



## REPORT

# 2022 Annual CCR Groundwater Report

*Nebraska Public Power District, Sheldon Station*

Submitted to:

**Nebraska Public Power District**

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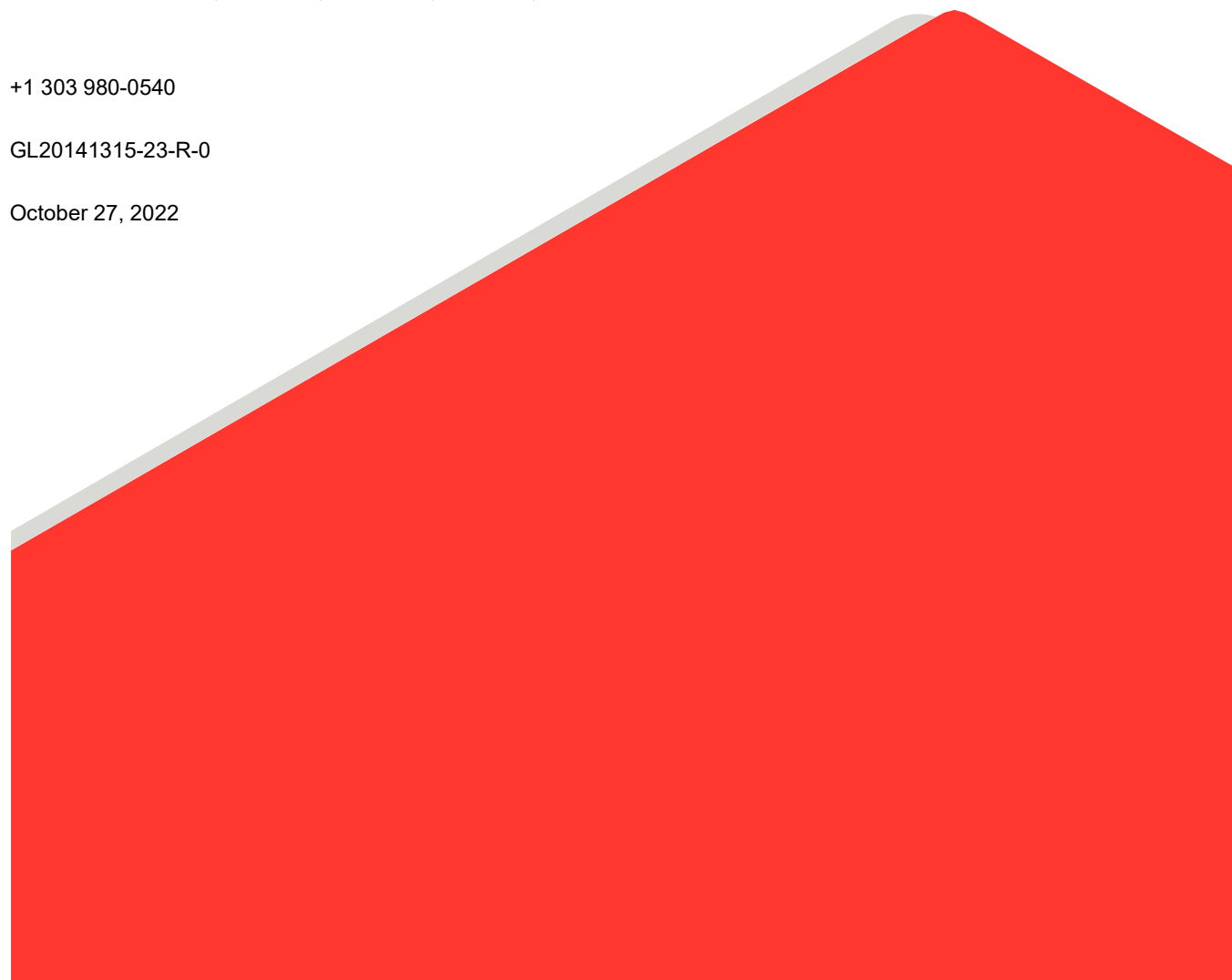
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## Executive Summary

This report presents the results from the 2022 Coal Combustion Residuals (CCR) groundwater monitoring program events at Nebraska Public Power District's Sheldon Station. The facility entered 2022 under a detection monitoring program and remains in detection monitoring based on the results of the first (Q1) and third (Q3) quarter 2022 detection monitoring sampling and analysis events.

For the Q1 2022 detection monitoring sampling event, potential exceedances were identified for chloride at upgradient well AP4-MW2 and sulfate at downgradient well AP4-MW5. Both results were determined to be false-positives following confirmatory re-sampling during the Q3 2022 detection monitoring sampling event.

Sulfate at upgradient well AP4-MW1 was determined to be a verified statistically significant increase (SSI) following the confirmatory re-sampling during the Q1 2022 detection monitoring sampling event. A successful alternate source demonstration was completed that determined that the source of the verified SSI was not Ash Landfill No. 4.

The Sheldon Station monitoring program remains in detection monitoring entering 2023.

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## 1.0 INTRODUCTION

Golder Associates USA Inc. (Golder), a member of WSP, prepared this report describing the 2022 Coal Combustion Residuals (CCR) groundwater sampling events and comparative statistical analysis for Nebraska Public Power District's (NPPD) Sheldon Station Ash Landfill No.4 (AP4; the Site) in Hallam, Nebraska. This report was written to meet the requirements of the Site's permitted Sampling and Analysis Plan (SAP) as approved by the Nebraska Department of Environment and Energy (NDEE) (Golder 2022a) and the federal CCR Rule's sections on groundwater monitoring and corrective action, 40 Code of Federal Regulations (CFR) 257.90 to 98 and applicable revisions to the CCR Rule.

### 1.1 Facility Information

Sheldon Station is owned and operated by NPPD and can generate 225 megawatts (MW) of power. The facility is located in southeastern Nebraska in Section 18, T7N, R6E, and is 19 miles south of Lincoln, in Lancaster County. The village of Hallam is the closest community to the Site and is 1.5 miles south of the facility. NPPD constructed Sheldon Station in 1958, switching the facility entirely to low-sulfur coal from Wyoming's Powder River Basin in 1974. The active CCR landfill at the Site (AP4) contains fly ash and bottom ash.

### 1.2 Purpose

The United States Environmental Protection Agency's (USEPA) CCR Rule established specific requirements for reporting of groundwater monitoring and corrective action at CCR facilities in 40 CFR 257.90 to 40 CFR 257.98. Per part (e) of 40 CFR 257.90, no later than January 31, 2018, and annually thereafter, owners or operators of CCR units must prepare an annual groundwater monitoring and corrective action report. The permitted SAP for AP4 was developed to comply with both the federal CCR regulations and NDEE requirements. In addition to the annual report for the federal CCR requirements, semi-annual reports are also prepared following each sampling event, at the request of the NDEE.

## 2.0 GROUNDWATER MONITORING NETWORK PROGRAM STATUS

The groundwater monitoring network for the active CCR landfill at Sheldon Station consists of seven monitoring wells, as shown in Figure 1 and Figure 2. The two upgradient wells are AP4-MW1 and AP4-MW2. The upgradient wells are marked by (U) throughout this report. The five downgradient monitoring wells are AP4-MW3, AP4-MW4, AP4-MW5, AP4-MW6, and AP4-MW7.

### 2.1 Completed Key Actions in 2022

A detection monitoring sampling event was completed during the first quarter (Q1) of 2022, with an associated semi-annual report provided to the NDEE within 30 days of the end of the quarter.

A detection monitoring sampling event was also completed during the third quarter (Q3) of 2022. Following the sampling event, the associated semi-annual report was provided to the NDEE within 30 days of the end of the quarter.

### 2.2 Installation and Decommissioning of Monitoring Wells

No monitoring wells were installed or decommissioned at Sheldon Station during 2022.

## 2.3 Problems and Resolutions

During both the Q1 and Q3 quarter 2022 monitoring events, analysis by Method 9056A required dilution due to the sample matrix, resulting in non-detects with elevated reporting limits for several well-parameter pairs. Results are consistent with past results and required dilutions. The following well-parameter pairs were reported as non-detects with elevated reporting limits:

- Chloride, 5x dilution factor, elevated reporting limit equal to 5.0 milligrams per liter (mg/L): AP4-MW3, AP4-MW4, AP4-MW6
- Fluoride, 5x dilution factor, elevated reporting limit equal to 0.500 mg/L: AP4-MW2 (U), AP4-MW5, AP4-MW7

Additionally, during the Q1 2022 monitoring event, results for boron by Method 6020A at wells AP4-MW2 and AP4-MW5 were reported as non-detects with elevated reporting limits due to a sample matrix effect on the internal standard associated with the analytical instrument and methodology. Boron results for AP4-MW2 (U) and AP4-MW5 were reported with a 4x dilution factor, with an elevated reporting limit equal to 0.400 mg/L. A laboratory-prepared duplicate for boron at AP4-MW2 (U) and included in the laboratory quality control samples was also reported with the elevated reporting limit. The elevated non-detects are not considered exceedances of the associated statistical limits. The elevated reporting limits were discussed with the analytical laboratory in an attempt to prevent similar occurrences in the future. Reporting limits for boron at AP4-MW2 (U) and AP4-MW5 during the Q3 2022 monitoring event were reported without additional dilutions, consistent with past events.

No further problems were encountered as part of the field sampling and analysis during the Q1 and Q3 2022 monitoring events.

## 2.4 Proposed Key Activities for 2023

Detection monitoring sampling events are planned for the Q1 and Q3 of 2023. The detection monitoring sampling events will consist of sampling, data review, and comparative statistical analysis. Following each detection monitoring sampling event, semi-annual reports will be provided to the NDEE.

## 3.0 GROUNDWATER MONITORING ANALYTICAL PROGRAM STATUS

Analytical activities associated with the groundwater monitoring program are described below.

### 3.1 Samples Collected

Sheldon Station staff collected eight initial baseline samples on a quarterly basis between September 15, 2015, and May 16, 2017, at each of the two upgradient and five downgradient monitoring wells. Detection monitoring samples have been collected on a semi-annual basis beginning on September 18, 2017. This report outlines the results of the detection monitoring sampling events that occurred on March 2, 2022, and August 23, 2022. Specific dates for each sample collected as part of the program are provided in Table 1 through Table 7.

#### 3.1.1 Groundwater Elevation and Flow Rate

Groundwater elevations were measured in each well during each sampling event prior to purging. Elevation measurements can be found in Table 8. Groundwater elevations and interpolated groundwater contours from the March 2022 (Q1 2022) detection monitoring sampling event and the August 2022 (Q3 2022) detection monitoring sampling event are shown in Figure 1 and Figure 2, respectively. Figure 3 shows groundwater elevations over time at the Site.

The groundwater flow rate across Ash Landfill 4 was estimated with the equation  $V_s = k \times i / n_e$ , where:

- $V_s$  is the groundwater flow rate, in feet per day (ft/day).
- $k$  is the hydraulic conductivity in ft/day, estimated at 0.005 ft/day from slug testing results from system wells.
- $i$  is the hydraulic gradient in feet per foot (ft/ft), calculated based on groundwater elevations during each monitoring event.
- $n_e$  is the effective porosity, a unitless parameter, estimated to be 0.2 for site soils.

The average groundwater flow rate for March 2022 was estimated to be  $8.7 \times 10^{-4}$  ft/day based on the calculated hydraulic gradient for March 2022 of 0.04 ft/ft. The average groundwater flow rate for August 2022 was estimated to be  $8.7 \times 10^{-4}$  ft/day, based on the calculated hydraulic gradient for August 2022 of 0.03 ft/ft.

## 3.2 Monitoring Data (Analytical Results)

Analytical results for the federal CCR Rule Appendix III detection monitoring results for the March 2022 and August 2022 detection monitoring events are shown in Table 1 through Table 7.

## 3.3 Baseline Statistical Analysis

The baseline (or background) period for each well-constituent pair within the Sheldon Station program with a minimum of eight samples collected through the Q3 2021 sampling event was reviewed for the potential to update the baseline periods. Baseline periods for the program wells were originally established with data collected between September 2015 and May 2017. The USEPA recommends updating the baseline period every two to three years when sampling is conducted on a semi-annual basis, or after every four to eight collected samples (USEPA 2009). For the well-constituent pairs within the program, results from nine samples collected between September 2017 and August 2021 were reviewed for potential inclusion in the updated statistical baseline periods.

The baseline update described in this document, as well as any future baseline update, included a review of any revisions to federal and state regulations and USEPA statistical guidance documents that may have been promulgated since the initial baseline was established or the previous baseline statistical update was conducted. The baseline period for a specific well-constituent pair was not reviewed for the potential to update if either an unresolved potential exceedance or a verified statistically significant increase (SSI) was identified that was not attributable to an alternative source separate from the facility. Compliance results that were previously determined to be false-positives during comparative statistical analysis were reviewed for potential inclusion in the updated baseline. If a successful alternative source demonstration (ASD) had been conducted for a verified SSI that determined that the SSI was not related to a release from the facility in question, the recent compliance data were reviewed for potential inclusion in the updated baseline.

### 3.3.1 Statistical Limits

Either a parametric or non-parametric method was used to generate the updated baseline statistical limit for eligible well-constituent pair. The statistical method varied between constituents and was selected based on the percentage of non-detect values in the baseline period and the baseline data distribution for each constituent at each well, in accordance with the Unified Guidance (USEPA 2009).

For those well-constituent pairs where concentrations of a given analyte were normally or transform-normally distributed and had greater than 50 percent detections, Shewhart-CUSUM (cumulative summation) control charts

were used. The Unified Guidance notes that Shewhart-CUSUM control charts use two separate evaluation procedures. The Shewhart portion is similar to a parametric prediction limit, comparing compliance measurements to a baseline limit. The CUSUM portion of the test analyzes new measurements against prior compliance measurements. The mean ( $\bar{x}$ ) and standard deviation ( $s$ ) of the baseline (i.e., background,  $BG$ ) dataset are used to calculate the statistical limit ( $SL$ ), by the following equation:

$$SL = \bar{x}_{BG} + h s_{BG}$$

Per the Unified Guidance,  $h$  is the standardized control limit, set at 4.5 for datasets with less than 12 points, and 4.0 for datasets with 12 points or more.

Where concentrations of a given well-constituent pair were not normally or transform-normally distributed, or contained less than or equal to 50 percent detections, a non-parametric prediction limit was used. The non-parametric prediction limit was assigned as either the highest detected value, excluding outliers, or the highest practical quantitation limit (PQL), whichever was greater.

### 3.3.2 Results of the Baseline Update

Information pertaining to the updated statistical baselines are provided in Appendix A. Baseline periods were updated through inclusion of available data collected between September 2015 and August 2021, notwithstanding removal of outliers as appropriate, per the methodology above, for the majority of well-constituent pairs, with exceptions noted in Section 3.3.2.1.

#### 3.3.2.1 Excluded Outliers

The following outliers were identified and excluded from the updated baseline periods. Reasoning for the removal of the outliers is provided below. Excluded outliers are retained with the dataset and will be reviewed as appropriate for inclusion in future baseline updates.

- AP4-MW1 (U), Chloride, 9/15/2015: Unusually high measurement; removal allows for a more conservative statistical limit to be established.
- AP4-MW2 (U), Boron, 11/23/2015: Non-detect value with an elevated reporting limit equal to five times the current reporting limit; removal allows for a more conservative statistical limit to be established.
- AP4-MW2 (U), Fluoride, 11/23/2015: Unusually high measurement; removal allows for a more conservative statistical limit to be established.
- AP4-MW4, Chloride, 9/15/2015: Unusually high measurement; removal allows for a more conservative statistical limit to be established.
- AP4-MW4, Field-Measured pH, 9/17/2019: Statistically identified outlier where removal allows establishment of a parametric statistical limit.
- AP4-MW4, Sulfate, 9/11/2018: Non-detect value inconsistent with total dissolved solids (TDS) value collected on same date and other sulfate values at AP4-MW4.
- AP4-MW5, Fluoride, 5/16/2017: Unusually high measurement; removal allows for a more conservative statistical limit to be established.



### **3.3.2.2 Baseline Periods Not Updated in March 2022**

The following well-constituent pairs had baseline periods that were not updated. The original baseline periods with dates from September 2015 to May 2017 will be retained for use in comparative statistical analysis.

- AP4-MW1 (U), Sulfate: A potential exceedance was identified for sulfate at AP4-MW1 during the Q3 2021 sampling event. Pending the results of the comparative statistical analysis for confirmatory re-sampling in Q1 2022, the well-constituent pair will be reassessed for the potential to update the baseline period.
- AP4-MW3, TDS: A statistically significant decreasing trend was identified at 95 percent and 99 percent. Following the Q1 2022 comparative statistical analysis, the well-constituent pair will be reassessed for the potential to update the baseline period.

### **3.3.2.3 Baseline Period Updated Following NDEE ASD Approval**

Following concurrence of the NDEE (2022) for the ASD conducted for sulfate at AP4-MW1 (U) following the Q1 detection monitoring event (Golder 2022), the baseline period for sulfate at AP4-MW1 (U) was reviewed for the potential to update the statistical limit. Results of the baseline update for sulfate at AP4-MW1 with data collected through March 2022 included in Table 9. The updated statistical limit has been used for the Q3 2022 comparative statistical analysis described in Section 3.4.

## **3.4 Comparative Statistical Analysis**

The comparative statistical analysis is summarized below with results presented in Table 10 through Table 16. A full description of the steps taken for the comparative statistical analysis can be found in the Groundwater Monitoring Statistical Methods Certification (Golder 2017a).

### **3.4.1 Definitions**

The following definitions are used in discussion of the comparative statistical analysis:

- SSI – defined as a result that exceeds the statistical limit established by the baseline statistical analysis, which has been verified by confirmatory re-sampling and analysis.
- Elevated CUSUM – occurs when the calculated CUSUM value is greater than the Shewhart-CUSUM limit established by the baseline statistical analysis, but the analytical result does not exceed the Shewhart-CUSUM limit. An elevated CUSUM is an indication that concentrations are gradually increasing and that analytical results may exceed the Shewhart-CUSUM limit in the future.
- Potential Exceedance – defined as an initial elevated CUSUM or an analytical result that exceeds the Shewhart-CUSUM limit or non-parametric prediction limit established by the baseline statistical analysis. Confirmatory re-sampling will determine if a potential exceedance is a false-positive or a verified SSI. Non-detect results that exceed either the Shewhart-CUSUM limit or the non-parametric prediction limit are not considered potential exceedances.
- False-positive – defined as an analytical result or elevated CUSUM that exceeded the associated statistical limit, but can be clearly attributed to laboratory error, changes in analytical precision, or is invalidated through confirmatory re-sampling. False-positives are not used in calculation of any subsequent CUSUM values.

- Confirmatory re-sampling – designated as the next sampling event.
- Verified exceedances (verified SSIs) – interpreted as two consecutive samples exceeding the statistical limit (the original sample and the confirmatory re-sample, or two, consecutive elevated CUSUMs) for the same parameter at the same well.

### 3.4.2 Potential Exceedances

Chloride at AP4-MW2 (U) was identified as a potential exceedance during the Q1 2022 detection monitoring event. Confirmatory re-sampling occurred during the Q3 2022 detection monitoring event, with results discussed below.

Sulfate at AP4-MW5 was identified as a potential exceedance during the Q1 2022 detection monitoring event. Confirmatory re-sampling occurred during the Q3 2022 detection monitoring event, with results discussed below.

No potential exceedances were identified for the Q3 2022 detection monitoring event.

### 3.4.3 False-Positives

No false-positives were identified during the Q1 2022 detection monitoring sampling event.

Following the Q3 2022 confirmatory re-sampling event, false-positives were identified for the Q1 2022 detection monitoring event for the following well-parameter pairs:

- Chloride at AP4-MW2 (U)
- Sulfate at AP4-MW5

### 3.4.4 Verified Exceedances

Sulfate at AP4-MW1 (U) was identified as a verified SSI during the Q1 2022 detection monitoring event. A potential exceedance was identified during the Q3 2021 sampling event and verified through confirmatory re-sampling during the Q1 2022 sampling event. Both the Q3 2021 and Q1 2022 results had elevated CUSUM values. The analytical results for sulfate at AP4-MW1 during the Q3 2021 and Q1 2022 sampling event were below the statistical limit. Following a successful ASD (Section 3.5.2), the baseline period for sulfate at AP4-MW1 was updated prior to the Q3 2022 detection monitoring event.

## 3.5 Program Transitions

Beginning in Q3 2017, the groundwater monitoring program at Sheldon Station transitioned from the initial baseline period to detection monitoring. During the initial baseline period, eight independent samples from each well within the program were collected and analyzed for the constituents listed in Appendix III and Appendix IV of the CCR Rule prior to October 17, 2017, as specified in 40 CFR 257.94(b).

### 3.5.1 Detection Monitoring

Samples for the detection monitoring program are collected on a semi-annual basis, beginning with the sample collected in September 2017. NPPD plans to continue to collect semi-annual samples under the detection monitoring program in 2023.

### 3.5.2 Alternative Source Demonstrations

Resulting from the verified SSI for sulfate at AP4-MW1 (U) verified during the Q1 2022 detection monitoring event, NPPD and Golder pursued an ASD. As an upgradient background location, groundwater from AP4-MW1 flows

north towards the landfill, as shown in Figure 1 and Figure 2. As such, AP4 is not considered the source of the verified SSI at AP4-MW1. A review of relevant site conditions and associated information was completed within 90 days of identification of the verified SSI and presented as an ASD, included as Appendix A. Following completion of the successful ASD and concurrence of the NDEE, Sheldon Station's AP4 remains in detection monitoring.

### 3.5.3 Assessment Monitoring

The current groundwater monitoring program at Sheldon Station is not in assessment monitoring. Assessment monitoring has not been triggered as described in 40 CFR 257.95.

### 3.5.4 Corrective Measures and Assessment

The current groundwater monitoring program at Sheldon Station does not indicate the need for corrective measures. An assessment of corrective measures, as described in 40 CFR 257.96, has not been required. No ASDs stemming from statistically significant levels of federal Appendix IV parameters identified as part of an assessment monitoring program has been made. No actions are required at this time.

## 4.0 RECOMMENDATIONS AND CLOSING

This report presents the results from the CCR detection monitoring events that occurred on March 2, 2022, and August 23, 2022, along with the associated comparative statistical analysis.

As described in the Groundwater Monitoring System Certification (Golder 2017b) and the Groundwater Monitoring Statistical Methods Certification (Golder 2017a), the groundwater monitoring and analytical procedures meet the general requirements of the CCR Rule, and modifications to the monitoring network and sampling program are not recommended at this time.

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- USEPA. 2015. Code of Federal Regulations Title 40 Part 257: Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities. April 17, 2015.

## Tables

Table 1. Data Summary Table - AP4-MW1 (U)

Analytes		9/15/2015	11/23/2015	3/15/2016	5/18/2016	8/9/2016	11/9/2016	3/7/2017	5/16/2017	9/19/2017	3/21/2018	9/11/2018	3/20/2019	9/17/2019	3/8/2020	9/1/2020	3/9/2021	8/25/2021	3/2/2022	8/23/2022
	Units	Background Collection								Detection Monitoring <sup>1</sup>										
Appendix III																				
Boron, Total	mg/L	0.0784	< 0.150	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	0.100	< 0.100	< 0.100	< 0.100	< 0.100
Calcium, Total	mg/L	89.8	90.4	95.1	103	93.0	88.3	103	92.3	91.0	99.6	82.4	94.2	93.7	85.3	94.0	96.2	93.7	92.6	101
Chloride	mg/L	22.5	7.05	5.57	6.43	6.24	11	5.37	7.48	7.47	6.52	5.61	6.15	1.18	6.74	7.27	7.13	7.17	6.81	7.59
Fluoride	mg/L	< 0.500	0.598	0.923	0.796	0.604	< 0.500	0.656	1.22	1.2	0.846	0.723	1.07	0.194	0.552	0.816	0.856	0.615	0.611	0.524
Field pH	pH units	6.95	6.94	7.46	7.26	7.19	7.19	7.32	7.19	7.17	7.36	7.23	7.59	7.60	7.37	7.16	6.8	7.14	7.11	7.20
Sulfate	mg/L	22.8	23.7	22.2	22.2	22.8	24.5	20.6	21.7	24.4	23.4	19.6	23.2	4.79	25.7	25.3	25.2	27.2	26.2	22.7
Total Dissolved Solids	mg/L	440	462	428	430	462	464	484	520	464	408	406	416	392	422	396	388	388	396	368
Appendix IV																				
Antimony, Total	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	---	---	---	---	---	---	---	---	---	---	---
Arsenic, Total	mg/L	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	---	---	---	---	---	---	---	---	---	---	---
Barium, Total	mg/L	0.23	0.258	0.221	0.199	0.193	0.209	0.269	0.231	---	---	---	---	---	---	---	---	---	---	---
Beryllium, Total	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	---	---	---	---	---	---	---	---	---	---	---
Cadmium, Total	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	---	---	---	---	---	---	---	---	---	---	---
Chromium, Total	mg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	---	---	---	---	---	---	---	---	---	---	---
Cobalt, Total	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	---	---	---	---	---	---	---	---	---	---	---
Fluoride	mg/L	< 0.500	0.598	0.923	0.796	0.604	< 0.500	0.656	1.22	---	---	---	---	---	---	---	---	---	---	---
Lead, Total	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	---	---	---	---	---	---	---	---	---	---	---
Lithium, Total	mg/L	0.0508	0.0513	0.0504	0.0505	0.0506	0.0546	< 0.05	< 0.05	---	---	---	---	---	---	---	---	---	---	---
Mercury, Total	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	---	---	---	---	---	---	---	---	---	---	---
Molybdenum, Total	mg/L	0.00725	0.00823	0.00724	0.00647	0.00656	0.00655	0.00883	0.00739	---	---	---	---	---	---	---	---	---	---	---
Radium-226	pCi/L	0.257 ± 0.0866	0.293 ± 0.104	0.35 ± 0.097	0.314 ± 0.0878	0.417 ± 0.111	0.527 ± 0.33	0.208 ± 0.0918	0.373 ± 0.125	---	---	---	---	---	---	---	---	---	---	---
Radium-228	pCi/L	2.14 ± 0.411	2.68 ± 0.446	1.49 ± 0.319	1.19 ± 0.318	1.26 ± 0.383	2.09 ± 0.453	2.02 ± 0.392	1.88 ± 0.383	---	---	---	---	---	---	---	---	---	---	---
Radium-226 + Radium-228	pCi/L	2.397 ± 0.42	2.973 ± 0.458	1.84 ± 0.333	1.51 ± 0.33	1.67 ± 0.399	2.62 ± 0.561	2.22 ± 0.403	2.25 ± 0.403	---	---	---	---	---	---	---	---	---	---	---
Selenium, Total	mg/L	0.00901	0.0123	0.0101	0.00873	0.00826	0.00816	0.0114	0.00999	---	---	---	---	---	---	---	---	---	---	---
Thallium, Total	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	---	---	---	---	---	---	---	---	---	---	---

Legend:  
--- Not analyzed  
mg/L: milligrams per liter  
pCi/L: picocuries per liter

NOTES:  
1. As indicated by the CCR Rule (40 CFR 257.94), the Detection Monitoring Program monitors all constituents found in Appendix III.

Table 2. Data Summary Table - AP4-MW2 (U)

Analytes		9/15/2015	11/23/2015	3/15/2016	5/18/2016	8/9/2016	11/9/2016	3/7/2017	5/16/2017	9/19/2017	3/21/2018	9/11/2018	3/20/2019	9/17/2019	3/8/2020	9/1/2020	3/9/2021	8/25/2021	3/2/2022	8/23/2022
	Units	Background Collection								Detection Monitoring <sup>1</sup>										
Appendix III																				
Boron, Total	mg/L	0.0831	< 0.500	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.100	< 0.100	< 0.100	< 0.400	< 0.100
Calcium, Total	mg/L	335	321	294	320	289	286	342	278	293	331	263	297	291	239	292	296	288	295	336
Chloride	mg/L	89.9	93.3	83.6	94.2	92.7	92.5	87	88.6	88.6	94.3	92	87.6	88.8	93.9	106.0	113.0	111	115	99.6
Fluoride	mg/L	< 0.500	3.1	0.596	0.666	0.558	< 0.500	< 0.500	0.935	0.677	0.687	< 0.500	0.612	0.702	0.715	< 0.500	< 0.500	0.533	< 0.500	< 0.500
Field pH	pH units	6.98	6.99	7.37	7.2	7.16	7.13	7.25	7.18	7.16	7.26	7.19	7.44	7.60	7.33	7.09	7.05	7.08	7.09	7.1
Sulfate	mg/L	884	888	797	804	901	842	774	797	894	879 E	827	923	855	857	874	876	882	933	906
Total Dissolved Solids	mg/L	1720	1840	1700	1830	1900	1790	2360	1780	2210	1650	1680	1730	1570	1740	1620	1680	1620	1560	1680
Appendix IV																				
Antimony, Total	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	---	---	---	---	---	---	---	---	---	---	---
Arsenic, Total	mg/L	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	---	---	---	---	---	---	---	---	---	---	---
Barium, Total	mg/L	0.0115	0.0117	0.0107	0.0102	0.00996	0.012	0.0138	0.0103	---	---	---	---	---	---	---	---	---	---	---
Beryllium, Total	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	---	---	---	---	---	---	---	---	---	---	---
Cadmium, Total	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	---	---	---	---	---	---	---	---	---	---	---
Chromium, Total	mg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	---	---	---	---	---	---	---	---	---	---	---
Cobalt, Total	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	---	---	---	---	---	---	---	---	---	---	---
Fluoride	mg/L	< 0.500	3.1	0.596	0.666	0.558	< 0.500	< 0.500	0.935	---	---	---	---	---	---	---	---	---	---	---
Lead, Total	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	---	---	---	---	---	---	---	---	---	---	---
Lithium, Total	mg/L	0.0811	0.0754	0.0699	0.0681	0.0523	0.0705	0.0661	0.0694	---	---	---	---	---	---	---	---	---	---	---
Mercury, Total	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	---	---	---	---	---	---	---	---	---	---	---
Molybdenum, Total	mg/L	0.00543	0.00555	0.00526	0.00533	0.00519	0.00494	0.00627	0.00491	---	---	---	---	---	---	---	---	---	---	---
Radium-226	pCi/L	0.258 ± 0.0937	0.241 ± 0.0886	0.28 ± 0.0846	0.312 ± 0.0834	0.334 ± 0.097	0.778 ± 0.403	0.25 ± 0.103	0.188 ± 0.0925	---	---	---	---	---	---	---	---	---	---	---
Radium-228	pCi/L	2.02 ± 0.457	2.53 ± 0.497	2.07 ± 0.384	2.2 ± 0.449	2.41 ± 0.467	2.49 ± 0.485	2.01 ± 0.41	2.01 ± 0.405	---	---	---	---	---	---	---	---	---	---	---
Radium-226 + Radium-228	pCi/L	2.278 ± 0.467	2.771 ± 0.505	2.35 ± 0.394	2.51 ± 0.456	2.74 ± 0.477	3.27 ± 0.631	2.26 ± 0.423	2.2 ± 0.415	---	---	---	---	---	---	---	---	---	---	---
Selenium, Total	mg/L	0.714	0.697	0.634	0.706	0.628	0.628	0.779	0.657	---	---	---	---	---	---	---	---	---	---	---
Thallium, Total	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	---	---	---	---	---	---	---	---	---	---	---

Legend:  
--- Not analyzed  
mg/L: milligrams per liter  
pCi/L: picocuries per liter  
E: Result exceeded calibration range.

NOTES:  
1. As indicated by the CCR rule (40 CFR 257.94), the Detection Monitoring Program monitors all constituents found in Appendix III.

Table 3. Data Summary Table - AP4-MW3

Analytes		9/15/2015	11/23/2015	3/15/2016	5/18/2016	8/9/2016	11/9/2016	3/7/2017	5/16/2017	9/19/2017	3/21/2018	9/11/2018	3/20/2019	9/17/2019	3/8/2020	9/1/2020	3/9/2021	8/25/2021	3/2/2022	8/23/2022
	Units	Background Collection								Detection Monitoring <sup>1</sup>										
Appendix III																				
Boron, Total	mg/L	0.0687	< 0.150	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Calcium, Total	mg/L	82.4	85.9	89.8	88.5	87.5	85	95.8	86.1	83.7	92.3	74.7	88.5	87.8	81.1	84.1	88.4	88.3	84.3	94.5
Chloride	mg/L	12.4	< 5.00	< 5.00	< 5.00	6.94	5.4	< 5.00	5.18	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00
Fluoride	mg/L	< 0.500	0.975	1.08	1.1	0.513	0.884	1.04	1.82	1.2	1.29	1.05	1.29	1.24	1.24	1.34	1.33	0.914	0.972	0.717
Field pH	pH units	7.15	7.21	7.60	7.38	7.30	7.34	7.39	7.40	7.28	7.48	7.43	7.69	7.60	7.56	7.3	6.55	7.36	7.27	7.40
Sulfate	mg/L	33.2	24.4	25.2	34.6	31.2	29	20.6	21.7	33.2	30.7	20	35	32.3	30.3	26.7	22.9	29.2	22.3	21
Total Dissolved Solids	mg/L	418	460	390	420	488	430	428	442	494	404	374	426	378	374	378	348	344	354	326
Appendix IV																				
Antimony, Total	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	---	---	---	---	---	---	---	---	---	---	---
Arsenic, Total	mg/L	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	---	---	---	---	---	---	---	---	---	---	---
Barium, Total	mg/L	0.218	0.235	0.225	0.222	0.206	0.232	0.271	0.238	---	---	---	---	---	---	---	---	---	---	---
Beryllium, Total	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	---	---	---	---	---	---	---	---	---	---	---
Cadmium, Total	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	---	---	---	---	---	---	---	---	---	---	---
Chromium, Total	mg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	---	---	---	---	---	---	---	---	---	---	---
Cobalt, Total	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	---	---	---	---	---	---	---	---	---	---	---
Fluoride	mg/L	< 0.500	0.975	1.08	1.1	0.513	0.884	1.04	1.82	---	---	---	---	---	---	---	---	---	---	---
Lead, Total	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	---	---	---	---	---	---	---	---	---	---	---
Lithium, Total	mg/L	0.0502	< 0.0500	0.0519	< 0.05	< 0.05	0.0538	0.0520	0.0547	---	---	---	---	---	---	---	---	---	---	---
Mercury, Total	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	---	---	---	---	---	---	---	---	---	---	---
Molybdenum, Total	mg/L	0.00922	0.0101	0.00992	0.00873	0.00928	0.00978	0.0116	0.00983	---	---	---	---	---	---	---	---	---	---	---
Radium-226	pCi/L	0.401 ± 0.101	0.389 ± 0.106	0.384 ± 0.103	0.501 ± 0.104	0.4 ± 0.102	0.426 ± 0.292	0.318 ± 0.108	0.188 ± 0.0889	---	---	---	---	---	---	---	---	---	---	---
Radium-228	pCi/L	3.69 ± 0.576	2.87 ± 0.491	2.91 ± 0.463	3.42 ± 0.547	2.65 ± 0.477	3.19 ± 0.561	2.35 ± 0.432	2.26 ± 0.422	---	---	---	---	---	---	---	---	---	---	---
Radium-226 + Radium-228	pCi/L	4.091 ± 0.474	3.259 ± 0.502	3.3 ± 0.474	3.92 ± 0.557	3.04 ± 0.487	3.62 ± 0.632	2.67 ± 0.445	2.45 ± 0.431	---	---	---	---	---	---	---	---	---	---	---
Selenium, Total	mg/L	0.0138	0.0164	0.0165	0.0145	0.0152	0.0154	0.0201	0.0191	---	---	---	---	---	---	---	---	---	---	---
Thallium, Total	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	---	---	---	---	---	---	---	---	---	---	---

Legend:  
--- Not analyzed  
mg/L: milligrams per liter  
pCi/L: picocuries per liter

NOTES:  
1. As indicated by the CCR rule (40 CFR 257.94), the Detection Monitoring Program monitors all constituents found in Appendix III.



Table 4. Data Summary Table - AP4-MW4

Analytes		9/15/2015	11/23/2015	3/15/2016	5/18/2016	8/9/2016	11/9/2016	3/7/2017	5/16/2017	9/19/2017	3/21/2018	9/11/2018	3/20/2019	9/17/2019	3/8/2020	9/1/2020	3/9/2021	8/25/2021	3/2/2022	8/23/2022
	Units	Background Collection								Detection Monitoring <sup>1</sup>										
Appendix III																				
Boron, Total	mg/L	0.0674	< 0.150	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Calcium, Total	mg/L	128	123	103	115	111	105	132	95.4	108	109	97.1	100	112	91.9	104	112	109	102	119
Chloride	mg/L	13	8.99	< 5.00	6.71	8.55	7.77	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00
Fluoride	mg/L	< 0.500	0.987	0.946	0.949	< 0.500	0.732	0.786	1.33	1.18	1.2	0.796	1.17	1.12	0.983	1.110	0.989	0.900	0.837	0.626
Field pH	pH units	7.02	7.17	7.40	7.25	7.15	7.22	7.23	7.31	7.23	7.32	7.29	7.60	7.75	7.43	7.22	7.23	7.17	7.13	7.3
Sulfate	mg/L	82.8	127	62.6	89.5	99.6	110	123	59.4	53.5	100	81.9	85.7	109	114	95.5	97.5	87.3	84.7	76.1
Total Dissolved Solids	mg/L	506	590	476	518	582	556	576	666	498	530	466	486	490	516	510	466	452	452	436
Appendix IV																				
Antimony, Total	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	---	---	---	---	---	---	---	---	---	---	---
Arsenic, Total	mg/L	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	---	---	---	---	---	---	---	---	---	---	---
Barium, Total	mg/L	0.151	0.14	0.168	0.128	0.131	0.177	0.123	0.158	---	---	---	---	---	---	---	---	---	---	---
Beryllium, Total	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	---	---	---	---	---	---	---	---	---	---	---
Cadmium, Total	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	---	---	---	---	---	---	---	---	---	---	---
Chromium, Total	mg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	---	---	---	---	---	---	---	---	---	---	---
Cobalt, Total	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	---	---	---	---	---	---	---	---	---	---	---
Fluoride	mg/L	< 0.500	0.987	0.946	0.949	< 0.500	0.732	0.786	1.33	---	---	---	---	---	---	---	---	---	---	---
Lead, Total	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	---	---	---	---	---	---	---	---	---	---	---
Lithium, Total	mg/L	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	---	---	---	---	---	---	---	---	---	---	---
Mercury, Total	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	---	---	---	---	---	---	---	---	---	---	---
Molybdenum, Total	mg/L	0.00509	0.0054	0.00493	0.00443	0.00481	0.00466	0.00642	0.00483	---	---	---	---	---	---	---	---	---	---	---
Radium-226	pCi/L	0.45 ± 0.107	0.451 ± 0.124	0.362 ± 0.104	0.471 ± 0.0996	0.36 ± 0.0976	< 0.481 U ± 0.277	0.327 ± 0.112	0.185 ± 0.0900	---	---	---	---	---	---	---	---	---	---	---
Radium-228	pCi/L	2.78 ± 0.489	1.59 ± 0.370	1.86 ± 0.360	2.62 ± 0.468	2.05 ± 0.452	1.39 ± 0.384	1.93 ± 0.397	1.9 ± 0.388	---	---	---	---	---	---	---	---	---	---	---
Radium-226 + Radium-228	pCi/L	3.23 ± 0.501	2.041 ± 0.390	2.23 ± 0.375	3.09 ± 0.478	2.41 ± 0.462	1.56 ± 0.474	2.25 ± 0.413	2.08 ± 0.399	---	---	---	---	---	---	---	---	---	---	---
Selenium, Total	mg/L	0.0259	0.0137	0.0181	0.0132	0.0198	0.0119	0.0104	0.013	---	---	---	---	---	---	---	---	---	---	---
Thallium, Total	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	---	---	---	---	---	---	---	---	---	---	---

Legend:  
--- Not analyzed  
mg/L: milligrams per liter  
pCi/L: picocuries per liter  
U: Result is less than the sample detection limit (varies by sample for radiological results).

NOTES:  
1. As indicated by the CCR rule (40 CFR 257.94), the Detection Monitoring Program monitors all constituents found in Appendix III.

Table 5. Data Summary Table - AP4-MW5

Analytes		9/15/2015	11/23/2015	3/15/2016	5/18/2016	8/9/2016	11/9/2016	3/7/2017	5/16/2017	9/19/2017	3/21/2018	9/11/2018	3/20/2019	9/17/2019	3/8/2020	9/1/2020	3/9/2021	8/25/2021	3/2/2022	8/23/2022
	Units	Background Collection								Detection Monitoring <sup>1</sup>										
Appendix III																				
Boron, Total	mg/L	0.0934	< 0.150	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	0.133	< 0.100	< 0.100	< 0.400	< 0.100
Calcium, Total	mg/L	358	520	439	460	523	517	608	310	488	537	146	541	504	363	579	210	177	600	178
Chloride	mg/L	8.98	8.99	5.77	6.97	7.98	10	5.69	6.76	< 5.00	6.59	< 5.00	5.1	5.43	6.03	6.19	5.56	< 5.00	5.71	< 5.00
Fluoride	mg/L	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	1.27	0.658	0.601	< 0.500	0.664	0.61	< 0.500	< 0.500	0.53	< 0.500	< 0.500	< 0.500
Field pH	pH units	6.75	7.05	7.08	6.89	6.81	6.82	6.90	6.90	6.82	6.97	7.27	7.23	7.26	7.06	6.82	6.94	7.04	6.67	7.1
Sulfate	mg/L	1420	1480	969	1410	1620	1570	1350	740	784	1630	468	1470	1370	1540	1580	678	592	1670	426
Total Dissolved Solids	mg/L	2540	2740	1950	2620	2860	2920	3010	1490	1710	2690	1020	2390	2210	2500	2740 H	1180	980	2450	750
Appendix IV																				
Antimony, Total	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	---	---	---	---	---	---	---	---	---	---	---
Arsenic, Total	mg/L	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	---	---	---	---	---	---	---	---	---	---	---
Barium, Total	mg/L	0.017	0.00903	0.0117	0.00926	0.00843	0.00795	0.00756	0.0124	---	---	---	---	---	---	---	---	---	---	---
Beryllium, Total	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	---	---	---	---	---	---	---	---	---	---	---
Cadmium, Total	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	---	---	---	---	---	---	---	---	---	---	---
Chromium, Total	mg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	---	---	---	---	---	---	---	---	---	---	---
Cobalt, Total	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	---	---	---	---	---	---	---	---	---	---	---
Fluoride	mg/L	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	1.27	---	---	---	---	---	---	---	---	---	---	---
Lead, Total	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	---	---	---	---	---	---	---	---	---	---	---
Lithium, Total	mg/L	0.0948	0.1330	0.1210	0.1280	0.1480	0.1680	0.1660	0.1080	---	---	---	---	---	---	---	---	---	---	---
Mercury, Total	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	---	---	---	---	---	---	---	---	---	---	---
Molybdenum, Total	mg/L	0.00444	0.00329	0.0035	0.00274	0.00263	0.00284	0.00373	0.00344	---	---	---	---	---	---	---	---	---	---	---
Radium-226	pCi/L	0.167 ± 0.0816	0.156 ± 0.103	0.267 ± 0.084	0.176 ± 0.0734	0.217 ± 0.0891	< 0.397 U ± 0.253	0.105 ± 0.068	< 0.109 U ± 0.058	---	---	---	---	---	---	---	---	---	---	---
Radium-228	pCi/L	2.08 ± 0.432	< 0.471 U ± 0.297	2 ± 0.392	1.02 ± 0.317	1.36 ± 0.373	0.972 ± 0.383	0.934 ± 0.294	< 0.361 U ± 0.234	---	---	---	---	---	---	---	---	---	---	---
Radium-226 + Radium-228	pCi/L	2.247 ± 0.44	0.505 ± 0.314	2.27 ± 0.40	1.19 ± 0.325	1.57 ± 0.384	1.21 ± 0.459	1.04 ± 0.302	< 0.361 U ± 0.241	---	---	---	---	---	---	---	---	---	---	---
Selenium, Total	mg/L	0.0563	< 0.00500	0.0286	0.0236	0.00561	< 0.00500	< 0.00500	0.0562	---	---	---	---	---	---	---	---	---	---	---
Thallium, Total	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	---	---	---	---	---	---	---	---	---	---	---

Legend:  
--- Not analyzed  
mg/L: milligrams per liter  
pCi/L: picocuries per liter  
U: Result is less than the sample detection limit (varies by sample for radiological results).  
H: Sample was prepped or analyzed beyond the specified holding time.

NOTES:  
1. As indicated by the CCR rule (40 CFR 257.94), the Detection Monitoring Program monitors all constituents found in Appendix III.

Table 6. Data Summary Table - AP4-MW6

Analytes		9/15/2015	11/23/2015	3/15/2016	5/18/2016	8/9/2016	11/9/2016	3/7/2017	5/16/2017	9/19/2017	3/21/2018	9/11/2018	3/20/2019	9/17/2019	3/8/2020	9/1/2020	3/9/2021	8/25/2021	3/2/2022	8/23/2022
	Units	Background Collection								Detection Monitoring <sup>1</sup>										
Appendix III																				
Boron, Total	mg/L	0.0862	< 0.150	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Calcium, Total	mg/L	103	105	101	104	106	101	118	94.1	106	106	92.7	90.6	101	99.2	99.5	105	99.9	99	116
Chloride	mg/L	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	5.28	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00	< 5.00
Fluoride	mg/L	0.87	0.85	1.37	1.61	1.21	1.45	1.35	1.62	1.62	2.19	1.31	1.5	1.46	2.08	1.82	1.53	1.20	1.35	102
Field pH	pH units	6.92	7.21	7.46	7.19	7.11	7.21	7.35	7.33	7.16	7.40	7.32	7.63	7.22	7.49	7.20	7.16	7.17	7.15	7.20
Sulfate	mg/L	58.5	96.6	51.3	50.7	70.6	69.1	59.3	53.4	50	60.5	46.7	57.7	65.2	75.5	51.8	58.4	61.8	53.8	52.3
Total Dissolved Solids	mg/L	468	506	506	436	514	530	584	550	498	432	396	440	458	422	454	414	414	402	382
Appendix IV																				
Antimony, Total	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	---	---	---	---	---	---	---	---	---	---	---
Arsenic, Total	mg/L	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	---	---	---	---	---	---	---	---	---	---	---
Barium, Total	mg/L	0.0725	0.0611	0.0622	0.0589	0.0605	0.0629	0.0672	0.0568	---	---	---	---	---	---	---	---	---	---	---
Beryllium, Total	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	---	---	---	---	---	---	---	---	---	---	---
Cadmium, Total	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	---	---	---	---	---	---	---	---	---	---	---
Chromium, Total	mg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	---	---	---	---	---	---	---	---	---	---	---
Cobalt, Total	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	---	---	---	---	---	---	---	---	---	---	---
Fluoride	mg/L	0.869	0.845	1.37	1.61	1.21	1.45	1.35	1.62	---	---	---	---	---	---	---	---	---	---	---
Lead, Total	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	---	---	---	---	---	---	---	---	---	---	---
Lithium, Total	mg/L	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	---	---	---	---	---	---	---	---	---	---	---
Mercury, Total	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	---	---	---	---	---	---	---	---	---	---	---
Molybdenum, Total	mg/L	0.00329	0.0039	0.00393	0.00344	0.00281	0.00397	0.00455	0.00411	---	---	---	---	---	---	---	---	---	---	---
Radium-226	pCi/L	0.287 ± 0.0872	0.232 ± 0.0917	0.227 ± 0.0771	0.261 ± 0.073	0.361 ± 0.113	0.545 ± 0.358	0.163 ± 0.0907	0.17 ± 0.0861	---	---	---	---	---	---	---	---	---	---	---
Radium-228	pCi/L	0.983 ± 0.307	0.766 ± 0.31	0.672 ± 0.243	0.699 ± 0.279	1.27 ± 0.439	0.735 ± 0.378	0.451 ± 0.245	0.752 ± 0.244	---	---	---	---	---	---	---	---	---	---	---
Radium-226 + Radium-228	pCi/L	1.27 ± 0.319	0.998 ± 0.323	0.899 ± 0.254	0.961 ± 0.288	1.63 ± 0.454	1.28 ± 0.521	0.614 ± 0.261	0.921 ± 0.259	---	---	---	---	---	---	---	---	---	---	---
Selenium, Total	mg/L	0.0103	0.00883	0.0109	0.00974	0.00984	0.0098	0.0112	0.0104	---	---	---	---	---	---	---	---	---	---	---
Thallium, Total	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	---	---	---	---	---	---	---	---	---	---	---

Legend:  
--- Not analyzed  
mg/L: milligrams per liter  
pCi/L: picocuries per liter

NOTES:  
1. As indicated by the CCR rule (40 CFR 257.94), the Detection Monitoring Program monitors all constituents found in Appendix III.

Table 7. Data Summary Table - AP4-MW7

Analytes		9/15/2015	11/23/2015	3/15/2016	5/18/2016	8/9/2016	11/9/2016	3/7/2017	5/16/2017	9/19/2017	3/21/2018	9/11/2018	3/20/2019	9/17/2019	3/8/2020	9/1/2020	3/9/2021	8/25/2021	3/2/2022	8/23/2022
	Units	Background Collection								Detection Monitoring <sup>1</sup>										
Appendix III																				
Boron, Total	mg/L	0.0758	< 0.150	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	< 0.100	< 0.100	< 0.100	< 0.100	< 0.100
Calcium, Total	mg/L	67.7	68.7	72	66.2	69.4	66.9	79	67.6	67.5	64.3	65.5	66.4	69.4	66.6	66.3	71.7	70.5	68.2	78.2
Chloride	mg/L	16.1	11.8	11.4	11.2	13	11.7	10.6	12.9	13.3	12.5	12.1	12.9	11.3	11.8	9.89	11.4	9.65	11.4	13.3
Fluoride	mg/L	< 0.500	< 0.500	0.738	< 0.500	< 0.500	< 0.500	< 0.500	1.02	< 0.500	0.52	< 0.500	< 0.500	0.589	< 0.500	0.513	< 0.500	< 0.500	< 0.500	< 0.500
Field pH	pH units	7.20	7.45	7.65	7.39	7.40	7.48	7.57	7.52	7.46	7.56	7.54	7.94	7.15	7.70	7.39	7.34	7.37	7.36	7.30
Sulfate	mg/L	46	39.8	40.4	43.3	40.7	45.6	36.8	35.2	42.7	41.6	34.5	44.2	51.1	49.9	40.6	47.7	50.5	47	40.8
Total Dissolved Solids	mg/L	546	548	516	558	588	616	534	538	598	476	480	536	504	510	404	488	488	490	490
Appendix IV																				
Antimony, Total	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	---	---	---	---	---	---	---	---	---	---	---
Arsenic, Total	mg/L	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	< 0.002	---	---	---	---	---	---	---	---	---	---	---
Barium, Total	mg/L	0.165	0.161	0.154	0.137	0.146	0.159	0.177	0.159	---	---	---	---	---	---	---	---	---	---	---
Beryllium, Total	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	---	---	---	---	---	---	---	---	---	---	---
Cadmium, Total	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	---	---	---	---	---	---	---	---	---	---	---
Chromium, Total	mg/L	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	---	---	---	---	---	---	---	---	---	---	---
Cobalt, Total	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	---	---	---	---	---	---	---	---	---	---	---
Fluoride	mg/L	< 0.500	< 0.500	0.738	< 0.500	< 0.500	< 0.500	< 0.500	1.02	---	---	---	---	---	---	---	---	---	---	---
Lead, Total	mg/L	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	< 0.0005	---	---	---	---	---	---	---	---	---	---	---
Lithium, Total	mg/L	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	---	---	---	---	---	---	---	---	---	---	---
Mercury, Total	mg/L	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	< 0.0002	---	---	---	---	---	---	---	---	---	---	---
Molybdenum, Total	mg/L	0.00841	0.00827	0.00823	0.0069	0.00785	0.00788	0.00955	0.00768	---	---	---	---	---	---	---	---	---	---	---
Radium-226	pCi/L	0.189 ± 0.0807	0.206 ± 0.865	0.277 ± 0.0928	0.25 ± 0.0781	0.29 ± 0.0907	< 0.404 U ± 0.271	0.357 ± 0.112	0.227 ± 0.092	---	---	---	---	---	---	---	---	---	---	---
Radium-228	pCi/L	1.2 ± 0.313	1.92 ± 0.396	1.58 ± 0.322	1.52 ± 0.342	1.60 ± 0.415	2.52 ± 0.481	1.91 ± 0.372	1.67 ± 0.358	---	---	---	---	---	---	---	---	---	---	---
Radium-226 + Radium-228	pCi/L	1.389 ± 0.323	2.126 ± 0.405	1.86 ± 0.335	1.77 ± 0.350	1.89 ± 0.425	2.83 ± 0.552	2.27 ± 0.389	1.89 ± 0.369	---	---	---	---	---	---	---	---	---	---	---
Selenium, Total	mg/L	0.00812	0.00846	0.00898	0.00834	0.00926	0.00764	0.00995	0.0103	---	---	---	---	---	---	---	---	---	---	---
Thallium, Total	mg/L	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001	---	---	---	---	---	---	---	---	---	---	---

Legend:  
--- Not analyzed  
mg/L: milligrams per liter  
pCi/L: picocuries per liter  
U: Result is less than the sample detection limit (varies by sample for radiological results).

NOTES:  
1. As indicated by the CCR rule (40 CFR 257.94), the Detection Monitoring Program monitors all constituents found in Appendix III.

Table 8 - Sheldon Station Ash Landfill No. 4 Groundwater Levels (ft amsl)

Sample Period	Upgradient Wells		Downgradient Wells				
	AP4-MW1	AP4-MW2	AP4-MW3	AP4-MW4	AP4-MW5	AP4-MW6	AP4-MW7
<b>MP Elev.</b>	<b>1425.95</b>	<b>1445.03</b>	<b>1411.72</b>	<b>1396.10</b>	<b>1403.10</b>	<b>1386.61</b>	<b>1424.29</b>
QTR-2002-4	1410.90	1422.78	1392.14	1375.99	1385.78	1374.15	1401.53
QTR-2003-1	1409.36	1421.35	1390.20	1374.01	1383.07	1374.06	1399.28
QTR-2003-2	1412.99	1421.11	1396.11	1376.52	1387.68	1376.90	1398.78
QTR-2003-3	1411.22	1421.87	1390.91	1372.66	1382.35	1369.46	1401.34
QTR-2003-4	1410.02	1422.24	1390.31	1373.48	1382.30	1369.10	1401.38
QTR-2004-1	1411.81	1420.78	1393.01	1377.92	1384.12	1377.59	1398.98
QTR-2004-2	1412.04	1420.72	1394.77	1375.64	1383.75	1374.83	1400.70
QTR-2004-3	1411.24	1421.22	1393.89	1375.55	1384.18	1373.85	1408.14
QTR-2004-4	1409.40	1421.39	1391.65	1373.40	1381.88	1374.65	1407.23
QTR-2005-1	1409.32	1420.12	1390.66	1372.78	1381.29	1374.62	1401.20
QTR-2005-2	1410.36	1419.77	1388.86	1372.63	1381.27	1374.55	1399.82
QTR-2005-3	1425.95	1445.03	1411.72	1396.10	1403.10	1386.61	1424.29
QTR-2005-4	1407.83	1419.58	1387.67	1372.52	1380.80	1369.44	1399.32
QTR-2006-1	1406.35	1418.91	1387.02	1372.42	1380.15	1371.76	1397.99
QTR-2006-2	1408.37	1418.43	1387.52	1372.42	1383.05	1372.36	1397.48
QTR-2006-3	1403.26	1417.13	1386.38	1372.30	1379.83	1370.22	1399.99
QTR-2006-4	1404.91	1419.42	1386.32	1372.25	1380.51	1369.90	1399.89
QTR-2007-1	1407.21	1417.13	1390.63	1372.89	1382.85	1374.67	1397.74
QTR-2007-3	1409.61	1417.42	1391.60	1373.85	1382.19	1370.84	1409.74
QTR-2008-2	1415.33	1417.33	1406.98	1385.69	1395.04	1379.15	1414.16
QTR-2008-3	1412.64	1418.64	1393.61	1376.05	1385.14	1373.43	1413.10
QTR-2009-2	1409.86	1417.98	1390.72	1374.15	1381.58	1374.49	1403.78
QTR-2009-3	1408.87	1417.88	1389.01	1372.47	1380.60	1370.31	1407.03
QTR-2010-2	1413.98	1418.11	1405.12	1381.85	1390.80	1375.51	1414.59
QTR-2010-3	1411.22	1419.23	1392.72	1374.81	1383.50	1374.39	1413.39
QTR-2011-2	1409.32	1418.12	1389.92	1374.80	1382.48	1374.55	1403.83
QTR-2011-3	1411.24	1418.58	1391.87	1373.60	1382.88	1373.56	1411.18
QTR-2012-2	1412.85	1418.13	1399.77	1377.74	1388.74	1375.41	1413.29
QTR-2012-3	1408.70	1418.58	1390.03	1372.72	1381.35	1369.47	1410.77
QTR-2013-2	1411.47	1416.93	1391.01	1375.34	1388.23	1375.31	1402.57
QTR-2013-4	1410.46	1417.32	1391.21	1373.05	1382.79	1370.11	1407.27
QTR-2014-2	1407.80	1416.98	1387.42	1372.03	1383.19	1374.23	1400.05
QTR-2014-4	1407.74	1417.08	1387.30	1372.10	1381.27	1371.75	1404.99
QTR-2015-2	1412.00	1415.13	1405.17	1379.63	1394.50	1375.75	1409.78

Sample Period	Upgradient Wells		Downgradient Wells				
	AP4-MW1	AP4-MW2	AP4-MW3	AP4-MW4	AP4-MW5	AP4-MW6	AP4-MW7
QTR-2015-3	1412.05	1418.38	1393.87	1376.77	1386.49	1371.86	1412.67
QTR-2015-4	1410.50	1418.89	1391.46	1374.49	1383.76	1372.41	1408.79
QTR-2016-1	1412.60	1420.38	1394.97	1377.65	1387.59	1374.66	1405.38
QTR-2016-2	1414.94	1418.83	1406.92	1384.72	1395.85	1376.79	1410.62
QTR-2016-3	1412.06	1419.51	1393.22	1375.65	1386.20	1373.11	1414.29
QTR-2016-4	1410.10	1419.93	1390.81	1373.60	1382.98	1372.41	1408.39
QTR-2017-1	1408.24	1419.54	1389.29	1372.83	1381.40	1373.83	1403.49
QTR-2017-2	1410.15	1419.00	1389.52	1373.35	1386.96	1373.96	1402.41
QTR-2017-3	1410.40	1419.35	1392.04	1372.70	1383.00	1372.12	1409.31
QTR-2018-1	1408.01	1418.76	1389.65	1372.37	1381.38	1374.21	1402.92
QTR-2018-3	1410.46	1417.88	1397.84	1375.90	1389.87	1374.85	1410.27
QTR-2019-1	1413.80	1418.53	1400.72	1383.19	1391.10	1377.89	1411.27
QTR-2019-3	1412.07	1422.34	1399.14	1377.58	1390.40	1374.46	1415.12
QTR-2020-1	1414.38	1424.75	1399.62	1378.73	1390.27	1374.60	1411.49
QTR-2020-2	1414.67	1427.03	1403.73	1380.90	1394.55	1375.70	1415.83
QTR-2020-3	1411.10	1428.23	1394.10	1375.29	1387.19	1373.30	1414.78
QTR-2021-1	1410.62	1425.54	1390.69	1375.14	1386.42	1374.19	1405.72
QTR-2021-3	1410.46	1426.36	1392.03	1373.93	1384.00	1371.92	1412.38
QTR-2022-1	1408.46	1424.04	1389.13	1372.69	1381.70	1373.66	1404.24
QTR-2022-3	1408.65	1421.92	1390.69	1371.45	1379.75	1370.26	1408.57
Mean	1410.73	1420.40	1393.38	1375.56	1385.24	1373.76	1406.71
SD	3.20	4.37	5.81	4.34	4.85	2.90	6.06
Maximum	1415.33	1428.23	1406.98	1385.69	1395.85	1379.15	1415.83
Minimum	1403.26	1415.13	1386.32	1371.45	1379.75	1369.10	1397.48
Range	12.07	13.10	20.66	14.24	16.10	10.05	18.35
Hydraulic Gradient			0.03				

MP = Measuring Point

MSL = Mean Sea Level (measured to nearest 0.01')

Table 9: APM4-MW1 (Upgradient) Baseline Update for Sulfate following NDEE August 2022 ASD Concurrence

Analyte	Unit	Current Start of Baseline Period	Current End of Baseline Period	Current Statistical Method	Current Statistical Limit	Current Number of Baseline Samples	Number of Samples Collected Since End of Current Baseline	WRS Significant at 95%?	Proceeding with Baseline Update?	Updated Start of Baseline Period	Updated End of Baseline Period	Total Number of Samples	Number of Samples in Updated Baseline	# ND in Updated Baseline	% ND in Updated Baseline	Temporal Trends Identified in Updated Baseline	Outliers Identified in Baseline Period	Removed Outliers	Seasonal Trend Identified	Baseline Data Distribution	Selected Statistical Method	Updated Statistical Limit
Sulfate	mg/L	9/15/2015	5/16/2017	CUSUM	28.0	8	10	Yes	Yes - See Notes.	9/15/2015	3/2/2022	18	17	0	0%	None	9/17/2019	9/17/2019	None	Normal	CUSUM	31.6

Notes:  
NDEE: Nebraska Department of Environment and Energy  
ASD: Alternative Source Demonstration  
mg/L - Milligrams per Lite  
NA: Not Analyzed  
CUSUM: Shewhart-CUSUM (cumulative summation) limit for parametric statistical analysis  
NP-PL: Non-parametric prediction limit  
Wilcoxon Rank Sum (WRS) analysis was first checked at  $\alpha = 95\%$  for significance. Tests where the WRS was significant at  $\alpha = 95\%$  were also evaluated at  $\alpha = 97.5\%$  and  $\alpha = 99\%$  regarding the potential to update the baseline period.  
WRS analysis for sulfate was significant at 95%, but not at 97.5% or 99%. Opting to proceed with reviewing for the potential to update the statistical baseline.  
Datasets with a baseline non-detect percentage of 50% or more were not tested for trends using the Sen's Slope/Mann-Kendall analysis or for data distribution, and are marked as NA for the associated Sen's Slope/Mann-Kendall analyses for temporal trends were performed at  $\alpha = 95\%$ . Kruskal-Wallis analysis for seasonal trends was performed at  $\alpha = 95\%$ .  
Where seasonal trends have been identified, data have been deseasonalized in setting the updated statistical limit.  
WRS analysis for sulfate was significant at 95%, but not at 97.5% or 99%. Opting to proceed with reviewing for the potential to update the statistical baseline.

**Table 10: Comparative Statistics - AP4-MW1 (U)**

		Statistical Method	Statistical Limit	Q1 2022 Detection Monitoring Result	Q1 2022 CUSUM Value	Q1 2022 - Within Limit?	Q3 2022 Detection Monitoring Result	Q3 2022 CUSUM Value	Q3 2022 - Within Limit?
<b>Appendix III Analytes</b>	<b>Unit</b>			3/2/2022			8/23/2022		
Boron, Total	mg/L	NP-PL	0.200	< 0.100	--	Yes	< 0.100	--	Yes
Calcium, Total	mg/L	CUSUM	115	93	93	Yes	101	96	Yes
Chloride	mg/L	NP-PL	11.00	6.81	--	Yes	7.59	--	Yes
Fluoride	mg/L	CUSUM	1.946	0.611	0.734	Yes	0.524	0.734	Yes
pH, Field	pH units	CUSUM	6.49, 8.00	7.11	7.25, 7.25	Yes	7.00	7.19, 7.25	Yes
Sulfate	mg/L	CUSUM	28.0 (Q1 2022) 31.6 (Q3 2022)	26.2	33.4	No - Verified SSI	22.7	23.6	Yes
Total Dissolved Solids	mg/L	CUSUM	584	396	434	Yes	368	434	Yes

## NOTES:

NP-PL: Non-Parametric Prediction Limit

CUSUM: Parametric Shewhart-CUSUM Control Chart

See text for discussion of baseline update for sulfate following the Q1 2022 detection monitoring event.



**Table 11: Comparative Statistics - AP4-MW2 (U)**

		Statistical Method	Statistical Limit	Q1 2022 Detection Monitoring Result	Q1 2022 CUSUM Value	Q1 2022 - Within Limit?	Q3 2022 Detection Monitoring Result	Q3 2022 CUSUM Value	Q3 2022 - Within Limit?
<b>Appendix III Analytes</b>	<b>Unit</b>			3/2/2022			8/23/2022		
Boron, Total	mg/L	NP-PL	0.200	< 0.400	--	Yes - See Text	< 0.100	--	Yes
Calcium, Total	mg/L	CUSUM	402	295	297	Yes	336	310	Yes
Chloride	mg/L	NP-PL	113.0	115	--	No - Potential Exceedance	99.6	--	Yes - Prior Result Was a False-Positive
Fluoride	mg/L	NP-PL	0.935	< 0.500	--	Yes	< 0.500	--	Yes
pH, Field	pH units	CUSUM	6.55, 7.85	7.09	7.20, 7.20	Yes	6.96	7.12, 7.20	Yes
Sulfate	mg/L	CUSUM	1027	933	890	Yes	906	898	Yes
Total Dissolved Solids	mg/L	NP-PL	2360	1560	--	Yes	1680	--	Yes

## NOTES:

NP-PL: Non-Parametric Prediction Limit

CUSUM: Parametric Shewhart-CUSUM Control Chart

**Table 12: Comparative Statistics - AP4-MW3**

		Statistical Method	Statistical Limit	Q1 2022 Detection Monitoring Result	Q1 2022 CUSUM Value	Q1 2022 - Within Limit?	Q3 2022 Detection Monitoring Result	Q3 2022 CUSUM Value	Q3 2022 - Within Limit?
<b>Appendix III Analytes</b>	<b>Unit</b>			3/2/2022			8/23/2022		
Boron, Total	mg/L	NP-PL	0.200	< 0.100	--	Yes	< 0.100	--	Yes
Calcium, Total	mg/L	CUSUM	105.2	84.3	86.5	Yes	94.5	89.8	Yes
Chloride	mg/L	NP-PL	12.40	< 5.00	--	Yes	< 5.00	--	Yes
Fluoride	mg/L	CUSUM	2.477	0.972	1.092	Yes	0.717	1.092	Yes
pH, Field	pH units	CUSUM	6.81, 7.99	7.27	7.40, 7.40	Yes	7.16	7.31, 7.40	Yes
Sulfate	mg/L	CUSUM	48.2	22.3	28.3	Yes	21.0	28.3	Yes
Total Dissolved Solids	mg/L	CUSUM	567	354	435	Yes	326	435	Yes

## NOTES:

NP-PL: Non-Parametric Prediction Limit

CUSUM: Parametric Shewhart-CUSUM Control Chart

**Table 13: Comparative Statistics - AP4-MW4**

		Statistical Method	Statistical Limit	Q1 2022 Detection Monitoring Result	Q1 2022 CUSUM Value	Q1 2022 - Within Limit?	Q3 2022 Detection Monitoring Result	Q3 2022 CUSUM Value	Q3 2022 - Within Limit?
<b>Appendix III Analytes</b>	<b>Unit</b>			3/2/2022			8/23/2022		
Boron, Total	mg/L	NP-PL	0.200	< 0.100	--	Yes	< 0.100	--	Yes
Calcium, Total	mg/L	CUSUM	153	102	109	Yes	119	109	Yes
Chloride	mg/L	NP-PL	8.99	< 5.00	--	Yes	< 5.00	--	Yes
Fluoride	mg/L	CUSUM	1.670	0.837	0.967	Yes	0.626	0.967	Yes
pH, Field	pH units	CUSUM	6.73, 7.79	7.13	7.26, 7.26	Yes	7.05	7.18, 7.26	Yes
Sulfate	mg/L	CUSUM	179.8	84.7	93.5	Yes	76.1	95.5	Yes
Total Dissolved Solids	mg/L	CUSUM	746	452	523	Yes	436	523	Yes

## NOTES:

NP-PL: Non-Parametric Prediction Limit

CUSUM: Parametric Shewhart-CUSUM Control Chart

**Table 14: Comparative Statistics - AP4-MW5**

		Statistical Method	Statistical Limit	Q1 2022 Detection Monitoring Result	Q1 2022 CUSUM Value	Q1 2022 - Within Limit?	Q3 2022 Detection Monitoring Result	Q3 2022 CUSUM Value	Q3 2022 - Within Limit?
<b>Appendix III Analytes</b>	<b>Unit</b>			3/2/2022			8/23/2022		
Boron, Total	mg/L	NP-PL	0.200	< 0.400	--	Yes - See Text	< 0.100	--	Yes
Calcium, Total	mg/L	CUSUM	798	600	502	Yes	178	450	Yes
Chloride	mg/L	CUSUM	15.58	5.71	6.37	Yes	< 5.00	6.37	Yes
Fluoride	mg/L	NP-PL	0.664	< 0.500	--	Yes	< 0.500	--	Yes
pH, Field	pH units	CUSUM	6.32, 7.63	6.67	6.83, 6.98	Yes	6.97	6.98, 6.98	Yes
Sulfate	mg/L	NP-PL	1630	1670	--	No - Potential Exceedance	426	--	Yes - Prior Result Was a False-Positive
Total Dissolved Solids	mg/L	CUSUM	4040	2450	2308	Yes	750	2308	Yes

## NOTES:

NP-PL: Non-Parametric Prediction Limit

CUSUM: Parametric Shewhart-CUSUM Control Chart

**Table 15: Comparative Statistics - AP4-MW6**

		Statistical Method	Statistical Limit	Q1 2022 Detection Monitoring Result	Q1 2022 CUSUM Value	Q1 2022 - Within Limit?	Q3 2022 Detection Monitoring Result	Q3 2022 CUSUM Value	Q3 2022 - Within Limit?
<b>Appendix III Analytes</b>	<b>Unit</b>			3/2/2022			8/23/2022		
Boron, Total	mg/L	NP-PL	0.200	< 0.100	--	Yes	< 0.100	--	Yes
Calcium, Total	mg/L	CUSUM	127	99	102	Yes	116	110	Yes
Chloride	mg/L	NP-PL	5.28	< 5.00	--	Yes	< 5.00	--	Yes
Fluoride	mg/L	CUSUM	2.90	1.35	1.47	Yes	1.02	1.47	Yes
pH, Field	pH units	CUSUM	6.72, 7.82	7.15	7.21, 7.27	Yes	6.98	7.13, 7.27	Yes
Sulfate	mg/L	CUSUM	114.9	53.8	60.5	Yes	52.3	60.5	Yes
Total Dissolved Solids	mg/L	CUSUM	687	402	472	Yes	382	472	Yes

## NOTES:

NP-PL: Non-Parametric Prediction Limit

CUSUM: Parametric Shewhart-CUSUM Control Chart

**Table 16: Comparative Statistics - AP4-MW7**

		Statistical Method	Statistical Limit	Q1 2022 Detection Monitoring Result	Q1 2022 CUSUM Value	Q1 2022 - Within Limit?	Q3 2022 Detection Monitoring Result	Q3 2022 CUSUM Value	Q3 2022 - Within Limit?
<b>Appendix III Analytes</b>	<b>Unit</b>			3/2/2022			8/23/2022		
Boron, Total	mg/L	NP-PL	0.200	< 0.100	--	Yes	< 0.100	--	Yes
Calcium, Total	mg/L	NP-PL	79.0	68.2	--	Yes	78.2	--	Yes
Chloride	mg/L	CUSUM	17.9	11.4	12.0	Yes	13.3	12.0	Yes
Fluoride	mg/L	NP-PL	1.020	< 0.500	--	Yes	< 0.500	--	Yes
pH, Field	pH units	CUSUM	6.87, 8.09	7.36	7.42, 7.48	Yes	7.19	7.37, 7.48	Yes
Sulfate	mg/L	CUSUM	63.2	47.0	43.0	Yes	40.8	43.0	Yes
Total Dissolved Solids	mg/L	CUSUM	732	490	525	Yes	490	525	Yes

## NOTES:

NP-PL: Non-Parametric Prediction Limit

CUSUM: Parametric Shewhart-CUSUM Control Chart

## Figures

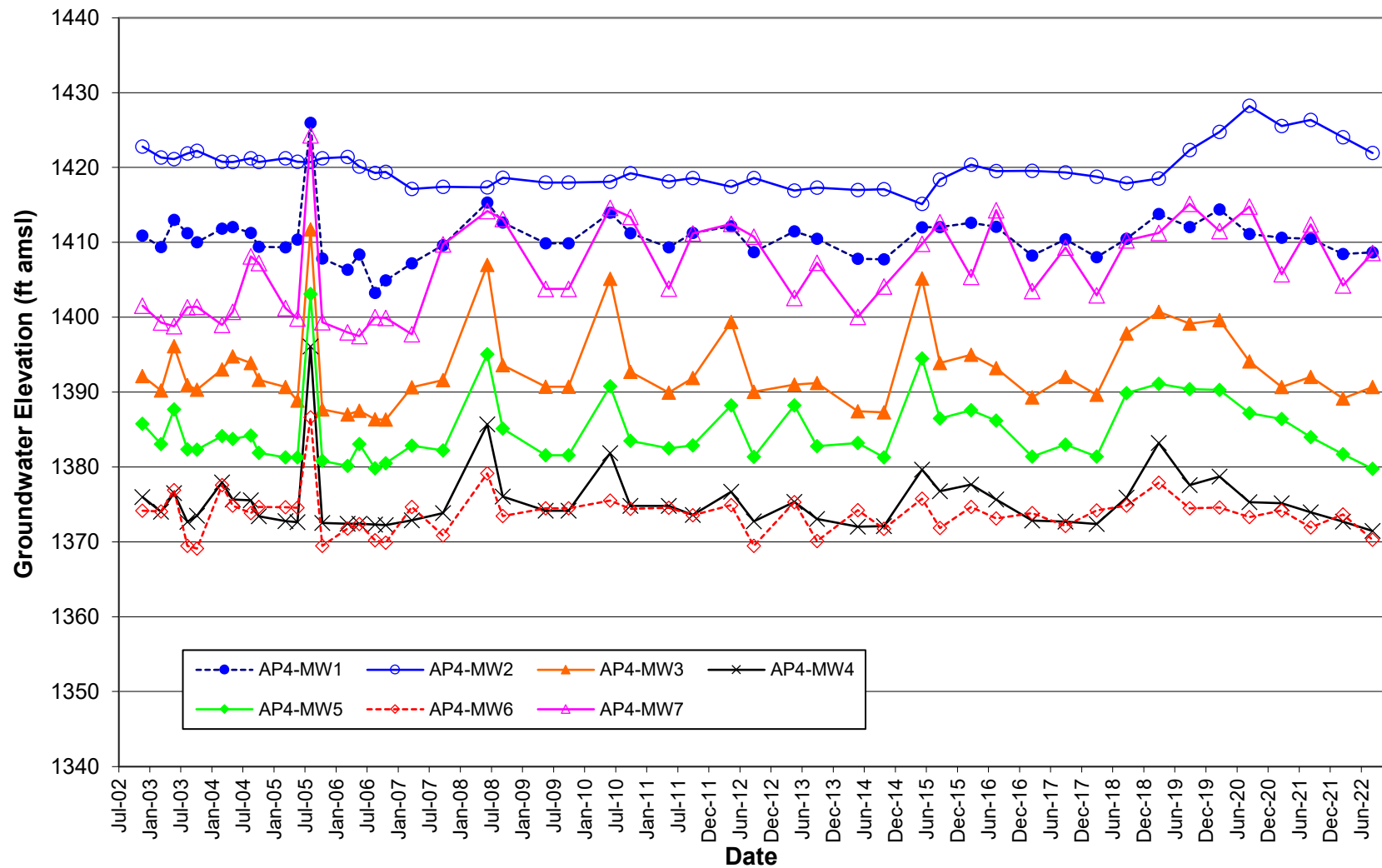








**FIGURE 3**  
**Sheldon Station Ash Landfill No. 4**  
**Groundwater Elevations**



**APPENDIX A**

**Baseline Update Tables for  
Groundwater Quality Monitoring at  
Nebraska Public Power District's  
Sheldon Station**

Table 1: APM4-MW1 (Upgradient) Baseline Update

Analyte	Unit	Current Start of Baseline Period	Current End of Baseline Period	Current Statistical Method	Current Statistical Limti	Current Number of Baseline Samples	Number of Samples Collected Since End of Current Baseline	WRS Significant at 95%?	Proceeding with Baseline Update?	Updated Start of Baseline Period	Updated End of Baseline Period	Total Number of Samples	Number of Samples in Updated Baseline	# ND in Updated Baseline	% ND in Updated Baseline	Temporal Trends Identified in Updated Baseline	Outliers Idenitifed in Baseline Period	Removed Outliers	Seasonal Trend Identified	Baseline Data Distribution	Selected Statistical Method	Updated Statistical Limit
Boron, Total	mg/L	09/15/2015	05/16/2017	NP-PL	0.200	8	9	No	Yes	09/15/2015	08/25/2021	17	17	15	88%	NA	None	None	None	NA	NP-PL	0.200
Calcium, Total	mg/L	09/15/2015	05/16/2017	CUSUM	120.1	8	9	No	Yes	09/15/2015	08/25/2021	17	17	0	0%	None	None	None	None	Normal	CUSUM	115.1
Chloride	mg/L	09/15/2015	05/16/2017	NP-PL	22.50	8	9	No	Yes	09/15/2015	08/25/2021	17	16	0	0%	None	9/15/2015 11/9/2016 9/17/2019	09/15/2015	None	Non-Normal	NP-PL	11.00
Fluoride	mg/L	09/15/2015	05/16/2017	CUSUM	1.835	8	9	No	Yes	09/15/2015	08/25/2021	17	17	2	12%	None	None	None	None	Normal	CUSUM	1.946
pH, Field-Measured	pH units	09/15/2015	05/16/2017	CUSUM	6.40, 7.98	8	9	No	Yes	09/15/2015	08/25/2021	17	17	0	0%	None	None	None	None	Normal	CUSUM	6.49, 8.00
Sulfate	mg/L	09/15/2015	05/16/2017	CUSUM	28.0	8	9	No	No - See Notes.	---	---	---	---	---	---	---	---	---	---	---	---	---
Total Dissolved Solids	mg/L	09/15/2015	05/16/2017	CUSUM	599	8	9	No	Yes	09/15/2015	08/25/2021	17	17	0	0%	Decreasing trend at 95% Not significant at 99%	None	None	None	Normal	CUSUM	584

Notes:  
mg/L - Milligrams per Liter  
NA: Not Analyzed  
CUSUM: Shewhart-CUSUM (cumulative summation) limit for parametric statistical analysis  
NP-PL: Non-parametric prediction limit  
Wilcoxon Rank Sum (WRS) analysis was first checked at  $\alpha = 95\%$  for significance. Tests where the WRS was significant at  $\alpha = 95\%$  were also evaluated at  $\alpha = 97.5\%$  and  $\alpha = 99\%$  regarding the potential to update the baseline period.  
Datasets with a baseline non-detect percentage of 50% or more were not tested for trends using the Sen's Slope/Mann-Kendall analysis or for data distribution, and are marked as NA for the associated tests.  
Sen's Slope/Mann-Kendall analyses for temporal trends were performed at  $\alpha = 95\%$ . Kruskal-Wallis analysis for seasonal trends was performed at  $\alpha = 95\%$ .  
Where seasonal trends have been identified, data have been deseasonalized in setting the updated statistical limit.  
A potential exceedance was identified in Q3 2021 for Sulfate at AP4-MW1. The baseline period has not been updated.  
A statistically significant decreasing trend was identified for Total Dissolved Solids at 95%, but was found to not be significant at 99%. The baseline was updated.

Table 2: AP4-MW2 (Upgradient) Baseline Update

Analyte	Unit	Current Start of Baseline Period	Current End of Baseline Period	Current Statistical Method	Current Statistical Limti	Current Number of Baseline Samples	Number of Samples Collected Since End of Current Baseline	WRS Significant at 95%?	Proceeding with Baseline Update?	Updated Start of Baseline Period	Updated End of Baseline Period	Total Number of Samples	Number of Samples in Updated Baseline	# ND in Updated Baseline	% ND in Updated Baseline	Temporal Trends Identified in Updated Baseline	Outliers Idenitifed in Baseline Period	Removed Outliers	Seasonal Trend Identified	Baseline Data Distribution	Selected Statistical Method	Updated Statistical Limit
Boron, Total	mg/L	09/15/2015	05/16/2017	NP-PL	0.500	8	9	No	Yes	09/15/2015	08/25/2021	17	17	16	94%	N/A	11/23/2015	11/23/2015	None	N/A	NP-PL	0.200
Calcium, Total	mg/L	09/15/2015	05/16/2017	CUSUM	418	8	9	No	Yes	09/15/2015	08/25/2021	17	17	0	0%	None	None	None	None	Normal	CUSUM	402
Chloride	mg/L	09/15/2015	05/16/2017	CUSUM	107	8	9	No	Yes	09/15/2015	08/25/2021	17	17	0	0%	None	None	None	None	Non-Normal	NP-PL	113
Fluoride	mg/L	09/15/2015	05/16/2017	NP-PL	3.100	8	9	No	Yes	09/15/2015	08/25/2021	17	16	6	38%	None	11/23/2015	11/23/2015	None	Non-Normal	NP-PL	0.935
pH, Field-Measured	pH units	09/15/2015	05/16/2017	CUSUM	6.57, 7.74	8	9	No	Yes	09/15/2015	08/25/2021	17	17	0	0%	None	None	None	None	Normal	CUSUM	6.55, 7.85
Sulfate	mg/L	09/15/2015	05/16/2017	CUSUM	1059	8	9	No	Yes	09/15/2015	08/25/2021	17	17	0	0%	None	None	None	None	Normal	CUSUM	1027
Total Dissolved Solids	mg/L	09/15/2015	05/16/2017	NP-PL	2360	8	9	No	Yes	09/15/2015	08/25/2021	17	17	0	0%	Decreasing trend at 95% Not significant at 99%	3/7/2017 9/19/2017	None	None	Non-Normal	NP-PL	2360

Notes:  
mg/L - Milligrams per Liter  
NA: Not Analyzed  
CUSUM: Shewhart-CUSUM (cumulative summation) limit for parametric statistical analysis  
NP-PL: Non-parametric prediction limit  
Wilcoxon Rank Sum (WRS) analysis was first checked at  $\alpha = 95\%$  for significance. Tests where the WRS was significant at  $\alpha = 95\%$  were also evaluated at  $\alpha = 97.5\%$  and  $\alpha = 99\%$  regarding the potential to update the baseline period.  
Datasets with a baseline non-detect percentage of 50% or more were not tested for trends using the Sen's Slope/Mann-Kendall analysis or for data distribution, and are marked as NA for the associated tests.  
Sen's Slope/Mann-Kendall analyses for temporal trends were performed at  $\alpha = 95\%$ . Kruskal-Wallis analysis for seasonal trends was performed at  $\alpha = 95\%$ .  
Where seasonal trends have been identified, data have been deseasonalized in setting the updated statistical limit.  
A statistically significant decreasing trend was identified for Total Dissolved Solids at 95%, but was found to not be significant at 99%. The baseline was updated.



Table 3: AP4-MW3 Baseline Update

Analyte	Unit	Current Start of Baseline Period	Current End of Baseline Period	Current Statistical Method	Current Statistical Limti	Current Number of Baseline Samples	Number of Samples Collected Since End of Current Baseline	WRS Significant at 95%?	Proceeding with Baseline Update?	Updated Start of Baseline Period	Updated End of Baseline Period	Total Number of Samples	Number of Samples in Updated Baseline	# ND in Updated Baseline	% ND in Updated Baseline	Temporal Trends Identified in Updated Baseline	Outliers Identitified in Baseline Period	Removed Outliers	Seasonal Trend Identified	Baseline Data Distribution	Selected Statistical Method	Updated Statistical Limit
Boron, Total	mg/L	09/15/2015	05/16/2017	NP-PL	0.200	8	9	No	Yes	09/15/2015	08/25/2021	17	17	16	94%	NA	None	None	None	NA	NP-PL	0.200
Calcium, Total	mg/L	09/15/2015	05/16/2017	CUSUM	105.6	8	9	No	Yes	09/15/2015	08/25/2021	17	17	0	0%	None	09/11/2018	None	None	Normal	CUSUM	105.2
Chloride	mg/L	09/15/2015	05/16/2017	NP-PL	12.40	8	9	No	Yes	09/15/2015	08/25/2021	17	17	13	76%	NA	None	None	None	NA	NP-PL	12.40
Fluoride	mg/L	09/15/2015	05/16/2017	CUSUM	2.845	8	9	Yes	Yes - See Notes	09/15/2015	08/25/2021	17	17	1	6%	Increasing trend at 95% Not significant at 99%	9/15/2015 8/9/2016 5/16/2017	None	None	Normal	CUSUM	2.477
pH, Field-Measured	pH units	09/15/2015	05/16/2017	CUSUM	6.73, 7.96	8	9	No	Yes	09/15/2015	08/25/2021	17	17	0	0%	None	None	None	None	Normal	CUSUM	6.81, 7.99
Sulfate	mg/L	09/15/2015	05/16/2017	CUSUM	51.2	8	9	No	Yes	09/15/2015	08/25/2021	17	17	0	0%	None	None	None	None	Normal	CUSUM	48.2
Total Dissolved Solids	mg/L	09/15/2015	05/16/2017	CUSUM	567	8	9	No	Yes	---	---	---	---	---	---	Decreasing trend at 95% and 99% - Baseline not updated	---	---	---	---	---	---

Notes:  
mg/L - Milligrams per Liter  
NA: Not Analyzed  
CUSUM: Shewhart-CUSUM (cumulative summation) limit for parametric statistical analysis  
NP-PL: Non-parametric prediction limit  
Wilcoxon Rank Sum (WRS) analysis was first checked at  $\alpha = 95\%$  for significance. Tests where the WRS was significant at  $\alpha = 95\%$  were also evaluated at  $\alpha = 97.5\%$  and  $\alpha = 99\%$  regarding the potential to update the baseline period.  
Datasets with a baseline non-detect percentage of 50% or more were not tested for trends using the Sen's Slope/Mann-Kendall analysis or for data distribution, and are marked as NA for the associated tests.  
Sen's Slope/Mann-Kendall analyses for temporal trends were performed at  $\alpha = 95\%$ . Kruskal-Wallis analysis for seasonal trends was performed at  $\alpha = 95\%$ .  
Where seasonal trends have been identified, data have been deseasonalized in setting the updated statistical limit.  
WRS analysis for fluoride was significant at 95% and 97.5%, but not at 99%. Opting to proceed with reviewing for the potential to update the statistical baseline.  
A statistically significant increasing trend was identified for Fluoride at 95%, but was found to not be significant at 99%. The baseline was updated.  
A statistically significant decreasing trend was identified for Total Dissolved Solids at 95% and at 99%. The baseline was updated.

Table 4: AP4-MW4 Baseline Update

Analyte	Unit	Current Start of Baseline Period	Current End of Baseline Period	Current Statistical Method	Current Statistical Limti	Current Number of Baseline Samples	Number of Samples Collected Since End of Current Baseline	WRS Significant at 95%?	Proceeding with Baseline Update?	Updated Start of Baseline Period	Updated End of Baseline Period	Total Number of Samples	Number of Samples in Updated Baseline	# ND in Updated Baseline	% ND in Updated Baseline	Temporal Trends Identified in Updated Baseline	Outliers Idenitifed in Baseline Period	Removed Outliers	Seasonal Trend Identified	Baseline Data Distribution	Selected Statistical Method	Updated Statistical Limit
Boron, Total	mg/L	09/15/2015	05/16/2017	NP-PL	0.200	8	9	No	Yes	09/15/2015	08/25/2021	17	17	16	94%	N/A	None	None	None	N/A	NP-PL	0.200
Calcium, Total	mg/L	09/15/2015	05/16/2017	CUSUM	172	8	9	No	Yes	09/15/2015	08/25/2021	17	17	0	0%	None	None	None	None	Normal	CUSUM	153
Chloride	mg/L	09/15/2015	05/16/2017	NP-PL	13	8	9	No	Yes	09/15/2015	08/25/2021	17	16	12	75%	N/A	09/15/2015	09/15/2015	None	N/A	NP-PL	8.99
Fluoride	mg/L	09/15/2015	05/16/2017	CUSUM	2.080	8	9	Yes	Yes - See notes	09/15/2015	08/25/2021	17	17	2	12%	None	9/15/15 8/9/16	None	None	Square	CUSUM	1.670
pH, Field-Measured	pH units	09/15/2015	05/16/2017	CUSUM	6.71, 7.73	8	9	No	Yes	09/15/2015	08/25/2021	17	17	0	0%	None	09/17/2019	09/17/2019	None	Normal	CUSUM	6.73, 7.79
Sulfate	mg/L	09/15/2015	05/16/2017	CUSUM	208.9	8	9	No	Yes	09/15/2015	08/25/2021	17	16	0	0%	None	09/11/2018	09/11/2018	None	Normal	CUSUM	179.8
Total Dissolved Solids	mg/L	09/15/2015	05/16/2017	CUSUM	826	8	9	No	Yes	09/15/2015	08/25/2021	17	17	0	0%	Decreasing trend at 95% Not significant at 99%	None	None	None	Normal	CUSUM	746

Notes:  
mg/L - Milligrams per Liter  
NA: Not Analyzed  
CUSUM: Shewhart-CUSUM (cumulative summation) limit for parametric statistical analysis  
NP-PL: Non-parametric prediction limit  
Wilcoxon Rank Sum (WRS) analysis was first checked at α = 95% for significance. Tests where the WRS was significant at α = 95% were also evaluated at α = 97.5% and α = 99% regarding the potential to update the baseline period.  
Datasets with a baseline non-detect percentage of 50% or more were not tested for trends using the Sen's Slope/Mann-Kendall analysis or for data distribution, and are marked as NA for the associated tests.  
Sen's Slope/Mann-Kendall analyses for temporal trends were performed at α = 95%. Kruskal-Wallis analysis for seasonal trends was performed at α = 95%.  
Where seasonal trends have been identified, data have been deseasonalized in setting the updated statistical limit.  
WRS analysis for fluoride was significant at 95%, but not at 97.5% or 99%. Opting to proceed with reviewing for the potential to update the statistical baseline.  
A statistically significant decreasing trend was identified for Total Dissolved Solids at 95%, but was found to not be significant at 99%. The baseline was updated.

Table 5: AP4-MW5 Baseline Update

Analyte	Unit	Current Start of Baseline Period	Current End of Baseline Period	Current Statistical Method	Current Statistical Limti	Current Number of Baseline Samples	Number of Samples Collected Since End of Current Baseline	WRS Significant at 95%?	Proceeding with Baseline Update?	Updated Start of Baseline Period	Updated End of Baseline Period	Total Number of Samples	Number of Samples in Updated Baseline	# ND in Updated Baseline	% ND in Updated Baseline	Temporal Trends Identified in Updated Baseline	Outliers Identified in Baseline Period	Removed Outliers	Seasonal Trend Identified	Baseline Data Distribution	Selected Statistical Method	Updated Statistical Limit
Boron, Total	mg/L	09/15/2015	05/16/2017	NP-PL	0.200	8	9	No	Yes	09/15/2015	08/25/2021	17	17	15	88%	N/A	None	None	None	N/A	NP-PL	0.200
Calcium, Total	mg/L	09/15/2015	05/16/2017	CUSUM	903	8	9	No	Yes	09/15/2015	08/25/2021	17	17	0	0%	None	None	None	None	Square	CUSUM	798
Chloride	mg/L	09/15/2015	05/16/2017	CUSUM	14.82	8	9	No	Yes	09/15/2015	08/25/2021	17	17	3	18%	Decreasing trend at 95% Not significant at 99%	None	None	None	Natural Log	CUSUM	15.58
Fluoride	mg/L	09/15/2015	05/16/2017	NP-PL	1.270	8	9	No	Yes	09/15/2015	08/25/2021	17	16	11	69%	N/A	05/16/2017	05/16/2017	None	N/A	NP-PL	0.664
pH, Field-Measured	pH units	09/15/2015	05/16/2017	CUSUM	6.38, 7.42	8	9	No	Yes	09/15/2015	08/25/2021	17	17	0	0%	None	None	None	None	Normal	CUSUM	6.32, 7.63
Sulfate	mg/L	09/15/2015	05/16/2017	CUSUM	2698	8	9	No	Yes	09/15/2015	08/25/2021	17	17	0	0%	None	None	None	None	Non-Normal	NP-PL	1630
Total Dissolved Solids	mg/L	09/15/2015	05/16/2017	CUSUM	4898	8	9	No	Yes	09/15/2015	08/25/2021	17	17	0	0%	None	None	None	None	Square	CUSUM	4040

Notes:  
mg/L - Milligrams per Liter  
NA: Not Analyzed  
CUSUM: Shewhart-CUSUM (cumulative summation) limit for parametric statistical analysis  
NP-PL: Non-parametric prediction limit  
Wilcoxon Rank Sum (WRS) analysis was first checked at  $\alpha = 95\%$  for significance. Tests where the WRS was significant at  $\alpha = 95\%$  were also evaluated at  $\alpha = 97.5\%$  and  $\alpha = 99\%$  regarding the potential to update the baseline period.  
Datasets with a baseline non-detect percentage of 50% or more were not tested for trends using the Sen's Slope/Mann-Kendall analysis or for data distribution, and are marked as NA for the associated tests.  
Sen's Slope/Mann-Kendall analyses for temporal trends were performed at  $\alpha = 95\%$ . Kruskal-Wallis analysis for seasonal trends was performed at  $\alpha = 95\%$ .  
Where seasonal trends have been identified, data have been deseasonalized in setting the updated statistical limit.



Table 6: AP4-MW6 Baseline Update

Analyte	Unit	Current Start of Baseline Period	Current End of Baseline Period	Current Statistical Method	Current Statistical Limit	Current Number of Baseline Samples	Number of Samples Collected Since End of Current Baseline	WRS Significant at 95%?	Proceeding with Baseline Update?	Updated Start of Baseline Period	Updated End of Baseline Period	Total Number of Samples	Number of Samples in Updated Baseline	# ND in Updated Baseline	% ND in Updated Baseline	Temporal Trends Identified in Updated Baseline	Outliers Identified in Baseline Period	Removed Outliers	Seasonal Trend Identified	Baseline Data Distribution	Selected Statistical Method	Updated Statistical Limit
Boron, Total	mg/L	09/15/2015	05/16/2017	NP-PL	0.200	8	9	No	Yes	09/15/2015	08/25/2021	17	17	16	94%	N/A	None	None	None	N/A	NP-PL	0.200
Calcium, Total	mg/L	09/15/2015	05/16/2017	CUSUM	134.3	8	9	No	Yes	09/15/2015	08/25/2021	17	17	0	0%	None	None	None	None	Normal	CUSUM	126.9
Chloride	mg/L	09/15/2015	05/16/2017	NP-PL	5.00	8	9	No	Yes	09/15/2015	08/25/2021	17	17	16	94%	N/A	None	None	None	N/A	NP-PL	5.28
Fluoride	mg/L	09/15/2015	05/16/2017	CUSUM	2.64	8	9	Yes	Yes - see notes	09/15/2015	08/25/2021	17	17	0	0%	None	None	None	None	Normal	CUSUM	2.90
pH, Field-Measured	pH units	09/15/2015	05/16/2017	CUSUM	6.48, 7.96	8	9	No	Yes	09/15/2015	08/25/2021	17	17	0	0%	None	None	None	Yes - Data Will Be Deseasonalized	Normal	CUSUM	6.72, 7.82
Sulfate	mg/L	09/15/2015	05/16/2017	CUSUM	132.4	8	9	No	Yes	09/15/2015	08/25/2021	17	16	0	0%	None	11/23/2015	None	None	Square Root	CUSUM	114.9
Total Dissolved Solids	mg/L	09/15/2015	05/16/2017	CUSUM	718	8	9	No	Yes	09/15/2015	08/25/2021	17	17	0	0%	Decreasing trend at 95% Not significant at 99%	None	None	None	Normal	CUSUM	687

Notes:  
mg/L - Milligrams per Liter  
NA: Not Analyzed  
CUSUM: Shewhart-CUSUM (cumulative summation) limit for parametric statistical analysis  
NP-PL: Non-parametric prediction limit  
Wilcoxon Rank Sum (WRS) analysis was first checked at  $\alpha = 95\%$  for significance. Tests where the WRS was significant at  $\alpha = 95\%$  were also evaluated at  $\alpha = 97.5\%$  and  $\alpha = 99\%$  regarding the potential to update the baseline period.  
Datasets with a baseline non-detect percentage of 50% or more were not tested for trends using the Sen's Slope/Mann-Kendall analysis or for data distribution, and are marked as NA for the associated tests.  
Sen's Slope/Mann-Kendall analyses for temporal trends were performed at  $\alpha = 95\%$ . Kruskal-Wallis analysis for seasonal trends was performed at  $\alpha = 95\%$ .  
Where seasonal trends have been identified, data have been deseasonalized in setting the updated statistical limit.  
WRS analysis for fluoride was significant at 95%, but not at 97.5% or 99%. Opting to proceed with reviewing for the potential to update the statistical baseline.  
A statistically significant decreasing trend was identified for Total Dissolved Solids at 95%, but was found to not be significant at 99%. The baseline was updated.

Table 7: AP4-MW7 Baseline Update

Analyte	Unit	Current Start of Baseline Period	Current End of Baseline Period	Current Statistical Method	Current Statistical Limti	Current Number of Baseline Samples	Number of Samples Collected Since End of Current Baseline	WRS Significant at 95%?	Proceeding with Baseline Update?	Updated Start of Baseline Period	Updated End of Baseline Period	Total Number of Samples	Number of Samples in Updated Baseline	# ND in Updated Baseline	% ND in Updated Baseline	Temporal Trends Identified in Updated Baseline	Outliers Idenitified in Baseline Period	Removed Outliers	Seasonal Trend Identified	Baseline Data Distribution	Selected Statistical Method	Updated Statistical Limit
Boron, Total	mg/L	09/15/2015	05/16/2017	NP-PL	0.200	8	9	No	Yes	09/15/2015	08/25/2021	17	17	16	94%	N/A	None	None	None	N/A	NP-PL	0.200
Calcium, Total	mg/L	09/15/2015	05/16/2017	NP-PL	79.0	8	9	No	Yes	09/15/2015	08/25/2021	17	17	0	0%	None	03/07/2017	None	None	Non-Normal	NP-PL	79.0
Chloride	mg/L	09/15/2015	05/16/2017	CUSUM	20.1	8	9	No	Yes	09/15/2015	08/25/2021	17	17	0	0%	None	09/15/2015	None	None	Normal	CUSUM	17.9
Fluoride	mg/L	09/15/2015	05/16/2017	NP-PL	1.020	8	9	No	Yes	09/15/2015	08/25/2021	17	17	12	71%	N/A	None	None	None	N/A	NP-PL	1.020
pH, Field-Measured	pH units	09/15/2015	05/16/2017	CUSUM	6.85, 8.07	8	9	No	Yes	09/15/2015	08/25/2021	17	17	0	0%	None	None	None	Yes - Data Will Be Deseasonalized	Normal	CUSUM	6.87, 8.09
Sulfate	mg/L	09/15/2015	05/16/2017	CUSUM	58.4	8	9	No	Yes	09/15/2015	08/25/2021	17	17	0	0%	None	None	None	None	Normal	CUSUM	63.2
Total Dissolved Solids	mg/L	09/15/2015	05/16/2017	CUSUM	700	8	9	No	Yes	09/15/2015	08/25/2021	17	17	0	0%	Decreasing trend at 95% Not significant at 99%	None	None	None	Normal	CUSUM	732

Notes:

mg/L - Milligrams per Liter

NA: Not Analyzed

CUSUM: Shewhart-CUSUM (cumulative summation) limit for parametric statistical analysis

NP-PL: Non-parametric prediction limit

Wilcoxon Rank Sum (WRS) analysis was first checked at  $\alpha = 95\%$  for significance. Tests where the WRS was significant at  $\alpha = 95\%$  were also evaluated at  $\alpha = 97.5\%$  and  $\alpha = 99\%$  regarding the potential to update the baseline period.

Datasets with a baseline non-detect percentage of 50% or more were not tested for trends using the Sen's Slope/Mann-Kendall analysis or for data distribution, and are marked as NA for the associated tests.

Sen's Slope/Mann-Kendall analyses for temporal trends were performed at  $\alpha = 95\%$ . Kruskal-Wallis analysis for seasonal trends was performed at  $\alpha = 95\%$ .

Where seasonal trends have been identified, data have been deseasonalized in setting the updated statistical limit.

A statistically significant decreasing trend was identified for Total Dissolved Solids at 95%, but was found to not be significant at 99%. The baseline was updated.

**APPENDIX B**

**Alternative Source Demonstration -  
Sulfate at AP4-MW1**

## TECHNICAL MEMORANDUM

**DATE** July 20, 2022

**Reference No.** 20141315-20-TM-0

**TO** Nebraska Public Power District

**CC** Jacob Sauer

**FROM** Erin Hunter

**EMAIL** [erin.hunter@wsp.com](mailto:erin.hunter@wsp.com)

### ALTERNATE SOURCE DEMONSTRATION FOR SULFATE AT UPGRADIENT LOCATION AP4-MW1

## 1.0 INTRODUCTION

On behalf of Nebraska Public Power District (NPPD), Golder Associates USA Inc. (Golder), a member of WSP, performed a statistical evaluation of groundwater quality for the first quarter groundwater detection monitoring event of 2022 (Q1 2022) at Sheldon Station Ash Landfill No. 4 (the Site), located at 4500 W Pella Road, Hallam, Lancaster County, Nebraska (Figure 1). The statistical evaluation was performed in accordance with the site groundwater statistical methods plan and applicable provisions of 40 Code of Federal Regulations (CFR) Part 257, "Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals (CCR) from Electric Utilities" (CCR Rule), as amended, and corresponding regulations under Nebraska Administrative Code (NAC) Title 132, Chapter 7 (Integrated Solid Waste Management Regulations, Groundwater Monitoring and Remedial Action).

Statistical analysis of the Appendix III detection monitoring data for sulfate in groundwater at upgradient monitoring well AP4-MW1 indicated a potential exceedance of the statistical limit based on the parametric Shewhart-CUSUM (cumulative summation) analysis in the Q3 2021 sampling result, which was subsequently verified as a statistically significant increase (SSI) in the Q1 2022 sampling event. Although identification of an SSI generally indicates that the groundwater monitoring program should transition from detection monitoring to assessment monitoring, 40 CFR 257.94(e)(2) and NAC Title 132, Chapter 7 0004.03C allows the owner or operator (i.e., NPPD) 90 days from the date of determination of an SSI (SSI verified April 28, 2022; 90 days from the date of determination: July 26, 2022), to demonstrate that a source other than the CCR unit caused the SSI for sulfate at AP4-MW1 or that the SSI is an indication of an error in sampling, analysis, statistical evaluation, or natural variability in groundwater quality that was not captured during the baseline data collection period.

In accordance with the provisions of the federal CCR Rule and NAC Title 132, Chapter 7, Golder has prepared this Alternate Source Demonstration (ASD) for the Site. This ASD includes an evaluation of geological and hydrogeological information regarding groundwater obtained from monitoring wells installed adjacent to the Site. This ASD conforms to the requirements of 40 CFR 257.94(e)(2) and NAC Title 132, Chapter 7 004.03C and provides the basis for concluding that the SSI for sulfate in groundwater at AP4-MW1 is not a result of impacts from Ash Landfill No. 4.

## 2.0 BACKGROUND

### 2.1 Site Geology and Hydrology

A well drilling program was initiated at Sheldon Station between 1998 and 1999. The borings were used to characterize the nature of the Pleistocene Age sediments and glacial till present in the area. In the area of the CCR unit, the thickness of the till ranges from approximately 180 to 200 feet, thinning toward the north. The composition of the till varies throughout the formation, generally consisting of predominantly clay to silty clay with sand lenses. The uppermost water-bearing zone is typically encountered between 15 and 25 feet below the ground surface in the area, well above the principal groundwater reservoir for the area (typically found approximately 300 feet below ground surface).

Regional groundwater in the uppermost water-bearing zone near Ash Landfill No. 4 flows from the southeast to the northwest. However, Sheldon Station is located in a geologic area dominated by glacial drift, and groundwater flow in the glacial deposits observed at Sheldon Station mimic local surface topography. The local groundwater flow system at Ash Landfill No. 4 varies from the regional groundwater flow pattern due to surface topography, which consists of a hill to the north and surface water drainages to the east and west of Ash Landfill No. 4. Thus, groundwater generally flows towards the landfill from the north and south, and away from the landfill to the east and west (see Figure 1 and Figure 2).

### 2.2 Groundwater Monitoring Network

Design of the federal CCR Rule-compliant monitoring program considered the size of the landfill, the disposal and operational history of the unit, anticipated groundwater flow direction, and saturated thickness of the uppermost aquifer. Based on these factors, a monitoring well network that consists of two background monitoring wells and five downgradient monitoring wells were installed around the Site. The monitoring wells are listed in Table 1 and presented in Figure 1 and Figure 2.

**Table 1: Monitoring Well Network**

CCR Unit	Background Monitoring Wells	Downgradient Monitoring Wells
Ash Landfill No. 4	AP4-MW1, AP4-MW2	AP4-MW3, AP4-MW4, AP4-MW5, AP4-MW6, AP4-MW7

The two upgradient wells included in the groundwater monitoring program are used to represent the background groundwater quality, including potential variability within the background. The five downgradient wells were installed along the western, northern, and eastern boundaries of the active ash landfill. The depths of the monitoring wells were selected such that the monitoring wells are screened 10 to 37 feet below the groundwater surface to yield groundwater samples that are representative of water quality in the uppermost water-bearing zone. Figure 3 presents the groundwater levels in the monitoring wells between Q4 2002 and Q1 2022. Water levels in both the upgradient and downgradient monitoring wells have been generally stable over the course of measurement, with a slight increase in sitewide water levels between Q3 2018 and Q1 2021.

## 2.3 Groundwater Conditions

Between September 2015 and May 2017, NPPD collected eight independent quarterly groundwater samples from each of the background and downgradient monitoring wells listed in Table 1 for baseline establishment, as required by 40 CFR 257.94. The results of the baseline monitoring phase were used to develop appropriate and statistically valid initial baseline values for each constituent–well pair (GAI 2017a).

Following completion of the eight baseline monitoring events, NPPD began collecting groundwater samples on a semiannual basis in September 2017 to support the detection monitoring program. Groundwater samples for detection monitoring are collected at the two background and five downgradient monitoring wells and analyzed for the Appendix III constituents listed in 40 CFR 257. During the detection monitoring program, groundwater analysis results are compared to the calculated statistical limits to determine whether groundwater quality remains consistent, or if identified changes are considered an SSI.

During the original baseline period between September 2015 and May 2017, sulfate concentrations at upgradient location AP4-MW1 ranged from 20.6 milligrams per liter (mg/L) to 24.5 mg/L (Figure 4). From the baseline period, a Shewhart-CUSUM parametric statistical limit of 28.0 mg/L was established for sulfate at AP4-MW1.

The Q3 2021 detection monitoring event resulted in a sulfate concentration of 27.2 mg/L and a CUSUM value of 30.9 mg/L, with the CUSUM value exceeding the statistical limit. Verification sampling was completed in March 2022 (i.e., Q1 2022) with a sulfate concentration of 26.2 mg/L and a CUSUM value of 33.4 mg/L, resulting in a verified SSI based on the consecutive CUSUM values.

For most other constituent–well pairs at the Site, a baseline update was conducted prior to the Q1 2022 sampling event (Golder 2022a), incorporating detection monitoring data collected between September 2017 and August 2021 into the baseline periods. However, due to the identification of the potential exceedance for sulfate at AP4-MW1 during the Q3 2021 sampling event, the baseline period for sulfate at AP4-MW1 was not updated at that time.

## 3.0 SOURCE EVALUATION

### 3.1 Groundwater Conditions

As an upgradient background location, groundwater from AP4-MW2 flows north and northeast towards AP4-MW1 and the landfill, as shown in Figure 1 and Figure 2. Groundwater elevations at the site have remained relatively consistent from the time of well installation, as shown in Figure 3. Additionally, groundwater flow rates and direction have remained relatively consistent, indicating that AP4-MW1 remains an upgradient location. Based on these findings, Ash Landfill No. 4 is not the source of the verified SSI for sulfate at AP4-MW1.

### 3.2 Sampling and Laboratory Testing Procedures

As part of the ASD, a review was conducted of the sampling and laboratory testing procedures used throughout the baseline monitoring period and detection monitoring conducted to date, along with the collected analytical results. A review of the statistical assessment methods and associated results found the procedures followed during the baseline and detection monitoring to be consistent with the stated procedures listed in the published Groundwater Statistical Methods Certification (GAI 2017b) and the approved Sampling and Analysis Plan for the Site (Golder 2022b). No differences were noted in the analytical procedures used for sulfate analysis over between 2015 and 2022.



## 4.0 CONCLUSION

In accordance with 40 CFR 257.94(e)(2) and NAC Title 132, Chapter 7, this ASD has been prepared in response to the identification of an SSI for sulfate at upgradient monitoring well AP4-MW1 following the Q1 2022 sampling event for Ash Landfill No. 4 at Sheldon Station.

A review of the groundwater flow, direction, and elevations indicate that the sulfate in groundwater at AP4-MW1 was not a result of seepage from the Site, and instead may represent previously uncaptured natural variability within the upgradient water. Therefore, no further action (i.e., transition to assessment monitoring) is warranted, and Sheldon Station Ash Landfill No. 4 will remain in detection monitoring. The current results for sulfate at AP4-MW1 will be reviewed for the potential to update the baseline period to better reflect previously uncaptured natural variability.

## 5.0 REFERENCES

GAI (Golder Associates Inc.). 2017a. Coal Combustion Residuals Landfill Groundwater Monitoring System Certification, Sheldon Station, Hallam Nebraska.

GAI. 2017b. Groundwater Monitoring Statistical Methods Certification, Sheldon Station Ash Landfill No. 4.

Golder (Golder Associates USA Inc.). 2022a. Baseline Update for Groundwater Quality Monitoring at Nebraska Public Power District's Sheldon Station.

Golder. 2022b. Sampling and Analysis Plan Permit No. NE0204285, Sheldon Station Ash Landfill No. 4.

### Golder Associates USA Inc.



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ELH/JJS/af



Jacob J. Sauer, PE  
Senior Lead Consultant



Attachments: Figure 1 – Ash Landfill No. 4 Groundwater Contours, August 2021  
Figure 2 – Ash Landfill No. 4 Groundwater Contours, March 2022  
Figure 3 – Sheldon Station Ash Landfill No. 4 Groundwater Elevations  
Figure 4 – Control Chart, AP4-M1 Sulfate

[https://golderassociates.sharepoint.com/sites/124836/Project%20Files/6%20Deliverables/TechMemos/20-tm-0/20141315-20-tm-0-asd\\_for\\_sulfate\\_at\\_upgradient\\_location\\_ap4-mw1\\_20jul22.docx](https://golderassociates.sharepoint.com/sites/124836/Project%20Files/6%20Deliverables/TechMemos/20-tm-0/20141315-20-tm-0-asd_for_sulfate_at_upgradient_location_ap4-mw1_20jul22.docx)

## Figures





Path: \\Denver-golder\golder\NPDS\helen09\_PROJECTS\2014\15\_MPPD\2020\_GW1\_Fire Name\_SS\_GW\_Maps\2021\_G3.dwg

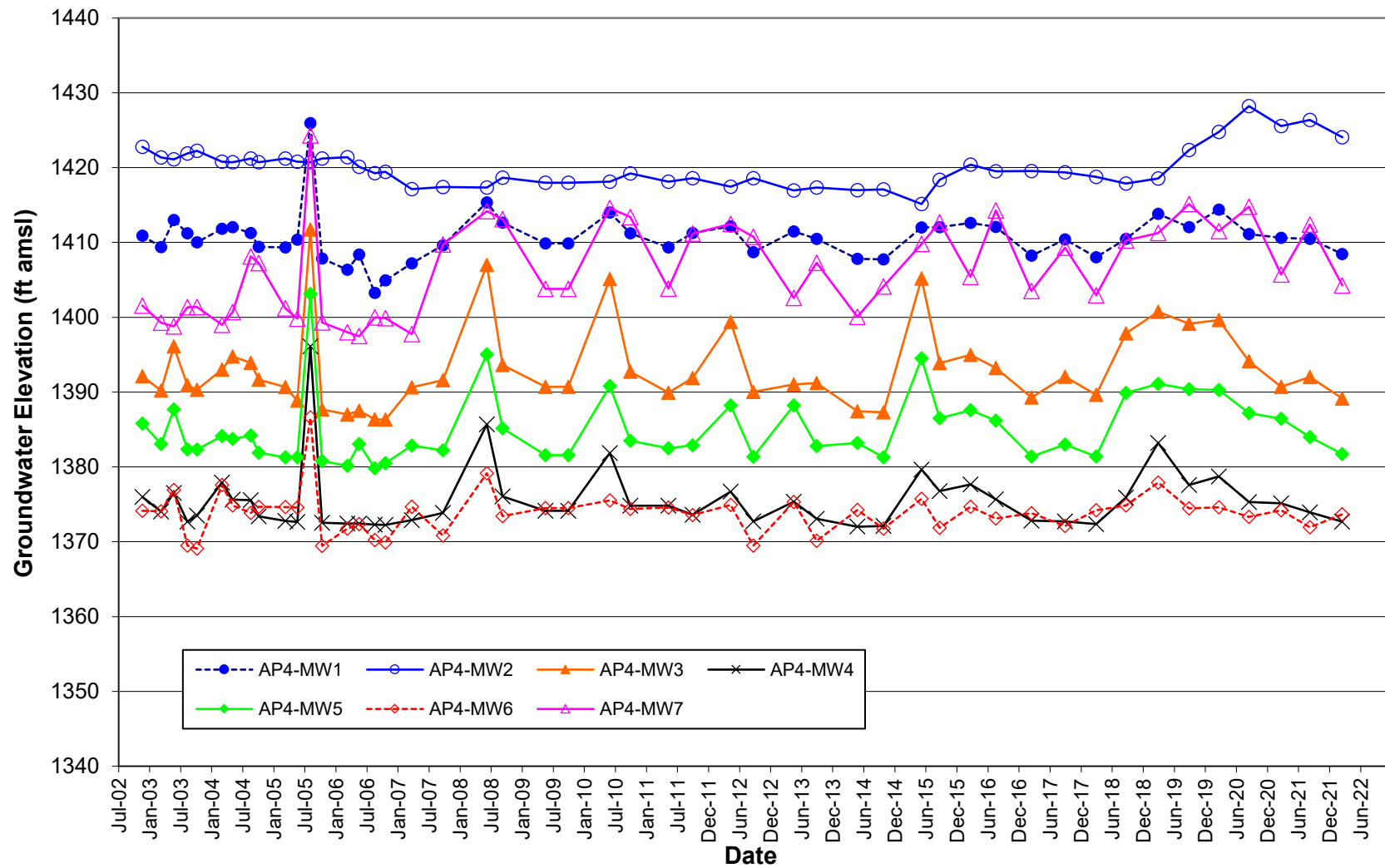


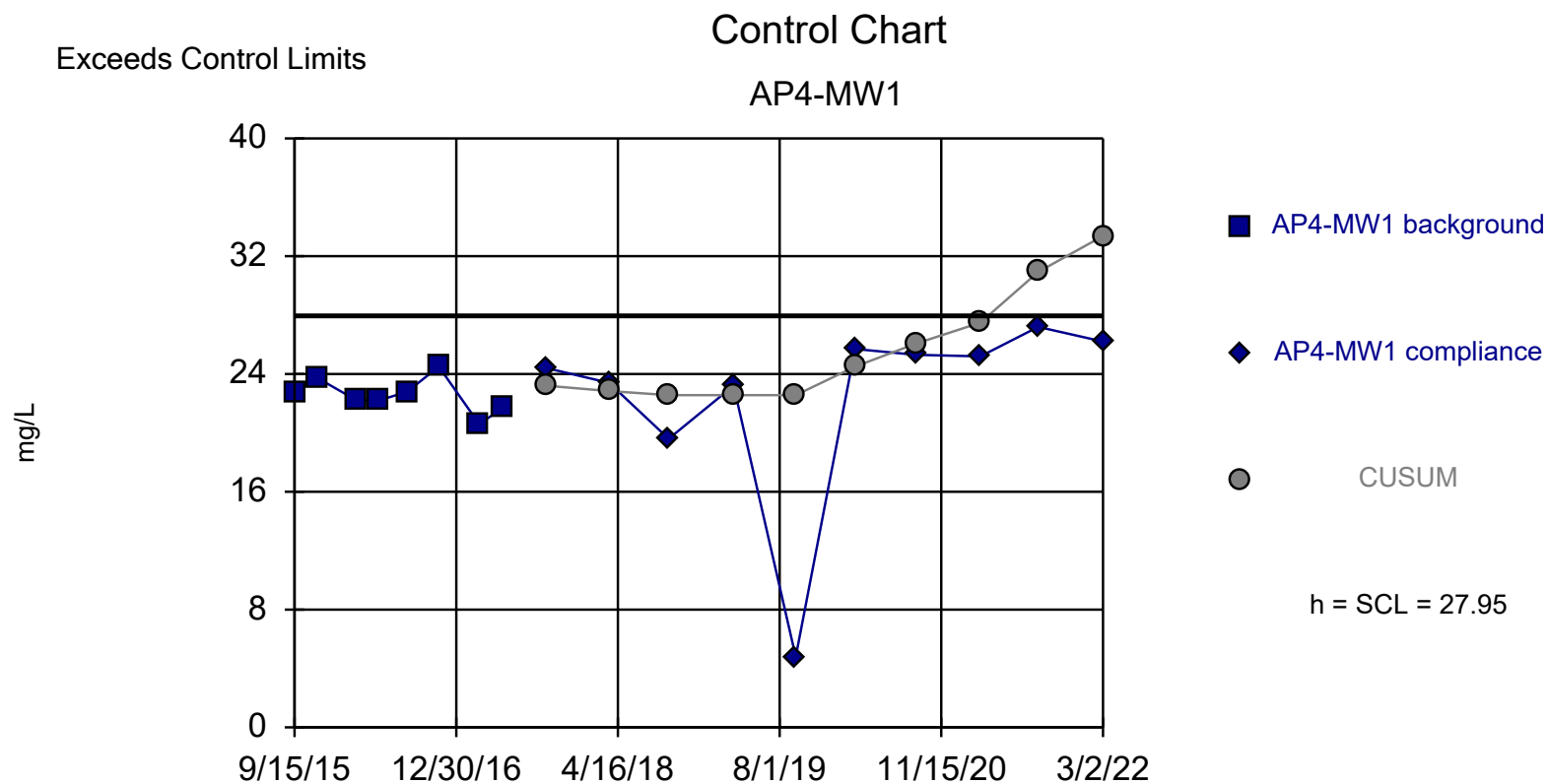
**FIGURE 1**  
ASH LANDFILL NO. 4  
GROUNDWATER CONTOURS  
AUGUST 2021





**FIGURE 3**  
**Sheldon Station Ash Landfill No. 4**  
**Groundwater Elevations**





Background Data Summary: Mean=22.56, Std. Dev.=1.196, n=8. Seasonality was not detected with 95% confidence. Normality test: Shapiro Wilk @alpha = 0.05, calculated = 0.9787, critical = 0.818. Report alpha = 0.01164. Dates ending 5/16/2017 used for control stats. Standardized h=4.5, SCL=4.5.

Constituent: Sulfate    Analysis Run 4/19/2022 9:05 AM  
Sheldon Station    Client: NPPD    Data: SheldonStation\_Q1-2022.mdb



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