2018 Annual Groundwater Monitoring and Corrective Action Report

Caledonia Ash Landfill

Caledonia, Wisconsin

We Energies

January 31, 2019

OBG
Part of Ramboll

JANUARY 31, 2019 | PROJECT #71202

2018 Annual Groundwater Monitoring and Corrective Action Report

Caledonia Ash Landfill

Caledonia, Wisconsin

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ACRONYMS AND ABBREVIATIONS

ASD	Alternate Source Demonstration
B	Boron
Ca	Calcium
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
mg/L	milligrams per liter
OBG	O'Brien & Gere Engineers, Inc., a part of Ramboll
SO_4	Sulfate
SSI	Statistically Significant Increase
TBD	To be Determined
TDS	Total Dissolved Solids

1 INTRODUCTION

This report has been prepared on behalf of We Energies by O'Brien & Gere Engineers, Inc., a part of Ramboll (OBG) to provide the information required by Title 40 of the Code of Federal Regulations (40 CFR) 257.90(e) for the Caledonia Ash Landfill located in Caledonia, Wisconsin.

In accordance with 40 CFR 257.90(e), the owner or operator of an existing coal combustion residual (CCR) unit must prepare an annual groundwater monitoring and corrective action report (Annual Report) for the preceding calendar year. The Annual Report must document the status of the groundwater monitoring and corrective action program for the CCR unit and summarize key actions completed, describe any problems encountered, discuss actions to resolve the problems, and project key activities for the upcoming year. At a minimum, the Annual Report must contain the following information, to the extent available:

(1) A map, aerial image, or diagram showing the CCR unit and all background (or upgradient) and downgradient monitoring wells, to include the well identification numbers, that are part of the groundwater monitoring program for the CCR unit;
(2) Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a narrative description of why those actions were taken;
(3) In addition to all the monitoring data obtained under 40 CFR 257.90 through 257.98, a summary including the number of groundwater samples that were collected for analysis for each background and downgradient well, the dates the samples were collected, and whether the sample was required by the detection monitoring or assessment monitoring programs;
(4) A narrative discussion of any transition between monitoring programs (*e.g.,* the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels); and
(5) Other information required to be included in the annual report as specified in 40 CFR 257.90 through 257.98.[1]

This report provides the required information for the Caledonia Ash Landfill for calendar year 2018.

[1] For calendar year 2018, corrective action and other information required to be included in the annual report as specified in 40 CFR 257.95 through 257.98 is not applicable.

2 MONITORING AND CORRECTIVE ACTION PROGRAM STATUS

The Caledonia Ash Landfill remained in Detection Monitoring (40 CFR 257.94) during 2018. Detection Monitoring Program sampling dates and parameters collected are provided in Table 1. Analytical results from the two sampling rounds collected and those statistically analyzed in 2018 are included in Table 2.

In accordance with 40 CFR 257.93(h)(2), the *Statistical Analysis Plan, Caledonia Ash Landfill* (Natural Resource Technology, an OBG Company, 2017), and within 90 days of completing sampling and analysis (receipt of data); analytical data was evaluated for statistically significant increases (SSIs) over background concentrations for Appendix III constituents at monitoring wells at the Caledonia Ash Landfill. SSIs and the SSI determination dates are provided in Table 1.

40 CFR 257.94(e)(2) allows 90 days to demonstrate that a SSI was caused by a source other than the CCR unit or resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality (i.e., an alternate source demonstration). Alternate source demonstrations (ASDs) were completed for the Caledonia Ash Landfill on the dates provided in Table 1. ASD documents are provided in Appendix A.

Table 1. Detection Monitoring Program Summary

Detection Monitoring Round	Sampling Date	Parameters Collected	Data Received	SSI Determination Date	SSI Parameters	Resample Date	ASD Date
1	11/14/2017-11/15/2017	Appendix III	12/18/2017	1/15/2018	B, Ca, SO_4, TDS	NA	4/15/2018
2	5/15/2018-5/16/2018	Appendix III	5/31/2018	8/29/2018	B, Ca, SO_4, TDS	9/7/2018	11/27/2018
3	11/14/2018-11/15/2018	Appendix III	11/29/2018	TBD (before 2/27/2019)	TBD	TBD	TBD

B – Boron
Ca – Calcium
NA – Not applicable
SO_4 – Sulfate
TBD – To Be Determined
TDS – Total Dissolved Solids

The Caledonia Ash Landfill remains in the Detection Monitoring Program in accordance with 40 CFR 257.94.

3 KEY ACTIONS COMPLETED IN 2018

Two groundwater sampling events were completed in 2018 as part of the Detection Monitoring Program, Rounds 2 and 3. One groundwater sample was collected from each background and downgradient well in the monitoring system during each event. One resampling event was completed in accordance with the *Statistical Analysis Plan, Caledonia Ash Landfill* (Natural Resource Technology, an OBG Company, 2017). Sampling dates are summarized in Table 1. All samples were collected and analyzed in accordance with the *Sampling and Analysis Plan* (Natural Resource Technology, an OBG Company, 2017) prepared for the Caledonia Ash Landfill. All monitoring data obtained under 40 CFR 257.90 through 257.98 (as applicable) in 2018 are presented in Table 2.

A map showing the groundwater monitoring system, including the CCR unit and all background (upgradient) and downgradient monitoring wells with well identification numbers, for the Caledonia Ash Landfill is presented on Figure 1. There were no changes to the monitoring system in 2018.

Statistical evaluation, including SSI determinations, of analytical data from the Detection Monitoring Program for November 14-15, 2017 (Detection Monitoring Round 1) and May 15-16, 2018 (Detection Monitoring Round 2) were completed within 90 days of receipt of the analytical data. Statistical evaluation of analytical data is being performed in accordance with the *Statistical Analysis Plan, Caledonia Ash Landfill* (Natural Resource Technology, an OBG Company, 2017).

Alternate Source Demonstrations for Detection Monitoring Rounds 1 and 2 dated April 15 and November 27, 2018, respectively, were prepared for the Caledonia Ash Landfill in 2018 and are provided in Appendix A. ASDs were prepared in accordance with 40 CFR 257.94(e)(2) and provide a description, data, and pertinent information supporting an alternate source applicable to the wells and parameters with SSIs at the Caledonia Ash Landfill. The ASDs support the position that the SSIs observed during the Detection Monitoring Program were not due to a release from the CCR unit but were either from an error in sampling or analysis or from naturally occurring conditions (e.g. natural variation in groundwater quality).

4 PROBLEMS ENCOUNTERED AND ACTIONS TO RESOLVE PROBLEMS

No problems were encountered during implementation of the Detection Monitoring Program during 2018. Groundwater samples were collected and analyzed in accordance with the *Sampling and Analysis Plan* (Natural Resource Technology, an OBG Company, 2017) prepared for the Caledonia Ash Landfill, and all data was accepted.

5 KEY ACTIVITIES PLANNED FOR 2019

The following key activities are planned for 2019:

- Continuation of the Detection Monitoring Program with semi-annual sampling scheduled for the 2nd and 4th quarters of 2019.
- Complete statistical evaluation of analytical data from the downgradient wells, using background data to determine whether a SSI of Appendix III parameters over background concentrations has occurred.
- If an SSI is identified, potential alternate sources (*i.e.*, a source other than the CCR unit caused the SSI or that that SSI resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality) will be evaluated. If an alternate source is demonstrated to be the cause of the SSI, a written demonstration will be completed within 90 days of SSI determination and included in the annual groundwater monitoring and corrective action report for 2019.
  - If an alternate source(s) is not identified to be the cause of the SSI, the applicable requirements of 40 CFR 257.94 through 257.98 (*e.g.*, assessment monitoring) will apply in 2019, including associated recordkeeping/notifications required by 40 CFR 257.105 through 257.108.

REFERENCES

Natural Resource Technology, an OBG Company, 2017, Sampling and Analysis Plan Revision 2, Caledonia Ash Landfill, Caledonia, Wisconsin, September 29, 2017.

Natural Resource Technology, an OBG Company, 2017, Statistical Analysis Plan, Caledonia Ash Landfill, Caledonia, Wisconsin, October 17, 2017.

Tables

Caledonia
Table 2. Caledonia Ash Landfill: Appendix III Analytical Results

Date Range: 11/01/2017 to 11/15/2018

Well Id	Date Sampled	Lab Id	B, tot, mg/L	Ca, tot, mg/L	Cl, tot, mg/L	F, tot, mg/L	pH (field), STD	SO4, tot, mg/L
W08D	11/14/2017	40161125002	0.456	49.100	11.900	1.100	7.410	222.000
	05/16/2018	AE27556	0.270	51.000	10.000	0.960	7.300	200.000
	11/14/2018	AE31851	0.450	50.000	10.000	0.950	7.500	210.000
W09D	11/14/2017	40161125003	0.394	18.600	4.900	1.400	8.230	32.200
	05/16/2018	AE27554	0.410	19.000	3.400	1.200	7.900	32.000
	09/07/2018	AE30278	0.390				7.900	
	11/14/2018	AE31849	0.410	19.000	3.400	1.200	8.000	34.000
W10D	11/14/2017	40161125004	0.417	20.400	4.300	1.400	8.070	44.500
	05/16/2018	AE27553	0.430	21.000	3.500	1.200	7.600	41.000
	11/15/2018	AE31854	0.440	21.000	3.500	1.200	8.000	43.000
W46D	11/14/2017	40161125001	0.391	27.000	6.800	1.200	7.580	34.500
	05/15/2018	AE27550	0.400	27.000	6.000	1.100	7.600	33.000
	11/14/2018	AE31848	0.380	26.000	5.800	1.000	7.600	36.000
W48	11/15/2017	40161125005	0.370	27.400	4.100	1.000	7.860	<1.000
	05/16/2018	AE27551	0.390	27.000	3.500	0.850	7.700	0.620
	11/15/2018	AE31852	0.390	26.000	3.500	0.820	7.800	0.560
W49	11/15/2017	40161125007	0.432	19.500	5.800	1.500	8.090	51.600
	05/16/2018	AE27557	0.440	18.000	5.000	1.200	7.800	47.000
	11/15/2018	AE31853	0.440	20.000	4.900	1.000	7.900	43.000
W50	11/15/2017	40161125008	0.490	26.200	5.800	1.300	7.840	80.800
	05/16/2018	AE27555	0.510	28.000	5.400	1.100	7.700	75.000
	11/15/2018	AE31855	0.520	27.000	5.700	1.000	7.800	76.000

Caledonia
Table 2. Caledonia Ash Landfill: Appendix III Analytical Results

Date Range: 11/01/2017 to 11/15/2018

Well Id	Date Sampled	Lab Id	TDS, mg/L
W08D	11/14/2017	40161125002	416.000
	05/16/2018	AE27556	440.000
	11/14/2018	AE31851	430.000
W09D	11/14/2017	40161125003	170.000
	05/16/2018	AE27554	180.000
	11/14/2018	AE31849	160.000
W10D	11/14/2017	40161125004	180.000
	05/16/2018	AE27553	180.000
	11/15/2018	AE31854	160.000
W46D	11/14/2017	40161125001	196.000
	05/15/2018	AE27550	200.000
	11/14/2018	AE31848	140.000
W48	11/15/2017	40161125005	244.000
	05/16/2018	AE27551	200.000
	11/15/2018	AE31852	130.000
W49	11/15/2017	40161125007	210.000
	05/16/2018	AE27557	180.000
	11/15/2018	AE31853	170.000
W50	11/15/2017	40161125008	260.000
	05/16/2018	AE27555	250.000
	11/15/2018	AE31855	220.000

Figures

Y:\GIS\Projects\16\1660\MXD\2018Annual_GWM_CAR\Figure 1_GW Samp Well Loc_Caledonia.mxd Author: GalamMC; Date/Time: 1/23/2019, 5:03:36 PM

DRAWN BY/DATE: MPG 12/18/18 REVIEWED BY/DATE: GRL 12/18/18 APPROVED BY DATE: GRL 1/23/19	GROUNDWATER SAMPLING WELL LOCATION MAP 2018 ANNUAL GROUNDWATER MONITORING AND CORRECTIVE ACTION REPORT WE ENERGIES CALEDONIA ASH LANDFILL CALEDONIA, WISCONSIN	PROJECT NO: 71202 FIGURE NO: 1 OBG Part of Ramboll

Appendix A

40 CFR 257.94(e)(2) Alternate Source Demonstrations (ASDs)

Appendix A1

April 15, 2018

OBG

Alternate Source Demonstration

Caledonia Ash Landfill

Caledonia, WI

We Energies

April 15, 2018

APRIL 15, 2018 | PROJECT #67985

Alternate Source Demonstration

Caledonia Ash Landfill
Caledonia, Wisconsin

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ACRONYMS AND ABBREVIATIONS

ASD	Alternate Source Demonstration
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
HDPE	High density polyethylene
mg/L	milligrams per liter
NRT	Natural Resource Technology, Inc.
OBG	O'Brien & Gere Engineers, Inc.
SSI	statistically significant increase
STD	standard units
TDS	Total dissolved solids
WAC	Wisconsin Administrative Code
WDNR	Wisconsin Department of Natural Resources

1 INTRODUCTION

1.1 OVERVIEW

This document has been prepared on behalf of We Energies by O'Brien & Gere Engineers, Inc. (OBG) to provide pertinent information for an alternate source demonstration (ASD) as allowed by 40 CFR § 257.94(e)(2) for the Caledonia Ash Landfill located in Caledonia, Wisconsin.

Initial background groundwater monitoring consisting of a minimum of eight samples as required under 40 CFR § 257.94(b) was initiated in November 2015 and completed prior to October 17, 2017. The first semi-annual detection monitoring sample was collected on November 14 and 15, 2017 for which analytical data was received on December 18, 2017. Statistical analysis of the first detection monitoring sample for statistically significant increases (SSIs) of 40 CFR Part 257 Subpart D (CCR Rule) Appendix III parameters over background concentrations was completed within 90 days of collection of the sample (January 15, 2018). The statistical determination identified the following SSIs at downgradient monitoring wells:

- Boron above the background prediction limit at wells W08D, W10D, W49, and W50
- Sulfate above the background prediction limit at wells W08D, W09D, W10D, W49, and W50
- Calcium above the background prediction limit at well W08D
- Total dissolved solids (TDS) above the background prediction limit at well W08D

40 CFR § 257.94(e)(2) allows the owner or operator 90 days from the date of determination to demonstrate that a source other than the coal combustion residuals (CCR) unit caused the SSI, or that the SSI resulted from errors in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. Pursuant to 40 CFR § 257.94(e)(2), the following demonstrates that sources other than the Caledonia Ash Landfill were the cause of the SSIs listed above. This ASD was completed within 90 days of determination of the SSIs (April 15, 2018) as required by 40 CFR § 257.94(e)(2).

1.2 LOCATION AND HISTORY

The Caledonia Ash Landfill complies with requirements under 40 CFR Part 257 located at the Oak Creek Power Plant (OCPP). The Oak Creek Site is an electrical power generating site located next to Lake Michigan in Oak Creek, Wisconsin. The Site occupies about 1,000 acres of land in portions of Section 31, T5N, R23E, Section 6, T4N, R23E, Section 1, T4N, R22E and Section 36, T5N, R22E, straddling Milwaukee and Racine counties. The Caledonia Landfill is located approximately 3,800 feet west of Lake Michigan.

The Oak Creek Site began commercial operation in 1953 with the completion of the first units of the OCPP. Electrical generation facilities and associated supporting infrastructure have expanded since that time, in response to increasing demand. The Site is bordered on the east by Lake Michigan and on the north, west, and south by residential, recreational, commercial, and undeveloped lands. Figure 1 shows the Caledonia Ash Landfill and adjacent properties. The eastern portion of the property is occupied by the power plant and structures related to the generation of electric power. Land use immediately surrounding the power plant is also related to power generation and CCR management. Prior to acquisition by We Energies, the property was undeveloped and/or residential, and primarily used for agricultural purposes.

The OCPP property also includes coal storage areas, electrical transmission facilities, wastewater treatment facilities, and water intake and discharge structures.

1.3 GROUNDWATER MONITORING

The Caledonia Ash Landfill uppermost aquifer groundwater monitoring system for compliance with the CCR Rule consists of two upgradient monitoring wells (W46D, and W48) and five downgradient monitoring wells (W08D, W09D, W10D, W49 and W50). A map showing the groundwater monitoring system, including the CCR unit and all background and downgradient monitoring wells, is presented in Figure 1. Groundwater generally flows to the northeast in the uppermost aquifer, representative groundwater contours are shown on Figure 2.

Samples were collected and analyzed in accordance with the Sampling and Analysis Plan (Natural Resource Technology, an OBG Company, 2017a) prepared for the landfill. All monitoring data obtained under 40 CFR § 257.90 through 257.98 (as applicable) are presented in Table 1. Statistical evaluation of analytical data was performed in accordance with the Statistical Analysis Plan, Caledonia Ash Landfill, We Energies (Natural Resource Technology, an OBG Company, 2017b).

Groundwater monitoring at the Oak Creek Site was initiated in 1975 around a previous disposal facility (Oak Creek North), but has been modified as additional landfills were opened and closed in response to state and federal groundwater monitoring requirements. Figure 1 shows wells in the vicinity of the Oak Creek Site that have been sampled over time as part of investigations or State groundwater monitoring requirements. This ASD focuses on groundwater data collected under the CCR Rule; however, since groundwater monitoring was initiated relatively recently (October 2015), in some cases data collected under the Wisconsin Department of Natural Resources (WDNR) monitoring program is used to provide historical perspective. This ASD also presents some data collected from potable water wells (Harkness et. al, 2017, and WDNR, 2013) located upgradient of the landfill and screened within dolomite bedrock (i.e. uppermost aquifer) to illustrate the variability in background groundwater quality. Additional data sources excerpted from these investigations are included in Attachment A.

1.4 CALEDONIA ASH LANDFILL

Caledonia Ash Landfill was originally permitted in 1987. Construction of the first phase of landfill development was completed in 1990 and a license to operate the site was issued the same year. The permitted area of the landfill covers approximately 45 acres and provides for a disposal capacity of 4,050,000 cubic yards of fly ash and other CCRs. The first six base cells were constructed with a 5-foot thick compacted clay liner and leachate collection system. A Plan of Operation Modification was approved on May 19, 2010, which changed the liner design for future cells to a composite liner consisting of a 4-foot thick compacted clay liner with a 60-mil HDPE geomembrane.

Cell 10 was constructed in 2010 and was approved for operation on March 10, 2011. There are three additional cells included with the permit that will be constructed in the future as additional space is needed.

1.5 OVERVIEW OF SITE HYDROGEOLOGY AND STRATIGRAPHY

A detailed hydrogeological assessment of the Oak Creek Site was completed and submitted to the WDNR in 2013, *Hydrogeology, Groundwater Quality, and Environmental Monitoring, Oak Creek Site, Oak Creek and Caledonia, Wisconsin* (Natural Resource Technology, Inc. (NRT) 2013). Information pertinent to this ASD is included in this report, however, more complete information on site hydrogeology and stratigraphy is available in the 2013 hydrogeologic assessment.

The site geology is heterogeneous, consisting of the Oak Creek Formation (clay till) with intermittent sand lenses of variable thicknesses occurring at several depths. Geologic investigations have indicated that sand units are not continuous across the site. The unlithified materials overlie the Silurian Dolomite bedrock, which is also the uppermost aquifer in this area. Most potable water wells in the vicinity of the site are screened in the upper portions of this aquifer.

The bedrock surface elevation is contoured on Figure 3. The site overlies a bedrock valley which trends northeast to southwest. Background well W46D is located near the base of the valley and W48 is located on the southern upper slope of the valley. Downgradient wells (W09D, W10D, W49 and W50) are located on the northern slope of the valley, W08D is located near the apex of the valley. The bedrock valley separates the upgradient and downgradient monitoring wells, and influences the groundwater chemistry at the downgradient locations.

Geologic cross-sections across the site are shown on Figures 4, 5 ,6, and 7. Cross Section B-B' and C-C' run west to east and illustrate the background wells and downgradient monitoring wells with respect to the bedrock valley. Cross-section D-D' and E-E' run north to south and show the extent of the intermediate sand to the south.

Vertical groundwater movement is limited within the clay till and as a result, significant downward gradients are present at the site. Regional groundwater flows eastward in the dolomite bedrock, likely discharging into Lake Michigan.

2 ALTERNATE SOURCE DEMONSTRATION

2.1 SUMMARY

Statistical analysis of the first detection monitoring sample for statistically significant increases (SSIs) of 40 CFR § Part 257 Appendix III parameters over background concentrations identified the following SSIs at downgradient monitoring wells:

- Boron at wells W08D, W10D, W49, and W50 higher than the background prediction interval
- Sulfate at wells W08D, W09D, W10D, W49, and W50 higher than the background prediction interval
- Calcium at well W08D higher than the background prediction interval
- TDS at well W08D higher than the background prediction interval

As allowed by 40 CFR § 257.94(e)(2), this ASD demonstrates that sources other than Caledonia Ash Landfill (the CCR Unit) caused the SSI or that the apparent SSI was a result of natural variation in groundwater quality. Lines of evidence supporting this ASD include the following:

- Landfill Design and Hydrogeology: The first portions of the Caledonia Ash Landfill were constructed in 1990 with a 5-foot clay liner with leachate collection, and since 2010 construction of additional cells have been completed with a composite 4-foot thick compacted clay liner and a 60-mil HDPE geomembrane. A leachate collection system underlies all portions of the landfill. The landfill also overlies a significant thickness of the Oak Creek Formation, which has very low permeability.
- Aquifer Geochemistry: The distribution of naturally occurring inorganic compounds and elements in the Silurian Dolomite is variable. In addition, differing geochemical and equilibrium conditions result in the naturally occurring presence of inorganic chemical concentrations that are unrelated to the Caledonia Ash Landfill. The naturally occurring variation in groundwater quality within the dolomite is supported by substantial groundwater sampling and investigation that has been previously completed in this portion of Wisconsin to identify potential sources of constituents detected in groundwater, including molybdenum. These investigations have provided information regarding the variability of naturally occurring concentrations of collocated inorganic constituents in the uppermost aquifer.

Data and information supporting these ASD lines of evidence are discussed in more detail below.

2.2 ASD SUPPORTING INFORMATION

2.2.1 Landfill Design and Hydrogeology

This ASD is supported by the fact that the Caledonia Ash Landfill was constructed with either a five-foot thick compacted clay liner or a 60-mil high density polyethylene (HDPE) liner overlying four feet of compacted clay as a liner. Precipitation and/or leachate that collects on top of the liner is removed by a leachate collection system and managed in accordance with the landfills operating permit. Leachate levels are monitored within the landfill and the system includes high level alarms to notify the landfill operators if leachate levels exceed predetermined levels. The system is flushed annually as part of regular operation and maintenance. System monitoring and reporting indicate that the leachate collection system is functioning as designed and indicate there is not significant leachate migration into underlying materials.

In the unlikely event that leachate was not captured by the collection system, the landfill and liner system overlie approximately 100 feet of silty clay and the potential for downward migration of leachate into the bedrock is limited by the low hydraulic conductivity of the Oak Creek Formation. Simpkins and Bradbury (1992) calculated downward velocities of 0.3 to 0.5 cm/yr in the Oak Creek Formation. At the highest velocities, it would require over 3,000 years for leachate to migrate through 50 feet of the Oak Creek Formation (a conservative thickness after removing potential sand lenses and fractured clay near the surface), but the Caledonia Ash Landfill has only been active for 20 years, indicating the SSIs are attributable to another source.

2.2.2 Aquifer Geochemistry

It is important to recognize that the geochemical signature of an aquifer system is a function of the mineralogy of aquifer host rocks, as well as the source and history of fluids that have flowed through the aquifer. Both of these factors have had an effect on groundwater quality in Wisconsin (Luzcaj, 2015). Elevated concentrations of boron and sulfate can be indicative of CCR impacts; however, these compounds are also present at variable concentrations within the bedrock aquifer. Regional studies have been completed to identify sources of molybdenum in private wells near the Caledonia Ash Landfill (WDNR, 2013, and Harkness et al, 2017), and these studies also investigated the occurrence of boron and tritium to determine if molybdenum was present due to the beneficial reuse of CCRs in the area.

Important conclusions from these studies are as follows:

- **WDNR, 2013 -** *"Both MW-06(W12B) and MW-07 (W12C) are nested monitoring wells screened at different depths, along with MW-08 (W12D). MW-07 is the shallowest well, followed by MW-06 which is deeper and MW-08 is the deepest, screened at the top of the dolomite. This monitoring well nest does not show significant vertical migration of the boron to the dolomite. In addition, the δ11B[1] value for MW-08 (W12D) is outside of the "mixing zone," suggesting it is naturally occurring, and tritium was not detected in MW-08 (W12D) but was detected in both MW-06 (W12B) and MW-07(W12C), suggesting that the water in the deepest well is more reflective of preash- disposal conditions."*

  "The data appear to be more conclusive regarding boron. While the [shallow] monitoring wells may have been affected, the boron isotope data and other evidence appear to show that the boron in most of the [bedrock aquifer] private wells is naturally occurring. Boron may also be coming from other man-made sources. There is more available boron data for the area's groundwater resources than molybdenum data. Boron is known to occur naturally in area groundwater."

- **HARKNESS ET AL, 2017** – *"the Silurian dolomite has dual permeability with the majority of flow dominated by fractures in the extensive, lower-conductivity mudstone units, and interspersed, coarse-grained lenses that allow for faster groundwater flow."*

  "Exchange between the Maquoketa Shale and the Silurian Dolomite have been reported in geophysical studies of the area, and both aquifers are known to host pyrite and other sulfide minerals."

  "We hypothesize that a groundwater flowpath through clay-rich unconsolidated materials would induce cation exchange. Na and B bound to clay particles would be preferentially exchanged for Ca and Mg, resulting in the evolution from Ca−Mg dominated shallow groundwater to Na- (and B-rich) dominated deep groundwater with increasing groundwater residence time."

  "While B and Na could be sourced from local water−rock interactions, they are commonly enriched and highly leachable from shales, and thus the strong correlation between B and Na, along with correlations between B and SO4 ($r = 0.66$, $p < 0.05$), and Na and SO4 ($r = 0.75$, $p < 0.05$) suggest that the sulfide oxidation may occur within shale; this would release Mo and allow it to subsequently mix into the shallow aquifer along with Na and B. The δ11B values >20‰ found in the groundwater are higher than the ~15% expected from exchange of B on marine clays, and yet are consistent with the values found in formation waters from shales."

  "In the case study of southeastern Wisconsin, the groundwater residence times indicate a premodern age for waters (recharged before 1950) in deep, Mo-rich groundwater from the eastern area of the study region. These groundwater wells all yielded apparent ages of >300 years."

The results of both investigations support a geogenic source of boron either in the dolomite aquifer itself, or from interactions of groundwater with the underlying Maquoketa Shale. These reports infer that elevated sulfate

[1] Stable boron isotopes have been used in other studies as an indicator of the boron source found in the environment around CCR disposal sites. These studies have found δ11B values between -40 ‰ and +6.6 ‰ in coal ash samples. Most natural waters have a δ11B value between+10 and +30 ‰. (Buska et al, 2007, Ruhl et al, 2011, and Ruhl, 2012)

and sodium concentrations occur with boron because of the groundwater residence time and interactions with the host rock. These investigations provide a framework for additional analysis of site concentrations and SSIs and provide additional data to characterize regional variability and groundwater age. In summary, the study data indicates naturally occurring groundwater, unimpacted by CCRs, may exhibit higher concentrations of boron, sodium, sulfate, and other compounds as a result of chemical interactions of groundwater with sulfide minerals as a result of long residence times within the Silurian Dolomite (i.e. uppermost aquifer).

The general water chemistry comparing leachate to background and downgradient groundwater quality is displayed in the Piper diagram below (Figure 8). Background groundwater are generally moderate calcium/magnesium (major cations) and a strong bicarbonate/carbonate (major anions) type water, with downgradient wells being slightly stronger in sodium/potassium cations with the exception of wells W08D and W12D, which are a stronger chloride-sulfate anion water rather than carbonate-bicarbonate. Leachate samples collected from the CCR Unit indicate a moderate calcium/magnesium and strong sulfate type water, with the percent calcium higher and magnesium lower when compared to groundwater.

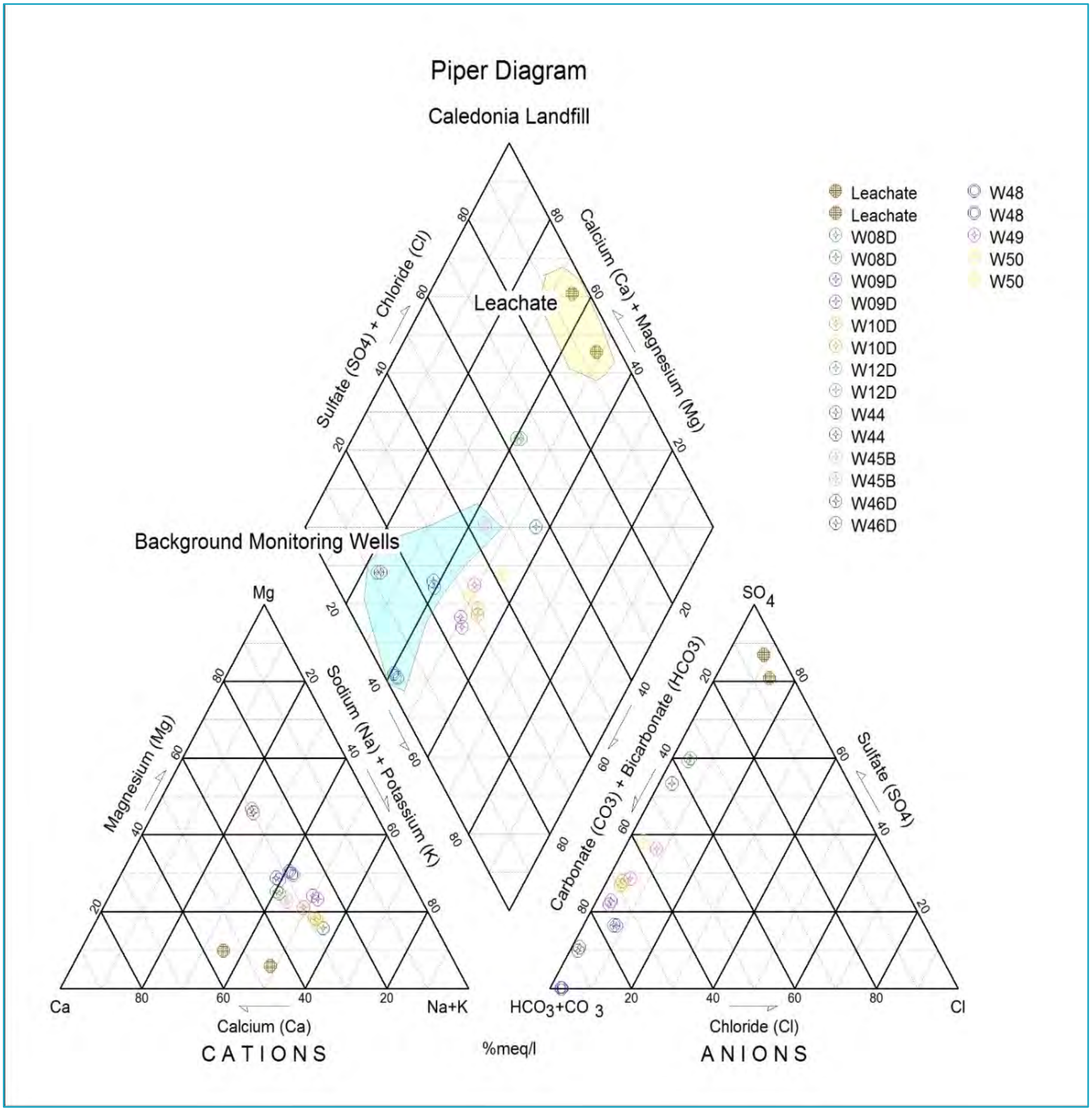


Figure 8. **Piper Diagram of Groundwater Quality Near Caledonia Ash Landfill**

The graphic also illustrates that groundwater samples collected from downgradient wells W09D, W10D, W49, and W50 plot closer to and within the range of the background groundwater, indicating they are not affected by leachate from the Caledonia Ash Landfill. W08D plots between the background water samples and leachate, which could be interpreted as being impacted by the CCR unit; however, additional analysis indicates the SSIs associated with W08D (discussed further below) are not related to the Caledonia Ash Landfill. A Stiff Diagram is provided in Figure 9 to illustrate the different groundwater quality in downgradient wells versus the leachate.

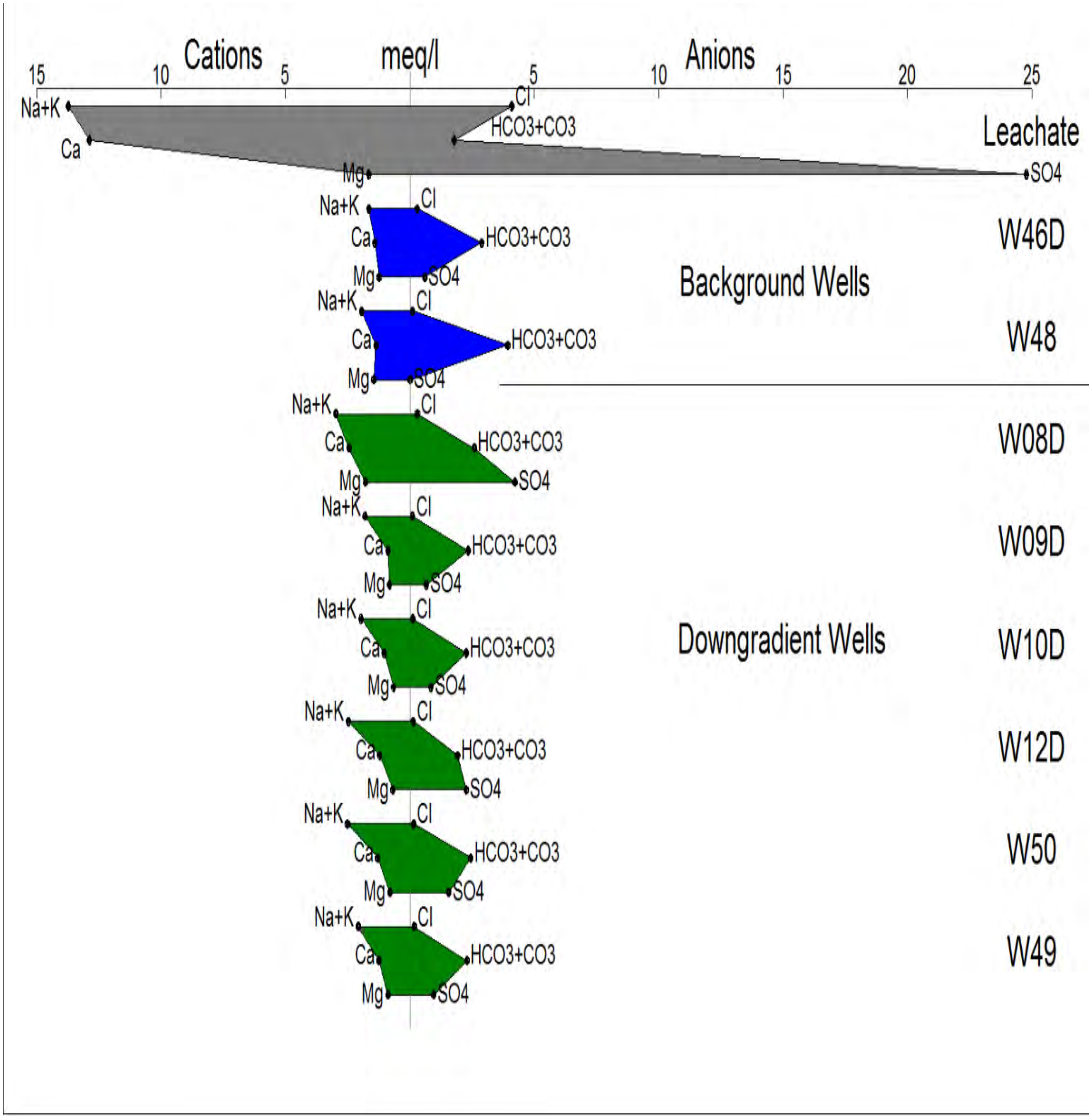


Figure 9. Stiff Diagram of Water Quality Near Caledonia Ash Landfill

At W08D, concentrations of boron, calcium, sulfate, and TDS in groundwater exceed background. Elevated concentrations in this well are attributed to several factors, including the geology and hydrogeologic position of this well in the aquifer.

- While developing the well, the water level in the well declined over 100 feet while pumping at a rate of less than 1 gallon per minute. This indicates low hydraulic conductivity within the screened zone, and the slow groundwater migration increases residence time, allowing for additional interaction between the groundwater and the aquifer rock matrix.

- The groundwater is highly reducing (median ORP of -260 mv) and exhibits lower pH (median of 7.5) in this portion of the aquifer, which increases the solubility of iron/manganese hydroxides onto which boron and sulfate are easily adsorbed. It also increases the solubility of calcium carbonate from the dolomite, which may result in higher calcium concentrations. Landfill leachate is alkaline, and lower pH values as observed in groundwater are indicative that the bedrock aquifer is not affected by the landfill. The oxidation of sulfide minerals can result in lower pH measurements and increased sulfate concentrations, both of which are present at this location.
- The concentrations of boron (median of 0.47 mg/L) and to a lesser degree sulfate (median of 240 mg/L) at W08D are similar in magnitude to W12D (median for boron or 0.5055 mg/L, sulfate 106.5 mg/L), which is not impacted by CCR leachate based on the boron isotope data discussed above (WDNR, 2013). The boron concentrations plotted versus screen elevation measured in the bedrock aquifer demonstrate that significantly lower concentrations exist in monitoring wells screened in the till immediately (Figure 10) beneath the CCR Unit (i.e. W08A, W08B, W08C) than in the Silurian Dolomite. Higher boron concentrations (>1 mg/L) at depth were also observed in wells PW-12 and PW-13 (Figure A-2, Attachment A), which are screened almost 300 feet below ground surface, southeast of the site near Lake Michigan. Boron isotopes measured in groundwater samples at these two locations are consistent with formation waters often observed in shale (WDNR, 2013).
- Elevated TDS concentrations at W08D are also a result of the low hydraulic conductivity of the dolomite at this location. Groundwater migrating slowly through the aquifer matrix dissolves the minerals, increasing the concentrations of dissolved compounds, including sodium, calcium, potassium, etc. The small increase in concentrations from naturally occurring compounds dissolving into groundwater results in higher TDS concentration but is not indicative of impacts from the CCR Unit.
- Concentrations of boron, calcium, and sulfate observed in groundwater at well W08D are within the range of variability identified in groundwater studies in southeast Wisconsin. Concentrations of these parameters at other locations (see Figures A-1 and A-2, Attachment A), are provided in Table 2. A ternary plot (Figure 11, below) illustrates the distribution of these three compounds at wells screened within the uppermost aquifer. Note that the boron concentrations (in mg/L) were multiplied by 100 and rounded to the nearest integer to provide a value scaled for comparison to calcium and sulfate concentrations.

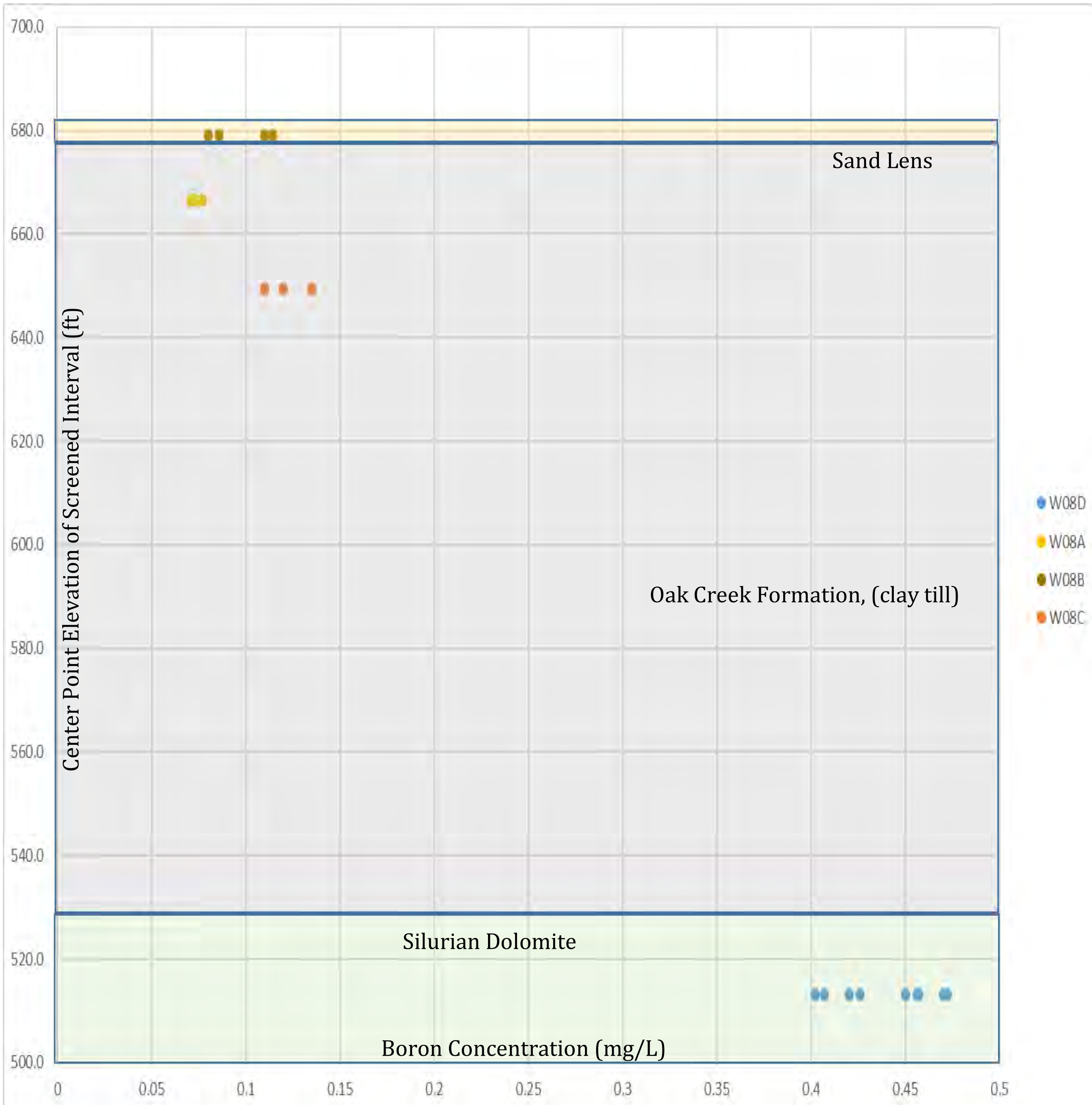


Figure 10. Concentrations of Boron With Depth, Monitoring Well Nest W08 A, B, C, D

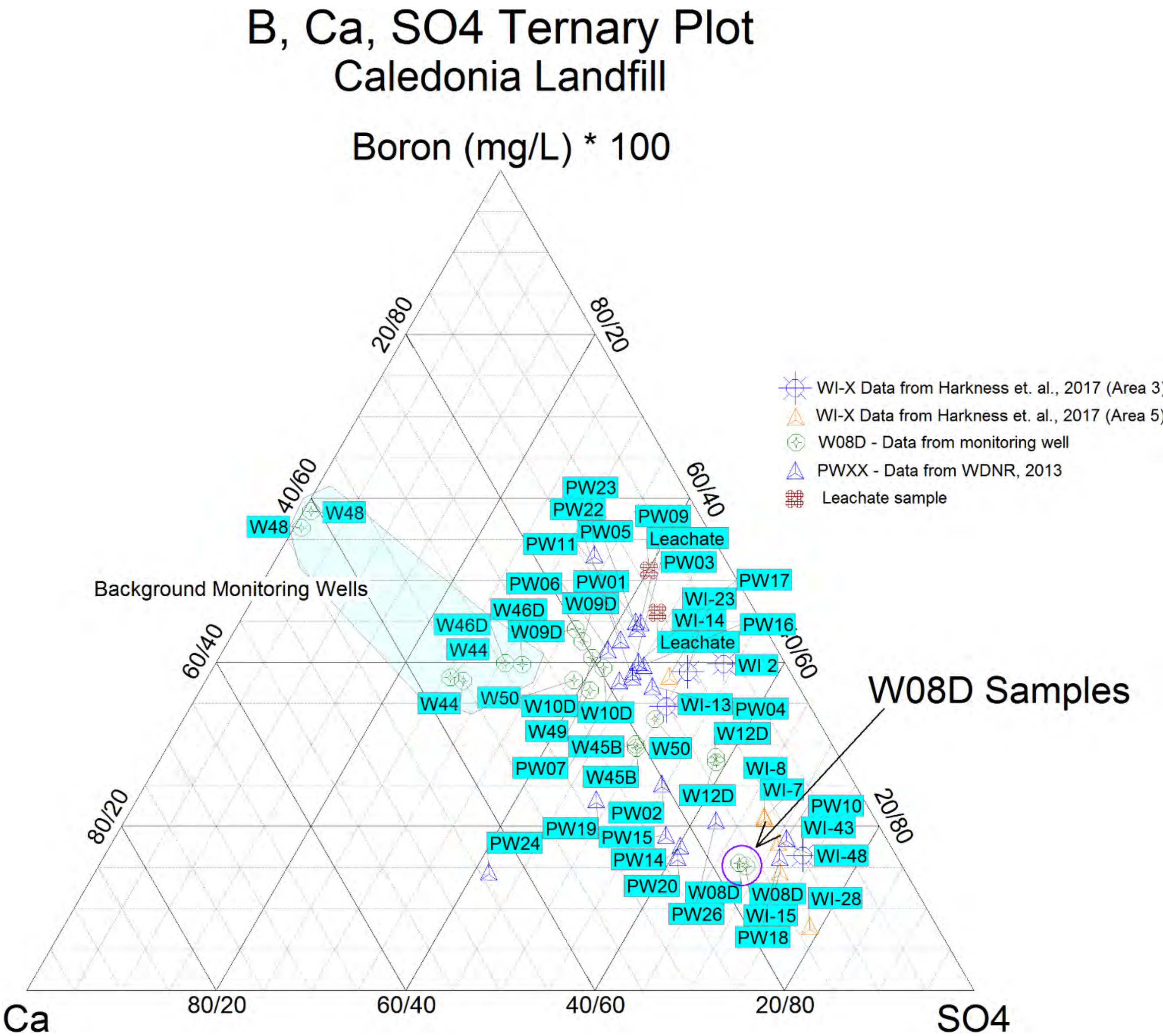


Figure 11. Boron, Calcium, and Sulfate Ternary Plot

The location where W08D plots (circled) on the ternary diagram is similar to other locations sampled during previous investigations. The locations with similar ratios to W08D are illustrated on the bedrock geology figure below (Figure 12). These locations generally occur downgradient (based on west to east flow) of areas where the bedrock transitions between formations - specifically between the Waukesha and Racine Formations. The presence of the bedrock valley results in elevations of bedrock at site monitoring wells (515 to 540 feet) that are similar to elevations where the Waukesha Formation is encountered at the bedrock surface. This indicates that downgradient site wells may be just downgradient of an unmapped transition zone, while upgradient well W48 is at a higher bedrock elevation and screened within the Racine Formation upgradient of the transition zone.

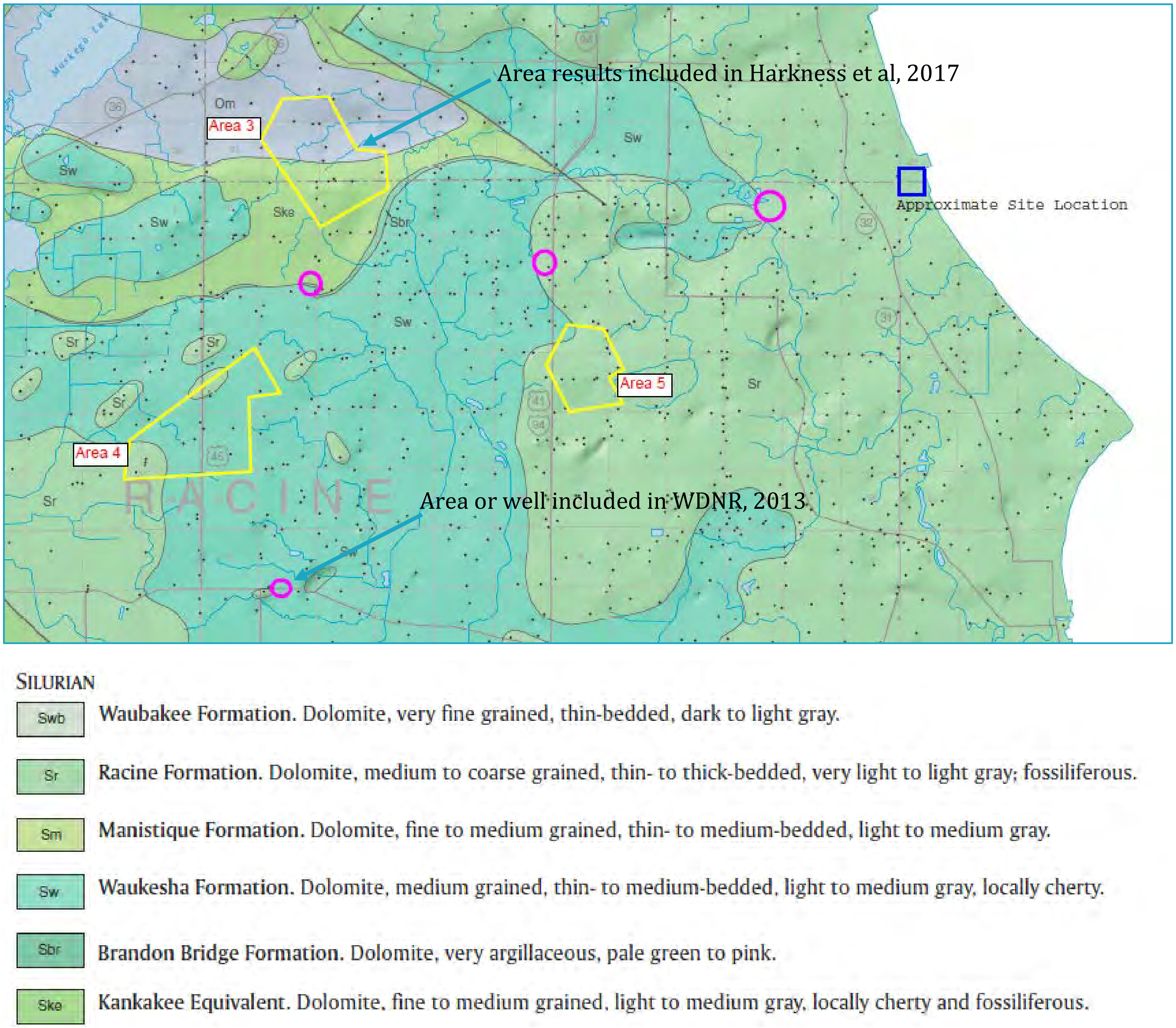


Figure 12. Regional Bedrock Geology

As discussed previously, the source of boron could be from local water–rock interactions, but boron and sodium compounds are commonly enriched and highly leachable from shales. A strong correlation between boron and sodium would support this hypothesis. A scatter plot of sodium and boron shown on Figure 13 includes both the site wells and additional sampling locations in the uppermost aquifer. The strong correlation coefficient of 0.96 indicates that there is a high correlation between boron and sodium indicating they are likely from the same source. Previous investigations indicate the strong correlation between these two parameters is evidence to support that the groundwater in the Silurian Dolomite is interacting with the underlying Maquoketa Shale, this results in progressively elevated concentrations of sodium and boron as the distance from recharge areas increases, as observed in CCR Rule monitoring wells on-site. The underlying shale as a potential source of boron in groundwater is consistent with the observation that higher boron concentrations occur at depth in the dolomite (because they are screened deeper and closer to the Maquoketa Shale).

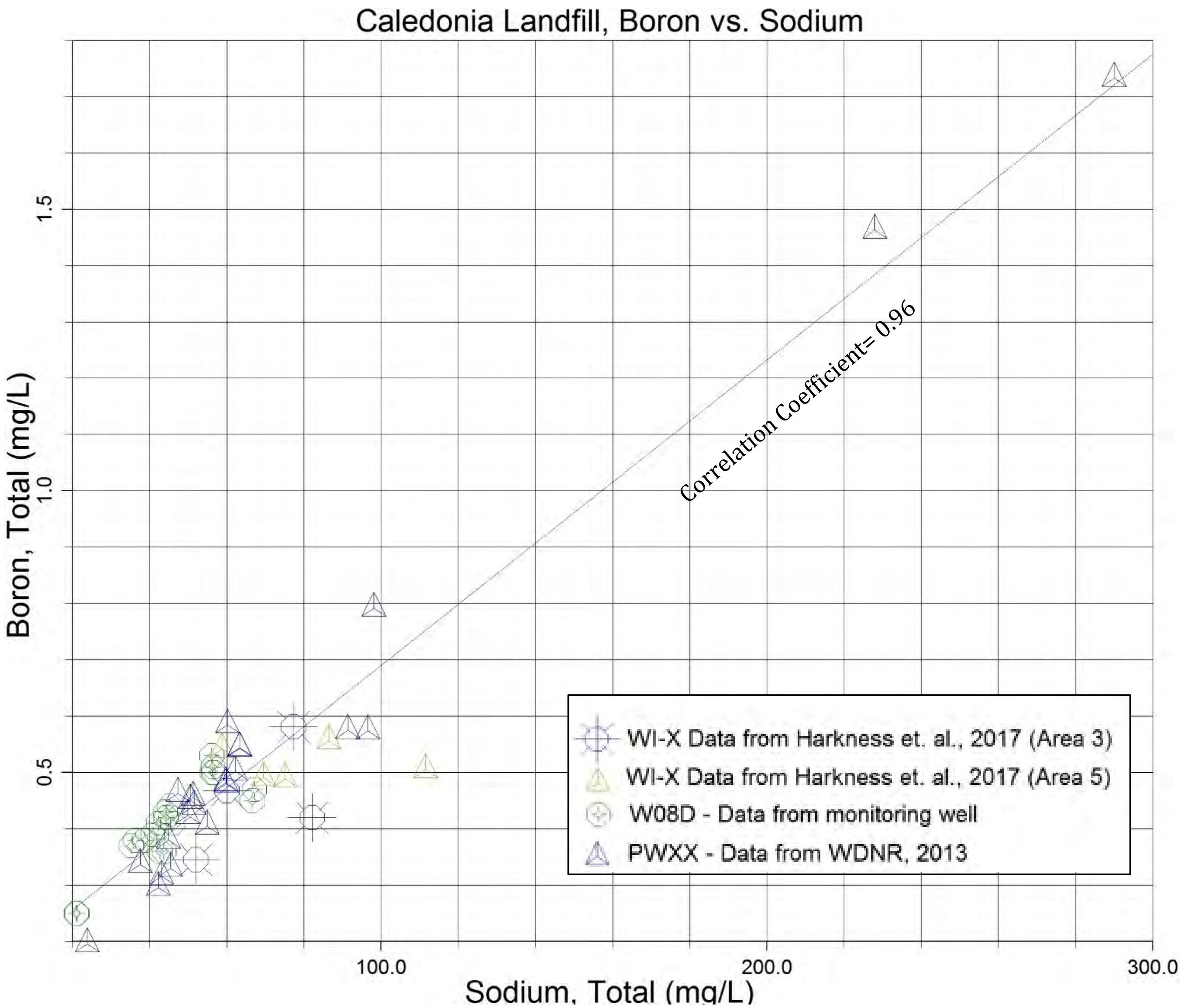


Figure 13. Scatter Plot-Boron vs. Sodium

In addition to the correlation between sodium and boron, the long residence time of groundwater in the Silurian Dolomite aquifer is also supported by tritium analysis of groundwater collected from many of these locations (Attachment A). The results included in the WDNR investigation did not show detectable concentrations of tritium (including well W12D located downgradient of the Caledonia Ash Landfill), indicating groundwater was recharged to the Silurian Dolomite prior to 1950, pre-dating the existence of the power plant. Harkness et al, 2017 estimated the mean groundwater age in the dolomite aquifer in the region at greater than 300 years, and in Areas 3 and 5 just upgradient of the site the youngest age of groundwater is 338 years.

Based on the analysis of boron variability and distribution, and the groundwater age dating completed during previous investigations, there is sufficient evidence to demonstrate that elevated boron, calcium, sulfate, and TDS concentrations in downgradient CCR monitoring wells are not associated with the Caledonia Ash Landfill but are from natural variability in groundwater within the uppermost aquifer. Boron is a conservative and non-reactive tracer of potential CCR impacts, but boron is not elevated in groundwater downgradient of the CCR Unit above naturally occurring concentrations. SSIs detected in groundwater within the shallow bedrock are unrelated to any potential impacts related to the Caledonia Ash Landfill.

2.3 SUMMARY OF LINES OF EVIDENCE FOR SSI PARAMETERS BY WELL

Discussion of the parameters with SSIs at each downgradient well location are discussed below.

Monitoring Well W08D

SSI exceedances for boron, calcium, sulfate and TDS at well W08D are discussed in detail in Section 2.2.2. Concentrations of boron, calcium, and sulfate observed in groundwater at well W08D are within the range of variability identified in groundwater studies in southeast Wisconsin. Elevated TDS concentrations at W08D are a result of the low hydraulic conductivity of the dolomite at this location. Groundwater migrating slowly through the aquifer matrix dissolves the minerals, increasing the concentrations of dissolved compounds, including sodium, calcium, potassium, etc. The small increase in concentrations from naturally occurring compounds dissolving into groundwater results in higher TDS concentration but is not indicative of impacts from the CCR Unit.

Monitoring Well WO9D

Concentrations of sulfate (median of 32.2 mg/L) slightly exceed the statistical upper limit of 30.2 mg/L for background wells W46D and W48 (see Figure 14 below). In the first round of detection monitoring, following completion of the eight rounds of background sampling, the sulfate concentration at background well W46D was 34.5 mg/L, which exceeds the highest observed sulfate concentration (33.9 mg/L) at well W09D since monitoring began in 2015. Additionally, sulfate concentrations at background well W46D are trending upward, suggesting that groundwater concentrations have not reached equilibrium since this background well was installed in 2015.

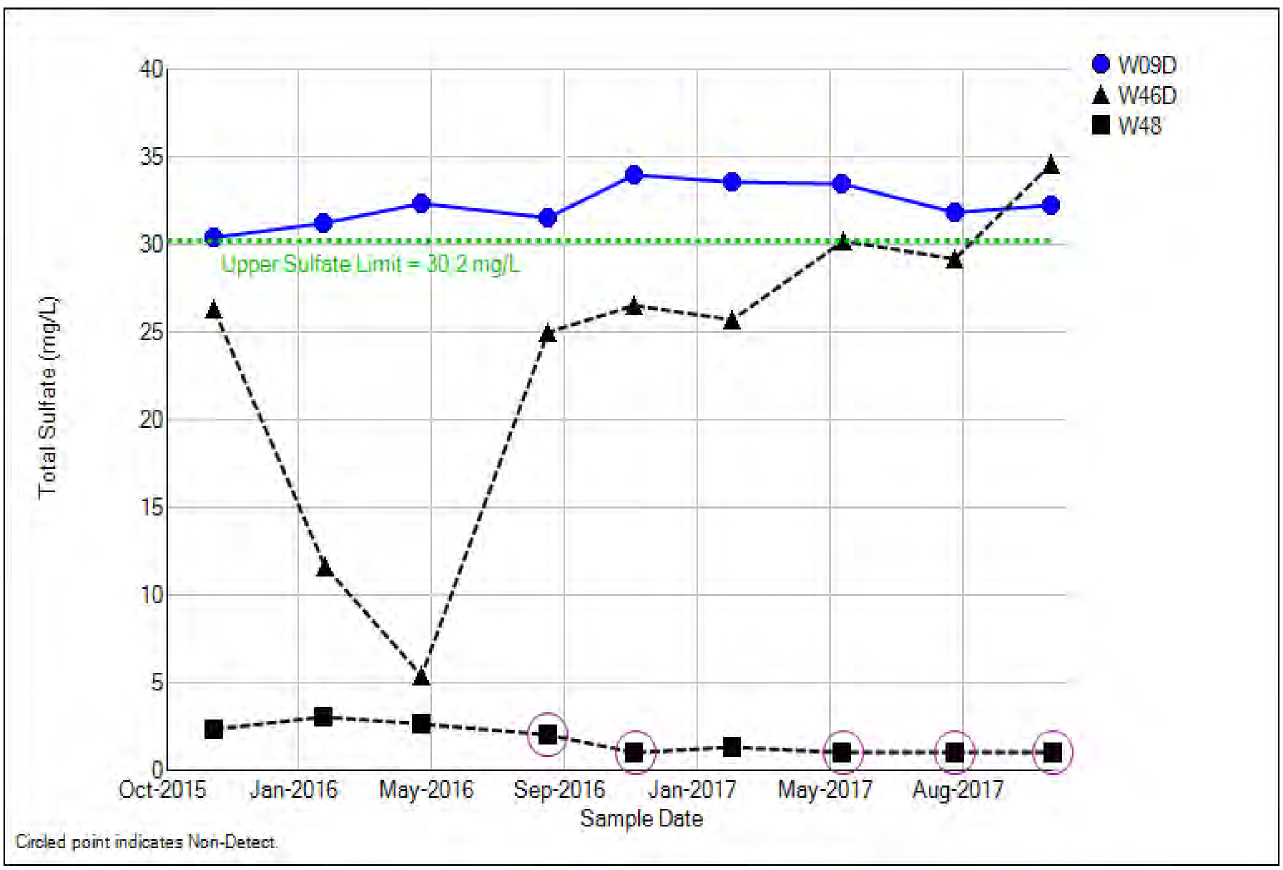


Figure 14. Time Series Plot of Reported SSI Parameters, W09D and Background

Boron concentrations at W09D do not exceed background (Figure 15). Boron is a conservative indicator of CCR impacts and because it is not present at elevated concentrations in W09D, sulfate impacts are not a result of the CCR unit.

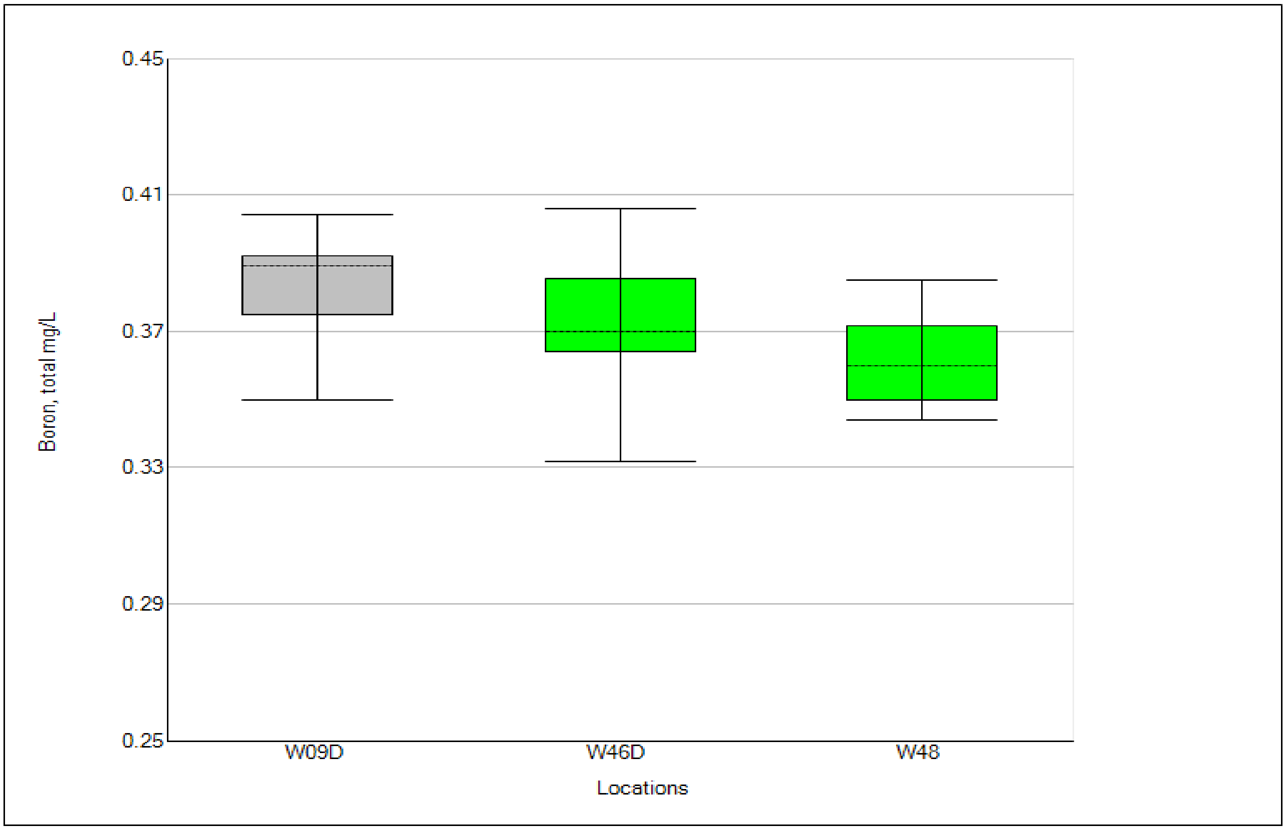


Figure 15. Box Plot of Boron Concentrations, W09D and Background

Monitoring Wells W10D, W49, and W50

Boron and sulfate concentrations exceed background at wells W10D, W49, and W50, as shown on the figures below (Figures 16 and 17). The elevated boron and sulfate concentrations observed in these downgradient wells relative to the two background wells are a function of natural hydrogeochemical variability within the Silurian Dolomite aquifer.

Figure 16. Time Series Plot of Boron, W10D, W49, and W50 and Background

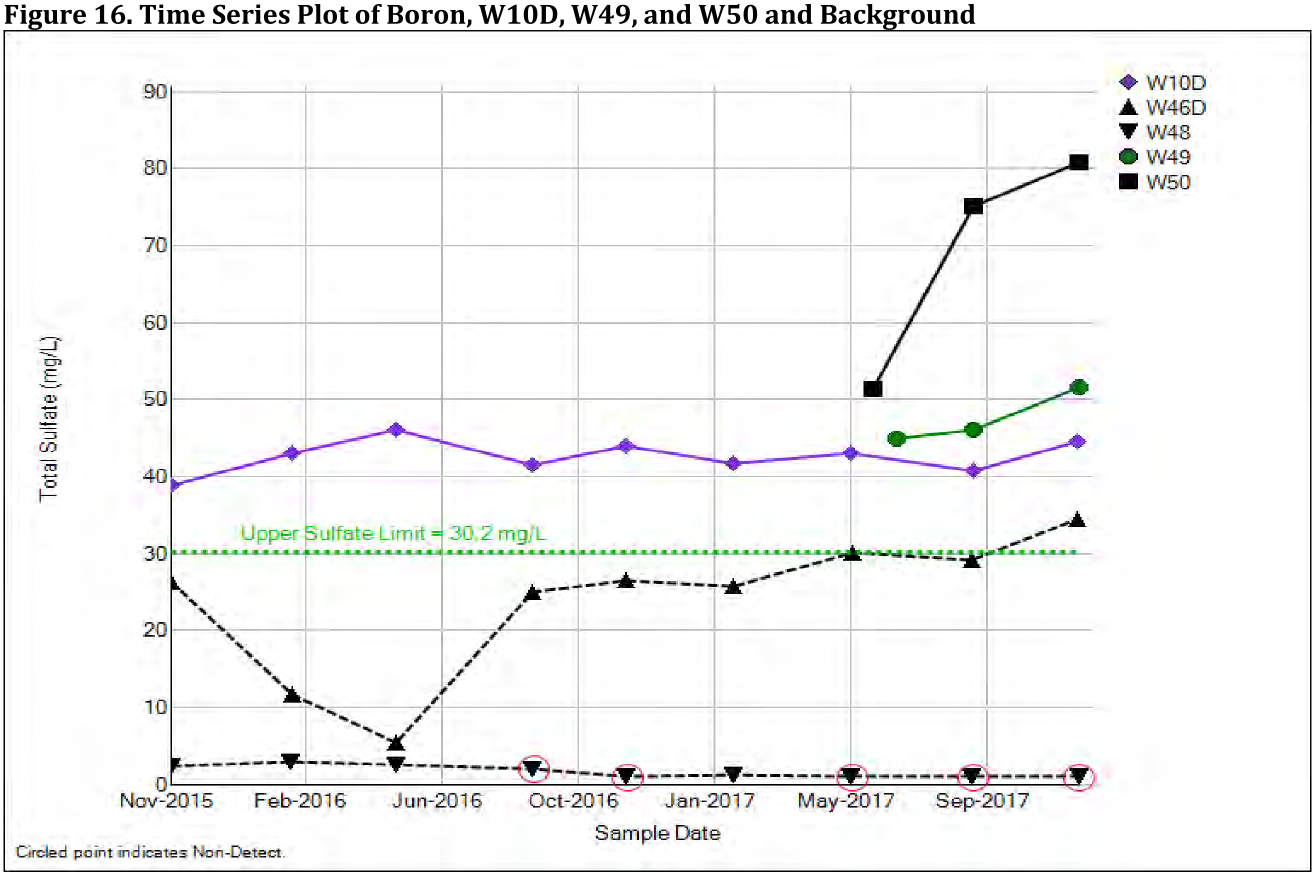


Figure 17. Time Series Plot of Sulfate, W10D, W49, and W50 and Background

Boron concentrations are plotted versus the midpoint of the screen elevation on Figure 18. The highest concentrations occur near an elevation of 522.5 at W12D, which was shown not to be impacted by CCR using boron isotopes and tritium analysis, and then decline at higher and lower elevations. W09D, W10D, and W49 generally fall within this curve, although the concentrations are slightly lower than would be expected based on the center point of their screened elevation.

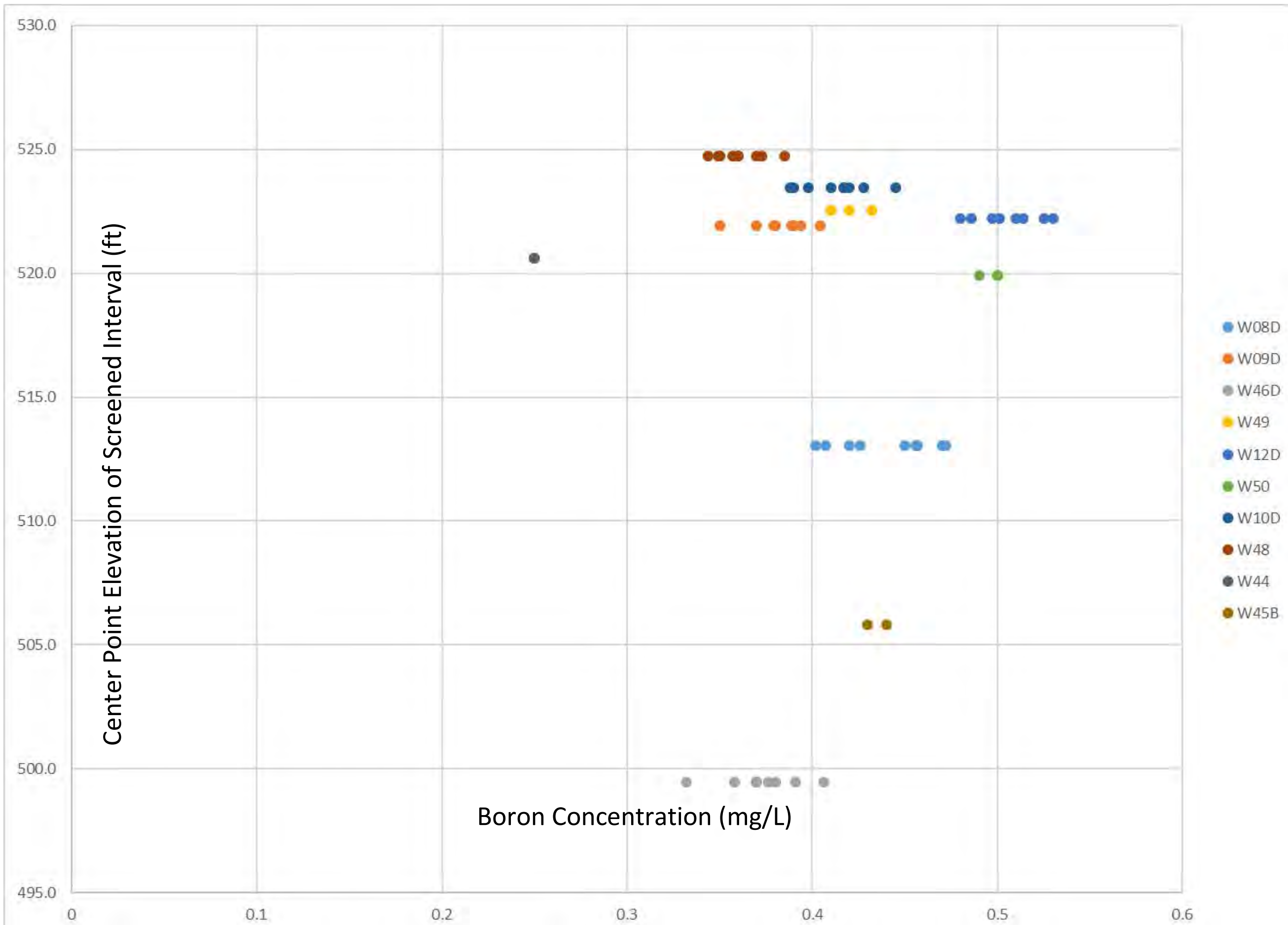


Figure 18. Boron Concentrations vs. Screened Elevations

Well locations W10D, W49, and W50 are located on the northern upslope of the bedrock valley (Figure 3). The bedrock surface was eroded to the southwest of W10D and W49, and west of W50. The lower bedrock surface within the valley located to the southwest and west of these wells also corresponds to the upgradient groundwater flow direction. The higher bedrock elevations within which wells W10D, W49, and W50 are screened (midpoint screen elevations of 520 to 522.5 ft) are over 20 feet higher in elevation than the midpoint screen elevation of background well W46D, which is near the base of the bedrock erosional valley. The slightly elevated concentrations of boron and sulfate in the higher elevation downgradient wells versus lower elevation upgradient well appears to be from varying geologic and geochemical conditions within these different bedrock horizons. Similar to the regional investigations discussed in Section 2.2.2, this may also indicate the dolomite formation transitions in this area, resulting in changes to chemical composition of the groundwater both vertically and laterally, and is accentuated by the bedrock valley between the upgradient and downgradient wells.

In addition to the observations discussed above, the field parameters measured at W10D and W49 indicate slightly less reducing conditions and more acidic groundwater. These conditions can elevate boron concentrations with respect to background.

Groundwater quality at well W50, because it is located within the same hydrostratigraphic unit between wells W08D and W12D, and because it has similar geochemical conditions and concentrations to these two locations, is unrelated to impacts from the landfill. Since boron concentrations are unrelated to the landfill, and because boron is a conservative indicator of CCR impacts, the lack of boron impacts in these wells indicate that the above-background sulfate concentrations are from an alternate natural source - a combination of water-rock interactions and groundwater interaction with the underlying Maquoketa Shale.

3 CONCLUSIONS AND CERTIFICATION

This document has been prepared on behalf of We Energies by OBG to provide pertinent information for an ASD as allowed by 40 CFR § 257.94(e)(2) for the Caledonia Ash Landfill located in Caledonia, Wisconsin.

Initial background groundwater monitoring consisting of a minimum of eight samples as required under 40 CFR § 257.94(b) was initiated in November 2015 and completed prior to October 17, 2017. The first semi-annual detection monitoring sample was collected on November 14 and 15, 2017 for which analytical data was received on December 18, 2017. Statistical analysis of the first detection monitoring sample for SSIs of 40 CFR Part 257 Appendix III parameters over background concentrations was completed within 90 days of collection of the sample (January 15, 2018). The determination identified the following SSIs (concentrations greater than background prediction intervals) at downgradient monitoring wells:

- Boron at wells W08D, W10D, W49, and W50
- Sulfate at wells W08D, W09D, W10D, W49, and W50
- Calcium at wells W08D
- TDS at wells W08D

40 CFR § 257.94(e)(2) allows the owner or operator 90 days from the date of determination to demonstrate that a source other than the CCR unit caused the SSI, or that the apparent SSI was from a source other than the CCR unit, or that the SSI resulted from errors in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. Pursuant to 40 CFR § 257.94(e)(2), this document demonstrates that sources other than the Caledonia Ash Landfill were the cause of the SSIs listed above. This ASD was completed within 90 days of determination of the SSIs (April 15, 2018) as required by 40 CFR § 257.94(e)(2).

Pursuant to 40 CFR § 257.94(e)(2), the following lines of evidence were presented in this report to demonstrate that the listed SSIs are due to alternate sources as follows:

- Landfill Design and Hydrogeology
- Aquifer Geochemistry

The preceding information serves as the ASD prepared in accordance with 40 CFR § 257.94(e)(2) and supports the position that the SSIs observed during the first semi-annual detection monitoring event are not due to a release from the CCR unit but were from naturally occurring conditions. Therefore, no further action (i.e. assessment monitoring) is warranted and the Caledonia Ash Landfill will remain in detection monitoring.

I, Glenn R. Luke, a qualified professional engineer in good standing in the State of Wisconsin, certify that enclosed information is accurate as of the date of my signature below. The content of this report is not to be used for other than its intended purpose and meaning, or for extrapolations beyond the interpretations contained herein.

Glenn R. Luke, PE
Professional Engineer No. 42834-6
State of Wisconsin
O'Brien & Gere Engineers, Inc.
Date: April 15, 2018

I, Nathaniel R. Keller, a qualified professional geologist, certify that the enclosed information is accurate as of the date of my signature below. The content of this report is not to be used for other than its intended purpose and meaning, or for extrapolations beyond the interpretations contained herein.

Nathaniel R. Keller, PG
Professional Geologist No. 1283-013
State of Wisconsin
O'Brien & Gere Engineers, Inc.
Date: April 15, 2018

REFERENCES

Buska, Paul M., Fitzpatrick, John and Watson, Lee R. and Kay, Robert T. *Evaluation of Ground-Water and Boron Sources by Use of Boron Stable-Isotope Ratios, Tritium, and Selected Water Chemistry Constituents near Beverly Shores, Northwestern Indiana, 2004.* U.S. Geological Survey Scientific Investigations Report 2007-5166. 2007.

Harkness, Jennifer S., Thomas H. Darrah, Myles T. Moore, Colin J. Whyte, Paul D. Mathewson, Tyson Cook, and Avner Vengosh, 2017. Naturally Occurring versus Anthropogenic Sources of Elevated Molybdenum in Groundwater: Evidence for Geogenic Contamination from Southeast Wisconsin, United States. *Environmental Science & Technology* 2017 *51* (21), 12190-12199.

Natural Resource Technology, 2013. Hydrogeology, Groundwater Quality, and Environmental Monitoring, Oak Creek Site, Oak Creek and Caledonia, Wisconsin, January 21, 2013.

Natural Resource Technology, an OBG Company, 2017a, Sampling and Analysis Plan – Revision 2, Caledonia Ash Landfill, Caledonia, WI, September 29, 2017.

Natural Resource Technology, an OBG Company, 2017b, Statistical Analysis Plan, Caledonia Ash Landfill, Caledonia, WI, October 17, 2017.

Luczaj, John. And Kevin Masarik. Groundwater Quantity and Quality Issues in a Water-Rich Region: Examples from Wisconsin, USA. Resources, 2015 (4), 323-357.

Ruhl, Laura S., Vengosh, Avner, Dwyer, Gary S., Hsu-Kim, Heileen and Deonarine, Amrika.A Twenty-Month Geochemical and Isotopic Investigation into Environmental Impacts of the 2008 TVA Coal Ash Spill, – May Denver, CO, USA : s.n., 2011. 2011 World of Coal Ash (WOCA) Conference - May 9-12, 2011.

Ruhl, Laura. Boron and Strontium Isotopic Characterization of Coal Combustion Residuals: Validation of Novel Environmental Tracers, Paper No. 30616-208920.. Charlotte, NC : s.n., 2012. 2012 Geological Society of America Annual Meeting and Exposition, 4-7 November.

WDNR, 2013. Caledonia Groundwater Molybdenum Investigation, Southeast Wisconsin. January 2013.

Tables

Caledonia
Table 1. Caledonia Ash Landfill: Appendix III Analytical Results

Date Range: 11/11/2015 to 11/15/2017

Well Id	Date Sampled	Lab Id	B, tot, mg/L	Ca, tot, mg/L	Cl, tot, mg/L	F, tot, mg/L	pH (field), STD	SO4, tot, mg/L
W08D	11/11/2015	40124666006	0.4070	52.500	13.000	1.000	7.700	181.000
	02/16/2016	40128456003	0.4260	54.700	11.500	0.720	7.440	191.000
	05/11/2016	40132272002	0.4720	57.600	11.600	0.760	7.400	196.000
	08/30/2016	40137606003	0.4020	58.200	10.400	0.710	7.600	177.000
	11/14/2016	40142064003	0.4570	57.000	12.900	1.100	7.400	204.000
	02/08/2017	40145548002	0.4200	51.800	11.000	0.860	7.940	201.000
	05/15/2017	40150143005	0.4700	51.400	10.600	0.910	7.450	204.000
	08/22/2017	40155549007	0.4500	48.900	10.800	1.100	6.940	203.000
	11/14/2017	40161125002	0.4560	49.100	11.900	1.100	7.410	222.000
W09D	11/11/2015	40124666005	0.3790	19.900	4.600	1.300	8.200	30.400
	02/16/2016	40128456004	0.4040	18.600	4.900	1.300	8.340	31.200
	05/11/2016	40132272003	0.3890	18.800	4.900	1.400	8.130	32.300
	08/30/2016	40137606004	0.3500	19.900	4.100	1.300	8.300	31.500
	11/14/2016	40142064004	0.3890	18.900	3.900	1.400	8.300	33.900
	02/08/2017	40145548003	0.3700	18.400	4.000	1.300	8.190	33.500
	05/15/2017	40150143006	0.3800	17.900	3.800	1.400	7.830	33.400
	08/22/2017	40155549008	0.3900	17.700	3.800	1.300	7.700	31.800
	11/14/2017	40161125003	0.3940	18.600	4.900	1.400	8.230	32.200
W10D	11/11/2015	40124666004	0.3980	22.700	4.700	1.200	8.200	38.800
	02/17/2016	40128456007	0.4450	23.300	6.300	1.200	8.100	43.000
	05/11/2016	40132272005	0.4280	21.600	6.500	1.300	7.900	46.000
	08/30/2016	40137606005	0.3880	21.800	4.700	1.300	8.100	41.600
	11/14/2016	40142064005	0.4170	21.600	4.400	1.400	8.000	44.000
	02/08/2017	40145548005	0.3900	20.500	4.300	1.300	8.360	41.700
	05/15/2017	40150143007	0.4100	20.300	4.200	1.400	7.980	43.000
	08/22/2017	40155549009	0.4200	20.700	4.200	1.300	7.870	40.800
	11/14/2017	40161125004	0.4170	20.400	4.300	1.400	8.070	44.500
W12D	11/11/2015	40124666007	0.5010	26.700	5.300	1.200	8.400	100.000
	02/16/2016	40128456001	0.5140	24.400	5.600	1.200	8.200	104.000
	05/11/2016	40132272001	0.5250	25.300	5.700	1.300	8.000	105.000
	08/30/2016	40137606007	0.4860	26.400	4.900	1.200	8.300	98.500
	11/14/2016	40142064001	0.4970	24.500	5.300	1.300	8.200	109.000
	02/08/2017	40145548008	0.4800	24.800	4.900	1.200	8.520	108.000
	05/15/2017	40150143003	0.5100	24.400	4.700	1.200	8.090	108.000
	08/22/2017	40155549011	0.5300	24.300	4.700	1.200	7.610	109.000
W46D	11/11/2015	40124666001	0.3320	31.000	6.100	0.820	8.100	26.300

Caledonia
Table 1. Caledonia Ash Landfill: Appendix III Analytical Results

Date Range: 11/11/2015 to 11/15/2017

			B, tot, mg/L	Ca, tot, mg/L	Cl, tot, mg/L	F, tot, mg/L	pH (field), STD	SO4, tot, mg/L
W46D	02/17/2016	40128456008	0.3760	35.900	7.400	0.740	7.800	11.600
	05/11/2016	40132272008	0.4060	33.200	10.100	4.000	7.400	5.400
	08/30/2016	40137606006	0.3580	30.300	7.200	2.300	7.600	25.000
	11/14/2016	40142064007	0.3700	29.600	9.600	0.540	7.500	26.500
	02/08/2017	40145548006	0.3700	28.400	10.400	<0.500	7.210	25.700
	05/16/2017	40150143010	0.3700	25.900	9.900	1.100	7.150	30.200
	08/21/2017	40155549004	0.3800	28.100	10.600	1.000	7.410	29.100
	11/14/2017	40161125001	0.3910	27.000	6.800	1.200	7.580	34.500
W48	11/11/2015	40124666002	0.3490	27.200	4.600	0.900	8.000	2.300
	02/16/2016	40128456002	0.3730	24.900	5.000	0.900	8.000	3.000
	05/11/2016	40132272006	0.3850	26.700	4.900	0.980	7.900	2.600
	08/30/2016	40137606001	0.3440	28.100	4.100	0.900	8.000	<2.000
	11/14/2016	40142064006	0.3570	26.500	4.100	0.990	8.000	<1.000
	02/08/2017	40145548001	0.3500	26.300	4.000	0.930	8.170	1.300
	05/15/2017	40150143004	0.3600	25.100	3.800	0.950	7.990	<1.000
	08/21/2017	40155549006	0.3600	27.300	3.800	0.920	7.460	<1.000
	11/15/2017	40161125005	0.3700	27.400	4.100	1.000	7.860	<1.000
W49	06/21/2017	40152212001	0.4200	40.600	6.500	1.200	7.970	44.900
	08/22/2017	40155549012	0.4100	24.900	6.300	1.300	7.870	46.100
	11/15/2017	40161125007	0.4320	19.500	5.800	1.500	8.090	51.600
W50	06/02/2017	40151093001	0.5000	30.800	6.500	1.200	6.920	51.300
	08/22/2017	40155549013	0.5000	25.900	5.400	1.200	7.150	75.200
	11/15/2017	40161125008	0.4900	26.200	5.800	1.300	7.840	80.800

Caledonia
Table 1. Caledonia Ash Landfill: Appendix III Analytical Results

Date Range: 11/11/2015 to 11/15/2017

Well Id	Date Sampled	Lab Id	TDS, mg/L
W08D	11/11/2015	40124666006	432.000
	02/16/2016	40128456003	460.000
	05/11/2016	40132272002	446.000
	08/30/2016	40137606003	484.000
	11/14/2016	40142064003	510.000
	02/08/2017	40145548002	454.000
	05/15/2017	40150143005	448.000
	08/22/2017	40155549007	444.000
	11/14/2017	40161125002	416.000
W09D	11/11/2015	40124666005	202.000
	02/16/2016	40128456004	198.000
	05/11/2016	40132272003	194.000
	08/30/2016	40137606004	206.000
	11/14/2016	40142064004	206.000
	02/08/2017	40145548003	192.000
	05/15/2017	40150143006	200.000
	08/22/2017	40155549008	208.000
	11/14/2017	40161125003	170.000
W10D	11/11/2015	40124666004	222.000
	02/17/2016	40128456007	190.000
	05/11/2016	40132272005	206.000
	08/30/2016	40137606005	232.000
	11/14/2016	40142064005	210.000
	02/08/2017	40145548005	192.000
	05/15/2017	40150143007	196.000
	08/22/2017	40155549009	222.000
	11/14/2017	40161125004	180.000
W12D	11/11/2015	40124666007	272.000
	02/16/2016	40128456001	278.000
	05/11/2016	40132272001	258.000
	08/30/2016	40137606007	296.000
	11/14/2016	40142064001	284.000
	02/08/2017	40145548008	240.000
	05/15/2017	40150143003	276.000
	08/22/2017	40155549011	272.000
W46D	11/11/2015	40124666001	230.000

Caledonia
Table 1. Caledonia Ash Landfill: Appendix III Analytical Results

Date Range: 11/11/2015 to 11/15/2017

			TDS, mg/L
W46D	02/17/2016	40128456008	244.000
	05/11/2016	40132272008	218.000
	08/30/2016	40137606006	256.000
	11/14/2016	40142064007	260.000
	02/08/2017	40145548006	114.000
	05/16/2017	40150143010	230.000
	08/21/2017	40155549004	232.000
	11/14/2017	40161125001	196.000
W48	11/11/2015	40124666002	254.000
	02/16/2016	40128456002	222.000
	05/11/2016	40132272006	224.000
	08/30/2016	40137606001	242.000
	11/14/2016	40142064006	238.000
	02/08/2017	40145548001	224.000
	05/15/2017	40150143004	236.000
	08/21/2017	40155549006	254.000
	11/15/2017	40161125005	244.000
W49	06/21/2017	40152212001	236.000
	08/22/2017	40155549012	216.000
	11/15/2017	40161125007	210.000
W50	06/02/2017	40151093001	270.000
	08/22/2017	40155549013	256.000
	11/15/2017	40161125008	260.000

Table 2- Summary of Indicator Parameters

Caledonia Ash Landfill							
Location ID	Sample Date	Calcium	Magnesium	Sodium	Chloride (mg/L)	Sulfate	Boron
We Energies CCR Database							
Leachate	5/16/2017	330	35.7	216	105	1380	14.6
Leachate	8/22/2017	258	20.1	282	145	1190	15.2
W08D	5/15/2017	51.4	22.9	67.2	10.6	204	0.47
W08D	8/22/2017	48.9	21.7	66.6	10.8	203	0.45
W09D	5/15/2017	17.9	10.1	38.7	3.8	33.4	0.38
W09D	8/22/2017	17.7	9.9	40.8	3.8	31.8	0.39
W10D	5/15/2017	20.3	7.9	42.3	4.2	43	0.41
W10D	8/22/2017	20.7	8	44.3	4.2	40.8	0.42
W12D	5/15/2017	24.4	8.5	56.4	4.7	108	0.51
W12D	8/22/2017	24.3	8.3	56.1	4.7	109	0.53
W44	5/15/2017	23.7	22.6	20.9	2.4	16.8	0.25
W44	8/21/2017	23.2	21.6	21.2	2.2	18	0.25
W45B	5/15/2017	30.3	13.1	44.1	11.8	72.1	0.43
W45B	8/21/2017	30.4	12.6	45.2	11.5	72.3	0.44
W46D	5/16/2017	25.9	13.8	35.2	9.9	30.2	0.37
W46D	8/21/2017	28.1	15	36.3	10.6	29.1	0.38
W48	5/15/2017	25.1	16.1	42.6	3.8	0.5*	0.36
W48	8/21/2017	27.3	17.6	43.7	3.8	0.5*	0.36
W49	8/22/2017	24.9	10.7	46	6.3	46.1	0.41
W50	6/2/2017	30.8	12.6	56.2	6.5	51.3	0.5
W50	8/22/2017	25.9	9.7	56.7	5.4	75.2	0.5
Area 3 Harkness et al., 2017							
WI 2	Unknown	9.5	4.3	77.3	12.7	78.4	0.5813
WI-13		15.1	9	52	2.5	50	0.3451
WI-14		13	6.6	60	5.4	60.7	0.4681
WI-43		25.1	15	82.1	5.1	188	0.4196
Area 5 Harkness et al., 2017							
WI-7	Unknown	27.3	11.6	75.1	1.4	159	0.496
WI-8		27.1	12.3	69.5	1.4	157.9	0.498
WI-15		51.5	24.6	86.4	1.8	281.4	0.5638
WI-23		18.6	8.4	58.8	1.2	69.7	0.5489
WI-28		88	41.1	111.6	2.7	516.3	0.5124
WI-48		35.5	163	NA	1.8	215.2	0.5547
WDNR, 2013							
PW01	Unknown	19.8	9.93	51.5	10.2	52.4	0.448
PW02		31.3	14.1	44.9	10.9	83.7	0.387
PW03		19.5	7.95	50.5	8.7	52.5	0.458
PW04		19.2	8.51	51.3	7.91	59.2	0.463
PW05		24.4	10.6	98.1	31.3	76.6	0.799
PW06		20.2	9.62	47.3	10.7	45.9	0.47

Table 2- Summary of Indicator Parameters

Caledonia Ash Landfill							
Location	Sample	Calcium	Magnesium	Sodium	Chloride	Sulfate	Boron
PW07	Unknown	21.1	10.8	49.9	7.65	49.7	0.431
PW09		15.6	6.73	63.3	11	51.9	0.55
PW10		32.9	12.2	96.6	11.1	222	0.581
PW11		16.2	7.18	63.3	11.1	51.2	0.551
PW12		44.6	17.7	228	83.6	300	1.47
PW13		15.5	5.48	290	113	179	1.74
PW14		40.5	19.7	43.1	4.06	110	0.323
PW15		40.9	20.1	45.4	9.18	103	0.337
PW16		18.4	11.3	59.9	7.96	55.6	0.487
PW17		18.8	11.6	59.8	7.92	54.4	0.489
PW18		44.2	17.7	91.4	3.24	255	0.582
PW19		41.7	19.4	37.6	2.53	71.6	0.344
PW20		43.2	19.8	42.3	3.85	113	0.303
PW22		18.9	8.1	62.2	9.56	49.1	0.509
PW23		15	9.43	60.2	11.7	37.1	0.592
PW24		61.6	45.5	23.8	6.78	58.2	0.203
PW26		33.5	16.3	54.9	3.12	124	0.412
R-01		0.0709	ND	0.053	0.3	ND	0.0122

Notes: *Non-detect concentrations presented as a concentration equal to half of the detection limit.
ND = Not Detected, NA = Not Analyzed

Figures

DRAWN BY/DATE: SDS 4/5/18

REVIEWED BY/DATE: NRK 4/5/18

APPROVED BY/DATE: NRK 4/12/18

GROUNDWATER SAMPLING WELL LOCATION MAP

ALTERNATE SOURCE DEMONSTRATION
CALEDONIA ASH LANDFILL
CALEDONIA, WI

PROJECT NO: 67985

FIGURE NO: 1

DRAWN BY/DATE:
SDS 9/14/17
REVIEWED BY/DATE:
JJW 9/14/17
APPROVED BY/DATE:
GRL 10/16/17

UPPERMOST AQUIFER UNIT
GROUNDWATER ELEVATION CONTOUR MAP
AUGUST 21, 2017

WE ENERGIES CCR RULE GROUNDWATER MONITORING
ALTERNATE SOURCE DEMONSTRATION
CALEDONIA ASH LANDFILL
CALEDONIA, WISCONSIN

PROJECT NO: 67985

FIGURE NO: 2

DRAWN BY/DATE: SDS 4/5/18
REVIEWED BY/DATE: NRK 4/5/18
APPROVED BY/DATE: NRK 4/12/18

TOP OF UPPERMOST AQUIFER- SILURIAN DOLOMITE

ALTERNATE SOURCE DEMONSTRATION
CALEDONIA ASH LANDFILL
CALEDONIA, WI

PROJECT NO: 67985

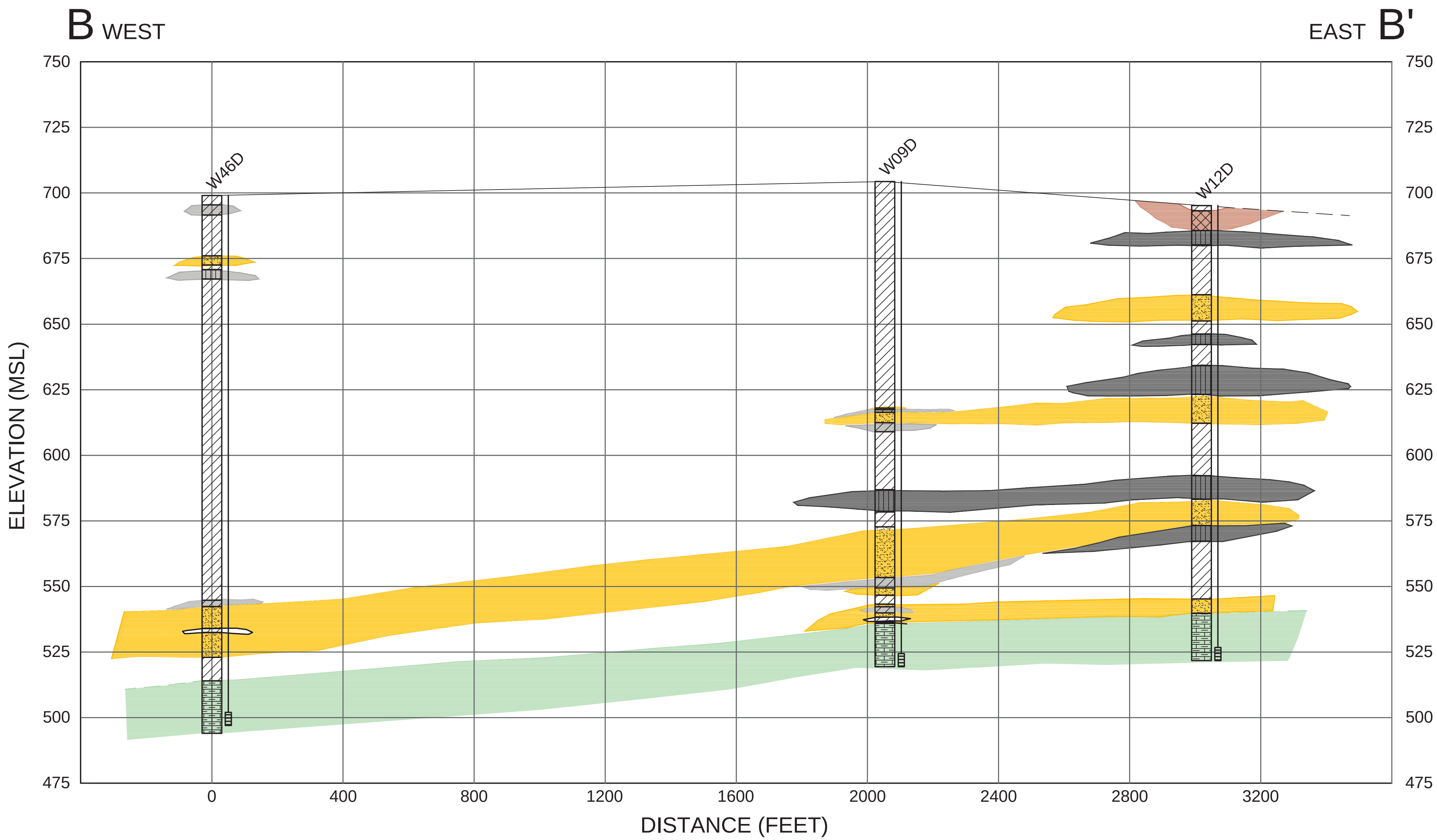
FIGURE NO: 3

N

0 350 700

SCALE IN FEET

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



W16D

MONITORING WELL LOCATION

B — B' CROSS-SECTION TRANSECT

ASH

SAND

SILT

CLAY

DOLOMITE (BEDROCK)

LOW/ NO RECOVERY

WELL SCREEN

ASH

SAND

SILT

SANDY CLAY/ SANDY SILT

DOLOMITE (BEDROCK)

VERTICAL SCALE IN FEET 50

400 HORIZONTAL SCALE IN FEET

VERTICAL EXAGGERATION = 8

DRAWN BY: DMD DATE: 04/14/15

CHECKED BY: JJW DATE: 04/28/15

APPROVED BY: JJW DATE: 04/28/15

DRAWING NO: Fig 3_Cross Section B-B

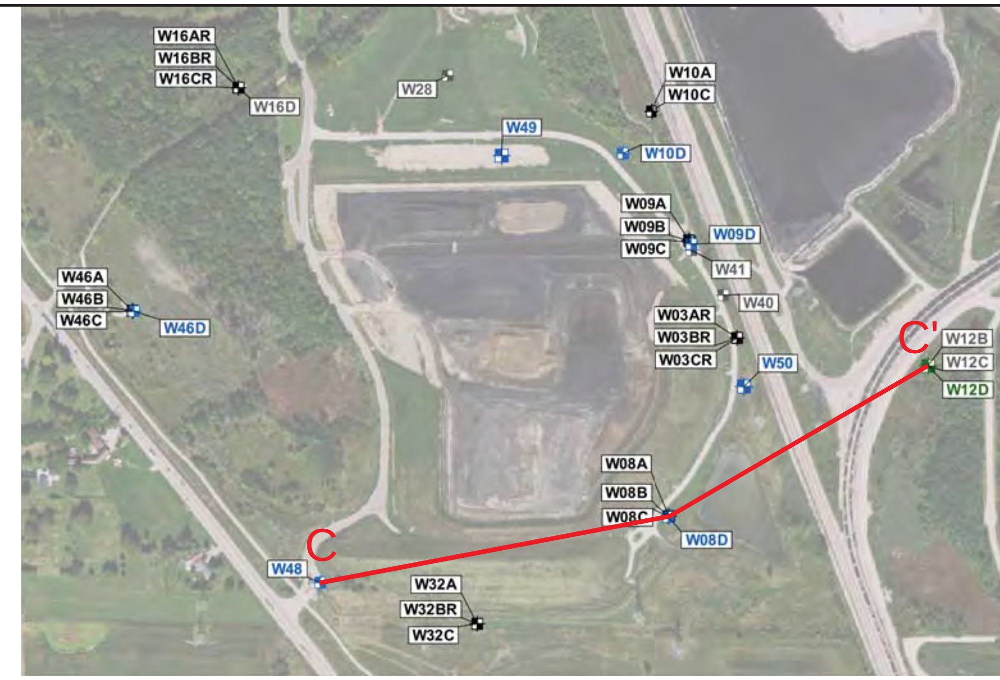
REFERENCE: .

GEOLOGIC CROSS-SECTION B-B'

WE ENERGIES CCR RULE GROUNDWATER MONITORING
ALTERNATE SOURCE DEMONSTRATION
WE ENERGIES CALEDONIA ASH LANDFILL
CALEDONIA, WISCONSIN

PROJECT NO.
67985

FIGURE NO.
4



N

0 350 700

SCALE IN FEET

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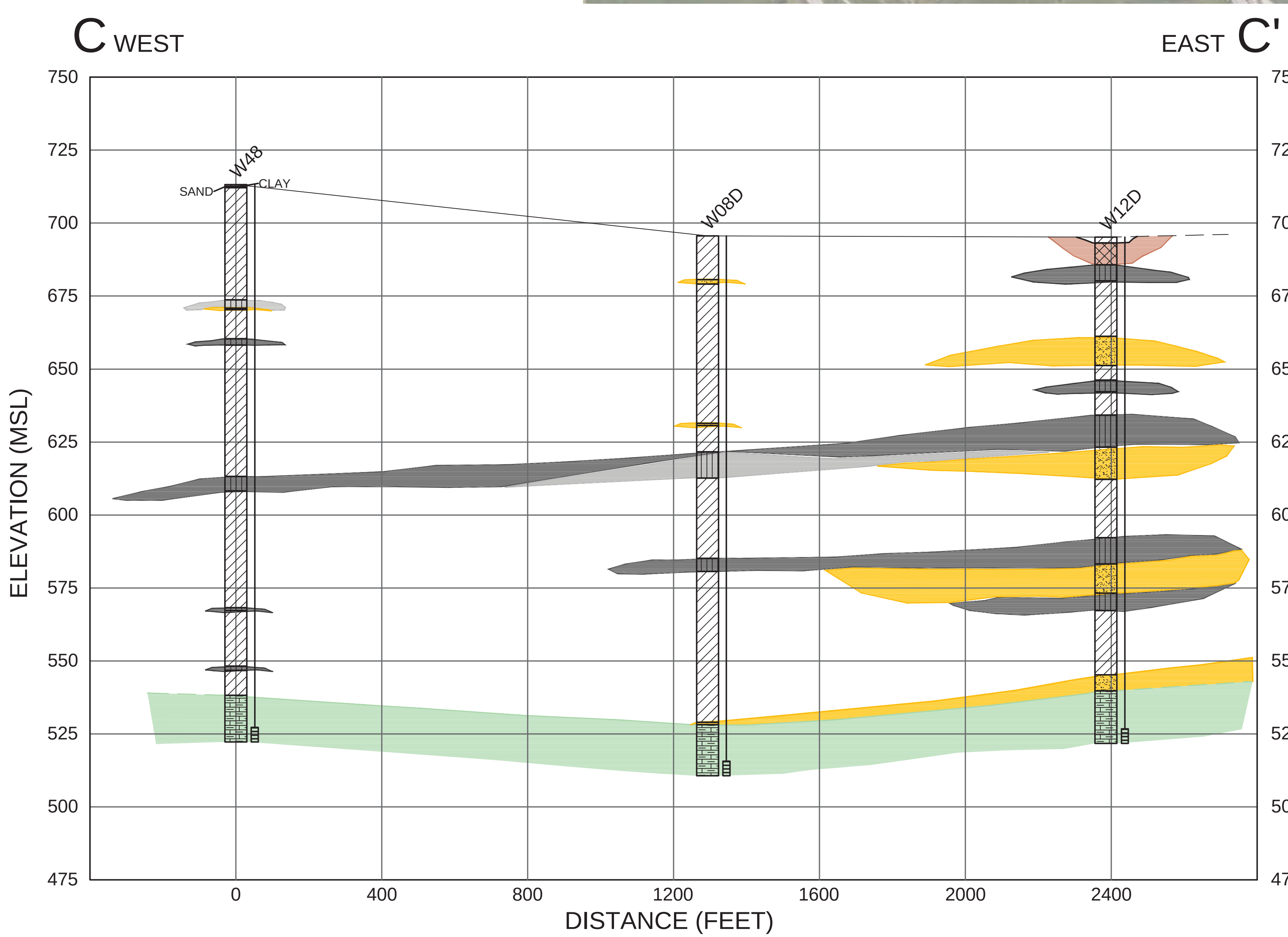

W16D	MONITORING WELL LOCATION
C — C'	CROSS-SECTION TRANSECT
	ASH
	SAND
	SILT
	CLAY
	DOLOMITE (BEDROCK)
	LOW/ NO RECOVERY
	WELL SCREEN
	ASH
	SAND
	SILT
	SANDY CLAY/ SANDY SILT
	DOLOMITE (BEDROCK)

VERTICAL SCALE IN FEET 50

HORIZONTAL SCALE IN FEET 400

VERTICAL EXAGGERATION = 8

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CHECKED BY:	JJW	DATE:	04/28/15
APPROVED BY:	JJW	DATE:	04/28/15
DRAWING NO:	Fig 4_Cross Section C-C		
REFERENCE: .			

GEOLOGIC CROSS-SECTION C-C'

WE ENERGIES CCR RULE GROUNDWATER MONITORING
ALTERNATE SOURCE DEMONSTRATION
WE ENERGIES CALEDONIA ASH LANDFILL
CALEDONIA, WISCONSIN

PROJECT NO.
67985

FIGURE NO.
5

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0 350 700

SCALE IN FEET

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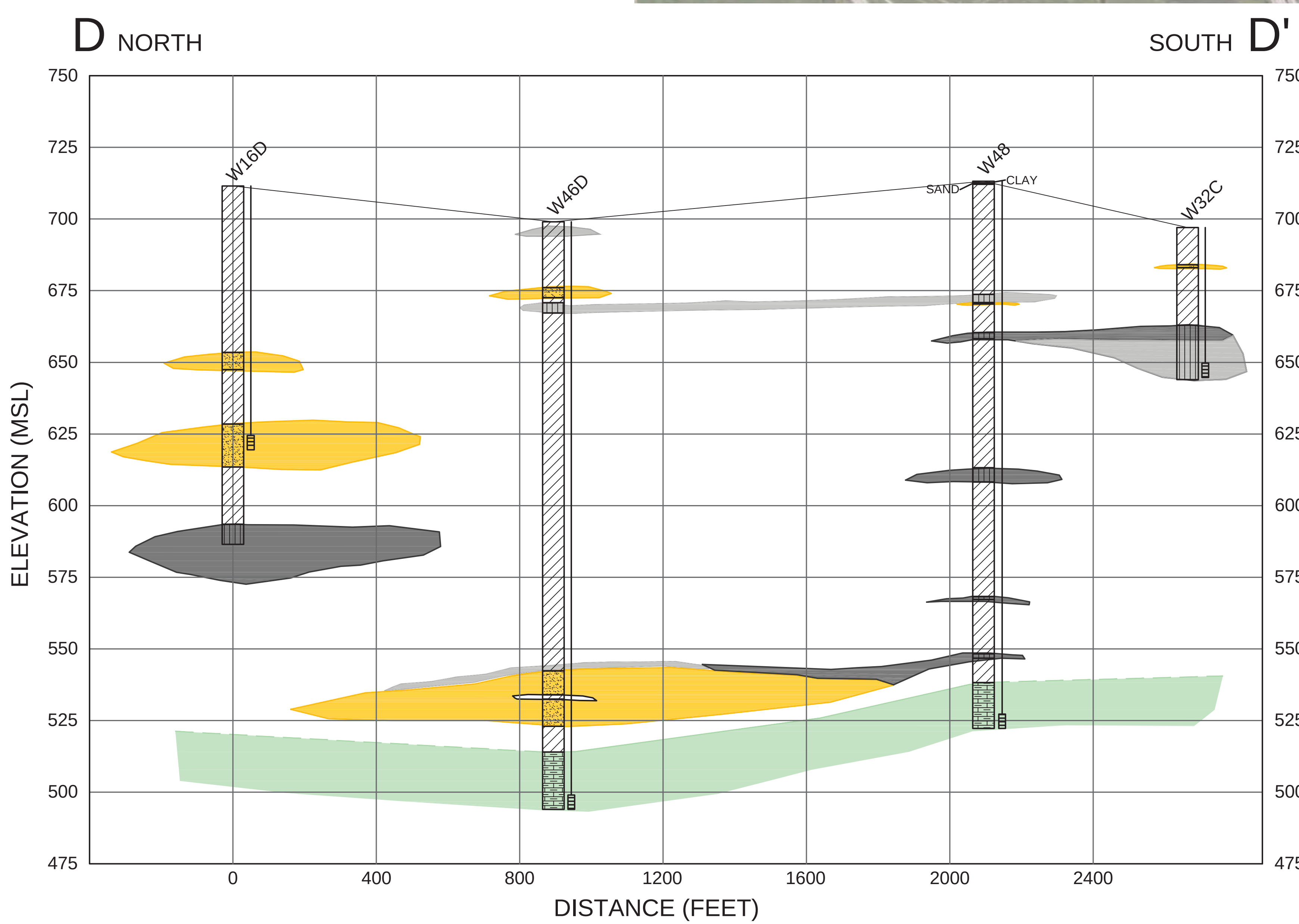

W16D MONITORING WELL LOCATION

D — D' CROSS-SECTION TRANSECT

SAND

SILT

CLAY

DOLOMITE (BEDROCK)

LOW/ NO RECOVERY

WELL SCREEN

SAND

SILT

SANDY CLAY/ SANDY SILT

DOLOMITE (BEDROCK)

VERTICAL SCALE IN FEET 50

HORIZONTAL SCALE IN FEET 400

VERTICAL EXAGGERATION = 8

DRAWN BY: DMD DATE: 04/14/15

CHECKED BY: JJW DATE: 04/28/15

APPROVED BY: JJW DATE: 04/28/15

DRAWING NO: Fig 2_Cross Section D-D

REFERENCE: .

GEOLOGIC CROSS-SECTION D-D'

WE ENERGIES CCR RULE GROUNDWATER MONITORING
ALTERNATE SOURCE DEMONSTRATION
WE ENERGIES CALEDONIA ASH LANDFILL
CALEDONIA, WISCONSIN

PROJECT NO.
67985

FIGURE NO.
6

N
0 350 700
SCALE IN FEET

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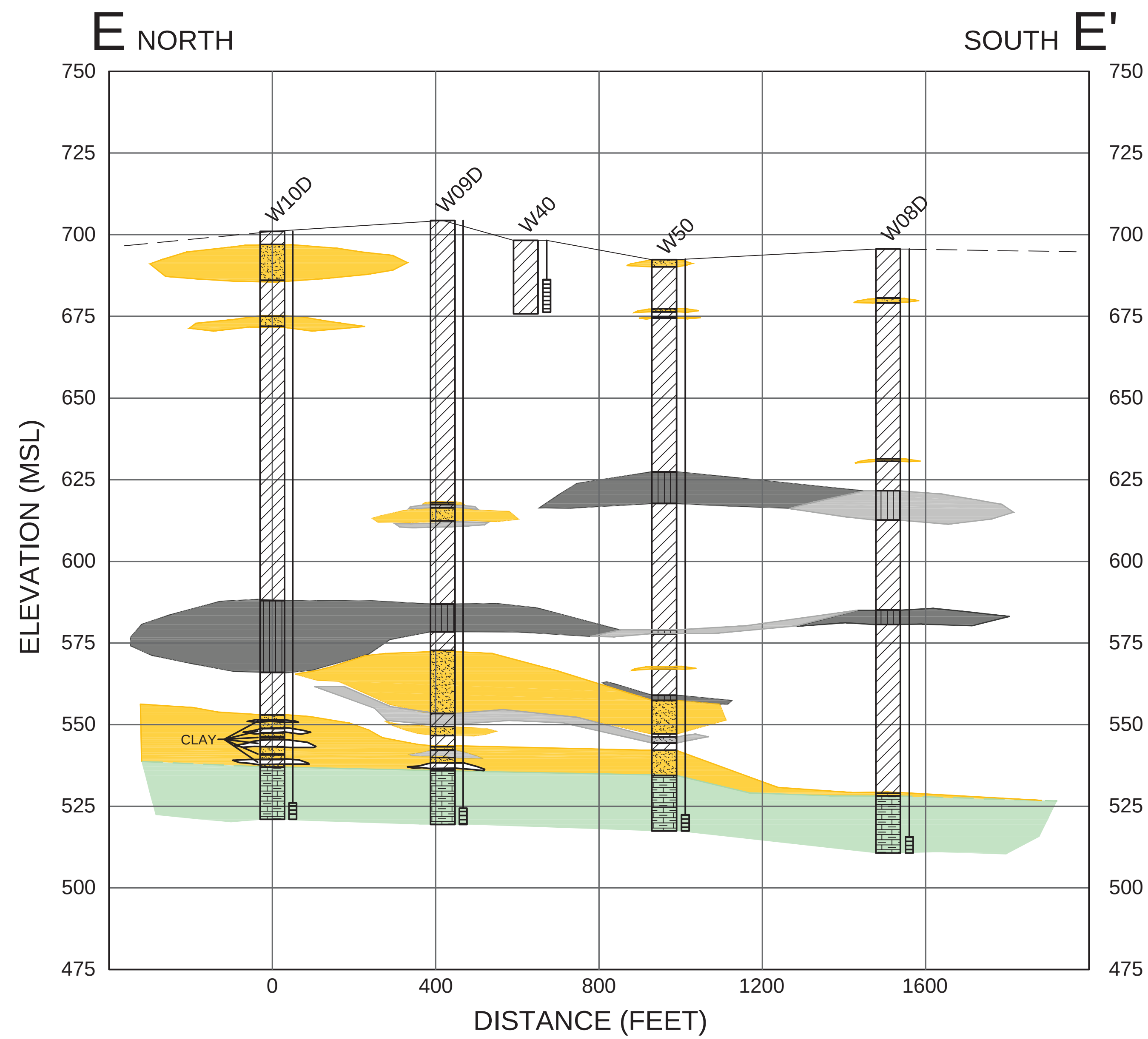

W16D MONITORING WELL LOCATION
E—E' CROSS-SECTION TRANSECT
SAND
SILT
CLAY
DOLOMITE (BEDROCK)
LOW/ NO RECOVERY
WELL SCREEN
SAND
SILT
SANDY CLAY/ SANDY SILT
DOLOMITE (BEDROCK)

VERTICAL SCALE IN FEET 50
400
HORIZONTAL SCALE IN FEET

VERTICAL EXAGGERATION = 8

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CHECKED BY: JJW	DATE: 08/31/17
APPROVED BY: JJW	DATE: 08/31/17
DRAWING NO: Fig 6_Cross Section E-E	
REFERENCE: .	

GEOLOGIC CROSS-SECTION E-E'

WE ENERGIES CCR RULE GROUNDWATER MONITORING
ALTERNATE SOURCE DEMONSTRATION
WE ENERGIES CALEDONIA ASH LANDFILL
CALEDONIA, WISCONSIN

PROJECT NO.
67985

FIGURE NO.
7

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Attachment A

Supplemental Regional Information

Figure A-1

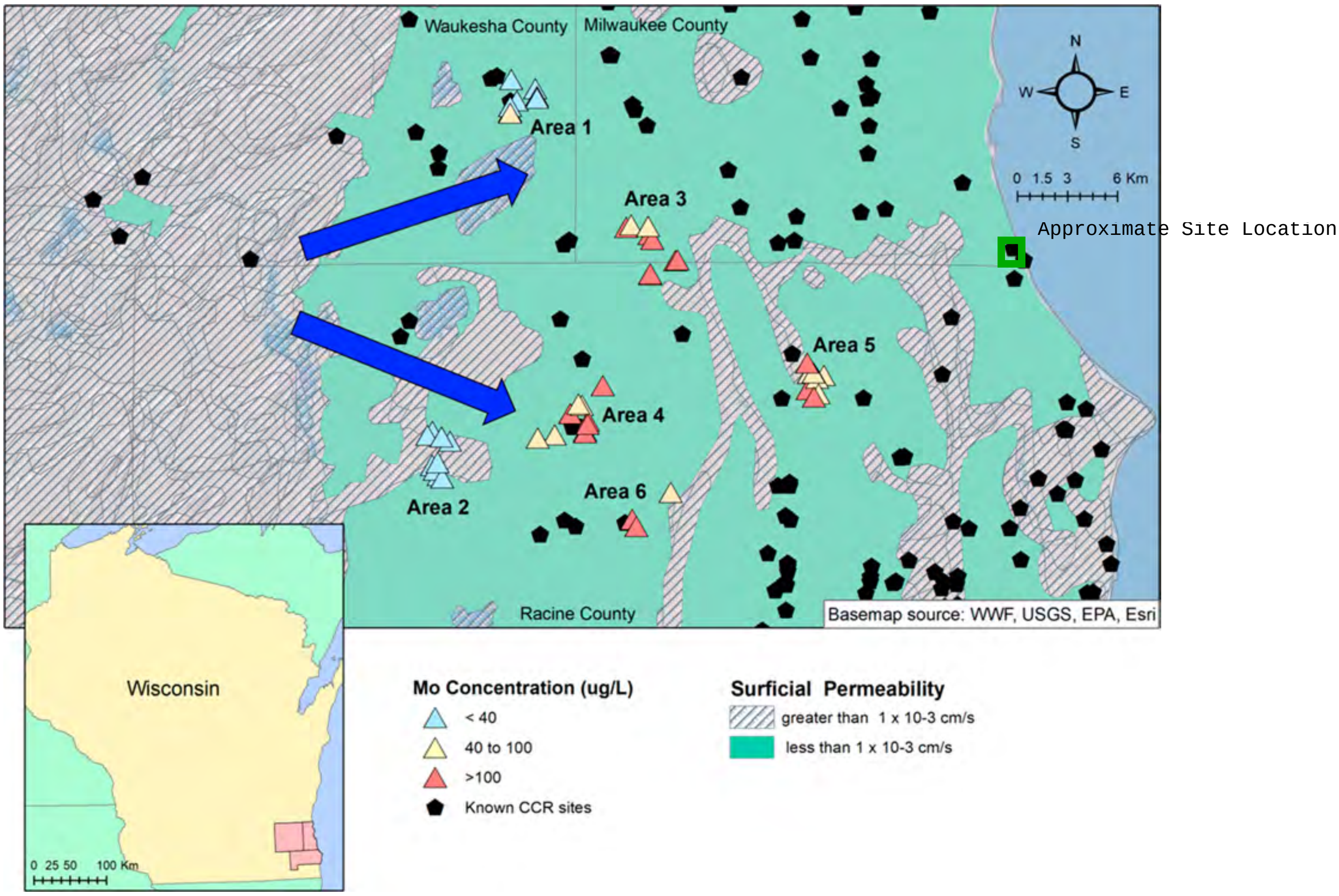


Figure 1. Location of drinking-water wells in southeast Wisconsin evaluated in this study. Areas 1−6 refer to the sample clusters selected for their previously reported molybdenum concentrations and locations with proximities to known coal ash disposal sites that include the following: Area 1 had previously reported low Mo and is located near (<1 km) known CCR disposal; Area 2 had previously reported low Mo and is located >1 km away from CCR disposal; Area 3 had previously reported high Mo and is located >1 km away from CCR disposal; Areas 4 and 6 had previously reported high Mo and are located near (<1 km) CCR disposal; and Area 5 was a mix of previously reported high and low Mo. The wells from these clusters are sorted by molybdenum concentrations measured in this study. The shaded areas in the western part of the region have higher hydraulic conductivity (>1 × 10^{-3} cm/s), and recharge of the regional groundwater occurs in this area. The green areas have relatively low hydraulic conductivity (<1 × 10^{-5} cm/s) and the surficial till deposits act as a confining layer.[31] The blue arrows represent regional groundwater flow from the recharge zone toward Lake Michigan to the east.[31]

concentrations of Mo in rocks (up to 1240 mg/kg) have been reported for organic-rich, sulphidic black shales.[4]

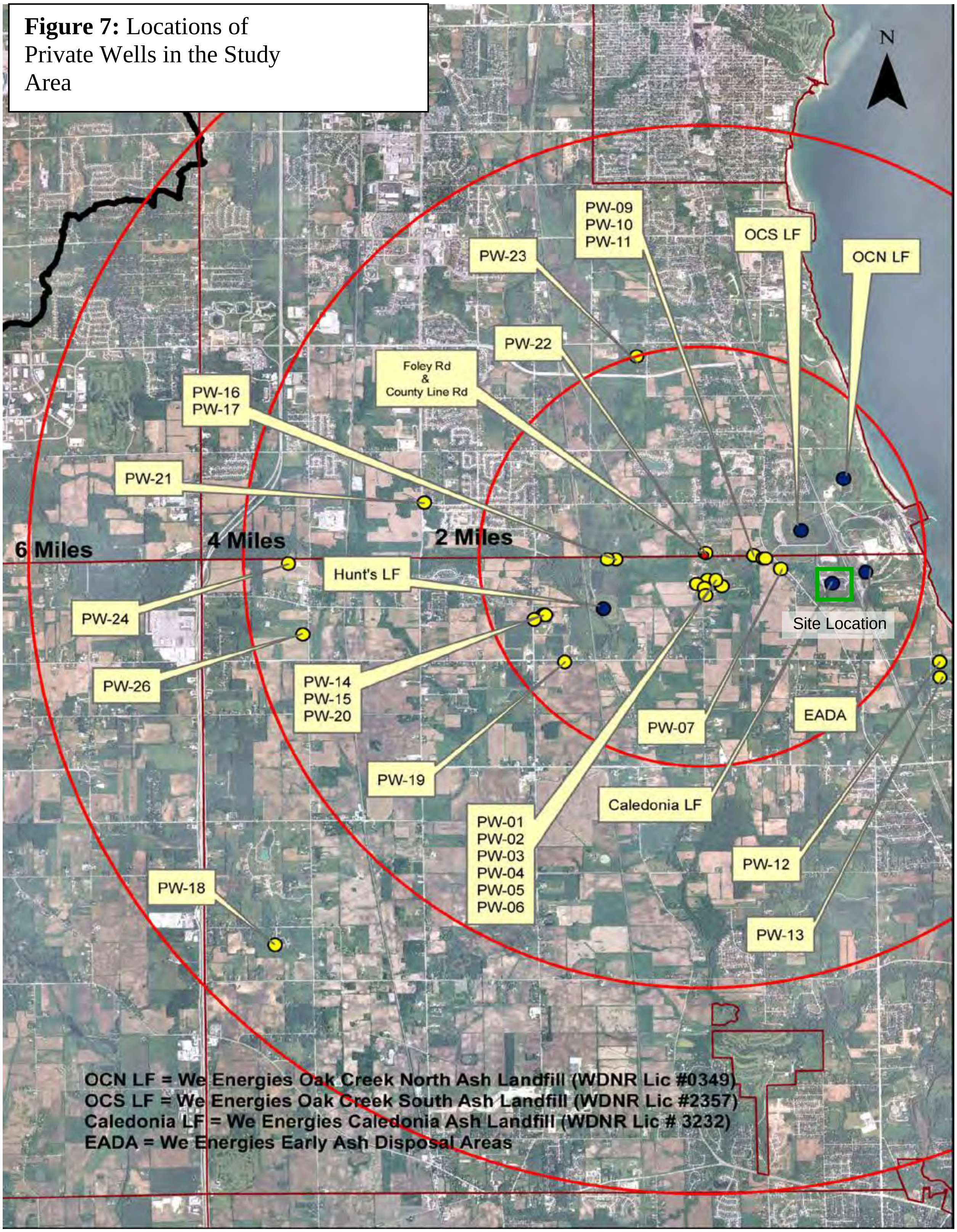
Recent studies have observed elevated concentrations of Mo and other metalloids such as Se and As in coals and coal combustion residues (CCR),[23] effluents derived from the discharge of coal ash ponds,[24] and groundwater and surface water impacted by CCR spills and leaking from coal ash ponds.[25,26] About 60% of CCRs generated in the U.S. are stored in surface impoundments and landfills, while the remaining volume is disposed through beneficial reuse.[27] Beneficial uses include encapsulating coal ash in concrete, wallboard, roofing material and bricks, while unencapsulated uses include structural fills and embankments for earth works and construction (i.e., roads). The unencapsulated uses currently account for a total of 12.6 million tons (27%) of CCRs reused in the U.S.;[27] however, there has been limited study on the impacts of this practice on underlying groundwater quality. Southeastern Wisconsin (Figure 1) represents an optimal study site for evaluating the possible connection between CCR surface disposal and the underlying groundwater quality. This area was chosen as a test location because of the association of CCR surface disposal with high concentrations of Mo and boron, another element strongly associated with CCR contamination, in drinking-water wells.[24,28,29]

About 85% of CCRs in Wisconsin have been disposed in the Wisconsin Electric Power Company (currently We Energies) landfills and as fill under roads, buildings, parks, and schools.[30] Clean Wisconsin, a nonprofit advocacy organization in Madison, WI, found records for more than one million tons of coal ash being "reused" between 1988 and 2012 in over 399 different construction projects throughout southeast Wisconsin.[31] On the basis of the occurrence of these activities, it was suggested that the high Mo in drinking-water wells in the study area may be from the leaching of Mo-rich effluents from the coal ash disposed widely throughout the area. However, a state run evaluation of drinking-water wells near a coal ash landfill pointed toward geogenic sources, such as the Maquoketa Shale confining layer or oxidation of pyrite found in the dolomite and shale.[32]

DOI: 10.1021/acs.est.7b03716
Environ. Sci. Technol. 2017, 51, 12190−12199

Figure A-2

Figure 7: Locations of Private Wells in the Study Area



4. Supporting Tables

Table S1. Field data for groundwater wells in southeastern Wisconsin. Well depth and lithology are from well drilling logs collected by the state. Conductivity, pH and ORP were measured in the field. NA represents constituents that were not analyzed.

Well ID	Aquifer	Well Depth (m)	Conductivity (µS/cm)	pH	ORP (mV)
Area 1 (Low Mo, known coal ash disposal)					
WI-16	Dolomite	71	294	8.7	-349.0
WI-18	Glacial Till	19	556	7.3	140.8
WI-19	Glacial Till	17	1222	7.3	-154.0
WI-20	Glacial Till	17	947	7.3	-246.0
WI-25	Dolomite	56	737	7.4	-438.0
WI-29	Glacial Till	27	772	7.5	-135.0
WI-41	Glacial Till	17	1093	7.3	-169.0
WI-42	Dolomite	31	491	7.6	-265.0
Area 2 (Low Mo, no known coal ash disposal)					
WI-9	Glacial Till	9	1397	7.2	-60.0
WI-10	Glacial Till	12	904	7.3	-24.0
WI-17	Dolomite	56	767	7.8	-283.0
WI-21	Dolomite	43	580	7.3	-464.0
WI-30	Dolomite	29	854	7.3	-284.0
WI-31	Glacial Till	43	959	7.2	-405.0
WI-36	Dolomite	41	645	7.3	-311.0
WI-37	Glacial Till	11	1175	6.9	-110.0
WI-39	Dolomite	53	601	7.2	-262.0
Area 3 (High Mo, no know coal ash disposal)					
WI 2	Dolomite	122	445.5	8.9	NA
WI-3	Glacial Till	51	632	8.6	NA
WI-13	Dolomite	107	355	8.9	-285.0
WI-14	Dolomite	102	379.5	8.9	-218.0
WI-22	Glacial Till	52	670	8.6	-378.0
WI-32	Glacial Till	94	470	8.3	-355.6
WI-38	Glacial Till	46	598	8.3	-352.0
WI-43	Dolomite	116	548	8.2	-192.0
WI-45	Glacial Till	90	341.5	8.4	-324.0
Area 4 (High Mo, known coal ash disposal)					
WI-1	Glacial Till	46	390	8.5	NA
WI-4	Dolomite	121	822	8.2	NA
WI-5	Dolomite	73	479	8.1	NA
WI-11	Glacial Till	46	1011	8.6	-157.0
WI-12	Dolomite	85	472	8.8	-210.0
WI-24	Dolomite	64	934	7.9	-347.0
WI-26	Dolomite	105	576	8.1	-319.0
WI-27	Dolomite	73	678	8.0	-283.0
WI-40	Dolomite	59	443	7.7	-218.0
WI-47	Dolomite	62	558	8.4	-295.0
Area 5 (Mix of high and low Mo)					
WI-6	Dolomite	49	1065	7.9	NA
WI-7	Dolomite	56	551	8.4	NA
WI-8	Dolomite	51	538.5	8.4	NA
WI-15	Dolomite	43	788	8.1	-272.6
WI-23	Dolomite	49	387	8.3	-470.0
WI-28	Dolomite	49	1313	8.3	-477.0
WI-34	Glacial Till	42	610	8.1	-133.0
WI-35	Dolomite	84	1518	8.2	-167.0
WI-48	Dolomite	49	636	8.1	-254.0
Area 6 (High Mo, known coal ash disposal)					
WI-33	Dolomite	99	655.5	8.1	-278.0
WI-44	Dolomite	58	857	7.9	-200.0
WI-46	Glacial Till	27	899	8.3	-313.0

Table S2. Water chemistry data for groundwater wells in southeastern Wisconsin. Data reported as b.d.l. are values below the detection limit of the analytical procedures. NA represents samples that were not analyzed for gas chemistry.

Well ID	Cl (mg/L)	SO_4 (mg/L)	DIC (mg/L)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	Mo (µg/L)	B (µg/L)	Sr (µg/L)	Mn (µg/L)	Fe (µg/L)	$\delta^{11}B$ (‰)	$^{87}Sr/^{86}Sr$
Area 1 (Low Mo, known coal ash disposal)													
WI-16	4.2	1.8	181	17.6	9.3	31.7	47.8	367.6	313.8	6.1	239.8	0.0	0.70919
WI-18	5.0	17.3	334	47.3	35.6	17.8	6.1	145.7	929.5	19.2	1394.6	14.4	0.70899
WI-19	142.4	68.6	434	81.7	70.9	69.0	3.7	156.1	1843.9	33.4	2749.2	5.5	0.70904
WI-20	42.0	119.0	424	65.7	67.7	21.7	4.1	127.5	1535.0	25.4	1759.0	2.9	0.70912
WI-25	21.2	53.4	375	63.9	44.6	16.6	4.9	100.2	959.1	40.3	2708.0	6.7	0.70923
WI-29	17.7	50.1	344	53.5	42.5	21.2	7.5	109.7	761.2	22.7	176.1	16.3	0.70919
WI-41	81.3	198.7	405	84.8	67.4	51.0	4.5	156.4	2847.4	18.4	1201.5	8.7	0.70889
WI-42	1.3	9.4	319	32.2	35.2	15.7	5.5	100.0	1004.7	7.4	463.2	2.7	0.70924
Area 2 (Low Mo, no known coal ash disposal)													
WI-9	261.4	38.4	432	95.1	45.3	163.2	1.8	57.7	108.0	54.5	b.d.l.	NA	NA
WI-10	47.1	20.0	481	88.4	45.8	30.0	0.7	31.3	74.2	0.0	b.d.l.	NA	NA
WI-17	4.0	10.8	505	71.7	52.4	9.4	1.8	80.4	622.3	21.2	2039.7	NA	0.70946
WI-21	1.4	0.8	405	39.8	37.3	27.4	0.7	155.6	663.3	17.3	1203.8	12.6	0.70932
WI-30	8.0	12.8	501	70.4	54.5	9.7	1.5	78.1	663.3	13.3	1359.5	NA	0.70934
WI-31	9.5	35.3	498	95.9	53.4	9.0	2.3	52.4	429.3	98.2	6580.6	6.4	0.70903
WI-36	2.9	13.5	499	65.9	48.6	12.1	2.0	66.6	624.0	22.8	1548.1	0.6	0.70941
WI-37	120.2	60.0	184	117.0	70.3	38.1	5.5	44.3	366.6	57.6	3704.5	NA	0.70987
WI-39	1.9	9.2	417	47.6	40.7	24.6	8.5	111.0	599.4	9.1	734.4	4.8	0.70938
Area 3 (High Mo, no know coal ash disposal)													
WI 2	12.7	78.4	NA	9.5	4.3	77.3	130.5	581.3	242.0	2.4	b.d.l.	22.2	0.70933
WI-3	3.6	209.5	NA	29.7	15.0	82.1	147.1	311.4	881.4	7.9	0.9	23.2	0.70896
WI-13	2.5	50.0	154	15.1	9.0	52.0	61.8	345.1	577.1	6.5	91.9	19.4	0.70897
WI-14	5.4	60.7	131	13.0	6.6	60.0	87.7	468.1	420.0	7.3	160.1	21.5	0.70910
WI-22	3.0	231.9	92	30.6	16.8	94.8	141.4	409.5	951.2	22.8	547.0	24.1	0.70896
WI-32	9.0	75.3	122	14.1	6.4	71.5	112.8	454.8	378.4	8.8	186.5	24.1	0.70903
WI-38	3.0	213.1	44	29.6	15.9	87.5	148.6	421.4	858.0	11.6	538.7	21.6	0.70897
WI-43	5.1	188.0	101	25.1	15.0	82.1	136.8	419.6	639.2	6.1	27.7	22.9	0.70919
WI-45	8.6	42.4	39	12.6	6.7	60.5	111.9	423.9	440.2	5.5	113.2	21.7	0.70896
Area 4 (High Mo, known coal ash disposal)													
WI-1	3.4	95.2	133	16.6	8.2	67.0	116.9	308.5	557.4	3.3	18.8	20.3	0.70889
WI-4	10.9	176.9	263	24.1	13.8	132.1	64.5	840.3	524.3	4.2	24.7	24.4	0.70955
WI-5	2.5	93.6	181	25.1	16.1	57.4	65.9	206.5	306.0	2.7	24.2	20.2	0.70967
WI-11	4.3	404.6	93	58.4	28.7	114.2	114.7	411.8	1706.7	16.8	93.4	22.6	0.70892
WI-12	1.5	64.4	140	2.3	0.4	105.4	45.9	344.2	1.4	b.d.l.	b.d.l.	16.0	NA
WI-24	2.4	359.4	99	57.3	29.8	102.6	132.1	413.0	1757.1	22.6	358.9	20.4	NA
WI-26	3.1	174.5	124	27.9	17.0	72.5	138.8	345.3	714.6	3.6	66.0	19.3	0.70904
WI-27	3.2	173.0	128	22.6	14.1	55.2	134.9	351.6	783.9	4.3	67.2	19.9	NA
WI-40	1.9	54.9	217	23.9	17.1	55.5	40.5	307.8	632.1	4.8	185.0	12.9	0.70912
WI-47	3.2	151.2	127	1.6	0.2	124.9	115.0	399.3	1.7	b.d.l.	b.d.l.	19.3	NA
Area 5 (Mix of high and low Mo)													
WI-6	2.7	336.8	194	4.6	1.2	222.3	41.1	471.6	35.1	13.8	169.2	25.2	NA
WI-7	1.4	159.0	116	27.3	11.6	75.1	106.4	496.0	855.0	12.1	133.5	26.2	0.70899
WI-8	1.4	157.9	NA	27.1	12.3	69.5	103.1	498.0	699.4	7.7	95.4	24.5	0.70913
WI-15	1.8	281.4	120	51.5	24.6	86.4	96.2	563.8	1963.8	11.9	213.6	26.2	0.70894
WI-23	1.2	69.7	154	18.6	8.4	58.8	65.4	548.9	731.7	5.4	157.7	26.9	0.70897
WI-28	2.7	516.3	87	88.0	41.1	111.6	95.0	512.4	3043.8	15.8	592.0	26.6	0.70893
WI-34	1.5	87.8	90	30.3	14.3	67.7	90.7	513.6	1043.9	51.3	157.4	26.5	NA
WI-35	2.5	582.6	66	6.5	0.4	320.1	126.9	522.1	6.9	b.d.l.	b.d.l.	29.1	NA
WI-48	1.8	215.2	62	35.5	163.0	NA	112.3	554.7	1040.8	6.9	69.7	27.0	0.70901
Area 6 (High Mo, known coal ash disposal)													
WI-33	1.3	153.9	139	31.0	21.6	63.3	81.8	406.5	1009.3	4.6	145.5	23.8	0.70900
WI-44	3.8	349.1	83	43.3	27.3	102.3	108.5	762.0	1232.5	19.5	195.7	24.7	0.70914
WI-46	3.0	345.9	94	17.8	7.4	174.7	118.3	527.3	579.3	4.4	b.d.l.	26.9	0.70886

Table S3. Noble gas data for groundwater wells in southeastern Wisconsin. Data reported as b.d.l. are values below the detection limit of the analytical procedures. NA represents samples that were not analyzed for gas chemistry.

Well ID	Aquifer	^{3}He (pcc/L)	^{4}He (μcc/L)	R/R_A	Tritium (T.U.)	Mean residence time (years)	(He/Ne)	$(He/Ne)_{AIR}$
Area 1 (Low Mo, known coal ash disposal)								
WI-16	Dolomite	98.3	366.41	0.2	b.d.l.	694	2.0	6.88
WI-18	Glacial Till	106.8	66.14	1.2	0.9	34.0	0.4	1.40
WI-19	Glacial Till	70.9	50.80	1.0	0.5	13.8	0.3	1.17
WI-20	Glacial Till	87.5	40.78	1.7	11.1	19.0	0.3	1.19
WI-25	Dolomite	159.5	67.83	1.7	2.1	44.4	0.4	1.27
WI-29	Glacial Till	245.0	310.83	0.6	b.d.l.	576	1.6	5.47
WI-41	Glacial Till	332.4	950.18	0.3	b.d.l.	1937	2.5	8.70
WI-42	Dolomite	118.9	156.85	0.5	0.2	249	0.7	2.53
Area 2 (Low Mo, no known coal ash disposal)								
WI-9	Glacial Till	252.0	672.23	0.3	b.d.l.	1345	3.3	11.38
WI-10	Glacial Till	769.8	4379.27	0.1	b.d.l.	9233	24.0	83.46
WI-17	Dolomite	86.7	65.88	1.0	0.2	35.2	0.3	1.02
WI-21	Dolomite	201.4	940.26	0.2	b.d.l.	1915	3.4	11.66
WI-30	Dolomite	72.3	43.22	1.2	8.2	10.9	0.3	1.02
WI-31	Glacial Till	215.4	456.88	0.3	b.d.l.	887	2.6	8.88
WI-36	Dolomite	83.0	58.80	1.0	0.1	38.9	0.4	1.37
WI-37	Glacial Till	49.1	35.05	1.0	0.8	10.5	0.3	1.09
WI-39	Dolomite	118.0	83.94	1.0	0.1	39.4	0.4	1.28
Area 3 (High Mo, no know coal ash disposal)								
WI 2	Dolomite							
WI-3	Glacial Till	330.6	1657.93	0.1	b.d.l.	3442	6.7	23.15
WI-13	Dolomite	119.2	302.23	0.3	b.d.l.	558	1.4	4.70
WI-14	Dolomite	NA	NA	NA	NA	NA	NA	NA
WI-22	Glacial Till	1900.9	8209.12	0.2	b.d.l.	17381	45.7	158.63
WI-32	Glacial Till	118.0	860.61	0.1	b.d.l.	1746	2.8	9.78
WI-38	Glacial Till	3261.5	9223.47	0.3	b.d.l.	19539	20.4	70.94
WI-43	Dolomite	116.3	481.02	0.2	b.d.l.	938	2.1	7.18
WI-45	Glacial Till	3987.7	10545.65	0.3	b.d.l.	22352	116.7	405.16
Area 4 (High Mo, known coal ash disposal)								
WI-1	Glacial Till	71.0	251.07	0.2	b.d.l.	449	1.2	4.13
WI-4	Dolomite	294.5	1738.35	0.1	b.d.l.	3614	9.0	31.40
WI-5	Dolomite	90.7	192.95	0.3	1.2	325	0.9	3.10
WI-11	Glacial Till	NA	NA	NA	NA	NA	NA	NA
WI-12	Dolomite	74.2	254.66	0.2	b.d.l.	457	1.1	3.78
WI-24	Dolomite	111.2	271.05	0.3	b.d.l.	492	1.3	4.69
WI-26	Dolomite	96.7	249.96	0.3	0.3	447	1.3	4.51
WI-27	Dolomite	248.2	1583.19	0.1	b.d.l.	3283	5.5	19.09
WI-40	Dolomite	78.1	194.49	0.3	0.3	329	0.8	2.85
WI-47	Dolomite	182.6	175.03	0.8	b.d.l.	287	0.4	1.30
Area 5 (Mix of high and low Mo)								
WI-6	Dolomite	185.8	510.45	0.3	b.d.l.	1001	2.3	7.90
WI-7	Dolomite	131.4	259.00	0.4	0.9	466	1.0	3.36
WI-8	Dolomite	79.5	249.70	0.2	b.d.l.	446	1.1	3.82
WI-15	Dolomite	113.7	439.65	0.2	b.d.l.	850	1.2	4.29
WI-23	Dolomite	599.7	2630.44	0.2	b.d.l.	5512	9.9	34.24
WI-28	Dolomite	198.0	474.74	0.3	b.d.l.	925	1.9	6.58
WI-34	Glacial Till	102.9	198.80	0.4	b.d.l.	338	1.1	3.87
WI-35	Dolomite	238.8	2071.99	0.1	b.d.l.	4323	7.0	24.28
WI-48	Dolomite	93.5	363.04	0.2	b.d.l.	687	1.2	4.01
Area 6 (High Mo, known coal ash disposal)								
WI-33	Dolomite	147.6	215.87	0.5	b.d.l.	374	1.0	3.47
WI-44	Dolomite	119.4	298.67	0.3	b.d.l.	550	0.8	2.87
WI-46	Glacial Till	559.1	1853.63	0.2	b.d.l.	3859	12.6	43.88

Table 1: Summary of Private Well Inorganic Parameter Sample Data

NA = Not Analyzed ND = Not Detected

			Molybdenum, Boron and Strontium					Indicators					RCRA Metals								Other Metals and Inorganics									
Sample ID	Well Depth (ft BGS) Casing Depth (ft BGS) Geologic Unit Well Open in	Sample Date	Molybdenum Concentration (ug/L)	Previous Mo Concentrations (ug/L)	Boron Concentration (ug/L)	Previous Boron Concentrations (ug/L)	Strontium Concentration (ug/L)	Total Dissolved Solids (mg/L)	Hardness (mg $CaCO_3$ / L)	Total Alkalinity (mg $CaCO_3$ / L)	Chloride (mg/L)	Calcium (ug/L)	Barium (ug/L)	Mercury (ug/L)	Lead (ug/L)	Selenium (ug/L)	Arsenic (ug/L)	Cadmium (ug/L)	Chromium (ug/L)	Silver (ug/L)	Aluminum (ug/L)	Iron (ug/L)	Sulfate as SO_4 (mg/L)	Magnesium (ug/L)	Potassium (ug/L)	Sodium (ug/L)	Thallium (ug/L)	Thorium (ug/L)	Uranium (ug/L)	Vanadium (ug/L)
			NR 140 ES: 40 ug/L		NR 140 ES: 1000 ug/L		NR 140 ES: None	NR 140 ES: None	NR 140 ES: None	NR 140 ES: None	NR 140 ES: 250 mg/L	NR 140 ES: None	NR 140 ES: 2000 ug/L	NR 140 ES: 2 ug/L	NR 140 ES: 15 ug/L	NR 140 ES: 50 ug/L	NR 140 ES: 10 ug/L	NR 140 ES: 5 ug/L	NR 140 ES (Total): 100 ug/L	NR 140 ES: 50 ug/L	NR 140 ES: 200 ug/L	NR 140 ES: 300 ug/L	NR 140 ES: 250 mg/L	NR 140 ES: None	NR 140 ES: None	NR 140 ES: None	NR 140 ES: 2 ug/L	NR 140 ES: None	MCL: 30 ug/L	NR 140 ES: 30 ug/L
PW-01	225 150 Limestone	09/26/2011	80	66, 62	448	471, 455	525	242	90.3	130	10.2	19800	31.1	0.2	0.069	ND	ND	ND	ND	ND	ND	542	52.4	9930	864	51500	ND	0.23	ND	ND
PW-02	250 150 Limestone	09/26/2011	88.2	85, 83	387	399, 394	716	262	136	130	10.9	31300	16.9	ND	0.195	ND	ND	ND	ND	ND	ND	112	83.7	14100	1930	44900	ND	0.077	ND	ND
PW-03	220 153 Limestone	09/26/2011	66.8	70, 67	458	480, 470	355	230	81.4	120	8.7	19500	33.6	ND	0.148	ND	ND	ND	ND	ND	ND	191	52.5	7950	833	50500	ND	0.282	0.077	ND
PW-04	175 140 Limestone	09/26/2011	64	65	463	450	644	234	83.1	120	7.91	19200	32.8	ND	4.26	ND	ND	ND	ND	ND	ND	384	59.2	8510	1060	51300	ND	0.099	ND	ND
PW-05	325 145 Limestone	09/26/2011	33.2	37, 35	799	859	581	356	104	180	31.3	24400	22.6	ND	2.82	ND	ND	ND	ND	ND	ND	343	76.6	10600	3680	98100	ND	0.299	ND	ND
PW-06	216 143 Limestone	09/26/2011	54.1	61, 59	470	508, 535	753	236	90.1	130	10.7	20200	38.2	ND	0.265	ND	0.376	ND	ND	ND	ND	51.5	45.9	9620	881	47300	ND	0.108	ND	ND
PW-07	Info Not Available	09/27/2011	32.4	45, 27, 39	431	540, 420, 420	975	250	97.2	140	7.65	21100	46.9	ND	6.12	ND	0.616	0.27	ND	ND	ND	6240	49.7	10800	944	49900	ND	0.071	ND	ND
PW-08	222 180 Limestone																													
PW-09	190 176 Limestone	09/26/2011	42.5	31.5, 42	550	532, 482	519	234	66.6	130	11	15600	28.7	ND	0.125	ND	ND	ND	ND	ND	ND	84.1	51.9	6730	797	63300	ND	ND	ND	ND
PW-10	Info Not Available	09/27/2011	145	124, 89.4	581	532, 482	1720	424	132	77	11.1	32900	34.1	0.4	1.47	ND	ND	ND	ND	ND	ND	213	222	12200	858	96600	ND	ND	ND	ND
PW-11	Info Not Available	09/26/2011	41.1	58, 42, 33, 56	551	720, 570, 520, 520	540	250	70.1	130	11.1	16200	32.2	ND	0.487	ND	ND	ND	ND	ND	ND	531	51.2	7180	815	63300	ND	ND	ND	ND
PW-12	305 143 Limestone	09/27/2011	35.9	44	1470	1190	1950	786	184	210	83.6	44600	5.54	ND	0.35	ND	ND	ND	ND	ND	ND	800	300	17700	4080	228000	ND	0.055	0.088	ND
PW-13	325 114 Red Shale	09/27/2011	10.9	24	1740	1040	466	764	61.3	310	113	15500	1.65	ND	0.113	ND	ND	ND	ND	ND	57.9	127	179	5480	5270	290000	ND	0.225	0.127	ND
PW-14	Info Not Available	09/26/2011	49.3	50	323	302	718	308	182	150	4.06	40500	23.7	ND	0.218	ND	1.07	ND	ND	ND	ND	1210	110	19700	2220	43100	ND	0.359	0.221	ND
PW-15	125 75 Limestone	09/26/2011	48.9	50	337	327	777	306	185	150	9.18	40900	25.3	ND	0.198	ND	1.17	ND	ND	ND	ND	387	103	20100	1940	45400	ND	0.075	0.165	ND
PW-16	Info Not Available	09/27/2011	40.2	43	487	470	975	264	92.6	140	7.96	18400	29.1	ND	0.663	ND	ND	ND	ND	ND	ND	442	55.6	11300	826	59900	ND	0.053	ND	ND
PW-17	Info Not Available	09/26/2011	41.7	37, 43	489, 477	473	990	256	94.4	150	7.92	18800	28.9	ND	1.22	ND	ND	ND	ND	ND	ND	283	54.4	11600	818	59800	ND	ND	ND	ND
PW-18	198 141 Red Shale	09/27/2011	121	120	582	540	1360	476	183	90	3.24	44200	37.6	ND	0.236	ND	ND	ND	ND	ND	ND	202	255	17700	1270	91400	ND	ND	ND	ND
PW-19	Info Not Available	09/26/2011	25.1	26	344	359	972	310	184	190	2.53	41700	66.7	ND	25.1	ND	0.464	ND	ND	ND	ND	625	71.6	19400	1650	37600	ND	ND	ND	ND
PW-20	Info Not Available	09/27/2011	45.6	46	303	300	677	318	190	150	3.85	43200	23.1	ND	0.355	ND	0.592	ND	ND	ND	ND	596	113	19800	2840	42300	ND	ND	ND	ND
PW-21	Owner said well at ~300', Water at ~50', Pump at ~98'	09/29/2011	NA	55	NA	460	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
PW-22	Info Not Available	09/26/2011	35.6	36, 35	509	542, 523	710	212	80.7	140	9.56	18900	28.2	ND	8.06	ND	ND	ND	ND	ND	ND	441	49.1	8100	837	62200	ND	0.19	ND	ND
PW-23	Info Not Available	09/26/2011	16.3	16	592	604	2610	216	76.2	150	11.7	15000	108	ND	0.361	ND	ND	ND	ND	ND	ND	54.6	37.1	9430	1130	60200	ND	0.208	ND	ND
PW-24	100 57 Limestone	09/27/2011	15.6	NA	203	NA	2110	422	341	330	6.78	61600	70.2	ND	0.43	ND	3.36	ND	ND	ND	ND	1070	58.2	45500	1970	23800	ND	0.06	0.446	ND
PW-25	157 85 Limestone																													
PW-26	Info Not Available	09/27/2011	70.6	NA	412	NA	956	352	151	130	3.12	33500	20.5	ND	1.12	ND	3.58	ND	ND	ND	ND	360	124	16300	1340	54900	ND	ND	ND	ND
R-01		09/27/2011	ND	NA	12.2	NA	0.4	NA	ND	ND	0.3	70.9	ND	ND	ND	ND	0.327	ND	ND	ND	ND	ND	ND	ND	ND	53	ND	ND	ND	0.38
PW-27	Duplicate for PW-07	09/27/2011	29.5	NA	431	NA	984	260	97.5	140	7.78	21100	46.6	ND	5.58	ND	0.303	0.235	ND	ND	ND	5590	48.5	10900	1000	51500	ND	ND	ND	ND
PW-28	Duplicate for PW-13	09/27/2011	10.7	NA	1740	NA	476	818	61.9	320	112	15700	1.67	ND	0.284	0.217	ND	ND	ND	ND	44.2	113	178	5500	5170	290000	ND	0.115	0.126	ND
PW-29	Duplicate for PW-18	09/27/2011	114	NA	580	NA	1360	480	182	90	3.21	44000	36.3	ND	0.479	ND	ND	ND	ND	ND	ND	191	256	17500	1310	92100	ND	ND	ND	ND
PW-30	Field Blank		ND	NA	ND	NA	ND	NA	ND	NA	NA	ND	0.065	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	70.3	ND	0.18	0.13	ND
PW-31	Field Blank		ND	NA	7.2	NA	ND	NA	ND	NA	NA	ND	5.99	ND	0.077	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	56.1	ND	ND	ND	ND

Table 7: Summary of Private Well Molybdenum, Boron & Strontium Isotopes and Tritium Data

NA = Not Analyzed   ND = Not Detected

			Tritium, Molybdenum, Boron & Strontium											
Sample ID	Well Depth (ft BGS) Casing Depth (ft BGS) Geologic Unit Well Open in	Sample Date	Tritium (TU) 1TU = 3.221 Picocurries/L	Tritium ± 1σ	Molybdenum Concentration (ug/L)	Previous Mo Concentrations (ug/L)	Molybdenum Isotope (δ 98/95 Mo) (per mil)	2sd	n (# of repetitions)	Boron Concentration (ug/L)	Previous Boron Concentrations (ug/L)	Boron Isotope (δ ^{11}B) (per mil)	Strontium Concentration (ug/L)	Strontium Isotope 87/86 Sr
					NR 140 ES: 40 ug/L					NR 140 ES: 1000 ug/L			NR 140 ES: None	
PW-01	225 150 Limestone	09/26/2011	1.1	0.3	80	66, 62	2.16 & 2.33	0.06 & 0.03	5 & 3	448	471, 455	24.23	525	0.70900
PW-02	250 150 Limestone	09/26/2011	<0.8	0.4	88.2	85, 83	2.68	0.01	3	387	399, 394	16.98	716	0.70906
PW-03	220 153 Limestone	09/26/2011	0.9	0.4	66.8	70, 67	NA	NA	NA	458	480, 470	25.22	355	0.70909
PW-04	175 140 Limestone	09/26/2011	1.0	0.4	64	65	NA	NA	NA	463	450	23.73	644	0.70898
PW-05	325 145 Limestone	09/26/2011	<0.8	0.4	33.2	37, 35	3.24	0.03	3	799	859	21.73	581	0.70920
PW-06	216 143 Limestone	09/26/2011	<0.8	0.4	54.1	61, 59	1.97	0.16	6	470	508, 535	23.23	753	0.70893
PW-07	Info Not Available	09/27/2011	<0.8	0.3	32.4	45, 27, 39	3.09 leach from PW-07: 2.91	0.17 leach from PW-07: 0.02	4 leach from PW-07: 4	431	540, 420, 420	23.73	975	0.70891
PW-08	222 180 Limestone													
PW-09	190 176 Limestone	09/26/2011	<0.8	0.3	42.5	31.5, 42	3.57 & 3.67	0.05 & 0.05	3 & 4	550	532, 482	24.23	519	0.70898
PW-10	Info Not Available	09/27/2011	<0.8	0.3	145	124, 89.4	2.42 & 2.31	0.11 & 0.02	3 & 4	581	532, 482	25.22	1720	0.70881
PW-11	Info Not Available	09/26/2011	0.9	0.4	41.1	58, 42, 33, 56				551	720, 570, 520, 520	23.48	540	0.70895
PW-12	305 143 Limestone	09/27/2011	<0.8	0.4	35.9	44	3.12	0.01	3	1470	1190	28.97	1950	0.70882
PW-13	325 114 Red Shale	09/27/2011	<0.8	0.4	10.9	24	3.06	0.07	3	1740	1040	29.22	466	0.70914
PW-14	Info Not Available	09/26/2011	<0.8	0.3	49.3	50	2.50	0.01	3	323	302	26.97	718	0.70923
PW-15	125 75 Limestone	09/26/2011	<0.8	0.4	48.9	50	2.50	0.02	3	337	327	27.72	777	0.70917
PW-16	Info Not Available	09/27/2011	<0.8	0.3	40.2	43	4.11 & 4.31	0.03 & 0.05	4 & 3	487	470	24.98	975	0.70883
PW-17	Info Not Available	09/26/2011	<0.8	0.3	41.7	37, 43	4.33	0.1	4	489, 477	473	24.98	990	0.70883
PW-18	198 141 Red Shale	09/27/2011	<0.8	0.3	121	120	1.67	0.07	4	582	540	26.22	1360	0.70891
PW-19	Info Not Available	09/26/2011	<0.8	0.3	25.1	26	2.29	0.20	5	344	359	25.72	972	0.70901
PW-20	Info Not Available	09/27/2011	<0.8	0.3	45.6	46	2.58	0.04	4	303	300	24.98	677	0.70922
PW-21	Owner said well at ~300', Water at ~50', Pump at ~98'	09/29/2011	<0.8	0.4	NA	55	NA	NA	NA	NA	460	23.73	NA	0.70897
PW-22	Info Not Available	09/26/2011	<0.8	0.3	35.6	36, 35	4.03	0.03	3	509	542, 523	24.98	710	0.70890
PW-23	Info Not Available	09/26/2011	<0.8	0.3	16.3	16	3.63	0.07	3	592	604	14.24	2610	0.70857
PW-24	100 57 Limestone	09/27/2011	<0.8	0.3	15.6	NA	2.25 & 2.22	0.19 & 0.16	6 & 5	203	NA	13.74	2110	0.70885
PW-25	157 85 Limestone													
PW-26	Info Not Available	09/27/2011	<0.8	0.3	70.6	NA	1.73	0.03	3	412	NA	26.47	956	0.70899
R-01		09/27/2011	12.9	1.0	ND	NA	NA	NA	NA	12.2	NA	NA	0.4	NA
PW-27	Duplicate for PW-07	09/27/2011	NA	NA	29.5	NA	NA	NA	NA	431	NA	NA	984	NA
PW-28	Duplicate for PW-13	09/27/2011	NA	NA	10.7	NA	NA	NA	NA	1740	NA	NA	476	NA
PW-29	Duplicate for PW-18	09/27/2011	NA	NA	114	NA	NA	NA	NA	580	NA	NA	1360	NA
PW-30	Field Blank		NA	NA	ND	NA	NA	NA	NA	ND	NA	NA	ND	NA
PW-31	Field Blank		NA	NA	ND	NA	NA	NA	NA	7.2	NA	NA	ND	NA

Table 8: Summary of Monitoring Well Molybdenum, Boron & Strontium Isotopes and Tritium Sample Data

NA = Not Analyzed ND = Not Detected

Sample ID	Description or Name given to monitoring pt by the facility	Geologic Unit Well Screened In	Screened interval (ft above MSL) and Depth (ft. BGS)	Sample Date	Sample Time	Tritium (TU) 1TU = 3.221 Picocurries/L	Tritium ± 1σ	Molybdenum Concentration (ug/L)	Molybdenum Isotope (δ 98/95 Mo) (per mil)	2sd	n	Boron Concentration (ug/L)	Boron Isotope ($\delta\ ^{11}B$) (per mil)	Strontium Concentration (ug/L)	Strontium Isotope 87/86 Sr
						Tritium, Molybdenum, Boron & Strontium									
We								NR 140 ES: 40 ug/L				NR 140 ES: 1000 ug/L		NR 140 ES: None	
MW-01	W-26CR	Till/Sand Seam	640 - 635 59 - 64	09/26/2011	15:15	1.4	0.4	14.3	1.94	0.05	3	176	5.99	2390	0.70886
MW-02	W-3BR	Till/Clay	683.83 - 673.83 7.5 - 17.5	09/27/2011	11:00	5.6	0.5	37.3	2.28	0.06	4	163	12.74	580	0.70939
MW-03	W-3CR	Till/Clay-Sand	646.3 - 641.3 45.5 - 50.4	09/27/2011	11:30	<0.8	0.4	57.6	NA	NA	NA	515	26.97	1050	0.70878
MW-04	W-27RR	Till/Silty Clay	694.9 - 684.9 10 - 20	09/27/2011	11:25	6.9	0.6	24.9	2.52 & 2.75	0.07 & 0.08	4 & 3	469	16.23	597	0.70993
MW-05	W-39C	Dolomite	512.14 - 507.14 205 - 210	09/26/2011	11:35	<0.8	0.3	40.1	2.78	0.05	3	466	23.48	648	0.70894
MW-06	W-12B	Till/Clay - just below ash	657 - 647 39 - 49	09/27/2011	8:47	5.3	0.5	7.44	NA	NA	NA	27400	14.24	2730	0.70905
MW-07	W-12C	Till/Clay	684 - 674 11.5 - 21.5	09/27/2011	9:23	8.6	0.8	6.96	NA	NA	NA	10600	11.74	864	0.71112
MW-08	W-12D	Dolomite	527.18 - 522.18 168 - 173	09/27/2011	10:03	<0.8	0.3	54.1	2.27 & 2.04 & 2.23	0.11 & 0.02 & 0.01	3 & 4 & 3	585	24.98	1430	0.70878
MW-09	W-16AR	Till/Silty Clay	685.1 - 680.1 29- 34	09/27/2011	14:20	1.6	0.3	60.7	1.56	0.02	3	324	19.73	1930	0.70869
MW-10	W-16BR	Till/Silty Clay	703.5 - 693.5 10 - 20	09/27/2011	14:11	4.7	0.5	32	NA	NA	NA	156	9.24	1250	0.70895
MW-11	W-16CR	Till/Silt	666.7 - 661.7 48 - 53	09/26/2011	11:05	3.1	0.4	18.9	2.21	0.04	4	191	11.74	2730	0.70873
MW-12	W-3AR	Till/Sand	663.7 - 658.7 27.1 - 32.1	09/27/2011	11:22	<0.8	0.3	69.7	1.01	0.03	3	574	28.47	1450	0.70872
MW-13	W-9C	Till/Clay	? - ? 42 - 48	09/27/2011	14:21	1.8	0.3	NA	1.47	0.11	4	NA	27.47	NA	0.70878
MW-14	W-32A	Till/Clay	? - ? ? - 30.5	09/26/2011	10:14	4.6	0.5	8.01	NA	NA	NA	113	3.00	1530	0.70890
MW-15															
MW-16	W-44	Dolomite	526.6 - 516.6 158 - 168	09/26/2011	14:50	<0.8	0.3	12	1.74	0.16	7	282	20.23	1550	0.70878
MW-17	W-45A	Till/Sand Seam	637.1 - 632.1 55 - 60	09/26/2011	14:05	<0.8	0.3	64	2.32	0.13	3	393	20.23	473	0.70884
MW-18	W-45B	Dolomite	508.3 - 503.3 184 - 189	09/27/2011	8:08	<0.8	0.3	34.2	3.12 & 3.18	0.15 & 0.04	6 & 3	471	13.49	405	0.70932
MW-19	W-47B	Dolomite	522.2 - 516.7 143.5 - 149	09/27/2011	13:46	<0.8	0.3	20.5	3.82 & 3.87 & 3.89	0.04 & 0.08 & 0.05	3 & 3 & 3	589	23.73	2240	0.70878
MW-20	Dup for MW-03	Till		09/27/2011	11:30	NA	NA	56.7	0.77	0.02	3	526	NA	1070	NA
MW-21	Dup for MW-08	Dolomite		09/27/2011	10:03	NA	NA	56	2.63	0	3	560	NA	1470	NA
MW-22	Field Blank	-		09/27/2011	15:00	13	1.1	0.065	NA	NA	NA	14.4	NA	0.3	NA
R-02	Rinse for Monitoring Well	-		09/27/2011	14:20	13.5	1.2	ND	NA	NA	NA	14.5	NA	ND	NA
Hunts															
MW-30	P-1A	till/sand	? - ? 7 - 17	11/28/2011	10:42	9.4	0.8	1.88	3.16	0.04	3	83.8	-0.75	251	0.71032
MW-31	P-1B	till/clay	? - ? 14 - 24	11/28/2011	10:28	8.8	0.8	0.355	3.01	0.15	4	709	3.75	674	0.70958
MW-32	P-2B	till/sand	? - ? 19.8 - 29.8	11/29/2011	10:15	8.6	0.8	0.299	NA	NA	NA	550	14.24	554	0.70978
MW-33															
MW-34	P-4BR	till/sand	? - ? 20 - 30	11/28/2011	15:44	10.7	0.9	1.62	NA	NA	NA	1640	3.25 & 2.00	802	0.70945
MW-35	MW-4D	till/sand & gravel	644.4 - 639 17.1 - 22.1	11/29/2011	10:36	6.9	0.7	1.61	NA	NA	NA	98.2	-1.00	494	0.70937 & 0.70935
MW-36	MW-6D	till/sand	621.2 - 616.2 42.1 - 47.1	11/28/2011	13:12	<0.8	0.3	6.02	NA	NA	NA	109	19.23	1090	0.70879
MW-37	P-3B	till/sand	? - ? 18.4 - 28.4	11/29/2011	10:41	9	0.8	0.288	2.47	0.09	4	496	-3.25	749	0.71009
MW-38	MW-8D	till/sand	643.4 - 638.4 18.7 - 23.7	11/29/2011	9:38	7.8	0.8	2.39	NA	NA	NA	161	16.23	1680	0.70895 & 0.70893
MW-39	MW-10S	till/sand	655.5 - 645.5 2.7 - 12.7	11/28/2011	12:10	7.8	0.7	0.345	NA	NA	NA	258	9.99 & 10.24	322	0.70961
MW-40	MW-10D	till/silt	638 - 633 20.5 - 25.5	11/28/2011	12:15	4.1	0.5	15.6	3.59	0.1	3	245	20.980	1020	0.70890
MW-41	MW-11D	till/sand	638.9 - 634.0 22.1 - 27.0	11/29/2011	11:11	<0.8	0.3	26.2	3.21	0.04	3	310	24.73	687	0.70918
MW-42	MW-13B	Dolomite	610.8 - 605.6 47.8 - 53	11/28/2011	14:03	6.5	0.7	5.82	2.82	0.1	4	157	22.23	708	0.70915
MW-43	MW-14S	till/sand	659.2 - 649.2 8.2 18.2	11/28/2011	14:00	11.5	0.9	2.44	NA	NA	NA	1480	8.24	1350	0.70952
MW-44	MW-16B	Dolomite	575.0 569.8 88.8 - 94.0	11/29/2011	12:23	8.3	0.7	10.7	3.65	0.06	3	129	24.48	403	0.70960
MW-45	MW-17B	Dolomite	605.7 - 600.5 59.1 - 64.3	11/28/2011	15:10	4.7	0.5	10.4	3.14	0.04	3	225	21.98	1150	0.70902
MW-46	Dup for MW-39	till/sand		11/28/2011	12:10	8.2	0.8	0.35	NA	NA	NA	262	9.99	327	0.70959
MW-47	Dup for MW-34	till		11/28/2011	15:44	10.3	0.9	1.71	NA	NA	NA	1540	2.00	815	0.70943
R-01	Rinse for Monitoring Well	-		11/29/2011	12:30	12.1	1.00	ND	NA	NA	NA	8	NA	1.4	NA
R-02	Rinse for Monitoring Well	-		11/29/2011	12:39	12.3	1.00	ND	NA	NA	NA	6.8	NA	0.7	NA

OBG

THERE'S A WAY

Appendix A2

November 27, 2018

November 27, 2018

Mr. Tim Muehlfeld, PE
WEC Business Services, LLC
333 W. Everett Street – A231
Milwaukee, WI 53226

RE: 40 CFR Section 257.94(e)(2) Alternate Source Demonstration (ASD)
Detection Monitoring Round 2, We Energies Caledonia Ash Landfill

Dear **Mr. Muehlfeld:**

This letter has been prepared by O'Brien & Gere Engineers, Inc. (OBG) to provide pertinent information for an alternate source demonstration (ASD) as allowed by Title 40 Code of Federal Regulations (40 CFR) Part 257, Subpart D, Section 257.94(e)(2) for the Caledonia Ash Landfill located in Caledonia, Wisconsin.

The second semi-annual detection monitoring samples (Detection Monitoring Round 2) were collected on May 15 and 16, 2018 for which analytical data was received on May 31, 2018. Analytical data is presented in the attached Table 1. In accordance with 40 CFR Section 257.93(h)(2), statistical analysis of the data from Detection Monitoring Round 2 to identify statistically significant increases (SSIs) of 40 CFR Part 257 Subpart D Appendix III parameters over background concentrations was completed within 90 days of receipt of the analytical data (August 29, 2018). The statistical determination identified the following SSIs at downgradient monitoring wells:

- Boron above the background prediction limit at wells W09D, W10D, W49, and W50
- Sulfate above the background prediction limit at wells W08D, W09D, W10D, W49, and W50
- Calcium above the background prediction limit at well W08D
- Total dissolved solids (TDS) above the background prediction limit at well W08D

The SSIs above background identified during Detection Monitoring Round 2 are consistent with Detection Monitoring Round 1, except for the boron concentration reported at W09D. Boron was not detected at a concentration indicative of a SSI above background at W09 during Detection Monitoring Round 1. For the wells and parameters listed above that are consistent with Detection Monitoring Round 1, an Alternate Source Demonstration (ASD), *Alternate Source Demonstration, Caledonia Ash Landfill, Caledonia, Wisconsin*; dated April 15, 2018 (OBG, 2018), prepared in accordance with 40 CFR Section 257.94(e)(2) provides a description, data, and pertinent information supporting an alternate source which applies to the wells and parameters with SSIs in Detection Monitoring Round 2 (and 1). The ASD supports the position that the SSIs observed during the Detection Monitoring Rounds 1 and 2, except for boron at W09D, were not due to a release from the CCR unit but were from naturally occurring conditions and anthropogenic impacts in the area of the Caledonia Ash Landfill.

40 CFR Section 257.94(e)(2) allows 90 days to demonstrate that an SSI was caused by a source other than the CCR unit or resulted from an error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. Accordingly, an alternate source demonstration for boron at well W09D was evaluated and completed within 90 days of the SSI determination, by November 27, 2018.

To verify the SSI, well W09D was resampled on September 7, 2018 and analyzed for only the SSI parameter (boron), in accordance the Statistical Analysis Plan[1]. Analytical results were received on September 20, 2018 and are included in Table 1. Statistical analysis of the boron resample data for statistically significant increases (SSIs) over background concentrations was completed on October 12, 2018. The statistical analysis determined that the resample concentration of boron at W09D did not exceed background.

The preceding information serves as the ASD prepared in accordance with 40 CFR Section 257.94(e)(2) and supports the position that the SSI reported during Detection Monitoring Round 2 was not due to a release from the CCR unit but was from either an error in sampling or analysis or naturally occurring conditions (e.g. natural variation in groundwater quality). Therefore, no further action (i.e. assessment monitoring) is warranted and the Caledonia Ash Landfill will remain in detection monitoring.

If you have any questions regarding this document, please do not hesitate to contact us.

Sincerely,
O'BRIEN & GERE ENGINEERS, INC.

Glenn R. Luke, PE
Managing Engineer
Professional Engineer No. 42834-6
State of Wisconsin
O'Brien & Gere Engineers, Inc.
Date: November 27, 2018

I, Glenn R. Luke, a qualified professional engineer in good standing in the State of Wisconsin, certify that enclosed information is accurate as of the date of my signature below. The content of this report is not to be used for other than its intended purpose and meaning, or for extrapolations beyond the interpretations contained herein.

Nathaniel R. Keller, PG
Senior Hydrogeologist
Professional Geologist No. 1283-013
State of Wisconsin
O'Brien & Gere Engineers, Inc.
Date: November 27, 2018

I, Nathaniel R. Keller, a qualified professional geologist, certify that the enclosed information is accurate as of the date of my signature below. The content of this report is not to be used for other than its intended purpose and meaning, or for extrapolations beyond the interpretations contained herein.

Attachments: Table 1. Caledonia Ash Landfill: Appendix III Analytical Results

[1] Natural Resource Technology, an OBG Company, 2017, Statistical Analysis Plan, Caledonia Ash Landfill, Caledonia, Wisconsin, October 17, 2017.

Caledonia
Table 1. Caledonia Ash Landfill: Appendix III Analytical Results

Date Range: 11/11/2015 to 09/07/2018

Well Id	Date Sampled	Lab Id	B, tot, mg/L	Ca, tot, mg/L	Cl, tot, mg/L	F, tot, mg/L	pH (field), STD	SO4, tot, mg/L
W08D	11/11/2015	40124666006	0.407	52.500	13.000	1.000	7.700	181.000
	02/16/2016	40128456003	0.426	54.700	11.500	0.720	7.440	191.000
	05/11/2016	40132272002	0.472	57.600	11.600	0.760	7.400	196.000
	08/30/2016	40137606003	0.402	58.200	10.400	0.710	7.600	177.000
	11/14/2016	40142064003	0.457	57.000	12.900	1.100	7.400	204.000
	02/08/2017	40145548002	0.420	51.800	11.000	0.860	7.940	201.000
	05/15/2017	40150143005	0.470	51.400	10.600	0.910	7.450	204.000
	08/22/2017	40155549007	0.450	48.900	10.800	1.100	6.940	203.000
	11/14/2017	40161125002	0.456	49.100	11.900	1.100	7.410	222.000
	05/16/2018	AE27556	0.270	51.000	10.000	0.960	7.300	200.000
W09D	11/11/2015	40124666005	0.379	19.900	4.600	1.300	8.200	30.400
	02/16/2016	40128456004	0.404	18.600	4.900	1.300	8.340	31.200
	05/11/2016	40132272003	0.389	18.800	4.900	1.400	8.130	32.300
	08/30/2016	40137606004	0.350	19.900	4.100	1.300	8.300	31.500
	11/14/2016	40142064004	0.389	18.900	3.900	1.400	8.300	33.900
	02/08/2017	40145548003	0.370	18.400	4.000	1.300	8.190	33.500
	05/15/2017	40150143006	0.380	17.900	3.800	1.400	7.830	33.400
	08/22/2017	40155549008	0.390	17.700	3.800	1.300	7.700	31.800
	11/14/2017	40161125003	0.394	18.600	4.900	1.400	8.230	32.200
	05/16/2018	AE27554	0.410	19.000	3.400	1.200	7.900	32.000
	09/07/2018	AE30278	0.390				7.900	
W10D	11/11/2015	40124666004	0.398	22.700	4.700	1.200	8.200	38.800
	02/17/2016	40128456007	0.445	23.300	6.300	1.200	8.100	43.000
	05/11/2016	40132272005	0.428	21.600	6.500	1.300	7.900	46.000
	08/30/2016	40137606005	0.388	21.800	4.700	1.300	8.100	41.600
	11/14/2016	40142064005	0.417	21.600	4.400	1.400	8.000	44.000
	02/08/2017	40145548005	0.390	20.500	4.300	1.300	8.360	41.700
	05/15/2017	40150143007	0.410	20.300	4.200	1.400	7.980	43.000
	08/22/2017	40155549009	0.420	20.700	4.200	1.300	7.870	40.800
	11/14/2017	40161125004	0.417	20.400	4.300	1.400	8.070	44.500
	05/16/2018	AE27553	0.430	21.000	3.500	1.200	7.600	41.000
W12D	11/11/2015	40124666007	0.501	26.700	5.300	1.200	8.400	100.000
	02/16/2016	40128456001	0.514	24.400	5.600	1.200	8.200	104.000
	05/11/2016	40132272001	0.525	25.300	5.700	1.300	8.000	105.000
	08/30/2016	40137606007	0.486	26.400	4.900	1.200	8.300	98.500
	11/14/2016	40142064001	0.497	24.500	5.300	1.300	8.200	109.000

Caledonia
Table 1. Caledonia Ash Landfill: Appendix III Analytical Results

Date Range: 11/11/2015 to 09/07/2018

			B, tot, mg/L	Ca, tot, mg/L	Cl, tot, mg/L	F, tot, mg/L	pH (field), STD	SO4, tot, mg/L
W12D	02/08/2017	40145548008	0.480	24.800	4.900	1.200	8.520	108.000
	05/15/2017	40150143003	0.510	24.400	4.700	1.200	8.090	108.000
	08/22/2017	40155549011	0.530	24.300	4.700	1.200	7.610	109.000
W46D	11/11/2015	40124666001	0.332	31.000	6.100	0.820	8.100	26.300
	02/17/2016	40128456008	0.376	35.900	7.400	0.740	7.800	11.600
	05/11/2016	40132272008	0.406	33.200	10.100	4.000	7.400	5.400
	08/30/2016	40137606006	0.358	30.300	7.200	2.300	7.600	25.000
	11/14/2016	40142064007	0.370	29.600	9.600	0.540	7.500	26.500
	02/08/2017	40145548006	0.370	28.400	10.400	<0.500	7.210	25.700
	05/16/2017	40150143010	0.370	25.900	9.900	1.100	7.150	30.200
	08/21/2017	40155549004	0.380	28.100	10.600	1.000	7.410	29.100
	11/14/2017	40161125001	0.391	27.000	6.800	1.200	7.580	34.500
	05/15/2018	AE27550	0.400	27.000	6.000	1.100	7.600	33.000
W48	11/11/2015	40124666002	0.349	27.200	4.600	0.900	8.000	2.300
	02/16/2016	40128456002	0.373	24.900	5.000	0.900	8.000	3.000
	05/11/2016	40132272006	0.385	26.700	4.900	0.980	7.900	2.600
	08/30/2016	40137606001	0.344	28.100	4.100	0.900	8.000	<2.000
	11/14/2016	40142064006	0.357	26.500	4.100	0.990	8.000	<1.000
	02/08/2017	40145548001	0.350	26.300	4.000	0.930	8.170	1.300
	05/15/2017	40150143004	0.360	25.100	3.800	0.950	7.990	<1.000
	08/21/2017	40155549006	0.360	27.300	3.800	0.920	7.460	<1.000
	11/15/2017	40161125005	0.370	27.400	4.100	1.000	7.860	<1.000
	05/16/2018	AE27551	0.390	27.000	3.500	0.850	7.700	0.620
W49	06/21/2017	40152212001	0.420	40.600	6.500	1.200	7.970	44.900
	08/22/2017	40155549012	0.410	24.900	6.300	1.300	7.870	46.100
	11/15/2017	40161125007	0.432	19.500	5.800	1.500	8.090	51.600
	05/16/2018	AE27557	0.440	18.000	5.000	1.200	7.800	47.000
W50	06/02/2017	40151093001	0.500	30.800	6.500	1.200	6.920	51.300
	08/22/2017	40155549013	0.500	25.900	5.400	1.200	7.150	75.200
	11/15/2017	40161125008	0.490	26.200	5.800	1.300	7.840	80.800
	05/16/2018	AE27555	0.510	28.000	5.400	1.100	7.700	75.000

Caledonia
Table 1. Caledonia Ash Landfill: Appendix III Analytical Results

Date Range: 11/11/2015 to 09/07/2018

Well Id	Date Sampled	Lab Id	TDS, mg/L
W08D	11/11/2015	40124666006	432.000
	02/16/2016	40128456003	460.000
	05/11/2016	40132272002	446.000
	08/30/2016	40137606003	484.000
	11/14/2016	40142064003	510.000
	02/08/2017	40145548002	454.000
	05/15/2017	40150143005	448.000
	08/22/2017	40155549007	444.000
	11/14/2017	40161125002	416.000
	05/16/2018	AE27556	440.000
W09D	11/11/2015	40124666005	202.000
	02/16/2016	40128456004	198.000
	05/11/2016	40132272003	194.000
	08/30/2016	40137606004	206.000
	11/14/2016	40142064004	206.000
	02/08/2017	40145548003	192.000
	05/15/2017	40150143006	200.000
	08/22/2017	40155549008	208.000
	11/14/2017	40161125003	170.000
	05/16/2018	AE27554	180.000
W10D	11/11/2015	40124666004	222.000
	02/17/2016	40128456007	190.000
	05/11/2016	40132272005	206.000
	08/30/2016	40137606005	232.000
	11/14/2016	40142064005	210.000
	02/08/2017	40145548005	192.000
	05/15/2017	40150143007	196.000
	08/22/2017	40155549009	222.000
	11/14/2017	40161125004	180.000
	05/16/2018	AE27553	180.000
W12D	11/11/2015	40124666007	272.000
	02/16/2016	40128456001	278.000
	05/11/2016	40132272001	258.000
	08/30/2016	40137606007	296.000
	11/14/2016	40142064001	284.000
	02/08/2017	40145548008	240.000

Caledonia
Table 1. Caledonia Ash Landfill: Appendix III Analytical Results

Date Range: 11/11/2015 to 09/07/2018

			TDS, mg/L
W12D	05/15/2017	40150143003	276.000
	08/22/2017	40155549011	272.000
W46D	11/11/2015	40124666001	230.000
	02/17/2016	40128456008	244.000
	05/11/2016	40132272008	218.000
	08/30/2016	40137606006	256.000
	11/14/2016	40142064007	260.000
	02/08/2017	40145548006	114.000
	05/16/2017	40150143010	230.000
	08/21/2017	40155549004	232.000
	11/14/2017	40161125001	196.000
	05/15/2018	AE27550	200.000
W48	11/11/2015	40124666002	254.000
	02/16/2016	40128456002	222.000
	05/11/2016	40132272006	224.000
	08/30/2016	40137606001	242.000
	11/14/2016	40142064006	238.000
	02/08/2017	40145548001	224.000
	05/15/2017	40150143004	236.000
	08/21/2017	40155549006	254.000
	11/15/2017	40161125005	244.000
	05/16/2018	AE27551	200.000
W49	06/21/2017	40152212001	236.000
	08/22/2017	40155549012	216.000
	11/15/2017	40161125007	210.000
	05/16/2018	AE27557	180.000
W50	06/02/2017	40151093001	270.000
	08/22/2017	40155549013	256.000
	11/15/2017	40161125008	260.000
	05/16/2018	AE27555	250.000

Part of Ramboll