

STATISTICAL ANALYSIS PLAN

BOTTOM ASH POND

Sherburne County (Sherco) Generating Plant
Becker, Minnesota

Prepared for:

Northern States Power Company, a Minnesota Corporation

Revision #1

May 6, 2021



15650 36th Avenue N, Suite 110

Plymouth, MN 55446

Tel 952-346-3900

Fax 952-346-3901

www.carlsonmccain.com

ENVIRONMENTAL \ ENGINEERING \ LAND SURVEYING

**Statistical Analysis Plan
Bottom Ash Pond
Table of Contents**

1.	Introduction	1
2.	Statistical Method.....	1
2.1	<i>Inter-well vs Intra-well Analysis</i>	2
2.2	<i>Background Data</i>	2
2.3	<i>Data Review & Outliers</i>	2
2.4	<i>Non-detects, Testing for Normality & Trends</i>	3
2.5	<i>Duplicate Data</i>	3
2.6	<i>Detection Monitoring and Determination of Statistically Significant Increases</i>	3
3.	Response to a Verified SSI	4
3.1	<i>Assessment Monitoring</i>	5
4.	References	5
5.	Professional Engineer Certification.....	7

1. Introduction

On April 17, 2015, the US Environmental Protection Agency (EPA) published the final rule for the management of Coal Combustion Residuals (CCR). The CCR rule is formally promulgated in the U.S. Code of Federal Regulations, Title 40, Parts 257 and 261 (EPA, 2015) along with amendments to the rule published in July, 2018 (EPA, 2018) and August, 2020 (EPA, 2020). This rule is applicable to the Bottom Ash Pond (Facility) at the Sherburne County Generating Plant (Sherco), which is owned and operated by Northern States Power Company, a Minnesota Corporation (NSPM). The Facility is located approximately 2 miles SW from the city of Becker, Minnesota, on the Sherco Plant property.

Pursuant to the 40 CFR, §257.90(c), NSPM must conduct groundwater monitoring and, if necessary, corrective action throughout the active life and post-closure care period of the CCR unit in accordance with 40 CFR, §257.93. The program must address the selection of statistical methods, and the selected statistical method(s) must be certified by a Qualified Professional Engineer. This Statistical Analysis Plan (Plan) describes the method(s) to be used in identifying a statistically significant increase (SSI) over the upgradient or background groundwater quality. This Plan is included as Appendix A within the Facility's *Bottom Ash Pond, CCR Groundwater Sampling and Analysis Plan* (Carlson McCain, 2021), and the reader is referred to the Sampling and Analysis Plan for additional information on the site-specific hydrogeology, groundwater monitoring system, sampling and analysis procedures, and reporting requirements.

2. Statistical Method

The fundamental goal of statistical analysis is to provide a quantifiable means to evaluate whether a CCR management unit has released contaminants into the groundwater. Upon completion of each compliance monitoring event, detected constituents will be statistically evaluated to identify if an SSI over background has occurred. Statistical methods used to test for an SSI will be implemented in accordance with the EPA's Unified Guidance Document (EPA 2009). The computer software MANAGES®, developed by the Electrical Power Research Institute, will be used to perform the analysis; however, NSPM reserves the right to perform the analysis using comparable statistical tools at a later date.

As groundwater monitoring progresses, the use of the selected statistical method will be subject to ongoing review. NSPM reserves the right to use other statistical tests in place of, or in addition to, the methods specified in this Plan if such methods are better suited for analysis of future results. Additionally, the methods in this Plan have been developed in accordance with the requirements of the CCR rule as published on April 17, 2015 (EPA, 2015), and as amended, and modifications to this Plan may occur if further revisions or amendments are made to the CCR

rule. If test methods are changed this work plan will be revised, as appropriate, and its certification updated.

2.1 *Inter-well vs Intra-well Analysis*

Based on the site hydrogeology and existing groundwater monitoring system described in the CCR Groundwater Monitoring System Certification (Carlson McCain, 2017), the site is well suited for inter-well analysis based upon the following:

- Historical data indicate consistent groundwater gradients and flow directions beneath the Facility.
- Groundwater travel times are sufficiently fast, 153 ft/yr, ensuring the bi-annual samples collected are independent (Carlson McCain, 2017).
- The monitoring wells that comprise the groundwater monitoring system at the Facility are all completed in the same aquifer and are positioned to detect a release from the Facility.
- Baseline data reflect background sources which can be characterized with up-gradient wells.

2.2 *Background Data*

The background data set is comprised of nine rounds of groundwater samples collected from each of the background wells in the groundwater monitoring from December of 2016 through September of 2017, meeting the requirements of §257.94(b). Samples were also collected from downgradient wells during the same time period. Each sample was analyzed for each of the parameters listed in Appendix III and Appendix IV of 40 CFR §257, as required by §257.94(b). Up-gradient data are defined by five wells: P-17, P-23, P-152A, P-157 and P-158.

The background dataset was evaluated and amended in December of 2020 to include data obtained from the background wells during the fall 2017 and years 2018 and 2019. Background data will continue to be evaluated and the data set amended, if appropriate, at a frequency of every two to three years.

2.3 *Data Review & Outliers*

Data review for each sampling event will include:

- Basic statistics will be prepared for each well, and parameter. This will include: total observations, % non-detects, pooled mean, mean, median, standard deviation, and type of distribution.
- Time series plots will be prepared for each well and parameter.

During background data set update, data will be reviewed for outliers and trends. The review will include:

- Data will be reviewed for trends in background wells using either parametric or non-parametric methods.
- Grubbs Outlier testing will be conducted on background wells.

If the data is determined to be an outlier, one of three options is possible: keep the data point “as is” in the database, replace the data point with a corrected value, or discard the data point from statistical calculations. The decision to keep, replace or discard a statistical outlier will be made on a case-by-case basis. In general, observations should be kept in the data set unless there is evidence of errors that would invalidate the data.

2.4 *Non-detects, Testing for Normality & Trends*

Statistical analysis will take into account the data’s distribution type, normal or non-normal. The Shapiro-Wilk test for normality will be performed for each combination of well and parameter. As part of the normality test, non-detect values will be replaced as a function of percent non-detect. If the percentage of non-detects is less than 50%, the non-detect value will be replaced with one-half the laboratory reporting limit (EPRI 2016). If the percentage of non-detects is 50% or higher, a non-parametric test will be used in lieu of parametric testing. Analytical results between the reporting limit and the method detection limit, i.e. “J-flagged” values, will be utilized if provided by the laboratory.

The presence of temporal effects such as seasonality or other time-dependent trends may be identified using time series plots, analysis of variance (ANOVA), a formal trend test such as Mann-Kendall, or one of the tests for autocorrelation listed in Chapter 14 of the Unified Guidance (EPA, 2009). If temporal trends are apparent, the data set will be adjusted as recommended in the Unified Guidance.

2.5 *Duplicate Data*

Blind duplicate samples are collected in the field as part of the Facility’s quality assurance / quality control (QA/QC) program. Results from these samples will be used strictly for QA/QC evaluation and not for statistical analysis.

2.6 *Detection Monitoring and Determination of Statistically Significant Increases*

During detection monitoring, each Appendix III parameter listed in Table 2 of the Sampling and Analysis Plan will be statistically evaluated to determine whether an SSI has occurred. The appropriate test method, parametric or non-parametric, will be determined for each parameter,

well and event combination based on the background evaluation criteria discussed in Sections 2.3 and 2.4, above. Interwell Prediction Intervals will be the primary method to compare compliance data to background data during detection monitoring. Compliance well data will be compared to the upper limit of the prediction interval generated using pooled background data from the upgradient wells. Interwell prediction limits on future values (or means), will be constructed in accordance with the procedures outlined Chapters 18 and 19 of the Unified Guidance to target appropriate annual site-wide false positive rates and statistical power.

If compliance data exceeds the upper prediction limit, a one-of-two pass resampling will be performed. The specific well and parameter will be re-sampled and re-analyzed. Re-sample results will be incorporated into the database, the new data will be reviewed as described in steps 2.3 & 2.4 above, and the data re-processed statistically. If the statistical analysis again reports the compliance data in exceedance of the upper prediction limit, an SSI will be confirmed.

For constituents which report 100% non-detects in background and compliance wells, the double quantification rule will be applied. Whereas, if the constituent concentration in a compliance well exceeds the highest historical laboratory reporting limit for two consecutive events, an SSI will be confirmed.

3. Response to a Verified SSI

In accordance with §257.94 item (e); NSPM will:

- 1) Within 90 days of the determination of an SSI, demonstrate that a source other than the Facility caused the SSI. Due to the complexity of chemical analysis, hydrogeology and background influences, the components of an alternate source demonstration (ASD) are not prescriptive. However, an ASD shall contain sufficient information to confirm the CCR Unit is not the cause of the SSI, and shall be certified by a qualified professional engineer. If a certified ASD is provided, the Facility may continue with detection monitoring.
 - a. The ASD will be included in the Facility's annual groundwater monitoring and corrective action report.
- 2) If a successful ASD is not made within 90 days of the SSI, the Facility must initiate assessment monitoring as required under §257.95.
 - a. A notification that an assessment monitoring program has been established will be placed in the Facility's operating record and posted to the CCR web site.

3.1 Assessment Monitoring

Assessment monitoring will be initiated if a successful ASD is not completed within 90 days of identifying an SSI, and will include the following steps:

- 1) Within 90 days of triggering an assessment monitoring program, and annually thereafter, sample each well for the Appendix IV parameters listed in Table 2 of the Sampling and Analysis Plan.
- 2) Within 90 days of receiving results from step 1), above, resample all wells for Appendix III parameters and detected (i.e. concentration above the reporting limit) Appendix IV parameters.
- 3) Establish groundwater protection standards (GWPS) for each detected Appendix IV parameter. The GWPS shall be the U.S. EPA Maximum Contaminant Level (MCL), the levels for specific constituents listed in §257.95(h)(2), or the background concentrations for the constituent, whichever is higher.
- 4) Determine whether concentrations of Appendix IV parameters exceed the GWPS. This will be done using confidence intervals. If the lower confidence limit exceeds the GWPS at the 95% confidence level then the constituent has been detected at a statistically significant level above the GWPS.
- 5) If concentrations of all Appendix III and Appendix IV parameters continue to be above background concentrations but below the applicable groundwater protection standard, assessment monitoring will continue.
- 6) If one or more Appendix IV parameters is shown by step 4) to exceed the GWPS, the following actions will be taken:
 - a. Place a notification in the operating record identifying the GWPS exceedances
 - b. Characterize the nature and extent of the release
 - c. Notify adjacent landowners located in the delineated extent of the contamination, and document notifications in the operating record.
 - d. Within 90 days:
 - i. Prepare an ASD for the exceedance, or
 - ii. Initiate an assessment of corrective measures in accordance with §257.96.

Assessment monitoring will continue until two consecutive rounds demonstrate Appendix III and Appendix IV constituents are below background levels, at which time the Facility may return to detection monitoring.

4. References

Carlson McCain, 2017. CCR Groundwater Monitoring System Certification, Bottom Ash Pond. Sherburne County (Sherco) Generating Plant; Becker, Minnesota. Prepared for Northern States Power Company, a Minnesota Corporation. October, 2017.

Carlson McCain, 2021. CCR Groundwater Sampling and Analysis Plan, Bottom Ash Pond, Becker, Minnesota. Northern States Power Company, a Minnesota Corporation. April, 2021.

EPA, 2009. Statistical analysis of Groundwater Monitoring Data at RCRA Facilities: Unified guidance. Environmental Protection Agency Office of Resource Conservation and Recovery. EPA 530/R-09-007. March, 2009

EPA, 2015. 40 CFR Parts 257 and 261; Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals From Electric Utilities; Final Rule, Federal Register vol. 80, no. 74. Environmental Protection Agency. April 17, 2015.

EPA, 2018. 40 CFR Part 257; Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals From Electric Utilities; Amendments to the National Minimum Criteria, Federal Register vol. 83, no. 146. Environmental Protection Agency. July 30, 2018.


EPA, 2020. 40 CFR Part 257; Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals From Electric Utilities; A Holistic Approach to Closure Part A: Deadline to Initiate Closure, Federal Register vol. 85, no. 168. Environmental Protection Agency. August 28, 2020.

EPRI, 2016. Presentation by Kirk Cameron on Treating Non-detects. Groundwater Resource Center Workshop, Statistical Methods for Analysis of Groundwater Monitoring Data. Electrical Power Research Institute, October, 2016.

The remainder of this page is intentionally left blank

5. Professional Engineer Certification

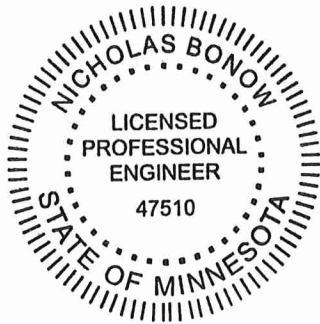
"I hereby certify that the selected statistical method described herein is appropriate for evaluating the ground water monitoring data for the Bottom Ash Pond at the Sherburne County Generating Plant, pursuant to 40 CFR 257.93(f). I am a duly licensed Professional Engineer under the laws of the state of Minnesota".



Nicholas Bonow, PE, PG
License No. 47510
Carlson McCain, Inc.

May 6, 2021

Date



License renewal date: June 30, 2022