



Annual Groundwater Monitoring Report

DE Karn Power Plant
Bottom Ash Pond CCR Unit
Essexville, Michigan

January 2018




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*Prepared For
Consumers Energy Company*



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Executive Summary

On April 17, 2015, the United States Environmental Protection Agency (USEPA) published the final rule for the regulation and management of Coal Combustion Residuals (CCR) under the Resource Conservation and Recovery Act (RCRA) (the CCR Rule). The CCR Rule, which became effective on October 19, 2015, applies to the Consumers Energy Company (CEC) Bottom Ash Pond (BAP) at the DE Karn (DEK) Power Plant Site (the Site). Pursuant to the CCR Rule, no later than January 31, 2018, and annually thereafter, the owner or operator of a CCR unit must prepare an annual groundwater monitoring and corrective action report for the CCR unit documenting the status of groundwater monitoring and corrective action for the preceding year in accordance with §257.90(e).

TRC Environmental Corporation (TRC) prepared this Annual Groundwater Monitoring Report for the DEK BAP CCR unit on behalf of CEC. This Annual Report was prepared in accordance with the requirements of §257.90(e) and presents the monitoring results and the statistical evaluation of the detection monitoring parameters (Appendix III to Part 257 of the CCR Rule) for the September 2017 semiannual groundwater monitoring event for the DEK BAP CCR unit. This event is the initial detection monitoring event performed to comply with §257.94. As part of the statistical evaluation, the data collected during detection monitoring events are evaluated to identify statistically significant increases (SSIs) in detection monitoring parameters to determine if concentrations in detection monitoring well samples exceed background levels.

Potential SSIs over background limits were noted for boron, fluoride, pH, and sulfate in one or more downgradient wells for the September 2017 monitoring event. This is the initial detection monitoring event; therefore, it is the initial identification of a SSI over background levels. According to §257.94(e), if the facility determines, pursuant to §257.93(h), that there is a SSI over background levels for one or more of the Appendix III constituents, the facility will, within 90 days of detecting a SSI, establish an assessment monitoring program ~~or~~ demonstrate that:

- A source other than the CCR unit caused the SSI, or
- The SSI resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality.

In response to the potential SSIs over background limits noted during September 2017, CEC plans to prepare an Alternative Source Demonstration (ASD) to evaluate whether a source other than the CCR unit caused the SSIs prior to initiating assessment monitoring.

Section 1

Introduction

1.1 Program Summary

On April 17, 2015, the United States Environmental Protection Agency (USEPA) published the final rule for the regulation and management of Coal Combustion Residuals (CCR) under the Resource Conservation and Recovery Act (RCRA) (the CCR Rule). The CCR Rule, which became effective on October 19, 2015, applies to the Consumers Energy Company (CEC) Bottom Ash Pond at the former DE Karn (DEK) Power Plant Site (the Site). Pursuant to the CCR Rule, no later than January 31, 2018, and annually thereafter, the owner or operator of a CCR unit must prepare an annual groundwater monitoring and corrective action report for the CCR unit documenting the status of groundwater monitoring and corrective action for the preceding year in accordance with §257.90(e).

TRC Environmental Corporation (TRC) prepared this Annual Groundwater Monitoring Report (Annual Report) for the DEK BAP CCR unit on behalf of CEC. This Annual Report was prepared in accordance with the requirements of §257.90(e) and presents the monitoring results and the statistical evaluation of the detection monitoring parameters (Appendix III to Part 257 of the CCR Rule) for the September 2017 semiannual groundwater monitoring event for the DEK BAP CCR unit. This event is the initial detection monitoring event performed to comply with §257.94. The monitoring was performed in accordance with the *DE Karn Monitoring Program Sample Analysis Plan* (SAP) (ARCADIS, May 2016) and statistically evaluated per the *Groundwater Statistical Evaluation Plan* (Stats Plan) (TRC, October 2017). As part of the statistical evaluation, the data collected during detection monitoring events are evaluated to identify statistically significant increases (SSIs) of detection monitoring parameters compared to background levels.

1.2 Site Overview

The DE Karn (DEK) Power Plant site (the Site) is located north of the JC Weadock (JCW) Power Plant site (JCW Site), east of the Saginaw River, south and west of Saginaw Bay (Figure 1). A discharge channel runs along the majority of the southern perimeter of the site and separates the facility from the JCW Site to the south. The plant began generating electricity in 1959. Two power generating units (Units 1 & 2) are coal-fueled and two units (Units 3 & 4) are oil- and natural gas-fueled.

The area authorized for disposal of solid waste includes historical Ponds A, B1, B2, C, D1, D2, and E, which includes settling basins, clarification ponds, and the ash transport ditches (Figure 2). Collectively, these areas comprise the DE Karn Solid Waste Disposal Area which is a 171-acre

Type III low hazard industrial waste landfill. The Karn landfill was permitted for construction in 1986 as a vertical expansion, and is governed by the Natural Resources Environmental Protection Act (NREPA), P.A. 451, as amended, Part 115 Solid Waste Disposal Area operating license No. 9442, dated June 29, 2015. The landfill is being monitored in accordance with the MDEQ-approved Part 115 *Hydrogeological Monitoring Plan Rev. 2: DE Karn Solid Waste Disposal Area* (June 5, 2015).

Closure activities at the landfill have commenced prior to the Effective Date of the CCR RCRA Rule (October 17, 2015); therefore, the landfill is only subject to permitting under state authorities.

Additionally, a bottom ash pond is located immediately to the south of historic Pond A that is the primary settling/detention structure for the National Pollutant Discharge Elimination System (NPDES) treatment system prior to discharge. It is characterized as an existing CCR surface impoundment and subject to the CCR RCRA Rule.

1.3 Geology/Hydrogeology

The majority of DEK Bottom Ash Pond area is comprised of surficial CCR and sand fill. USGS topographic maps and aerial photographs dating back to 1938, in addition to field descriptions of subsurface soil at the site, indicate that the site was largely developed by reclaiming low-lands through construction of perimeter dikes and subsequent ash filling.

The surficial fill consists of a mixture of varying percentages of ash, sand, and clay-rich fill ranging from 5 to 15 feet thick. Below the surficial fill, native alluvium and lacustrine soils are present at varying depths. Generally, there is a well graded sand unit present to depths of 10-30 feet below ground surface (ft bgs) overlying a clay till which is observed at depths ranging from 25 to 75 ft bgs. A sandstone unit, which is part of the Saginaw formation, was generally encountered at 80-90 ft bgs.

The site is bound by several surface water features (Figure 1): the Saginaw River to the west, Saginaw Bay (Lake Huron) to the north and east, and a discharge channel to the south. In general, shallow groundwater is encountered at a similar or slightly higher elevation relative to the surrounding surface water features. Groundwater flow in the upper aquifer is largely controlled by the surface water elevations of Saginaw River and Saginaw Bay. In the vicinity of the DEK Bottom Ash Pond, the shallow groundwater flow is generally radial, flowing outward from the pond area toward the surrounding surface water bodies.

Based on the hydrogeology at the site, particularly the conductive properties of the sandy aquifer and the prominent and consistent radial groundwater flow direction from the area of the DEK Bottom Ash Pond, in addition to the history of CCR-related operations throughout the DE Karn Site, an inter-well statistical approach is recommended for detection monitoring as outlined in the Stats Plan.

Section 2

Groundwater Monitoring

2.1 Monitoring Well Network

A groundwater monitoring system has been established for the DEK BAP unit, which defined the monitoring well network for detection monitoring. The detection monitoring well network for the DEK BAP CCR unit currently consists of 10 monitoring wells (four background monitoring wells and six downgradient monitoring wells) that are screened in the uppermost aquifer. The monitoring well locations are shown on Figure 2.

Four monitoring wells located south of the DEK BAP on the JCW site provide data on background groundwater quality that has not been affected by the CCR unit (MW-15002, MW-15008, MW-15016, and MW-15019). Due to the site hydrogeology and operational history of the site, a hydraulically upgradient location was not available to monitor this CCR unit. The area where background wells are located, while not upgradient, is not affected by any CCR units and therefore meets the requirements of § 257.91(a)(1). Background groundwater quality data from these four background wells are additionally used for the CCR groundwater monitoring program at two active CCR units on the JCW site.

Groundwater around the DEK BAP CCR unit is fairly radial; therefore, the six downgradient wells (DEK-MW-15001 through DEK-MW-15006) were installed in the accessible areas along the perimeter of the CCR Unit.

As shown on Figure 2, monitoring well MW-15018, MW-15020, MW-15024, and MW-15027 are used for water level measurements only. These wells were originally installed as a part of the background well network, but because of the relatively close lateral spacing of the eight background wells, the results for each well may not be as statistically independent as desired for evaluation of CCR monitoring data. Regardless, if background can be appropriately characterized with fewer wells [a minimum of one upgradient (background) and three downgradient wells are required per § 257.91(c)(1)], it is appropriate to select a smaller number of wells to represent background for the site. As presented in the Stats Plan, monitoring wells MW-15002, MW-15008, MW-15016, and MW-15019 have been selected to represent background groundwater quality at the Karn and Weadock sites.

2.2 Background Sampling

Background groundwater monitoring was conducted at the DEK BAP CCR unit from December 2015 through August 2017 in accordance with the SAP. Data collection included eight rounds (Rounds 1 through 8) of static water elevation measurements, analysis for parameters required

in the CCR Rule's Appendix III and Appendix IV to Part 257, and field parameters (dissolved oxygen, oxidation reduction potential, pH, specific conductivity, temperature, and turbidity) from all 14 monitoring wells installed at the site. The Rounds 1 through 7 groundwater samples were collected and analyzed by CEC's Laboratory Services, Jackson, Michigan. Round 8 groundwater sampling was conducted by TRC from August 1 through 4, 2017, and analyzed by Pace Analytical Services, LLC (Pace). Background data are included in Appendix A Tables 1 through 4, where: Table 1 is a summary of static water elevation data; Table 2 (background) and Table 3 (downgradient) are each a summary of groundwater analytical data compared to potentially relevant criteria; and Table 4 is a summary of field data.

In addition to the data tables, groundwater contour maps were developed for each of the background events to evaluate groundwater flow directions. The contour maps for each background monitoring event are also included in Appendix A as Figures 1 through 8.

2.3 Semiannual Groundwater Monitoring

The semiannual monitoring parameters for the detection groundwater monitoring program were selected per the CCR Rule's Appendix III to Part 257 – Constituents for Detection Monitoring. The Appendix III indicator parameters consist of boron, calcium, chloride, fluoride, pH (field reading), sulfate, and total dissolved solids (TDS) and were analyzed in accordance with the SAP. In addition to pH, the collected field parameters included dissolved oxygen, oxidation reduction potential, specific conductivity, temperature, and turbidity.

2.3.1 Data Summary

The initial semiannual groundwater detection monitoring event for 2017 was performed on September 18 and 19, 2017, by TRC personnel and samples were analyzed by Pace in accordance with the SAP. Static water elevation data were collected at all monitoring well locations. Groundwater samples were collected from the four background monitoring wells and six downgradient monitoring wells for the Appendix III indicator parameters and field parameters. A summary of the groundwater data collected during the September 2017 event is provided on Table 1 (static groundwater elevation data), Table 2 (analytical results), and Table 3 (field data).

2.3.2 Data Quality Review

Data from each round were evaluated for completeness, overall quality and usability, method-specified sample holding times, precision and accuracy, and potential sample contamination. The data were found to be complete and usable for the purposes of the CCR monitoring program. Particular data non-conformances are summarized in Appendix B.

2.3.3 Groundwater Flow Rate and Direction

Groundwater elevation data collected during the most recent background sampling event were similar to data collected during the initial eight rounds of sampling that commenced in October 2015. Groundwater elevations at the site are generally within the range of 580 to 588 feet above mean sea level (ft AMSL) and groundwater is typically encountered at a similar or slightly higher elevation relative to the surrounding surface water features, flowing outward toward the bounding surface water features. Groundwater elevations measured during the September 2017 sampling event are provided on Table 1 and were used to construct a groundwater contour map (Figure 3).

The map indicates that current groundwater flow continues to radiate outward from the BAP area toward the surface water. The geometric mean hydraulic gradient throughout the DEK BAP CCR unit area during this event is estimated at 0.0066 ft/ft. The gradient was calculated using the well pair DEK-MW-15004/DEK-MW-15005, as well as the well water elevation difference and distance between DEK-MW-15001 and the discharge channel (Figure 3). Using the mean hydraulic conductivity of 15 ft/day (ARCADIS, 2016) and an assumed effective porosity of 0.3, the estimated average seepage velocity is approximately 0.33 ft/day or 120 ft/year for this event.

The general flow direction is similar to that identified in previous monitoring rounds and continues to demonstrate that the downgradient wells are appropriately positioned to detect the presence of Appendix III parameters that could potentially migrate from the DEK BAP CCR unit.

Section 3

Statistical Evaluation

3.1 Establishing Background Limits

Per the Stats Plan, background limits were established for the Appendix III indicator parameters following the eighth round of background monitoring using data collected from the four established background monitoring wells (MW-15002, MW-15008, MW-15016, and MW-15019). The statistical evaluation of the background data is presented in detail in Appendix C. The Appendix III background limits will be used throughout the detection monitoring period to determine whether groundwater has been impacted from the DEK BAP CCR unit by comparing concentrations in the downgradient wells to the background limits for each Appendix III indicator parameter.

3.2 Data Comparison to Background Limits

The concentrations of the indicator parameters in the downgradient wells were compared to the statistical background limits calculated from the background data collected from MW-15002, MW-15008, MW-15016, and MW-15019. The comparisons are presented on Table 4.

The statistical evaluation of the September 2017 Appendix III indicator parameters shows potential SSIs over background for:

- Boron at DEK-MW-15001, DEK-MW-15002, DEK-MW-15003, DEK-MW-15004, DEK-MW-15005, DEK-MW-15006;
- Fluoride at DEK-MW-15001;
- Field pH at DEK-MW-15001, DEK-MW-15002, DEK-MW-15003, DEK-MW-15005, DEK-MW-15006; and
- Sulfate at DEK-MW-15006.

The initial observation of an indicator parameter concentration above the established background limits does not necessarily constitute a SSI. Per the Stats Plan, if there is an exceedance of a prediction limit for one or more of the parameters, the well(s) of concern can be resampled within 30 days of the completion of the initial statistical analysis for verification purposes. There were no SSIs compared to background for calcium, chloride or TDS at any of the downgradient wells.

Section 4

Conclusions and Recommendations

Potential SSIs over background limits were noted for boron, fluoride, pH, and sulfate in one or more downgradient wells during September 2017. This is the initial detection monitoring event; therefore, it is the initial identification of a SSI over background levels. According to §257.94(e), if the facility determines, pursuant to §257.93(h), that there is a SSI over background levels for one or more of the Appendix III constituents, the facility will, within 90 days of detecting a SSI, establish an assessment monitoring program ~~or~~ demonstrate that:

- A source other than the CCR unit caused the SSI, or
- The SSI resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality.

The owner or operator must complete a written demonstration (i.e., Alternative Source Demonstration, ASD), of the above within 90 days of confirming the SSI. Based on the outcome of the ASD the following steps will be taken:

- If a successful ASD is completed, a certification from a qualified professional engineer is required, and the CCR unit may continue with detection monitoring.
- If a successful ASD is not completed within the 90-day period, the owner or operator of the CCR unit must initiate an assessment monitoring program as required under §257.95. The facility must also include the ASD in the annual groundwater monitoring and corrective action report required by §257.90(e), in addition to the certification by a qualified professional engineer.

During the 90-day period after triggering assessment monitoring, groundwater samples will be collected from the groundwater monitoring system wells and analyzed for Appendix IV constituents pursuant to §257.95(b). Within 90 days of obtaining the results from the first assessment monitoring event, groundwater samples will be collected from the groundwater monitoring system wells and analyzed for Appendix III parameters and the detected Appendix IV parameters in the initial assessment monitoring event.

In response to the potential SSIs over background limits noted during September 2017, CEC plans to prepare an ASD to evaluate whether a source other than the DEK BAP CCR unit caused the SSIs prior to initiating assessment monitoring. Based on the results from the ASD, CEC will continue executing the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98.

Section 5

References

ARCADIS. May 13, 2016. Summary of Monitoring Well Design, Installation, and Development. DE Karn Electric Generation Facility – Essexville, Michigan. Prepared for Consumers Energy Company.

ARCADIS. May 18, 2016. Electric Generation Facilities RCRA CCR Detection Monitoring Program. DE Karn Monitoring Program Sample Analysis Plan, Essexville, Michigan. Prepared for Consumers Energy Company.

TRC Environmental Corporation. October 2017. Groundwater Statistical Evaluation Plan – DE Karn Power Plant, Bottom Ash Pond, Essexville, Michigan. Prepared for Consumers Energy Company.

Consumers Energy Company. June 5, 2015. Hydrogeological Monitoring Plan Rev. 2: DE Karn Solid Waste Disposal Area.

Tables

Table 1
Summary of Groundwater Elevation Data – September 2017
DE Karn and JC Weadock – RCRA CCR Monitoring Program
Essexville, Michigan

Well Location	Ground Surface Elevation (ft)	TOC Elevation (ft)	Geologic Unit of Screen Interval	Screen Interval Depth (ft BGS)			Screen Interval Elevation (ft)			Borehole Terminus Depth (ft BGS)	Borehole Terminus Elevation (ft)	September 18, 2017	
												Depth to Water (ft BTOC)	Groundwater Elevation (ft)
Background													
MW-15002	584.9	587.71	Sand	4.0	to	14.0	580.9	to	570.9	15.0	569.9	6.89	580.82
MW-15008	582.7	585.36	Sand with clay from 8 - 8.5 ft bgs	4.0	to	14.0	578.7	to	568.7	39.0	543.7	4.26	581.10
MW-15016	583.7	586.49	Sand	2.5	to	5.5	581.2	to	578.2	9.0	574.7	5.77	580.72
MW-15018	583.6	586.42	Sand	3.0	to	7.0	580.6	to	576.6	9.0	574.6	5.60	580.82
MW-15019	583.5	586.17	Sand (4 - 7.5 ft bgs) and Sand/Clay (7.5 - 14 ft bgs)	4.0	to	14.0	579.5	to	569.5	19.0	564.5	5.20	580.97
MW-15020	582.5	585.95	Sand	4.0	to	14.0	578.5	to	568.5	19.0	563.5	4.87	581.08
MW-15024	583.7	586.56	Sand	4.0	to	14.0	579.7	to	569.7	19.5	564.2	5.53	581.03
MW-15027	583.2	586.25	Sand	5.0	to	15.0	578.2	to	568.2	15.5	567.7	5.18	581.07
JCW Bottom Ash Pond													
JCW-MW-15007	585.2	587.40	Sand	2.5	to	6.0	582.7	to	579.2	19.0	566.2	4.42	582.98
JCW-MW-15009	586.9	589.64	Sand	5.0	to	10.0	581.9	to	576.9	10.0	576.9	8.80	580.84
JCW-MW-15010	595.2	597.76	Sand	15.5	to	17.0	579.7	to	578.2	19.0	576.2	15.61	582.15
JCW-MW-15028	586.7	589.37	Sand	19.0	to	22.0	567.7	to	564.7	22.0	564.7	8.50	580.87
JCW Landfill													
JCW-MW-15011	594.9	597.07	Sand	12.5	to	16.0	582.4	to	578.9	18.0	576.9	14.24	582.83
JCW-MW-15012	592.2	595.07	Sand (10.8 - 15 ft bgs) and Clay (15 - 15.8 ft bgs)	10.8	to	15.8	581.4	to	576.4	19.0	573.2	14.00	581.07
JCW-MW-15023	592.7	595.32	Sand	13.0	to	18.0	579.7	to	574.7	19.0	573.7	13.15	582.17
DEK Bottom Ash Pond													
DEK-MW-15001	592.1	594.64	Sand	16.0	to	17.0	576.1	to	575.1	19.0	573.1	8.35	586.29
DEK-MW-15002	588.3	590.87	Sand	10.0	to	13.0	578.3	to	575.3	19.0	569.3	4.31	586.56
DEK-MW-15003	599.9	602.79	Sand	21.0	to	25.0	578.9	to	574.9	29.0	570.9	12.95	589.84
DEK-MW-15004 ⁽¹⁾	604.9	607.40	Sand	30.0	to	35.0	574.9	to	569.9	39.0	565.9	21.51	590.29
DEK-MW-15005	586.8	589.72	Sand	14.5	to	19.5	572.3	to	567.3	19.5	567.3	8.02	581.70
DEK-MW-15006	586.5	589.24	Sand	13.5	to	18.5	573.0	to	568.0	19.5	567.0	8.61	580.63

Notes:
Survey conducted by Rowe Professional Services Company, November 2015.
Elevation in feet relative to North American Vertical Datum 1988 (NAVD 88).
TOC: Top of well casing.
ft BTOC: Feet below top of well casing.
ft BGS: Feet below ground surface.
(1) Approximately 4.4-ft of riser added to DEK-MW-15004 subsequent to Round 7. Groundwater elevations adjusted accordingly. New TOC survey pending.

Table 2
Summary of Groundwater Sampling Results (Analytical) – September 2017
DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

Sample Location:						DEK-MW-15001	DEK-MW-15002	DEK-MW-15003	DEK-MW-15004	DEK-MW-15005	DEK-MW-15006
Sample Date:						9/18/2017	9/18/2017	9/18/2017	9/19/2017	9/18/2017	9/18/2017
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	downgradient					
Appendix III											
Boron	ug/L	NC	500	500	7,200	2,700	870	1,030	730	714	1,070
Calcium	mg/L	NC	NC	NC	500	82.4	66.9	62.1	66.5	44.3	76.8
Chloride	mg/L	250**	250	250	50	82.2	84.9	60.2	79.8	79.3	133
Fluoride	ug/L	4,000	NC	NC	NC	2,100	<1,000	<1,000	<1,000	<1,000	<1,000
pH, Field	SU	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	7.5	7.9	7.9	7.3	7.9	7.8
Sulfate	mg/L	250**	250	250	500	36.2	290	54.3	283	273	886
Total Dissolved Solids	mg/L	500**	500	500	500	594	722	426	596	638	1,670

Notes:

ug/L - micrograms per liter.

mg/L - milligrams per liter.

SU - standard units; pH is a field parameter.

MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.

NC - no criteria.

* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.

** - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April, 2012.

^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using default hardness of 150 mg CaCO3/L per MDEQ RRD Op Memo 5, Sept. 30, 2004. Generic GSI criterion for calcium and sulfate is the total dissolved solids criterion. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters, based on footnote {FF}.

BOLD value indicates an exceedance of one or more of the listed criteria.

RED value indicates an exceedance of the MCL.

All metals were analyzed as total unless otherwise specified.

Table 2
Summary of Groundwater Sampling Results (Analytical) – September 2017
DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

Sample Location:						MW-15002	MW-15008	MW-15016	MW-15018	MW-15019	MW-15020	MW-15024	MW-15027
Sample Date:						9/19/2017	9/19/2017	9/19/2017	9/19/2017	9/19/2017	9/19/2017	9/19/2017	9/19/2017
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	background							
Appendix III													
Boron	ug/L	NC	500	500	7,200	313	183	602	105	324	178	217	223
Calcium	mg/L	NC	NC	NC	500	249	109	160	113	155	82.2	102	103
Chloride	mg/L	250**	250	250	50	2,270	329	99.5	79.4	438	298	418	379
Fluoride	ug/L	4,000	NC	NC	NC	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000	<1,000
pH, Field	SU	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	6.9	6.8	7.1	7.2	6.9	7.0	7.1	7.0
Sulfate	mg/L	250**	250	250	500	<2.0	3.9	13.3	7.1	99.7	39.3	5.6	15.0
Total Dissolved Solids	mg/L	500**	500	500	500	4,280	848	756	478	1,200	794	1,000	968

Notes:

ug/L - micrograms per liter.

mg/L - milligrams per liter.

SU - standard units; pH is a field parameter.

MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.

NC - no criteria.

* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.

** - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April, 2012.

^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using default hardness of 150 mg CaCO3/L per MDEQ RRD Op Memo 5, Sept. 30, 2004. Generic GSI criterion for calcium and sulfate is the total dissolved solids criterion. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters, based on footnote {FF}.

BOLD value indicates an exceedance of one or more of the listed criteria.

RED value indicates an exceedance of the MCL.

All metals were analyzed as total unless otherwise specified.

Table 3
Summary of Field Parameter Results – September 2017
DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

Sample Location	Sample Date	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	pH (SU)	Specific Conductivity (umhos/cm)	Temperature (°C)	Turbidity (NTU)
Background							
MW-15002	9/19/2017	0.19	-39.6	6.9	7,725	15.85	5.44
MW-15008	9/19/2017	0.14	-10.5	6.8	1,533	14.88	3.67
MW-15016	9/19/2017	0.16	-6.4	7.1	1,243	18.55	5.37
MW-15018	9/19/2017	0.14	-51.1	7.2	852	17.70	2.32
MW-15019	9/19/2017	0.14	-42.3	6.9	2,001	16.05	1.69
MW-15020	9/19/2017	0.48	-16.6	7.0	1,377	15.40	2.12
MW-15024	9/19/2017	0.17	9.2	7.1	1,648	15.27	<1
MW-15027	9/19/2017	0.15	10.1	7.0	1,607	15.73	<1
Downgradient							
DEK-MW-15001	9/18/2017	0.25	78.1	7.5	805	14.20	1.47
DEK-MW-15002	9/18/2017	0.13	63.8	7.9	1,035	14.62	8.06
DEK-MW-15003	9/18/2017	0.15	-114.9	7.9	676	16.09	<1
DEK-MW-15004	9/19/2017	0.20	44.4	7.3	887	17.43	1.29
DEK-MW-15005	9/18/2017	0.16	23.4	7.9	953	15.10	<1
DEK-MW-15006	9/18/2017	0.14	-94.3	7.8	2,262	15.34	<1

Notes:

mg/L - Milligrams per Liter.

mV - Millivolts.

SU - Standard units.

umhos/cm - Micromhos per centimeter.

°C - Degrees Celcius

NTU - Nephelometric Turbidity Unit.

Table 4
Comparison of Appendix III Parameter Results to Background Limits – September 2017
DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

Sample Location:			DEK-MW-15001	DEK-MW-15002	DEK-MW-15003	DEK-MW-15004	DEK-MW-15005	DEK-MW-15006
Sample Date:			9/18/2017	9/18/2017	9/18/2017	9/19/2017	9/18/2017	9/18/2017
Constituent	Unit	UTL	downgradient					
Appendix III								
Boron	ug/L	619	2,700	870	1,030	730	714	1,070
Calcium	mg/L	302	82.4	66.9	62.1	66.5	44.3	76.8
Chloride	mg/L	2,440	82.2	84.9	60.2	79.8	79.3	133
Fluoride	ug/L	1,000	2,100	<1,000	<1,000	<1,000	<1,000	<1,000
pH, Field	SU	6.5-7.3	7.5	7.9	7.9	7.3	7.9	7.8
Sulfate	mg/L	407	36.2	290	54.3	283	273	886
Total Dissolved Solids	mg/L	4,600	594	722	426	596	638	1,670

Notes:

ug/L - micrograms per liter.

mg/L - milligrams per liter.

SU - standard units; pH is a field parameter.

All metals were analyzed as total unless otherwise specified.

RESULT

Shading and bold font indicates an exceedance of the Upper Tolerance Limit (UTL) using the number of significant figures in the UTL.

Figures





LEGEND

- BACKGROUND MONITORING WELL
- DEK BOTTOM ASH POND MONITORING WELL
- SURFACE WATER GAUGING STATION
- MONITORING WELL (STATIC WATER LEVEL ONLY)
- SLURRY WALL (APPROXIMATE)

NOTES

- BASE MAP IMAGERY FROM USDA – NATIONAL AGRICULTURE IMAGERY PROGRAM, 7/10/2016.
- WELL LOCATIONS SURVEYED BY ROWE PROFESSIONAL SERVICES COMPANY ON 11/4/2015.
- NOAA/NATIONAL OCEANIC SERVICE GREAT LAKES GAUGING STATION, ESSEXVILLE, MI (ID: 9075035).

1" = 1,000'
1:12,000

PROJECT:		CONSUMERS ENERGY COMPANY DE KARN POWER PLANT ESSEXVILLE, MICHIGAN	
TITLE:			
SITE PLAN WITH CCR MONITORING WELL LOCATIONS			
DRAWN BY:		J. PAPEZ	PROJ NO.:
CHECKED BY:		D. LITZ	269767-002
APPROVED BY:		G. CROCKFORD	FIGURE 2
DATE:		JANUARY 2018	

1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080
www.trcsolutions.com

FILE NO.: 269767-002-002.mxd

TRC - GIS
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation
Plot Date: 1/3/2018, 16:55:59 PM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\ConsumersEnergy\JCW\CD_GMA2017_269767\269767-002_3-021.mxd



LEGEND

BACKGROUND MONITORING WELL

DEK BOTTOM ASH POND MONITORING WELL

JCW BOTTOM ASH POND MONITORING WELL

JCW LANDFILL MONITORING WELL

SURFACE WATER GAUGING STATION

MONITORING WELL (STATIC WATER LEVEL ONLY)

SLURRY WALL (APPROXIMATE)

GROUNDWATER ELEVATION CONTOUR (2' INTERVAL, DASHED WHERE INFERRED)

(580.85) GROUNDWATER ELEVATION (FEET, MSL)

- NOTES**
1.

BASE MAP IMAGERY FROM USDA – NATIONAL AGRICULTURE IMAGERY PROGRAM, 7/10/2016.
2.

WELL LOCATIONS SURVEYED BY ROWE PROFESSIONAL SERVICES COMPANY ON 11/4/2015.
3.

NOAA/NATIONAL OCEANIC SERVICE GREAT LAKES GAUGING STATION, ESSEXVILLE, MI (ID: 9075035).

1" = 1,000'

1:12,000

PROJECT:

CONSUMERS ENERGY COMPANY
DE KARN AND JC WEADOCK POWER PLANTS
ESSEXVILLE, MICHIGAN

TITLE:

SHALLOW GROUNDWATER CONTOUR MAP
SEPTEMBER 2017

DRAWN BY:

S. MAJOR

CHECKED BY:

D. LITZ

APPROVED BY:

G. CROCKFORD

DATE:

JANUARY 2018

PROJ NO.:

269767-002

FIGURE 3

1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080
www.trcsolutions.com

FILE NO.:

269767-002_3-021.mxd

Appendix A

Background Data

Table 1
Summary of Groundwater Elevation Data
DE Karn and JC Weadock – RCRA CCR Monitoring Program
Essexville, Michigan

Well Location	Ground Surface Elevation (ft)	TOC Elevation (ft)	Geologic Unit of Screen Interval	Screen Interval Depth (ft BGS)			Screen Interval Elevation (ft)			Borehole Terminus Depth (ft BGS)	Borehole Terminus Elevation (ft)	Round 1		Round 2		Round 3		Round 4	
												December 8, 2015		March 28, 2016		May 23, 2016		August 22, 2016	
												Depth to Water (ft BTOC)	Groundwater Elevation (ft)	Depth to Water (ft BTOC)	Groundwater Elevation (ft)	Depth to Water (ft BTOC)	Groundwater Elevation (ft)	Depth to Water (ft BTOC)	Groundwater Elevation (ft)
Background																			
MW-15002	584.9	587.71	Sand	4.0	to	14.0	580.9	to	570.9	15.0	569.9	7.22	580.49	6.20	581.51	6.83	580.88	6.79	580.92
MW-15008	582.7	585.36	Sand with clay from 8 - 8.5 ft bgs	4.0	to	14.0	578.7	to	568.7	39.0	543.7	4.68	580.68	4.34	581.02	4.45	580.91	4.52	580.84
MW-15016	583.7	586.49	Sand	2.5	to	5.5	581.2	to	578.2	9.0	574.7	3.76	582.73	3.10	583.39	5.18	581.31	3.85	582.64
MW-15018	583.6	586.42	Sand	3.0	to	7.0	580.6	to	576.6	9.0	574.6	5.92	580.50	5.03	581.39	5.60	580.82	5.38	581.04
MW-15019	583.5	586.17	Sand (4 - 7.5 ft bgs) and Sand/Clay (7.5 - 14 ft bgs)	4.0	to	14.0	579.5	to	569.5	19.0	564.5	5.78	580.39	5.06	581.11	5.31	580.86	5.27	580.90
MW-15020	582.5	585.95	Sand	4.0	to	14.0	578.5	to	568.5	19.0	563.5	5.34	580.61	4.99	580.96	5.11	580.84	5.17	580.78
MW-15024	583.7	586.56	Sand	4.0	to	14.0	579.7	to	569.7	19.5	564.2	6.29	580.27	5.50	581.06	5.74	580.82	5.70	580.86
MW-15027	583.2	586.25	Sand	5.0	to	15.0	578.2	to	568.2	15.5	567.7	5.65	580.60	5.29	580.96	5.42	580.83	5.48	580.77
JCW Bottom Ash Pond																			
JCW-MW-15007	585.2	587.40	Sand	2.5	to	6.0	582.7	to	579.2	19.0	566.2	3.82	583.58	2.98	584.42	4.28	583.12	3.66	583.74
JCW-MW-15009	586.9	589.64	Sand	5.0	to	10.0	581.9	to	576.9	10.0	576.9	8.80	580.84	7.05	582.59	8.10	581.54	7.56	582.08
JCW-MW-15010	595.2	597.76	Sand	15.5	to	17.0	579.7	to	578.2	19.0	576.2	15.75	582.01	14.64	583.12	15.13	582.63	15.34	582.42
JCW-MW-15028	586.7	589.37	Sand	19.0	to	22.0	567.7	to	564.7	22.0	564.7	6.97	582.40	4.46	584.91	6.80	582.57	5.70	583.67
JCW Landfill																			
JCW-MW-15011	594.9	597.07	Sand	12.5	to	16.0	582.4	to	578.9	18.0	576.9	12.67	584.40	12.39	584.68	12.87	584.20	13.26	583.81
JCW-MW-15012	592.2	595.07	Sand (10.8 - 15 ft bgs) and Clay (15 - 15.8 ft bgs)	10.8	to	15.8	581.4	to	576.4	19.0	573.2	14.53	580.54	13.33	581.74	13.64	581.43	14.13	580.94
JCW-MW-15023	592.7	595.32	Sand	13.0	to	18.0	579.7	to	574.7	19.0	573.7	11.15	584.17	10.40	584.92	11.01	584.31	11.99	583.33
DEK Bottom Ash Pond																			
DEK-MW-15001	592.1	594.64	Sand	16.0	to	17.0	576.1	to	575.1	19.0	573.1	8.67	585.97	6.80	587.84	8.55	586.09	6.34	588.30
DEK-MW-15002	588.3	590.87	Sand	10.0	to	13.0	578.3	to	575.3	19.0	569.3	4.85	586.02	3.98	586.89	4.62	586.25	4.10	586.77
DEK-MW-15003	599.9	602.79	Sand	21.0	to	25.0	578.9	to	574.9	29.0	570.9	13.97	588.82	12.96	589.83	13.42	589.37	12.40	590.39
DEK-MW-15004 ⁽¹⁾	604.9	607.40	Sand	30.0	to	35.0	574.9	to	569.9	39.0	565.9	18.54	588.86	18.00	589.40	18.03	589.37	17.49	589.91
DEK-MW-15005	586.8	589.72	Sand	14.5	to	19.5	572.3	to	567.3	19.5	567.3	10.00	579.72	8.95	580.77	8.98	580.74	8.65	581.07
DEK-MW-15006	586.5	589.24	Sand	13.5	to	18.5	573.0	to	568.0	19.5	567.0	9.59	579.65	8.56	580.68	8.52	580.72	8.23	581.01

Notes:
Survey conducted by Rowe Professional Services Company, November 2015.
Elevation in feet relative to North American Vertical Datum 1988 (NAVD 88).
TOC: Top of well casing.
ft BTOC: Feet below top of well casing.
ft BGS: Feet below ground surface.
(1) Approximately 4.4-ft of riser added to DEK-MW-15004 subsequent to Round 7. Groundwater elevations adjusted accordingly. New TOC survey pending.

Table 1
Summary of Groundwater Elevation Data
DE Karn and JC Weadock – RCRA CCR Monitoring Program
Essexville, Michigan

Well Location	Ground Surface Elevation (ft)	TOC Elevation (ft)	Geologic Unit of Screen Interval	Screen Interval Depth (ft BGS)			Screen Interval Elevation (ft)			Round 5		Round 6		Round 7		Round 8	
										November 29, 2016		February 20, 2017		May 16, 2017		August 1, 2017	
										Depth to Water (ft BTOC)	Groundwater Elevation (ft)	Depth to Water (ft BTOC)	Groundwater Elevation (ft)	Depth to Water (ft BTOC)	Groundwater Elevation (ft)	Depth to Water (ft BTOC)	Groundwater Elevation (ft)
Background																	
MW-15002	584.9	587.71	Sand	4.0	to	14.0	580.9	to	570.9	6.62	581.09	6.89	580.82	6.67	581.04	6.77	580.94
MW-15008	582.7	585.36	Sand with clay from 8 - 8.5 ft bgs	4.0	to	14.0	578.7	to	568.7	4.60	580.76	4.45	580.91	4.36	581.00	4.11	581.25
MW-15016	583.7	586.49	Sand	2.5	to	5.5	581.2	to	578.2	3.22	583.27	3.11	583.38	3.93	582.56	5.45	581.04
MW-15018	583.6	586.42	Sand	3.0	to	7.0	580.6	to	576.6	5.35	581.07	5.66	580.76	5.49	580.93	5.44	580.98
MW-15019	583.5	586.17	Sand (4 - 7.5 ft bgs) and Sand/Clay (7.5 - 14 ft bgs)	4.0	to	14.0	579.5	to	569.5	5.41	580.76	5.57	580.60	5.28	580.89	5.14	581.03
MW-15020	582.5	585.95		Sand	4.0	to	14.0	578.5	to	568.5	5.21	580.74	5.09	580.86	5.03	580.92	4.79
MW-15024	583.7	586.56	Sand	4.0	to	14.0	579.7	to	569.7	5.96	580.60	6.07	580.49	5.69	580.87	5.43	581.13
MW-15027	583.2	586.25	Sand	5.0	to	15.0	578.2	to	568.2	5.56	580.69	5.40	580.85	5.31	580.94	5.10	581.15
JCW Bottom Ash Pond																	
JCW-MW-15007	585.2	587.40	Sand	2.5	to	6.0	582.7	to	579.2	3.25	584.15	3.74	583.66	3.98	583.42	4.34	583.06
JCW-MW-15009	586.9	589.64	Sand	5.0	to	10.0	581.9	to	576.9	9.19	580.45	9.35	580.29	8.33	581.31	8.23	581.41
JCW-MW-15010	595.2	597.76	Sand	15.5	to	17.0	579.7	to	578.2	16.69	581.07	16.70	581.06	15.48	582.28	15.31	582.45
JCW-MW-15028	586.7	589.37	Sand	19.0	to	22.0	567.7	to	564.7	7.05	582.32	7.62	581.75	6.90	582.47	7.77	581.60
JCW Landfill																	
JCW-MW-15011	594.9	597.07	Sand	12.5	to	16.0	582.4	to	578.9	14.68	582.39	14.42	582.65	12.59	584.48	13.25	583.82
JCW-MW-15012	592.2	595.07	Sand (10.8 - 15 ft bgs) and Clay (15 - 15.8 ft bgs)	10.8	to	15.8	581.4	to	576.4	15.48	579.59	15.15	579.92	14.00	581.07	13.45	581.62
JCW-MW-15023	592.7	595.32	Sand	13.0	to	18.0	579.7	to	574.7	13.95	581.37	13.75	581.57	11.60	583.72	12.25	583.07
DEK Bottom Ash Pond																	
DEK-MW-15001	592.1	594.64	Sand	16.0	to	17.0	576.1	to	575.1	7.38	587.26	8.31	586.33	8.49	586.15	8.40	586.24
DEK-MW-15002	588.3	590.87	Sand	10.0	to	13.0	578.3	to	575.3	4.20	586.67	4.42	586.45	4.42	586.45	4.57	586.30
DEK-MW-15003	599.9	602.79	Sand	21.0	to	25.0	578.9	to	574.9	13.21	589.58	13.64	589.15	13.51	589.28	12.97	589.82
DEK-MW-15004 ⁽¹⁾	604.9	607.40	Sand	30.0	to	35.0	574.9	to	569.9	18.35	589.05	18.60	588.80	17.61	589.79	21.54	590.26
DEK-MW-15005	586.8	589.72	Sand	14.5	to	19.5	572.3	to	567.3	10.33	579.39	9.84	579.88	8.98	580.74	8.43	581.29
DEK-MW-15006	586.5	589.24	Sand	13.5	to	18.5	573.0	to	568.0	9.95	579.29	9.43	579.81	8.51	580.73	7.87	581.37

Notes:
Survey conducted by Rowe Professional Services Company, November 2015.
Elevation in feet relative to North American Vertical Datum 1988 (NAVD 88).
TOC: Top of well casing.
ft BTOC: Feet below top of well casing.
ft BGS: Feet below ground surface.
(1) Approximately 4.4-ft of riser added to DEK-MW-15004 subsequent to Round 7. Groundwater elevations adjusted accordingly. New TOC survey pending.

Table 2
Summary of Analytical Results for Background Groundwater Samples
DE Karn and JC Weadock – RCRA CCR Monitoring Program
Essexville, Michigan

Sample Location:						MW-15002							
Sample Date:						12/8/2015	3/28/2016	5/23/2016	8/22/2016	11/30/2016	2/22/2017	5/17/2017	8/1/2017
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	background							
Appendix III													
Boron	ug/L	NC	500	500	7,200	275	22	163	79	48	133	138	205
Calcium	mg/L	NC	NC	NC	500	198	174	288	114	84.7	260	267	255
Chloride	mg/L	250**	250	250	50	1,130	773	2,140	420	260	1,470	1,970	2,290
Fluoride	ug/L	4,000	NC	NC	NC	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
pH, Field	SU	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	7.04	7	6.6	6.9	7.2	7	6.8	6.87
Sulfate	mg/L	250**	250	250	500	9.63	40.3	5.25	39.8	23.4	13.1	11.5	<2.0
Total Dissolved Solids	mg/L	500**	500	500	500	2,400	1,700	4,500	1,300	980	3,100	4,300	4,600
Appendix IV													
Antimony	ug/L	6	6	6	130	<1	<1	<1	<1	<1	<1	<1	<1.0
Arsenic	ug/L	10	10	10	10	4	<1	7	<1	2	2	3	4.8
Barium	ug/L	2,000	2,000	2,000	670	1,010	216	796	167	212	851	580	912
Beryllium	ug/L	4	4	4	6.7	<1	<1	<1	<1	<1	<1	<1	<1.0
Cadmium	ug/L	5	5	5	3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Chromium	ug/L	100	100	100	11	1	1	2	<1	1	1	2	1.3
Cobalt	ug/L	NC	40	100	100	<15	<15	<15	<15	<15	<15	<15	<15.0
Fluoride	ug/L	4,000	NC	NC	NC	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Lead	ug/L	NC	4	4	29	<1	<1	<1	<1	<1	<1	<1	<1.0
Lithium	ug/L	NC	170	350	440	37.7	<10	21	<10	<10	24	22	31
Mercury	ug/L	2	2	2	0.20#	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Molybdenum	ug/L	NC	73	210	3,200	<5	<5	<5	<5	<5	<5	<5	<5.0
Radium-226	pCi/L	5	NC	NC	NC	0.637	0.330	0.893	<0.264	<0.402	0.556	0.879	1.72
Radium-226/228	pCi/L	5	NC	NC	NC	2.05	<0.644	2.52	<1.05	<0.433	2.04	2.98	4.65
Radium-228	pCi/L	5	NC	NC	NC	1.41	<0.644	1.63	<1.05	<0.433	1.48	2.10	2.93
Selenium	ug/L	50	50	50	5	<1	<1	1	<1	<1	<1	<1	<1.0
Thallium	ug/L	2	2	2	3.7	<2	<2	<2	<2	<2	<2	<2	<2.0

Notes:

ug/L - micrograms per liter.

mg/L - milligrams per liter.

SU - standard units; pH is a field parameter.

pCi/L - picocuries per liter.

MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.

NC - no criteria.

NA - Result not yet available.

* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.

** - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April, 2012.

^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using default hardness of 150 mg CaCO3/L per MDEQ RRD Op Memo 5, Sept. 30, 2004. Generic GSI criterion for calcium and sulfate is the total dissolved solids criterion. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters, based on footnote {FF}. Chromium GSI criterion based on hexavalent chromium per footnote {H}.

- If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.

BOLD value indicates an exceedance of one or more of the listed criteria.

RED value indicates an exceedance of the MCL.

All metals were analyzed as total unless otherwise specified.

Table 2
Summary of Analytical Results for Background Groundwater Samples
DE Karn and JC Weadock – RCRA CCR Monitoring Program
Essexville, Michigan

Sample Location:						MW-15008							
Sample Date:						12/9/2015	3/29/2016	5/24/2016	8/23/2016	11/30/2016	2/22/2017	5/17/2017	8/2/2017
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	background							
Appendix III													
Boron	ug/L	NC	500	500	7,200	236	169	176	202	204	174	187	164
Calcium	mg/L	NC	NC	NC	500	114	126	113	114	113	107	114	108
Chloride	mg/L	250**	250	250	50	292	231	246	214	192	200	149	300
Fluoride	ug/L	4,000	NC	NC	NC	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
pH, Field	SU	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	6.82	6.7	6.5	6.7	6.8	6.8	7	6.90
Sulfate	mg/L	250**	250	250	500	5.15	26.7	8.60	17.9	25.6	27.7	10.1	13.4
Total Dissolved Solids	mg/L	500**	500	500	500	860	720	880	730	790	760	840	866
Appendix IV													
Antimony	ug/L	6	6	6	130	<1	<1	<1	<1	<1	<1	<1	<1.0
Arsenic	ug/L	10	10	10	10	<1	1	1	1	1	<1	<1	<1.0
Barium	ug/L	2,000	2,000	2,000	670	69	64	63	58	69	57	60	58.2
Beryllium	ug/L	4	4	4	6.7	<1	<1	<1	<1	<1	<1	<1	<1.0
Cadmium	ug/L	5	5	5	3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Chromium	ug/L	100	100	100	11	3	2	3	2	2	1	2	1.1
Cobalt	ug/L	NC	40	100	100	<15	<15	<15	<15	<15	<15	<15	<15.0
Fluoride	ug/L	4,000	NC	NC	NC	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Lead	ug/L	NC	4	4	29	<1	<1	<1	<1	<1	<1	<1	<1.0
Lithium	ug/L	NC	170	350	440	22.3	19.7	17	20	22	20	19	22
Mercury	ug/L	2	2	2	0.20#	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Molybdenum	ug/L	NC	73	210	3,200	<5	<5	<5	<5	<5	<5	<5	<5.0
Radium-226	pCi/L	5	NC	NC	NC	0.481	0.546	0.411	0.320	0.444	<0.419	0.228	<0.937
Radium-226/228	pCi/L	5	NC	NC	NC	1.53	1.42	1.61	1.96	1.46	0.826	1.45	<1.79
Radium-228	pCi/L	5	NC	NC	NC	1.05	0.874	1.20	1.64	1.01	0.717	1.22	<0.848
Selenium	ug/L	50	50	50	5	<1	<1	<1	<1	<1	<1	<1	<1.0
Thallium	ug/L	2	2	2	3.7	<2	<2	<2	<2	<2	<2	<2	<2.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.
NC - no criteria.
NA - Result not yet available.
* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
** - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April, 2012.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using default hardness of 150 mg CaCO3/L per MDEQ RRD Op Memo 5, Sept. 30, 2004. Generic GSI criterion for calcium and sulfate is the total dissolved solids criterion. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters, based on footnote {FF}. Chromium GSI criterion based on hexavalent chromium per footnote {H}.
- If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.
BOLD value indicates an exceedance of one or more of the listed criteria.
RED value indicates an exceedance of the MCL.
All metals were analyzed as total unless otherwise specified.

Table 2
Summary of Analytical Results for Background Groundwater Samples
DE Karn and JC Weadock – RCRA CCR Monitoring Program
Essexville, Michigan

Sample Location:						MW-15016							
Sample Date:						12/8/2015	3/29/2016	5/24/2016	8/22/2016	11/30/2016	2/22/2017	5/17/2017	8/1/2017
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	background							
Appendix III													
Boron	ug/L	NC	500	500	7,200	490	56	472	660	435	463	491	590
Calcium	mg/L	NC	NC	NC	500	178	204	188	216	192	295	221	208
Chloride	mg/L	250**	250	250	50	89.7	264	91.1	93.6	83.0	160	110	113
Fluoride	ug/L	4,000	NC	NC	NC	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
pH, Field	SU	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	7.06	7.1	6.8	6.8	7	7.2	6.9	7.00
Sulfate	mg/L	250**	250	250	500	35.1	151	75.0	70.6	18.1	817	243	294
Total Dissolved Solids	mg/L	500**	500	500	500	670	1,000	900	920	840	1,700	1,100	1,090
Appendix IV													
Antimony	ug/L	6	6	6	130	<1	<1	<1	<1	<1	<1	<1	<1.0
Arsenic	ug/L	10	10	10	10	11	2	16	18	16	2	12	20.5
Barium	ug/L	2,000	2,000	2,000	670	237	114	233	299	241	109	151	197
Beryllium	ug/L	4	4	4	6.7	<1	<1	<1	<1	<1	<1	<1	<1.0
Cadmium	ug/L	5	5	5	3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Chromium	ug/L	100	100	100	11	1	1	1	<1	<1	2	<1	<1.0
Cobalt	ug/L	NC	40	100	100	<15	<15	<15	<15	<15	<15	<15	<15.0
Fluoride	ug/L	4,000	NC	NC	NC	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Lead	ug/L	NC	4	4	29	<1	<1	<1	<1	<1	<1	<1	<1.0
Lithium	ug/L	NC	170	350	440	31.2	16.9	33	48	28	181	88	83
Mercury	ug/L	2	2	2	0.20#	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Molybdenum	ug/L	NC	73	210	3,200	6	<5	<5	<5	<5	6	<5	<5.0
Radium-226	pCi/L	5	NC	NC	NC	0.311	0.303	0.292	<0.199	<0.304	<0.312	0.479	<1.01
Radium-226/228	pCi/L	5	NC	NC	NC	1.58	0.750	1.40	<1.41	1.08	0.736	0.958	<2.34
Radium-228	pCi/L	5	NC	NC	NC	1.27	<0.673	1.11	<1.41	0.871	0.573	<0.619	<1.33
Selenium	ug/L	50	50	50	5	<1	<1	<1	<1	<1	2	1	<1.0
Thallium	ug/L	2	2	2	3.7	<2	<2	<2	<2	<2	<2	<2	<2.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.
NC - no criteria.
NA - Result not yet available.
* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
** - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April, 2012.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using default hardness of 150 mg CaCO3/L per MDEQ RRD Op Memo 5, Sept. 30, 2004. Generic GSI criterion for calcium and sulfate is the total dissolved solids criterion. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters, based on footnote {FF}. Chromium GSI criterion based on hexavalent chromium per footnote {H}.
- If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.
BOLD value indicates an exceedance of one or more of the listed criteria.
RED value indicates an exceedance of the MCL.
All metals were analyzed as total unless otherwise specified.

Table 2
Summary of Analytical Results for Background Groundwater Samples
DE Karn and JC Weadock – RCRA CCR Monitoring Program
Essexville, Michigan

Sample Location:						MW-15018							
Sample Date:						12/9/2015	3/29/2016	5/24/2016	8/23/2016	11/30/2016	2/22/2017	5/16/2017	8/2/2017
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	background							
Appendix III													
Boron	ug/L	NC	500	500	7,200	105	341	89	157	76	72	85	101
Calcium	mg/L	NC	NC	NC	500	167	203	110	176	177	138	124	104
Chloride	mg/L	250**	250	250	50	121	90.1	123	139	125	120	89.2	47.7
Fluoride	ug/L	4,000	NC	NC	NC	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
pH, Field	SU	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	6.96	7.1	7	6.9	7.1	7	6.9	7.23
Sulfate	mg/L	250**	250	250	500	74.6	161	37.3	66.6	121	51.7	28.0	10.3
Total Dissolved Solids	mg/L	500**	500	500	500	720	880	650	760	840	690	580	478
Appendix IV													
Antimony	ug/L	6	6	6	130	<1	<1	<1	<1	<1	<1	<1	<1.0
Arsenic	ug/L	10	10	10	10	2	12	4	7	5	4	6	4.4
Barium	ug/L	2,000	2,000	2,000	670	136	223	98	189	145	158	135	135
Beryllium	ug/L	4	4	4	6.7	<1	<1	<1	<1	<1	<1	<1	<1.0
Cadmium	ug/L	5	5	5	3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Chromium	ug/L	100	100	100	11	1	1	2	<1	<1	1	1	<1.0
Cobalt	ug/L	NC	40	100	100	<15	<15	<15	<15	<15	<15	<15	<15.0
Fluoride	ug/L	4,000	NC	NC	NC	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Lead	ug/L	NC	4	4	29	<1	<1	<1	<1	<1	<1	<1	<1.0
Lithium	ug/L	NC	170	350	440	19	38.7	14	21	19	18	16	14
Mercury	ug/L	2	2	2	0.20#	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Molybdenum	ug/L	NC	73	210	3,200	<5	6	<5	<5	<5	<5	<5	<5.0
Radium-226	pCi/L	5	NC	NC	NC	<0.214	0.463	<0.140	<0.317	<0.326	<0.283	<0.242	0.731
Radium-226/228	pCi/L	5	NC	NC	NC	0.701	1.38	<0.368	<1.15	0.749	<0.371	<0.608	1.80
Radium-228	pCi/L	5	NC	NC	NC	0.539	0.918	<0.368	<1.15	0.495	<0.371	<0.608	1.07
Selenium	ug/L	50	50	50	5	<1	2	<1	<1	<1	<1	<1	<1.0
Thallium	ug/L	2	2	2	3.7	<2	<2	<2	<2	<2	<2	<2	<2.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.
NC - no criteria.
NA - Result not yet available.
* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
** - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April, 2012.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using default hardness of 150 mg CaCO3/L per MDEQ RRD Op Memo 5, Sept. 30, 2004. Generic GSI criterion for calcium and sulfate is the total dissolved solids criterion. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters, based on footnote {FF}. Chromium GSI criterion based on hexavalent chromium per footnote {H}.
- If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.
BOLD value indicates an exceedance of one or more of the listed criteria.
RED value indicates an exceedance of the MCL.
All metals were analyzed as total unless otherwise specified.

Table 2
Summary of Analytical Results for Background Groundwater Samples
DE Karn and JC Weadock – RCRA CCR Monitoring Program
Essexville, Michigan

Sample Location:						MW-15019							
Sample Date:						12/9/2015	3/29/2016	5/24/2016	8/23/2016	11/30/2016	2/22/2017	5/16/2017	8/2/2017
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	background							
Appendix III													
Boron	ug/L	NC	500	500	7,200	304	244	279	343	300	317	299	293
Calcium	mg/L	NC	NC	NC	500	171	150	179	227	154	149	146	165
Chloride	mg/L	250**	250	250	50	437	387	408	358	359	379	357	380
Fluoride	ug/L	4,000	NC	NC	NC	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
pH, Field	SU	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	6.84	6.8	6.7	6.7	6.8	6.8	6.7	6.86
Sulfate	mg/L	250**	250	250	500	99.7	51.2	116	195	67.3	54.2	49.5	120
Total Dissolved Solids	mg/L	500**	500	500	500	1,400	1,100	1,300	1,300	1,100	1,200	1,100	1,250
Appendix IV													
Antimony	ug/L	6	6	6	130	<1	<1	<1	<1	<1	<1	<1	<1.0
Arsenic	ug/L	10	10	10	10	<1	<1	1	<1	<1	<1	<1	<1.0
Barium	ug/L	2,000	2,000	2,000	670	293	263	269	319	275	289	283	265
Beryllium	ug/L	4	4	4	6.7	<1	<1	<1	<1	<1	<1	<1	<1.0
Cadmium	ug/L	5	5	5	3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Chromium	ug/L	100	100	100	11	2	2	2	<1	<1	1	<1	<1.0
Cobalt	ug/L	NC	40	100	100	<15	<15	<15	<15	<15	<15	<15	<15.0
Fluoride	ug/L	4,000	NC	NC	NC	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Lead	ug/L	NC	4	4	29	<1	<1	<1	<1	<1	<1	<1	<1.0
Lithium	ug/L	NC	170	350	440	15.8	11	14	21	13	13	14	16
Mercury	ug/L	2	2	2	0.20#	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Molybdenum	ug/L	NC	73	210	3,200	<5	<5	<5	<5	<5	<5	<5	<5.0
Radium-226	pCi/L	5	NC	NC	NC	1.02	0.477	0.515	0.759	0.524	<0.300	0.360	<0.844
Radium-226/228	pCi/L	5	NC	NC	NC	1.84	1.24	1.50	1.68	1.01	1.05	1.74	<1.57
Radium-228	pCi/L	5	NC	NC	NC	0.815	0.766	0.987	0.918	<0.666	0.814	1.38	<0.722
Selenium	ug/L	50	50	50	5	<1	<1	<1	<1	<1	<1	<1	<1.0
Thallium	ug/L	2	2	2	3.7	<2	<2	<2	<2	<2	<2	<2	<2.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.
NC - no criteria.
NA - Result not yet available.
* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
** - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April, 2012.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using default hardness of 150 mg CaCO3/L per MDEQ RRD Op Memo 5, Sept. 30, 2004. Generic GSI criterion for calcium and sulfate is the total dissolved solids criterion. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters, based on footnote {FF}. Chromium GSI criterion based on hexavalent chromium per footnote {H}.
- If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.
BOLD value indicates an exceedance of one or more of the listed criteria.
RED value indicates an exceedance of the MCL.
All metals were analyzed as total unless otherwise specified.

Table 2
Summary of Analytical Results for Background Groundwater Samples
DE Karn and JC Weadock – RCRA CCR Monitoring Program
Essexville, Michigan

Sample Location:						MW-15020							
Sample Date:						12/9/2015	3/29/2016	5/24/2016	8/23/2016	11/30/2016	2/22/2017	5/17/2017	8/2/2017
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	background							
Appendix III													
Boron	ug/L	NC	500	500	7,200	191	139	151	214	154	146	173	174
Calcium	mg/L	NC	NC	NC	500	112	101	104	118	92.9	103	123	102
Chloride	mg/L	250**	250	250	50	281	203	259	186	147	177	230	310
Fluoride	ug/L	4,000	NC	NC	NC	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
pH, Field	SU	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	7.03	7	6.8	6.9	7	7	7	7.05
Sulfate	mg/L	250**	250	250	500	50.7	33.8	43.7	83.5	41.7	33.0	30.3	49.6
Total Dissolved Solids	mg/L	500**	500	500	500	900	680	830	720	640	670	760	894
Appendix IV													
Antimony	ug/L	6	6	6	130	<1	<1	<1	<1	<1	<1	<1	<1.0
Arsenic	ug/L	10	10	10	10	<1	<1	<1	<1	1	1	<1	<1.0
Barium	ug/L	2,000	2,000	2,000	670	76	63	68	67	52	66	81	80.3
Beryllium	ug/L	4	4	4	6.7	<1	<1	<1	<1	<1	<1	<1	<1.0
Cadmium	ug/L	5	5	5	3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Chromium	ug/L	100	100	100	11	2	1	1	<1	2	1	1	<1.0
Cobalt	ug/L	NC	40	100	100	<15	<15	<15	<15	<15	<15	<15	<15.0
Fluoride	ug/L	4,000	NC	NC	NC	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Lead	ug/L	NC	4	4	29	<1	<1	<1	<1	<1	<1	<1	<1.0
Lithium	ug/L	NC	170	350	440	25.5	19.7	20	24	24	23	23	25
Mercury	ug/L	2	2	2	0.20#	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Molybdenum	ug/L	NC	73	210	3,200	<5	<5	<5	<5	<5	<5	<5	<5.0
Radium-226	pCi/L	5	NC	NC	NC	0.456	0.398	<0.201	0.353	<0.230	<0.329	0.283	<0.781
Radium-226/228	pCi/L	5	NC	NC	NC	1.42	1.50	0.972	1.29	1.24	1.03	1.04	<1.74
Radium-228	pCi/L	5	NC	NC	NC	0.966	1.10	0.784	<1.16	1.07	0.723	0.761	1.28
Selenium	ug/L	50	50	50	5	<1	<1	<1	<1	<1	<1	<1	<1.0
Thallium	ug/L	2	2	2	3.7	<2	<2	<2	<2	<2	<2	<2	<2.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.
NC - no criteria.
NA - Result not yet available.
* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
** - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April, 2012.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using default hardness of 150 mg CaCO3/L per MDEQ RRD Op Memo 5, Sept. 30, 2004. Generic GSI criterion for calcium and sulfate is the total dissolved solids criterion. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters, based on footnote {FF}. Chromium GSI criterion based on hexavalent chromium per footnote {H}.
- If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.
BOLD value indicates an exceedance of one or more of the listed criteria.
RED value indicates an exceedance of the MCL.
All metals were analyzed as total unless otherwise specified.

Table 2
Summary of Analytical Results for Background Groundwater Samples
DE Karn and JC Weadock – RCRA CCR Monitoring Program
Essexville, Michigan

Sample Location:						MW-15024							
Sample Date:						12/9/2015	3/29/2016	5/24/2016	8/23/2016	11/30/2016	2/22/2017	5/16/2017	8/2/2017
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	background							
Appendix III													
Boron	ug/L	NC	500	500	7,200	268	213	205	249	203	240	213	182
Calcium	mg/L	NC	NC	NC	500	109	108	103	113	90.8	97.3	116	119
Chloride	mg/L	250**	250	250	50	448	354	333	349	268	297	284	380
Fluoride	ug/L	4,000	NC	NC	NC	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
pH, Field	SU	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	7.11	7	6.9	6.9	7.1	7	6.8	7.07
Sulfate	mg/L	250**	250	250	500	<2	<2	13.5	<2	2.53	<2	11.3	14.9
Total Dissolved Solids	mg/L	500**	500	500	500	1,100	990	940	950	800	870	920	958
Appendix IV													
Antimony	ug/L	6	6	6	130	<1	<1	<1	<1	<1	<1	<1	1.1
Arsenic	ug/L	10	10	10	10	<1	<1	1	<1	<1	<1	<1	<1.0
Barium	ug/L	2,000	2,000	2,000	670	112	100	88	101	78	88	97	91.7
Beryllium	ug/L	4	4	4	6.7	<1	<1	<1	<1	<1	<1	<1	<1.0
Cadmium	ug/L	5	5	5	3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Chromium	ug/L	100	100	100	11	1	1	2	1	1	2	4	<1.0
Cobalt	ug/L	NC	40	100	100	<15	<15	<15	<15	<15	<15	<15	<15.0
Fluoride	ug/L	4,000	NC	NC	NC	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Lead	ug/L	NC	4	4	29	<1	<1	2	<1	<1	<1	<1	<1.0
Lithium	ug/L	NC	170	350	440	22.6	18.3	16	20	17	19	19	22
Mercury	ug/L	2	2	2	0.20#	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Molybdenum	ug/L	NC	73	210	3,200	<5	<5	<5	<5	6	<5	<5	<5.0
Radium-226	pCi/L	5	NC	NC	NC	0.312	0.506	0.348	<0.301	0.368	0.410	0.412	<0.899
Radium-226/228	pCi/L	5	NC	NC	NC	1.23	1.52	1.18	1.01	1.66	1.31	1.12	1.79
Radium-228	pCi/L	5	NC	NC	NC	0.922	1.01	0.835	0.751	1.29	0.901	0.706	1.04
Selenium	ug/L	50	50	50	5	<1	<1	<1	<1	<1	<1	<1	<1.0
Thallium	ug/L	2	2	2	3.7	<2	<2	<2	<2	<2	<2	<2	<2.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.
NC - no criteria.
NA - Result not yet available.
* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
** - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April, 2012.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using default hardness of 150 mg CaCO3/L per MDEQ RRD Op Memo 5, Sept. 30, 2004. Generic GSI criterion for calcium and sulfate is the total dissolved solids criterion. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters, based on footnote {FF}. Chromium GSI criterion based on hexavalent chromium per footnote {H}.
- If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.
BOLD value indicates an exceedance of one or more of the listed criteria.
RED value indicates an exceedance of the MCL.
All metals were analyzed as total unless otherwise specified.

Table 2
Summary of Analytical Results for Background Groundwater Samples
DE Karn and JC Weadock – RCRA CCR Monitoring Program
Essexville, Michigan

Sample Location:						MW-15027							
Sample Date:						12/9/2015	3/29/2016	5/24/2016	8/23/2016	11/30/2016	2/22/2017	5/17/2017	8/2/2017
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	background							
Appendix III													
Boron	ug/L	NC	500	500	7,200	208	144	181	253	169	135	178	199
Calcium	mg/L	NC	NC	NC	500	103	109	108	111	95.8	93.6	120	113
Chloride	mg/L	250**	250	250	50	348	285	348	293	223	225	275	386
Fluoride	ug/L	4,000	NC	NC	NC	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
pH, Field	SU	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	7.02	6.9	6.8	6.8	7	7	7.1	6.97
Sulfate	mg/L	250**	250	250	500	16.0	30.7	12.9	20.8	25.4	19.5	22.9	10.8
Total Dissolved Solids	mg/L	500**	500	500	500	800	890	980	850	790	750	910	982
Appendix IV													
Antimony	ug/L	6	6	6	130	<1	<1	<1	<1	<1	<1	<1	<1.0
Arsenic	ug/L	10	10	10	10	<1	<1	1	<1	<1	<1	<1	<1.0
Barium	ug/L	2,000	2,000	2,000	670	95	89	95	94	78	79	103	107
Beryllium	ug/L	4	4	4	6.7	<1	<1	<1	<1	<1	<1	<1	<1.0
Cadmium	ug/L	5	5	5	3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Chromium	ug/L	100	100	100	11	2	1	2	1	1	1	2	<1.0
Cobalt	ug/L	NC	40	100	100	<15	<15	<15	<15	<15	<15	<15	<15.0
Fluoride	ug/L	4,000	NC	NC	NC	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Lead	ug/L	NC	4	4	29	<1	<1	<1	<1	<1	<1	<1	<1.0
Lithium	ug/L	NC	170	350	440	27.2	21.3	21	23	20	19	23	26
Mercury	ug/L	2	2	2	0.20#	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Molybdenum	ug/L	NC	73	210	3,200	<5	<5	<5	<5	<5	<5	<5	<5.0
Radium-226	pCi/L	5	NC	NC	NC	0.386	0.461	0.485	0.359	<0.305	0.396	0.431	<0.878
Radium-226/228	pCi/L	5	NC	NC	NC	1.36	1.40	1.31	1.28	0.962	1.61	1.27	2.15
Radium-228	pCi/L	5	NC	NC	NC	0.970	0.934	0.823	0.918	0.706	1.21	0.836	1.56
Selenium	ug/L	50	50	50	5	<1	<1	<1	<1	<1	<1	<1	<1.0
Thallium	ug/L	2	2	2	3.7	<2	<2	<2	<2	<2	<2	<2	<2.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.
NC - no criteria.
NA - Result not yet available.
* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
** - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April, 2012.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using default hardness of 150 mg CaCO3/L per MDEQ RRD Op Memo 5, Sept. 30, 2004. Generic GSI criterion for calcium and sulfate is the total dissolved solids criterion. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters, based on footnote {FF}. Chromium GSI criterion based on hexavalent chromium per footnote {H}.
- If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.
BOLD value indicates an exceedance of one or more of the listed criteria.
RED value indicates an exceedance of the MCL.
All metals were analyzed as total unless otherwise specified.

Table 3
Summary of Analytical Results for Bottom Ash Pond Groundwater Samples
DE Karn – RCRA CCR Monitoring Program
Essexville, Michigan

Sample Location:						DEK-MW-15001							
Sample Date:						12/10/2015	3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	downgradient							
Appendix III													
Boron	ug/L	NC	500	500	7,200	3,630	2,420	3,110	2,810	2,740	2,520	3,270	2,690
Calcium	mg/L	NC	NC	NC	500	108	87.8	92.2	95.0	75.1	96.8	85.8	71.8
Chloride	mg/L	250**	250	250	50	75.7	79.0	75.7	72.5	71.0	76.5	75.0	81.9
Fluoride	ug/L	4,000	NC	NC	NC	<1000	1,530	1,440	1,160	1,500	1,650	1,330	1,700
pH, Field	SU	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	7.62	7.5	7.5	7.4	7.4	7.4	7.4	7.56
Sulfate	mg/L	250**	250	250	500	72.4	53.3	64.9	37.4	52.7	53.4	59.9	66.3
Total Dissolved Solids	mg/L	500**	500	500	500	600	470	510	480	470	450	510	516
Appendix IV													
Antimony	ug/L	6	6	6	130	<1	<1	<1	<1	<1	<1	<1	<1.0
Arsenic	ug/L	10	10	10	10	118	159	138	108	144	133	145	158
Barium	ug/L	2,000	2,000	2,000	670	114	69	73	100	98	91	95	94.2
Beryllium	ug/L	4	4	4	6.7	<1	<1	<1	<1	<1	<1	<1	<1.0
Cadmium	ug/L	5	5	5	3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Chromium	ug/L	100	100	100	11	<1	1	<1	<1	<1	<1	1	<1.0
Cobalt	ug/L	NC	40	100	100	<15	<15	<15	<15	<15	<15	<15	<15.0
Fluoride	ug/L	4,000	NC	NC	NC	<1000	1,530	1,440	1,160	1,500	1,650	1,330	1,700
Lead	ug/L	NC	4	4	29	<1	<1	<1	<1	<1	<1	<1	<1.0
Lithium	ug/L	NC	170	350	440	71.9	48.7	51	55	52	48	55	53
Mercury	ug/L	2	2	2	0.20#	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Molybdenum	ug/L	NC	73	210	3,200	<5	<5	<5	<5	<5	<5	<5	<5.0
Radium-226	pCi/L	5	NC	NC	NC	<0.297	0.244	0.240	<0.195	<0.292	0.565	<0.315	<0.934
Radium-226/228	pCi/L	5	NC	NC	NC	1.18	1.56	0.879	<0.509	<0.405	1.21	1.29	<1.70
Radium-228	pCi/L	5	NC	NC	NC	0.909	1.32	0.639	<0.509	<0.405	0.642	1.20	<0.770
Selenium	ug/L	50	50	50	5	4	3	3	1	2	<1	<1	<1.0
Thallium	ug/L	2	2	2	3.7	<2	<2	<2	<2	<2	<2	<2	<2.0

Notes:

ug/L - micrograms per liter.

mg/L - milligrams per liter.

SU - standard units; pH is a field parameter.

pCi/L - picocuries per liter.

MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.

NC - no criteria.

NA - Results not yet available.

* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.

** - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April, 2012.

^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using default hardness of 150 mg CaCO3/L per MDEQ RRD Op Memo 5, Sept. 30, 2004. Generic GSI criterion for calcium and sulfate is the total dissolved solids criterion. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters, based on footnote {FF}. Chromium GSI criterion based on hexavalent chromium per footnote {H}.

- If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.

BOLD value indicates an exceedance of one or more of the listed criteria.

RED value indicates an exceedance of the MCL.

All metals were analyzed as total unless otherwise specified.

Table 3
Summary of Analytical Results for Bottom Ash Pond Groundwater Samples
DE Karn – RCRA CCR Monitoring Program
Essexville, Michigan

Sample Location:						DEK-MW-15002							
Sample Date:						12/10/2015	3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	downgradient							
Appendix III													
Boron	ug/L	NC	500	500	7,200	780	676	668	746	893	858	824	805
Calcium	mg/L	NC	NC	NC	500	102	119	99.6	105	94.8	149	80.1	71.1
Chloride	mg/L	250**	250	250	50	83.5	97.6	90.0	89.2	86.1	88.2	80.5	87.8
Fluoride	ug/L	4,000	NC	NC	NC	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
pH, Field	SU	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	7.78	7.5	7.6	7.5	7.6	7.5	7.5	7.84
Sulfate	mg/L	250**	250	250	500	275	418	291	384	326	289	299	256
Total Dissolved Solids	mg/L	500**	500	500	500	790	890	800	1,700	810	810	1,500	696
Appendix IV													
Antimony	ug/L	6	6	6	130	<1	<1	<1	<1	<1	<1	<1	<1.0
Arsenic	ug/L	10	10	10	10	61	118	82	79	54	62	76	48.3
Barium	ug/L	2,000	2,000	2,000	670	140	148	136	131	121	120	107	96.1
Beryllium	ug/L	4	4	4	6.7	<1	<1	<1	<1	<1	<1	<1	<1.0
Cadmium	ug/L	5	5	5	3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Chromium	ug/L	100	100	100	11	1	2	1	<1	1	2	2	<1.0
Cobalt	ug/L	NC	40	100	100	<15	<15	<15	<15	<15	<15	<15	<15.0
Fluoride	ug/L	4,000	NC	NC	NC	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Lead	ug/L	NC	4	4	29	<1	<1	<1	<1	<1	<1	3	<1.0
Lithium	ug/L	NC	170	350	440	50.7	53	43	44	40	41	42	36
Mercury	ug/L	2	2	2	0.20#	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Molybdenum	ug/L	NC	73	210	3,200	19	30	29	41	26	27	38	27.7
Radium-226	pCi/L	5	NC	NC	NC	<0.301	0.301	0.314	0.513	0.255	0.680	0.321	<0.854
Radium-226/228	pCi/L	5	NC	NC	NC	1.07	0.946	1.57	1.42	0.802	1.52	1.25	1.88
Radium-228	pCi/L	5	NC	NC	NC	0.809	0.645	1.26	0.908	0.547	0.844	0.929	1.17
Selenium	ug/L	50	50	50	5	<1	<1	2	<1	<1	<1	<1	<1.0
Thallium	ug/L	2	2	2	3.7	<2	<2	<2	<2	<2	<2	<2	<2.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
pCi/L - picocuries per liter.
MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.
NC - no criteria.
NA - Results not yet available.
* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.
** - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April, 2012.
^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using default hardness of 150 mg CaCO3/L per MDEQ RRD Op Memo 5, Sept. 30, 2004. Generic GSI criterion for calcium and sulfate is the total dissolved solids criterion. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters, based on footnote {FF}. Chromium GSI criterion based on hexavalent chromium per footnote {H}.
- If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.
BOLD value indicates an exceedance of one or more of the listed criteria.
RED value indicates an exceedance of the MCL.
All metals were analyzed as total unless otherwise specified.

Table 3
Summary of Analytical Results for Bottom Ash Pond Groundwater Samples
DE Karn – RCRA CCR Monitoring Program
Essexville, Michigan

Sample Location:						DEK-MW-15003							
Sample Date:						12/10/2015	3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/4/2017
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	downgradient							
Appendix III													
Boron	ug/L	NC	500	500	7,200	1,020	920	982	1,010	1,140	1,090	1,270	1,160
Calcium	mg/L	NC	NC	NC	500	41.7	57.3	56.3	64.1	64.1	85.4	68.2	58.8
Chloride	mg/L	250**	250	250	50	63.8	62.0	61.2	59.8	54.8	56.3	54.9	61.7
Fluoride	ug/L	4,000	NC	NC	NC	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
pH, Field	SU	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	8.37	7.8	7.9	7.7	7.8	7.7	7.8	7.87
Sulfate	mg/L	250**	250	250	500	64.3	71.6	75.7	76.8	71.9	64.5	57.6	55.8
Total Dissolved Solids	mg/L	500**	500	500	500	370	400	420	430	440	430	420	506
Appendix IV													
Antimony	ug/L	6	6	6	130	<1	<1	<1	<1	<1	<1	<1	<1.0
Arsenic	ug/L	10	10	10	10	498	517	543	527	525	372	450	437
Barium	ug/L	2,000	2,000	2,000	670	96	69	68	73	71	71	66	68.5
Beryllium	ug/L	4	4	4	6.7	<1	<1	<1	<1	<1	<1	<1	<1.0
Cadmium	ug/L	5	5	5	3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Chromium	ug/L	100	100	100	11	2	2	2	<1	<1	<1	1	<1.0
Cobalt	ug/L	NC	40	100	100	<15	<15	<15	<15	<15	<15	<15	<15.0
Fluoride	ug/L	4,000	NC	NC	NC	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Lead	ug/L	NC	4	4	29	<1	<1	<1	<1	<1	<1	<1	<1.0
Lithium	ug/L	NC	170	350	440	22.8	22.6	26	27	30	30	35	35
Mercury	ug/L	2	2	2	0.20#	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Molybdenum	ug/L	NC	73	210	3,200	8	7	8	6	5	5	5	5.0
Radium-226	pCi/L	5	NC	NC	NC	<0.221	<0.227	<0.235	<0.184	<0.287	0.252	<0.324	0.226
Radium-226/228	pCi/L	5	NC	NC	NC	<0.473	<0.520	<0.546	0.469	<0.363	<0.340	<0.646	<1.14
Radium-228	pCi/L	5	NC	NC	NC	<0.473	<0.520	<0.546	0.423	<0.363	<0.340	<0.646	<0.936
Selenium	ug/L	50	50	50	5	<5	<1	2	<1	<1	<1	<1	<1.0
Thallium	ug/L	2	2	2	3.7	<2	<2	<2	<2	<2	<2	<2	<2.0

Notes:

ug/L - micrograms per liter.

mg/L - milligrams per liter.

SU - standard units; pH is a field parameter.

pCi/L - picocuries per liter.

MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.

NC - no criteria.

NA - Results not yet available.

* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.

** - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April, 2012.

^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using default hardness of 150 mg CaCO3/L per MDEQ RRD Op Memo 5, Sept. 30, 2004. Generic GSI criterion for calcium and sulfate is the total dissolved solids criterion. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters, based on footnote {FF}. Chromium GSI criterion based on hexavalent chromium per footnote {H}.

- If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.

BOLD value indicates an exceedance of one or more of the listed criteria.

RED value indicates an exceedance of the MCL.

All metals were analyzed as total unless otherwise specified.

Table 3
Summary of Analytical Results for Bottom Ash Pond Groundwater Samples
DE Karn – RCRA CCR Monitoring Program
Essexville, Michigan

Sample Location:						DEK-MW-15004							
Sample Date:						12/10/2015	3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	downgradient							
Appendix III													
Boron	ug/L	NC	500	500	7,200	478	435	514	472	535	637	839	785
Calcium	mg/L	NC	NC	NC	500	61.7	68.3	71.1	78.9	73.0	108	74.2	67.4
Chloride	mg/L	250**	250	250	50	71.5	72.7	72.3	77.4	73.3	75.3	70.3	81.4
Fluoride	ug/L	4,000	NC	NC	NC	<1000	<1000	<1000	1,550	<1000	<1000	<1000	<1000
pH, Field	SU	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	7.95	7.7	7.4	7.4	7.5	7.5	7.5	7.55
Sulfate	mg/L	250**	250	250	500	213	188	184	198	215	211	220	258
Total Dissolved Solids	mg/L	500**	500	500	500	680	560	560	580	590	580	590	642
Appendix IV													
Antimony	ug/L	6	6	6	130	<1	<1	<1	<1	<1	<1	<1	<1.0
Arsenic	ug/L	10	10	10	10	56	95	108	104	117	116	111	121
Barium	ug/L	2,000	2,000	2,000	670	107	94	102	110	115	110	103	111
Beryllium	ug/L	4	4	4	6.7	<1	<1	<1	<1	<1	<1	<1	<1.0
Cadmium	ug/L	5	5	5	3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Chromium	ug/L	100	100	100	11	<1	2	<1	<1	<1	1	<1	<1.0
Cobalt	ug/L	NC	40	100	100	<15	<15	<15	<15	<15	<15	<15	<15.0
Fluoride	ug/L	4,000	NC	NC	NC	<1000	<1000	<1000	1,550	<1000	<1000	<1000	<1000
Lead	ug/L	NC	4	4	29	<1	<1	<1	<1	<1	<1	<1	<1.0
Lithium	ug/L	NC	170	350	440	35.8	29.5	36	34	37	36	38	39
Mercury	ug/L	2	2	2	0.20#	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Molybdenum	ug/L	NC	73	210	3,200	29	25	21	24	27	30	29	30.4
Radium-226	pCi/L	5	NC	NC	NC	<0.258	0.400	0.233	0.264	0.244	0.328	0.347	0.805
Radium-226/228	pCi/L	5	NC	NC	NC	<0.556	0.932	0.76	0.936	0.588	0.665	1.63	1.64
Radium-228	pCi/L	5	NC	NC	NC	<0.556	0.532	0.527	0.672	<0.396	<0.458	1.28	0.833
Selenium	ug/L	50	50	50	5	<1	<1	1	<1	<1	<1	<1	<1.0
Thallium	ug/L	2	2	2	3.7	<2	<2	<2	<2	<2	<2	<2	<2.0

Notes:

ug/L - micrograms per liter.

mg/L - milligrams per liter.

SU - standard units; pH is a field parameter.

pCi/L - picocuries per liter.

MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.

NC - no criteria.

NA - Results not yet available.

* - Michigan Part 201 Generic Drinking Water Cleanup Criteria, December 30, 2013.

** - Secondary Maximum Contaminant Level (SMCL), EPA Secondary Drinking Water Regulations (SDWR) April, 2012.

^ - Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Hardness-dependent criteria calculated using default hardness of 150 mg CaCO3/L per MDEQ RRD Op Memo 5, Sept. 30, 2004. Generic GSI criterion for calcium and sulfate is the total dissolved solids criterion. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters, based on footnote {FF}. Chromium GSI criterion based on hexavalent chromium per footnote {H}.

- If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.

BOLD value indicates an exceedance of one or more of the listed criteria.

RED value indicates an exceedance of the MCL.

All metals were analyzed as total unless otherwise specified.

Table 3
Summary of Analytical Results for Bottom Ash Pond Groundwater Samples
DE Karn – RCRA CCR Monitoring Program
Essexville, Michigan

Sample Location:						DEK-MW-15005							
Sample Date:						12/10/2015	3/30/2016	5/26/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	downgradient							
Appendix III													
Boron	ug/L	NC	500	500	7,200	410	396	465	589	687	712	788	792
Calcium	mg/L	NC	NC	NC	500	58.5	68.6	72.7	98.4	71.1	76.3	55.0	49.2
Chloride	mg/L	250**	250	250	50	77.9	82.6	82.3	93.9	80.1	77.5	73.3	81.4
Fluoride	ug/L	4,000	NC	NC	NC	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
pH, Field	SU	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	8.04	7.7	7.5	7.6	7.7	7.7	7.6	7.88
Sulfate	mg/L	250**	250	250	500	223	251	269	355	329	281	263	300
Total Dissolved Solids	mg/L	500**	500	500	500	620	660	660	810	740	680	650	732
Appendix IV													
Antimony	ug/L	6	6	6	130	<1	<1	<1	<1	<1	<1	<1	<1.0
Arsenic	ug/L	10	10	10	10	5	15	16	23	29	29	28	31.9
Barium	ug/L	2,000	2,000	2,000	670	87	94	104	149	120	101	83	92.2
Beryllium	ug/L	4	4	4	6.7	<1	<1	<1	<1	<1	<1	<1	<1.0
Cadmium	ug/L	5	5	5	3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Chromium	ug/L	100	100	100	11	<1	1	1	<1	<1	1	2	<1.0
Cobalt	ug/L	NC	40	100	100	<15	<15	<15	<15	<15	<15	<15	<15.0
Fluoride	ug/L	4,000	NC	NC	NC	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Lead	ug/L	NC	4	4	29	<1	<1	<1	<1	<1	<1	<1	<1.0
Lithium	ug/L	NC	170	350	440	23.7	23	29	30	26	23	26	27
Mercury	ug/L	2	2	2	0.20#	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Molybdenum	ug/L	NC	73	210	3,200	40	33	32	37	44	40	36	41.9
Radium-226	pCi/L	5	NC	NC	NC	<0.238	0.263	0.180	0.300	0.367	0.490	<0.321	0.707
Radium-226/228	pCi/L	5	NC	NC	NC	1.20	0.686	0.458	1.22	0.917	0.940	0.875	1.72
Radium-228	pCi/L	5	NC	NC	NC	1.03	<0.429	<0.404	0.919	0.550	0.450	0.685	1.01
Selenium	ug/L	50	50	50	5	2	<1	1	<1	<1	<1	<1	<1.0
Thallium	ug/L	2	2	2	3.7	<2	<2	<2	<2	<2	<2	<2	<2.0

Notes:

ug/L - micrograms per liter.

mg/L - milligrams per liter.

SU - standard units; pH is a field parameter.

pCi/L - picocuries per liter.

MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.

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- If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.

BOLD value indicates an exceedance of one or more of the listed criteria.

RED value indicates an exceedance of the MCL.

All metals were analyzed as total unless otherwise specified.

Table 3
Summary of Analytical Results for Bottom Ash Pond Groundwater Samples
DE Karn – RCRA CCR Monitoring Program
Essexville, Michigan

Sample Location:						DEK-MW-15006							
Sample Date:						12/10/2015	3/30/2016	5/25/2016	8/24/2016	12/1/2016	2/23/2017	5/18/2017	8/3/2017
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	downgradient							
Appendix III													
Boron	ug/L	NC	500	500	7,200	1,070	706	942	979	1,230	1,120	1,420	1,240
Calcium	mg/L	NC	NC	NC	500	196	130	105	130	79.1	83.9	38.6	39.9
Chloride	mg/L	250**	250	250	50	153	152	135	188	128	102	97.1	104
Fluoride	ug/L	4,000	NC	NC	NC	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
pH, Field	SU	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5	6.5 - 9.0	7.42	7.5	7.5	7.6	7.8	7.7	8.1	7.92
Sulfate	mg/L	250**	250	250	500	1,320	1,130	917	1,160	886	636	513	547
Total Dissolved Solids	mg/L	500**	500	500	500	2,400	2,100	1,700	2,200	1,800	1,300	1,100	1,110
Appendix IV													
Antimony	ug/L	6	6	6	130	<1	<1	<1	<1	<1	<1	<1	<1.0
Arsenic	ug/L	10	10	10	10	13	19	18	20	20	20	20	14.6
Barium	ug/L	2,000	2,000	2,000	670	97	55	44	58	41	30	27	31.0
Beryllium	ug/L	4	4	4	6.7	<1	<1	<1	<1	<1	<1	<1	<1.0
Cadmium	ug/L	5	5	5	3	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Chromium	ug/L	100	100	100	11	<1	1	1	<1	1	1	2	<1.0
Cobalt	ug/L	NC	40	100	100	<15	<15	<15	<15	<15	<15	<15	<15.0
Fluoride	ug/L	4,000	NC	NC	NC	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Lead	ug/L	NC	4	4	29	<1	<1	<1	<1	<1	<1	<1	<1.0
Lithium	ug/L	NC	170	350	440	36.1	20.7	22	22	19	16	16	17
Mercury	ug/L	2	2	2	0.20#	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.20
Molybdenum	ug/L	NC	73	210	3,200	23	37	34	36	64	82	68	64.2
Radium-226	pCi/L	5	NC	NC	NC	0.392	0.363	0.463	0.286	<0.362	<0.307	<0.354	<0.945
Radium-226/228	pCi/L	5	NC	NC	NC	1.29	1.11	0.964	0.748	<0.421	<0.562	0.585	<1.85
Radium-228	pCi/L	5	NC	NC	NC	0.901	0.743	0.501	<0.578	<0.421	<0.562	0.483	<0.906
Selenium	ug/L	50	50	50	5	3	2	2	<1	<1	1	1	<1.0
Thallium	ug/L	2	2	2	3.7	<2	<2	<2	<2	<2	<2	<2	<2.0

Notes:

ug/L - micrograms per liter.

mg/L - milligrams per liter.

SU - standard units; pH is a field parameter.

pCi/L - picocuries per liter.

MCL - Maximum Contaminant Level, EPA Drinking Water Standards and Health Advisories, April, 2012.

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- If detected above 0.20 ug/L, further evaluation of low-level mercury may be necessary to evaluate the GSI pathway per Michigan Part 201 and MDEQ policy and procedure 09-014 dated June 20, 2012.

BOLD value indicates an exceedance of one or more of the listed criteria.

RED value indicates an exceedance of the MCL.

All metals were analyzed as total unless otherwise specified.

Table 4
Summary of Field Parameters
DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

Sample Location	Sample Date	Dissolved Oxygen	Oxidation Reduction Potential	pH	Specific Conductivity	Temperature	Turbidity
		mg/L	mV	SU	umhos/cm	°C	NTU
Background Monitoring Wells							
MW-15002	12/08/15	0.75	-104.4	7.04	3,628	11.07	0.6
	03/28/16	0.30	-53.7	7.00	3,044	7.30	1.3
	05/23/16	0.20	-84.5	6.60	7,225	13.20	<1
	08/22/16	0.60	-66.1	6.90	2,330	17.90	2.9
	11/30/16	0.80	-84.1	7.20	1,761	12.00	4.3
	02/22/17	0.10	-119.5	7.00	5,727	7.60	6.4
	05/17/17	0.00	-77.5	6.85	7,063	14.66	<1
08/01/17	0.18	-60.2	6.87	7,486	17.16	6.3	
MW-15008	12/09/15	0.28	-56.9	6.82	1,320	10.88	8.3
	03/29/16	0.20	-87.1	6.70	1,542	6.90	7.0
	05/24/16	0.20	-77.3	6.50	1,565	10.40	5.2
	08/23/16	0.50	-112.7	6.70	1,373	15.00	3.3
	11/30/16	0.60	-80.9	6.80	1,352	12.90	5.0
	02/22/17	0.10	-146.2	6.80	1,465	9.20	6.1
	05/17/17	0.03	-58.2	6.70	1,553	13.73	<1
08/02/17	0.41	-35.2	6.90	1,283	15.48	<1	
MW-15016	12/08/15	0.57	-87.3	7.06	1,205	6.31	4.6
	03/29/16	0.20	-106.7	7.10	1,593	6.00	3.3
	05/24/16	0.30	-100.1	6.80	1,493	15.20	3.1
	08/22/16	0.40	-133.3	6.80	1,573	21.60	4.8
	11/30/16	0.60	-75.7	7.00	1,450	8.60	9.0
	02/22/17	0.30	12.7	7.20	2,551	4.80	8.4
	05/17/17	0.10	-84.2	7.01	1,747	15.14	8.3
08/01/17	0.18	-90.6	7.00	1,663	21.51	3.7	
MW-15018	12/09/15	0.66	57.6	6.96	1,051	9.20	2.6
	03/29/16	0.30	-49.2	7.10	1,565	7.10	2.1
	05/24/16	0.20	-74.4	7.00	1,115	15.40	1.8
	08/23/16	0.40	-109.8	6.90	1,418	19.80	<1
	11/30/16	0.70	-73.8	7.10	1,387	11.00	2.3
	02/22/17	0.10	-114.2	7.00	1,285	7.80	6.5
	05/16/17	0.09	-82.5	7.09	1,041	12.97	7.0
08/02/17	0.19	-92.9	7.23	769	17.71	4.7	
MW-15019	12/09/15	0.47	-40.8	6.84	1,838	10.01	1.2
	03/29/16	0.20	-74.9	6.80	2,220	8.40	1.0
	05/24/16	0.20	-83.9	6.70	2,210	13.60	2.3
	08/23/16	0.40	-98.6	6.70	2,364	17.70	<1
	11/30/16	0.60	-55.2	6.80	2,161	12.00	5.1
	02/22/17	0.10	-118.0	6.80	2,317	8.00	3.2
	05/16/17	0.07	-79.3	6.82	2,223	13.28	<1
08/02/17	0.20	-76.7	6.86	2,158	16.49	2.8	

Notes:

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umhos/cm - Micromhos per centimeter.
°C - Degrees Celcius
NTU - Nephelometric Turbidity Unit.
SU - Standard Unit

Table 4
Summary of Field Parameters
DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

Sample Location	Sample Date	Dissolved Oxygen	Oxidation Reduction Potential	pH	Specific Conductivity	Temperature	Turbidity
		mg/L	mV	SU	umhos/cm	°C	NTU
Background Monitoring Wells							
MW-15020	12/09/15	0.30	-62.2	7.03	1,278	10.86	6.7
	03/29/16	0.20	-89.1	7.00	1,338	6.80	3.7
	05/24/16	0.20	-99.4	6.80	1,465	11.60	4.5
	08/23/16	0.40	-112.7	6.90	1,306	16.20	1.8
	11/30/16	0.50	-83.7	7.00	1,155	13.50	4.8
	02/22/17	0.20	-117.6	7.00	1,312	8.70	8.2
	05/17/17	0.04	-89.5	6.93	1,560	12.48	<1
08/02/17	0.62	-29.9	7.05	24	16.80	<1	
MW-15024	12/09/15	0.48	-30.6	7.11	1,632	11.53	4.8
	03/29/16	0.20	-42.2	7.00	1,866	8.80	<1
	05/24/16	0.30	-68.9	6.90	1,711	12.90	<1
	08/23/16	0.40	-71.7	6.90	1,798	16.90	<1
	11/30/16	0.70	-30.8	7.10	1,493	13.20	3.1
	02/22/17	0.10	-100.3	7.00	1,771	9.90	1.7
	05/16/17	0.06	-64.7	6.99	1,792	13.88	<1
08/02/17	0.20	-38.8	7.07	1,810	14.94	1.4	
MW-15027	12/09/15	0.29	-53.2	7.02	1,404	10.81	7.2
	03/29/16	0.20	-64.1	6.90	1,696	8.20	<1
	05/24/16	0.20	-73.3	6.80	1,751	11.40	<1
	08/23/16	0.40	-94.2	6.80	1,663	17.40	<1
	11/30/16	0.60	-51.6	7.00	1,393	12.80	1.5
	02/22/17	0.10	-126.9	7.00	1,483	8.70	3.2
	05/17/17	1.20	-72.5	6.88	1,780	13.05	<1
08/02/17	0.28	-65.1	6.97	1,760	16.74	3.5	
DE Karn Bottom Ash Pond							
DEK-MW-15001	12/10/15	0.52	-94.4	7.62	809	12.24	1.7
	03/30/16	0.40	-105.2	7.50	840	9.60	<1
	05/26/16	0.50	-117.9	7.50	892	14.10	<1
	08/24/16	0.50	-159.9	7.40	863	15.00	<1
	12/01/16	0.50	-130.4	7.40	725	12.50	<1
	02/23/17	0.10	-183.9	7.40	865	12.00	2.4
	05/18/17	0.40	-83.9	7.44	955	15.42	<1
08/03/17	0.20	-100.4	7.56	825	14.10	4.7	
DEK-MW-15002	12/10/15	0.25	-133.7	7.78	1,024	11.65	4.8
	03/30/16	0.20	-133.8	7.50	1,381	10.00	9.7
	05/26/16	0.30	-184.6	7.60	1,261	14.90	4.2
	08/24/16	0.40	-165.7	7.50	1,359	16.60	<1
	12/01/16	0.40	-155.1	7.60	1,176	12.50	<1
	02/23/17	0.10	-207.9	7.50	1,385	10.80	7.3
	05/18/17	0.43	-115.2	7.49	1,338	18.50	4.1
08/03/17	0.18	-131.7	7.84	1,128	14.85	8.8	

Notes:

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umhos/cm - Micromhos per centimeter.

°C - Degrees Celcius

NTU - Nephelometric Turbidity Unit.

SU - Standard Unit

Table 4
Summary of Field Parameters
DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

Sample Location	Sample Date	Dissolved Oxygen	Oxidation Reduction Potential	pH	Specific Conductivity	Temperature	Turbidity
		mg/L	mV	SU	umhos/cm	°C	NTU
DE Karn Bottom Ash Pond							
DEK-MW-15003	12/10/15	0.25	-203.4	8.37	561	12.38	0.9
	03/30/16	0.30	-177.5	7.80	732	12.80	<1
	05/26/16	0.30	-175.2	7.90	735	16.80	<1
	08/24/16	0.40	-117.3	7.70	762	18.50	<1
	12/01/16	0.50	-170.1	7.80	681	12.10	<1
	02/23/17	0.30	-152.2	7.70	734	14.80	<1
	05/18/17	0.13	-92.4	7.85	780	19.02	<1
	08/04/17	0.23	-144.6	7.87	730	14.61	7.8
DEK-MW-15004	12/10/15	0.23	-165.7	7.95	824	13.85	1.9
	03/30/16	0.30	-161.9	7.70	935	15.30	<1
	05/26/16	0.30	-155.0	7.40	905	18.20	<1
	08/24/16	0.40	-74.3	7.40	967	20.10	<1
	12/01/16	0.50	-141.3	7.50	856	13.80	<1
	02/23/17	0.30	-151.8	7.50	927	16.80	<1
	05/18/17	0.14	-128.8	7.46	1,003	19.49	<1
	08/03/17	0.33	-130.9	7.55	965	19.59	6.3
DEK-MW-15005	12/10/15	0.34	-38.6	8.04	799	11.64	<1
	03/30/16	0.30	-73.5	7.70	1,048	11.50	1.3
	05/26/16	0.30	-78.2	7.50	1,046	13.90	2.0
	08/24/16	0.50	-112.4	7.60	1,258	19.90	<1
	12/01/16	0.40	-120.8	7.70	1,049	12.60	<1
	02/23/17	0.30	-131.1	7.70	1,078	11.50	<1
	05/18/17	0.05	-70.9	7.60	1,106	14.65	<1
	08/03/17	0.25	-130.8	7.88	1,041	15.75	6.1
DEK-MW-15006	12/10/15	0.31	52.0	7.42	2,711	10.25	1.3
	03/30/16	0.20	-97.9	7.50	2,994	11.50	6.8
	05/25/16	0.30	-94.2	7.50	2,484	13.90	2.3
	08/24/16	0.40	-153.4	7.60	3,270	16.30	1.4
	12/01/16	0.80	-127.9	7.80	2,574	11.60	<1
	02/23/17	0.40	-148.9	7.70	1,933	11.80	<1
	05/18/17	0.41	-76.8	8.07	1,936	15.06	<1
	08/03/17	0.21	-129.6	7.92	1,729	15.48	7.2

Notes:

mg/L - Milligrams per Liter.

mV - Millivolts.

umhos/cm - Micromhos per centimeter.

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LEGEND

- BACKGROUND MONITORING WELL
- BEDROCK MONITORING WELL
- DEK BOTTOM ASH POND MONITORING WELL
- JCW BOTTOM ASH POND MONITORING WELL
- JCW LANDFILL MONITORING WELL
- SURFACE WATER GAUGING STATION
- SLURRY WALL (APPROXIMATE)
- GROUNDWATER ELEVATION CONTOUR (2' INTERVAL, DASHED WHERE INFERRED)
- GROUNDWATER ELEVATION (FEET, MSL)

NOTES

- BASE MAP IMAGERY FROM USDA – NATIONAL AGRICULTURE IMAGERY PROGRAM, 7/10/2016.
- WELL LOCATIONS SURVEYED BY ROWE PROFESSIONAL SERVICES COMPANY ON 11/4/2015.
- NOAA/NATIONAL OCEANIC SERVICE GREAT LAKES GAUGING STATION, ESSEXVILLE, MI (ID: 9075035).

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Feet

1" = 1,000'

1:12,000

PROJECT:

CONSUMERS ENERGY COMPANY
DE KARN AND JC WEADOCK POWER PLANTS
ESSEXVILLE, MICHIGAN

TITLE:

SHALLOW GROUNDWATER CONTOUR MAP
DECEMBER 2015

DRAWN BY:

J. PAPEZ

PROJ NO.:

269767-002/3

CHECKED BY:

D. LITZ

APPROVED BY:

G. CROCKFORD

DATE:

OCTOBER 2017

FIGURE 1

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FILE NO.:

269767-002_3-001.mxd



LEGEND

- BACKGROUND MONITORING WELL
- BEDROCK MONITORING WELL
- DEK BOTTOM ASH POND MONITORING WELL
- JCW BOTTOM ASH POND MONITORING WELL
- JCW LANDFILL MONITORING WELL
- SURFACE WATER GAUGING STATION
- SLURRY WALL (APPROXIMATE)
- GROUNDWATER ELEVATION CONTOUR (2' INTERVAL, DASHED WHERE INFERRED)
- GROUNDWATER ELEVATION (FEET, MSL)

NOTES

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- NOAA/NATIONAL OCEANIC SERVICE GREAT LAKES GAUGING STATION, ESSEXVILLE, MI (ID: 9075035).

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PROJECT:

CONSUMERS ENERGY COMPANY
DE KARN AND JC WEADOCK POWER PLANTS
ESSEXVILLE, MICHIGAN

TITLE:

SHALLOW GROUNDWATER CONTOUR MAP
MARCH 2016

DRAWN BY:

J. PAPEZ

PROJ NO.:

269767-002/3

CHECKED BY:

D. LITZ

APPROVED BY:

G. CROCKFORD

DATE:

OCTOBER 2017

FIGURE 2

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FILE NO.:

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LEGEND

- BACKGROUND MONITORING WELL
- BEDROCK MONITORING WELL
- DEK BOTTOM ASH POND MONITORING WELL
- JCW BOTTOM ASH POND MONITORING WELL
- JCW LANDFILL MONITORING WELL
- SURFACE WATER GAUGING STATION
- SLURRY WALL (APPROXIMATE)
- GROUNDWATER ELEVATION CONTOUR (2' INTERVAL, DASHED WHERE INFERRED)
- GROUNDWATER ELEVATION (FEET, MSL)

NOTES

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- NOAA/NATIONAL OCEANIC SERVICE GREAT LAKES GAUGING STATION, ESSEXVILLE, MI (ID: 9075035).

1" = 1,000'
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PROJECT:		CONSUMERS ENERGY COMPANY DE KARN AND JC WEADOCK POWER PLANTS ESSEXVILLE, MICHIGAN	
TITLE: SHALLOW GROUNDWATER CONTOUR MAP MAY 2016			
DRAWN BY:		J. PAPEZ	PROJ NO.: 269767-002/3
CHECKED BY:		D. LITZ	FIGURE 3
APPROVED BY:		G. CROCKFORD	
DATE:		OCTOBER 2017	

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FILE NO.: 269767-002_3-003.mxd



LEGEND

- BACKGROUND MONITORING WELL
- BEDROCK MONITORING WELL
- DEK BOTTOM ASH POND MONITORING WELL
- JCW BOTTOM ASH POND MONITORING WELL
- JCW LANDFILL MONITORING WELL
- SURFACE WATER GAUGING STATION
- SLURRY WALL (APPROXIMATE)
- GROUNDWATER ELEVATION CONTOUR (2' INTERVAL, DASHED WHERE INFERRED)
- GROUNDWATER ELEVATION (FEET, MSL)

NOTES

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- NOAA/NATIONAL OCEANIC SERVICE GREAT LAKES GAUGING STATION, ESSEXVILLE, MI (ID: 9075035).

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PROJECT:

CONSUMERS ENERGY COMPANY
DE KARN AND JC WEADOCK POWER PLANTS
ESSEXVILLE, MICHIGAN

TITLE:

SHALLOW GROUNDWATER CONTOUR MAP
AUGUST 2016

DRAWN BY:

J. PAPEZ

PROJ NO.:

269767-002/3

CHECKED BY:

D. LITZ

APPROVED BY:

G. CROCKFORD

DATE:

OCTOBER 2017

FIGURE 4

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FILE NO.:

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LEGEND

- BACKGROUND MONITORING WELL
- BEDROCK MONITORING WELL
- DEK BOTTOM ASH POND MONITORING WELL
- JCW BOTTOM ASH POND MONITORING WELL
- JCW LANDFILL MONITORING WELL
- SURFACE WATER GAUGING STATION
- SLURRY WALL (APPROXIMATE)
- GROUNDWATER ELEVATION CONTOUR (2' INTERVAL, DASHED WHERE INFERRED)
- GROUNDWATER ELEVATION (FEET, MSL)

NOTES

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- WELL LOCATIONS SURVEYED BY ROWE PROFESSIONAL SERVICES COMPANY ON 11/4/2015.
- NOAA/NATIONAL OCEANIC SERVICE GREAT LAKES GAUGING STATION, ESSEXVILLE, MI (ID: 9075035).

1" = 1,000'
1:12,000

PROJECT:		CONSUMERS ENERGY COMPANY DE KARN AND JC WEADOCK POWER PLANTS ESSEXVILLE, MICHIGAN	
TITLE: SHALLOW GROUNDWATER CONTOUR MAP NOVEMBER 2016			
DRAWN BY:	J. PAPEZ	PROJ NO.:	269767-002/3
CHECKED BY:	D. LITZ	FIGURE 5	
APPROVED BY:	G. CROCKFORD		
DATE:	OCTOBER 2017		

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LEGEND

- BACKGROUND MONITORING WELL
- BEDROCK MONITORING WELL
- DEK BOTTOM ASH POND MONITORING WELL
- JCW BOTTOM ASH POND MONITORING WELL
- JCW LANDFILL MONITORING WELL
- SURFACE WATER GAUGING STATION
- SLURRY WALL (APPROXIMATE)
- GROUNDWATER ELEVATION CONTOUR (2' INTERVAL, DASHED WHERE INFERRED)
- GROUNDWATER ELEVATION (FEET, MSL)

NOTES

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- NOAA/NATIONAL OCEANIC SERVICE GREAT LAKES GAUGING STATION, ESSEXVILLE, MI (ID: 9075035).

0 1,000 2,000 Feet
1" = 1,000'
1:12,000

PROJECT:

CONSUMERS ENERGY COMPANY
DE KARN AND JC WEADOCK POWER PLANTS
ESSEXVILLE, MICHIGAN

TITLE:

SHALLOW GROUNDWATER CONTOUR MAP
FEBRUARY 2017

DRAWN BY: J. PAPEZ

PROJ NO.: 269767-002/3

CHECKED BY: D. LITZ

APPROVED BY: G. CROCKFORD

DATE: OCTOBER 2017

FIGURE 6

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FILE NO.:

269767-002_3-006.mxd



LEGEND

- BACKGROUND MONITORING WELL
- BEDROCK MONITORING WELL
- DEK BOTTOM ASH POND MONITORING WELL
- JCW BOTTOM ASH POND MONITORING WELL
- JCW LANDFILL MONITORING WELL
- SURFACE WATER GAUGING STATION
- SLURRY WALL (APPROXIMATE)
- GROUNDWATER ELEVATION CONTOUR (2' INTERVAL, DASHED WHERE INFERRED)
- GROUNDWATER ELEVATION (FEET, MSL)

NOTES

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- NOAA/NATIONAL OCEANIC SERVICE GREAT LAKES GAUGING STATION, ESSEXVILLE, MI (ID: 9075035).

1" = 1,000'
1:12,000

PROJECT:		CONSUMERS ENERGY COMPANY DE KARN AND JC WEADOCK POWER PLANTS ESSEXVILLE, MICHIGAN	
TITLE: SHALLOW GROUNDWATER CONTOUR MAP MAY 2017			
DRAWN BY: J. PAPEZ		PROJ NO.: 269767-002/3	
CHECKED BY: D. LITZ		FIGURE 7	
APPROVED BY: G. CROCKFORD			
DATE: OCTOBER 2017			

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LEGEND

- BACKGROUND MONITORING WELL
- BEDROCK MONITORING WELL
- DEK BOTTOM ASH POND MONITORING WELL
- JCW BOTTOM ASH POND MONITORING WELL
- JCW LANDFILL MONITORING WELL
- SURFACE WATER GAUGING STATION
- SLURRY WALL (APPROXIMATE)
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- NOAA/NATIONAL OCEANIC SERVICE GREAT LAKES GAUGING STATION, ESSEXVILLE, MI (ID: 9075035).

010002000Feet

1" = 1,000'
1:12,000

PROJECT:

CONSUMERS ENERGY COMPANY
DE KARN AND JC WEADOCK POWER PLANTS
ESSEXVILLE, MICHIGAN

TITLE:

SHALLOW GROUNDWATER CONTOUR MAP
AUGUST 2017

DRAWN BY:

J. PAPEZ

PROJ NO.:

269767-002/3

CHECKED BY:

D. LITZ

APPROVED BY:

G. CROCKFORD

DATE:

OCTOBER 2017

FIGURE 8

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FILE NO.:

269767-002_3-019.mxd

Appendix B

Data Quality Review

Laboratory Data Quality Review

Groundwater Monitoring Event September 2017

CEC DE Karn and JC Weadock Background Wells

Groundwater samples were collected by TRC for the September 2017 sampling event. Samples were analyzed for anions, total metals, and total dissolved solids by Pace Analytical Services, LLC (Pace), located in Grand Rapids, Michigan. The laboratory analytical results are reported in laboratory report 462721.

During the September 2017 sampling event, a groundwater sample was collected from each of the following wells:

- MW-15002
- MW-15008
- MW-15016
- MW-15018
- MW-15019
- MW-15020
- MW-15024
- MW-15027

Each sample was analyzed for the following constituents:

Analyte Group	Method
Anions (Chloride, Fluoride, Sulfate)	EPA 300.0
Total Metals	EPA 6020A, EPA 6010C
Total Dissolved Solids	SM 2540C

TRC reviewed the laboratory data to assess data usability. The following sections summarize the data review procedure and the results of the review.

Data Usability Review Procedure

The analytical data were reviewed using the USEPA National Functional Guidelines for Inorganic Superfund Methods Data Review (USEPA, 2017). The following items were included in the evaluation of the data:

- Sample receipt, as noted in the cover page or case narrative;
- Technical holding times for analyses;
- Data for method blanks and field blanks. Method blanks are used to assess potential contamination arising from laboratory sample preparation and/or analytical procedures. Field blanks are used to assess potential contamination arising from field procedures;
- Reporting limits (RLs) compared to project-required RLs;
- Data for blind field duplicates. Field duplicate samples are used to assess variability introduced by the sampling and analytical processes;

- Data for laboratory control samples (LCSs). The LCSs are used to assess the accuracy of the analytical method using a clean matrix; and
- Overall usability of the data.

This data usability report addresses the following items:

- Usability of the data if quality control (QC) results suggest potential problems with all or some of the data;
- Actions regarding specific QC criteria exceedances.

Review Summary

The data quality objectives and laboratory completeness goals for the project were met, and the data are usable for their intended purpose. A summary of the data quality review, including non-conformances and issues identified in this evaluation are noted below.

- Appendix III constituents will be utilized for the purposes of a detection monitoring program.
- Data are usable for the purposes of the detection monitoring program.
- When the data are evaluated through a detection monitoring statistical program, findings below may be used to support the removal of outliers.

QA/QC Sample Summary:

- A field blank (FB-05) was collected; no analytes were detected in the blank samples.
- Dup-05 corresponds to MW-15024; relative percent differences (RPDs) between the parent and duplicate sample were within the QC limits.
- Laboratory duplicates analyses were performed on non-project samples; RPDs were within QC limits.
- MS/MSD analyses were performed on non-project samples.

Laboratory Data Quality Review

Groundwater Monitoring Event September 2017

CEC DE Karn Bottom Ash Pond

Groundwater samples were collected by TRC for the September 2017 sampling event. Samples were analyzed for anions, total metals, and total dissolved solids by Pace Analytical Services, LLC (Pace), located in Grand Rapids, Michigan. The laboratory analytical results are reported in laboratory report 462678.

During the September 2017 sampling event, a groundwater sample was collected from each of the following wells:

- DEK-MW-15001
- DEK-MW-15002
- DEK-MW-15003
- DEK-MW-15004
- DEK-MW-15005
- DEK-MW-15006

Each sample was analyzed for the following constituents:

Analyte Group	Method
Anions (Chloride, Fluoride, Sulfate)	EPA 300.0
Total Metals	EPA 6020A, EPA 6010C
Total Dissolved Solids	SM 2540C

TRC reviewed the laboratory data to assess data usability. The following sections summarize the data review procedure and the results of the review.

Data Usability Review Procedure

The analytical data were reviewed using the USEPA National Functional Guidelines for Inorganic Superfund Methods Data Review (USEPA, 2017). The following items were included in the evaluation of the data:

- Sample receipt, as noted in the cover page or case narrative;
- Technical holding times for analyses;
- Data for method blanks, equipment blanks, and field blanks. Method blanks are used to assess potential contamination arising from laboratory sample preparation and/or analytical procedures. Field and equipment blanks are used to assess potential contamination arising from field procedures;
- Percent recoveries for matrix spike (MS) and matrix spike duplicates (MSD). Percent recoveries are calculated for each analyte spiked and used to assess bias due to sample matrix effects;

- Reporting limits (RLs) compared to project-required RLs;
- Data for blind field duplicates. Field duplicate samples are used to assess variability introduced by the sampling and analytical processes;
- Data for laboratory control samples (LCSs). The LCSs are used to assess the accuracy of the analytical method using a clean matrix;
- Data for laboratory duplicates, when available. The laboratory duplicates are replicate analyses of one sample and are used to assess the precision of the analytical method; and
- Overall usability of the data.

This data usability report addresses the following items:

- Usability of the data if quality control (QC) results suggest potential problems with all or some of the data;
- Actions regarding specific QC criteria exceedances.

Review Summary

The data quality objectives and laboratory completeness goals for the project were met, and the data are usable for their intended purpose. A summary of the data quality review, including non-conformances and issues identified in this evaluation, are noted below.

- Appendix III constituents will be utilized for the purposes of a detection monitoring program.
- Data are usable for the purposes of the detection monitoring program.
- When the data are evaluated through a detection monitoring statistical program, findings below may be used to support the removal of outliers.

QA/QC Sample Summary:

- One equipment blank (EB-01) and one field blank (FB-01) were collected; no analytes were detected in the blank samples.
- Dup-01 corresponds to DEK-MW-15004; relative percent differences (RPDs) between the parent and duplicate sample were within the QC limits.
- Laboratory duplicate analyses were performed on samples DEK-MW-15001, DEK-MW-15004, and DEK-MW-15006; RPDs were within QC limits.
- MS/MSD analyses were performed on samples DEK-MW-15001 and DEK-MW-15006.
 - MS/MSD analyses were performed on samples DEK-MW-15001 and DEK-MW-15006 for chloride in batch 5462. The chloride recoveries in both MS/MSDs were below the lower control limit. The chloride results for samples analyzed in the same batch may be biased low.

- MS/MSD analyses were performed on samples DEK-MW-15001 and DEK-MW-15006 for sulfate in batch 5462. The sulfate recoveries in the MS/MSD performed on sample DEK-MW-15006 were not evaluated due to sample dilution. The sulfate recoveries in the MS/MSD performed on sample DEK-MW-15001 were below the lower control limit. The sulfate results for samples analyzed in the same batch may be biased low.
- MS/MSD analyses were performed on sample DEK-MW-15006 for calcium in batch 5301. The calcium recovery in the MS was below the lower laboratory control limit. The calcium results for samples analyzed in the same batch may be biased low.
- MS/MSD analyses were performed on sample DEK-MW-15006 for boron in batch 5303. The boron recoveries in the MS/MSD were above the upper laboratory control limit. The boron concentration in the parent sample was >4x the spike concentration; therefore, the laboratory control limits were not applicable.

Appendix C

Statistical Background Limits

Technical Memorandum

Date: January 15, 2018

To: J.R. Register, CEC
Brad Runkel, CEC

From: Darby Litz, TRC
Sarah Holmstrom, TRC
Joyce Peterson, TRC

Project No.: 269767.0000 Phase 002, Task 003

Subject: Background Statistical Evaluation (R1-R8) – Consumers Energy, DE Karn

Pursuant to the United States Environmental Protection Agency's (U.S. EPA's) Resource Conservation and Recovery Act (RCRA) Coal Combustion Residual rule ("CCR Rule") promulgated on April 17, 2015, the owner or operator of a CCR Unit must collect a minimum of eight rounds of background groundwater data to initiate a detection monitoring program and evaluate statistically significant increases above background (40 CFR §257.94). This memorandum presents the background statistical limits derived for the Consumers Energy Company (CEC) DE Karn Power Plant (DE Karn site) in Essexville, Michigan.

There is one coal ash management facility associated with the plant—a wet ash dewatering area (Bottom Ash Pond), which is the primary settling/detention structure for the NPDES treatment system prior to discharge. In response to the CCR Rule, CEC had 6 groundwater monitoring wells installed at locations downgradient of the DE Karn Bottom Ash Pond and 8 background wells installed on the JC Weadock site property to the south to serve as a groundwater monitoring system (in accordance with 40 CFR 257.91).

Following the baseline data collection period (December 2015 through August 2017), the background data for the DE Karn site were evaluated in accordance with the Groundwater Statistical Evaluation Plan (Stats Plan) (TRC, October 2017). The DE Karn site groundwater data are maintained within a database accessible through Sanitas™ statistical software. Sanitas™ is a software tool that is commercially available for performing statistical evaluation consistent with procedures outlined in U.S. EPA's Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities (Unified Guidance; UG). Within the Sanitas™ statistical program (and the UG), tolerance limits were selected to perform the statistical calculation for background limits. Use of tolerance limits is a streamlined

Technical Memorandum

approach that offers adequate statistical power under the current, initial stage of establishing background and developing the monitoring program and is an acceptable approach for detection monitoring under the CCR rule. Upper tolerance limits (UTLs) were calculated for each of the CCR Appendix III parameters. The following narrative describes the methods employed and the results obtained and the Sanitas™ output files are included as an attachment.

The set of background wells utilized for the CCR BAP unit at the DE Karn site includes MW-15002, MW-15008, MW-15016, and MW-15019. These wells were selected from among a larger set of 8 potential background wells as detailed in a memo dated October 3, 2017 (TRC), based on representativeness and coverage for the CCR Appendix III parameters. Background wells MW-15002, MW-15008, MW-15016, and MW-15019 are also part of the groundwater monitoring system for the two CCR units at the neighboring JC Weadock site. The background evaluation included the following steps:

- Review of data quality reports for the baseline/background data sets for CCR Appendix III constituents;
- Graphical representation of the baseline data as time versus concentration (T v. C) by well/constituent pair;
- Graphical representation of cumulative baseline background data sorted from lowest to highest concentration for each constituent;
- Outlier testing of individual data points that appear from the graphical representations as potential outliers;
- Evaluation of percentage of nondetects for each baseline/background well-constituent (w/c) pair;
- Distribution of the data; and
- Calculation of the UTL for each cumulative baseline/background data set (upper and lower tolerance limits were calculated for field pH).

The results of these evaluations are presented and discussed below.

Data Quality

Data from each sampling round were evaluated for completeness, overall quality and usability, method-specified sample holding times, precision and accuracy, and potential sample contamination. The review was completed using the following quality control (QC) information which at a minimum included chain-of-custody forms, investigative sample results including blind field duplicates, and matrix spike and matrix spike duplicates (MS/MSDs) recoveries, and, as provided by the laboratory, method blanks, laboratory control spikes, laboratory duplicates. The data were found to be complete and usable for the purposes of the CCR monitoring program.

Technical Memorandum

Time versus Concentration Graphs

The T v. C graphs show potential outliers for boron (low value for MW-15016 in March 2016) and sulfate (high value for MW-15016 in February 2017). These data sets will be tested by the Sanitas™ software to assess whether the potential outliers are statistically significant.

While variations in results are present, the graphs do not suggest that data sets, as a whole, likely have overall trending or seasonality. The data sets are of relatively short duration for making such observations.

Cumulative Baseline Data Sets

Ideally, the background data sets provide a continuous concentration distribution. The ideal is rarely achieved by multiple background wells representing a relatively large geographic area such as is the case at the Karn and Weadock complex. When sorted by concentration, the data generally group by well. Most of the parameters have a relatively consistent distribution, but chloride and TDS clearly have some wells with higher values than the other background wells. These results need to be taken into consideration as they represent potential non-CCR upgradient contributions to downgradient wells.

Outlier Testing

The Dixon's Outlier Test in Sanitas™ was used to test the potential outlier in the boron data set for MW-15016 that was identified in the T v. C graphs (Figure 1) and in the cumulative concentration distribution (Figure 2). The suspect data point was found to be an outlier at the 0.05 significance level (see attached Sanitas™ output file). With the outlier removed, Sanitas found that the boron data set at MW-15016 was normally distributed at the 0.01 significance level. The outlier data point will be excluded from the background/baseline UTL calculations. The Dixon's Outlier Test in Sanitas™ was also conducted for the potential outlier in the sulfate data set for MW-15016. In this case, the suspect was not found to be an outlier, but the data set was found to be lognormally distributed. The data point will be retained for the background/baseline UTL calculations.

Percentage of Nondetects

Table 1 summarizes the percentage of results below the reporting limit for each w/c pair.

Technical Memorandum

Table 1
Summary of Percentage of Baseline Results Below Reporting Limit

WELL	CONSTITUENT	PERCENT NON-DETECT
MW-15002	Boron	0
	Calcium	0
	Chloride	0
	Fluoride	100
	Field pH	0
	Sulfate	12.5
	Total Dissolved Solids	0
MW-15008	Boron	0
	Calcium	0
	Chloride	0
	Fluoride	100
	Field pH	0
	Sulfate	0
	Total Dissolved Solids	0
MW-15016	Boron	0
	Calcium	0
	Chloride	0
	Fluoride	100
	Field pH	0
	Sulfate	0
	Total Dissolved Solids	0
MW-15019	Boron	0
	Calcium	0
	Chloride	0
	Fluoride	100
	Field pH	0
	Sulfate	0
	Total Dissolved Solids	0
COMBINED	Boron	0
	Calcium	0
	Chloride	0
	Fluoride	100
	Field pH	0
	Sulfate	3.125
	Total Dissolved Solids	0

Technical Memorandum

Distribution of the Data Sets

The distribution of the data sets is determined by the Sanitas™ software during calculation of the upper tolerance limit. The Shapiro-Wilk normality test is used for samples sizes less than 50.

Non-detect/censored data were handled in accordance with the Stats Plan. If the data appear to be non-normal, mathematical transformations of the data may be utilized such that the transformed data follow a normal distribution (e.g., lognormal distributions). Alternatively, non-parametric tests may be utilized when data cannot be normalized. Table 2 summarizes the distributions determined by the Sanitas™ software. The distribution is based on the combined baseline results for all four background monitoring wells.

Table 2
Summary of Background/Baseline Data Distributions

CONSTITUENT	DISTRIBUTION
Boron	Normal
Boron (outlier removed)	Normal
Calcium	Normal
Chloride	Normalized by natural log transformation
Fluoride	All ND – use highest RL
Field pH	Normal
Sulfate	Normalized by cube root transformation
Total Dissolved Solids	Nonnormal

Upper Tolerance Limits

Table 3 presents the calculated upper tolerance limits for the background/baseline data sets. The data set with an observed outlier is included both with and without the outlier value included in the data set. For normal and lognormal distributions, UTLs are calculated for 95 percent coverage and 95 percent confidence using parametric tolerance limits. For nonnormal background datasets, a nonparametric tolerance limit is utilized, resulting in the highest value from the background dataset as the UTL. The achieved confidence and/or coverage rates depend entirely on the number of background data points, and coverage rates for various confidence levels are shown in the Sanitas™ outputs for nonparametric tolerance limits. Verification resampling (1 of 2) is recommended per the Stats Plan and UG to achieve a site-wide false positive rate within the range specified in the CCR rules.

Technical Memorandum

Table 3
Summary of Baseline Upper Tolerance Limits

CONSTITUENT	UPPER TOLERANCE LIMIT – FROM SANITAS™
Boron (outlier removed)	619 µg/L
Calcium	302 mg/L
Chloride	2,440 mg/L
Fluoride	1,000 µg/L
Field pH	6.5 – 7.3 s.u.
Sulfate	407 mg/L
Total Dissolved Solids	4,600 mg/L*

*Nonparametric Tolerance Limit

Attachments

Figure 1 – Background Concentration Time-Series Charts

Figure 2 – Combined Background Distribution

Sanitas™ Output Files

Technical Memorandum

Figures

Figure 1
Background Concentration Time-Series Charts
Karn/Weadock Site - RCRA CCR Monitoring Program

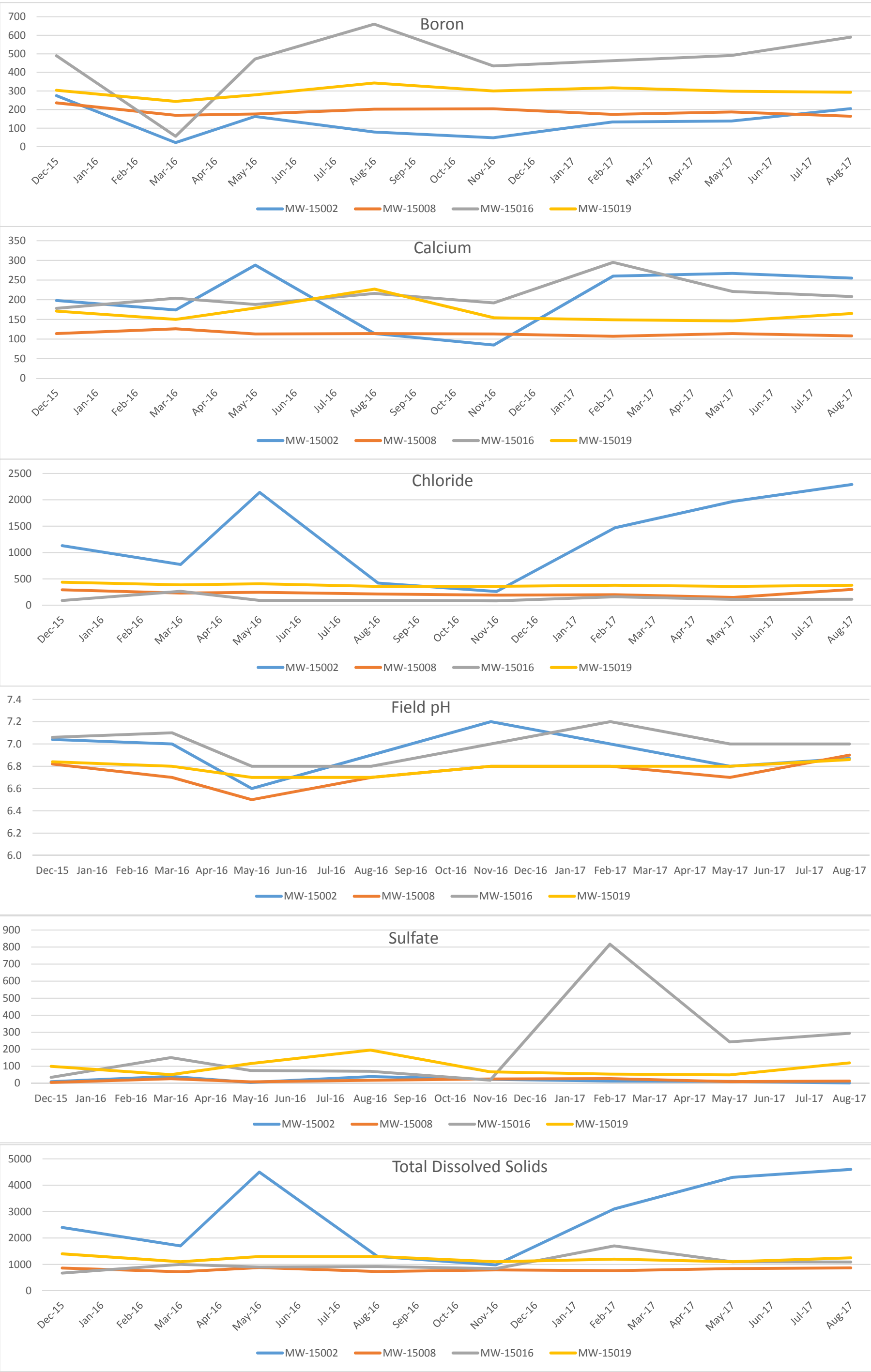
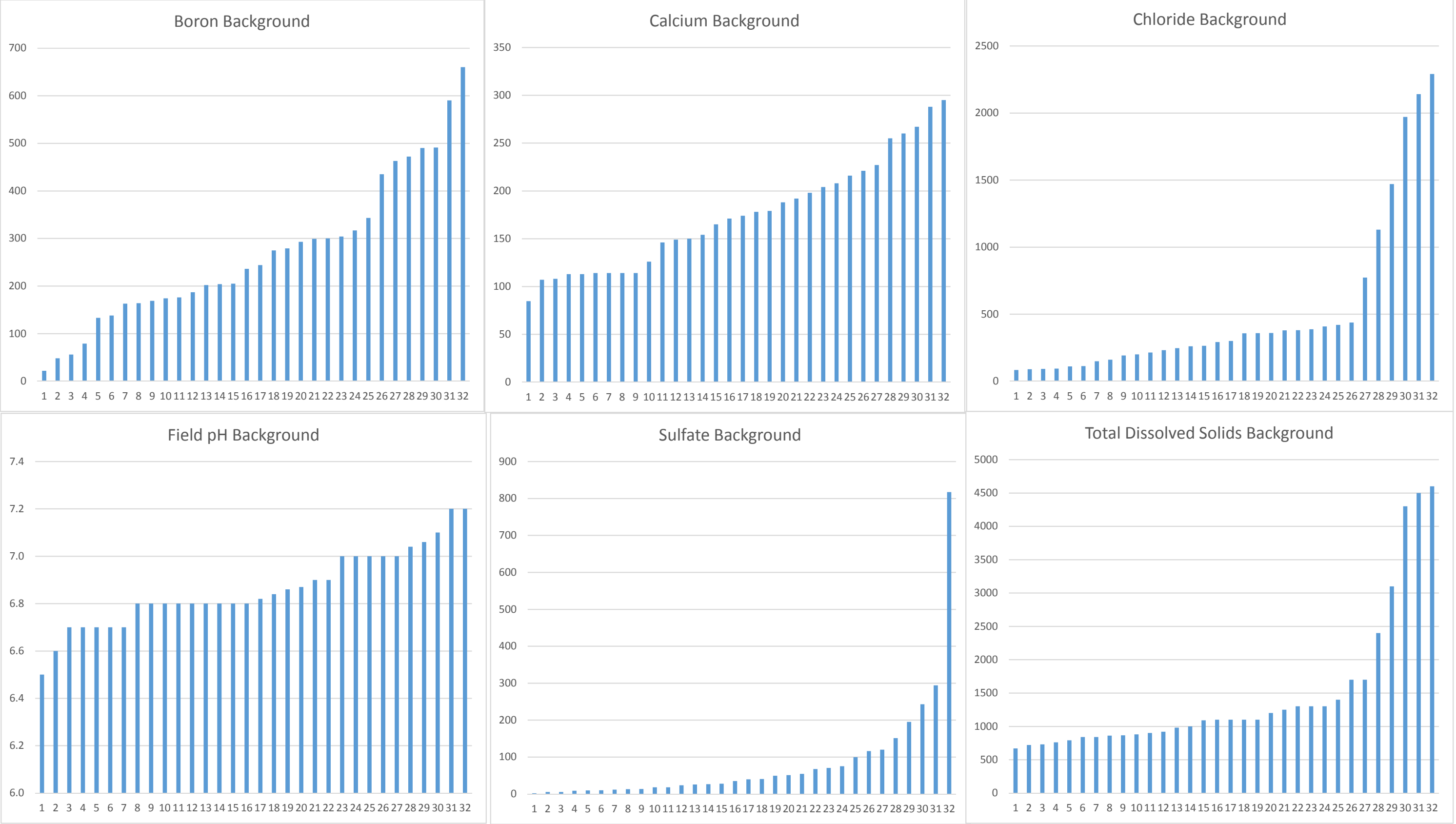


Figure 2
Cumulative Background Concentrations
Karn/Weadock Complex - RCRA CCR Monitoring Program

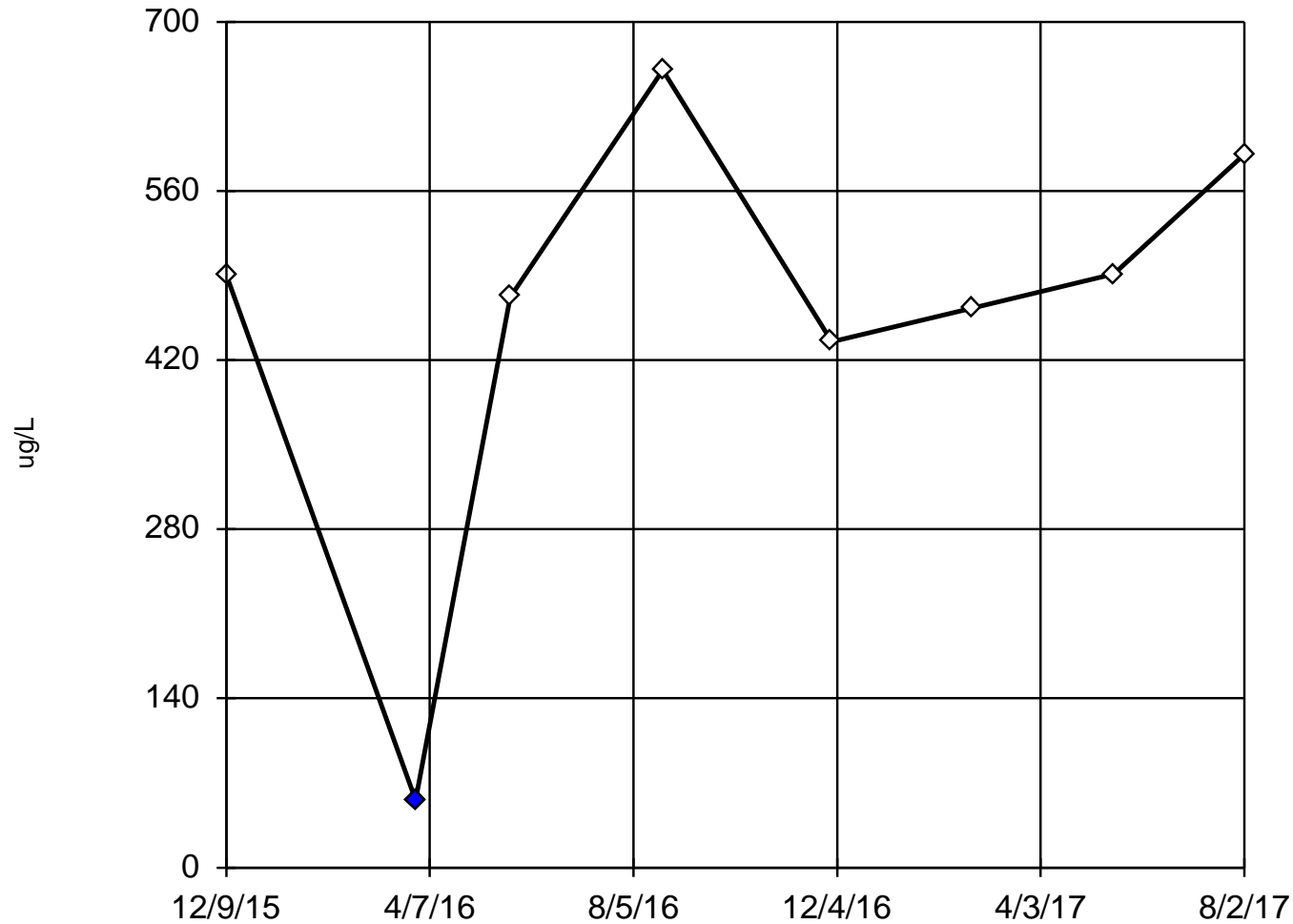


Technical Memorandum

Sanitas™ Output Files

EPA 1989 Outlier Screening

MW-15016 (bg)



n = 8

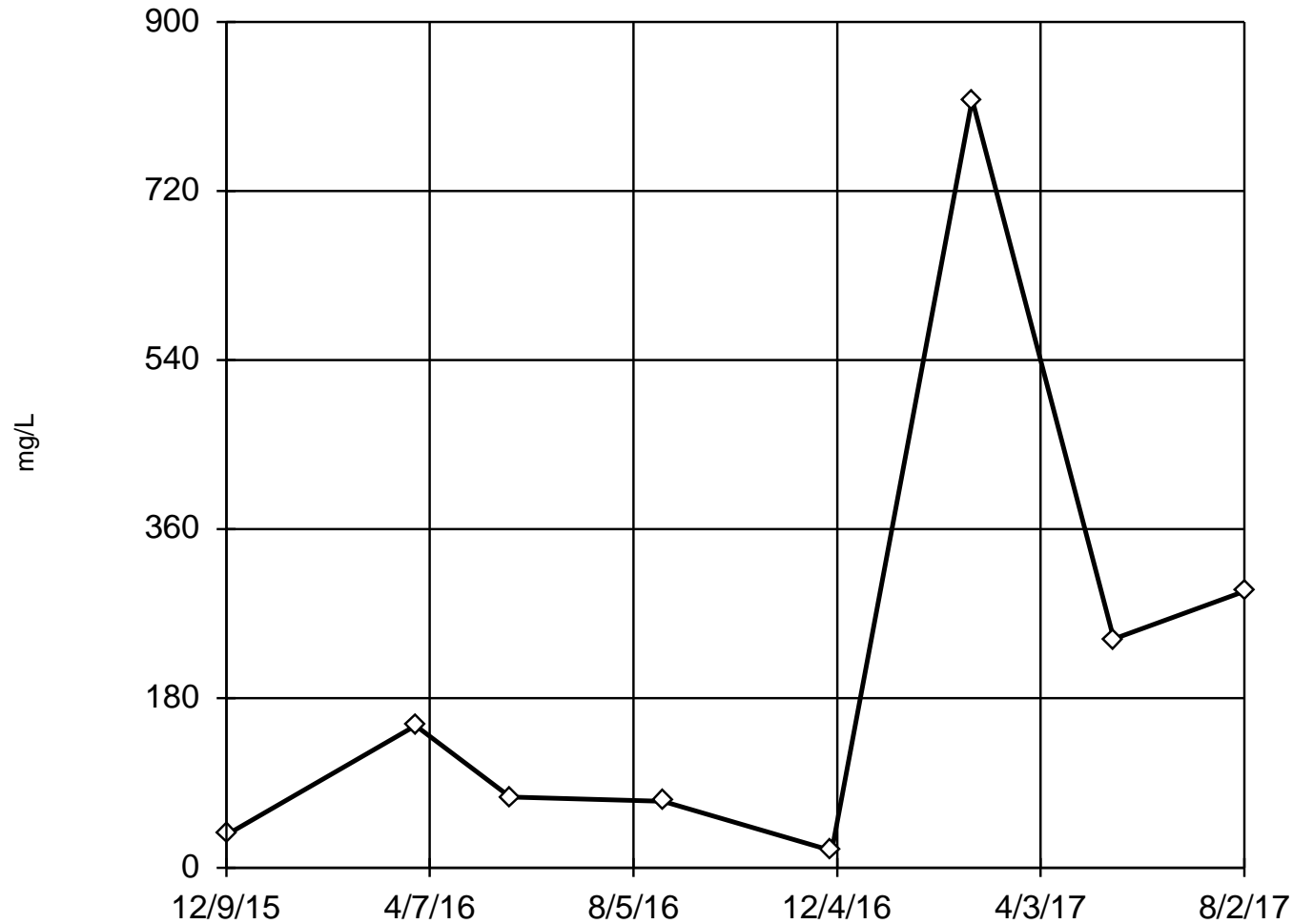
Statistical outlier is drawn as solid.
Mean 457.1, std. dev. 178.4, critical Tn 2.032.
After removing suspect data: mean 514.4, std. dev. 80.42, Tn 1.938.

Normality test used:
Shapiro Wilk@alpha = 0.05
Calculated = 0.848
Critical = 0.803
The distribution, after removal of suspect value, was found to be normally distributed.

Constituent: Boron, Total Analysis Run 11/16/2017 4:25 PM
Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas

EPA 1989 Outlier Screening

MW-15016 (bg)



n = 8

No statistical outliers.
Mean 213, std. dev. 263.2,
critical Tn 2.032

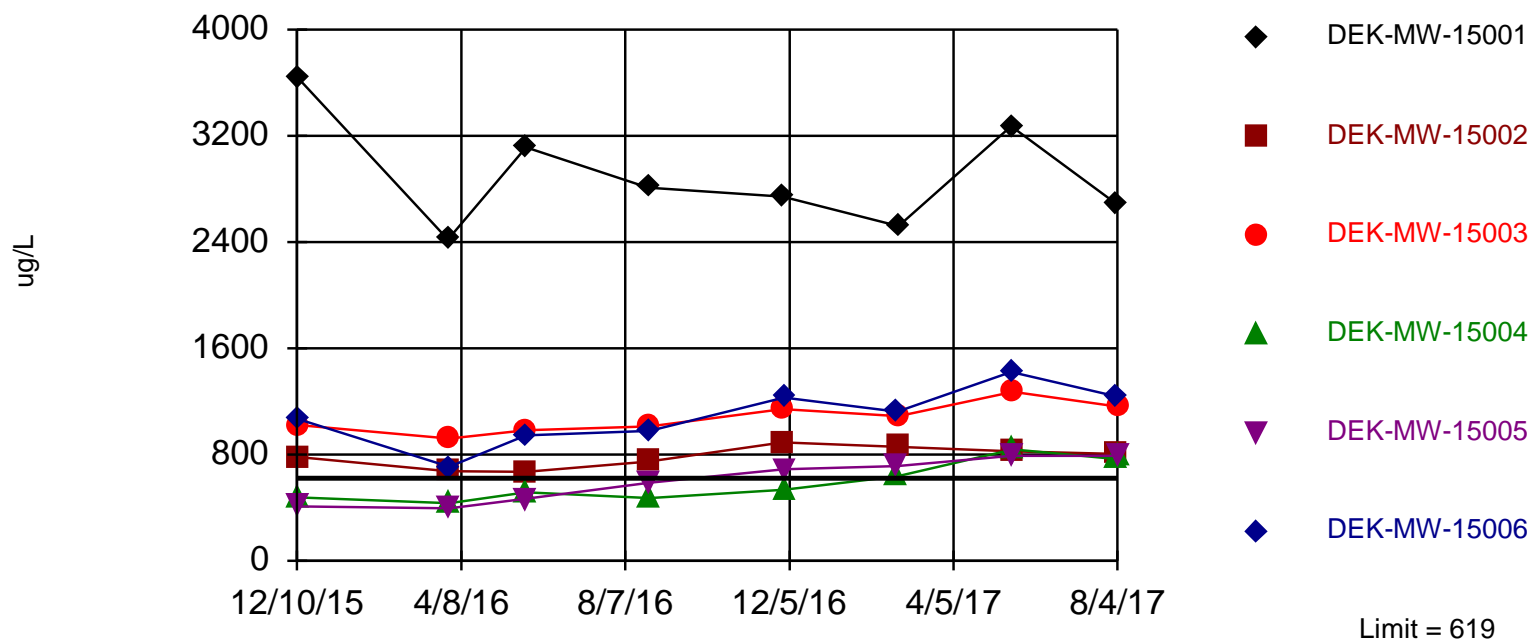
Normality test used:
Shapiro Wilk@alpha =
0.05
Calculated = 0.9853
Critical = 0.818 (after
natural log transforma-
tion)
The distribution was found
to be log-normal.

Constituent: Sulfate Analysis Run 11/16/2017 4:26 PM

Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas

Exceeds Limit: DEK-MW-15001, DEK-MW-15002, DEK-MW-15003, DEK-MW-15004,...

Tolerance Limit Interwell Parametric



95% coverage. Most recent observation is compared with limit. Background Data Summary: Mean=276, Std. Dev.=155.3, n=31. Normality test: Shapiro Wilk @alpha = 0.05, calculated = 0.9427, critical = 0.929. Report alpha = 0.05.

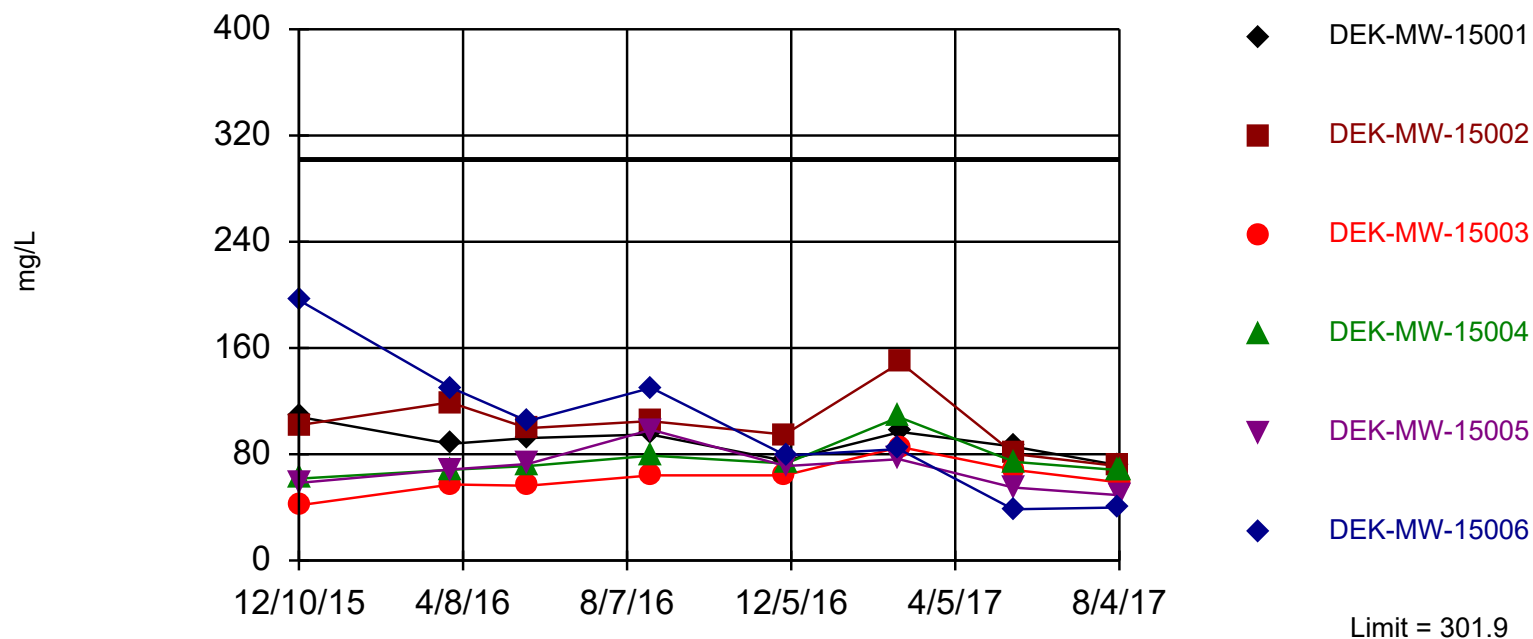
Outlier Removed:
MW-15016 3/29/2016

Constituent: Boron, Total Analysis Run 11/16/2017 4:29 PM
Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas

Within Limit

Tolerance Limit

Interwell Parametric



95% coverage. Most recent observation is compared with limit. Background Data Summary: Mean=174.8, Std. Dev.=57.82, n=32. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9402, critical = 0.904. Report alpha = 0.05.

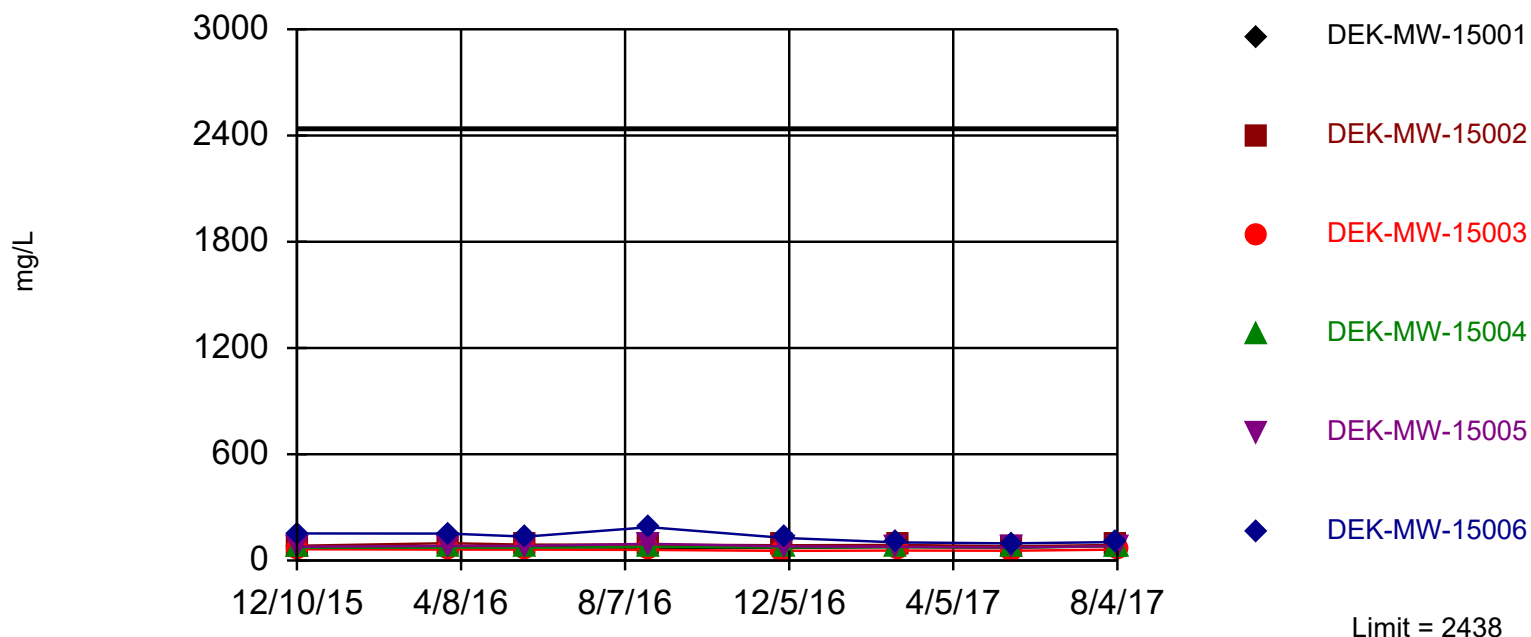
Constituent: Calcium, Total Analysis Run 11/20/2017 2:13 PM

Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas

Within Limit

Tolerance Limit

Interwell Parametric



95% coverage. Most recent observation is compared with limit. Background Data Summary (based on natural log transformation): Mean=5.764, Std. Dev.=0.9258, n=32. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9196, critical = 0.904. Report alpha = 0.05.

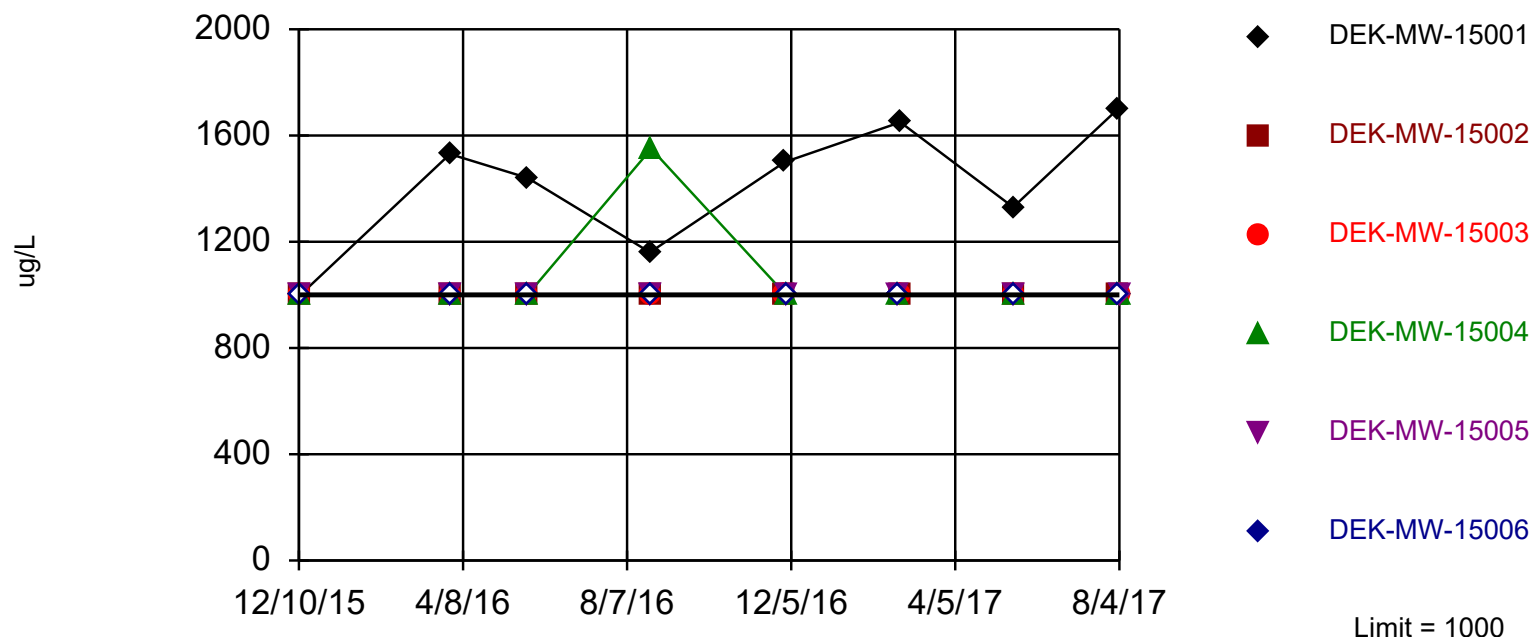
Constituent: Chloride Analysis Run 11/20/2017 2:13 PM

Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas

Exceeds Limit: DEK-MW-15001

Tolerance Limit

Interwell Non-parametric



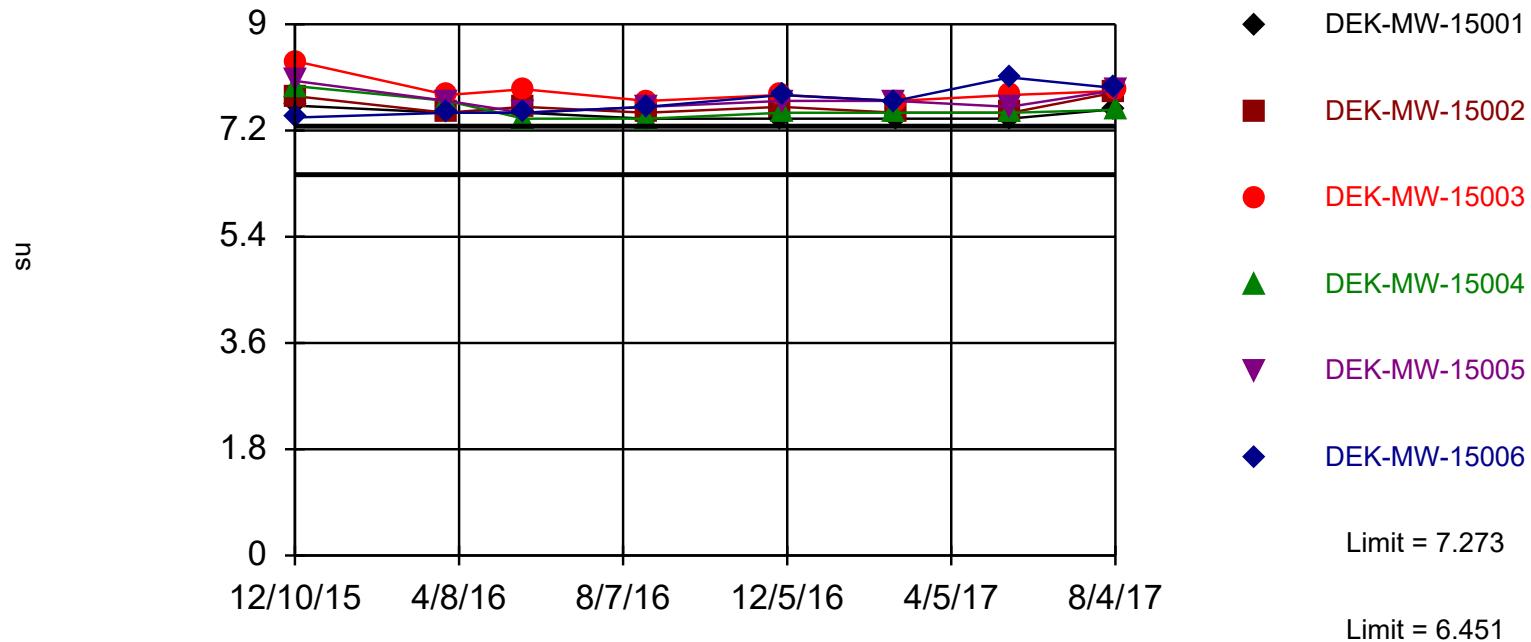
Non-parametric test used in lieu of parametric tolerance limit because censored data exceeded 75%. Most recent observation is compared with limit. All background values were censored; limit is most recent reporting limit. 86.52% coverage at alpha=0.01; 91.21% coverage at alpha=0.05; 97.85% coverage at alpha=0.5. Report alpha = 0.1937.

Constituent: Fluoride Analysis Run 11/20/2017 2:14 PM

Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas

Exceeds Limits: DEK-MW-15001, DEK-MW-15002, DEK-MW-15003, DEK-MW-15004,...

Tolerance Limit Interwell Parametric



95% coverage. Most recent observation is compared with limit. Background Data Summary: Mean=6.862, Std. Dev.=0.1628, n=32. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9544, critical = 0.904. Report alpha = 0.025 per tail.

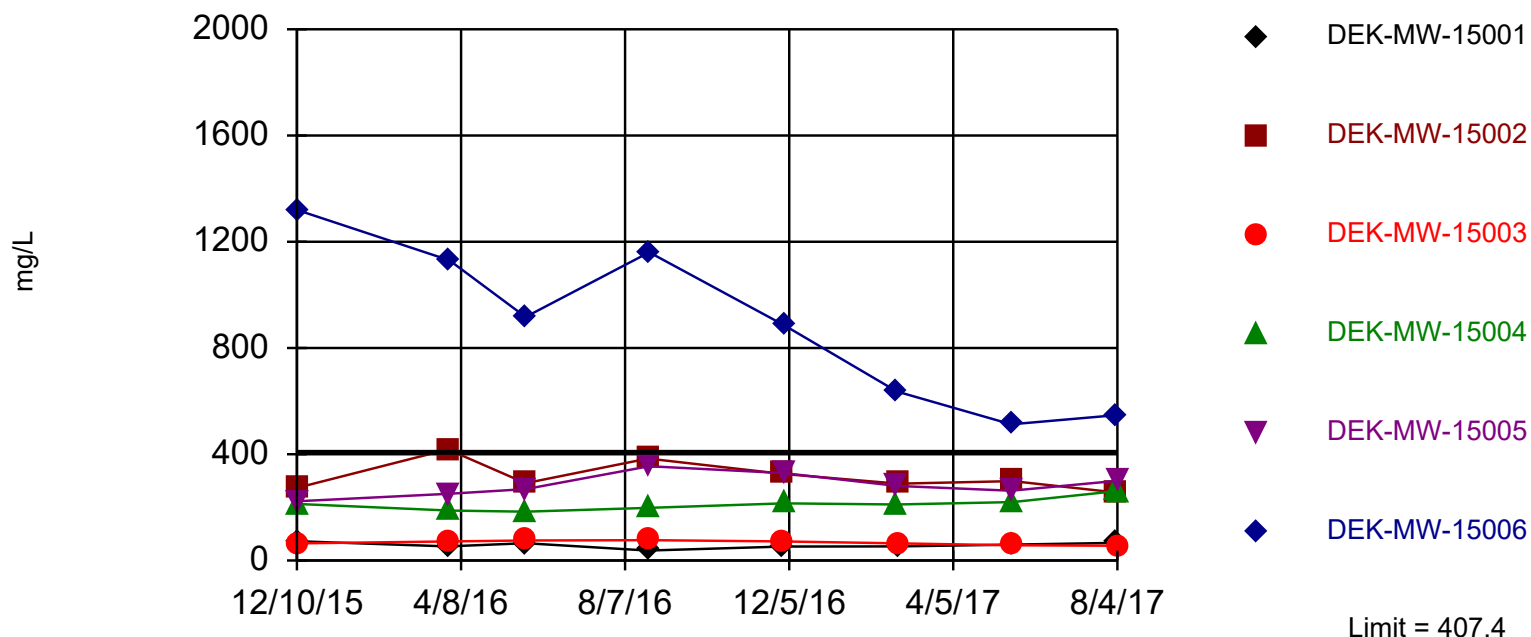
Constituent: pH, Field Analysis Run 11/20/2017 2:15 PM

Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas

Exceeds Limit: DEK-MW-15006

Tolerance Limit

Interwell Parametric



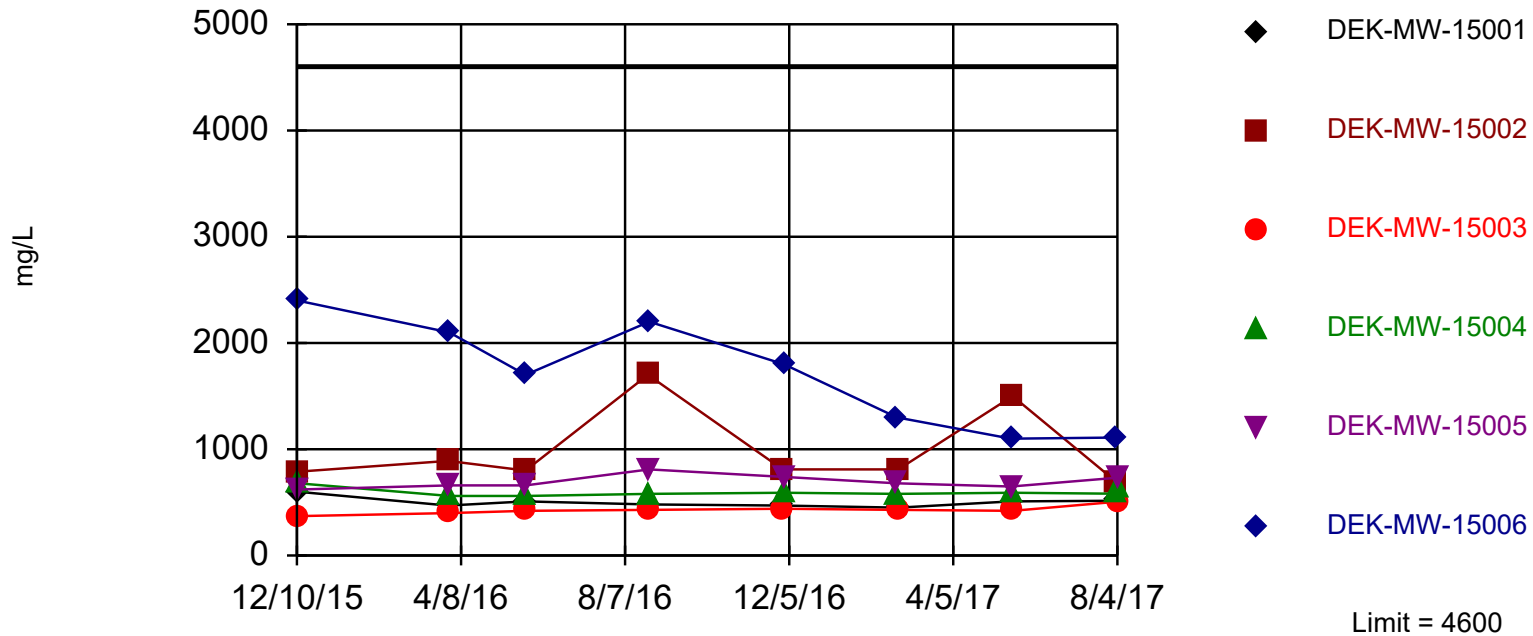
95% coverage. Most recent observation is compared with limit. Background Data Summary (based on cube root transformation): Mean=3.637, Std. Dev.=1.718, n=32, 3.125% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9137, critical = 0.904. Report alpha = 0.05.

Constituent: Sulfate Analysis Run 11/20/2017 2:17 PM

Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas

Within Limit

Tolerance Limit Interwell Non-parametric



Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Most recent observation is compared with limit. Limit is highest of 32 background values. 86.52% coverage at alpha=0.01; 91.21% coverage at alpha=0.05; 97.85% coverage at alpha=0.5. Report alpha = 0.1937.

Constituent: Total Dissolved Solids, Dissolved Analysis Run 11/20/2017 2:16 PM

Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas