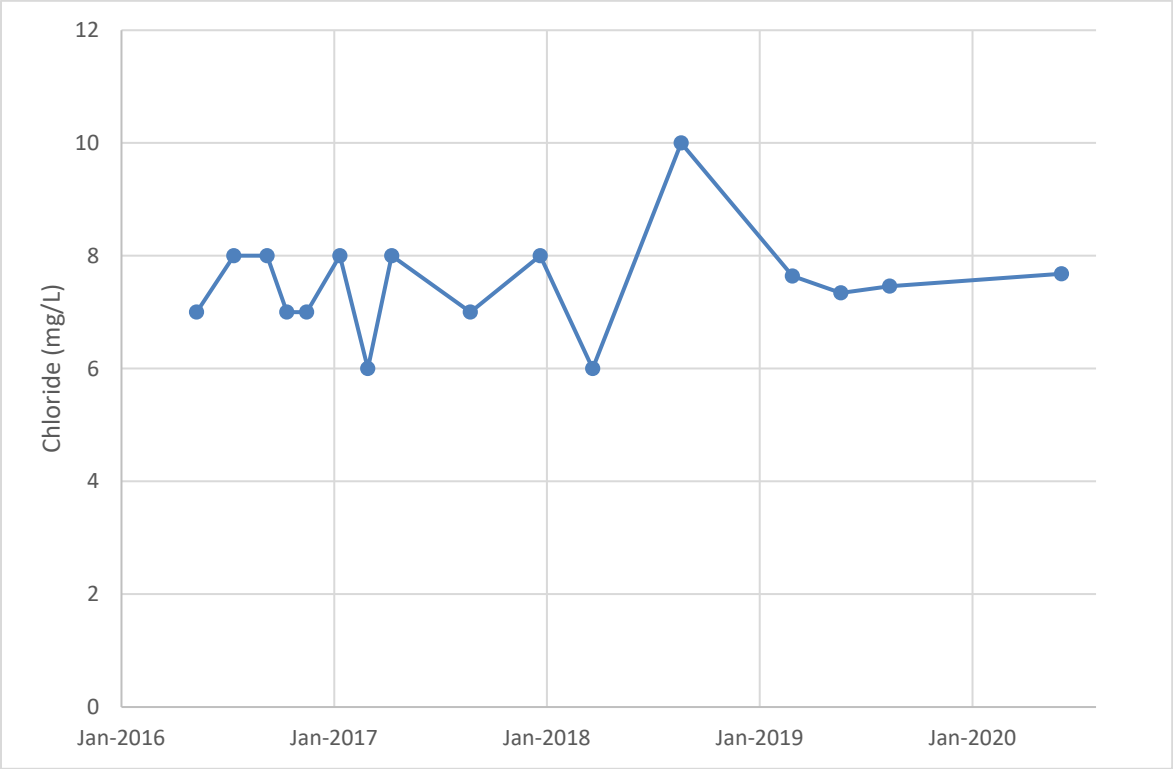
AMERICAN ELECTRIC POWER

Figure 5

Columbus, Ohio

28-Dec-2020

internal info: path, date revised, author



Notes: Chloride concentrations are shown in milligrams per liter (mg/L).

AD-34 Chloride Time Series Graph
Pirkey Landfill

Geosyntec consultants

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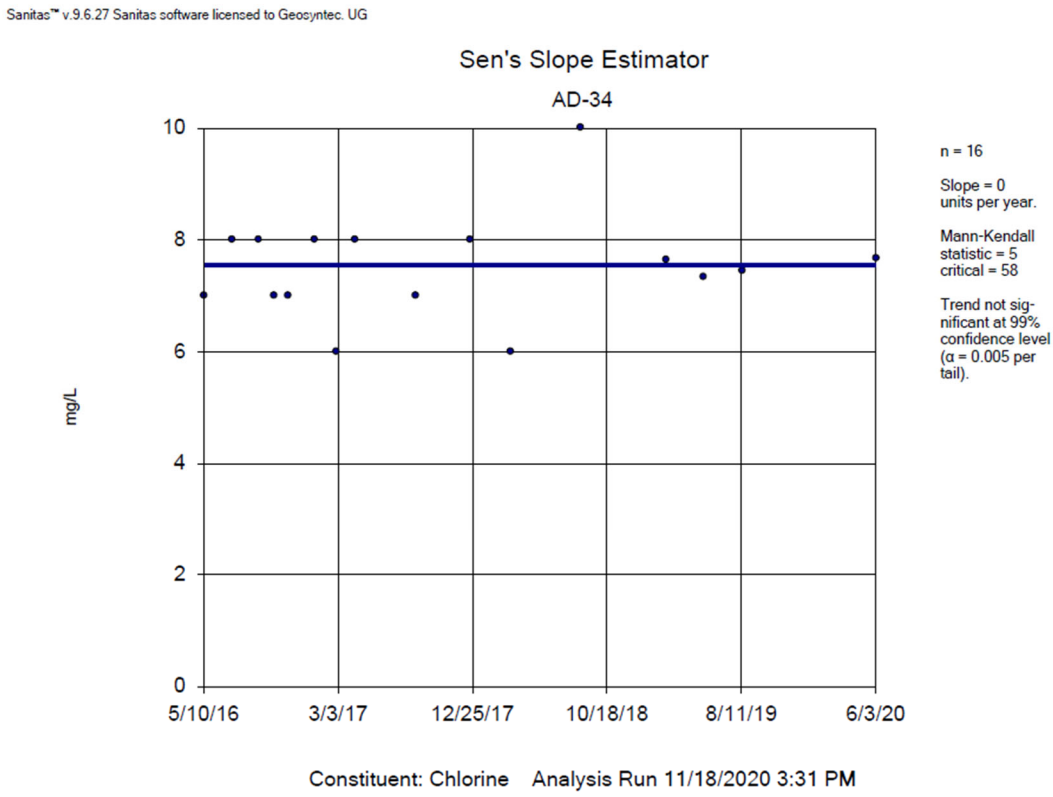
Figure 6

Columbus, Ohio

28-Dec-2020

internal info: path, date revised, author



Notes: Analysis of chloride concentrations was completed using Sanitas™. No significant increasing trend was identified at 99% confidence level.

AD-34 Chloride Trend Test
Pirkey Landfill

Geosyntec consultants | AMERICAN ELECTRIC POWER

Columbus, Ohio | 28-Dec -2020

Figure 7

internal info: path, date revised, author

ATTACHMENT A
February 2019 Landfill Leachate
Laboratory Analytical Report

Client Sample ID: LANDFILL LEACHATE-1

Lab Sample ID: 490-168409-1

Date Collected: 02/11/19 15:45
Matrix: Water
Date Received: 02/13/19 09:40

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Fluoride	0.50	J	1.0	0.010	mg/L			02/14/19 16:31	1
Sulfate	2200	B	500	3.0	mg/L			02/15/19 12:11	100
Chloride	640		150	10	mg/L			02/15/19 11:55	50

Method: 6020A - Metals (ICP/MS) - Total Recoverable

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	0.0044	B	0.0030	0.00080	mg/L		02/13/19 15:36	02/18/19 17:23	1
Arsenic	0.045		0.0050	0.00040	mg/L		02/13/19 15:36	02/15/19 17:49	1
Barium	0.048	J	0.20	0.00010	mg/L		02/13/19 15:36	02/15/19 17:49	1
Beryllium	0.00011	J	0.0040	0.00010	mg/L		02/13/19 15:36	02/15/19 17:49	1
Boron	5000	U	5000	180	mg/L		02/19/19 10:08	02/20/19 15:59	5000
Cadmium	0.00030	J	0.0050	0.00010	mg/L		02/13/19 15:36	02/15/19 17:49	1
Calcium	590		1.0	0.053	mg/L		02/13/19 15:36	02/15/19 17:49	1
Chromium	0.0050	U	0.0050	0.00050	mg/L		02/13/19 15:36	02/15/19 17:49	1
Cobalt	0.00043	J	0.0050	0.00010	mg/L		02/13/19 15:36	02/15/19 17:49	1
Lead	0.00029	J B	0.0050	0.00010	mg/L		02/13/19 15:36	02/15/19 17:49	1
Lithium	0.042		0.040	0.0030	mg/L		02/13/19 15:36	02/15/19 17:49	1
Molybdenum	3.7		0.010	0.0010	mg/L		02/13/19 15:36	02/15/19 17:49	1
Selenium	0.13		0.010	0.00030	mg/L		02/13/19 15:36	02/18/19 17:23	1
Thallium	0.0020	U	0.0020	0.00080	mg/L		02/13/19 15:36	02/15/19 17:49	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	0.00050		0.00020	0.00010	mg/L		02/15/19 10:11	02/18/19 12:51	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	5100		1.0	0.28	mg/L			02/14/19 12:50	1

ATTACHMENT B
Certification by Qualified Professional Engineer

CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER

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

Beth Ann Gross
Printed Name of Licensed Professional Engineer

Beth Gross
Signature

Geosyntec Consultants
2039 Centre Pointe Blvd, Suite 103
Tallahassee, Florida 32308

Texas Registered Engineering Firm
No. F-1182

79864	Texas	12/31/2020
License Number	Licensing State	Date

APPENDIX IV

Reports documenting monitoring well plugging and abandonment or well installation are included in the appendix.

STATE OF TEXAS WELL REPORT for Tracking #540556

Owner:	**American Electric Power Company**	Owner Well #:	**AD-7R**
Address:	**502 N. Allen Street Shreveport, LA 71101**	Grid #:	**35-37-1**
		Latitude:	**32° 27' 43.7" N**
Well Location:	**2400 Farm Road 3251 Hallsville, TX 75650**	Longitude:	**094° 29' 18.3" W**
Well County:	**Harrison**	Elevation:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Start Date: **3/3/2020** Drilling End Date: **3/3/2020**

	Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
Borehole:	**8.25**	**0**	**31.5**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Filter Packed**

	Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
Filter Pack Intervals:	**18**	**31.5**	**Sand**	**20/40**

Annular Seal Data: **No Data**

Seal Method: **Poured**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Slab Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **C&S Lease**

1873 FM 1252 E
Kilgore, TX 75663

Driller Name: **Buford E. Collier** License Number: **50089**

Apprentice Name: **David Diduch** Apprentice Number: **60297**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**1.5**	**Top soil, vegetation, black silt, gravel, light gray/red/brown clayey silt**
1.5	**10**	**Red/light gray clay, low plasticity, high stiffness, iron ore present, trace silt,**
10	**15**	**Maroon/light gray clay, high stiffness, low plasticity, iron ore, wet**
15	**20**	**Black silty clay, low-moderate plasticity, wet, Maroon/orange clayey silt, wet, good cohesion, iron ore, gray/orange clayey silt, iron ore present, wet, good cohesion**
20	**24.6**	**Black clayey silt, Dark gray fine grained sand, trace clay, wet, black silty clay, low-moderate plasticity, moderate to low stiffness**
24.6	**31.5**	**Dark gray fine grained sand, wet, well sorted, orange fine grained sand, wet, well sorted, tan fine grained sand, wet, well sorted, iron present**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**20**
2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**20**	**30**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking Number on your written request.

Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540