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Jared Morrison
Director Environmental Services
Evergy, Inc.

12/09/2022

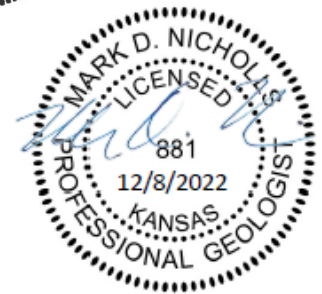
Date

TECHNICAL MEMORANDUMDecember 8, 2022
File No. 129778-048

TO: Evergy Kansas Central, Inc.
Jared Morrison – Director, Water and Waste Programs

FROM: Haley & Aldrich, Inc.
Steven F. Putrich, P.E., Principal Consultant – Engineering Principal
Mark Nicholls, P.G., Senior Associate – Senior Hydrogeologist

SUBJECT: Semi-Annual Groundwater Monitoring Data
Assessment Monitoring Statistical Evaluation
Tecumseh Energy Center, Bottom Ash Settling Area



This analysis is provided in accordance with paragraph 10.c of the Consent Agreement and Final Order In the Matter of Evergy Kansas Central, Inc.: Docket No. RCRA-07-2023-0001 date November 7, 2022. Pursuant to the requirements of the consent agreement, the statistical evaluations for assessment monitoring groundwater data collected after January 1, 2018 at the Tecumseh Energy Center (TEC) Bottom Ash Settling Area (BASA) have been assessed using interwell comparison methods to establish background levels and identify Appendix IV statistically significant levels (SSL) and to determine groundwater protection standards (GWPS) in accordance with Code of Federal Regulations Title 40 (40 CFR) § 257.95(h) and (i). Tables 1 through 4 provide the results of this analysis for each semi-annual assessment sampling event with a summary of all identified SSLs in Table 5.

The statistical evaluation discussed in this memorandum was conducted to determine if Appendix IV groundwater monitoring constituents that are detected in the annual event are present in downgradient wells at concentrations that represent an SSL above the GWPS consistent with the requirements of the 40 CFR § 257.93 and 257.95 (Rule). GWPS values for each of the Appendix IV constituents have been set equal to the highest value of the maximum contaminant level, levels provided in 40 CFR § 257.95(h)(2) (from regional screening levels), or background concentrations.

During Evergy's implementation of its groundwater monitoring program for the evaluation of groundwater monitoring constituents at the TEC BASA under the assessment monitoring program, interwell statistical analyses were utilized for all constituents at all downgradient monitoring wells to determine if any SSLs above the GWPS were present, except for the specific constituents at specific wells which had previously been determined to be influenced by an alternate source. Intrawell analyses were only applied to arsenic at monitoring wells MW-9 and MW-10 and cobalt at MW-9. This document provides the results generated by applying only interwell statistical analyses for all wells at the TEC BASA for assessment monitoring data collected after January 1, 2018. The semi-annual assessment monitoring sampling events were completed in September 2018, March 2019, October 2019, and December 2019.

Statistical Evaluation of Appendix IV Constituents

The Rule provides four specific options for statistical evaluation of groundwater quality data collected at a coal combustion residual (CCR) unit (40 CFR § 257.93(f)(1-4)). The statistical method used for these evaluations (tolerance limit [TL]) was certified by Haley & Aldrich, Inc. on January 14, 2019 in the *Selection of Statistical Procedures Certification, Tecumseh Energy Center, Bottom Ash Settling Pond*. The TL method, as determined applicable for this sampling event, was used to evaluate potential SSLs above background. Background levels for each constituent listed in Appendix IV were computed as upper tolerance limits (UTLs), and a minimum 95 percent confidence coefficient and 95 percent coverage. The most recent groundwater sampling event from each compliance well was compared to the corresponding background UTL to determine if an SSI existed.

STATISTICAL EVALUATION

An interwell evaluation was used to determine SSLs. Interwell evaluation compares the most recent values from downgradient compliance wells against a background dataset derived from the upgradient wells. The TL method was used to complete statistical evaluations of the referenced datasets. The TL procedure is one in which a concentration limit for each constituent is established from the distribution of the background data, with a minimum 95 percent confidence level. The upper endpoint of a tolerance interval is the UTL. Depending on whether the data distribution is parametric or non-parametric, TL procedures are used to evaluate groundwater monitoring data using this method. Parametric TLs utilize normally distributed data or normalized data via a transformation of the sample background data used to construct the limit. If the data are non-normal and a transformation is not indicated, non-parametric procedures (order statistics or bootstrap methods) are used to calculate the TL. If all the background data are non-detect, a maximum reporting limit may serve as an appropriate UTL.

These statistical evaluations were conducted using the background dataset for all Appendix IV constituents that were detected in the annual assessment monitoring sample event using parametric TLs. If an Appendix IV constituent concentration from the sampling event was above the GWPS, the lower confidence limit (LCL) for the downgradient well constituent will be used to evaluate if an SSI is present. The LCL is the lower end of the confidence interval range, which is an estimated concentration range intended to contain the true mean or median of the population from which the sample is drawn. The confidence interval range is designed to locate the true population mean or median with a high degree of statistical confidence, or conversely, with a low probability of error.

The UTLs were calculated from the background well dataset using Chemstat software after testing for outlier sample results that would warrant removal from the dataset based on likely error in sampling or measurement. Both visual and statistical outlier tests for the background data were performed using Chemstat and EPA's ProUCL 5.1 software, and a visual inspection of the data was performed using box plots and distribution plots for the downgradient sample data. No sample data were identified as outliers that warranted removal from the dataset.

BACKGROUND DISTRIBUTIONS

Groundwater analytical results for each sampling event at the background monitoring well location (MW-7) were combined to calculate the UTL for each detected Appendix IV constituent. The variability and distribution of the pooled dataset were evaluated to determine the method for UTL calculation. In accordance with statistical methods defined in *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance, March 2009*, background concentrations were updated based on statistical evaluation of analytical results collected through September 2018 for all constituents except cadmium, which was updated through June 2018.

RESULTS OF APPENDIX IV DOWNGRADIENT STATISTICAL COMPARISONS

Concentrations of each of the detected Appendix IV constituents from the semi-annual assessment monitoring events at the downgradient well locations were compared to their respective background UTLs and GWPS values. A sample concentration greater than the GWPS is considered to represent an SSL. The results of the groundwater assessment monitoring statistical evaluations for the September 2018, March 2019, October 2019, and December 2019 sampling events are provided in Tables 1 through 4, respectively. **SSLs above GWPS at TEC BASA identified based on results of statistical evaluation of groundwater sampling data are summarized in Table 5.**

Attachments:

Table 1 – Summary of Semi-Annual Assessment Groundwater Monitoring Statistical Evaluation – September 2018 Sampling Event

Table 2 – Summary of Semi-Annual Assessment Groundwater Monitoring Statistical Evaluation – March 2019 Sampling Event

Table 3 – Summary of Semi-Annual Assessment Groundwater Monitoring Statistical Evaluation – October 2019 Sampling Event

Table 4 – Summary of Semi-Annual Assessment Groundwater Monitoring Statistical Evaluation – December 2019 Sampling Event

Table 5 – Statistically Significant Levels of Appendix IV Constituents – Summary Table

TABLES

TABLE 1
SUMMARY OF SEMI-ANNUAL ASSESSMENT GROUNDWATER MONITORING STATISTICAL EVALUATION
 SEPTEMBER 2018 SAMPLING EVENT
 TECUMSEH ENERGY CENTER
 BOTTOM ASH SETTLING AREA

Location Id	Frequency of Detection	Percent Non-Detects	Range of Non-Detect	Maximum Detect	Variance	Standard Deviation	Coefficient of Variance	CCR MCL or CFR § 257.95(h)(2)*	Report Result Unit	MCL Comparison		Outlier Presence	Outlier Removed	Trend	Distribution Well	September 2018 Concentration (mg/L)	Inter-well Analysis ¹		Groundwater Protection Standard	
										Number of Detection Exceedances	Number of Non-Detection Exceedances						Background Limits ² (UTL) mg/L	SSI	GWPS (Higher of MCL/ 40 CFR § 257.95(h)(2) or UTL)	SSL
CCR Appendix-IV: Arsenic, Total (mg/L)																				
MW-7 (upgradient)	10/10	0%	-	0.0021	4.489E-08	0.0002119	0.1358	0.010	mg/L	0	0	Yes	No	Stable	Non-parametric	0.0015	0.0021		0.010	
MW-8	10/10	0%	-	0.0041	5.911E-07	0.0007688	0.3343	0.010	mg/L	0	0	No	No	Stable	Normal	0.0028		Yes		No
MW-9	10/10	0%	-	0.14	0.0002754	0.0166	0.1521	0.010	mg/L	10	0	No	No	Stable	Normal	0.099		Yes		Yes
MW-10	10/10	0%	-	0.077	0.0001534	0.01239	0.2068	0.010	mg/L	10	0	No	No	Stable	Normal	0.040		Yes		Yes
CCR Appendix-IV: Barium, Total (mg/L)																				
MW-7 (upgradient)	10/10	0%	-	0.10	0.00008988	0.00948	0.123	2	mg/L	0	0	No	No	Stable	Normal	0.079	0.0953		2	
MW-8	10/10	0%	-	0.063	0.000007122	0.002669	0.04578	2	mg/L	0	0	No	No	Stable	Normal	0.057		No		No
MW-9	10/10	0%	-	0.91	0.006201	0.07875	0.0993	2	mg/L	0	0	No	No	Stable	Normal	0.91		Yes		No
MW-10	10/10	0%	-	0.35	0.0006844	0.02616	0.08779	2	mg/L	0	0	No	No	Stable	Normal	0.35		Yes		No
CCR Appendix-IV: Cobalt, Total (mg/L)																				
MW-7 (upgradient)	8/10	20%	0.001-0.001	0.0022	1.782E-07	0.0004222	0.3104	0.006	mg/L	0	0	No	No	Decreasing	Normal	0.0010	0.0022		0.006	
MW-8	9/10	10%	0.001-0.001	0.0018	7.289E-08	0.00027	0.1956	0.006	mg/L	0	0	No	No	Stable	Normal	0.0014		No		No
MW-9	10/10	0%	-	0.031	0.00004566	0.006757	0.3775	0.006	mg/L	10	0	No	No	Stable	Normal	0.011		Yes		Yes
MW-10	8/10	20%	0.001-0.001	0.0065	0.00003451	0.001858	0.4863	0.006	mg/L	2	0	No	No	Stable	Normal	<0.0010		No		No
CCR Appendix-IV: Fluoride, Total (mg/L)																				
MW-7 (upgradient)	11/11	0%	-	0.37	0.00074	0.0272	0.08501	4.0	mg/L	0	0	Yes	No	Stable	Normal	0.33	0.37		4.0	
MW-8	11/11	0%	-	0.33	0.0008073	0.02841	0.1035	4.0	mg/L	0	0	No	No	Stable	Normal	0.31		No		No
MW-9	11/11	0%	-	0.56	0.005067	0.07118	0.1677	4.0	mg/L	0	0	No	No	Stable	Normal	0.51		Yes		No
MW-10	11/11	0%	-	0.55	0.001745	0.04178	0.09011	4.0	mg/L	0	0	No	No	Stable	Normal	0.51		Yes		No
CCR Appendix-IV: Lithium, Total (mg/L)																				
MW-7 (upgradient)	10/10	0%	-	0.029	0.000008544	0.002923	0.1223	0.040	mg/L	0	0	Yes	No	Stable	Normal	0.029	0.0295		0.040	
MW-8	10/10	0%	-	0.024	0.00001454	0.003814	0.1997	0.040	mg/L	0	0	No	No	Stable	Normal	0.022		No		No
MW-9	8/10	20%	0.01-0.01	0.018	0.000006544	0.002558	0.1983	0.040	mg/L	0	0	No	No	NA	Non-parametric	0.012		No		No
MW-10	3/10	70%	0.01-0.01	0.011	0.0000001	0.0003162	0.03131	0.040	mg/L	0	0	No	No	Stable	Normal	<0.010		No		No
CCR Appendix-IV: Molybdenum, Total (mg/L)																				
MW-7 (upgradient)	10/10	0%	-	0.013	0.000003	0.001732	0.1646	0.100	mg/L	0	0	No	No	Stable	Normal	0.0082	0.0138		0.100	
MW-8	10/10	0%	-	0.044	0.00001218	0.00349	0.08902	0.100	mg/L	0	0	No	No	Stable	Normal	0.037		Yes		No
MW-9	9/10	10%	0.001-0.001	0.0079	0.000004839	0.0022	0.5774	0.100	mg/L	0	0	No	No	Stable	Normal	<0.0010		No		No
MW-10	10/10	0%	-	0.0049	7.566E-07	0.0008698	0.2492	0.100	mg/L	0	0	No	No	Stable	Normal	0.0027		No		No
CCR Appendix-IV: Radium-226 & 228, Total (pCi/L)																				
MW-7 (upgradient)	10/10	0%	-	5.88	2.721	1.65	1.318	5	pCi/L	1	0	Yes	No	Stable	Non-parametric	0.398	5.88		5.88	
MW-8	10/10	0%	-	1.308	0.1376	0.371	0.407	5	pCi/L	0	0	No	No	Stable	Normal	1.29		No		No
MW-9	10/10	0%	-	3.249	0.4152	0.6443	0.346	5	pCi/L	0	0	No	No	Stable	Normal	2.53		No		No
MW-10	10/10	0%	-	3.58	0.4863	0.6973	0.3229	5	pCi/L	0	0	No	No	Stable	Normal	3.58		No		No

Notes & Abbreviations:

¹ Statistical evaluation was completed for Appendix IV constituents detected during the June 2018 annual assessment monitoring sampling event.

² Based on background data collected from 08/30/2016 through 09/06/2018.

* Values obtained from U.S. Environmental Protection Agency Federal CCR Rule Title 40 Code of Federal Regulations (CFR) § 257.95(h)(2)

CCR = coal combustion residuals

GWPS = Groundwater Protection Standard

MCL = maximum contaminant level

mg/L = milligrams per Liter

NA = not analyzed

pCi/L = picoCuries per Liter

SSI = statistically significant increase

SSL = statistically significant level

UTL = upper tolerance limits

TABLE 2
SUMMARY OF SEMI-ANNUAL ASSESSMENT GROUNDWATER MONITORING STATISTICAL EVALUATION
MARCH 2019 SAMPLING EVENT
TECUMSEH ENERGY CENTER
BOTTOM ASH SETTLING AREA

Location Id	Frequency of Detection	Percent Non-Detects	Range of Non-Detect	Maximum Detect	Variance	Standard Deviation	Coefficient of Variance	CCR MCL or CFR § 257.95(h)(2)*	Report Result Unit	MCL Comparison		Outlier Presence	Outlier Removed	Trend	Distribution Well	March 2019 Concentration (mg/L)	Inter-well Analysis ¹		Groundwater Protection Standard	
										Number of Detection Exceedances	Number of Non-Detection Exceedances						Background Limits ² (UTL) mg/L	SSI	GWPS (Higher of MCL/40 CFR § 257.95(h)(2) or UTL)	SSL
CCR Appendix-IV: Arsenic, Total (mg/L)																				
MW-7 (upgradient)	11/11	0%	-	0.0021	4.055E-08	0.0002014	0.1288	0.010	mg/L	0	0	Yes	No	Stable	Non-parametric	0.0016	0.0021		0.010	
MW-8	11/11	0%	-	0.0041	0.00000532	0.0007294	0.3171	0.010	mg/L	0	0	No	No	Stable	Normal	0.0023		Yes		No
MW-9	11/11	0%	-	0.14	0.000682	0.02611	0.254	0.010	mg/L	11	0	No	No	Stable	Normal	0.040		Yes		Yes
MW-10	11/11	0%	-	0.077	0.0002306	0.01519	0.2664	0.010	mg/L	11	0	No	No	Stable	Normal	0.028		Yes		Yes
CCR Appendix-IV: Barium, Total (mg/L)																				
MW-7 (upgradient)	11/11	0%	-	0.1	0.00008096	0.008998	0.1166	2	mg/L	0	0	Yes	No	Stable	Normal	0.078	0.0953		2	
MW-8	11/11	0%	-	0.063	0.00008091	0.002844	0.04912	2	mg/L	0	0	No	No	Stable	Normal	0.054		No		No
MW-9	11/11	0%	-	0.91	0.0114	0.1068	0.1387	2	mg/L	0	0	No	No	Stable	Normal	0.54		Yes		No
MW-10	11/11	0%	-	0.36	0.0009655	0.03107	0.1023	2	mg/L	0	0	No	No	Stable	Normal	0.36		Yes		No
CCR Appendix-IV: Cadmium⁴, Total (mg/L)																				
MW-7 (upgradient)	0/10	100%	0.0005-0.0005	-	0	0	0	0.005	mg/L	0	0	NA	NA	NA	NA	<0.00050	0.0005 ³		0.005	
MW-8	0/10	100%	0.0005-0.0005	-	0	0	0	0.005	mg/L	0	0	NA	NA	NA	NA	<0.00050		No		No
MW-9	3/10	70%	0.0005-0.0005	0.0013	6.387E-08	0.0002527	0.4191	0.005	mg/L	0	0	Yes	No	NA	Non-parametric	0.0013		Yes		No
MW-10	0/10	100%	0.0005-0.0005	-	0	0	0	0.005	mg/L	0	0	NA	NA	NA	NA	<0.00050		No		No
CCR Appendix-IV: Cobalt, Total (mg/L)																				
MW-7 (upgradient)	9/11	18%	0.001-0.001	0.0022	1.656E-07	0.000407	0.2945	0.006	mg/L	0	0	No	No	Decreasing	Normal	0.0016	0.0022		0.006	
MW-8	9/11	18%	0.001-0.001	0.0018	7.873E-08	0.0002806	0.2085	0.006	mg/L	0	0	No	No	Stable	Normal	<0.0010		No		No
MW-9	11/11	0%	-	0.048	0.0001235	0.01111	0.5384	0.006	mg/L	11	0	No	No	Stable	Normal	0.048		Yes		Yes
MW-10	9/11	18%	0.001-0.001	0.0065	0.00003638	0.001907	0.5298	0.006	mg/L	2	0	No	No	Stable	Normal	0.0014		No		No
CCR Appendix-IV: Fluoride, Total (mg/L)																				
MW-7 (upgradient)	12/12	0%	-	0.37	0.0009727	0.03119	0.09901	4.0	mg/L	0	0	No	No	Stable	Non-parametric	0.38	0.37		4.0	
MW-8	12/12	0%	-	0.33	0.0008992	0.02999	0.1107	4.0	mg/L	0	0	No	No	Stable	Normal	0.23		No		No
MW-9	12/12	0%	-	0.56	0.004772	0.06908	0.1641	4.0	mg/L	0	0	No	No	Stable	Normal	0.38		Yes		No
MW-10	12/12	0%	-	0.55	0.001697	0.04119	0.08827	4.0	mg/L	0	0	No	No	Stable	Normal	0.50		Yes		No
CCR Appendix-IV: Lithium, Total (mg/L)																				
MW-7 (upgradient)	11/11	0%	-	0.029	0.000009218	0.003036	0.1251	0.040	mg/L	0	0	Yes	No	Stable	Normal	0.028	0.0295		0.040	
MW-8	11/11	0%	-	0.024	0.00001349	0.003673	0.1942	0.040	mg/L	0	0	No	No	Stable	Normal	0.017		No		No
MW-9	9/11	18%	0.01-0.01	0.021	0.00001185	0.003443	0.2525	0.040	mg/L	0	0	No	No	Stable	Normal	0.021		No		No
MW-10	3/11	73%	0.01-0.01	0.011	9.091E-08	0.0003015	0.02988	0.040	mg/L	0	0	No	No	NA	Non-parametric	<0.010		No		No
CCR Appendix-IV: Molybdenum, Total (mg/L)																				
MW-7 (upgradient)	11/11	0%	-	0.013	0.00000547	0.002339	0.2334	0.100	mg/L	0	0	No	No	Stable	Normal	0.0050	0.0138		0.100	
MW-8	11/11	0%	-	0.044	0.00001707	0.004132	0.1074	0.100	mg/L	0	0	No	No	Stable	Normal	0.031		Yes		No
MW-9	10/11	9%	0.001-0.001	0.0079	0.000004874	0.002208	0.5482	0.100	mg/L	0	0	No	No	Stable	Normal	0.0062		No		No
MW-10	11/11	0%	-	0.0049	7.125E-07	0.0008441	0.2456	0.100	mg/L	0	0	No	No	Stable	Normal	0.0029		No		No
CCR Appendix-IV: Radium-226 & 228, Total (pCi/L)																				
MW-7 (upgradient)	11/11	0%	-	5.88	2.57	1.603	1.398	5	pCi/L	1	0	Yes	No	Stable	Non-parametric	0.0090	5.88		5.88	
MW-8	11/11	0%	-	1.308	0.142	0.3768	0.4327	5	pCi/L	0	0	No	No	Stable	Normal	0.465		No		No
MW-9	11/11	0%	-	3.249	0.5045	0.7103	0.4051	5	pCi/L	0	0	No	No	Stable	Normal	0.663		No		No
MW-10	11/11	0%	-	3.58	0.4693	0.685	0.3253	5	pCi/L	0	0	No	No	Stable	Normal	1.57		No		No

Notes and Abbreviations:

- ¹ Statistical evaluation was completed for Appendix IV constituents detected during the June 2018 annual assessment monitoring sampling event.
- ² Based on background data collected from 08/30/2016 through 09/06/2018, unless otherwise noted.
- ³ Based on background data collected from 08/30/2016 through 06/11/2018.
- ⁴ Cadmium was not detected during the June 2018 annual assessment monitoring sampling event; however, analytical data for cadmium was provided in the laboratory report. Therefore, the data was included in this evaluation.

* Values obtained from U.S. Environmental Protection Agency Federal CCR Rule Title 40 Code of Federal Regulations (CFR) § 257.95(h)(2)

CCR = coal combustion residuals

GWPS = Groundwater Protection Standard

MCL = maximum contaminant level

mg/L = milligrams per Liter

NA = not analyzed

pCi/L = picoCuries per Liter

SSI = statistically significant increase

SSL = statistically significant level

UTL = upper tolerance limits

TABLE 3
SUMMARY OF SEMI-ANNUAL ASSESSMENT GROUNDWATER MONITORING STATISTICAL EVALUATION
 OCTOBER 2019 SAMPLING EVENT
 TECUMSEH ENERGY CENTER
 BOTTOM ASH SETTLING AREA

Location Id	Frequency of Detection	Percent Non-Detects	Range of Non-Detect	Maximum Detect	Variance	Standard Deviation	Coefficient of Variance	CCR MCL or CFR § 257.95(h)(2)*	Report Result Unit	MCL Comparison		Outlier Presence	Outlier Removed	Trend	Distribution Well	October 2019 Concentration (mg/L)	Inter-well Analysis ¹		Groundwater Protection Standard	
										Number of Detection Exceedances	Number of Non-Detection Exceedances						Background Limits ² (UTL) mg/L	SSI	GWPS (Higher of MCL/ 40 CFR § 257.95(h)(2) or UTL)	SSL
CCR Appendix-IV: Arsenic, Total (mg/L)																				
MW-7 (upgradient)	13/13	0%	-	0.0021	3.397E-08	0.0001843	0.1175	0.010	mg/L	0	0	Yes	No	Stable	Non-parametric	0.0160	0.0021		0.010	
MW-8	13/13	0%	-	0.0041	0.00000471	0.0006863	0.2916	0.010	mg/L	0	0	No	No	Stable	Normal	0.0024		Yes		No
MW-9	13/13	0%	-	0.14	0.0007757	0.02785	0.284	0.010	mg/L	13	0	No	No	Decreasing	Normal	0.051		Yes		Yes
MW-10	13/13	0%	-	0.077	0.0003392	0.01842	0.3537	0.010	mg/L	13	0	No	No	Decreasing	Normal	0.021		Yes		Yes
CCR Appendix-IV: Barium, Total (mg/L)																				
MW-7 (upgradient)	13/13	0%	-	0.1	0.0001235	0.01111	0.1497	2	mg/L	0	0	Yes	No	Stable	Normal	0.053	0.0953		2	
MW-8	13/13	0%	-	0.064	0.00001047	0.003236	0.05565	2	mg/L	0	0	No	No	Stable	Normal	0.064		No		No
MW-9	13/13	0%	-	0.91	0.02334	0.1528	0.2052	2	mg/L	0	0	No	No	Stable	Normal	0.85		Yes		No
MW-10	13/13	0%	-	0.36	0.00116	0.03406	0.1115	2	mg/L	0	0	No	No	Stable	Normal	0.36		Yes		No
CCR Appendix-IV: Cadmium, Total (mg/L)																				
MW-7 (upgradient)	0/12	100%	0.0005-0.0005	-	0	0	0	0.005	mg/L	0	0	NA	NA	NA	NA	<0.00050	0.0005 ³		0.005	
MW-8	0/12	100%	0.0005-0.0005	-	0	0	0	0.005	mg/L	0	0	NA	NA	NA	NA	<0.00050		No		No
MW-9	4/12	67%	0.0005-0.0005	0.0013	5.347E-08	0.0002312	0.393	0.005	mg/L	0	0	Yes	No	NA	Non-parametric	<0.00050		No		No
MW-10	0/12	100%	0.0005-0.0005	-	0	0	0	0.005	mg/L	0	0	NA	NA	NA	NA	<0.00050		No		No
CCR Appendix-IV: Cobalt, Total (mg/L)																				
MW-7 (upgradient)	10/13	23%	0.001-0.001	0.0022	0.000000154	0.0003924	0.2866	0.006	mg/L	0	0	No	No	Decreasing	Normal	<0.0010	0.0022		0.006	
MW-8	10/13	23%	0.001-0.001	0.0018	7.526E-08	0.0002743	0.2073	0.006	mg/L	0	0	No	No	Decreasing	Normal	0.0014		No		No
MW-9	13/13	0%	-	0.048	0.0001151	0.01073	0.5073	0.006	mg/L	13	0	No	No	Stable	Normal	0.016		Yes		Yes
MW-10	11/13	15%	0.001-0.001	0.0091	0.000005668	0.002381	0.6105	0.006	mg/L	3	0	No	No	Stable	Normal	0.002		No		No
CCR Appendix-IV: Fluoride (mg/L)																				
MW-7 (upgradient)	14/14	0%	-	0.37	0.0008681	0.02946	0.0929	4.0	mg/L	0	0	Yes	No	Stable	Normal	0.34	0.37		4.0	
MW-8	13/14	7%	0.2-0.2	0.33	0.001134	0.03368	0.1274	4.0	mg/L	0	0	No	No	Stable	Normal	0.25		No		No
MW-9	13/14	7%	0.2-0.2	0.56	0.008003	0.08946	0.2248	4.0	mg/L	0	0	No	No	Stable	Normal	0.32		No		No
MW-10	13/14	7%	0.2-0.2	0.55	0.006579	0.08111	0.1829	4.0	mg/L	0	0	No	No	Stable	Normal	0.41		Yes		No
CCR Appendix-IV: Lithium, Total (mg/L)																				
MW-7 (upgradient)	13/13	0%	-	0.029	0.00001258	0.003546	0.1482	0.040	mg/L	0	0	Yes	No	Stable	Normal	0.017	0.0295		0.040	
MW-8	13/13	0%	-	0.024	0.00001153	0.003395	0.1809	0.040	mg/L	0	0	No	No	Stable	Normal	0.017		No		No
MW-9	10/13	23%	0.01-0.01	0.021	0.00001431	0.003783	0.2732	0.040	mg/L	0	0	No	No	Stable	Normal	<0.010		No		No
MW-10	3/13	77%	0.01-0.01	0.011	7.692E-08	0.0002774	0.02752	0.040	mg/L	0	0	No	No	NA	Non-parametric	<0.010		No		No
CCR Appendix-IV: Molybdenum, Total (mg/L)																				
MW-7 (upgradient)	13/13	0%	-	0.013	0.000005279	0.002298	0.2326	0.100	mg/L	0	0	No	No	Decreasing	Normal	0.0110	0.0138		0.100	
MW-8	13/13	0%	-	0.044	0.00002827	0.005317	0.1419	0.100	mg/L	0	0	No	No	Stable	Normal	0.039		Yes		No
MW-9	12/13	8%	0.001-0.001	0.0085	0.000005898	0.002429	0.5719	0.100	mg/L	0	0	No	No	Stable	Normal	0.0085		No		No
MW-10	13/13	0%	-	0.0053	0.000000879	0.0009375	0.2582	0.100	mg/L	0	0	No	No	Stable	Normal	0.0041		No		No
CCR Appendix-IV: Radium-226 & 228 (pCi/L)																				
MW-7 (upgradient)	11/11	0%	-	5.88	2.57	1.603	1.398	5	pCi/L	1	0	Yes	No	Stable	Non-parametric	0.403	5.88		5.88	
MW-8	11/11	0%	-	1.308	0.142	0.3768	0.4327	5	pCi/L	0	0	No	No	Stable	Normal	0.721		No		No
MW-9	11/11	0%	-	3.249	0.5045	0.7103	0.4051	5	pCi/L	0	0	No	No	Stable	Normal	1.67		No		No
MW-10	11/11	0%	-	3.58	0.4693	0.685	0.3253	5	pCi/L	0	0	No	No	Stable	Normal	2.64		No		No

Notes and Abbreviations:

¹ Statistical evaluation was completed for Appendix IV constituents detected during the June 2019 annual assessment monitoring sampling event.

² Based on background data collected from 08/30/2016 through 09/06/2018, unless otherwise noted.

³ Based on background data collected from 08/30/2016 through 06/11/2018.

* Values obtained from U.S. Environmental Protection Agency Federal CCR Rule Title 40 Code of Federal Regulations (CFR) § 257.95(h)(2)

CCR = coal combustion residuals

GWPS = Groundwater Protection Standard

MCL = maximum contaminant level

mg/L = milligrams per liter

NA = not analyzed

pCi/L = picoCuries per liter

SSI = statistically significant increase

SSL = statistically significant level

UTL = upper tolerance limits

TABLE 4
SUMMARY OF SEMI-ANNUAL ASSESSMENT GROUNDWATER MONITORING STATISTICAL EVALUATION
 DECEMBER 2019 SAMPLING EVENT
 TECUMSEH ENERGY CENTER
 BOTTOM ASH SETTLING AREA

Location Id	Frequency of Detection	Percent Non-Detects	Range of Non-Detect	Maximum Detect	Variance	Standard Deviation	Coefficient of Variance	CCR MCL or CFR § 257.95(h)(2)*	Report Result Unit	MCL Comparison				Trend	Distribution Well	December 2019 Concentration (mg/L)	Inter-well Analysis ¹		Groundwater Protection Standard	
										Number of Detection Exceedances	Number of Non-Detection Exceedances	Outlier Presence	Outlier Removed				Background Limits ² (UTL) mg/L	SSI	GWPS (Higher of MCL/40 CFR § 257.95(h)(2) or UTL)	SSL
CCR Appendix-IV: Arsenic, Total (mg/L)																				
MW-7 (upgradient)	14/14	0%	-	0.0021	3.143E-08	0.0001773	0.1128	0.010	mg/L	0	0	Yes	No	Stable	Non-parametric	0.0016	0.0021		0.010	
MW-8	14/14	0%	-	0.0041	6.055E-07	0.0007782	0.3158	0.010	mg/L	0	0	No	No	Stable	Normal	0.0039		Yes		No
MW-9	13/13	0%	-	0.14	0.0007757	0.02785	0.284	0.010	mg/L	13	0	No	No	Decreasing	Normal	NS		NA		NA
MW-10	14/14	0%	-	0.077	0.0003617	0.01902	0.3788	0.010	mg/L	14	0	No	No	Decreasing	Normal	0.026		Yes		Yes
CCR Appendix-IV: Barium, Total (mg/L)																				
MW-7 (upgradient)	14/14	0%	-	0.1	0.0001462	0.01209	0.1663	2	mg/L	0	0	Yes	No	Decreasing	Normal	0.053	0.0953		2	
MW-8	14/14	0%	-	0.077	0.00003504	0.005919	0.09948	2	mg/L	0	0	Yes	No	Stable	Non-parametric	0.077		No		No
MW-9	13/13	0%	-	0.91	0.02334	0.1528	0.2052	2	mg/L	0	0	Yes	No	Stable	Normal	NS		NA		NA
MW-10	14/14	0%	-	0.36	0.001073	0.03276	0.1074	2	mg/L	0	0	No	No	Stable	Normal	0.30		Yes		No
CCR Appendix-IV: Cadmium, Total (mg/L)																				
MW-7 (upgradient)	0/13	100%	0.0005-0.0005	-	0	0	0	0.005	mg/L	0	0	NA	NA	NA	NA	<0.00050	0.0005 ³		0.005	
MW-8	0/13	100%	0.0005-0.0005	-	0	0	0	0.005	mg/L	0	0	NA	NA	NA	NA	<0.00050		No		No
MW-9	4/12	67%	0.0005-0.0005	0.0013	5.347E-08	0.0002312	0.393	0.005	mg/L	0	0	Yes	No	Stable	Non-parametric	NS		NA		NA
MW-10	0/13	100%	0.0005-0.0005	-	0	0	0	0.005	mg/L	0	0	NA	NA	NA	NA	<0.00050		No		No
CCR Appendix-IV: Cobalt, Total (mg/L)																				
MW-7 (upgradient)	11/14	21%	0.001-0.001	0.0022	1.554E-07	0.0003942	0.2816	0.006	mg/L	0	0	No	No	Decreasing	Normal	0.0018	0.0022		0.006	
MW-8	11/14	21%	0.001-0.001	0.0025	1.684E-07	0.0004104	0.2916	0.006	mg/L	0	0	No	No	Decreasing	Normal	0.0025		Yes		No
MW-9	13/13	0%	-	0.048	0.0001151	0.01073	0.5073	0.006	mg/L	13	0	No	No	Stable	Normal	NS		NA		NA
MW-10	12/14	14%	0.001-0.001	0.0091	0.000005319	0.002306	0.6035	0.006	mg/L	3	0	No	No	Stable	Normal	0.0028		Yes		No
CCR Appendix-IV: Fluoride (mg/L)																				
MW-7 (upgradient)	15/15	0%	-	0.37	0.001435	0.03788	0.1219	4.0	mg/L	0	0	Yes	No	Stable	Normal	0.22	0.37		4.0	
MW-8	13/15	13%	0.2-0.2	0.33	0.001329	0.03645	0.1402	4.0	mg/L	0	0	No	No	Stable	Normal	<0.20		No		No
MW-9	13/14	7%	0.2-0.2	0.56	0.008003	0.08946	0.2248	4.0	mg/L	0	0	No	No	Stable	Normal	NS		NA		NA
MW-10	14/15	7%	0.2-0.2	0.55	0.006692	0.08181	0.1871	4.0	mg/L	0	0	Yes	No	Stable	Normal	0.35		No		No
CCR Appendix-IV: Lithium, Total (mg/L)																				
MW-7 (upgradient)	14/14	0%	-	0.029	0.00001161	0.003407	0.1424	0.040	mg/L	0	0	Yes	No	Stable	Normal	0.024	0.0295		0.040	
MW-8	14/14	0%	-	0.024	0.00001259	0.003549	0.1854	0.040	mg/L	0	0	No	No	Stable	Normal	0.024		No		No
MW-9	10/13	23%	0.01-0.01	0.021	0.00001431	0.003783	0.2732	0.040	mg/L	0	0	No	No	Stable	Normal	NS		NA		NA
MW-10	3/14	79%	0.01-0.01	0.011	7.143E-08	0.0002673	0.02654	0.040	mg/L	0	0	No	No	Stable	Normal	<0.010		No		No
CCR Appendix-IV: Molybdenum, Total (mg/L)																				
MW-7 (upgradient)	14/14	0%	-	0.013	0.000004874	0.002208	0.2233	0.100	mg/L	0	0	No	No	Decreasing	Normal	0.010	0.0138		0.100	
MW-8	14/14	0%	-	0.046	0.0000313	0.005595	0.147	0.100	mg/L	0	0	No	No	Stable	Normal	0.046		Yes		No
MW-9	12/13	8%	0.001-0.001	0.0085	0.000005898	0.002429	0.5719	0.100	mg/L	0	0	No	No	Stable	Normal	NS		NA		NA
MW-10	14/14	0%	-	0.0053	8.434E-07	0.0009183	0.2496	0.100	mg/L	0	0	No	No	Stable	Normal	0.0043		No		No
CCR Appendix-IV: Radium-226 & 228 (pCi/L)																				
MW-7 (upgradient)	13/14	7%	0.403-0.403	5.88	2.029	1.424	1.365	5	pCi/L	1	0	Yes	No	Stable	Non-parametric	0.666	5.88		5.88	
MW-8	13/14	7%	0.721-0.721	1.46	0.1445	0.3802	0.4317	5	pCi/L	0	0	No	No	Stable	Normal	0.569		No		No
MW-9	13/13	0%	-	3.249	0.4626	0.6802	0.4025	5	pCi/L	0	0	No	No	Stable	Normal	NS		NA		NA
MW-10	14/14	0%	-	3.58	0.4067	0.6377	0.3049	5	pCi/L	0	0	No	No	Stable	Normal	1.60		No		No

Notes and Abbreviations:

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² Based on background data collected from 08/30/2016 through 09/06/2018, unless otherwise noted.

³ Based on background data collected from 08/30/2016 through 06/11/2018.

* Values obtained from U.S. Environmental Protection Agency Federal CCR Rule Title 40 Code of Federal Regulations (CFR) § 257.95(h)(2)

CCR = coal combustion residuals

GWPS = Groundwater Protection Standard

MCL = maximum contaminant level

mg/L = milligrams per liter

NA = not analyzed

NS = sample not collected; no sample

pCi/L = picoCuries per liter

SSI = statistically significant increase

SSL = statistically significant level

UTL = upper tolerance limits

TABLE 5
STATISTICALLY SIGNIFICANT LEVELS OF APPENDIX IV CONSTITUENTS - SUMMARY TABLE
 TECUMSEH ENERGY CENTER
 BOTTOM ASH SETTLING AREA

Constituent	Sampling Event	Well ID	Groundwater Protection Standard (mg/L)
Arsenic	September 2018	MW-9	0.010
		MW-10	
	March 2019	MW-9	
		MW-10	
	October 2019	MW-9	
		MW-10	
	December 2019	MW-9	
		MW-10	
Cobalt	September 2018	MW-9	0.006
	March 2019	MW-9	
	October 2019	MW-9	
	December 2019	MW-9	

Notes and Abbreviations:
 mg/L = milligrams per liter