REPORT

Annual Groundwater Monitoring Report – 2025

Nucla Station Ash Disposal Facility
Nucla, Colorado

Submitted to:

Tri-State Generation and Transmission Association, Inc.
PO Box 33695, Denver, Colorado, USA 80233

Submitted by:

WSP USA Inc.
7245 W Alaska Drive, Suite 200, Lakewood, Colorado, USA 80226

+1 303 980 0540

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Executive Summary

This report summarizes the 2025 groundwater monitoring activities and results for the detection monitoring program for the closed coal combustion residuals (CCR) landfill that served the former Nucla Station, along with the comparative statistical analysis. The CCR landfill, which is owned by Tri-State Generation and Transmission Association, Inc., is currently in detection monitoring. No program transitions occurred in 2025.

An alternative source demonstration (ASD) was conducted in April 2025 to demonstrate that the verified statistically significant increase (SSI) for field-measured pH in MO-4, which was identified following the December 2024 confirmatory resampling event, was not an indication of a release from the facility. It was recommended that the facility remain in detection monitoring.

Fluoride in MO-3 was identified as a potential exceedance following the first semi-annual 2025 sampling event. Confirmatory resampling conducted in July 2025 indicated that the first semi-annual 2025 detection monitoring result was a false-positive SSI. No further action is needed.

Field-measured pH in MO-1 was identified as a potential exceedance of the lower statistical limit following the first semi-annual 2025 sampling event. Confirmatory resampling conducted in July 2025 verified the first semi-annual 2025 detection monitoring result as an SSI with a value lower than the lower statistical limit. The second semi-annual 2025 result was lower than the lower statistical limit and is a verified SSI. However, an ASD is not required because MO-1 is an upgradient monitoring well, and the CCR landfill was determined not to be the source of the verified SSIs based on a review of water elevation measurements, the inferred groundwater flow direction, and the geographic location of the monitoring well in relation to the CCR landfill. No additional action is needed.

Total recoverable boron and field-measured pH in MO-3 were identified as potential exceedances following the second semi-annual 2025 sampling event. Confirmatory resampling is scheduled for the first quarter of 2025. Review and statistical analysis of the confirmatory resampling results will be completed in the first quarter of 2025.

No other potential exceedances, false-positive SSIs, or verified SSIs were identified for the 2025 detection monitoring program.

As described in the Groundwater Monitoring System Certification (Golder 2019) and the Groundwater Statistical Method Certification (Golder 2020), the groundwater monitoring and analytical procedures for the program meet the requirements of 40 CFR 257 Subpart D (the CCR Rule). Modifications to the monitoring network and sampling program are not necessary at this time.

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1.0 INTRODUCTION

WSP USA Inc. (WSP) prepared this report to describe the 2025 groundwater monitoring activities and comparative statistical analysis for the Nucla Station Ash Disposal Facility (the Facility), which is a coal combustion residuals (CCR) landfill owned by Tri-State Generation and Transmission Association, Inc. (Tri-State) and subject to regulation under 40 CFR 257 Subpart D (the CCR Rule). This report was prepared to meet the requirements of 40 CFR 257.90(e).

1.1 Facility Information

The Facility serves as the location for containment of CCRs that were generated at Tri-State's Nucla Station, which was a 110-megawatt coal-fired electric generation plant located near Nucla, Colorado. Nucla Station was retired in September 2019 and subsequently demolished. Within the 81.65-acre property of the Facility, the CCR disposal footprint comprises approximately 61 acres. Closure of the Facility was completed in 2022.

1.2 Purpose

The CCR Rule establishes specific requirements for reporting of groundwater monitoring activities and corrective action in 40 CFR 257.90. Per 40 CFR 257.90(e), 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 PROGRAM STATUS

The groundwater monitoring system for the Facility consists of five monitoring wells, as described in the Groundwater Monitoring System Certification (Golder 2019). The two upgradient monitoring wells are MO-1 and MO-2. The three downgradient monitoring wells are MO-3, MO-4, and MO-5. The groundwater monitoring program for the Facility is currently in detection monitoring.

2.1 Completed Key Actions in 2025

The following key actions were completed in 2025:

- The 2024 Annual Groundwater Monitoring Report (WSP 2025) was finalized and placed within the operating record and on Tri-State's publicly accessible CCR website.
- An alternative source demonstration (ASD) was conducted in April 2025 to demonstrate that the verified statistically significant increase (SSI) for field-measured pH in MO-4, which was identified from the December 2024 confirmatory resampling event, was not an indication of a release from the Facility, and it was recommended that the Facility remain in detection monitoring. The ASD is provided in Appendix A.
- Sampling events for the detection monitoring program were conducted in the second quarter on April 29 and 30, and in the fourth quarter on October 21 and 22.
- Confirmatory resampling was conducted on July 23 for the potential exceedance identified from the first semi-annual 2025 sampling event.

2.2 Installation and Decommissioning of Monitoring Wells

No monitoring wells were installed or decommissioned for the Facility in 2025.

2.3 Problems and Resolutions

The groundwater monitoring program uses pressure transducers installed in the monitoring wells to measure the static water level in each monitoring well during each sampling event. As detailed in the 2024 annual report (WSP 2025), while reviewing the field notes from the December 2024 confirmatory resampling event for MO-3, WSP identified a potential inconsistency in the measurements recorded by the pressure transducer installed in MO-3. This prompted further review of the pressure transducer readings recorded in the field notes for each monitoring well. Based on this review, the following shifts in the pressure transducer readings were identified:

- MO-3: A new pressure transducer was installed in the monitoring well prior to the December 2024 confirmatory resampling event. The new pressure transducer indicates a pressure head approximately 8 feet higher than the pressure transducer that was previously installed in the monitoring well at approximately the same elevation indicated. However, a manual water level measurement obtained in January 2025 indicated that the water level had not increased in the monitoring well when compared to the previous manual water level measurement in MO-3.

- MO-4: The pressure head measured by the pressure transducer increased approximately 15 feet between the October 2022 and April 2023 sampling events. However, a manual water level measurement obtained in January 2025 indicated that the water level had not increased in the monitoring well when compared to the previous manual water level measurement for MO-4.

An investigation into the discrepancies between the pressure transducer readings and manual water level measurements occurred in 2025, and it was determined that the pressure transducers in MO-3 and MO-4 malfunctioned. To address this issue, new pressure transducers were installed in all five monitoring wells in April 2025, and new benchmarks for the pressure readings were established based on manual water level measurements. The 2025 water elevations for MO-3 are consistent with water elevations historically reported for MO-3. The 2025 water elevations for MO-4 are consistent with water elevations reported for 2024 and prior to 2023. The 2023 water elevations reported for MO-4 in the 2023 Annual Groundwater Monitoring Report (WSP 2024) are approximately 15 feet higher than the other water elevations reported for MO-4 and are likely erroneous.

2.4 Proposed Key Activities for 2026

The following key actions are expected to be completed in 2026:

- Confirmatory resampling for potential exceedances identified from the second semi-annual 2025 sampling event will occur in the first quarter of 2025.

- Sampling events for the detection monitoring program are planned to occur in the second and fourth quarters of 2026.

3.0 GROUNDWATER MONITORING RESULTS AND ANALYSIS

Results from the groundwater monitoring program in 2025 are described in this section.

3.1 Groundwater Flow

The depth to groundwater was recorded in each monitoring well prior to purging for each sampling event. Static water elevations are presented in Table 1 through Table 5. Static water elevations for the first semi-annual 2025 sampling event and the second semi-annual 2025 sampling event are shown in Figure 1 and Figure 2, respectively.

The Morrison aquifer is characterized as highly heterogeneous with zones that are variably transmissive and/or subjected to variable amounts of confining pressure. This characterization is supported by the significant differences in static water levels, water column heights, and recovery times observed in the monitoring wells that have been installed to serve as the groundwater monitoring system for the Facility. Sandstone lenses in the Morrison aquifer vary considerably with respect to transmissivity (i.e., thickness and hydraulic conductivity) and horizontal extent due to the alluvial, shoreline, and lacustrine environments that deposited the Salt Wash and Brushy Basin Members of the Morrison Formation, resulting in interbedded siltstone, mudstone, claystone, and shale units. Static water elevation data suggest a general southerly groundwater flow direction in the Morrison aquifer near the Facility. However, the heterogeneity and interbedded nature of the Morrison Formation beneath the Facility and the significant differences in recharge characteristics between monitoring wells suggest a lack of horizontal continuity and confound the ability to precisely discern groundwater flow direction and rate.

3.2 Monitoring Data (Analytical Results)

Analytical results from detection monitoring in 2025 are shown in Table 1 through Table 5.

3.3 Samples Collected

The sampling events for detection monitoring were conducted in April 2025 (first semi-annual 2025 sampling event) and October 2025 (second semi-annual 2025 sampling event). Additionally, samples were collected from MO-1 and MO-3 in July 2025 for confirmatory resampling associated with the detection monitoring program.

3.4 Comparative Statistical Analysis

The comparative statistical analysis is summarized below, and the results are presented in Table 6 through Table 10. A full description of the steps taken for the comparative statistical analysis can be found in the Groundwater Statistical Method Certification (Golder 2020).

3.4.1 Definitions

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

- SSI – is a statistically significant increase and is defined as an analytical result that exceeds the parametric or non-parametric statistical limit established by the baseline statistical analysis.
- Potential Exceedance – is defined as an initial analytical result that exceeds the parametric or non-parametric statistical limit established by the baseline statistical analysis. Confirmatory resampling is used to determine whether the potential exceedance is a false-positive SSI or a verified SSI.
- False-positive SSI – is defined as an analytical result that exceeds the statistical limit but can clearly be attributed to laboratory error or changes in analytical precision or is invalidated through confirmatory resampling.

- Confirmatory resampling – is designated as the resampling event that occurs within 90 days of identifying an SSI over the statistical limit for determination of a verified SSI [1].
- Verified SSI – is interpreted as two consecutive SSIs (the original sample and the confirmatory resample for analytical results) for the same constituent at the same monitoring well.

If the data are assessed with a trend test, confirmatory resampling is generally not applicable, and a verified SSI is defined as a statistically significant increasing trend in the eight most recent results.

3.4.2 Potential Exceedances

Field-measured pH for the sample collected from MO-1 and the fluoride concentration for the sample collected from MO-3 during the first semi-annual 2025 sampling event exceeded the respective statistical limits and were therefore identified as potential exceedances. Results of the confirmatory resampling conducted in July 2025 are discussed in Section 3.4.3 and Section 3.4.4.

The total recoverable boron concentration and field-measured pH for the sample collected from MO-3 during the second semi-annual 2025 sampling event exceeded the respective statistical limits and were therefore identified as potential exceedances. Confirmatory resampling is scheduled for the first quarter of 2025. Review and statistical analysis of the confirmatory resampling results will be completed in the first quarter of 2025.

3.4.3 False-positive Statistically Significant Increases

Confirmatory resampling for the potential exceedance associated with the first semi-annual 2025 sampling event occurred on July 23, 2025. The confirmatory resampling identified the fluoride result for the sample collected from MO-3 during the first semi-annual 2025 sampling event as a false-positive SSI. No further action is needed.

3.4.4 Verified Statistically Significant Increases

A potential exceedance of the lower statistical limit for field-measured pH in MO-1 was identified following the first semi-annual 2025 sampling event. This potential exceedance was verified with confirmatory resampling in July 2025. The second semi-annual 2025 result was lower than the lower statistical limit and is a verified SSI. However, an ASD is not required because MO-1 is an upgradient monitoring well, and the CCR landfill was determined not to be the source of the verified SSIs based on a review of water elevation measurements, the inferred groundwater flow direction, and the geographic location of the monitoring well in relation to the CCR landfill. No additional action is needed.

4.0 PROGRAM TRANSITIONS

In the fourth quarter of 2017, the groundwater monitoring program for the Facility transitioned from the baseline period to detection monitoring. The Facility remains in detection monitoring, and no program transitions occurred in 2025.

[1] Confirmatory resampling might not occur within 90 days of the sampling event that resulted in the potential exceedance because of the additional time required for activities that must occur before a potential exceedance can be identified. These activities include sample delivery, analytical testing, review of results, and comparative statistical analysis.

4.1 Detection Monitoring

Samples for the detection monitoring program are collected on a semi-annual basis, beginning with the sample collected in October 2017. Tri-State plans to collect samples for the detection monitoring program in the second and fourth quarters of 2026.

4.2 Assessment Monitoring

The groundwater monitoring program for the Facility is not in assessment monitoring. Assessment monitoring has not been triggered as described in 40 CFR 257.95. As such, no ASDs have been made under an assessment monitoring program, and no actions are required.

4.3 Corrective Measures and Assessment

The groundwater monitoring program for the Facility does not indicate the need for corrective measures. An assessment of corrective measures, as described in 40 CFR 257.96, is not required.

5.0 RECOMMENDATIONS AND CLOSING

This report presents the groundwater monitoring activities and results for the 2025 detection monitoring program for the Nucla Station Ash Disposal Facility, along with the comparative statistical analysis. The significant findings from the 2025 monitoring activities and comparative statistical analysis are as follows:

- A potential exceedance of the upper statistical limit for field-measured pH in MO-4 was identified for the second semi-annual 2024 sampling event (WSP 2025) and was verified as an SSI following the confirmatory resampling event in December 2024. An ASD was conducted in April 2025 to demonstrate that the verified SSI for field-measured pH in MO-4 was not an indication of a release from the Facility, and it was recommended that the Facility remain in detection monitoring. No further action is needed.
- Fluoride in MO-3 was identified as a potential exceedance following the first semi-annual 2025 sampling event. Confirmatory resampling conducted in July 2025 indicated that this result was a false-positive SSI. No further action is needed.
- Field-measured pH in MO-1 was lower than the lower statistical limit and identified as a potential exceedance following the first semi-annual 2025 sampling event. Confirmatory resampling conducted in July 2025 verified the result as an SSI. The second semi-annual 2025 result was lower than the lower statistical limit and is a verified SSI. However, an ASD is not required because MO-1 is an upgradient monitoring well, and the CCR landfill was determined not to be the source of the verified SSIs based on a review of water elevation measurements, the inferred groundwater flow direction, and the geographic location of the monitoring well in relation to the CCR landfill. No further action is needed.
- Total recoverable boron and field-measured pH in MO-3 were identified as potential exceedances following the second semi-annual 2025 sampling event. Confirmatory resampling is scheduled for the first quarter of 2025. Review and statistical analysis of the confirmatory resampling results will be completed in the first quarter of 2025.
- No other potential exceedances, false-positive SSIs, or verified SSIs were identified from the 2025 detection monitoring program.

As described in the Groundwater Monitoring System Certification (Golder 2019) and the Groundwater Statistical Method Certification (Golder 2020), the groundwater monitoring and analytical procedures meet the requirements of the CCR Rule. Modifications to the monitoring network and sampling program are not necessary at this time.

Signature Page

WSP USA Inc.

Sara Harkins, PG (WY)
Senior Geochemist/Geologist

Jason Obermeyer, PE (CO, ID, KS, MI, NM, TX)
Leader, Senior Technical Principal

Brenna Bourque
Associate Geochemist

SAH/JEO/BKB/rm

https://wsponlinenam.sharepoint.com/sites/us-tirstategroundwater/shared documents/project files/nucla ccr/2025 nucla ccr/6_deliverables/004-rpt-2025_annual_groundwater_report/rev0/31403149.2403-004-rpt-0-2025_annual_ groundwater_report_27jan26.docx

6.0 REFERENCES

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Tables

Table 1: Sample Results Summary Table – MO-1

Analytes	Units	First Semi-Annual 2025		Second Semi-Annual 2025
		Compliance Event	Resampling Event	Compliance Event
Static Water Elevation	ft amsl	5716.1	5716.0	5715.9
Water Level Date	--	4/24/2025	7/17/2025	10/16/2025
Sample Date	--	4/30/2025	7/23/2025	10/22/2025
Appendix III				
Boron, Total Recoverable	mg/L	0.387	--	0.407
Calcium, Total Recoverable	mg/L	4.12	--	3.16
Chloride	mg/L	259	--	241
Fluoride	mg/L	< 12.5 U	--	1.81 B
pH, Field-Measured	pH units	11.4	11.3	11.3
Sulfate	mg/L	445	--	412
Total Dissolved Solids	mg/L	1420	--	1440

Notes:

ft amsl: feet above mean sea level
mg/L: milligrams per liter
Non-detects are reported as less than the practical quantitation limit.
B: Analyte was detected between the method detection limit and the practical quantitation limit.
U: Analyte was not detected above the practical quantitation limit.

Table 2: Sample Results Summary Table – MO-2

Analytes	Units	First Semi-Annual 2025	Second Semi-Annual 2025
		Compliance Event	Compliance Event
Static Water Elevation	ft amsl	5738.3	5738.9
Water Level Date	--	4/24/2025	10/16/2025
Sample Date	--	4/30/2025	10/22/2025
Appendix III			
Boron, Total Recoverable	mg/L	0.323 B	0.377 B
Calcium, Total Recoverable	mg/L	53.0	51.0
Chloride	mg/L	2060	1780
Fluoride	mg/L	< 25 U	< 25 U
pH, Field-Measured	pH units	7.9	7.9
Sulfate	mg/L	1870	1640
Total Dissolved Solids	mg/L	6180	6220

Notes:

ft amsl: feet above mean sea level

mg/L: milligrams per liter

Non-detects are reported as less than the practical quantitation limit.

B: Analyte was detected between the method detection limit and the practical quantitation limit.

U: Analyte was not detected above the method detection limit.

Table 3: Sample Results Summary Table – MO-3

Analytes	Units	First Semi-Annual 2025		Second Semi-Annual 2025
		Compliance Event	Resampling Event	Compliance Event
Static Water Elevation	ft amsl	5636.8	5636.7	5636.8
Water Level Date	--	4/24/2025	7/17/2025	10/16/2025
Sample Date	--	4/29/2025	7/23/2025	10/21/2025
Appendix III				
Boron, Total Recoverable	mg/L	0.674	--	0.725
Calcium, Total Recoverable	mg/L	18.9	--	18.7
Chloride	mg/L	154	--	143
Fluoride	mg/L	3.64 B	2.52	2.77
pH, Field-Measured	pH units	7.8	7.8	7.7
Sulfate	mg/L	782	--	697
Total Dissolved Solids	mg/L	2330	--	2400

Notes:

ft amsl: feet above mean sea level

mg/L: milligrams per liter

B: Analyte was detected between the method detection limit and the practical quantitation limit.

Table 4: Sample Results Summary Table – MO-4

Analytes	Units	First Semi-Annual 2025	Second Semi-Annual 2025
		Compliance Event	Compliance Event
Static Water Elevation	ft amsl	5638.1	5638.1
Water Level Date	--	4/24/2025	10/16/2025
Sample Date	--	4/29/2025	10/21/2025
Appendix III			
Boron, Total Recoverable	mg/L	0.360 B	0.456 B
Calcium, Total Recoverable	mg/L	46.9	46.4
Chloride	mg/L	948	815
Fluoride	mg/L	< 25 U	< 25 U
pH, Field-Measured	pH units	7.7	7.6
Sulfate	mg/L	1980	1660
Total Dissolved Solids	mg/L	4810	4960

Notes:

ft amsl: feet above mean sea level

mg/L: milligrams per liter

Non-detects are reported as less than the practical quantitation limit.

B: Analyte was detected between the method detection limit and the practical quantitation limit.

U: Analyte was not detected above the method detection limit.

Table 5: Sample Results Summary Table – MO-5

Analytes	Units	First Semi-Annual 2025	Second Semi-Annual 2025
		Compliance Event	Compliance Event
Static Water Elevation	ft amsl	5661.0	5662.4
Water Level Date	--	4/24/2025	10/16/2025
Sample Date	--	4/29/2025	10/21/2025
Appendix III			
Boron, Total Recoverable	mg/L	0.327 B	0.388 B
Calcium, Total Recoverable	mg/L	12.8	11.5
Chloride	mg/L	914	781
Fluoride	mg/L	< 25 U	< 25 U
pH, Field-Measured	pH units	8.5	8.4
Sulfate	mg/L	1740	1440
Total Dissolved Solids	mg/L	4530	4810

Notes:

ft amsl: feet above mean sea level

mg/L: milligrams per liter

Non-detects are reported as less than the practical quantitation limit.

B: Analyte was detected between the method detection limit and the practical quantitation limit.

U: Analyte was not detected above the method detection limit.

Table 6: Statistics Summary Table – MO-1

Analytes	Units	Selected Statistical Method	Statistical Limit	April 2025		July 2025		October 2025	
				Compliance Event (4/30/2025)	SSI Determination	Resample Event (7/23/2025)	SSI Determination	Compliance Event (10/22/2025)	SSI Determination
Appendix III									
Boron, Total Recoverable	mg/L	P-PL	0.45	0.387	No	--	No	0.407	No
Calcium, Total Recoverable	mg/L	P-PL	24	4.12	No	--	No	3.16	No
Chloride	mg/L	Trend[1]	NL	259	No	--	No	241	No
Fluoride	mg/L	P-PL	2.7	< 12.5 U[2]	No	--	No	1.81 B	No
pH, Field-Measured	pH units	P-PL	11.5, 12.2	11.4	Potential Exceedance	11.3	Verified SSI	11.3	Verified SSI
Sulfate	mg/L	Trend[1]	NL	445	No	--	No	412	No
Total Dissolved Solids	mg/L	P-PL	2056	1420	No	--	No	1440	No

Notes:

NL: Statistical limit was not calculated for analytes for which the Sen's Slope methodology was selected.

P-PL: parametric prediction limit

mg/L: milligrams per liter

Non-detects are reported as less than the practical quantitation limit.

B: Analyte was detected between the method detection limit and the practical quantitation limit.

U: Analyte was not detected above the practical quantitation limit.

1) Baseline data exhibited a statistically significant decreasing trend. Therefore, a trend analysis is used for the determination of SSIs.

2) Result is not considered an SSI because it is a non-detect with a method detection limit of 2.5 mg/L, which is below the statistical limit.

Table 7: Statistics Summary Table – MO-2

Analytes	Units	Selected Statistical Method	Statistical Limit	April 2025		October 2025	
				Compliance Event (4/30/2025)	SSI Determination	Compliance Event (10/22/2025)	SSI Determination
Appendix III							
Boron, Total Recoverable	mg/L	P-PL	0.44	0.323 B	No	0.377 B	No
Calcium, Total Recoverable	mg/L	P-PL	61	53.0	No	51.0	No
Chloride	mg/L	P-PL	2223	2060	No	1780	No
Fluoride	mg/L	NP-PL	12.5	< 25 U(1)	No	< 25 U(1)	No
pH, Field-Measured	pH units	P-PL	7.6, 8.6	7.9	No	7.9	No
Sulfate	mg/L	P-PL	2227	1870	No	1640	No
Total Dissolved Solids	mg/L	P-PL	6652	6180	No	6220	No

Notes:

P-PL: parametric prediction limit

NP-PL: non-parametric prediction limit

mg/L: milligrams per liter

Non-detects are reported as less than the practical quantitation limit.

B: Analyte was detected between the method detection limit and the practical quantitation limit.

U: Analyte was not detected above the practical quantitation limit.

1) Result is not considered an SSI because it is a non-detect with a method detection limit of 5 mg/L, which is below the statistical limit.

Table 8: Statistics Summary Table – MO-3

Analytes	Units	Selected Statistical Method	Statistical Limit	April 2025		July 2025		October 2025	
				Compliance Event (4/29/2025)	SSI Determination	Resample Event (7/23/2025)	SSI Determination	Compliance Event (10/21/2025)	SSI Determination
Appendix III									
Boron, Total Recoverable	mg/L	P-PL	0.72	0.674	No	--	No	0.725	Potential Exceedance
Calcium, Total Recoverable	mg/L	P-PL	21	18.9	No	--	No	18.7	No
Chloride	mg/L	P-PL	179	154	No	--	No	143	No
Fluoride	mg/L	P-PL	3.2	3.64 B	False-Positive SSI	2.52	No	2.77	No
pH, Field-Measured	pH units	NP-PL	7.8, 8.1	7.8	No	7.8	--(1)	7.7	Potential Exceedance
Sulfate	mg/L	P-PL	855	782	No	--	No	697	No
Total Dissolved Solids	mg/L	P-PL	2598	2330	No	--	No	2400	No

Notes:

P-PL: parametric prediction limit

NP-PL: non-parametric prediction limit

mg/L: milligrams per liter

B: Analyte was detected between the method detection limit and the practical quantitation limit.

1) Field-measured pH is reported for informational purposes. SSI determination for the confirmatory resampling event only applies to parameters identified as potential exceedances from the preceding sampling event.

Table 9: Statistics Summary Table – MO-4

Analytes	Units	Selected Statistical Method	Statistical Limit	April 2025		October 2025	
				Compliance Event (4/29/2025)	SSI Determination	Compliance Event (10/21/2025)	SSI Determination
Appendix III							
Boron, Total Recoverable	mg/L	P-PL	0.50	0.360 B	No	0.456 B	No
Calcium, Total Recoverable	mg/L	P-PL	51	46.9	No	46.4	No
Chloride	mg/L	P-PL	1072	948	No	815	No
Fluoride	mg/L	NP-PL	12.5	< 25 U(1)	No	< 25 U(1)	No
pH, Field-Measured	pH units	NP-PL	7.4, 7.7	7.7	No	7.6	No
Sulfate	mg/L	P-PL	2056	1980	No	1660	No
Total Dissolved Solids	mg/L	P-PL	5328	4810	No	4960	No

Notes:

P-PL: parametric prediction limit

NP-PL: non-parametric prediction limit

mg/L: milligrams per liter

Non-detects are reported as less than the practical quantitation limit.

B: Analyte was detected between the method detection limit and the practical quantitation limit.

U: Analyte was not detected above the practical quantitation limit.

1) Result is not considered an SSI because it is a non-detect with a method detection limit of 5 mg/L, which is below the statistical limit.

Table 10: Statistics Summary Table – MO-5

Analytes	Units	Selected Statistical Method	Statistical Limit	April 2025		October 2025	
				Compliance Event (04/29/2025)	SSI Determination	Compliance Event (10/21/2025)	SSI Determination
Appendix III							
Boron, Total Recoverable	mg/L	P-PL	0.52	0.327 B	No	0.388 B	No
Calcium, Total Recoverable	mg/L	Trend(1)	NL	12.8	No	11.5	No
Chloride	mg/L	P-PL	1180	914	No	781	No
Fluoride	mg/L	NP-PL	12.5	< 25 U(2)	No	< 25 U(2)	No
pH, Field-Measured	pH units	P-PL	7.6, 9.3	8.5	No	8.4	No
Sulfate	mg/L	P-PL	1996	1740	No	1440	No
Total Dissolved Solids	mg/L	P-PL	5468	4530	No	4810	No

Notes:

NL: Statistical limit was not calculated for analytes for which the Sen's Slope methodology was selected

P-PL: parametric prediction limit

NP-PL: non-parametric prediction limit

mg/L: milligrams per liter

Non-detects are reported as less than the practical quantitation limit.

B: Analyte was detected between the method detection limit and the practical quantitation limit.

U: Analyte was not detected above the practical quantitation limit.

1) Baseline data exhibited a statistically significant decreasing trend. Therefore, a trend analysis is used for the determination of SSIs.

2) Result is not considered an SSI because it is a non-detect with a method detection limit of 5 mg/L, which is below the statistical limit.

Figures

LEGEND

- PROPERTY BOUNDARY
- 5990 EXISTING GROUND TOPOGRAPHY (REFERENCE 1)
- MO-1 MONITORING WELL
- 5716.1 STATIC WATER ELEVATION (NOTES 1 AND 2)

NOTE(S)

1. STATIC WATER LEVELS AT MO-1, MO-2, MO-3, MO-4, AND MO-5 WERE MEASURED ON APRIL 24, 2025.
2. STATIC WATER ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL.

REFERENCE(S)

1. THE EXISTING GROUND TOPOGRAPHY WAS OBTAINED BY EPP & ASSOCIATES ON MAY 13, 2022.
2. THE AERIAL IMAGERY WAS OBTAINED FROM THE ESRI BASEMAP SERVICE, MAXAR VIVID. AERIAL IMAGERY WAS CAPTURED ON NOVEMBER 15, 2023.

N

0 150 300
SCALE FEET

CLIENT
TRI-STATE GENERATION AND TRANSMISSION ASSOCIATION
1100 WEST 116TH AVENUE
WESTMINSTER, COLORADO 80234

CONSULTANT
wsp

YYYY-MM-DD	2026-01-12
DESIGNED	BJP
PREPARED	GIH
REVIEWED	SAH
APPROVED	JEO

PROJECT
NUCLA STATION ASH DISPOSAL FACILITY
COAL COMBUSTION RESIDUALS LANDFILL
2025 ANNUAL GROUNDWATER MONITORING REPORT

TITLE
MONITORING WELL LOCATIONS AND STATIC WATER ELEVATIONS (FIRST SEMI-ANNUAL 2025 SAMPLING EVENT)

PROJECT NO.	REV.	FIGURE
31403149.2403	0	1

Path: N:\TRI-STATE GENERATION AND TRANSMISSION_TRI-STATE\NUCLA ASH LANDFILL\99_PROJECTS\31403149.3795 | File Name: CCR Well Locations-Aerial-Topo_April25.dwg

LEGEND

- PROPERTY BOUNDARY
- 5990 EXISTING GROUND TOPOGRAPHY (REFERENCE 1)
- MO-1 MONITORING WELL
- 5715.9 STATIC WATER ELEVATION (NOTES 1 AND 2)

NOTE(S)

1. STATIC WATER LEVELS AT MO-1, MO-2, MO-3, MO-4, AND MO-5 WERE MEASURED ON OCTOBER 16, 2025.
2. STATIC WATER ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL.

REFERENCE(S)

1. THE EXISTING GROUND TOPOGRAPHY WAS OBTAINED BY EPP & ASSOCIATES ON MAY 13, 2022.
2. THE AERIAL IMAGERY WAS OBTAINED FROM THE ESRI BASEMAP SERVICE, MAXAR VIVID. AERIAL IMAGERY WAS CAPTURED ON NOVEMBER 15, 2023.

N

0 150 300
SCALE FEET

CLIENT
TRI-STATE GENERATION AND TRANSMISSION ASSOCIATION
1100 WEST 116TH AVENUE
WESTMINSTER, COLORADO 80234

CONSULTANT
wsp

YYYY-MM-DD	2026-01-12
DESIGNED	BJP
PREPARED	GIH
REVIEWED	SAH
APPROVED	JEO

PROJECT
NUCLA STATION ASH DISPOSAL FACILITY
COAL COMBUSTION RESIDUALS LANDFILL
2025 ANNUAL GROUNDWATER MONITORING REPORT

TITLE
MONITORING WELL LOCATIONS AND STATIC WATER ELEVATIONS (SECOND SEMI-ANNUAL 2025 SAMPLING EVENT)

PROJECT NO.	REV.	FIGURE
31403149.2403	0	2

Path: N:\TRI-STATE GENERATION AND TRANSMISSION_TRI-STATE\NUCLA ASH LANDFILL\99_PROJECTS\31403149.3795 | File Name: CCR Well Locations-Aerial-Topo_October25.dwg

APPENDIX A

Alternative Source Demonstration for Field pH in Monitoring Well MO-4

CERTIFICATION

Professional Engineer Certification Statement [40 CFR 257.94(e)(2)]

I hereby certify that, having reviewed the attached documentation and being familiar with the provisions of Title 40 of the Code of Federal Regulations Section 257.94 (40 CFR 257.94), this written demonstration is accurate to the best of my knowledge and has been prepared in accordance with recognized and generally accepted good engineering practices, including the consideration of applicable industry standards, and the requirements of 40 CFR 257.94(e)(2).

WSP USA Inc.

Signature

April 8, 2025
Date of Certification

Jason Obermeyer, PE
Name

40294
Colorado Professional Engineer Number

COLORADO LICENSED PROFESSIONAL ENGINEER
JASON E. OBERMEYER
40294

REPORT

Alternative Source Demonstration for Field pH in Monitoring Well MO-4

Nucla Station Ash Disposal Facility

Submitted to:

Tri-State Generation and Transmission Association, Inc.

1100 W 116th Avenue, Westminster, Colorado 80234

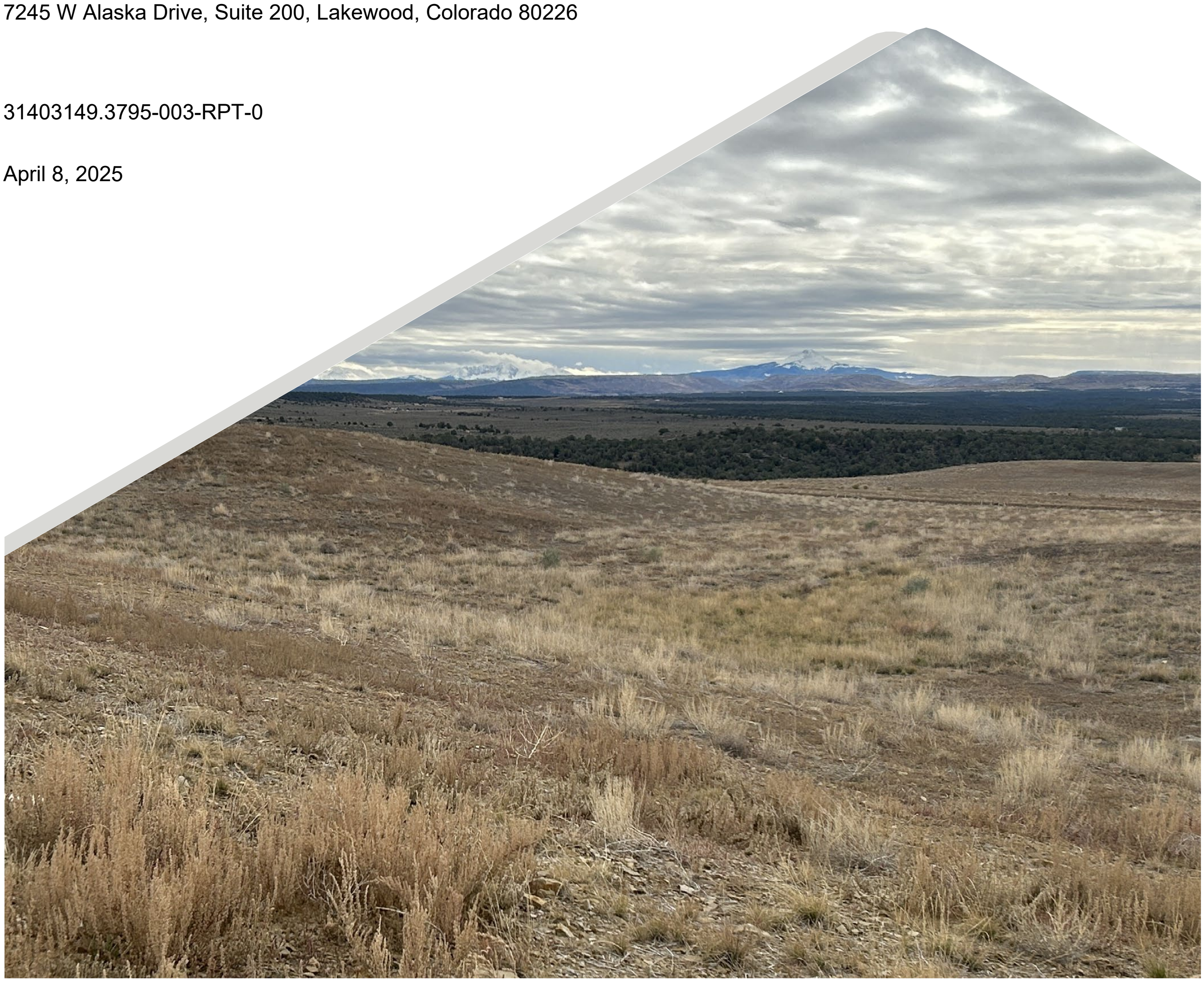
Submitted by:

WSP USA Inc.

7245 W Alaska Drive, Suite 200, Lakewood, Colorado 80226

31403149.3795-003-RPT-0

April 8, 2025



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TABLES

FIGURES

1.0 INTRODUCTION

On behalf of Tri-State Generation and Transmission Association, Inc. (Tri-State), WSP USA Inc. (WSP) performed a statistical evaluation of groundwater monitoring results for the October 2024 groundwater detection monitoring event for the Nucla Station Ash Disposal Facility (the Facility), a closed coal combustion residuals (CCR) landfill that served the former Nucla Station. The statistical evaluation was performed in accordance 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” (the CCR Rule) and as described in the Groundwater Statistical Method Certification (Golder 2020).

Statistical analyses for the October 2024 detection monitoring (Appendix III list) results for groundwater at downgradient monitoring well MO-4 indicated a potential exceedance for field pH. This potential exceedance was subsequently verified as a statistically significant increase (SSI) following the confirmatory sampling event in December 2024.

Although determination of a verified SSI generally indicates that the groundwater monitoring program should transition from detection monitoring to assessment monitoring, 40 CFR 257.94(e)(2) allows the owner or operator (i.e., Tri-State) 90 days from the date of determining a verified SSI to demonstrate that a source other than the regulated CCR unit caused the SSI or that the SSI is an indication of an error in sampling, analysis, or statistical evaluation or natural variability in groundwater quality that was not fully captured during the baseline data collection period.

WSP’s review of the hydrological and geologic conditions at the site indicates that the SSI for field pH at MO-4 is not an indication of an impact from the Facility. This alternative source demonstration (ASD) conforms to the requirements of 40 CFR 257.94(e)(2) and provides the basis for concluding that the SSI for field pH at MO-4 is not an indication of an impact from the Facility. The following sections provide a summary of the site geology and hydrogeology, WSP’s evaluation of analytical results, and lines of evidence demonstrating that an alternative source is responsible for the SSI for field pH at MO-4. More specifically, this report supports the demonstration that the SSI for field pH at MO-4 (October 2024 sample and December 2024 resample) is a result of natural variability in groundwater quality that was not fully captured during baseline data collection and inherent variability in field meter measurements.

2.0 BACKGROUND

The Facility is owned by Tri-State. The Facility is a closed disposal site for CCRs and other permitted utility-related wastes that were produced from the operation of Tri-State’s Nucla Station. Nucla Station was a 100-megawatt coal-fired electric generating facility that was retired in September 2019. The Facility received the known final receipt of waste in December 2021, and closure of the Facility was completed in May 2022. The Facility is a monofill based on the homogeneity of the disposed material. It is located approximately 2.5 miles southeast of the former Nucla Station site in Montrose County, Colorado.

2.1 Facility Development and Closure

Placement of CCRs in the Facility commenced in 1987 on a 40-acre parcel at the northern end of the site known as the “North 40.” Tri-State expanded the Facility laterally onto a 40-acre parcel located directly south of the original footprint known as the “South 40,” with placement of CCRs in the expansion commencing in 2006. CCRs disposed in the Facility were hauled from the power plant site in trucks and placed in a dry condition, with water added only as necessary to control fugitive dust generation.

Waste disposal at the Facility was initially enabled by the construction of an earthen starter dike at the perimeter of the Facility. Waste was placed within the disposal area created by the starter dike until the available capacity was consumed. At that point, the capacity of the Facility was increased by constructing a 5-foot-high containment berm on top of the waste and slightly inside of the starter dike. When additional capacity was needed, another 5-foot-high containment berm was constructed atop and slightly inside of the previous containment berm. This process was repeated as necessary to contain the waste being generated, which eventually created an earthen embankment around the perimeter of the permitted disposal area. At approximate 20-foot vertical intervals, the containment berms were inwardly offset an additional 10 feet to establish benches with terrace channels for stormwater management. The containment berms also provided final cover over previously deposited waste soon after placement, resulting in progressive closure of the embankment slopes. The final cover system was also progressively placed across the top surface once areas reached final grades. Engineering evaluations were conducted to verify that the soil properties, moisture-density conditions, layer thickness, and vegetation characterizing the final cover system satisfy the requirements of the Closure Plan (Golder 2022b). Soil-atmosphere modeling (Golder 2022a) has demonstrated that the percolation rate through the final cover system constructed at the Facility is expected to be negligible.

Nucla Station was retired in 2019 and ceased to generate CCRs. The Facility continued to receive permitted utility-related waste during demolition of the power plant infrastructure and restoration of the former power plant site in 2020 and 2021. The final receipt of waste occurred in December 2021. Closure of the remaining open areas of the Facility was completed in May 2022 (Golder 2022b).

2.2 Groundwater Monitoring Program

The groundwater monitoring system for the Facility consists of five monitoring wells, as described in the Groundwater Monitoring System Certification (Golder 2019). The two upgradient monitoring wells are MO-1 and MO-2. The three downgradient monitoring wells are MO-3, MO-4, and MO-5. Figure 1 depicts the Facility layout and locations of the groundwater monitoring wells.

2.3 Site Geology and Hydrogeology

Near-surface geology at the Facility is generally characterized by a thin layer (0 to 15 feet thick) of unconsolidated sandy clay, gravelly clay, and clayey sand regolith material underlain by the Dakota Sandstone (thickness of up to approximately 110 feet, where present), the Burro Canyon Formation (thickness of approximately 90 to 210 feet), and the Morrison Formation, which is approximately 700 to 800 feet thick regionally.

The Dakota Sandstone is a coastal plain deposit consisting primarily of sandstone and conglomerate with interbedded mudstone, carbonaceous shale, coal, and claystone (Masbruch and Shope 2014). The Burro Canyon Formation is a fluvial and floodplain deposit predominantly composed of relatively higher-permeability sandstone and conglomerate interbedded with lower-permeability siltstone, shale, claystone, and mudstone (Lowe et al. 2007; Masbruch and Shope 2014).

The Morrison Formation is composed of the Brushy Basin Member and Salt Wash Member. The Brushy Basin Member represents the uppermost member of the Morrison Formation and is composed of variegated mudstone, claystone, and siltstone with discontinuous lenses of conglomerate and sandstone. The Salt Wash Member underlies the Brushy Basin Member and is a fine- to medium-grained fluvial sandstone with discontinuous interbedded conglomeratic sandstone and mudstone (Freethey and Cordy 1991; Lowe et al. 2007; Masbruch and Shope 2014).

The uppermost aquifer at the Facility is within the Morrison Formation, with the depths to groundwater in the monitoring wells ranging from 215 feet to 303 feet in October 2024. MO-4 is screened in the Morrison Formation with a screen interval from 439 to 509 feet below ground surface.

The Morrison aquifer is characterized as highly heterogeneous with zones that are variably transmissive and/or subjected to variable amounts of confining pressure. This characterization is supported by the significant differences in groundwater levels, water column heights, and recovery times observed in the monitoring wells that have been installed to serve as the groundwater monitoring system for the Facility. Sandstone lenses in the Morrison aquifer vary considerably with respect to transmissivity (i.e., thickness and hydraulic conductivity) and horizontal extent due to the alluvial, shoreline, and lacustrine environments that deposited the Salt Wash and Brushy Basin Members of the Morrison Formation, resulting in interbedded siltstone, mudstone, claystone, and shale units. Groundwater elevation data suggest a general southerly groundwater flow direction in the Morrison aquifer near the Facility. However, the heterogeneity and interbedded nature of the Morrison Formation beneath the Facility and the significant differences in recharge characteristics between monitoring wells suggest a lack of horizontal continuity and confound the ability to precisely discern groundwater flow direction and rate.

2.4 Field pH in MO-4

The initial baseline sampling for the well network consisted of sampling on an approximately monthly basis between December 2016 and August 2017 at each of the monitoring wells, with additional baseline samples collected from MO-2 and MO-4 in October 2017. Following this initial baseline period, the sample frequency was changed to semi-annual for detection monitoring. Subseqent baseline updates have occurred, with a baseline period of February 2017 through October 2022 currently used for most well-constituent pairs.

The resulting baseline data were used to establish intrawell baseline statistical limits for each Appendix III constituent at each monitoring well. For field pH in MO-4, non-parametric prediction limits of 7.4 standard units (S.U.) (lower statistical limit) and 7.7 S.U. (upper statistical limit) were established using a baseline period of February 2017 through October 2022.

Intrawell baseline statistical limits represent groundwater conditions in each individual monitoring well (USEPA 2009). Samples collected after baseline statistical limits were established are part of the detection monitoring program. Data from detection monitoring sampling are compared against the baseline statistical limits to assess possible changes in groundwater chemistry at each well. When the concentration of a given constituent exceeds the statistical limit in two consecutive sampling events, the result is considered a verified SSI over the baseline concentration. In the case of field pH, which is a two-tailed limit, values below the lower statistical limit also indicate an SSI.

Field pH at MO-4 exceeded the non-parametric upper statistical limit of 7.7 S.U. during second semi-annual compliance event in October 2024 (7.8 S.U.) and during the confirmatory sampling event in December 2024 (7.8 S.U.), indicating an SSI over baseline. These readings, along with the most recent values for other network wells, are presented in Figure 2.

Given the potential for calibration and user errors to impact the accuracy of field pH measurements, both baseline and compliance readings have been rounded to the nearest tenth for reporting and statistical analysis. The unrounded field pH values for the October and December 2024 sampling events were 7.76 S.U. and 7.75 S.U., respectively, with both results rounded to 7.8 S.U. The inherent variability associated with field pH instrument measurements is discussed further in Section 3.4.

3.0 EVALUATION OF POTENTIAL SOURCES

3.1 Progressively Closed Facility with Dry Waste Placement

As described in Section 2.1, waste was deposited in the Facility in a dry condition, with water used only as needed to control fugitive dust generation. Additionally, progressive closure was employed during the active life of the Facility to limit the open area that could receive precipitation. The remaining open areas of the Facility were closed between November 2021 and May 2022. Engineering evaluations indicate that the soil cover material and placement conditions for progressive closure and final closure met the requirements of the Closure Plan for the Facility (Golder 2022b) and that percolation through the final cover system at the Facility is expected to be negligible (Golder 2022a). With minimal interstitial water available to be transmitted as leachate and negligible percolation through the final cover system, there is little possibility of a release from the Facility.

3.2 Travel Time

Even though there is little possibility of a release from the Facility because there is minimal interstitial water available to be transmitted as leachate and negligible percolation through the final cover system, the potential for a hypothetical release of CCR-impacted water to be affecting monitored groundwater quality was evaluated by estimating the travel time in the unsaturated/vadose zone using a simplified, yet conservative, analytical method for advective transport. The travel time for potential subsurface impacts to reach the top of the potentiometric surface within the Morrison Formation is based on the site hydrogeology, including:

- Vadose zone thickness of 234 feet at MO-4.
- Site-specific saturated hydraulic conductivity (*K*) values from five in situ packer tests performed in the Burro Canyon Formation at various depths, with horizontal *K* results ranging from 1.4×10^{-7} to 9.0×10^{-6} centimeters per second (cm/s), and one in situ packer test performed in the Morrison Formation, with a horizontal *K* result of 6.0×10^{-8} cm/s (WCTI and Agapito 1987). The test results and profile for the horizontally layered system represented in the analysis are shown in Table 1. The test results were used to calculate an equivalent hydraulic conductivity of 1.53×10^{-7} cm/s using a thickness-weighted harmonic average from the equation:

  $$K_{eq} = \sum d_i \,/\, \sum \left({}^{d_i}/_{K_i} \right)$$

  where K_{eq} is the equivalent hydraulic conductivity for a horizontally layered system, d_i is the thickness of a given layer, and K_i is the hydraulic conductivity of that layer.
- A site-specific mean[1] porosity value of 0.19 (WCTI and Agapito 1987).

[1] Site-specific values less than the minimum value for siltstone or sandstone (0.137) presented by Morris and Johnson (1967) were excluded from the mean calculation.

Table 1: Profile for Travel Time Calculation

Formation	Layer Top (ft bgs)	Layer Bottom (ft bgs)	Layer Thickness, *d* (ft)	Horizontal Hydraulic Conductivity, *K* (cm/s)	Basis for Hydraulic Conductivity Value
Burro Canyon	0	55	55	9.0×10^{-6}	Packer test at 30-40 ft bgs
	55	95	40	4.2×10^{-7}	Packer test at 70-80 ft bgs
	95	130	35	1.4×10^{-7}	Packer test at 110-120 ft bgs
	130	170	40	3.6×10^{-7}	Packer test at 140-150 ft bgs
Morrison	170	234	64	6.0×10^{-8}	Packer test at 190-200 ft bgs

Note:
ft bgs = feet below ground surface.

For demonstration purposes, the estimates of the above properties at the site were used to evaluate the travel time of flow and conservative contaminant transport through the Burro Canyon Formation and to the top of the potentiometric surface within the Morrison Formation from the following equation:

$$t = \sum d_i \times n / K_{eq} \times i$$

where *t* is the travel time, *n* is the porosity, and *i* is the hydraulic gradient (which is conservatively assumed to be a unit gradient downward).

The conservatively estimated travel time for a subsurface release near MO-4 is approximately 288 years.

This travel time estimate is conservative since it is based on advective transport, which does not incorporate retardation in transport processes due to sorption or dispersion; assumes high-moisture conditions and simplification in using saturated hydraulic conductivity to estimate travel time instead of more applicable, lower values of unsaturated hydraulic conductivity; and omits potential additional travel time in the unsaturated zone within the Morrison Formation. As noted in Section 2.3, groundwater flow in the Morrison Formation occurs through disconnected sandstone lenses. While the potentiometric surface in MO-4 is 234 feet below ground surface, MO-4 is screened in sandstone lenses of the Morrison Formation with a screen interval between 439 and 509 feet below ground surface.

The estimate also assumes an isotropic system based on horizontal hydraulic conductivity values, whereas the vertical hydraulic conductivity for anisotropic systems typical of formations like the Burro Canyon Formation and the Morrison Formation would likely be at least 10 times lower. This would result in a travel time estimate greater than 2,000 years.

Given that the Facility started operation in 1987, this analysis suggests that a hypothetical release of CCR-impacted water would not reach the uppermost aquifer until at least the year 2275 (and likely much later). Consequently, time travel analysis challenges the plausibility that the cause of the SSI in MO-4 is the Facility because it is not realistic for a release from the CCR unit to travel to the top of the potentiometric surface within the Morrison Formation near MO-4 during the time span from 1987 to 2024.

3.3 Uncaptured Natural Variability

The upgradient and downgradient monitoring wells show a range of field pH values during baseline and compliance monitoring. Summary statistics are useful for evaluating variability within MO-4 and amongst the other monitoring wells[2] and are presented in Table 2 for both the baseline and compliance monitoring periods. A time series chart is presented in Figure 2.

MO-4 has lower field pH values than other upgradient and downgradient wells, ranging between 7.4 to 7.7 S.U. during baseline monitoring and 7.6 to 7.8 S.U. during compliance monitoring. Variation is present in the range of baseline field pH values at each monitoring well, as indicated by the standard deviation and coefficient of variation for each dataset. When compared to other monitoring wells, the MO-4 baseline data have the smallest range, lowest standard deviation, and lowest coefficient of variation.

Given the monthly sample collection for the initial baseline period (Section 2.4), the possibility of the samples showing serial correlation was reviewed due to the expediency of sample collection. Serial correlation is an indication that samples collected sequentially, particularly over compressed timelines, may not be statistically independent, a key assumption for many statistical tests. The samples collected during the baseline period at MO-4 were tested to evaluate the presence of serial correlation using a Rank von Neumann ratio test, as shown in Figure 3[3]. At each of the tested alpha levels, the collected baseline samples were found to exhibit serial correlation, suggesting that the samples are not statistically independent. This can result in the statistical analysis being invalid and can also indicate that the baseline does not have enough independent samples to capture the complete range in natural variability.

Table 2: Field-Measured pH Summary Statistics

Subset	Monitoring Well	Date Range	Number of Samples	Minimum (S.U.)	Mean (S.U.)	Maximum (S.U.)	Coefficient of Variation	Standard Deviation
Baseline	MO-2	Feb 2017 - Oct 2022	20	7.8	8.1	8.4	0.02	0.18
	MO-3	Feb 2017 - Oct 2022	21	7.8	7.9	8.1	0.01	0.08
	MO-4	Feb 2017 - Oct 2022	22	7.4	7.5	7.7	0.01	0.07
	MO-5	Feb 2017 - Oct 2022	22	7.7	8.3	8.8	0.03	0.29
Compliance	MO-2	Apr 2023 - Oct 2024	4	7.9	8.0	8.0	0.01	0.06
	MO-3	Apr 2023 - Dec 2024	5	7.8	7.8	7.9	0.01	0.05
	MO-4	Apr 2023 - Dec 2024	5	7.6	7.7	7.8	0.01	0.08
	MO-5	Apr 2023 - Dec 2024	5	8.4	8.5	8.6	0.01	0.09

[2] pH values at MO-1 are suspected to be influenced by grout interaction (Golder 2021) and have been excluded from this discussion.

[3] As noted in Section 2.4, the pH values were rounded to the tenths decimal place for reporting and detection monitoring statistics. As rounding values reduces variability, this test was run with both rounded and unrounded values, with both tests exhibiting serial correlation. The test result for the unrounded values is presented in Figure 3.

3.4 Instrument Variability

The primary goal in a groundwater detection monitoring program is to identify real changes to groundwater quality if they occur. As discussed in Section 2.4, field pH at MO-4 exceeded the upper non-parametric statistical limit of 7.7 S.U. during both the October 2024 compliance event (field pH measured at 7.8 S.U.) and the confirmatory sampling event in December 2024 (field pH measured at 7.8 S.U.). The upper non-parametric statistical limit is set at the highest value observed during the baseline period for the well.

A non-parametric methodology was selected for field pH at MO-4 because the baseline data were found not to be normally distributed and could not be transformed to a normal distribution. The presence of a normal distribution is a requirement to implement a parametric methodology. Although the observed 0.1 S.U. increase in field pH is considered an SSI per the selected statistical methodology, this change is relatively minor, especially when considering the potential sources of variability inherent in field pH measurements.

MO-4 is sampled with a low-flow methodology as outlined by Puls and Barcelona (1996). One of the key aspects of this method is to monitor stabilization parameters during well purging, with a minimum of three successive readings meeting stabilization criteria, which for field pH is ± 0.1 S.U. The sampling protocol at the Facility has been to conduct a series of verification checks every 1 to 2 minutes with two field meters after the stabilization criteria have been met and then take a final measurement with the primary meter as the field pH measurement for the sample. Table 3 presents the post-stabilization field pH values recorded during the October and December 2024 sampling events, showing that the field pH verification checks for both events with the secondary meter were below the upper non-parametric prediction limit for field pH of 7.8 S.U. This table also highlights variability between pH meters for a given measurement (ranging from 0.06 to 0.11 S.U.), as well as differences in field pH measurements taken minutes apart, even after stabilization criteria have been met (ranging from 0.02 to 0.07 S.U.).

In this context, it is worth noting that starting with the October 2023 sampling event, field staff used a different primary pH meter than the meter that had been used for the previous seven events. Additionally, the pH probe on the primary meter was replaced between the May and October 2024 sampling events, coinciding with the timing of when the SSI was initially identified. Both the change in pH meter and the change in probe could have contributed to the 0.1 S.U. increase in field pH at MO-4. As presented in Figure 2, the October 2024 field pH measurements at MO-5 and MO-3 also increased by at least 0.1 S.U. over their May 2024 values, further suggesting a difference in sensitivity with the pH meter used during the October 2024 sampling event.

Table 3: Field pH Verification Results for MO-4 (October and December 2024)

Event	Time/Statistic	Primary Meter (S.U.)	Secondary Meter (S.U.)	Difference (S.U.)
October 2024	1210	7.76	7.67	0.09
	1211	7.75	7.66	0.09
	1212	7.73	7.66	0.07
	1213	7.76	7.65	0.11
	1214	7.76	-	-
	Minimum	**7.73**	**7.65**	**0.07**
	Maximum	**7.76**	**7.67**	**0.11**
	Spread	**0.03**	**0.02**	**-**
December 2024	0942	7.80	7.73	0.07
	0942	7.81	7.74	0.07
	0942	7.81	7.74	0.07
	0943	7.80	7.73	0.07
	0944	7.80	7.74	0.06
	0944	7.78	7.72	0.06
	0945	7.80	7.72	0.08
	0946	7.76	7.70	0.06
	0947	7.76	7.70	0.06
	0947	7.77	7.70	0.07
	0948	7.74	7.68	0.06
	0948	7.75	-	-
	Minimum	**7.74**	**7.68**	**0.06**
	Maximum	**7.81**	**7.74**	**0.08**
	Spread	**0.07**	**0.06**	**-**

Note:

Gray shading indicates the final collected field pH value used in reporting and statistics.

Field staff calibrate both the primary and secondary field pH meters at the start of every sampling day. As a further quality control check, field staff check the pH probe readings in calibration buffers at the end of each sampling day. Confirmation of pH probe readings with calibrated buffer solutions is intended to show that the pH meter is accurately recording pH measurements over a range of pH values. Table 4 presents the post-sampling calibration check data for the October and December 2024 sampling events. With the exception of the December 2024 check for the 4.01 pH buffer, the buffer checks range from 0.08 S.U. below the calibration standard to 0.07 S.U. above the calibration standard. Given that pH measurements can exhibit minor deviation from the known standard based on temperature and other atmospheric factors, it is logical to suppose that pH measurements for groundwater samples would have the potential to exhibit similar variability.

While the differences in individual meter readings when compared to one another and meter readings versus standard solutions are each relatively small when considered individually, the combined effect could explain a 0.1 S.U. increase in values at MO-4.

Table 4: Post-sampling Field Meter pH Calibration Checks (October and December 2024)

Event	Calibration Standard (S.U.)	Primary Meter		Secondary Meter	
		End of Day Reading (S.U.)	Difference (S.U.)	End of Day Reading (S.U.)	Difference (S.U.)
October 2024	4.01	4.02	0.01	3.96	-0.05
	7.00	6.98	-0.02	6.92	-0.08
	10.01	10.04	0.03	10.00	-0.01
December 2024	4.01	3.95	-0.06	3.80	-0.21
	7.00	7.03	0.03	7.07	0.07
	10.01	9.99	-0.02	10.00	-0.01

Notes:

According to the manufacturer, the accuracy of the field pH measurements is ± 0.02 S.U., assuming proper calibration.

pH values are corrected for temperature by the field instrument.

3.5 Common CCR Indicators

If the Facility were the source of increased field pH in MO-4, then CCR-indicative constituents (e.g., boron, calcium, chloride, fluoride, sulfate, and total dissolved solids [TDS]) would also be expected to increase. Figure 3 shows time series graphs of Appendix III parameters. The October 2024 and December 2024 samples exhibited the highest field pH readings in MO-4. Other Appendix III parameters are generally stable, with the exception of sulfate, which exhibited a visually decreasing trend between May 2022 and May 2024.

Table 5 presents the concentration ranges for Appendix III parameters during the baseline and compliance monitoring periods at MO-4. Compliance monitoring values are within the range of baseline monitoring values, and with the exception of one boron value, the highest reported value for each constituent was measured during the baseline monitoring period. If contamination of groundwater from CCR-impacted seepage were affecting MO-4, an increase in other indicator concentrations would be expected. Since concentrations of other CCR indicator parameters decreased or remained within the range of historical values, it is unlikely that the Facility is the source of the change in field pH leading to the identification of the SSI in MO-4.

Table 5: Concentration Ranges for Common CCR Indicator Constituents in MO-4

Sampling Location	Date Range	Total Dissolved Solids (mg/L)	Boron (mg/L)	Calcium (mg/L)	Chloride (mg/L)	Sulfate (mg/L)
Baseline	Feb 2017 - Oct 2022	4,690 - 5,210	0.286 - 0.447	43.7 - 50.7	825 - 1,070	1,810 - 2,040
Compliance	Apr 2023 - Dec 2024	4,780 - 5,180	0.341 - 0.489	38.8 - 50.2	806 - 939	1,670 - 1,820

Note:

Fluoride was generally non-detect in both the baseline and compliance monitoring, and the detection limit was variable.

4.0 EVIDENCE OF AN ALTERNATIVE SOURCE

Primary lines of evidence and conclusions drawn from the evidence used to support this ASD are provided in Table 6. In summary, the SSI identified for field pH in samples collected from MO-4 is not considered to be an indication of a release from the Facility.

Table 6: Primary and Supporting Lines of Evidence from ASD Analysis

Key Line of Evidence	Supporting Evidence	Description
Engineering Controls	Progressively closed facility with dry waste placement	There is little possibility of a release from the Facility because there is minimal interstitial water available to be transmitted as leachate and negligible percolation through the final cover system.
Hydrogeology	Travel time though the vadose zone	A conservative travel time estimate indicates that a hypothetical release of CCR-impacted water would take at least 288 years to travel to the top of the potentiometric surface within the Morrison Formation. Therefore, it is not realistic for a release from the Facility to influence groundwater near MO-4 during the time span from 1987 to 2024.
Water Quality	Uncaptured natural variability	The baseline samples collected from MO-4 display statistical serial correlation for field pH, suggesting that the full range of natural variability may not have been captured during baseline monitoring. Additionally, downgradient well MO-4 has lower recorded field pH values than the other Facility monitoring wells, and when compared to other monitoring wells, the MO-4 baseline data have the smallest range, lowest standard deviation, and lowest coefficient of variation.
	Lack of increasing trends for CCR indicator parameters	Concentrations of other parameters that are considered to be good leachate indicators for the waste contained in the Facility have been stable or decreasing in MO-4. If changes to field pH values were attributable the waste contained within the Facility, increases in concentrations for other CCR indicator parameters (e.g., boron, calcium, chloride, fluoride, sulfate, and TDS) would be expected.
Sampling Instrumentation	Inherent variability in field pH measurements	There is inherent variability in field pH measurements, as demonstrated by the field verification checks using multiple meters and post-sampling checks against calibration buffers. Additionally, the pH probe on the primary meter was replaced between the May and October 2024 sampling events, coinciding with the timing of when the SSI was initially identified, which suggests that the 0.1 S.U. increase in field pH at MO-4 could be due to the use of a different instrument and/or probe.

5.0 CONCLUSIONS

In accordance with 40 CFR 257.94(e)(2), this ASD has been prepared in response to the identification of a verified SSI for field pH at MO-4. This demonstration details the reasons behind WSP's conclusion that the SSI for field pH at MO-4 is not an indication of groundwater impacts from the Facility, but rather a reflection of natural variability in field-measured pH values that was not fully captured during the baseline data collection period and inherent variability in field meter measurements.

Based on the findings of this demonstration, WSP recommends that Tri-State continue with the detection monitoring program for the Facility.

6.0 REFERENCES

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Signature Page

Sara Harkins
Senior Geochemist/Geologist

Jason Obermeyer, PE
Practice Leader, Senior Technical Principal

SAH/JEO/rm

https://wsponlinenam.sharepoint.com/sites/us-tirstategroundwater/shared documents/project files/nucla ccr/2024-31403149.3795/6_deliverables/003-rpt-asd_fieldph_mw4/rev0/31403149.3795-003-rpt-0-asd_field_ph_mo-4_08apr25.docx

Figures

LEGEND

- PROPERTY BOUNDARY
- 5990 EXISTING GROUND TOPOGRAPHY (REFERENCE 1)
- MO-1 MONITORING WELL

REFERENCE(S)

1. EXISTING GROUND TOPOGRAPHY AND AERIAL IMAGERY IN THE LANDFILL AREA WERE OBTAINED BY EPP & ASSOCIATES ON MAY 13, 2022.
2. SURROUNDING AERIAL IMAGERY WAS OBTAINED FROM THE NATIONAL AGRICULTURAL IMAGERY PROGRAM, UNITED STATES DEPARTMENT OF AGRICULTURE, 2019.

N

0 150 300
SCALE FEET

CLIENT TRI-STATE GENERATION AND TRANSMISSION ASSOCIATION 1100 WEST 116TH AVENUE WESTMINSTER, COLORADO 80234	PROJECT NUCLA STATION ASH DISPOSAL FACILITY MONTROSE COUNTY, COLORADO

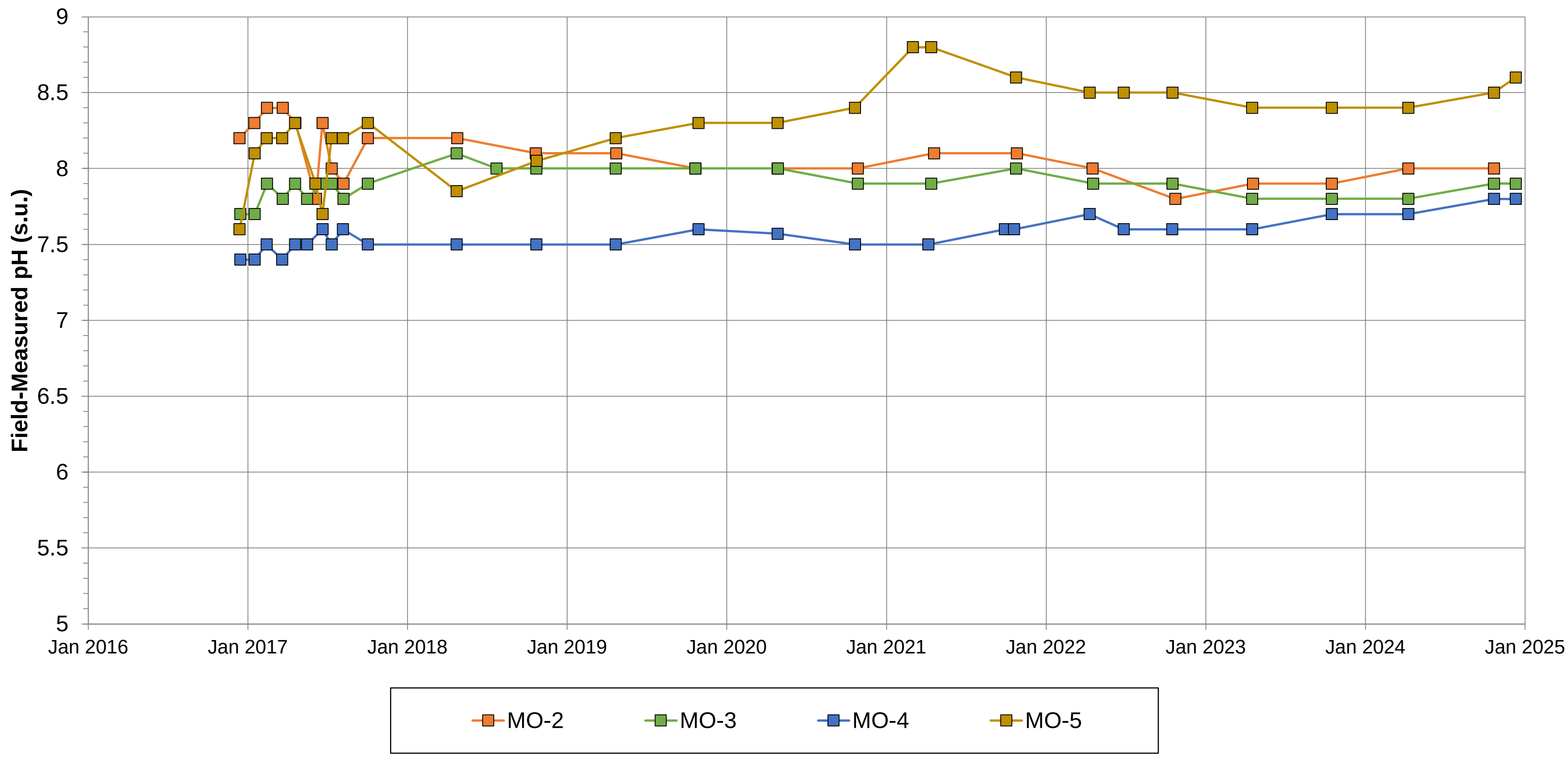
CONSULTANT		
wsp	YYYY-MM-DD	2025-04-04
	DESIGNED	BJP
	PREPARED	JEO
	REVIEWED	SAH
	APPROVED	JEO

TITLE
MONITORING WELL LOCATIONS

PROJECT NO.	REV.	FIGURE
31403149.3795	0	1

Path: N:\TRI-STATE GENERATION AND TRANSMISSION_TRI-STATE\NUCLA ASH LANDFILL\99_PROJECTS\31403149 | File Name: CCR Well Locations MO-4 ASD Figure 1.dwg

PATH: https://wsponlinenam.sharepoint.com/Sites/US-TirStateGroundwater/Shared Documents/Project Files/Nucla CCR/2024-31403149.3795/5_ Technical Work/CCR GW/ASD pH MO-4/FINAL | FILE NAME: Working Data MO-4.xlsm



CLIENT	PROJECT
TRI-STATE GENERATION AND TRANSMISSION ASSOCIATION	NUCLA STATION ASH DISPOSAL FACILITY MONTROSE COUNTY, COLORADO

CONSULTANT

TITLE
Field-Measured pH Time Series

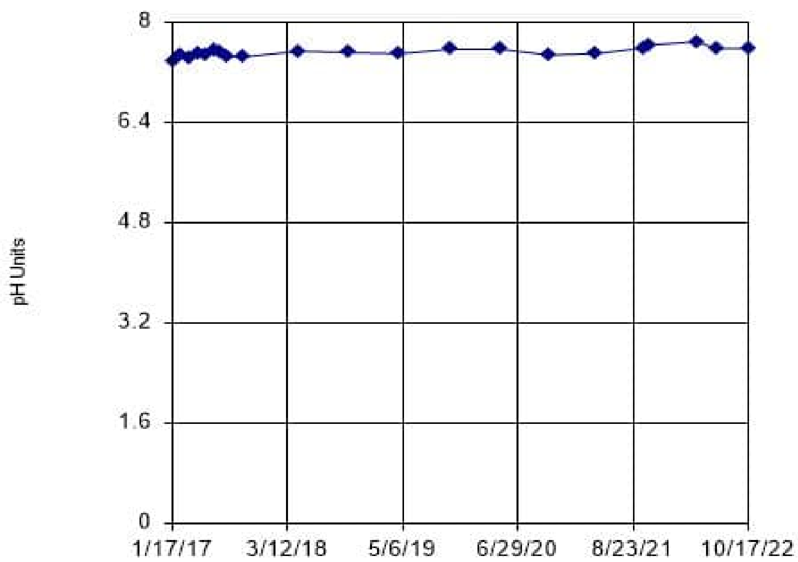
PROJECT NO.	PHASE	REV.	FIGURE
31403149.3795	4	0	2

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

Sanitas™ v.10.0.24 Sanitas software licensed to Golder Associates. EPA

Rank Von Neumann

MO-4



R(V) = 0.7607

Alpha	Table	Sig.
0.005	0.96	Yes
0.010	1.05	Yes
0.025	1.18	Yes
0.050	1.31	Yes
0.100	1.45	Yes

Constituent: pH, field measured [original] Analysis Run 4/4/2025 9:51 AM

Tri-State CCR Client: Golder Associates Data: MO-4 pH Stats

CLIENT

TRI-STATE GENERATION AND TRANSMISSION ASSOCIATION

PROJECT

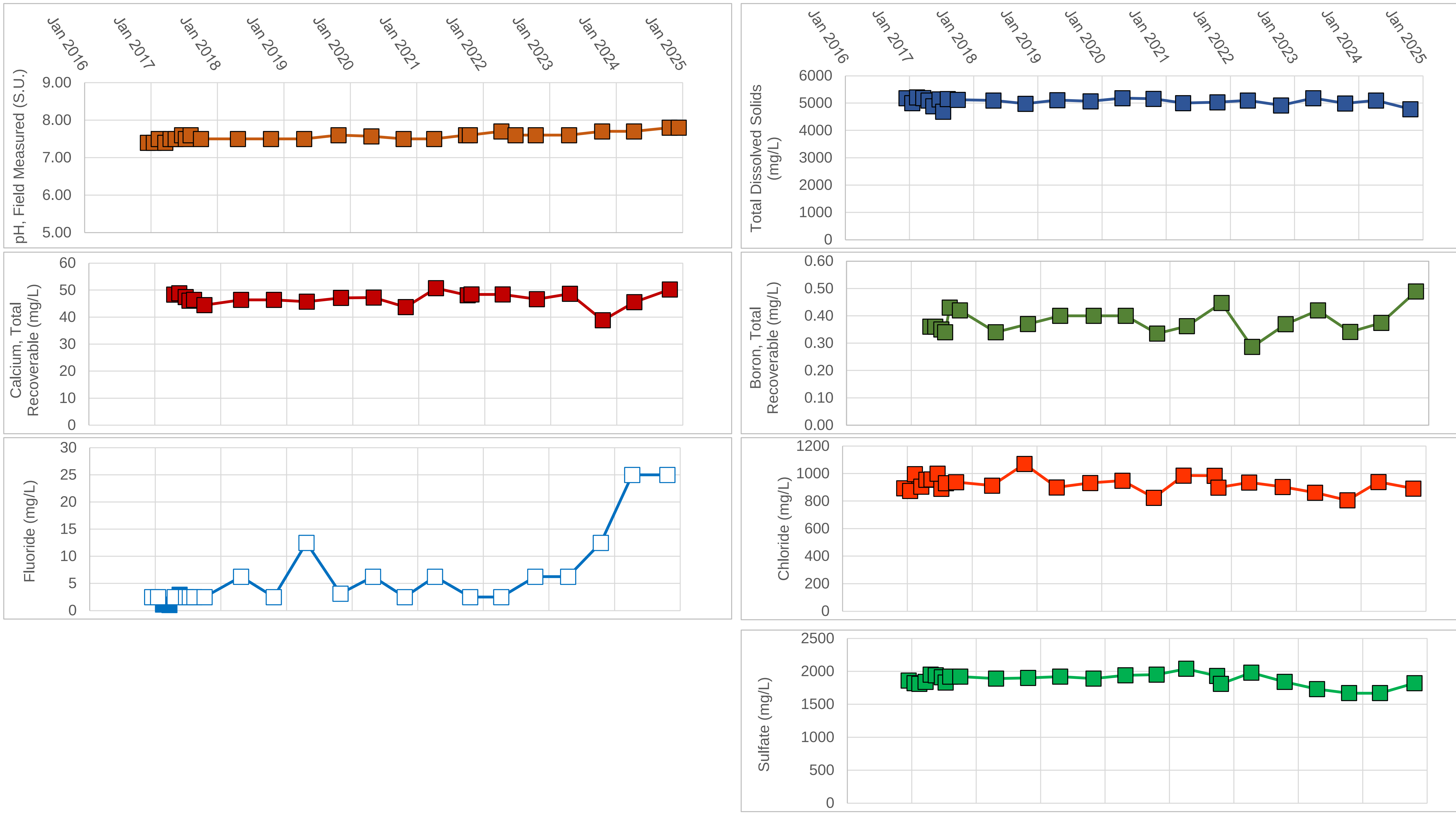
NUCLA STATION ASH DISPOSAL FACILITY
MONTROSE COUNTY, COLORADO

CONSULTANT

TITLE

Rank von Neumann Test for the MO-4 Baseline Period

PROJECT NO.	PHASE	REV.	FIGURE
31403149.3795	4	0	3



Note:
Non-detects are plotted at one-half the practical quantitation limit with an open symbol

CLIENT
TRI-STATE GENERATION AND TRANSMISSION ASSOCIATION

PROJECT
NUCLA STATION ASH DISPOSAL FACILITY
MONTROSE COUNTY, COLORADO

CONSULTANT
wsp

TITLE
Time Series of Appendix III Constituents in MO-4

PROJECT NO.	PHASE	REV.	FIGURE
31403149.3795	4	0	4

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