Annual Groundwater Monitoring Report

Southwestern Electric Power Company

Flint Creek Power Plant

Primary Bottom Ash Pond CCR Management Unit

Gentry, Arkansas

January 2020

Prepared by:
American Electric Power Service Corporation
1 Riverside Plaza
Columbus, Ohio 43215

SOUTHWESTERN ELECTRIC POWER COMPANY℠

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BOUNDLESS ENERGY℠

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I. Overview

This *Annual Groundwater Monitoring Report* (Report) has been prepared to report the status of activities for the preceding year for an existing CCR unit at Southwestern Electric Power Company's, a wholly-owned subsidiary of American Electric Power Company (AEP), Flint Creek Power Plant. The USEPA's CCR rules require that the Annual Groundwater Monitoring Report be posted to the operating record for the preceding year no later than January 31, 2020.

At the beginning of 2019 the PBAP was in detection monitoring. At the end of 2019 the PBAP was still in detection monitoring.

In general, the following activities were completed:

- Groundwater samples were collected and analyzed for Appendix III constituents, as specified in 40 CFR 257.94 *et seq.* and AEP's *Groundwater Sampling and Analysis Plan (2016)*;
- Groundwater data underwent various validation tests, including tests for completeness, valid values, transcription errors, and consistent units;
- Two sampling events occurred in 2018 and were not reported in the 2018 annual report. The 1st half 2018 detection monitoring sampling event resulted in no SSIs. The 2nd half 2018 detection monitoring sampling event resulted in no SSIs.
- A SSI was determined for calcium in well AP-59 for the 1st half 2019 groundwater sampling and analysis event;
- A successful alternate source demonstration was prepared for the 1st half 2019 groundwater event;
- The 2nd half 2019 groundwater sampling event has not completed its statistical evaluation report.
- 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;
- Other information required to be included in the annual report such as alternate source demonstration or assessment of corrective measures, if applicable.

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

II. Groundwater Monitoring Well Locations and Identification Numbers

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

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

III. Monitoring Wells Installed or Decommissioned

There were no monitoring wells installed or decommissioned this year.

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

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

V. Statistical Evaluation of 2018 and 2019 Events

The 1st half 2018 statistical analysis report is included in Appendix II. No SSIs were determined to for this report.

The 2nd half 2018 statistical analysis report is included in Appendix II. No SSIs were determined to for this report.

The 1st half 2019 statistical analysis report is included in Appendix II. A SSI was determined to exist in this report, however a successful alternate source demonstration was prepared that addressed the SSI.

The 2nd half 2019 statistical analysis report is under development and not available in this report.

VI. Alternate Source Demonstration

In the 1st half 2019 sampling event, a SSI in calcium was determined at well AP-59. An alternate source determination report was prepared. This report documented that natural variation in calcium concentrations caused the relatively high sample concentrations. That is, a cause other than the CCR unit caused the statistical result. See Appendix III.

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

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

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

VIII. Other Information Required

No other information applies at this time.

IX. Description of Any Problems Encountered in 2019 and Actions Taken

No problems were encountered this year.

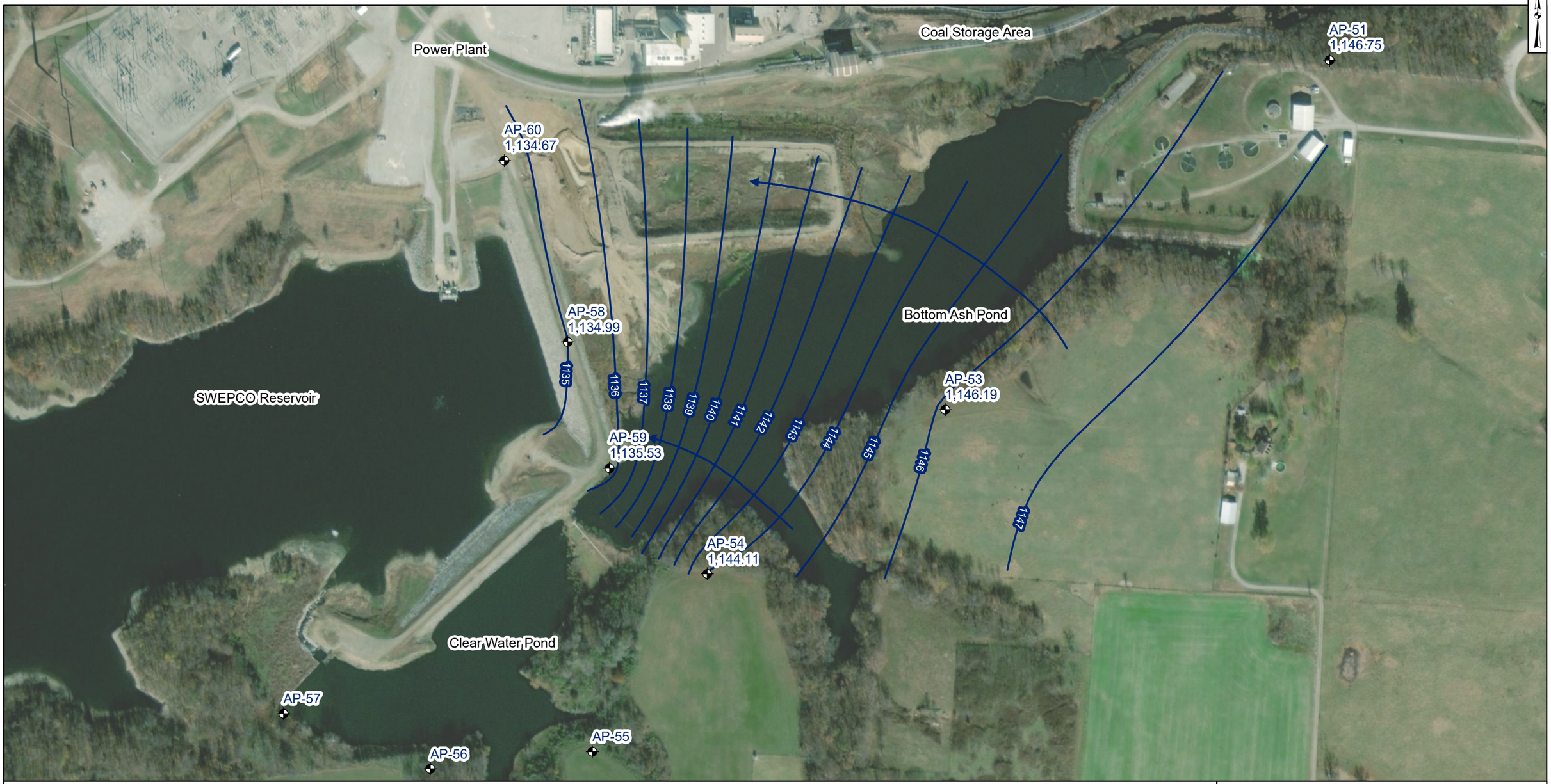
X. A Projection of Key Activities for the Upcoming Year

Key activities for next year include:

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



Legend

- Monitoring Wells
- Groundwater Contour Elevation
- Groundwater Flow Direction

Notes

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

200 100 0 200 Feet

Potentiometric Surface Map
Uppermost Aquifer - March 2018

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

Geosyntec consultants

Columbus, Ohio | 2018/09/17

Figure **X**

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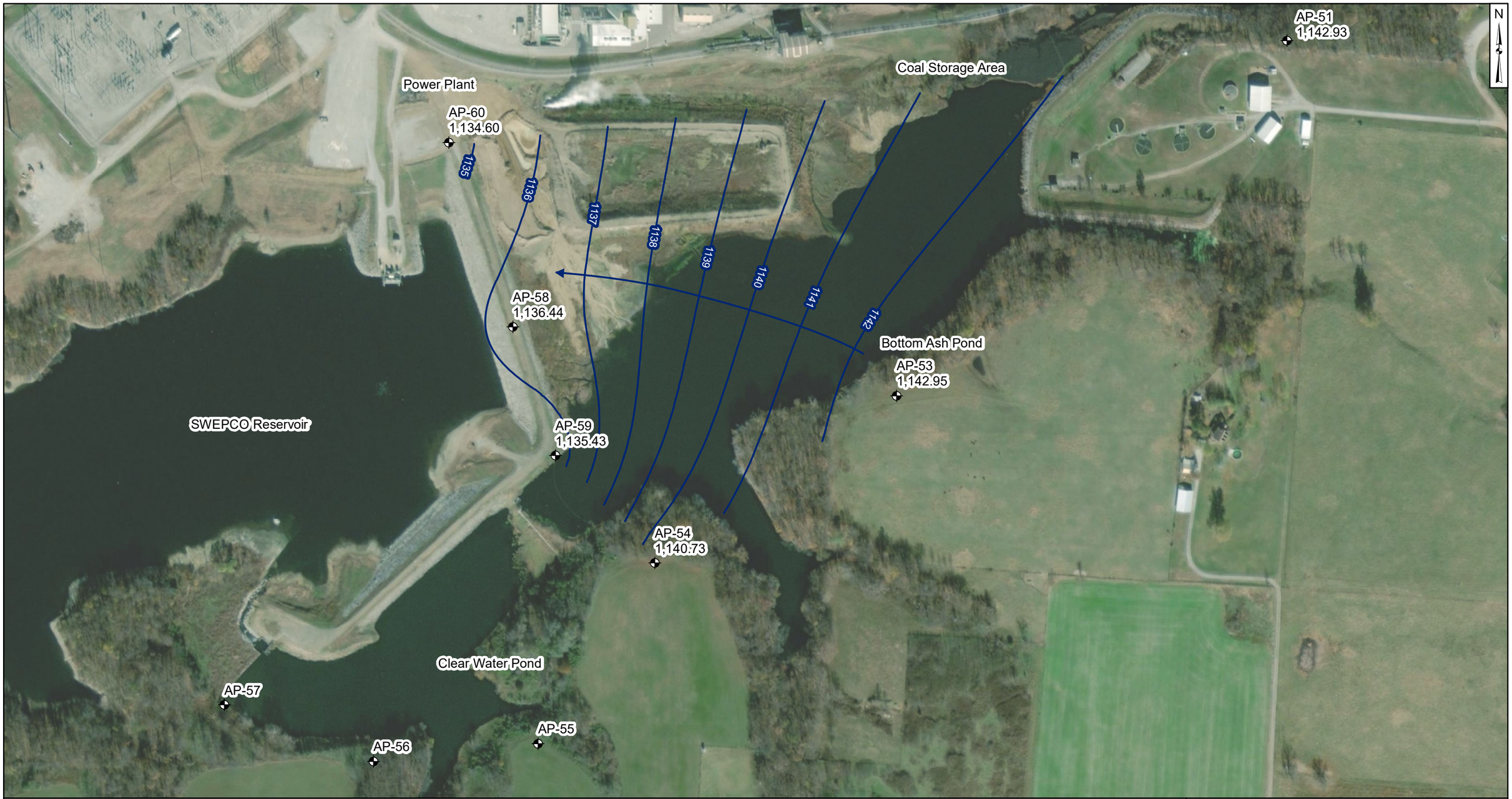

Legend

- Monitoring Wells
- Groundwater Contour Elevation
- Groundwater Flow Direction

Notes

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

200 100 0 200 Feet

Potentiometric Surface Map
Uppermost Aquifer - August 2018

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

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Figure **X**

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Legend

- Monitoring Wells
- Groundwater Contour Elevation
- Groundwater Flow Direction

Notes

- Monitoring well coordinates and water level data were collected March 11-12, 2019, provided by AEP.
- Site features are based on information available in the Groundwater Monitoring Well Network Evaluation (Terracon, 2017) provided by AEP.
- Groundwater elevation units are feet above mean sea level.

200 100 0 200 Feet

Potentiometric Surface Map
Uppermost Aquifer - March 2019

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

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Figure **X**

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Legend

- Monitoring Wells
- Groundwater Contour Elevation
- Groundwater Flow Direction

Notes

- Monitoring well coordinates and water level data were collected August 27-28, 2019 provided by AEP.
- Site features are based on information available in the Groundwater Monitoring Well Network Evaluation (Terracon, 2017) provided by AEP.
- Groundwater elevation units are feet above mean sea level.
- AP-55, AP-56, and AP-57 were not gauged in August 2019.

200 100 0 200 Feet

Potentiometric Surface Map
Uppermost Aquifer - August 2019

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

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Figure **X**

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

Geosyntec Consultants, Inc.

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

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

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

Geosyntec Consultants, Inc.

			2019-03		2019-08	
CCR Management Unit	Monitoring Well	Well Diameter (inches)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Primary Bottom Ash Pond	AP-51 [1]	2.0	61	1.0	62	1.0
	AP-53 [1]	2.0	184	0.3	177	0.3
	AP-54 [1]	2.0	476	0.1	378	0.2
	AP-58 [2]	2.0	128	0.5	137	0.4
	AP-59 [2]	2.0	463	0.1	447	0.1
	AP-60 [2],[3]	2.0	160	0.4	137	0.4

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

Table 1 - Groundwater Data Summary: AP-51
Flint Creek - PBAP
Appendix III Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/24/2016	Background	0.01	4.86	4	<0.083 U	4.6	61	2
7/18/2016	Background	0.01	5.07	6	<0.083 U	5.3	80	4
9/13/2016	Background	0.01	5.84	6	<0.083 U	5.3	64	3
10/5/2016	Background	0.00767833 J	5.24	7	<0.083 U	5.0	80	4
11/8/2016	Background	0.01	5.23	7	<0.083 U	5.2	76	4
1/24/2017	Background	0.00849011 J	5.43	5	<0.083 U	5.1	80	<0.14 U
3/7/2017	Background	0.01	5.05	5	<0.083 U	5.0	40	0.5139 J
4/26/2017	Background	0.01475	4.21	6	0.28 J	5.2	96	6
5/16/2017	Background	0.01135	5.55	6	<0.083 U	5.1	60	3
6/16/2017	Background	0.0186	5.61	7	<0.083 U	5.1	68	3
8/29/2017	Detection	0.01706	5.13	6	<0.083 U	4.8	50	3
3/28/2018	Detection	0.01519	11.1	2	<0.083 U	7.8	96	9
8/28/2018	Detection	0.011	6.69	- -	- -	7.7	74	- -
10/22/2018	Detection	- -	- -	9.71	<0.083 U	- -	- -	2.14
3/11/2019	Detection	0.01 J	6.20	7.84	0.04 J	7.6	70	<0.06 U
6/10/2019	Detection	<0.04 U	13.1	7.79	0.05 J	7.2	106	2.6
8/28/2019	Detection	<0.02 U	6.79	7	<0.083 U	6.0	56	1

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: AP-51
Flint Creek - PBAP
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
5/24/2016	Background	<0.93 U	<1.05 U	80	0.257631 J	0.0935902 J	0.258389 J	0.434643 J	1.063	<0.083 U	<0.68 U	<0.00013 U	0.01938 J	0.92212 J	1.24502 J	<0.86 U
7/18/2016	Background	<0.93 U	<1.05 U	86	0.308658 J	<0.07 U	1	2.39535 J	- -	<0.083 U	0.839767 J	0.003	0.01329 J	<0.29 U	<0.99 U	<0.86 U
9/13/2016	Background	<0.93 U	<1.05 U	128	0.373982 J	<0.07 U	6	14	2.38	<0.083 U	3.72318 J	0.005	0.00978 J	<0.29 U	<0.99 U	<0.86 U
10/5/2016	Background	<0.93 U	<1.05 U	98	0.329677 J	<0.07 U	2	5	1.656	<0.083 U	1.49287 J	0.008	<0.005 U	<0.29 U	<0.99 U	<0.86 U
11/8/2016	Background	1.28923 J	<1.05 U	105	0.453846 J	0.226326 J	4	9	1.387	<0.083 U	2.07767 J	0.004	0.00949 J	<0.29 U	<0.99 U	<0.86 U
1/24/2017	Background	<0.93 U	<1.05 U	103	0.366323 J	<0.07 U	2	4.46068 J	1.916	<0.083 U	<0.68 U	0.003	<0.005 U	<0.29 U	<0.99 U	<0.86 U
3/7/2017	Background	7.00	<1.05 U	95	0.355243 J	0.128375 J	2	5	1.31	<0.083 U	0.88397 J	0.002	<0.005 U	0.586637 J	<0.99 U	<0.86 U
4/26/2017	Background	<0.93 U	<1.05 U	62.43	0.24 J	<0.07 U	1.96	4.08 J	0.6089	0.28 J	<0.68 U	0.00216	<0.005 U	<0.29 U	<0.99 U	<0.86 U
5/16/2017	Background	<0.93 U	<1.05 U	101	0.42 J	0.1 J	1.86	6.92	2.935	<0.083 U	<0.68 U	0.00315	<0.005 U	<0.29 U	<0.99 U	<0.86 U
6/16/2017	Background	<0.93 U	2.5 J	88.87	0.27 J	<0.07 U	0.89 J	5.26	1.728	<0.083 U	<0.68 U	0.0024	<0.005 U	<0.29 U	<0.99 U	<0.86 U

Notes:
µg/L: micrograms 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
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AP-53
Flint Creek - PBAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/24/2016	Background	0.11	4.15	10	<0.083 U	4.7	80	25
7/18/2016	Background	0.109	3.49	12	<0.083 U	4.5	104	30
9/13/2016	Background	0.155	5.54	13	<0.083 U	4.7	104	35
10/5/2016	Background	0.121	3.39	13	0.205 J	4.9	110	32
11/8/2016	Background	0.138	3.38	14	<0.083 U	5.0	118	31
1/24/2017	Background	0.158	3.87	14	<0.083 U	5.0	132	47
3/7/2017	Background	0.137	3.85	13	<0.083 U	5.0	112	47
4/26/2017	Background	0.124	3.89	15	<0.083 U	5.6	200	48
5/16/2017	Background	0.118	3.46	14	<0.083 U	4.5	90	42
6/16/2017	Background	0.122	3.39	14	<0.083 U	5.0	136	38
8/29/2017	Detection	0.114	2.82	11	<0.083 U	4.8	92	34
3/28/2018	Detection	0.115	3.51	12	<0.083 U	5.0	114	43
8/28/2018	Detection	0.124	3.37	- -	- -	5.6	120	- -
10/22/2018	Detection	- -	- -	19.2	<0.083 U	- -	- -	45
3/11/2019	Detection	0.114	3.09	12.3	0.07 J	5.2	130	34.6
6/10/2019	Detection	0.110	3.37	13.4	0.06	5.2	98	32.8
8/28/2019	Detection	0.083	3.11	8	<0.083 U	5.4	96	21

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: AP-53
Flint Creek - PBAP
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
5/24/2016	Background	<0.93 U	6	142	1	0.585577 J	37	12	3.55	<0.083 U	11	0.006	0.159	2.50374 J	<0.99 U	<0.86 U
7/18/2016	Background	<0.93 U	2.79903 J	76	0.473295 J	0.0914021 J	7	4.26267 J	- -	<0.083 U	1.07393 J	0.004	0.046	0.344001 J	1.20159 J	<0.86 U
9/13/2016	Background	<0.93 U	24	258	3	1	94	27	5.93	<0.083 U	30	0.036	0.085	6	<0.99 U	0.981236 J
10/5/2016	Background	<0.93 U	<1.05 U	63	0.289207 J	<0.07 U	2	3.26642 J	0.568	0.205 J	<0.68 U	0.009	0.025	<0.29 U	<0.99 U	<0.86 U
11/8/2016	Background	<0.93 U	8	122	0.980287 J	3	26	13	2.06	<0.083 U	8	0.01	0.118	1.0939 J	<0.99 U	<0.86 U
1/24/2017	Background	1.37199 J	3.86298 J	97	0.663471 J	0.0732158 J	16	9	2.16	<0.083 U	3.91103 J	0.006	0.183	0.821188 J	<0.99 U	<0.86 U
3/7/2017	Background	1.45983 J	7	110	0.851036 J	0.485904 J	21	15	1.915	<0.083 U	8	0.007	0.14	1.44927 J	<0.99 U	<0.86 U
4/26/2017	Background	1.23 J	4.82 J	102	0.61 J	0.22 J	15.41	7.89	1.552	<0.083 U	4.13 J	0.00623	<0.005 U	0.96 J	2.14 J	<0.86 U
5/16/2017	Background	1.95 J	1.53 J	64.08	0.33 J	<0.07 U	3.01	2.9 J	1.327	<0.083 U	<0.68 U	0.00228	0.04	0.31 J	<0.99 U	<0.86 U
6/16/2017	Background	1.15 J	3.1 J	71.32	0.41 J	<0.07 U	5.78	3 J	2.139	<0.083 U	0.87 J	0.00357	0.043	<0.29 U	<0.99 U	<0.86 U

Notes:
µg/L: micrograms 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
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AP-54
Flint Creek - PBAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/24/2016	Background	0.249	10.4	14	<0.083 U	5.8	180	77
7/18/2016	Background	0.255	10	16	<0.083 U	5.8	178	78
9/13/2016	Background	0.266	10.6	16	<0.083 U	5.6	172	75
10/5/2016	Background	0.255	11.8	15	0.1943 J	5.5	164	67
11/8/2016	Background	0.26	11.3	15	<0.083 U	5.7	168	71
1/24/2017	Background	0.284	11.2	14	<0.083 U	5.5	164	71
3/7/2017	Background	0.259	11.3	14	<0.083 U	5.4	150	64
4/26/2017	Background	0.256	10.8	15	<0.083 U	6.1	154	66
5/16/2017	Background	0.256	9.58	16	<0.083 U	5.1	136	66
6/16/2017	Background	0.249	7.53	15	<0.083 U	5.3	192	62
8/29/2017	Detection	0.259	11.3	13	<0.083 U	5.5	156	63
3/28/2018	Detection	0.223	5.61	13	<0.083 U	5.3	130	64
8/28/2018	Detection	0.240	15.5	- -	- -	5.9	168	- -
10/22/2018	Detection	- -	- -	18.3	<0.083 U	- -	- -	54.4
3/11/2019	Detection	0.219	14.5	16.0	0.09 J	6.4	160	47.2
6/10/2019	Detection	0.209	10.7	15.3	0.07	6.5	134	52.5
8/28/2019	Detection	0.213	12.2	12	<0.083 U	6.8	154	51

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: AP-54
Flint Creek - PBAP
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
5/24/2016	Background	<0.93 U	<1.05 U	35	0.177109 J	<0.07 U	0.485517 J	7	1	<0.083 U	<0.68 U	0.000736668 J	0.02407 J	<0.29 U	<0.99 U	1.05347 J
7/18/2016	Background	<0.93 U	<1.05 U	58	0.294165 J	<0.07 U	1	13	- -	<0.083 U	<0.68 U	0.001	0.031	<0.29 U	<0.99 U	<0.86 U
9/13/2016	Background	<0.93 U	<1.05 U	38	0.0361596 J	<0.07 U	0.470668 J	7	3.37	<0.083 U	<0.68 U	0.000599096 J	0.0122 J	<0.29 U	<0.99 U	<0.86 U
10/5/2016	Background	<0.93 U	<1.05 U	35	0.175329 J	<0.07 U	1	6	1.59	0.1943 J	<0.68 U	0.006	0.02499 J	<0.29 U	1.26436 J	<0.86 U
11/8/2016	Background	<0.93 U	1.8333 J	227	0.250807 J	0.164026 J	9	19	1.722	<0.083 U	1.30257 J	0.002	0.049	1.06052 J	<0.99 U	<0.86 U
1/24/2017	Background	<0.93 U	4.57372 J	109	0.660002 J	0.132116 J	25	24	1.107	<0.083 U	7	0.006	0.082	3.34504 J	<0.99 U	<0.86 U
3/7/2017	Background	<0.93 U	<1.05 U	96	0.164735 J	<0.07 U	4	12	2.125	<0.083 U	<0.68 U	0.003	0.00568 J	0.545312 J	<0.99 U	<0.86 U
4/26/2017	Background	<0.93 U	<1.05 U	31.04	0.1 J	<0.07 U	0.42 J	4.4 J	0.769	<0.083 U	<0.68 U	0.00048 J	0.017 J	<0.29 U	<0.99 U	<0.86 U
5/16/2017	Background	<0.93 U	<1.05 U	34.92	0.16 J	<0.07 U	0.44 J	5.33	1.222	<0.083 U	<0.68 U	0.00078 J	0.02 J	<0.29 U	<0.99 U	<0.86 U
6/16/2017	Background	5.57	1.65 J	46.98	0.28 J	<0.07 U	0.53 J	7.14	1.325	<0.083 U	<0.68 U	0.00127	0.018 J	<0.29 U	<0.99 U	<0.86 U

Notes:
µg/L: micrograms 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
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AP-58
Flint Creek - PBAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/24/2016	Background	1.44	24.9	18	0.8759 J	7.1	602	213
7/18/2016	Background	1.68	27.4	21	0.8849 J	8.4	691	229
9/13/2016	Background	1.66	17.5	23	0.7518 J	8.3	644	238
10/5/2016	Background	1.56	18.9	27	0.8942 J	8.8	696	231
11/7/2016	Background	1.26	30.5	22	0.5598 J	7.8	562	186
1/24/2017	Background	1.09	34.4	16	<0.083 U	8.1	448	158
3/7/2017	Background	0.829	48.1	14	<0.083 U	7.0	420	123
4/26/2017	Background	0.613	59	14	0.53 J	7.1	374	111
5/16/2017	Background	0.473	69.3	13	0.4677 J	7.5	344	104
6/16/2017	Background	0.416	70.1	12	<0.083 U	6.0	398	101
8/29/2017	Detection	0.333	75.5	12	<0.083 U	7.8	344	96
12/21/2017	Detection	0.268	73.9	- -	- -	7.4	304	80
3/26/2018	Detection	0.228	77.2	8	<0.083 U	7.4	262	70
8/28/2018	Detection	0.237	75.9	- -	- -	6.9	300	- -
10/23/2018	Detection	- -	- -	12.5	<0.083 U	- -	- -	75.5
3/12/2019	Detection	0.178	74.8	8.13	0.33	8.4	290	49.9
6/11/2019	Detection	0.173	78.3	7.64	0.36	7.6	272	52.2
8/27/2019	Detection	0.149	76.1	6	0.222 J	7.5	292	53

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: AP-58
Flint Creek - PBAP
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
5/24/2016	Background	<0.93 U	5	37	0.105636 J	<0.07 U	0.810009 J	3.86496 J	0.548	0.8759 J	<0.68 U	<0.00013 U	0.032	62	<0.99 U	<0.86 U
7/18/2016	Background	<0.93 U	22	104	3	0.459763 J	8	7	- -	0.8849 J	12	0.018	0.042	66	2.81093 J	<0.86 U
9/13/2016	Background	0.971405 J	25	39	0.162863 J	<0.07 U	2	2.29869 J	1.007	0.7518 J	2.19582 J	0.007	0.02274 J	68	1.13435 J	1.02461 J
10/5/2016	Background	1.99545 J	18	41	0.382276 J	<0.07 U	3	2.68738 J	0.787	0.8942 J	1.93685 J	0.017	<0.005 U	63	2.55318 J	<0.86 U
11/7/2016	Background	<0.93 U	14	41	0.108253 J	<0.07 U	1	1.28551 J	1.65	0.5598 J	<0.68 U	0.008	0.00775 J	44	<0.99 U	<0.86 U
1/24/2017	Background	<0.93 U	11	56	0.0635907 J	<0.07 U	2	1.8255 J	1.896	<0.083 U	<0.68 U	0.009	0.00625 J	39	<0.99 U	<0.86 U
3/7/2017	Background	<0.93 U	8	42	0.0245 J	<0.07 U	1	1.05431 J	0.938	<0.083 U	0.928114 J	0.015	<0.005 U	26	<0.99 U	<0.86 U
4/26/2017	Background	<0.93 U	6.14	49.86	0.09 J	<0.07 U	1.57	1.36 J	1.163	0.53 J	<0.68 U	0.01194	0.006 J	16.9	<0.99 U	<0.86 U
5/16/2017	Background	<0.93 U	4.32 J	43.08	0.03 J	<0.07 U	0.75 J	0.87 J	0.663	0.4677 J	<0.68 U	0.01188	<0.005 U	14.05	<0.99 U	<0.86 U
6/16/2017	Background	2.16 J	2.71 J	41.48	0.03 J	<0.07 U	0.58 J	0.57 J	2.268	<0.083 U	<0.68 U	0.01182	<0.005 U	12.23	<0.99 U	<0.86 U

Notes:
µg/L: micrograms 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
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AP-59
Flint Creek - PBAP
Appendix III Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
5/24/2016	Background	0.25	39.3	19	0.7409 J	7.4	240	37
7/18/2016	Background	0.339	38	14	0.6517 J	6.8	220	27
9/13/2016	Background	0.38	36.5	13	0.583 J	7.3	216	25
10/5/2016	Background	0.347	34.6	14	0.7085 J	7.1	220	26
11/7/2016	Background	0.323	35.6	15	0.5832 J	7.2	216	32
1/24/2017	Background	0.317	38.4	13	<0.083 U	7.0	240	40
3/7/2017	Background	0.253	42	13	<0.083 U	7.9	236	43
4/26/2017	Background	0.222	41.4	15	0.61 J	7.2	226	40
5/16/2017	Background	0.208	39.5	13	0.5762 J	7.1	186	38
6/16/2017	Background	0.227	36.2	12	<0.083 U	6.7	224	31
8/29/2017	Detection	0.295	35.4	12	0.6463 J	7.1	210	21
12/21/2017	Detection	0.279	46.8	- -	- -	6.9	228	- -
3/26/2018	Detection	0.218	43.2	12	<0.083 U	7.0	180	40
8/28/2018	Detection	0.277	42.2	- -	- -	7.1	180	- -
10/23/2018	Detection	- -	- -	19	0.548 J	- -	- -	26.7
3/11/2019	Detection	0.221	45.2	15.0	0.59	7.4	46	35.5
6/11/2019	Detection	0.233	46.7	14.7	0.65	7.3	88	38.4
7/9/2019	Detection	- -	45.3	- -	- -	7.0	- -	- -
8/27/2019	Detection	0.246	42.6	11	0.413 J	8.9	228	26

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: AP-59
Flint Creek - PBAP
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
5/24/2016	Background	<0.93 U	<1.05 U	67	<0.02 U	<0.07 U	0.583478 J	2.01538 J	0.711	0.7409 J	<0.68 U	0.000378518 J	0.029	7	<0.99 U	1.24044 J
7/18/2016	Background	<0.93 U	<1.05 U	72	0.0339425 J	<0.07 U	3	2.54042 J	- -	0.6517 J	1.02999 J	0.000590098 J	0.035	9	<0.99 U	1.07757 J
9/13/2016	Background	<0.93 U	<1.05 U	82	<0.02 U	<0.07 U	<0.23 U	2.3351 J	0.725	0.583 J	<0.68 U	0.000162193 J	<0.005 U	9	<0.99 U	1.01454 J
9/14/2016	Background	- -	- -	- -	- -	- -	- -	- -	1.288	- -	- -	- -	- -	- -	- -	- -
10/5/2016	Background	<0.93 U	<1.05 U	89	<0.02 U	<0.07 U	0.300781 J	2.72689 J	0.725	0.7085 J	<0.68 U	0.011	<0.005 U	8	<0.99 U	1.63378 J
11/7/2016	Background	<0.93 U	<1.05 U	93	<0.02 U	<0.07 U	<0.23 U	3.0738 J	1.109	0.5832 J	<0.68 U	0.00039204 J	<0.005 U	8	<0.99 U	<0.86 U
1/24/2017	Background	<0.93 U	<1.05 U	107	<0.02 U	<0.07 U	<0.23 U	3.38517 J	0.3279	<0.083 U	<0.68 U	0.000152708 J	<0.005 U	8	<0.99 U	1.21456 J
3/7/2017	Background	<0.93 U	<1.05 U	96	<0.02 U	<0.07 U	0.244944 J	3.32152 J	0.713	<0.083 U	<0.68 U	0.006	<0.005 U	7	<0.99 U	<0.86 U
4/26/2017	Background	<0.93 U	1.58 J	104	<0.02 U	<0.07 U	<0.23 U	3.36 J	1.319	0.61 J	<0.68 U	0.00026 J	<0.005 U	5.33	<0.99 U	<0.86 U
5/16/2017	Background	<0.93 U	<1.05 U	93.9	<0.02 U	<0.07 U	<0.23 U	3 J	0.618	0.5762 J	<0.68 U	0.00033 J	0.006 J	5.66	<0.99 U	1.09 J
6/16/2017	Background	<0.93 U	1.96 J	86.79	<0.02 U	<0.07 U	<0.23 U	2.83 J	2.251	<0.083 U	<0.68 U	0.00021 J	<0.005 U	6.4	<0.99 U	<0.86 U
3/26/2018	Detection	1.79 J	3.19 J	105	<0.02 U	<0.07 U	0.63 J	3.84 J	1.044	<0.083 U	0.98 J	0.00036 J	<0.005 U	4.68 J	<0.99 U	<0.86 U

Notes:
µg/L: micrograms 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
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: AP-60
Flint Creek - PBAP
Appendix III Constituents

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
12/19/2016	Background	1.4	16.7	14	0.0946 J	8.9	369	165
1/24/2017	Background	1.12	33.2	13	<0.083 U	7.8	356	152
3/7/2017	Background	1.26	25.9	12	<0.083 U	8.1	340	145
3/29/2017	Background	1.14	43	13	<0.083 U	8.4	368	140
4/26/2017	Background	1.3	25	15	0.58 J	7.6	340	160
5/16/2017	Background	1.41	16.3	14	0.558 J	8.6	302	167
6/16/2017	Background	1.2	29.2	15	<0.083 U	7.8	368	152
6/28/2017	Background	1.35	17.7	16	0.5516 J	7.5	368	166
8/29/2017	Detection	1.13	32.3	13	0.4518 J	7.7	356	146
12/21/2017	Detection	0.857	46.2	- -	- -	7.2	332	128
3/26/2018	Detection	0.645	45.5	9	<0.083 U	8.6	284	113
8/28/2018	Detection	1.27	31.1	- -	- -	7.8	276	- -
10/23/2018	Detection	- -	- -	15.7	<0.083 U	- -	- -	135
3/11/2019	Detection	0.728	21.2	11.0	0.31	10.9	310	114
6/11/2019	Detection	0.559	3.44	9.79	0.29	10.0	304	108
7/9/2019	Detection	- -	- -	- -	- -	7.7	- -	- -
8/27/2019	Detection	0.756	10.7	8	0.2 J	10.9	330	99

Notes:
mg/L: milligrams per liter
SU: standard unit
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J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: AP-60
Flint Creek - PBAP
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
12/19/2016	Background	<0.93 U	9	17	0.0543046 J	<0.07 U	2	1.92133 J	1.176	0.0946 J	0.742652 J	0.001	<0.005 U	60	<0.99 U	<0.86 U
1/24/2017	Background	1.34724 J	3.61807 J	34	<0.02 U	<0.07 U	0.502321 J	0.87237 J	0.771	<0.083 U	<0.68 U	0.000637932 J	<0.005 U	55	<0.99 U	<0.86 U
3/7/2017	Background	<0.93 U	9	15	<0.02 U	<0.07 U	0.297514 J	0.458637 J	1.121	<0.083 U	<0.68 U	0.003	<0.005 U	57	<0.99 U	<0.86 U
3/29/2017	Background	<0.93 U	7	41	0.023217 J	<0.07 U	3	2.22346 J	1.158	<0.083 U	1.84769 J	0.002	0.00961 J	53	<0.99 U	<0.86 U
4/26/2017	Background	<0.93 U	11.42	24.03	0.12 J	<0.07 U	3.75	3.01 J	0.429	0.58 J	2.91 J	0.00236	0.01 J	56.38	<0.99 U	0.98 J
5/16/2017	Background	1 J	11.39	13.05	0.03 J	<0.07 U	0.91 J	0.66 J	2.082	0.558 J	<0.68 U	0.00048 J	0.009 J	62.09	<0.99 U	<0.86 U
6/16/2017	Background	<0.93 U	7.69	27.23	<0.02 U	<0.07 U	<0.23 U	0.42 J	3.697	<0.083 U	<0.68 U	0.00063 J	<0.005 U	54.18	<0.99 U	<0.86 U
6/28/2017	Background	<0.93 U	9.32	12.61	<0.02 U	<0.07 U	0.37 J	0.37 J	7.167	0.5516 J	<0.68 U	0.00031 J	0.006 J	63.76	<0.99 U	<0.86 U

Notes:
µg/L: micrograms per liter
SU: standard unit
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J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

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.

Geosyntec consultants

941 Chatham Lane, Suite 103
Columbus, Ohio 43212
PH 614.468.0415
FAX 614.468.0416
www.geosyntec.com

Memorandum

Date:	January 11, 2019
To:	David Miller (AEP)
Copies to:	Terence Wehling (AEP)
From:	Allison Kreinberg and Bruce Sass, Ph.D. (Geosyntec)
Subject:	Evaluation of Detection Monitoring Data at Flint Creek Plant's Primary Bottom Ash Pond (PBAP)

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257.90-257.98, "CCR rule"), a detection monitoring event was completed on March 26, 2018 at the Primary Bottom Ash Pond (PBAP), an existing CCR unit at the Flint Creek Power Plant located in Gentry, Arkansas.

Ten background monitoring events were conducted at the Flint Creek PBAP prior to these detection monitoring events, and upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. 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 15, 2018. An alternative source demonstration (ASD) was certified on April 3, 2018 which resulted in a revision to the calculated prediction limits for all Appendix III parameters.

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. Because the initial result did not exceed the UPL, a second sample was not required.

Detection monitoring results and the relevant background values are summarized in Table 1. No SSIs were observed at the Flint Creek PBAP CCR unit, and as a result the Flint Creek PBAP 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 Evaluation
Flint Creek Plant - PBAP

Geosyntec Consultants, Inc.

Parameter	Units	Description	AP-58	AP-59	AP-60
			3/26/2018	3/26/2018	3/26/2018
Boron	mg/L	Intrawell Background Value (UPL)	2.20	0.424	1.55
		Detection Monitoring Data	0.228	0.218	0.645
Calcium	mg/L	Intrawell Background Value (UPL)	85.1	43.6	48.7
		Detection Monitoring Data	77.2	43.2	45.5
Chloride	mg/L	Intrawell Background Value (UPL)	29	19	17
		Detection Monitoring Data	8	12	9
Fluoride	mg/L	Intrawell Background Value (UPL)	1.09	0.774	0.95
		Detection Monitoring Data	0.083	0.083	0.083
pH	SU	Intrawell Background Value (UPL)	9.42	7.91	9.26
		Intrawell Background Value (LPL)	5.78	6.41	6.90
		Detection Monitoring Data	7.41	7.04	8.62
Sulfate	mg/L	Intrawell Background Value (UPL)	296	49	181
		Detection Monitoring Data	70	40	113
TDS	mg/L	Intrawell Background Value (UPL)	822	258	409
		Detection Monitoring Data	262	180	284

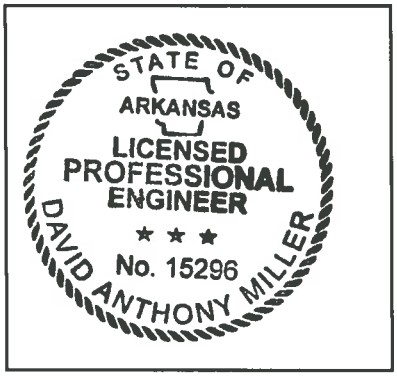
Notes
UPL: Upper prediction limit
LPL: Lower prediction limit
TDS: Total dissolved solids
Bold values exceed the background value.
Background values are shaded gray.

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 15, 2018 *Statistical Analysis Summary* report, is appropriate for evaluating the groundwater monitoring data for the Flint Creek PBAP CCR management area and that the requirements of 40 CFR 257.93(f) have been met.



DAVID ANTHONY MILLER

Printed Name of Licensed Professional Engineer

David Anthony Miller

Signature

15296	ARKANSAS	01.17.19
License Number	Licensing State	Date

Geosyntec consultants

941 Chatham Lane, Suite 103
Columbus, Ohio 43212
PH 614.468.0415
FAX 614.468.0416
www.geosyntec.com

Memorandum

Date:	February 8, 2019
To:	David Miller (AEP)
Copies to:	Terence Wehling (AEP)
From:	Allison Kreinberg and Bruce Sass, Ph.D. (Geosyntec)
Subject:	Evaluation of Detection Monitoring Data at Flint Creek Plant's Primary Bottom Ash Pond (PBAP)

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257 Subpart D, "CCR rule"), a detection monitoring event was completed on August 28, 2018 at the Primary Bottom Ash Pond (PBAP), an existing CCR unit at the Flint Creek Power Plant located in Gentry, Arkansas. Because the sample analyses for chloride, fluoride, and sulfate were completed out of past holding time, resampling was completed on October 22, 2018.

Ten background monitoring events were conducted at the Flint Creek PBAP prior to these detection monitoring events, and upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. 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 15, 2018. An alternative source demonstration (ASD) was certified on April 3, 2018 which resulted in a revision to the calculated prediction limits for all Appendix III parameters.

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. Because the initial result did not exceed the UPL, a second sample was not required.

Detection monitoring results and the relevant background values are summarized in Table 1. No SSIs were observed at the Flint Creek PBAP CCR unit, and as a result the Flint Creek PBAP 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 Evaluation
Flint Creek Plant - Primary Bottom Ash Pond

Geosyntec Consultants, Inc.

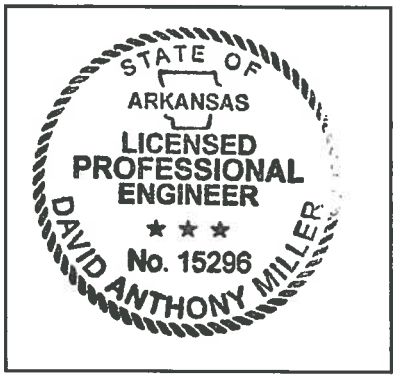
Parameter	Units	Description	AP-58	AP-59	AP-60
			10/22/2018	10/22/2018	10/22/2018
Boron	mg/L	Intrawell Background Value (UPL)	2.20	0.424	1.55
		Detection Monitoring Result	0.237	0.277	1.27
Calcium	mg/L	Intrawell Background Value (UPL)	85.1	43.6	48.7
		Detection Monitoring Result	76	42	31.1
Chloride	mg/L	Intrawell Background Value (UPL)	29	19	17
		Detection Monitoring Result	13	19	16
Fluoride	mg/L	Intrawell Background Value (UPL)	1.09	0.774	0.950
		Detection Monitoring Result	<0.083	0.548	<0.083
pH	SU	Intrawell Background Value (UPL)	9.42	7.91	9.26
		Intrawell Background Value (LPL)	5.78	6.41	6.90
		Detection Monitoring Result	6.90	7.07	7.76
Sulfate	mg/L	Intrawell Background Value (UPL)	296	49	181
		Detection Monitoring Result	76	27	135
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	822	258	409
		Detection Monitoring Result	300	180	276

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
Bold values exceed the background value.
Background values are shaded gray.
Chloride, Fluoride, and Sulfate parameters analyzed on October 22, 2018, all other Appendix III parameters analyzed on August 28, 2018
Based on a 1-of-2 resampling, a statistically significant increase (SSI) is only identified when both samples in the detection monitoring period are above the calculated background value.

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 15, 2018 *Statistical Analysis Summary* report, is appropriate for evaluating the groundwater monitoring data for the Flint Creek PBAP CCR management area and that the requirements of 40 CFR 257.93(f) have been met.



DAVID ANTHONY MILLER

Printed Name of Licensed Professional Engineer

David Anthony Miller

Signature

15296	ARKANSAS	02.18.19
License Number	Licensing State	Date

Geosyntec consultants

941 Chatham Lane, Suite 103
Columbus, Ohio 43212
PH 614.468.0415
FAX 614.468.0416
www.geosyntec.com

Memorandum

Date:	August 13, 2019
To:	David Miller (AEP)
Copies to:	Terence Wehling (AEP)
From:	Allison Kreinberg and Bruce Sass, Ph.D. (Geosyntec)
Subject:	Evaluation of Detection Monitoring Data at Flint Creek Plant's Primary Bottom Ash Pond (PBAP)

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257 Subpart D, "CCR rule"), detection monitoring sampling events were completed on March 11-12, 2019 and July 9, 2019 at the Primary Bottom Ash Pond (PBAP), an existing CCR unit at the Flint Creek Power Plant located in Gentry, Arkansas.

Upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values based on the ten background monitoring events conducted prior to October 17, 2017. 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 15, 2018. An alternative source demonstration (ASD) was certified on April 3, 2018 which resulted in a revision to the calculated prediction limits for all Appendix III parameters.

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. For samples where the initial result did not exceed the UPL, a second sample was not required.

Detection monitoring results and the relevant background values are summarized in Table 1. Calcium concentrations exceeded the intrawell UPL of 43.6 mg/L in both the initial (45.2 mg/L) and second (45.3 mg/L) samples collected at AP-59. Therefore, an SSI over background is concluded for calcium at AP-59.

In response to the exceedances noted above, the Flint Creek PBAP CCR unit will either transition to assessment monitoring or an alternate source demonstration for calcium will be conducted.

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 Evaluation
Flint Creek - Primary Bottom Ash Pond

Geosyntec Consultants, Inc.

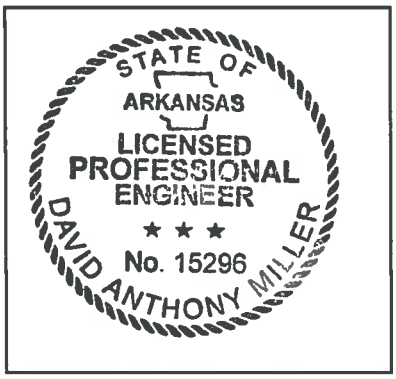
Parameter	Units	Description	AP-58	AP-59		AP-60	
			3/12/2019	3/11/2019	7/9/2019	3/11/2019	7/9/2019
Boron	mg/L	Intrawell Background Value (UPL)	2.20	0.424		1.55	
		Detection Monitoring Data	0.178	0.221	--	0.728	--
Calcium	mg/L	Intrawell Background Value (UPL)	85.1	43.6		48.7	
		Detection Monitoring Data	74.8	**45.2**	**45.3**	21.2	--
Chloride	mg/L	Intrawell Background Value (UPL)	29.3	18.5		17.2	
		Detection Monitoring Data	8.13	15.0	--	11.0	--
Fluoride	mg/L	Intrawell Background Value (UPL)	1.09	0.774		0.95	
		Detection Monitoring Data	0.33	0.59	--	0.31	--
pH	SU	Intrawell Background Value (UPL)	9.4	7.9		9.3	
		Intrawell Background Value (LPL)	5.8	6.4		6.9	
		Detection Monitoring Data	8.4	7.4	**--**	**10.9**	7.0
Sulfate	mg/L	Intrawell Background Value (UPL)	296	48.5		181	
		Detection Monitoring Data	49.9	35.5	--	114	--
TDS	mg/L	Intrawell Background Value (UPL)	822	258		409	
		Detection Monitoring Data	264	232	--	300	--

Notes
UPL: Upper prediction limit
LPL: Lower prediction limit
TDS: Total dissolved solids
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 15, 2018 *Statistical Analysis Summary* report, is appropriate for evaluating the groundwater monitoring data for the Flint Creek PBAP CCR management area and that the requirements of 40 CFR 257.93(f) have been met.



DAVID ANTHONY MILLER

Printed Name of Licensed Professional Engineer

David Anthony Miller

Signature

15296	ARKANSAS	08.13.19
License Number	Licensing State	Date

APPENDIX III

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

ALTERNATIVE SOURCE DEMONSTRATION REPORT FEDERAL CCR RULE

Flint Creek Plant
Primary Bottom Ash Pond
Gentry, Arkansas

Submitted to

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

941 Chatham Lane
Suite 103
Columbus, Ohio 43221

November 8, 2019

CHA8462

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LIST OF ACRONYMS AND ABBREVIATIONS

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

SECTION 1

INTRODUCTION AND SUMMARY

Ten background monitoring events were conducted at the Flint Creek Primary Bottom Ash Pond (PBAP). Upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. A lower prediction limit (LPL) was also calculated for pH. Prediction limits were calculated based on a one-of-two retesting procedure. With this procedure, a statistically significant increase (SSI) is concluded only if both samples in a series of two exceeds the UPL, or in the case of pH is above the LPL. In practice, if the initial result did not result in an exceedance, a second sample was not collected or analyzed.

The first semi-annual detection monitoring event of 2019 was performed in March 2019 (initial sampling event) and July 2019 (verification sampling event), and the results were compared to the calculated prediction limits. An SSI was identified for calcium at well AP-59 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

United States Environmental Protection Agency (USEPA) regulations (USEPA, 2015) regarding detection monitoring programs for coal combustion residuals (CCR) landfills and surface impoundments provide owners and operators with the option to make an alternative source demonstration (ASD) when an SSI is identified (40 CFR 257.94(e)(2)):

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

Calcium concentrations at AP-59 of 45.2 milligrams per liter (mg/L) and 45.3 mg/L were reported for the sampling and re-sampling events on March 11, 2019 and July 9, 2019, respectively. Both concentrations exceeded the UPL of 43.6 mg/L. Pursuant to 40 CFR 257.94(e)(2) of the CCR Rule (40 CFR 257), Geosyntec Consultants, Inc. (Geosyntec) has prepared this Alternative Source Demonstration (ASD) report, which documents that the SSI for calcium at AP-59 should not be attributed to the Flint Creek PBAP.

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 increase in calcium concentration was based on a Type IV cause and not by a release from the Flint Creek PBAP.

SECTION 2

ALTERNATIVE SOURCE DEMONSTRATION

The method used to assess possible alternative sources of the SSI for calcium at AP-59 and the proposed alternative source are described below. In addition, the future sampling requirements for the Flint Creek PBAP are presented.

2.1 Proposed Alternative Source

An initial review of field forms, site geochemistry, and laboratory quality assurance/quality control (QA/QC) data did not identify alternative sources due to Type I or Type II issues. A review of the statistical analyses of the groundwater data for calcium did not identify any Type III issues. However, a review of the geochemistry at the site identified the calcium exceedance at AP-59 as due to natural variation, which is a Type IV issue.

Based on the boring logs and well logs in the groundwater monitoring network report for the PBAP, the site is underlain by weathered residuum of the Boone Formation, which overlies the cherty limestone of the Boone Formation (Terracon, 2017). The report describes the Boone Formation as a gray, crinoidal limestone that is nearly pure calcium carbonate ($CaCO_3$). Well AP-59 is screened from 20 to 30 feet below ground surface (ft bgs), where the boring log noted a heavily weathered limestone (Attachment A).

Groundwater saturation with respect to limestone mineral calcite ($CaCO_3$) was evaluated using the geochemical modeling code PHREEQC. Saturation indices (SI) were calculated for datasets where concentrations for all major cations, anions and pH were available. Model results show that AP-59 groundwater has fluctuated between undersaturated conditions (denoted by SI values below -0.2) and saturated conditions (between -0.2 and 0.2) since monitoring began (Figure 1). Results indicate that AP-59 groundwater was saturated with respect to calcite in March 2017 (SI=0.15) and March 2019 (SI=-0.19) and below saturation at all other sampling events.

Figure 2 shows SI results compared to water level measurements for the same time interval. It appears that higher water levels drive the system toward calcite equilibrium, while falling water levels lead to undersaturation. Mechanistically, as water levels rise, calcite dissolves in order for the system to reach equilibrium from a state of undersaturation, which contributes calcium to the aqueous phase (Garrels and Christ, 1965). This may be brought about by changing contact with more weathered (passivated) limestone at lower elevations and fresher (more reactivated) limestone surfaces at higher elevations. Changes in water levels, and thus calcite saturation, at AP-59 appear to be driven by recharge from precipitation, as shown by the corresponding peaks in groundwater elevation following major rain events in April 2017 and May 2019 (Figure 3).

While natural variation due to changes in water level elevation is identified as the cause of fluctuating calcium concentrations at AP-59, the lack of exceedances for other parameters is further evidence that there has not been a release from the PBAB. If a release had occurred,

groundwater at well AP-59 likely would have experienced a rise in highly mobile constituents such as boron and chloride. However, a review of boron and chloride data show that they have remained stable over time (Figure 4). Likewise, while the calcium concentrations increased in the March and July 2019 events, they do not appear to be part of a longer trend of consistently increasing concentrations (Figure 5). A subsequent sample was collected at AP-59 in August 2019 to serve as the initial sample for the second semiannual detection monitoring event of 2019 at the Flint Creek PBAP. The reported calcium concentration for this sample is 42.6 mg/L, which is below the UPL and provides further evidence that there is not an increasing trend for calcium at AP-59.

Based on the presence of calcite in the aquifer, the lack of other exceedances, and the absence of a positive trend in calcium at AP-59, the observed calcium concentrations during the first semi-annual event are not considered indicative of a release from the Flint Creek PBAP.

2.2 Sampling Requirements

The ASD described above supports the position that the identified SSI is not due to a release from the Flint Creek PBAP. Therefore, the unit will remain in the detection monitoring. Groundwater at the unit will 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 SSIs in Appendix III detection monitoring constituents are not due to a release from the Flint Creek PBAP during the March and July 2019 sampling events. The identified SSI for calcium at well AP-59 was attributed to natural variation. Therefore, no further action is warranted, and the Flint Creek PBAP will remain in the detection monitoring program. Certification of this ASD by a qualified professional engineer is provided in Attachment B.

SECTION 4

REFERENCES

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

Garrels, R. M. and Christ, C. L. 1965. Solutions, minerals, and equilibria. New York, Harper & Row.

Terracon, 2017. Report 1 – Groundwater Monitoring Network for CCR Compliance. SWEPCO – Flint Creek Primary Bottom Ash Pond. October.

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

TABLES

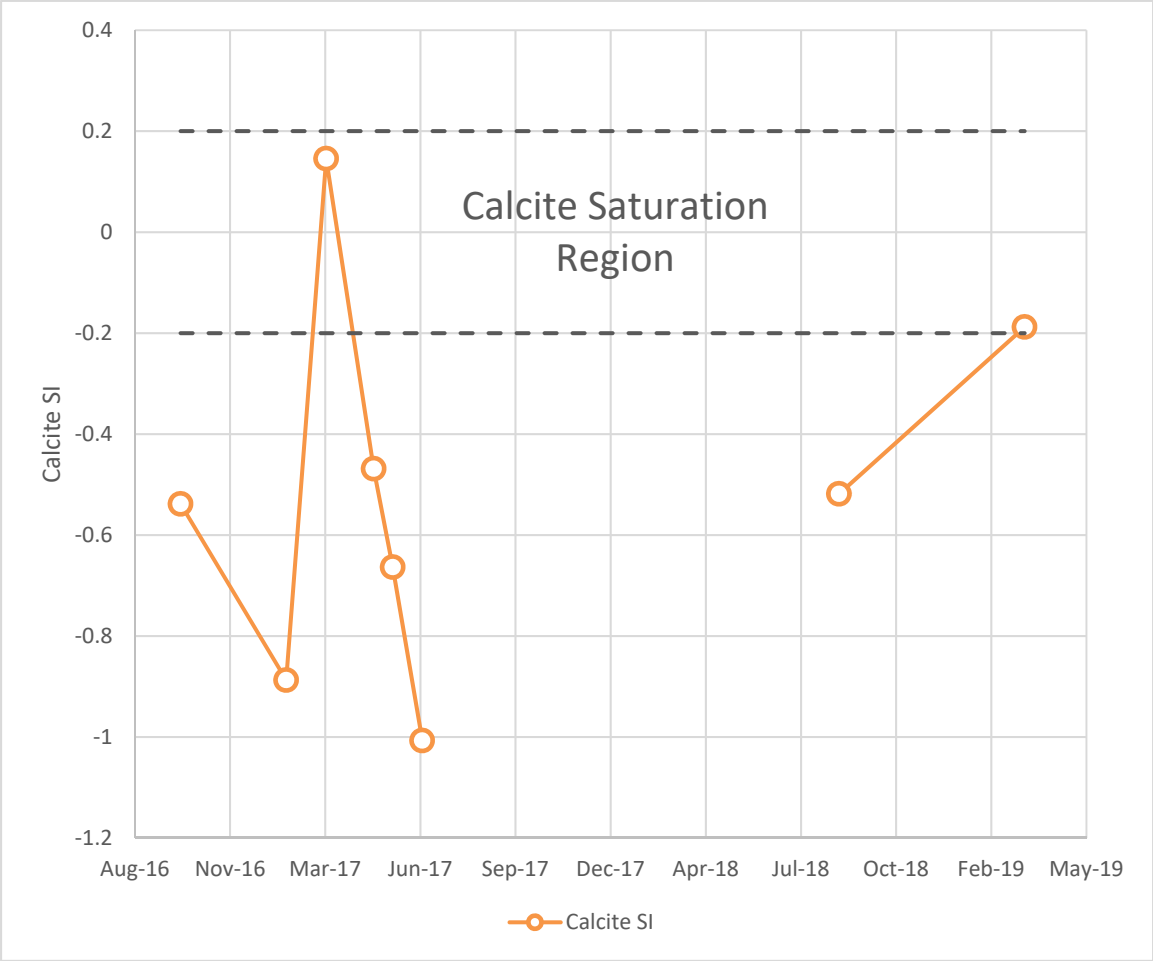
Table 1: Detection Monitoring Data Evaluation
Flint Creek - Primary Bottom Ash Pond

Geosyntec Consultants, Inc.

Parameter	Units	Description	AP-58	AP-59		AP-60	
			3/12/2019	3/11/2019	7/9/2019	3/11/2019	7/9/2019
Boron	mg/L	Intrawell Background Value (UPL)	2.20	0.424		1.55	
		Detection Monitoring Data	0.178	0.221	--	0.728	--
Calcium	mg/L	Intrawell Background Value (UPL)	85.1	43.6		48.7	
		Detection Monitoring Data	74.8	**45.2**	**45.3**	21.2	--
Chloride	mg/L	Intrawell Background Value (UPL)	29.3	18.5		17.2	
		Detection Monitoring Data	8.13	15.0	--	11.0	--
Fluoride	mg/L	Intrawell Background Value (UPL)	1.09	0.774		0.95	
		Detection Monitoring Data	0.33	0.59	--	0.31	--
pH	SU	Intrawell Background Value (UPL)	9.4	7.9		9.3	
		Intrawell Background Value (LPL)	5.8	6.4		6.9	
		Detection Monitoring Data	8.4	7.4	**--**	**10.9**	7.0
Sulfate	mg/L	Intrawell Background Value (UPL)	296	48.5		181	
		Detection Monitoring Data	49.9	35.5	--	114	--
TDS	mg/L	Intrawell Background Value (UPL)	822	258		409	
		Detection Monitoring Data	264	232	--	300	--

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

FIGURES



Notes: Saturation indices were calculated for events where all major cations, anions, and pH data were available. No line is shown between July 2017 and July 2018, as insufficient data were available during this time period. Dashed horizontal lines have values of -0.2 and 0.2, which define a typical range for mineral saturation.

Calcite Saturation Indices at AP-59

Flint Creek PBAP

Geosyntec consultants

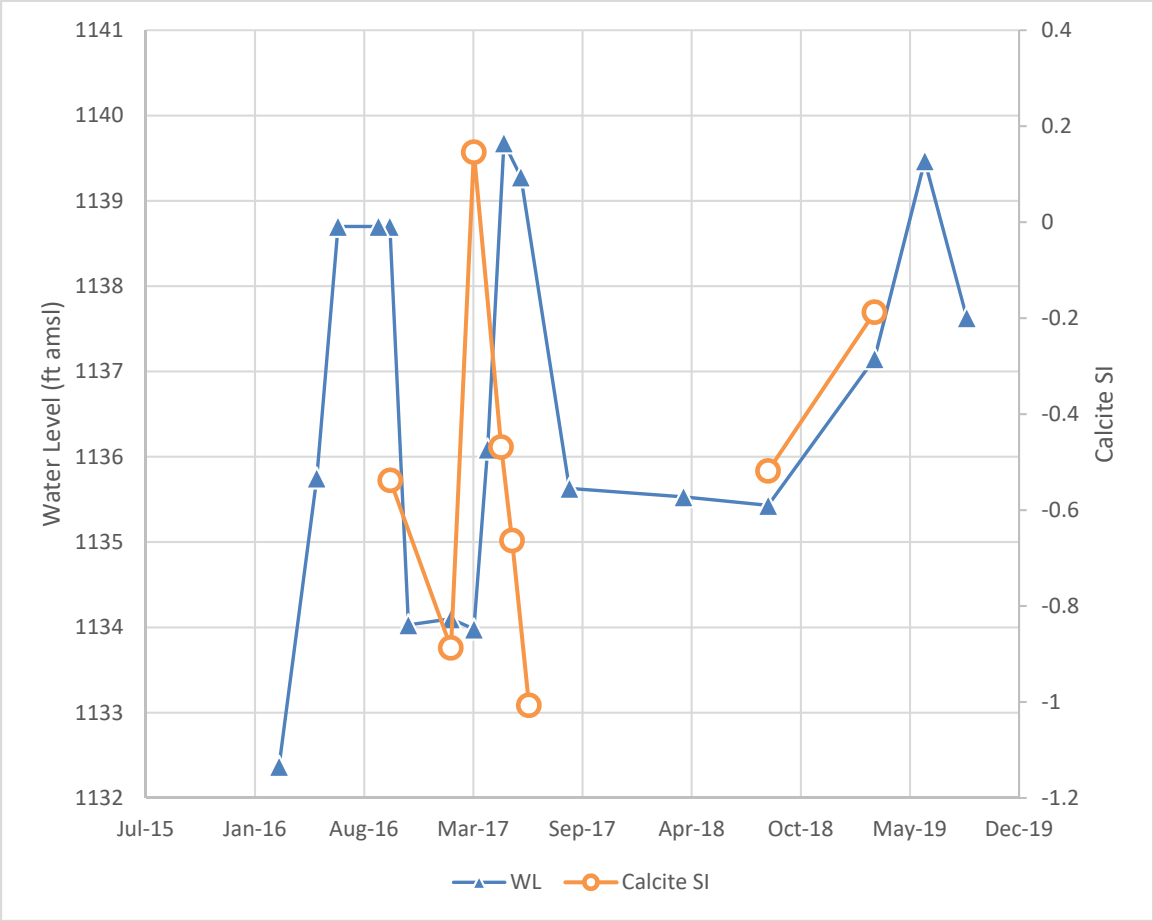
AMERICAN ELECTRIC POWER

Figure **1**

Columbus, Ohio

24-Oct-2019

internal info: path, date revised, author



Notes: Groundwater elevation is shown as feet above mean sea level (ft amsl). AP-59 is screened from 1125 to 1135 ft amsl. Saturation indices (SI) were calculated for events where all major cations, anions, and pH data were available. No line for saturation indices is shown between July 2017 and July 2018, as insufficient data were available during this time period.

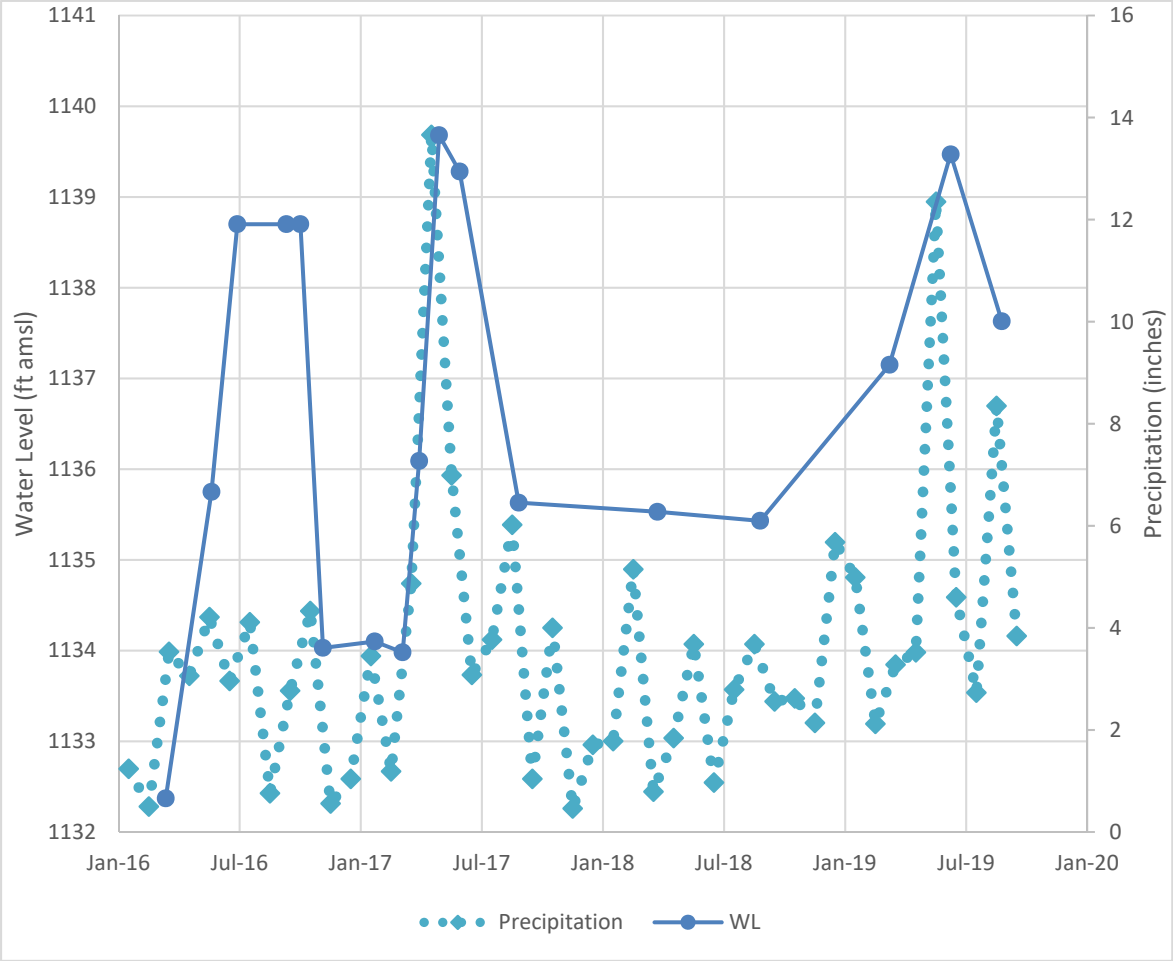
Saturation Indices and Water Levels at AP-59
Flint Creek PBAP

Geosyntec consultants | AMERICAN ELECTRIC POWER

Columbus, Ohio | 24-Oct-2019

Figure **2**

internal info: path, date revised, author



Notes: Groundwater elevation at AP-59 is shown as feet above mean sea level (ft amsl). Precipitation was reported for the Northwest Arkansas Regional Airport, which is located approximately 13 miles east of the site. Data was accessed via www.weatherunderground.com. Precipitation is reported as the cumulative inches for each month.

Precipitation and Water Levels at AP-59

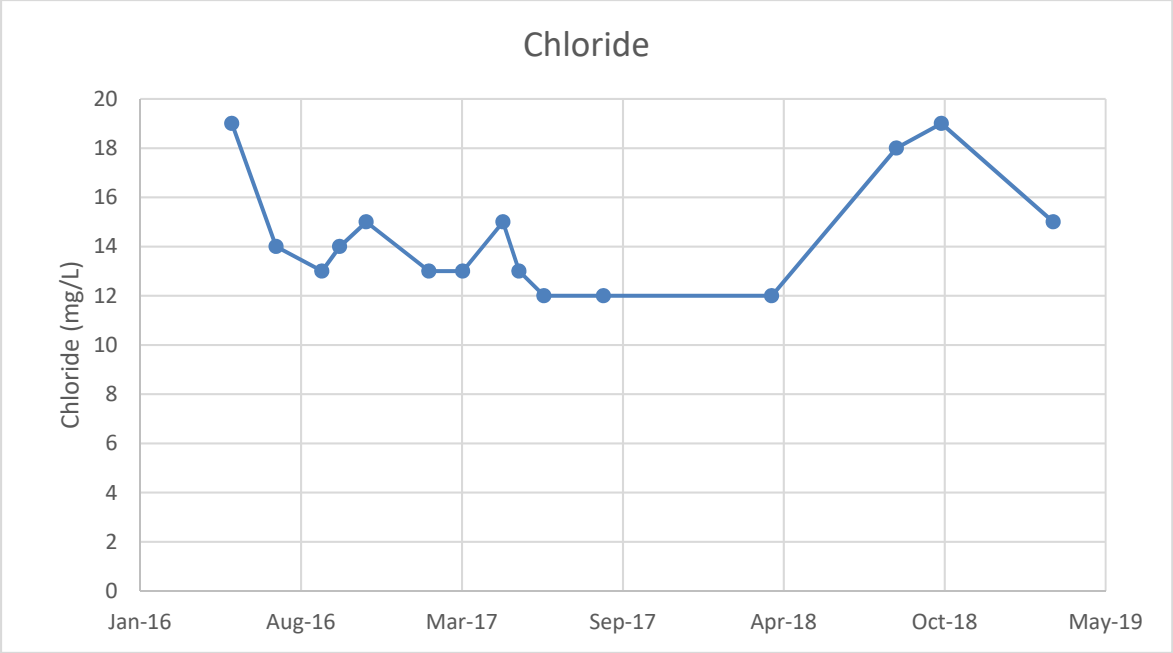
Flint Creek PBAP

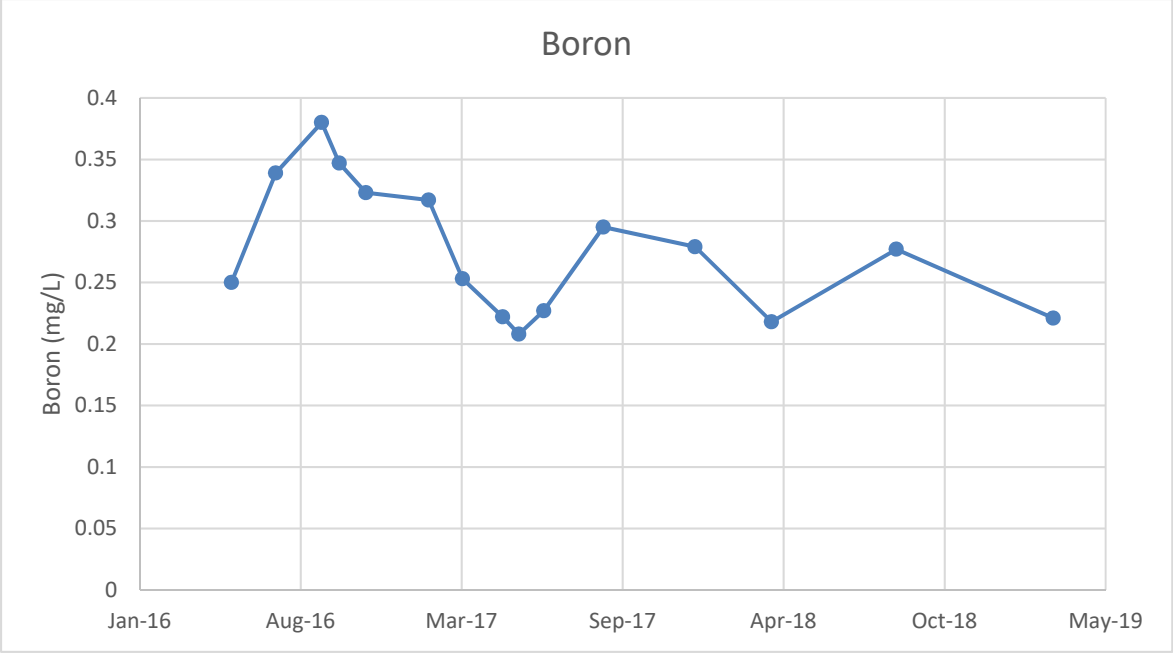
Geosyntec consultants | AMERICAN ELECTRIC POWER

Columbus, Ohio | 31-Oct-2019

Figure **3**

internal info: path, date revised, author





Notes: Data collected from AP-59 during the background and detection monitoring periods under the Federal CCR Rule are shown.

Boron and Chloride Time Series at AP-59

Flint Creek PBAP

Geosyntec consultants

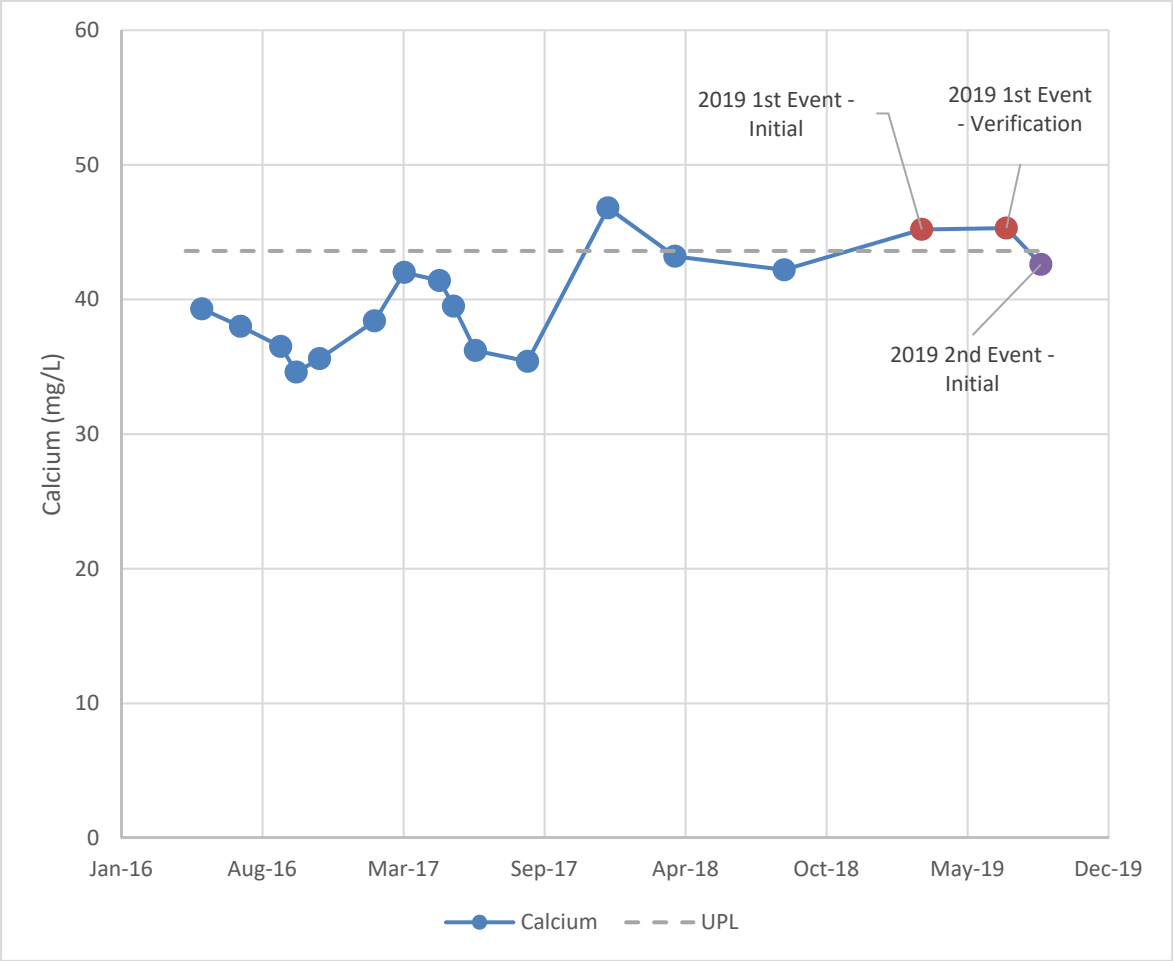
AMERICAN ELECTRIC POWER

Columbus, Ohio

24-Oct-2019

Figure **4**

internal info: path, date revised, author



Notes: Data collected from AP-59 during the background and detection monitoring period under the Federal CCR Rule are shown. Red circles represent data for the current detection monitoring event. The purple circle represents data collected for the second semiannual detection monitoring event of 2019.

Calcium Time Series at AP-59

Flint Creek PBAP

Geosyntec consultants

AMERICAN ELECTRIC POWER

Columbus, Ohio

24-Oct-2019

Figure **5**

internal info: path, date revised, author

ATTACHMENT A

AP-59 Boring Log

Terracon
Consulting Engineers and Scientists
25809 I-30 South BRYANT, AR. 72022
PH. (501) 847-9292 FAX. (501) 847-9210

FIELD BORING LOG

BORING NO.: AP-59 PAGE: 1 of 1

TOTAL DEPTH: 30 FEET BELOW GROUND SURFACE (BGS)

CLIENT: AMERICAN ELECTRIC POWER	PROJECT: FLINT CREEK - CCR WELL INSTALLATION
JOB NO.: 216-001-35157182-001	DRILLING CO.: ANDERSON ENGINEERING
LOGGED BY: ADAM HOOPER	DRILLER: GARY MOYERS
DATE DRILLED: 2/3/2016	RIG TYPE: CME 75 BUGGY

DRILLING METHOD: HOLLOW STEM AUGER /AIR ROTARY

SAMPLING METHOD: 5' CONTINUOUS SAMPLER - LOGGED BY CUTTINGS

N: N/A E: N/A G.S. ELEV. N/A

Depth BGS	DESCRIPTION	Litho. Symbol	Remarks
0	0'-8.5' SILTY CLAY - FILL red and brown		
5			
10	8.5'-14.5' LIMESTONE and SILTY CLAY hard while drilling		
15	14.5'-17' SILTY CLAY red		Moisture at top of rock at 17' bgs
20	17'-30' LIMESTONE light gray, crystalline, thin fracture/void at 22' bgs		Water at 22' bgs 17' - 30' Logged by cuttings
25			
30	Total Depth of Boring at 30' bgs		

ATTACHMENT B

Certification by a 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 Flint Creek Primary Bottom Ash Pond 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 Ann Gross
Signature

Geosyntec Consultants
2039 Centre Point Blvd, Suite 103
Tallahassee, FL 32308

9846	Arkansas	11/11/2019
License Number	Licensing State	Date