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October 13, 2017

Subject: Groundwater Monitoring Well Data Statistical Methods Certification of Compliance for the CCR Rule

Dear Mr. Corbett:

CH2M HILL Engineers, Inc. (CH2M) reviewed and conducted an exploratory evaluation of the initial groundwater monitoring data from the Stanton Energy Center Coal Combustion Residual (CCR) landfill. This exploratory evaluation followed the recommended guidance found in:

EPA's Unified Guidance, Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities.
EPA 530/R-09-007. March 2009.

The groundwater data were collected between September 2015 and July 2017. Nine or eight samples of the constituents found in the CCR Rule, Section 257, Appendixes III and IV, were analyzed. The exploratory analysis included the following steps:

- Graphical plots
- Descriptive statistics
- Outlier analysis
- Temporal independence evaluation
- Distribution analysis (normality)
- Trend analysis
- Temporal and spatial variability
- Recommended statistical analysis methods

The exploratory analysis developed appropriate statistical methods for evaluating groundwater monitoring data from each well-constituent pair.

Selected Statistical Methods

The upgradient well (MW-A) is adjacent to a closed unlined CCR landfill, near the upgradient edge of the OUC property, and cannot be used to establish unaffected upgradient background period groundwater quality conditions. For the purposes of the CCR Rule the background period is July 2015 through October 2017. The landfill is adjacent to the upgradient edge of the OUC property. Because the spatial variability

analysis results indicated significant differences between the wells, each monitoring well's future data will be compared to its own background period level. OUC will use the data collected quarterly through July 2017 to establish a background level for each well-constituent pair, as described below. Some constituents, particularly the Appendix IV list of parameters monitored for detection purposes, had all results below the laboratory detection limit. In these cases, the Maximum Reporting Limit will be applied to determine future action. Others had a large fraction of samples below laboratory detection limits. For lists with high non-detection levels (greater than 50 percent), only nonparametric methods can be used.

In general, most of the Appendix III list of parameters had sufficient detected results to allow for parametric parameter prediction. Several of the datasets had trends, either increasing or decreasing, that must be accounted for when the prediction limits are set to assess future monitoring results. Table 1 lists the statistical method recommended for the Appendix III constituents. The appropriate methodology section(s) from EPA (2009) and the maximum contaminant level (MCL) are listed where appropriate for reference. Censored data occurs when there are non-detects, or perhaps outliers. These will be managed on a case-by-case basis. Of the Appendix III constituents, fluoride had the most non-detects and will likely use the reporting limit (RL) as the upper tolerance limit. Monitoring well MW-D had a high number of non-detects for sulfate and the total dissolved solids (TDS) data were not normal. Additional monitoring data will be required from MW-D to determine if a change in method is justified.

Table 1. Recommended Statistical Methods for Appendix III List of Parameters for Detection Monitoring

Statistical Method Certification, Coal Combustion Residuals Landfill, Stanton Energy Center

Constituent	Compliance Well	Exploratory Data Results			Exploratory Data Conclusion	Ref. EPA, 2009	MCL	(units)
		Potential Outlier	Normal/ Lognormal	Trend				
Boron	MW-B		N	increasing	Parametric Prediction Limit and address trend	18.2.1, 5.2.5	None	
	MW-C		N	increasing	Parametric Prediction Limit and address trend and censored data	18.2.1, 5.2.5		
	MW-D		LN	increasing	Parametric Prediction Limit for LN data along with addressing trend	18.2.1, 5.2.5		
Calcium	MW-B		N	decreasing	Parametric Prediction Limit and address trend	18.2.1, 5.2.5	None	
	MW-C		N	none	Parametric Prediction Limit	18.2.1		

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Statistical Method Certification, Coal Combustion Residuals Landfill, Stanton Energy Center

Constituent	Compliance Well	Exploratory Data Results			Exploratory Data Conclusion	Ref. EPA, 2009	MCL	(units)
		Potential Outlier	Normal/ Lognormal	Trend				
Calcium	MW-D		LN	decreasing	Parametric Prediction Limit for LN data along with addressing trend	18.2.1, 5.2.5		
Chloride	MW-B		N	decreasing	Parametric Prediction Limit and address trend	18.2.1, 5.2.5	250	mg/L, Federal secondary
	MW-C		N	increasing	Parametric Prediction Limit and address trend	18.2.1, 5.2.5		
	MW-D		LN	increasing	Parametric Prediction Limit for LN data along with addressing trend	18.2.1, 5.2.5		
Fluoride	MW-B		high non-detects		Nonparametric Prediction Limit, addressing censored data	18.3.1	4	mg/L, FL secondary
	MW-C		100% non-detects		Nonparametric Prediction Limit, addressing censored data	18.3.1		
	MW-D		high non-detects		Nonparametric Prediction Limit, addressing censored data	18.3.1		
pH	MW-B		N	increasing	Parametric Prediction Limit and address trend	18.2.1, 5.2.5	None	
	MW-C		N	decreasing	Parametric Prediction Limit and address trend	18.2.1, 5.2.5		
	MW-D		N	decreasing	Parametric Prediction Limit and address trend	18.2.1, 5.2.5		
Sulfate	MW-B		N	none	Parametric Prediction Limit	18.2.1	250	mg/L, secondary

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Constituent	Compliance Well	Exploratory Data Results			Exploratory Data Conclusion	Ref. EPA, 2009	MCL	(units)
		Potential Outlier	Normal/ Lognormal	Trend				
Sulfate	MW-C	P	N	none	Parametric Prediction Limit, addressing censored data	18.2.1		
	MW-D		high non-detects		Nonparametric Prediction Limit	18.3.1		
TDS	MW-B		N	decreasing	Parametric Prediction Limit and address trend	18.2.1, 5.2.5	500	mg/L, secondary
	MW-C		N	none	Parametric Prediction Limit	18.2.1, 5.2.5		
	MW-D	P	Non	none	Retest normality with more data. If LN, then Parametric Prediction Limit, else Nonparametric			

Notes:

Potential outliers: None unless noted P

Normal / Lognormal: N or LN, respectively. Non means data were not either. Test could not be conducted when high non-detects were present.

mg/L = milligram per liter; µg/L means microgram per liter

Most of the Appendix IV constituents will be monitored and assessed utilizing the Maximum Reporting Limit if the monitoring program proceeds into assessment from detection monitoring results. In this rule, if a well-constituent pair in the '100% non-detect' group that exhibits quantified measurements (that is, at or above the reporting limit [RL]) in two consecutive sample and resample events, then this result warrants further assessment. This does not necessarily mean that the levels are problematic, just that OUC will need to determine if these are confirmed detections and maybe take other investigations. Table 2 lists the parameters and wells that have data that warrant either a parametric or nonparametric test. In accordance with EPA guidance (2009), nonparametric data require a high number of samples to provide sufficient statistical test power. The RL will be used to compare if the reading are high in nonparametric upper tolerance limit (UTL) until there are enough data to establish a background limit.

Table 2. Recommended Statistical Methods for Appendix IV List of Parameters for Detection Monitoring
Statistical Method Certification, Coal Combustion Residuals Landfill, Stanton Energy Center

		Exploratory Data Results						
Constituent	Compliance Well	Potential Outlier	Normal/Lognormal	Trend	Exploratory Data Conclusion	Ref. EPA, 2009	MCL	(units)
Antimony	MW-B		high non-detects		Nonparametric UTL	18.3.1	6	µg/L
	MW-C		high non-detects		Nonparametric UTL	18.3.1		
	MW-D		high non-detects		Nonparametric UTL	18.3.1		
Arsenic	MW-B				Maximum Reporting Limit	6.2.2	10	µg/L
	MW-C				Maximum Reporting Limit	6.2.2		
	MW-D				Maximum Reporting Limit	6.2.2		
Barium	MW-B		LN	decreasing	Parametric UTL with 95% confidence, 95% coverage for LN data after trend removal	18.2.1	2	mg/L
	MW-C		N	increasing	Parametric UTL with 95% confidence, 95% coverage for N data after trend removal	18.2.1		
	MW-D	P	Non		Nonparametric UTL	18.3.1		
Beryllium	MW-B		LN	decreasing	Parametric UTL with 95% confidence, 95% coverage for LN data after trend removal	18.2.1	4	µg/L
	MW-C		high non-detects		Nonparametric UTL	18.3.1		
	MW-D		high non-detects		Nonparametric UTL	18.3.1		
Cadmium	MW-B				Maximum Reporting Limit	6.2.2	5	µg/L
	MW-C		high non-detects		Nonparametric UTL	18.3.1		

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Statistical Method Certification, Coal Combustion Residuals Landfill, Stanton Energy Center

		Exploratory Data Results						
Constituent	Compliance Well	Potential Outlier	Normal/ Lognormal	Trend	Exploratory Data Conclusion	Ref. EPA, 2009	MCL	(units)
Cadmium	MW-D				Maximum Reporting Limit	6.2.2		
Chromium	MW-B				Maximum Reporting Limit	6.2.2	100	µg/L
	MW-C		high non-detects		Nonparametric UTL	18.3.1		
	MW-D		high non-detects		Nonparametric UTL	18.3.1		
Cobalt	MW-B				Maximum Reporting Limit	6.2.2	None	
	MW-C				Maximum Reporting Limit	6.2.2		
	MW-D				Maximum Reporting Limit	6.2.2		
Lead	MW-B				Maximum Reporting Limit	6.2.2	15	µg/L
	MW-C		high non-detects		Nonparametric UTL	18.3.1		
	MW-D		high non-detects		Nonparametric UTL	18.3.1		
Lithium	MW-B		N	none	Parametric UTL with 95% confidence, 95% coverage for N data	18.2.1	None	
	MW-C		N	none	Parametric UTL with 95% confidence, 95% coverage for N and LN data, and consider using censored data technique	15		
	MW-D		high non-detects		Nonparametric UTL	18.3.1		
Mercury	MW-B				Maximum Reporting Limit	6.2.2	2	µg/L
	MW-C				Maximum Reporting Limit	6.2.2		

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Exploratory Data Results								
Constituent	Compliance Well	Potential Outlier	Normal/ Lognormal	Trend	Exploratory Data Conclusion	Ref. EPA, 2009	MCL	(units)
Mercury	MW-D				Maximum Reporting Limit	6.2.2		
Molybdenum	MW-B				Maximum Reporting Limit	6.2.2	None	
	MW-C				Maximum Reporting Limit	6.2.2		
	MW-D				Maximum Reporting Limit	6.2.2		
Radium-226_228	MW-B		N	none	Parametric UTL with 95% confidence, 95% coverage for N data after addressing censored data	18.2.1	5	pCi/L
	MW-C		high non-detects		Nonparametric UTL	18.3.1		
	MW-D		high non-detects		Nonparametric UTL	18.3.1		
Selenium	MW-B		high non-detects		Nonparametric UTL	18.3.1	50	µg/L
	MW-C		high non-detects		Nonparametric UTL	18.3.1		
	MW-D				Maximum Reporting Limit	6.2.2		
Thallium	MW-B				Maximum Reporting Limit	6.2.2	2	µg/L
	MW-C				Maximum Reporting Limit	6.2.2		
	MW-D				Maximum Reporting Limit	6.2.2		

Notes:
Potential outliers: None unless noted P
Normal / Lognormal: N or LN, respectively.
UTL means upper tolerance limit
mg/L = milligram per liter; µg/L means microgram per liter

Performance Standard

As required by Section 257.93(g)(1), parametric methods were selected only for constituents that were normally distributed or could be transformed into a normal distribution. The selection of parametric

compared with non-parametric methods in Tables 1 and 2 show which data sets were normally distributed or could be transformed. Individual well analysis procedures will be used (that is, intrawell testing). The statistical tests do not need to be done at the listed Type I error level in Section 257.93(g) because tolerance interval and prediction interval tests are being used, but the tests must be at least as effective as any other approach for evaluating groundwater data. The EPA Unified Guidance (2009) will be utilized to establish appropriate limits based on the sample size and type of test.

The recommended statistical evaluations will be applied annually to the new data to assess potential increases from background period data. Every 3 years this extensive exploratory analysis will be reconducted to validate or modify the exploratory study assumptions, the baseline metrics, and the specific statistical methods.

Provided the selected statistical method, a statistically-significant increase over background period values cannot be confirmed or denied until the results of retesting have been obtained. Retesting during detection monitoring is an integral part of the statistical methodology for control of the sitewide false positive rate when multiple monitoring locations and parameters are being evaluated. EPA (2009) recommends that prediction intervals be combined with retesting to maintain a low site wide false positive rate while providing high statistical power. Therefore, a *1-of-2 retesting scheme* will be used during detection monitoring to verify an apparent detection that exceeds the background values for Appendix III constituents (Chapter 19; EPA, 2009).

If the detection monitoring results do not exceed the upper prediction limit, then no retesting is needed. However, if a detection monitoring result does exceed the upper prediction limit, then one additional samples will be collected and tested prior to the next regularly scheduled sampling event. The sampling will occur only at the monitoring well(s) and for the constituent(s) that appear to exceed the upper prediction limit. The sample will be evaluated within 90 days of receiving the analytical results from the laboratory. If the sample does not show a statistically-significant increase over the background limit then no further action will be taken until the next regularly scheduled detection monitoring sampling event. However, if the sample results do show a statistically-significant increase over background values then action must be taken as required by Section 257.94(e) of the CCR Rule.

The Appendix IV assessment constituents will also be monitored as required by the CCR Rule (Section 257.95). These exploratory results recommend upper tolerance limits that can be used to determine if a change may be occurring.

Certification

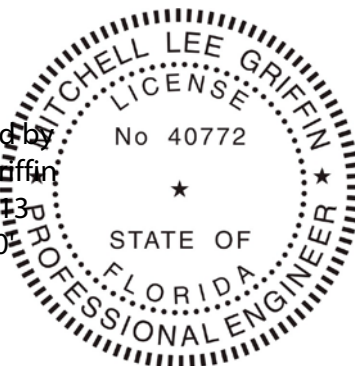
I certify that the recommended statistical methods for evaluating the groundwater monitoring well data at the Stanton Energy Center CCR management area meet the intent of Federal CCR Rule 257.93(f)(6).

With regards,
CH2M HILL Engineers, Inc.

**Mitchell Lee
Griffin**

Mitchell L. Griffin, P.E.
Water Resources Principal Technologist

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This report has been electronically signed and sealed by Mitchell L. Griffin, P.E. on October 13, 2017, using a digital signature.

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