REPORT

Annual Coal Combustion Residuals Groundwater Monitoring and Corrective Action Report - 2022

Nebraska Public Power District, Gerald Gentleman Station

Submitted to:

Nebraska Public Power District

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Submitted by:

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GL20141315-24-R-0

January 2023

Executive Summary

This report presents the results from groundwater monitoring that occurred at Nebraska Public Power District's Gerald Gentleman Station in 2022 to meet the requirements of the United States Environmental Protection Agency's Coal Combustion Residuals Rule (40 Code of Federal Regulations 257.90 through 257.98). The facility entered 2022 under a detection monitoring event and remains in detection monitoring based on the results of sampling and analysis events conducted in the second quarter (Q2) and fourth quarter (Q4) of 2022.

No potential exceedances were identified during either the Q2 2022 or Q4 2022 detection monitoring sampling events. A potential exceedance identified for chloride at APMW-8A during the Q4 2021 detection monitoring sampling event was found to be a false-positive following confirmatory re-sampling during the Q2 2022 sampling event.

Verified statistically significant increases were identified for chloride at APMW-6 and sulfate at APMW-19 during the Q2 2022 and Q4 2022 sampling events. Both verified statistically significant increase were originally identified following the Q4 2021 sampling event. Successful alternative source demonstrations were conducted following the Q4 2021 and Q2 2022 events, which are included within this report. Based on the results of the Q4 2022 event, NPPD will review the previously completed alternative source demonstrations for continued applicability. Pending completion of the ASD reviews, NPPD will remain in detection monitoring for the first semi-annual detection monitoring event of 2023, to be conducted in Q2 2023.

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

Table of Contents

FIGURES

APPENDICES

1.0 INTRODUCTION

WSP USA Inc. (WSP), which acquired Golder Associates USA Inc. (Golder) in 2022, prepared this report describing the 2022 groundwater sampling and comparative statistical analysis for Nebraska Public Power District's (NPPD) Gerald Gentleman Station (GGS) in Sutherland, Nebraska. This report was written to meet the requirements of the federal Coal Combustion Residuals (CCR) Rule's sections on groundwater monitoring and corrective action, 40 Code of Federal Regulations (CFR) 257.90 to 257.98.

1.1 Facility Information

GGS is located approximately 5 miles south of Sutherland, Nebraska, and 1.2 miles south of Sutherland Reservoir. The ash disposal facility at GGS is situated in the NW ¼, NE ½, Section 30 of Township 13 N, Range 33 W, in Lincoln County, Nebraska. NPPD began operating GGS in 1979 as a coal-fired electrical generation facility. GGS is both owned and operated by NPPD. The plant, with a generation capacity of 1,365 megawatts (MW) of power, uses a low-sulfur coal from Wyoming's Powder River Basin. The active CCR landfill at the site contains fly ash and bottom ash.

1.2 Purpose

The federal CCR Rule established specific requirements for reporting of groundwater monitoring and corrective actions in 40 CFR 257.90. 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.

2.0 GROUNDWATER MONITORING NETWORK PROGRAM STATUS

The groundwater monitoring network for the active CCR landfill at GGS consists of 14 monitoring wells, as shown in Figure 1 and Figure 2. The four upgradient wells are APMW-5, APMW-15, APMW-16A, and APMW-17 and are indicated by the inclusion of "(U)" throughout the text. The ten downgradient monitoring wells are APMW-4, APMW-6, APMW-8A, APMW-10, APMW-11, APMW-12, APMW-13, APMW-14, APMW-18, and APMW-19.

2.1 Completed Key Actions in 2022

The following key actions were completed in 2022:

- The 2021 annual CCR groundwater monitoring and corrective action report was completed and placed within the operating record and on NPPD's publicly accessible CCR website (Golder 2022).
- Detection monitoring samples were collected in June and December 2022 and analyzed for the Appendix III constituent list associated with the CCR Rule.
- Comparative statistical analysis was completed for the second quarter (Q2) 2022 and fourth quarter (Q4) 2022 detection monitoring events, collected in June and December 2022, respectively.

2.2 Installation and Decommissioning of Monitoring Wells

No monitoring wells associated with the ash disposal facility groundwater quality monitoring network were installed or decommissioned at GGS in 2022.

2.3 Problems and Resolutions

A sample was unable to be collected at APMW-5 (U) on December 5, 2022, due to insufficient water in the well. The remaining wells within the monitoring network were able to be sampled during the monitoring event. NPPD will continue to monitor APMW-5 during future sampling events.

2.4 Proposed Key Activities for 2023

The following key activities are expected to be completed in 2023:

- The 2022 annual monitoring report will be placed on the publicly accessible CCR website.
- Detection monitoring sampling events and associated comparative statistical analysis are planned to occur in Q2 and Q4 2023.

3.0 GROUNDWATER MONITORING ANALYTICAL PROGRAM STATUS

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

3.1 Samples Collected

GGS staff collected monitoring samples from program wells on June 21 and 22, 2022, and December 5 and 6, 2022. Specific dates for each sample are provided on the tables included as Appendix A.

3.1.1 Groundwater Elevation and Flow Rate

Groundwater elevations were measured in each well during the Q2 sampling event and 12 of the 14 wells during the Q4 event prior to purging. APMW-5 was dry during the Q4 2022 monitoring event, with both a groundwater level and a sample for laboratory analysis unable to be collected. During sampling, the groundwater level at APMW-4 was below the level of the dedicated low-flow pump, resulting in a groundwater level not being recorded, but enough water was present for a sample to be collected for laboratory analysis. Groundwater elevation measurements can be found in the tables included as Appendix A for each location. Groundwater elevations and interpolated groundwater contours are shown in Figure 1 for the June 2022 (Q2 2022) detection monitoring sampling event. Groundwater elevations and interpolated groundwater contours are shown on Figure 2 for the December 2022 (Q4 2022) detection monitoring sampling event.

The groundwater flow rate across the facility 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, estimated from slug testing results from system wells, in ft/day
- i is the hydraulic gradient, calculated based on groundwater elevations for each monitoring event, in feet per feet (ft/ft)
- n_e is the effective porosity, estimated to be 0.25 for site soils

Hydraulic conductivity values at the site range from 0.14 to 19 ft/day, based on slug test data reported in *Design and Construction of a Groundwater Monitoring Network, Final Report*, issued in September 1991 by Woodward-Clyde Consultants. According to the 1991 report, a hydraulic conductivity value of 0.14 ft/day represents the Ogallala Formation silts. Values of 16 and 19 ft/day were reported for Ogallala Formation sands. Both 0.14 and 19 ft/day have been used to estimate the range of hydraulic conductivities present at GGS. The effective porosity estimate listed above is based on typical values for sands and silts, as presented in *Applied Hydrogeology* (Fetter, 1994).

Based on the range of site values for hydraulic conductivity, the estimated effective porosity and calculated hydraulic gradient based on water level readings, the average groundwater flow rate for June 2022 was estimated between 5.0 x 10^{-4} ft/day and 6.7 x 10^{-2} per day ft/day. The average groundwater flow rate from wells with recorded groundwater elevations for December 2022 was estimated between 4.3 x 10^{-4} ft/day and 5.8 x 10^{-2} ft/day.

3.2 Monitoring Data (Analytical Results)

Analytical results for the CCR Rule Appendix III detection monitoring events in June 2022 and December 2022 are shown in the tables included as Appendix A.

3.3 Comparative Statistical Analysis

A description of the steps taken for comparative statistical analysis is summarized below with the results presented in the tables included as Appendix B.

Comparative statistical analysis is conducted following each detection monitoring event, consisting of the Appendix III parameters (USEPA 2015). For both Shewhart-CUSUM limits and non-parametric prediction limits (NP-PL), the comparative statistical analysis consists of a comparison of detection monitoring results collected during the period of interest to the statistical limit calculated from the baseline data collection period. For well-constituent pairs with increasing trends identified during the baseline period, an alternative trend test, as described by the Electric Power Research Institute (EPRI) (2015) has been used to determine compliance. For well-constituent pairs with decreasing trends identified for the baseline period, a Sen's Slope test was used to assess the compliance results. At present, no well-constituent pairs have either increasing or decreasing trends within the baseline period and no alternative methods for trend analysis have been used within this report. Additional information on the methods used for the comparative statistical analysis can be found in the Groundwater Monitoring Statistical Methods Certification (Golder Associates Inc. [GAI] 2017a).

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

- Elevated CUSUM – Defined as 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. For elevated CUSUMs in the case of two-tailed analysis for field-measured pH, the CUSUM value may also be below the lower Shewhart-CUSUM limit established by the baseline statistical analysis.
- Potential Exceedance – Defined as an initial elevated CUSUM or an initial analytical result that exceeds the Shewhart-CUSUM limit or non-parametric statistical limit established by the baseline statistical analysis. Confirmatory re-sampling will determine if the potential exceedance is a false-positive or a verified statistically

significant increase (SSI). Non-detect results that exceed either the Shewhart-CUSUM limit or the non-parametric statistical limit are not considered potential exceedances.

- False-positive – Defined as an analytical result that exceeds the statistical limit that can clearly be 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 scheduled sampling event.
- Verified SSI – Interpreted as two consecutive exceedances (the original sample and the confirmatory re-sample for analytical results, or two consecutive elevated CUSUMs) for the same constituent at the same well.

Results of the statistical analysis for the Q2 2022 and Q4 2022 detection monitoring events are shown on the tables included as Appendix B. For reporting purposes, compliance samples with non-detect results are shown at the practical quantitation limit (PQL) on the tables included as Appendix B.

3.3.1 Potential Exceedances

No potential exceedances were identified for either the Q2 2022 or Q4 2022 detection monitoring sampling events.

3.3.2 False-Positives

The potential exceedance identified for chloride at APMW-8A during the Q4 2021 detection monitoring sampling event was determined to be a false-positive through confirmatory re-sampling conducted during the Q2 2022 sampling event.

3.3.3 Verified SSIs

The following verified SSIs were identified during the Q2 2022 and Q4 2022 detection monitoring sampling events:

- APMW-6, Chloride Elevated CUSUM (initially verified during the Q4 2021 event)
- APMW-19, Sulfate Elevated CUSUM (initially verified during the Q4 2021 event)

Sulfate at APMW-19 was previously identified as a verified SSI. Both the current analytical and calculated CUSUM values for the Q4 2022 detection monitoring sampling event are below the associated statistical limits. The result will remain considered a verified SSI until two consecutive analytical results and calculated CUSUM values are below the statistical limit.

3.4 Program Transitions

Beginning in Q4 2017, the groundwater monitoring program at GGS transitioned from the baseline period to detection monitoring. During the 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 rule prior to October 17, 2017, as specified in 40 CFR 257.94(b), with the previously noted exceptions of APMW-4 and APMW-5 (U) due to lack of precipitation (GAI 2018).

3.4.1 Detection Monitoring

Samples for the detection monitoring program are collected on a semi-annual basis, beginning with the sample collected in November 2017. NPPD plans to collect semi-annual samples for the detection monitoring program in Q2 and Q4 2023.

3.4.2 Alternative Source Demonstrations

Resulting from the verified SSIs for chloride at APMW-6 and sulfate at APMW-19 identified during the Q4 2021 detection monitoring sampling event, NPPD pursued alternate source demonstrations (ASDs) which are included as Appendix C. As specified in 40 CFR 257.94, the ASDs were completed within 90 days of identification of the SSIs. As a result of the successful ASDs, NPPD remained in detection monitoring for the Q2 2022 detection monitoring sampling event.

Following the Q2 2022 detection monitoring event, the previously completed ASDs for chloride at APMW-6 and sulfate at APMW-19 were reviewed for continued applicability. The successful ASDs were completed within 90 days of identification of the SSIs, and are included as Appendix D.

Based on the Q4 2022 verified SSIs, the previously completed ASDs for chloride at APMW-6 and sulfate at APMW-19 will be reviewed for continued applicability. As specified in 40 CFR 257.94, NPPD has 90 days to complete the ASDs. Pending successful completion of the ASDs, NPPD will remain in detection monitoring.

3.4.3 Assessment Monitoring

The current groundwater monitoring program at GGS is not in assessment monitoring. Assessment monitoring has not been triggered as described in 40 CFR 257.95. If a successful ASD as described in Section 3.4.2 is not completed, GGS will enter assessment monitoring under the steps described in 40 CFR 257.95.

3.4.4 Corrective Measures and Assessment

The current groundwater monitoring program at GGS 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 for Appendix IV parameters have been made. No corrective actions are required at this time.

4.0 RECOMMENDATIONS AND CLOSING

This report presents the results from the Q2 2022 and Q4 2022 detection monitoring events of the CCR program and the associated comparative statistical analysis. The groundwater monitoring and analytical procedures implemented at GGS meet the requirements of the CCR Rule and are consistent with the approach described in the Groundwater Monitoring System Certification (GAI 2017b) and the Groundwater Monitoring Statistical Methods Certification (GAI 2017a). Modifications to the monitoring network and sampling program are not recommended at this time. Comparative statistics presented within this report support remaining in detection monitoring, pending results of the ASDs for chloride at APMW-6 and sulfate at APMW-19.

Signature Page

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https://golderassociates.sharepoint.com/sites/124836/project files/6 deliverables/reports/24-r-nppd_2022_ccr_annual/24-r-0/20141315-24-r-a-nppd_2022_ccr_annual_25jan23.docx

5.0 REFERENCES

Electric Power Research Institute (EPRI). 2015. Groundwater Monitoring Guidance for the Coal Combustion Residuals Rule – 2015 Technical Report, November 2015.

Fetter, Charles Willard. 1994. Applied Hydrogeology, 3rd Edition. Prentice-Hall.

Golder Associates Inc. (GAI). 2017a. Groundwater Monitoring Statistical Methods Certification, Gerald Gentleman Station Ash Disposal Facility. October 10, 2017.

Golder Associates Inc. (GAI). 2017b. Coal Combustion Residuals Landfill Groundwater Monitoring System Certification, Gerald Gentleman Station, Sutherland, Nebraska. October 10, 2017.

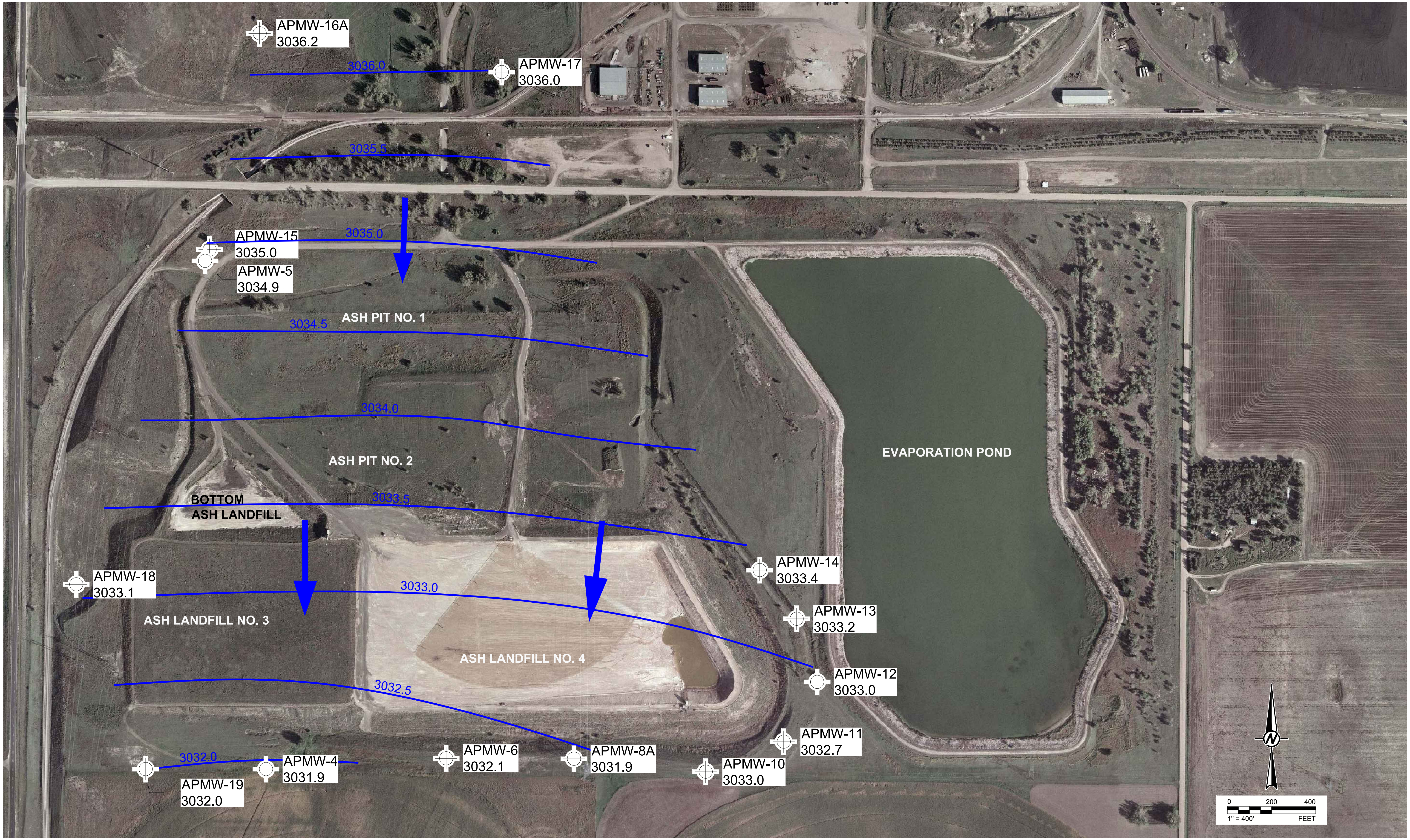
Golder Associates Inc. (GAI). 2018. Annual Groundwater Report – 2017, Nebraska Public Power District – Gerald Gentleman Station. January 24, 2018.

Golder Associates USA Inc. (Golder). 2022. Annual Coal Combustion Residuals Groundwater Monitoring and Corrective Action Report – 2021, Nebraska Public Power District, Gerald Gentleman Station. Published January 2022.

United States Environmental Protection Agency (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.

Woodward-Clyde Consultants. 1991. Design and Construction of a Groundwater Monitoring Network, Final Report. September 1991.

Figures

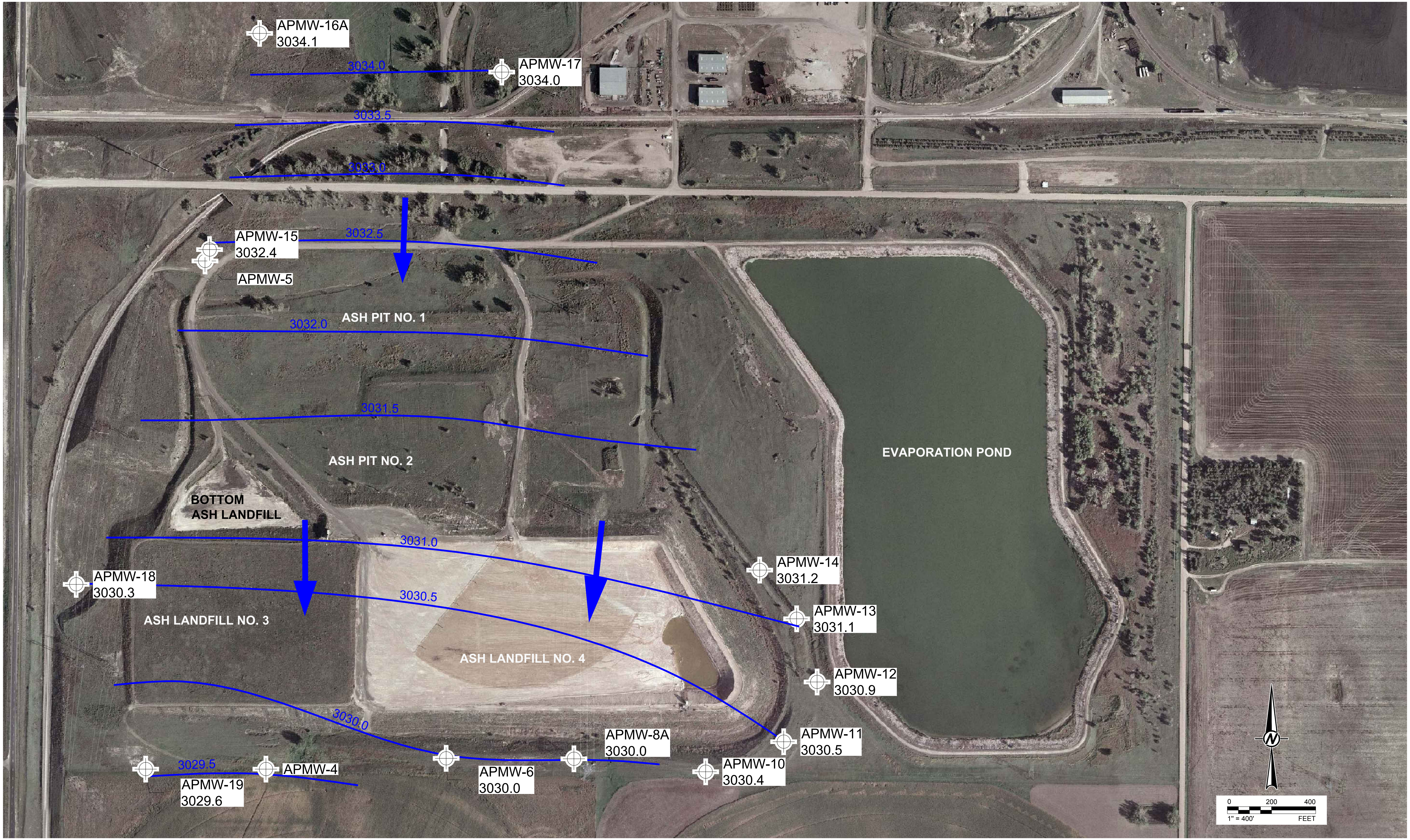


NOTE

GROUNDWATER CONTOURS DEVELOPED FROM LEVELS MEASURED IN ACTIVE MONITORING WELLS SHOWN.

NEBRASKA PUBLIC POWER DISTRICT
GERALD GENTLEMAN STATION
GROUNDWATER MONITORING WELL NETWORK
JUNE 2022 GROUNDWATER CONTOURS
FIGURE 1

Path: \\golder.gds\comp\exdata\office\Denver\acad\NPPD\GGS\99_PROJECTS\20141315 GGS GW Quality 2020_2022\ | File Name: 20141315A002_GGS_Q2-2022.dwg



NOTE

GROUNDWATER CONTOURS DEVELOPED FROM LEVELS MEASURED IN ACTIVE MONITORING WELLS SHOWN.

NEBRASKA PUBLIC POWER DISTRICT
GERALD GENTLEMAN STATION
GROUNDWATER MONITORING WELL NETWORK
DECEMBER 2022 GROUNDWATER CONTOURS
FIGURE 2

Path: \\golder.gds\complexdata\office\Denver\acad\NPPD\GGS\99_PROJECTS\20141315 GGS GW Quality 2020_2022\ | File Name: 20141315A002_GGS_Q4-2022.dwg

APPENDIX A

Monitoring Data

Table A1. Data Summary Table - APMW-5 (Upgradient)

Analytes		6/21/2022	12/5/2022
	Units	Detection Monitoring [1]	
Water Elevation	ft amsl	3034.9	***
Appendix III			
Boron, Total	mg/L	< 0.100	---
Calcium, Total	mg/L	67.5	---
Chloride	mg/L	16.4	---
Fluoride	mg/L	< 0.500	---
pH, Field	pH units	7.61	---
pH	pH units	7.8	---
Sulfate	mg/L	44.7	---
Total Dissolved Solids	mg/L	282	---
Appendix IV			
Antimony, Total	mg/L	---	---
Arsenic, Total	mg/L	---	---
Barium, Total	mg/L	---	---
Beryllium, Total	mg/L	---	---
Cadmium, Total	mg/L	---	---
Chromium, Total	mg/L	---	---
Cobalt, Total	mg/L	---	---
Fluoride	mg/L	---	---
Lead, Total	mg/L	---	---
Lithium, Total	mg/L	---	---
Mercury, Total	mg/L	---	---
Molybdenum, Total	mg/L	---	---
Radium-226	pCi/L	---	---
Radium-228	pCi/L	---	---
Radium-226 + Radium-228	pCi/L	---	---
Selenium, Total	mg/L	---	---
Thallium, Total	mg/L	---	---

Legend:
---. Not analyzed
ft amsl, feet above mean sea level
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.

*** APMW-5 was dry during the Q4 2022 sampling event, preventing collection of a sample. See text for details.

Table A2. Data Summary Table - APMW-15 (Upgradient)

Analytes		**6/21/2022**	**12/5/2022**
	Units	**Detection Monitoring [1]**	
Water Elevation	ft amsl	3035.0	3032.4
Appendix III			
Boron, Total	mg/L	0.114	0.104
Calcium, Total	mg/L	97.5	96.4
Chloride	mg/L	31.1	20.8
Fluoride	mg/L	< 0.500	< 0.500
pH, Field	pH units	7.27	7.68
pH	pH units	7.6	7.5
Sulfate	mg/L	126	94.7
Total Dissolved Solids	mg/L	494	456
Appendix IV			
Antimony, Total	mg/L	---	---
Arsenic, Total	mg/L	---	---
Barium, Total	mg/L	---	---
Beryllium, Total	mg/L	---	---
Cadmium, Total	mg/L	---	---
Chromium, Total	mg/L	---	---
Cobalt, Total	mg/L	---	---
Fluoride	mg/L	---	---
Lead, Total	mg/L	---	---
Lithium, Total	mg/L	---	---
Mercury, Total	mg/L	---	---
Molybdenum, Total	mg/L	---	---
Radium-226	pCi/L	---	---
Radium-228	pCi/L	---	---
Radium-226 + Radium-228	pCi/L	---	---
Selenium, Total	mg/L	---	---
Thallium, Total	mg/L	---	---

Legend:
---. Not analyzed
ft amsl, feet above mean sea level
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 A3. Data Summary Table - APMW-16A (Upgradient)

Analytes		6/21/2022	12/5/2022
	Units	Detection Monitoring [1]	
Water Elevation	ft amsl	3036.2	3034.1
Appendix III			
Boron, Total	mg/L	0.128	0.140
Calcium, Total	mg/L	96.5	113
Chloride	mg/L	21.8	19.5
Fluoride	mg/L	< 0.500	< 0.500
pH, Field	pH units	7.18	7.41
pH	pH units	7.5	7.4
Sulfate	mg/L	143	128
Total Dissolved Solids	mg/L	504	540
Appendix IV			
Antimony, Total	mg/L	---	---
Arsenic, Total	mg/L	---	---
Barium, Total	mg/L	---	---
Beryllium, Total	mg/L	---	---
Cadmium, Total	mg/L	---	---
Chromium, Total	mg/L	---	---
Cobalt, Total	mg/L	---	---
Fluoride	mg/L	---	---
Lead, Total	mg/L	---	---
Lithium, Total	mg/L	---	---
Mercury, Total	mg/L	---	---
Molybdenum, Total	mg/L	---	---
Radium-226	pCi/L	---	---
Radium-228	pCi/L	---	---
Radium-226 + Radium-228	pCi/L	---	---
Selenium, Total	mg/L	---	---
Thallium, Total	mg/L	---	---

Legend:
---. Not analyzed
ft amsl, feet above mean sea level
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 A4. Data Summary Table - APMW-17 (Upgradient)

Analytes	Units	6/21/2022	12/5/2022
		Detection Monitoring [1]	
Water Elevation	ft amsl	3036.0	3034.0
Appendix III			
Boron, Total	mg/L	< 0.100	< 0.100
Calcium, Total	mg/L	98.6	114
Chloride	mg/L	15.3	18.5
Fluoride	mg/L	< 0.500	< 0.500
pH, Field	pH units	7.21	7.55
pH	pH units	7.5	7.5
Sulfate	mg/L	85.1	86.1
Total Dissolved Solids	mg/L	390	394
Appendix IV			
Antimony, Total	mg/L	---	---
Arsenic, Total	mg/L	---	---
Barium, Total	mg/L	---	---
Beryllium, Total	mg/L	---	---
Cadmium, Total	mg/L	---	---
Chromium, Total	mg/L	---	---
Cobalt, Total	mg/L	---	---
Fluoride	mg/L	---	---
Lead, Total	mg/L	---	---
Lithium, Total	mg/L	---	---
Mercury, Total	mg/L	---	---
Molybdenum, Total	mg/L	---	---
Radium-226	pCi/L	---	---
Radium-228	pCi/L	---	---
Radium-226 + Radium-228	pCi/L	---	---
Selenium, Total	mg/L	---	---
Thallium, Total	mg/L	---	---

Legend:
---. Not analyzed
ft amsl, feet above mean sea level
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 A5. Data Summary Table - APMW-4

Analytes		6/21/2022	12/6/2022
	Units	Detection Monitoring [1]	
Water Elevation	ft amsl	3031.9	***
Appendix III			
Boron, Total	mg/L	< 0.100	< 0.100
Calcium, Total	mg/L	52.1	53.7
Chloride	mg/L	45.3	34.6
Fluoride	mg/L	< 0.500	< 0.500
pH, Field	pH units	7.83	7.69
pH	pH units	7.9	8.0
Sulfate	mg/L	28.5	20.9
Total Dissolved Solids	mg/L	234	224
Appendix IV			
Antimony, Total	mg/L	---	---
Arsenic, Total	mg/L	---	---
Barium, Total	mg/L	---	---
Beryllium, Total	mg/L	---	---
Cadmium, Total	mg/L	---	---
Chromium, Total	mg/L	---	---
Cobalt, Total	mg/L	---	---
Fluoride	mg/L	---	---
Lead, Total	mg/L	---	---
Lithium, Total	mg/L	---	---
Mercury, Total	mg/L	---	---
Molybdenum, Total	mg/L	---	---
Radium-226	pCi/L	---	---
Radium-228	pCi/L	---	---
Radium-226 + Radium-228	pCi/L	---	---
Selenium, Total	mg/L	---	---
Thallium, Total	mg/L	---	---

Legend:
---. Not analyzed
ft amsl, feet above mean sea level
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.

***The water level in APMW-4 was below the top of the pump. Samples were able to be collected normally after purging.

Table A6. Data Summary Table - APMW-6

Analytes	Units	6/21/2022	12/6/2022
		Detection Monitoring [1]	
Water Elevation	ft amsl	3032.1	3030.1
Appendix III			
Boron, Total	mg/L	< 0.100	< 0.100
Calcium, Total	mg/L	52.5	55.2
Chloride	mg/L	17.0	15.0
Fluoride	mg/L	< 0.500	< 0.500
pH, Field	pH units	7.58	7.71
pH	pH units	7.8	7.8
Sulfate	mg/L	28.4	22.3
Total Dissolved Solids	mg/L	238	246
Appendix IV			
Antimony, Total	mg/L	---	---
Arsenic, Total	mg/L	---	---
Barium, Total	mg/L	---	---
Beryllium, Total	mg/L	---	---
Cadmium, Total	mg/L	---	---
Chromium, Total	mg/L	---	---
Cobalt, Total	mg/L	---	---
Fluoride	mg/L	---	---
Lead, Total	mg/L	---	---
Lithium, Total	mg/L	---	---
Mercury, Total	mg/L	---	---
Molybdenum, Total	mg/L	---	---
Radium-226	pCi/L	---	---
Radium-228	pCi/L	---	---
Radium-226 + Radium-228	pCi/L	---	---
Selenium, Total	mg/L	---	---
Thallium, Total	mg/L	---	---

Legend:
---. Not analyzed
ft amsl, feet above mean sea level
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 A7. Data Summary Table - APMW-8A

Analytes		6/21/2022	12/6/2022
	Units	Detection Monitoring [1]	
Water Elevation	ft amsl	3031.9	3030.1
Appendix III			
Boron, Total	mg/L	< 0.100	< 0.100
Calcium, Total	mg/L	108	86.4
Chloride	mg/L	89.4	71.9
Fluoride	mg/L	< 0.500	< 0.500
pH, Field	pH units	7.38	7.56
pH	pH units	7.6	7.6
Sulfate	mg/L	85.4	29.1
Total Dissolved Solids	mg/L	418	334
Appendix IV			
Antimony, Total	mg/L	---	---
Arsenic, Total	mg/L	---	---
Barium, Total	mg/L	---	---
Beryllium, Total	mg/L	---	---
Cadmium, Total	mg/L	---	---
Chromium, Total	mg/L	---	---
Cobalt, Total	mg/L	---	---
Fluoride	mg/L	---	---
Lead, Total	mg/L	---	---
Lithium, Total	mg/L	---	---
Mercury, Total	mg/L	---	---
Molybdenum, Total	mg/L	---	---
Radium-226	pCi/L	---	---
Radium-228	pCi/L	---	---
Radium-226 + Radium-228	pCi/L	---	---
Selenium, Total	mg/L	---	---
Thallium, Total	mg/L	---	---

Legend:
---. Not analyzed
ft amsl, feet above mean sea level
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 A8. Data Summary Table - APMW-10

Analytes		6/21/2022	12/6/2022
	Units	Detection Monitoring [1]	
Water Elevation	ft amsl	3033.0	3030.4
Appendix III			
Boron, Total	mg/L	< 0.100	< 0.100
Calcium, Total	mg/L	57.9	60.4
Chloride	mg/L	19.9	17.5
Fluoride	mg/L	< 0.500	< 0.500
pH, Field	pH units	7.61	7.8
pH	pH units	7.7	7.3
Sulfate	mg/L	50.0	35.9
Total Dissolved Solids	mg/L	278	242
Appendix IV			
Antimony, Total	mg/L	---	---
Arsenic, Total	mg/L	---	---
Barium, Total	mg/L	---	---
Beryllium, Total	mg/L	---	---
Cadmium, Total	mg/L	---	---
Chromium, Total	mg/L	---	---
Cobalt, Total	mg/L	---	---
Fluoride	mg/L	---	---
Lead, Total	mg/L	---	---
Lithium, Total	mg/L	---	---
Mercury, Total	mg/L	---	---
Molybdenum, Total	mg/L	---	---
Radium-226	pCi/L	---	---
Radium-228	pCi/L	---	---
Radium-226 + Radium-228	pCi/L	---	---
Selenium, Total	mg/L	---	---
Thallium, Total	mg/L	---	---

Legend:
---. Not analyzed
ft amsl, feet above mean sea level
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 A9. Data Summary Table - APMW-11

Analytes		6/22/2022	12/6/2022
	Units	Detection Monitoring[1]	
Water Elevation	ft amsl	3032.7	3030.5
Appendix III			
Boron, Total	mg/L	< 0.100	< 0.100
Calcium, Total	mg/L	92.2	93.3
Chloride	mg/L	86.7	59.5
Fluoride	mg/L	< 0.500	< 0.500
pH, Field	pH units	7.32	7.61
pH	pH units	7.6	7.6
Sulfate	mg/L	45.3	37.0
Total Dissolved Solids	mg/L	382	368
Appendix IV			
Antimony, Total	mg/L	---	---
Arsenic, Total	mg/L	---	---
Barium, Total	mg/L	---	---
Beryllium, Total	mg/L	---	---
Cadmium, Total	mg/L	---	---
Chromium, Total	mg/L	---	---
Cobalt, Total	mg/L	---	---
Fluoride	mg/L	---	---
Lead, Total	mg/L	---	---
Lithium, Total	mg/L	---	---
Mercury, Total	mg/L	---	---
Molybdenum, Total	mg/L	---	---
Radium-226	pCi/L	---	---
Radium-228	pCi/L	---	---
Radium-226 + Radium-228	pCi/L	---	---
Selenium, Total	mg/L	---	---
Thallium, Total	mg/L	---	---

Legend:
---. Not analyzed
ft amsl, feet above mean sea level
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 A10. Data Summary Table - APMW-12

Analytes		6/22/2022	12/6/2022
	Units	Detection Monitoring [1]	
Water Elevation	ft amsl	3033.0	3030.9
Appendix III			
Boron, Total	mg/L	0.321	0.328
Calcium, Total	mg/L	159	168
Chloride	mg/L	169	165
Fluoride	mg/L	< 0.500	< 0.500
pH, Field	pH units	6.99	7.25
pH	pH units	7.3	7.8
Sulfate	mg/L	280	259
Total Dissolved Solids	mg/L	1010	996
Appendix IV			
Antimony, Total	mg/L	---	---
Arsenic, Total	mg/L	---	---
Barium, Total	mg/L	---	---
Beryllium, Total	mg/L	---	---
Cadmium, Total	mg/L	---	---
Chromium, Total	mg/L	---	---
Cobalt, Total	mg/L	---	---
Fluoride	mg/L	---	---
Lead, Total	mg/L	---	---
Lithium, Total	mg/L	---	---
Mercury, Total	mg/L	---	---
Molybdenum, Total	mg/L	---	---
Radium-226	pCi/L	---	---
Radium-228	pCi/L	---	---
Radium-226 + Radium-228	pCi/L	---	---
Selenium, Total	mg/L	---	---
Thallium, Total	mg/L	---	---

Legend:
---. Not analyzed
ft amsl, feet above mean sea level
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 A11. Data Summary Table - APMW-13

Analytes		6/22/2022	12/6/2022
	Units	Detection Monitoring [1]	
Water Elevation	ft amsl	3033.2	3031.1
Appendix III			
Boron, Total	mg/L	0.318	0.284
Calcium, Total	mg/L	159	161
Chloride	mg/L	156	122
Fluoride	mg/L	< 0.500	< 0.500
pH, Field	pH units	7.04	7.32
pH	pH units	7.3	7.3
Sulfate	mg/L	296	241
Total Dissolved Solids	mg/L	978	934
Appendix IV			
Antimony, Total	mg/L	---	---
Arsenic, Total	mg/L	---	---
Barium, Total	mg/L	---	---
Beryllium, Total	mg/L	---	---
Cadmium, Total	mg/L	---	---
Chromium, Total	mg/L	---	---
Cobalt, Total	mg/L	---	---
Fluoride	mg/L	---	---
Lead, Total	mg/L	---	---
Lithium, Total	mg/L	---	---
Mercury, Total	mg/L	---	---
Molybdenum, Total	mg/L	---	---
Radium-226	pCi/L	---	---
Radium-228	pCi/L	---	---
Radium-226 + Radium-228	pCi/L	---	---
Selenium, Total	mg/L	---	---
Thallium, Total	mg/L	---	---

Legend:
---. Not analyzed
ft amsl, feet above mean sea level
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 A12. Data Summary Table - APMW-14

Analytes		6/22/2022	12/6/2022
	Units	Detection Monitoring [1]	
Water Elevation	ft amsl	3033.4	3031.2
Appendix III			
Boron, Total	mg/L	0.246	0.205
Calcium, Total	mg/L	152	148
Chloride	mg/L	121	95.3
Fluoride	mg/L	< 0.500	< 0.500
pH, Field	pH units	7.15	7.36
pH	pH units	7.4	7.4
Sulfate	mg/L	204	154
Total Dissolved Solids	mg/L	838	742
Appendix IV			
Antimony, Total	mg/L	---	---
Arsenic, Total	mg/L	---	---
Barium, Total	mg/L	---	---
Beryllium, Total	mg/L	---	---
Cadmium, Total	mg/L	---	---
Chromium, Total	mg/L	---	---
Cobalt, Total	mg/L	---	---
Fluoride	mg/L	---	---
Lead, Total	mg/L	---	---
Lithium, Total	mg/L	---	---
Mercury, Total	mg/L	---	---
Molybdenum, Total	mg/L	---	---
Radium-226	pCi/L	---	---
Radium-228	pCi/L	---	---
Radium-226 + Radium-228	pCi/L	---	---
Selenium, Total	mg/L	---	---
Thallium, Total	mg/L	---	---

Legend:
---. Not analyzed
ft amsl, feet above mean sea level
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 A13. Data Summary Table - APMW-18

Analytes		6/21/2022	12/5/2022
	Units	Detection Monitoring [1]	
Water Elevation	ft amsl	3033.1	3030.3
Appendix III			
Boron, Total	mg/L	< 0.100	< 0.100
Calcium, Total	mg/L	90.4	92.3
Chloride	mg/L	113	88.1
Fluoride	mg/L	< 0.500	< 0.500
pH, Field	pH units	7.41	7.67
pH	pH units	7.6	7.7
Sulfate	mg/L	32.8	19.4
Total Dissolved Solids	mg/L	372	396
Appendix IV			
Antimony, Total	mg/L	---	---
Arsenic, Total	mg/L	---	---
Barium, Total	mg/L	---	---
Beryllium, Total	mg/L	---	---
Cadmium, Total	mg/L	---	---
Chromium, Total	mg/L	---	---
Cobalt, Total	mg/L	---	---
Fluoride	mg/L	---	---
Lead, Total	mg/L	---	---
Lithium, Total	mg/L	---	---
Mercury, Total	mg/L	---	---
Molybdenum, Total	mg/L	---	---
Radium-226	pCi/L	---	---
Radium-228	pCi/L	---	---
Radium-226 + Radium-228	pCi/L	---	---
Selenium, Total	mg/L	---	---
Thallium, Total	mg/L	---	---

Legend:
---. Not analyzed
ft amsl, feet above mean sea level
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 A14. Data Summary Table - APMW-19

Analytes		6/21/2022	12/5/2022
	Units	Detection Monitoring [1]	
Water Elevation	ft amsl	3032.0	3029.6
Appendix III			
Boron, Total	mg/L	< 0.100	< 0.100
Calcium, Total	mg/L	102	84.5
Chloride	mg/L	47.1	26.7
Fluoride	mg/L	< 0.500	< 0.500
pH, Field	pH units	7.31	7.6
pH	pH units	7.5	7.6
Sulfate	mg/L	146	62.5
Total Dissolved Solids	mg/L	462	344
Appendix IV			
Antimony, Total	mg/L	---	---
Arsenic, Total	mg/L	---	---
Barium, Total	mg/L	---	---
Beryllium, Total	mg/L	---	---
Cadmium, Total	mg/L	---	---
Chromium, Total	mg/L	---	---
Cobalt, Total	mg/L	---	---
Fluoride	mg/L	---	---
Lead, Total	mg/L	---	---
Lithium, Total	mg/L	---	---
Mercury, Total	mg/L	---	---
Molybdenum, Total	mg/L	---	---
Radium-226	pCi/L	---	---
Radium-228	pCi/L	---	---
Radium-226 + Radium-228	pCi/L	---	---
Selenium, Total	mg/L	---	---
Thallium, Total	mg/L	---	---

Legend:
---. Not analyzed
ft amsl, feet above mean sea level
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.

APPENDIX B

Comparative Statistical Results

Table B1: Comparative Statistics - APMW-5 (Upgradient)

		Statistical Method	Statistical Limit	Detection Monitoring Result	CUSUM Value	Within Limit?	Detection Monitoring Result	CUSUM Value	Within Limit?
Detection Monitoring Analytes	**Units**			6/21/2022			12/5/2022		
Boron, Total	mg/L	NP-PL	0.200	< 0.100	--	Yes	***	--	--
Calcium, Total	mg/L	CUSUM	120.2	67.5	71.5	Yes	***	--	--
Chloride	mg/L	CUSUM	108.1	16.4	35.7	Yes	***	--	--
Fluoride	mg/L	CUSUM	1.785	< 0.500	0.727	Yes	***	--	--
pH, Field	pH units	NP-PL	7.23, 9.71	7.61	--	Yes	***	--	--
Sulfate	mg/L	CUSUM	76.9	44.7	42.1	Yes	***	--	--
Total Dissolved Solids	mg/L	CUSUM	653	282	385.8	Yes	***	--	--

Notes:

NP-PL: Non-Parametric Prediction Limit

CUSUM: Parametric Shewhart-CUSUM Control Chart

*** APMW-5 was dry during the Q4 2022 sampling event. See text for details.

Table B2: Comparative Statistics - APMW-15 (Upgradient)

		Statistical Method	Statistical Limit	Detection Monitoring Result	CUSUM Value	Within Limit?	Detection Monitoring Result	CUSUM Value	Within Limit?
Detection Monitoring Analytes	**Units**			6/21/2022			12/6/2022		
Boron, Total	mg/L	NP-PL	0.200	0.114	--	Yes	0.104	--	Yes
Calcium, Total	mg/L	CUSUM	145.0	97.5	105.8	Yes	96.4	105.8	Yes
Chloride	mg/L	CUSUM	40.4	31.1	34.0	Yes	20.8	34.0	Yes
Fluoride	mg/L	NP-PL	0.716	< 0.500	--	Yes	< 0.500	--	Yes
pH, Field	pH units	CUSUM	6.24, 8.15	7.27	7.20, 7.20	Yes	7.68	7.20, 7.44	Yes
Sulfate [1]	mg/L	CUSUM	208.6	126.0	137.8	Yes	94.7	137.8	Yes
Total Dissolved Solids	mg/L	CUSUM	853	494	585	Yes	456	585	Yes

Notes:

NP-PL: Non-Parametric Prediction Limit

CUSUM: Parametric Shewhart-CUSUM Control Chart

Table B3: Comparative Statistics - APMW-16A (Upgradient)

		Statistical Method	Statistical Limit	Detection Monitoring Result	CUSUM Value	Within Limit?	Detection Monitoring Result	CUSUM Value	Within Limit?
Detection Monitoring Analytes	**Units**			6/21/2022			12/6/2022		
Boron, Total	mg/L	NP-PL	0.200	0.128	--	Yes	0.14	--	Yes
Calcium, Total [1]	mg/L	CUSUM	199.3	96.5	133.8	Yes	113.0	133.5	Yes
Chloride [1]	mg/L	CUSUM	126.2	21.8	56.4	Yes	19.5	56.1	Yes
Fluoride	mg/L	NP-PL	1.490	< 0.500	--	Yes	< 0.500	--	Yes
pH, Field	pH units	CUSUM	6.08, 8.00	7.18	7.04, 7.04	Yes	7.41	7.04, 7.17	Yes
Sulfate [1]	mg/L	CUSUM	278	143	194	Yes	128	193	Yes
Total Dissolved Solids [1]	mg/L	CUSUM	1046	504	715	Yes	540	714	Yes

Notes:

NP-PL: Non-Parametric Prediction Limit

CUSUM: Parametric Shewhart-CUSUM Control Chart

1. Seasonality was detected in the baseline period. Statistical limits may vary slightly between monitoring events due to deseasonalization of the data or if seasonality is not identified in the full data set (i.e. the baseline period and any comparative points).

Table B4: Comparative Statistics - APMW-17 (Upgradient)

		Statistical Method	Statistical Limit	Detection Monitoring Result	CUSUM Value	Within Limit?	Detection Monitoring Result	CUSUM Value	Within Limit?
Detection Monitoring Analytes	**Units**			6/21/2022			12/6/2022		
Boron, Total	mg/L	NP-PL	0.200	< 0.100	--	Yes	< 0.100	--	Yes
Calcium, Total	mg/L	CUSUM	183.8	98.6	140	Yes	114	140	Yes
Chloride	mg/L	CUSUM	59.0	15.3	42.5	Yes	18.5	42.5	Yes
Fluoride	mg/L	NP-PL	1.070	< 0.500	--	Yes	< 0.500	--	Yes
pH, Field	pH units	CUSUM	5.99, 7.88	7.21	7.12, 7.12	Yes	7.55	7.12, 7.36	Yes
Sulfate	mg/L	CUSUM	224.9	85.1	142	Yes	86.1	142	Yes
Total Dissolved Solids	mg/L	CUSUM	926.8	390	589	Yes	394	589	Yes

Notes:
NP-PL: Non-Parametric Prediction Limit
CUSUM: Parametric Shewhart-CUSUM Control Chart

Table B5: Comparative Statistics - APMW-4

		Statistical Method	Statistical Limit	Detection Monitoring Result	CUSUM Value	Within Limit?	Detection Monitoring Result	CUSUM Value	Within Limit?
Detection Monitoring Analytes	**Units**			6/21/2022			12/6/2022		
Boron, Total	mg/L	NP-PL	0.200	< 0.100	--	Yes	< 0.100	--	Yes
Calcium, Total	mg/L	CUSUM	64.3	52.1	55.1	Yes	53.7	55.1	Yes
Chloride	mg/L	CUSUM	51.4	45.3	44.7	Yes	34.6	38.5	Yes
Fluoride	mg/L	NP-PL	0.569	< 0.500	--	Yes	< 0.500	--	Yes
pH, Field	pH units	CUSUM	6.21, 9.02	7.83	7.62, 7.62	Yes	7.69	7.62, 7.62	Yes
Sulfate	mg/L	CUSUM	40.5	28.5	28.0	Yes	20.9	28.0	Yes
Total Dissolved Solids	mg/L	CUSUM	428	234	306	Yes	224	306	Yes

Notes:
NP-PL: Non-Parametric Prediction Limi
CUSUM: Parametric Shewhart-CUSUM Control Char

Table B6: Comparative Statistics - APMW-6

		Statistical Method	Statistical Limit	Detection Monitoring Result	CUSUM Value	Within Limit?	Detection Monitoring Result	CUSUM Value	Within Limit?
Detection Monitoring Analytes	**Units**			6/21/2022			12/6/2022		
Boron, Total	mg/L	NP-PL	0.200	< 0.100	--	Yes	< 0.100	--	Yes
Calcium, Total	mg/L	CUSUM	65.7	52.5	52.4	Yes	55.2	52.4	Yes
Chloride	mg/L	CUSUM	20.4	17	40.8	No - Verified Exceedance	15	43.1	No - Verified Exceedance
Fluoride	mg/L	NP-PL	0.713	< 0.500	--	Yes	< 0.500	--	Yes
pH, Field	pH units	CUSUM	6.24, 8.62	7.58	7.43, 7.43	Yes	7.71	7.43, 7.43	Yes
Sulfate	mg/L	CUSUM	38.4	28.4	28.1	Yes	22.3	28.1	Yes
Total Dissolved Solids	mg/L	CUSUM	413.5	238	291	Yes	246	291	Yes

Notes:
NP-PL: Non-Parametric Prediction Limit
CUSUM: Parametric Shewhart-CUSUM Control Chart

Table B7: Comparative Statistics - APMW-8A

		Statistical Method	Statistical Limit	Detection Monitoring Result	CUSUM Value	Within Limit?	Detection Monitoring Result	CUSUM Value	Within Limit?
Detection Monitoring Analytes	**Units**			6/21/2022			12/6/2022		
Boron, Total	mg/L	NP-PL	0.200	< 0.100	--	Yes	< 0.100	--	Yes
Calcium, Total	mg/L	CUSUM	175.6	108	106	Yes	86.4	106	Yes
Chloride	mg/L	CUSUM	104.9	89.4	101.3	Yes - Prior Result was a False Positive	71.9	89.3	Yes
Fluoride	mg/L	NP-PL	13.7	< 0.500	--	Yes	< 0.500	--	Yes
pH, Field	pH units	CUSUM	5.86, 8.61	7.38	7.23, 7.23	Yes	7.56	7.23, 7.23	Yes
Sulfate	mg/L	CUSUM	244.9	85.4	90.5	Yes	29.1	90.5	Yes
Total Dissolved Solids	mg/L	CUSUM	849.9	418	536	Yes	334	536	Yes

Notes:
NP-PL: Non-Parametric Prediction Limit
CUSUM: Parametric Shewhart-CUSUM Control Chart

Table B8: Comparative Statistics - APMW-10

		Statistical Method	Statistical Limit	Detection Monitoring Result	CUSUM Value	Within Limit?	Detection Monitoring Result	CUSUM Value	Within Limit?
Detection Monitoring Analytes	**Units**			6/21/2022			12/6/2022		
Boron, Total	mg/L	NP-PL	0.200	< 0.100	--	Yes	< 0.100	--	Yes
Calcium, Total	mg/L	CUSUM	78.3	57.9	62.5	Yes	60.4	62.5	Yes
Chloride	mg/L	CUSUM	63.8	19.9	38.1	Yes	17.5	38.1	Yes
Fluoride	mg/L	NP-PL	3.78	< 0.500	--	Yes	< 0.500	--	Yes
pH, Field	pH units	CUSUM	5.95, 8.89	7.61	7.42, 7.42	Yes	7.8	7.42, 7.43	Yes
Sulfate	mg/L	CUSUM	72.4	50.0	46.1	Yes	35.9	46.1	Yes
Total Dissolved Solids	mg/L	CUSUM	488.5	278	358	Yes	242	358	Yes

Notes:
NP-PL: Non-Parametric Prediction Limit
CUSUM: Parametric Shewhart-CUSUM Control Chart

Table B9: Comparative Statistics - APMW-11

		Statistical Method	Statistical Limit	Detection Monitoring Result	CUSUM Value	Within Limit?	Detection Monitoring Result	CUSUM Value	Within Limit?
Detection Monitoring Analytes	**Units**			6/22/2022			12/6/2022		
Boron, Total	mg/L	NP-PL	0.200	< 0.100	--	Yes	< 0.100	--	Yes
Calcium, Total	mg/L	CUSUM	101.7	92.2	92.4	Yes	93.3	99.1	Yes
Chloride	mg/L	CUSUM	137	86.7	74.6	Yes	59.5	74.16	Yes
Fluoride	mg/L	NP-PL	6.96	< 0.500	--	Yes	< 0.500	--	Yes
pH, Field	pH units	CUSUM	6.89, 7.83	7.32	7.36, 7.36	Yes	7.61	7.36, 7.49	Yes
Sulfate	mg/L	CUSUM	75.0	45.3	38.7	Yes	37.0	34.3	Yes
Total Dissolved Solids	mg/L	CUSUM	622	382	438	Yes	368	438	Yes

Notes:
NP-PL: Non-Parametric Prediction Limit
CUSUM: Parametric Shewhart-CUSUM Control Chart

Table B10: Comparative Statistics - APMW-12

		Statistical Method	Statistical Limit	Detection Monitoring Result	CUSUM Value	Within Limit?	Detection Monitoring Result	CUSUM Value	Within Limit?
Detection Monitoring Analytes	**Units**			6/22/2022			12/6/2022		
Boron, Total	mg/L	CUSUM	0.389	0.321	0.295	Yes	0.328	0.313	Yes
Calcium, Total	mg/L	CUSUM	203.4	159	166	Yes	168	166	Yes
Chloride	mg/L	CUSUM	271.9	169	163	Yes	165	163	Yes
Fluoride	mg/L	NP-PL	21.3	< 0.500	--	Yes	< 0.500	--	Yes
pH, Field	pH units	CUSUM	6.28, 7.66	6.99	6.97, 6.97	Yes	7.25	6.97, 7.10	Yes
Sulfate	mg/L	CUSUM	383	280	302	Yes	259	302	Yes
Total Dissolved Solids	mg/L	CUSUM	1602	1010	1108	Yes	996	1108	Yes

Notes:
NP-PL: Non-Parametric Prediction Limit
CUSUM: Parametric Shewhart-CUSUM Control Chart

Table B11: Comparative Statistics - APMW-13

		Statistical Method	Statistical Limit	Detection Monitoring Result	CUSUM Value	Within Limit?	Detection Monitoring Result	CUSUM Value	Within Limit?
Detection Monitoring Analytes	**Units**			6/22/2022			12/6/2022		
Boron, Total	mg/L	CUSUM	0.449	0.318	0.314	Yes	0.284	0.314	Yes
Calcium, Total	mg/L	CUSUM	196.0	159	148	Yes	161	149	Yes
Chloride	mg/L	CUSUM	189.6	156	144	Yes	122	141	Yes
Fluoride	mg/L	NP-PL	8.250	< 0.500	--	Yes	< 0.500	--	Yes
pH, Field	pH units	CUSUM	6.05, 8.11	7.04	7.08, 7.08	Yes	7.32	7.08, 7.08	Yes
Sulfate	mg/L	CUSUM	362	296	281	Yes	241	264	Yes
Total Dissolved Solids	mg/L	CUSUM	1215	978	1026	Yes	934	1026	Yes

Notes:
NP-PL: Non-Parametric Prediction Limit
CUSUM: Parametric Shewhart-CUSUM Control Chart

Table B12: Comparative Statistics - APMW-14

		Statistical Method	Statistical Limit	Detection Monitoring Result	CUSUM Value	Within Limit?	Detection Monitoring Result	CUSUM Value	Within Limit?
Detection Monitoring Analytes	**Units**			6/22/2022			12/6/2022		
Boron, Total	mg/L	CUSUM	0.382	0.246	0.261	Yes	0.205	0.261	Yes
Calcium, Total	mg/L	CUSUM	194.8	152	157.6	Yes	148	157.6	Yes
Chloride	mg/L	CUSUM	207.3	121	135	Yes	95.3	135	Yes
Fluoride	mg/L	NP-PL	19.2	< 0.500	--	Yes	< 0.500	--	Yes
pH, Field	pH units	CUSUM	6.03, 8.44	7.15	7.17, 7.17	Yes	7.36	7.17, 7.17	Yes
Sulfate	mg/L	CUSUM	272	204	217	Yes	154	217	Yes
Total Dissolved Solids	mg/L	CUSUM	1240	838	949	Yes	742	949	Yes

Notes:
NP-PL: Non-Parametric Prediction Limit
CUSUM: Parametric Shewhart-CUSUM Control Chart

Table B13: Comparative Statistics - APMW-18

		Statistical Method	Statistical Limit	Detection Monitoring Result	CUSUM Value	Within Limit?	Detection Monitoring Result	CUSUM Value	Within Limit?
Detection Monitoring Analytes	**Units**			6/21/2022			12/6/2022		
Boron, Total	mg/L	NP-PL	0.200	< 0.100	--	Yes	< 0.100	--	Yes
Calcium, Total	mg/L	CUSUM	103.7	90.4	85.5	Yes	92.3	91.2	Yes
Chloride	mg/L	CUSUM	160.4	113	101.8	Yes	88.1	107.9	Yes
Fluoride	mg/L	NP-PL	1.740	< 0.500	--	Yes	< 0.500	--	Yes
pH, Field	pH units	CUSUM	5.99, 8.01	7.41	7.33, 7.33	Yes	7.67	7.33, 7.49	Yes
Sulfate	mg/L	CUSUM	147.7	32.8	38.3	Yes	19.4	38.3	Yes
Total Dissolved Solids	mg/L	CUSUM	638	372	401	Yes	396	401	Yes

Notes:
NP-PL: Non-Parametric Prediction Limit
CUSUM: Parametric Shewhart-CUSUM Control Chart

Table B14: Comparative Statistics - APMW-19

		Statistical Method	Statistical Limit	Detection Monitoring Result	CUSUM Value	Within Limit?	Detection Monitoring Result	CUSUM Value	Within Limit?
Detection Monitoring Analytes	**Units**			6/21/2022			12/6/2022		
Boron, Total	mg/L	NP-PL	0.200	< 0.100	--	Yes	< 0.100	--	Yes
Calcium, Total	mg/L	CUSUM	142.9	102.0	89.7	Yes	84.5	85.3	Yes
Chloride	mg/L	CUSUM	71.7	47.1	44.8	Yes	26.7	40.0	Yes
Fluoride	mg/L	NP-PL	0.665	< 0.500	--	Yes	< 0.500	--	Yes
pH, Field	pH units	CUSUM	6.25, 8.29	7.31	7.27, 7.27	Yes	7.60	7.27, 7.27	Yes
Sulfate	mg/L	CUSUM	191.2	146.0	208.1	No - Verified SSI	62.5	124.6	Yes - Previously Verified SSI
Total Dissolved Solids	mg/L	CUSUM	645	462	499	Yes	344	468	Yes

Notes:
NP-PL: Non-Parametric Prediction Limit
CUSUM: Parametric Shewhart-CUSUM Control Chart

See text for discussion regarding the Q4 2022 sulfate result at APMW-19.

APPENDIX C

Alternative Source Demonstrations - Q4 2021

REPORT

Alternative Source Demonstration for Sulfate at APMW-19

Nebraska Public Power District

Submitted to:

Nebraska Public Power District

Gerald Gentleman Station,
6089 South Highway 25,
Sutherland, Nebraska 69165

Submitted by:

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31404512.000-001-RPT-0

April 27, 2022

Table of Contents

TABLES

FIGURES

APPENDICES

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 from the fourth quarter (Q4) of 2021 groundwater detection monitoring event at the Gerald Gentleman Station (GGS or Site) ash landfill (or CCR Unit), located at 6089 South Highway 25, Sutherland, Lincoln County, Nebraska. The statistical evaluation was performed in accordance with the site Sampling and Analysis Plan (Golder 2019a), which was developed in compliance with 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; Final Rule" (CCR Final 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 analyses of the Appendix III detection monitoring data for sulfate in groundwater at the downgradient monitoring well APMW-19 indicated a potential exceedance of the statistical limit based on the parametric Cumulative Sum analysis (CUSUM) in the second quarter (Q2) 2021 sampling results, which was subsequently verified as evidence of a statistically-significant increase (SSI) after the Q4 2021 event. Although determination of an SSI generally indicates that the groundwater monitoring program should transition from detection monitoring to assessment monitoring, both 40 CFR §257.94(e)(2) and NAC Title 132, Ch. 7, 004.03 allow the owner or operator (i.e., NPPD) 90 days from the date of determination (January 28, 2022) to demonstrate a source other than the CCR Unit, or another condition, caused the potential SSI for sulfate at APMW-19.

Golder's review of the hydrological and geologic conditions at the Site indicated the potential for the SSI to have resulted from a source other than the CCR unit. To assess potential sulfate sources and the natural variability of sulfate concentrations in groundwater, Golder reviewed analytical results of previously collected CCR-impacted water samples from the ash landfills, surface water from the Sutherland Reservoir, and groundwater samples. Based upon this assessment and in accordance with provisions of the CCR Final Rule, the NAC, and the site Sampling and Analysis Plan (Golder 2019a), Golder prepared this Alternative Source Demonstration (ASD) for the CCR unit. This ASD includes an evaluation of geological, hydrogeological, and chemical information regarding ash, surface water, and groundwater obtained from surface waters and monitoring wells installed within and adjacent to the CCR Unit.

This ASD conforms to the requirements of 40 CFR §257.94(e)(2) and NAC Title 132, Ch.7, 004.03 and provides the basis for concluding that the apparent SSI for sulfate in groundwater at APMW-19 are not a result of a release from the CCR Unit. The following sections provide a summary of the GGS CCR Unit, analytical and geochemical assessment results, a conceptual site model, and lines of evidence demonstrating an alternative source is responsible for the sulfate SSI in groundwater at APMW-19.

2.0 BACKGROUND

2.1 Description of Waste Disposal Area

The ash landfill at GGS is located southwest of the plant's generation facility, in the northern one-half of Section 30, Township 13N, Range 33W. The ash disposal facility consists of Ash Landfill Nos. 1, 2, 3, and 4 and the bottom ash landfill. Ash Landfill Nos.1 and 2 are closed, and Ash Landfill Nos. 3 and 4 are active (Figure 1). The bottom ash landfill was closed in October 2018.

Fly ash is currently disposed at Ash Landfill No. 4 and in the east cell of Ash Landfill No. 3. The liner design at Ash Landfill No. 4 consists of a 60-mil high density polyethylene (HDPE) geomembrane over compacted subgrade. Prior to geomembrane installation, the existing subgrade was scored to a depth of at least 6 inches and compacted to 95 percent of its maximum dry density (standard Proctor). Smooth HDPE geomembrane was placed on the bottom of the ash landfill and textured HDPE geomembrane was placed on the side slopes. Construction quality assurance for the geomembrane installation was performed by Golder Construction Services and completed on November 15, 1994. There is no leachate collection system (LCS) at Ash Landfill No. 4.

The original liner at Ash Landfill No. 3 consisted of 2 feet of soil compacted to 95 percent of the standard Proctor maximum dry density. The average permeability of the liner was $1.2\text{x}10^{-8}$ centimeters per second (cm/sec). Ash Landfill No. 3 was previously closed in 1995 with 2.0 to 7.5 feet of soil cover. This cover was removed and the historically placed CCR was covered with a new liner in 2015. The new liner system at Ash Landfill No. 3 consists of a prepared subgrade overlain by a geosynthetic clay liner and 60-mil linear low-density polyethylene geomembrane. Ash Landfill No. 3 also has a 1-foot LCS sand layer that reports to two sumps. Construction of the new Ash Landfill No. 3 liner system was completed in November 2015.

To the east of the ash landfill, plant process water, such as boiler blowdown, is managed in a 50-acre evaporation pond, as shown in Figure 1. The bottom of the approximately 8 to 10 feet deep evaporation pond consists of re-compacted native soils.

2.2 Site Geology

The geologic sequence near the ash landfill was summarized by Woodward-Clyde in 1991. In the report, soil boring data from nine boreholes (APMW-1, APMW-2, APMW-3, APMW-4, APMW-5, EPMW-1, EPMW-2, EPMW-3, and EPMW-4) were used to characterize the Site geology. The geologic sequence, from top to bottom, was described as follows:

- 4 to 5 feet of topsoil and/or fill
- 20 to 35 feet of eolian silty sands
- 8 to 10 feet of silty clay paleosol at the top of the Ogallala Formation
- 25 to 35 feet of Ogallala Formation silts
- approximately 50 feet of Ogallala Formation sands or Ogallala Formation silts and clays, to the bottoms of the boreholes

The topsoil layer consists of stiff, dark brown, low to medium plasticity silty clay directly overlying the eolian silts and sands. Thickness of topsoil ranges from 0 to 4 feet. The fill material consists of stiff, dark brown, low plasticity sandy silty clay with trace gravel and other debris. Fill thickness ranges from 0 to 5 feet.

The eolian silts and sands (Quaternary Period) consist of loose to medium dense, tan, very fine-grained, well-rounded, and well-sorted sandy silts and silty sands. The thickness of this unit ranges from 17 feet (APMW-5) to 34 feet (EPMW-2). Materials with a bimodal texture (two distinct grain sizes) are present in the lower part of this unit. The eolian silts and sands are interpreted as wind-blown dune sand deposits.

The Ogallala Formation (Tertiary Period) was encountered in each of the nine boreholes at a depth beginning at 16 to 38 feet below ground surface (ft bgs) and extending to the bottom of the boreholes (109 to 133 ft bgs). The Ogallala Formation near the ash landfill may be separated into three general stratigraphic units:

- upper silty clay paleosol unit
- middle clayey or sandy silt unit
- lower unit of either predominantly sand and gravel or an equivalent unit of predominantly silt and clay

The top of the Ogallala Formation is represented by a widespread paleosol (a previous soil horizon) that consists of a very stiff, reddish-brown to buff, low plasticity, silty clay to clayey silt with abundant calcareous nodules, calcareous matrix, and interbedded layers of caliche up to 1-foot thick. The thickness of the initial paleosol is about 8 to 10 feet, but the presence of interbedded caliche layers continues into the middle and lower Ogallala units.

The middle Ogallala Formation unit consists of a stiff to very stiff, buff-white to reddish-brown, low plasticity, clayey silt to sandy silt with abundant calcareous nodules, matrix, and caliche layers. Scattered occurrences of calcareously cemented siltstone layers from 0.5- to 1-foot thick are present in the lower part of this unit. The thickness of this middle unit ranges from about 25 to 35 feet. The clayey silts and sandy silts of this unit were possibly deposited as overbank or floodplain deposits in an alluvial depositional system.

There are two distinct lithofacies recognized in the lower Ogallala Formation unit. This unit is present for about 45 to 50 feet in the borings. One lithofacies consists of dense to very dense, reddish-brown, fine-grained silty sands grading into medium- and coarse-grained, poorly-graded sands with some fine gravels and some calcareously cemented sandstone beds (0.5- to 1-foot thick). This lithofacies was primarily encountered in borings on the northern side of the ash landfill (APMW-1, APMW-2, APMW-5, and EPMW-1).

The second lithofacies recognized in the lower unit consists of stiff to hard, reddish-brown, low plasticity clayey or sandy silts with some calcareously-cemented siltstone beds. This lithofacies was encountered in borings on the southern side of the ash landfill (APMW-3, APMW-4, EPMW-2, EPMW-3, and EPMW-4).

The lithologic differences and areal distribution of the two lower units suggest that the units were deposited in two separate facies of an alluvial system. The sand and gravel unit is possibly a series of longitudinal bars, channels, and channel-fill deposits, while the silt and clay unit is possibly a series of upper channel fills, overbank, or floodplain deposits (Woodward-Clyde 1991).

2.3 Site Hydrogeology

Based on observations made during logging of soil borings and findings of the Nebraska Water Survey Paper No. 70 (Goeke et al. 1992), the unsaturated geologic units underlying the ash landfill area consist of topsoil (0 to 4 feet thick), eolian silts and sands (15 to 25 feet thick), Ogallala Formation silts (40 to 50 feet thick), and Ogallala Formation sands and gravels (unsaturated portion of this unit is approximately 20 to 25 feet thick). Beneath these units lies 10 feet or more of saturated Ogallala Formation sands and gravels. Based on the Site observations, the thickness of the vadose zone ranges from approximately 90 to 100 feet.

The saturated geologic units underlying the ash landfill area consist of Ogallala Formation silts and sands that extend to the bottom of the aquifer. The Ogallala Formation is underlain by the White River Group, which is composed of the Brule and Chadron formations. The bedrock formations of the White River Group are not considered to be an important potential source of water, and therefore their surface is considered to form the base of the aquifer and is regarded as the lower drilling limit for irrigation wells in the agricultural region near the Site. Underlying the White River Group is the impermeable Pierre Shale (Goeke et al. 1992).

Available groundwater elevation data indicate that groundwater beneath GGS flows from north to south (Figure 1). The groundwater gradient is controlled by the Sutherland Reservoir, an approximately 3,200-acre open water body located 1.5 miles north of the ash landfill that is used as a source of condenser cooling water for GGS (McMahon et al. 2010). Since groundwater level monitoring began in 1996, regular water level fluctuations have been observed in the monitoring wells located around the ash landfill. These fluctuations are attributed to seasonal trends in water consumption or recharge and precipitation patterns. From the time-series plot of historical water levels in each monitoring well (Figure 2), long-term changes in water levels between 1996 and 2021 are apparent. In general, water levels rose approximately 1.5 feet between 1996 and 2000 before declining between 9 to 10 feet between 2000 and 2009. The cause of the decline is not clear, but possible explanations include a regional response to the drought being experienced by parts of the western United States and/or a change in the amount of groundwater used for irrigation in the area around the Site. Between 2009 and 2021 water levels have continued to show seasonal variability, with seasonal maximums occurring in the spring and seasonal minimums occurring in the fall with no apparent long-term increasing or decreasing trend.

2.4 Groundwater Monitoring Network

Design of the ash landfill groundwater monitoring program considered the size, disposal and operational history, anticipated groundwater flow direction, and saturated thickness of the uppermost aquifer. Based on these factors, a monitoring well network that consists of four background monitoring wells and ten downgradient monitoring wells was installed around the ash landfill. The monitoring wells are listed in Table 1 and presented in Figure 1.

Table 3: Monitoring Well Network

Location	Background Monitoring Wells	Downgradient Monitoring Wells
Ash Landfill	APMW-5, APMW-15, APMW-16A, APMW-17	APMW-4, APMW-6, APMW-8A, APMW-10, APMW-11, APMW-12, APMW-13, APMW-14, APMW-18, APMW-19

The four upgradient monitoring wells included in the groundwater monitoring program are used to represent the background groundwater quality, including potential variability. The 10 downgradient wells were installed along the western, southern, and eastern boundaries of the active ash landfill. The depths of the monitoring wells were selected such that the monitoring wells are screened in the Ogallala Formation to yield groundwater samples that are representative of water quality in the uppermost water-bearing zone.

2.5 Groundwater Monitoring Program

Between March 1996 and December 2015, groundwater samples were collected for arsenic, selenium, and sulfate measurement twice a year from the 10 GGS monitoring wells administered under the Nebraska Department of Environment and Energy (NDEE) monitoring program (APMW-5, APMW-15, APMW-4, APMW-6, APMW-8A, APMW-10, APMW-11, APMW-12, APMW-13, and APMW-14). In June 2005, boron measurements were added to the analyte list. In 2015, four additional monitoring wells were installed to support the federal CCR monitoring program (APMW-16A, APMW-17, APMW-18, and APMW-19) and have been incorporated into the NDEE monitoring program.

For APMW-19, the current baseline was calculated using 13 independent baseline groundwater samples collected between December 2015 and November 2019. The results of the baseline monitoring phase were used to develop appropriate and statistically valid baseline values for each constituent at each monitoring well (Golder 2017 and Golder 2019a).

2.5.1 Sulfate Concentration Trends

Sulfate concentrations in the upgradient and downgradient groundwater are shown in Appendix A, Figure A8. Sulfate concentrations in upgradient groundwater (from the four background monitoring wells) ranged from 17.6 to 237 milligrams per liter (mg/L) between March 1996 and November 2021. Sulfate concentrations varied between 13.4 to 640 mg/L in downgradient groundwater wells (based on the 10 downgradient monitoring wells) over the same period.

During the APMW-19 baseline monitoring period (December 2015 to November 2019), sulfate concentrations in groundwater at this well remained relatively steady compared to other downgradient wells, with values ranging between 38.1 and 135 mg/L in the 13 samples collected. A concentration of 191 mg/L was calculated as the parametric CUSUM statistical limit for sulfate at this monitoring well.

The Q2 2021 detection monitoring event reported a sulfate concentration of 161 mg/L in groundwater at APMW-19 and the parametric CUSUM value exceeded the statistical limit of 191 mg/L. The exceedance was verified in Q4 2021 when the reported sulfate concentration was 122 mg/L and the parametric CUSUM value of 223 mg/L exceeded the statistical allowance of 191 mg/L a second time.

2.6 Review of Sampling and Laboratory Testing Procedures

As part of the ASD, a review was conducted of the sampling and laboratory testing procedures used throughout baseline monitoring and detection monitoring to date, along with the collected results. Golder found that the analytical methodologies used were consistent with the stated objectives of the sampling program. No anomalies were found within the sampling and laboratory testing procedures and the collected results are considered valid.

Additionally, a review of the statistical assessment methods and associated results found the procedures followed during baseline and detection monitoring to be consistent with the stated procedures listed in the published Groundwater Monitoring Statistical Methods Certification (Golder 2017). Calculated limits were found to be consistent with the chosen statistical procedures as described in the Sampling and Analysis Plan (Golder 2019a) and recommended methodology found within the Unified Guidance (Environmental Protection Agency [EPA] 2009).

3.0 DATA SOURCES USED IN ALTERNATIVE SOURCE REVIEW

To assess groundwater downgradient of the GGS CCR facilities, Golder reviewed previously collected data and performed supplemental assessment activities. The following sections summarize the supplemental assessment activities.

3.1 Groundwater

3.1.1 On-site Groundwater Monitoring Data

NPPD GGS field personnel routinely collect groundwater samples from 14 monitoring wells around the ash landfill at GGS and submit them for chemical analysis. The following datasets were available to characterize the groundwater in the vicinity of the ash landfills:

- **NDEE and CCR monitoring programs:** As described in Section 2.5, the ongoing groundwater monitoring samples were collected between 1996 and present, and analyzed for field parameters, major cations, major anions, and select dissolved metals.
- **Supplemental sampling in First Quarter (Q1) 2019:** In February 2019, an additional set of groundwater samples were collected from 8 of the 14 wells (APMW-5, APMW-17, APMW-4, APMW-8A, APMW-18, APMW-19, APMW-12, and APMW-14) to support the Q4 2018 ASD for fluoride at APMW-19 (Golder 2019b). These samples were analyzed for field parameters, major cations, major anions, and select dissolved metals. In addition, detection monitoring groundwater samples collected in Q4 2019 also had an expanded analyte list, including field parameters, major cations, major anions, and select dissolved metals.

3.1.2 Upgradient Offsite Monitoring Data

As discussed in Section 2.3, upgradient groundwater is sourced from the Sutherland Reservoir, which is fed by the Sutherland Canal with water from North Platte and South Platte Rivers. The following data sources were used to constrain the range of potential water qualities upgradient of GGS and the ash landfill:

- **North Platte and South Platte Rivers:** The United States Geological Survey (USGS) monitored South Platte River chemistry at Roscoe, Nebraska between 1975 and 2013 (USGS 2016a). The monitoring location at Roscoe, Nebraska is less than one mile downstream of where South Platte River water is diverted into the Sutherland Canal. The USGS also characterized North Platte River water between 1972 and 2011 at Keystone, NE, immediately downstream of Lake Ogallala, where North Platte River water is diverted into the Sutherland Canal (USGS 2016b).
- **Sutherland Reservoir and Canal:** Surface water samples were collected from the Sutherland Reservoir and Sutherland Canal on October 28, 2019, to assess the source of regional groundwater at the site. These samples were analyzed for field parameters, major cations, major anions, and select dissolved metals (Golder 2019b). In addition to samples collected by NPPD personnel, seven water samples were collected from the center of the Sutherland Reservoir by the USGS between August 2005 and December 2006 (USGS 2016c and USGS 2016d).
- **Shallow Groundwater around the Sutherland Reservoir:** Between September 2005 and May 2007, the USGS collected 14 shallow groundwater samples from 12 wells less than one mile from the perimeter of Sutherland Reservoir (USGS 2016e).
- **Upgradient Wells:** In Q2 2021, NPPD personnel collected groundwater samples from wells north and east of GGS to characterize the regional groundwater. The wells included potable water wells (PW #1, PW #2, and PW #3), livestock watering wells (livestock well), and operating wells (OW-20, OW-21, OW-22, OW-23, OW-24, OW-25, and OW-36), as shown in Figure 3. The samples were analyzed for field parameters, major cations, major anions, and select dissolved metals.

3.2 Evaporation Pond

In Q1 2019 and Q4 2020, surface water samples were collected from the evaporation pond. The samples were analyzed for field parameters, major cations, major anions, and select dissolved metals.

3.3 Coal Combustion Residuals Contact Water

To characterize the potential for the material in the ash landfill to release contaminants, NPPD GGS field personnel retrieved sump water from the Ash Landfill No. 3 LCS, and pond water in direct contact with CCR materials in Ash Landfill No.4 on October 28, 2019. These sample were analyzed for the same suite of parameters as the groundwater: field parameters, major cations, major anions, and select dissolved metals (Golder 2019b).

3.4 Geochemical Methods

The geochemical analysis of groundwater and surface water samples included field parameters, major cations and anions, and dissolved metals. Conductivity, pH, and temperature were measured in the field using a handheld meter. The pH of each sample was also measured in the laboratory. Major anions analyzed included chloride, sulfate, and bicarbonate and major cations included calcium, magnesium, potassium, and sodium.

The laboratory analyzed the ash landfill pond and sump water, on-site and off-site groundwater, and surface water (evaporation pond, Sutherland Reservoir, and Sutherland Canal) samples using the following methods:

- alkalinity following Standard Method (SM) 2320B Alkalinity by Titration (2005)
- chloride, fluoride, and sulfate following USEPA SW846 9056A Determination of Inorganic Anions by Ion Chromatography Revision 1 (February 2007)
- pH following SM 4500 H+ B (2017)
- antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, lead, lithium, magnesium, molybdenum, potassium, selenium, sodium, and thallium following USEPA SW-846 6020A (November 2004)
- ammonia following USEPA 350.1 Determination of Ammonia Nitrogen by Automated Colorimetry, Revision 2 (August 1993)
- total Kjeldahl nitrogen following USEPA 351.2 Determination of Total Kjeldahl Nitrogen by Semi-Automated Colorimetry, Revision 2 (August 1993)
- total nitrate-nitrite nitrogen following USEPA 353.2 Determination of Nitrate-Nitrite Nitrogen by Automated Colorimetry, Revision 2 (August 1993)
- dissolved silica following SM4500-SiO2-C Silica, Molybdosilicate Method (2017)

4.0 DATA EVALUATION

Historical concentrations of Appendix III analytes and selected Appendix IV analytes in groundwater at GGS, including analytes that are typically indicators of potential CCR seepage (e.g., arsenic, barium, molybdenum, and selenium), are presented in time series plots in Appendix A. The plots include the results of the supplemental samples that were collected in Q1 2019 to support the Q4 2018 ASD for fluoride at APMW-19 (Golder 2019b). Sampling for the Appendix IV analytes concluded with the end of baseline monitoring in Q2 2017, which means there is a gap of six quarters in the data plots until the supplemental sampling results are shown in Q1 2019.

Figure 4 presents a Piper diagram with relative major ion chemistry for the monitoring well groundwater samples (only for samples analyzed for all major cations and anions; Q4 2017, Q1 2019, Q4 2019, and Q2 2021), off-site upgradient groundwater (NPPD and USGS sampled wells), regional groundwater sources (Sutherland Reservoir, Sutherland Canal, and North and South Platte River), and coal ash impacted waters (Ash Landfill No. 3 sump water, Ash Landfill No. 4 surface pond water, and evaporation pond water). The groundwater at the upgradient monitoring wells was dominated by calcium and bicarbonate. Samples from the downgradient monitoring wells were also majority calcium and bicarbonate ions, with the exception of a single sample (Q1 2019) from APMW-12 that was dominated by calcium and sulfate. The Sutherland Reservoir and Canal water, along with the average North and South Platte River waters are generally dominated by calcium, sodium, bicarbonate, and sulfate. The Ash Landfill No. 3 sump water sample was primarily sodium and bicarbonate, while the Ash Landfill No. 4 pond water was dominated by sodium and sulfate. The evaporation pond water also contained majority sodium and sulfate ions.

4.1 Potential Sulfate Sources

Several potential sources, other than the active CCR Units, can contribute sulfate to local groundwater at GGS, including outflows from the Sutherland Reservoir into regional groundwater, seepage from the evaporation pond, and seepage from historical deposits of fly ash that remain at GGS. These three potential sources of sulfate to groundwater are described in this section.

4.1.1 Regional Groundwater from Sutherland Reservoir

As described in Section 2.3, the groundwater gradient in the area around the ash landfill shows groundwater flows from north to south, rather than from south to north in the direction of the South Platte River. The groundwater flow direction appears to be based on both the groundwater recharge provided by the Sutherland Reservoir to the north of GGS and groundwater extraction by irrigation wells located south of GGS that are pumped seasonally and used to support local agriculture. The Sutherland Reservoir is fed by the Sutherland Canal, which delivers water from both the North and South Platte Rivers for use as condenser cooling water at GGS.

The USGS collected 60 samples for sulfate concentration analysis from the South Platte River at Roscoe, Nebraska between 1975 and 2013 (USGS 2016a). Sulfate concentrations in the South Platte River ranged from 208 to 890 mg/L. The USGS collected 26 samples for sulfate concentration analysis from the North Platte River at Keystone, NE between 1972 and 2011 (USGS 2016b). Sulfate concentrations in the North Platte River ranged from 150 to 230 mg/L.

The sulfate concentrations of the Sutherland Reservoir and Sutherland Canal samples collected by NPPD field staff in October 2019 were 172 and 164 mg/L, respectively (Section 3.2). The seven Sutherland Reservoir samples the USGS collected between August 2005 and December 2006 had sulfate concentrations that ranged from 194 to 220 mg/L (USGS 2016c and USGS 2016d). The sulfate concentrations in the Sutherland Reservoir and Sutherland Canal at the times of sampling (2005, 2006, and 2019) were more similar to concentrations observed in the North Platte River and lower than concentrations observed in the South Platte River.

Sulfate concentrations in the North Platte River, South Platte River, and Sutherland Reservoir were sufficiently high enough to be regarded as a source of the elevated concentrations measured in groundwater at the upgradient monitoring wells at the Site and the elevated concentrations measured in downgradient groundwater at APMW-8a and APMW-19. While the elevated sulfate concentrations at APMW-19 were only observed during detection monitoring (161 mg/L in Q2 2021 and 122 mg/L in Q4 2021, which triggered the SSI), elevated concentrations at APMW-8A (27.2 mg/L to 145 mg/L) were observed during the baseline and detection monitoring periods. The groundwater samples collected by the USGS and NPPD immediately around the Sutherland Reservoir (less than 1 mile) also support the hypothesis that the reservoir is the source of the elevated sulfate concentrations at the Site (USGS 2016e). These shallow groundwater samples (14 collected by the USGS and 14 samples collected by NPPD) had sulfate concentrations of between 162 and 296 mg/L, which is similar to the 12.8 to 237 mg/L sulfate concentration range measured in groundwater at the GGS upgradient monitoring wells (APMW-5, APMW-15, APMW-16A, and APMW-17) between March 1996 and November 2021.

Figure 5 displays a box and whisker plot of the sulfate concentrations from the GGS monitoring well network and samples of possible sulfate sources at the Site. The plot indicates that groundwater containing elevated sulfate concentrations has been traveling across the Site, including past the background monitoring wells, and has only recently started reaching downgradient monitoring wells.

McMahon et al. (2010) details the southernly flow of surface water from the Sutherland Canal and Sutherland Reservoir to the surrounding groundwater near GGS. Their analysis indicated that the front "edge" of Sutherland Reservoir water was in the approximate area of the CCR landfills, though the low density of wells sampled around the CCR landfills limited the resolution in that area.

4.1.2 Evaporation Pond

Although the evaporation pond is located to the east of APMW-19 and side-gradient in terms of groundwater flow (i.e., seepage from the evaporation pond would be unlikely to impact groundwater at monitoring well APMW-19), evaporation pond water quality was evaluated as a potential source in this section as it contains water related to GGS plant operations.

Groundwater quality at the three downgradient monitoring wells located around the evaporation pond (i.e., APMW-12, APMW-13, and APMW-14) indicates that process water discharged from the GGS plant and stored in the evaporation pond has migrated to groundwater. Historical monitoring results show that elevated concentrations of boron (Figure A2), chloride (Figure A4), sulfate (Figure A8), and TDS (Figure A9), which are elements that are typically associated with CCR, were detected in groundwater at these three monitoring wells closest to the evaporation pond compared to the background monitoring wells.

Based on the slight differences in water quality between the groundwater at the monitoring wells APMW-12, APMW-13 and APMW-14 and the evaporation pond, mixing between the evaporation pond water and the upgradient groundwater likely occurs and groundwater at the monitoring wells is not entirely composed of seepage from the evaporation pond. This mixing reaction is supported by the Piper diagram in Figure 4, which shows samples from monitoring wells APMW-12 and APMW-14 plot on a mixing line between the evaporation pond and background groundwater end-member data points.

During the Q4 2020 sampling of the evaporation pond surface water, the sulfate concentration was 468 mg/L. Based on the similarities in water quality between the evaporation pond and adjacent groundwater monitoring wells (APMW-12, APMW-13, and APMW-14), the evaporation pond is considered a potential source of sulfate to groundwater at GGS. However, it is unlikely the evaporation pond influenced groundwater quality at APMW-19, which is side gradient to groundwater flow underneath the evaporation pond (Figure 1).

4.1.3 Historical Ash Landfills

Historical deposits of fly ash present at GGS in the closed soil-lined Ash Landfills Nos. 1 and 2 may release soluble constituents to groundwater as the seepage generated by infiltrating precipitation interacts with the ash. While it was not feasible to collect a sample of seepage from Ash Landfills Nos. 1 and 2 directly, ash-impacted waters collected from Ash Landfill No. 3 sump and Ash Landfill No. 4 pond (Section 3.3) had sulfate concentrations of 1,270 and 1,810 mg/L, respectively, and are assumed to represent potential ash impacted waters from closed ash landfills. At these concentrations, ash-impacted seepage has the potential to increase sulfate concentrations in downgradient wells, including AMPW-19.

A ternary plot comparing sodium, potassium, and sulfate (Figure 6) reveals that ash impacted waters (i.e., contact water) have higher relative sodium abundances and lower relative potassium and sulfate abundances compared to the upgradient and downgradient groundwater. If infiltrating precipitation was leaching sulfate from the closed fly ash storage facilities, the relative concentrations of sodium would increase considerably in the groundwater and would be more similar to the ash impacted waters, but this elevated sodium signature was not observed in any of the samples collected from the downgradient groundwater monitoring wells.

In addition to the elevated levels of sulfate in the ash-impacted waters, boron was also identified as a primary CCR indicator based on high concentrations in sump water from Ash Landfill No. 3 (18.3 mg/L) and pond water from Ash Landfill No.4 (13.8 mg/L). Boron concentrations in groundwater at the upgradient and downgradient CCR Unit monitoring wells are presented in Appendix A Figure A2. All upgradient and downgradient CCR Unit monitoring wells, with the exception of monitoring wells near the evaporation pond that may be influenced by process waters, have boron concentrations below the practical quantitation limit (PQL) (typically less than 0.2 mg/L). If seepage from the ash landfills were impacting groundwater and causing the sulfate SSI, boron concentrations would be expected to be increasing.

4.1.4 Mineral Weathering

Another potential source of sulfate in the watershed is from the natural weathering of sulfur bearing minerals. McMahon et al. (2007) used a mass balance approach to study increases in sulfate concentrations along a groundwater flow path in Central Nebraska. They determined that the oxidation of pyrite was the likely source of sulfate increases in groundwater. These natural weathering products have the potential to raise concentrations to a small degree, but the natural concentrations were relatively low compared to the concentrations in groundwater generated by the Sutherland Reservoir, particularly as demonstrated by comparing groundwater quality between the USGS shallow wells and the GGS upgradient wells (Figure 5).

5.0 EVIDENCE OF AN ALTERNATIVE SOURCE

Based on the testing results and list of potential alternate sources of sulfate presented in this report, primary lines of evidence and conclusions drawn from the evidence used to support this ASD are provided in Table 2.

Table 4: Primary Lines of Evidence and Supporting ASD Analysis

Key Line of Evidence	Supporting Evidence	Description
Lack of Primary CCR Indicators	Boron concentrations in groundwater	Boron (Figure A2) is a primary CCR indicator based on high concentrations in sump water from Ash Landfill No. 3 (18.3 mg/L) and pond water from Ash Landfill No.4 (13.8 mg/L). All upgradient and downgradient CCR unit monitoring wells, with the exception of monitoring wells near the evaporation pond that may be influenced by process waters, have boron concentrations below the PQL (typically <0.2 mg/L).
	Sodium concentrations in CCR impacted waters	The relative abundance of sodium in CCR impacted waters would indicate that high sodium concentrations would also be expected in groundwater if sulfate was from CCR materials (Figure 6). Relative increases in sodium were not observed in monitoring wells at the Site, suggesting an alternative source of elevated sulfate in groundwater at APMW-19.

Key Line of Evidence	Supporting Evidence	Description
Groundwater Geochemistry	Elevated and variable sulfate concentrations in background monitoring wells Relative ion abundances in groundwater differs from ash landfill water	Sulfate concentrations in groundwater at background monitoring wells APMW-5, APMW-16A, and APMW-17 were elevated compared to sulfate concentrations at monitoring well APMW-19 throughout the baseline monitoring period. Since the CCR unit cannot influence the sulfate groundwater concentration in the upgradient wells, the only explanation is that there is an alternate source of sulfate present in groundwater across the Site.
	Relative ion abundances in groundwater differs from ash landfill water	As presented in the Piper plot (Figure 4), relative differences in major ion concentrations show a distinct dissimilarity between the ash-impacted sump and pond waters and the downgradient groundwater samples, including from APMW-19. The geochemical properties of the downgradient groundwater samples are not consistent with seepage from the CCR unit.
Local Sources of Sulfate	Hydrogeology	The North and South Platte Rivers, which are ultimately the source of groundwater recharge that occurs from the Sutherland Reservoir located approximately 1.5 miles north of the ash landfill, have sulfate concentrations between 150 and 890 mg/L. Samples from shallow wells near the Sutherland Reservoir and upgradient wells (Figures 4 and 5) indicate that groundwater with elevated sulfate is migrating south through the Site (McMahon et al. 2010).
	Mineral weathering of sulfate bearing minerals	McMahon et al. (2007) found that small increases in sulfate concentrations along a groundwater flow path in Central Nebraska were due to pyrite oxidation.

6.0 CONCEPTUAL SITE MODEL

Golder developed a conceptual site model (CSM) that is presented graphically in Figure 7 to frame and support the ASD assessment approach. The CSM presents the GGS site layout, a summary of the geologic and hydrogeologic information, and a discussion of groundwater monitoring data, which together lays the groundwork for consideration and development of the ASD. Additionally, the CSM summarizes the findings of literature research that suggest certain naturally occurring groundwater conditions observed in Nebraska are present at the Site and may contribute to naturally elevated sulfate concentrations in groundwater around the ash landfill.

7.0 CONCLUSIONS

In accordance with §257.95(g)(3) and NAC Title 132, Ch.7, 004.03, this ASD has been prepared in response the identification of SSIs for sulfate at monitoring well APMW-19 following the Q4 2021 sampling event for the ash landfill at GGS.

A review of historical analytical results indicates that the elevated sulfate concentrations in groundwater at APMW-19 were not the result of seepage from the ash landfill but can be attributed to naturally occurring sulfate in regional groundwater. Therefore, no further action (i.e., transition to Assessment Monitoring) is warranted, and the Gerald Gentleman Station ash landfill will remain in detection monitoring.

Signature Page

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8.0 REFERENCES

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

Goeke JW, Peckenpaugh JM, Cady RE, Dugan JT. 1992. Hydrogeology of Parts of the Twin Platte and Middle Republican Natural Resources Districts, Southwestern Nebraska, Nebraska Water Survey Paper No. 70, Conservation and Survey Division, University of Nebraska-Lincoln, 89 pp.

Golder Associates Inc. 2017. Coal Combustion Residuals Landfill Groundwater Monitoring System Certification, Nebraska Public Power District Gerald Gentlemen Station, Sutherland, Nebraska.

Golder Associates Inc. 2019a. Sampling and Analysis Plan, Gerald Gentleman Station Ash Landfill. December.

Golder Associates Inc. 2019b. Alternate Source Demonstration, Nebraska Public Power District Gerald Gentlemen Station, Sutherland, Nebraska, April.

McMahon PB, Böhlke JK, Carney CP. 2007. Vertical gradients in water chemistry and age in the northern High Plains aquifer, Nebraska, 2003. US Geological Survey.

McMahon, PB, Carney CP, Poeter EP, Peterson SM. 2010. Use of geochemical, isotopic, and age tracer data to develop models of groundwater flow for the purpose of water management, northern High Plains aquifer, USA. Applied Geochemistry, 25(6), pp.910-922.

USGS (US Geological Survey. 2016a. National Water Information System data available on the World Wide Web (USGS Water Data for the Nation: USGS 06764880 South Platte River at Roscoe, Nebr.), accessed April 2020, at URL: https://nwis.waterdata.usgs.gov/nwis/qwdata/?site_no=06764880&agency_cd=USGS&amp.

USGS. 2016b. National Water Information System data available on the World Wide Web (USGS Water Data for the Nation: USGS 06690500 North Platte River Near Keystone, Nebr.), accessed April 2020, at URL: https://nwis.waterdata.usgs.gov/nwis/qwdata/?site_no=06690500&agency_cd=USGS&amp.

USGS. 2016c. National Water Information System data available on the World Wide Web (USGS Water Data for the Nation: USGS 410630101080202 Sutherland Reservoir Middle Deep), accessed April 2020, at URL: https://waterdata.usgs.gov/nwis/inventory?agency_code=USGS&site_no=410630101080202.

USGS. 2016d. National Water Information System data available on the World Wide Web (USGS Water Data for the Nation: USGS 410630101080201 Sutherland Reservoir Middle Shallow), accessed April 2020, at URL: https://nwis.waterdata.usgs.gov/usa/nwis/qwdata/?site_no=410630101080201.

USGS. 2016e. National Water Information System data available on the World Wide Web (USGS Water Data for the Nation: USGS-410711101060201, USGS-410606101061301, USGS-410529101062501, USGS-410542101053501, USGS-410438101055301, USGS-410452101055301, USGS-410522101075601, USGS-410508101091501, USGS-410456101091801, USGS-410530101093701, and USGS-410811101072501), accessed April 2020, at URL: https://www.waterqualitydata.us/portal/#siteid=USGS-410711101060201&siteid=USGS-410606101061301&siteid=USGS-410529101062501&siteid=USGS-410542101053501&siteid=USGS-410438101055301&siteid=USGS-410452101055301&siteid=USGS-410522101075601&siteid=USGS-410508101091501&siteid=USGS-410456101091801&siteid=USGS-410530101093701&siteid=USGS-410811101072501&mimeType=csv.

Woodward-Clyde Consultants. 1991. Design and Construction of a Groundwater Monitoring Network, Final Report, Gerald Gentleman Station, Nebraska Public Power District, Sutherland, Nebraska, WCC Project No. 90MC176, Omaha, Nebraska, September.

Figures

NOTE

GROUNDWATER CONTOURS DEVELOPED FROM LEVELS MEASURED IN ACTIVE MONITORING WELLS SHOWN.

WSP GOLDER

NEBRASKA PUBLIC POWER DISTRICT
GERALD GENTLEMAN STATION
GROUNDWATER MONITORING WELL NETWORK
NOVEMBER 2021 GROUNDWATER CONTOURS
FIGURE 1

Path: \\golder.gds\complexdata\office\denver\acad\NPPD\GGS\99_PROJECTS\20141315 GGS GW Quality 2020\ | File Name: 20141315A002_GGS_Q4-2021.dwg

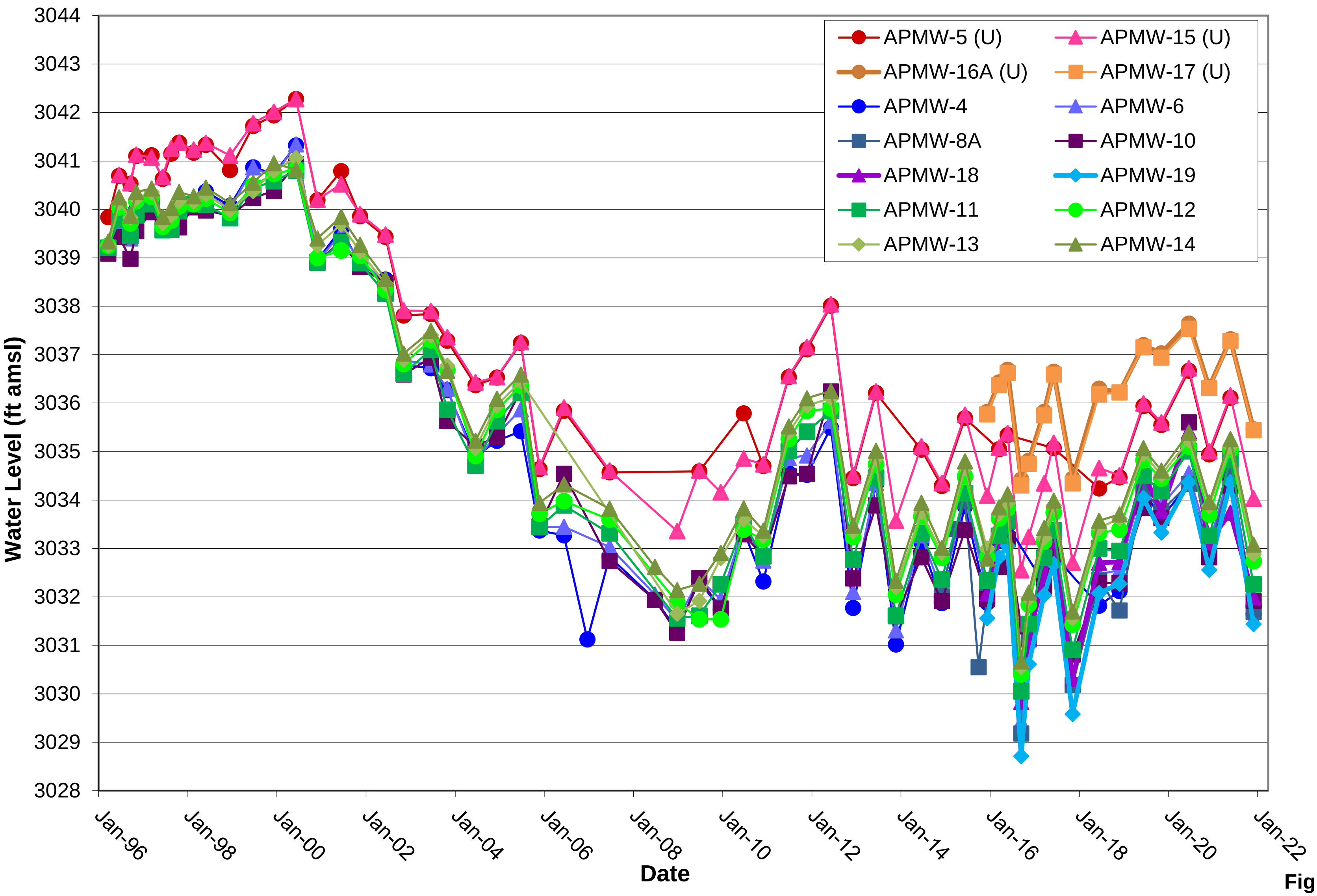

Figure 2

Groundwater Monitoring Well Water Levels

Alternative Source Demonstration

Nebraska Public Power District - Gerald Gentleman Station

Golder Associates USA

FINAL

4/28/2022

NPPD GGS

31404512

https://golderassociates.sharepoint.com/sites/124836/Project Files/5 Technical Work/1 Gerald Gentleman Station/2021 - Q4/NDEE Report/Tables and Figures/[GGS Water Levels 2

WSP GOLDER

NOTES

1. WELL LOCATIONS ARE APPROXIMATE.

REFERENCE(S)

1. AERIAL IMAGERY OBTAINED FROM ESRI (MAY 2020).

NEBRASKA PUBLIC POWER DISTRICT
GERALD GENTLEMAN STATION
Q2 2021 SAMPLING LOCATIONS

FIGURE 3

Path: \\golder.gds\complexdata\office\Denver\acad\NPPD\GGS\99_PROJECTS\20141315 GGS GW Quality 2020\ | File Name: ASD_20141315A002_GGS_Figure 3.dwg

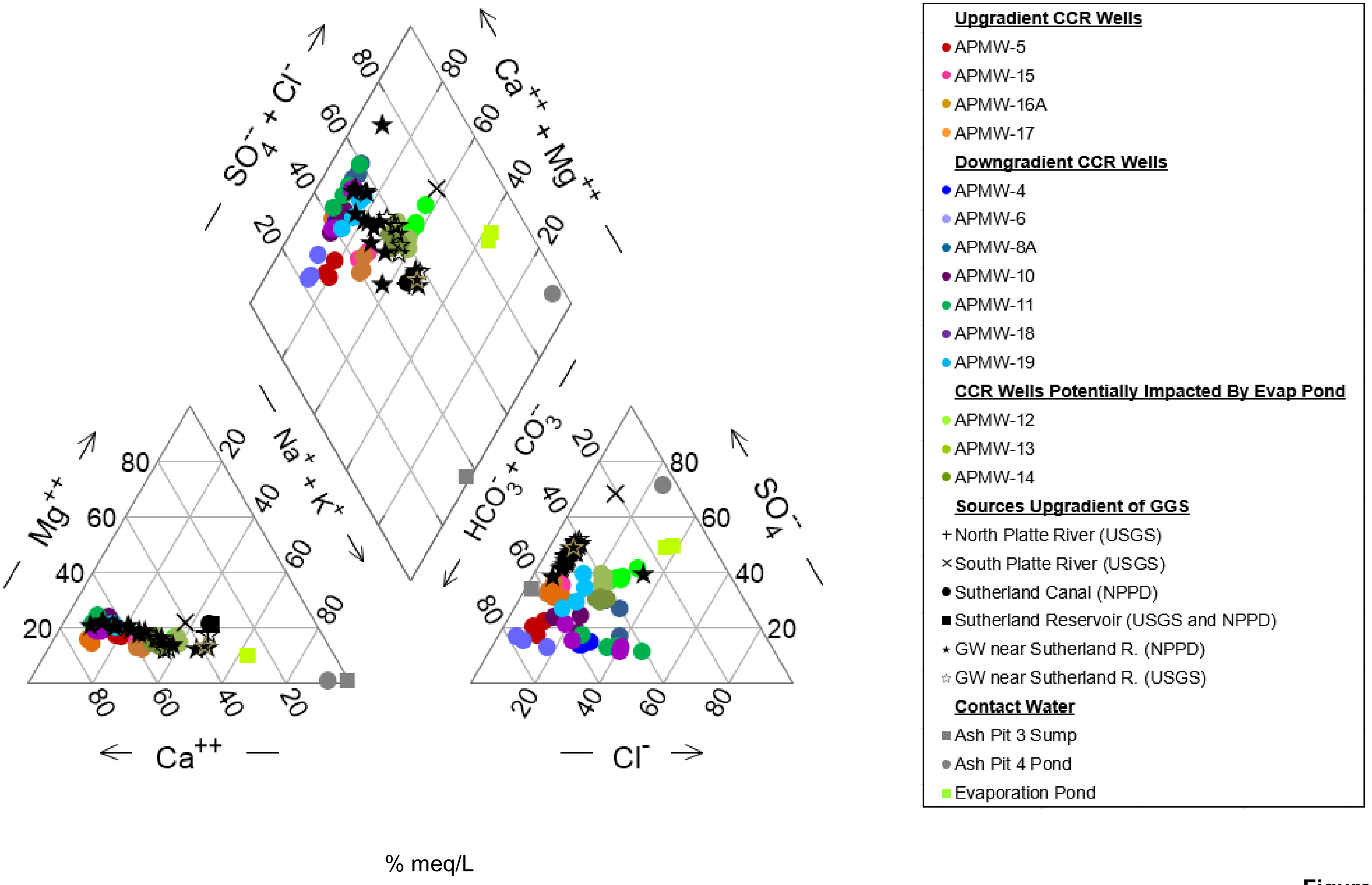

Figure 4

Piper Diagram of Groundwater

Alternate Source Demonstration

Nebraska Public Power District - Gerald Gentleman Station

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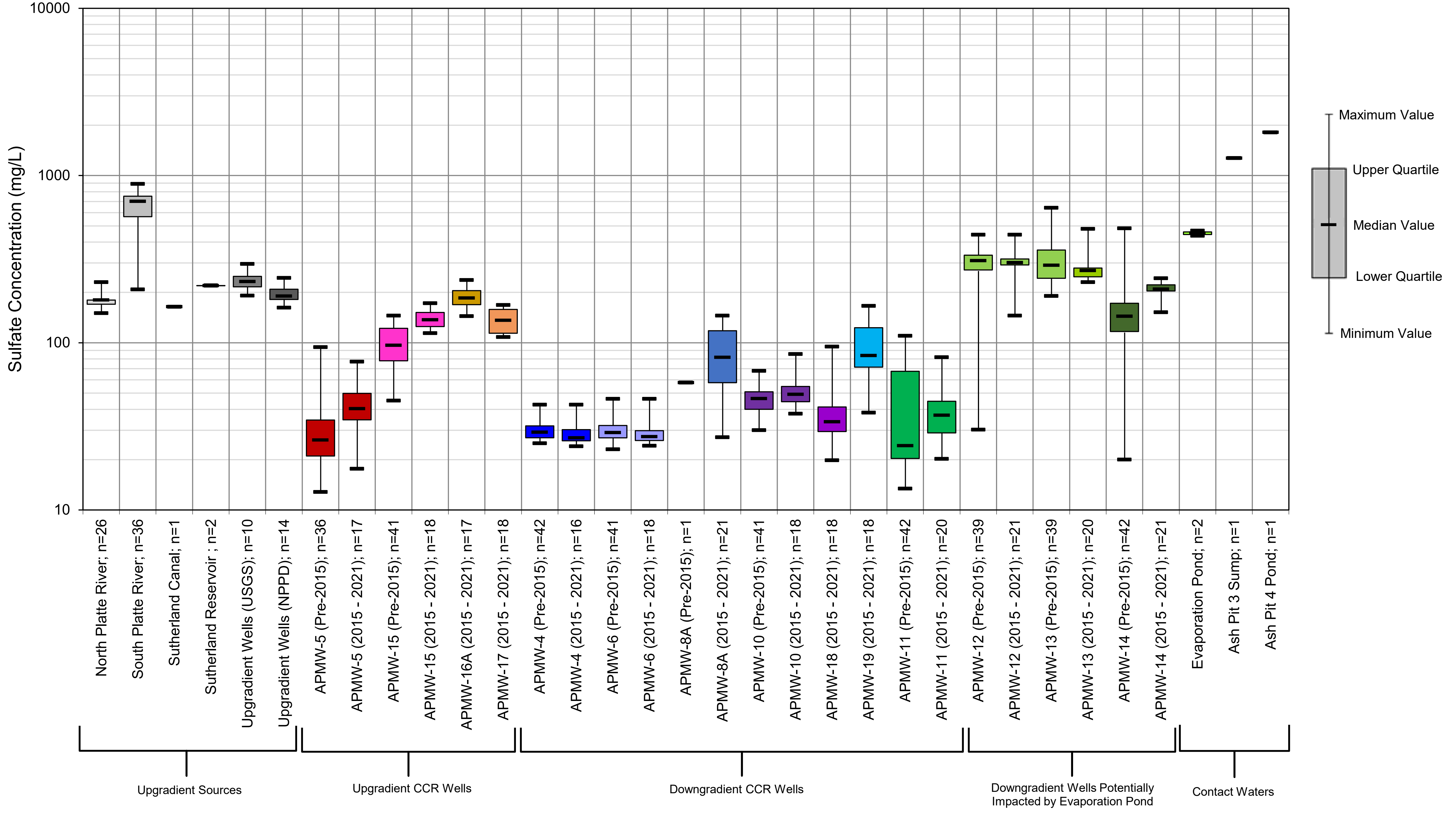


CLIENT

Nebraska Public Power District: Gerald Gentleman Station

CONSULTANT

WSP GOLDER

PROJECT

Alternate Source Demonstration

TITLE

Sulfate

PROJECT NO.	PHASE	REV.	FIGURE
31404512	1		5

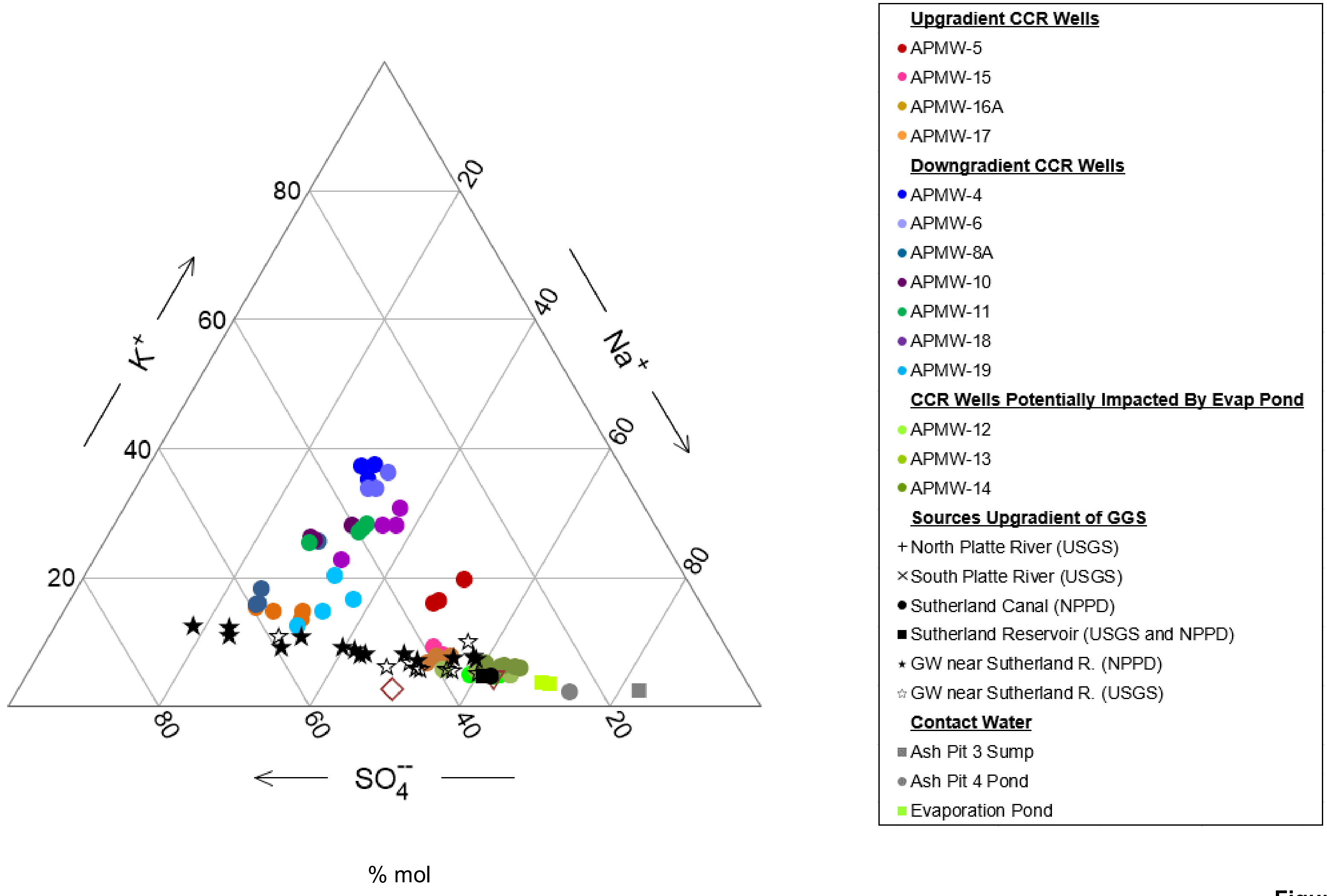


Figure 6

Ternary Diagram of Groundwater

Alternate Source Demonstration

Nebraska Public Power District - Gerald Gentleman Station

Golder Associates USA

https://golderassociates.sharepoint.com/sites/160112/Project Files/5 Technical Work/02_Working Data/[GGS Q2 2021 Piper, Ternary, CSM.xlsx]Ternary

NPPD GGS

4/28/2022

31404512

https://golderassociates.sharepoint.com/sites/160112/Project Files/5 Technical Work/02_Working Data/[GGS Q2 2021 Piper, Ternary, CSM.xlsx]CSM - Sulfate

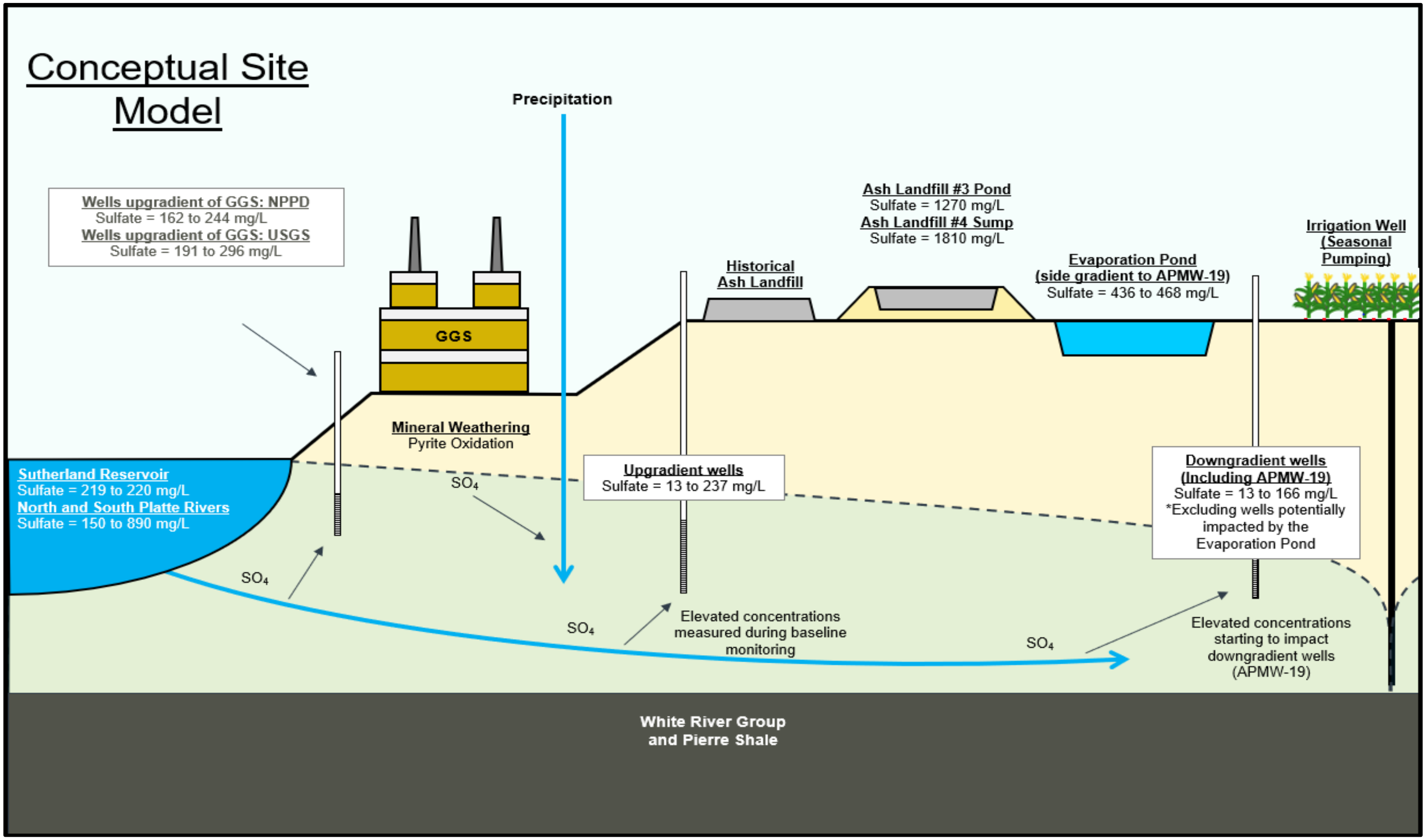


Figure 7

Sulfate Conceptual Site Model

Alternate Source Demonstration

Nebraska Public Power District - Gerald Gentleman Station

NPPD GGS

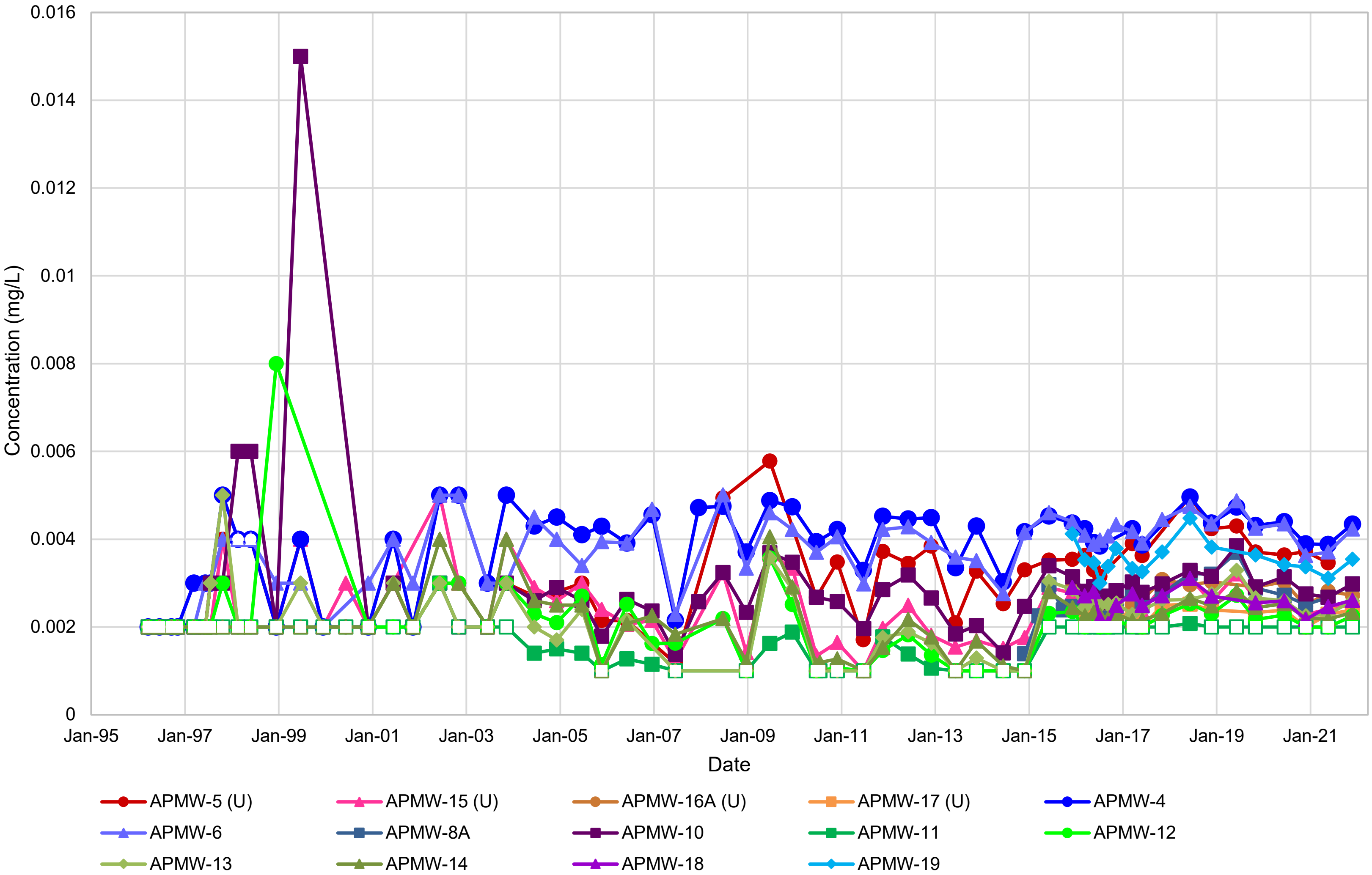
4/28/2022

31404512

Golder Associates USA

APPENDIX A

Historical Concentrations of Appendix III and Selected Appendix IV Analytes



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-1

Arsenic

Nebraska Public Power District

Gerald Gentleman Station

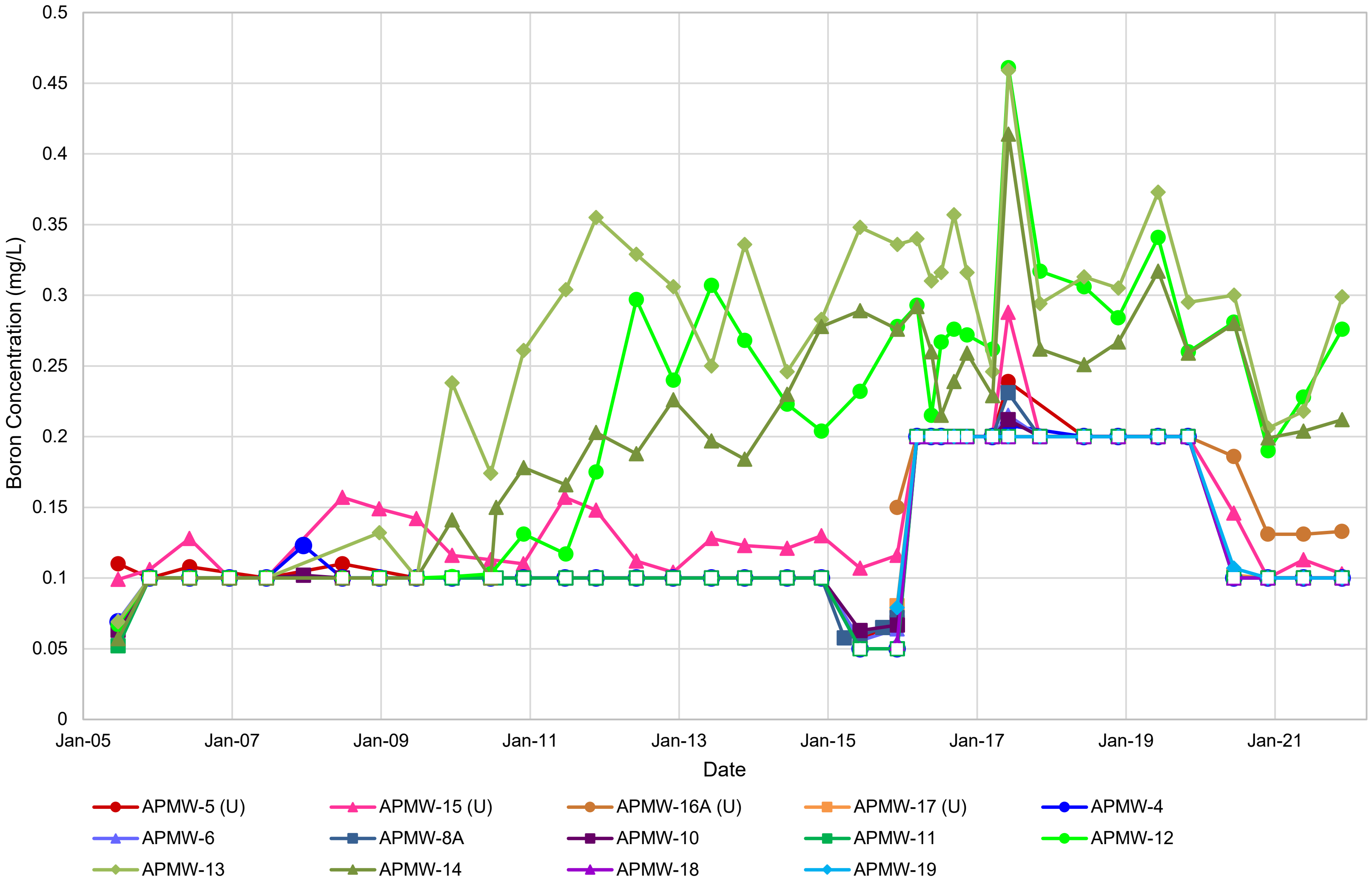
Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.

https://golderassociates.sharepoint.com/sites/160112/Project Files/5 Technical Work/02_Working Data/[Appendix A_TimeSeries GGS NDEE - w App IV - Q42021.xlsm]A-2



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-2

Boron

Nebraska Public Power District

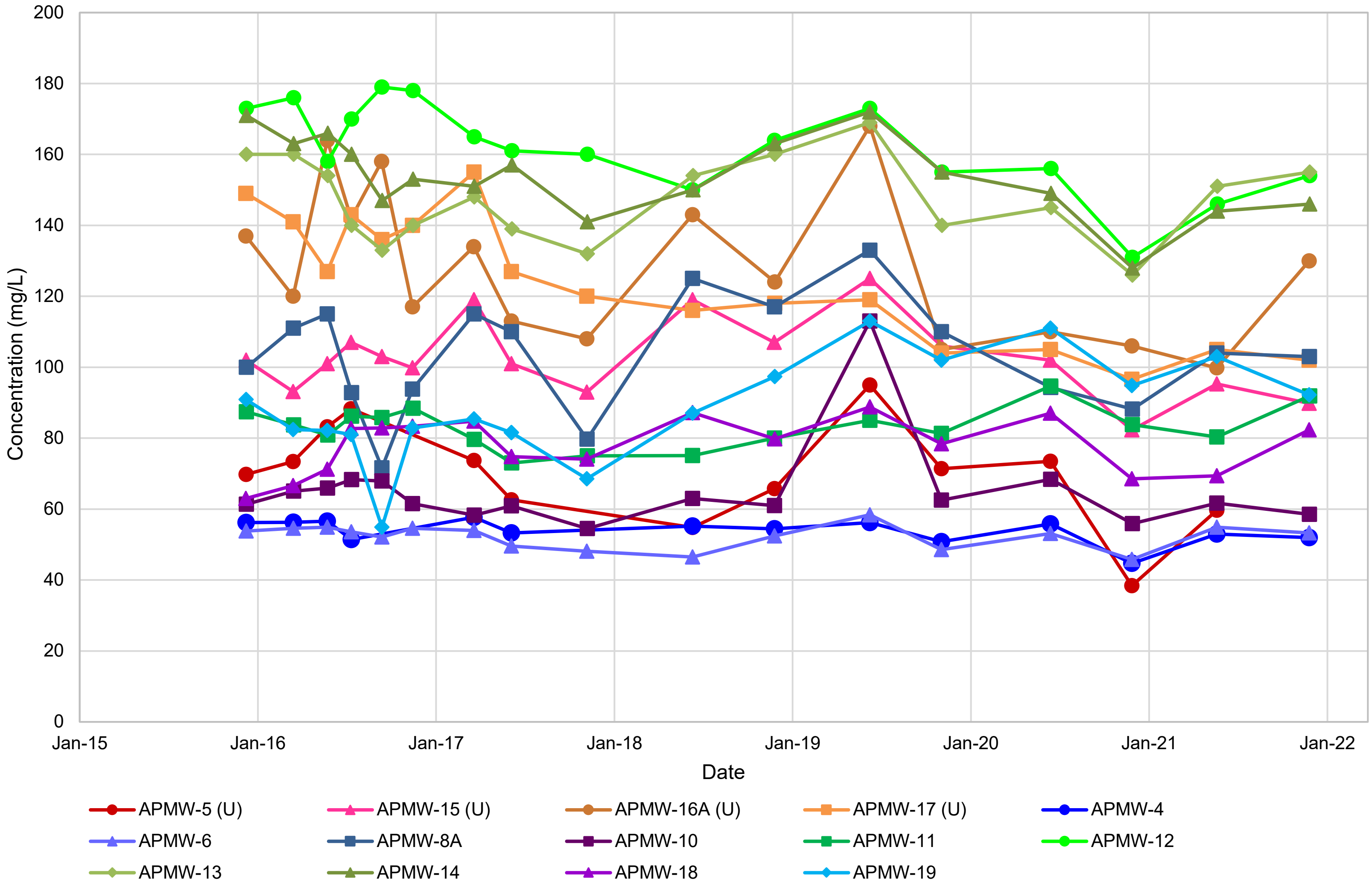
Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-3

Calcium

Nebraska Public Power District

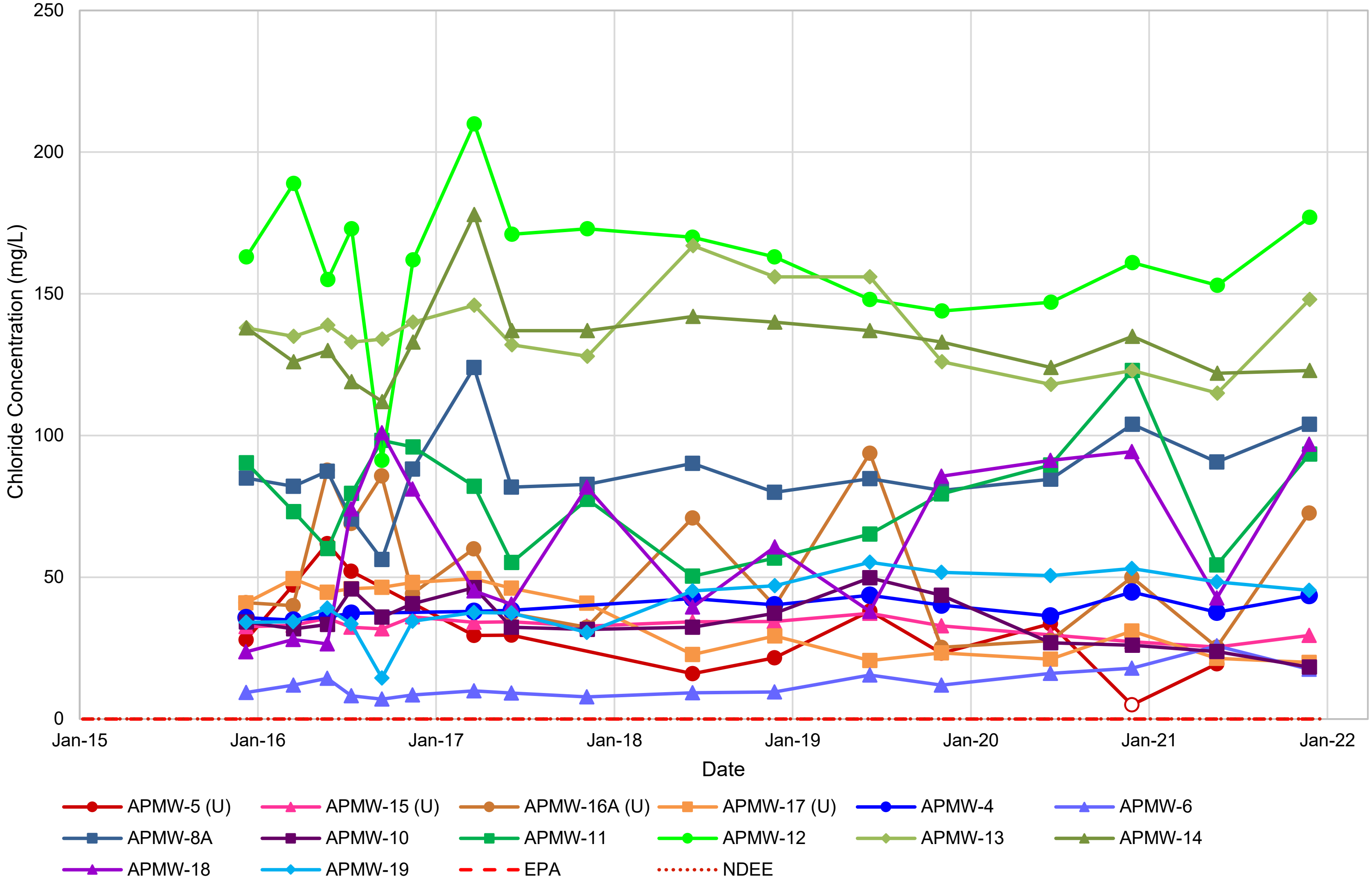
Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-4

Chloride

Nebraska Public Power District

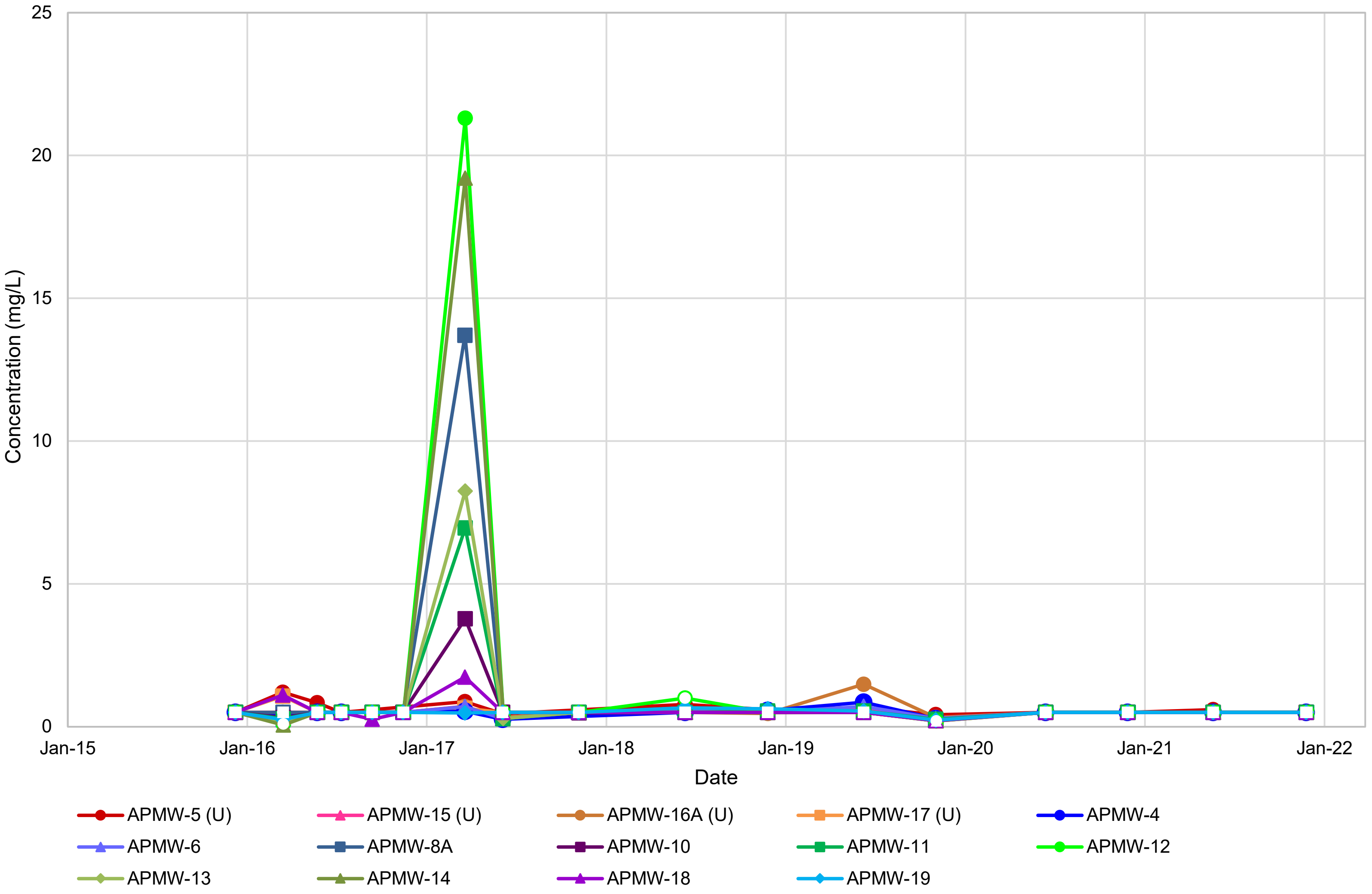
Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-5

Fluoride

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

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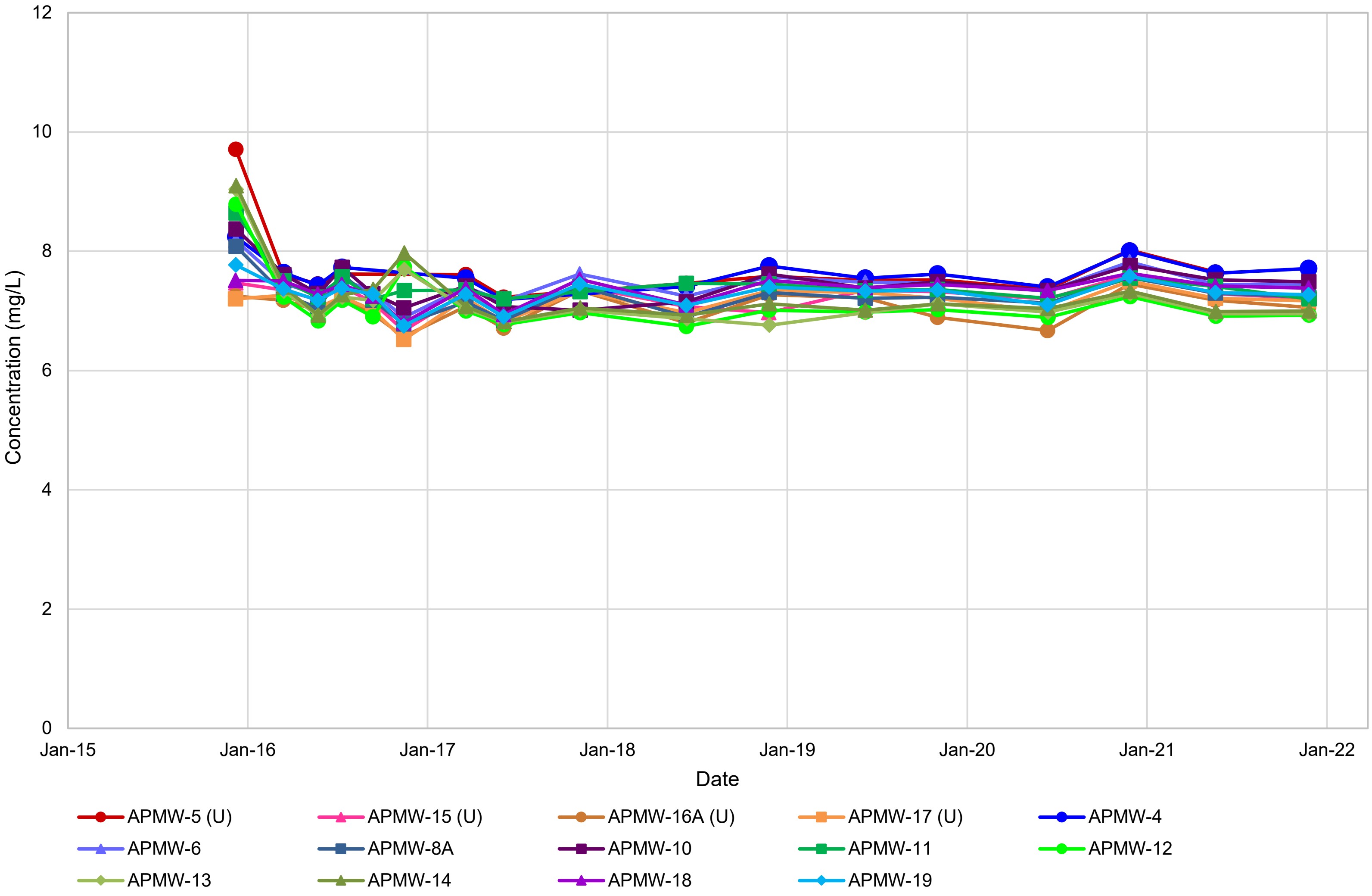


Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-6

pH, Field Measured

Nebraska Public Power District

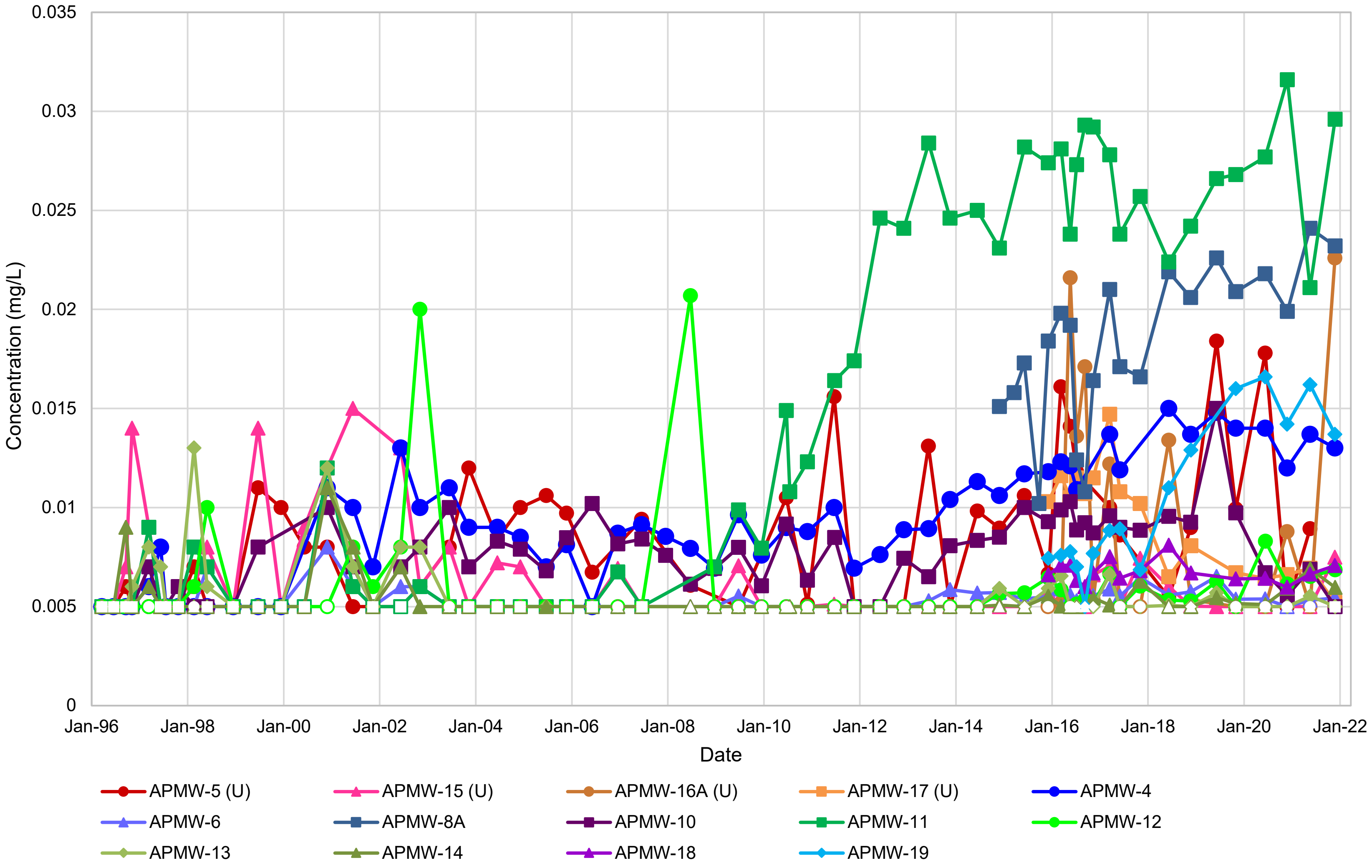
Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-7

Selenium

Nebraska Public Power District

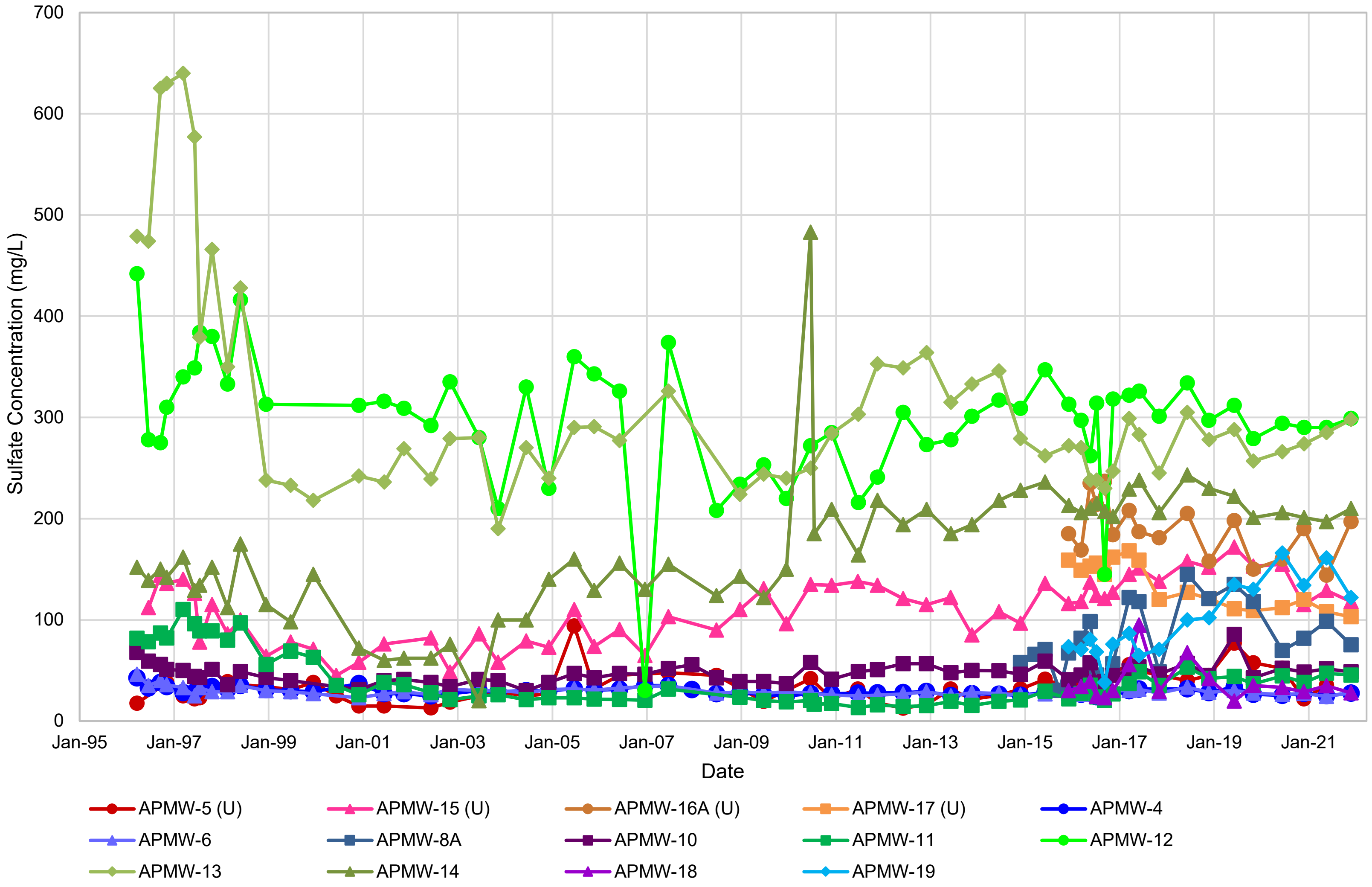
Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-8

Sulfate

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

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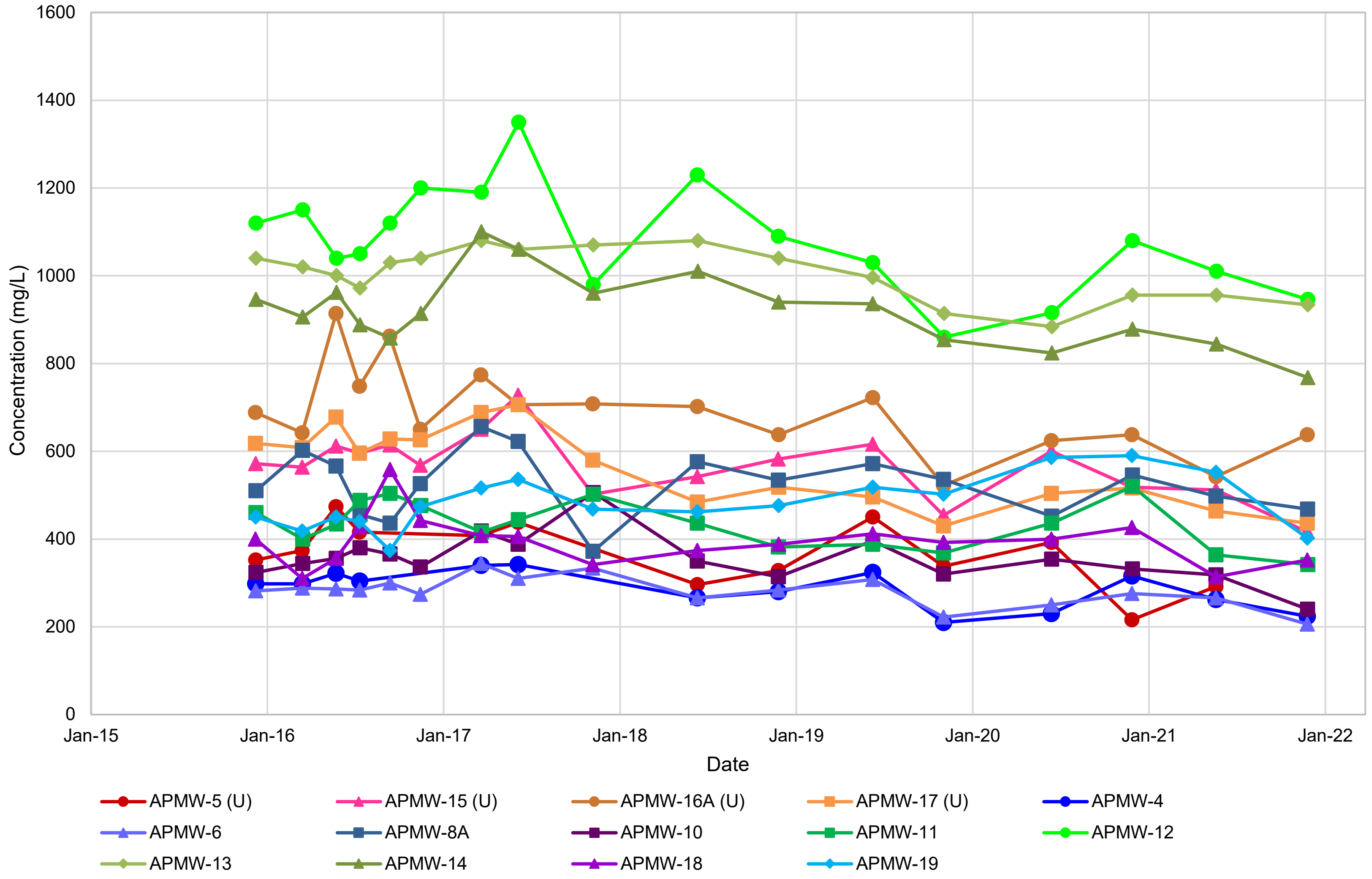
https://golderassociates.sharepoint.com/sites/160112/Project Files/5 Technical Work/02_Working Data/[Appendix A_TimeSeries GGS NDEE - w App IV - Q42021.xlsm]A-8



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-9

Total Dissolved Solids

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

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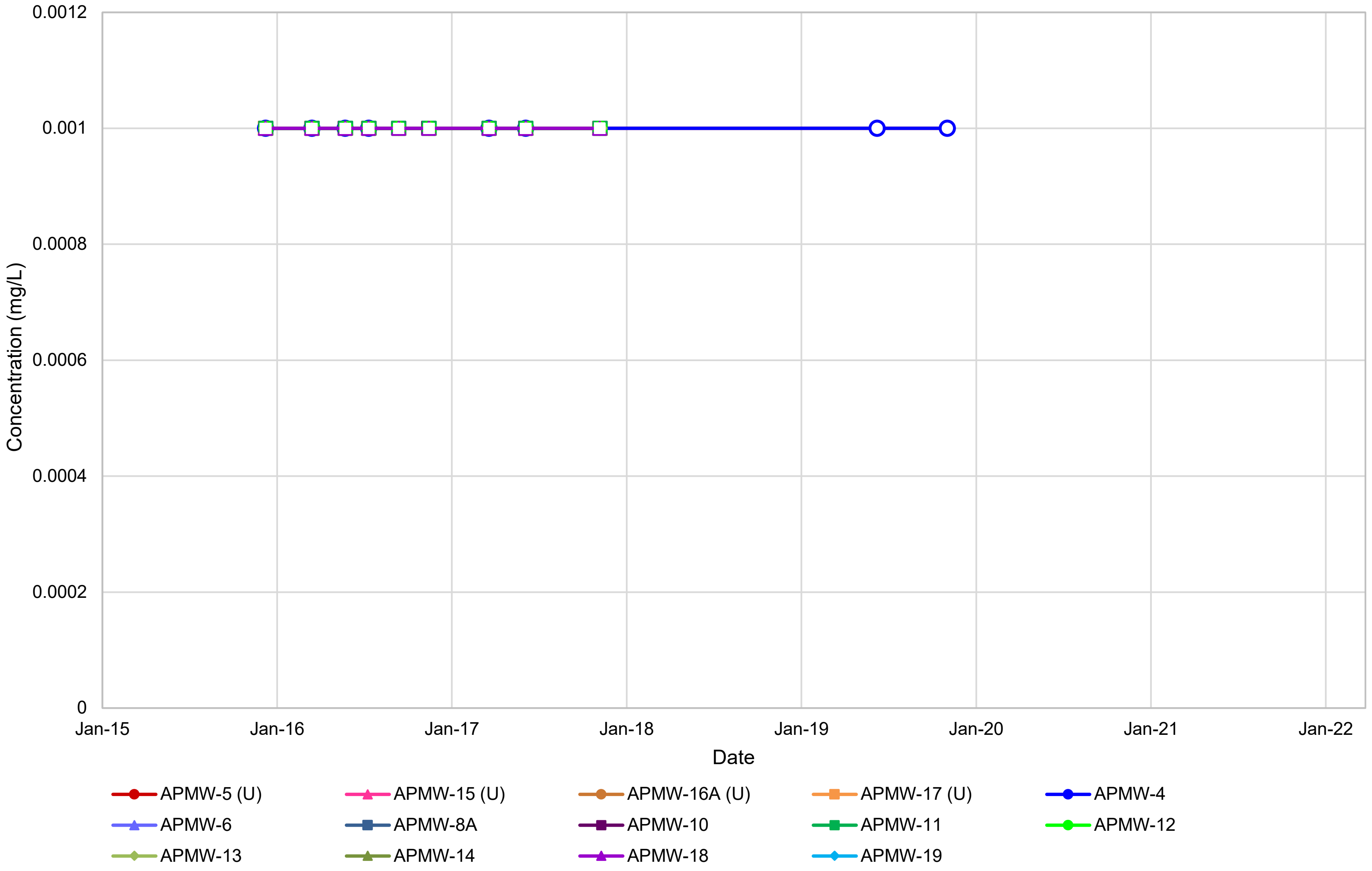
https://golderassociates.sharepoint.com/sites/160112/Project Files/5 Technical Work/02_Working Data/[Appendix A_TimeSeries GGS NDEE - w App IV - Q42021.xlsm]A-9



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-10

Antimony

Nebraska Public Power District

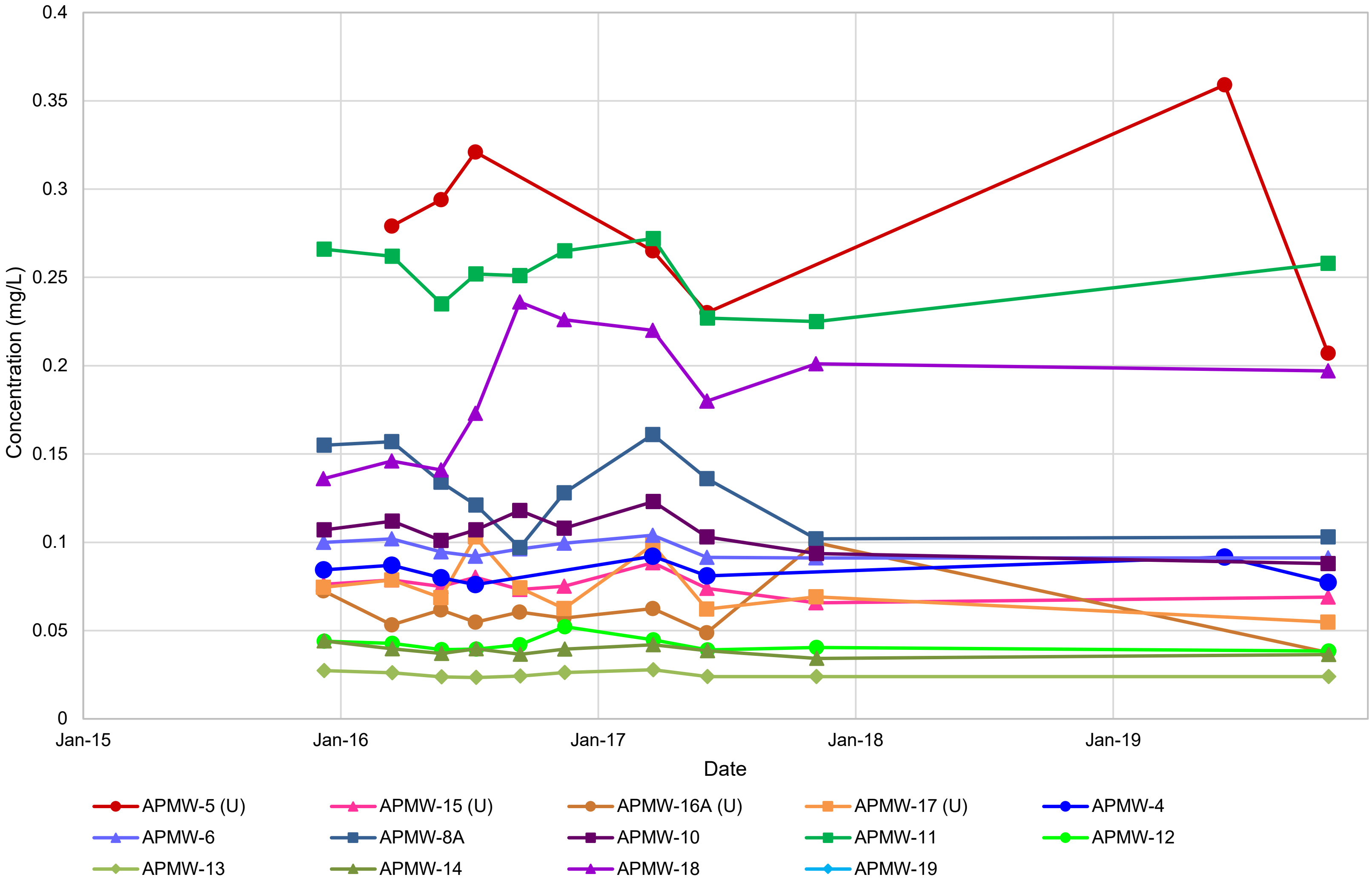
Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-11

Barium

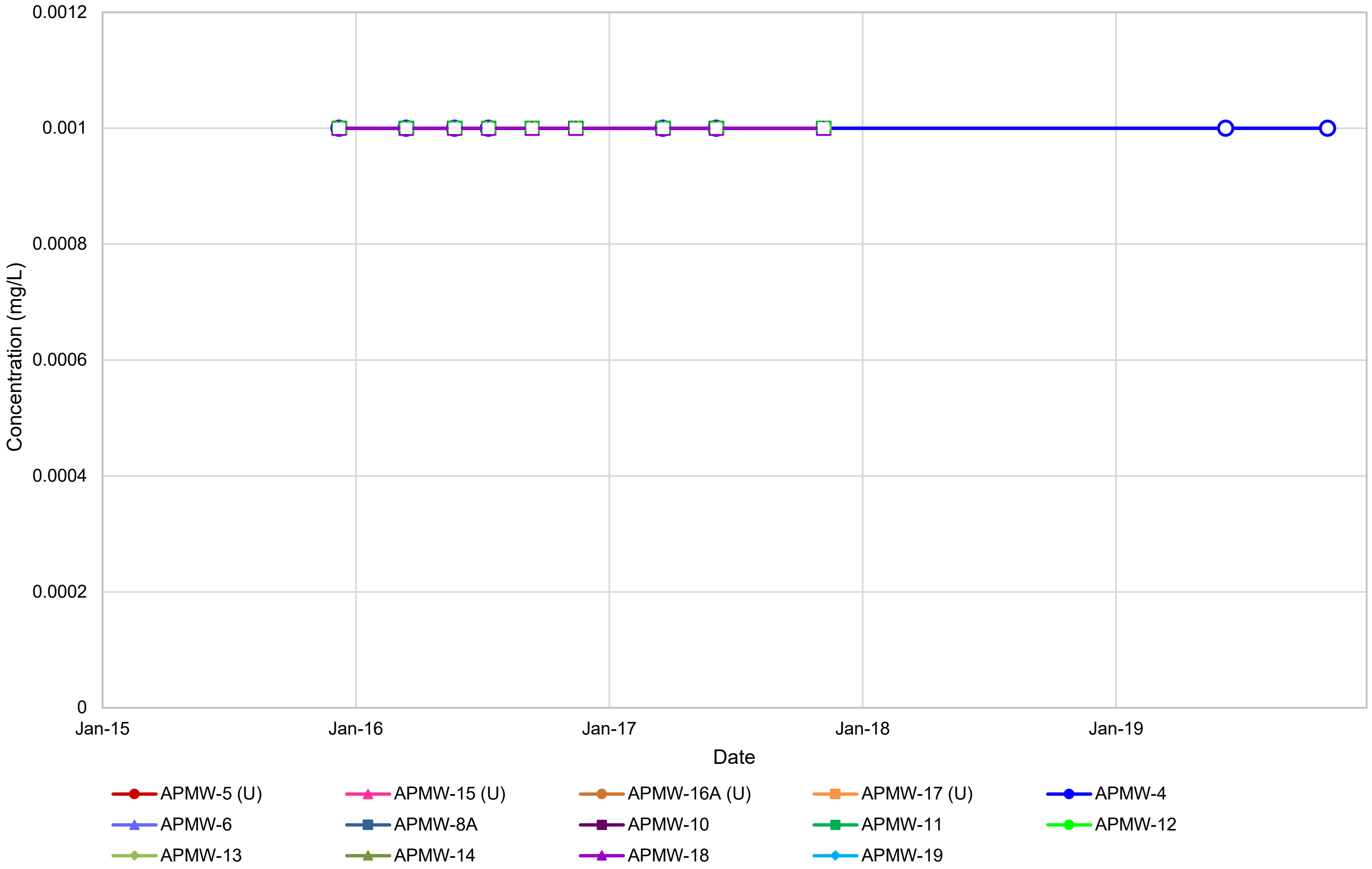
Nebraska Public Power District
Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022
31404512.000

Golder Associates USA Inc.

https://golderassociates.sharepoint.com/sites/160112/Project Files/5 Technical Work/02_Working Data/[Appendix A_TimeSeries GGS NDEE - w App IV - Q42021.xlsm]A-11



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-12

Beryllium

Nebraska Public Power District

Gerald Gentleman Station

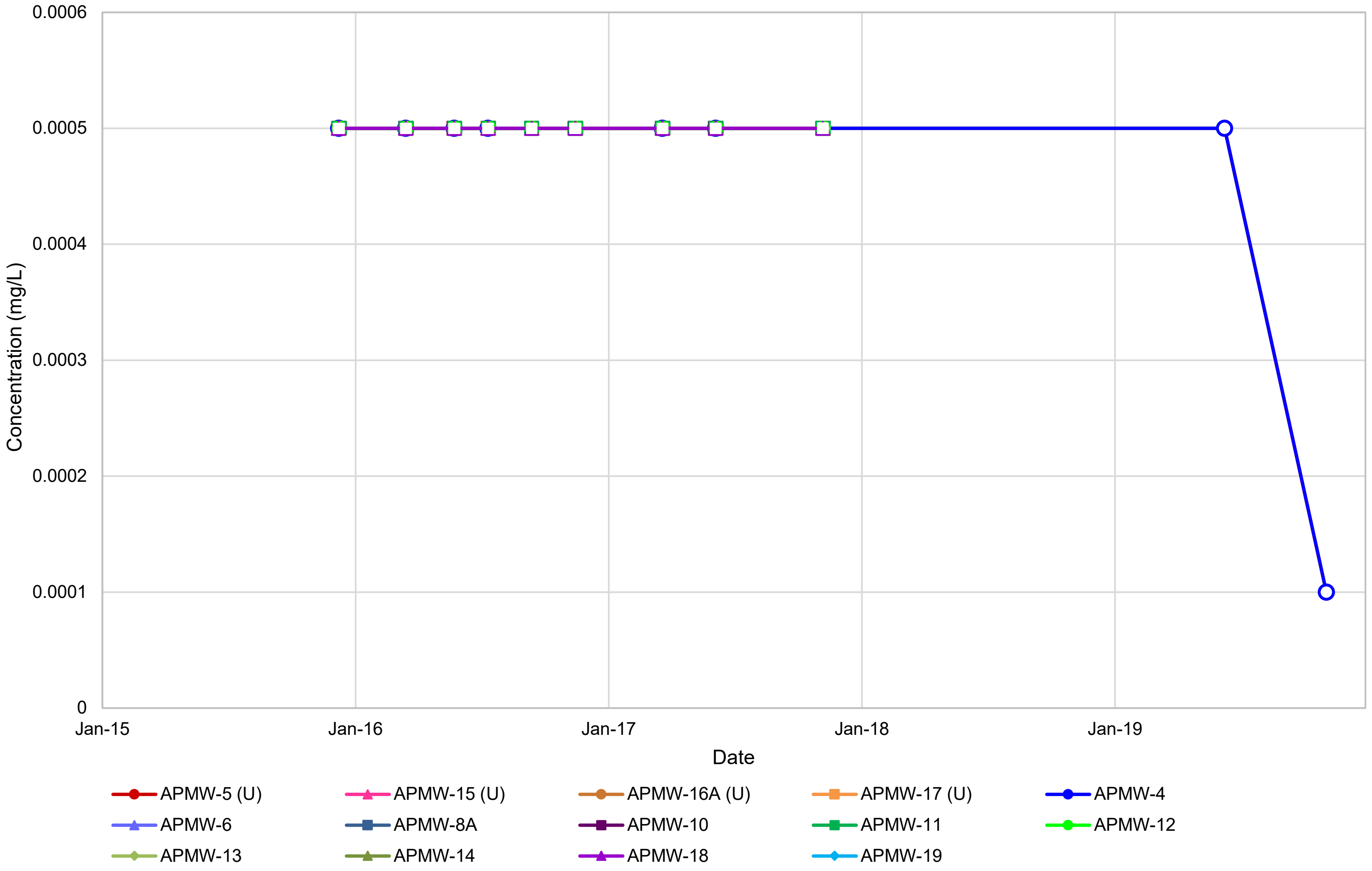
Golder Associates USA Inc.

Denver, Colorado, USA

4/27/2022

31404512.000

https://golderassociates.sharepoint.com/sites/160112/Project Files/5 Technical Work/02_Working Data/[Appendix A_TimeSeries GGS NDEE - w App IV - Q42021.xlsm]A-12



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-13

Cadmium

Nebraska Public Power District

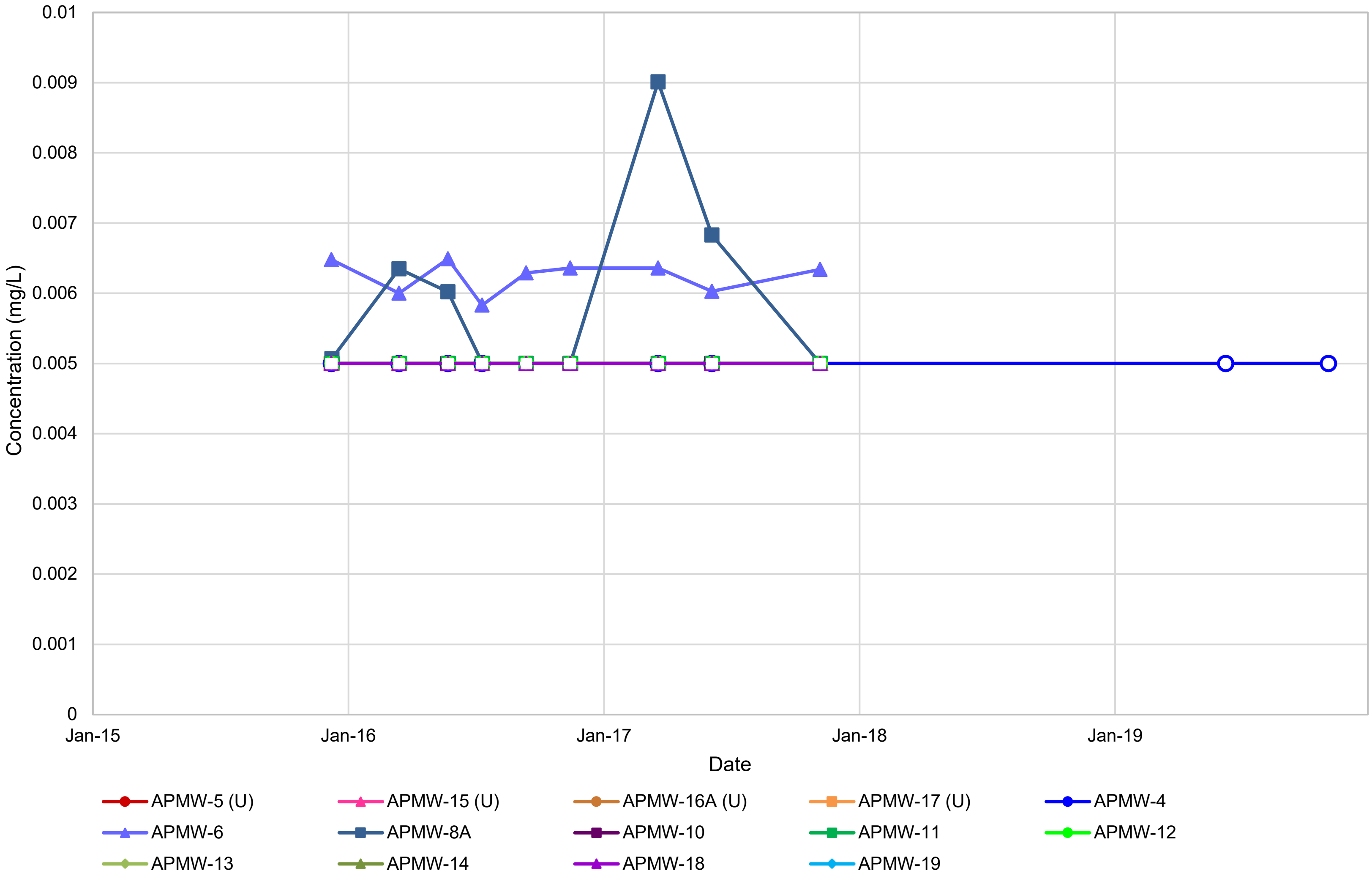
Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-14

Chromium

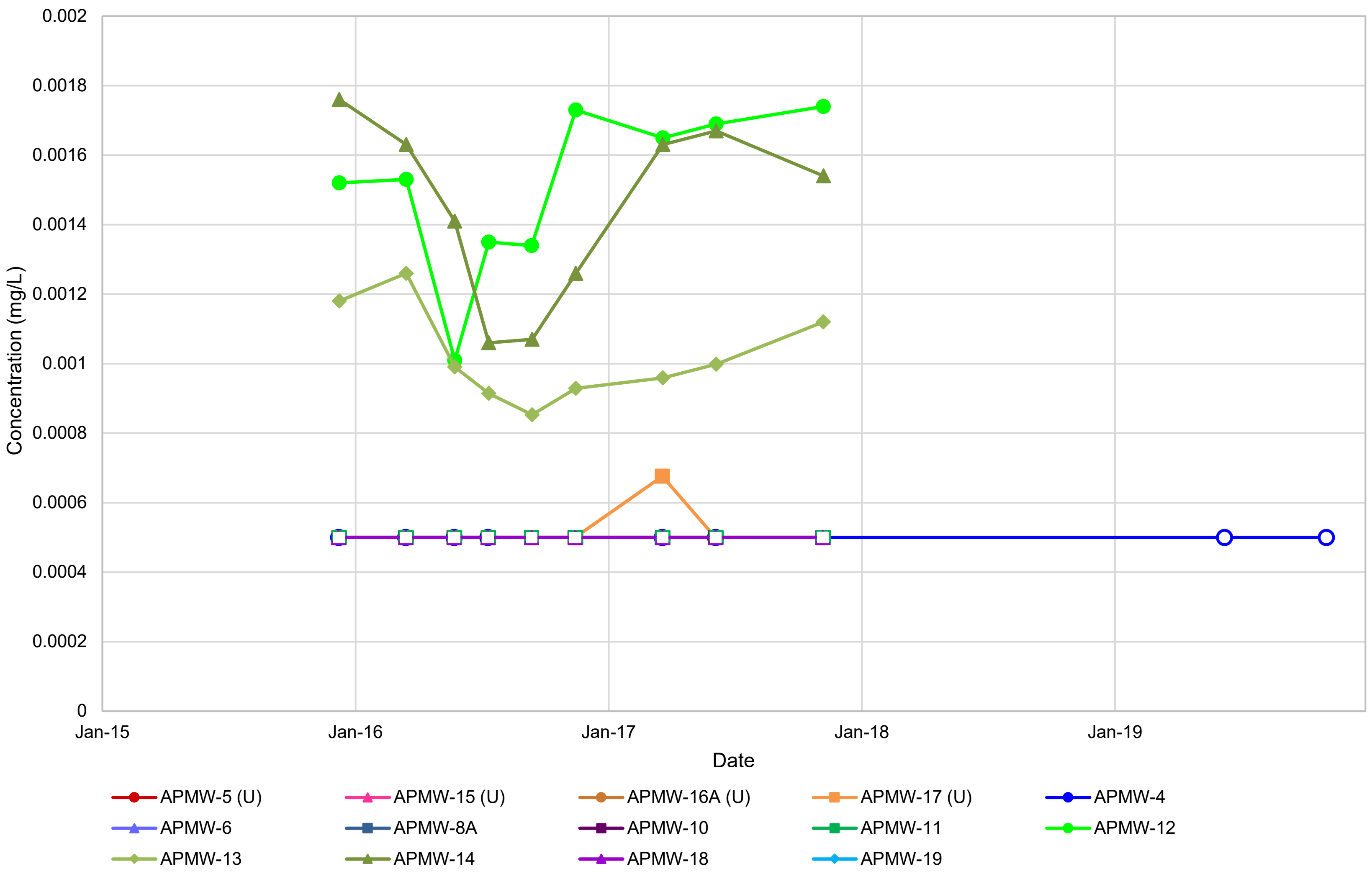
Nebraska Public Power District
Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-15

Cobalt

Nebraska Public Power District

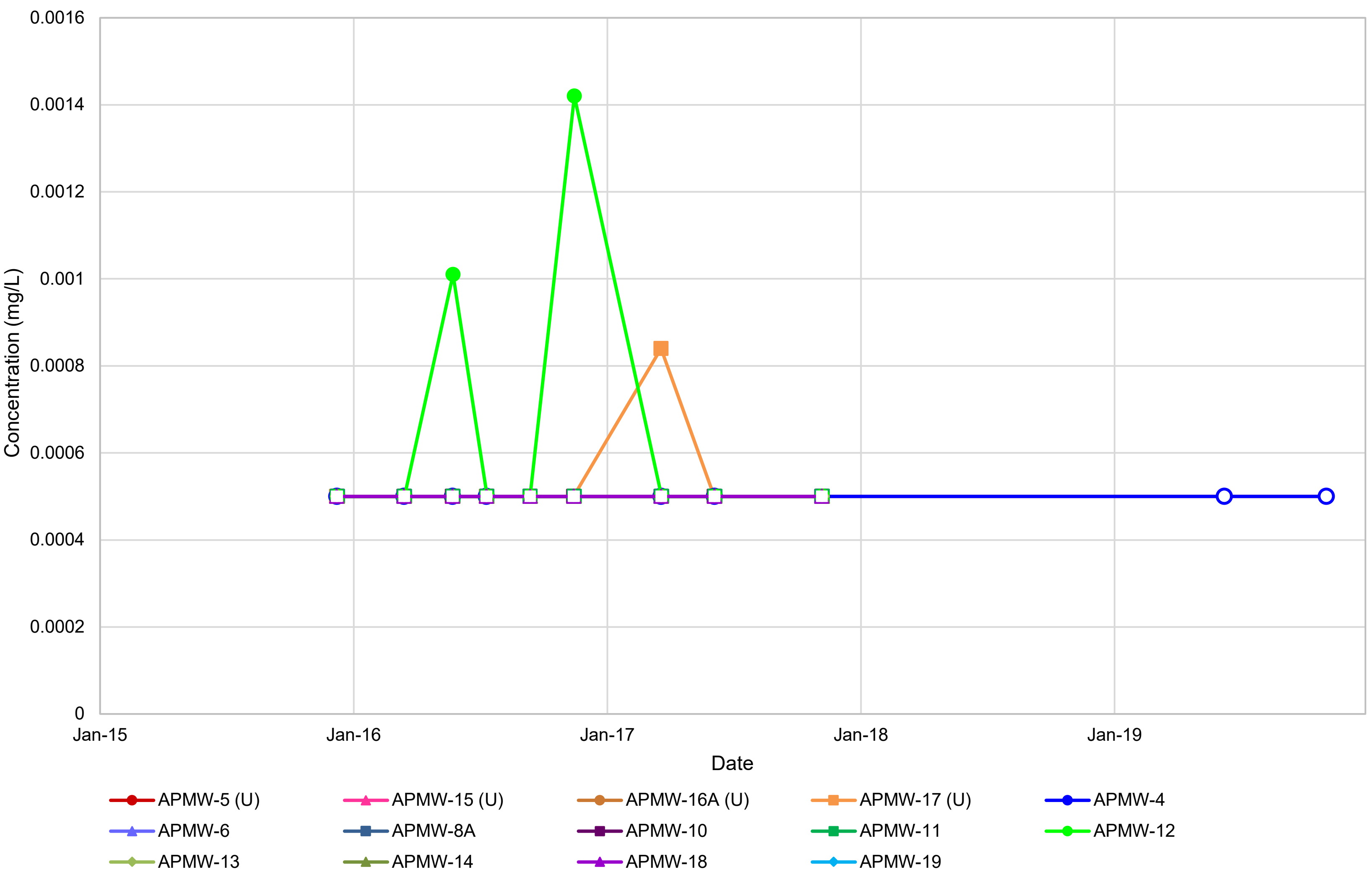
Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-16

Lead

Nebraska Public Power District

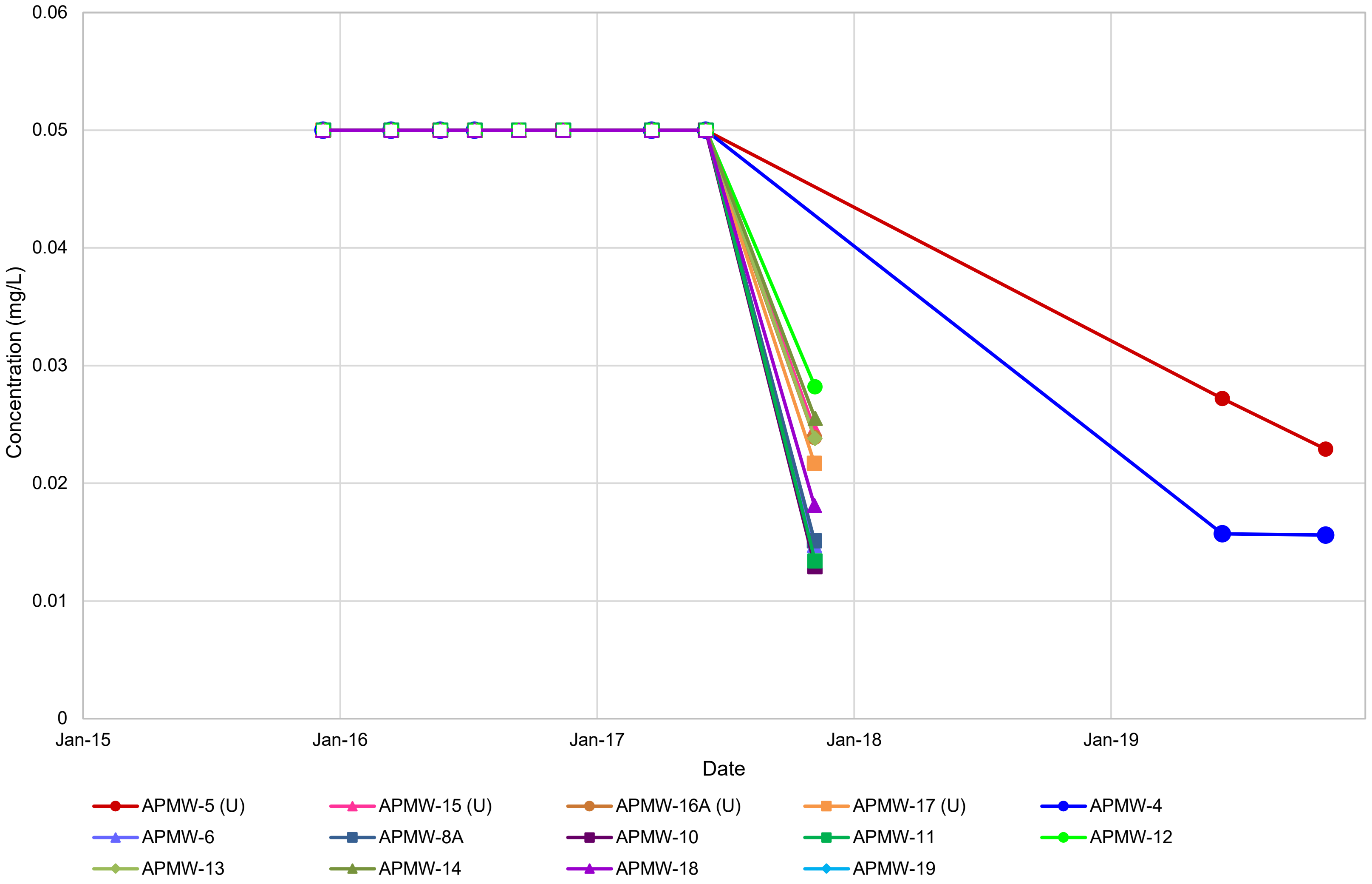
Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-17

Lithium

Nebraska Public Power District

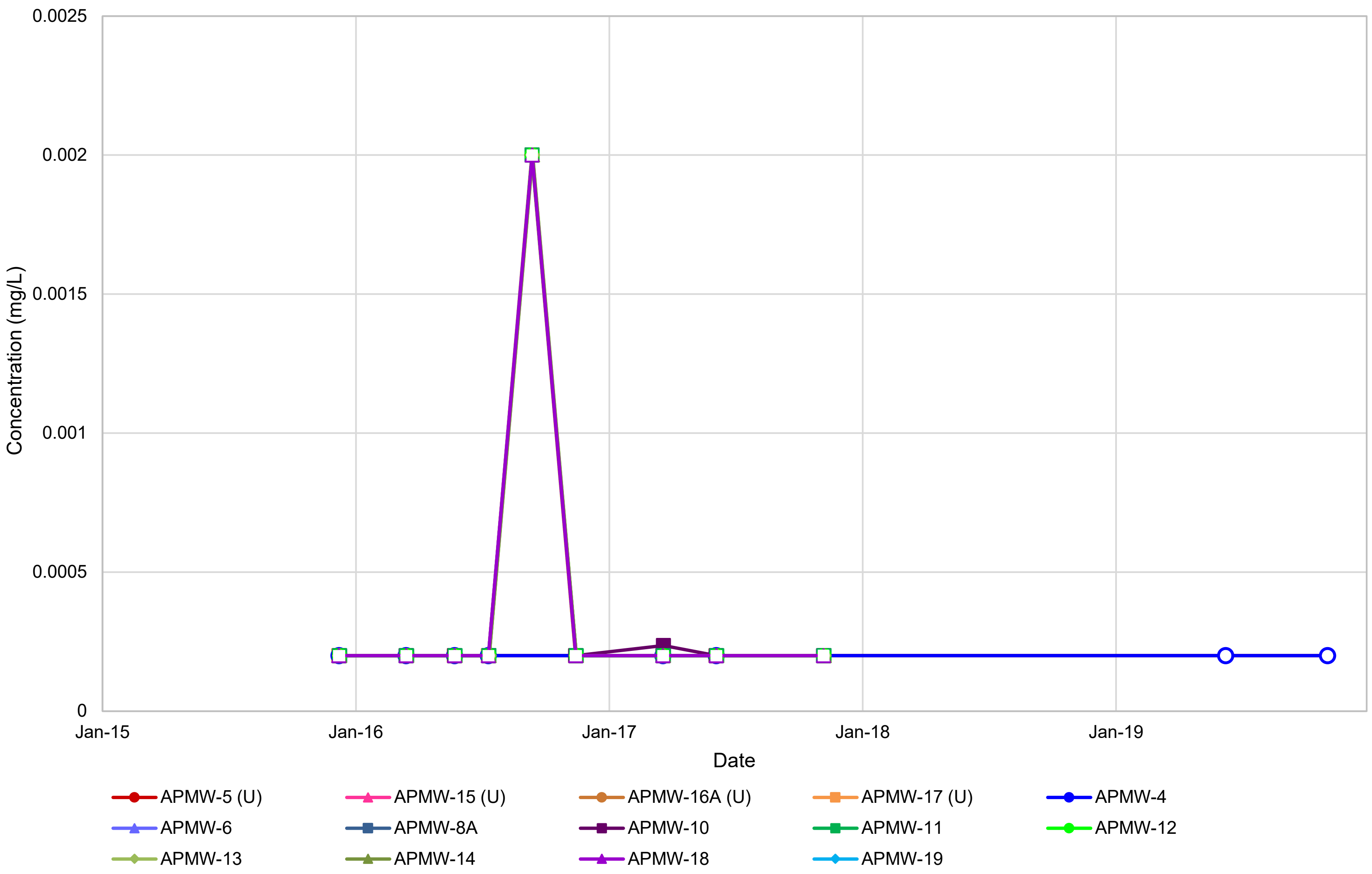
Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-18

Mercury

Nebraska Public Power District

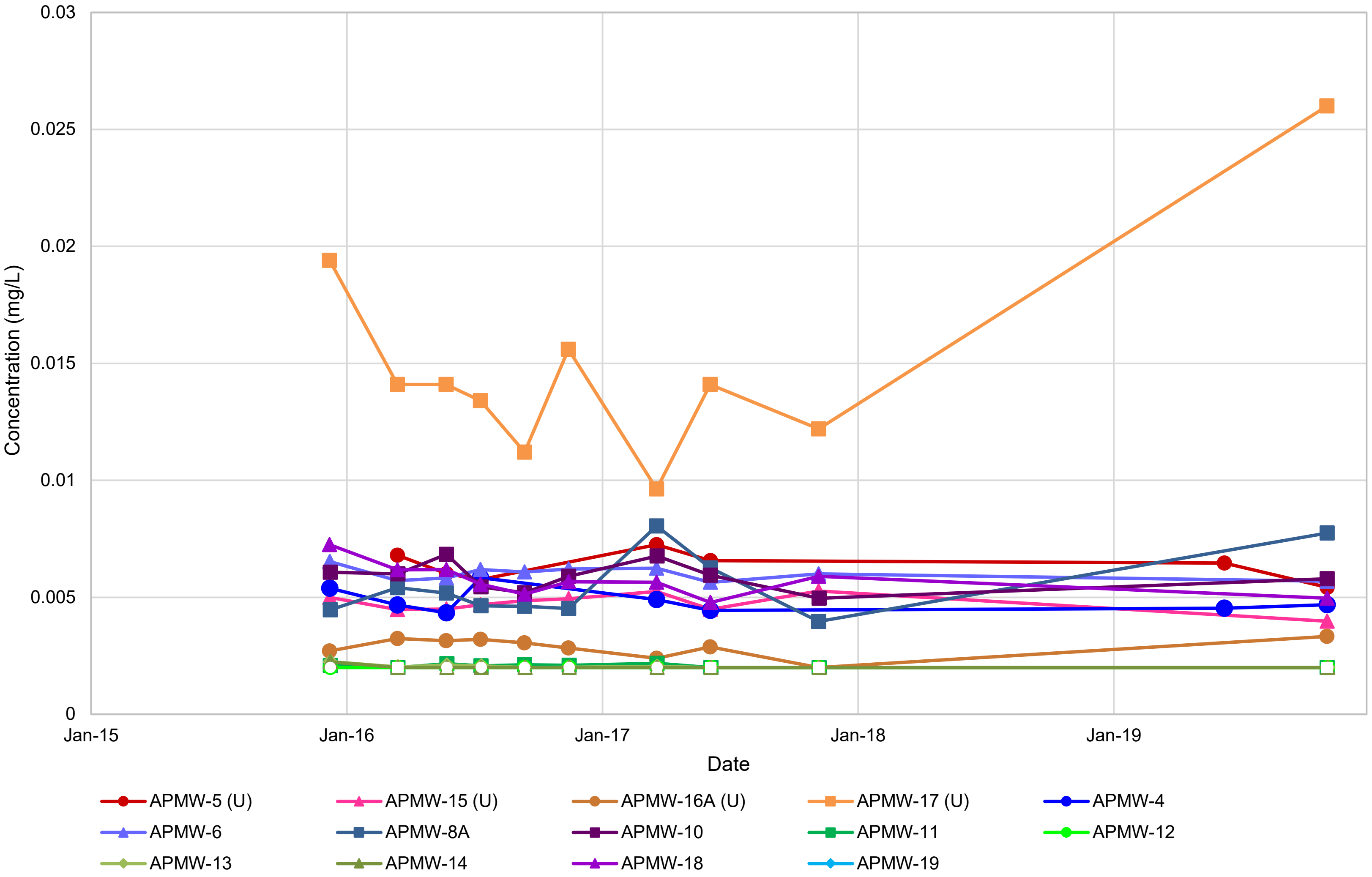
Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-19

Molybdenum

Nebraska Public Power District
Gerald Gentleman Station

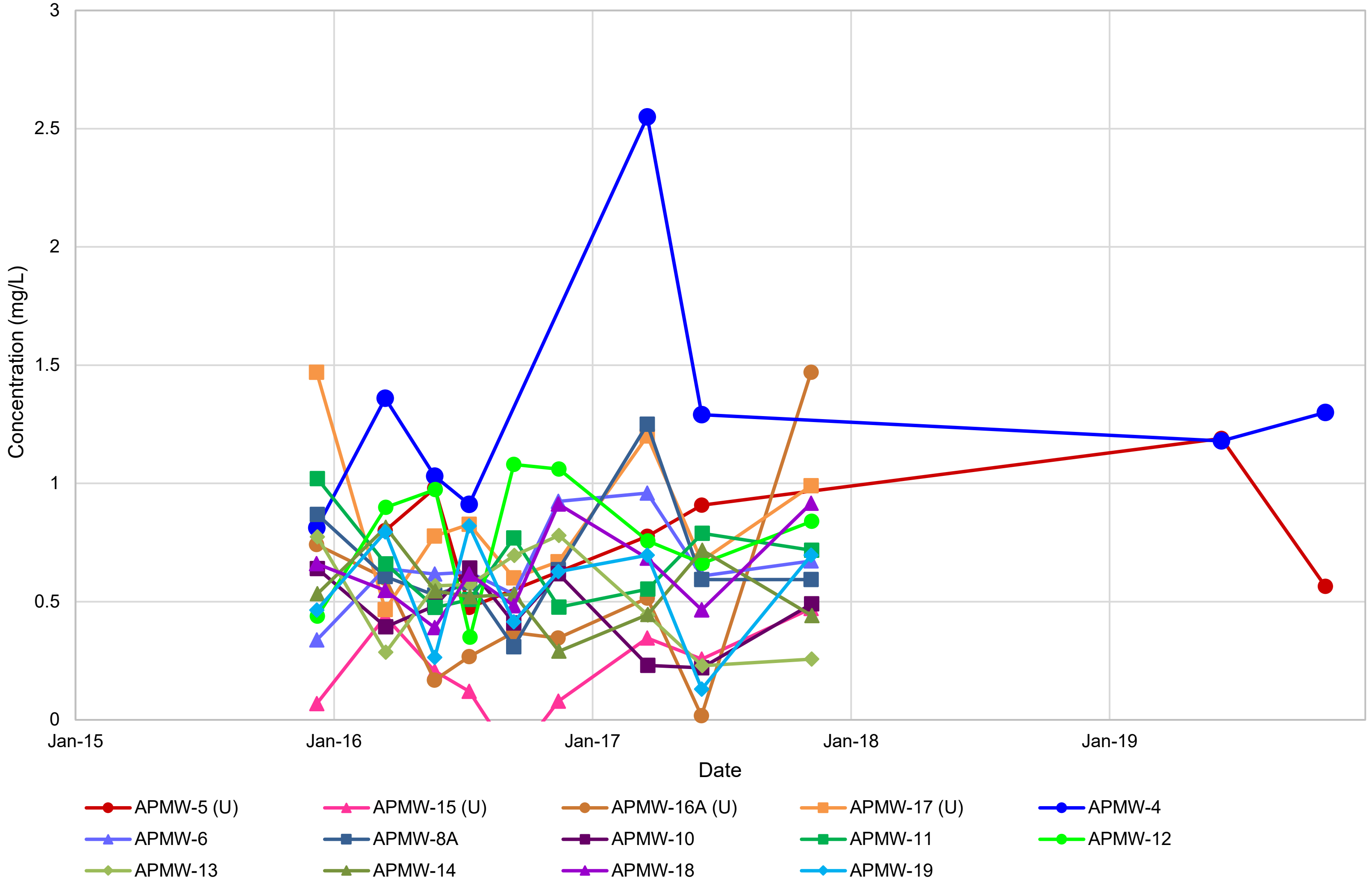
Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.

https://golderassociates.sharepoint.com/sites/160112/Project Files/5 Technical Work/02_Working Data/[Appendix A_TimeSeries GGS NDEE - w App IV - Q42021.xlsm]A-19



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-20

Radium, Total

Nebraska Public Power District

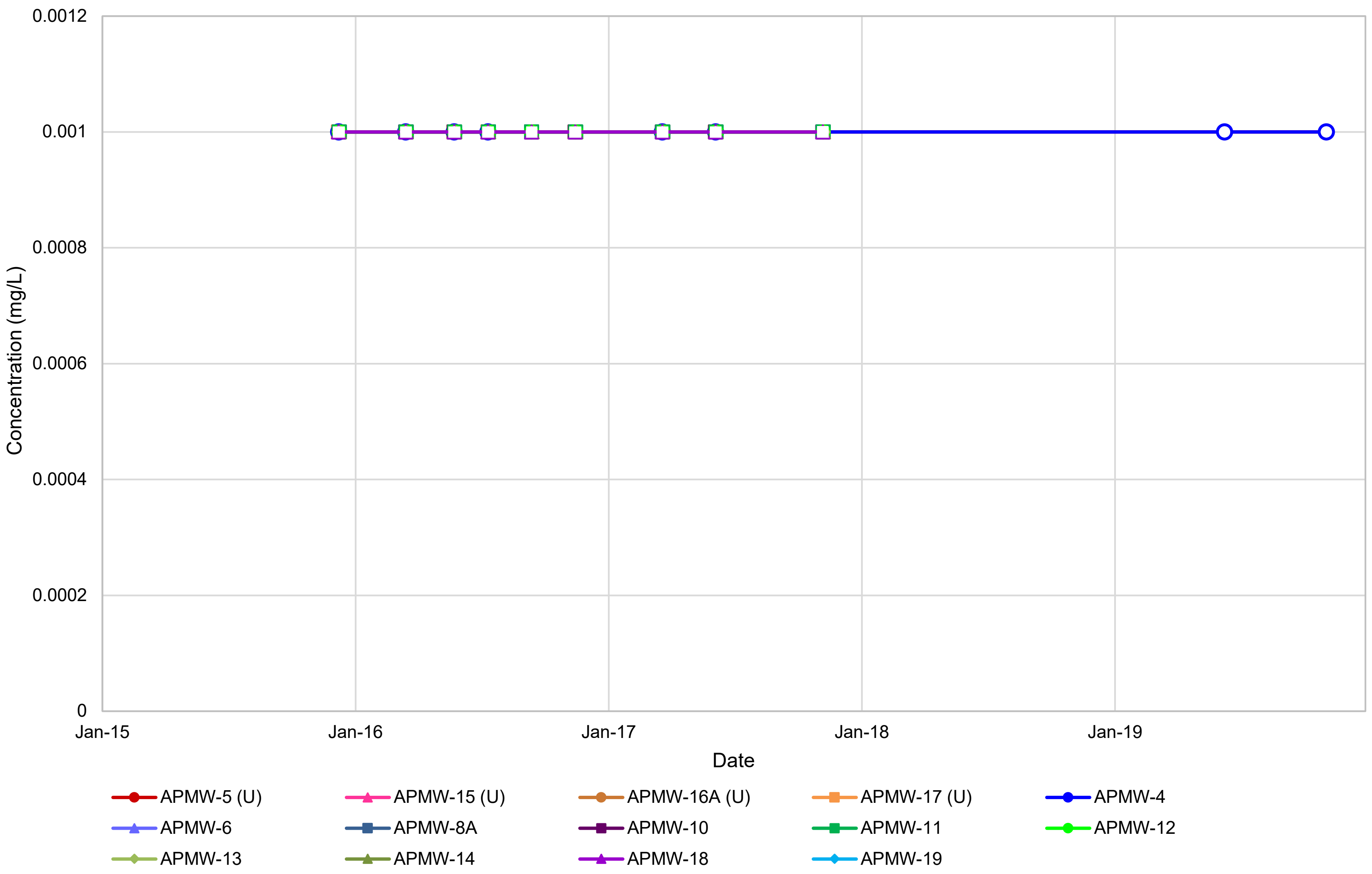
Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-21

Thallium

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.

golder.com

REPORT

Alternative Source Demonstration for Chloride at APMW-6

Nebraska Public Power District

Submitted to:

Nebraska Public Power District

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31404512.000-002-RPT-0

April 27, 2022

Table of Contents

TABLES

FIGURES

APPENDICES

APPENDIX A

Historical Concentrations of Appendix III and Selected Appendix IV Analytes

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 from the fourth quarter (Q4) of 2021 groundwater detection monitoring event at the Gerald Gentleman Station (GGS or Site) ash landfill (or CCR Unit), located at 6089 South Highway 25, Sutherland, Lincoln County, Nebraska. The statistical evaluation was performed in accordance with the site Sampling and Analysis Plan (Golder 2019a), which was developed in compliance with 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; Final Rule" (CCR Final 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 analyses of the Appendix III detection monitoring data for chloride in groundwater at the downgradient monitoring well APMW-6 indicated a potential exceedance of the statistical limit based on the parametric Cumulative Sum analysis (CUSUM) in the second quarter (Q2) 2021 sampling results, which was subsequently verified as evidence of a statistically significant increase (SSI) after the Q4 2021 event. Although determination of an SSI generally indicates that the groundwater monitoring program should transition from detection monitoring to assessment monitoring, both 40 CFR §257.94(e)(2) and NAC Title 132, Ch. 7, 004.03 allow the owner or operator (i.e., NPPD) 90 days from the date of determination (January 28, 2022) to demonstrate a source other than the CCR Unit, or another condition, caused the potential SSI for chloride at APMW-6.

Golder's review of the hydrological and geologic conditions at the Site indicated the potential for the SSI to have resulted from a source other than the CCR Unit. To assess potential chloride sources and the natural variability of chloride concentrations in groundwater, Golder reviewed analytical results of previously collected CCR-impacted water samples from the ash landfills, surface water from the Sutherland Reservoir, and groundwater samples. Based upon this assessment and in accordance with provisions of the CCR Final Rule, the NAC, and the site SAP (Golder 2019a), Golder prepared this Alternative Source Demonstration (ASD) for the CCR Unit. This ASD includes an evaluation of geological, hydrogeological, and chemical information regarding ash, surface water, and groundwater obtained from surface waters and monitoring wells installed within and adjacent to the CCR Unit.

This ASD conforms to the requirements of 40 CFR §257.94(e)(2) and NAC Title 132, Ch.7, 004.03 and provides the basis for concluding that the apparent SSI for chloride in groundwater at APMW-6 are not a result of a release from the CCR unit. The following sections provide a summary of the GGS CCR Unit, analytical and geochemical assessment results, a conceptual site model, and lines of evidence demonstrating an alternative source is responsible for the chloride SSI in groundwater at APMW-6.

2.0 BACKGROUND

2.1 Description of Waste Disposal Area

The ash landfill at GGS is located southwest of the plant's generation facility, in the northern one-half of Section 30, Township 13N, Range 33W. The ash disposal facility consists of Ash Landfill Nos. 1, 2, 3, and 4 and the bottom ash landfill. Ash Landfill Nos.1 and 2 are closed, and Ash Landfill Nos. 3 and 4 are active (Figure 1). The bottom ash landfill was closed in October 2018.

Fly ash is currently disposed at Ash Landfill No. 4 and in the east cell of Ash Landfill No. 3. The liner design at Ash Landfill No. 4 consists of a 60-mil high density polyethylene (HDPE) geomembrane over compacted subgrade. Prior to geomembrane installation, the existing subgrade was scored to a depth of at least 6 inches and compacted to

95 percent of its maximum dry density (standard Proctor). Smooth HDPE geomembrane was placed on the bottom of the ash landfill and textured HDPE geomembrane was placed on the side slopes. Construction quality assurance for the geomembrane installation was performed by Golder Construction Services and completed on November 15, 1994. There is no leachate collection system (LCS) at Ash Landfill No. 4.

The original liner at Ash Landfill No. 3 consisted of 2 feet of soil compacted to 95 percent of the standard Proctor maximum dry density. The average permeability of the liner was 1.2×10^{-8} centimeters per second (cm/sec). Ash Landfill No. 3 was previously closed in 1995 with 2.0 to 7.5 feet of soil cover. This cover was removed and the historically placed CCR was covered with a new liner in 2015. The new liner system at Ash Landfill No. 3 consists of a prepared subgrade overlain by a geosynthetic clay liner and 60-mil linear low-density polyethylene (LLDPE) geomembrane. Ash Landfill No. 3 also has a 1-foot LCS sand layer that reports to two sumps. Construction of the new Ash Landfill No. 3 liner system was completed in November 2015.

To the east of the ash landfill, plant process water, such as boiler blowdown, is managed in a 50-acre evaporation pond, as shown in Figure 1. The bottom of the approximately 8 to 10 feet deep evaporation pond consists of re-compacted native soils.

2.2 Site Geology

The geologic sequence near the ash landfill was summarized by Woodward-Clyde in 1991. In the report, soil boring data from nine boreholes (APMW-1, APMW-2, APMW-3, APMW-4, APMW-5, EPMW-1, EPMW-2, EPMW-3, and EPMW-4) were used to characterize the Site geology. The geologic sequence, from top to bottom, was described as follows:

- 4 to 5 feet of topsoil and/or fill
- 20 to 35 feet of eolian silty sands
- 8 to 10 feet of silty clay paleosol at the top of the Ogallala Formation
- 25 to 35 feet of Ogallala Formation silts
- approximately 50 feet of Ogallala Formation sands or Ogallala Formation silts and clays, to the bottoms of the boreholes

The topsoil layer consists of stiff, dark brown, low to medium plasticity silty clay directly overlying the eolian silts and sands. Thickness of topsoil ranges from 0 to 4 feet. The fill material consists of stiff, dark brown, low plasticity sandy silty clay with trace gravel and other debris. Fill thickness ranges from 0 to 5 feet.

The eolian silts and sands (Quaternary Period) consist of loose to medium dense, tan, very fine-grained, well-rounded, and well-sorted sandy silts and silty sands. The thickness of this unit ranges from 17 feet (APMW-5) to 34 feet (EPMW-2). Materials with a bimodal texture (two distinct grain sizes) are present in the lower part of this unit. The eolian silts and sands are interpreted as wind-blown dune sand deposits.

The Ogallala Formation (Tertiary Period) was encountered in each of the nine boreholes at a depth beginning at 16 to 38 feet below ground surface (ft bgs) and extending to the bottom of the boreholes (109 to 133 ft bgs). The Ogallala Formation near the ash landfill may be separated into three general stratigraphic units:

- upper silty clay paleosol unit
- middle clayey or sandy silt unit
- lower unit of either predominantly sand and gravel or an equivalent unit of predominantly silt and clay

The top of the Ogallala Formation is represented by a widespread paleosol (a previous soil horizon) that consists of a very stiff, reddish-brown to buff, low plasticity, silty clay to clayey silt with abundant calcareous nodules, calcareous matrix, and interbedded layers of caliche up to 1-foot thick. The thickness of the initial paleosol is about 8 to 10 feet, but the presence of interbedded caliche layers continues into the middle and lower Ogallala units.

The middle Ogallala Formation unit consists of a stiff to very stiff, buff-white to reddish-brown, low plasticity, clayey silt to sandy silt with abundant calcareous nodules, matrix, and caliche layers. Scattered occurrences of calcareously cemented siltstone layers from 0.5- to 1-foot thick are present in the lower part of this unit. The thickness of this middle unit ranges from about 25 to 35 feet. The clayey silts and sandy silts of this unit were possibly deposited as overbank or floodplain deposits in an alluvial depositional system.

There are two distinct lithofacies recognized in the lower Ogallala Formation unit. This unit is present for about 45 to 50 feet in the borings. One lithofacies consists of dense to very dense, reddish-brown, fine-grained silty sands grading into medium- and coarse-grained, poorly-graded sands with some fine gravels and some calcareously cemented sandstone beds (0.5- to 1-foot thick). This lithofacies was primarily encountered in borings on the northern side of the ash landfill (APMW-1, APMW-2, APMW-5, and EPMW-1).

The second lithofacies recognized in the lower unit consists of stiff to hard, reddish-brown, low plasticity clayey or sandy silts with some calcareously-cemented siltstone beds. This lithofacies was encountered in borings on the southern side of the ash landfill (APMW-3, APMW-4, EPMW-2, EPMW-3, and EPMW-4).

The lithologic differences and areal distribution of the two lower units suggest that the units were deposited in two separate facies of an alluvial system. The sand and gravel unit are possibly a series of longitudinal bars, channels, and channel-fill deposits, while the silt and clay unit is possibly a series of upper channel fills, overbank, or floodplain deposits (Woodward-Clyde 1991).

2.3 Site Hydrogeology

Based on observations made during logging of soil borings and findings of the Nebraska Water Survey Paper No. 70 (Goeke et al. 1992), the unsaturated geologic units underlying the ash landfill area consist of topsoil (0 to 4 feet thick), eolian silts and sands (15 to 25 feet thick), Ogallala Formation silts (40 to 50 feet thick), and Ogallala Formation sands and gravels (unsaturated portion of this unit is approximately 20 to 25 feet thick). Beneath these units lies 10 feet or more of saturated Ogallala Formation sands and gravels. Based on the Site observations, the thickness of the vadose zone ranges from approximately 90 to 100 feet.

The saturated geologic units underlying the ash landfill area consist of Ogallala Formation silts and sands that extend to the bottom of the aquifer. The Ogallala Formation is underlain by the White River Group, which is composed of the Brule and Chadron formations. The bedrock formations of the White River Group are not considered to be an important potential source of water, and therefore their surface is considered to form the base of the aquifer and is regarded as the lower drilling limit for irrigation wells in the agricultural region near the Site. Underlying the White River Group is the impermeable Pierre Shale (Goeke et al. 1992).

Available groundwater elevation data indicate that groundwater beneath GGS flows from north to south (Figure 1). The groundwater gradient is controlled by the Sutherland Reservoir, an approximately 3,200-acre open water body located 1.5 miles north of the ash landfill that is used as a source of condenser cooling water for GGS (McMahon et al. 2010). Since groundwater level monitoring began in 1996, regular water level fluctuations have been observed in the monitoring wells located around the ash landfill. These fluctuations are attributed to seasonal trends in water consumption or recharge and precipitation patterns. From the time-series plot of historical water levels in each monitoring well (Figure 2), long-term changes in water levels between 1996 and 2021 are apparent. In general, water levels rose approximately 1.5 feet between 1996 and 2000 before declining between 9 to 10 feet between 2000 and 2009. The cause of the decline is not clear, but possible explanations include a regional response to the drought being experienced by parts of the western United States and/or a change in the amount of groundwater used for irrigation in the area around the Site. Between 2009 and 2021 water levels have continued to show seasonal variability, with seasonal maximums occurring in the spring and seasonal minimums occurring in the fall with no apparent long-term increasing or decreasing trend.

2.4 Groundwater Monitoring Network

Design of the ash landfill groundwater monitoring program considered the size, disposal and operational history, anticipated groundwater flow direction, and saturated thickness of the uppermost aquifer. Based on these factors, a monitoring well network that consists of four background monitoring wells and ten downgradient monitoring wells was installed around the ash landfill. The monitoring wells are listed in Table 1 and presented in Figure 1.

Table 1: Monitoring Well Network

Location	Background Monitoring Wells	Downgradient Monitoring Wells
Ash Landfill	APMW-5, APMW-15, APMW-16A, APMW-17	APMW-4, APMW-6, APMW-8A, APMW-10, APMW-11, APMW-12, APMW-13, APMW-14, APMW-18, APMW-19

The four upgradient monitoring wells included in the groundwater monitoring program are used to represent the background groundwater quality, including potential variability. The ten downgradient wells were installed along the western, southern, and eastern boundaries of the active ash landfill. The depths of the monitoring wells were selected such that the monitoring wells are screened in the Ogallala Formation to yield groundwater samples that are representative of water quality in the uppermost water-bearing zone.

2.5 Groundwater Monitoring Program

Between March 1996 and December 2015, groundwater samples were collected for arsenic, selenium, and sulfate measurement twice a year from the ten GGS monitoring wells administered under the Nebraska Department of Environment and Energy (NDEE) monitoring program (APMW-5, APMW-15, APMW-4, APMW-6, APMW-8A, APMW-10, APMW-11, APMW-12, APMW-13, and APMW-14). In June 2005, boron measurements were added to the analyte list. In 2015, four additional monitoring wells were installed to support the federal CCR monitoring program (APMW-16A, APMW-17, APMW-18, and APMW-19) and have been incorporated into the NDEE monitoring program.

For APMW-6, the current baseline for chloride was calculated using 13 independent baseline groundwater samples collected between December 2015 and November 2019. The results of the baseline monitoring phase were used to develop appropriate and statistically valid baseline values (Golder 2017 and Golder 2019a).

2.5.1 Chloride Concentration Trends

Chloride concentrations in the upgradient and downgradient groundwater are shown in Appendix A, Figure A4. Chloride concentrations in upgradient groundwater (from the four background monitoring wells) ranged from 28 to 87.8 milligrams per liter (mg/L) between December 2015 and November 2021. Chloride concentrations varied between 7.02 to 210 mg/L in downgradient groundwater wells (based on the 10 downgradient monitoring wells) over the same period.

During the current baseline dates for APMW-6 (December 2015 to November 2019), chloride concentrations in groundwater at APMW-6 remained relatively steady compared to other downgradient wells, with values ranging between 7.02 and 14.4 mg/L in the 13 samples representing the current baseline period. A concentration of 20.4 mg/L was calculated as the parametric CUSUM statistical limit for chloride at APMW-6.

The Q2 2021 detection monitoring event reported a chloride concentration of 25.8 mg/L in groundwater at APMW-6 with a parametric CUSUM value of 31.7 mg/L, both exceeding the statistical limit of 20.4 mg/L. The exceedance was verified in Q4 2021 when the reported chloride concentration was 17.6 mg/L, while the parametric CUSUM value of 36.6 mg/L exceeded the statistical allowance of 20.4 mg/L a second time.

2.6 Review of Sampling and Laboratory Testing Procedures

As part of the ASD, a review was conducted of the sampling and laboratory testing procedures used throughout baseline monitoring and detection monitoring to date, along with the collected results. Golder found that the analytical methodologies used were consistent with the stated objectives of the sampling program. No anomalies were found within the sampling and laboratory testing procedures and the collected results are considered valid.

Additionally, a review of the statistical assessment methods and associated results found the procedures followed during baseline and detection monitoring to be consistent with the stated procedures listed in the published Groundwater Monitoring Statistical Methods Certification (Golder 2017). Calculated limits were found to be consistent with the chosen statistical procedures as described in the Sampling and Analysis Plan (Golder 2019a) and recommended methodology found within the Unified Guidance (Environmental Protection Agency [EPA] 2009).

3.0 DATA SOURCES USED IN ALTERNATIVE SOURCE REVIEW

To assess groundwater downgradient of the GGS CCR facilities, Golder reviewed previously collected data and performed supplemental assessment activities. The following sections summarize the supplemental assessment activities.

3.1 Groundwater

3.1.1 On-site Groundwater Monitoring Data

NPPD GGS field personnel routinely collect groundwater samples from 14 monitoring wells around the ash landfill at GGS and submit them for chemical analysis. The following datasets were available to characterize the groundwater in the vicinity of the ash landfills:

- **NDEE and CCR monitoring programs:** As described in Section 2.5, the ongoing groundwater monitoring samples were collected between 1996 and present, and analyzed for field parameters, major cations, major anions, and select dissolved metals.

- **Supplemental sampling in First Quarter (Q1) 2019:** In February 2019, an additional set of groundwater samples were collected from eight of the 14 wells (APMW-5, APMW-17, APMW-4, APMW-8A, APMW-18, APMW-19, APMW-12, and APMW-14) to support the Q4 2018 ASD for fluoride at APMW-19 (Golder 2019b). These samples were analyzed for field parameters, major cations, major anions, and select dissolved metals. In addition, detection monitoring groundwater samples collected in Q4 2019 also had an expanded analyte list, including field parameters, major cations, major anions, and select dissolved metals.

3.1.2 Upgradient Off-site Monitoring Data

As discussed in Section 2.3, upgradient groundwater is sourced from the Sutherland Reservoir, which is fed by the Sutherland Canal with water from North Platte and South Platte Rivers. The following data sources were used to constrain the range of potential water qualities upgradient of GGS and the ash landfill:

- **North Platte and South Platte Rivers:** The United States Geological Survey (USGS) monitored South Platte River chemistry at Roscoe, Nebraska between 1975 and 2013 (USGS 2016a). The monitoring location at Roscoe, Nebraska is less than one mile downstream of where South Platte River water is diverted into the Sutherland Canal. The USGS also characterized North Platte River water between 1972 and 2011 at Keystone, Nebraska, immediately downstream of Lake Ogallala, where North Platte River water is diverted into the Sutherland Canal (USGS 2016b).

- **Sutherland Reservoir and Canal:** Surface water samples were collected from the Sutherland Reservoir and Sutherland Canal on October 28, 2019, to assess the source of regional groundwater at the site. These samples were analyzed for field parameters, major cations, major anions, and select dissolved metals (Golder 2019b). In addition to samples collected by NPPD personnel, seven water samples were collected from the center of the Sutherland Reservoir by the USGS between August 2005 and December 2006 (USGS 2016c and USGS 2016d).

- **Shallow Groundwater around the Sutherland Reservoir:** Between September 2005 and May 2007, the USGS collected 14 shallow groundwater samples from 12 wells less than one mile from the perimeter of Sutherland Reservoir (USGS 2016e).

- **Upgradient Wells:** In Q2 2021, NPPD personnel collected groundwater samples from wells north and east of GGS to characterize the regional groundwater. The wells included potable water wells (PW #1, PW #2, and PW #3), livestock watering wells (livestock well), and operating wells (OW-20, OW-21, OW-22, OW-23, OW-24, OW-25, and OW-36, as shown in Figure 3. The samples were analyzed for field parameters, major cations, major anions, and select dissolved metals.

3.2 Evaporation Pond

In Q1 2019 and Q4 2020, surface water samples were collected from the evaporation pond. The samples were analyzed for field parameters, major cations, major anions, and select dissolved metals.

3.3 Coal Combustion Residuals Contact Water

To characterize the potential for the material in the ash landfill to release contaminants, NPPD GGS field personnel retrieved sump water from the Ash Landfill No. 3 LCS, and pond water in direct contact with CCR materials in Ash Landfill No.4 on October 28, 2019. These sample were analyzed for the same suite of parameters as the groundwater: field parameters, major cations, major anions, and select dissolved metals (Golder 2019b).

3.4 Geochemical Methods

The geochemical analysis of groundwater and surface water samples included field parameters, major cations and anions, and dissolved metals. Conductivity, pH, and temperature were measured in the field using a handheld meter. The pH of each sample was also measured in the laboratory. Major anions analyzed included chloride, sulfate, and bicarbonate and major cations included calcium, magnesium, potassium, and sodium.

The laboratory analyzed the ash landfill pond and sump water, onsite and off-site groundwater, and surface water (evaporation pond, Sutherland Reservoir, and Sutherland Canal) samples using the following methods:

- alkalinity following Standard Method (SM) 2320B Alkalinity by Titration (2005)
- chloride, fluoride, and sulfate following USEPA SW846 9056A Determination of Inorganic Anions by Ion Chromatography Revision 1 (February 2007)
- pH following SM 4500 H+ B (2017)
- antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, lead, lithium, magnesium, molybdenum, potassium, selenium, sodium, and thallium following USEPA SW-846 6020A (November 2004)
- ammonia following USEPA 350.1 Determination of Ammonia Nitrogen by Automated Colorimetry, Revision 2 (August 1993)
- total Kjeldahl nitrogen following USEPA 351.2 Determination of Total Kjeldahl Nitrogen by Semi-Automated Colorimetry, Revision 2 (August 1993)
- total nitrate-nitrite nitrogen following USEPA 353.2 Determination of Nitrate-Nitrite Nitrogen by Automated Colorimetry, Revision 2 (August 1993)
- dissolved silica following SM4500-SiO2-C Silica, Molybdosilicate Method (2017)

4.0 DATA EVALUATION

Historical concentrations of Appendix III analytes and selected Appendix IV analytes in groundwater at GGS, including analytes that are typically indicators of potential CCR seepage (e.g., arsenic, barium, molybdenum, and selenium), are presented in time series plots in Appendix A. The plots include the results of the supplemental samples that were collected in Q1 2019 to support the Q4 2018 ASD for fluoride at APMW-19 (Golder 2019b). Sampling for the Appendix IV analytes concluded with the end of baseline monitoring in Q2 2017, which means there is a gap of six quarters in the data plots until the supplemental sampling results are shown in Q1 2019.

Figure 4 presents a Piper diagram with relative major ion chemistry for the monitoring well groundwater samples (only for samples analyzed for all major cations and anions; Q4 2017, Q1 2019, Q4 2019, and Q2 2021), offsite upgradient groundwater (NPPD and USGS sampled wells), regional groundwater sources (Sutherland Reservoir, Sutherland Canal, and North and South Platte River), and coal ash impacted waters (Ash Landfill No. 3 sump water, Ash Landfill No. 4 surface pond water, and evaporation pond water). The groundwater at the upgradient monitoring wells was dominated by calcium and bicarbonate. Samples from the downgradient monitoring wells were also majority calcium and bicarbonate ions, with the exception of a single sample (Q1 2019) from APMW-12 that was dominated by calcium and sulfate. The Sutherland Reservoir and Canal water, along with the average North and South Platte River waters are generally dominated by calcium, sodium, bicarbonate, and sulfate. The Ash Landfill No. 3 sump water sample was primarily sodium and bicarbonate, while the Ash Landfill No. 4 pond water was dominated by sodium and sulfate. The evaporation pond water also contained majority sodium and sulfate ions.

4.1 Potential Chloride Sources

Several potential sources, other than the active CCR Units, can contribute chloride to local groundwater at GGS, including outflows from the Sutherland Reservoir into regional groundwater, seepage from the evaporation pond, and seepage from historical deposits of fly ash that remain at GGS. These three potential sources of chloride to groundwater are described in this section.

4.1.1 Regional Groundwater from Sutherland Reservoir

As described in Section 2.3, the groundwater gradient in the area around the ash landfill shows groundwater flows from north to south, rather than from south to north in the direction of the South Platte River. The groundwater flow direction appears to be based on both the groundwater recharge provided by the Sutherland Reservoir to the north of GGS and groundwater extraction by irrigation wells located south of GGS that are pumped seasonally and used to support local agriculture. The Sutherland Reservoir is fed by the Sutherland Canal, which delivers water from both the North and South Platte Rivers for use as condenser cooling water at GGS.

The USGS collected 60 samples for chloride concentration analysis from the South Platte River at Roscoe, Nebraska between 1975 and 2013 (USGS 2016a). Chloride concentrations in the South Platte River ranged from 33 to 110 mg/L. The USGS collected 26 samples for chloride concentration analysis from the North Platte River at Keystone, Nebraska between 1972 and 2011 (USGS 2016b). Chloride concentrations in the North Platte River ranged from 16 to 24 mg/L.

The chloride concentrations of the Sutherland Reservoir and Sutherland Canal samples collected by NPPD field staff in October 2019 were 21.9 and 20.9 mg/L, respectively (Section 3.1.2). The seven Sutherland Reservoir samples the USGS collected between August 2005 and December 2006 had chloride concentrations that ranged from 23.4 to 27.2 mg/L (USGS 2016c and USGS 2016d). The chloride concentrations in the Sutherland Reservoir and Sutherland Canal at the times of sampling (2005, 2006, and 2019) were more similar to concentrations observed in the North Platte River and lower than concentrations observed in the South Platte River.

Chloride concentrations in the North Platte River, South Platte River, and Sutherland Reservoir were sufficiently high enough to be regarded as a source of the elevated concentrations measured in groundwater at the upgradient monitoring wells at the Site and the elevated concentrations measured in downgradient groundwater at APMW-6, APMW-8A, and APMW-18. The groundwater from APMW-6 has the lowest chloride concentrations of any background or downgradient CCR monitoring well (Figure 5 and Appendix A Figure A4). While the small increases in chloride concentrations at APMW-6 were only observed during detection monitoring (25.8 mg/L in Q2 2021 and 17.6 mg/L in Q4 2021, which triggered the SSI), elevated concentrations at APMW-8A (56.3 mg/L to 124 mg/L) and APMW-18 (23.7 mg/L to 101 mg/L) were observed during the baseline and detection monitoring periods. The groundwater samples collected by the USGS and NPPD immediately around the Sutherland Reservoir (less than 1 mile) also support the hypothesis that the reservoir is the source of the elevated chloride concentrations at the Site (USGS 2016e). These shallow groundwater samples (14 collected by the USGS and 14 samples collected by NPPD) had chloride concentrations of between 19.3 and 122 mg/L, which is similar to the 5 to 93.8 mg/L chloride concentration range measured in groundwater at the GGS upgradient monitoring wells (APMW-5, APMW-15, APMW-16A, and APMW-17) between December 2015 and November 2021.

Figure 5 displays a box and whisker plot of the chloride concentrations from the GGS monitoring well network and samples of possible chloride sources at the Site. The plot indicates that groundwater-containing elevated chloride concentrations has been traveling across the Site, including past the background monitoring wells, and has only recently started reaching downgradient monitoring wells.

McMahon et al. (2010) details the southernly flow of surface water from the Sutherland Canal and Sutherland Reservoir to the surrounding groundwater near GGS. Their analysis indicated that the front “edge” of Sutherland Reservoir water was in the approximate area of the CCR landfills, though the low density of wells sampled around the CCR landfills limited the resolution in that area.

4.1.2 Evaporation Pond

Although the evaporation pond is located to the east of APMW-6, and side-gradient in terms of groundwater flow (i.e., seepage from the evaporation pond would be unlikely to impact groundwater at monitoring well APMW-6), evaporation pond water quality was evaluated as a potential source in this section as it contains water related to GGS plant operations.

Groundwater quality at the three downgradient monitoring wells located around the evaporation pond (i.e., APMW-12, APMW-13, and APMW-14) indicates that process water discharged from the GGS plant and stored in the evaporation pond has migrated to groundwater. Historical monitoring results show that elevated concentrations of boron (Figure A2), chloride (Figure A4), sulfate (Figure A8), and TDS (Figure A9), which are elements that are typically associated with CCR, were detected in groundwater at these three monitoring wells closest to the evaporation pond compared to the background monitoring wells.

Based on the slight differences in water quality between the groundwater at the monitoring wells APMW-12, APMW-13 and APMW-14 and the evaporation pond, mixing between the evaporation pond water and the upgradient groundwater likely occurs and groundwater at the monitoring wells is not entirely composed of seepage from the evaporation pond. This mixing reaction is supported by the Piper diagram in Figure 4, which shows samples from monitoring wells APMW-12 and APMW-14 plot on a mixing line between the evaporation pond and background groundwater end-member data points.

During the Q4 2020 sampling of the evaporation pond surface water, the chloride concentration was 259 mg/L. Based on the similarities in water quality between the evaporation pond and adjacent groundwater monitoring wells (APMW-12, APMW-13, and APMW-14), the evaporation pond is considered a potential source of chloride to groundwater at GGS. However, it is unlikely the evaporation pond influenced groundwater quality at APMW-6, which is side gradient to groundwater flow underneath the evaporation pond (Figure 1).

4.1.3 Historical Ash Landfills

Historical deposits of fly ash present at GGS in the closed soil-lined Ash Landfills Nos. 1 and 2 may release soluble constituents to groundwater as the seepage generated by infiltrating precipitation interacts with the ash. While it was not feasible to collect a sample of seepage from Ash Landfills Nos. 1 and 2 directly, ash-impacted waters collected from Ash Landfill No. 3 sump and Ash Landfill No. 4 pond (Section 3.3) had chloride concentrations of 69 and 463 mg/L, respectively, and are assumed to represent potential ash impacted waters from closed ash landfills. At these concentrations, ash impacted seepage has the potential to increase chloride concentrations in downgradient wells, including APMW-6.

A ternary plot comparing sodium, potassium, and sulfate (Figure 6) reveals that ash impacted waters (i.e., contact water) have higher relative sodium abundances and lower relative potassium and sulfate abundances compared to the upgradient and downgradient groundwater. If infiltrating precipitation was leaching chloride from the closed fly ash storage facilities, the relative concentrations of sodium would increase considerably in the groundwater and would be more similar to the ash impacted waters, but this elevated sodium signature was not observed in any of the samples collected from the downgradient groundwater monitoring wells.

In addition to the elevated levels of chloride in the ash-impacted waters, boron was also identified as a primary CCR indicator based on high concentrations in sump water from Ash Landfill No. 3 (18.3 mg/L) and pond water from Ash Landfill No.4 (13.8 mg/L). Boron concentrations in groundwater at the upgradient and downgradient CCR Unit monitoring wells are presented in Appendix A, Figure A2. All upgradient and downgradient CCR Unit monitoring wells, with the exception of monitoring wells near the evaporation pond that may be influenced by process waters, have boron concentrations below the practical quantitation limit (PQL) (typically less than 0.2 mg/L). If seepage from the ash landfills were impacting groundwater and causing the chloride SSI, boron concentrations would be expected to be increasing.

5.0 EVIDENCE OF AN ALTERNATIVE SOURCE

Based on the testing results and list of potential alternate sources of chloride presented in this report, primary lines of evidence and conclusions drawn from the evidence used to support this ASD are provided in Table 2.

Table 2: Primary Lines of Evidence and Supporting ASD Analysis

Key Line of Evidence	Supporting Evidence	Description
Lack of Primary CCR Indicators	Boron concentrations in groundwater	Boron (Figure A2) is a primary CCR indicator based on high concentrations in sump water from Ash Landfill No. 3 (18.3 mg/L) and pond water from Ash Landfill No.4 (13.8 mg/L). All upgradient and downgradient CCR unit monitoring wells, with the exception of monitoring wells near the evaporation pond that may be influenced by process waters, have boron concentrations below the PQL (typically <0.2 mg/L).
	Sodium concentrations in CCR impacted waters	The relative abundance of sodium in CCR impacted waters would indicate that high sodium concentrations would also be expected in groundwater if chloride was from CCR materials (Figure 6). Relative increases in sodium were not observed in monitoring wells at the Site, suggesting an alternative source of elevated chloride in groundwater at APMW-6
Groundwater Geochemistry	Elevated and variable chloride concentrations in background monitoring wells	Chloride concentrations in groundwater at background monitoring wells APMW-5, APMW-16A, and APMW-17 were elevated compared to chloride concentrations at monitoring well APMW-6 throughout the baseline monitoring period. Since the CCR unit cannot influence the chloride groundwater concentration in the upgradient wells, the only explanation is that there is an alternate source of chloride present in groundwater across the Site.

Key Line of Evidence	Supporting Evidence	Description
	Relative ion abundances in groundwater differs from ash landfill water	As presented in the Piper plot (Figure 4), relative differences in major ion concentrations show a distinct dissimilarity between the ash-impacted sump and pond waters and the downgradient groundwater samples, including from APMW-6. The geochemical properties of the downgradient groundwater samples are not consistent with seepage from the CCR unit.
Local Sources of Chloride	Hydrogeology	The North and South Platte Rivers, which are ultimately the source of groundwater recharge that occurs from the Sutherland Reservoir located approximately 1.5 miles north of the ash landfill, have chloride concentrations between 20 and 94 mg/L. Samples from shallow wells near the Sutherland Reservoir and upgradient wells (Figures 4 and 5) indicate that groundwater with elevated chloride is migrating south through the Site (McMahon et al. 2010). Chloride concentrations in groundwater at APMW-6 were lower than other nearby wells, indicating that APMW-6 is the last of the downgradient monitoring wells to be affected by the higher chloride groundwater migrating south (Figure 5 and Appendix A Figure A4).

6.0 CONCEPTUAL SITE MODEL

Golder developed a conceptual site model (CSM) that is presented graphically in Figure 7 to frame and support the ASD assessment approach. The CSM presents the GGS site layout, a summary of the geologic and hydrogeologic information, and a discussion of groundwater monitoring data, which together lays the groundwork for consideration and development of the ASD. Additionally, the CSM summarizes the findings of literature research that suggest certain naturally occurring groundwater conditions observed in Nebraska are present at the Site and may contribute to naturally elevated chloride concentrations in groundwater around the ash landfill.

7.0 CONCLUSIONS

In accordance with §257.95(g)(3) and NAC Title 132, Ch.7, 004.03, this ASD has been prepared in response the identification of an SSI for chloride at monitoring well APMW-6 following the Q4 2021 sampling event for the ash landfill at Gerald Gentleman Station.

A review of historical analytical results indicates that the elevated chloride concentrations in groundwater at APMW-6 were not the result of seepage from the ash landfill but can be attributed to chloride in regional groundwater. Therefore, no further action (i.e., transition to Assessment Monitoring) is warranted, and the Gerald Gentleman Station ash landfill will remain in detection monitoring.

Signature Page

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GL/ES/JS/df

https://golderassociates.sharepoint.com/sites/160112/project files/6 deliverables/002-r-chloride_alternative_source_demo/rev0/31404512.000-002-rpt-0-chloride_asd_apmw6_27apr22.docx

8.0 REFERENCES

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

Goeke JW, Peckenpaugh JM, Cady RE, Dugan JT. 1992. Hydrogeology of Parts of the Twin Platte and Middle Republican Natural Resources Districts, Southwestern Nebraska, Nebraska Water Survey Paper No. 70, Conservation and Survey Division, University of Nebraska-Lincoln, 89 pp.

Golder Associates Inc. 2017. Coal Combustion Residuals Landfill Groundwater Monitoring System Certification, Nebraska Public Power District Gerald Gentlemen Station, Sutherland, Nebraska.

Golder Associates Inc. 2019a. Sampling and Analysis Plan, Gerald Gentleman Station Ash Landfill. December.

Golder Associates Inc. 2019b. Alternate Source Demonstration, Nebraska Public Power District Gerald Gentlemen Station, Sutherland, Nebraska, April.

McMahon, PB, Carney CP, Poeter EP, Peterson SM. 2010. Use of geochemical, isotopic, and age tracer data to develop models of groundwater flow for the purpose of water management, northern High Plains aquifer, USA. Applied Geochemistry, 25(6), pp.910-922.

USGS (US Geological Survey). 2016a. National Water Information System data available on the World Wide Web (USGS Water Data for the Nation: USGS 06764880 South Platte River at Roscoe, Nebr.), accessed April 2020, at URL: https://nwis.waterdata.usgs.gov/nwis/qwdata/?site_no=06764880&agency_cd=USGS&amp.

USGS. 2016b. National Water Information System data available on the World Wide Web (USGS Water Data for the Nation: USGS 06690500 North Platte River Near Keystone, Nebr.), accessed April 2020, at URL: https://nwis.waterdata.usgs.gov/nwis/qwdata/?site_no=06690500&agency_cd=USGS&amp.

USGS. 2016c. National Water Information System data available on the World Wide Web (USGS Water Data for the Nation: USGS 410630101080202 Sutherland Reservoir Middle Deep), accessed April 2020, at URL: https://waterdata.usgs.gov/nwis/inventory?agency_code=USGS&site_no=410630101080202.

USGS. 2016d. National Water Information System data available on the World Wide Web (USGS Water Data for the Nation: USGS 410630101080201 Sutherland Reservoir Middle Shallow), accessed April 2020, at URL: https://nwis.waterdata.usgs.gov/usa/nwis/qwdata/?site_no=410630101080201.

USGS. 2016e. National Water Information System data available on the World Wide Web (USGS Water Data for the Nation: USGS-410711101060201, USGS-410606101061301, USGS-410529101062501, USGS-410542101053501, USGS-410438101055301, USGS-410452101055301, USGS-410522101075601, USGS-410508101091501, USGS-410456101091801, USGS-410530101093701, and USGS-410811101072501), accessed April 2020, at URL: https://www.waterqualitydata.us/portal/#siteid=USGS-410711101060201&siteid=USGS-410606101061301&siteid=USGS-410529101062501&siteid=USGS-410542101053501&siteid=USGS-410438101055301&siteid=USGS-410452101055301&siteid=USGS-410522101075601&siteid=USGS-410508101091501&siteid=USGS-410456101091801&siteid=USGS-410530101093701&siteid=USGS-410811101072501&mimeType=csv.

Woodward-Clyde Consultants. 1991. Design and Construction of a Groundwater Monitoring Network, Final Report, Gerald Gentleman Station, Nebraska Public Power District, Sutherland, Nebraska, WCC Project No. 90MC176, Omaha, Nebraska, September.

Figures

WSP GOLDER

NOTE

GROUNDWATER CONTOURS DEVELOPED FROM LEVELS MEASURED IN ACTIVE MONITORING WELLS SHOWN.

NEBRASKA PUBLIC POWER DISTRICT
GERALD GENTLEMAN STATION
GROUNDWATER MONITORING WELL NETWORK
NOVEMBER 2021 GROUNDWATER CONTOURS
FIGURE 1

Path: \\golder.gds\complexdata\office\denver\acad\NPPD\GGS\99_PROJECTS\20141315 GGS GW Quality 2020\ | File Name: 20141315A002_GGS_Q4-2021.dwg https://golderassociates.sharepoint.com/sites/124836/Project Files/5 Technical Work/1 Gerald Gentleman Station/2021 - Q4/NDEE Report/Tables and Figures/[GGS Water Levels 2

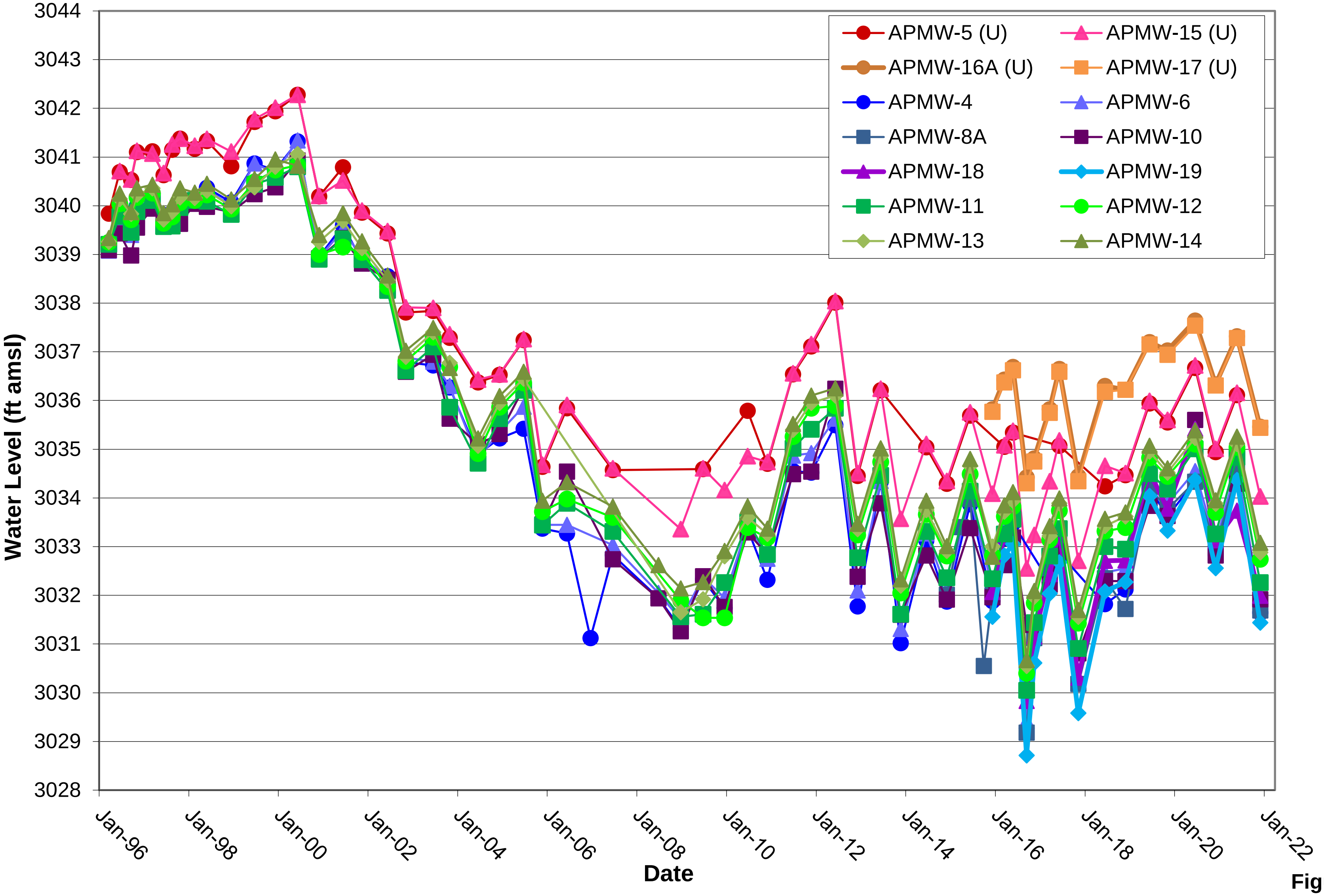

Figure 2

Groundwater Monitoring Well Water Levels

Alternative Source Demonstration

Nebraska Public Power District - Gerald Gentleman Station

Golder Associates USA

FINAL

4/28/2022

NPPD GGS

31404512

NOTES

1. WELL LOCATIONS ARE APPROXIMATE.

REFERENCE(S)

1. AERIAL IMAGERY OBTAINED FROM ESRI (MAY 2020).

WSP GOLDER

NEBRASKA PUBLIC POWER DISTRICT
GERALD GENTLEMAN STATION
Q2 2021 SAMPLING LOCATIONS

FIGURE 3

Path: \\golder.gds\complexdata\office\Denver\acad\NPPD\GGS\99_PROJECTS\20141315 GGS GW Quality 2020\ | File Name: ASD_20141315A002_GGS_Figure 3.dwg

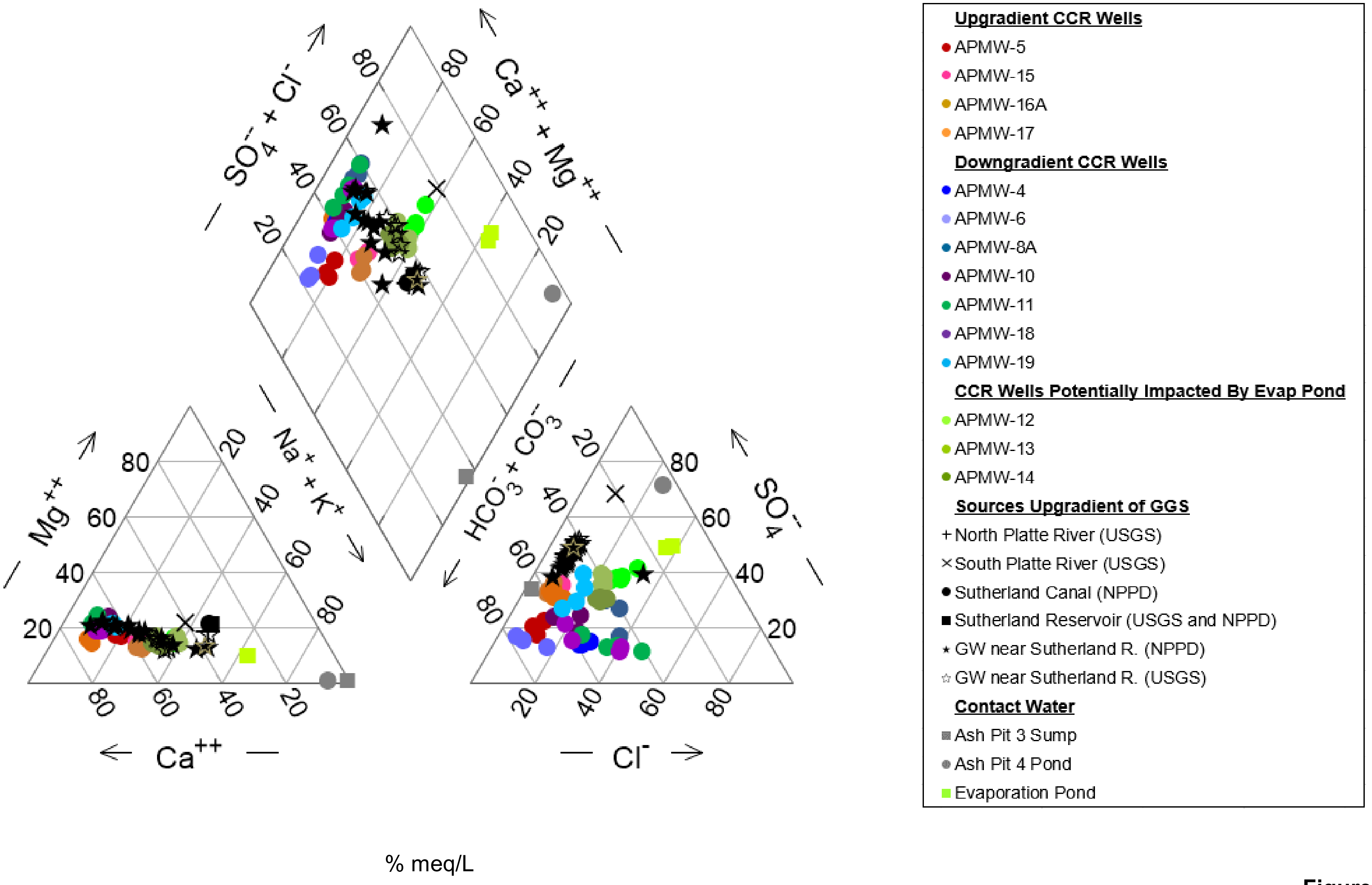

Figure 4

Piper Diagram of Groundwater

Alternate Source Demonstration

Nebraska Public Power District - Gerald Gentleman Station

NPPD GGS

4/28/2022

31404512

Golder Associates USA

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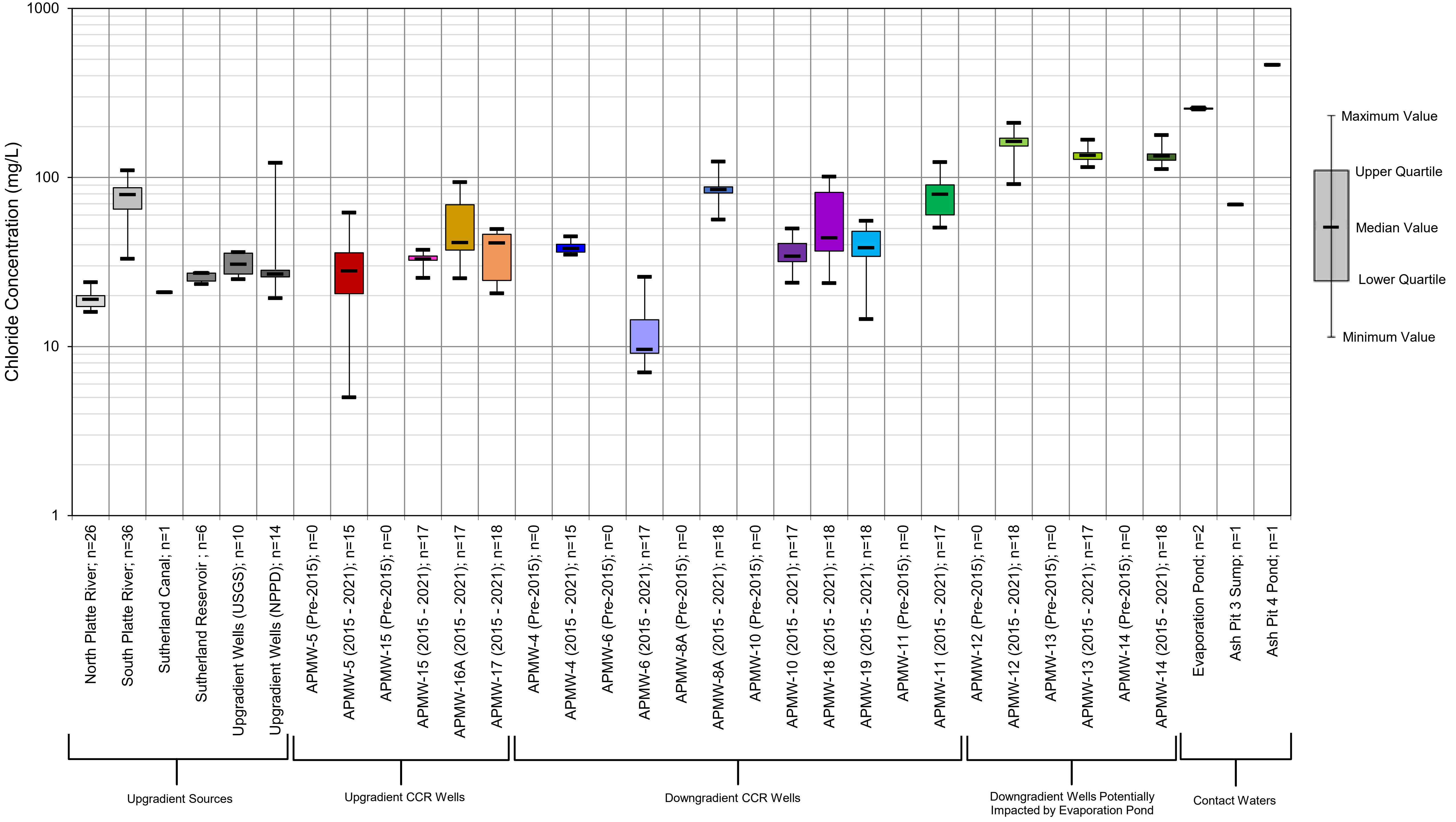


CLIENT

Nebraska Public Power District: Gerald Gentleman Station

PROJECT

Alternate Source Demonstration

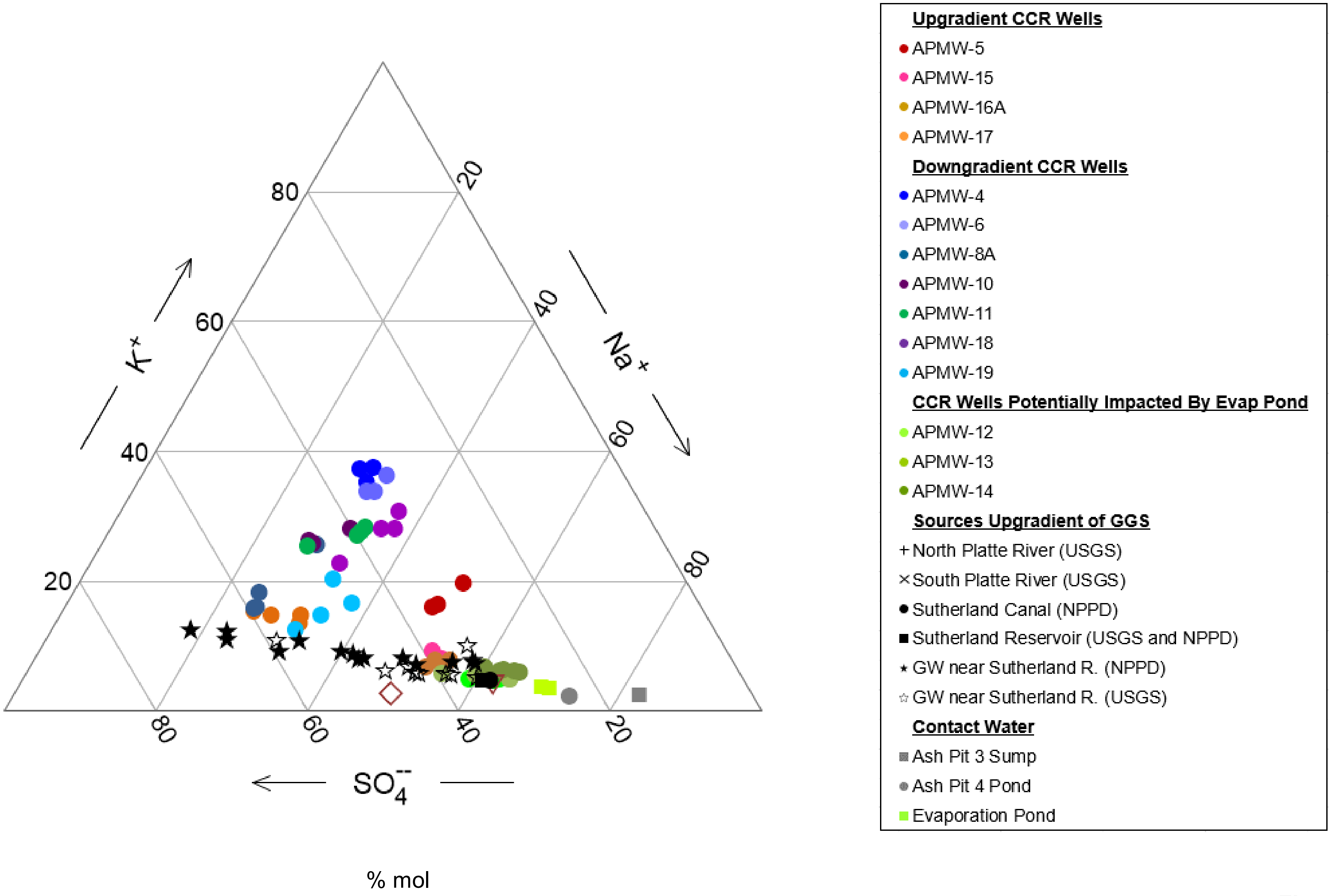
CONSULTANT

WSP GOLDER

TITLE

Chloride

PROJECT NO.	PHASE	REV.	FIGURE
31404512	1		5



https://golderassociates.sharepoint.com/sites/160112/Project Files/5 Technical Work/02_Working Data/[GGS Q2 2021 Piper, Ternary, CSM.xlsx]Ternary

Figure 6

Ternary Diagram of Groundwater

Alternate Source Demonstration

Nebraska Public Power District - Gerald Gentleman Station

NPPD GGS

4/28/2022

31404512

Golder Associates USA

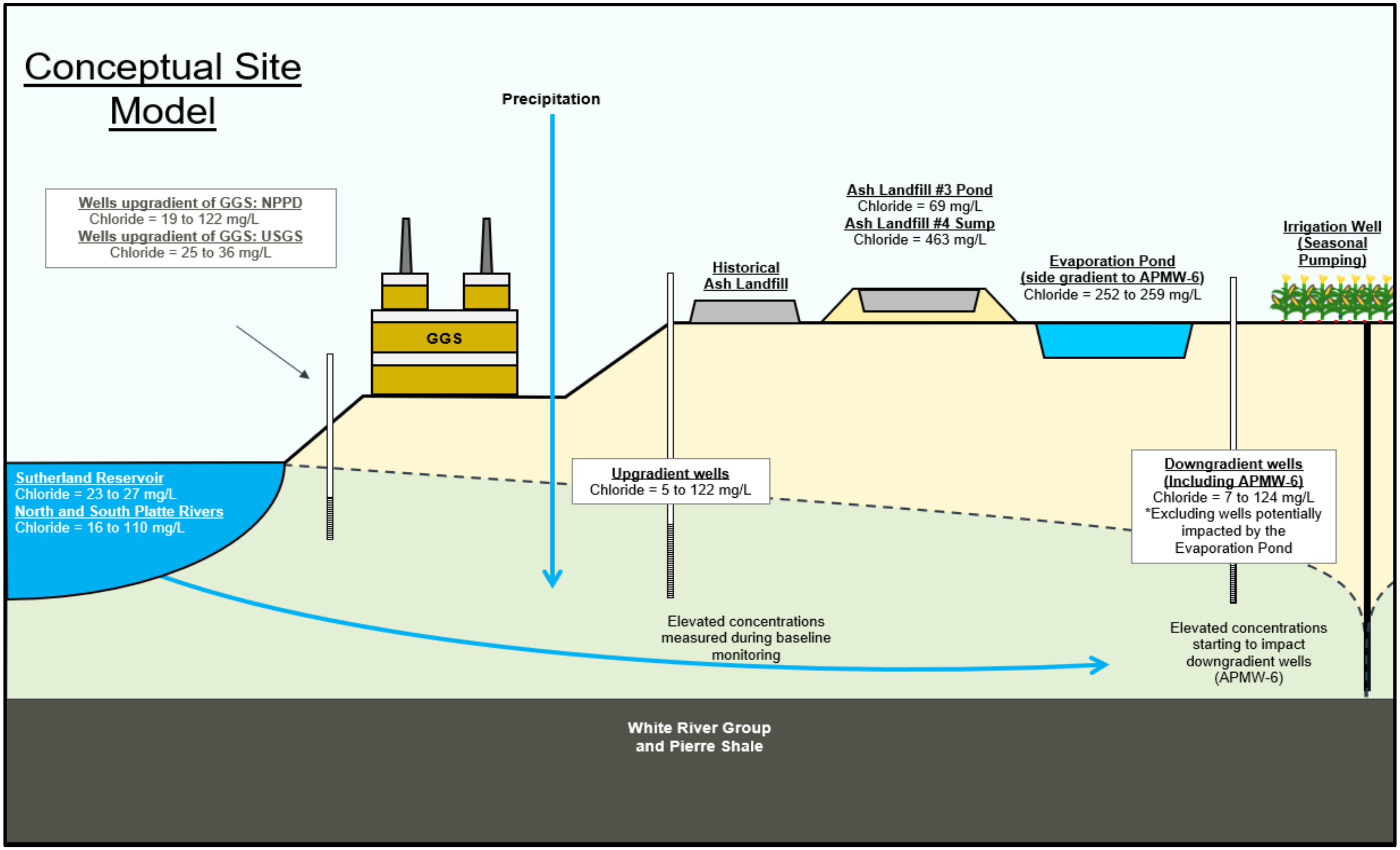


Figure 7

Chloride Conceptual Site Model

Alternate Source Demonstration

Nebraska Public Power District - Gerald Gentleman Station

Golder Associates USA

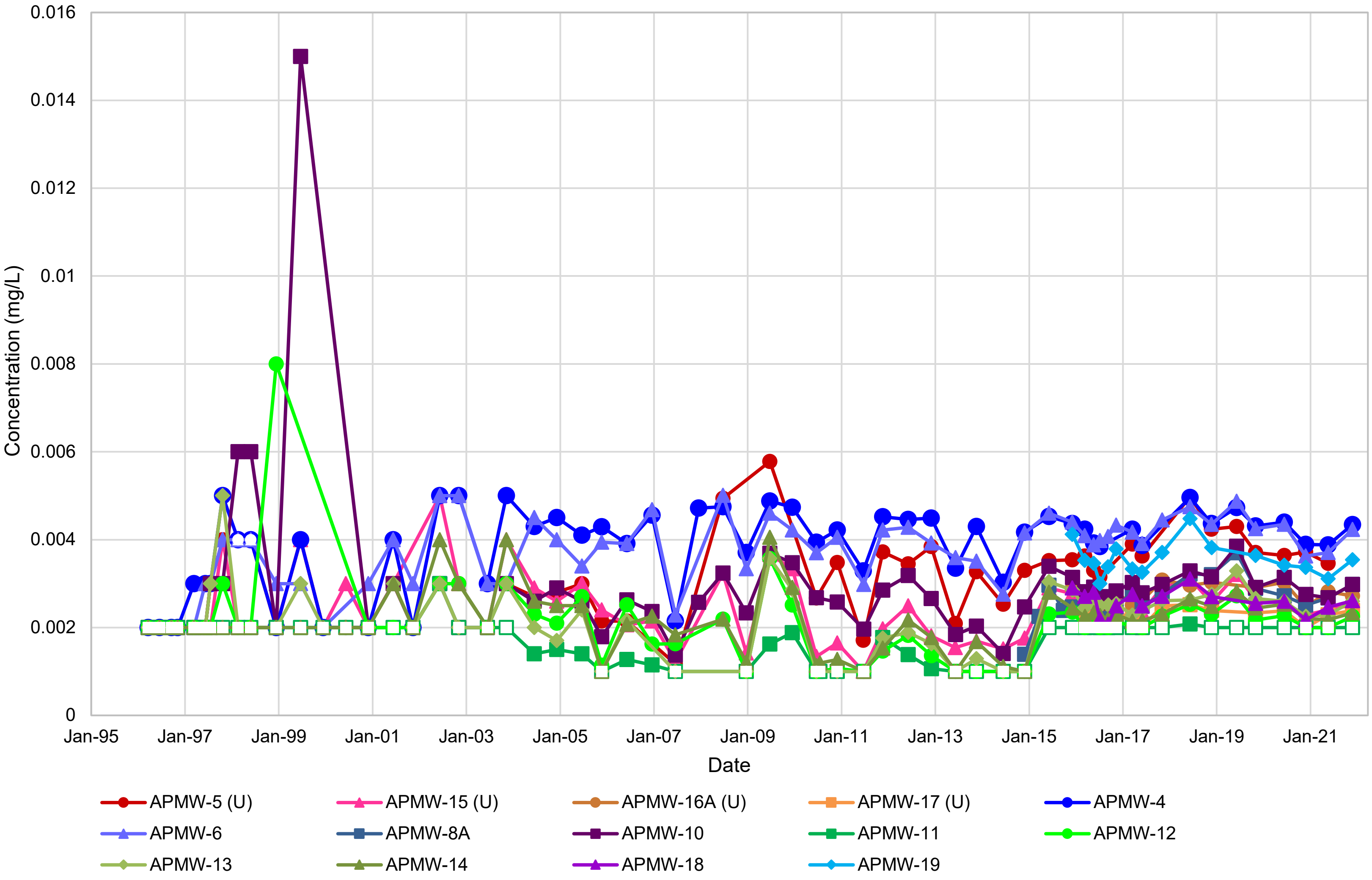
NPPD GGS

4/28/2022

31404512

APPENDIX A

Historical Concentrations of Appendix III and Selected Appendix IV Analytes



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-1

Arsenic

Nebraska Public Power District

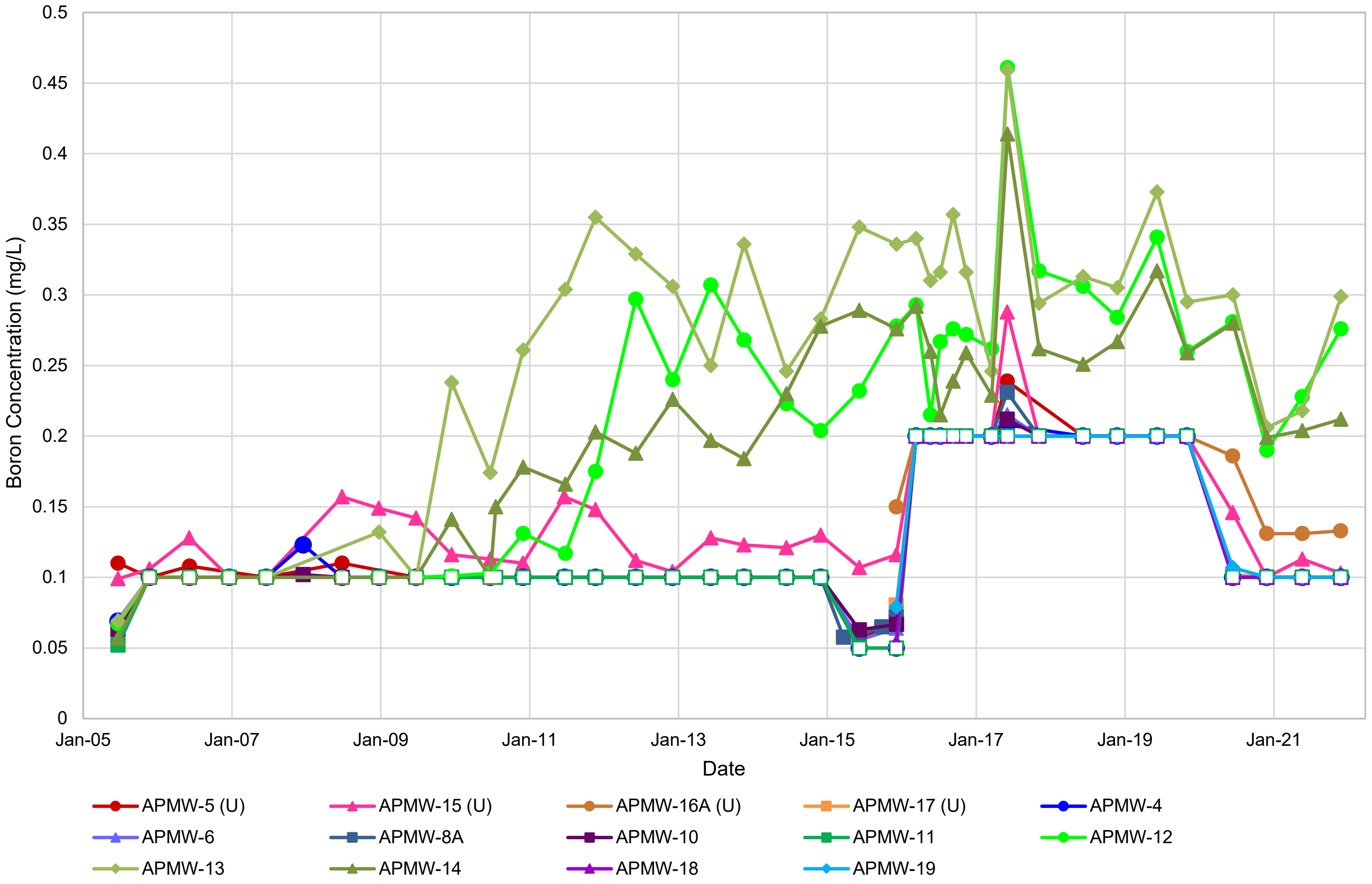
Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-2

Boron

Nebraska Public Power District

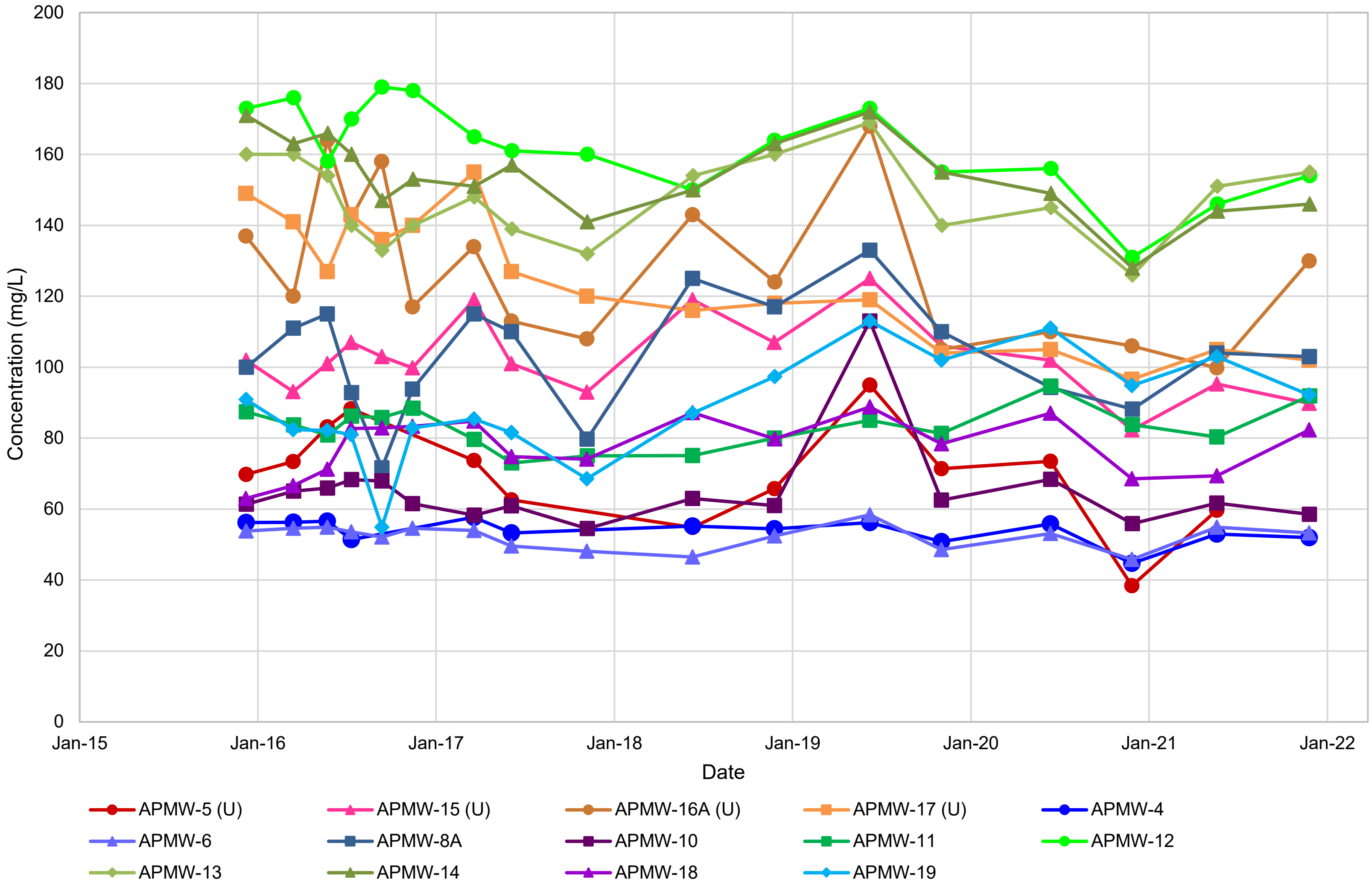
Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.



Non-detect values are plotted with an open symbol at the practical quantitation limit.

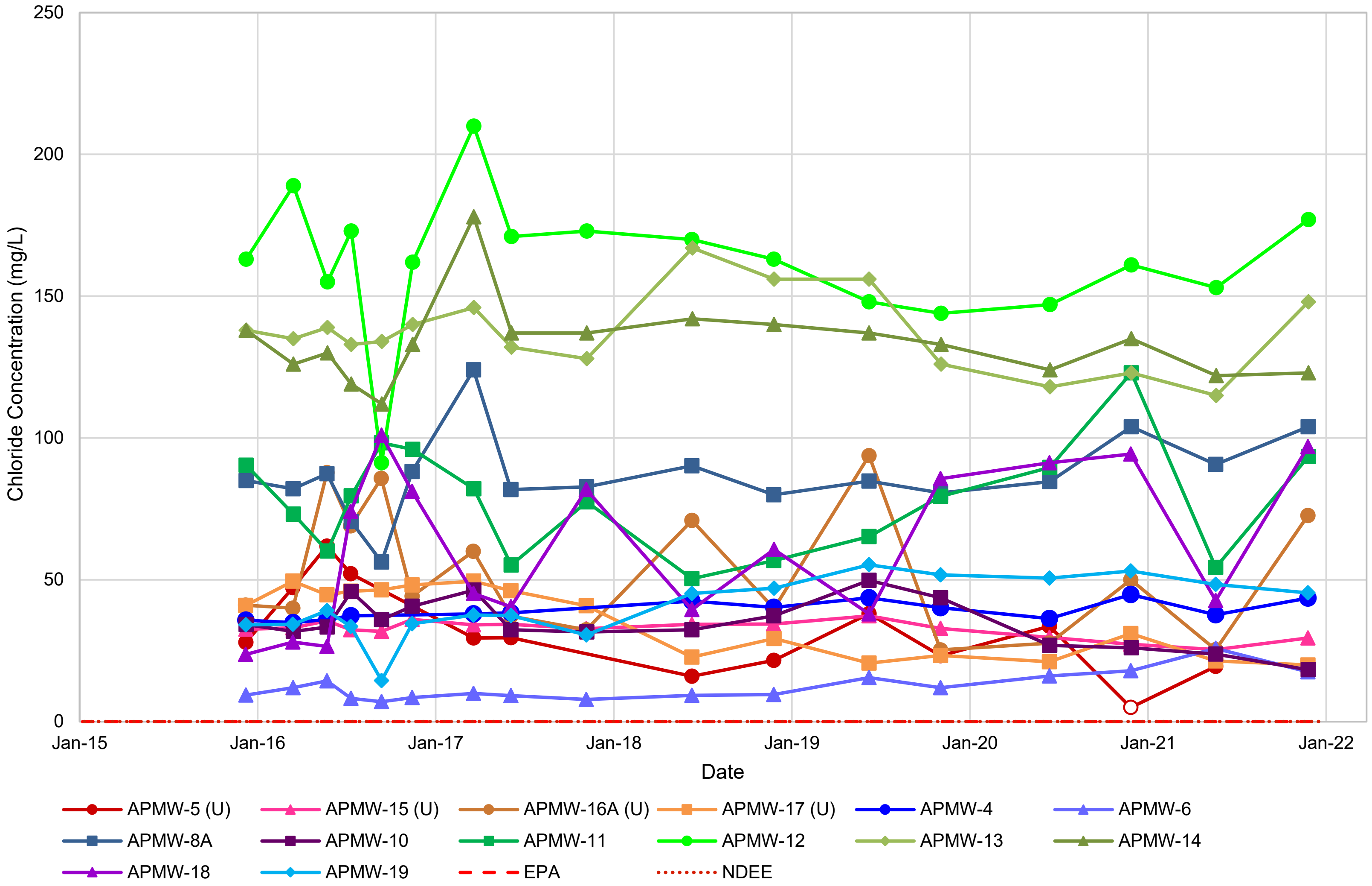
Figure A-3

Calcium

Nebraska Public Power District
Gerald Gentleman Station

Denver, Colorado, USA
4/27/2022
31404512.000

Golder Associates USA Inc.



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-4

Chloride

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.

https://golderassociates.sharepoint.com/sites/160112/Project Files/5 Technical Work/02_Working Data/[Appendix A_TimeSeries GGS NDEE - w App IV - Q42021.xlsm]A-4

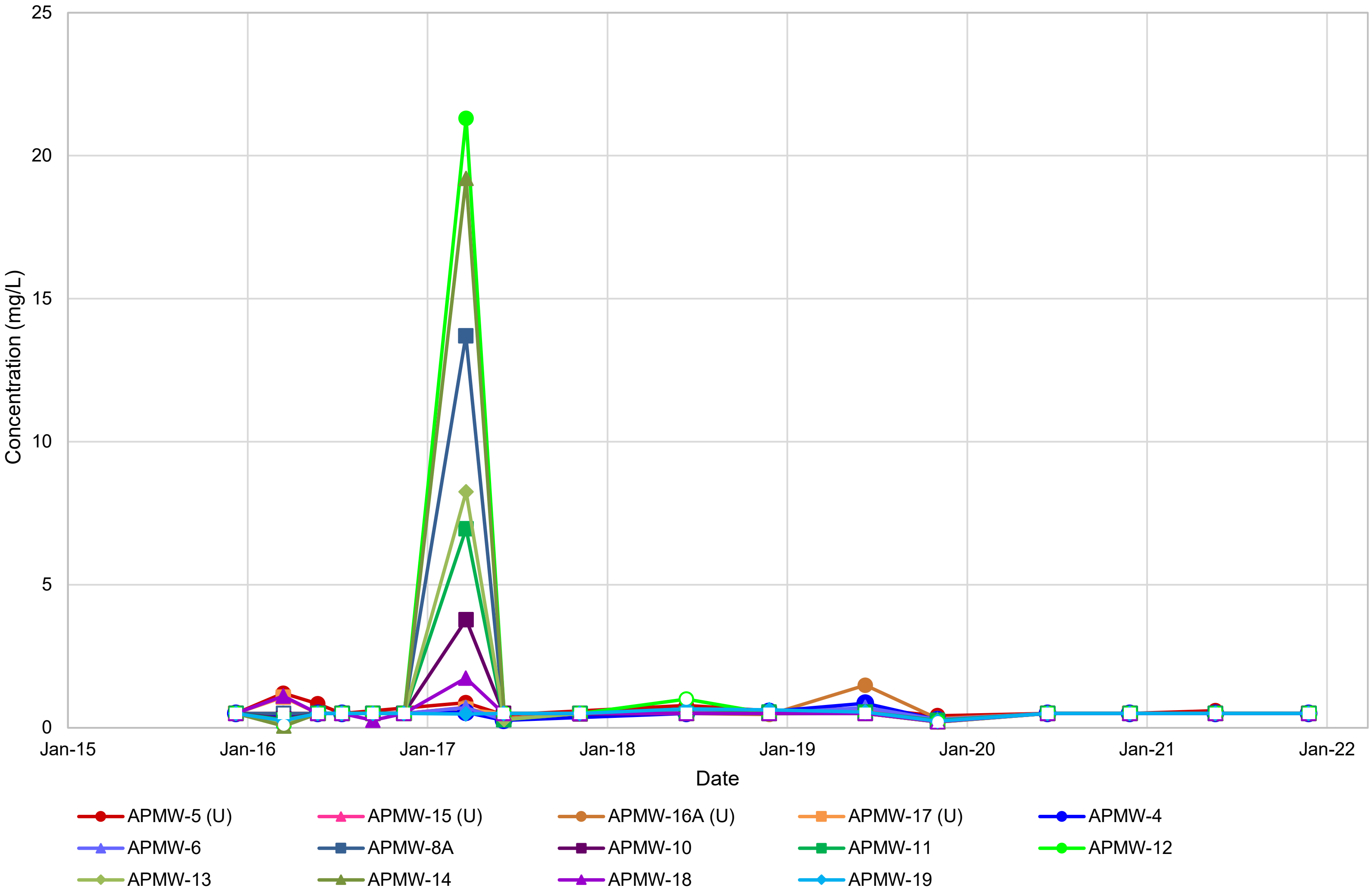


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Figure A-5

Fluoride

Nebraska Public Power District

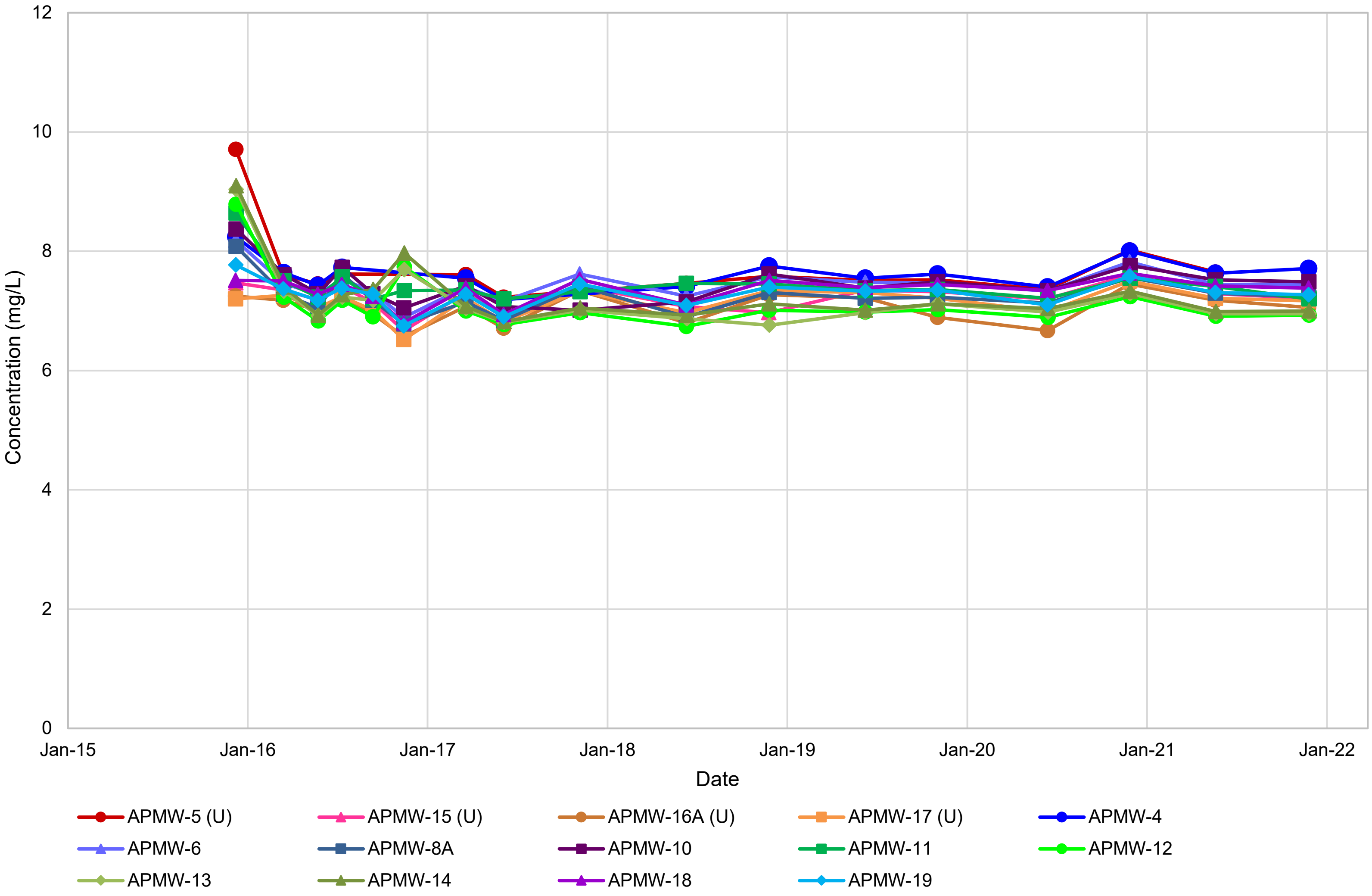
Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-6

pH, Field Measured

Nebraska Public Power District

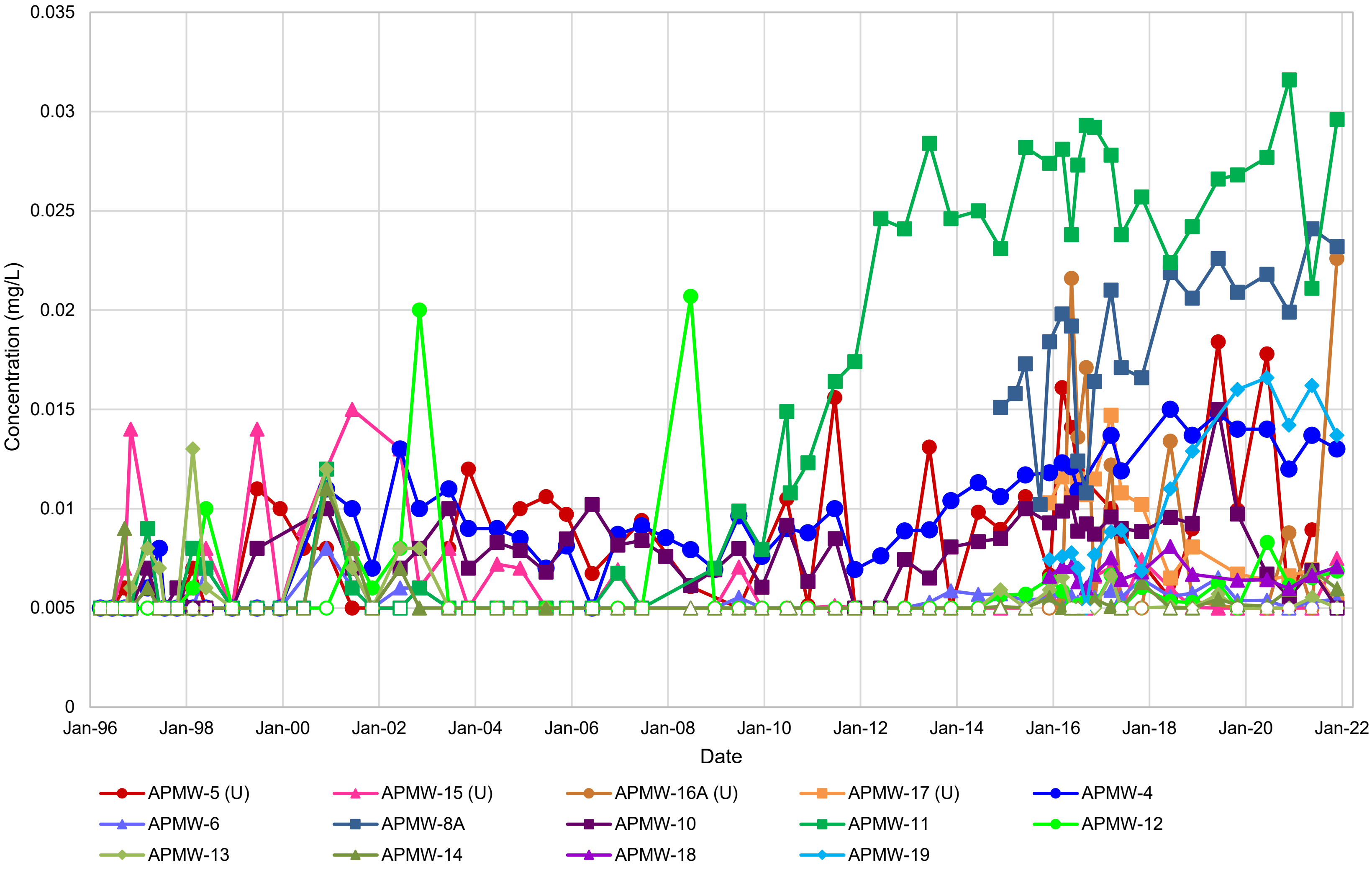
Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-7

Selenium

Nebraska Public Power District
Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.

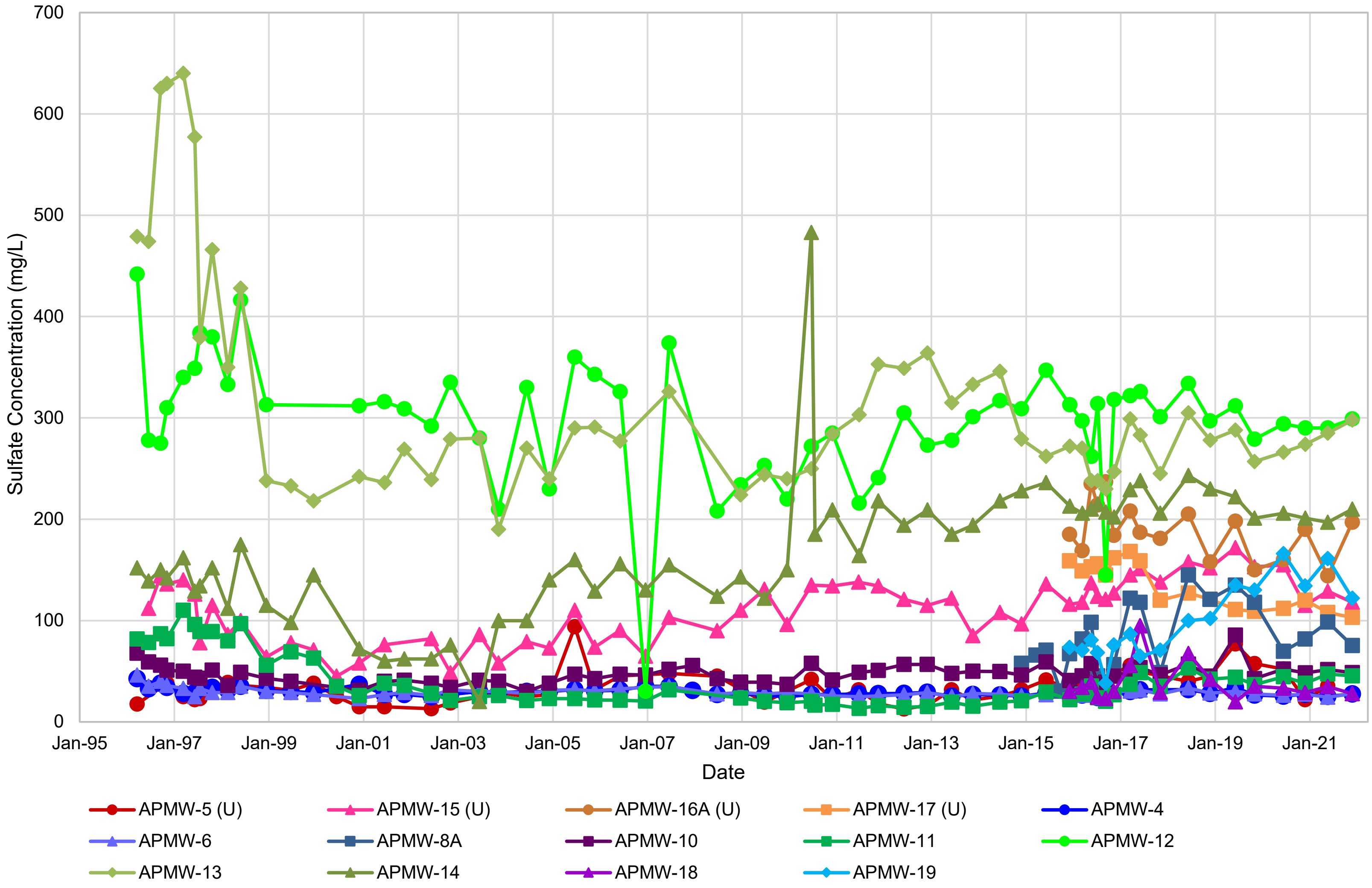


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Figure A-8

Sulfate

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

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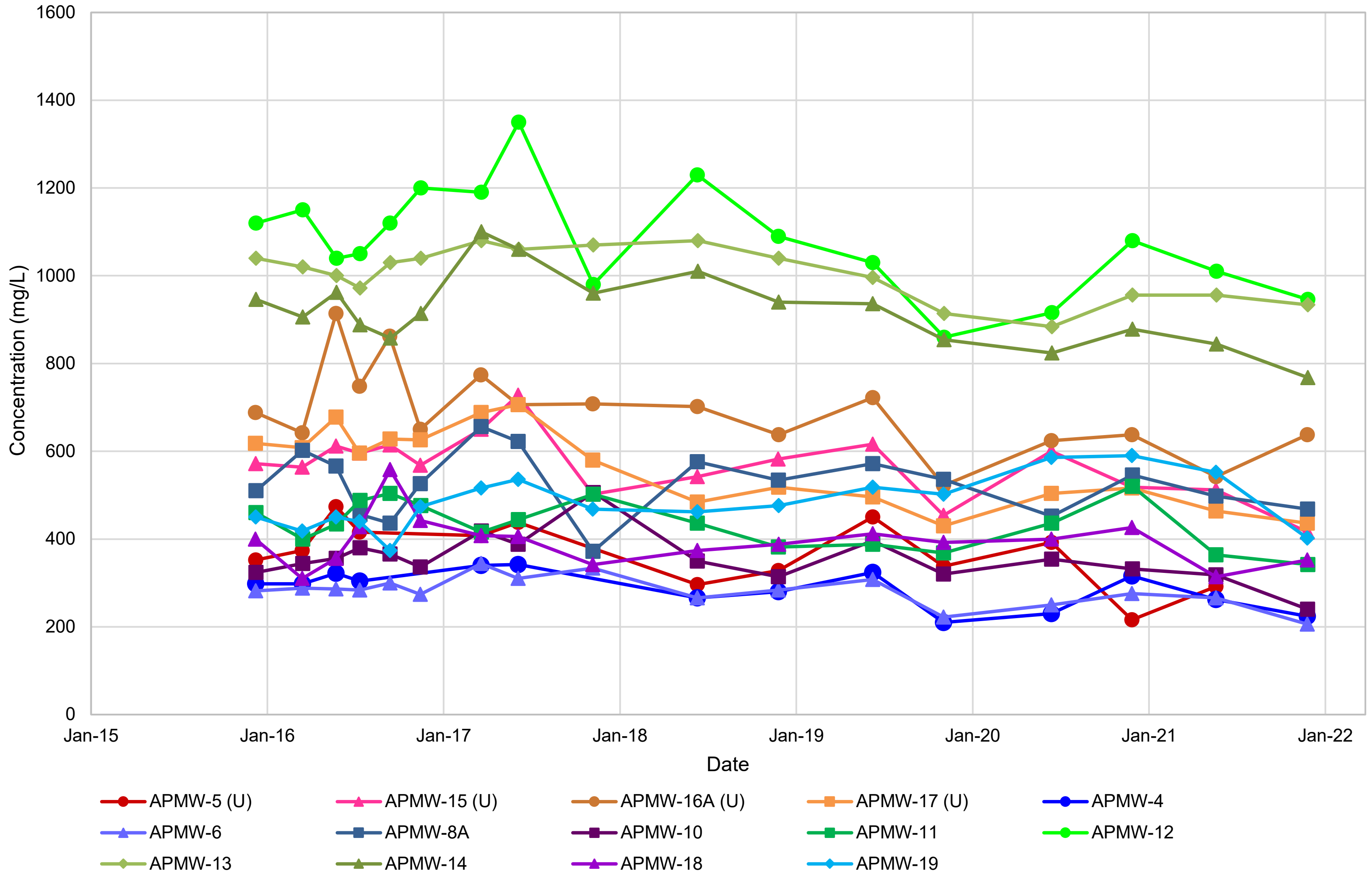

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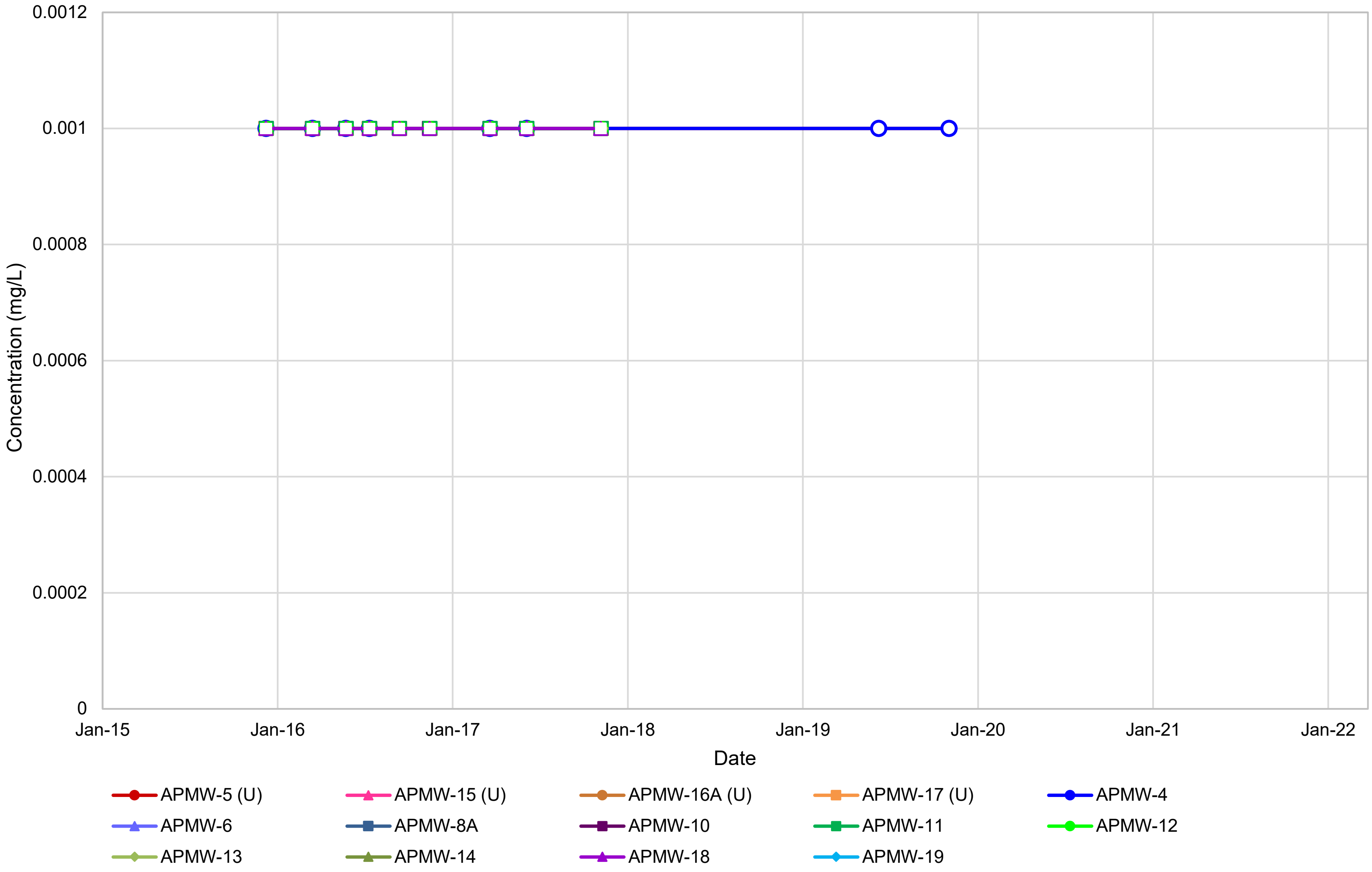
Figure A-9

Total Dissolved Solids

Nebraska Public Power District

Gerald Gentleman Station



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-10

Antimony

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

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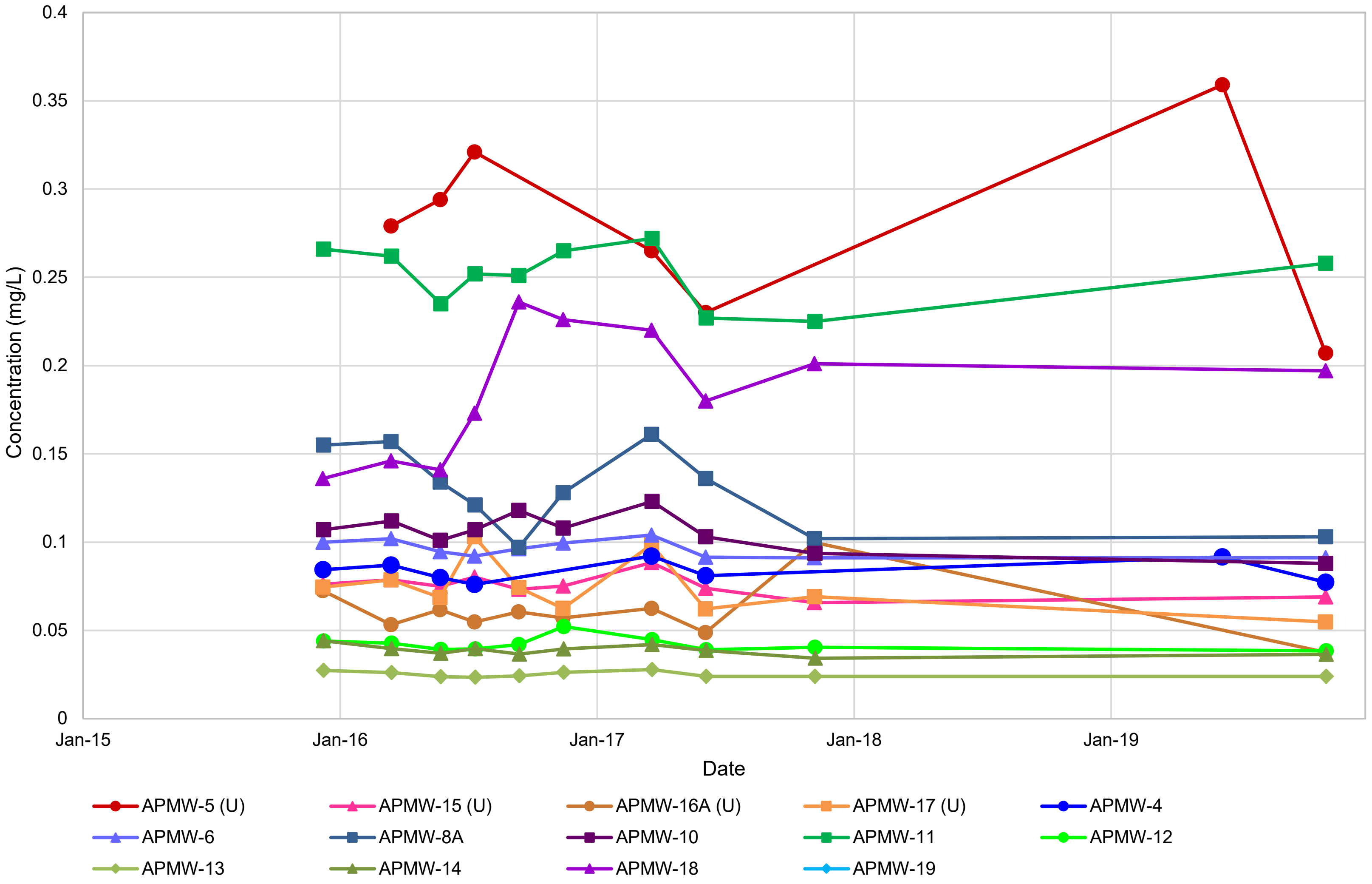
https://golderassociates.sharepoint.com/sites/160112/Project Files/5 Technical Work/02_Working Data/[Appendix A_TimeSeries GGS NDEE - w App IV - Q42021.xlsm]A-11



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-11

Barium

Nebraska Public Power District

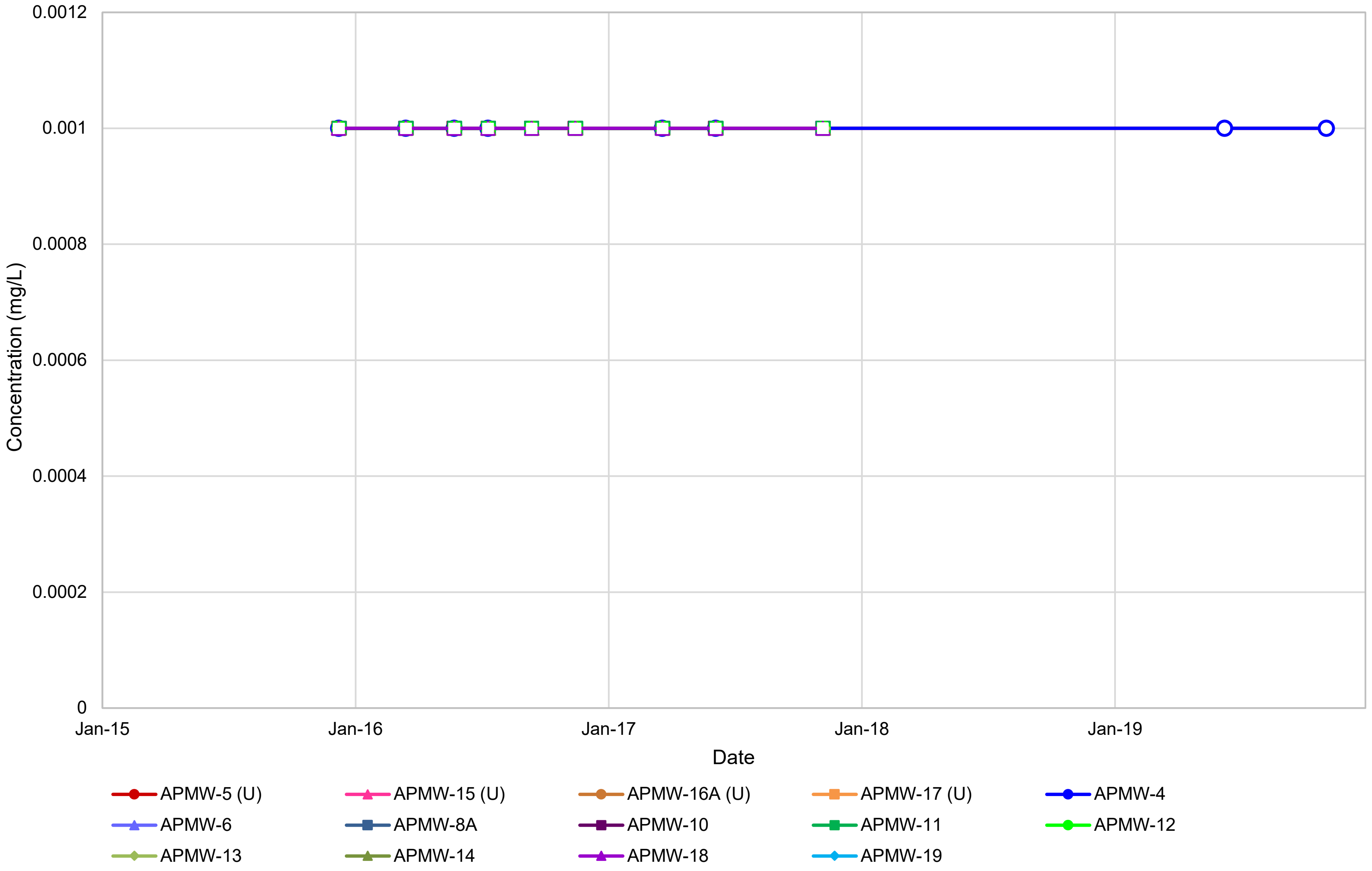
Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-12

Beryllium

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.

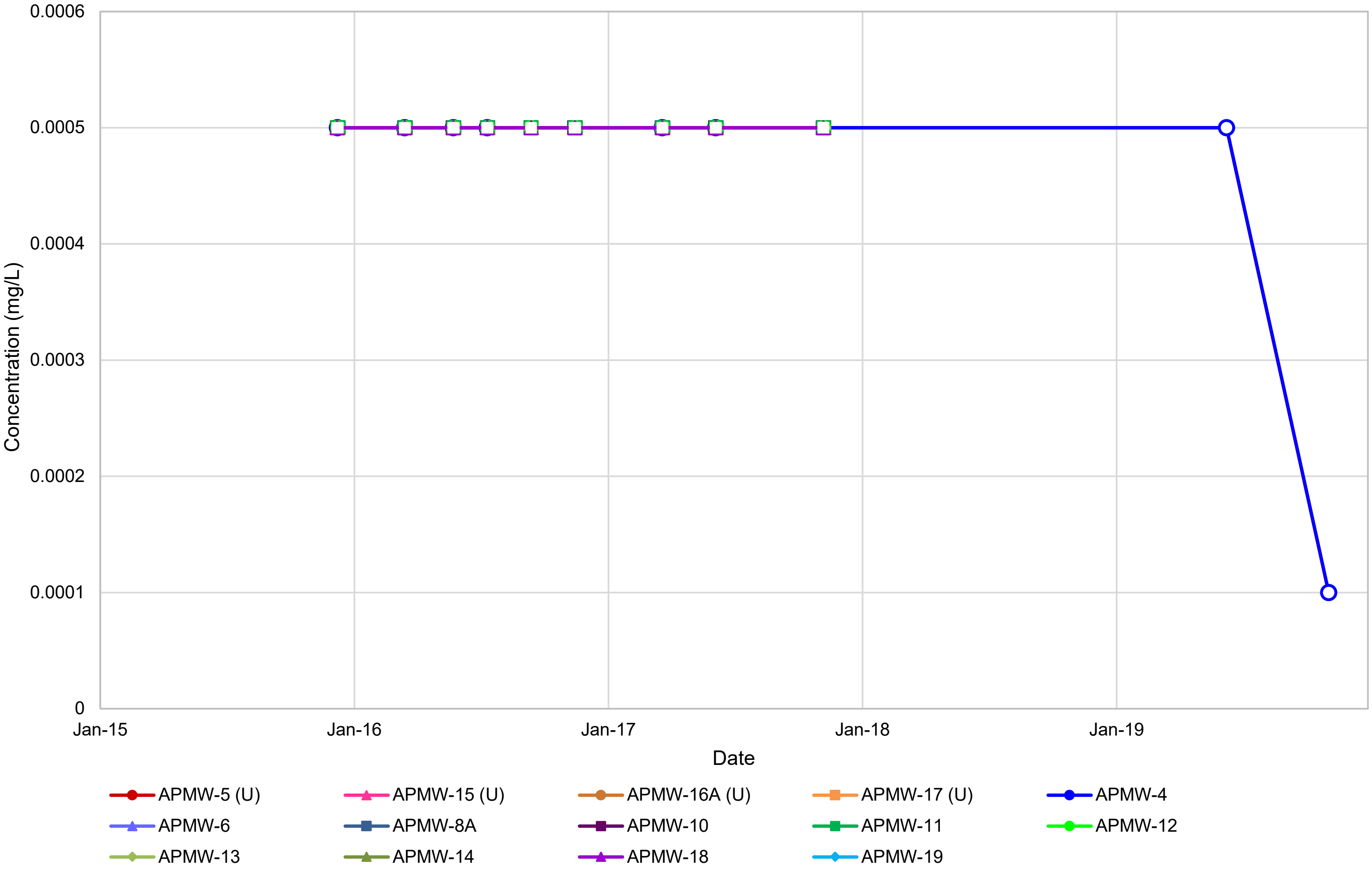


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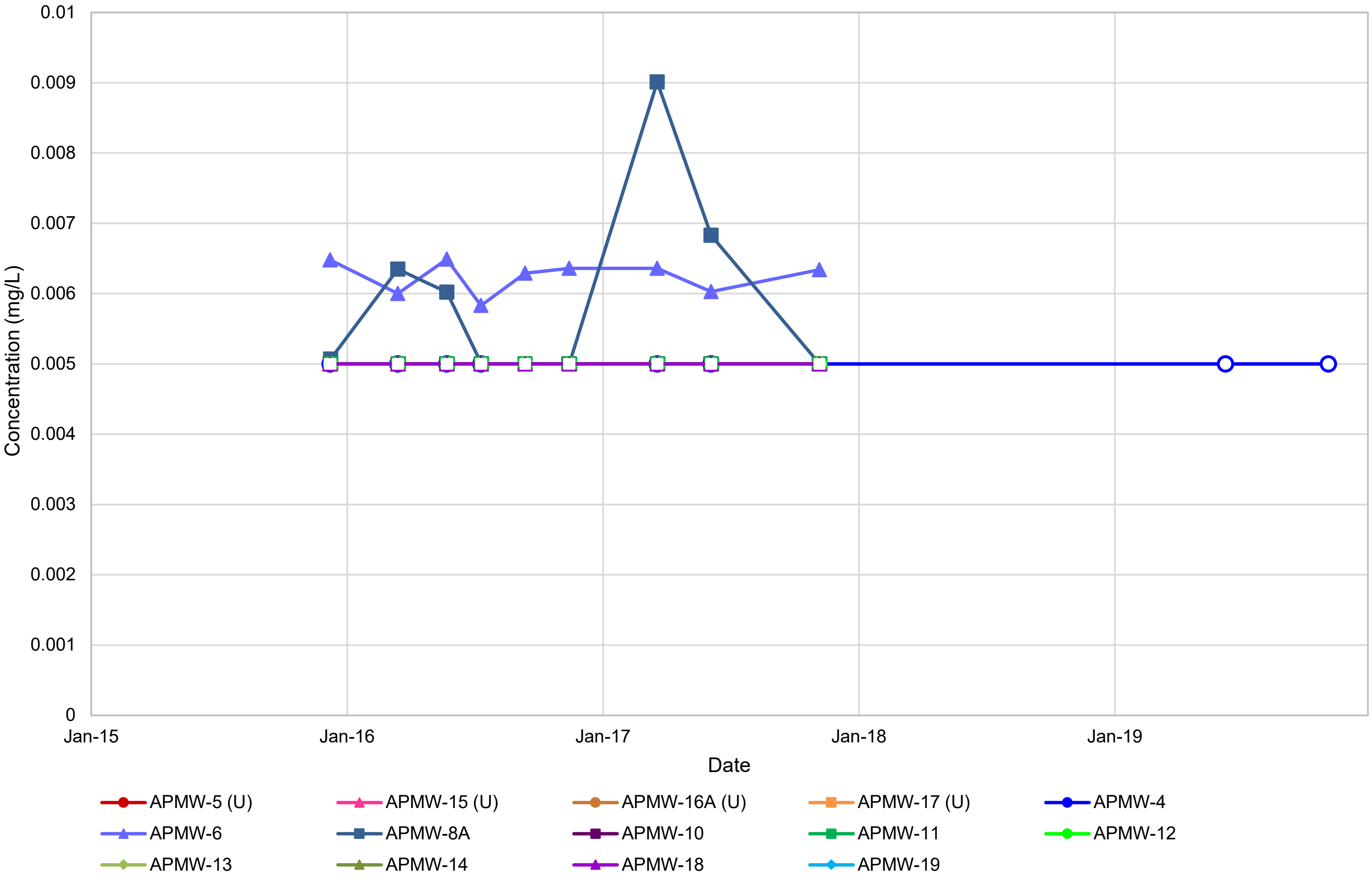
Figure A-13

Cadmium

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-14

Chromium

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.

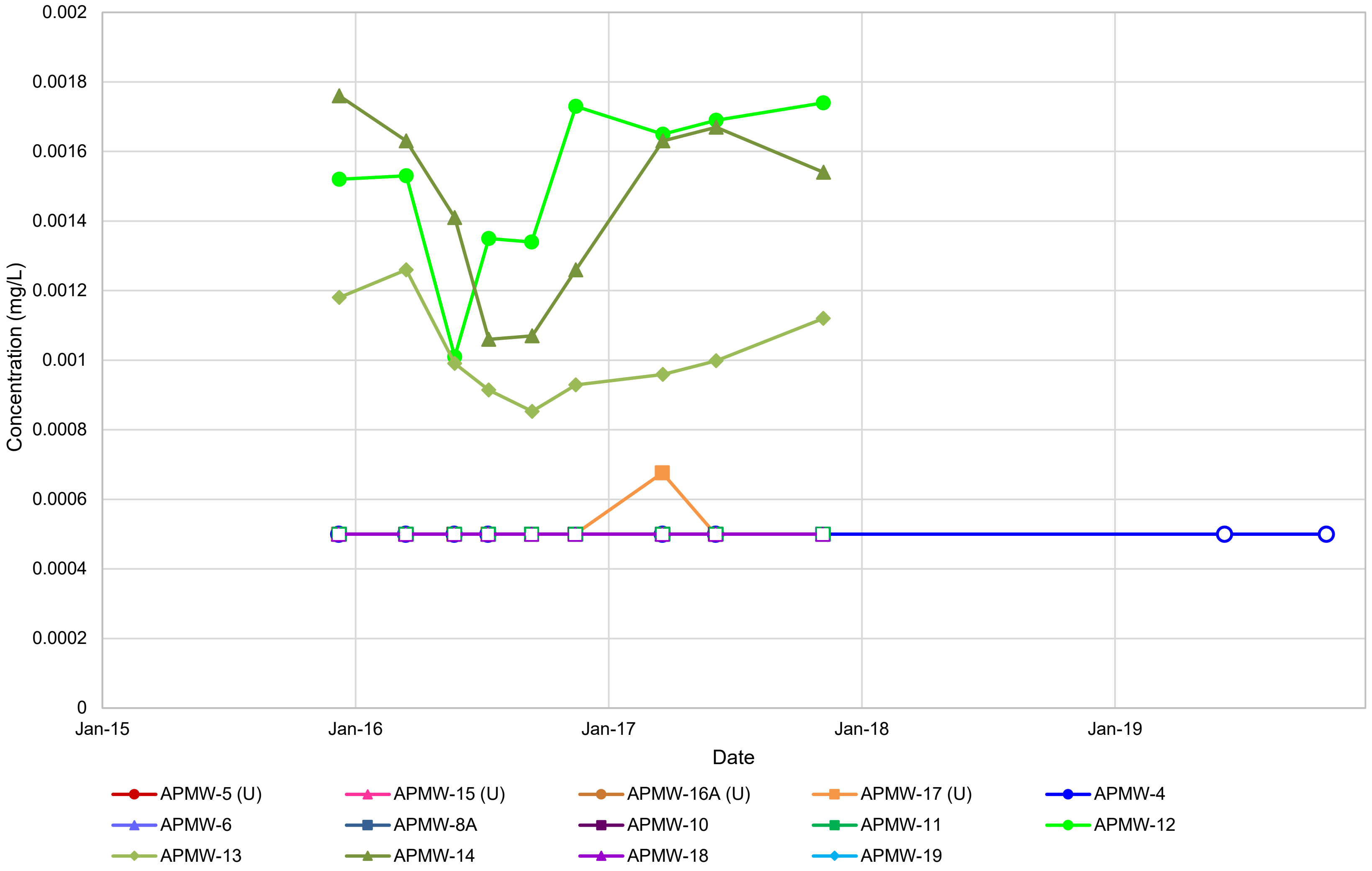


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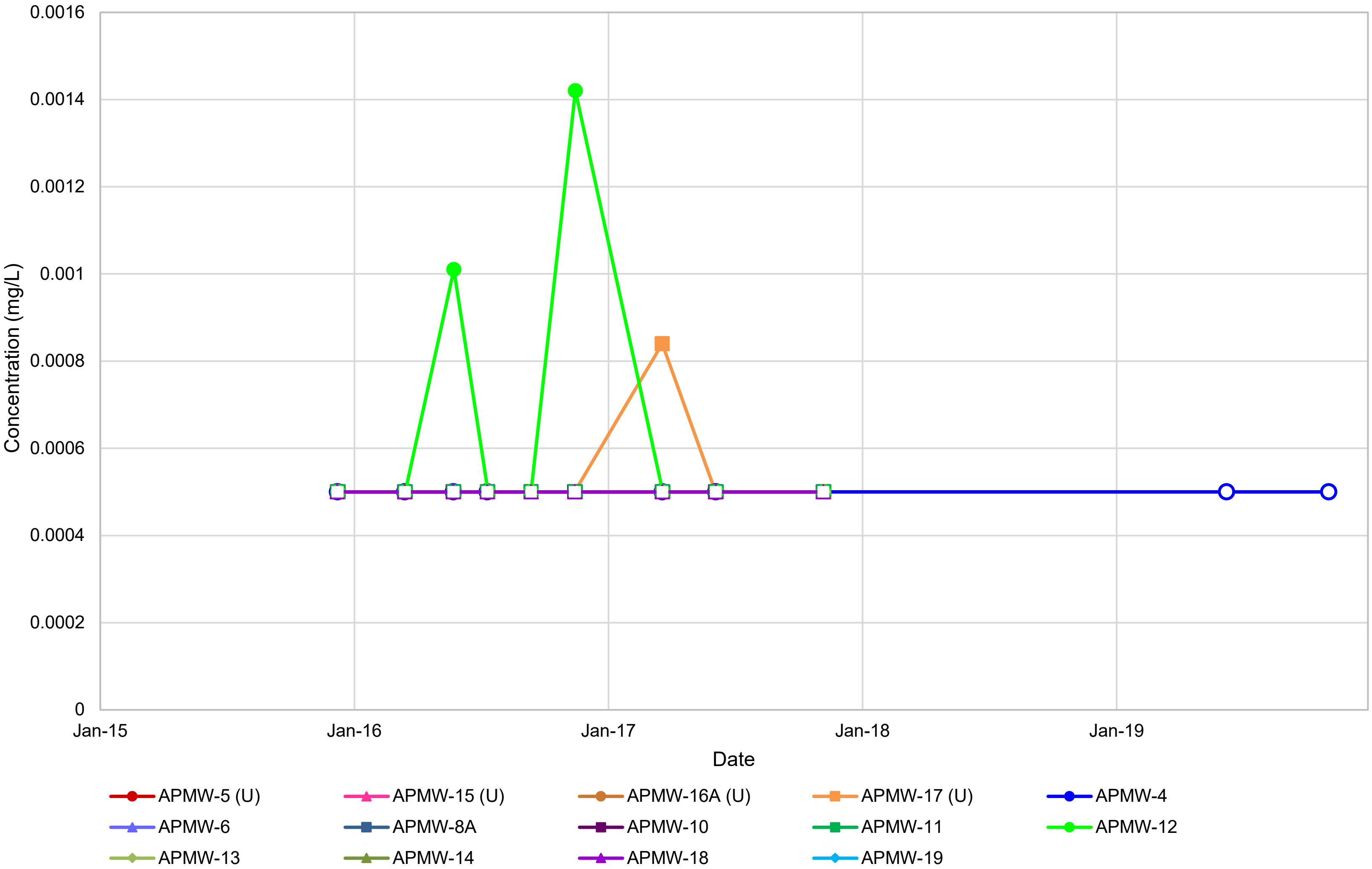
Figure A-15

Cobalt

Nebraska Public Power District

Gerald Gentleman Station



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-16

Lead

Nebraska Public Power District

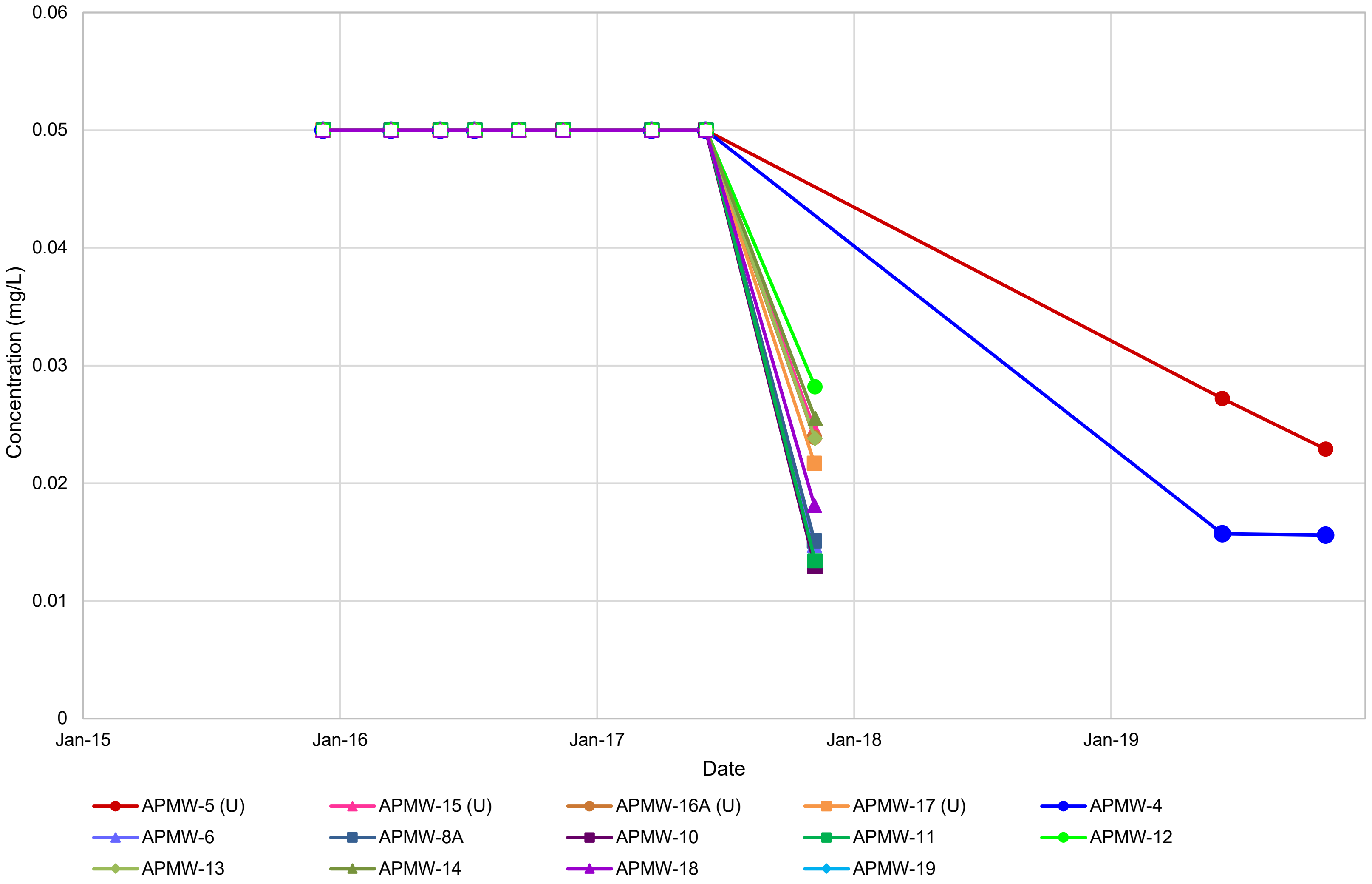
Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.



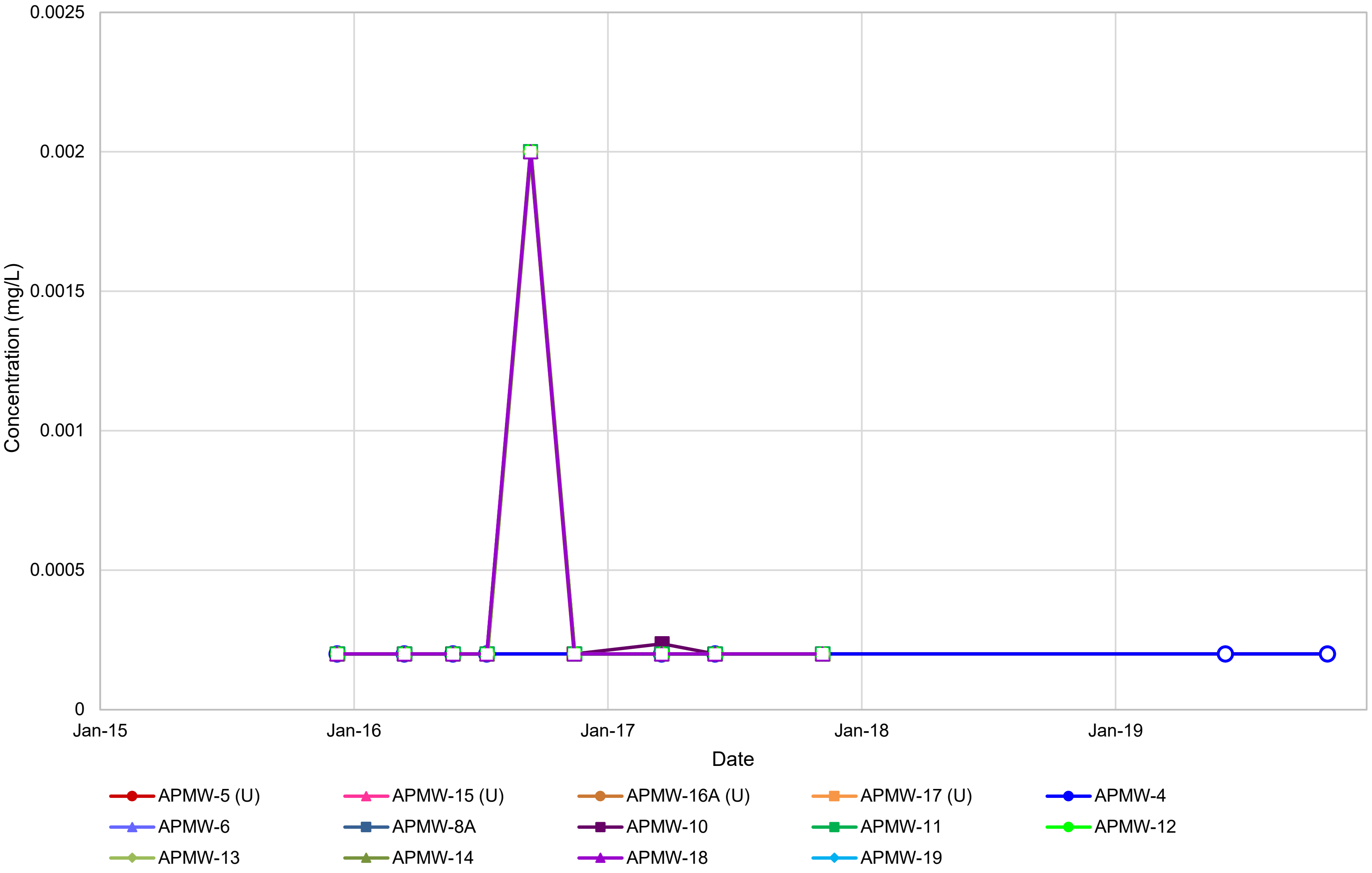
Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-17

Lithium

Nebraska Public Power District
Gerald Gentleman Station

Denver, Colorado, USA



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-18

Mercury

Nebraska Public Power District

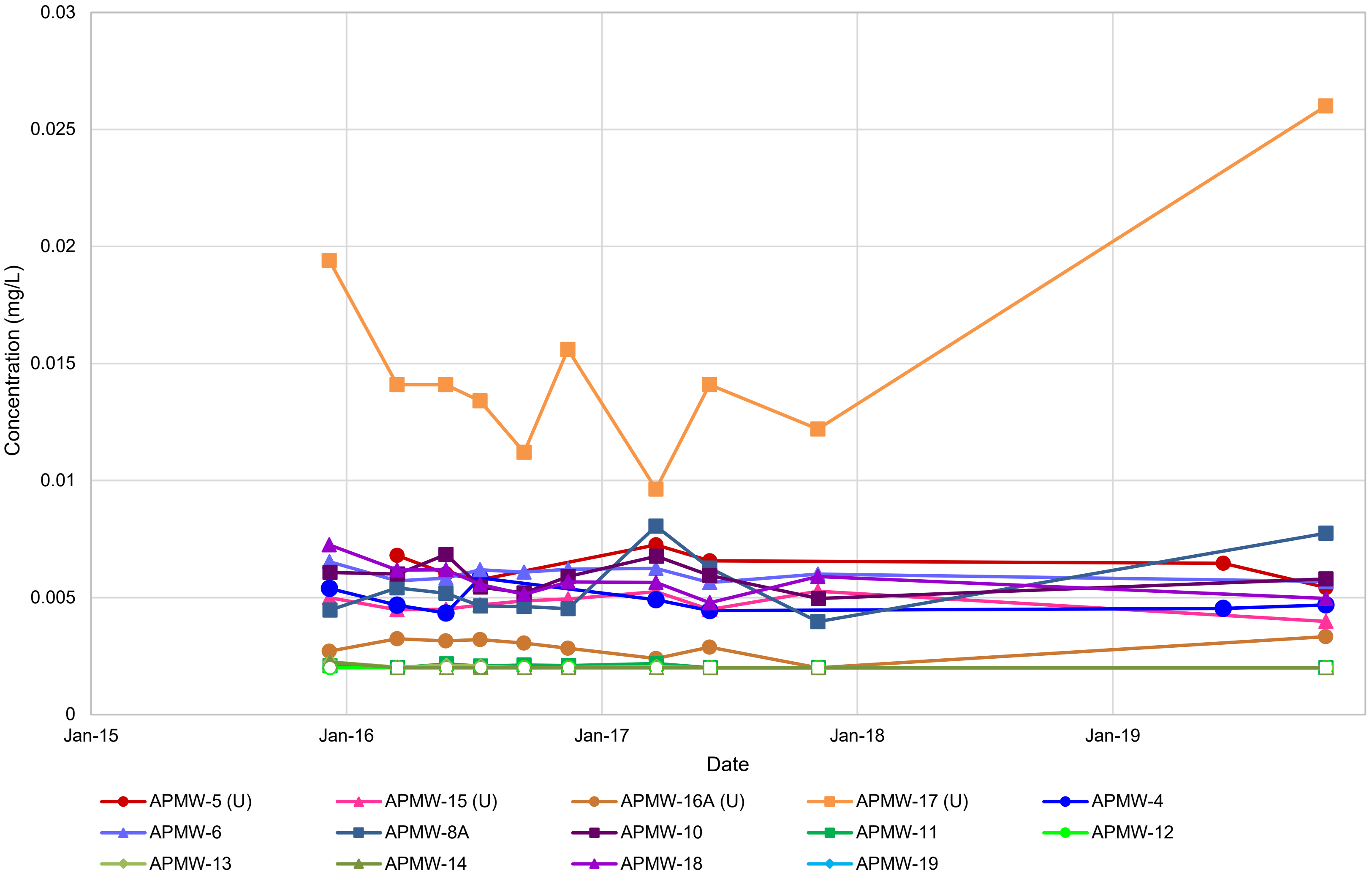
Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-19

Molybdenum

Nebraska Public Power District

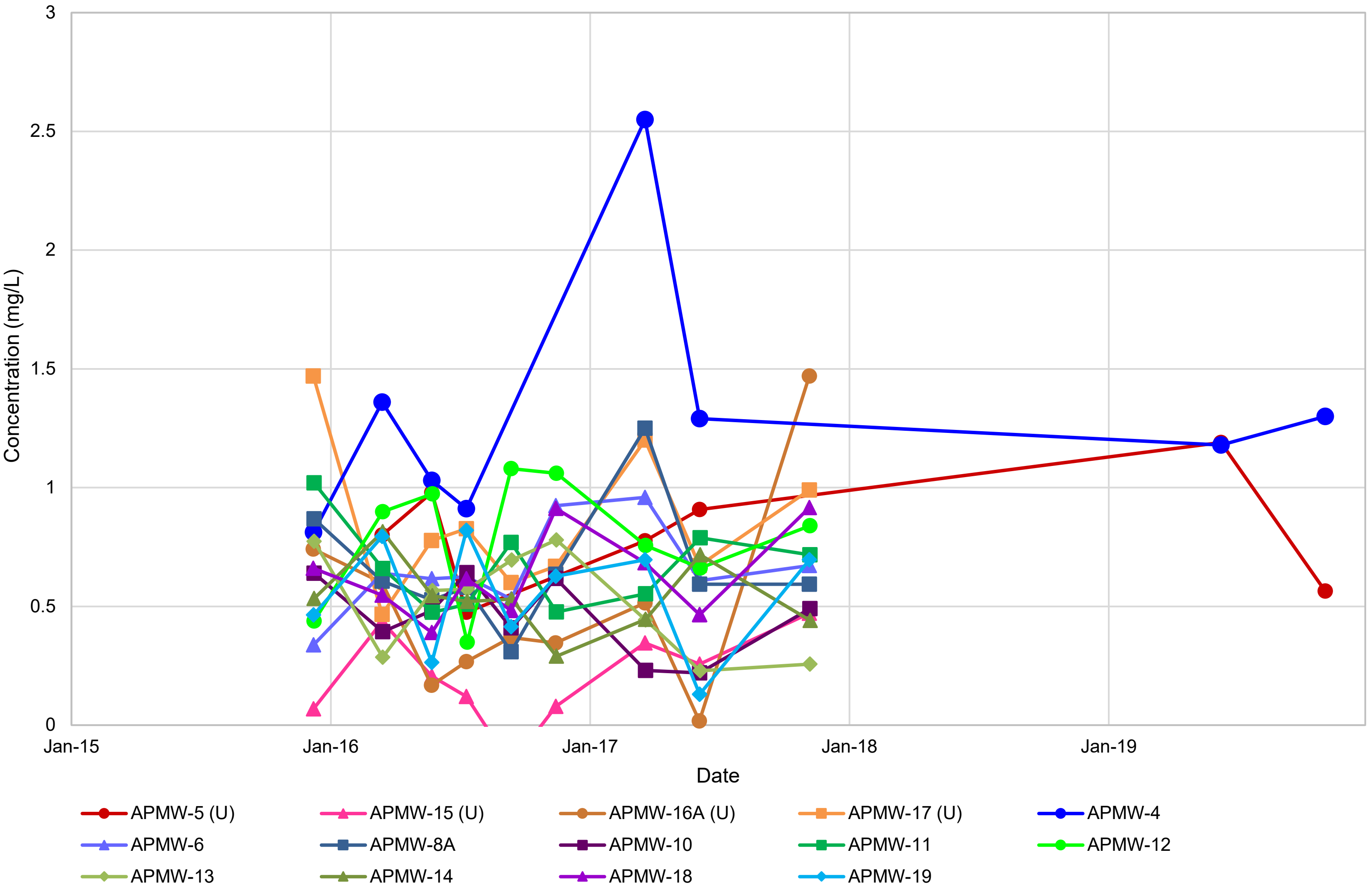
Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-20

Radium, Total

Nebraska Public Power District

Gerald Gentleman Station

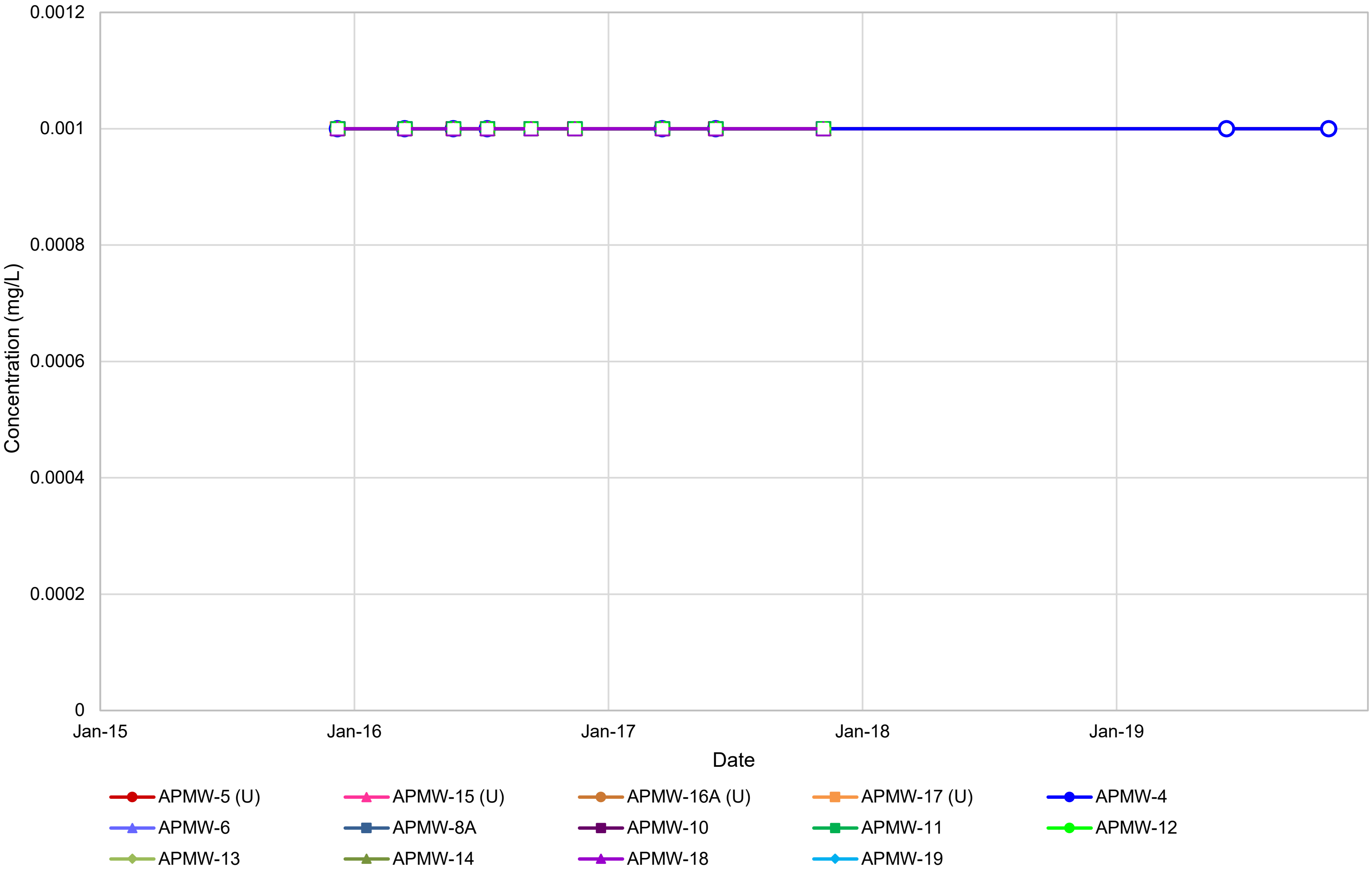
Denver, Colorado, USA

4/27/2022

31404512.000

Golder Associates USA Inc.

https://golderassociates.sharepoint.com/sites/160112/Project Files/5 Technical Work/02_Working Data/[Appendix A_TimeSeries GGS NDEE - w App IV - Q42021.xlsm]A-20



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-21

Thallium

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

4/27/2022

31404512.000

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APPENDIX D

Alternative Source Demonstrations - Q2 2022

REPORT

Alternative Source Demonstration for Sulfate at APMW-19

Nebraska Public Power District

Submitted to:

Nebraska Public Power District

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31404512.000-003-R-0

October 26, 2022

Table of Contents

TABLES

FIGURES

APPENDICES

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 from the second quarter (Q2) groundwater detection monitoring event of 2022 at the Gerald Gentleman Station (GGS or Site) Ash Landfill (or Coal Combustion Residuals [CCR] Unit), located at 6089 South Highway 25, Sutherland, Lincoln County, Nebraska. The statistical evaluation was performed in accordance with the Site Sampling and Analysis plan (Golder 2019a), which was developed in compliance with applicable provisions of 40 Code of Federal Regulations (CFR) Part 257, “Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule” (CCR Final 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 analyses of the Appendix III detection monitoring data for sulfate in groundwater at the downgradient monitoring well APMW-19 indicated a potential exceedance of the statistical limit based on the parametric Cumulative Sum (CUSUM) analysis in the Q2 2021 sampling results, which was subsequently verified as evidence of a statistically-significant increase (SSI) after the fourth quarter (Q4) 2021 event and again after the Q2 2022 results. Although determination of an SSI generally indicates that the groundwater monitoring program should transition from detection monitoring to assessment monitoring, both 40 Code of Federal Regulations (CFR) §257.94(e)(2) and NAC Title 132, Ch. 7, 004.03 allow the owner or operator (i.e., NPPD) 90 days from the date of determination (October 26, 2022) to demonstrate a source other than the CCR Unit, or another condition, caused the potential SSI for sulfate at APMW-19.

Golder’s review of the hydrological and geologic conditions at the Site indicated the potential for the SSI to have resulted from a source other than the CCR Unit. To assess potential sulfate sources and the natural variability of sulfate concentrations in groundwater, Golder reviewed analytical results of previously collected CCR-impacted water samples from the ash landfills, evaporation pond, surface water from the Sutherland Reservoir, surface waters from nearby agricultural areas, and groundwater samples. Based upon this assessment and in accordance with provisions of the CCR Final Rule, the NAC, and the site Sampling and Analysis Plan (Golder 2019a), Golder prepared this Alternative Source Demonstration (ASD) for the CCR Unit. This ASD includes an evaluation of geological, hydrogeological, and chemical information regarding ash, surface water, and groundwater obtained from surface waters and monitoring wells installed within and adjacent to the CCR Unit.

This ASD conforms to the requirements of 40 CFR §257.94(e)(2) and NAC Title 132, Ch.7, 004.03 and provides the basis for concluding that the apparent SSI for sulfate in groundwater at APMW-19 is not a result of a release from the CCR Unit. The following sections provide a summary of the GGS CCR Unit, analytical and geochemical assessment results, a conceptual site model, and lines of evidence demonstrating an alternative source is responsible for the sulfate SSI in groundwater at APMW-19.

2.0 BACKGROUND

2.1 Description of Waste Disposal Area

The Ash Landfill at GGS is located southwest of the plant’s generation facility, in the northern one-half of Section 30, Township 13N, Range 33W. The ash disposal facility consists of Ash Landfill Nos. 1, 2, 3, and 4 and the Bottom Ash Landfill. Ash Landfill Nos.1 and 2 are closed and Ash Landfill Nos. 3 and 4 are active (Figure 1). The Bottom Ash Landfill was closed in October 2018.

Fly ash is currently disposed at Ash Landfill No. 4 and in the east cell of Ash Landfill No. 3. The liner design at Ash Landfill No. 4 consists of a 60-mil high density polyethylene (HDPE) geomembrane over compacted subgrade. Prior to geomembrane installation, the existing subgrade was scored to a depth of at least 6 inches and compacted to 95 percent of its maximum dry density (standard Proctor). Smooth HDPE geomembrane was placed on the bottom of the Ash Landfill and textured HDPE geomembrane was placed on the side slopes. Construction quality assurance for the geomembrane installation was performed by Golder Construction Services and completed on November 15, 1994. There is no leachate collection system (LCS) at Ash Landfill No. 4.

The original liner at Ash Landfill No. 3 consisted of 2 feet (ft) of soil compacted to 95 percent of the standard Proctor maximum dry density. The average permeability of the liner was 1.2×10^{-8} centimeters per second (cm/sec). Ash Landfill No. 3 was previously closed in 1995 with 2.0 to 7.5 ft of soil cover. This cover was removed, and the historically placed CCR was covered with a new liner in 2015. The new liner system at Ash Landfill No. 3 consists of a prepared subgrade overlain by a geosynthetic clay liner and 60-mil linear low-density polyethylene geomembrane. Ash Landfill No. 3 also has a 1-foot LCS sand layer that reports to two sumps. Construction of the new Ash Landfill No. 3 liner system was completed in November 2015.

To the east of the Ash Landfill, plant process water, such as boiler blowdown, is managed in a 50-acre evaporation pond, as shown in Figure 1. CCR materials are not stored within the evaporation pond, and the facility is not regulated under the CCR rule. The bottom of the approximately 8- to 10-foot deep evaporation pond consists of re-compacted native soils.

2.2 Site Geology

The geologic sequence near the Ash Landfill was summarized by Woodward-Clyde in 1991. In the report, soil boring data from nine boreholes (APMW-1, APMW-2, APMW-3, APMW-4, APMW-5, EPMW-1, EPMW-2, EPMW-3, and EPMW-4) were used to characterize the Site geology. The geologic sequence, from top to bottom, was described as follows:

- 4 to 5 ft of topsoil and/or fill
- 20 to 35 ft of eolian silty sands
- 8 to 10 ft of silty clay paleosol at the top of the Ogallala Formation
- 25 to 35 ft of Ogallala Formation silts
- approximately 50 ft of Ogallala Formation sands or Ogallala Formation silts and clays, to the bottoms of the boreholes

The topsoil layer consists of stiff, dark brown, low to medium plasticity silty clay directly overlying the eolian silts and sands. Thickness of topsoil ranges from 0 to 4 ft. The fill material consists of stiff, dark brown, low plasticity sandy silty clay with trace gravel and other debris. Fill thickness ranges from 0 to 5 ft.

The eolian silts and sands (Quaternary Period) consist of loose to medium dense, tan, very fine-grained, well-rounded, and well-sorted sandy silts and silty sands. The thickness of this unit ranges from 17 ft (APMW-5) to 34 ft (EPMW-2). Materials with a bimodal texture (two distinct grain sizes) are present in the lower part of this unit. The eolian silts and sands are interpreted as wind-blown dune sand deposits.

The Ogallala Formation (Tertiary Period) was encountered in each of the nine boreholes at a depth beginning at 16 to 38 ft below ground surface (bgs) and extending to the bottom of the boreholes (109 to 133 ft bgs). The Ogallala Formation near the Ash Landfill may be separated into three general stratigraphic units:

- upper silty clay paleosol unit
- middle clayey or sandy silt unit
- lower unit of either predominantly sand and gravel or an equivalent unit of predominantly silt and clay

The top of the Ogallala Formation is represented by a widespread paleosol (a previous soil horizon) that consists of a very stiff, reddish-brown to buff, low plasticity, silty clay to clayey silt with abundant calcareous nodules, calcareous matrix, and interbedded layers of caliche up to 1 ft thick. The thickness of the initial paleosol is about 8 to 10 ft, but the presence of interbedded caliche layers continues into the middle and lower Ogallala units.

The middle Ogallala Formation unit consists of a stiff to very stiff, buff-white to reddish-brown, low plasticity, clayey silt to sandy silt with abundant calcareous nodules, matrix, and caliche layers. Scattered occurrences of calcareously cemented siltstone layers from 1/2 to 1 ft thick are present in the lower part of this unit. The thickness of this middle unit ranges from about 25 to 35 ft. The clayey silts and sandy silts of this unit were possibly deposited as overbank or floodplain deposits in an alluvial depositional system.

There are two distinct lithofacies recognized in the lower Ogallala Formation unit. This unit is present for about 45 to 50 ft in the borings. One lithofacies consists of dense to very dense, reddish-brown, fine-grained silty sands grading into medium- and coarse-grained, poorly-graded sands with some fine gravels and some calcareously cemented sandstone beds (1/2 to 1 ft thick). This lithofacies was primarily encountered in borings on the northern side of the Ash Landfill (APMW-1, APMW-2, APMW-5, and EPMW-1; Woodward-Clyde 1991).

The second lithofacies recognized in the lower unit consists of stiff to hard, reddish-brown, low plasticity clayey or sandy silts with some calcareously-cemented siltstone beds. This lithofacies was encountered in borings on the southern side of the Ash Landfill (APMW-3, APMW-4, EPMW-2, EPMW-3, and EPMW-4; Woodward-Clyde 1991).

The lithologic differences and areal distribution of the two lower units suggest that the units were deposited in two separate facies of an alluvial system. The sand and gravel unit is possibly a series of longitudinal bars, channels, and channel-fill deposits, while the silt and clay unit is possibly a series of upper channel fills, overbank, or floodplain deposits (Woodward-Clyde 1991).

2.3 Site Hydrogeology

Based on observations made during logging of soil borings and findings of the Nebraska Water Survey Paper No. 70 (Goeke et al. 1992), the unsaturated geologic units underlying the Ash Landfill area consist of topsoil (0 to 4ft thick), eolian silts and sands (1 to 25 ft thick), Ogallala Formation silts (40 to 50 ft thick), and Ogallala Formation sands and gravels (unsaturated portion of this unit is approximately 20 to 25 ft thick). Beneath these units lies 10 ft or more of the saturated Ogallala Formation sands and gravels. Based on the Site observations, the thickness of the vadose zone ranges from approximately 90 to 100 ft.

The saturated geologic units underlying the Ash Landfill area consist of Ogallala Formation silts and sands that extend to the bottom of the aquifer. The Ogallala Formation is underlain by the White River Group, which is composed of the Brule and Chadron formations. The bedrock formations of the White River Group are not considered to be an important potential source of water, and therefore their surface is considered to form the base of the aquifer and is regarded as the lower drilling limit for irrigation wells in the agricultural region near the Site. Underlying the White River Group is the impermeable Pierre Shale (Goeke et al. 1992).

Available groundwater elevation data indicate that groundwater beneath GGS flows from north to south (Figure 1). The groundwater gradient is controlled by the Sutherland Reservoir, an approximately 3,200-acre open water body located 1.5 miles north of the Ash Landfill that is used as a source of condenser cooling water for GGS (McMahon et al. 2010). Since groundwater level monitoring began in 1996, regular water level fluctuations have been observed in the monitoring wells located around the Ash Landfill. These fluctuations are attributed to seasonal trends in water consumption or recharge and precipitation patterns. From the time-series plot of historical water levels in each monitoring well (Figure 2), long-term changes in water levels between 1996 and 2022 are apparent. In general, water levels rose approximately 1.5 ft between 1996 and 2000 before declining between 9 to 10 ft between 2000 and 2009. The cause of the decline is not clear, but possible explanations include a regional response to the drought being experienced by parts of the western United States and/or a change in the amount of groundwater used for irrigation in the area around the Site. Between 2009 and 2022 water levels have continued to show seasonal variability, with seasonal maximums occurring in the spring and seasonal minimums occurring in the fall with no apparent long-term increasing or decreasing trend.

Groundwater flow velocity ranges from 5.0×10^{-4} to 6.7×10^{-2} feet per day (ft/day) and was estimated based on the following site-specific hydrogeologic data:

- Estimated site hydraulic conductivities range from 0.14 ft/day to 19 ft/day (Woodward-Clyde 1991).
- An average horizontal hydraulic gradient of 0.00091 feet per foot (ft/ft) from the potentiometric surface shown in Figure 1.
- An average effective porosity for Ogallala Formation sands and silts of 25 percent (Fetter 1994).

Two agricultural fields are present immediately to the south of the ash landfills. Historical aerial imagery (Figure 3) showed that there was no center-pivot irrigation system prior to 2004. By 2006, a center-pivot irrigation system was installed, and aerial images from 2006, 2012, and 2020 indicate that irrigation water from that center-pivot was crossing the property boundary of GGS, as delineated by the greener foliage compared to the unirrigated land. The greener foliage along the southern edge of the ash landfills also indicates that irrigation runoff discharges north towards GGS, into the ditch between the ash landfills and the agricultural fields.

Photographs of the southern property boundary of the Site taken on August 2, 2022, indicate two drainages are present from the agricultural area onto GGS property (Figure 4A and 4B), although no runoff was observed in the drainages. On August 11, 2022, NPPD observed irrigation water from the center pivot spraying across the property boundary (Figure 4C).

2.4 Groundwater Monitoring Network

Design of the Ash Landfill groundwater monitoring program considered the size, disposal and operational history, anticipated groundwater flow direction, and saturated thickness of the uppermost aquifer. Based on these factors, a monitoring well network that consists of four upgradient (background) monitoring wells and ten downgradient monitoring wells was installed around the Ash Landfill. The monitoring wells are listed in Table 1 and presented in Figure 1.

Table 1: Monitoring Well Network

Location	Upgradient (Background) Monitoring Wells	Downgradient Monitoring Wells
Ash Landfill	APMW-5, APMW-15, APMW-16A, APMW-17	APMW-4, APMW-6, APMW-8A, APMW-10, APMW-11, APMW-12, APMW-13, APMW-14, APMW-18, APMW-19

The four upgradient monitoring wells included in the groundwater monitoring program are used to represent the background groundwater quality, including potential variability. The 10 downgradient wells were installed along the western, southern, and eastern boundaries of the active Ash Landfill. The depths of the monitoring wells were selected such that the monitoring wells are screened in the Ogallala Formation to yield groundwater samples that are representative of water quality in the uppermost water-bearing zone.

2.5 Groundwater Monitoring Program

Between March 1996 and December 2015, groundwater samples were collected for arsenic, selenium, and sulfate measurement twice a year from the 10 GGS monitoring wells administered under the Nebraska Department of Environment and Energy (NDEE) monitoring program (APMW-5, APMW-15, APMW-4, APMW-6, APMW-8A, APMW-10, APMW-11, APMW-12, APMW-13, and APMW-14). In June 2005, boron measurements were added to the NDEE analyte list. In 2015, four additional monitoring wells were installed to support the federal CCR monitoring program (APMW-16A, APMW-17, APMW-18, and APMW-19) and have been incorporated into the NDEE monitoring program.

For APMW-19, the current baseline was calculated using 13 independent groundwater samples collected between December 2015 and November 2019. Statistically valid baseline values were developed for each constituent at each monitoring well (Golder 2017 and Golder 2019a).

2.5.1 Sulfate Concentration Trends

Sulfate concentrations in the upgradient and downgradient groundwater are shown in Appendix A, Figure A8. Sulfate concentrations in upgradient groundwater (from the four upgradient monitoring wells) ranged from 12.8 to 237 milligrams per liter (mg/L) between March 1996 and June 2022. Sulfate concentrations varied between 13.4 and 640 mg/L in downgradient groundwater wells (based on the 10 downgradient monitoring wells) over the same period.

During the current APMW-19 baseline monitoring period (December 2015 – November 2019), sulfate concentrations in groundwater at this well remained relatively steady compared to other downgradient wells, with values ranging between 38.1 and 135 mg/L in the 13 samples collected. A concentration of 191 mg/L was calculated as the parametric CUSUM statistical limit for sulfate at this monitoring well.

The Q2 2021 detection monitoring event reported a sulfate concentration of 161 mg/L in groundwater at APMW-19 and the parametric CUSUM value of 212 mg/L exceeded the statistical limit of 191 mg/L. The exceedance was verified in Q4 2021 when the reported sulfate concentration was 122 mg/L, and the parametric CUSUM value of 223 mg/L exceeded the statistical limit of 191 mg/L. A successful ASD report was prepared and submitted to NDEE on April 28, 2022 (Golder 2022) and accepted by NDEE on July 8, 2022 (NDEE 2022).

The Q2 2022 detection monitoring event reported a sulfate concentration of 146 mg/L, which resulted in a parametric CUSUM value of 208 mg/L and exceeded the statistical limit of 191 mg/L.

2.6 Review of Sampling and Laboratory Testing Procedures

As part of the ASD, a review was conducted of the sampling and laboratory testing procedures used throughout baseline monitoring and detection monitoring to date, along with the collected results. Golder found that the analytical methodologies used were consistent with the stated objectives of the sampling program. No anomalies were found within the sampling and laboratory testing procedures and the collected results are considered valid.

Additionally, a review of the statistical assessment methods and associated results found the procedures followed during baseline and detection monitoring to be consistent with the stated procedures listed in the published Groundwater Monitoring Statistical Methods Certification (Golder 2017). Calculated limits were found to be consistent with the chosen statistical procedures as described in the Sampling and Analysis Plan (Golder 2019a) and recommended methodology found within the Unified Guidance (United States Environmental Protection Agency [EPA] 2009).

3.0 DATA SOURCES USED IN ALTERNATIVE SOURCE REVIEW

To assess groundwater downgradient of the GGS CCR facilities, Golder reviewed previously-collected data and performed supplemental assessment activities. The following sections summarize the supplemental assessment activities.

3.1 Groundwater

3.1.1 On-site Groundwater Monitoring Data

NPPD GGS field personnel routinely collect groundwater samples from 14 monitoring wells around the Ash Landfill at GGS and submit them for chemical analysis. The following datasets were available to characterize the groundwater in the vicinity of the ash landfills:

- **NDEE and CCR Monitoring Programs:** As described in Section 2.5, the ongoing groundwater monitoring samples were collected between 1996 and 2022, and analyzed for field parameters, major cations, major anions, and select dissolved metals.

- **Supplemental Sampling in First Quarter (Q1) 2019:** In February 2019, an additional set of groundwater samples were collected from eight of the 14 wells (APMW-5, APMW-17, APMW-4, APMW-8A, APMW-18, APMW-19, APMW-12, and APMW-14) to support the Q4 2018 ASD for fluoride at APMW-19 (Golder 2019b). These samples were analyzed for field parameters, major cations, major anions, and select dissolved metals. In addition, detection monitoring groundwater samples collected in Q4 2019 and Q2 2021 also had an expanded analyte list, including field parameters, major cations, major anions, and select dissolved metals.

3.1.2 Upgradient Offsite Monitoring Data

As discussed in Section 2.3, upgradient groundwater is sourced from the Sutherland Reservoir, which is fed by the Sutherland Canal with water from North Platte and South Platte Rivers. The following data sources were used to constrain the range of potential water qualities upgradient of GGS and the Ash Landfill:

- **North Platte and South Platte Rivers:** The United States Geological Survey (USGS) monitored South Platte River chemistry at Rosco, Nebraska, between 1975 and 2013 (USGS 2016a). The monitoring location at Rosco, Nebraska, is less than one mile downstream of where South Platte River water is diverted into the Sutherland Canal. The USGS also characterized North Platte River water between 1972 and 2011 at Keystone, Nebraska, immediately downstream of Lake Ogallala, where North Platte River water is diverted into the Sutherland Canal (USGS 2016b).

- **Sutherland Reservoir and Canal:** Surface water samples were collected from the Sutherland Reservoir and Sutherland Canal on October 28, 2019, to assess the source of regional groundwater at the site. These samples were analyzed for field parameters, major cations, major anions, and select dissolved metals (Golder 2019b). In addition to samples collected by NPPD personnel, seven water samples were collected from the center of the Sutherland Reservoir by the USGS between August 2005 and December 2006 (USGS 2016c and USGS 2016d).
- **Shallow Groundwater around the Sutherland Reservoir:** Between September 2005 and May 2007, the USGS collected 14 shallow groundwater samples from 12 wells less than one mile from the perimeter of Sutherland Reservoir (USGS 2016e).
- **Upgradient Wells:** In Q2 2021, NPPD personnel collected groundwater samples from wells north and east of GGS to characterize the regional groundwater. The wells included potable water wells (PW #1, PW #2, and PW #3), livestock watering wells (livestock well), and operating wells (OW-20, OW-21, OW-22, OW-23, OW-24, OW-25, and OW-36, as shown in Figure 5. The samples were analyzed for field parameters, major cations, major anions, and select dissolved metals.

3.2 Irrigation Water

Two types of irrigation water are identified as potentially important: center pivot spray and irrigation runoff. Center pivot spray is irrigation water that is sprayed directly onto GGS property without touching agricultural soil by the irrigation system near the southern property boundary (Figure 4c). Historical aerial imagery indicates that this irrigation system was installed in 2006 (Figure 3). NPPD was able to collect two samples of center pivot spray on August 11, 2022, with one sample collected from a tire depression in the ground and one sample caught directly in a bucket as the water sprayed onto the Site. Samples were sent to Eurofins Cedar Fall for water quality analysis, including field parameters, major cations, major anions, and select dissolved metals (Results in Appendix B). These samples were collected to characterize the water quality of the center pivot spray as it flows and infiltrates on the ground in the area of APMW-19.

Irrigation water runoff is surface water that flows through agricultural soils prior to traveling onto the Site through drainages into the ditch immediately south of the CCR Unit and immediately upgradient of multiple downgradient monitoring wells, including APMW-4, APMW-6, APMW-8A, APMW-10, and APMW-11. Three indications that irrigation runoff is occurring includes:

1) Historical aerial images from 2012 and 2020 showing green vegetation in the ditch outside of the range of the center pivot spray.

2) Deep drainages at low points between the agricultural fields and the ditch south of the CCR unit (Figures 4A and 4B).

3) Corn shucks in the ditch on NPPD property (Figure 4C).

NPPD field personnel monitored the drainages and ditch for irrigation water runoff to characterize the water quality of this flow. Unfortunately, no irrigation water runoff was observed in the drainages and ditch. Ongoing monitoring will continue until irrigation water runoff samples can be collected.

3.3 Evaporation Pond

In Q1 2019 and Q4 2020, surface water samples were collected from the evaporation pond. The samples were analyzed for field parameters, major cations, major anions, and select dissolved metals.

3.4 Coal Combustion Residuals Contact Water

To characterize the potential for the material in the Ash Landfill to release contaminants, NPPD GGS field personnel retrieved sump water from the Ash Landfill No. 3 LCS, and pond water in direct contact with CCR materials in Ash Landfill No.4 on October 28, 2019. These sample were analyzed for the same suite of parameters as the groundwater: field parameters, major cations, major anions, and select dissolved metals (Golder 2019b).

3.5 Geochemical Methods

The geochemical analysis of groundwater and surface water samples included field parameters, major cations and anions, and dissolved metals. Conductivity, pH, and temperature were measured in the field using a handheld meter. The pH of each sample was also measured in the laboratory. Major anions analyzed included chloride, sulfate, and bicarbonate and major cations included calcium, magnesium, potassium, and sodium.

The laboratory analyzed the Ash Landfill pond and sump water, onsite and off-site groundwater, and surface water (evaporation pond, Sutherland Reservoir, and Sutherland Canal) samples using the following methods:

- pH following SM 4500 H+ B (2017)
- alkalinity following Standard Method (SM) 2320B Alkalinity by Titration (2005)
- chloride, fluoride, and sulfate following USEPA SW846 9056A Determination of Inorganic Anions by Ion Chromatography Revision 1 (February 2007)
- ammonia following USEPA 350.1 Determination of Ammonia Nitrogen by Automated Colorimetry, Revision 2 (August 1993)
- total Kjeldahl nitrogen following USEPA 351.2 Determination of Total Kjeldahl Nitrogen by Semi-Automated Colorimetry, Revision 2 (August 1993)
- total nitrate-nitrite nitrogen following USEPA 353.2 Determination of Nitrate-Nitrite Nitrogen by Automated Colorimetry, Revision 2 (August 1993)
- antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, lead, lithium, magnesium, molybdenum, potassium, selenium, sodium, and thallium following USEPA SW-846 6020A (November 2004)

4.0 DATA EVALUATION

Historical concentrations of Appendix III analytes and selected Appendix IV analytes in groundwater at GGS, including analytes that are typically indicators of potential CCR seepage (e.g., arsenic, barium, molybdenum, and selenium), are presented in time series plots in Appendix A. The plots include the results of the supplemental samples that were collected in Q1 2019 to support the Q4 2018 ASD for fluoride at APMW-19 (Golder 2019b). Sampling for the Appendix IV analytes concluded with the end of baseline monitoring in Q2 2017, which means there is a gap of six quarters in the data plots until the supplemental sampling results are shown in Q1 2019.

Figure 6 presents a Piper diagram with relative major ion chemistry for the monitoring well groundwater samples (only for samples analyzed for all major cations and anions; Q4 2017, Q1 2019, Q4 2019, and Q2 2021), off-site upgradient groundwater (NPPD and USGS sampled wells), regional groundwater sources (Sutherland Reservoir, Sutherland Canal, and North and South Platte River), irrigation waters from the center pivot spray, evaporation pond water, and coal ash impacted waters (Ash Landfill No. 3 sump water and Ash Landfill No. 4 surface pond water). The groundwater at the upgradient monitoring wells was dominated by calcium and bicarbonate. Samples from the downgradient monitoring wells were also majority calcium and bicarbonate ions, with the exception of a single sample (Q1 2019) from APMW-12 that was dominated by calcium and sulfate. The Sutherland Reservoir and Sutherland Canal water, along with the average North and South Platte River waters are generally dominated by calcium, sodium, bicarbonate, and sulfate. Irrigation waters from the center pivot spray were dominated by calcium and bicarbonate. The evaporation pond water contained majority sodium and sulfate ions. The Ash Landfill No. 3 sump water sample was primarily sodium and bicarbonate, while the Ash Landfill No. 4 pond water was dominated by sodium and sulfate.

4.1 Potential Sulfate Sources

Several potential sources, other than the active CCR Units, can contribute sulfate to local groundwater at GGS, including outflows from the Sutherland Reservoir into regional groundwater, irrigation water runoff and center pivot spray from across southern property boundary, seepage from the evaporation pond, and seepage from historical deposits of fly ash that remain at GGS. These four potential sources of sulfate to groundwater are described in this section.

4.1.1 Regional Groundwater from Sutherland Reservoir

As described in Section 2.3, the groundwater gradient in the area around the Ash Landfill shows groundwater flows from north to south, rather than from south to north in the direction of the South Platte River. The groundwater flow direction appears to be based on both the groundwater recharge provided by the Sutherland Reservoir to the north of GGS and groundwater extraction by irrigation wells located south of GGS that are pumped seasonally and used to support local agriculture. The Sutherland Reservoir is fed by the Sutherland Canal, which delivers water from both the North and South Platte Rivers for use as condenser cooling water at GGS.

The USGS collected 35 samples for sulfate concentration analysis from the South Platte River at Rosco, Nebraska, between 1975 and 2013 (USGS 2016a). Sulfate concentrations in the South Platte River ranged from 208 to 890 mg/L. The USGS collected 26 samples for sulfate concentration analysis from the North Platte River at Keystone, Nebraska, between 1972 and 2011 (USGS 2016b). Sulfate concentrations in the North Platte River ranged from 150 to 230 mg/L.

The sulfate concentrations of the Sutherland Reservoir and Sutherland Canal samples collected by NPPD field staff in October 2019 were 172 and 164 mg/L, respectively (Section 3.2). The seven Sutherland Reservoir samples the USGS collected between August 2005 and December 2006 had sulfate concentrations that ranged from 194 to 220 mg/L (USGS 2016c and USGS 2016d). The sulfate concentrations in the Sutherland Reservoir and Sutherland Canal at the times of sampling (2005, 2006, and 2019) were more similar to concentrations observed in the North Platte River and lower than concentrations observed in the South Platte River.

Sulfate concentrations in the North Platte River, South Platte River, and Sutherland Reservoir were sufficiently high enough to be regarded as a source of the elevated concentrations measured in groundwater at the upgradient monitoring wells at the Site and the elevated concentrations measured in downgradient groundwater at

APMW-8a and APMW-19. While the elevated sulfate concentrations at APMW-19 were only observed during detection monitoring (161 mg/L in Q2 2021,122 mg/L in Q4 2021 and 146 mg/L in Q2 2022, which triggered the SSI), elevated concentrations at APMW-8A (27.2 mg/L to 145 mg/L) were observed during the baseline and detection monitoring periods. The groundwater samples collected by the USGS and NPPD immediately around the Sutherland Reservoir (less than one mile) also support the hypothesis that the reservoir is the source of the elevated sulfate concentrations at the Site (USGS 2016e). These shallow groundwater samples (10 collected by the USGS and 11 samples collected by NPPD) had sulfate concentrations of between 162 and 296 mg/L, which is within the 12.8 to 237 mg/L sulfate concentration range measured in groundwater at the GGS upgradient monitoring wells (APMW-5, APMW-15, APMW-16A, and APMW-17) between March 1996 and June 2022.

Figure 7 displays a box and whisker plot of the sulfate concentrations from the GGS monitoring well network and samples of possible sulfate sources at the Site. The plot suggests that groundwater containing elevated sulfate concentrations has been traveling across the Site, including past the upgradient monitoring wells, and has only recently started reaching downgradient monitoring wells.

McMahon et al. (2010) details the southernly flow of surface water from the Sutherland Canal and Sutherland Reservoir to the surrounding groundwater near GGS. Their analysis indicated that the front “edge” of Sutherland Reservoir water was in the approximate area of the CCR landfills, though the low density of wells sampled around the CCR landfills limited the resolution in that area.

4.1.2 Irrigation Water

Irrigation water (Section 2.3) was recently identified as a potential source at other downgradient monitoring wells at GGS and is evaluated as a potential source of sulfate because of its proximity to APMW-19. It is not considered a likely source of sulfate because APMW-19 is out of center pivot spray range and side-gradient to the ditch that may be impacted by irrigation water runoff.

As discussed in Section 2.3, historical ariel imagery (Figure 3) and site photographs (Figure 4) indicate that center pivot spray and irrigation water runoff are crossing the southern property boundary at GGS and flowing into the ditch immediately south of Ash Landfills No. 3 and No. 4. Ponded water in that ditch could infiltrate to groundwater and would have the potential to impact the wells located south of the Ash Landfills (APMW-4, APMW-6, APMW-8A, APMW-10, and APMW-11). As this ditch is side-gradient to the east of APMW-19, it is unlikely that irrigation water could impact sulfate concentrations at APMW-19.

Sulfate concentrations in center pivot irrigation water samples (Section 3.2) were not elevated over concentrations recently observed in APMW-19 (122.0 to 161 mg/L between Q2 2021 and Q2 2022). The piper diagram (Figure 6) also shows that groundwater from APMW-19 does not have a similar signature (calcium sulfate dominant) to irrigation waters (calcium bicarbonate dominant), which is a further indication that irrigation water is not impacting APMW-19.

4.1.3 Evaporation Pond

Although the evaporation pond is located to the east of APMW-19 and side-gradient in terms of groundwater flow (i.e., seepage from the evaporation pond would be unlikely to impact groundwater at monitoring well APMW-19), evaporation pond water quality was evaluated as a potential source in this section as it contains water related to GGS plant operations.

Groundwater quality at the three downgradient monitoring wells located around the evaporation pond (i.e., APMW-12, APMW-13, and APMW-14) indicates that process water discharged from the GGS plant and stored in the evaporation pond has migrated to groundwater. Historical monitoring results show that elevated concentrations of boron (Figure A2), chloride (Figure A4), sulfate (Figure A8), and TDS (Figure A9), which are elements that are typically associated with CCR, were detected in groundwater at these three monitoring wells closest to the evaporation pond compared to the upgradient monitoring wells.

Based on the slight differences in water quality between the groundwater at the monitoring wells APMW-12, APMW-13 and APMW-14 and the evaporation pond, mixing between the evaporation pond water and the upgradient groundwater likely occurs and groundwater at the monitoring wells is not entirely composed of seepage from the evaporation pond. This mixing reaction is supported by the Piper diagram in Figure 6, which shows samples from monitoring wells APMW-12 and APMW-14 plot on a mixing line between the evaporation pond and upgradient groundwater end-member data points.

During the Q4 2020 sampling of the evaporation pond surface water, the sulfate concentration was 468 mg/L. Based on the similarities in water quality between the evaporation pond and adjacent groundwater monitoring wells (APMW-12, APMW-13 and APMW-14), the evaporation pond is considered a potential source of sulfate to groundwater at GGS. However, it is unlikely the evaporation pond influenced groundwater quality at APMW-19, which is side gradient to groundwater flow underneath the evaporation pond (Figure 1).

4.1.4 Historical Ash Landfills

Historical deposits of fly ash present at GGS in the closed soil-lined Ash Landfills Nos. 1 and 2 may release soluble constituents to groundwater as the seepage generated by infiltrating precipitation interacts with the ash. While it was not feasible to collect a sample of seepage from Ash Landfills Nos. 1 and 2 directly, ash-impacted waters collected from Ash Landfill No. 3 sump and Ash Landfill No. 4 pond (Section 3.4) had sulfate concentrations of 1,270 and 1,810 mg/L, respectively, and are assumed to represent potential ash impacted waters from closed ash landfills. At these concentrations, ash-impacted seepage has the potential to increase sulfate concentrations in downgradient wells, including AMPW-19.

A ternary plot comparing sodium, potassium, and sulfate (Figure 8) reveals that ash impacted waters (i.e., contact water) have higher relative sodium abundances and lower relative potassium and sulfate abundances compared to the upgradient and downgradient groundwater. If infiltrating precipitation was leaching sulfate from the closed fly ash storage facilities, the relative concentrations of sodium would increase considerably in the groundwater and would be more similar to the ash impacted waters, but this elevated sodium signature was not observed in any of the samples collected from the downgradient groundwater monitoring wells.

In addition to the elevated levels of sulfate in the ash-impacted waters, boron was also identified as a primary CCR indicator based on high concentrations in sump water from Ash Landfill No. 3 (18.3 mg/L) and pond water from Ash Landfill No.4 (13.8 mg/L). Boron concentrations in groundwater at the upgradient and downgradient CCR Unit monitoring wells are presented in Appendix A Figure A2. All upgradient and downgradient CCR Unit monitoring wells, with the exception of monitoring wells near the evaporation pond that may be influenced by process waters, have boron concentrations below the practical quantitation limit (PQL) (typically <0.2 mg/L). If seepage from the ash landfills were impacting groundwater and causing the sulfate SSI, boron concentrations would be expected to be increasing.

4.1.5 Mineral Weathering

Another potential source of sulfate in the watershed is from the natural weathering of sulfur-bearing minerals. McMahon et al. (2007) used a mass balance approach to study increases in sulfate concentrations along a groundwater flow path in Central Nebraska. They determined that the oxidation of pyrite was the likely source of sulfate increases in groundwater. These natural weathering products have the potential to raise concentrations to a small degree, but the natural concentrations were relatively low compared to the concentrations in groundwater generated by the Sutherland Reservoir, particularly as demonstrated by comparing groundwater quality between the USGS shallow wells and the GGS upgradient wells (Figure 7).

5.0 EVIDENCE OF AN ALTERNATIVE SOURCE

Based on the testing results and list of potential alternate sources of sulfate presented in this report, primary lines of evidence and conclusions drawn from the evidence used to support this ASD are provided in Table 2.

Table 2: Primary Lines of Evidence and Supporting ASD Analysis

Key Line of Evidence	Supporting Evidence	Description
Lack of Primary CCR Indicators	Boron concentrations in groundwater	Boron (Figure A2) is a primary CCR indicator based on high concentrations in sump water from Ash Landfill No. 3 (18.3 mg/L) and pond water from Ash Landfill No.4 (13.8 mg/L). All upgradient and downgradient CCR unit monitoring wells, with the exception of monitoring wells near the evaporation pond that may be influenced by process waters, have boron concentrations below the PQL (typically <0.2 mg/L).
	Sodium concentrations in CCR impacted waters	The relative abundance of sodium in CCR-impacted waters would indicate that high sodium concentrations would also be expected in groundwater if sulfate was from CCR materials (Figure 8). Relative increases in sodium were not observed in monitoring wells at the Site, suggesting an alternative source of elevated sulfate in groundwater at APMW-19.
Groundwater Geochemistry	Elevated and variable sulfate concentrations in upgradient monitoring wells	Sulfate concentrations in groundwater at upgradient monitoring wells APMW-15, APMW-16A, and APMW-17 were elevated compared to sulfate concentrations at monitoring well APMW-19 throughout the baseline monitoring period. Since the CCR Unit cannot influence the sulfate groundwater concentration in the upgradient wells, the only explanation is that there is an alternate source of sulfate present in groundwater across the Site.
	Relative ion abundances in groundwater differs from Ash Landfill water	As presented in the Piper plot (Figure 6), relative differences in major ion concentrations show a distinct dissimilarity between the ash-impacted sump and pond waters and the downgradient groundwater samples, including from APMW-19. The geochemical properties of the downgradient groundwater samples are not consistent with seepage from the CCR Unit.

Key Line of Evidence	Supporting Evidence	Description
Local Sources of Sulfate	Hydrogeology	The North and South Platte Rivers, which are ultimately the source of groundwater recharge that occurs from the Sutherland Reservoir located approximately 1.5 miles north of the Ash Landfill, have sulfate concentrations between 150 and 890 mg/L. Samples from shallow wells near the Sutherland Reservoir and upgradient wells (Figures 4 and 5) indicate that groundwater with elevated sulfate is migrating south through the Site (McMahon et al. 2010).
	Mineral weathering of sulfate bearing minerals	McMahon et al. (2007) found that small increases in sulfate concentrations along a groundwater flow path in Central Nebraska were due to pyrite oxidation.
Engineering Controls	Both Active CCR Landfill are Lined	The new liner system at Ash Landfill No. 3 consists of a prepared subgrade overlain by a geosynthetic clay liner and 60-mil linear low-density polyethylene (LLDPE) geomembrane. Ash Landfill No. 3 also has a 1-foot LCS sand layer that reports to two sumps. The liner design at Ash Landfill No. 4 consists of a 60-mil HDPE geomembrane over compacted subgrade.

6.0 CONCEPTUAL SITE MODEL

Golder developed a conceptual site model (CSM) that is presented graphically in Figure 9 to frame and support the ASD assessment approach. The CSM presents the GGS site layout, a summary of the geologic and hydrogeologic information, and a discussion of groundwater monitoring data, which together lays the groundwork for consideration and development of the ASD. Additionally, the CSM summarizes the findings of literature research that suggest certain naturally occurring groundwater conditions observed in Nebraska are present at the Site and may contribute to naturally elevated sulfate concentrations in groundwater around the Ash Landfill.

7.0 CONCLUSIONS

In accordance with §257.95(g)(3) and NAC Title 132, Ch.7, 004.03, this ASD has been prepared in response the identification of SSIs for sulfate at monitoring well APMW-19 following the Q2 2022 sampling event for the Ash Landfill at GGS.

A review of historical analytical results indicates that the elevated sulfate concentrations in groundwater at APMW-19 were not the result of seepage from the Ash Landfill but can be attributed to naturally occurring sulfate in regional groundwater from the Sutherland Reservoir. Therefore, no further action (i.e., transition to Assessment Monitoring) is warranted, and the GGS Ash Landfill will remain in detection monitoring.

Signature Page

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GL/ES/JS/df

https://golderassociates.sharepoint.com/sites/141322/project files/6 deliverables/reports/3-r-asd_sulfate_apmw19/3-r-0/31404512.000-3-r-0_asd_sulfate_apmw19_26oct22.docx

8.0 REFERENCES

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

Fetter, Charles Willard. 1994. Applied Hydrogeology, 3rd Edition. Prentice-Hall.

Peckenpaugh JM, Cady RE, Dugan JT. 1992. Hydrogeology of Parts of the Twin Platte and Middle Republican Natural Resources Districts, Southwestern Nebraska, Nebraska Water Survey Paper No. 70, Conservation and Survey Division, University of Nebraska-Lincoln, 89 pp.

Golder Associates Inc. 2017. Coal Combustion Residuals Landfill Groundwater Monitoring System Certification, Nebraska Public Power District Gerald Gentlemen Station, Sutherland, Nebraska.

Golder Associates Inc. 2019a. Sampling and Analysis Plan, Gerald Gentleman Station Ash Landfill. December.

Golder Associates Inc. 2019b. Alternate Source Demonstration, Nebraska Public Power District Gerald Gentlemen Station, Sutherland, Nebraska, April.

Golder Associates Inc. 2022. Alternative Source Demonstration for Sulfate at APMW-19, Nebraska Public Power District Gerald Gentlemen Station, Sutherland, Nebraska, April.

McMahon PB, Böhlke JK, Carney CP. 2007. Vertical gradients in water chemistry and age in the northern High Plains aquifer, Nebraska, 2003. US Geological Survey.

McMahon, PB, Carney CP, Poeter EP, Peterson SM. 2010. Use of geochemical, isotopic, and age tracer data to develop models of groundwater flow for the purpose of water management, northern High Plains aquifer, USA. Applied Geochemistry, 25(6), pp.910-922.

Nebraska Department of Environment and Energy (NDEE). 2022. Letter from Ed Southwick RCRA/Federal Facilities Section Supervisor to Brian Kozisek NPPD Environmental Protection Supervisor. Alternative Source Demonstrations for Chloride in APMW-19 and Sulfate and APMW-6. May 26, 2022.

USGS (US Geological Survey. 2016a. National Water Information System data available on the World Wide Web (USGS Water Data for the Nation: USGS 06764880 South Platte River at Roscoe, Nebr.), accessed April 2020, at URL: https://nwis.waterdata.usgs.gov/nwis/qwdata/?site_no=06764880&agency_cd=USGS&amp.

USGS. 2016b. National Water Information System data available on the World Wide Web (USGS Water Data for the Nation: USGS 06690500 North Platte River Near Keystone, Nebr.), accessed April 2020, at URL: https://nwis.waterdata.usgs.gov/nwis/qwdata/?site_no=06690500&agency_cd=USGS&amp.

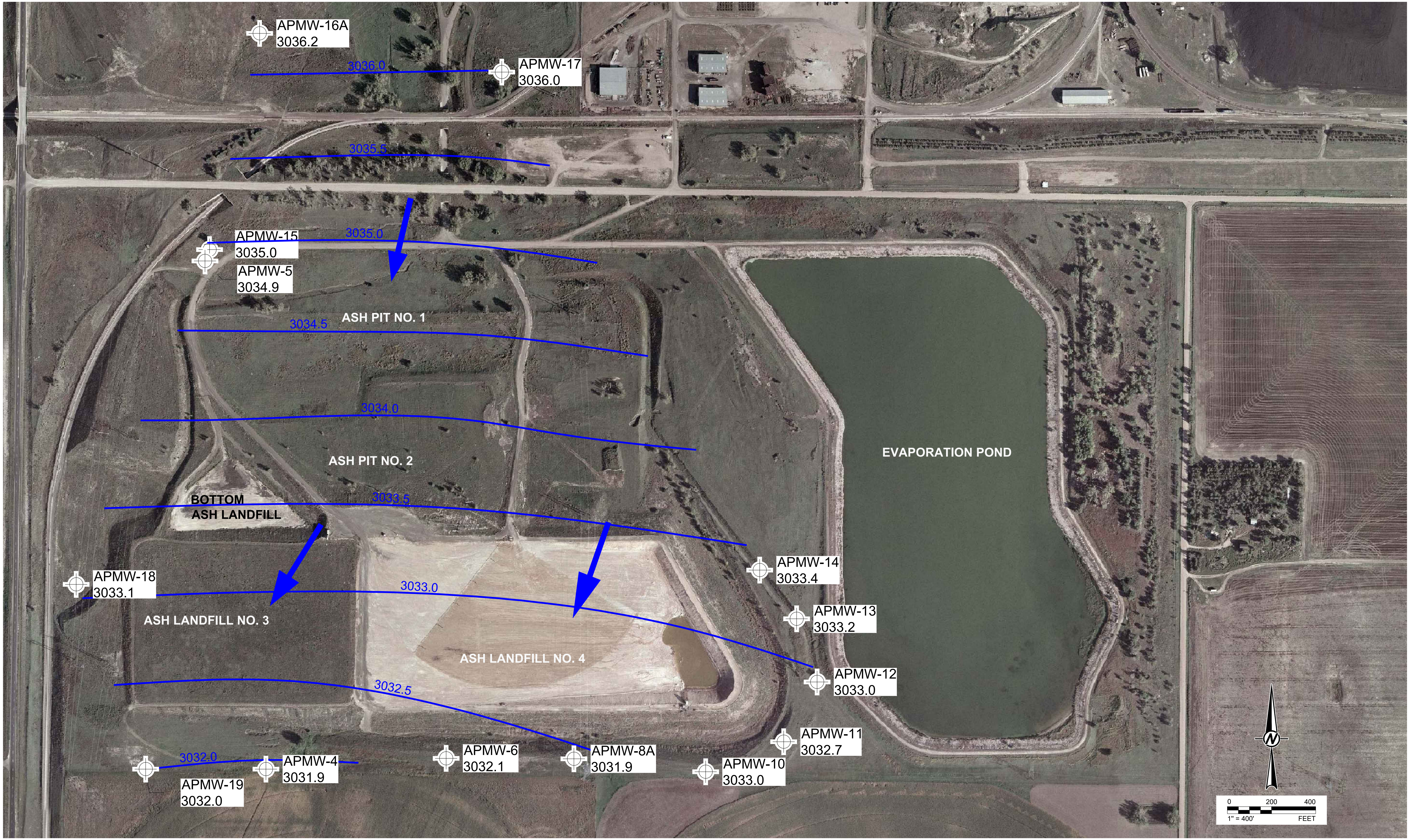
USGS. 2016c. National Water Information System data available on the World Wide Web (USGS Water Data for the Nation: USGS 410630101080202 Sutherland Reservoir Middle Deep), accessed April 2020, at URL: https://waterdata.usgs.gov/nwis/inventory?agency_code=USGS&site_no=410630101080202.

USGS. 2016d. National Water Information System data available on the World Wide Web (USGS Water Data for the Nation: USGS 410630101080201 Sutherland Reservoir Middle Shallow), accessed April 2020, at URL: https://nwis.waterdata.usgs.gov/usa/nwis/qwdata/?site_no=410630101080201.

USGS. 2016e. National Water Information System data available on the World Wide Web (USGS Water Data for the Nation: USGS-410711101060201, USGS-410606101061301, USGS-410529101062501, USGS-410542101053501, USGS-410438101055301, USGS-410452101055301, USGS-410522101075601, USGS-410508101091501, USGS-410456101091801, USGS-410530101093701, and USGS-410811101072501), accessed April 2020, at URL: https://www.waterqualitydata.us/portal/#siteid=USGS-410711101060201&siteid=USGS-410606101061301&siteid=USGS-410529101062501&siteid=USGS-410542101053501&siteid=USGS-410438101055301&siteid=USGS-410452101055301&siteid=USGS-410522101075601&siteid=USGS-410508101091501&siteid=USGS-410456101091801&siteid=USGS-410530101093701&siteid=USGS-410811101072501&mimeType=csv.

Woodward-Clyde Consultants. 1991. Design and Construction of a Groundwater Monitoring Network, Final Report, Gerald Gentleman Station, Nebraska Public Power District, Sutherland, Nebraska, WCC Project No. 90MC176, Omaha, Nebraska, September.

Figures



NOTE

GROUNDWATER CONTOURS DEVELOPED FROM LEVELS MEASURED IN ACTIVE MONITORING WELLS SHOWN.

wsp GOLDER

NEBRASKA PUBLIC POWER DISTRICT GERALD GENTLEMAN STATION GROUNDWATER MONITORING WELL NETWORK JUNE 2022
GROUNDWATER CONTOURS

FIGURE 1

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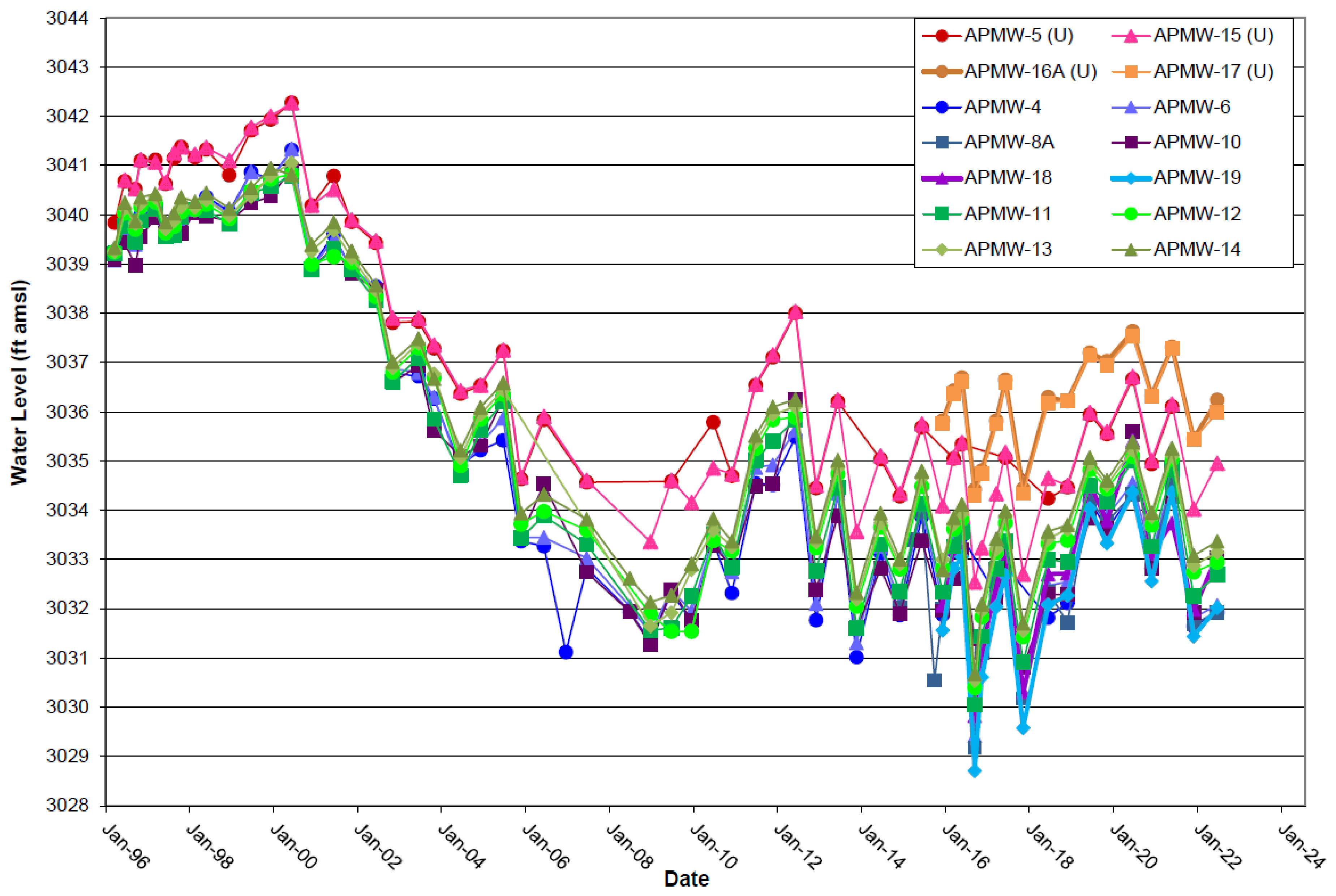

CLIENT

Nebraska Public Power District: Gerald Gentleman Station

CONSULTANT

WSP GOLDER

PROJECT

Alternate Source Demonstration

TITLE

Groundwater Monitoring Well Water Levels

PROJECT NO.	PHASE	REV.	FIGURE
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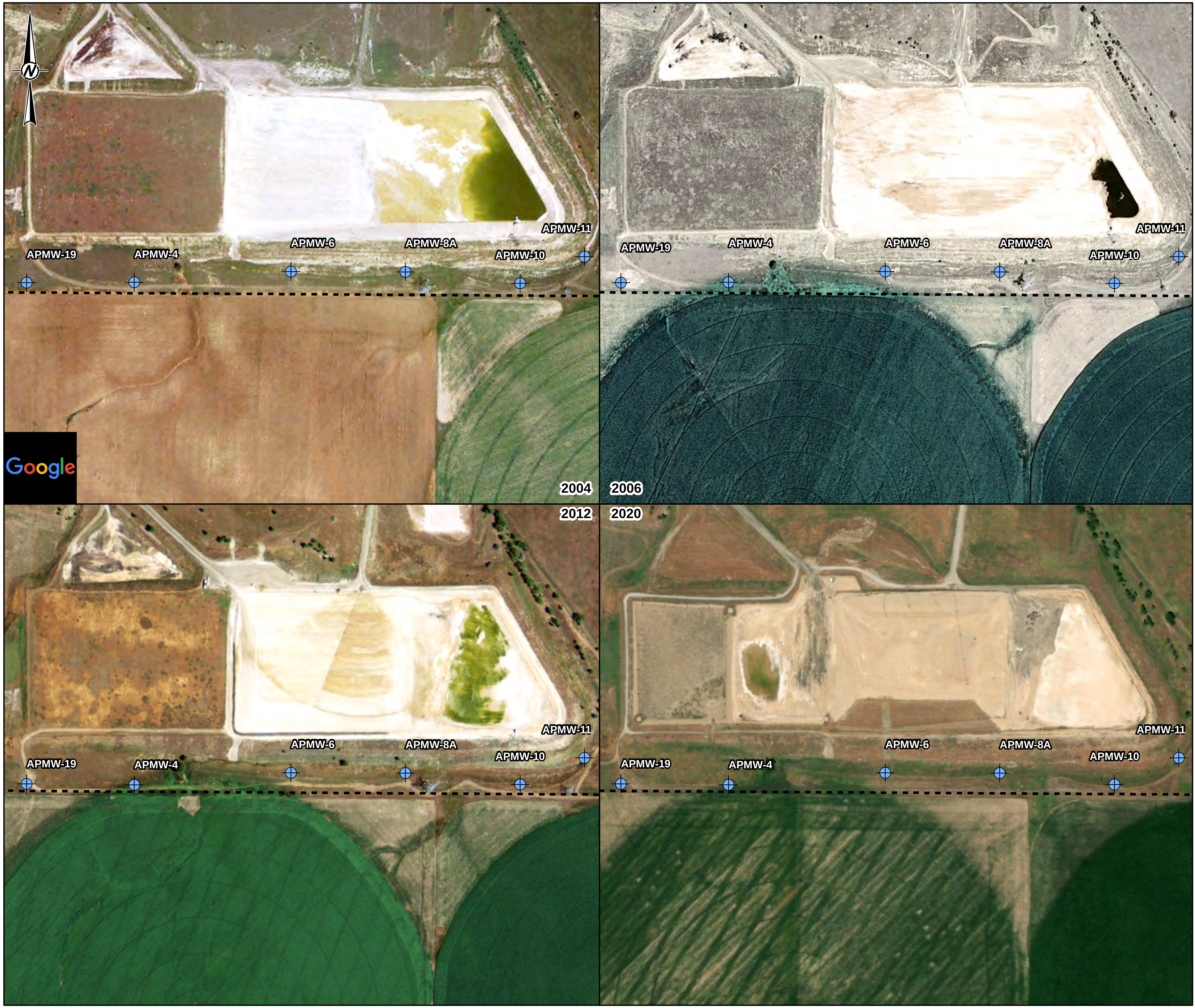

LEGEND

- ⌖ MONITORING WELLS (QUALITY)
- ⌐ ¬ APPROXIMATE NPPD PROPERTY BOUNDARY

KEY MAP

0 250 500 1,000 Feet

REFERENCES

1. AERIAL IMAGERY: NATIONAL AGRICULTURE IMAGERY PROGRAM (NAIP), USDA. IMAGERY COLLECTED 06/26/2012, AND 07/14/2006.
2. AERIAL IMAGERY: ESRI PROVIDED BASEMAP. VIVID. MAXAR. IMAGERY COLLECTED 07/03/2020
3. AERIAL IMAGERY: COPYRIGHT GOOGLE 2021. IMAGERY CAPTURED MAY 2004.. IMAGE ACCURACY TO BE CONSIDERED APPROXIMATE. GOOGLE IS NOT LIABLE FOR ANY DECISIONS MADE BASED ON THE CONTENTS OF THE IMAGE SHOWN ON THIS FIGURE.
4. APPROXIMATE WATER WELL LOCATIONS: NEBRASKA DEPARTMENT OF NATURAL RESOURCES. DATASET DOWNLOADED MARCH 2019.
5. APPROXIMATE NPPD PARCEL BOUNDARIES: LINCOLN COUNTY ASSESSOR'S OFFICE, APRIL 2019.

CLIENT
NEBRASKA PUBLIC POWER DISTRICT
GERALD GENTLEMAN STATION
SUTHERLAND, NEBRASKA

PROJECT
Alternative Source Demonstration

Aerial Imagery of Irrigation Water Runoff and Center Pivot spray onto GGS Property

CONSULTANT
WSP GOLDER

YYYY-MM-DD	2021-10-26
DESIGNED	RG/JAM
PREPARED	JAM
REVIEWED	GOL
APPROVED	JS

PROJECT NO.
31404512.000

FIGURE
3

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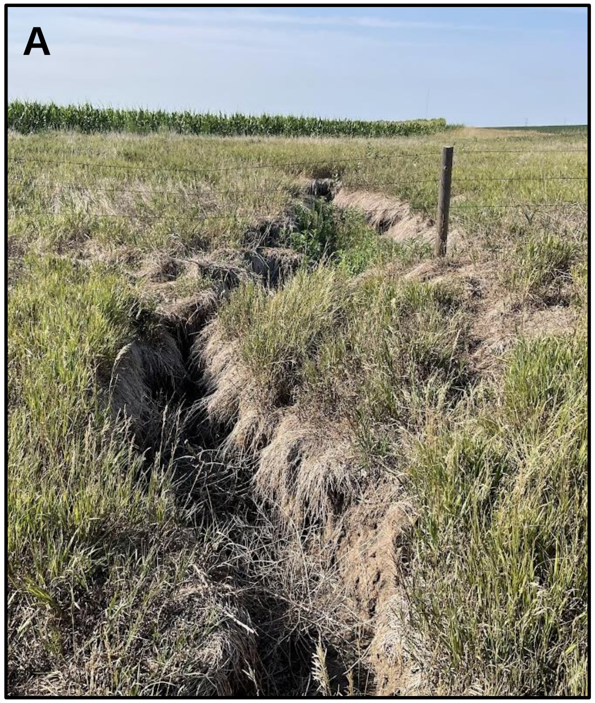

Evidence of past irrigation water runoff

East Drainage from agricultural fields onto NPPD GGS property at southern property boundary fence. No water in the drainage at the time of photograph.

Photo taken by Gregory Lehn (WSP-Golder) on August 2nd, 2022 facing south.

Evidence of past irrigation water runoff

West Drainage from agricultural fields onto NPPD GGS property at southern property boundary fence. Presence of dried corn shucks indicates previous flows through the drainage.

Photo taken by Gregory Lehn (WSP-Golder) on August 2nd, 2022 facing south.

Evidence of center pivot spray

Irrigation system spray from agricultural fields onto NPPD GGS property along southern property boundary fence. Water has been observed ponded on the surface and grass is green throughout the summer months.

Photo taken by Douglas Harris (NPPD) on August 11th, 2022 facing east along southern boundary.

CLIENT

Nebraska Public Power District: Gerald Gentleman Station

CONSULTANT

WSP GOLDER

PROJECT

Alternate Source Demonstration

TITLE

Photographs of Drainages and Center Pivot Spray onto GGS Property

PROJECT NO.	PHASE	REV.	FIGURE
31404512.000	1		4

NOTES

1. WELL LOCATIONS ARE APPROXIMATE.

REFERENCE(S)

1. AERIAL IMAGERY OBTAINED FROM ESRI (MAY 2020).

NEBRASKA PUBLIC POWER DISTRICT
GERALD GENTLEMAN STATION
Q2 2021 UPGRADIENT GROUNDWATER SAMPLING LOCATIONS

FIGURE 5

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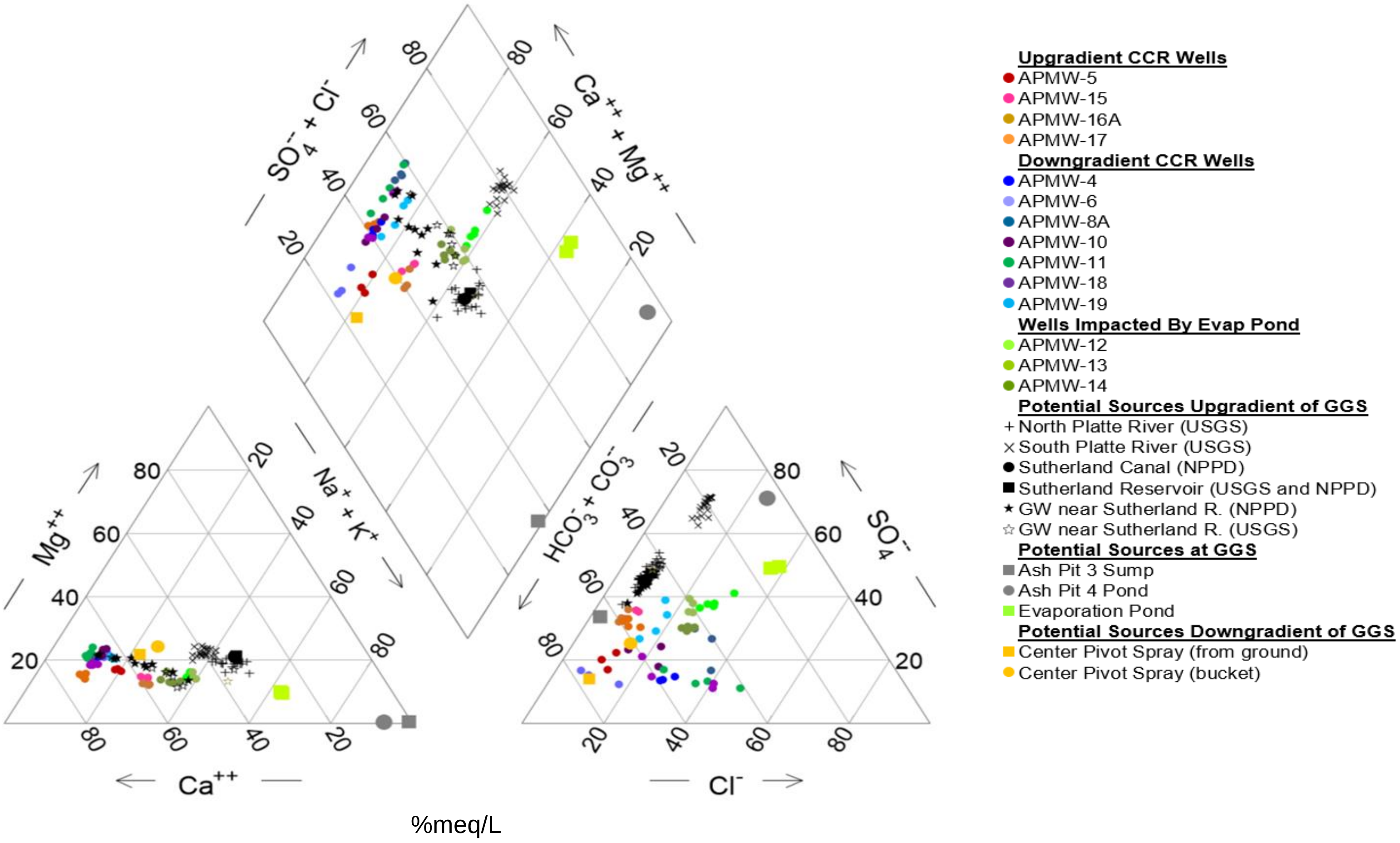

CLIENT

Nebraska Public Power District: Gerald Gentleman Station

CONSULTANT

WSP GOLDER

PROJECT

Alternate Source Demonstration

TITLE

Piper Diagram of Groundwater and Potential Sulfate Sources

PROJECT NO. 31404512.000

PHASE 1

REV.

FIGURE 6

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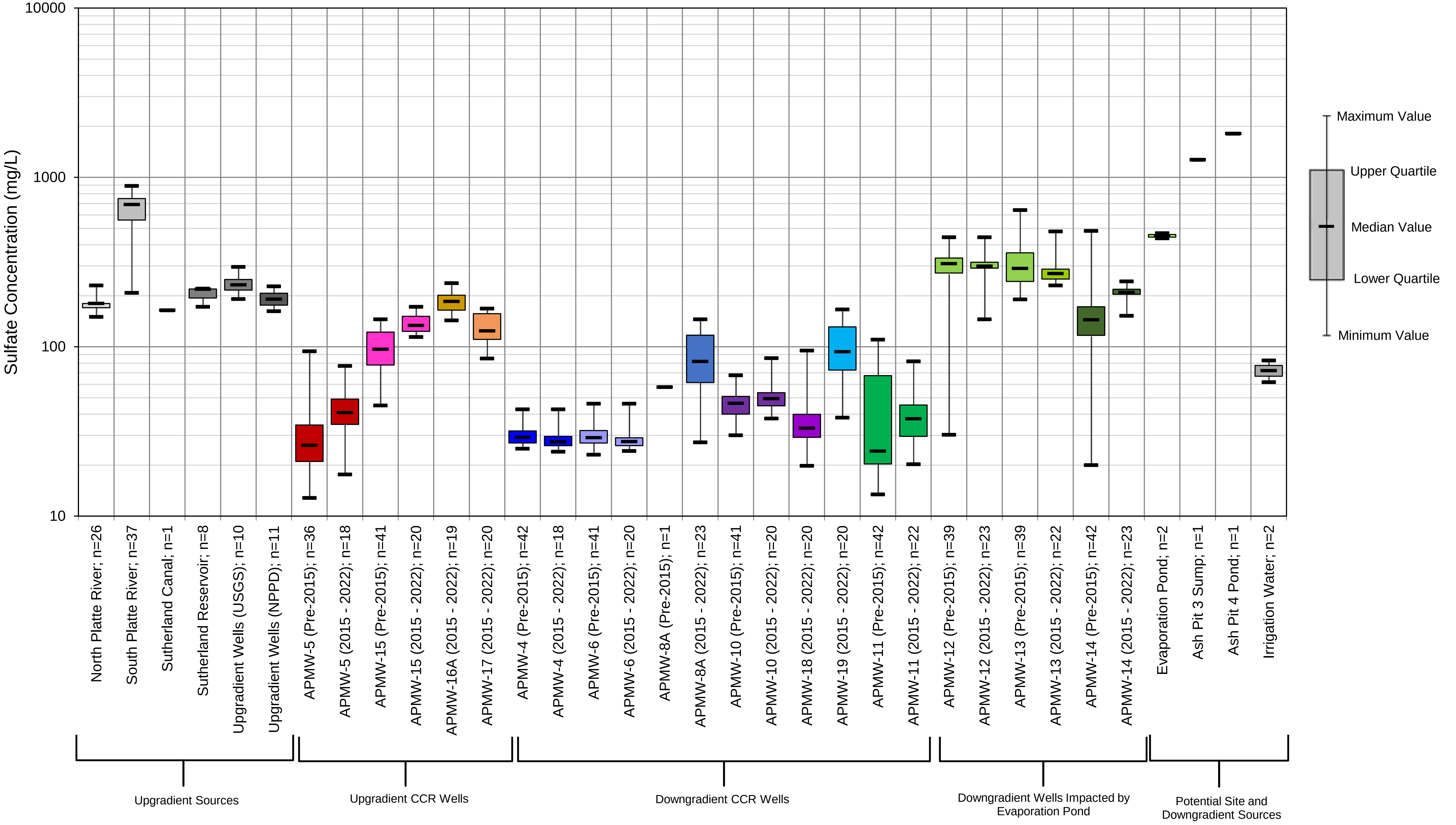

CLIENT
Nebraska Public Power District: Gerald Gentleman Station

PROJECT
Alternate Source Demonstration

CONSULTANT
WSP GOLDER

TITLE
Box and Whisker of Sulfate Concentrations

PROJECT NO.	PHASE	REV.	FIGURE
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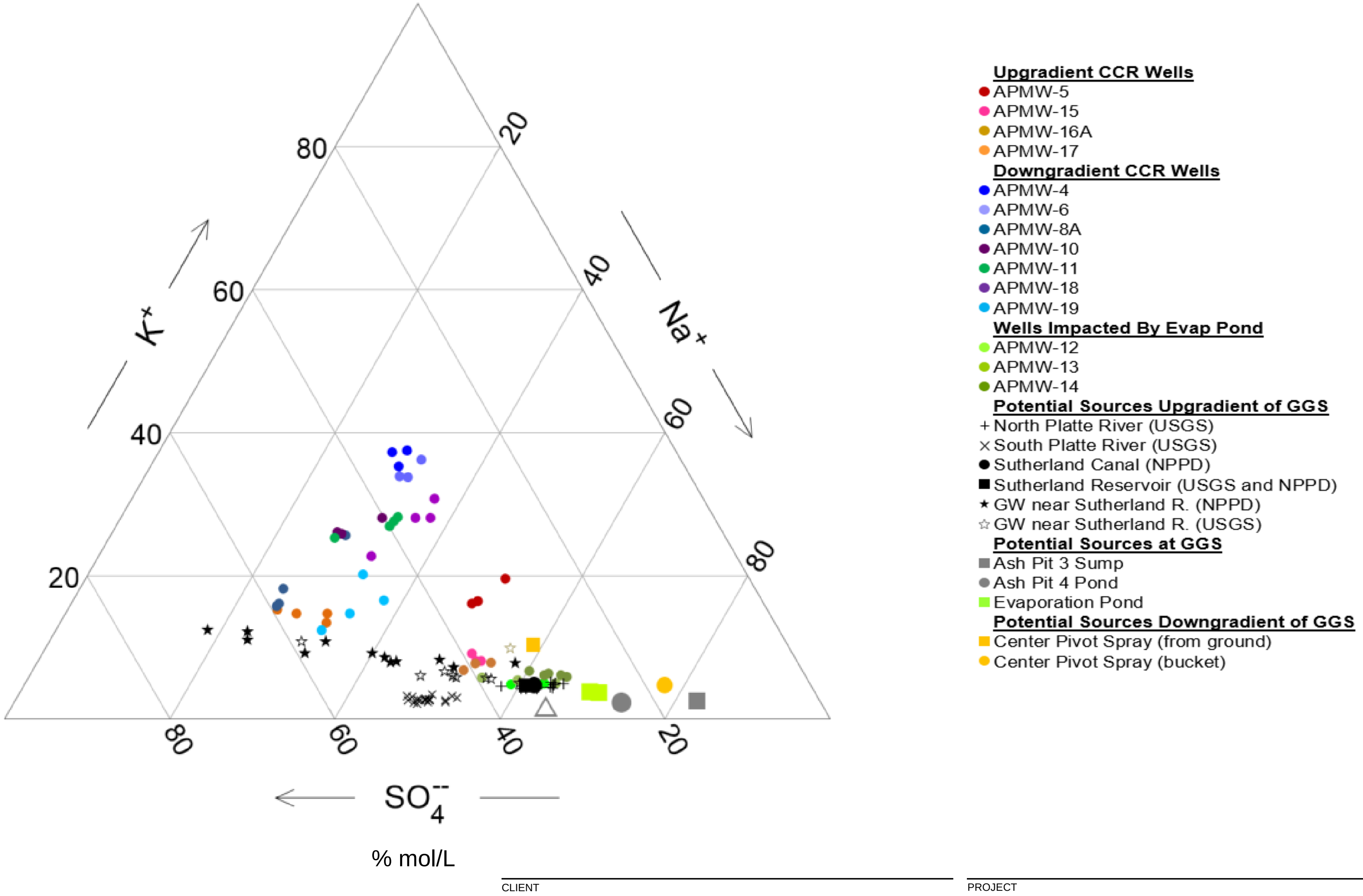

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Nebraska Public Power District: Gerald Gentleman Station

CONSULTANT

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PROJECT

Alternate Source Demonstration

TITLE

Ternary Diagram of Groundwater and Potential Sulfate Sources

PROJECT NO.	PHASE	REV.	FIGURE
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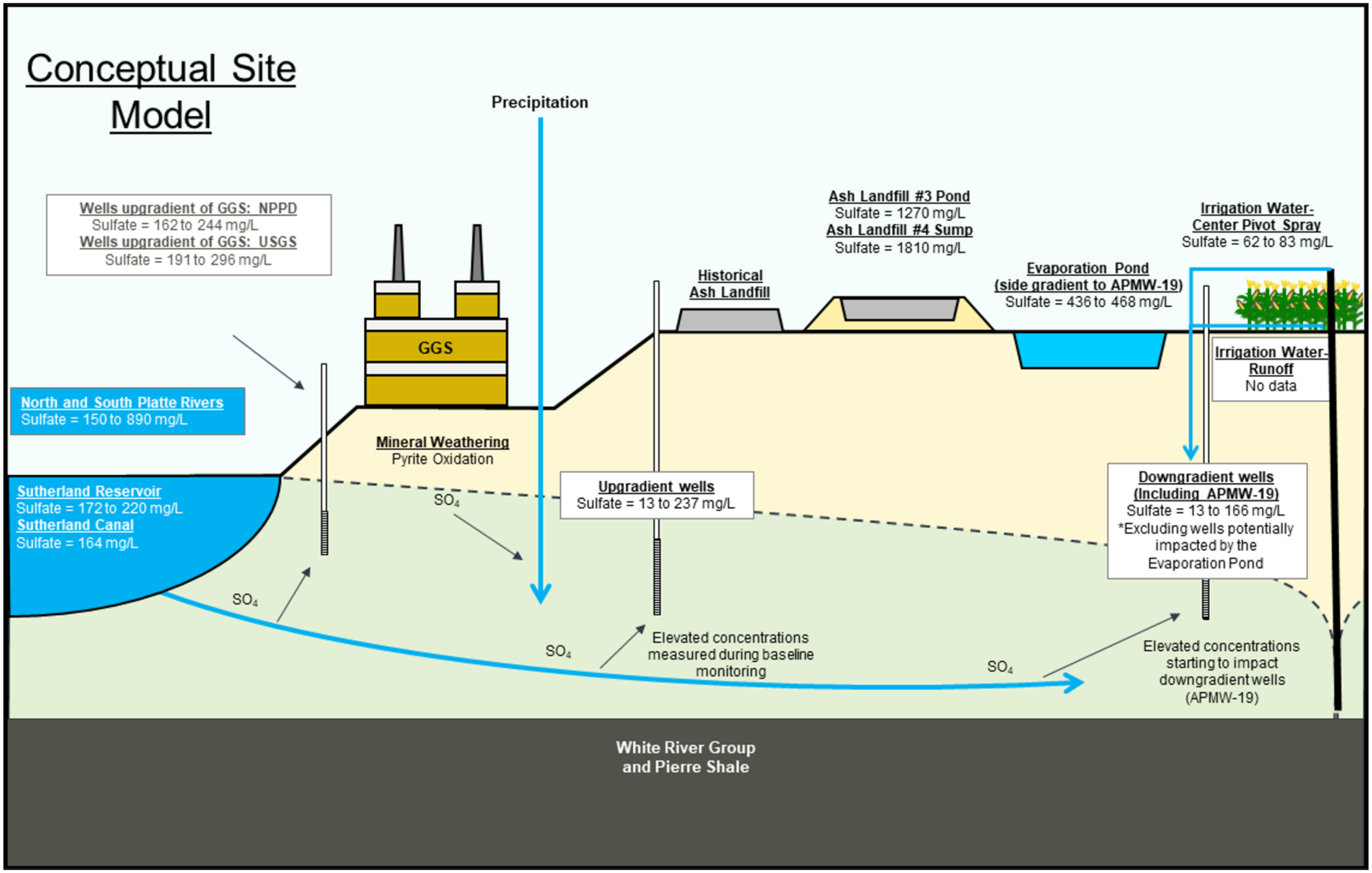

CLIENT

Nebraska Public Power District: Gerald Gentleman Station

PROJECT

Alternate Source Demonstration

CONSULTANT

WSP GOLDER

TITLE

Sulfate Conceptual Site Model

PROJECT NO.	PHASE	REV.	FIGURE
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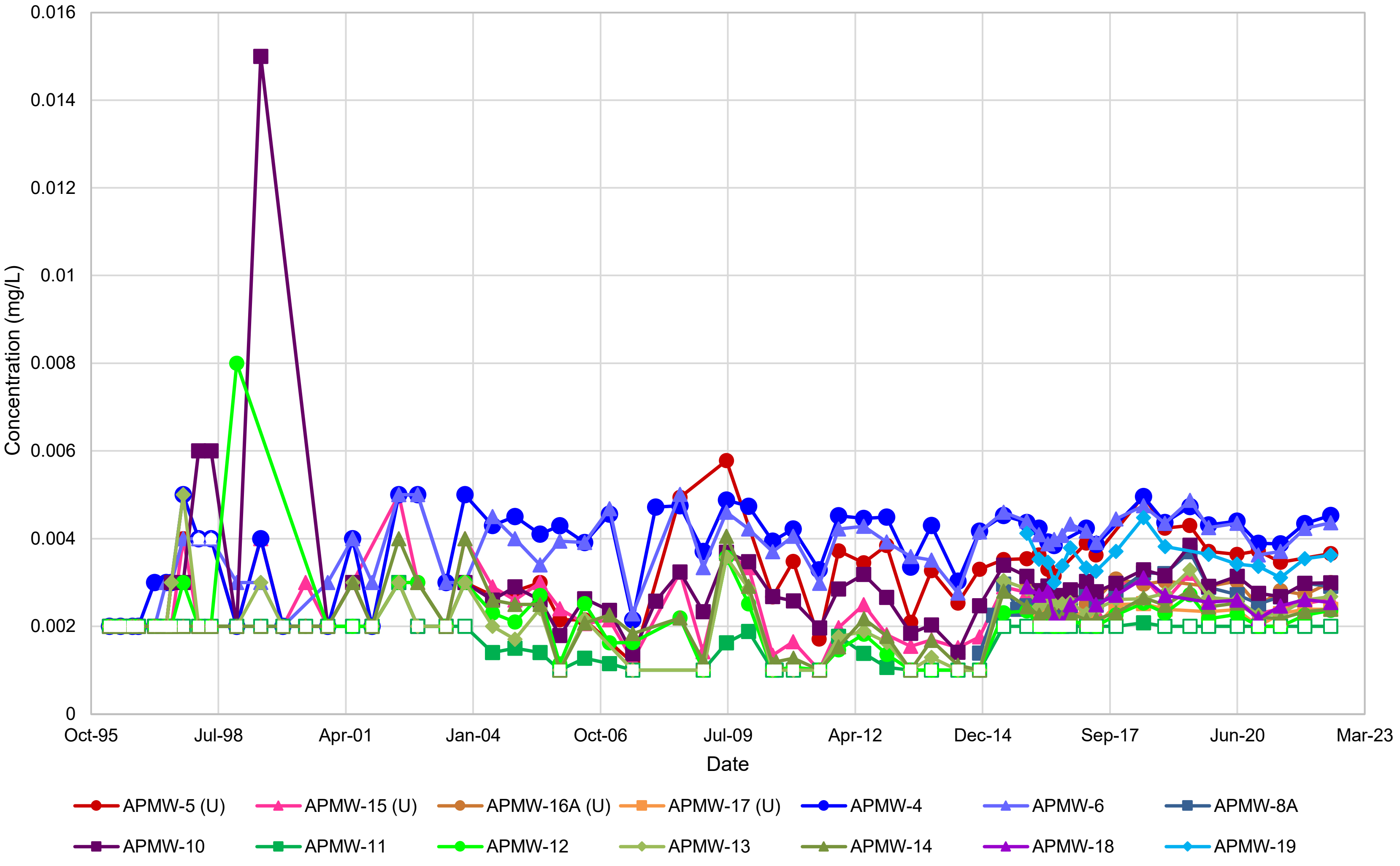
APPENDIX A

Historical Concentrations of Appendix III and Selected Appendix IV Analytes



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-1

Arsenic

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022

31404512.000

Golder Associates USA Inc., A Member of WSP

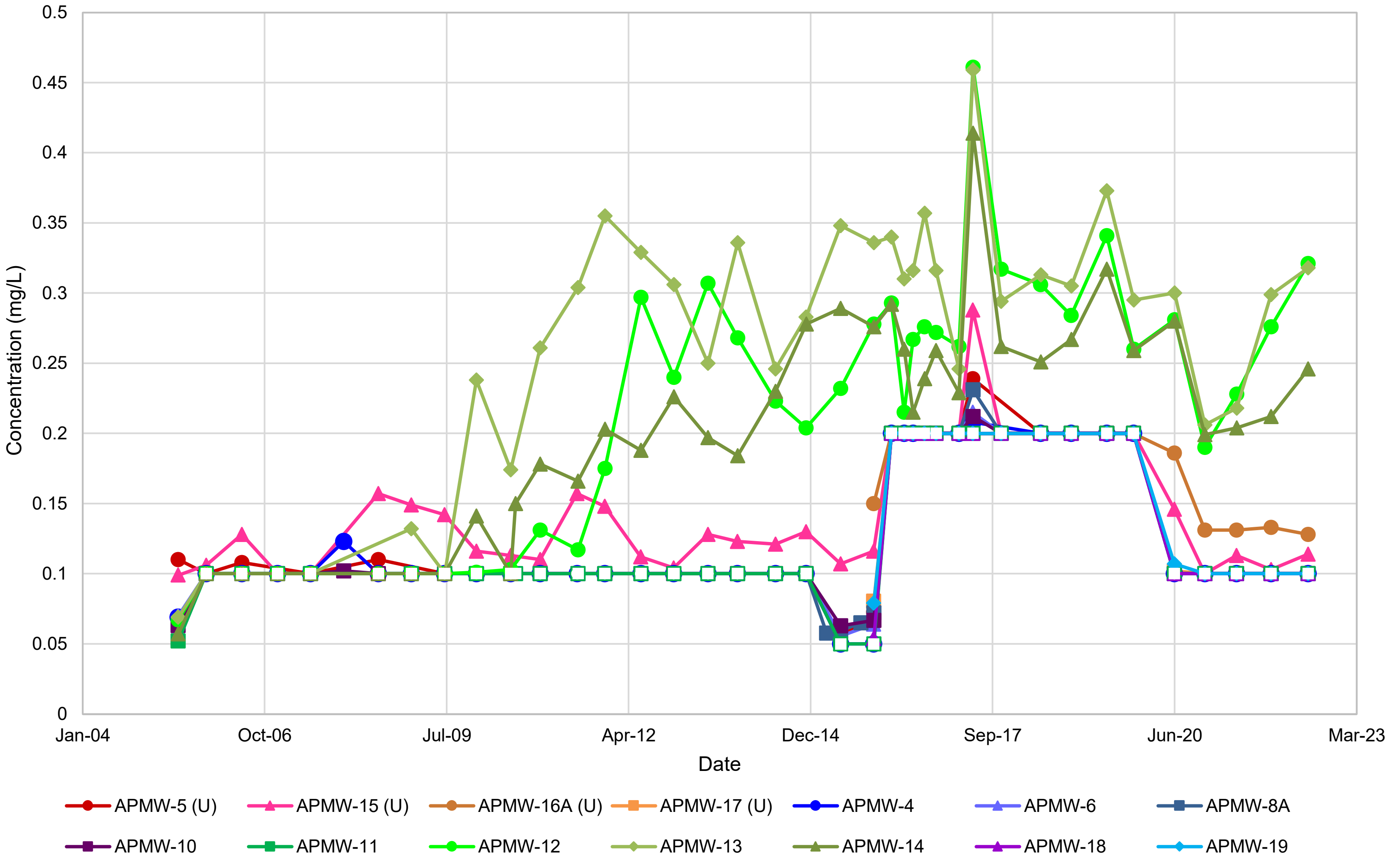


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Figure A-2

Boron

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022

31404512.000

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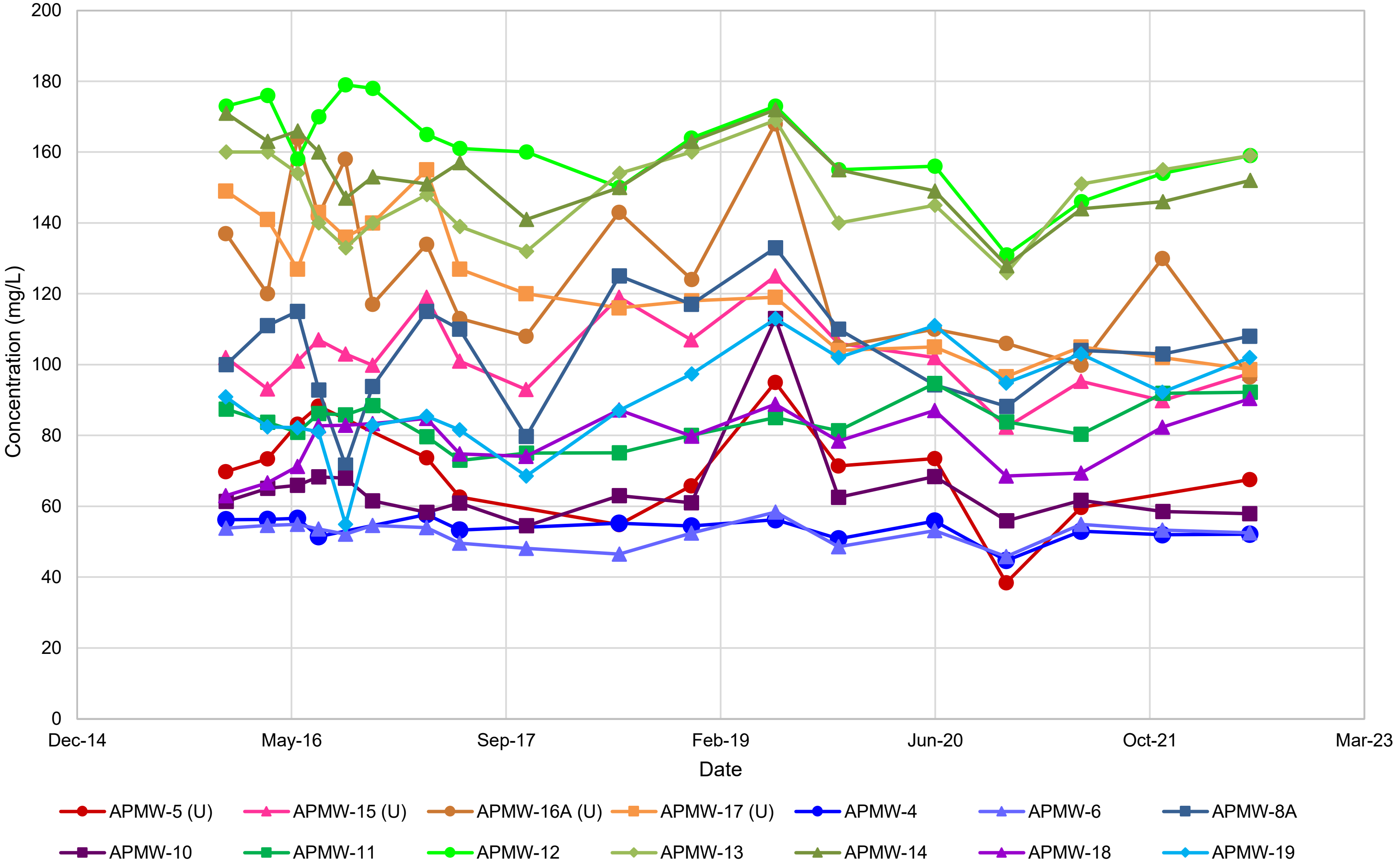

Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-3

Calcium

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022 31404512.000

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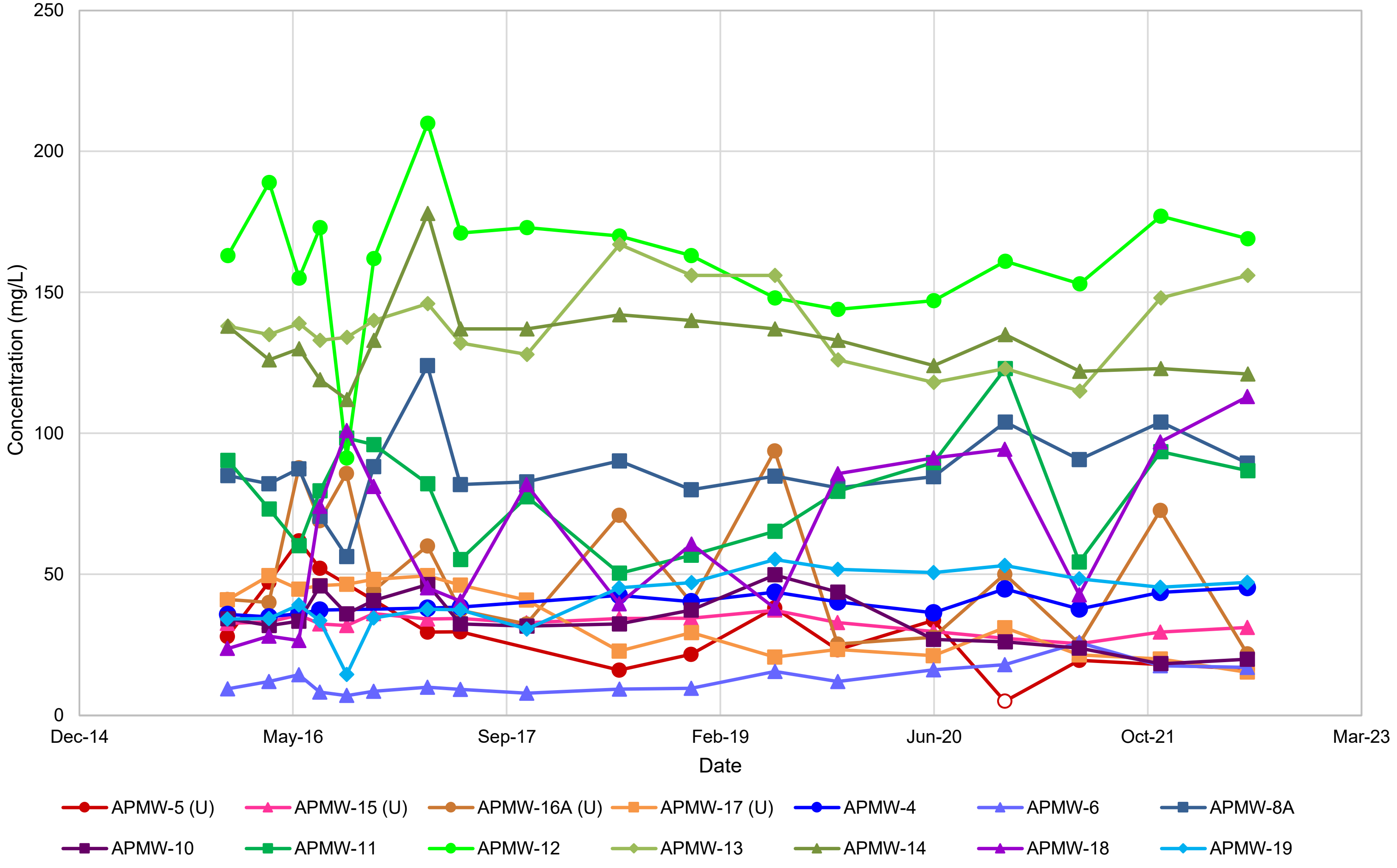

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Figure A-4

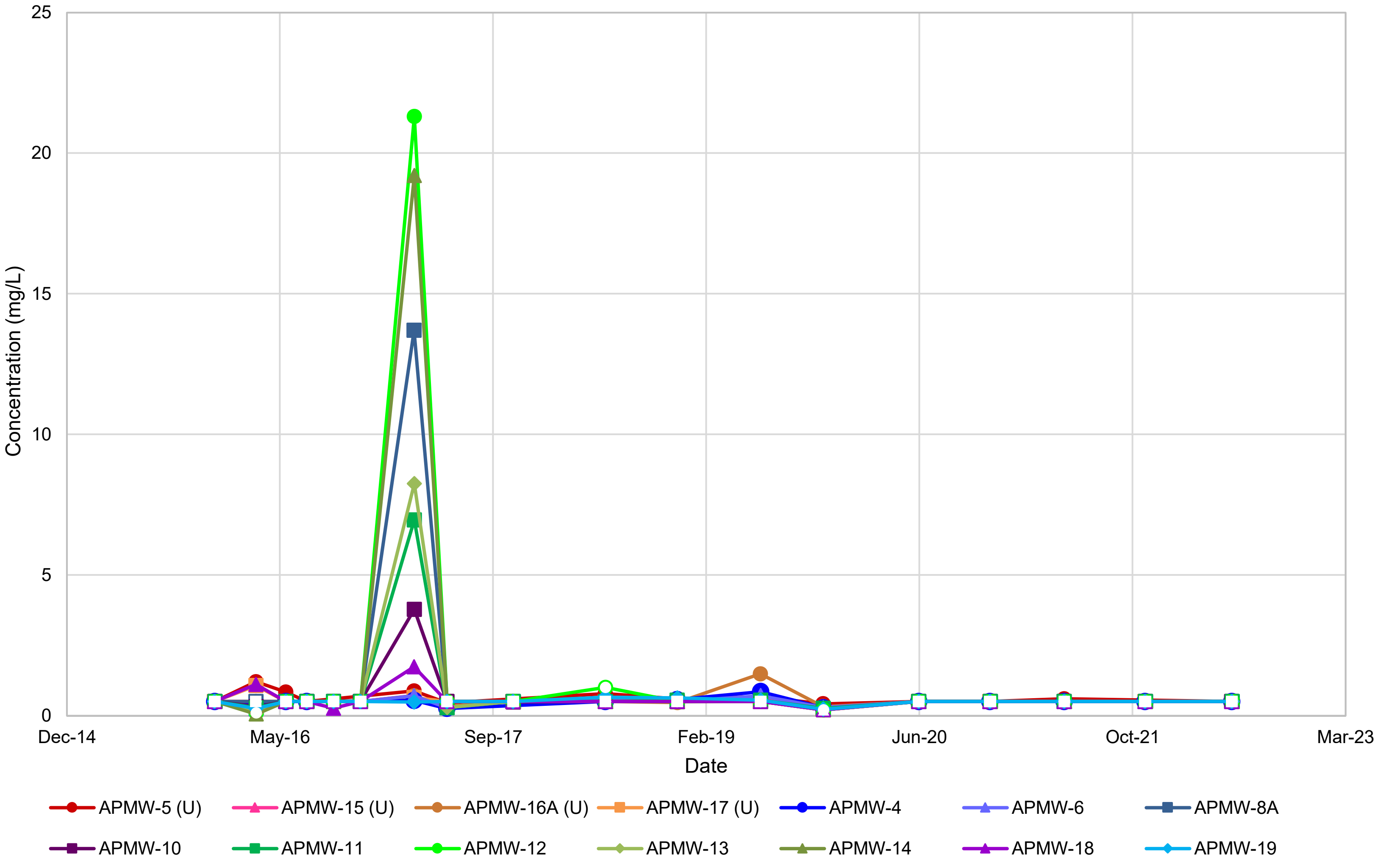
Chloride

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

Golder Associates USA Inc., A Member of WSP



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-5

Fluoride

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022

31404512.000

Golder Associates USA Inc., A Member of WSP

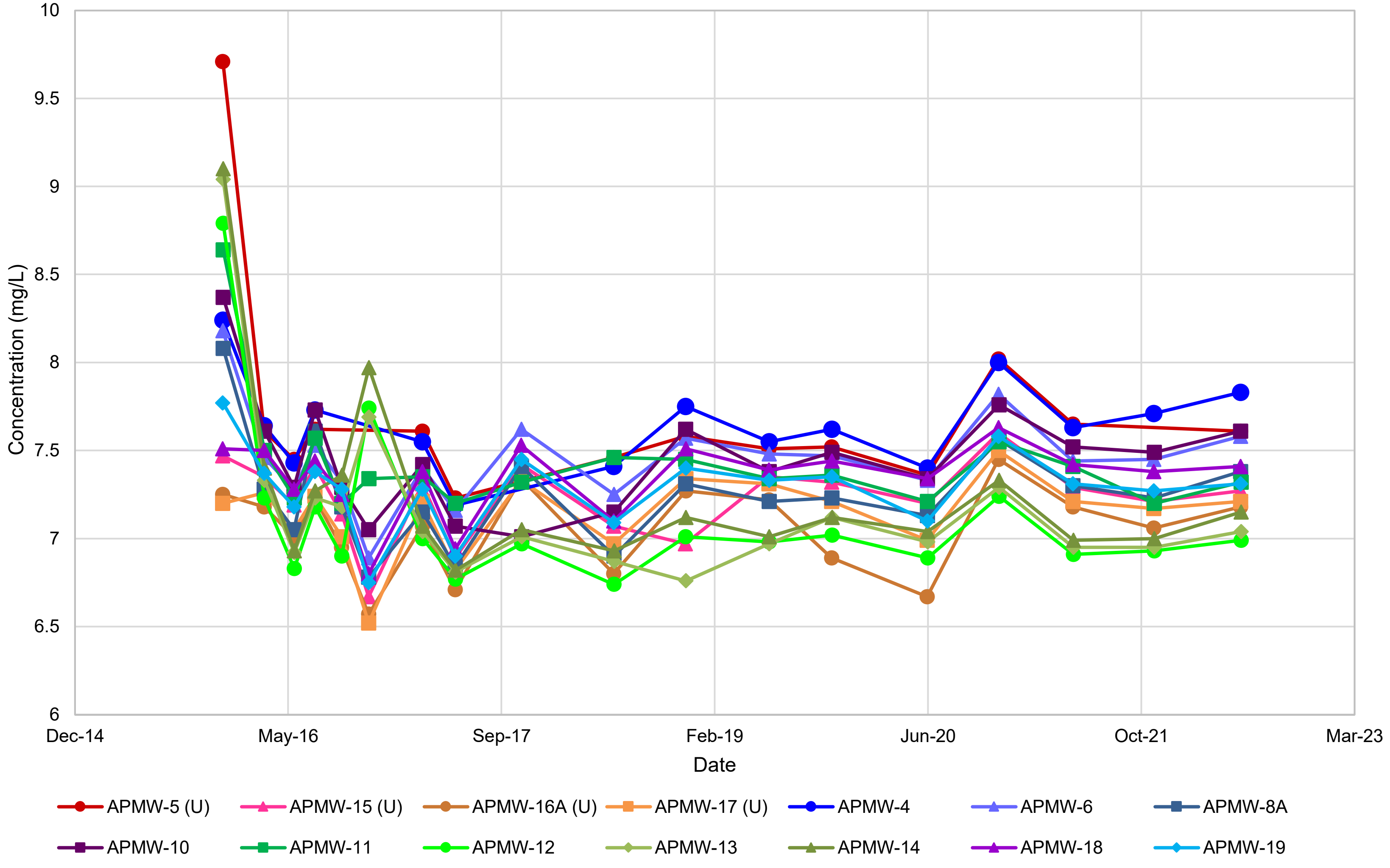


Figure A-6

pH, Field Measured

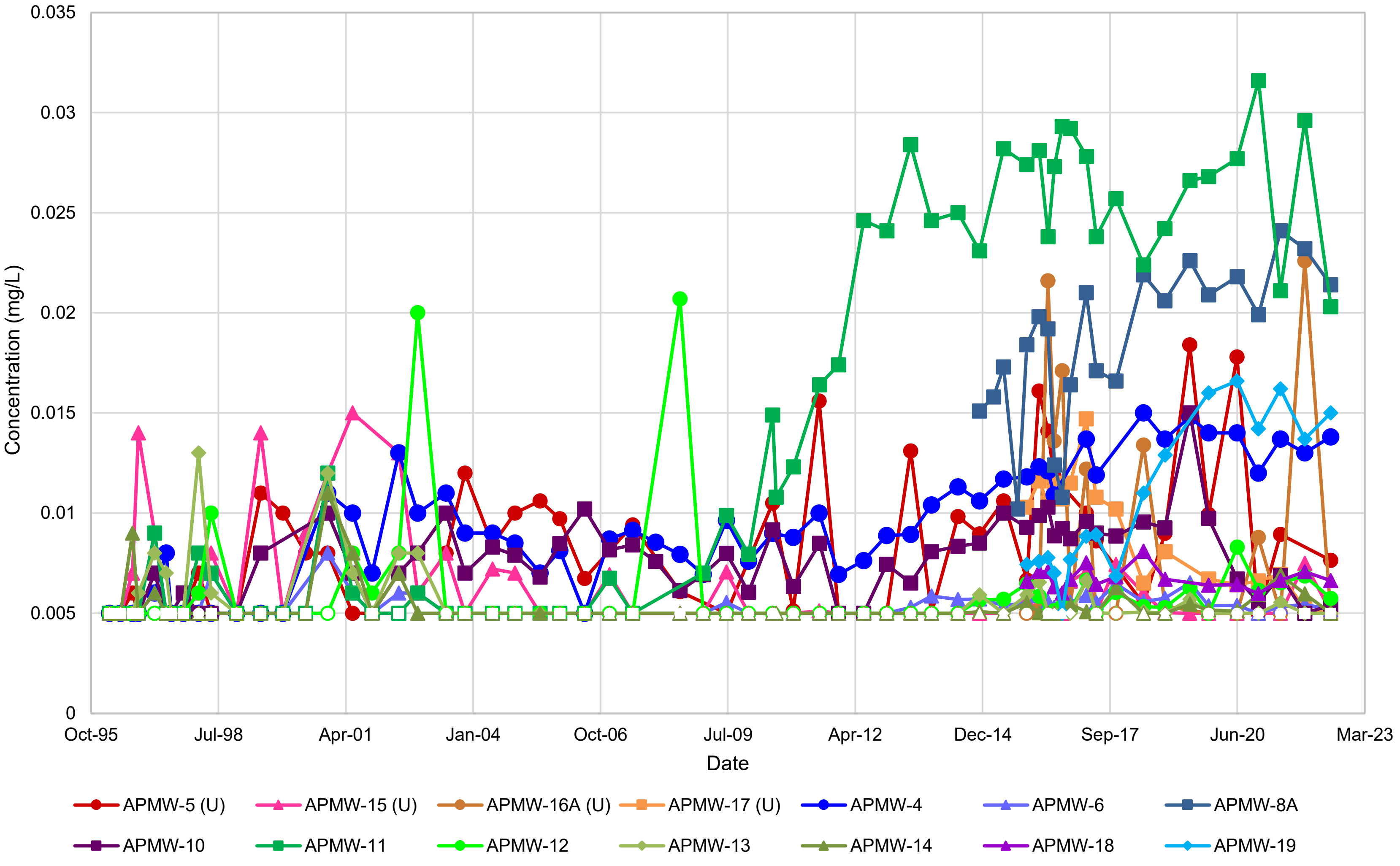
Non-detect values are plotted with an open symbol at the practical quantitation limit.

Nebraska Public Power District
Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022 31404512.000

Golder Associates USA Inc., A Member of WSP



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-7

Selenium

Nebraska Public Power District

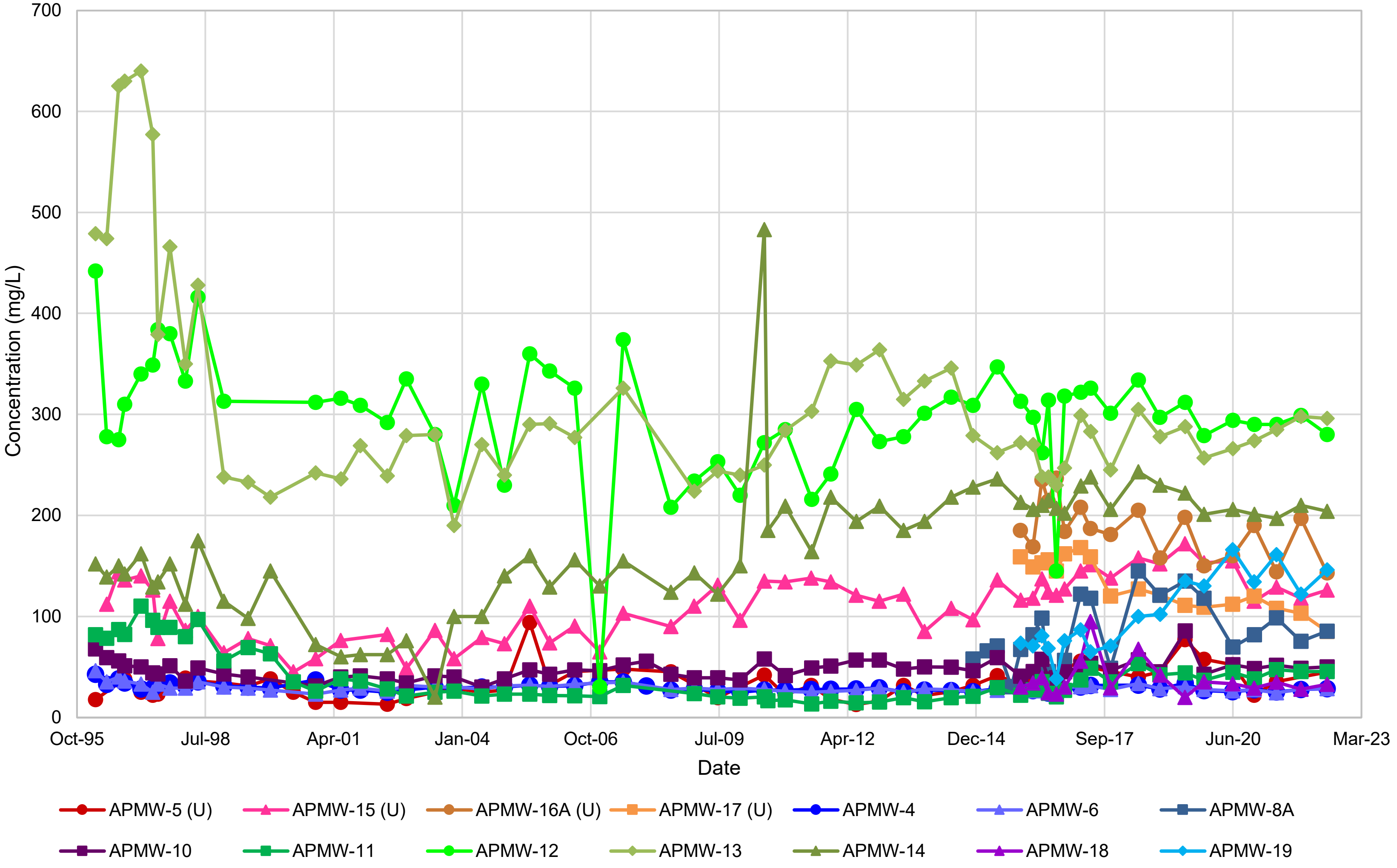
Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022

31404512.000

Golder Associates USA Inc., A Member of WSP



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-8

Sulfate

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022

31404512.000

Golder Associates USA Inc., A Member of WSP

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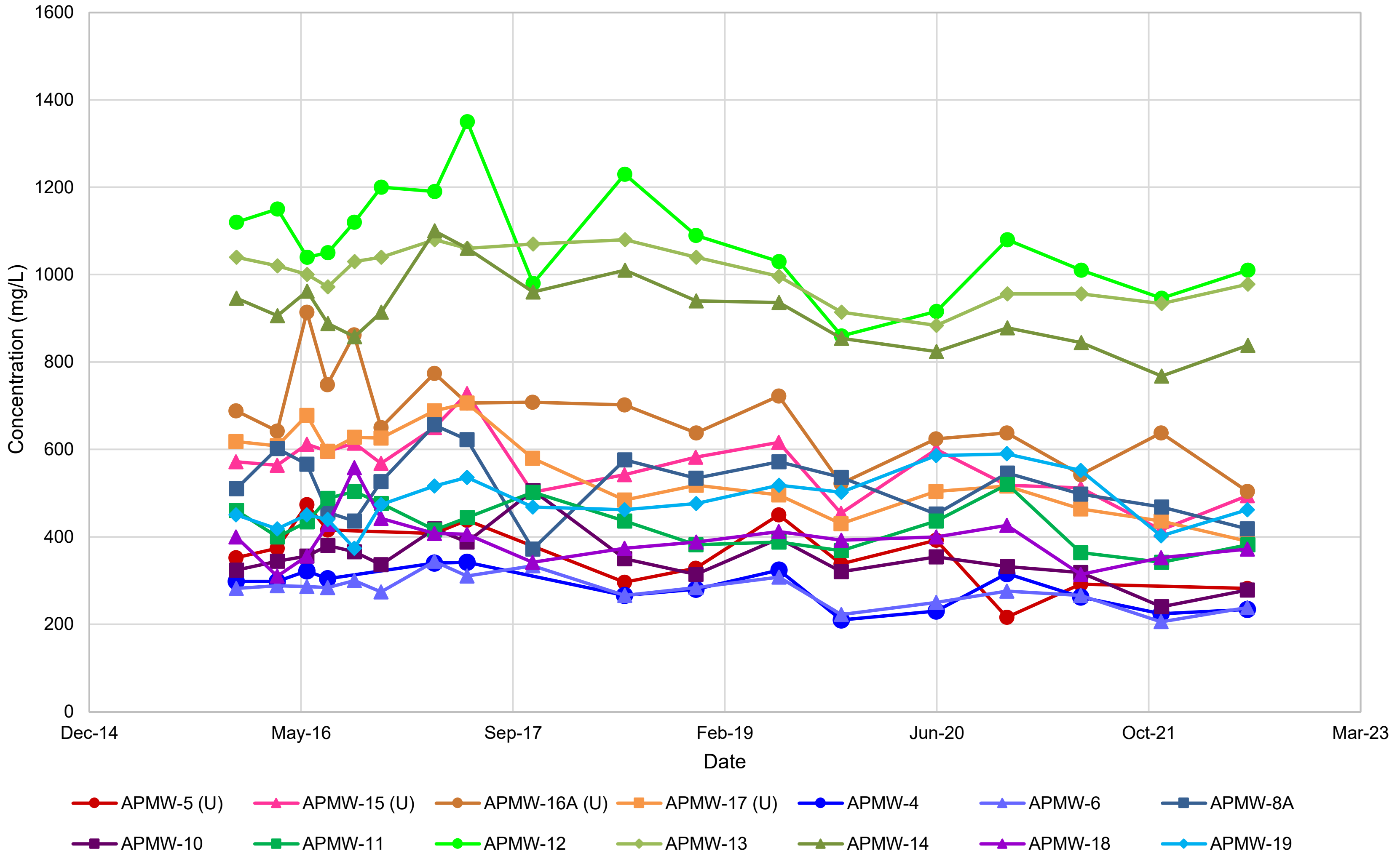


Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-9

Total Dissolved Solids

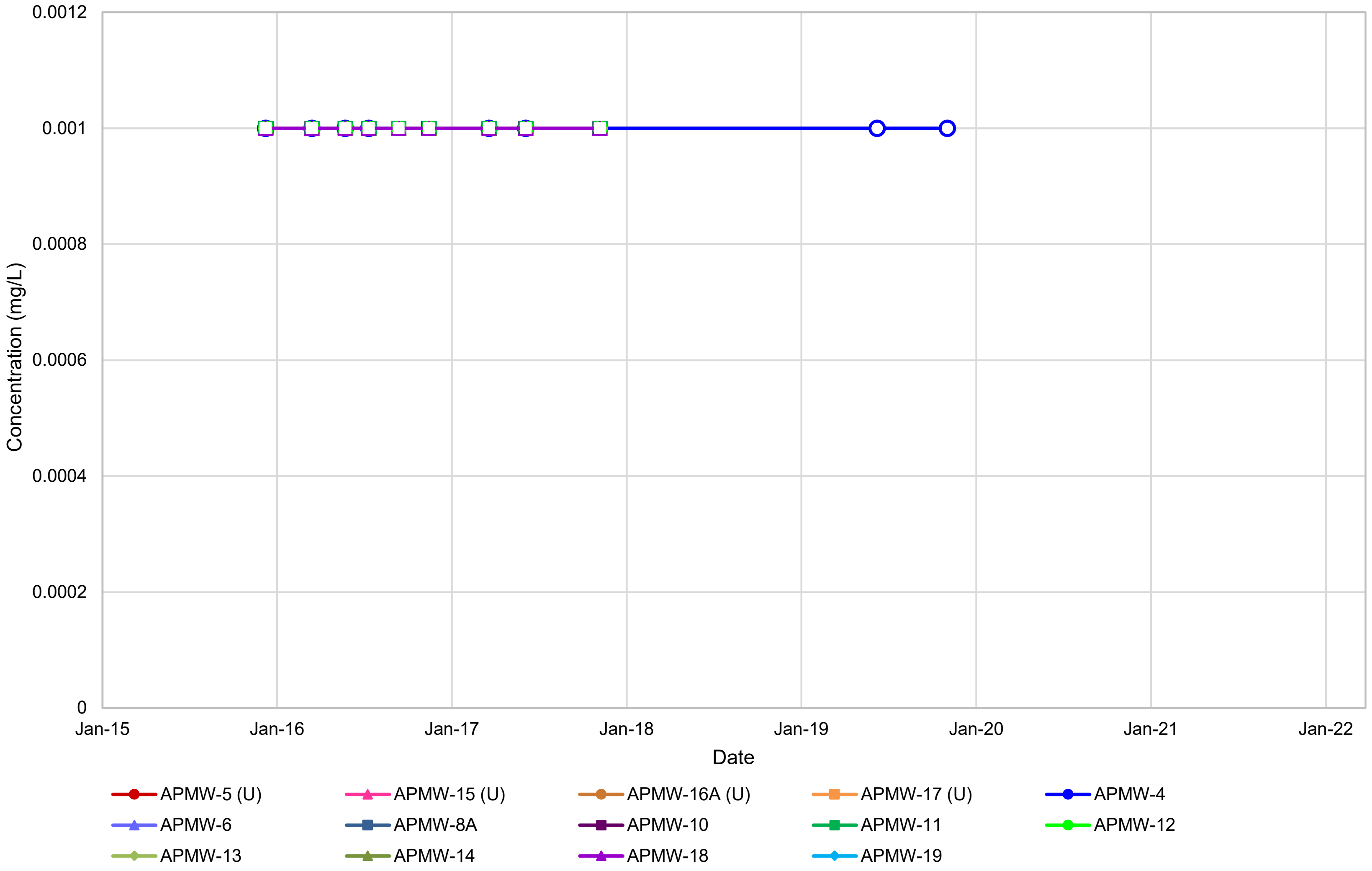
Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022 31404512.000

Golder Associates USA Inc., A Member of WSP



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-10

Antimony

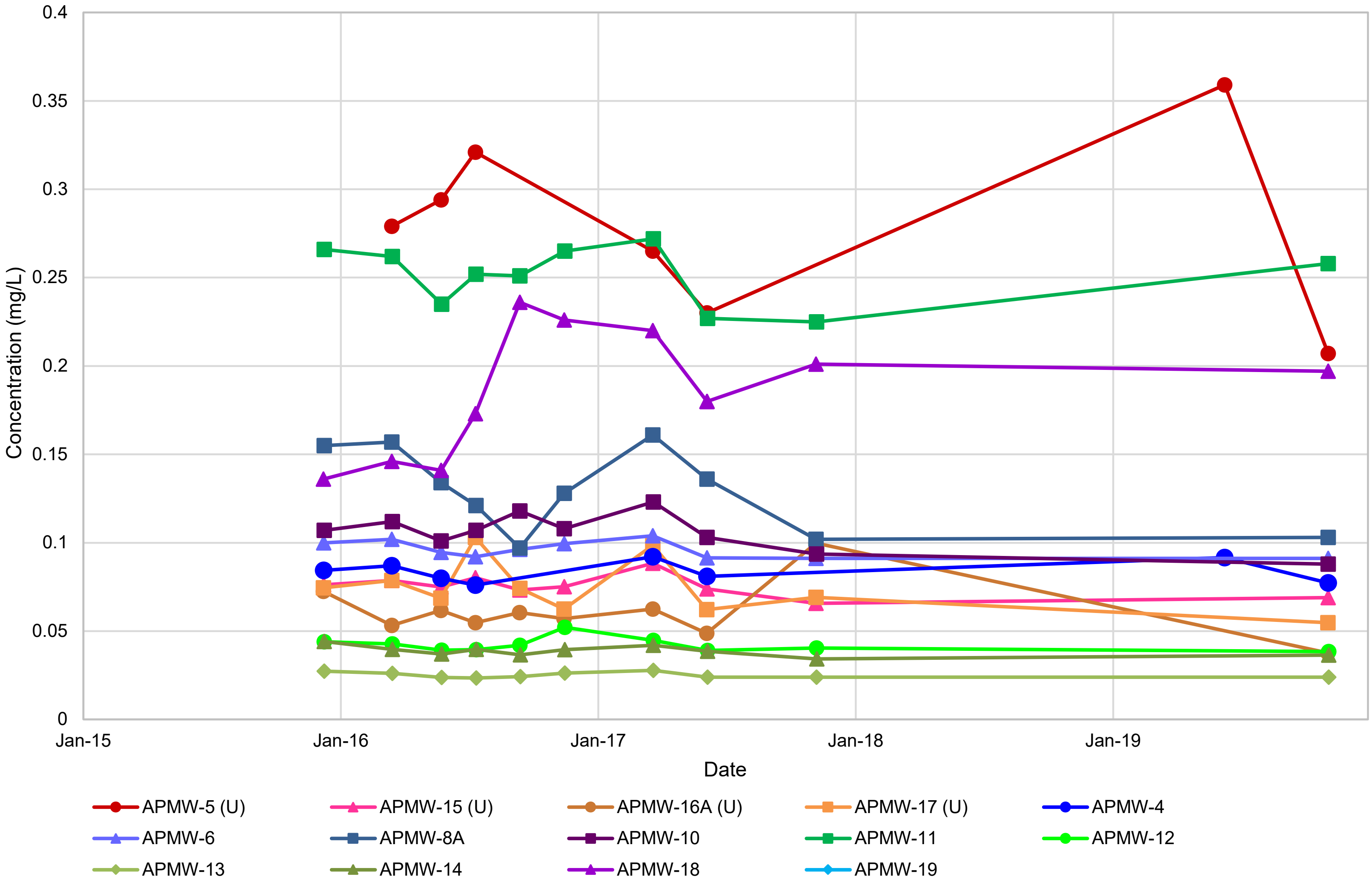
Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022 31404512.000

Golder Associates USA Inc., A Member of WSP



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-11

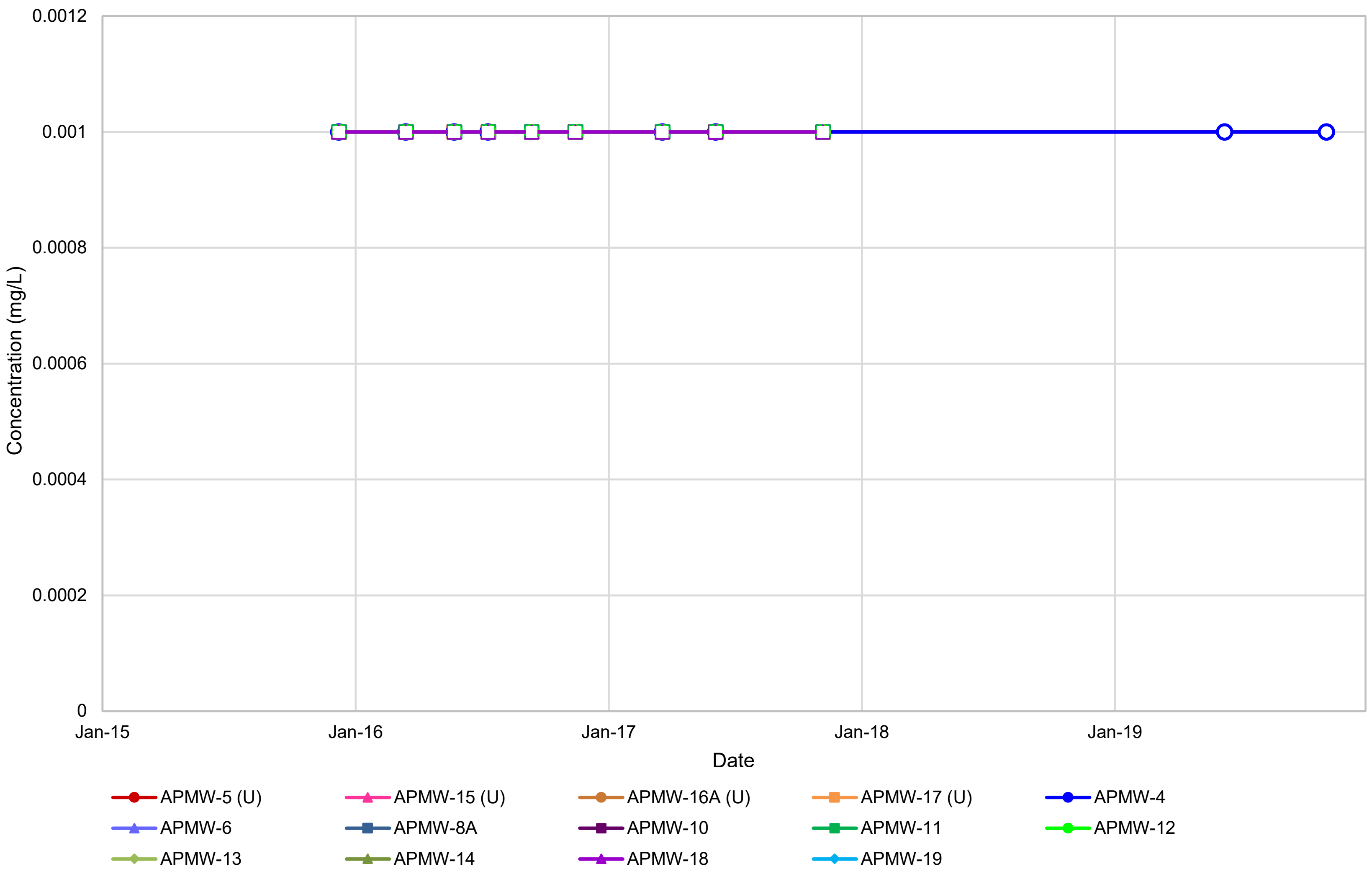
Barium

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

Golder Associates USA Inc., A Member of WSP



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-12

Beryllium

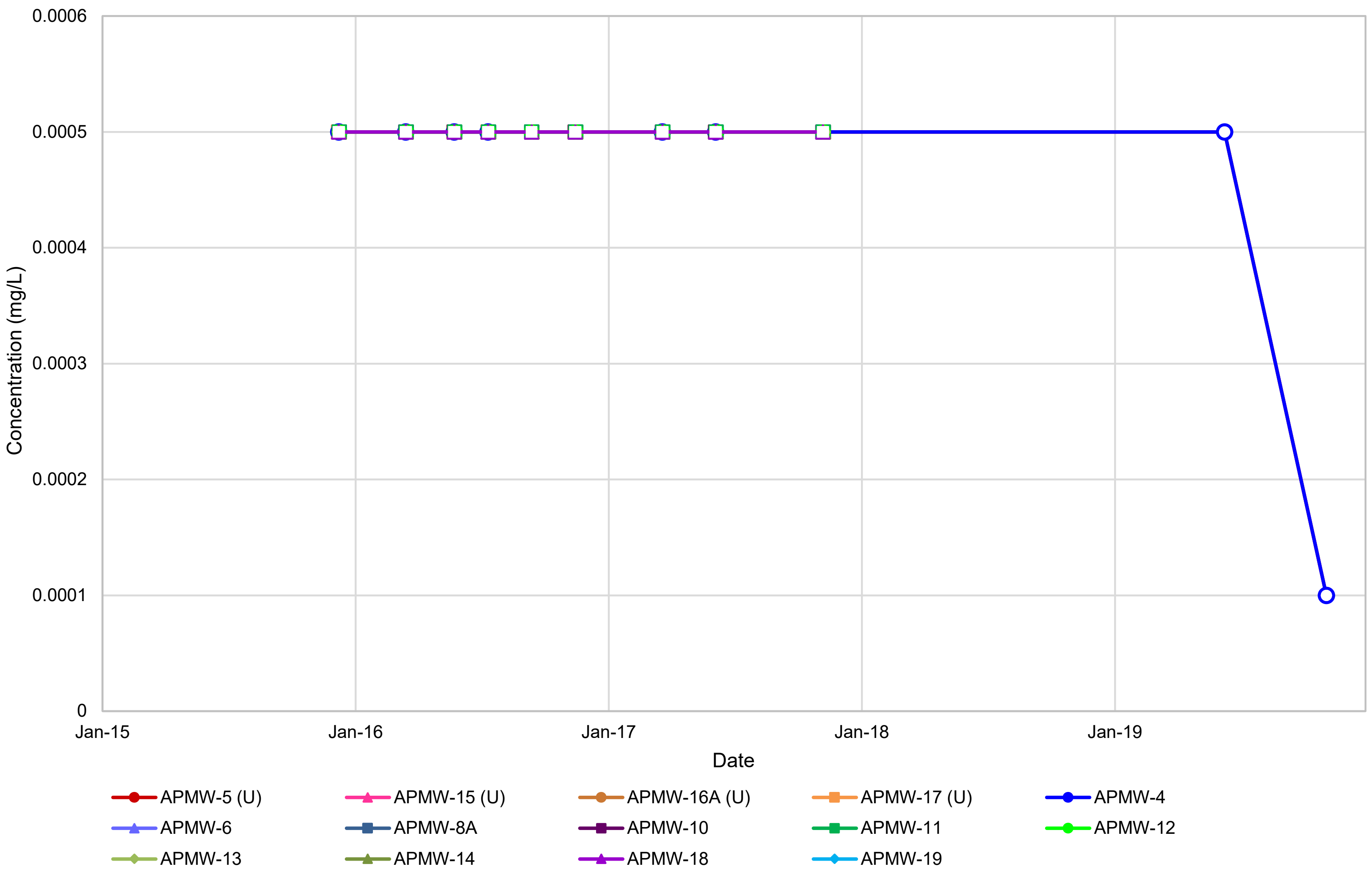
Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022 31404512.000

Golder Associates USA Inc., A Member of WSP



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-13

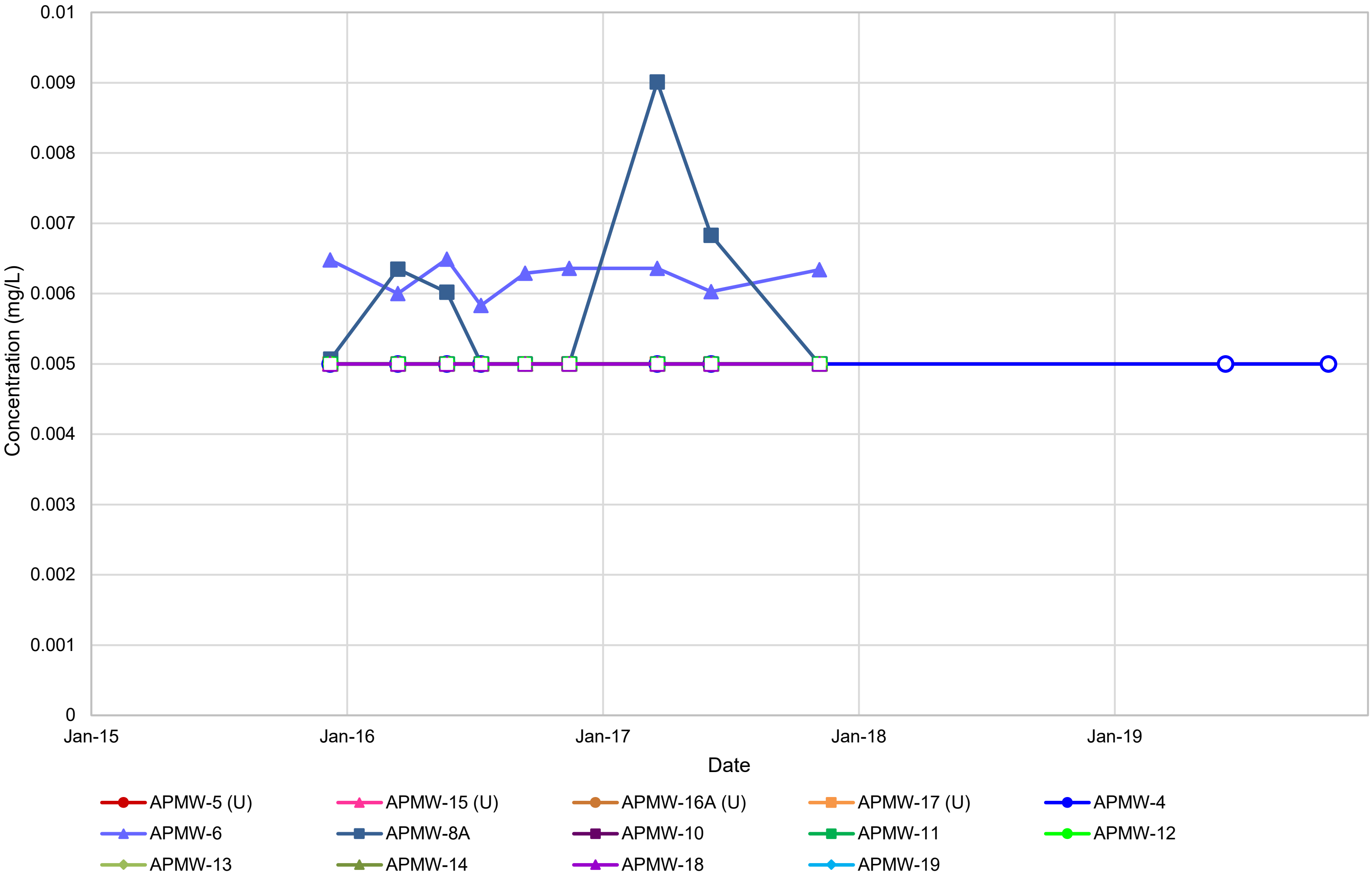
Cadmium

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

Golder Associates USA Inc., A Member of WSP



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-14

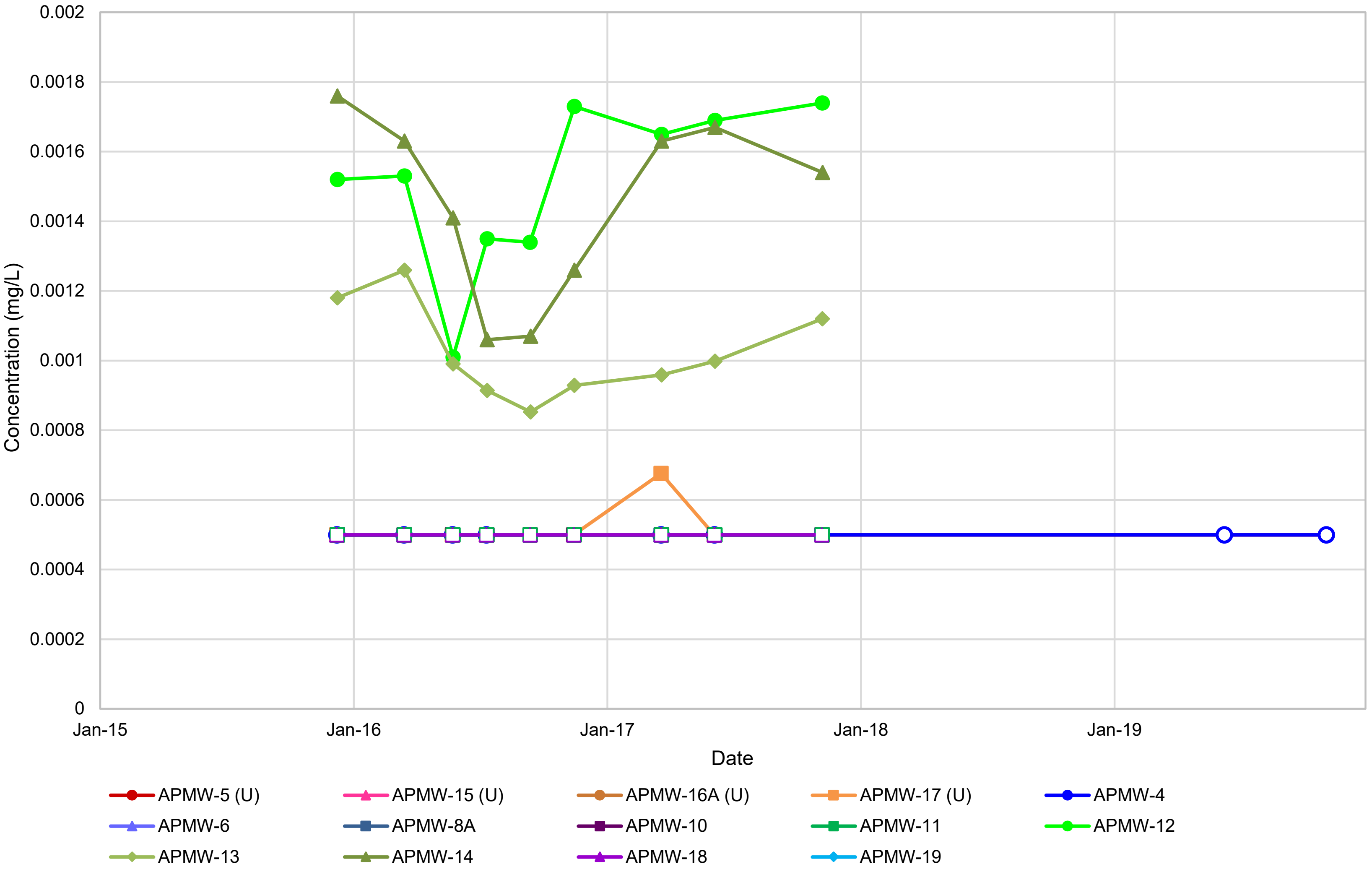
Chromium

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

Golder Associates USA Inc., A Member of WSP



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-15

Cobalt

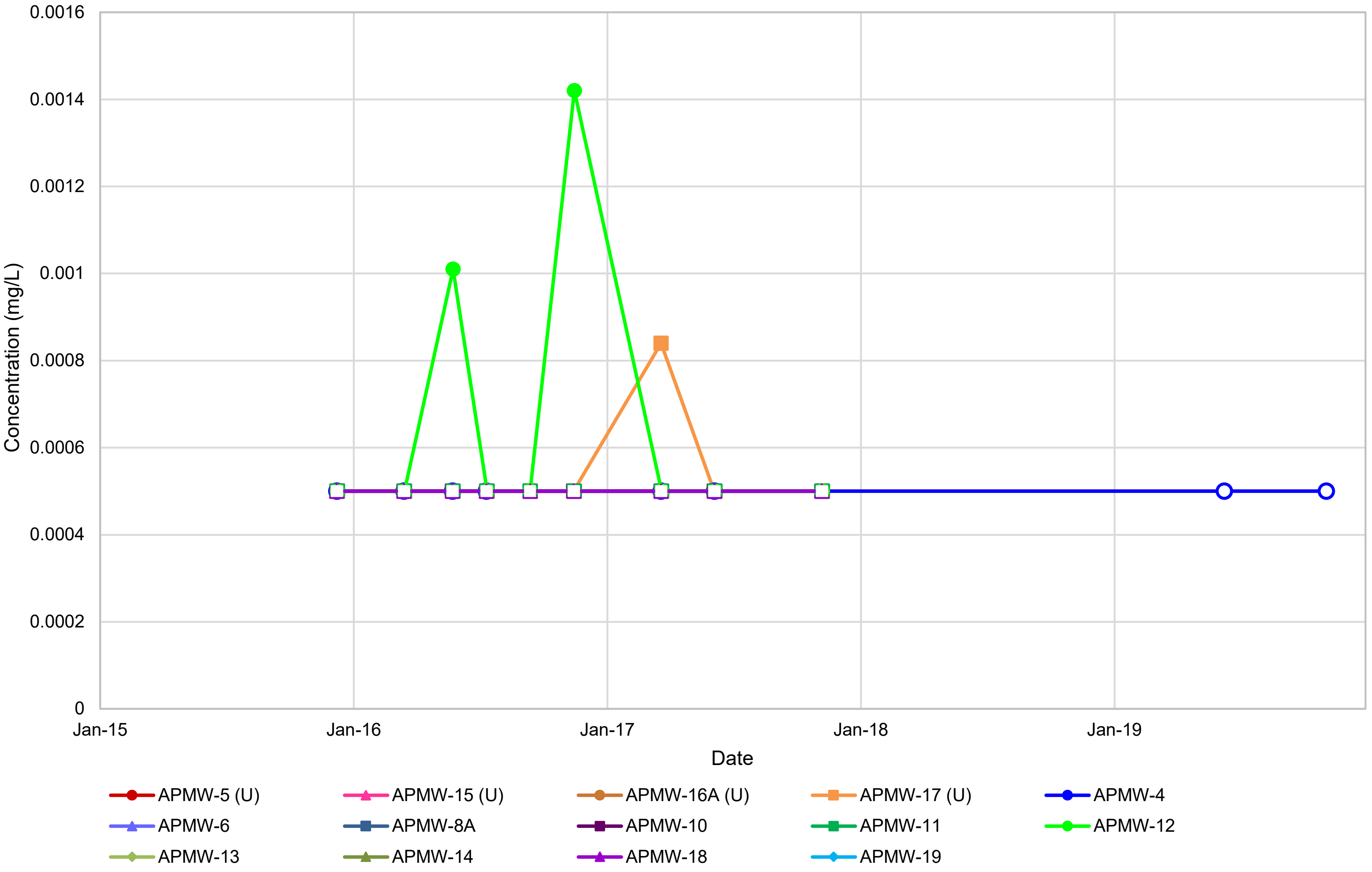
Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022 31404512.000

Golder Associates USA Inc., A Member of WSP



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-16

Lead

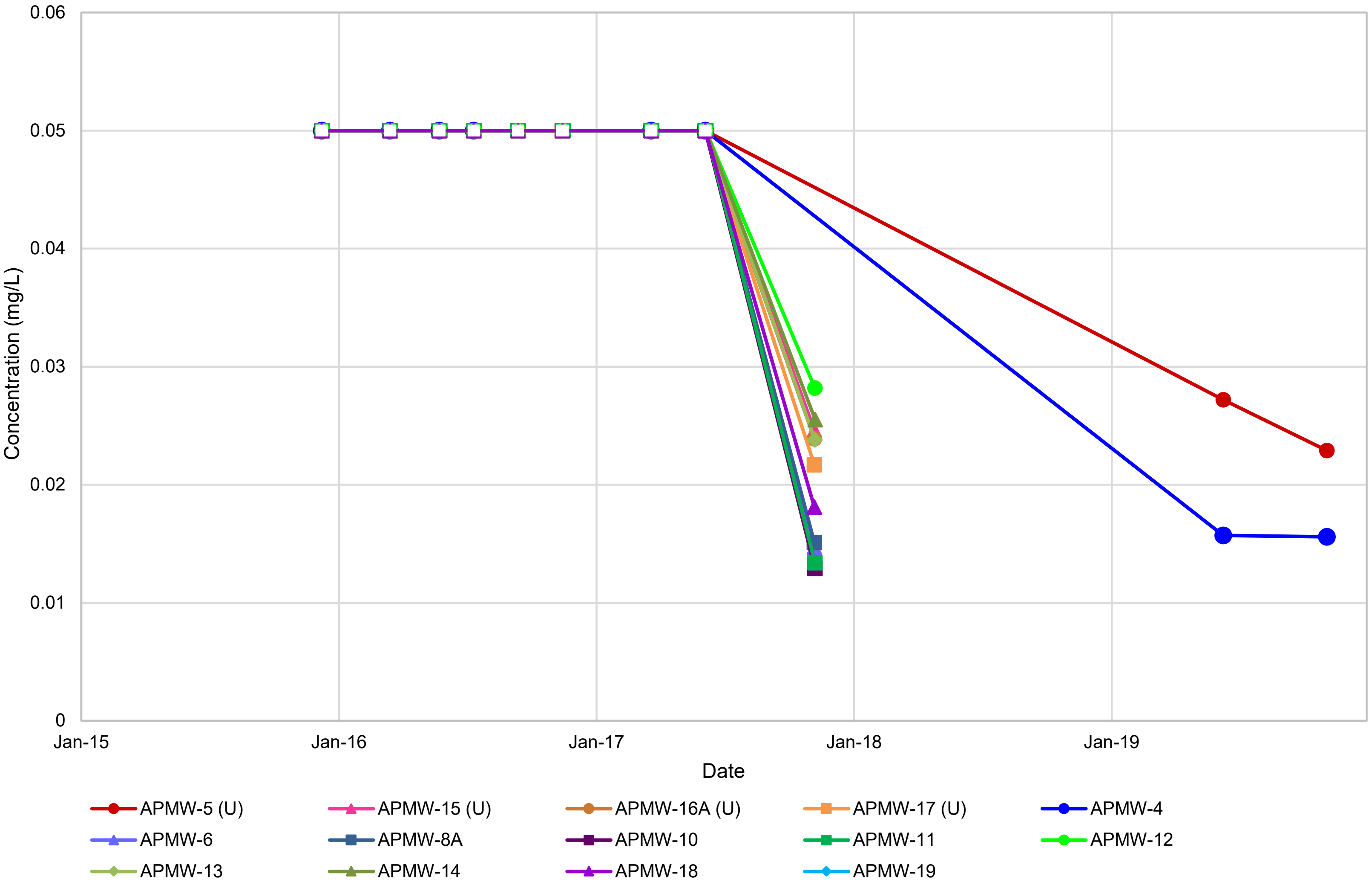
Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022 31404512.000

Golder Associates USA Inc., A Member of WSP



Non-detect values are plotted with an open symbol at the practical quantitation limit.

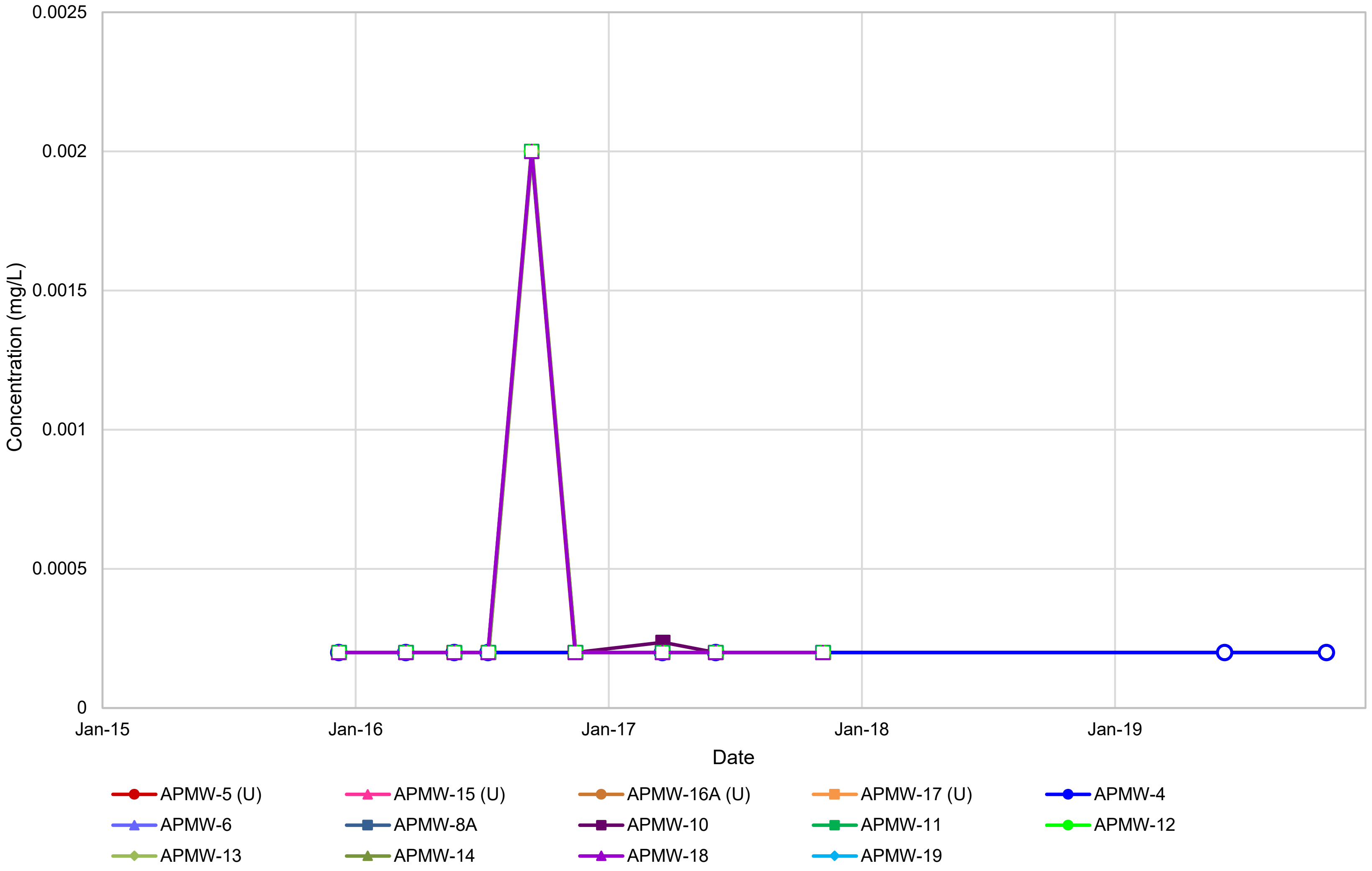
Figure A-17

Lithium

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-18

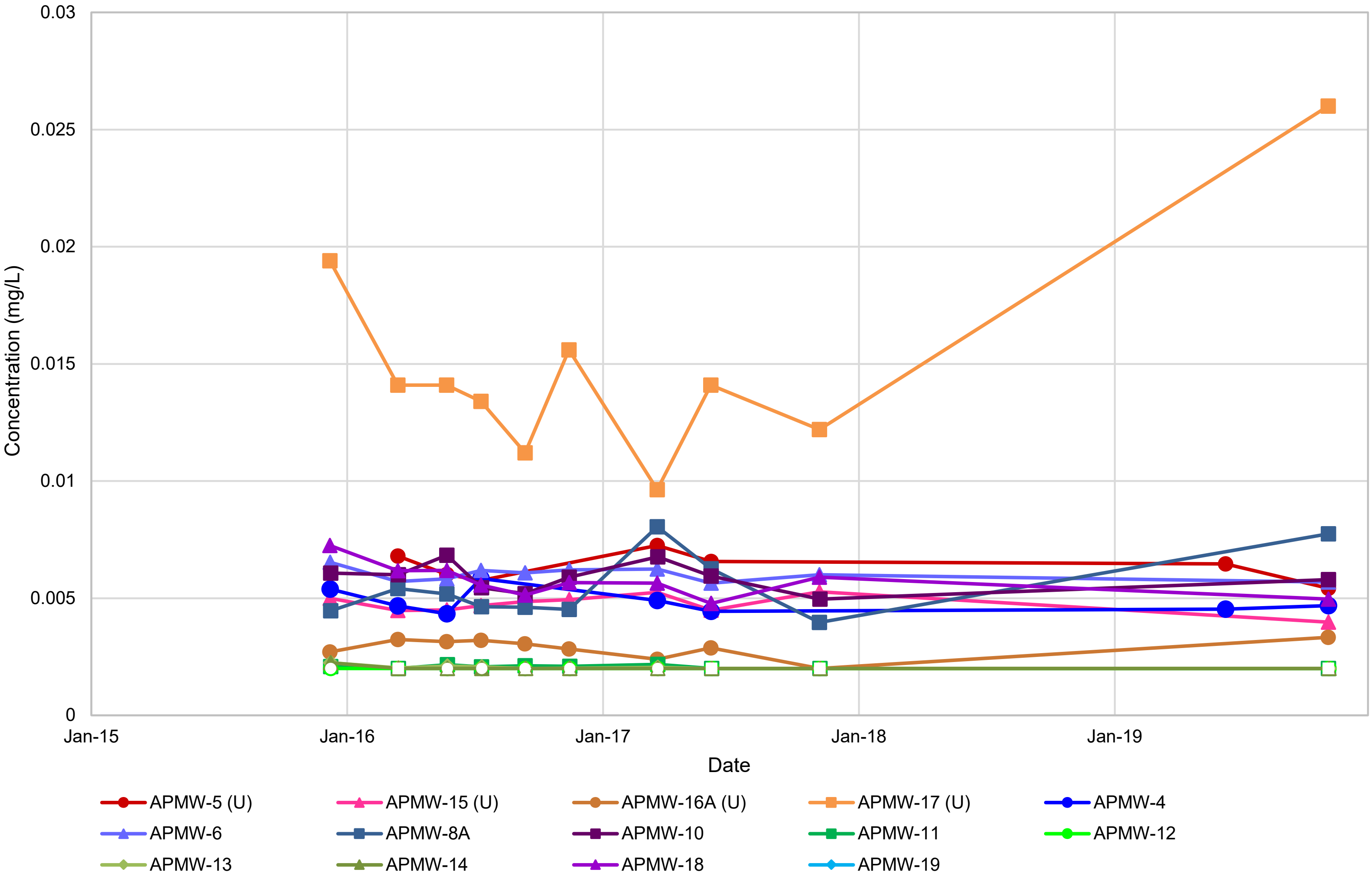
Mercury

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

Golder Associates USA Inc., A Member of WSP



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-19

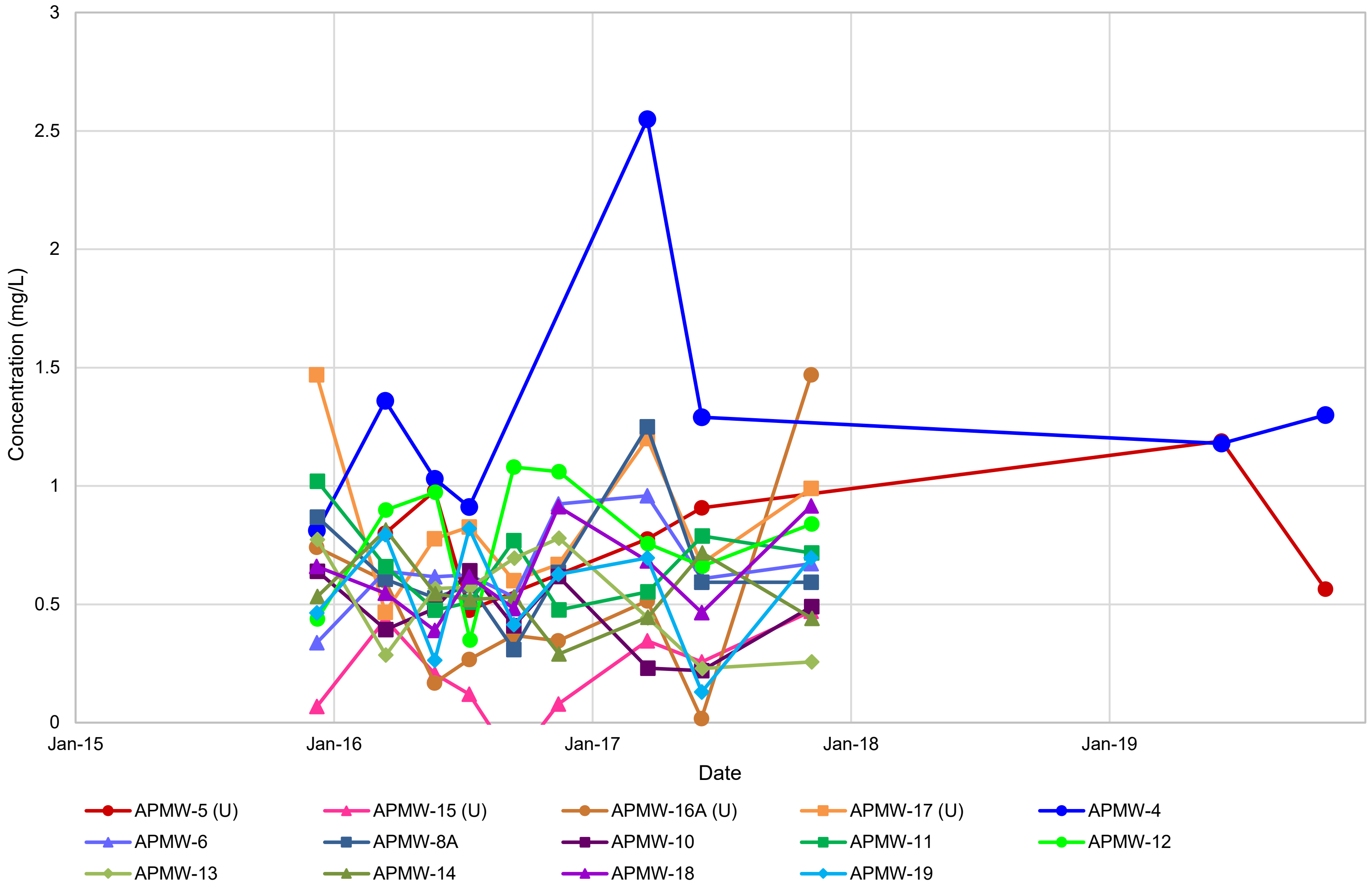
Molybdenum

Nebraska Public Power District
Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022 31404512.000

Golder Associates USA Inc., A Member of WSP



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-20

Radium, Total

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022 31404512.000

Golder Associates USA Inc., A Member of WSP

Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-21

Thallium

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

Golder Associates USA Inc., A Member of WSP

APPENDIX B

Eurofins Laboratory Report for Irrigation Water Samples

eurofins | Environment Testing America

1
2
3
4
5
6
7
8
9
10
11
12
13
14

ANALYTICAL REPORT

Eurofins Cedar Falls
3019 Venture Way
Cedar Falls, IA 50613
Tel: (319)277-2401

Laboratory Job ID: 310-237917-1
Client Project/Site: Irrigation Runoff

For:
Nebraska Public Power District
6089 S Hwy 25
Gerald Gentleman Station South
Sutherland, Nebraska 69165

Attn: Doug Harris

Authorized for release by:
8/24/2022 3:50:48 PM
Brian Graettinger, Lab Director
(319)595-2012
Brian.Graettinger@et.eurofinsus.com

Designee for

Shirley Thompson, Client Service Manager
(319)277-2401
Shirley.Thompson@et.eurofinsus.com

Table of Contents

Case Narrative

Job ID: 310-237917-1

Laboratory: Eurofins Cedar Falls

Narrative

Job Narrative
310-237917-1

Comments
No additional comments.

Receipt
The samples were received on 8/12/2022 8:35 AM. Unless otherwise noted below, the samples arrived in good condition, and where required, properly preserved and on ice. The temperature of the cooler at receipt was -1.6º C.

HPLC/IC
Method 9056A: The following samples were diluted due to the nature of the sample matrix: Road Track (310-237917-1) and Pivot Bucket (310-237917-2). Elevated reporting limits (RLs) are provided.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Metals
Method 6020A: Due to sample matrix effect on the internal standard (ISTD), a dilution was required for the following sample: Road Track (310-237917-1).

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

General Chemistry
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

Sample Summary

Client: Nebraska Public Power District
Project/Site: Irrigation Runoff

Job ID: 310-237917-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
310-237917-1	Road Track	Water	08/11/22 11:00	08/12/22 08:35
310-237917-2	Pivot Bucket	Water	08/11/22 11:05	08/12/22 08:35

Detection Summary

Client Sample ID: Road Track

Lab Sample ID: 310-237917-1

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloride	31.5		5.00		mg/L	5		9056A	Total/NA
Sulfate	61.7		5.00		mg/L	5		9056A	Total/NA
Barium	0.0228		0.00200		mg/L	1		6020A	Total/NA
Boron	0.166	*+	0.100		mg/L	1		6020A	Total/NA
Calcium	71.7		2.00		mg/L	4		6020A	Total/NA
Lithium	0.0464		0.0100		mg/L	1		6020A	Total/NA
Magnesium	16.8		2.00		mg/L	4		6020A	Total/NA
Potassium	8.28		0.500		mg/L	1		6020A	Total/NA
Sodium	28.2		1.00		mg/L	1		6020A	Total/NA
Total Kjeldahl Nitrogen	4.66		1.00		mg/L	1		351.2	Total/NA
Nitrate Nitrite as N	1.69		0.100		mg/L	1		353.2	Total/NA
Alkalinity as CaCO3 to pH 4.5	356		25.0		mg/L	1		SM 2320B	Total/NA
pH	8.1	HF	0.1		SU	1		SM 4500 H+ B	Total/NA

Client Sample ID: Pivot Bucket

Lab Sample ID: 310-237917-2

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloride	34.1		5.00		mg/L	5		9056A	Total/NA
Sulfate	82.8		5.00		mg/L	5		9056A	Total/NA
Barium	0.377		0.00200		mg/L	1		6020A	Total/NA
Calcium	156		0.500		mg/L	1		6020A	Total/NA
Cobalt	0.000798		0.000500		mg/L	1		6020A	Total/NA
Lithium	0.0108		0.0100		mg/L	1		6020A	Total/NA
Magnesium	45.0		0.500		mg/L	1		6020A	Total/NA
Molybdenum	0.00401		0.00200		mg/L	1		6020A	Total/NA
Potassium	8.65		0.500		mg/L	1		6020A	Total/NA
Sodium	86.7		1.00		mg/L	1		6020A	Total/NA
Ammonia as N	0.690		0.500		mg/L	1		350.1	Total/NA
Total Kjeldahl Nitrogen	3.74		1.00		mg/L	1		351.2	Total/NA
Nitrate Nitrite as N	3.89		0.100		mg/L	1		353.2	Total/NA
Alkalinity as CaCO3 to pH 4.5	209		10.0		mg/L	1		SM 2320B	Total/NA
pH	8.2	HF	0.1		SU	1		SM 4500 H+ B	Total/NA

This Detection Summary does not include radiochemical test results.

Client Sample Results

Client Sample ID: Road Track

Lab Sample ID: 310-237917-1

Date Collected: 08/11/22 11:00
Date Received: 08/12/22 08:35
Matrix: Water

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**31.5**		5.00		mg/L			08/22/22 15:34	5
Fluoride	<0.500		0.500		mg/L			08/22/22 15:34	5
Sulfate	**61.7**		5.00		mg/L			08/22/22 15:34	5

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.00200		0.00200		mg/L		08/16/22 08:30	08/18/22 17:47	1
Arsenic	<0.00200		0.00200		mg/L		08/16/22 08:30	08/18/22 17:47	1
Barium	**0.0228**		0.00200		mg/L		08/16/22 08:30	08/18/22 17:47	1
Beryllium	<0.00400		0.00400		mg/L		08/16/22 08:30	08/19/22 16:31	4
Boron	**0.166**	***+**	0.100		mg/L		08/16/22 08:30	08/18/22 17:47	1
Cadmium	<0.000100		0.000100		mg/L		08/16/22 08:30	08/18/22 17:47	1
Calcium	**71.7**		2.00		mg/L		08/16/22 08:30	08/19/22 16:31	4
Chromium	<0.00500		0.00500		mg/L		08/16/22 08:30	08/18/22 17:47	1
Cobalt	<0.000500		0.000500		mg/L		08/16/22 08:30	08/18/22 17:47	1
Lead	<0.000500		0.000500		mg/L		08/16/22 08:30	08/18/22 17:47	1
Lithium	**0.0464**		0.0100		mg/L		08/16/22 08:30	08/18/22 17:47	1
Magnesium	**16.8**		2.00		mg/L		08/16/22 08:30	08/19/22 16:31	4
Molybdenum	<0.00200		0.00200		mg/L		08/16/22 08:30	08/18/22 17:47	1
Potassium	**8.28**		0.500		mg/L		08/16/22 08:30	08/18/22 17:47	1
Selenium	<0.00500		0.00500		mg/L		08/16/22 08:30	08/18/22 17:47	1
Sodium	**28.2**		1.00		mg/L		08/16/22 08:30	08/18/22 17:47	1
Thallium	<0.00100		0.00100		mg/L		08/16/22 08:30	08/18/22 17:47	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.000200		0.000200		mg/L		08/22/22 14:34	08/23/22 12:41	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Ammonia as N	<0.500		0.500		mg/L		08/18/22 09:51	08/18/22 20:31	1
Total Kjeldahl Nitrogen	**4.66**		1.00		mg/L		08/17/22 07:00	08/17/22 19:01	1
Nitrate Nitrite as N	**1.69**		0.100		mg/L			08/16/22 20:12	1
Alkalinity as CaCO3 to pH 4.5	**356**		25.0		mg/L			08/15/22 08:30	1

Analyte	Result	Qualifier	RL	RL	Unit	D	Prepared	Analyzed	Dil Fac
pH	**8.1**	**HF**	0.1		SU			08/12/22 15:15	1

Client Sample ID: Pivot Bucket

Lab Sample ID: 310-237917-2

Date Collected: 08/11/22 11:05
Date Received: 08/12/22 08:35
Matrix: Water

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**34.1**		5.00		mg/L			08/22/22 15:49	5
Fluoride	<0.500		0.500		mg/L			08/22/22 15:49	5
Sulfate	**82.8**		5.00		mg/L			08/22/22 15:49	5

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.00200		0.00200		mg/L		08/16/22 08:30	08/18/22 18:03	1
Arsenic	<0.00200		0.00200		mg/L		08/16/22 08:30	08/18/22 18:03	1
Barium	**0.377**		0.00200		mg/L		08/16/22 08:30	08/18/22 18:03	1
Beryllium	<0.00100		0.00100		mg/L		08/16/22 08:30	08/19/22 16:34	1
Boron	<0.100	*+	0.100		mg/L		08/16/22 08:30	08/18/22 18:03	1
Cadmium	<0.000100		0.000100		mg/L		08/16/22 08:30	08/18/22 18:03	1
Calcium	**156**		0.500		mg/L		08/16/22 08:30	08/18/22 18:03	1
Chromium	<0.00500		0.00500		mg/L		08/16/22 08:30	08/18/22 18:03	1
Cobalt	**0.000798**		0.000500		mg/L		08/16/22 08:30	08/18/22 18:03	1
Lead	<0.000500		0.000500		mg/L		08/16/22 08:30	08/18/22 18:03	1
Lithium	**0.0108**		0.0100		mg/L		08/16/22 08:30	08/18/22 18:03	1
Magnesium	**45.0**		0.500		mg/L		08/16/22 08:30	08/18/22 18:03	1
Molybdenum	**0.00401**		0.00200		mg/L		08/16/22 08:30	08/18/22 18:03	1
Potassium	**8.65**		0.500		mg/L		08/16/22 08:30	08/18/22 18:03	1
Selenium	<0.00500		0.00500		mg/L		08/16/22 08:30	08/18/22 18:03	1
Sodium	**86.7**		1.00		mg/L		08/16/22 08:30	08/18/22 18:03	1
Thallium	<0.00100		0.00100		mg/L		08/16/22 08:30	08/18/22 18:03	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.000200		0.000200		mg/L		08/22/22 14:38	08/23/22 12:48	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Ammonia as N	**0.690**		0.500		mg/L		08/18/22 09:51	08/18/22 20:32	1
Total Kjeldahl Nitrogen	**3.74**		1.00		mg/L		08/17/22 07:00	08/17/22 19:02	1
Nitrate Nitrite as N	**3.89**		0.100		mg/L			08/16/22 20:13	1
Alkalinity as CaCO3 to pH 4.5	**209**		10.0		mg/L			08/15/22 08:30	1

Analyte	Result	Qualifier	RL	RL	Unit	D	Prepared	Analyzed	Dil Fac
pH	**8.2**	**HF**	0.1		SU			08/12/22 15:21	1

Definitions/Glossary

Client: Nebraska Public Power District
Project/Site: Irrigation Runoff

Job ID: 310-237917-1

Qualifiers

Metals

Qualifier	Qualifier Description
*+	LCS and/or LCSD is outside acceptance limits, high biased.

General Chemistry

Qualifier	Qualifier Description
HF	Field parameter with a holding time of 15 minutes. Test performed by laboratory at client's request.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)
TNTC	Too Numerous To Count

Method: 9056A - Anions, Ion Chromatography

Lab Sample ID: MB 310-363601/3
Matrix: Water
Analysis Batch: 363601

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	<1.00		1.00		mg/L			08/22/22 10:23	1
Fluoride	<0.100		0.100		mg/L			08/22/22 10:23	1
Sulfate	<1.00		1.00		mg/L			08/22/22 10:23	1

Lab Sample ID: LCS 310-363601/4
Matrix: Water
Analysis Batch: 363601

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits		
Chloride			10.0	10.06		mg/L		101	90 - 110		
Fluoride			2.00	2.035		mg/L		102	90 - 110		
Sulfate			10.0	10.08		mg/L		101	90 - 110		

Method: 6020A - Metals (ICP/MS)

Lab Sample ID: MB 310-362614/1-A
Matrix: Water
Analysis Batch: 362935

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 362614

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.00200		0.00200		mg/L		08/16/22 08:30	08/17/22 14:51	1
Arsenic	<0.00200		0.00200		mg/L		08/16/22 08:30	08/17/22 14:51	1
Barium	<0.00200		0.00200		mg/L		08/16/22 08:30	08/17/22 14:51	1
Beryllium	<0.00100		0.00100		mg/L		08/16/22 08:30	08/17/22 14:51	1
Boron	<0.100		0.100		mg/L		08/16/22 08:30	08/17/22 14:51	1
Cadmium	<0.000100		0.000100		mg/L		08/16/22 08:30	08/17/22 14:51	1
Calcium	<0.500		0.500		mg/L		08/16/22 08:30	08/17/22 14:51	1
Chromium	<0.00500		0.00500		mg/L		08/16/22 08:30	08/17/22 14:51	1
Cobalt	<0.000500		0.000500		mg/L		08/16/22 08:30	08/17/22 14:51	1
Lead	<0.000500		0.000500		mg/L		08/16/22 08:30	08/17/22 14:51	1
Magnesium	<0.500		0.500		mg/L		08/16/22 08:30	08/17/22 14:51	1
Molybdenum	<0.00200		0.00200		mg/L		08/16/22 08:30	08/17/22 14:51	1
Potassium	<0.500		0.500		mg/L		08/16/22 08:30	08/17/22 14:51	1
Selenium	<0.00500		0.00500		mg/L		08/16/22 08:30	08/17/22 14:51	1
Sodium	<1.00		1.00		mg/L		08/16/22 08:30	08/17/22 14:51	1
Thallium	<0.00100		0.00100		mg/L		08/16/22 08:30	08/17/22 14:51	1

Lab Sample ID: MB 310-362614/1-A
Matrix: Water
Analysis Batch: 363247

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 362614

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Lithium	<0.0100		0.0100		mg/L		08/16/22 08:30	08/19/22 16:24	1

Lab Sample ID: LCS 310-362614/2-A
Matrix: Water
Analysis Batch: 362935

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 362614

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits		
Antimony			0.200	0.2356		mg/L		118	80 - 120		

QC Sample Results

Client: Nebraska Public Power District
Project/Site: Irrigation Runoff

Job ID: 310-237917-1

Method: 6020A - Metals (ICP/MS) (Continued)

Lab Sample ID: LCS 310-362614/2-A
Matrix: Water
Analysis Batch: 362935

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 362614

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Arsenic	0.200	0.2068		mg/L		103	80 - 120
Barium	0.100	0.1131		mg/L		113	80 - 120
Beryllium	0.100	0.1097		mg/L		110	80 - 120
Cadmium	0.100	0.1050		mg/L		105	80 - 120
Calcium	2.00	1.612		mg/L		81	80 - 120
Chromium	0.100	0.1047		mg/L		105	80 - 120
Cobalt	0.100	0.1036		mg/L		104	80 - 120
Lead	0.200	0.2116		mg/L		106	80 - 120
Magnesium	2.00	2.050		mg/L		102	80 - 120
Molybdenum	0.200	0.2236		mg/L		112	80 - 120
Potassium	2.00	2.059		mg/L		103	80 - 120
Selenium	0.400	0.3907		mg/L		98	80 - 120
Sodium	2.00	2.207		mg/L		110	80 - 120
Thallium	0.200	0.2293		mg/L		115	80 - 120

Lab Sample ID: LCS 310-362614/2-A
Matrix: Water
Analysis Batch: 363247

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 362614

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Lithium	0.200	0.2192		mg/L		110	80 - 120

Lab Sample ID: LCS 310-362614/2-A
Matrix: Water
Analysis Batch: 363273

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 362614

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Boron	0.200	0.2190		mg/L		109	80 - 120

Method: 7470A - Mercury (CVAA)

Lab Sample ID: MB 310-363323/1-A
Matrix: Water
Analysis Batch: 363477

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 363323

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.000200		0.000200		mg/L		08/22/22 14:34	08/23/22 11:44	1

Lab Sample ID: LCS 310-363323/2-A
Matrix: Water
Analysis Batch: 363477

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 363323

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Mercury	0.00167	0.001689		mg/L		101	80 - 120

Method: 7470A - Mercury (CVAA) (Continued)

Lab Sample ID: MB 310-363324/1-A
Matrix: Water
Analysis Batch: 363477

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 363324

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.000200		0.000200		mg/L		08/22/22 14:38	08/23/22 12:44	1

Lab Sample ID: LCS 310-363324/2-A
Matrix: Water
Analysis Batch: 363477

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 363324

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Mercury			0.00167	0.001697		mg/L		102	80 - 120

Lab Sample ID: 310-237917-2 MS
Matrix: Water
Analysis Batch: 363477

Client Sample ID: Pivot Bucket
Prep Type: Total/NA
Prep Batch: 363324

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec Limits
Mercury	<0.000200		0.00167	0.001664		mg/L		100	80 - 120

Lab Sample ID: 310-237917-2 MSD
Matrix: Water
Analysis Batch: 363477

Client Sample ID: Pivot Bucket
Prep Type: Total/NA
Prep Batch: 363324

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
Mercury	<0.000200		0.00167	0.001669		mg/L		100	80 - 120	0	20

Method: 350.1 - Nitrogen, Ammonia

Lab Sample ID: MB 310-363012/1-A
Matrix: Water
Analysis Batch: 363102

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 363012

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Ammonia as N	<0.500		0.500		mg/L		08/18/22 09:51	08/18/22 20:09	1

Lab Sample ID: LCS 310-363012/2-A
Matrix: Water
Analysis Batch: 363102

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 363012

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Ammonia as N			4.00	4.056		mg/L		101	90 - 110

Method: 351.2 - Nitrogen, Total Kjeldahl

Lab Sample ID: MB 310-362810/1-A
Matrix: Water
Analysis Batch: 362944

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 362810

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Kjeldahl Nitrogen	<1.00		1.00		mg/L		08/17/22 07:00	08/17/22 18:34	1

Method: 351.2 - Nitrogen, Total Kjeldahl (Continued)

Lab Sample ID: LCS 310-362810/2-A
Matrix: Water
Analysis Batch: 362944

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 362810

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Total Kjeldahl Nitrogen	4.01	4.054		mg/L		101	90 - 110

Method: 353.2 - Nitrogen, Nitrate-Nitrite

Lab Sample ID: MB 310-362793/43
Matrix: Water
Analysis Batch: 362793

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Nitrate Nitrite as N	<0.100		0.100		mg/L			08/16/22 19:56	1

Lab Sample ID: LCS 310-362793/44
Matrix: Water
Analysis Batch: 362793

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Nitrate Nitrite as N	5.32	5.674		mg/L		107	90 - 110

Method: SM 2320B - Alkalinity

Lab Sample ID: MB 310-362556/1
Matrix: Water
Analysis Batch: 362556

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Alkalinity as CaCO3 to pH 4.5	<5.00		5.00		mg/L			08/15/22 08:30	1

Lab Sample ID: LCS 310-362556/2
Matrix: Water
Analysis Batch: 362556

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Alkalinity as CaCO3 to pH 4.5	1000	997.5		mg/L		100	90 - 110

Method: SM 4500 H+ B - pH

Lab Sample ID: LCS 310-362509/1
Matrix: Water
Analysis Batch: 362509

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
pH	7.00	7.0		SU		100	98 - 102

Lab Sample ID: LCS 310-362509/25
Matrix: Water
Analysis Batch: 362509

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
pH	7.00	7.0		SU		100	98 - 102

QC Sample Results

Method: SM 4500 H+ B - pH (Continued)

Lab Sample ID: 310-237917-1 DU
Matrix: Water
Analysis Batch: 362509
Client Sample ID: Road Track
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier		DU Result	DU Qualifier	Unit	D			RPD	RPD Limit
pH	8.1	HF		8.0		SU				0.5	20

HPLC/IC

Analysis Batch: 363601

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-1	Road Track	Total/NA	Water	9056A	
310-237917-2	Pivot Bucket	Total/NA	Water	9056A	
MB 310-363601/3	Method Blank	Total/NA	Water	9056A	
LCS 310-363601/4	Lab Control Sample	Total/NA	Water	9056A	

Metals

Prep Batch: 362614

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-1	Road Track	Total/NA	Water	3005A	
310-237917-2	Pivot Bucket	Total/NA	Water	3005A	
MB 310-362614/1-A	Method Blank	Total/NA	Water	3005A	
LCS 310-362614/2-A	Lab Control Sample	Total/NA	Water	3005A	

Analysis Batch: 362935

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
MB 310-362614/1-A	Method Blank	Total/NA	Water	6020A	362614
LCS 310-362614/2-A	Lab Control Sample	Total/NA	Water	6020A	362614

Analysis Batch: 363152

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-1	Road Track	Total/NA	Water	6020A	362614
310-237917-2	Pivot Bucket	Total/NA	Water	6020A	362614

Analysis Batch: 363247

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-1	Road Track	Total/NA	Water	6020A	362614
310-237917-2	Pivot Bucket	Total/NA	Water	6020A	362614
MB 310-362614/1-A	Method Blank	Total/NA	Water	6020A	362614
LCS 310-362614/2-A	Lab Control Sample	Total/NA	Water	6020A	362614

Analysis Batch: 363273

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
LCS 310-362614/2-A	Lab Control Sample	Total/NA	Water	6020A	362614

Prep Batch: 363323

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-1	Road Track	Total/NA	Water	7470A	
MB 310-363323/1-A	Method Blank	Total/NA	Water	7470A	
LCS 310-363323/2-A	Lab Control Sample	Total/NA	Water	7470A	

Prep Batch: 363324

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-2	Pivot Bucket	Total/NA	Water	7470A	
MB 310-363324/1-A	Method Blank	Total/NA	Water	7470A	
LCS 310-363324/2-A	Lab Control Sample	Total/NA	Water	7470A	
310-237917-2 MS	Pivot Bucket	Total/NA	Water	7470A	
310-237917-2 MSD	Pivot Bucket	Total/NA	Water	7470A	

QC Association Summary

Metals

Analysis Batch: 363477

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-1	Road Track	Total/NA	Water	7470A	363323
310-237917-2	Pivot Bucket	Total/NA	Water	7470A	363324
MB 310-363323/1-A	Method Blank	Total/NA	Water	7470A	363323
MB 310-363324/1-A	Method Blank	Total/NA	Water	7470A	363324
LCS 310-363323/2-A	Lab Control Sample	Total/NA	Water	7470A	363323
LCS 310-363324/2-A	Lab Control Sample	Total/NA	Water	7470A	363324
310-237917-2 MS	Pivot Bucket	Total/NA	Water	7470A	363324
310-237917-2 MSD	Pivot Bucket	Total/NA	Water	7470A	363324

General Chemistry

Analysis Batch: 362509

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-1	Road Track	Total/NA	Water	SM 4500 H+ B	
310-237917-2	Pivot Bucket	Total/NA	Water	SM 4500 H+ B	
LCS 310-362509/1	Lab Control Sample	Total/NA	Water	SM 4500 H+ B	
LCS 310-362509/25	Lab Control Sample	Total/NA	Water	SM 4500 H+ B	
310-237917-1 DU	Road Track	Total/NA	Water	SM 4500 H+ B	

Analysis Batch: 362556

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-1	Road Track	Total/NA	Water	SM 2320B	
310-237917-2	Pivot Bucket	Total/NA	Water	SM 2320B	
MB 310-362556/1	Method Blank	Total/NA	Water	SM 2320B	
LCS 310-362556/2	Lab Control Sample	Total/NA	Water	SM 2320B	

Analysis Batch: 362793

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-1	Road Track	Total/NA	Water	353.2	
310-237917-2	Pivot Bucket	Total/NA	Water	353.2	
MB 310-362793/43	Method Blank	Total/NA	Water	353.2	
LCS 310-362793/44	Lab Control Sample	Total/NA	Water	353.2	

Prep Batch: 362810

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-1	Road Track	Total/NA	Water	351.2	
310-237917-2	Pivot Bucket	Total/NA	Water	351.2	
MB 310-362810/1-A	Method Blank	Total/NA	Water	351.2	
LCS 310-362810/2-A	Lab Control Sample	Total/NA	Water	351.2	

Analysis Batch: 362944

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-1	Road Track	Total/NA	Water	351.2	362810
310-237917-2	Pivot Bucket	Total/NA	Water	351.2	362810
MB 310-362810/1-A	Method Blank	Total/NA	Water	351.2	362810
LCS 310-362810/2-A	Lab Control Sample	Total/NA	Water	351.2	362810

Prep Batch: 363012

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-1	Road Track	Total/NA	Water	Distill/Ammonia	
310-237917-2	Pivot Bucket	Total/NA	Water	Distill/Ammonia	

QC Association Summary

General Chemistry (Continued)

Prep Batch: 363012 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
MB 310-363012/1-A	Method Blank	Total/NA	Water	Distill/Ammonia	
LCS 310-363012/2-A	Lab Control Sample	Total/NA	Water	Distill/Ammonia	

Analysis Batch: 363102

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-1	Road Track	Total/NA	Water	350.1	363012
310-237917-2	Pivot Bucket	Total/NA	Water	350.1	363012
MB 310-363012/1-A	Method Blank	Total/NA	Water	350.1	363012
LCS 310-363012/2-A	Lab Control Sample	Total/NA	Water	350.1	363012

Lab Chronicle

Client: Nebraska Public Power District
Project/Site: Irrigation Runoff

Job ID: 310-237917-1

Client Sample ID: Road Track

Lab Sample ID: 310-237917-1

Date Collected: 08/11/22 11:00
Date Received: 08/12/22 08:35

Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	9056A		5	363601	DHM5	EET CF	08/22/22 15:34
Total/NA	Prep	3005A			362614	QTZ5	EET CF	08/16/22 08:30
Total/NA	Analysis	6020A		1	363152	A6US	EET CF	08/18/22 17:47
Total/NA	Prep	3005A			362614	QTZ5	EET CF	08/16/22 08:30
Total/NA	Analysis	6020A		4	363247	A6US	EET CF	08/19/22 16:31
Total/NA	Prep	7470A			363323	XXW3	EET CF	08/22/22 14:34
Total/NA	Analysis	7470A		1	363477	XXW3	EET CF	08/23/22 12:41
Total/NA	Prep	Distill/Ammonia			363012	ENB7	EET CF	08/18/22 09:51
Total/NA	Analysis	350.1		1	363102	ZJX4	EET CF	08/18/22 20:31
Total/NA	Prep	351.2			362810	W9YR	EET CF	08/17/22 07:00
Total/NA	Analysis	351.2		1	362944	ZJX4	EET CF	08/17/22 19:01
Total/NA	Analysis	353.2		1	362793	ZJX4	EET CF	08/16/22 20:12
Total/NA	Analysis	SM 2320B		1	362556	MAQ3	EET CF	08/15/22 08:30
Total/NA	Analysis	SM 4500 H+ B		1	362509	N7RT	EET CF	08/12/22 15:15

Client Sample ID: Pivot Bucket

Lab Sample ID: 310-237917-2

Date Collected: 08/11/22 11:05
Date Received: 08/12/22 08:35

Matrix: Water

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	9056A		5	363601	DHM5	EET CF	08/22/22 15:49
Total/NA	Prep	3005A			362614	QTZ5	EET CF	08/16/22 08:30
Total/NA	Analysis	6020A		1	363152	A6US	EET CF	08/18/22 18:03
Total/NA	Prep	3005A			362614	QTZ5	EET CF	08/16/22 08:30
Total/NA	Analysis	6020A		1	363247	A6US	EET CF	08/19/22 16:34
Total/NA	Prep	7470A			363324	XXW3	EET CF	08/22/22 14:38
Total/NA	Analysis	7470A		1	363477	XXW3	EET CF	08/23/22 12:48
Total/NA	Prep	Distill/Ammonia			363012	ENB7	EET CF	08/18/22 09:51
Total/NA	Analysis	350.1		1	363102	ZJX4	EET CF	08/18/22 20:32
Total/NA	Prep	351.2			362810	W9YR	EET CF	08/17/22 07:00
Total/NA	Analysis	351.2		1	362944	ZJX4	EET CF	08/17/22 19:02
Total/NA	Analysis	353.2		1	362793	ZJX4	EET CF	08/16/22 20:13
Total/NA	Analysis	SM 2320B		1	362556	MAQ3	EET CF	08/15/22 08:30
Total/NA	Analysis	SM 4500 H+ B		1	362509	N7RT	EET CF	08/12/22 15:21

Laboratory References:

EET CF = Eurofins Cedar Falls, 3019 Venture Way, Cedar Falls, IA 50613, TEL (319)277-2401

Accreditation/Certification Summary

Laboratory: Eurofins Cedar Falls

All accreditations/certifications held by this laboratory are listed. Not all accreditations/certifications are applicable to this report.

Authority	Program	Identification Number	Expiration Date
Colorado	Petroleum Storage Tank Program	IA100001 (OR)	09-29-22
Georgia	State	IA100001 (OR)	09-29-22
Illinois	NELAP	200024	11-29-22
Iowa	State	007	12-01-21 *
Kansas	NELAP	E-10341	01-31-23
Minnesota	NELAP	019-999-319	12-31-22
Minnesota (Petrofund)	State	3349	01-18-24
North Dakota	State	R-186	09-29-22
Oregon	NELAP	IA100001	09-29-22

* Accreditation/Certification renewal pending - accreditation/certification considered valid.

Method Summary

Method	Method Description	Protocol	Laboratory
9056A	Anions, Ion Chromatography	SW846	EET CF
6020A	Metals (ICP/MS)	SW846	EET CF
7470A	Mercury (CVAA)	SW846	EET CF
350.1	Nitrogen, Ammonia	MCAWW	EET CF
351.2	Nitrogen, Total Kjeldahl	MCAWW	EET CF
353.2	Nitrogen, Nitrate-Nitrite	MCAWW	EET CF
SM 2320B	Alkalinity	SM	EET CF
SM 4500 H+ B	pH	SM	EET CF
3005A	Preparation, Total Metals	SW846	EET CF
351.2	Nitrogen, Total Kjeldahl	MCAWW	EET CF
7470A	Preparation, Mercury	SW846	EET CF
Distill/Ammonia	Distillation, Ammonia	None	EET CF

Protocol References:

MCAWW = "Methods For Chemical Analysis Of Water And Wastes", EPA-600/4-79-020, March 1983 And Subsequent Revisions.
None = None
SM = "Standard Methods For The Examination Of Water And Wastewater"
SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

EET CF = Eurofins Cedar Falls, 3019 Venture Way, Cedar Falls, IA 50613, TEL (319)277-2401

eurofins | Environment Testing
America

310-237917 Chain of Custody

Cooler/Sample Receipt and Temperature Log Form

Client Information

Client: Nebraska Public Power

City/State: CITY Sutherland STATE NE | Project:

Receipt Information

Date/Time Received: DATE 8-12 22 TIME 835 | Received By:

Delivery Type: ☑ UPS ☐ FedEx ☐ FedEx Ground ☐ US Mail ☐ Spee-Dee
☐ Lab Courier ☐ Lab Field Services ☐ Client Drop-off ☐ Other:________________

Condition of Cooler/Containers

Sample(s) received in Cooler? ☑ Yes ☐ No *If yes:* Cooler ID:

Multiple Coolers? ☐ Yes ☑ No *If yes:* Cooler # _____ of _____

Cooler Custody Seals Present? ☑ Yes ☐ No *If yes:* Cooler custody seals intact? ☑ Yes ☐ No

Sample Custody Seals Present? ☐ Yes ☑ No *If yes:* Sample custody seals intact? ☐ Yes ☐ No

Trip Blank Present? ☐ Yes ☑ No *If yes:* Which VOA samples are in cooler? ↓

Temperature Record

Coolant: ☑ Wet ice ☐ Blue ice ☐ Dry ice ☐ Other:________________ ☐ NONE

Thermometer ID: P | Correction Factor (°C): 0

• **Temp Blank Temperature** – If no temp blank, or temp blank temperature above criteria, proceed to Sample Container Temperature

Uncorrected Temp (°C): -1.6 | Corrected Temp (°C): -1.6

• **Sample Container Temperature**

Container(s) used:	CONTAINER 1	CONTAINER 2
Uncorrected Temp (°C):		
Corrected Temp (°C):		

Exceptions Noted

1) If temperature exceeds criteria, was sample(s) received same day of sampling? ☐ Yes ☐ No
   a) *If yes:* Is there evidence that the chilling process began? ☐ Yes ☐ No

2) If temperature is <0°C, are there obvious signs that the integrity of sample containers is compromised? (e.g., bulging septa, broken/cracked bottles, frozen solid?) ☐ Yes ☐ No

NOTE. If yes, contact PM before proceeding. If no, proceed with login

Additional Comments

2-5 [illegible]

Eurofins Cedar Falls
3019 Venture Way
Cedar Falls IA 50613
Phone (319) 277-2401 Phone (319) 277-2425

Chain of Custody Record

eurofins Environment Testing America

Client Information

Client Contact: Doug Harris

Company: Nebraska Public Power District

PWSID:

Address: 6089 S Hwy 25 Gerald Gentleman Station

City: Sutherland

State, Zip: NE 69165

Phone: 308-530-1124

Email: ddharri@nppd com

Project Name: Irrigation Runoff

Site: GGS

Sampler: Doug Harris

Phone: 308-530-1124

Due Date Requested

TAT Requested (days):

Compliance Project: Δ Yes x No

PO #: 4500245807

WO #:

Project #: 31007155

SSOW#:

Lab PM: Hayes, Shawn M

E-Mail: Shawn Hayes@et.eurofinsus.com

Carrier Tracking No(s):

State of Origin:

COC No:

Page: Page 1 of 1

Job #:

Analysis Requested

Preservation Codes:

A - HCL
B - NaOH
C Zn Acetate
D Nitric Acid
E - NaHSO4
F - MeOH
G - Amchlor
H - Ascorbic Acid
I - Ice
J - DI Water
K - EDTA
L - EDA

M Hexane
N - None
O - AsNaO2
P - Na2O4S
Q Na2SO3
R - Na2S2O3
S - H2SO4
T - TSP Dodecahydrate
U - Acetone
V - MCAA
W - pH 4-5
Z - other (specify)

Other:

Sample Identification	**Sample Date**	**Sample Time**	**Sample Type** (C=comp, G=grab)	**Matrix** (W=water S=solid, O=waste/oil, BT=Tissue, A=Air)	**Field Filtered Sample (Yes or No)**	**Perform MS/MSD (Yes or No)**	**350 1 Ammonia, 351 2 TKN, 353.2 Nitrate+Nitrite**	**6020A, 7470A Select Metals**	**2320B Alkalinity, 9056A Chloride, Fluoride, Sulfate, SM4500_H+ pH**	**Total Number of containers**	**Special Instructions/Note**
				Preservation Code:			S	D	N		
Road Track	8-11-22	1100	G	Water			X	X	X		
Pivot Bucket	8-11-22	1105	G	water			X	X	X		

↑ sample bottles only partially filled due to lack of sample - please do what we can

Doug

Possible Hazard Identification
☒ *Non-Hazard* ☐ *Flammable* ☐ *Skin Irritant* ☐ *Poison B* ☐ *Unknown* ☐ *Radiological*

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ *Return To Client* ☐ *Disposal By Lab* ☐ *Archive For* ________ *Months*

Deliverable Requested I, II III IV, Other (specify)

Special Instructions/QC Requirements.

Empty Kit Relinquished by:

Date

Time

Method of Shipment:

Relinquished by: Doug Harris	Date/Time: 8-11-22 1400	Company: NPPD	Received by: ML	Date/Time: 8-12-22 835	Company
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company

Custody Seals Intact: Δ Yes Δ No

Custody Seal No

Cooler Temperature(s) °C and Other Remarks:

Ver: 01/16/2019

Login Sample Receipt Checklist

Client: Nebraska Public Power District

Job Number: 310-237917-1

Login Number: 237917

List Source: Eurofins Cedar Falls

List Number: 1

Creator: Costello, Mackenzie K

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	N/A	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

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REPORT

Alternative Source Demonstration for Chloride at APMW-6

Nebraska Public Power District

Submitted to:

Nebraska Public Power District

Gerald Gentleman Station,
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Sutherland, Nebraska 69165

Submitted by:

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October 26, 2022

Table of Contents

TABLES

FIGURES

APPENDICES

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 from the second quarter groundwater detection monitoring event in 2022 (Q2 2022) at the Gerald Gentleman Station (GGS or Site) ash landfill (or CCR Unit), located at 6089 South Highway 25, Sutherland, Lincoln County, Nebraska. The statistical evaluation was performed in accordance with the Site Sampling and Analysis Plan (Golder 2019a), which was developed in compliance with 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; Final Rule" (CCR Final 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 analyses of the Appendix III detection monitoring data for chloride in groundwater at the downgradient monitoring well APMW-6 indicated a potential exceedance of the statistical limit based on the parametric Cumulative Summation analysis (CUSUM) in the Q2 2021 sampling results, which was subsequently verified as evidence of a statistically significant increase (SSI) after the Q4 2021 event and again after the Q2 2022 results. Although determination of an SSI generally indicates that the groundwater monitoring program should transition from detection monitoring to assessment monitoring, both 40 CFR §257.94(e)(2) and NAC Title 132, Ch. 7, 004.03 allow the owner or operator (i.e., NPPD) 90 days from the date of determination (October 26, 2022) to demonstrate a source other than the CCR Unit, or another condition, caused the potential SSI for chloride at APMW-6.

Golder's review of the hydrological and geologic conditions at the Site indicated the potential for the SSI to have resulted from a source other than the CCR Unit. To assess potential chloride sources and the natural variability of chloride concentrations in groundwater, Golder reviewed analytical results of previously collected CCR-impacted water samples from the ash landfills, evaporation pond, surface water from the Sutherland Reservoir, surface waters from nearby agricultural areas, and groundwater samples. Based upon this assessment and in accordance with provisions of the CCR Final Rule, the NAC, and the site SAP (Golder 2019a), Golder prepared this Alternative Source Demonstration (ASD) for the CCR Unit. This ASD includes an evaluation of geological, hydrogeological, and chemical information regarding ash, surface water, and groundwater obtained from surface waters and monitoring wells installed within and adjacent to the CCR Unit.

This ASD conforms to the requirements of 40 CFR §257.94(e)(2) and NAC Title 132, Ch.7, 004.03 and provides the basis for concluding that the apparent SSI for chloride in groundwater at APMW-6 are not a result of a release from the CCR unit. The following sections provide a summary of the GGS CCR Unit, analytical and geochemical assessment results, a conceptual site model, and lines of evidence demonstrating an alternative source is responsible for the chloride SSI in groundwater at APMW-6.

2.0 BACKGROUND

2.1 Description of Waste Disposal Area

The ash landfill at GGS is located southwest of the plant's generation facility, in the northern one-half of Section 30, Township 13N, Range 33W. The ash disposal facility consists of Ash Landfill Nos. 1, 2, 3, and 4 and the bottom ash landfill. Ash Landfill Nos.1 and 2 are closed, and Ash Landfill Nos. 3 and 4 are active (Figure 1). The bottom ash landfill was closed in October 2018.

Fly ash is currently disposed at Ash Landfill No. 4 and in the east cell of Ash Landfill No. 3. The liner design at Ash Landfill No. 4 consists of a 60-mil high density polyethylene (HDPE) geomembrane over compacted subgrade. Prior to geomembrane installation, the existing subgrade was scored to a depth of at least 6 inches and compacted to 95 percent of its maximum dry density (standard Proctor). Smooth HDPE geomembrane was placed on the bottom of the ash landfill and textured HDPE geomembrane was placed on the side slopes. Construction quality assurance for the geomembrane installation was performed by Golder Construction Services and completed on November 15, 1994. There is no leachate collection system (LCS) at Ash Landfill No. 4.

The original liner at Ash Landfill No. 3 consisted of 2 feet of soil compacted to 95 percent of the standard Proctor maximum dry density. The average permeability of the liner was 1.2×10^{-8} centimeters per second (cm/sec). Ash Landfill No. 3 was previously closed in 1995 with 2.0 to 7.5 feet of soil cover. This cover was removed and the historically placed CCR was covered with a new liner in 2015. The new liner system at Ash Landfill No. 3 consists of a prepared subgrade overlain by a geosynthetic clay liner and 60-mil linear low-density polyethylene (LLDPE) geomembrane. Ash Landfill No. 3 also has a 1-foot LCS sand layer that reports to two sumps. Construction of the new Ash Landfill No. 3 liner system was completed in November 2015.

To the east of the ash landfill, plant process water, such as boiler blowdown, is managed in a 50-acre evaporation pond, as shown in Figure 1. CCR materials are not stored within the evaporation pond, and the facility is not regulated under the CCR rule. The bottom of the approximately 8 to 10 feet deep evaporation pond consists of re-compacted native soils.

2.2 Site Geology

The geologic sequence near the ash landfill was summarized by Woodward-Clyde in 1991. In the report, soil boring data from nine boreholes (APMW-1, APMW-2, APMW-3, APMW-4, APMW-5, EPMW-1, EPMW-2, EPMW-3, and EPMW-4) were used to characterize the Site geology. The geologic sequence, from top to bottom, was described as follows:

- 4 to 5 feet of topsoil and/or fill
- 20 to 35 feet of eolian silty sands
- 8 to 10 feet of silty clay paleosol at the top of the Ogallala Formation
- 25 to 35 feet of Ogallala Formation silts
- approximately 50 feet of Ogallala Formation sands or Ogallala Formation silts and clays, to the bottoms of the boreholes

The topsoil layer consists of stiff, dark brown, low to medium plasticity silty clay directly overlying the eolian silts and sands. Thickness of topsoil ranges from 0 to 4 feet. The fill material consists of stiff, dark brown, low plasticity sandy silty clay with trace gravel and other debris. Fill thickness ranges from 0 to 5 feet.

The eolian silts and sands (Quaternary Period) consist of loose to medium dense, tan, very fine-grained, well-rounded, and well-sorted sandy silts and silty sands. The thickness of this unit ranges from 17 feet (APMW-5) to 34 feet (EPMW-2). Materials with a bimodal texture (two distinct grain sizes) are present in the lower part of this unit. The eolian silts and sands are interpreted as wind-blown dune sand deposits.

The Ogallala Formation (Tertiary Period) was encountered in each of the nine boreholes at a depth beginning at 16 to 38 feet below ground surface (ft bgs) and extending to the bottom of the boreholes (109 to 133 ft bgs). The Ogallala Formation near the ash landfill may be separated into three general stratigraphic units:

- upper silty clay paleosol unit
- middle clayey or sandy silt unit
- lower unit of either predominantly sand and gravel or an equivalent unit of predominantly silt and clay

The top of the Ogallala Formation is represented by a widespread paleosol (a previous soil horizon) that consists of a very stiff, reddish-brown to buff, low plasticity, silty clay to clayey silt with abundant calcareous nodules, calcareous matrix, and interbedded layers of caliche up to 1-foot thick. The thickness of the initial paleosol is about 8 to 10 feet, but the presence of interbedded caliche layers continues into the middle and lower Ogallala units.

The middle Ogallala Formation unit consists of a stiff to very stiff, buff-white to reddish-brown, low plasticity, clayey silt to sandy silt with abundant calcareous nodules, matrix, and caliche layers. Scattered occurrences of calcareously cemented siltstone layers from 0.5- to 1-foot thick are present in the lower part of this unit. The thickness of this middle unit ranges from about 25 to 35 feet. The clayey silts and sandy silts of this unit were possibly deposited as overbank or floodplain deposits in an alluvial depositional system.

There are two distinct lithofacies recognized in the lower Ogallala Formation unit. This unit is present for about 45 to 50 feet in the borings. One lithofacies consists of dense to very dense, reddish-brown, fine-grained silty sands grading into medium- and coarse-grained, poorly-graded sands with some fine gravels and some calcareously cemented sandstone beds (0.5- to 1-foot thick). This lithofacies was primarily encountered in borings on the northern side of the ash landfill (APMW-1, APMW-2, APMW-5, and EPMW-1; Woodward-Clyde 1991).

The second lithofacies recognized in the lower unit consists of stiff to hard, reddish-brown, low plasticity clayey or sandy silts with some calcareously-cemented siltstone beds. This lithofacies was encountered in borings on the southern side of the ash landfill (APMW-3, APMW-4, EPMW-2, EPMW-3, and EPMW-4; Woodward-Clyde 1991).

The lithologic differences and areal distribution of the two lower units suggest that the units were deposited in two separate facies of an alluvial system. The sand and gravel unit are possibly a series of longitudinal bars, channels, and channel-fill deposits, while the silt and clay unit is possibly a series of upper channel fills, overbank, or floodplain deposits (Woodward-Clyde 1991).

2.3 Site Hydrogeology

Based on observations made during logging of soil borings and findings of the Nebraska Water Survey Paper No. 70 (Goeke et al. 1992), the unsaturated geologic units underlying the ash landfill area consist of topsoil (0 to 4 feet thick), eolian silts and sands (15 to 25 feet thick), Ogallala Formation silts (40 to 50 feet thick), and Ogallala Formation sands and gravels (unsaturated portion of this unit is approximately 20 to 25 feet thick). Beneath these units lies 10 feet or more of saturated Ogallala Formation sands and gravels. Based on the Site observations, the thickness of the vadose zone ranges from approximately 90 to 100 feet.

The saturated geologic units underlying the ash landfill area consist of Ogallala Formation silts and sands that extend to the bottom of the aquifer. The Ogallala Formation is underlain by the White River Group, which is composed of the Brule and Chadron formations. The bedrock formations of the White River Group are not considered to be an important potential source of water, and therefore their surface is considered to form the base of the aquifer and is regarded as the lower drilling limit for irrigation wells in the agricultural region near the Site. Underlying the White River Group is the impermeable Pierre Shale (Goeke et al. 1992).

Available groundwater elevation data indicate that groundwater beneath GGS flows from north to south (Figure 1). The groundwater gradient is controlled by the Sutherland Reservoir, an approximately 3,200-acre open water body located 1.5 miles north of the ash landfill that is used as a source of condenser cooling water for GGS (McMahon et al. 2010). Since groundwater level monitoring began in 1996, regular water level fluctuations have been observed in the monitoring wells located around the ash landfill. These fluctuations are attributed to seasonal trends in water consumption or recharge and precipitation patterns. From the time-series plot of historical water levels in each monitoring well (Figure 2), long-term changes in water levels between 1996 and 2022 are apparent. In general, water levels rose approximately 1.5 feet between 1996 and 2000 before declining between 9 to 10 feet between 2000 and 2009. The cause of the decline is not clear, but possible explanations include a regional response to the drought being experienced by parts of the western United States and/or a change in the amount of groundwater used for irrigation in the area around the Site. Between 2009 and 2022 water levels have continued to show seasonal variability, with seasonal maximums occurring in the spring and seasonal minimums occurring in the fall with no apparent long-term increasing or decreasing trend.

Groundwater flow velocity ranges from 5.0×10^{-4} to 6.7×10^{-2} per day (ft/day) and was estimated based on the following site-specific hydrogeologic data:

- estimated site hydraulic conductivities range from 0.14 ft/day to 19 ft/day (Woodward-Clyde 1991)
- an average horizontal hydraulic gradient of 0.00091 feet per foot (ft/ft) from the potentiometric surface shown in Figure 1
- an average effective porosity for Ogallala Formation sands and silts of 25 percent (Fetter 1994)

Two agricultural field are present immediately to the south of the ash landfills. Historical aerial imagery (Figure 3) showed that there was no center-pivot irrigation system prior to 2004. By 2006, a center-pivot irrigation system was installed, and aerial images from 2006, 2012, and 2020 indicates that irrigation water from that center-pivot was crossing the property boundary of GGS, as delineated by the greener foliage compared to the unirrigated land. The greener foliage along the southern edge of the ash landfills also indicates that the irrigation runoff discharges north towards GGS, into the ditch at that location.

Photographs of the southern property boundary indicate taken August 2, 2022, indicate two drainages are present from the agricultural area onto GGS property (Figure 4A and 4B), though no runoff was observed in the drainages. On August 11, 2022, NPPD observed irrigation water from the center pivot spraying across the property boundary (Figure 4C).

2.4 Groundwater Monitoring Network

Design of the ash landfill groundwater monitoring program considered the size, disposal and operational history, anticipated groundwater flow direction, and saturated thickness of the uppermost aquifer. Based on these factors, a monitoring well network that consists of four upgradient (background) monitoring wells and ten downgradient monitoring wells was installed around the ash landfill. The monitoring wells are listed in Table 1 and presented in Figure 1.

Table 1: Monitoring Well Network

Location	Upgradient (Background) Monitoring Wells	Downgradient Monitoring Wells
Ash Landfill	APMW-5, APMW-15, APMW-16A, APMW-17	APMW-4, APMW-6, APMW-8A, APMW-10, APMW-11, APMW-12, APMW-13, APMW-14, APMW-18, APMW-19

The four upgradient monitoring wells included in the groundwater monitoring program are used to represent the background groundwater quality, including potential variability. The ten downgradient wells were installed along the western, southern, and eastern boundaries of the active ash landfill. The depths of the monitoring wells were selected such that the monitoring wells are screened in the Ogallala Formation to yield groundwater samples that are representative of water quality in the uppermost water-bearing zone.

2.5 Groundwater Monitoring Program

Between March 1996 and December 2015, groundwater samples were collected for arsenic, selenium, and sulfate measurement twice a year from the 10 GGS monitoring wells administered under the Nebraska Department of Environment and Energy (NDEE) monitoring program (APMW-5, APMW-15, APMW-4, APMW-6, APMW-8A, APMW-10, APMW-11, APMW-12, APMW-13, and APMW-14). In June 2005, boron measurements were added to the analyte list. In 2015, four additional monitoring wells were installed to support the federal CCR monitoring program (APMW-16A, APMW-17, APMW-18, and APMW-19) and have been incorporated into the NDEE monitoring program.

For APMW-6, the current baseline for chloride was calculated using 13 independent groundwater samples collected between December 2015 and November 2019. Statistically valid baseline values were developed for each constituent at each monitoring well (Golder 2017 and Golder 2019a).

2.5.1 Chloride Concentration Trends

Chloride concentrations in the upgradient and downgradient groundwater are shown in Appendix A, Figure A4. Chloride concentrations in upgradient groundwater (from the four upgradient monitoring wells) ranged from less than 5.0 to 93.8 milligrams per liter (mg/L) between December 2015 and June 2022. Chloride concentrations varied between 7.02 to 210 mg/L in downgradient groundwater wells (based on the 10 downgradient monitoring wells) over the same period.

During the current baseline dates for APMW-6 (December 2015 to November 2019), chloride concentrations in groundwater at APMW-6 remained relatively steady compared to other downgradient wells, with values ranging between 7.0 and 15.5 mg/L in the 13 samples representing the current baseline period. A concentration of 20.4 mg/L was calculated as the parametric CUSUM statistical limit for chloride at APMW-6.

The Q2 2021 detection monitoring event reported a chloride concentration of 25.8 mg/L in groundwater at APMW-6 with a parametric CUSUM value of 31.7 mg/L, both exceeding the statistical limit of 20.4 mg/L. The exceedance was verified in Q4 2021 when the reported chloride concentration was 17.6 mg/L with a parametric CUSUM value of 36.6 mg/L exceeded the statistical allowance of 20.4 mg/L. A successful alternative source demonstration report was prepared for the elevated chloride at APMW-6 and submitted to NDEE on April 28, 2022 (Golder 2022) and accepted by NDEE on July 8, 2022 (NDEE 2022).

The Q2 2022 detection monitoring event reported a chloride concentration of 17.0 mg/L, which resulted in a parametric CUSUM value of 40.8 mg/L, which continued to exceed the statistical allowance of 20.4 mg/L.

2.6 Review of Sampling and Laboratory Testing Procedures

As part of the ASD, a review was conducted of the sampling and laboratory testing procedures used throughout baseline monitoring and detection monitoring to date, along with the collected results. Golder found that the analytical methodologies used were consistent with the stated objectives of the sampling program. No anomalies were found within the sampling and laboratory testing procedures and the collected results are considered valid.

Additionally, a review of the statistical assessment methods and associated results found the procedures followed during baseline and detection monitoring to be consistent with the stated procedures listed in the published Groundwater Monitoring Statistical Methods Certification (Golder 2017). Calculated limits were found to be consistent with the chosen statistical procedures as described in the Sampling and Analysis Plan (Golder 2019a) and recommended methodology found within the Unified Guidance (Environmental Protection Agency [EPA] 2009).

3.0 DATA SOURCES USED IN ALTERNATIVE SOURCE REVIEW

To assess groundwater downgradient of the GGS CCR facilities, Golder reviewed previously collected data and performed supplemental assessment activities. The following sections summarize the supplemental assessment activities.

3.1 Groundwater

3.1.1 On-site Groundwater Monitoring Data

NPPD GGS field personnel routinely collect groundwater samples from 14 monitoring wells around the ash landfill at GGS and submit them for chemical analysis. The following datasets were available to characterize the groundwater in the vicinity of the ash landfills:

- **NDEE and CCR monitoring programs:** As described in Section 2.5, the ongoing groundwater monitoring samples were collected between 1996 and 2022, and analyzed for field parameters, major cations, major anions, and select dissolved metals.
- **Supplemental sampling in First Quarter (Q1) 2019:** In February 2019, an additional set of groundwater samples were collected from eight of the 14 wells (APMW-5, APMW-17, APMW-4, APMW-8A, APMW-18, APMW-19, APMW-12, and APMW-14) to support the Q4 2018 ASD for fluoride at APMW-19 (Golder 2019b). These samples were analyzed for field parameters, major cations, major anions, and select dissolved metals. In addition, detection monitoring groundwater samples collected in Q4 2019 and Q2 2021 also had an expanded analyte list, including field parameters, major cations, major anions, and select dissolved metals.

3.1.2 Upgradient Off-site Monitoring Data

As discussed in Section 2.3, upgradient groundwater is sourced from the Sutherland Reservoir, which is fed by the Sutherland Canal with water from North Platte and South Platte Rivers. The following data sources were used to constrain the range of potential water qualities upgradient of GGS and the ash landfill:

- **North Platte and South Platte Rivers:** The United States Geological Survey (USGS) monitored South Platte River chemistry at Roscoe, Nebraska between 1975 and 2013 (USGS 2016a). The monitoring location at Roscoe, Nebraska is less than one mile downstream of where South Platte River water is diverted into the Sutherland Canal. The USGS also characterized North Platte River water between 1972 and 2011 at Keystone, Nebraska, immediately downstream of Lake Ogallala, where North Platte River water is diverted into the Sutherland Canal (USGS 2016b).

- **Sutherland Reservoir and Canal:** Surface water samples were collected from the Sutherland Reservoir and Sutherland Canal on October 28, 2019, to assess the source of regional groundwater at the site. These samples were analyzed for field parameters, major cations, major anions, and select dissolved metals (Golder 2019b). In addition to samples collected by NPPD personnel, seven water samples were collected from the center of the Sutherland Reservoir by the USGS between August 2005 and December 2006 (USGS 2016c and USGS 2016d).
- **Shallow Groundwater around the Sutherland Reservoir:** Between September 2005 and May 2007, the USGS collected 14 shallow groundwater samples from 12 wells less than one mile from the perimeter of Sutherland Reservoir (USGS 2016e).
- **Upgradient Wells:** In Q2 2021, NPPD personnel collected groundwater samples from wells north and east of GGS to characterize the regional groundwater. The wells included potable water wells (PW #1, PW #2, and PW #3), livestock watering wells (livestock well), and operating wells (OW-20, OW-21, OW-22, OW-23, OW-24, OW-25, and OW-36, as shown in Figure 5. The samples were analyzed for field parameters, major cations, major anions, and select dissolved metals.

3.2 Irrigation Water

Two types of irrigation water are identified as potentially important: center pivot spray and irrigation runoff. Center pivot spray is irrigation water that is sprayed directly onto GGS property without touching agricultural soil by the irrigation system near the southern property boundary (Figure 4c). Historical aerial imagery indicates that this irrigation system was installed in 2006 (Figure 3). NPPD was able to collect two samples of center pivot spray on August 11, 2022, with one sample collected from a tire depression in the ground and one sample caught directly in a bucket as the water sprayed onto the Site. Samples were sent to Eurofins Cedar Fall for water quality analysis, including field parameters, major cations, major anions, and select dissolved metals (Results in Appendix B). These samples were collected to characterize the water quality of the center pivot spray as it flows and infiltrates on the ground in the area of APMW-6.

Irrigation water runoff is surface water that flows through agricultural soils prior to traveling onto the Site through drainages into the ditch immediately south of the CCR unit and immediately upgradient of multiple downgradient monitoring wells, including APMW-4, APMW-6, APMW-8A, APMW-10, and APMW-11. Three indications that irrigation runoff is occurring include:

1) Historical aerial images from 2012 and 2020 showing green vegetation in the ditch outside of the range of the center pivot spray.
2) Deep drainages at low points between the agricultural fields and the ditch south of the CCR unit (Figure 4A and 4B).
3) Corn shucks in the ditch on NPPD property (Figure 4C).

NPPD field personnel monitored the drainages and ditch for irrigation water runoff to characterize the water quality of this flow. Unfortunately, no irrigation water runoff was observed in the drainages and ditch. Ongoing monitoring will continue until irrigation water runoff samples can be collected.

3.3 Evaporation Pond

In Q1 2019 and Q4 2020, surface water samples were collected from the evaporation pond. The samples were analyzed for field parameters, major cations, major anions, and select dissolved metals.

3.4 Coal Combustion Residuals Contact Water

To characterize the potential for the material in the ash landfill to release contaminants, NPPD GGS field personnel retrieved sump water from the Ash Landfill No. 3 LCS, and pond water in direct contact with CCR materials in Ash Landfill No.4 on October 28, 2019. These sample were analyzed for the same suite of parameters as the groundwater: field parameters, major cations, major anions, and select dissolved metals (Golder 2019b).

3.5 Geochemical Methods

The geochemical analysis of groundwater and surface water samples included field parameters, major cations and anions, and dissolved metals. Conductivity, pH, and temperature were measured in the field using a handheld meter. The pH of each sample was also measured in the laboratory. Major anions analyzed included chloride, sulfate, and bicarbonate and major cations included calcium, magnesium, potassium, and sodium.

The laboratory analyzed the ash landfill pond and sump water, onsite and off-site groundwater, and surface water (evaporation pond, Sutherland Reservoir, and Sutherland Canal) samples using the following methods:

- pH following SM 4500 H+ B (2017)
- alkalinity following Standard Method (SM) 2320B Alkalinity by Titration (2005)
- chloride, fluoride, and sulfate following USEPA SW846 9056A Determination of Inorganic Anions by Ion Chromatography Revision 1 (February 2007)
- ammonia following USEPA 350.1 Determination of Ammonia Nitrogen by Automated Colorimetry, Revision 2 (August 1993)
- total Kjeldahl nitrogen following USEPA 351.2 Determination of Total Kjeldahl Nitrogen by Semi-Automated Colorimetry, Revision 2 (August 1993)
- total nitrate-nitrite nitrogen following USEPA 353.2 Determination of Nitrate-Nitrite Nitrogen by Automated Colorimetry, Revision 2 (August 1993)
- antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, lead, lithium, magnesium, molybdenum, potassium, selenium, sodium, and thallium following USEPA SW-846 6020A (November 2004)

4.0 DATA EVALUATION

Historical concentrations of Appendix III analytes and selected Appendix IV analytes in groundwater at GGS, including analytes that are typically indicators of potential CCR seepage (e.g., arsenic, barium, molybdenum, and selenium), are presented in time series plots in Appendix A. The plots include the results of the supplemental samples that were collected in Q1 2019 to support the Q4 2018 ASD for fluoride at APMW-19 (Golder 2019b).

Sampling for the Appendix IV analytes concluded with the end of baseline monitoring in Q2 2017, which means there is a gap of six quarters in the data plots until the supplemental sampling results are shown in Q1 2019.

Figure 6 presents a Piper diagram with relative major ion chemistry for the monitoring well groundwater samples (only for samples analyzed for all major cations and anions; Q4 2017, Q1 2019, Q4 2019, and Q2 2021), offsite upgradient groundwater (NPPD and USGS sampled wells), regional groundwater sources (Sutherland Reservoir, Sutherland Canal, and North and South Platte River), irrigation waters from the center pivot spray, evaporation pond water, and coal ash impacted waters (Ash Landfill No. 3 sump water and Ash Landfill No. 4 surface pond water). The groundwater at the upgradient monitoring wells was dominated by calcium and bicarbonate. Samples from the downgradient monitoring wells were also majority calcium and bicarbonate ions, with the exception of a single sample (Q1 2019) from APMW-12 that was dominated by calcium and sulfate. The Sutherland Reservoir and Canal water, along with the average North and South Platte River waters are generally dominated by calcium, sodium, bicarbonate, and sulfate. Irrigation waters from the center pivot spray were dominated by calcium and bicarbonate. The evaporation pond water contained majority sodium and sulfate ions. The Ash Landfill No. 3 sump water sample was primarily sodium and bicarbonate, while the Ash Landfill No. 4 pond water was dominated by sodium and sulfate.

4.1 Potential Chloride Sources

Several potential sources, other than the active CCR Units, can contribute chloride to local groundwater at GGS, including outflows from the Sutherland Reservoir into regional groundwater, irrigation water runoff and center pivot spray from across southern property boundary, seepage from the evaporation pond, and seepage from historical deposits of fly ash that remain at GGS. These four potential sources of chloride to groundwater are described in this section.

4.1.1 Regional Groundwater from Sutherland Reservoir

As described in Section 2.3, the groundwater gradient in the area around the ash landfill shows groundwater flows from north to south, rather than from south to north in the direction of the South Platte River. The groundwater flow direction appears to be based on both the groundwater recharge provided by the Sutherland Reservoir to the north of GGS and groundwater extraction by irrigation wells located south of GGS that are pumped seasonally and used to support local agriculture. The Sutherland Reservoir is fed by the Sutherland Canal, which delivers water from both the North and South Platte Rivers for use as condenser cooling water at GGS.

The USGS collected 37 samples for chloride concentration analysis from the South Platte River at Roscoe, Nebraska between 1975 and 2013 (USGS 2016a). Chloride concentrations in the South Platte River ranged from 28 to 140 mg/L. The USGS collected 26 samples for chloride concentration analysis from the North Platte River at Keystone, Nebraska between 1972 and 2011 (USGS 2016b). Chloride concentrations in the North Platte River ranged from 16 to 24 mg/L.

The chloride concentrations of the Sutherland Reservoir and Sutherland Canal samples collected by NPPD field staff in October 2019 were 21.9 and 20.9 mg/L, respectively (Section 3.1.2). The six Sutherland Reservoir samples the USGS collected between August 2005 and December 2006 had chloride concentrations that ranged from 23.4 to 27.2 mg/L (USGS 2016c and USGS 2016d). The chloride concentrations in the Sutherland Reservoir and Sutherland Canal at the times of sampling (2005, 2006, and 2019) were more similar to concentrations observed in the North Platte River and lower than concentrations observed in the South Platte River.

Chloride concentrations in the North Platte River, South Platte River, and Sutherland Reservoir were sufficiently high enough to be regarded as a source of the elevated concentrations measured in groundwater at the upgradient monitoring wells at the Site and the elevated concentrations measured in downgradient groundwater at APMW-6, APMW-8A, and APMW-18. The groundwater from APMW-6 has the lowest chloride concentrations of any upgradient or downgradient CCR monitoring well (Figure 7 and Appendix A Figure A4). While the small increases in chloride concentrations at APMW-6 were only observed during detection monitoring (25.8 mg/L in Q2 2021, 17.6 mg/L in Q4 2021 which triggered the SSI, and 17.0 in Q2 2022), elevated concentrations at APMW-8A (56.3 mg/L to 124 mg/L) and APMW-18 (23.7 mg/L to 101 mg/L) were observed during the baseline and detection monitoring periods. The groundwater samples collected by the USGS and NPPD immediately around the Sutherland Reservoir (less than 1 mile) also support the hypothesis that the reservoir is the source of the elevated chloride concentrations at the Site (USGS 2016e). These shallow groundwater samples (10 collected by the USGS and 11 samples collected by NPPD) had chloride concentrations of between 21.9 and 36.1 mg/L, which is similar to the 5 to 93.8 mg/L chloride concentration range measured in groundwater at the GGS upgradient monitoring wells (APMW-5, APMW-15, APMW-16A, and APMW-17) between December 2015 and June 2022.

Figure 7 displays a box and whisker plot of the chloride concentrations from the GGS monitoring well network and samples of possible chloride sources at the Site. The plot indicates that groundwater-containing elevated chloride concentrations has been traveling across the Site, including past the upgradient monitoring wells, and has only recently started reaching downgradient monitoring wells.

McMahon et al. (2010) details the southernly flow of surface water from the Sutherland Canal and Sutherland Reservoir to the surrounding groundwater near GGS. Their analysis indicated that the front “edge” of Sutherland Reservoir water was in the approximate area of the CCR landfills, though the low density of wells sampled around the CCR landfills limited the resolution in that area.

4.1.2 Irrigation Water

As discussed in Section 2.3, historical ariel imagery (Figure 3) and site photographs (Figure 4) indicate that irrigation water runoff and center pivot spray are crossing the southern property boundary at GGS and flowing into the ditch immediately south of Ash Landfill No. 3 and No. 4. Ponded water in that ditch could infiltrate to groundwater and would have the potential to impact the wells located south of the ash landfills (APMW-4, APMW-6, APMW-8A, APMW-10, and APMW-11).

Chloride concentrations in center pivot irrigation water samples (Section 3.2) were elevated over concentrations recently observed in APMW-6 (17.0 to 25.8 mg/L between Q2 2021 and Q2 2022). On the piper diagram (Figure 6), groundwater from APMW-6 does have a similar signature (calcium bicarbonate dominant) to irrigation waters.

While two samples were collected and analyzed to represent center pivot spray water quality, NPPD field personnel did not observe irrigation water runoff to sample during the spring and summer of 2022.

4.1.3 Evaporation Pond

Although the evaporation pond is located to the east of APMW-6, and side-gradient in terms of groundwater flow (i.e., seepage from the evaporation pond would be unlikely to impact groundwater at monitoring well APMW-6), evaporation pond water quality was evaluated as a potential source in this section as it contains water related to GGS plant operations.

Groundwater quality at the three downgradient monitoring wells located around the evaporation pond (i.e., APMW-12, APMW-13, and APMW-14) indicates that process water discharged from the GGS plant and stored in the evaporation pond has migrated to groundwater. Historical monitoring results show that elevated concentrations of boron (Figure A2), chloride (Figure A4), sulfate (Figure A8), and TDS (Figure A9), which are elements that are typically associated with CCR, were detected in groundwater at these three monitoring wells closest to the evaporation pond compared to the upgradient monitoring wells.

Based on the slight differences in water quality between the groundwater at the monitoring wells APMW-12, APMW-13 and APMW-14 and the evaporation pond, mixing between the evaporation pond water and the upgradient groundwater likely occurs and groundwater at the monitoring wells is not entirely composed of seepage from the evaporation pond. This mixing reaction is supported by the Piper diagram in Figure 6, which shows samples from monitoring wells APMW-12 and APMW-14 plot on a mixing line between the evaporation pond and upgradient groundwater end-member data points.

During the Q4 2020 sampling of the evaporation pond surface water, the chloride concentration was 259 mg/L. Based on the similarities in water quality between the evaporation pond and adjacent groundwater monitoring wells (APMW-12, APMW-13, and APMW-14), the evaporation pond is considered a potential source of chloride to groundwater at GGS. However, it is unlikely the evaporation pond influenced groundwater quality at APMW-6, which is side gradient to groundwater flow underneath the evaporation pond (Figure 1).

4.1.4 Historical Ash Landfills

Historical deposits of fly ash present at GGS in the closed soil-lined Ash Landfills Nos. 1 and 2 may release soluble constituents to groundwater as the seepage generated by infiltrating precipitation interacts with the ash. While it was not feasible to collect a sample of seepage from Ash Landfills Nos. 1 and 2 directly, ash-impacted waters collected from Ash Landfill No. 3 sump and Ash Landfill No. 4 pond (Section 3.4) had chloride concentrations of 69 and 463 mg/L, respectively, and are assumed to represent potential ash impacted waters from closed ash landfills. At these concentrations, ash impacted seepage has the potential to increase chloride concentrations in downgradient wells, including APMW-6.

A ternary plot comparing sodium, potassium, and sulfate (Figure 8) reveals that ash impacted waters (i.e., contact water) have higher relative sodium abundances and lower relative potassium and sulfate abundances compared to the upgradient and downgradient groundwater. If infiltrating precipitation was leaching chloride from the closed fly ash storage facilities, the relative concentrations of sodium would increase considerably in the groundwater and would be more similar to the ash impacted waters, but this elevated sodium signature was not observed in any of the samples collected from the downgradient groundwater monitoring wells.

In addition to the elevated levels of chloride in the ash-impacted waters, boron was also identified as a primary CCR indicator based on high concentrations in sump water from Ash Landfill No. 3 (18.3 mg/L) and pond water from Ash Landfill No.4 (13.8 mg/L). Boron concentrations in groundwater at the upgradient and downgradient CCR Unit monitoring wells are presented in Appendix A, Figure A2. All upgradient and downgradient CCR Unit monitoring wells, with the exception of monitoring wells near the evaporation pond that may be influenced by process waters, have boron concentrations below the practical quantitation limit (PQL) (typically less than 0.2 mg/L). If seepage from the ash landfills were impacting groundwater and causing the chloride SSI, boron concentrations would be expected to be increasing.

5.0 EVIDENCE OF AN ALTERNATIVE SOURCE

Based on the testing results and list of potential alternate sources of chloride presented in this report, primary lines of evidence and conclusions drawn from the evidence used to support this ASD are provided in Table 2.

Table 2: Primary Lines of Evidence and Supporting ASD Analysis

Key Line of Evidence	Supporting Evidence	Description
Lack of Primary CCR Indicators	Boron concentrations in groundwater	Boron (Figure A2) is a primary CCR indicator based on high concentrations in sump water from Ash Landfill No. 3 (18.3 mg/L) and pond water from Ash Landfill No.4 (13.8 mg/L). All upgradient and downgradient CCR unit monitoring wells, with the exception of monitoring wells near the evaporation pond that may be influenced by process waters, have boron concentrations below the PQL (typically <0.2 mg/L).
	Sodium concentrations in CCR impacted waters	The relative abundance of sodium in CCR impacted waters would indicate that high sodium concentrations would also be expected in groundwater if chloride was from CCR materials (Figure 8). Relative increases in sodium were not observed in monitoring wells at the Site, suggesting an alternative source of elevated chloride in groundwater at APMW-6
Groundwater Geochemistry	Elevated and variable chloride concentrations in upgradient monitoring wells	Chloride concentrations in groundwater at upgradient monitoring wells APMW-5, APMW-16A, and APMW-17 were elevated compared to chloride concentrations at monitoring well APMW-6 throughout the baseline monitoring period. Since the CCR unit cannot influence the chloride groundwater concentration in the upgradient wells, the only explanation is that there is an alternate source of chloride present in groundwater across the Site.
	Relative ion abundances in groundwater differs from ash landfill water	As presented in the Piper plot (Figure 6), relative differences in major ion concentrations show a distinct dissimilarity between the ash-impacted sump and pond waters and the downgradient groundwater samples, including from APMW-6. The geochemical properties of the downgradient groundwater samples are not consistent with seepage from the CCR unit.
Engineering Controls	Both Active CCR Landfill are Lined	The liner system at Ash Landfill No. 3 consists of a prepared subgrade overlain by a geosynthetic clay liner and 60-mil linear low-density polyethylene (LLDPE) geomembrane. Ash Landfill No. 3 also has a 1-foot LCS sand layer that reports to two sumps. The liner design at Ash Landfill No. 4 consists of a 60-mil high density polyethylene (HDPE) geomembrane over compacted subgrade.

Key Line of Evidence	Supporting Evidence	Description
		Liner system are less likely to release seepage and impact groundwater.
Local Sources of Chloride	Hydrogeology	The North and South Platte Rivers, which are ultimately the source of groundwater recharge that occurs from the Sutherland Reservoir located approximately 1.5 miles north of the ash landfill, have chloride concentrations between 16 and 140 mg/L. Samples from shallow wells near the Sutherland Reservoir and upgradient wells (Figures 6 and 7) indicate that groundwater with elevated chloride is migrating south through the Site (McMahon et al. 2010). Chloride concentrations in groundwater at APMW-6 were lower than other nearby wells, indicating that APMW-6 is the last of the downgradient monitoring wells to be affected by the higher chloride groundwater migrating south (Figure 7 and Appendix A Figure A4).
	Drainages from agricultural lands flow into the ditch immediately upgradient of APMW-6	Irrigation waters spraying directly onto GGS property near APMW-6 had sufficiently elevated chloride concentrations (32 to 34 mg/L) to be a potential source of chloride in groundwater downgradient of the ash landfills. Additional study is needed to understand the water quality, frequency, and magnitude of irrigation water runoff events.

6.0 CONCEPTUAL SITE MODEL

Golder developed a conceptual site model (CSM) that is presented graphically in Figure 9 to frame and support the ASD assessment approach. The CSM presents the GGS site layout, a summary of the geologic and hydrogeologic information, and a discussion of groundwater monitoring data, which together lays the groundwork for consideration and development of the ASD. Additionally, the CSM summarizes the findings of literature research that suggest certain naturally occurring groundwater conditions observed in Nebraska are present at the Site and may contribute to naturally elevated chloride concentrations in groundwater around the ash landfill.

7.0 CONCLUSIONS

In accordance with §257.95(g)(3) and NAC Title 132, Ch.7, 004.03, this ASD has been prepared in response the identification of an SSI for chloride at monitoring well APMW-6 following the Q2 2022 sampling event for the ash landfill at Gerald Gentleman Station.

A review of historical analytical results indicates that the elevated chloride concentrations in groundwater at APMW-6 were not the result of seepage from the ash landfill but can be attributed to chloride in regional groundwater from the Sutherland Reservoir or in infiltrating surficial flows of irrigation water from agricultural lands immediately to the south of the GGS property. Therefore, no further action (i.e., transition to Assessment Monitoring) is warranted, and the Gerald Gentleman Station ash landfill will remain in detection monitoring.

Signature Page

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Senior Lead Consultant

GL/ES/JS/rm

8.0 REFERENCES

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

Fetter Charles Willard. 1994. Applied Hydrogeology, 3rd Edition. Prentice-Hall.

Goeke JW, Peckenpaugh JM, Cady RE, Dugan JT. 1992. Hydrogeology of Parts of the Twin Platte and Middle Republican Natural Resources Districts, Southwestern Nebraska, Nebraska Water Survey Paper No. 70, Conservation and Survey Division, University of Nebraska-Lincoln, 89 pp.

Golder (Golder Associates Inc.). 2017. Coal Combustion Residuals Landfill Groundwater Monitoring System Certification, Nebraska Public Power District Gerald Gentlemen Station, Sutherland, Nebraska.

Golder. 2019a. Sampling and Analysis Plan, Gerald Gentleman Station Ash Landfill. December.

Golder. 2019b. Alternate Source Demonstration, Nebraska Public Power District Gerald Gentlemen Station, Sutherland, Nebraska, April.

Golder. 2022. Alternative Source Demonstration for Chloride at APMW-6, Nebraska Public Power District Gerald Gentlemen Station, Sutherland, Nebraska, April.

McMahon PB, Carney CP, Poeter EP, Peterson SM. 2010. Use of geochemical, isotopic, and age tracer data to develop models of groundwater flow for the purpose of water management, northern High Plains aquifer, USA. Applied Geochemistry, 25(6), pp.910-922.

NDEE (Nebraska Department of Environment and Energy). 2022. Letter from Ed Southwick RCRA/Federal Facilities Section Supervisor to Brian Kozisek NPPD Environmental Protection Supervisor. Alternative Source Demonstrations for Chloride in APMW-19 and Sulfate and APMW-6. May 26, 2022.

USGS (US Geological Survey). 2016a. National Water Information System data available on the World Wide Web (USGS Water Data for the Nation: USGS 06764880 South Platte River at Roscoe, Nebr.), accessed April 2020, at URL: https://nwis.waterdata.usgs.gov/nwis/qwdata/?site_no=06764880&agency_cd=USGS&amp.

USGS. 2016b. National Water Information System data available on the World Wide Web (USGS Water Data for the Nation: USGS 06690500 North Platte River Near Keystone, Nebr.), accessed April 2020, at URL: https://nwis.waterdata.usgs.gov/nwis/qwdata/?site_no=06690500&agency_cd=USGS&amp.

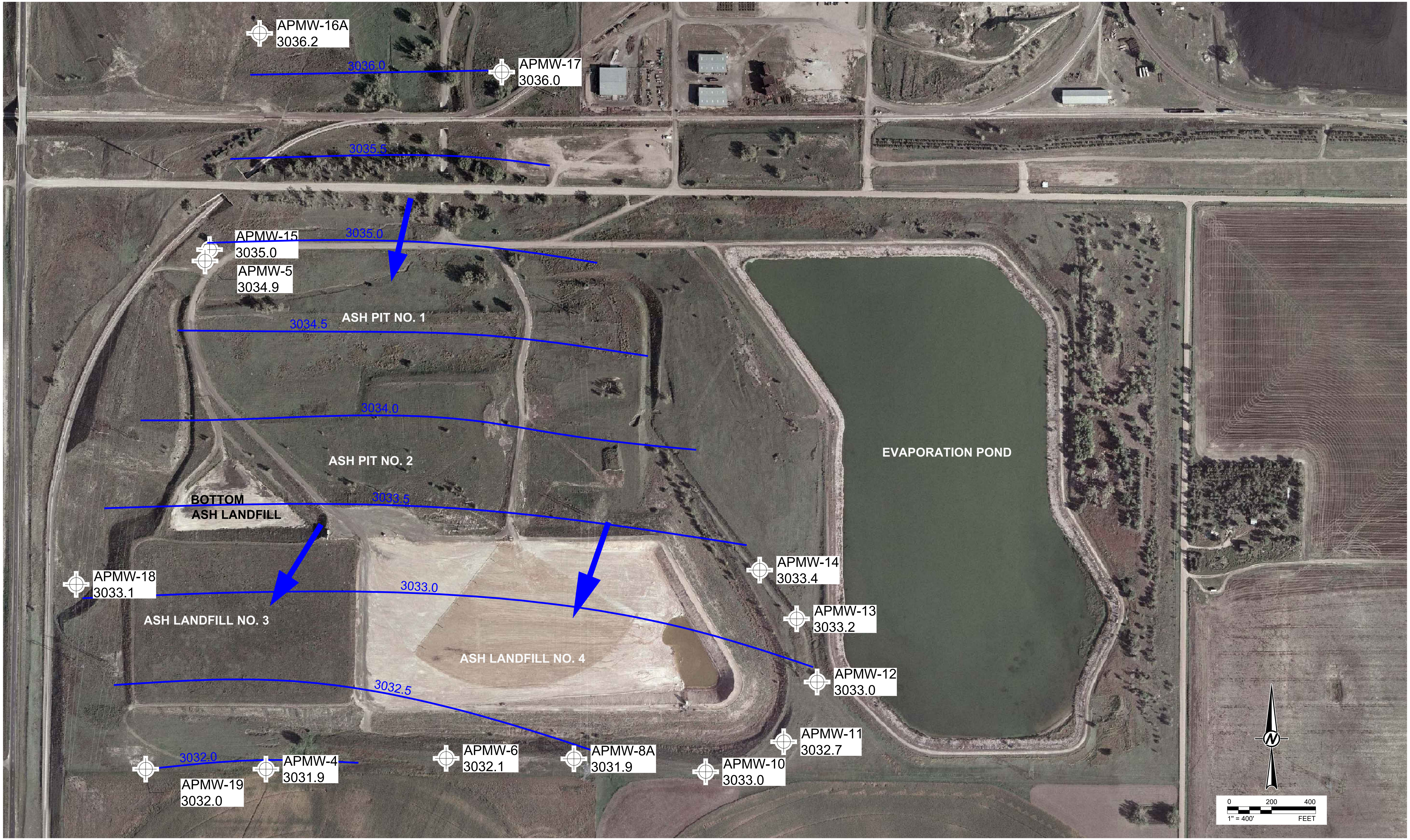
USGS. 2016c. National Water Information System data available on the World Wide Web (USGS Water Data for the Nation: USGS 410630101080202 Sutherland Reservoir Middle Deep), accessed April 2020, at URL: https://waterdata.usgs.gov/nwis/inventory?agency_code=USGS&site_no=410630101080202.

USGS. 2016d. National Water Information System data available on the World Wide Web (USGS Water Data for the Nation: USGS 410630101080201 Sutherland Reservoir Middle Shallow), accessed April 2020, at URL: https://nwis.waterdata.usgs.gov/usa/nwis/qwdata/?site_no=410630101080201.

USGS. 2016e. National Water Information System data available on the World Wide Web (USGS Water Data for the Nation: USGS-410711101060201, USGS-410606101061301, USGS-410529101062501, USGS-410542101053501, USGS-410438101055301, USGS-410452101055301, USGS-410522101075601, USGS-410508101091501, USGS-410456101091801, USGS-410530101093701, and USGS-410811101072501), accessed April 2020, at URL: https://www.waterqualitydata.us/portal/#siteid=USGS-410711101060201&siteid=USGS-410606101061301&siteid=USGS-410529101062501&siteid=USGS-410542101053501&siteid=USGS-410438101055301&siteid=USGS-410452101055301&siteid=USGS-410522101075601&siteid=USGS-410508101091501&siteid=USGS-410456101091801&siteid=USGS-410530101093701&siteid=USGS-410811101072501&mimeType=csv.

Woodward-Clyde Consultants. 1991. Design and Construction of a Groundwater Monitoring Network, Final Report, Gerald Gentleman Station, Nebraska Public Power District, Sutherland, Nebraska, WCC Project No. 90MC176, Omaha, Nebraska, September.

Figures



NOTE

GROUNDWATER CONTOURS DEVELOPED FROM LEVELS MEASURED IN ACTIVE MONITORING WELLS SHOWN.

wsp GOLDER

NEBRASKA PUBLIC POWER DISTRICT GERALD GENTLEMAN STATION GROUNDWATER MONITORING WELL NETWORK JUNE 2022 GROUNDWATER CONTOURS

FIGURE 1

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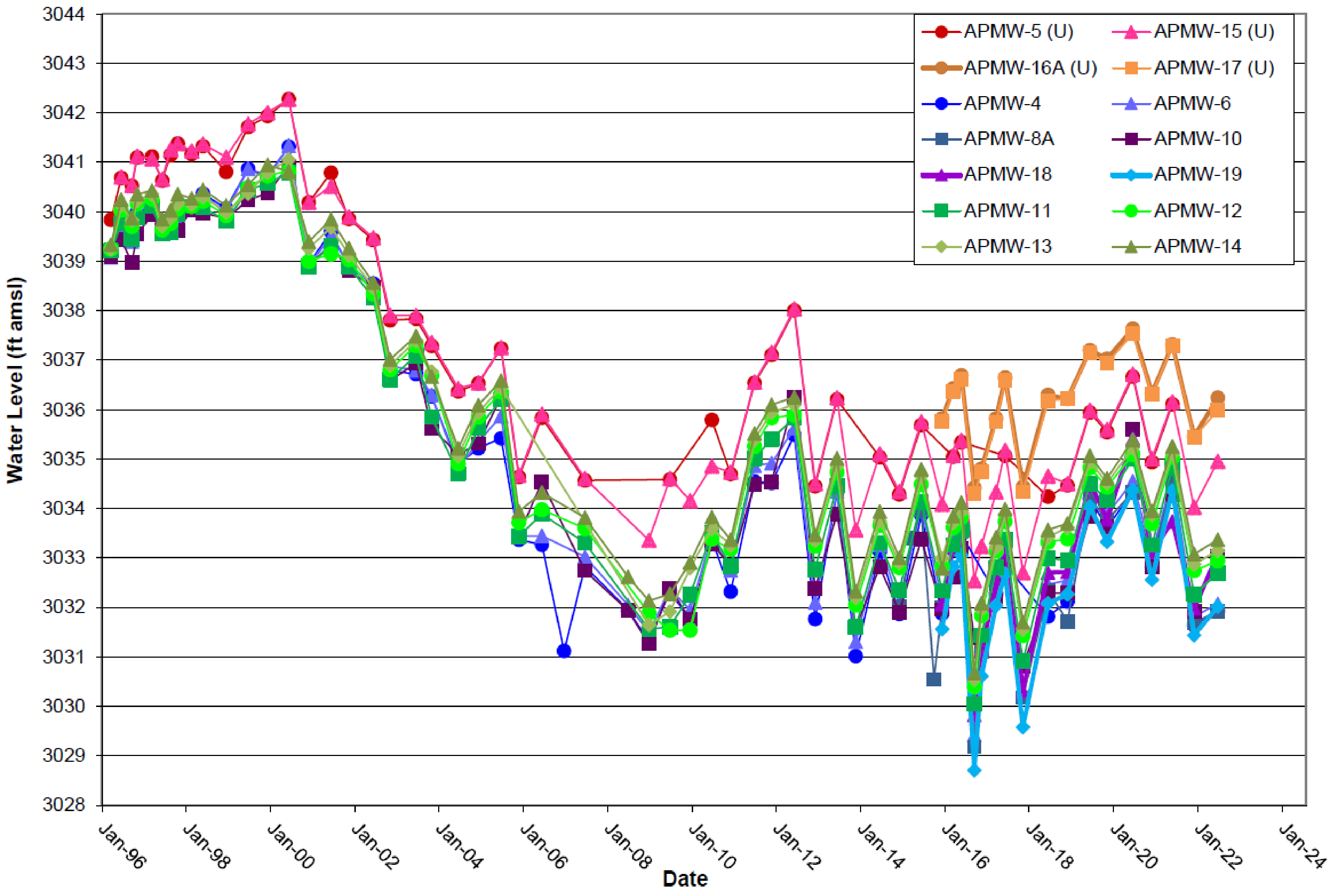

CLIENT

Nebraska Public Power District: Gerald Gentleman Station

CONSULTANT

WSP GOLDER

PROJECT

Alternate Source Demonstration

TITLE

Groundwater Monitoring Well Water Levels

PROJECT NO.	PHASE	REV.	FIGURE
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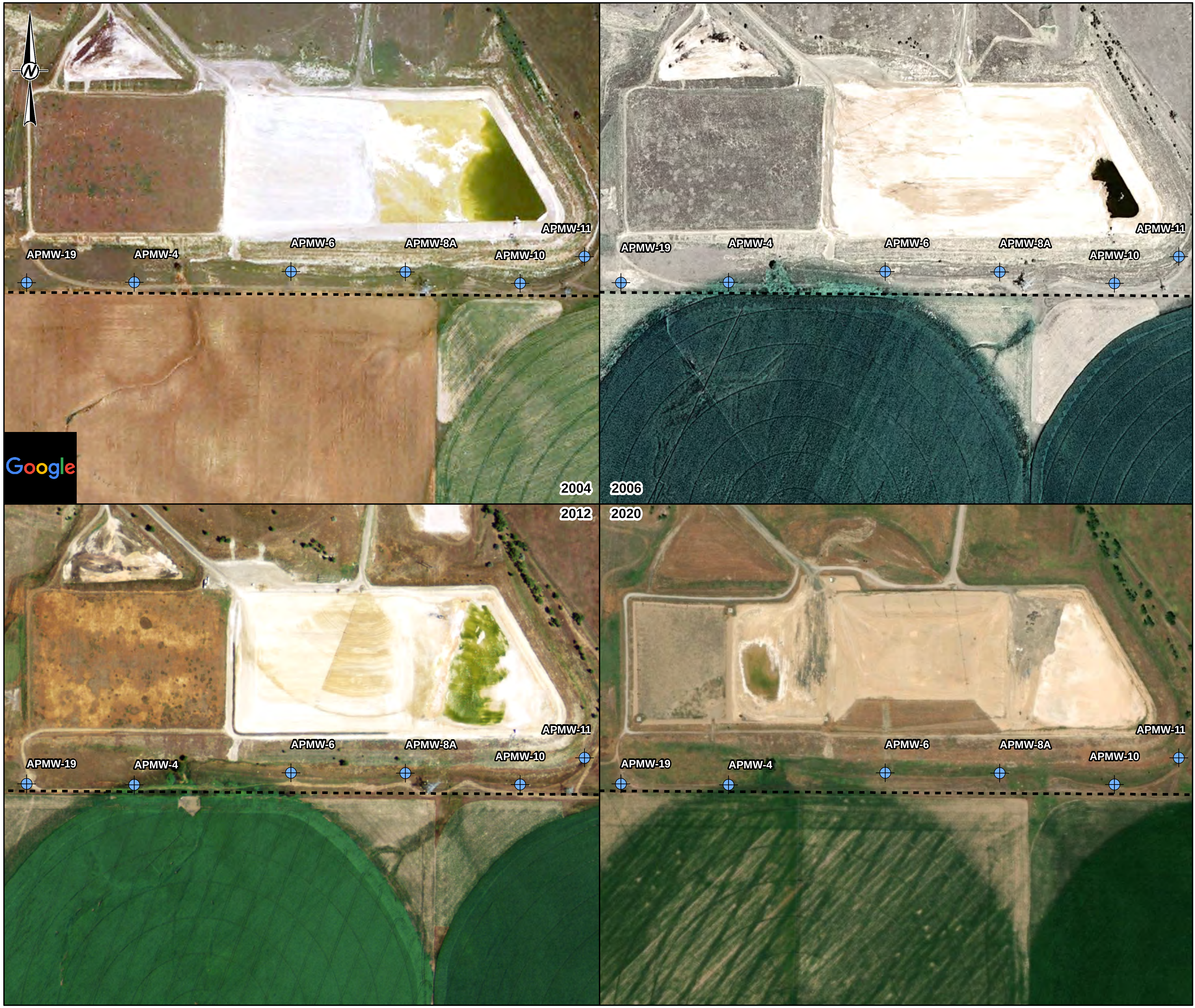

LEGEND

⌖ MONITORING WELLS (QUALITY)

▭ APPROXIMATE NPPD PROPERTY BOUNDARY

0 250 500 1,000 Feet

REFERENCES

1. AERIAL IMAGERY: NATIONAL AGRICULTURE IMAGERY PROGRAM (NAIP), USDA. IMAGERY COLLECTED 06/26/2012, AND 07/14/2006.
2. AERIAL IMAGERY: ESRI PROVIDED BASEMAP. VIVID. MAXAR. IMAGERY COLLECTED 07/03/2020
3. AERIAL IMAGERY: COPYRIGHT GOOGLE 2021. IMAGERY CAPTURED MAY 2004.. IMAGE ACCURACY TO BE CONSIDERED APPROXIMATE. GOOGLE IS NOT LIABLE FOR ANY DECISIONS MADE BASED ON THE CONTENTS OF THE IMAGE SHOWN ON THIS FIGURE.
4. APPROXIMATE WATER WELL LOCATIONS: NEBRASKA DEPARTMENT OF NATURAL RESOURCES. DATASET DOWNLOADED MARCH 2019.
5. APPROXIMATE NPPD PARCEL BOUNDARIES: LINCOLN COUNTY ASSESSOR'S OFFICE, APRIL 2019.

CLIENT
NEBRASKA PUBLIC POWER DISTRICT
GERALD GENTLEMAN STATION
SUTHERLAND, NEBRASKA

PROJECT
Alternative Source Demonstration

Aerial Imagery of Irrigation Water Runoff and Center Pivot spray onto GGS Property

CONSULTANT
wsp GOLDER

YYYY-MM-DD	2021-10-26
DESIGNED	RG/JAM
PREPARED	JAM
REVIEWED	GOL
APPROVED	JS

PROJECT NO.
31404512.000

FIGURE
3

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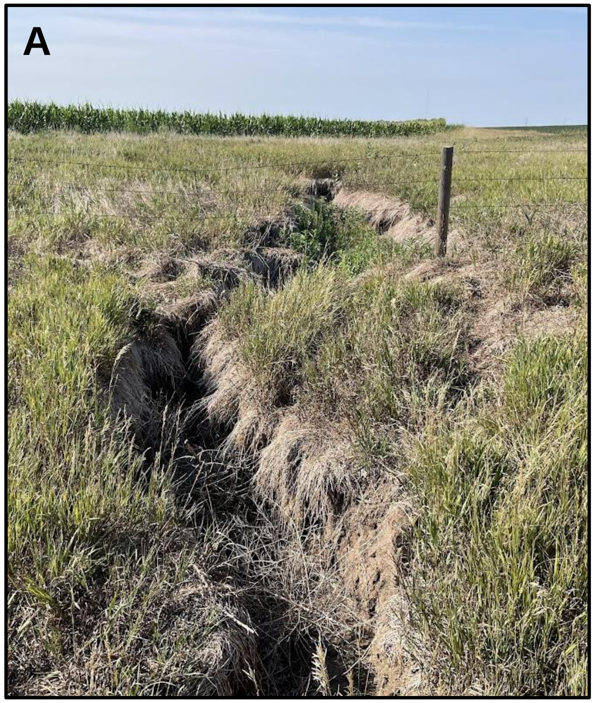

Evidence of past irrigation water runoff

East Drainage from agricultural fields onto NPPD GGS property at southern property boundary fence. No water in the drainage at the time of photograph.

Photo taken by Gregory Lehn (WSP-Golder) on August 2nd, 2022 facing south.

Evidence of past irrigation water runoff

West Drainage from agricultural fields onto NPPD GGS property at southern property boundary fence. Presence of dried corn shucks indicates previous flows through the drainage.

Photo taken by Gregory Lehn (WSP-Golder) on August 2nd, 2022 facing south.

Evidence of center pivot spray

Irrigation system spray from agricultural fields onto NPPD GGS property along southern property boundary fence. Water has been observed ponded on the surface and grass is green throughout the summer months.

Photo taken by Douglas Harris (NPPD) on August 11th, 2022 facing east along southern boundary.

CLIENT
Nebraska Public Power District: Gerald Gentleman Station

PROJECT
Alternate Source Demonstration

CONSULTANT
WSP GOLDER

TITLE
Photographs of Drainages and Center Pivot Spray onto GGS Property

PROJECT NO.	PHASE	REV.	FIGURE
31404512.000	1		4

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM: ANSI A

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0

NOTES

1. WELL LOCATIONS ARE APPROXIMATE.

REFERENCE(S)

1. AERIAL IMAGERY OBTAINED FROM ESRI (MAY 2020).

WSP GOLDER

NEBRASKA PUBLIC POWER DISTRICT
GERALD GENTLEMAN STATION
Q2 2021 UPGRADIENT GROUNDWATER SAMPLING LOCATIONS

FIGURE 5

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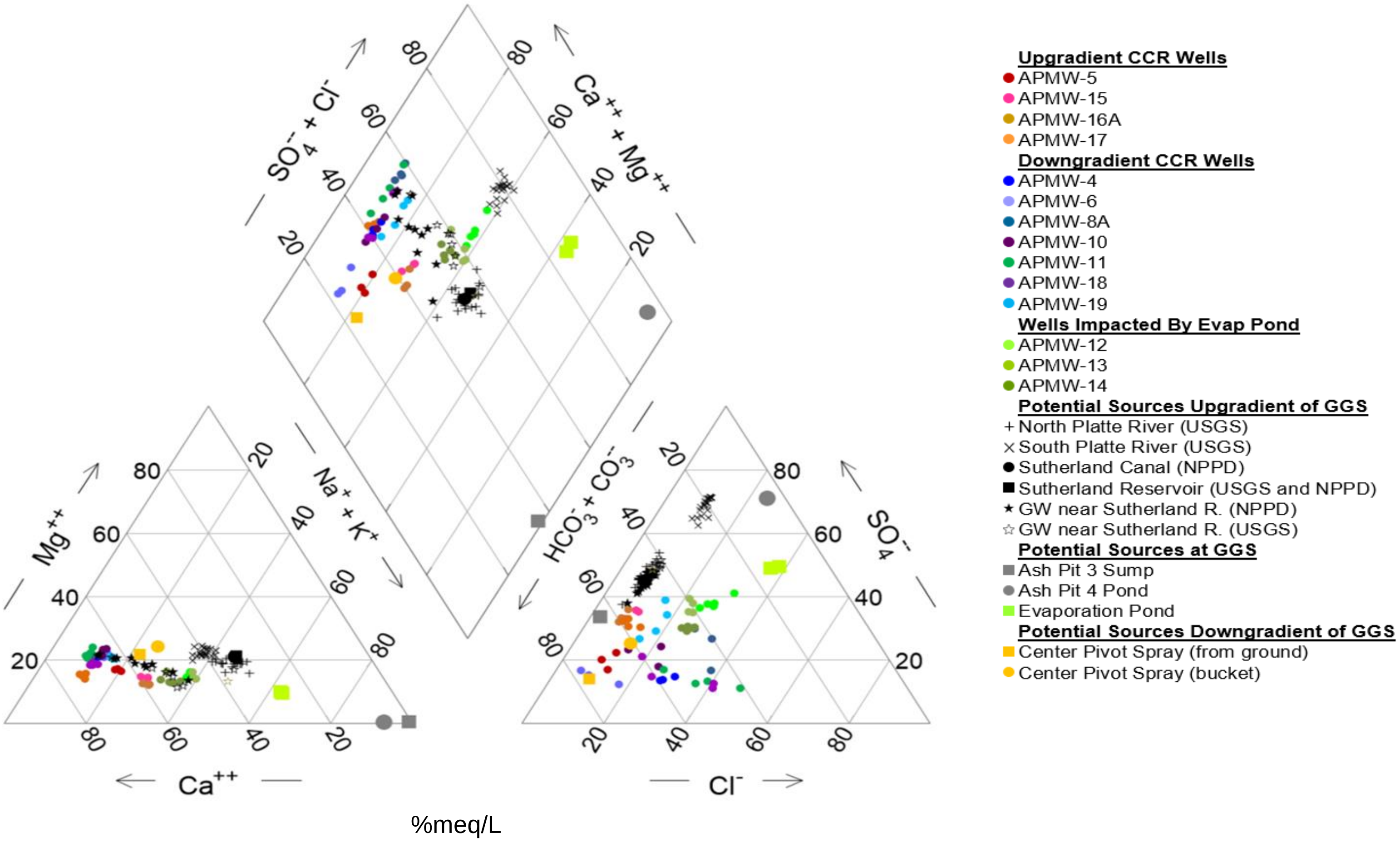

CLIENT

Nebraska Public Power District: Gerald Gentleman Station

CONSULTANT

WSP GOLDER

PROJECT

Alternate Source Demonstration

TITLE

Piper Diagram of Groundwater and Potential Chloride Sources

PROJECT NO.	PHASE	REV.	FIGURE
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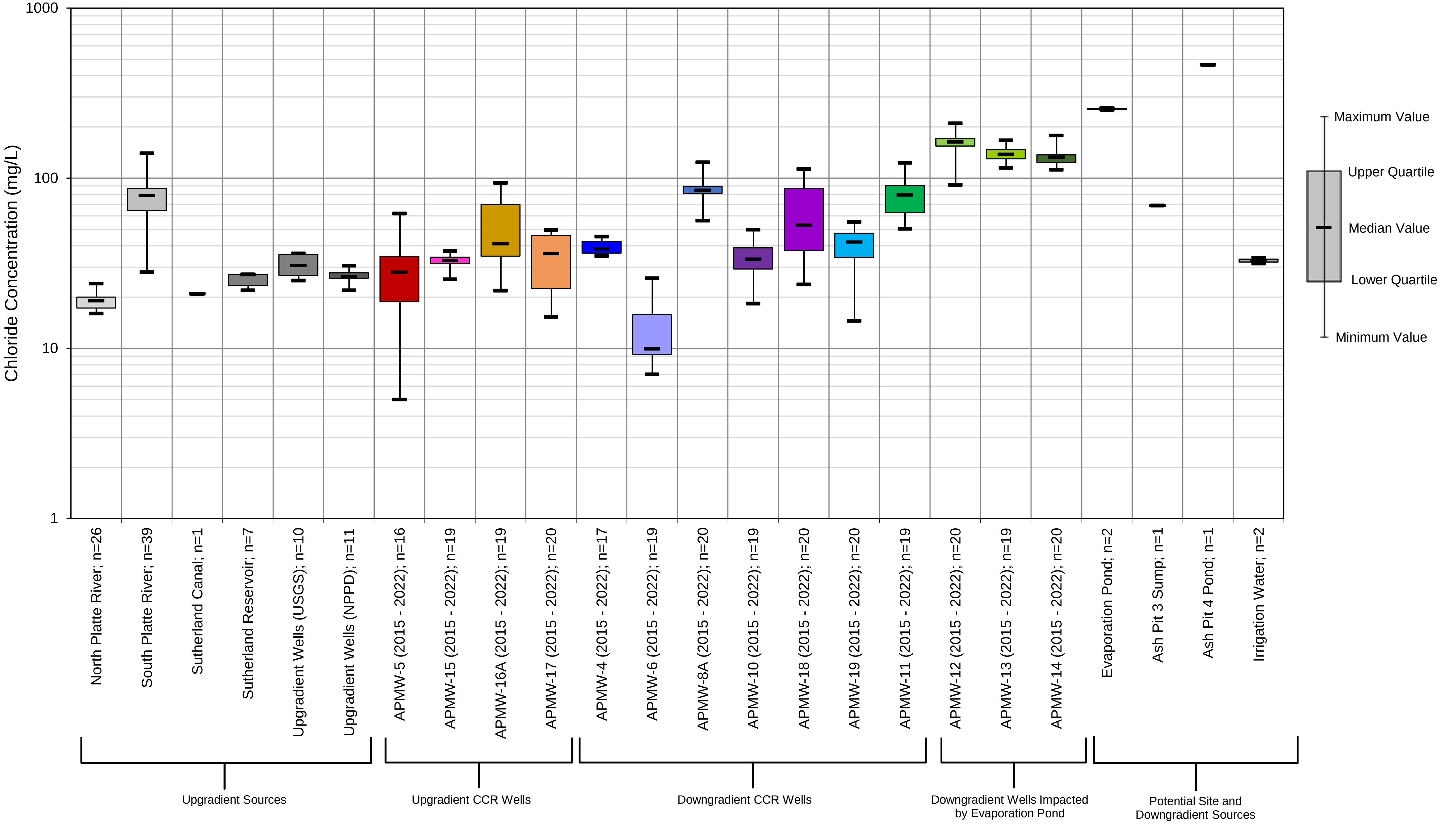

CLIENT

Nebraska Public Power District: Gerald Gentleman Station

PROJECT

Alternate Source Demonstration

CONSULTANT

WSP GOLDER

TITLE

Chloride Box and Whisker Plot

PROJECT NO.	PHASE	REV.	FIGURE
31404512.000	1		7

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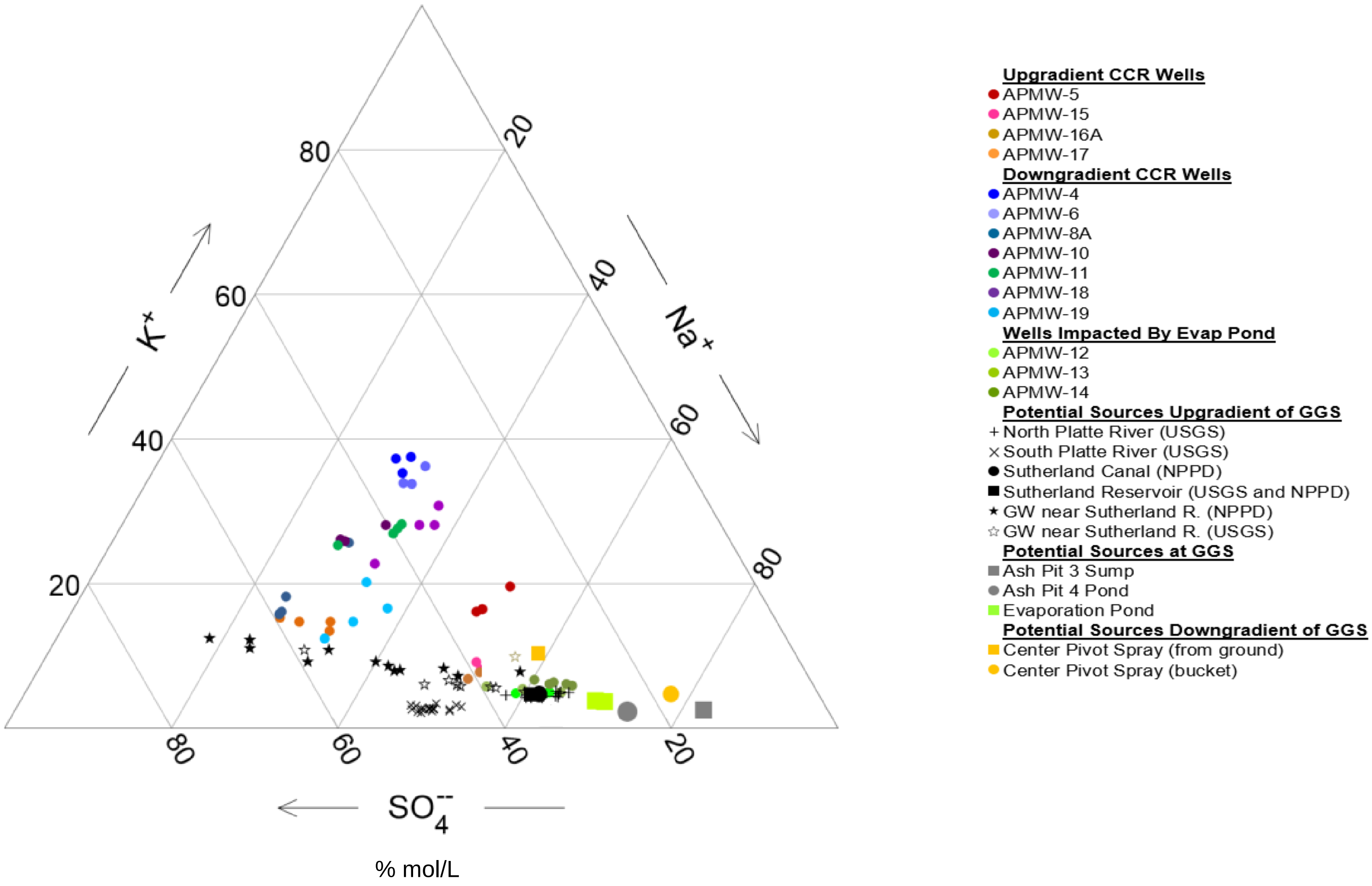

CLIENT

Nebraska Public Power District: Gerald Gentleman Station

CONSULTANT

WSP GOLDER

PROJECT

Alternate Source Demonstration

TITLE

Ternary Diagram of Groundwater and Potential Chloride Sources

PROJECT NO.	PHASE	REV.	FIGURE
31404512.000	1		8

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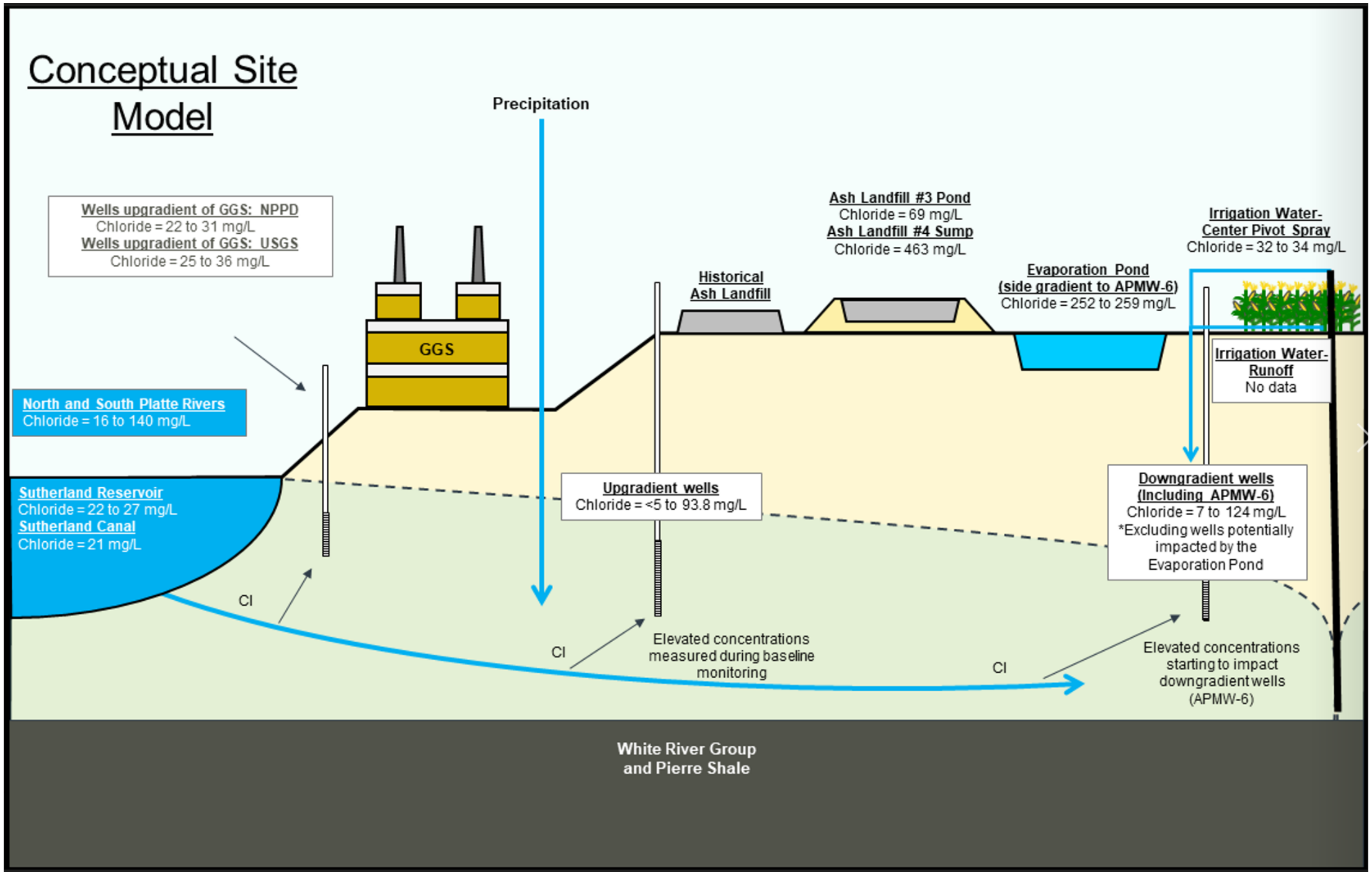


CLIENT

Nebraska Public Power District: Gerald Gentleman Station

CONSULTANT

WSP GOLDER

PROJECT

Alternate Source Demonstration

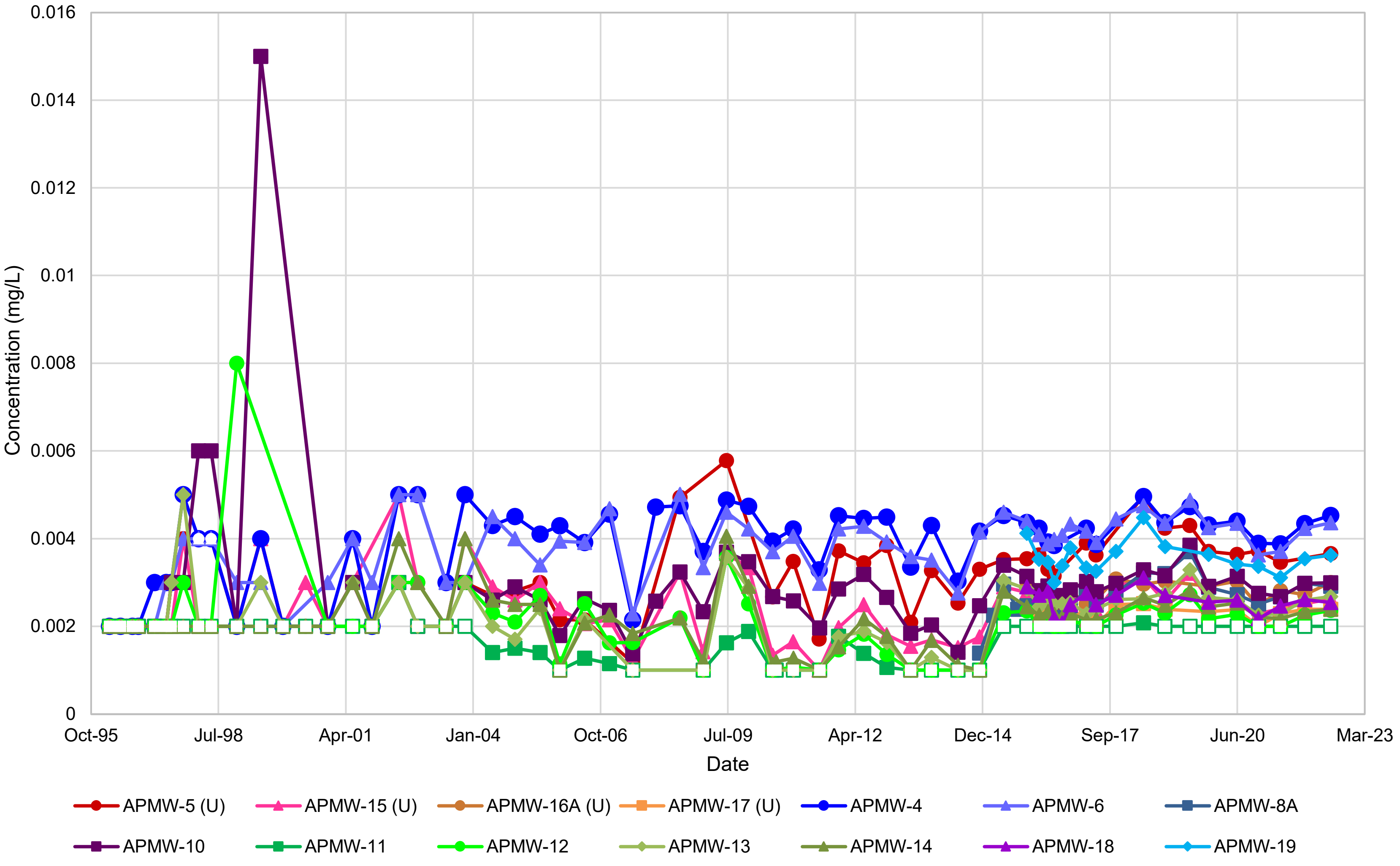
TITLE

Chloride Conceptual Site Model

PROJECT NO.	PHASE	REV.	FIGURE
31404512.000	1		9

APPENDIX A

Historical Concentrations of Appendix III and Selected Appendix IV Analytes



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-1

Arsenic

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

Golder Associates USA Inc., A Member of WSP

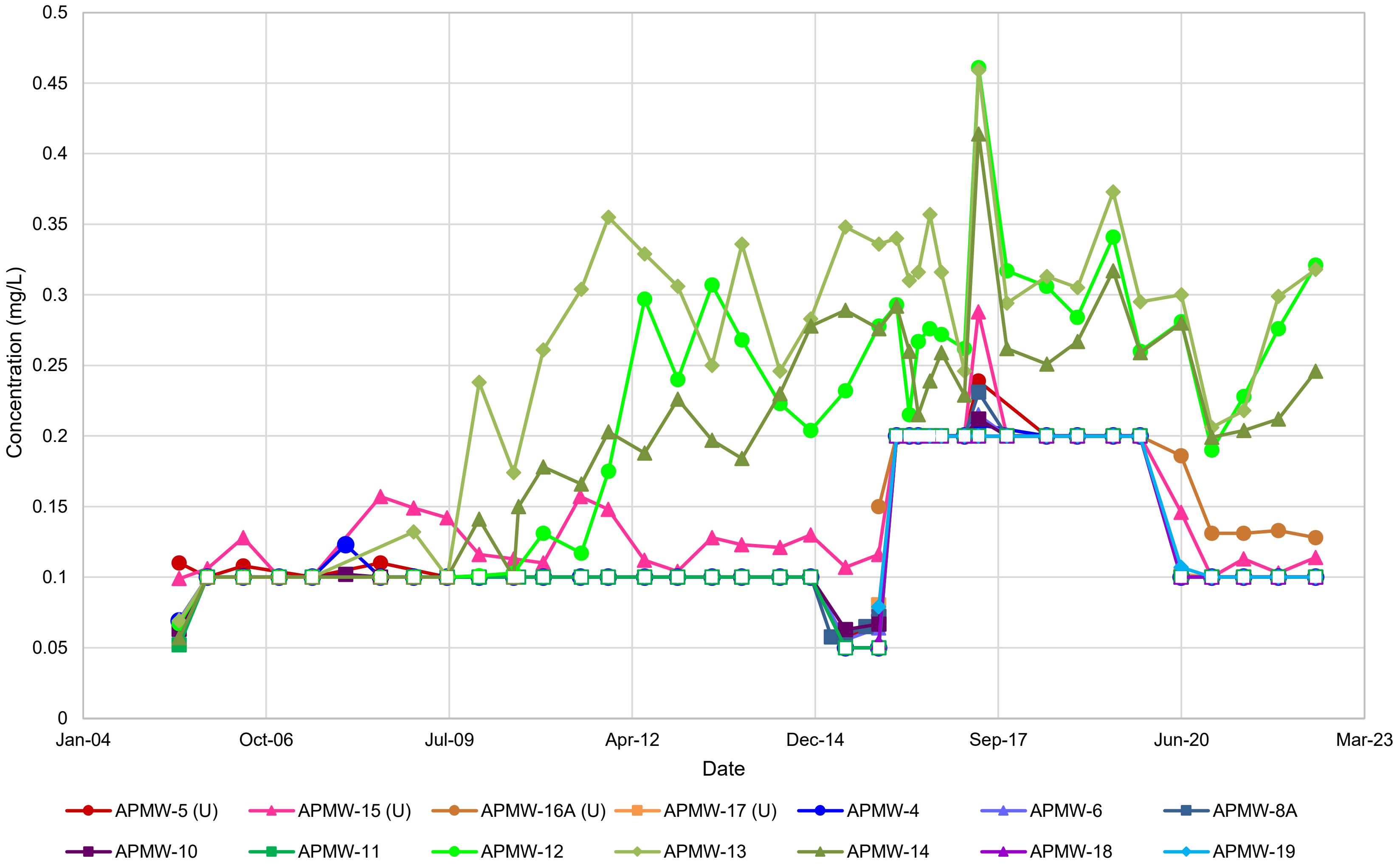


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Figure A-2

Boron

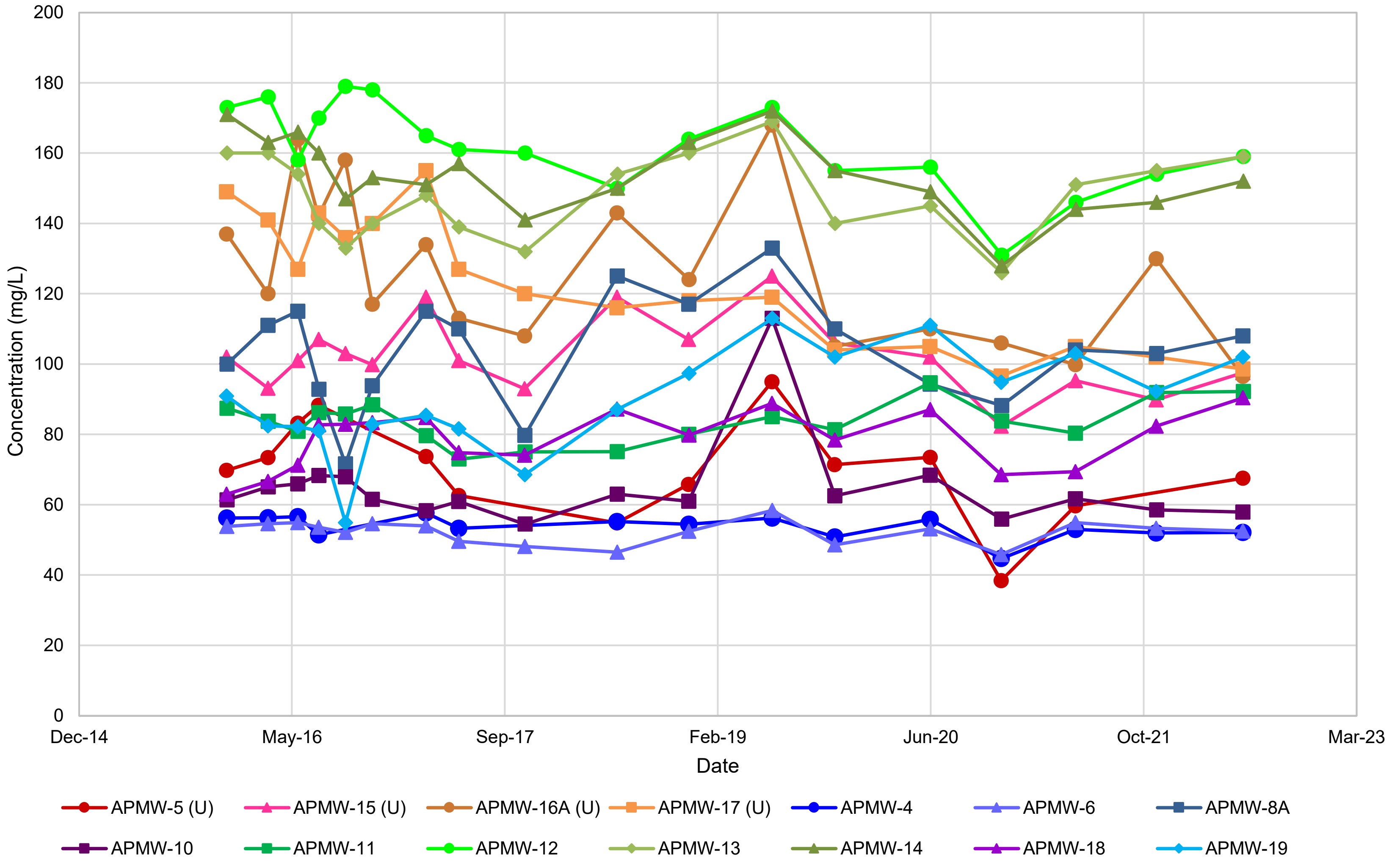
Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022 31404512.000

Golder Associates USA Inc., A Member of WSP



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-3

Calcium

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022

31404512.000

Golder Associates USA Inc., A Member of WSP

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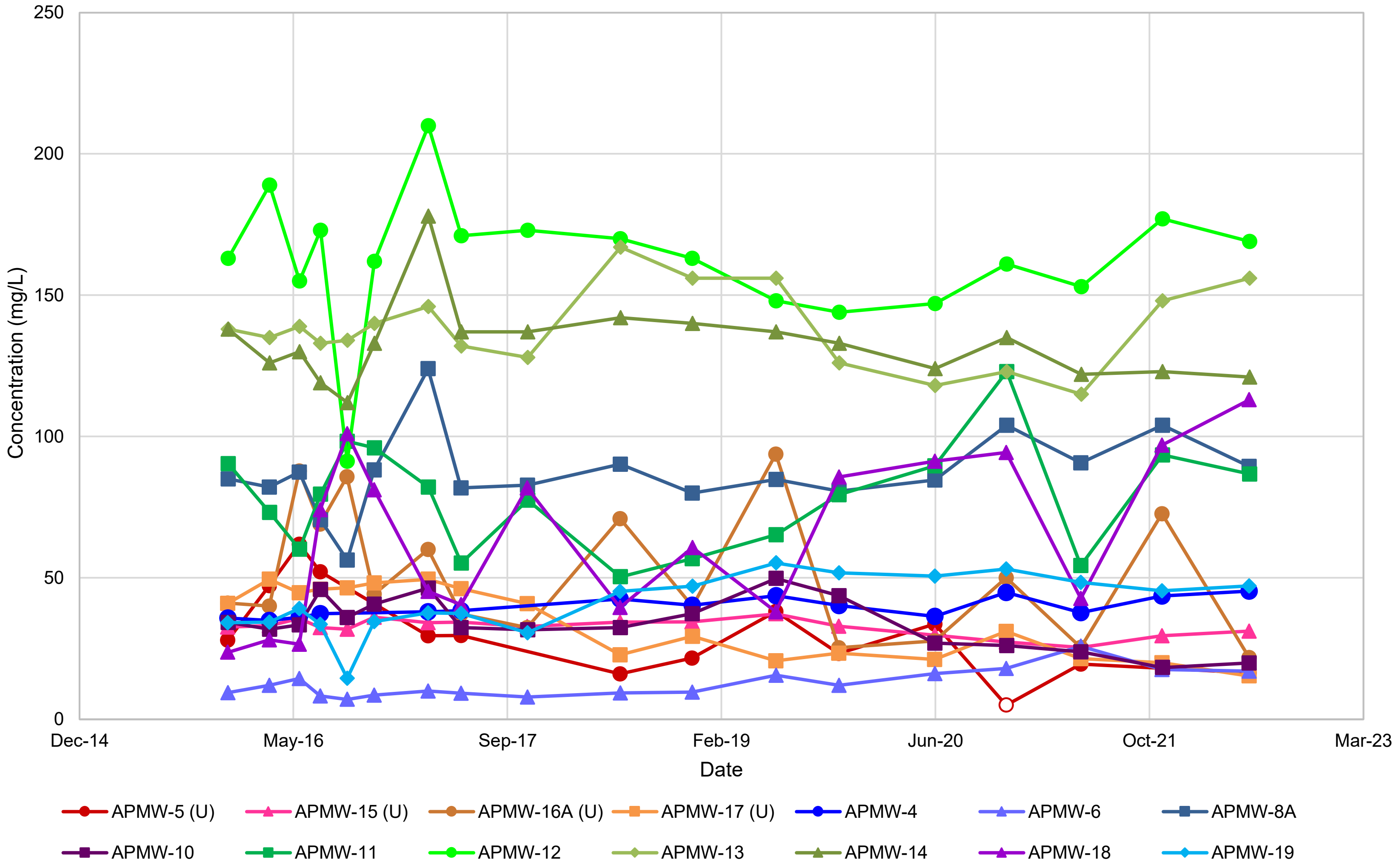


Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-4

Chloride

Nebraska Public Power District

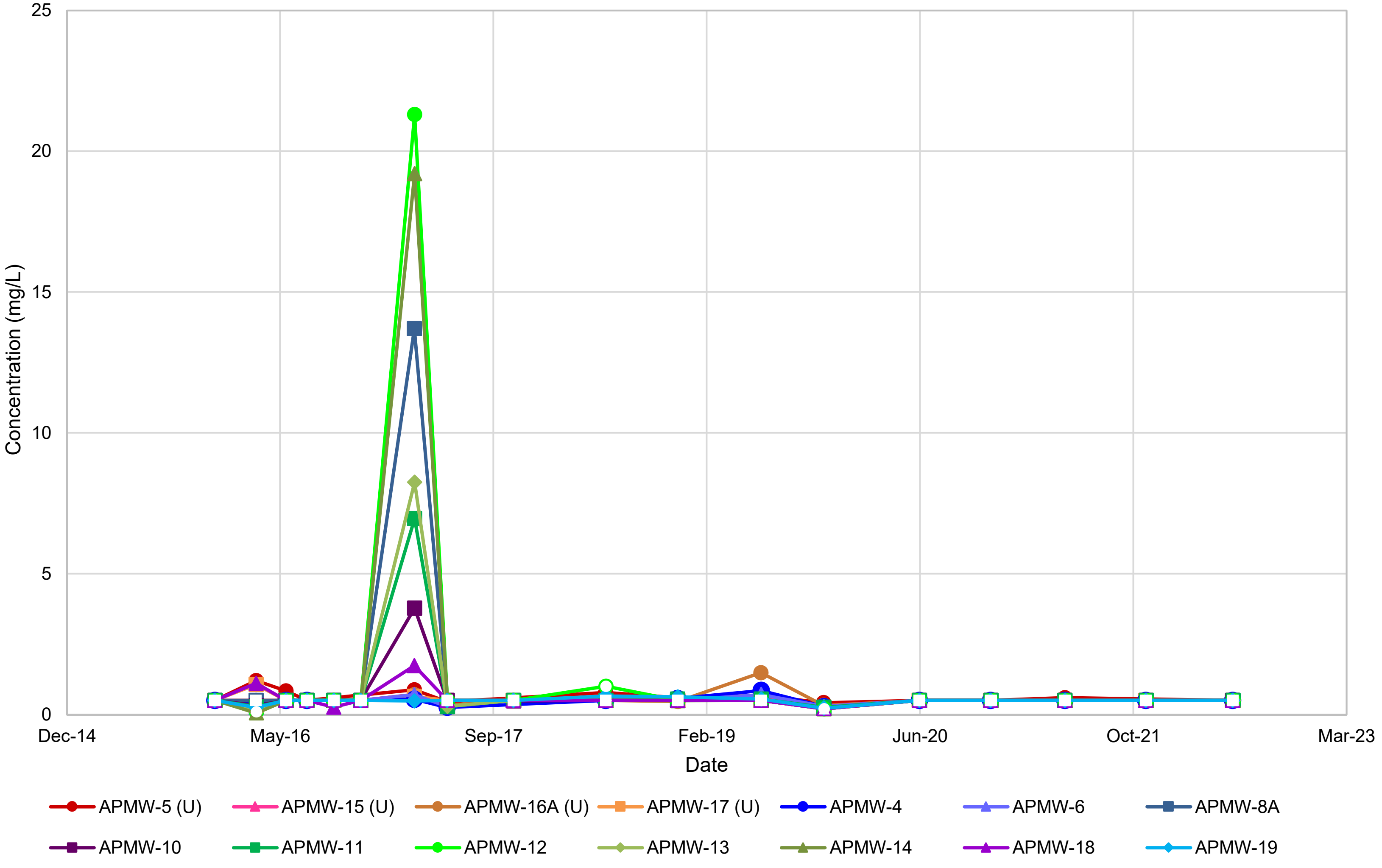
Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022 31404512.000

Golder Associates USA Inc., A Member of WSP

https://golderassociates.sharepoint.com/sites/124836/Project Files/5 Technical Work/1 Gerald Gentleman Station/2022 - Q2/Data Evaluation/[TimeSeries GGS NDEE.xlsm]A-4



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-5

Fluoride

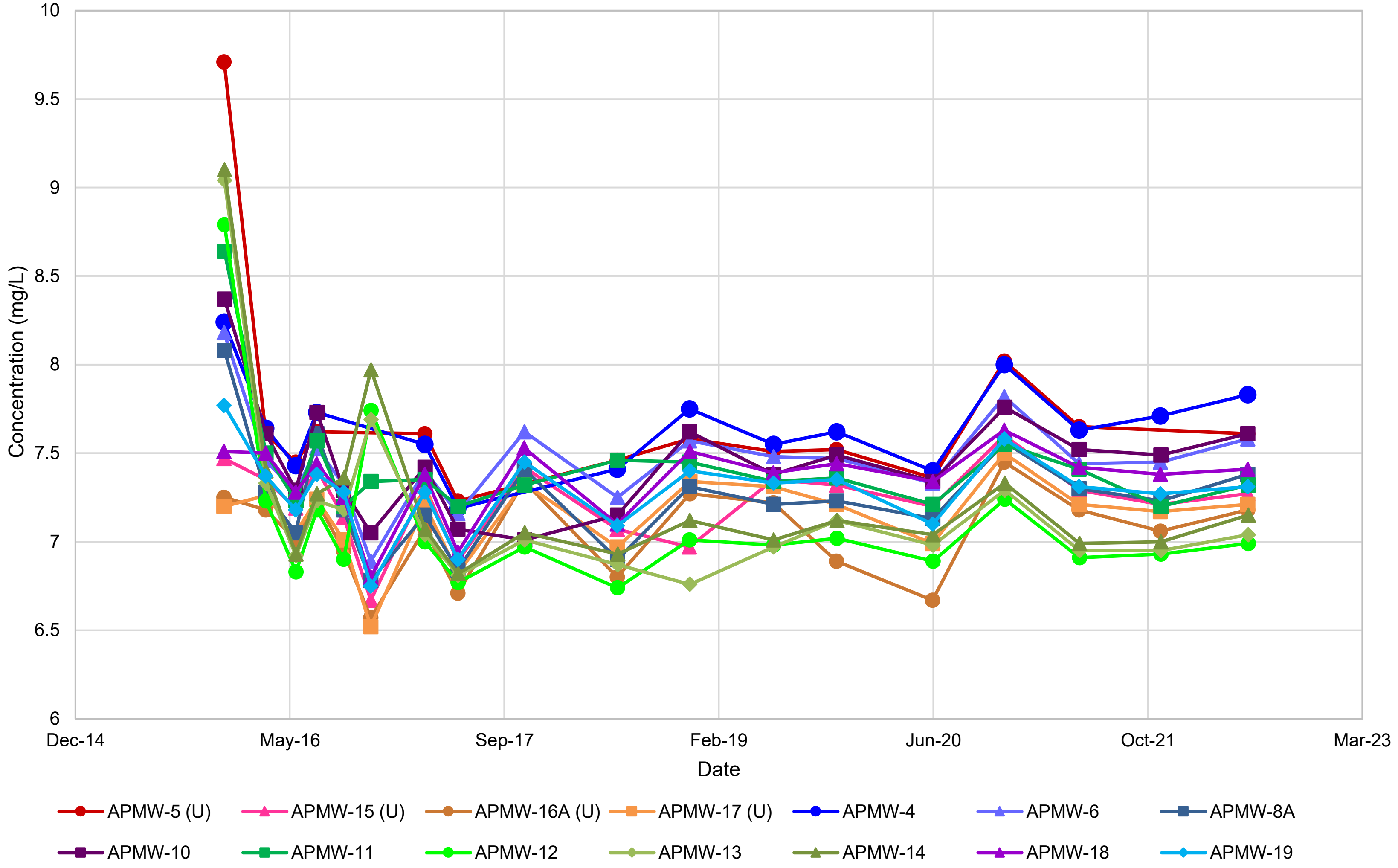
Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022 31404512.000

Golder Associates USA Inc., A Member of WSP



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-6

pH, Field Measured

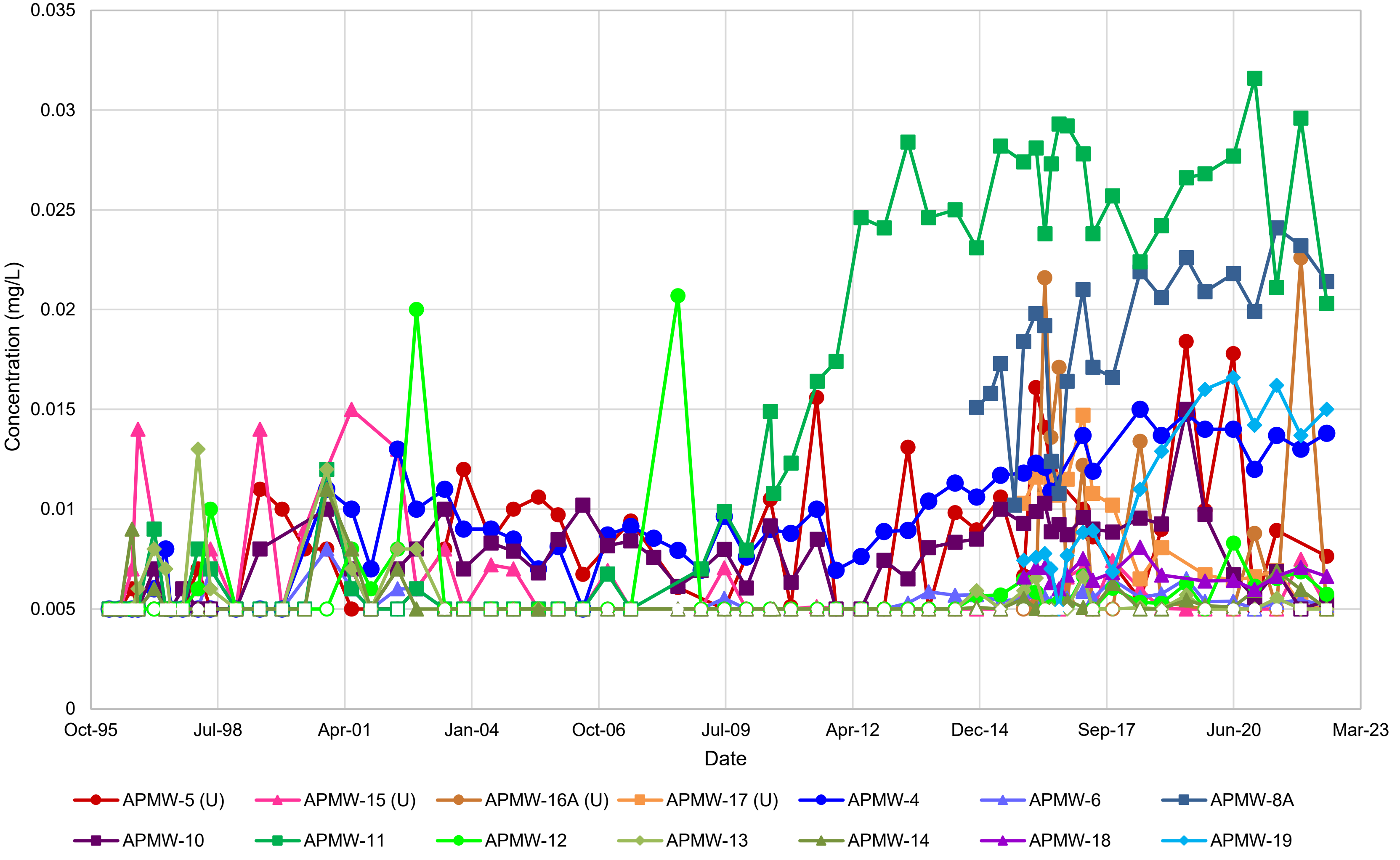
Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022 31404512.000

Golder Associates USA Inc., A Member of WSP



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-7

Selenium

Nebraska Public Power District

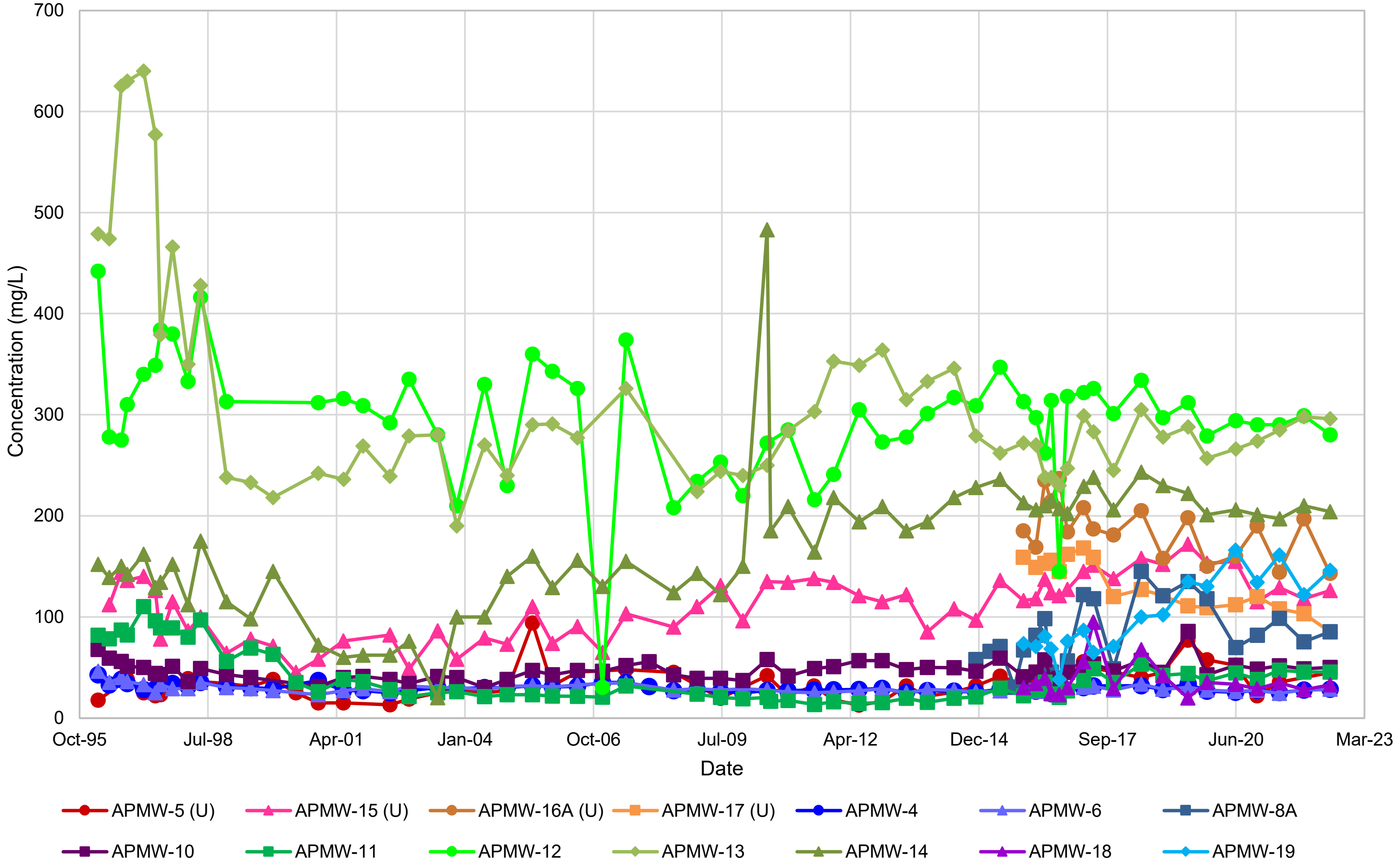
Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022

31404512.000

Golder Associates USA Inc., A Member of WSP

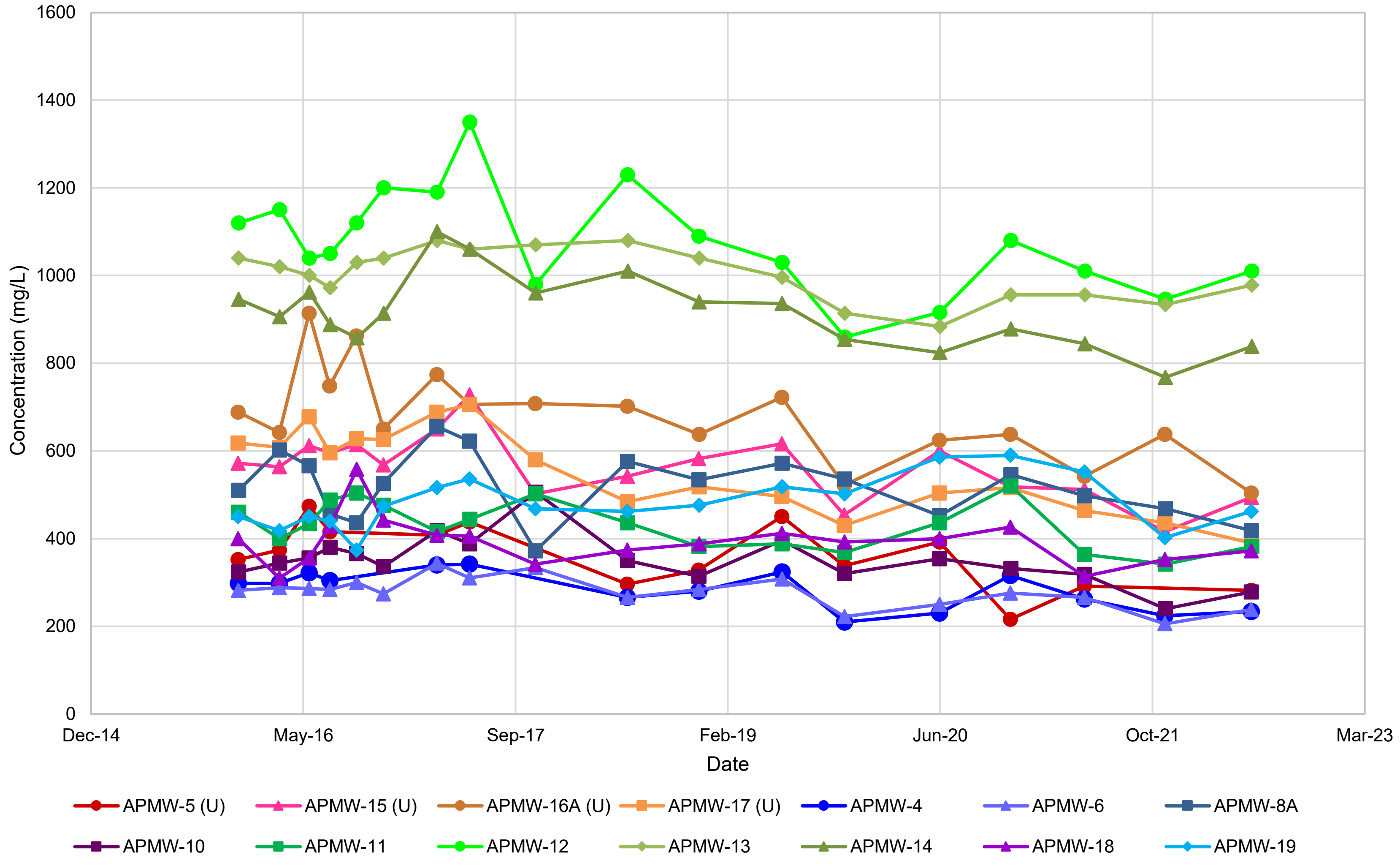


Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-8

Sulfate

Nebraska Public Power District
Gerald Gentleman Station



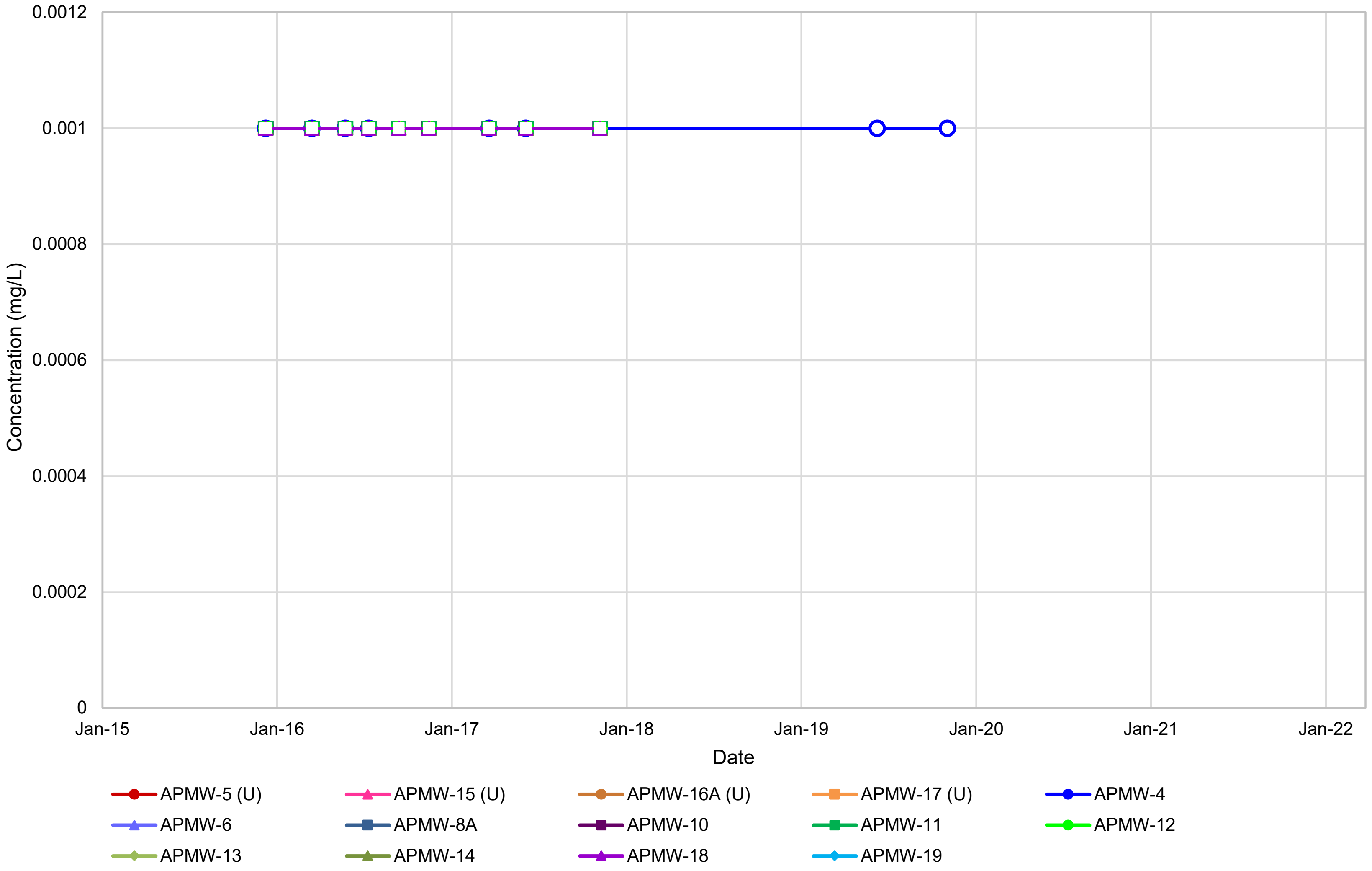
Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-9

Total Dissolved Solids

Nebraska Public Power District

Gerald Gentleman Station



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-10

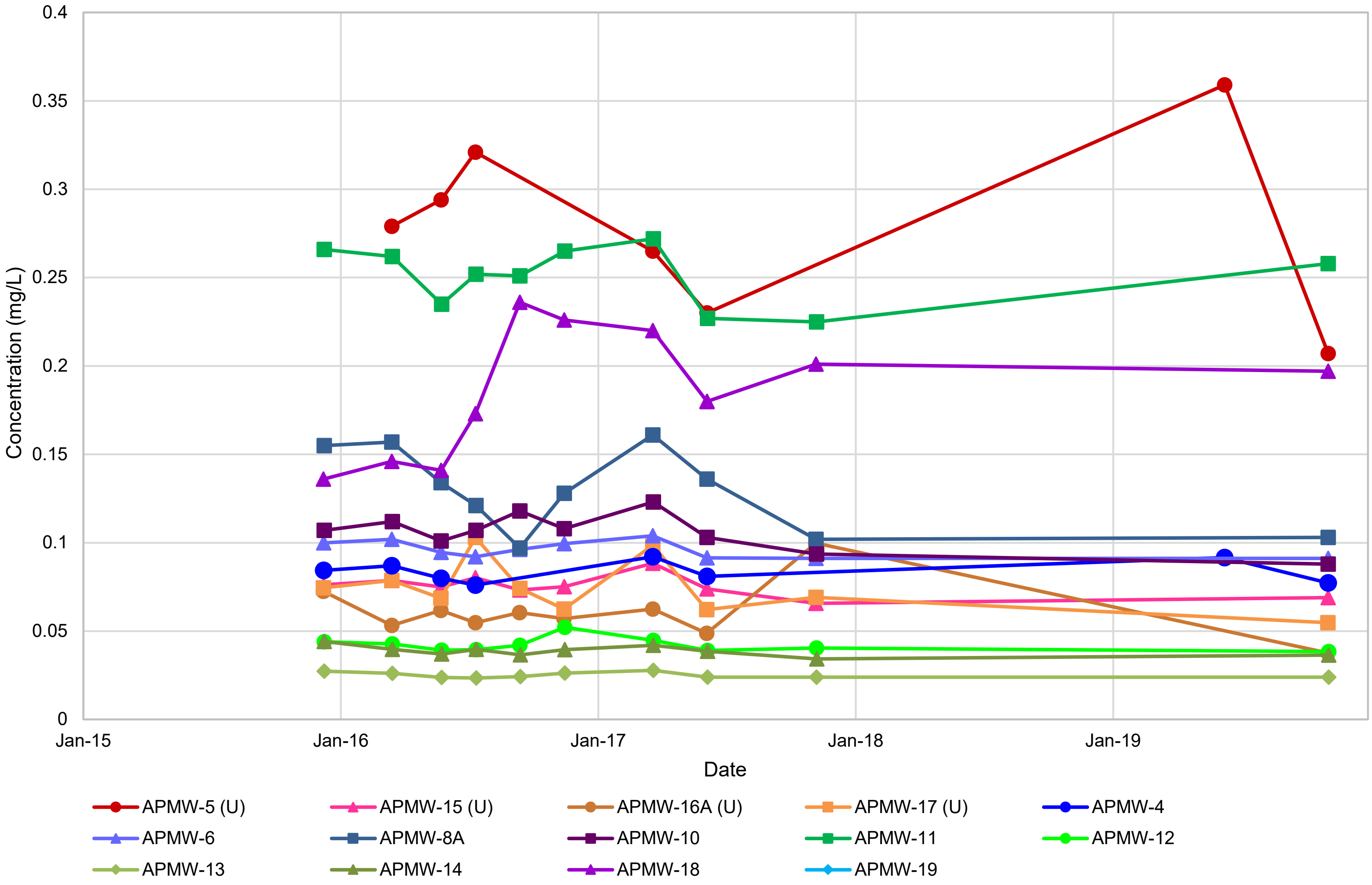
Antimony

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

Golder Associates USA Inc., A Member of WSP



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-11

Barium

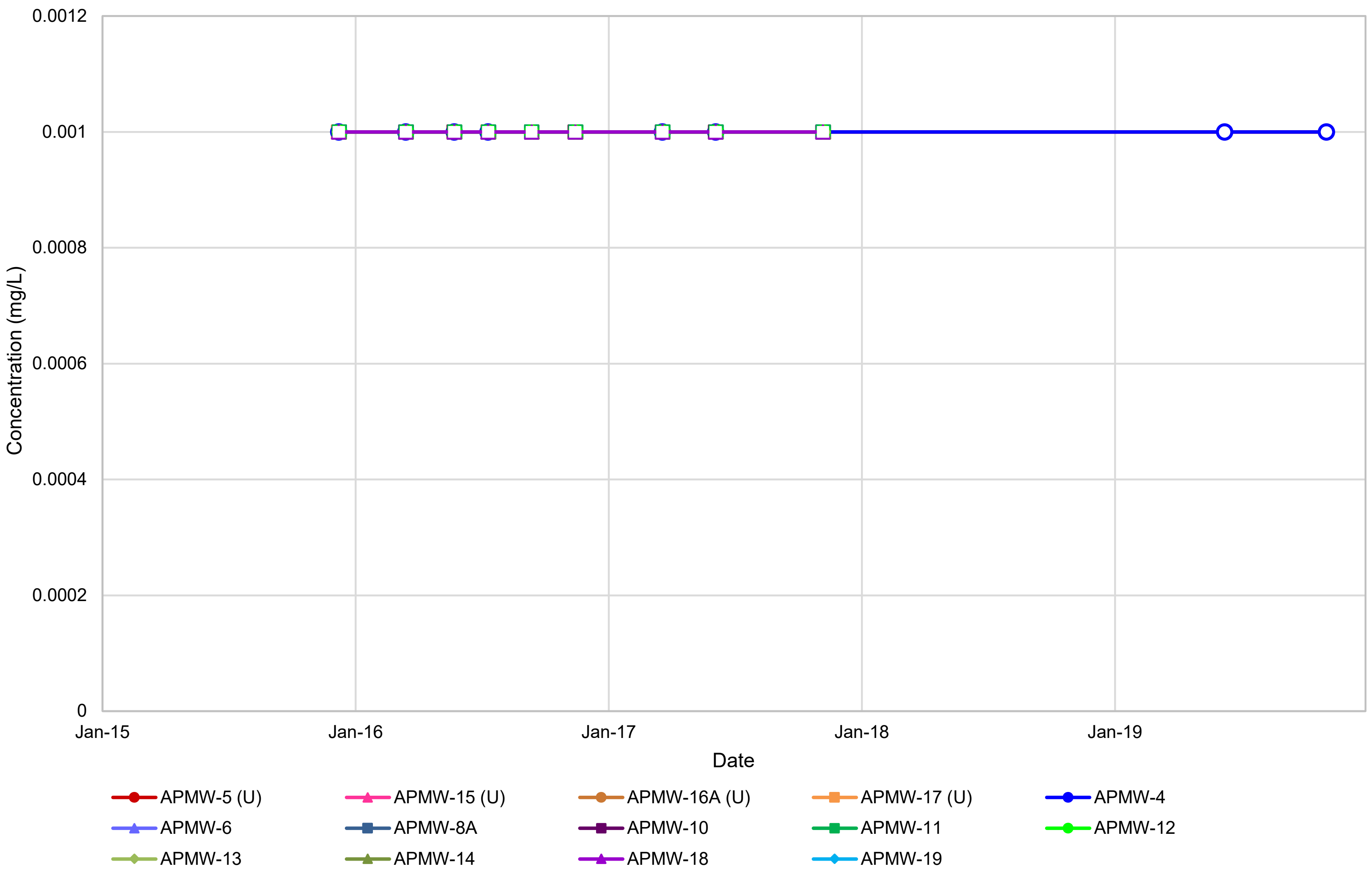
Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022 31404512.000

Golder Associates USA Inc., A Member of WSP



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-12

Beryllium

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

Golder Associates USA Inc., A Member of WSP

Non-detect values are plotted with an open symbol at the practical quantitation limit.

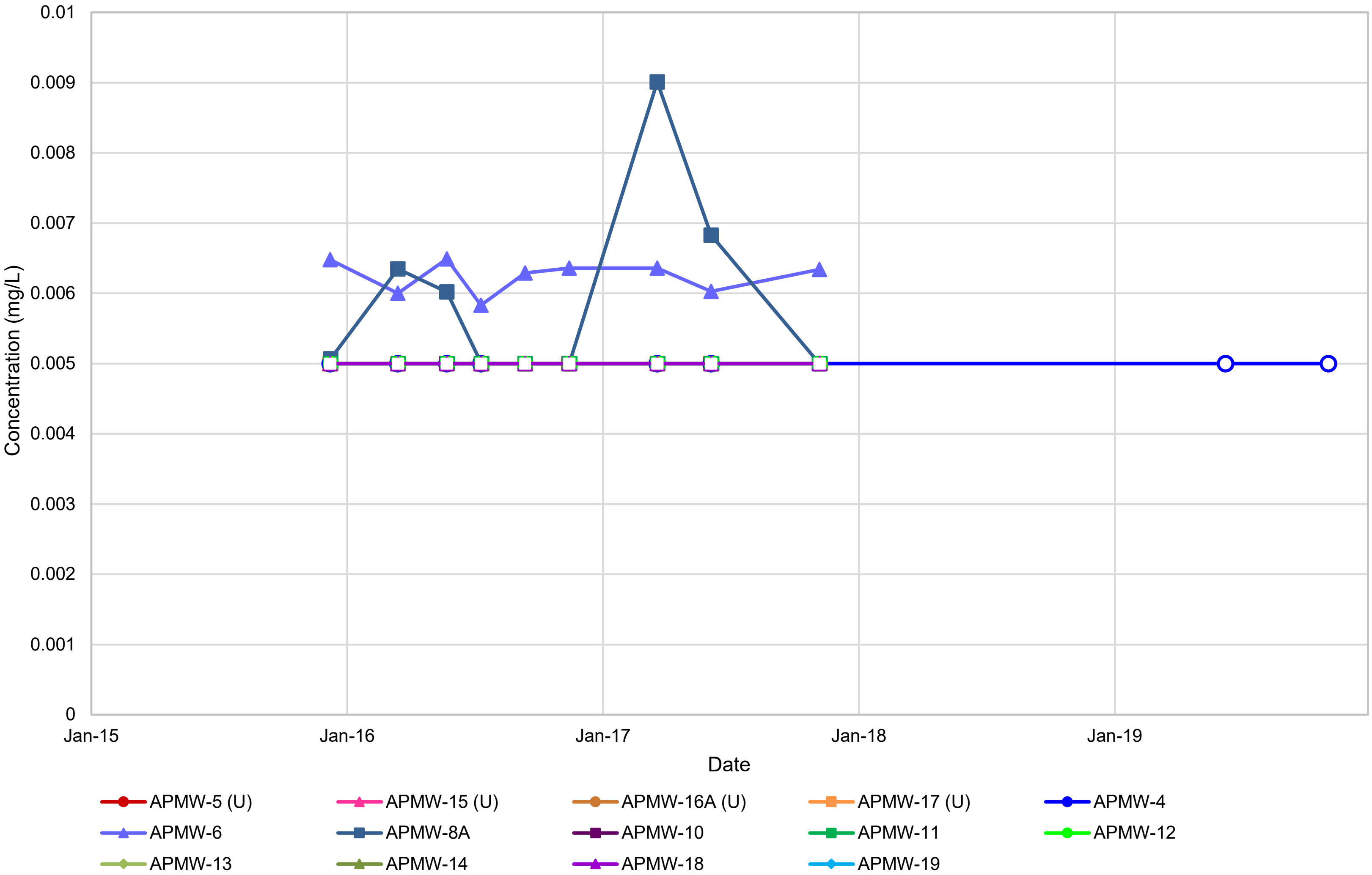
Figure A-13

Cadmium

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA



Non-detect values are plotted with an open symbol at the practical quantitation limit.

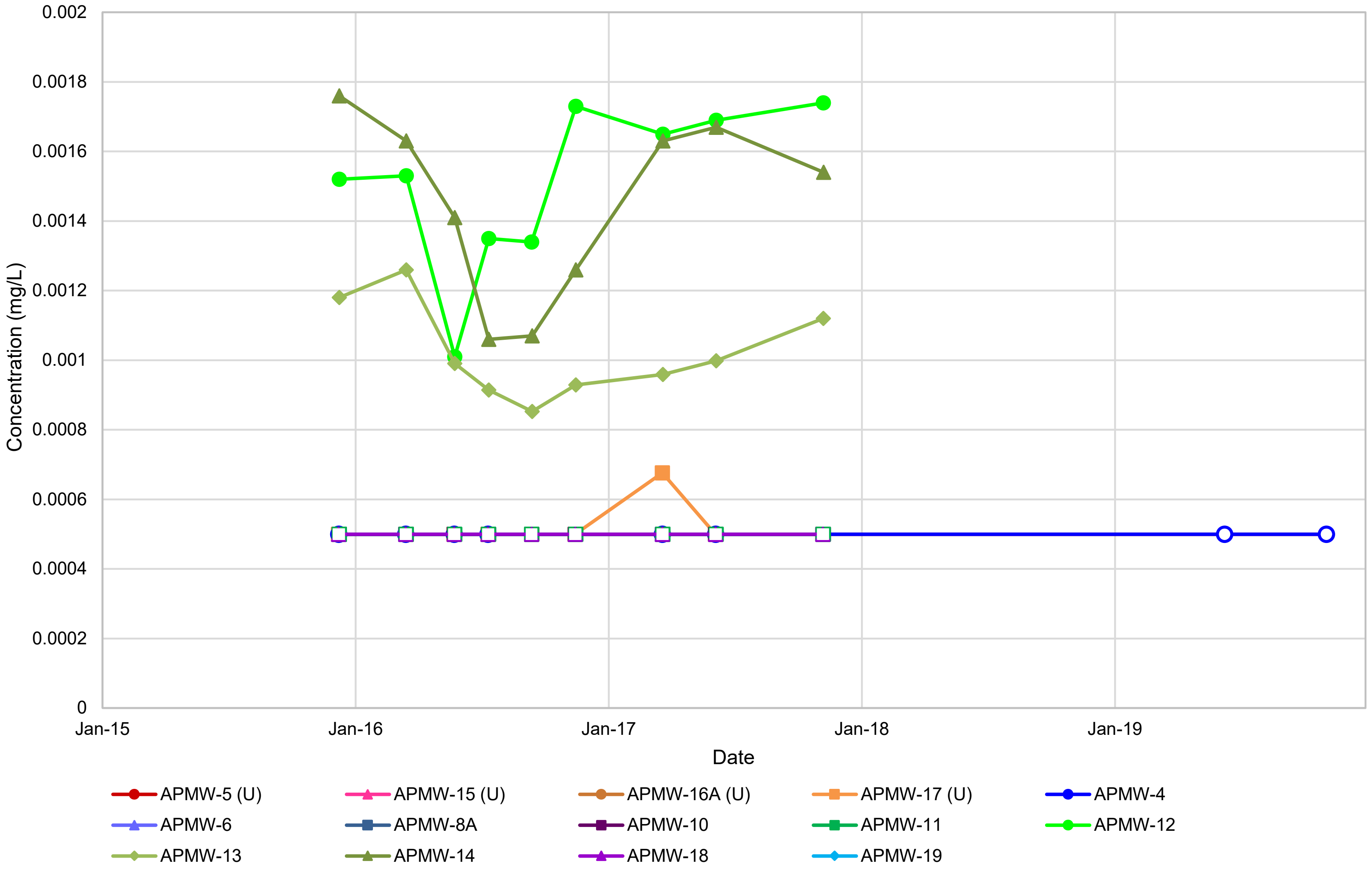
Figure A-14

Chromium

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-15

Cobalt

Nebraska Public Power District

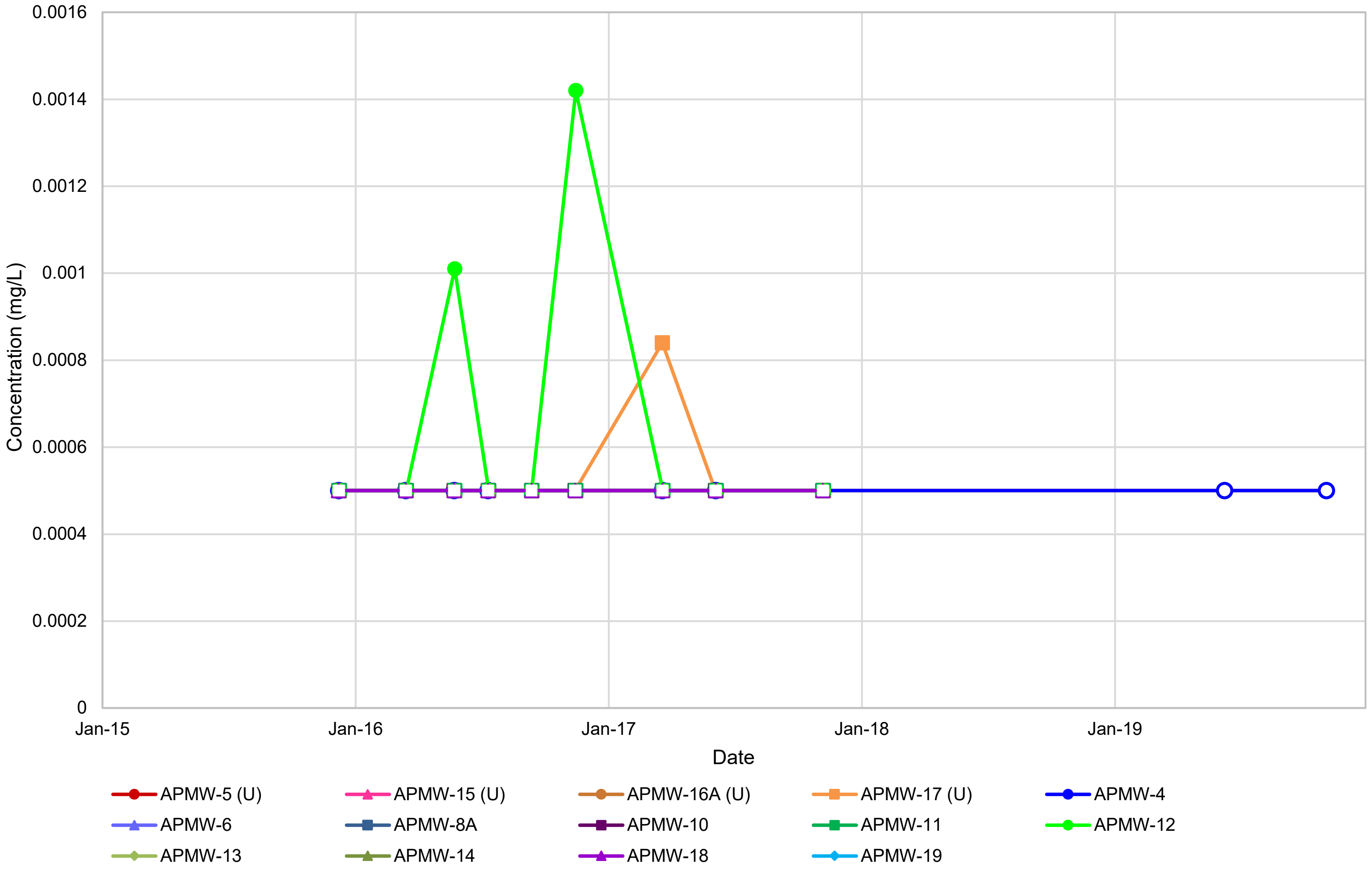
Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022 31404512.000

Golder Associates USA Inc., A Member of WSP

https://golderassociates.sharepoint.com/sites/160112/Project Files/5 Technical Work/02_Working Data/[Appendix A_TimeSeries GGS NDEE - w App IV - Q42021.xlsm]A-16



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-16

Lead

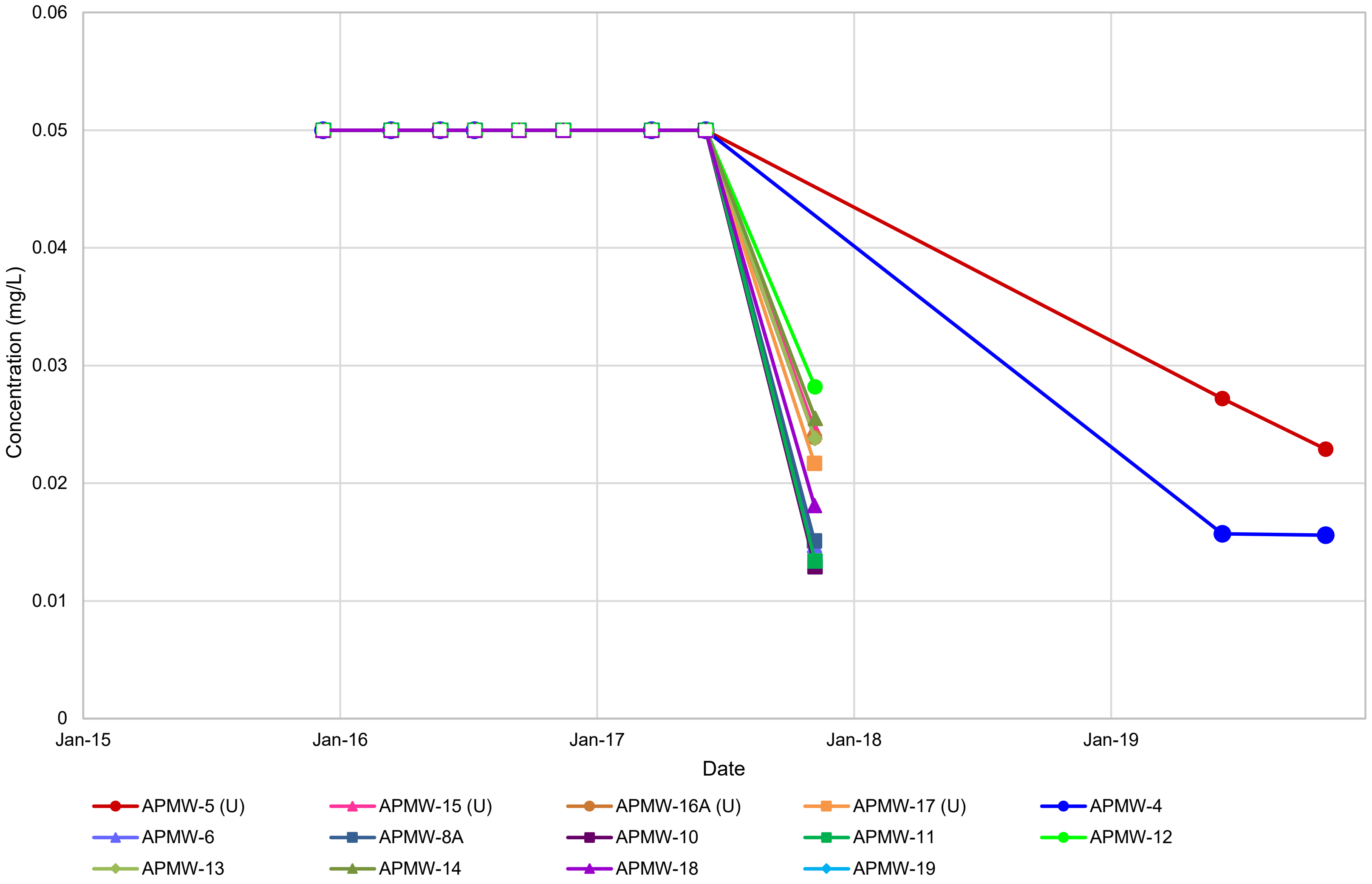
Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022 31404512.000

Golder Associates USA Inc., A Member of WSP



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-17

Lithium

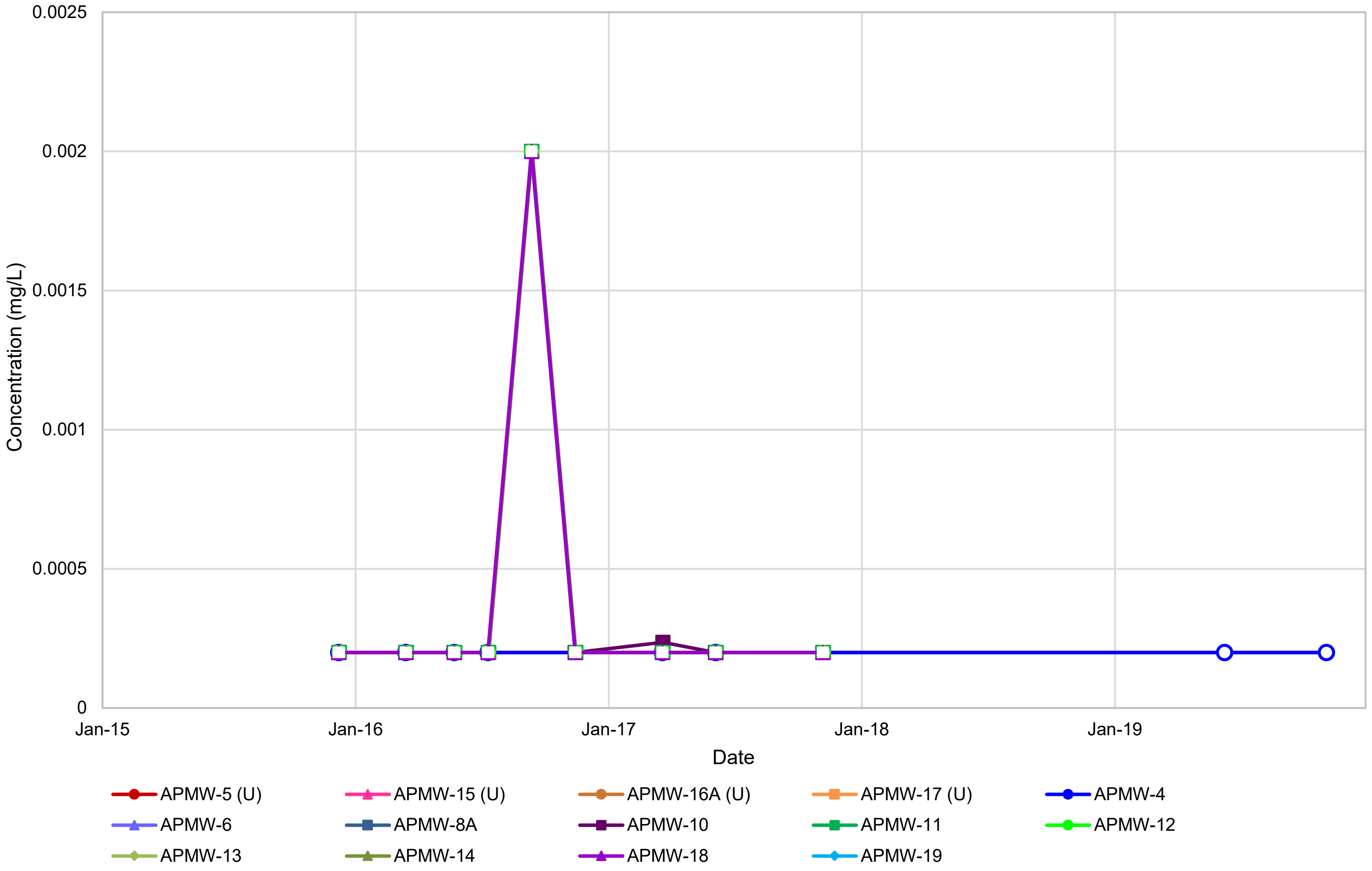
Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022 31404512.000

Golder Associates USA Inc., A Member of WSP



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-18

Mercury

Nebraska Public Power District

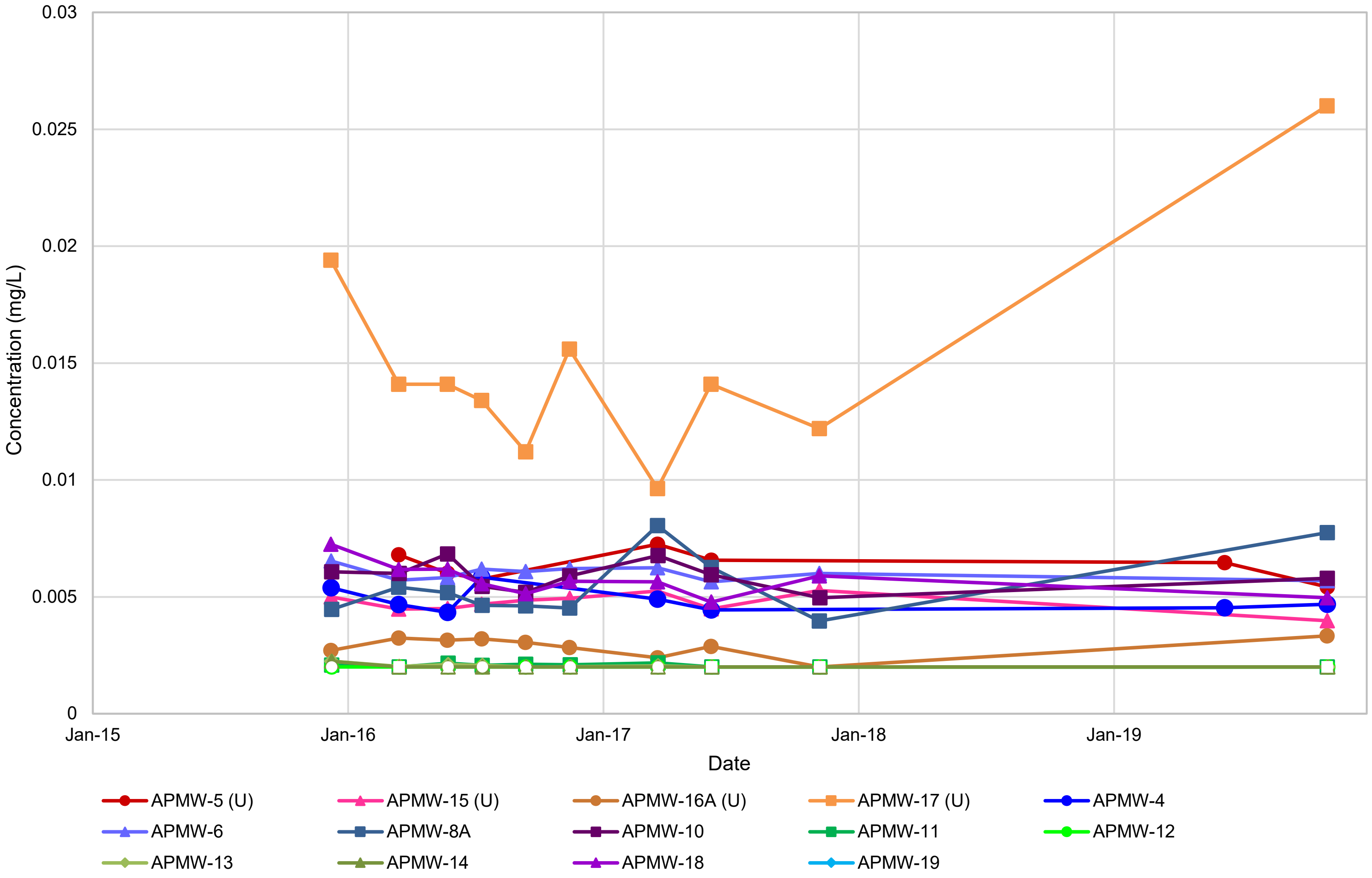
Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022 31404512.000

Golder Associates USA Inc., A Member of WSP

https://golderassociates.sharepoint.com/sites/160112/Project Files/5 Technical Work/02_Working Data/[Appendix A_TimeSeries GGS NDEE - w App IV - Q42021.xlsm]A-18



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-19

Molybdenum

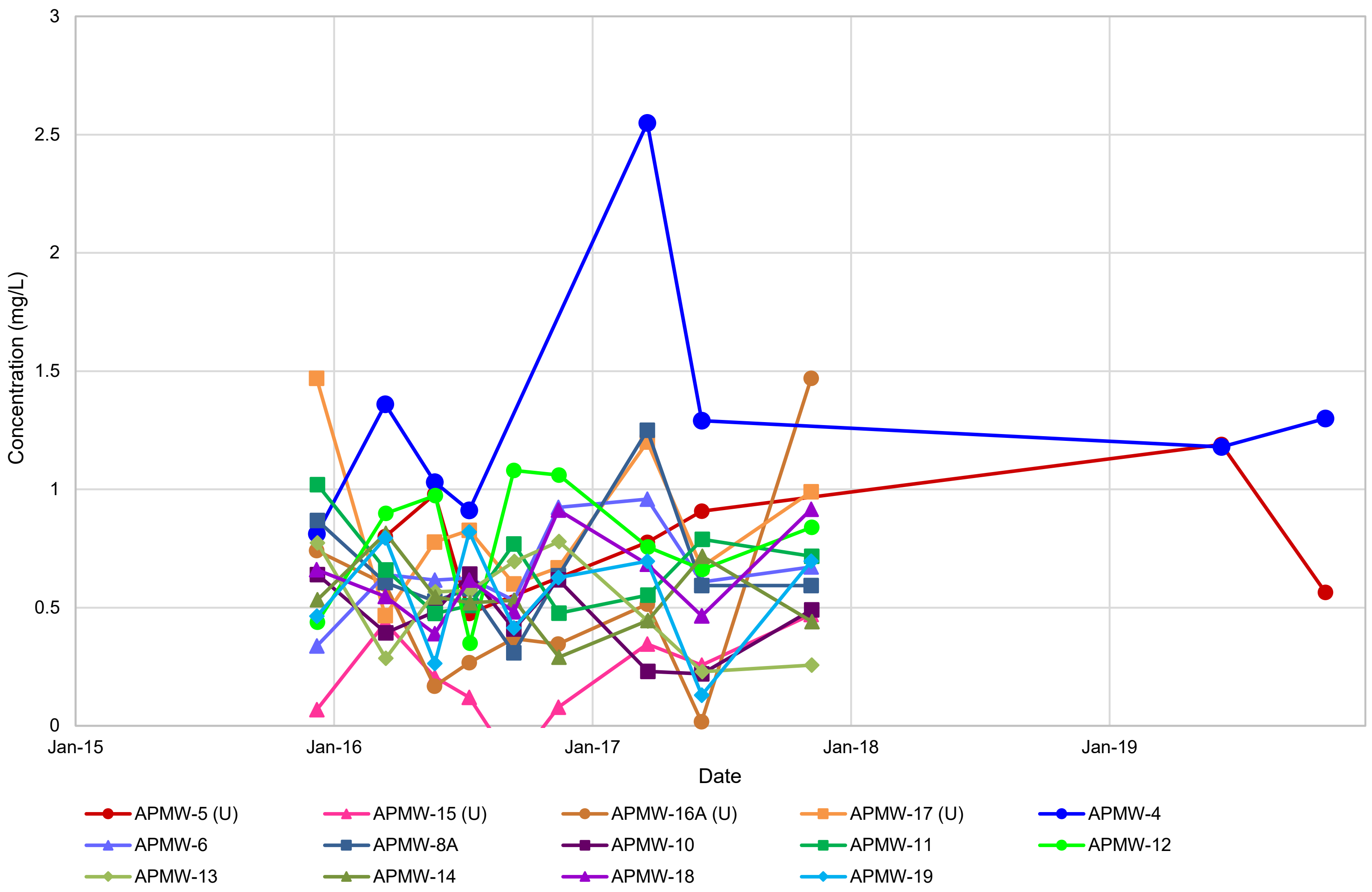
Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022 31404512.000

Golder Associates USA Inc., A Member of WSP



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-20

Radium, Total

Nebraska Public Power District

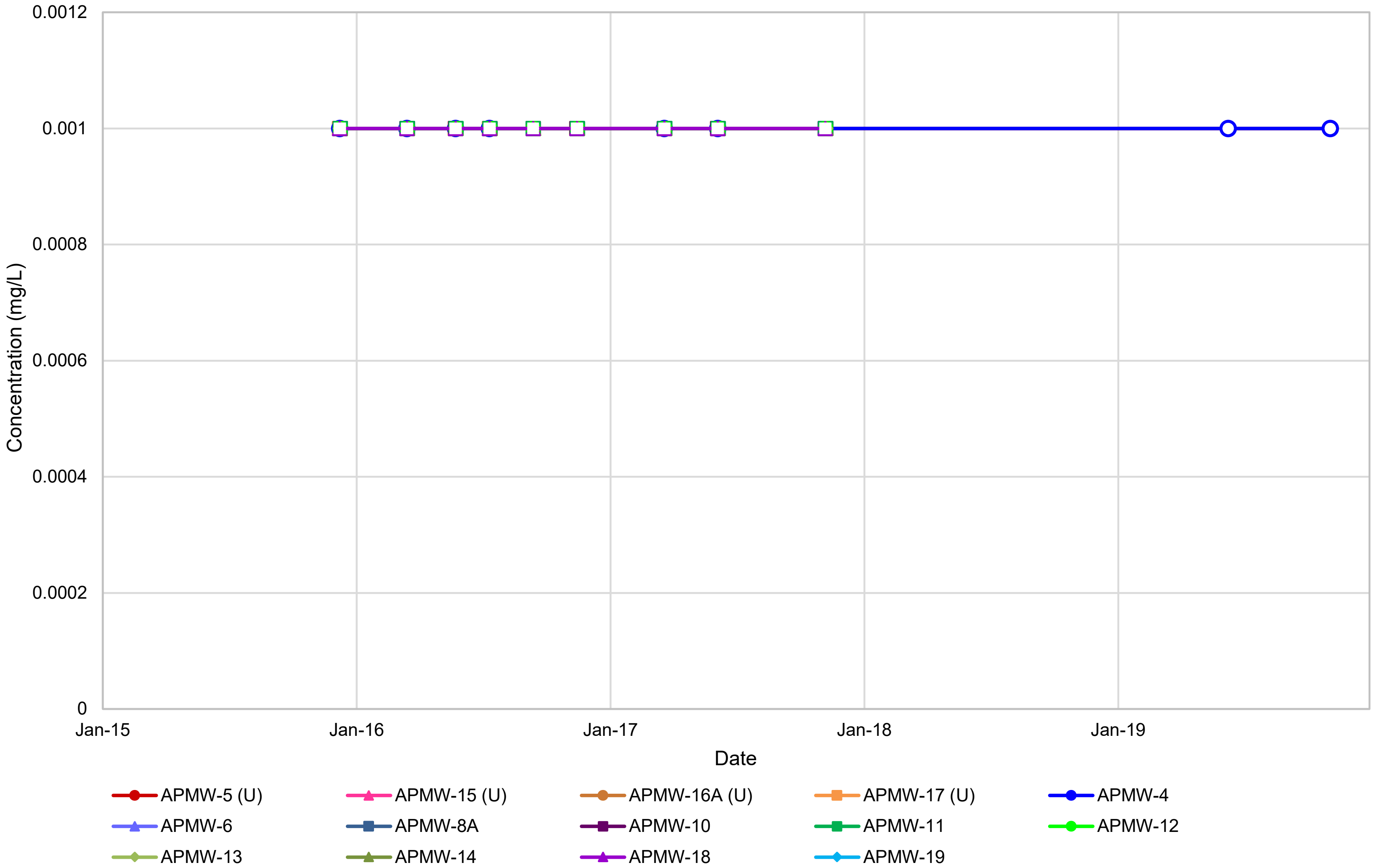
Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022 31404512.000

Golder Associates USA Inc., A Member of WSP

https://golderassociates.sharepoint.com/sites/160112/Project Files/5 Technical Work/02_Working Data/[Appendix A_TimeSeries GGS NDEE - w App IV - Q42021.xlsm]A-20



Non-detect values are plotted with an open symbol at the practical quantitation limit.

Figure A-21

Thallium

Nebraska Public Power District

Gerald Gentleman Station

Denver, Colorado, USA

10/26/2022 31404512.000

Golder Associates USA Inc., A Member of WSP

https://golderassociates.sharepoint.com/sites/160112/Project Files/5 Technical Work/02_Working Data/[Appendix A_TimeSeries GGS NDEE - w App IV - Q42021.xlsm]A-21

APPENDIX B

Eurofins TestAmerica Laboratory Report for Irrigation Water Samples

eurofins | Environment Testing America

1
2
3
4
5
6
7
8
9
10
11
12
13
14

ANALYTICAL REPORT

Eurofins Cedar Falls
3019 Venture Way
Cedar Falls, IA 50613
Tel: (319)277-2401

Laboratory Job ID: 310-237917-1
Client Project/Site: Irrigation Runoff

For:
Nebraska Public Power District
6089 S Hwy 25
Gerald Gentleman Station South
Sutherland, Nebraska 69165

Attn: Doug Harris

Authorized for release by:
8/24/2022 3:50:48 PM
Brian Graettinger, Lab Director
(319)595-2012
Brian.Graettinger@et.eurofinsus.com

Designee for

Shirley Thompson, Client Service Manager
(319)277-2401
Shirley.Thompson@et.eurofinsus.com

Table of Contents

Case Narrative

Client: Nebraska Public Power District
Project/Site: Irrigation Runoff

Job ID: 310-237917-1

Job ID: 310-237917-1

Laboratory: Eurofins Cedar Falls

Narrative

Job Narrative
310-237917-1

Comments
No additional comments.

Receipt
The samples were received on 8/12/2022 8:35 AM. Unless otherwise noted below, the samples arrived in good condition, and where required, properly preserved and on ice. The temperature of the cooler at receipt was -1.6º C.

HPLC/IC
Method 9056A: The following samples were diluted due to the nature of the sample matrix: Road Track (310-237917-1) and Pivot Bucket (310-237917-2). Elevated reporting limits (RLs) are provided.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Metals
Method 6020A: Due to sample matrix effect on the internal standard (ISTD), a dilution was required for the following sample: Road Track (310-237917-1).

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

General Chemistry
No analytical or quality issues were noted, other than those described in the Definitions/Glossary page.

Sample Summary

Client: Nebraska Public Power District
Project/Site: Irrigation Runoff

Job ID: 310-237917-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
310-237917-1	Road Track	Water	08/11/22 11:00	08/12/22 08:35
310-237917-2	Pivot Bucket	Water	08/11/22 11:05	08/12/22 08:35

Detection Summary

1 2 3 4 5 6 7 8 9 10 11 12 13 14

Client Sample ID: Road Track — Lab Sample ID: 310-237917-1

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloride	31.5		5.00		mg/L	5		9056A	Total/NA
Sulfate	61.7		5.00		mg/L	5		9056A	Total/NA
Barium	0.0228		0.00200		mg/L	1		6020A	Total/NA
Boron	0.166	*+	0.100		mg/L	1		6020A	Total/NA
Calcium	71.7		2.00		mg/L	4		6020A	Total/NA
Lithium	0.0464		0.0100		mg/L	1		6020A	Total/NA
Magnesium	16.8		2.00		mg/L	4		6020A	Total/NA
Potassium	8.28		0.500		mg/L	1		6020A	Total/NA
Sodium	28.2		1.00		mg/L	1		6020A	Total/NA
Total Kjeldahl Nitrogen	4.66		1.00		mg/L	1		351.2	Total/NA
Nitrate Nitrite as N	1.69		0.100		mg/L	1		353.2	Total/NA
Alkalinity as CaCO3 to pH 4.5	356		25.0		mg/L	1		SM 2320B	Total/NA
pH	8.1	HF	0.1		SU	1		SM 4500 H+ B	Total/NA

Client Sample ID: Pivot Bucket — Lab Sample ID: 310-237917-2

Analyte	Result	Qualifier	RL	MDL	Unit	Dil Fac	D	Method	Prep Type
Chloride	34.1		5.00		mg/L	5		9056A	Total/NA
Sulfate	82.8		5.00		mg/L	5		9056A	Total/NA
Barium	0.377		0.00200		mg/L	1		6020A	Total/NA
Calcium	156		0.500		mg/L	1		6020A	Total/NA
Cobalt	0.000798		0.000500		mg/L	1		6020A	Total/NA
Lithium	0.0108		0.0100		mg/L	1		6020A	Total/NA
Magnesium	45.0		0.500		mg/L	1		6020A	Total/NA
Molybdenum	0.00401		0.00200		mg/L	1		6020A	Total/NA
Potassium	8.65		0.500		mg/L	1		6020A	Total/NA
Sodium	86.7		1.00		mg/L	1		6020A	Total/NA
Ammonia as N	0.690		0.500		mg/L	1		350.1	Total/NA
Total Kjeldahl Nitrogen	3.74		1.00		mg/L	1		351.2	Total/NA
Nitrate Nitrite as N	3.89		0.100		mg/L	1		353.2	Total/NA
Alkalinity as CaCO3 to pH 4.5	209		10.0		mg/L	1		SM 2320B	Total/NA
pH	8.2	HF	0.1		SU	1		SM 4500 H+ B	Total/NA

This Detection Summary does not include radiochemical test results.

Client Sample Results

Client: Nebraska Public Power District
Project/Site: Irrigation Runoff

Job ID: 310-237917-1

Client Sample ID: Road Track

Date Collected: 08/11/22 11:00
Date Received: 08/12/22 08:35

Lab Sample ID: 310-237917-1

Matrix: Water

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**31.5**		5.00		mg/L			08/22/22 15:34	5
Fluoride	<0.500		0.500		mg/L			08/22/22 15:34	5
Sulfate	**61.7**		5.00		mg/L			08/22/22 15:34	5

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.00200		0.00200		mg/L		08/16/22 08:30	08/18/22 17:47	1
Arsenic	<0.00200		0.00200		mg/L		08/16/22 08:30	08/18/22 17:47	1
Barium	**0.0228**		0.00200		mg/L		08/16/22 08:30	08/18/22 17:47	1
Beryllium	<0.00400		0.00400		mg/L		08/16/22 08:30	08/19/22 16:31	4
Boron	**0.166**	***+**	0.100		mg/L		08/16/22 08:30	08/18/22 17:47	1
Cadmium	<0.000100		0.000100		mg/L		08/16/22 08:30	08/18/22 17:47	1
Calcium	**71.7**		2.00		mg/L		08/16/22 08:30	08/19/22 16:31	4
Chromium	<0.00500		0.00500		mg/L		08/16/22 08:30	08/18/22 17:47	1
Cobalt	<0.000500		0.000500		mg/L		08/16/22 08:30	08/18/22 17:47	1
Lead	<0.000500		0.000500		mg/L		08/16/22 08:30	08/18/22 17:47	1
Lithium	**0.0464**		0.0100		mg/L		08/16/22 08:30	08/18/22 17:47	1
Magnesium	**16.8**		2.00		mg/L		08/16/22 08:30	08/19/22 16:31	4
Molybdenum	<0.00200		0.00200		mg/L		08/16/22 08:30	08/18/22 17:47	1
Potassium	**8.28**		0.500		mg/L		08/16/22 08:30	08/18/22 17:47	1
Selenium	<0.00500		0.00500		mg/L		08/16/22 08:30	08/18/22 17:47	1
Sodium	**28.2**		1.00		mg/L		08/16/22 08:30	08/18/22 17:47	1
Thallium	<0.00100		0.00100		mg/L		08/16/22 08:30	08/18/22 17:47	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.000200		0.000200		mg/L		08/22/22 14:34	08/23/22 12:41	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Ammonia as N	<0.500		0.500		mg/L		08/18/22 09:51	08/18/22 20:31	1
Total Kjeldahl Nitrogen	**4.66**		1.00		mg/L		08/17/22 07:00	08/17/22 19:01	1
Nitrate Nitrite as N	**1.69**		0.100		mg/L			08/16/22 20:12	1
Alkalinity as CaCO3 to pH 4.5	**356**		25.0		mg/L			08/15/22 08:30	1

Analyte	Result	Qualifier	RL	RL	Unit	D	Prepared	Analyzed	Dil Fac
pH	**8.1**	**HF**	0.1		SU			08/12/22 15:15	1

Client Sample Results

Client Sample ID: Pivot Bucket

Lab Sample ID: 310-237917-2

Date Collected: 08/11/22 11:05
Matrix: Water
Date Received: 08/12/22 08:35

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	**34.1**		5.00		mg/L			08/22/22 15:49	5
Fluoride	<0.500		0.500		mg/L			08/22/22 15:49	5
Sulfate	**82.8**		5.00		mg/L			08/22/22 15:49	5

Method: 6020A - Metals (ICP/MS)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.00200		0.00200		mg/L		08/16/22 08:30	08/18/22 18:03	1
Arsenic	<0.00200		0.00200		mg/L		08/16/22 08:30	08/18/22 18:03	1
Barium	**0.377**		0.00200		mg/L		08/16/22 08:30	08/18/22 18:03	1
Beryllium	<0.00100		0.00100		mg/L		08/16/22 08:30	08/19/22 16:34	1
Boron	<0.100	*+	0.100		mg/L		08/16/22 08:30	08/18/22 18:03	1
Cadmium	<0.000100		0.000100		mg/L		08/16/22 08:30	08/18/22 18:03	1
Calcium	**156**		0.500		mg/L		08/16/22 08:30	08/18/22 18:03	1
Chromium	<0.00500		0.00500		mg/L		08/16/22 08:30	08/18/22 18:03	1
Cobalt	**0.000798**		0.000500		mg/L		08/16/22 08:30	08/18/22 18:03	1
Lead	<0.000500		0.000500		mg/L		08/16/22 08:30	08/18/22 18:03	1
Lithium	**0.0108**		0.0100		mg/L		08/16/22 08:30	08/18/22 18:03	1
Magnesium	**45.0**		0.500		mg/L		08/16/22 08:30	08/18/22 18:03	1
Molybdenum	**0.00401**		0.00200		mg/L		08/16/22 08:30	08/18/22 18:03	1
Potassium	**8.65**		0.500		mg/L		08/16/22 08:30	08/18/22 18:03	1
Selenium	<0.00500		0.00500		mg/L		08/16/22 08:30	08/18/22 18:03	1
Sodium	**86.7**		1.00		mg/L		08/16/22 08:30	08/18/22 18:03	1
Thallium	<0.00100		0.00100		mg/L		08/16/22 08:30	08/18/22 18:03	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.000200		0.000200		mg/L		08/22/22 14:38	08/23/22 12:48	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Ammonia as N	**0.690**		0.500		mg/L		08/18/22 09:51	08/18/22 20:32	1
Total Kjeldahl Nitrogen	**3.74**		1.00		mg/L		08/17/22 07:00	08/17/22 19:02	1
Nitrate Nitrite as N	**3.89**		0.100		mg/L			08/16/22 20:13	1
Alkalinity as CaCO3 to pH 4.5	**209**		10.0		mg/L			08/15/22 08:30	1

Analyte	Result	Qualifier	RL	RL	Unit	D	Prepared	Analyzed	Dil Fac
pH	**8.2**	**HF**	0.1		SU			08/12/22 15:21	1

Definitions/Glossary

Client: Nebraska Public Power District
Project/Site: Irrigation Runoff

Job ID: 310-237917-1

Qualifiers

Metals

Qualifier	Qualifier Description
*+	LCS and/or LCSD is outside acceptance limits, high biased.

General Chemistry

Qualifier	Qualifier Description
HF	Field parameter with a holding time of 15 minutes. Test performed by laboratory at client's request.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CFU	Colony Forming Unit
CNF	Contains No Free Liquid
DER	Duplicate Error Ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL	Detection Limit (DoD/DOE)
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision Level Concentration (Radiochemistry)
EDL	Estimated Detection Limit (Dioxin)
LOD	Limit of Detection (DoD/DOE)
LOQ	Limit of Quantitation (DoD/DOE)
MCL	EPA recommended "Maximum Contaminant Level"
MDA	Minimum Detectable Activity (Radiochemistry)
MDC	Minimum Detectable Concentration (Radiochemistry)
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
MPN	Most Probable Number
MQL	Method Quantitation Limit
NC	Not Calculated
ND	Not Detected at the reporting limit (or MDL or EDL if shown)
NEG	Negative / Absent
POS	Positive / Present
PQL	Practical Quantitation Limit
PRES	Presumptive
QC	Quality Control
RER	Relative Error Ratio (Radiochemistry)
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)
TNTC	Too Numerous To Count

QC Sample Results

Client: Nebraska Public Power District
Project/Site: Irrigation Runoff

Job ID: 310-237917-1

Method: 9056A - Anions, Ion Chromatography

Lab Sample ID: MB 310-363601/3
Matrix: Water
Analysis Batch: 363601

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Chloride	<1.00		1.00		mg/L			08/22/22 10:23	1
Fluoride	<0.100		0.100		mg/L			08/22/22 10:23	1
Sulfate	<1.00		1.00		mg/L			08/22/22 10:23	1

Lab Sample ID: LCS 310-363601/4
Matrix: Water
Analysis Batch: 363601

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Chloride	10.0	10.06		mg/L		101	90 - 110
Fluoride	2.00	2.035		mg/L		102	90 - 110
Sulfate	10.0	10.08		mg/L		101	90 - 110

Method: 6020A - Metals (ICP/MS)

Lab Sample ID: MB 310-362614/1-A
Matrix: Water
Analysis Batch: 362935

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 362614

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	<0.00200		0.00200		mg/L		08/16/22 08:30	08/17/22 14:51	1
Arsenic	<0.00200		0.00200		mg/L		08/16/22 08:30	08/17/22 14:51	1
Barium	<0.00200		0.00200		mg/L		08/16/22 08:30	08/17/22 14:51	1
Beryllium	<0.00100		0.00100		mg/L		08/16/22 08:30	08/17/22 14:51	1
Boron	<0.100		0.100		mg/L		08/16/22 08:30	08/17/22 14:51	1
Cadmium	<0.000100		0.000100		mg/L		08/16/22 08:30	08/17/22 14:51	1
Calcium	<0.500		0.500		mg/L		08/16/22 08:30	08/17/22 14:51	1
Chromium	<0.00500		0.00500		mg/L		08/16/22 08:30	08/17/22 14:51	1
Cobalt	<0.000500		0.000500		mg/L		08/16/22 08:30	08/17/22 14:51	1
Lead	<0.000500		0.000500		mg/L		08/16/22 08:30	08/17/22 14:51	1
Magnesium	<0.500		0.500		mg/L		08/16/22 08:30	08/17/22 14:51	1
Molybdenum	<0.00200		0.00200		mg/L		08/16/22 08:30	08/17/22 14:51	1
Potassium	<0.500		0.500		mg/L		08/16/22 08:30	08/17/22 14:51	1
Selenium	<0.00500		0.00500		mg/L		08/16/22 08:30	08/17/22 14:51	1
Sodium	<1.00		1.00		mg/L		08/16/22 08:30	08/17/22 14:51	1
Thallium	<0.00100		0.00100		mg/L		08/16/22 08:30	08/17/22 14:51	1

Lab Sample ID: MB 310-362614/1-A
Matrix: Water
Analysis Batch: 363247

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 362614

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Lithium	<0.0100		0.0100		mg/L		08/16/22 08:30	08/19/22 16:24	1

Lab Sample ID: LCS 310-362614/2-A
Matrix: Water
Analysis Batch: 362935

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 362614

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Antimony	0.200	0.2356		mg/L		118	80 - 120

Method: 6020A - Metals (ICP/MS) (Continued)

Lab Sample ID: LCS 310-362614/2-A
Matrix: Water
Analysis Batch: 362935

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 362614

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Arsenic	0.200	0.2068		mg/L		103	80 - 120
Barium	0.100	0.1131		mg/L		113	80 - 120
Beryllium	0.100	0.1097		mg/L		110	80 - 120
Cadmium	0.100	0.1050		mg/L		105	80 - 120
Calcium	2.00	1.612		mg/L		81	80 - 120
Chromium	0.100	0.1047		mg/L		105	80 - 120
Cobalt	0.100	0.1036		mg/L		104	80 - 120
Lead	0.200	0.2116		mg/L		106	80 - 120
Magnesium	2.00	2.050		mg/L		102	80 - 120
Molybdenum	0.200	0.2236		mg/L		112	80 - 120
Potassium	2.00	2.059		mg/L		103	80 - 120
Selenium	0.400	0.3907		mg/L		98	80 - 120
Sodium	2.00	2.207		mg/L		110	80 - 120
Thallium	0.200	0.2293		mg/L		115	80 - 120

Lab Sample ID: LCS 310-362614/2-A
Matrix: Water
Analysis Batch: 363247

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 362614

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Lithium	0.200	0.2192		mg/L		110	80 - 120

Lab Sample ID: LCS 310-362614/2-A
Matrix: Water
Analysis Batch: 363273

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 362614

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Boron	0.200	0.2190		mg/L		109	80 - 120

Method: 7470A - Mercury (CVAA)

Lab Sample ID: MB 310-363323/1-A
Matrix: Water
Analysis Batch: 363477

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 363323

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.000200		0.000200		mg/L		08/22/22 14:34	08/23/22 11:44	1

Lab Sample ID: LCS 310-363323/2-A
Matrix: Water
Analysis Batch: 363477

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 363323

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Mercury	0.00167	0.001689		mg/L		101	80 - 120

Method: 7470A - Mercury (CVAA) (Continued)

Lab Sample ID: MB 310-363324/1-A
Matrix: Water
Analysis Batch: 363477

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 363324

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	<0.000200		0.000200		mg/L		08/22/22 14:38	08/23/22 12:44	1

Lab Sample ID: LCS 310-363324/2-A
Matrix: Water
Analysis Batch: 363477

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 363324

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits		
Mercury			0.00167	0.001697		mg/L		102	80 - 120		

Lab Sample ID: 310-237917-2 MS
Matrix: Water
Analysis Batch: 363477

Client Sample ID: Pivot Bucket
Prep Type: Total/NA
Prep Batch: 363324

Analyte	Sample Result	Sample Qualifier	Spike Added	MS Result	MS Qualifier	Unit	D	%Rec	%Rec Limits		
Mercury	<0.000200		0.00167	0.001664		mg/L		100	80 - 120		

Lab Sample ID: 310-237917-2 MSD
Matrix: Water
Analysis Batch: 363477

Client Sample ID: Pivot Bucket
Prep Type: Total/NA
Prep Batch: 363324

Analyte	Sample Result	Sample Qualifier	Spike Added	MSD Result	MSD Qualifier	Unit	D	%Rec	%Rec Limits	RPD	RPD Limit
Mercury	<0.000200		0.00167	0.001669		mg/L		100	80 - 120	0	20

Method: 350.1 - Nitrogen, Ammonia

Lab Sample ID: MB 310-363012/1-A
Matrix: Water
Analysis Batch: 363102

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 363012

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Ammonia as N	<0.500		0.500		mg/L		08/18/22 09:51	08/18/22 20:09	1

Lab Sample ID: LCS 310-363012/2-A
Matrix: Water
Analysis Batch: 363102

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 363012

Analyte			Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits		
Ammonia as N			4.00	4.056		mg/L		101	90 - 110		

Method: 351.2 - Nitrogen, Total Kjeldahl

Lab Sample ID: MB 310-362810/1-A
Matrix: Water
Analysis Batch: 362944

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 362810

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Kjeldahl Nitrogen	<1.00		1.00		mg/L		08/17/22 07:00	08/17/22 18:34	1

Method: 351.2 - Nitrogen, Total Kjeldahl (Continued)

Lab Sample ID: LCS 310-362810/2-A
Matrix: Water
Analysis Batch: 362944

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 362810

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Total Kjeldahl Nitrogen	4.01	4.054		mg/L		101	90 - 110

Method: 353.2 - Nitrogen, Nitrate-Nitrite

Lab Sample ID: MB 310-362793/43
Matrix: Water
Analysis Batch: 362793

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Nitrate Nitrite as N	<0.100		0.100		mg/L			08/16/22 19:56	1

Lab Sample ID: LCS 310-362793/44
Matrix: Water
Analysis Batch: 362793

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Nitrate Nitrite as N	5.32	5.674		mg/L		107	90 - 110

Method: SM 2320B - Alkalinity

Lab Sample ID: MB 310-362556/1
Matrix: Water
Analysis Batch: 362556

Client Sample ID: Method Blank
Prep Type: Total/NA

Analyte	MB Result	MB Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Alkalinity as CaCO3 to pH 4.5	<5.00		5.00		mg/L			08/15/22 08:30	1

Lab Sample ID: LCS 310-362556/2
Matrix: Water
Analysis Batch: 362556

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
Alkalinity as CaCO3 to pH 4.5	1000	997.5		mg/L		100	90 - 110

Method: SM 4500 H+ B - pH

Lab Sample ID: LCS 310-362509/1
Matrix: Water
Analysis Batch: 362509

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
pH	7.00	7.0		SU		100	98 - 102

Lab Sample ID: LCS 310-362509/25
Matrix: Water
Analysis Batch: 362509

Client Sample ID: Lab Control Sample
Prep Type: Total/NA

Analyte	Spike Added	LCS Result	LCS Qualifier	Unit	D	%Rec	%Rec Limits
pH	7.00	7.0		SU		100	98 - 102

Method: SM 4500 H+ B - pH (Continued)

Lab Sample ID: 310-237917-1 DU
Matrix: Water
Analysis Batch: 362509

Client Sample ID: Road Track
Prep Type: Total/NA

Analyte	Sample Result	Sample Qualifier		DU Result	DU Qualifier	Unit	D			RPD	RPD Limit
pH	8.1	HF		8.0		SU				0.5	20

1 2 3 4 5 6 7 8 9 10 11 12 13 14

HPLC/IC

Analysis Batch: 363601

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-1	Road Track	Total/NA	Water	9056A	
310-237917-2	Pivot Bucket	Total/NA	Water	9056A	
MB 310-363601/3	Method Blank	Total/NA	Water	9056A	
LCS 310-363601/4	Lab Control Sample	Total/NA	Water	9056A	

Metals

Prep Batch: 362614

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-1	Road Track	Total/NA	Water	3005A	
310-237917-2	Pivot Bucket	Total/NA	Water	3005A	
MB 310-362614/1-A	Method Blank	Total/NA	Water	3005A	
LCS 310-362614/2-A	Lab Control Sample	Total/NA	Water	3005A	

Analysis Batch: 362935

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
MB 310-362614/1-A	Method Blank	Total/NA	Water	6020A	362614
LCS 310-362614/2-A	Lab Control Sample	Total/NA	Water	6020A	362614

Analysis Batch: 363152

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-1	Road Track	Total/NA	Water	6020A	362614
310-237917-2	Pivot Bucket	Total/NA	Water	6020A	362614

Analysis Batch: 363247

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-1	Road Track	Total/NA	Water	6020A	362614
310-237917-2	Pivot Bucket	Total/NA	Water	6020A	362614
MB 310-362614/1-A	Method Blank	Total/NA	Water	6020A	362614
LCS 310-362614/2-A	Lab Control Sample	Total/NA	Water	6020A	362614

Analysis Batch: 363273

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
LCS 310-362614/2-A	Lab Control Sample	Total/NA	Water	6020A	362614

Prep Batch: 363323

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-1	Road Track	Total/NA	Water	7470A	
MB 310-363323/1-A	Method Blank	Total/NA	Water	7470A	
LCS 310-363323/2-A	Lab Control Sample	Total/NA	Water	7470A	

Prep Batch: 363324

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-2	Pivot Bucket	Total/NA	Water	7470A	
MB 310-363324/1-A	Method Blank	Total/NA	Water	7470A	
LCS 310-363324/2-A	Lab Control Sample	Total/NA	Water	7470A	
310-237917-2 MS	Pivot Bucket	Total/NA	Water	7470A	
310-237917-2 MSD	Pivot Bucket	Total/NA	Water	7470A	

Metals

Analysis Batch: 363477

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-1	Road Track	Total/NA	Water	7470A	363323
310-237917-2	Pivot Bucket	Total/NA	Water	7470A	363324
MB 310-363323/1-A	Method Blank	Total/NA	Water	7470A	363323
MB 310-363324/1-A	Method Blank	Total/NA	Water	7470A	363324
LCS 310-363323/2-A	Lab Control Sample	Total/NA	Water	7470A	363323
LCS 310-363324/2-A	Lab Control Sample	Total/NA	Water	7470A	363324
310-237917-2 MS	Pivot Bucket	Total/NA	Water	7470A	363324
310-237917-2 MSD	Pivot Bucket	Total/NA	Water	7470A	363324

General Chemistry

Analysis Batch: 362509

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-1	Road Track	Total/NA	Water	SM 4500 H+ B	
310-237917-2	Pivot Bucket	Total/NA	Water	SM 4500 H+ B	
LCS 310-362509/1	Lab Control Sample	Total/NA	Water	SM 4500 H+ B	
LCS 310-362509/25	Lab Control Sample	Total/NA	Water	SM 4500 H+ B	
310-237917-1 DU	Road Track	Total/NA	Water	SM 4500 H+ B	

Analysis Batch: 362556

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-1	Road Track	Total/NA	Water	SM 2320B	
310-237917-2	Pivot Bucket	Total/NA	Water	SM 2320B	
MB 310-362556/1	Method Blank	Total/NA	Water	SM 2320B	
LCS 310-362556/2	Lab Control Sample	Total/NA	Water	SM 2320B	

Analysis Batch: 362793

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-1	Road Track	Total/NA	Water	353.2	
310-237917-2	Pivot Bucket	Total/NA	Water	353.2	
MB 310-362793/43	Method Blank	Total/NA	Water	353.2	
LCS 310-362793/44	Lab Control Sample	Total/NA	Water	353.2	

Prep Batch: 362810

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-1	Road Track	Total/NA	Water	351.2	
310-237917-2	Pivot Bucket	Total/NA	Water	351.2	
MB 310-362810/1-A	Method Blank	Total/NA	Water	351.2	
LCS 310-362810/2-A	Lab Control Sample	Total/NA	Water	351.2	

Analysis Batch: 362944

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-1	Road Track	Total/NA	Water	351.2	362810
310-237917-2	Pivot Bucket	Total/NA	Water	351.2	362810
MB 310-362810/1-A	Method Blank	Total/NA	Water	351.2	362810
LCS 310-362810/2-A	Lab Control Sample	Total/NA	Water	351.2	362810

Prep Batch: 363012

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-1	Road Track	Total/NA	Water	Distill/Ammonia	
310-237917-2	Pivot Bucket	Total/NA	Water	Distill/Ammonia	

General Chemistry (Continued)

Prep Batch: 363012 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
MB 310-363012/1-A	Method Blank	Total/NA	Water	Distill/Ammonia	
LCS 310-363012/2-A	Lab Control Sample	Total/NA	Water	Distill/Ammonia	

Analysis Batch: 363102

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
310-237917-1	Road Track	Total/NA	Water	350.1	363012
310-237917-2	Pivot Bucket	Total/NA	Water	350.1	363012
MB 310-363012/1-A	Method Blank	Total/NA	Water	350.1	363012
LCS 310-363012/2-A	Lab Control Sample	Total/NA	Water	350.1	363012

Lab Chronicle

Client Sample ID: Road Track

Lab Sample ID: 310-237917-1

Date Collected: 08/11/22 11:00

Matrix: Water

Date Received: 08/12/22 08:35

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	9056A		5	363601	DHM5	EET CF	08/22/22 15:34
Total/NA	Prep	3005A			362614	QTZ5	EET CF	08/16/22 08:30
Total/NA	Analysis	6020A		1	363152	A6US	EET CF	08/18/22 17:47
Total/NA	Prep	3005A			362614	QTZ5	EET CF	08/16/22 08:30
Total/NA	Analysis	6020A		4	363247	A6US	EET CF	08/19/22 16:31
Total/NA	Prep	7470A			363323	XXW3	EET CF	08/22/22 14:34
Total/NA	Analysis	7470A		1	363477	XXW3	EET CF	08/23/22 12:41
Total/NA	Prep	Distill/Ammonia			363012	ENB7	EET CF	08/18/22 09:51
Total/NA	Analysis	350.1		1	363102	ZJX4	EET CF	08/18/22 20:31
Total/NA	Prep	351.2			362810	W9YR	EET CF	08/17/22 07:00
Total/NA	Analysis	351.2		1	362944	ZJX4	EET CF	08/17/22 19:01
Total/NA	Analysis	353.2		1	362793	ZJX4	EET CF	08/16/22 20:12
Total/NA	Analysis	SM 2320B		1	362556	MAQ3	EET CF	08/15/22 08:30
Total/NA	Analysis	SM 4500 H+ B		1	362509	N7RT	EET CF	08/12/22 15:15

Client Sample ID: Pivot Bucket

Lab Sample ID: 310-237917-2

Date Collected: 08/11/22 11:05

Matrix: Water

Date Received: 08/12/22 08:35

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Analyst	Lab	Prepared or Analyzed
Total/NA	Analysis	9056A		5	363601	DHM5	EET CF	08/22/22 15:49
Total/NA	Prep	3005A			362614	QTZ5	EET CF	08/16/22 08:30
Total/NA	Analysis	6020A		1	363152	A6US	EET CF	08/18/22 18:03
Total/NA	Prep	3005A			362614	QTZ5	EET CF	08/16/22 08:30
Total/NA	Analysis	6020A		1	363247	A6US	EET CF	08/19/22 16:34
Total/NA	Prep	7470A			363324	XXW3	EET CF	08/22/22 14:38
Total/NA	Analysis	7470A		1	363477	XXW3	EET CF	08/23/22 12:48
Total/NA	Prep	Distill/Ammonia			363012	ENB7	EET CF	08/18/22 09:51
Total/NA	Analysis	350.1		1	363102	ZJX4	EET CF	08/18/22 20:32
Total/NA	Prep	351.2			362810	W9YR	EET CF	08/17/22 07:00
Total/NA	Analysis	351.2		1	362944	ZJX4	EET CF	08/17/22 19:02
Total/NA	Analysis	353.2		1	362793	ZJX4	EET CF	08/16/22 20:13
Total/NA	Analysis	SM 2320B		1	362556	MAQ3	EET CF	08/15/22 08:30
Total/NA	Analysis	SM 4500 H+ B		1	362509	N7RT	EET CF	08/12/22 15:21

Laboratory References:

EET CF = Eurofins Cedar Falls, 3019 Venture Way, Cedar Falls, IA 50613, TEL (319)277-2401

Accreditation/Certification Summary

Client: Nebraska Public Power District
Project/Site: Irrigation Runoff

Job ID: 310-237917-1

Laboratory: Eurofins Cedar Falls

All accreditations/certifications held by this laboratory are listed. Not all accreditations/certifications are applicable to this report.

Authority	Program	Identification Number	Expiration Date
Colorado	Petroleum Storage Tank Program	IA100001 (OR)	09-29-22
Georgia	State	IA100001 (OR)	09-29-22
Illinois	NELAP	200024	11-29-22
Iowa	State	007	12-01-21 *
Kansas	NELAP	E-10341	01-31-23
Minnesota	NELAP	019-999-319	12-31-22
Minnesota (Petrofund)	State	3349	01-18-24
North Dakota	State	R-186	09-29-22
Oregon	NELAP	IA100001	09-29-22

* Accreditation/Certification renewal pending - accreditation/certification considered valid.

Method Summary

Client: Nebraska Public Power District
Project/Site: Irrigation Runoff

Job ID: 310-237917-1

Method	Method Description	Protocol	Laboratory
9056A	Anions, Ion Chromatography	SW846	EET CF
6020A	Metals (ICP/MS)	SW846	EET CF
7470A	Mercury (CVAA)	SW846	EET CF
350.1	Nitrogen, Ammonia	MCAWW	EET CF
351.2	Nitrogen, Total Kjeldahl	MCAWW	EET CF
353.2	Nitrogen, Nitrate-Nitrite	MCAWW	EET CF
SM 2320B	Alkalinity	SM	EET CF
SM 4500 H+ B	pH	SM	EET CF
3005A	Preparation, Total Metals	SW846	EET CF
351.2	Nitrogen, Total Kjeldahl	MCAWW	EET CF
7470A	Preparation, Mercury	SW846	EET CF
Distill/Ammonia	Distillation, Ammonia	None	EET CF

Protocol References:

MCAWW = "Methods For Chemical Analysis Of Water And Wastes", EPA-600/4-79-020, March 1983 And Subsequent Revisions.
None = None
SM = "Standard Methods For The Examination Of Water And Wastewater"
SW846 = "Test Methods For Evaluating Solid Waste, Physical/Chemical Methods", Third Edition, November 1986 And Its Updates.

Laboratory References:

EET CF = Eurofins Cedar Falls, 3019 Venture Way, Cedar Falls, IA 50613, TEL (319)277-2401

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America

310-237917 Chain of Custody

Cooler/Sample Receipt and Temperature Log Form

Client Information

Client: Nebraska Public Power

City/State: CITY Sutherland STATE NE

Project:

Receipt Information

Date/Time Received: DATE 8-12-22 TIME 835

Received By:

Delivery Type: ☑ UPS ☐ FedEx ☐ FedEx Ground ☐ US Mail ☐ Spee-Dee
☐ Lab Courier ☐ Lab Field Services ☐ Client Drop-off ☐ Other:______________

Condition of Cooler/Containers

Sample(s) received in Cooler?	☑ Yes	☐ No	*If yes:* Cooler ID:
Multiple Coolers?	☐ Yes	☑ No	*If yes:* Cooler # _____ of _____
Cooler Custody Seals Present?	☑ Yes	☐ No	*If yes:* Cooler custody seals intact? ☑ Yes ☐ No
Sample Custody Seals Present?	☐ Yes	☑ No	*If yes:* Sample custody seals intact? ☐ Yes ☐ No
Trip Blank Present?	☐ Yes	☑ No	*If yes:* Which VOA samples are in cooler? ↓

Temperature Record

Coolant: ☑ Wet ice ☐ Blue ice ☐ Dry ice ☐ Other:______________ ☐ NONE

Thermometer ID: P	Correction Factor (°C): 0

• **Temp Blank Temperature** – If no temp blank, or temp blank temperature above criteria, proceed to Sample Container Temperature

Uncorrected Temp (°C): -1.6	Corrected Temp (°C): -1.6

• **Sample Container Temperature**

Container(s) used:	CONTAINER 1	CONTAINER 2
Uncorrected Temp (°C):		
Corrected Temp (°C):		

Exceptions Noted

1) If temperature exceeds criteria, was sample(s) received same day of sampling? ☐ Yes ☐ No
   a) *If yes:* Is there evidence that the chilling process began? ☐ Yes ☐ No

2) If temperature is <0°C, are there obvious signs that the integrity of sample containers is compromised? (e.g., bulging septa, broken/cracked bottles, frozen solid?) ☐ Yes ☐ No

NOTE. If yes, contact PM before proceeding. If no, proceed with login

Additional Comments

Document CED-P-SAM-FRM45521
Revision: 26
Date: 27 Jan 2022

General temperature criteria is 0 to 6°C
Bacteria temperature criteria is 0 to 10°C

2-5 [illegible]

Eurofins Cedar Falls
3019 Venture Way
Cedar Falls IA 50613
Phone (319) 277-2401 Phone (319) 277-2425

Chain of Custody Record

eurofins
Environment Testing America

Client Information	Sampler: Doug Harris	Lab PM: Hayes, Shawn M	Carrier Tracking No(s):	COC No:
Client Contact: Doug Harris	Phone: 308-530-1124	E-Mail: Shawn Hayes@et.eurofinsus.com	State of Origin:	Page: Page 1 of 1
Company: Nebraska Public Power District	PWSID:			Job #:

Address: 6089 S Hwy 25 Gerald Gentleman Station
City: Sutherland
State, Zip: NE 69165
Phone: 308-530-1124
Email: ddharri@nppd com
Project Name: Irrigation Runoff
Site: GGS

Due Date Requested:
TAT Requested (days):
Compliance Project: ∆ Yes x No
PO #: 4500245807
WO #:
Project #: 31007155
SSOW#:

Analysis Requested

Sample Identification	Sample Date	Sample Time	Sample Type (C=comp, G=grab)	Matrix (W=water S=solid, O=waste/oil, BT=Tissue, A=Air)	Field Filtered Sample (Yes or No)	Perform MS/MSD (Yes or No)	350 1 Ammonia, 351 2 TKN, 353.2 Nitrate+Nitrite	6020A, 7470A Select Metals	2320B Alkalinity, 9056A Chloride, Fluoride, Sulfate, SM4500_H+ pH	Total Number of containers	Special Instructions/Note
				Preservation Code:			S	D	N		
Road Track	8-11-22	1100	G	Water			X	X	X		
Pivot Bucket	8-11-22	1105	G	water			X	X	X		

↑ sample bottles only partially filled due to lack of sample - please do what we can
Doug

Preservation Codes:
A - HCL
B - NaOH
C Zn Acetate
D Nitric Acid
E - NaHSO4
F - MeOH
G - Amchlor
H - Ascorbic Acid
I - Ice
J - DI Water
K - EDTA
L - EDA
M Hexane
N - None
O - AsNaO2
P - Na2O4S
Q Na2SO3
R - Na2S2O3
S - H2SO4
T - TSP Dodecahydrate
U - Acetone
V - MCAA
W - pH 4-5
Z - other (specify)
Other:

Possible Hazard Identification
☒ *Non-Hazard* ☐ *Flammable* ☐ *Skin Irritant* ☐ *Poison B* ☐ *Unknown* ☐ *Radiological*

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ *Return To Client* ☐ *Disposal By Lab* ☐ *Archive For* ________ *Months*

Deliverable Requested I, II III IV, Other (specify)
Special Instructions/QC Requirements.

Empty Kit Relinquished by:	Date	Time	Method of Shipment:

Relinquished by: Doug Harris	Date/Time: 8-11-22 1400	Company: NPPD	Received by: MC	Date/Time: 8-12-22 835	Company
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company
Relinquished by:	Date/Time:	Company	Received by:	Date/Time:	Company

Custody Seals Intact: ∆ Yes ∆ No	Custody Seal No	Cooler Temperature(s) °C and Other Remarks:

Ver: 01/16/2019

Login Sample Receipt Checklist

Client: Nebraska Public Power District

Job Number: 310-237917-1

Login Number: 237917

List Number: 1

Creator: Costello, Mackenzie K

List Source: Eurofins Cedar Falls

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	N/A	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	True	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	True	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

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