Alternate Source Demonstration for the Neal North Active CCR Monofill

Permit 97-SDP-12-95P
Neal North Energy Center
Sergeant Bluff, Iowa

MidAmerican Energy Company

January 26, 2026

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Certification

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for the Neal North Active CCR Monofill
Neal North Energy Center
Sergeant Bluff, Iowa
MidAmerican Energy Company

LICENSED PROFESSIONAL ENGINEER
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I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

Michael J. Alowitz, P.E. — **Date:** 1/26/2026

License Number: 18160

My license renewal date is: December 31, 2026

Pages or sheets covered by this seal: Entire Document

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1. Introduction

This Alternate Source Determination (ASD) Report was prepared by GHD Services Inc. (GHD) on behalf of MidAmerican Energy Company (MidAmerican) in compliance with the Federal Coal Combustion Residual (CCR) rule (40 Code of Federal Regulations [CFR] Part §257) for the active Neal North Energy Center (Neal North) Coal Combustion Residual Monofill (Neal North Monofill) located near Sergeant Bluff, Iowa. The Neal North Monofill is located in the SW ¼ of the SW ¼ of Section 30, Township 87N, Range 47W (Cells 1 and 2) and the E ½ of the SW ¼ of Section 30, Township 87N, Range 47W (Permitted Area for Future Cells) in Woodbury County, Iowa. The Site Location Map (Figure 1) also shows the location of MidAmerican's Neal North Energy Center facility. The Neal North Monofill extent and monitoring well locations are shown on Figure 2.

The Neal North Monofill is permitted under Iowa Department of Natural Resources (IDNR) Operating Permit No. 97-SDP-12 95P, originally issued September 15, 2021, and subsequent amendments. A renewed operating permit was issued March 21, 2024, and incorporated previous amendments. The Neal North Monofill was constructed with a composite liner system including a 2-foot compacted clay liner and 60-mil high density polyethylene (HDPE) plastic liner. The Operating Permit includes current Cells 1 and 2.

As described in 40 CFR §257.94(e)(2), statistically significant differences from background levels for a constituent may be evaluated to demonstrate that a source other than the CCR unit has caused the statistically significant difference from background or resulted from error in sampling, analysis statistical evaluation, or natural variation in groundwater quality. The purpose of this report is to describe the ASD for statistically significant increases (SSIs) identified at the Neal North CCR Monofill.

2. Description of Statistically Significant Increases

The September 2025 semiannual sampling event verified SSIs for boron, calcium, chloride, pH, sulfate, and/or total dissolved solids (TDS) at monitoring wells MW-19, MW-21, MW-23R, and MW-57R. Below is a summary of the SSIs.

Verified SSIs at the Active Monofill - September 2025

Analyte	Monitoring Well
Boron	MW-19 and MW-21
Calcium	MW-19 and MW-21
Chloride	MW-23R and MW-57R
pH	MW-23R
Sulfate	MW-19 and MW-21
Total Dissolved Solids (TDS)	MW-19 and MW-21

Originally, baseline monitoring under the Federal CCR rule occurred at the Neal North Monofill during eight monitoring events conducted between December 2015 and July 2017. These first eight events represented the selected baseline period required for both inter-well and intra-well comparisons. An original baseline data evaluation was presented in the 2017 Annual Groundwater Monitoring and Corrective Action Report (AGWMCAR; GHD, 2018). A change in background conditions was observed following that time, with parameter concentrations significantly changing compared to the original baseline period conditions in upgradient wells (i.e., not a Site-related effect). Therefore, the baseline data sets were extended to update the inter-well and intra-well comparison values in the 2021 AGWMCAR (GHD, 2022).

Data from the downgradient monitoring wells listed in the table above is compared to background monitoring wells MW-13R, MW-27, MW-29R, MW-223S, and MW-231SR. The method to establish upgradient/background concentrations at the Neal North Monofill is Upper Tolerance Limits (UTLs). UTLs for the upgradient/background monitoring wells were provided in the 2025 AGWMCAR (GHD, 2026); where trends were observed in the baseline data, the minimum and maximum values for upgradient/background concentrations are provided in lieu of UTLs. The UTLs for the pooled background/upgradient monitoring wells are provided in Table 1. Table 2 provides the intra-well (or location-specific) UTLs for each well and analyte in the detection monitoring program. Leachate concentrations since sampling began in 2016 are provided in Table 3.

3. Description of Neal North Monofill Alternate Source Demonstration

3.1 Calcium and Sulfate

Although SSIs were identified in groundwater, the lined Neal North Monofill is not believed to be the source of the SSIs due to the nature of the Neal North Monofill construction and operation methods.

The Neal North Monofill has two individual cells constructed in 2010 and 2013, respectively. The liner system in each cell includes a minimum 2-foot compacted clay liner with a maximum permeability of 1 x 10^{-7} centimeters per second (cm/s) overlain by a high-density polyethylene (HDPE) membrane liner. A leachate management system above the HDPE liner moves leachate along the sloped cell floors to the sump where it is pumped out of the cell.

The compacted clay liner was tested during and after construction by performing density testing and collecting samples of the clay liner to verify permeability requirements were met. The test results met or exceeded the minimum requirements. In addition, oversight of materials and construction techniques was completed. The HDPE liner was also subject to observation during installation and testing including an electrical leak location survey to identify, repair, and subsequently re-test installation or manufacturing defects. These tests help provide a high level of confidence in the integrity of the liner system. Any identified defects or leaks were repaired before the cell received any CCR. Construction documentation and applicable test reports were provided to the Iowa Department of Natural Resources (IDNR) for review prior to IDNR's approval to place CCR in each cell.

The Neal North Monofill is equipped with a leachate collection and transport system. The system was tested in April 2018 to determine whether leachate could be the cause of the identified SSIs. A small leak was found in the exterior containment pipe north of the Neal North Monofill (north of monitoring wells MW-11/MW-12 and south of monitoring wells MW-31/MW-32). No leaks were identified in the interior pipe carrying leachate; however, flanges and gaskets on interior piping within collection manholes were replaced where needed. Based on the testing conducted, the leachate transport piping is not the cause of the identified SSIs.

To demonstrate the lined Neal North Monofill is not the source of the SSIs, the necessary leachate leakage rate to result in the observed SSI was calculated.

3.1.1 Theoretical Leachate Leakage Rate

A leak through an HDPE and membrane liner system can be modeled using the Giroud equation:

$$Q = C[1 + 0.1\left(\frac{h_w}{t}\right)^{0.95}]a^{0.1}{h_w}^{0.9}{k_s}^{0.74}$$

Where:

Q = flow through defect/hole in liner (cubic meters per second, [m^3/s]).

C = A dimensionless constant related to quality of the contact between the HDPE membrane and underlying clay. Ranges from 0.21 (good) to 1.15 (poor) for the HDPE/clay interface.

h_w = Leachate head (driving force through the defect) (meters, [m]).

t = Clay thickness (meters, m).

a = Defect area (square meters, [m^2]).

k_s = Clay hydraulic conductivity (centimeters per second, [cm/s]).

The Giroud equation was used to conservatively estimate the potential leakage through the Neal North Monofill floor. The table below shows the parameters used for the model and the design/construction requirements that were demonstrated during installation of the liner system.

Comparison of Modelled Conservative Values and Design or Construction Requirements for Monofill Liner System

Parameter	Conservative Value	Design/ Construction	Notes
C	0.68	See note	Based on quality of installation 0.68 is middle of range.
h_w (m)	1	0.3	1 foot head or less maintained by pumping.
t (m)	0.55	0.61	Conservative value is 1.8 feet.
a (m^2)	0.09	Not applicable	Equivalent to a 1-foot diameter hole.
k_s (cm/s)	1×10^{-6}	1×10^{-7}	Conservative value is an order of magnitude below the project requirement.

The modeled conservative assumptions include a theoretical 1-foot hole in the HDPE liner in the same area as a portion of the clay liner that has an order-of-magnitude-greater permeability than required and verified during construction, and 0.2-foot less thickness than required and verified during construction. Under these conservative assumptions, the theoretical leakage rate is estimated at 190,350 gallons per year. For comparison, when the same value for C is used, and the design/construction standards for thickness and permeability in the table above are used, but a conservative 1-foot diameter hole is still assumed, the theoretical leakage rate is only 34,142 gallons per year.

3.1.2 Required Leakage to Impact Aquifer

If the Neal North Monofill is the source of impacts to the groundwater, the theoretical mass added to the aquifer to create the impact can be calculated and related to the leachate concentration to estimate how much leachate must leak to create the impact. Calculations are illustrated in Appendix A.

Calcium and sulfate were used in this evaluation. The mean background concentrations are summarized below.

Average Concentrations at Wells with Identified SSIs

Constituent	Monitoring Wells with SSIs Used in Evaluation	Concentration (mg/L) - September 2025	Average Background Concentration (mg/L)[a]
Calcium	MW-19 and MW-21	401	167
Sulfate	MW-19 and MW-21	1017	118

Note:
[a] *Pooled from background monitoring wells MW-13/MW-13R, MW-27, MW-29/MW-29R, MW-223S, and MW-231S/MW-231SR from December 2015 to September 2025.*
mg/L - milligrams per liter.

An evaluation was conducted to determine how much leachate would be required to add 234 milligrams per liter (mg/L) calcium and 899 mg/L sulfate to the aquifer. The calculations used are provided in Appendix A.

The aquifer size was estimated as the footprint of the Neal North Monofill with an approximate 50-foot buffer zone or 18.8 acres. The aquifer thickness was assumed to be 20 feet with a porosity of 0.3. This represents an aquifer water volume of approximately 139 million liters.

The average concentrations in leachate from 2016 to 2025 was 227 mg/L for calcium and 1293 mg/L for sulfate.

Theoretical Leachate Contributions

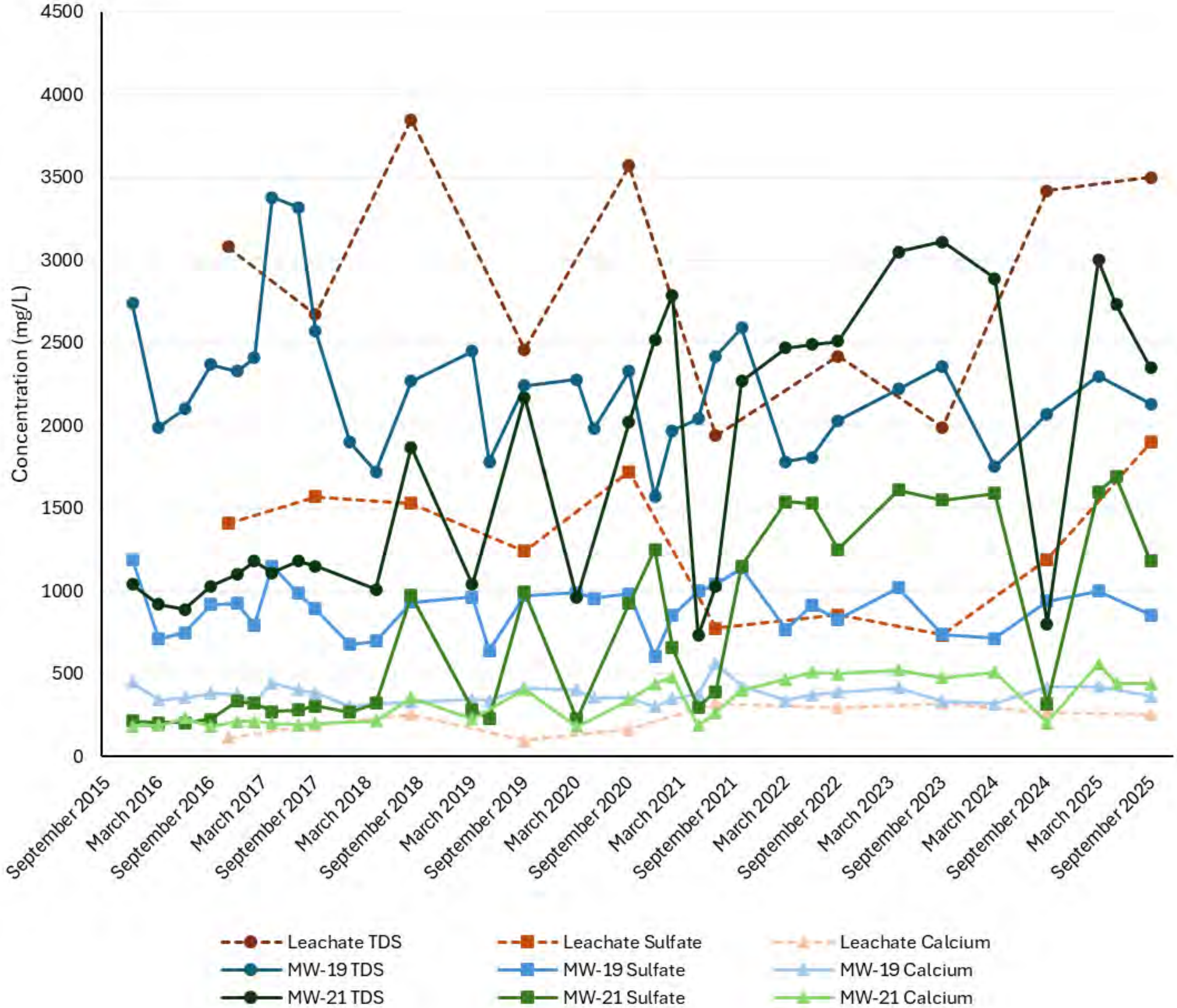
Constituent	Average Leachate Concentration (mg/L)	Volume of Leachate Leakage Required (gallon)
Calcium	227	37,977,039
Sulfate	1293	25,614,877

For the leachate to raise the concentrations in the aquifer enough to see the concentrations observed at monitoring wells MW-19 and MW-21, it would require 25.6 to 37.9 million gallons of leachate to be released. This does not account for flow through the aquifer over time and conservatively assumes any leachate leaks and subsurface impact remains within the modeled aquifer footprint.

The theoretical leakage calculations conservatively estimate that 25.6 to 37.9 million gallons of leachate is required to raise the calcium and sulfate concentration above background as observed in the Neal North Monofill (Appendix A). The theoretical leakage calculations demonstrate that 190,350 gallons per year is a conservative leakage rate. Over the more than 15½ years of operation of the Neal North Monofill, the conservative cumulative volume of leachate released through a theoretical 1-foot-diameter hole in the HDPE liner is 2.95 million gallons, which is more than 22.5 million gallons below the conservative estimate of leachate leakage required to generate the observed calcium and sulfate concentrations.

3.2 TDS

TDS is a measurement of the total amount of ions dissolved in the groundwater. The concentration of TDS is largely comprised of calcium and sulfate. At monitoring wells MW-19 and MW-21 specifically, a spike in calcium and sulfate generally corresponds with a spike in TDS as can be seen in the graph below. Based on the calculations in Section 3.1, it can then be inferred that the TDS increases observed at monitoring wells MW-19 and MW-21 are also not from a leachate release.



3.3 Boron

The Giroud equation was also completed for boron at monitoring wells MW-19 and MW-21 through September 2025 (Appendix A). Assuming over 15½ years of operation, the leachate required to see the concentrations at monitoring wells MW-19 and MW-21 would be 2.2 million gallons, which is 750,000 gallons less than what would be added from the theoretical leak (2.95 million gallons). Although the Giroud equation does not apply through September 2025 for boron, the volume required to obtain the calcium and sulfate concentrations are still so much larger (25.6 and 37.9 million, respectively) indicating that leachate could not be the source of the observed SSIs. Although not a current SSI, monitoring well MW-25 was also evaluated recently for a verified boron SSI using the Giroud equation in July 2025 (GHD, 2025b) and similar ranges for leachate, boron, calcium, and sulfate were reported. It was also determined that leachate was not the cause of the verified SSI.

In addition to this, boron concentrations at monitoring wells MW-19 and MW-21 have remained stable since groundwater sampling began in 2015 (Appendix B). This is further supported when comparing the inter-well and intra-well evaluations conducted on baseline data. A confirmed SSI evaluation was initiated when both the March and September 2025 events exceeded the inter-well UTLs, but neither well exceeded the intra-well UTLs for any event in 2025 (Tables 1 and 2). The inter-well UTLs are representative of site conditions, pooling the background well data (MW-13R, MW-27, MW-29R, MW-223S, and MW-231SR) from December 2015 to October 2021. Intra-well values were calculated on a per-well per-constituent basis, providing a UTL that is typical for each monitoring well in the

Active Monofill network from December 2015 to September 2020. An intra-well method takes into account the natural spatial variability that may exist between well locations. Constituent concentrations greater than upgradient background conditions might be incorrectly attributed to impact from the Neal North Closed Monofill, when the differences are actually natural and unrelated to the Neal North Closed Monofill due to locally varying distributions of groundwater constituents.

Boron Concentrations and Upper-Tolerance Limits for Monitoring Wells MW-19 and MW-21

Well	Event	Boron Concentration (mg/L)	Intra-Well 95/95 UTL (mg/L)	Inter-Well 95/95 UTL (mg/L)
MW-19	March 2025	0.640	0.790	0.328
	September 2025	0.554		
MW-21	March 2025	0.460	0.286 TO 0.472	
	September 2025	0.348		

Based on the verified calculations for calcium and sulfate at monitoring wells MW-19 and MW-21, TDS concentrations trends at monitoring wells MW-19 and MW-21, as well as the stability of boron concentrations at monitoring wells MW-19 and MW-21 since 2015, leachate is not the source of the observed SSIs for boron in monitoring wells MW-19 and MW-21. If leachate produced the patterns seen for boron, then similar patterns would also be seen for the other parameters discussed in Sections 3.1 and 3.2.

3.4 Chloride and pH

Natural variability in groundwater and a change in geology at the screened interval due to well replacement has been identified as the cause of the observed SSIs at monitoring wells MW-23R (chloride and pH) and MW-57R (chloride) at the Neal North monofill (GHD, 2025a; GHD, 2025b). A variability in mean concentrations and concentration ranges indicated that significant spatial variability exists for chloride and pH in groundwater. The variability in these monitoring wells is not attributable to a release from the lined Neal North Monofill.

Average Appendix III Concentrations in Original and Replacements Wells

Constituent	Unit	MW-13 Upgradient	MW-13R Upgradient	MW-23	MW-23R	MW-57	MW-57R
Boron	mg/L	0.215	0.124	0.287	0.197	0.359	0.344
Calcium	mg/L	173	142	260	172	347	237
Chloride	mg/L	13.5	25.4	9.31	15.3	6.60	21.4
Fluoride	mg/L	1.06	0.727	0.569	0.784	0.534	0.778
pH, lab	s.u.	7.2	7.3	6.8	7.4	6.9	7.3
Sulfate	mg/L	73.3	53.5	286	231	818	333
Total dissolved solids (TDS)	mg/L	795	550	1189	823	2102	1167

Notes:
Monitoring well MW-13 average concentrations based on samples collected between December 2015 and December 2020.
Monitoring wells MW-23 and MW-57 concentrations based on samples collected between December 2015 and September 2020.
Monitoring wells MW-13R, MW-23R, and MW-57R average concentrations based on samples collected between July 2021 and September 2025.
s.u. - standard unit.

The above table was updated to include data through the September 2025 semiannual sampling event. The ASD due to natural variability in groundwater is supported by inconsistent concentration ranges of the analytes at monitoring wells MW-23R, MW-57R, and other comparable monitoring wells relative to the corresponding original well. Since monitoring wells MW-13/MW-13R is an upgradient/background well and would not be affected by a theoretical leachate release and it presents similar Appendix III concentration patterns to monitoring wells MW-23/MW-23R and monitoring wells MW-57MW-57R, the fluctuations found in monitoring wells MW-13R, MW-23R. and MW-57R are not attributed to impacts from CCR, but a natural range of concentrations and variability in groundwater.

4. Summary and Conclusions

It has been conservatively demonstrated that the lined Neal North Monofill is not the source of the observed SSIs for boron, calcium, chloride, sulfate, TDS, and/or pH at monitoring wells MW-19, MW-21, MW-23R and/or MW-57R.

For calcium and sulfate, even a conservative leachate leakage rate yields a theoretical release volume that is below the volume required to create the observed variances between background and downgradient wells. Boron would also need to follow similar trends if leachate was the cause of the recent SSIs but does not. Chloride and pH show significant variability in groundwater, indicating this, and their replacement to a deeper well depth, as the likely cause of the observed SSIs at monitoring wells MW-23R and MW-57R.

As demonstrated in this Report, the lined Neal North Monofill is not the source of the observed SSIs in groundwater. As a result of this demonstration, the Neal North Monofill will continue with a detection monitoring program under 40 CFR §257.94(e)(2).

5. References

- GHD, 2018. Annual Groundwater Monitoring and Corrective Action Report. Neal North CCR Monofill, Permit No. 97-SDP-12-95P, Sergeant Bluff, Iowa, MidAmerican Energy Company. January 31, 2018.
- GHD, 2022. Annual Groundwater Monitoring and Corrective Action Report. Neal North CCR Monofill, Permit No. 97-SDP-12-95P, Sergeant Bluff, Iowa, MidAmerican Energy Company. January 31, 2022.
- GHD, 2025a. Alternate Source Demonstration for the Neal North Active CCR Monofill. Neal North Energy Center, Sergeant Bluff, Iowa, Permit No. 97-SDP-12-95P. January 27, 2025.
- GHD, 2025b. Alternate Source Demonstration for the Neal North Active CCR Monofill. Neal North Energy Center, Sergeant Bluff, Iowa, Permit No. 97-SDP-12-95P. July 28, 2025.
- GHD, 2026. Annual Groundwater Monitoring and Corrective Action Report for the Neal North CCR Monofill. Neal North Energy Center, Sergeant Bluff, Iowa, Permit No. 97-SDP-12 95P. January 31, 2026.

Tables

Table 1

Inter-Well Comparisons for 2025 Monitoring Data vs. Upgradient Background UTLs
MidAmerican Energy Company
Neal North CCR Active Monofill
Sergeant Bluff, Iowa

Well	Observation	Monitoring Event	Boron mg/L	Calcium mg/L	Chloride mg/L	Fluoride mg/L	pH, lab s.u.	Sulfate mg/L	TDS mg/L
	Pooled	*Baseline 95/95 UTL*	0.328	242	41.6	2.98	6.9 J - 7.9 J	318	1128
	Background	*Baseline 99/95 UTL*	0.385	271	70.8	6.49	6.9 J - 7.9 J	336	1306
MW-5R	3/17/2025	Detection	0.370	160	10.0	1.0 U	7.7 J	320	930
	5/20/2025	Verification	--	--	--	--	7.3 J	--	--
	9/19/2025	Detection	0.208	109	9.06	1.00 U	7.7 J	121	556
MW-11/ MW-11R	3/17/2025	Detection	0.172 /0.168	123 /134	5.00 U /5.07	1.00 U / 1.00 U	7.9 J /7.8 J	86.9 /85.5	530 /558
	9/19/2025	Detection	0.159 /0.133	110 /110	5.00 U /5.00 U	1.00 U / 1.00 U	7.8 J / 7.8 J	74.0 /71.7	474 /502
MW-19	3/17/2025	Detection	**0.640**	**420**	20.0	1.0 U	7.4 J	**1000**	**2300**
	5/19/2025	Verification	--	--	--	--	**6.6 J**	--	--
	9/19/2025	Detection	**0.554**	**364**	19.3	1.00 U	7.3 J	**854**	**2130**
MW-21	3/17/2025	Detection	**0.460**	**560**	6.70	1.0 U	7.4 J	**1600**	**3000**
	5/19/2025	Verification	--	**441**	--	--	**6.8 J**	**1690**	**2730**
	9/19/2025	Detection	0.348	**437**	6.51	1.00 U	7.4 J	**1180**	**2350**
MW-23/ MW-23R	3/17/2025	Detection	0.208	191	12.9	1.00 U	7.7 J	241	958
	9/19/2025	Detection	0.216	194	13.2	1.00 U	7.6 J	298	960
MW-25	3/17/2025	Detection	**0.512**	197	5.00 U	1.00 U	7.8 J	**394**	1130
	9/19/2025	Detection	no sample	no sample	no sample	no sample	no sample	no sample	no sample
MW-57/ MW-57R	3/17/2025	Detection	0.362	205	17.5	1.00 U	7.8 J	274	1080
	5/20/2025	Verification	--	--	--	--	7.1 J / 7.1 J	--	--
	9/19/2025	Detection	0.309	224	19.2	1.00 U	7.6 J	323	1180

Table 1

Inter-Well Comparisons for 2025 Monitoring Data vs. Upgradient Background UTLs
MidAmerican Energy Company
Neal North CCR Active Monofill
Sergeant Bluff, Iowa

Well	Observation	Monitoring Event	Boron mg/L	Calcium mg/L	Chloride mg/L	Fluoride mg/L	pH, lab s.u.	Sulfate mg/L	TDS mg/L
	Pooled	*Baseline 95/95 UTL*	0.328	242	41.6	2.98	6.9 J - 7.9 J	318	1128
	Background	*Baseline 99/95 UTL*	0.385	271	70.8	6.49	6.9 J - 7.9 J	336	1306
MW-59S	3/17/2025	Detection	0.235	157	5.96	1.00 U	7.7 J	124	748
	5/19/2025	Verification	--	143	--	--	7.2 J	--	--
	9/19/2025	Detection	0.195	147	5.43	1.00 U	7.6 J	117	718
MW-60S	3/17/2025	Detection	0.194	135	6.56	1.00 U	7.8 J	137	648
	5/19/2025	Verification	--	--	--	--	7.2 J	--	--
	9/18/2025	Detection	0.155	122	8.66	1.00 U	7.7 J	142	640

Notes:
9.87/9.81 - Field duplicate results.
U - Not detected at the associated reporting limit.
J - Estimated concentration.
340 Value exceeds inter-well baseline 95/95 UTL or is outside of baseline range.
0.740 Value exceeds inter-well baseline 99/95 UTL.
Pooled Background consists of MW-13R, MW-27, MW-29R, MW-223S, and MW-231SR.
† - Trend present during baseline period, no UTL values calculated (baseline range listed for comparison).

Table 2

Intra-Well Comparisons for 2025 Monitoring Data
MidAmerican Energy Company
Neal North CCR Active Monofill
Sergeant Bluff, Iowa

Well	Observation	Monitoring Event	Boron mg/L	Calcium mg/L	Chloride mg/L	Fluoride mg/L	pH, lab s.u.	Sulfate mg/L	TDS mg/L
MW-13/MW-13R	*Baseline 95/95 UTL*		*0.678*	*306*	*30.1*	*6.49*	*6.76 - 7.67*	*97.3*	*1041*
(Background)	*Baseline 99/95 UTL*		*0.678*	*306*	*36.6*	*6.49*	*6.63 - 7.8*	*106*	*1132*
	3/11/2025	Detection	0.136	147	17.3	1.00 U	7.8 J	38.7	580
	9/17/2025	Detection	0.131	141	11.0	1.00 U	7.1 J	47.4	540
MW-27	*Baseline 95/95 UTL*		*0.319*	*204*	*14.5 - 28.8 †*	*1.55*	*6.9 J - 7.8 J*	*212*	*1176*
(Background)	*Baseline 99/95 UTL*		*0.345*	*218*	*14.5 - 28.8 †*	*1.55*	*6.9 J - 7.8 J*	*240*	*1303*
	3/12/2025	Detection	0.228	157	24.5	1.00 U	7.8 J	81.1	692
	9/16/2025	Detection	0.274	160	15.5	1.00 U	7.1 J	53.7	658
MW-29/MW-29R	*Baseline 95/95 UTL*		*0.205*	*248*	*18.1*	*6.44*	*6.87 J - 7.9 J*	*225*	*1266*
(Background)	*Baseline 99/95 UTL*		*0.205*	*267*	*21.1*	*6.44*	*6.87 J - 7.9 J*	*257*	*1410*
	3/12/2025	Detection	0.158 /0.156	187 /190	12.0 /9.49	1.00 U /1.00 U	7.7 J /7.7 J	140 /136	774 /768
	9/16/2025	Detection	0.173	203	8.73	1.00 U	7.0 J	133	850
MW-223S	*Baseline 95/95 UTL*		*0.200 U*	*90.5 - 131 †*	*5.00 U - 18.1 †*	*6.15*	*7.26 J - 7.9 J*	*5.00 U - 44.2 †*	*265 - 780 †*
(Background)	*Baseline 99/95 UTL*		*0.200 U*	*90.5 - 131 †*	*5.00 U - 18.1 †*	*6.15*	*7.26 J - 7.9 J*	*5.00 U - 44.2 †*	*265 - 780 †*
	3/13/2025	Detection	0.142	130	15.2	0.200 U	7.6 J	**88.5**	510
	9/17/2025	Detection	0.180	200	**22.8**	0.200 U	7.0 J	**222**	778
MW-231S/	*Baseline 95/95 UTL*		*0.256*	*245*	*20.2*	*0.500 U*	*6.71 - 7.45*	*352*	*1181*
MW-231SR	*Baseline 99/95 UTL*		*0.256*	*262*	*23.5*	*0.500 U*	*6.59 - 7.58*	*415*	*1311*
(Background)	3/13/2025	Detection	0.200	190	9.30	0.200 U	**7.8 J**	177	788
	5/20/2025	Verification	--	--	--	--	7.2 J	--	--
	9/17/2025	Detection	0.221 /0.231	171 /177	16.3 /14.2	0.200 U /1.00 U	7.0 J /7.1 J	110 /103	740 /648
MW-5R	*Baseline 95/95 UTL*		*1.60*	*198*	*20.6*	*1.85*	*6.87 - 7.60*	*507*	*1455*
	Baseline 99/95 UTL		*1.60*	*198*	*23.6*	*1.85*	*6.76 - 7.71*	*507*	*1455*
	3/17/2025	Detection	0.370	160	10.0	1.0 U	7.7 J	320	930
	5/20/2025	Verification	--	--	--	--	7.3 J	--	--
	9/19/2025	Detection	0.208	109	9.06	1.00 U	7.7 J	121	556

Table 2

Intra-Well Comparisons for 2025 Monitoring Data
MidAmerican Energy Company
Neal North CCR Active Monofill
Sergeant Bluff, Iowa

Well	Observation	Monitoring Event	Boron mg/L	Calcium mg/L	Chloride mg/L	Fluoride mg/L	pH, lab s.u.	Sulfate mg/L	TDS mg/L
MW-11/MW-11R	*Baseline 95/95 UTL*		*0.607*	*131 - 242*	*5.00 U - 90.6*	*12.2*	*6.93 J - 8.0 J*	*120 - 182*	*538 - 1220*
	Baseline 99/95 UTL		*0.607*	*131 - 242*	*5.00 U - 90.6*	*12.2*	*6.93 J - 8.0 J*	*120 - 182*	*538 - 1220*
	3/17/2025	Detection	0.172 /0.168	123 /134	5.00 U /5.07	1.00 U / 1.00 U	7.9 J /7.8 J	86.9 /85.5	530 /558
	9/19/2025	Detection	0.159 /0.133	110 /110	5.00 U /5.00 U	1.00 U / 1.00 U	7.8 J / 7.8 J	74.0 /71.7	474 /502
MW-19	*Baseline 95/95 UTL*		*0.790*	*481*	*4.26 - 73.9*	*12.2*	*6.22 - 7.37*	*1287*	*3565*
	Baseline 99/95 UTL		*0.857*	*521*	*4.26 - 73.9*	*12.2*	*6.00 - 7.58*	*1423*	*3986*
	3/17/2025	Detection	0.640	420	20.0	1.0 U	7.4 J	1000	2300
	5/19/2025	Verification	--	--	--	--	6.6 J	--	--
	9/19/2025	Detection	0.554	364	19.3	1.00 U	7.3 J	854	2130
MW-21	*Baseline 95/95 UTL*		*0.286 - 0.472*	*406*	*34.8*	*6.75*	*6.72 - 7.31*	*202 - 991*	*2170*
	Baseline 99/95 UTL		*0.286 - 0.472*	*406*	*34.8*	*6.75*	*6.61 - 7.42*	*202 - 991*	*2170*
	3/17/2025	Detection	0.460	**560**	6.70	1.0 U	7.4 J	**1600**	**3000**
	5/19/2025	Verification	--	**441**	--	--	6.8 J	**1690**	**2730**
	9/19/2025	Detection	0.348	**437**	6.51	1.00 U	7.4 J	**1180**	**2350**
MW-23/MW-23R	*Baseline 95/95 UTL*		*0.25 - 0.318*	*372*	*12.8*	*1.54*	*6.65 J - 7.14 J*	*655*	*1757*
	Baseline 99/95 UTL		*0.25 - 0.318*	*414*	*14.0*	*1.54*	*6.65 J - 7.14 J*	*899*	*1962*
	3/17/2025	Detection	0.208	191	12.9	1.00 U	**7.7 J**	241	958
	9/19/2025	Detection	0.216	194	13.2	1.00 U	**7.6 J**	298	960
MW-25	*Baseline 95/95 UTL*		*0.375*	*277*	*15.7*	*3.54*	*6.73 - 7.32*	*519*	*2461*
	Baseline 99/95 UTL		*0.402*	*289*	*15.7*	*3.54*	*6.64 - 7.43*	*519*	*2808*
	3/17/2025	Detection	**0.512**	197	5.00 U	1.00 U	**7.8 J**	394	1130
	9/19/2025	Detection	no sample	no sample	no sample	no sample	no sample	no sample	no sample
MW-57/MW-57R	*Baseline 95/95 UTL*		*0.409*	*427*	*11.8*	*1.00*	*6.58 - 7.18*	*1110*	*2723*
	Baseline 99/95 UTL		*0.429*	*455*	*14.3*	*1.00*	*6.48 - 7.28*	*1214*	*2982*
	3/17/2025	Detection	0.362	205	**17.5**	1.00 U	**7.8 J**	274	1080
	5/20/2025	Verification	--	--	--	--	7.1 J / 7.1 J	--	--
	9/19/2025	Detection	0.309	224	**19.2**	1.00 U	**7.6 J**	323	1180

Table 2

Intra-Well Comparisons for 2025 Monitoring Data
MidAmerican Energy Company
Neal North CCR Active Monofill
Sergeant Bluff, Iowa

Well	Observation	Monitoring Event	Boron mg/L	Calcium mg/L	Chloride mg/L	Fluoride mg/L	pH, lab s.u.	Sulfate mg/L	TDS mg/L
MW-59S	*Baseline 95/95 UTL*		*0.204*	*155*	*15.1*	*3.84*	*6.80 - 7.38*	*102 - 136*	*855*
	Baseline 99/95 UTL		*0.204*	*161*	*15.1*	*3.84*	*6.70 - 7.48*	*102 - 136*	*911*
	3/17/2025	Detection	**0.235**	157	5.96	1.00 U	**7.7 J**	124	748
	5/19/2025	Verification	--	143	--	--	7.2 J	--	--
	9/19/2025	Detection	0.195	147	5.43	1.00 U	**7.6 J**	117	718
MW-60S	*Baseline 95/95 UTL*		*0.330*	*138*	*16.3*	*1.21*	*7.02 J - 7.26 J*	*175*	*799*
	Baseline 99/95 UTL		*0.330*	*145*	*18.6*	*1.21*	*7.02 J - 7.26 J*	*184*	*857*
	3/17/2025	Detection	0.194	135	6.56	1.00 U	**7.8 J**	137	648
	5/19/2025	Verification	--	--	--	--	7.2 J	--	--
	9/18/2025	Detection	0.155	122	8.66	1.00 U	**7.7 J**	142	640

Notes:
368/370 - Field duplicate results.
U - Not detected at the associated reporting limit.
J - Estimated concentration.
28.0 Value exceeds intra-well baseline 95/95 UTL or is outside of baseline range (for baseline data sets with temporal trends).
7.2 J Value exceeds intra-well baseline 99/95 UTL.
† - Trend present during baseline period, no UTL values calculated (baseline range listed for comparison).

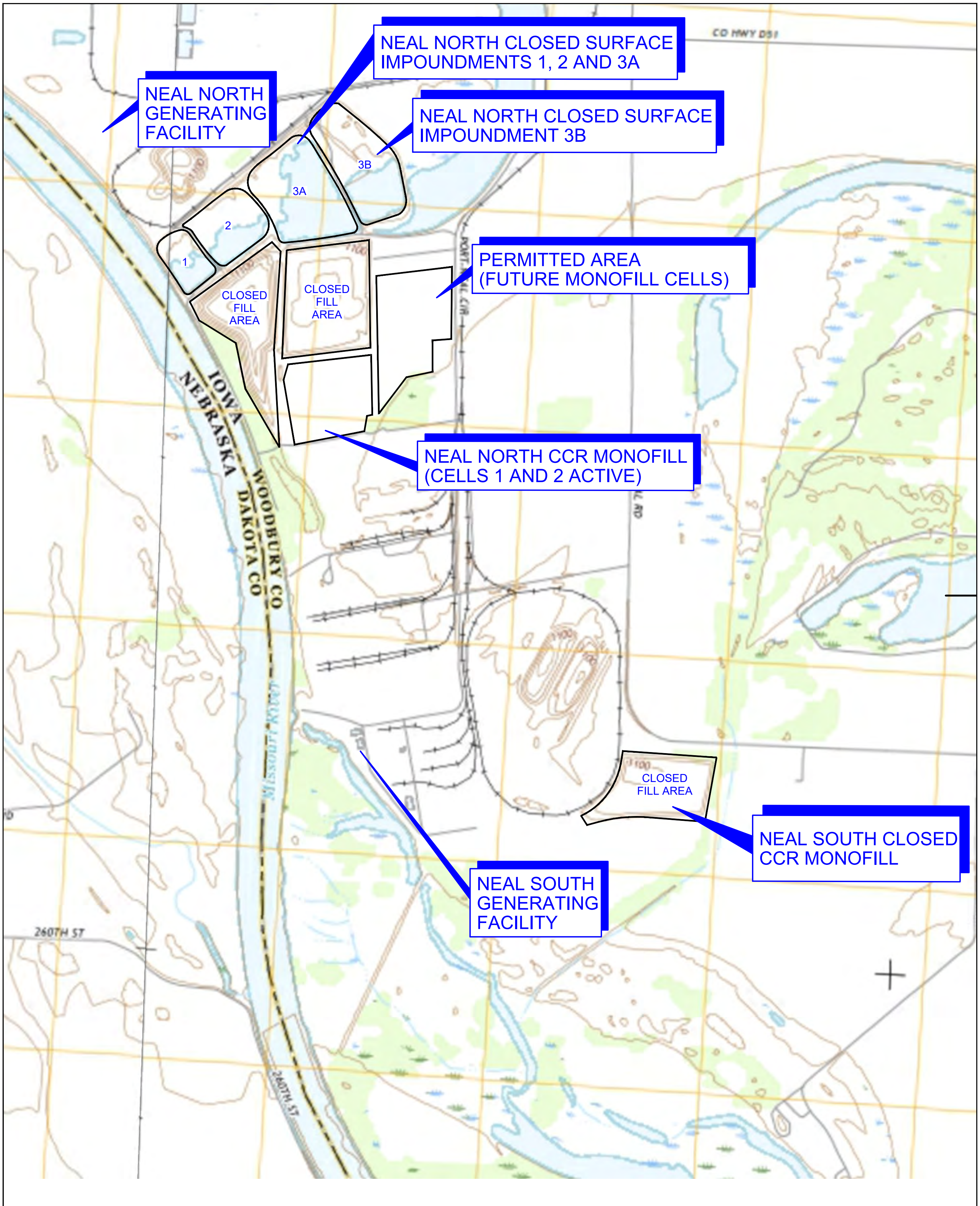
Table 3

Leachate Analytical Results
MidAmerican Energy Company
Neal North Active CCR Monofill
Sergeant Bluff, Iowa

Analyte	Units	Leachate-1116 11/8/2016	Leachate-0917 9/12/2017	Leachate-0818 8/28/2018	Leachate-0919 9/19/2019	Leachate-0920 9/23/2020	Leachate-0721 7/15/2021	Leachate-0922 9/15/2022	Leachate-0923 9/14/2023	Leachate-0924 9/12/2024	Leachate-0925 9/17/2025
Appendix III											
Boron	mg/L	5.35	3.49	6.60	5.85	4.69	2.04 J	2.09	1.86	3.27	5.72
Calcium	mg/L	113	191	254	95.9	164	321	295	321	264	255
Chloride	mg/L	149	271	476	84.9	379	283	407	255	722	192
Fluoride	mg/L	0.558	0.500 U	0.500 U	0.619	0.500 U	0.500 U	0.500 U	1.00 U	1.00 U	1.00 U
pH, lab	s.u.	11.1	9.8	11.1	11.3	8.8 J	8.3 J	8.3 J	8.1 J	8.6 J	9.1 J
Sulfate	mg/L	1410	1570	1530	1240	1720	774	856	735	1190	1900
Total dissolved solids (TDS)	mg/L	3080	2670	3850	2460	3570	1940	2420	1990	3420	3500
Appendix IV											
Antimony	mg/L	0.00152	0.00100 U	0.00300 U	0.00100 U	0.00100 U	0.00200 U	0.00200 U	0.00200 U	0.00200 U	0.00200 U
Arsenic	mg/L	0.0151	0.0193	0.0178	0.0124	0.0140	0.00448	0.00517	0.00405	0.00549	0.00683
Barium	mg/L	0.0775	0.157	0.111	0.0901	0.0914	0.0715	0.0806	0.0836	0.0779	0.0815
Beryllium	mg/L	0.00100 U	0.00100 U	0.00300 U	0.00100 U	0.00100 U	0.00100 U	0.00100 U	0.00100 U	0.00100 U	0.00100 U
Cadmium	mg/L	0.000500 U	0.000500 U	0.00150 U	0.000469	0.000548	0.000100 U	0.000100 U	0.000200 U	0.000200 U	0.000361
Chromium	mg/L	0.131	0.485	0.792	0.456	0.373	0.0515	0.0611	0.0384	0.0444	0.354
Cobalt	mg/L	0.00266	0.00330	0.00213	0.00481	0.00528	0.00116	0.00116	0.000593	0.00185	0.00380
Lead	mg/L	0.000500 U	0.00290	0.00150 U	0.000500 U	0.000500 U	0.000500 U	0.000500 U	0.000500 U	0.000500 U	0.000500 U
Lithium	mg/L	0.100 U	0.0120	0.0300 U	0.0100 U	0.0111	0.0100 U	0.0100 U	0.0108	0.0100 U	0.0135
Mercury	mg/L	0.000200 U	0.000200 U	0.000200 U	0.000200 U	0.000200 U	0.000200 U	0.000200 U	0.000200 U	0.000200 U	0.000200 U
Molybdenum	mg/L	0.682	0.626	1.53	1.03	1.52	0.127	0.149	0.0927	0.345	0.978
Radium-226 & 228	pCi/L	1.80	1.05	0.314	0.101	0.974 U	0.793	1.11	1.62	0.985 U	0.885
Selenium	mg/L	0.172	0.208	0.435	0.299	0.425	0.0249	0.0455	0.0465	0.0783	0.351
Thallium	mg/L	0.00100 U	0.00100 U	0.00300 U	0.00100 U	0.00100 U	0.00100 U	0.00100 U	0.00100 U	0.00100 U	0.00100 U

Notes:
- U - Not detected at the associated reporting limit.
- J - Estimated concentration.
- s.u. - Standard Units.
- mg/L - Milligrams per liter.
- pCi/L - Picocuries per liter.

Figures



GHD

MIDAMERICAN ENERGY COMPANY
NEAL NORTH CCR ACTIVE MONOFILL
SERGEANT BLUFF, IOWA

SITE LOCATION MAP

Project No. **12576482**
Date **January 2026**

FIGURE 1

Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\11230862-Enviro Projs\Project Files\12576482\01 WIP\Env\Figures\RPT022\12576482-GHD-00-00-RPT-EN-D101_WA-022.dwg
Plot Date: 09 January 2026 2:00 PM

SOURCE: USGS QUADRANGLE MAP: SALIX, IOWA (2015) & HOMER, NEBRASKA (2014)

LEGEND

● MW-29	SHALLOW GROUNDWATER MONITORING WELL	△	BACKGROUND SAMPLING LOCATION
◑ MW-30	DEEP GROUNDWATER MONITORING WELL	□	DOWNGRADIENT SAMPLING LOCATION
		◇	GAUGING LOCATION

0 250 500 ft
1" = 500 ft
Coordinate System:
STATE PLANE
IOWA NORTH NAD83

N

GHD

MIDAMERICAN ENERGY COMPANY
NEAL NORTH CCR ACTIVE MONOFILL
SERGEANT BLUFF, IOWA

SITE MAP AND MONITORING NETWORK

Project No. 12576482
Date January 2026

FIGURE 2

Filename: C:\ADSK\ACCDocs\GHD Services Pty Ltd\11230862-Enviro Projs\Project Files\12576482\01 WIP\Env\Figures\RPT022\12576482-GHD-00-00-RPT-EN-D102_WA-022.dwg
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Appendices

Appendix A

Leachate Evaluation and Calculations

Theoretical Volume of Released Leachate Needed to Impact Aquifer
MidAmerican Energy Company
Neal North Active CCR Monofill
Sergeant Bluff, Iowa

AQUIFER SIZE AND CHARACTERISTICS - this is used to calculate the estimated volume of possibly impacted water

Area	18.8	acres	Cells 1 and 2 are 14.1 acres (combined), 50' buffer yields 18.8 acres
Depth	20	feet	assumed
Porosity	0.3		assumed
Volume	4,913,568	cubic feet of water	
Time For an Aquifer Flush	4	years	
Volume	36,753,489	gallons	
Volume	139,295,722	liters	A

CONCENTRATIONS OF CALCIUM

Average "impacted" concentration	401	mg/l		Average calcium concentration at wells with SSIs during verification event.
Background concentration	167	mg/l		Mean concentration of pooled background data
Increase to evaluate	234	mg/l	B	
Average Leachate Concentration	227	mg/l	C	Average of 2016-2025 leachate concentrations

VOLUME OF LEACHATE TO MAKE IMPACT (ASSUMES NO AQUIFER FLUSH)

Excluding any losses, what volume of leachate at concentration C is needed to create the increase B in the volume A?

Mass of Possible Addition to Aquifer: B*A	32,595,198,935	mg	D
	32,595	kg	
Volume of leachate to produce D	143,591,185	liters	
	37,977,039	**gallons**	

CONCENTRATIONS OF SULFATE

Average "impacted" concentration	1017	mg/l		Average sulfate concentration at wells with SSIs during verification event.
Background concentration	118	mg/l		Mean concentration of pooled background data
Increase to evaluate	899	mg/l	B	
Average Leachate Concentration	1293	mg/l	C	Average of 2016-2025 leachate concentrations

VOLUME OF LEACHATE TO MAKE IMPACT (ASSUMES NO AQUIFER FLUSH)

Excluding any losses, what volume of leachate at concentration C is needed to create the increase B in the volume A?

Mass of Possible Addition to Aquifer: B*A	125,226,854,029	mg	D
	125,227	kg	
Volume of leachate to produce D	96,849,848	liters	
	25,614,877	**gallons**	

CALCULATE THEORETICAL LEAKAGE RATE

Assuming a hole in the HDPE membrane, how much could leak out?

Q=C[1+0.1(h_w/t)^0.95]a^$^{0.1}$hw^$^{0.9}$*ks^$^{0.74}$

http://www.gseworld.com/content/documents/technical-notes/Hydraulic_Equivalency.pdf

Q = flow through defect in m3/s
C = dimensionless contact. Related to quality of contact between the membrane and underlying clay (Good = 0.21 to poor = 1.15)
h_w = liquid head on top of the geomembrane in m
t = Clay thickness in m
a = defect area in the geomembrane (square meters)
k_s = hydraulic conductivity of the clay (m/s)

		Notes		Design Criteria	
C	0.68	no units 1.15 is a poor value			
hw	1	meter		0.304878	meters (note sump is a little deeper)
t	0.548780488	meter - based on 1.8 foot thickness		0.609756	2 feet of clay
Diameter of hole	1	foot	Assumed for conservation		
a	0.092950625	sq m	based on diameter above in feet		
k_s	0.000001	m/s	Assumed high for conservation	1E-07	cm/s
Q	2.29113E-05	m3/s			
Q	0.00605253	gallons/second			
Q	190,350	gallons/year			

Total "leak" volume since inception:	**2,950,420**	**gallons**	Assumes gallons/year above rate for lifetime of landfill
	15.5 years since inception		

Appendix A

Theoretical Volume of Released Leachate Needed to Impact Aquifer
MidAmerican Energy Company
Neal North Active CCR Monofill
Sergeant Bluff, Iowa

AQUIFER SIZE AND CHARACTERISTICS - this is used to calculate the estimated volume of possibly impacted water

Area	18.8	acres	Cells 1 and 2 are 14.1 acres (combined), 50' buffer yields 18.8 acres
Depth	20	feet	assumed
Porosity	0.3		assumed
Volume	4,913,568	cubic feet of water	
Time For an Aquifer Flush	4	years	
Volume	36,753,489	gallons	
Volume	139,295,722	liters	**A**

CONCENTRATIONS OF BORON

Average "impacted" concentration	0.451	mg/l		Average boron concentration at wells with SSIs during verification event.
Background concentration	0.206	mg/l		Mean concentration of pooled background data
Increase to evaluate	0.245	mg/l	**B**	
Average Leachate Concentration	4.10	mg/l	**C**	Average of 2016-2025 leachate concentrations

VOLUME OF LEACHATE TO MAKE IMPACT (ASSUMES NO AQUIFER FLUSH)

Excluding any losses, what volume of leachate at concentration C is needed to create the increase B in the volume A?

Mass of Possible Addition to Aquifer: B*A	34,127,452	mg	**D**
	34	kg	
Volume of leachate to produce D	8,323,769	liters	
	2,201,473	**gallons**	

CALCULATE THEORETICAL LEAKAGE RATE

Assuming a hole in the HDPE membrane, how much could leak out?

$Q=C[1+0.1(h_w/t)^{0.95}]a^{0.1}hw^{0.9} \cdot ks^{0.74}$

http://www.gseworld.com/content/documents/technical-notes/Hydraulic_Equivalency.pdf

Q = flow through defect in m3/s
C = dimensionless contact. Related to quality of contact between the membrane and underlying clay (Good = 0.21 to poor = 1.15)
h_w = liquid head on top of the geomembrane in m
t = Clay thickness in m
a = defect area in the geomembrane (square meters)
k_s = hydraulic conductivity of the clay (m/s)

		Notes		Design Criteria	
C	0.68	no units 1.15 is a poor value			
hw	1	meter		0.304878	meters (note sump is a little deeper)
t	0.548780488	meter - based on 1.8 foot thickness		0.609756	2 feet of clay
Diameter of hole	1	foot	Assumed for conservation		
a	0.092950625	sq m	based on diameter above in feet		
k_s	0.000001	m/s	Assumed high for conservation	1E-07	cm/s
Q	2.29113E-05	m3/s			
Q	0.00605253	gallons/second			
Q	190,350	gallons/year			

Total "leak" volume since inception: **2,950,420** **gallons** Assumes gallons/year above rate for lifetime of landfill

Appendix B

Trend Test Analysis

Mann-Kendall Trend Analysis

n	10
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	11.1803
Standardized Value of S	-1.0733
M-K Test Value (S)	-13
Tabulated p-value	0.1460
Approximate p-value	0.1416

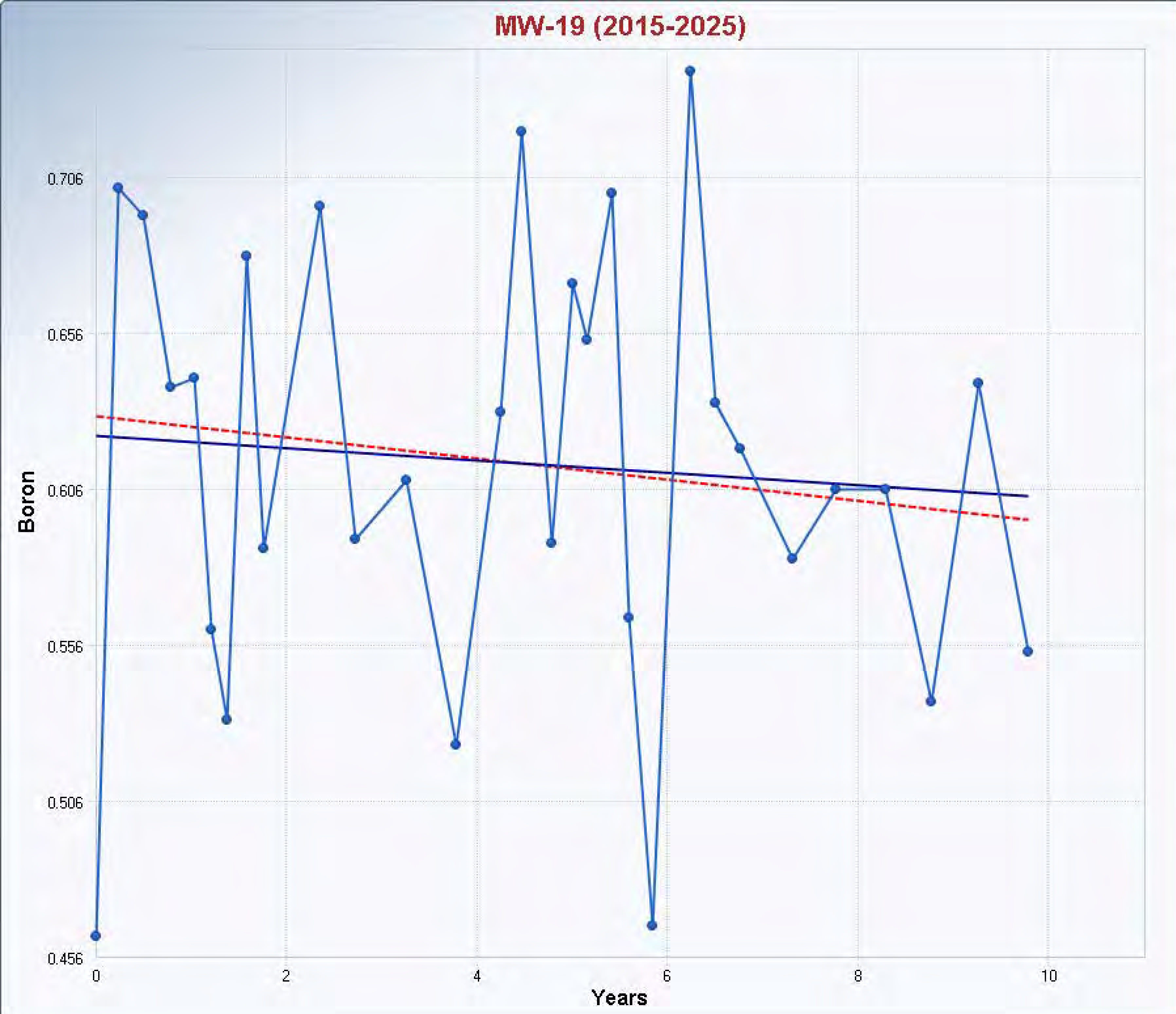
OLS Regression Line (Blue)

OLS Regression Slope	-0.2145
OLS Regression Intercept	5.0290

Theil-Sen Trend Line (Red)

Theil-Sen Slope	-0.2650
Theil-Sen Intercept	5.2244

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	30
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	56.0417
Standardized Value of S	-0.6959
M-K Test Value (S)	-40
Appx. Critical Value (0.05)	-1.6449
Approximate p-value	0.2432

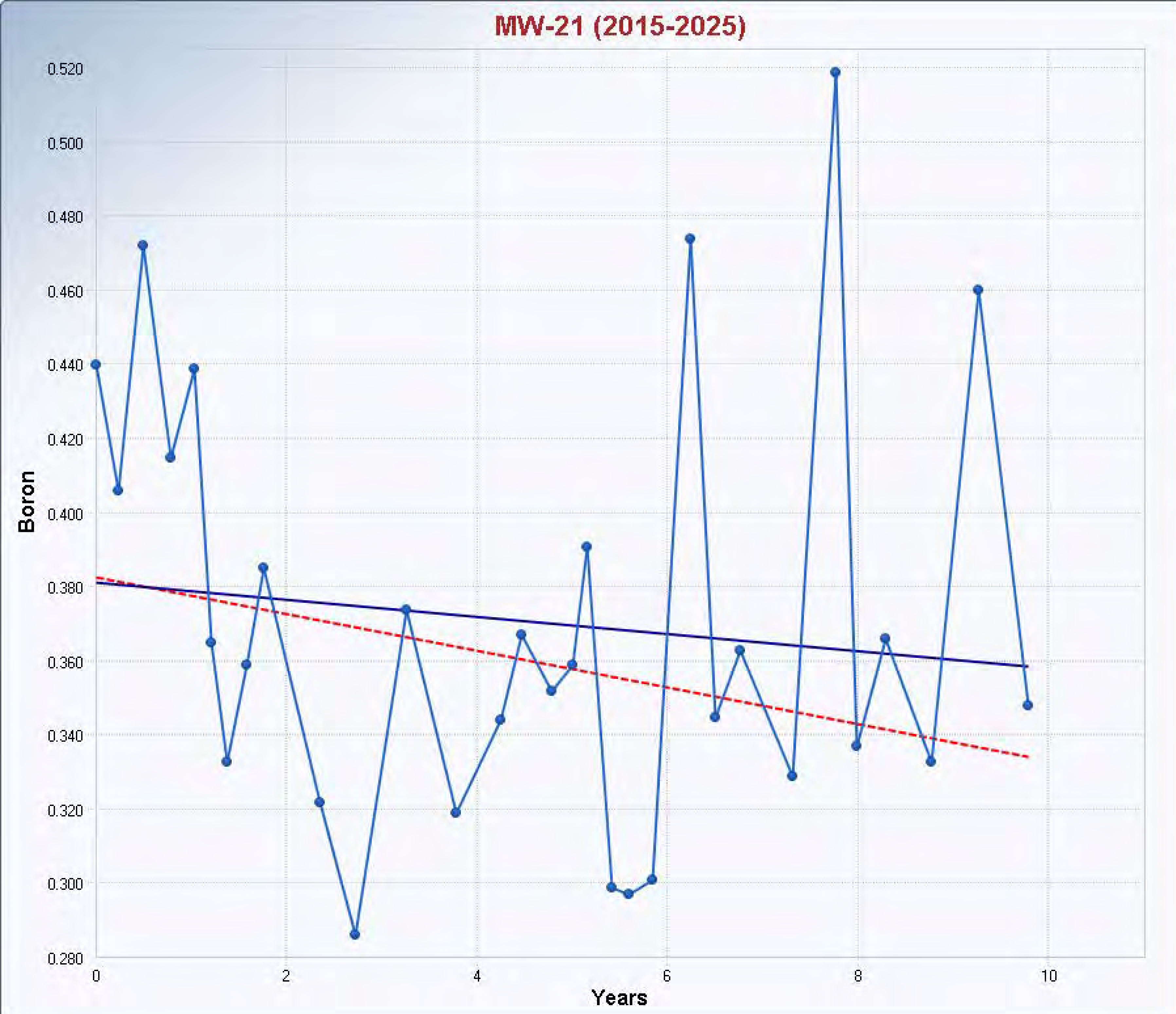
OLS Regression Line (Blue)

OLS Regression Slope	-0.0020
OLS Regression Intercept	0.6234

Theil-Sen Trend Line (Red)

Theil-Sen Slope	-0.0034
Theil-Sen Intercept	0.6298

Insufficient statistical evidence of a significant trend at the specified level of significance.



Mann-Kendall Trend Analysis

n	31
Confidence Coefficient	0.9500
Level of Significance	0.0500
Standard Deviation of S	58.8189
Standardized Value of S	-1.2241
M-K Test Value (S)	-73
Appx. Critical Value (0.05)	-1.6449
Approximate p-value	0.1105

OLS Regression Line (Blue)

OLS Regression Slope	-0.0023
OLS Regression Intercept	0.3813

Theil-Sen Trend Line (Red)

Theil-Sen Slope	-0.0050
Theil-Sen Intercept	0.3828

Insufficient statistical evidence of a significant trend at the specified level of significance.