2018 Annual Groundwater Monitoring Report

DE Karn Power Plant
Bottom Ash Pond CCR Unit

Essexville, Michigan

January 2019

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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) located in Essexville, Michigan. 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). On behalf of CEC, TRC Environmental Corporation (TRC) prepared this Annual Groundwater Monitoring Report for the DEK BAP CCR unit.

In the January 31, 2018 *Annual Groundwater Monitoring Report for the DE Karn Power Plant Bottom Ash Pond CCR Unit,* covering calendar year 2017 activities, CEC reported that boron, fluoride, pH, and sulfate were observed during groundwater detection monitoring at one or more downgradient monitoring well(s) with potential statistically significant increases (SSIs) above background concentration levels. TRC performed an Alternate Source Demonstration for the aforementioned constituents and did not find strong enough evidence within 90 days to determine the observation of constituents above background was attributable to a source other than the coal combustion residual (CCR) unit. Therefore, CEC initiated an Assessment Monitoring Program for the DEK BAP CCR Unit pursuant to §257.95 of the CCR Rule that included sampling and analyzing groundwater within the groundwater monitoring system for all constituents listed in Appendix IV. The DEK BAP monitoring system was subsequently sampled for the Appendix III and Appendix IV constituents in May 2018, within 90 days from the initial assessment monitoring (Appendix IV only) sampling event. The results from the initial assessment monitoring sampling event were used to establish groundwater protection standards (GWPSs) for the Appendix IV constituents in accordance with §257.95(h), as presented in the *Groundwater Protection Standards* technical memorandum dated October 15, 2018. Assessment monitoring data that has been collected and evaluated in 2018, including the establishment of the GWPSs, are presented in this report.

In 2019, CEC compared the assessment monitoring data to the GWPSs to determine whether or not Appendix IV constituents are detected at statistically significant levels above the GWPSs in accordance with §257.95. The statistical comparison of the May 2018 data to the GWPSs was

completed on January 14, 2019, in accordance with §257.93(h)(2) and within the compliance schedule clarified by EPA in April 2018.

According to §257.95(g)(3), if the facility determines pursuant to §257.93(h), that any Appendix IV constituents were detected at a statistically significant level exceeding the GWPSs, the facility will either conduct an alternate source demonstration or initiate an assessment of corrective measures according to §257.96 within 90 days. Based on the results of the statistical evaluation CEC will be seeking to initiate an assessment of corrective measures within 90 days of the completion of the statistical analysis. CEC will continue executing the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98.

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 (BAP) 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). On behalf of CEC, TRC Environmental Corporation (TRC) prepared this Annual Groundwater Monitoring Report for calendar year 2018 activities at the DEK BAP CCR unit.

In the January 31, 2018 *Annual Groundwater Monitoring Report for the DE Karn Power Plant Bottom Ash Pond CCR Unit,* covering calendar year 2017 activities, CEC reported that Appendix III constituents boron, fluoride, pH, and sulfate were observed within groundwater at one or more downgradient monitoring well(s) with potential statistically significant increases (SSIs) above background concentration levels. TRC performed an Alternate Source Demonstration (ASD) for the aforementioned constituents and did not find strong enough evidence within 90 days to determine the observation of constituents above background was attributable to a source other than the CCR unit. Therefore, CEC initiated an Assessment Monitoring Program for the DEK BAP CCR unit pursuant to §257.95 of the CCR Rule that included sampling and analyzing groundwater within the groundwater monitoring system for all constituents listed in Appendix IV.

The results from the initial assessment monitoring sampling event were used to establish groundwater protection standards (GWPSs) for the Appendix IV constituents in accordance with §257.95(h), as presented in the *Groundwater Protection Standards* technical memorandum dated October 15, 2018 (Appendix C) (TRC, October 2018). The DEK BAP monitoring system was subsequently sampled for the Appendix III and Appendix IV constituents within 90 days from the initial Appendix IV sampling event. Assessment monitoring data that has been collected and evaluated in 2018 are presented in this report.

1.2 Site Overview

The 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 locations of the Karn Lined Impoundment CCR Unit and the DEK Bottom Ash Pond Unit are shown on Figure 2. Previously, the DEK Bottom Ash Pond was used for wet ash dewatering and was the primary settling/detention structure for the NPDES treatment system prior to discharge. CEC provided notification of initiation of closure on October 12, 2018 to implement the certified closure plan by removal of CCR under the self-implementing requirements and schedule of the CCR Rule. In preparation for removal of the Bottom Ash Pond, a new lined impoundment CCR unit (Karn Lined Impoundment CCR unit) has been constructed. The liner system for the new impoundment was designed as a double composite liner system, with the primary and secondary composite liners each consisting of 60-mil High Density Polyethylene (HDPE) geomembrane (GM) overlaying a 236-mil geosynthetic clay liner (GCL)[1]. The wet ash dewatering was relocated to the new impoundment (KLI CCR unit), which began receipt of CCR in June 2018.

The DEK Bottom Ash Pond and KLI are located adjacent to the DEK Solid Waste Disposal Area. The Solid Waste Disposal Area received sluiced fly ash until the conversion to Dry Fly Ash handling was completed in December 2008. While the fly ash sluicing was in operation, the Solid Waste Disposal Area received slurried ash that traveled through a series of ponds to an eventual NPDES outfall on Saginaw Bay. The ponds were routinely dredged, and the ash was placed within the DEK Landfill. Consumers Energy received Solid Waste Construction Permit No. 0195 on December 12, 1986 for constructing a Type III Landfill based on the vertical expansion over the historically sluiced fly ash through dredge and stack operations and moisture conditioned dry fly ash.

Closure activities at the DEK Landfill commenced prior to the Effective Date of the CCR Rule (October 17, 2015); therefore, the landfill is subject only to permitting under state authorities. The DEK Landfill is being monitored in accordance with the Michigan Department of Environmental Quality (MDEQ)-approved HMP. The DEK Solid Waste Disposal Area is currently authorized under a permit (Groundwater Discharge Authorization GWE-0005) issued

[1] Golder Associates Inc. 2018. *Bottom Ash Lined Impoundment Liner System Design Certification Report, DE Karn Generating Facility, Essexville, Michigan.* April.

pursuant to Part 31[2] to discharge to the unusable aquifer directly underlying the solid waste that vents almost immediately to the Saginaw River and Saginaw Bay. Interim monitoring and compliance monitoring pursuant to Part 31 and Part 115[3] detailed in the revised HMP was approved by the MDEQ on January 8, 2018.

1.3 Geology/Hydrogeology

The majority of DEK BAP 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 BAP, the shallow groundwater flow is generally radial, flowing outward from the pond area toward the surrounding surface water bodies.

[2] Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act (NREPA), Public Act 451 of 1994.
[3] Part 115, Solid Waste Management, of the Natural Resources and Environmental Protection Act (NREPA), Public Act 451 of 1994.

Section 2
Groundwater Monitoring

2.1 Monitoring Well Network

In accordance with 40 CFR 257.91, CEC established a groundwater monitoring system for the DEK BAP unit, which 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 CCR unit 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.

In the vicinity of the DEK BAP, the shallow groundwater flow is generally radial, flowing outward from the pond area toward the surrounding surface water bodies (Figures 3 and 4). Therefore, the six wells downgradient of the DEK Bottom Ash Pond encircle the CCR unit (DEK-MW-15001 through DEK-MW-15006).

Monitoring well DEK-MW-15001 was decommissioned on April 18, 2018 due to the installation of the new Karn Lined Impoundment, which is a new double composite lined CCR unit constructed as a replacement to the DEK BAP. Monitoring well DEK-MW-18001 was installed on May 21, 2018 approximately 80 feet southeast of DEK-MW-15001 to maintain the perimeter downgradient monitoring well network. The locations of these monitoring wells are shown on Figure 2. The decommissioning log for DEK-MW-15001 as well as the soil boring log and well construction diagram for DEK-MW-18001 are included in Appendix A. Although the new well is considered a replacement well, the data from the two wells are not being combined in the statistical analyses at this time due to insufficient amount of data from the new well to compare the two data sets. Therefore, the statistical analysis for DEK-MW-15001 terminates at the April 2018 sampling event and statistical analysis for DEK-MW-18001 will commence once sufficient data have been collected from the new monitoring well (a minimum of four independent sampling events).

2.2 Preliminary Assessment Monitoring

CEC reported in the 2017 Annual Report that Appendix III constituents boron, fluoride, pH, and sulfate were observed within groundwater at one or more downgradient monitoring well(s) with potential SSIs above background concentration levels. TRC performed an ASD for the constituents and did not find strong enough evidence within 90 days to determine the observation of constituents above background was attributable to a source other than the CCR unit. Therefore, CEC initiated an Assessment Monitoring Program for the BAP CCR unit pursuant to §257.95 that included sampling and analyzing groundwater within the groundwater monitoring system for all constituents listed in Appendix IV. The monitoring was performed in accordance with the *DE Karn Monitoring Program Sample Analysis Plan* (SAP) (ARCADIS, May 2016).

2.2.1 Data Summary

The preliminary Appendix IV only assessment monitoring event (per §257.95(b)) was performed on April 9 through April 12, 2018. Downgradient monitoring wells DEK-MW-15001 through DEK-MW-15006 and background monitoring wells MW-15002, MW-15008, MW-15016, and MW-15019 were sampled during this event.

Static water elevation measurements were collected at all monitoring well locations. Static water elevation data are summarized in Table 1 and groundwater elevation data are shown on Figure 3. Monitoring wells were purged with peristaltic pumps utilizing low-flow sampling methodology. Field parameters were stabilized at each monitoring well prior to collecting groundwater samples. Field parameters for each monitoring well are summarized in Table 2.

The groundwater samples were analyzed by Pace Analytical Services, LLC (Pace) for Appendix IV constituents during the preliminary assessment monitoring event, in accordance with the SAP. The analytical results from each event are summarized in Table 3.

2.2.2 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. The data quality reviews are summarized in Appendix B.

2.2.3 Groundwater Flow Rate and Direction

Groundwater elevation data collected during the April 2018 assessment monitoring events were generally similar to data collected previously in the background and detection monitoring events.

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 April 2018 sampling event are provided on Table 1 and were used to construct groundwater contour map (Figure 3).

The figure shows 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 0.0080 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-15003 and the discharge channel. Using the mean hydraulic conductivity of 15 ft/day (ARCADIS, 2016) and an assumed effective porosity of 0.3, the estimated average seepage velocity was approximately 0.40 ft/day or 150 ft/year, which is consistent with previous estimates.

2.3 Semiannual Semi-Annual Assessment Groundwater Monitoring

Per §257.95(d), within 90 days of the preliminary assessment monitoring event and semiannually thereafter, all wells must be resampled and analyzed for all constituents from Appendix III and for those constituents in Appendix IV of the CCR Rule that were detected during prior sampling. In addition to the Appendix III and IV constituents, field parameters including dissolved oxygen, oxidation reduction potential, specific conductivity, temperature, and turbidity were collected at each well. Samples were collected and analyzed according to the SAP.

2.3.1 Data Summary

The first semiannual assessment monitoring event for 2018 was performed on May 21 through May 24, 2018 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. Downgradient monitoring wells DEK-MW-15002 through DEK-MW-15006, DEK-MW-18001, and background monitoring wells MW-15002, MW-15008, MW-15016, and MW-15019 were sampled during this event for the Appendix III and Appendix IV constituents and field parameters. A summary of the groundwater data collected during the May 2018 event is provided on Table 1 (static groundwater elevation data), Table 2 (analytical results), and Table 3 (field data).

The second semiannual groundwater assessment monitoring event for 2018 was performed on November 5 through November 9, 2018 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. Downgradient monitoring wells DEK-MW-15002 through DEK-MW-15006, DEK-MW-18001, and background monitoring wells MW-15002, MW-15008, MW-15016, and MW-15019 were sampled during this event for the Appendix III and Appendix IV constituents and field parameters. As of the writing of this report, lab analysis and data quality review are ongoing. Therefore, a summary of groundwater data will be provided after laboratory analysis is complete and results have been reviewed for usability. It is anticipated that the November 2018 data summary will be available in March 2019. Consumers Energy will enter this information into the operating record as soon as it is available and will include it in the forthcoming 2019 Annual Groundwater Monitoring and Corrective Action Report.

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. The data quality reviews are summarized in Appendix B.

2.3.3 Groundwater Flow Rate and Direction

Groundwater elevation data collected during the May 2018 sampling event were similar to data collected previously in the background and detection monitoring sampling events. 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 May 2018 sampling event are provided on Table 1 and were used to construct groundwater contour map (Figure 4).

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 these events is estimated at 0.0076 ft/ft. The gradient was calculated using the same well pairs as the aforementioned April 2018 event. Using the mean hydraulic conductivity of 15 ft/day (ARCADIS, 2016) and an assumed effective porosity of 0.3, the estimated average seepage velocity was approximately 0.38 ft/day or 140 ft/year, which is consistent with previous estimates.

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 or Appendix IV constituents that could potentially migrate from the DEK BAP CCR unit.

Section 3
Statistical Evaluation

3.1 Establishing Groundwater Protection Standards

In accordance with §257.95(h) and the *Groundwater Statistical Evaluation Plan* (Stats Plan) (TRC, October 2017), groundwater protection standards (GWPSs) were established for the Appendix IV constituents following the preliminary assessment monitoring event using nine rounds of data collected from the background monitoring wells MW-15002, MW-15008, MW-15016, and MW-15019 (December 2015 through April 2018). The calculation of the GWPSs is documented in the *Groundwater Protection Standards* technical memorandum included in Appendix C of this annual report (TRC, October 2018). The GWPS is established as the higher of the EPA Maximum Contaminant Level (MCL) or statistically derived background level for constituents with MCLs and the higher of the EPA Regional Screening Levels (RSLs) or background level for constituents with RSLs. The Appendix IV GWPSs will be used to assess whether groundwater has been impacted from the DEK BAP CCR unit by statistically comparing concentrations in the downgradient wells to the GWPSs for each Appendix IV constituent.

3.2 Data Comparison to Groundwater Protection Standards

Consistent with the *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (Unified Guidance) (USEPA, 2009), the preferred method for comparisons to a fixed standard are confidence limits. An exceedance of the standard occurs when the 99 percent lower confidence level of the downgradient data exceeds the GWPS. The statistical data comparison was reported on January 14, 2019, within 90 days of establishing the GWPSs in accordance with §257.93(h)(2) and within the compliance schedule clarified by the USEPA in a letter dated April 30, 2018 (USEPA, April 2018).

The statistical evaluation report has been entered into operating record by CEC on January 14, 2019 in accordance with §257.105(h)(8). Notification of the statistical analysis of the assessment monitoring data compared to the GWPS, if necessary, will be made in accordance with §257.106(h) and posting such notification to the publicly accessible compliance website in accordance with §257.107(h) will be completed within 30 days of days of the completion of the statistical analysis. This evaluation will be included in the 2019 Annual Groundwater Monitoring and Corrective Action Report since it was completed in calendar year 2019.

Subsequently, following receipt of final laboratory reports for all Appendix IV constituents and completion of data quality review, the results from the November 2018 semiannual sampling event will also be statistically compared to the GWPSs using the same approach as the initial

event. It is anticipated that the statistical comparison of the second semiannual 2018 event will be completed in March/April 2019. Consumers Energy will enter this information into the operating record as soon as it is available and will include it in the forthcoming 2019 Annual Groundwater Monitoring and Corrective Action Report.

Section 4
Conclusions and Recommendations

Semiannually after triggering assessment monitoring, groundwater samples will be collected from the groundwater monitoring system wells and analyzed for Appendix III and Appendix IV constituents pursuant to §257.95(d). In accordance with §257.93(h)(2) and within the compliance schedule clarified by the EPA in April 2018, the first round of semiannual assessment monitoring data were statistically evaluated against the GWPSs as reported on January 14, 2019. CEC has placed this analysis in the operating record in accordance with §257.105(h)(8) on January 14, 2019. Notification that one or more Appendix IV constituents have been detected at statistically significant levels above the GWPS will be submitted, if necessary, in accordance with §257.106(h) and posting such notifications to the publicly accessible compliance website in accordance with §257.107(h) will be completed within 30 days of the completion of the statistical analysis. This evaluation will be included in the 2019 Annual Groundwater Monitoring and Corrective Action Report since it was completed in 2019.

According to §257.95(g)(3), if the facility determines pursuant to §257.93(h), that any Appendix IV constituents were detected at a statistically significant level exceeding the GWPSs, the facility will either conduct an alternate source demonstration or initiate an assessment of corrective measures according to §257.96 within 90 days. Based on the results of the statistical evaluation CEC will be seeking to initiate an assessment of corrective measures within 90 days of the completion of the statistical analysis. CEC will continue executing the self-implementing groundwater compliance schedule in conformance with §257.90 - §257.98.

In addition, the statistical evaluation of the second semiannual 2018 monitoring event is anticipated to be completed in March/April 2019 and will be posted to the public website within 30 days of being finalized. Consumers Energy will enter this information into the operating record as soon as it is available and will include it in the forthcoming 2019 Annual Groundwater Monitoring and Corrective Action Report.

The next semiannual monitoring event is tentatively scheduled for the second calendar quarter of 2019.

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.

Consumers Energy Company. December 19, 2017. Hydrogeological Monitoring Plan Rev. 3: DE Karn Solid Waste Disposal Area.

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

TRC. October 15, 2018. Groundwater Protection Standards, Consumers Energy, DE Karn Site, Bottom Ash Pond CCR Unit, technical memorandum prepared for Consumers Energy Company.

TRC Environmental Corporation. January 2018. Annual Groundwater Monitoring Report – DE Karn Power Plant, Bottom Ash Pond CCR Unit. Prepared for Consumers Energy Company.

USEPA. 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance. Office of Conservation and Recovery. EPA 530/R-09-007.

USEPA. April 2015. 40 CFR Parts 257 and 261. Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule. 80 Federal Register 74 (April 17, 2015), pp. 21301-21501 (80 FR 21301).

USEPA. July 2018. 40 CFR Part 257. Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals from Electric Utilities; Amendments to the National Minimum Criteria (Phase One, Part One); Final Rule. 83 Federal Register 146 (July 30, 2018), pp. 36435-36456 (83 FR 36435).

USEPA. April 2018. Barnes Johnson (Office of Resource Conservation and Recovery) to James Roewer (c/o Edison Electric Institute) and Douglas Green, Margaret Fawal (Venable LLP). Re: Coal Combustion Residuals Rule Groundwater Monitoring Requirements. April 30, 2018. United States Environmental Protection Agency, Washington, D.C. 20460. Office of Solid Waste and Emergency Response, now the Office of Land and Emergency Management.

Tables

Table 1

Summary of Groundwater Elevation Data

DE Karn and JC Weadock – RCRA CCR Monitoring Program

Essexville, Michigan

Well Location	TOC Elevation (ft)	Geologic Unit of Screen Interval	Screen Interval Elevation (ft)			April 9, 2018		May 14, 2018	
						Depth to Water (ft BTOC)	Groundwater Elevation (ft)	Depth to Water (ft BTOC)	Groundwater Elevation (ft)
Background									
MW-15002	587.71	Sand	580.9	to	570.9	6.65	581.06	6.57	581.14
MW-15008	585.36	Sand with clay	578.7	to	568.7	4.38	580.98	4.15	581.21
MW-15016	586.49	Sand	581.2	to	578.2	4.06	582.43	4.34	582.15
MW-15018	586.42	Sand	580.6	to	576.6	5.07	581.35	5.33	581.09
MW-15019	586.17	Sand and Sand/Clay	579.5	to	569.5	5.21	580.96	5.13	581.04
MW-15020	585.95	Sand	578.5	to	568.5	5.08	580.87	4.81	581.14
MW-15024	586.56	Sand	579.7	to	569.7	5.80	580.76	5.50	581.06
MW-15027	586.25	Sand	578.2	to	568.2	5.37	580.88	5.11	581.14
DEK Bottom Ash Pond									
DEK-MW-15001(1)	594.64	Sand	576.1	to	575.1	11.44	583.20	--	--
DEK-MW-18001(1)	593.47	Sand	579.2	to	574.2	--	--	8.49	584.98
DEK-MW-15002	590.87	Sand	578.3	to	575.3	4.57	586.30	4.41	586.46
DEK-MW-15003	602.80	Sand	578.8	to	574.8	14.24	588.56	14.11	588.69
DEK-MW-15004	611.05	Sand	576.6	to	571.6	22.91	588.14	22.87	588.18
DEK-MW-15005	589.72	Sand	572.3	to	567.3	9.10	580.62	8.67	581.05
DEK-MW-15006	589.24	Sand	573.0	to	568.0	8.60	580.64	8.20	581.04
JCW Bottom Ash Pond									
JCW-MW-15007	587.40	Sand	582.7	to	579.2	3.69	583.71	3.89	583.51
JCW-MW-15009	589.64	Sand	581.9	to	576.9	8.48	581.16	8.09	581.55
JCW-MW-15010	597.76	Sand	579.7	to	578.2	16.37	581.39	15.55	582.21
JCW-MW-15028	589.37	Sand	567.7	to	564.7	6.93	582.44	6.84	582.53
JCW Landfill									
JCW-MW-15011	597.07	Sand	582.4	to	578.9	14.36	582.71	13.59	583.48
JCW-MW-15012	595.07	Sand and Clay	581.4	to	576.4	14.48	580.59	13.75	581.32
JCW-MW-15023	595.32	Sand	579.7	to	574.7	13.36	581.96	12.66	582.66

Notes:

Survey data from: Rowe Professional Services Company (Nov. 2015) and Consumers Energy Company drawings: SG-21733, Sheet 1, Rev. G (Karn, 11/27/18); and SG-21733, Sheet 2, Rev. C (Weadock, 11/27/18).

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.

--: Not measured.

(1) - DEK-MW-15001 was decommissioned on April 18, 2018 due to the installation of the new Karn Lined Impoundment. DEK-MW-18001 was installed on May 21, 2018.

Table 2
Summary of Field Parameter Results – April and May 2018
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	4/9/2018	0.31	23.4	6.7	9,267	7.43	2.30
	5/22/2018	0.32	-29.7	7.0	6,259	11.00	4.82
MW-15008	4/10/2018	0.19	-5.6	6.6	1,507	6.43	4.85
	5/22/2018	0.24	-33.8	6.8	1,456	9.35	4.58
MW-15016	4/10/2018	1.33	45.7	7.3	1,675	4.74	3.77
	5/22/2018	0.34	45.4	7.3	1,547	13.30	1.74
MW-15019	4/9/2018	0.25	-58.1	6.8	2,091	5.93	3.79
	5/22/2018	0.23	-53.1	6.9	2,030	9.41	3.91
Downgradient							
DEK-MW-15001(1)	4/10/2018	0.21	-33.7	7.3	845	10.10	1.76
DEK-MW-18001(1)	5/23/2018	0.31	-68.0	7.8	740	14.73	2.71
DEK-MW-15002	4/12/2018	0.22	-108.1	7.5	1,077	9.64	4.45
	5/23/2018	0.26	-138.2	8.0	1,065	14.18	2.59
DEK-MW-15003	4/12/2018	1.19	-126.6	7.8	678	13.63	1.31
	5/23/2018	0.33	-123.8	8.2	666	17.25	2.02
DEK-MW-15004	4/12/2018	0.37	-124.3	7.3	844	16.48	4.95
	5/23/2018	0.49	-106.3	7.7	813	19.66	4.56
DEK-MW-15005	4/11/2018	0.20	-74.1	7.7	847	10.99	3.10
	5/24/2018	0.40	-61.5	7.8	847	14.51	2.37
DEK-MW-15006	4/11/2018	0.22	-113.0	7.9	2,427	9.26	3.86
	5/24/2018	0.47	-97.4	8.2	1,547	13.99	1.33

Notes:
mg/L - Milligrams per Liter.
mV - Millivolts.
SU - Standard units.
umhos/cm - Micromhos per centimeter.
°C - Degrees Celcius
NTU - Nephelometric Turbidity Unit.
(1) - DEK-MW-15001 was decommissioned on April 18, 2018 due to the installation of the new Karn Lined Impoundment. DEK-MW-18001 was installed on May 21, 2018.

Table 3
Summary of Groundwater Sampling Results (Analytical) – April and May 2018
DE Karn Bottom Ash Pond – RCRA CCR Monitoring Program
Essexville, Michigan

					Sample Location:	DEK-MW-15001[1]	DEK-MW-18001[1]	DEK-MW-15002		DEK-MW-15003		DEK-MW-15004		DEK-MW-15005		DEK-MW-15006	
					Sample Date:	4/10/2018	5/23/2018	4/12/2018	5/23/2018	4/12/2018	5/23/2018	4/12/2018	5/23/2018	4/11/2018	5/24/2018	4/11/2018	5/24/2018
Constituent	Unit	EPA MCL	MI Residential*	MI Non-Residential*	MI GSI^	downgradient											
Appendix III																	
Boron	ug/L	NC	**500**	**500**	4,000	--	**1,600**	--	**967**	--	**1,010**	--	**800**	--	**806**	--	**1,200**
Calcium	mg/L	NC	NC	NC	500	--	64.9	--	53.7	--	58.1	--	47.8	--	33.4	--	21.9
Chloride	mg/L	250**	250	250	**50**	--	**69.1**	--	**79.7**	--	**57.2**	--	**72.5**	--	**72.6**	--	**85.8**
Fluoride	ug/L	4,000	NC	NC	NC	1,600	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	1,200	1,100	< 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	7.3	7.8	7.5	8.0	7.8	8.2	7.3	7.7	7.7	7.8	7.9	8.2
Sulfate	mg/L	**250****	**250**	**250**	500	--	30.6	--	**263**	--	39.1	--	176	--	182	--	**401**
Total Dissolved Solids	mg/L	**500****	**500**	**500**	**500**	--	434	--	**660**	--	354	--	494	--	**524**	--	**944**
Appendix IV																	
Antimony	ug/L	6	6	6	2.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	**10**	**10**	**10**	**10**	**103**	**225**	**56.4**	**67.0**	**478**	**450**	**134**	**119**	**28.3**	**31.7**	**18.3**	**25.7**
Barium	ug/L	2,000	2,000	2,000	1,200	117	101	82.7	84.5	61.2	73.3	86.9	79.6	54.9	58.5	39.6	22.8
Beryllium	ug/L	4	4	4	25	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	5	5	5	2.5	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Chromium	ug/L	100	100	100	11	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	NC	40	100	100	< 15.0	< 15.0	< 15.0	< 15.0	< 15.0	< 15.0	< 15.0	< 15.0	< 15.0	< 15.0	< 15.0	< 15.0
Fluoride	ug/L	4,000	NC	NC	NC	1,600	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	1,200	1,100	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	NC	4	4	14	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	320[2]
Lithium	ug/L	NC	170	350	440	61	23	43	35	39	33	39	30	24	19	18	< 10
Mercury	ug/L	2	2	2	0.20#	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	NC	73	210	120	< 5.0	< 5.0	30.8	35.4	< 5.0	5.3	32.0	30.9	39.0	41.9	71.6	48.7
Radium-226	pCi/L	NC	NC	NC	NC	< 0.686	0.906	< 0.478	< 0.698	0.686	< 0.842	< 0.641	< 0.791	< 0.587	< 0.740	< 0.688	< 0.738
Radium-226/228	pCi/L	5	NC	NC	NC	< 1.42	1.63	1.42	< 1.44	< 1.33	1.63	< 1.49	< 1.54	< 1.34	< 1.53	< 1.44	< 1.86
Radium-228	pCi/L	NC	NC	NC	NC	1.08	< 0.733	1.16	< 0.744	< 0.755	1.12	< 0.847	< 0.753	0.756	0.857	< 0.755	< 1.12
Selenium	ug/L	50	50	50	5	1.2	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Thallium	ug/L	2	2	2	2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 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.

* - 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 hardness of 258 mg CaCO3/L (average of SW-01 [Lake Huron] and SW-02 [Saginaw River] collected in April 2018) per footnote {G} of Michigan Part 201 criteria tables. Chromium GSI criterion based on hexavalent chromium per footnote {H}. GSI criterion is protective for surface water used as a drinking water source as described in footnote {X}. GSI criterion for chloride is 50 mg/L when the discharge is to the Great Lakes or connecting waters per footnote {FF}

- 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.

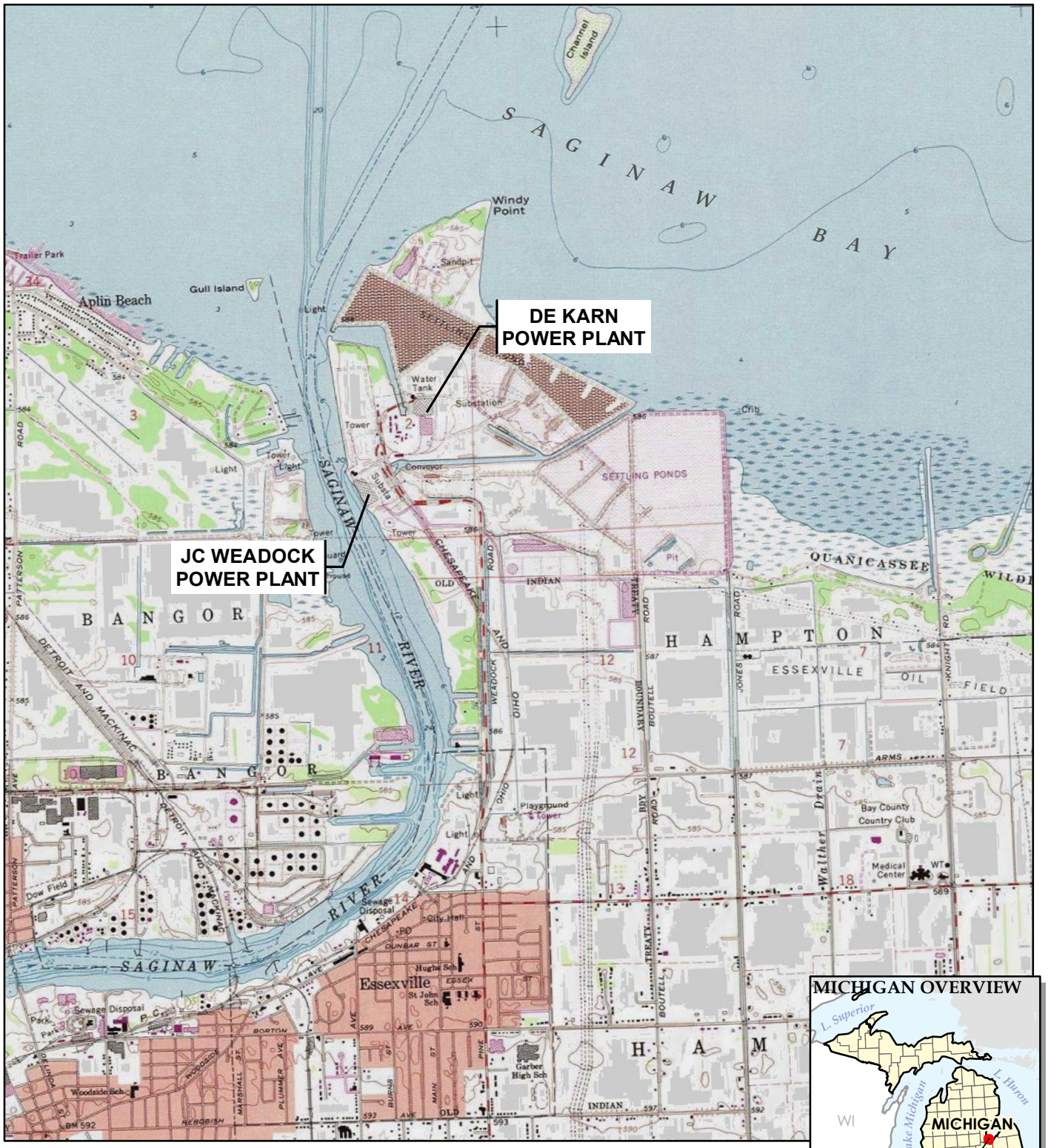
RED value indicates an exceedance of the MCL.

All metals were analyzed as total unless otherwise specified.

(1) - DEK-MW-15001 was decommissioned on April 18, 2018 due to the installation of the new Karn Lined Impoundment. DEK-MW-18001 was installed on May 21, 2018.

(2) - Outlier; single detection above reporting limit.

Figures



BASE MAP FROM USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE SERIES.

N

1 " = 3,000 '
1:36,000

0 3,000 6,000
FEET

TRC
1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080
TRC - GIS

PROJECT:

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

TITLE:

SITE LOCATION MAP

DRAWN BY:	J. PAPEZ
CHECKED BY:	D. LITZ
APPROVED BY:	G. CROCKFORD
DATE:	OCTOBER 2017
PROJ. NO.:	269767-002/3
FILE:	269767-002_3-007SLM.mxd

FIGURE 1

E:\ConsumersEnergy\CCR_GW\2017_269767\269767-002_3-007SLM.mxd -- Saved By: SMAJOR on 10/12/2017, 08:42:53 AM

LEGEND

- BACKGROUND MONITORING WELL
- DEK BOTTOM ASH POND & LINED IMPOUNDMENT MONITORING WELL
- DEK BOTTOM ASH POND MONITORING WELL
- DEK LINED IMPOUNDMENT MONITORING WELL
- DECOMMISSIONED MONITORING WELL
- JCW BOTTOM ASH POND MONITORING WELL
- JCW LANDFILL MONITORING WELL
- MONITORING WELL (STATIC WATER LEVEL ONLY)
- SURFACE WATER GAUGING STATION
- SLURRY WALL (APPROXIMATE)
- EXTENT OF GEOSYNTHETICS (KARN LINED IMPOUNDMENT)

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).

N

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:

SITE PLAN

DRAWN BY:	S. MAJOR	PROJ NO.:	290805-001
CHECKED BY:	D. LITZ		
APPROVED BY:	G. CROCKFORD		**FIGURE 2**
DATE:	JANUARY 2019		

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

FILE NO.: 290805-001-018.mxd

Plot Date: 1/24/2019, 12:08:13 PM by SMAJOR -- LAYOUT: ANSI B (11"x17")
Path: E:\Consumers\Energy\CCR GW\2017 269767\290805-001-018.mxd
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0

TRC - GIS

Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0
Plot Date: 1/24/2019, 12:10:02 PM by SMAJOR -- LAYOUT: ANSI B (11"x17")
Path: E:\ConsumersEnergy\CCR_GW\2017_269767\290805-001-017.mxd

LEGEND

- BACKGROUND MONITORING WELL
- DEK BOTTOM ASH POND & LINED IMPOUNDMENT MONITORING WELL
- DEK BOTTOM ASH POND MONITORING
- DECOMMISSIONED MONITORING
- JCW BOTTOM ASH POND MONITORING
- JCW LANDFILL MONITORING
- 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).
4. MONITORING WELL DEK- MW-18001 INSTALLED IN MAY 2018. SURVEY DATA NOT YET AVAILABLE.

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 APRIL 2018

DRAWN BY:	S. MAJOR	PROJ NO.:	290805-001
CHECKED BY:	D. LITZ		
APPROVED BY:	G. CROCKFORD		**FIGURE 3**
DATE:	JANUARY 2019		

TRC
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Ann Arbor, MI 48108-3284
Phone: 734.971.7080
www.trcsolutions.com

FILE NO.: 290805-001-017.mxd

LEGEND

- BACKGROUND MONITORING WELL
- DEK BOTTOM ASH POND & LINED IMPOUNDMENT MONITORING WELL
- DEK BOTTOM ASH POND MONITORING WELL
- DECOMMISSIONED MONITORING WELL
- JCW BOTTOM ASH POND MONITORING WELL
- JCW LANDFILL MONITORING WELL
- MONITORING WELL (STATIC WATER LEVEL ONLY)
- GROUNDWATER ELEVATION CONTOUR (2' INTERVAL, DASHED WHERE INFERRED)
- SLURRY WALL (APPROXIMATE)
- *(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).

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 MAY 2018

DRAWN BY:	S. MAJOR	PROJ NO.:	290805-001
CHECKED BY:	D. LITZ		
APPROVED BY:	G. CROCKFORD		**FIGURE 4**
DATE:	JANUARY 2019		

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

FILE NO.: 290805-001-019.mxd

Plot Date: 1/24/2019, 12:05:43 PM by SMAJOR -- LAYOUT: ANSI B (11"x17")
Path: E:\ConsumersEnergy\CCR_GW\2017_269767\290805-001-019.mxd
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0
TRC - GIS

Appendix A
Monitoring Well Records

MONITORING WELL DECOMMISSIONING LOG

PROJECT NAME:	Karn 2018 Well Decommissioning	**MONITORING WELL ID:**	DEK-MW-15001
PROJECT NUMBER:	290804 P2 T4	DATE: 04/18/2018	
OBSERVED BY:	Jacob Krenz	LOCATION: Located halfway up the south berm on the new impoundment project.	LOCATION COORDINATES: N: 782854.00 E: 13263363.70
DRILLING CONTRACTOR:	STEARNS DRILLING		
CREW CHIEF:	Brian Marshall	TOP OF CASING ELEV.: 594.80	SURFACE ELEV.: NM

PROTECTIVE COVER TYPE:	☑ STICK-UP ☐ FLUSH MOUNT ☐ TRAF. BOX ☐ OTHER		
PROTECTIVE COVER DIAMETER:	☐ 4" ☐ 8" ☐ 9" ☐ 10" ☐ 12" ☑ OTHER NA		
WELL MATERIAL:	☑ PVC ☐ SS ☐ IRON ☐ GALVANIZED STEEL ☐ OTHER		
WELL CASING DIAMETER:	☐ 1" ☑ 2" ☐ 4" ☐ 6" ☐ 8" ☐ OTHER		
WELL SCREEN MATERIAL:	☑ PVC ☐ SS ☐ IRON ☐ GALVANIZED STEEL ☑ OTHER		
WELL SCREEN LENGTH:	☐ 5-FT ☐ 10-FT ☐ UNKNOWN ☑ OTHER 1-FT	**DTW:** 7.8	T/ PVC
WELL SCREEN SLOT SIZE:	☑ 0.01" ☐ 0.02" ☐ UNKNOWN ☐ OTHER	**DTB:** 20.05	T/ PVC

DECOMMISSIONING PROCEDURE: OVERDRILL AND GROUT

NOTES:
The protective cover was previously removed to extend the well above grade due to construction of a berm for the new ash impoundment. The well casing was pulled using a skid loader and the remaining hole was filled from above with hydrated bentonite.

GROUTING PROCEDURE:	FILL FROM ABOVE					
GROUT TYPE:	NA					
GROUT MIX:	NA					
GROUT INTERVAL:	NA	FT-BGS	TO	NA	FT-BGS	
BENTONITE SEAL:						
SEAL INTERVAL:	20	FT-BGS	TO	2	FT-BGS	

NOTES:
A 6" PVC casing was installed around the existing well casing when the well was extended. There was benseal between the 6" casing and the 2" well casing. As the well casing was pulled the benseal collapsed into the remaining hole.

ADDITIONAL COMMENTS:
No protective cover was present on the well at the time of decommissioning

Doug Ley 10/8/18
SIGNED DATE

Vinit E. Bunny 10/8/18
CHECKED DATE

WELL CONSTRUCTION LOG

WELL NO. DEK-MW-18001

Facility/Project Name	Date Drilling Started	Date Drilling Completed	Project Number
Consumers Energy DE Karn CCR Monitoring	5/21/18	5/21/18	290804.0000

Drilling Firm	Drilling Method	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Stearns Drilling	Hollow Stem Auger	590.7	593.47	18.0	8.0

Boring Location: Approximately 70 feet south and 30 feet west of decommissioned monitoring well DEK-MW-15001.
N: 782780.00 E: 13263320.00

Personnel
Logged By - Jacob Krenz
Driller - Gary Geerligs

Drilling Equipment: CME LC 60

Civil Town/City/or Village	County	State
Essexville	Bay County	Michigan

Water Level Observations:
While Drilling: Date/Time 5/21/18 00:00 ▽ Depth (ft bgs) 7.0
After Drilling: Date/Time 5/22/18 07:08 ▼ Depth (ft bgs) 5.49

SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	WELL DIAGRAM	COMMENTS
1 SS	100	3 5 5 5	0–1	**TOPSOIL** black (10YR 2/1).				
			1–2	**CLAY WITH SAND** mostly clay, few to little fine to medium sand, trace fine gravel, low plasticity, yellowish brown (10YR 5/4), stiff, moist.	CL			
2 SS	100	4 5 6 7	2–3	**SAND** mostly medium sand, yellowish brown (10YR 5/6), dry, loose.	SP			
				CLAY WITH SAND mostly clay, few to little fine to medium sand, trace fine gravel, low plasticity, yellowish brown (10YR 5/4), stiff, moist.	CL			
			3–4	**SAND** mostly fine to medium sand, pale brown (10YR 6/3, dry, loose.	SP			
				CLAY WITH SAND mostly clay, few to little fine to medium sand, trace fine gravel, low plasticity, yellowish brown (10YR 5/4), stiff, moist.	CL			
3 SS	80	3 3 4 4	4–5	**SAND** mostly fine to medium sand, dark yellowish brown (10YR 4/4), moist, loose.	SP			
				CLAY WITH SAND mostly clay, few to little fine to medium sand, trace fine gravel, low plasticity, yellowish brown (10YR 5/4), stiff, moist.	CL			
			6	**SAND** mostly fine to medium sand, dark yellowish brown (10YR 3/6), moist, loose.	SP			
4 SS	80	3 1 1 1	6–7	**CLAY** mostly clay, trace fine sand, trace silt, low to medium plasticity, gray (10YR 5/1), moist, medium stiff.	CL			
			7–8	**SAND** mostly medium to coarse sand, very dark gray (10YR 3/1), saturated, loose.	SP			
5 SS	80	0 1 2 4	9	Change to fine to medium sand, trace silt at 9.0 feet.				

SOIL BORING WELL CONSTRUCTION LOG 290804P1T6.CEC.FLUORIDEASSESSMENT.GPJ TRC_CORP.GDT 290804.0000 1/22/19

Signature:

Firm: TRC Environmental Corporation
1540 Eisenhower Place Ann Arbor, MI 48108
734-971-7080
Fax 734-971-9022

WELL CONSTRUCTION LOG

WELL NO. DEK-MW-18001

SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	WELL DIAGRAM	COMMENTS
6 SS	70	5, 9, 7, 6	11	Change to mostly fine sand, trace ash at 11.0 feet.				
7 SS	60	4, 6, 9, 7	12–13	Change to mostly medium sand, saturated, trace shell fragments, no ash at 13.0 feet.	SP			
8 SS	60	5, 5, 9, 7	14–15					
9 SS	75	5, 9, 12, 14	16–17	**CLAY** mostly clay, trace to few sand, trace gravel, low plasticity, gray (10YR 5/1), moist, very stiff.	CL			
			18	End of boring at 18.0 feet below ground surface.				
			19					
			20					
			21					
			22					
			23					

WELL CONSTRUCTION DIAGRAM

PROJ. NAME:	CONSUMERS ENERGY DE KARN CCR MONITORING	WELL ID:	**DEK-MW-18001**
PROJ. NO:	290804.0000	DATE INSTALLED: 5/21/2018 INSTALLED BY: J.KRENZ	CHECKED BY: M. Brehob

ELEVATION (BENCHMARK: USGS)	DEPTH BELOW OR ABOVE GROUND SURFACE (FEET)	
593.47	2.77	TOP OF CASING
590.70	0.0	GROUND SURFACE
	1.5	CEMENT SURFACE PLUG
		GROUT/BACKFILL MATERIAL: NA
		GROUT/BACKFILL METHOD: NA
14.27		RISER PIPE LENGTH
	NA	GROUT
		BENTONITE SEAL MATERIAL: MEDIUM CHIPS
	9.5	BENTONITE SEAL
579.20	11.5	TOP OF SCREEN
5.00		SCREEN LENGTH
		FILTER PACK MATERIAL: MEDIUM, WASHED SAND
574.20	16.5	BOTTOM OF SCREEN
	16.5	BOTTOM OF FILTER PACK
	NA	BENTONITE PLUG
		BACKFILL MATERIAL: NATURAL COLLAPSE
572.70	18.0	HOLE BOTTOM

NOTES:

CASING AND SCREEN DETAILS

TYPE OF RISER: 2-INCH PVC

PIPE SCHEDULE: 40

PIPE JOINTS: THREADED O-RINGS

SCREEN TYPE: 2-INCH PVC

SCR. SLOT SIZE: 0.01-INCH

BOREHOLE DIAMETER: 8.00 IN. FROM 0 TO 16.5 FT.
2.00 IN. FROM 16.5 TO 18.0 FT.

SURF. CASING DIAMETER: ____ IN. FROM ____ TO ____ FT.
____ IN. FROM ____ TO ____ FT.

WELL DEVELOPMENT

DEVELOPMENT METHOD: SURGE AND PUMP

TIME DEVELOPING: 0.5 HOURS

WATER REMOVED: 67.5 GALLONS

WATER ADDED: 0 GALLONS

WATER CLARITY BEFORE / AFTER DEVELOPMENT

CLARITY BEFORE: VERY TURBID

COLOR BEFORE: LIGHT BROWN

CLARITY AFTER: CLEAR

COLOR AFTER: NONE

ODOR (IF PRESENT): NONE

WATER LEVEL SUMMARY

MEASUREMENT (FEET)			DATE	TIME
DTB BEFORE DEVELOPING:	19.71	T/PVC	5/22/2018	7:08
DTB AFTER DEVELOPING:	19.65	T/PVC	5/24/2018	15:53
SWL BEFORE DEVELOPING:	8.49	T/PVC	5/22/2018	7:08
SWL AFTER DEVELOPING:	8.35	T/PVC	5/24/2018	15:53
OTHER SWL:		T/PVC		
OTHER SWL:		T/PVC		

PROTECTIVE CASING DETAILS

PERMANENT, LEGIBLE WELL LABEL ADDED? ☑ YES ☐ NO

PROTECTIVE COVER AND LOCK INSTALLED? ☑ YES ☐ NO

LOCK KEY NUMBER: NEW LOCK NOT YET ADDED BY CEC

Appendix B
Data Quality Reviews

Laboratory Data Quality Review
Groundwater Monitoring Event April 2018
CEC DE Karn and JC Weadock Background Wells

Groundwater samples were collected by TRC for the April 2018 sampling event. Samples were analyzed for anions and total metals by Pace Analytical Services, LLC (Pace), located in Grand Rapids, Michigan, and for radium by Pace located in Greensburg, Pennsylvania. The laboratory analytical results are reported in laboratory reports 4610843 and 4610844.

During the April 2018 sampling event, a groundwater sample was collected from each of the following wells:

- MW-15002
- MW-15008
- MW-15016
- MW-15019

Each sample was analyzed for the following constituents:

Analyte Group	Method
Anions (Fluoride)	EPA 300.0
Total Metals	EPA 6020A, EPA 6010C, EPA 7470A
Radium (Radium-226, Radium-228, Total Radium)	EPA 903.1, EPA 904.0

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) and the Department of Energy Evaluation of Radiochemical Data Usability (USDOE, 1997). The following items were included in the evaluation of the data:

- Sample receipt;
- Technical holding times for analyses;
- Reporting limits (RLs) compared to project-required RLs;
- 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;
- Data for laboratory control samples (LCSs). The LCSs are used to assess the accuracy of the analytical method using a clean matrix;

- Percent recoveries for matrix spike (MS) and matrix spike duplicates (MSD), when performed on project samples. Percent recoveries are calculated for each analyte spiked and used to assess bias due to sample matrix effects;
- 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;
- Data for blind field duplicates. Field duplicate samples are used to assess variability introduced by the sampling and analytical processes; 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 IV constituents will be utilized for the purposes of an assessment monitoring program.
- Data are usable for the purposes of the assessment monitoring program.
- When the data are evaluated through an assessment monitoring statistical program, findings below may be used to support the removal of outliers.

QA/QC Sample Summary:

- A method blank was analyzed with each analytical batch; no analytes were detected in the blank samples.
- The LCS recoveries for all analytes were within QC limits.
- A field blank (FB-20180410) was collected; no analytes were detected in the blank samples.
- Dup_20180410 corresponds to MW-15008_20180410; 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 April 2018
CEC DE Karn Bottom Ash Pond

Groundwater samples were collected by TRC for the April 2018 sampling event. Samples were analyzed for anions and total metals by Pace Analytical Services, LLC (Pace), located in Grand Rapids, Michigan, and for radium by Pace located in Greensburg, Pennsylvania. The laboratory analytical results are reported in laboratory reports 4610839 and 4610840.

During the April 2018 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 (Fluoride)	EPA 300.0
Total Metals	EPA 6020A, EPA 6010C, EPA 7470A
Radium (Radium-226, Radium-228, Total Radium)	EPA 903.1, EPA 904.0

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) and the Department of Energy Evaluation of Radiochemical Data Usability (USDOE, 1997). The following items were included in the evaluation of the data:

- Sample receipt;
- Technical holding times for analyses;
- Reporting limits (RLs) compared to project-required RLs;
- 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;
- Data for laboratory control samples (LCSs). The LCSs are used to assess the accuracy of the analytical method using a clean matrix;

- Percent recoveries for matrix spike (MS) and matrix spike duplicates (MSD), when performed on project samples. Percent recoveries are calculated for each analyte spiked and used to assess bias due to sample matrix effects;
- 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;
- Data for blind field duplicates. Field duplicate samples are used to assess variability introduced by the sampling and analytical processes; 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 IV constituents will be utilized for the purposes of an assessment monitoring program.
- Data are usable for the purposes of the assessment monitoring program.
- When the data are evaluated through an assessment monitoring statistical program, findings below may be used to support the removal of outliers.

QA/QC Sample Summary:

- A method blank was analyzed with each analytical batch; no analytes were detected in the blank samples.
- One equipment blank (EB-4) and one field blank (FB-4) were collected; no analytes were detected in the blank samples.
- The LCS recoveries for all analytes were within QC limits.
- MS/MSD analyses were performed on sample DEK-MW-15006 for metals. All criteria were met.
- Dup-4 corresponds to DEK-MW-15005; relative percent differences (RPDs) between the parent and duplicate sample were within the QC limits.
- Laboratory duplicate analyses were performed on non-project samples; RPDs were within QC limits.

Laboratory Data Quality Review
Groundwater Monitoring Event May 2018
CEC DE Karn and JC Weadock Background Wells

Groundwater samples were collected by TRC for the May 2018 sampling event. Samples were analyzed for anions, total dissolved solids, and total metals by Pace Analytical Services, LLC (Pace), located in Grand Rapids, Michigan, and for radium by Pace located in Greensburg, Pennsylvania. The laboratory analytical results are reported in laboratory reports 4612624 and 4612625.

During the May 2018 sampling event, a groundwater sample was collected from each of the following wells:

- MW-15002
- MW-15008
- MW-15016
- MW-15019

Each sample was analyzed for the following constituents:

Analyte Group	Method
Anions (Fluoride, Chloride, Sulfate)	EPA 300.0
Total Dissolved Solids	SM 2540C-11
Total Metals	EPA 6020A, EPA 6010C, EPA 7470A
Radium (Radium-226, Radium-228, Total Radium)	EPA 903.1, EPA 904.0

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) and the Department of Energy Evaluation of Radiochemical Data Usability (USDOE, 1997). The following items were included in the evaluation of the data:

- Sample receipt;
- Technical holding times for analyses;
- Reporting limits (RLs) compared to project-required RLs;
- 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;

- Data for laboratory control samples (LCSs). The LCSs are used to assess the accuracy of the analytical method using a clean matrix;
- Percent recoveries for matrix spike (MS) and matrix spike duplicates (MSD), when performed on project samples. Percent recoveries are calculated for each analyte spiked and used to assess bias due to sample matrix effects;
- 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;
- Data for blind field duplicates. Field duplicate samples are used to assess variability introduced by the sampling and analytical processes; 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 and IV constituents will be utilized for the purposes of an assessment monitoring program.
- Data are usable for the purposes of the assessment monitoring program.
- When the data are evaluated through an assessment monitoring statistical program, findings below may be used to support the removal of outliers.

QA/QC Sample Summary:

- A method blank was analyzed with each analytical batch; no analytes were detected in the blank samples.
- The LCS recoveries for all analytes were within QC limits.
- A field blank (FB_20180522) was collected; no analytes were detected in the blank samples.
- The field duplicate pair samples were Dup_20180522 with MW-15019_20180522; relative percent differences (RPDs) between the parent and duplicate sample were within the QC limits (20%), with the exception of sulfate (25%). Potential uncertainty exists for sulfate results for the field duplicate pair (see attached Table); however, the concentrations of sulfate detected in both the duplicate and primary sample were within the range of historical sulfate concentrations observed in MW-15019.

- Laboratory duplicates analyses were performed on non-project samples; thus, these QC samples were not evaluated.
- MS/MSD analyses were performed on non-project samples; thus, these QC samples were not evaluated.

Attachment B
Summary of Data Non-Conformances for Background Groundwater Analytical Data
DE Karn & JC Weadock – RCRA CCR Monitoring Program
Essexville, Michigan

Samples	Collection Date	Analyte	Non-Conformance/Issue
Dup_20180522	5/22/2018	Sulfate	RPD for the field duplicate pair exceeded the 20% acceptance limit. Potential uncertainty exists for sulfate results due to the field duplicate variability; however, concentrations are within range of historical sulfate concetrations. Data deemed usable for intended purpose.
MW-15019_20180522	5/22/2018		

Laboratory Data Quality Review
Groundwater Monitoring Event May 2018
CEC DE Karn Bottom Ash Pond

Groundwater samples were collected by TRC for the May 2018 sampling event. Samples were analyzed for anions, total dissolved solids, and total metals by Pace Analytical Services, LLC (Pace), located in Grand Rapids, Michigan, and for radium by Pace located in Greensburg, Pennsylvania. The laboratory analytical results are reported in laboratory reports 4612768 and 4612778.

During the May 2018 sampling event, a groundwater sample was collected from each of the following wells:

- DEK-MW-18001
- DEK-MW-15003
- DEK-MW-15005
- DEK-MW-15002
- DEK-MW-15004
- DEK-MW-15006

Each sample was analyzed for the following constituents:

Analyte Group	Method
Anions (Fluoride, Chloride, Sulfate)	EPA 300.0
Total Dissolved Solids	SM 2540C-11
Total Metals	EPA 6020A, EPA 6010C, EPA 7470A
Radium (Radium-226, Radium-228, Total Radium)	EPA 903.1, EPA 904.0

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) and the Department of Energy Evaluation of Radiochemical Data Usability (USDOE, 1997). The following items were included in the evaluation of the data:

- Sample receipt;
- Technical holding times for analyses;
- Reporting limits (RLs) compared to project-required RLs;
- 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;

- Data for laboratory control samples (LCSs). The LCSs are used to assess the accuracy of the analytical method using a clean matrix;
- Percent recoveries for matrix spike (MS) and matrix spike duplicates (MSD), when performed on project samples. Percent recoveries are calculated for each analyte spiked and used to assess bias due to sample matrix effects;
- 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;
- Data for blind field duplicates. Field duplicate samples are used to assess variability introduced by the sampling and analytical processes; 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 and IV constituents will be utilized for the purposes of an assessment monitoring program.
- Data are usable for the purposes of the assessment monitoring program.
- When the data are evaluated through an assessment monitoring statistical program, findings below may be used to support the removal of outliers.

QA/QC Sample Summary:

- A method blank was analyzed with each analytical batch; no analytes were detected in the blank samples.
- One equipment blank (EB-4) and one field blank (FB-4) were collected; no analytes were detected in the blank samples.
- The LCS recoveries for all analytes were within QC limits.
- MS/MSD analyses were performed on sample DEK-MW-18001 for metals, anions, and radium.
    - The arsenic recovery in the MSD and the boron recoveries in the MS/MSD in batch 25053 were below the lower laboratory control limits. The arsenic and boron

concentrations in the parent sample were >4x the spike concentration; therefore, the laboratory control limits are not applicable. Data usability was not affected.

  - The chloride recoveries in the MS/MSD were below the lower laboratory control limit in batch 24693. The chloride results for samples analyzed in this batch may be biased low (see attached Table); however, the concentrations of chloride detected in the samples in batch 24693 were within the range of historical chloride concentrations.

- The field duplicate pair samples were Dup-04 and 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-18001 and DEK-MW-15005 for anions, and on samples DEK-MW-18001 and FB-04 for total dissolved solids; RPDs were within QC limits.

Attachment B
Summary of Data Non-Conformances for Bottom Ash Pond Groundwater Analytical Data
DE Karn – RCRA CCR Monitoring Program
Essexville, Michigan

Samples	Collection Date	Analyte	Non-Conformance/Issue
DEK-MW-15002-20180523	5/23/2018	Chloride	Recoveries in the MS/MSD were below the lower laboratory control limits. Result may be biased low; however, concentrations are within range of historical chloride concentrations. Data deemed usable for intended purpose.
DEK-MW-15003-20180523	5/23/2018		
DEK-MW-15004-20180523	5/23/2018		
DEK-MW-15005-20180524	5/24/2018		
DEK-MW-15006-20180524	5/24/2018		
DEK-MW-18001-20180523	5/23/2018		
DUP-04-20180523	5/23/2018		
EB-04-20180524	5/24/2018		
FB-04-20180524	5/24/2018		

Appendix C
Groundwater Protection Standards

Technical Memorandum

Date:	October 15, 2018; Revised December 7, 2018
To:	Harold D. Register, Jr., CEC Brad Runkel, CEC
From:	Darby Litz, TRC Sarah Holmstrom, TRC Joyce Peterson, TRC
Project No.:	290804.0000 Phase 001, Task 002
Subject:	Groundwater Protection Standards – Consumers Energy, DE Karn Site, Bottom Ash Pond

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). The first detection monitoring event for the Consumers Energy Company (CEC) DE Karn Power Plant (DEK site) in Essexville, Michigan, was conducted on September 18 and 19, 2017. During this event several Appendix III constituents were observed in downgradient monitoring wells at concentrations constituting statistically significant increases (SSIs) over the background concentrations established for the site (2017 Annual Report). Alternative Source Demonstrations (ASDs) were unsuccessful for one or more SSI, thereby triggering the requirement for establishing an Assessment Monitoring Program in accordance with 40 CFR §257.95. Groundwater samples were collected on April 10 through 12, 2018, that were analyzed for Appendix IV parameters pursuant to §257.95(b). In compliance with §257.95(d), additional groundwater samples were collected on May 21 through 24, 2018, and were analyzed for Appendix III and IV parameters. Analytical data collected from the background monitoring wells are presented in attached Table A1.

If assessment monitoring is triggered pursuant to §257.94(e)(1), data are compared to Groundwater Protection Standards (GWPSs). The CCR Rule [§257.95(h)] requires GWPSs to be established for Appendix IV constituents that have been detected during baseline sampling. Per §257.95(h)[1], the MCLs will be the GWPSs for those constituents that have established MCLs. For Appendix IV constituents that do not have established MCLs, the GWPSs are based upon the EPA Regional Screening Levels (RSLs).

[1] As amended per Phase One, Part One of the CCR Rule (83 FR 36435).

For constituents that have statistically derived background levels higher than the MCL and/or RSL, the GWPS becomes the background level.

This memorandum presents the background statistical limits and GWPSs derived for the Appendix IV parameters for the DE Karn site using the aforementioned approach pursuant to §257.95(h). However, it should be noted that in the future, risk-based standards may be used in place of the GWPSs presented in this memorandum based on promulgated rule changes and/or authorization for the state of Michigan to administer and enforce compliance with the CCR Rule.

Following the Appendix IV baseline data collection period (December 2015 through April 2018), the Appendix IV background data were evaluated in accordance with the Groundwater Statistical Evaluation Plan (Stats Plan) (TRC, October 2017). The June 2018 data were not included in the baseline dataset and were not used to establish background limits. The DEK 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 approach that offers adequate statistical power under the current, initial stage of establishing background and developing the monitoring program. Additionally, tolerance limits are recommended by the UG as an acceptable approach to establish background-based groundwater protection standards for assessment monitoring under the CCR rule. Upper tolerance limits (UTLs) were calculated for each of the CCR Appendix IV 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 DEK BAP, JCW BAP, and JCW LF sites includes MW-15002, MW-15008, MW-15016, and MW-15019. The background evaluation included the following steps:

- Review of data quality reports for the baseline/background data sets for CCR Appendix IV 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 background well-constituent (w/c) pair;
- Distribution of the data;

- Calculation of the UTL for each cumulative background data set; and
- Establishment of GWPS as the higher of the MCL, RSL or the UTL for each Appendix IV constituent.

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.

Time versus Concentration Graphs

The T v. C graphs show a potential outlier for lithium (high value for MW-15016 in February 2017) (Figure 1). This data set 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 (Figure 2). Most of the parameters have a relatively consistent distribution. 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 lithium 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 not be an outlier at the 0.01 significance level (see attached Sanitas™ output file). The potential outlier was not confirmed and not removed from the data set. The data point will be retained for the Groundwater Protection Standards UTL calculations.

Percentage of Nondetects

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

Table 1
Summary of Percentage of Appendix IV Baseline Results Below Reporting Limit

WELL	CONSTITUENT	PERCENT NON-DETECT
MW-15002	Antimony	100
	Arsenic	25
	Barium	0
	Beryllium	100
	Cadmium	100
	Chromium	13
	Cobalt	100
	Fluoride	100
	Lead	100
	Lithium	38
	Mercury	100
	Molybdenum	100
	Selenium	88
	Thallium	100
	Radium 226 and 228 combined	38
MW-15008	Antimony	100
	Arsenic	50
	Barium	0
	Beryllium	100
	Cadmium	100
	Chromium	0
	Cobalt	100
	Fluoride	100
	Lead	100
	Lithium	0
	Mercury	100
	Molybdenum	100
	Selenium	100
	Thallium	100
	Radium 226 and 228 combined	13
MW-15016	Antimony	100
	Arsenic	0
	Barium	0
	Beryllium	100
	Cadmium	100
	Chromium	50

Table 1
Summary of Percentage of Appendix IV Baseline Results Below Reporting Limit

WELL	CONSTITUENT	PERCENT NON-DETECT
MW-15016 *(cont'd)*	Cobalt	100
	Fluoride	100
	Lead	100
	Lithium	0
	Mercury	100
	Molybdenum	75
	Selenium	75
	Thallium	100
	Radium 226 and 228 combined	25
MW-15019	Antimony	100
	Arsenic	88
	Barium	0
	Beryllium	100
	Cadmium	100
	Chromium	50
	Cobalt	100
	Fluoride	100
	Lead	100
	Lithium	0
	Mercury	100
	Molybdenum	100
	Selenium	100
	Thallium	100
	Radium 226 and 228 combined	13
COMBINED	Antimony	100
	Arsenic	41
	Barium	0
	Beryllium	100
	Cadmium	100
	Chromium	28
	Cobalt	100
	Fluoride	100
	Lead	100
	Lithium	9
	Mercury	100
	Molybdenum	94
	Selenium	91
	Thallium	100
	Radium 226 and 228 combined	2

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 nonnormal, 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
Antimony	All ND – use highest RL
Arsenic	Nonnormal
Barium	Normalized by natural log transformation
Beryllium	All ND – use highest RL
Cadmium	All ND – use highest RL
Chromium	Nonnormal
Cobalt	All ND – use highest RL
Fluoride	All ND – use highest RL
Lead	All ND – use highest RL
Lithium	Nonnormal
Mercury	All ND – use highest RL
Molybdenum	Nonnormal (>75% censored data)
Selenium	Nonnormal (>75% censored data)
Thallium	All ND – use highest RL
Radium 226 and 228 combined	Normalized by square root transformation

ND = Non-detect
RL = Reporting Limit

Upper Tolerance Limits

Table 3 presents the calculated upper tolerance limits for the background/baseline data sets. For data sets with normal distributions or distributions normalized by transformation, 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.

Table 3
Summary of Initial Groundwater Protection Standards

CONSTITUENT	UNITS	UPPER TOLERANCE LIMIT – FROM SANITAS™	MAXIMUM CONTAMINANT LEVEL	REGIONAL SCREENING LEVEL	GROUNDWATER PROTECTION STANDARD
Antimony	ug/L	RL (1)	6	NA	6
Arsenic	ug/L	21	10	NA	21
Barium	ug/L	1,300	2,000	NA	2,000
Beryllium	ug/L	RL (1)	4	NA	4
Cadmium	ug/L	RL (0.2)	5	NA	5
Chromium	ug/L	3	100	NA	100
Cobalt	ug/L	RL (15)	NC	6	15
Fluoride	ug/L	RL (1,000)	4,000	NA	4,000
Lead	ug/L	RL (1)	NC	15	15
Lithium	ug/L	180	NC	40	180
Mercury	ug/L	RL (0.2)	2	NA	2
Molybdenum	ug/L	6	NC	100	100
Selenium	ug/L	2	50	NA	50
Thallium	ug/L	RL (2)	2	NA	2
Radium 226 and 228 combined	pCi/L	3.32	5	NA	5

RL = Reporting Limit
NC = No Criteria
NA = Not Applicable

Revised 12/7/18

Attachments

Table A1 – Summary of Groundwater Sampling Results (Analytical)

Figure 1 – Background Concentration Time-Series Charts

Figure 2 – Combined Background Distribution

Sanitas™ Output Files

Table A1
Summary of Groundwater Sampling Results
(Analytical)

Table A1
Summary of Groundwater Sampling Results (Analytical) – December 2015 to May 2018
DE Karn & JC Weadock Background – 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	9/19/2017	4/9/2018	5/22/2018
Constituent	Unit	Background										
Appendix III												
Boron	ug/L	275	22	163	79	48	133	138	205	313	--	69.2
Calcium	mg/L	198	174	288	114	84.7	260	267	255	249	--	221
Chloride	mg/L	1,130	773	2,140	420	260	1,470	1,970	2,290	2,270	--	2,020
Fluoride	ug/L	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
pH, Field	SU	7.0	7.0	6.6	6.9	7.2	7.0	6.8	6.9	6.9	6.7	7.0
Sulfate	mg/L	9.63	40.3	5.25	39.8	23.4	13.1	11.5	< 2.0	< 2.0	--	37.8
Total Dissolved Solids	mg/L	2,400	1,700	4,500	1,300	980	3,100	4,300	4,600	4,280	--	3,810
Appendix IV												
Antimony	ug/L	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0
Arsenic	ug/L	4	< 1	7	< 1	2	2	3	4.8	--	< 1.0	< 1.0
Barium	ug/L	1,010	216	796	167	212	851	580	912	--	547	364
Beryllium	ug/L	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0
Cadmium	ug/L	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20
Chromium	ug/L	1	1	2	< 1	1	1	2	1.3	--	< 1.0	< 1.0
Cobalt	ug/L	< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0
Fluoride	ug/L	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0
Lithium	ug/L	37.7	< 10	21	< 10	< 10	24	22	31	--	24	14
Mercury	ug/L	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20
Molybdenum	ug/L	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	--	< 5.0	< 5.0
Radium-226	pCi/L	0.637	0.33	0.893	< 0.264	< 0.402	0.556	0.879	1.72	--	0.866	0.751
Radium-226/228	pCi/L	2.047	< 0.644	2.523	< 1.05	< 0.433	2.036	2.98	4.65	--	2.45	2.47
Radium-228	pCi/L	1.41	< 0.644	1.63	< 1.05	< 0.433	1.48	2.1	2.93	--	1.58	1.72
Selenium	ug/L	< 1	< 1	1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0
Thallium	ug/L	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 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.

-- - not analyzed.

All metals were analyzed as total unless otherwise specified.

Table A1
Summary of Groundwater Sampling Results (Analytical) – December 2015 to May 2018
DE Karn & JC Weadock Background – 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	9/19/2017	4/10/2018	4/10/2018	5/22/2018
Constituent	Unit	Background											
Appendix III												Field Dup	
Boron	ug/L	236	169	176	202	204	174	187	164	183	--	--	153
Calcium	mg/L	114	126	113	114	113	107	114	108	109	--	--	111
Chloride	mg/L	292	231	246	214	192	200	149	300	329	--	--	255
Fluoride	ug/L	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
pH, Field	SU	6.8	6.7	6.5	6.7	6.8	6.8	6.7	6.9	6.8	6.6	--	6.8
Sulfate	mg/L	5.15	26.7	8.6	17.9	25.6	27.7	10.1	13.4	3.9	--	--	4.3
Total Dissolved Solids	mg/L	860	720	880	730	790	760	840	866	848	--	--	744
Appendix IV													
Antimony	ug/L	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	< 1	1	1	1	1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0
Barium	ug/L	69	64	63	58	69	57	60	58.2	--	57.1	56.7	54.7
Beryllium	ug/L	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20
Chromium	ug/L	3	2	3	2	2	1	2	1.1	--	< 1.0	1.1	2.0
Cobalt	ug/L	< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 15.0
Fluoride	ug/L	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0
Lithium	ug/L	22.3	19.7	17	20	22	20	19	22	--	26	25	19
Mercury	ug/L	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	--	< 5.0	< 5.0	< 5.0
Radium-226	pCi/L	0.481	0.546	0.411	0.32	0.444	< 0.419	0.228	< 0.937	--	< 0.621	< 0.420	< 0.929
Radium-226/228	pCi/L	1.531	1.42	1.611	1.96	1.454	0.826	1.45	< 1.79	--	< 1.26	< 1.15	2.00
Radium-228	pCi/L	1.05	0.874	1.2	1.64	1.01	0.717	1.22	< 0.848	--	0.795	< 0.727	1.94
Selenium	ug/L	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0
Thallium	ug/L	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 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.

-- - not analyzed.

All metals were analyzed as total unless otherwise specified.

Table A1
Summary of Groundwater Sampling Results (Analytical) – December 2015 to May 2018
DE Karn & JC Weadock Background – 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	9/19/2017	4/10/2018	5/22/2018
Constituent	Unit	Background										
Appendix III												
Boron	ug/L	490	56	472	660	435	463	491	590	602	--	409
Calcium	mg/L	178	204	188	216	192	295	221	208	160	--	212
Chloride	mg/L	89.7	264	91.1	93.6	83	160	110	113	99.5	--	82.4
Fluoride	ug/L	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
pH, Field	SU	7.1	7.1	6.8	6.8	7.0	7.2	7.0	7.0	7.1	7.3	7.3
Sulfate	mg/L	35.1	151	75	70.6	18.1	817	243	294	13.3	--	539
Total Dissolved Solids	mg/L	670	1,000	900	920	840	1,700	1,100	1,090	756	--	1,230
Appendix IV												
Antimony	ug/L	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0
Arsenic	ug/L	11	2	16	18	16	2	12	20.5	--	< 1.0	< 1.0
Barium	ug/L	237	114	233	299	241	109	151	197	--	41.8	47.4
Beryllium	ug/L	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0
Cadmium	ug/L	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20
Chromium	ug/L	1	1	1	< 1	< 1	2	< 1	< 1.0	--	< 1.0	< 1.0
Cobalt	ug/L	< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0
Fluoride	ug/L	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0
Lithium	ug/L	31.2	16.9	33	48	28	181	88	83	--	120	100
Mercury	ug/L	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20
Molybdenum	ug/L	6	< 5	< 5	< 5	< 5	6	< 5	< 5.0	--	5.4	6.5
Radium-226	pCi/L	0.311	0.303	0.292	< 0.199	< 0.304	< 0.312	0.479	< 1.01	--	< 0.658	< 0.711
Radium-226/228	pCi/L	1.581	0.75	1.402	< 1.41	1.079	0.736	0.958	< 2.34	--	< 1.36	< 1.48
Radium-228	pCi/L	1.27	< 0.673	1.11	< 1.41	0.871	0.573	< 0.619	< 1.33	--	< 0.697	< 0.765
Selenium	ug/L	< 1	< 1	< 1	< 1	< 1	2	1	< 1.0	--	1.7	1.2
Thallium	ug/L	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 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.

-- - not analyzed.

All metals were analyzed as total unless otherwise specified.

Table A1
Summary of Groundwater Sampling Results (Analytical) – December 2015 to May 2018
DE Karn & JC Weadock Background – 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	9/19/2017	4/9/2018	5/22/2018	5/22/2018
Constituent	Unit	Background											
Appendix III													Field Dup
Boron	ug/L	304	244	279	343	300	317	299	293	324	--	225	247
Calcium	mg/L	171	150	179	227	154	149	146	165	155	--	128	137
Chloride	mg/L	437	387	408	358	359	379	357	380	438	--	382	379
Fluoride	ug/L	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
pH, Field	SU	6.8	6.8	6.7	6.7	6.8	6.8	6.8	6.9	6.9	6.8	6.9	--
Sulfate	mg/L	99.7	51.2	116	195	67.3	54.2	49.5	120	99.7	--	51.6	66.4
Total Dissolved Solids	mg/L	1,400	1,100	1,300	1,300	1,100	1,200	1,100	1,250	1,200	--	1,080	1,120
Appendix IV													
Antimony	ug/L	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0
Arsenic	ug/L	< 1	< 1	1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0
Barium	ug/L	293	263	269	319	275	289	283	265	--	246	258	255
Beryllium	ug/L	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20
Chromium	ug/L	2	2	2	< 1	< 1	1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0
Cobalt	ug/L	< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--	< 15.0	< 15.0	< 15.0
Fluoride	ug/L	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0
Lithium	ug/L	15.8	11	14	21	13	13	14	16	--	17	11	12
Mercury	ug/L	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	--	< 5.0	< 5.0	< 5.0
Radium-226	pCi/L	1.02	0.477	0.515	0.759	0.524	< 0.3	0.36	< 0.844	--	0.444	< 0.690	< 0.799
Radium-226/228	pCi/L	1.835	1.243	1.502	1.677	1.006	1.045	1.74	< 1.57	--	1.03	< 1.56	< 1.59
Radium-228	pCi/L	0.815	0.766	0.987	0.918	< 0.666	0.814	1.38	< 0.722	--	< 0.589	< 0.874	0.964
Selenium	ug/L	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--	< 1.0	< 1.0	< 1.0
Thallium	ug/L	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2.0	--	< 2.0	< 2.0	< 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.

-- - not analyzed.

All metals were analyzed as total unless otherwise specified.

Table A1
Summary of Groundwater Sampling Results (Analytical) – December 2015 to May 2018
DE Karn & JC Weadock Background – 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	9/19/2017
Constituent	Unit	Background								
Appendix III										
Boron	ug/L	208	144	181	253	169	135	178	199	223
Calcium	mg/L	103	109	108	111	95.8	93.6	120	113	103
Chloride	mg/L	348	285	348	293	223	225	275	386	379
Fluoride	ug/L	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
pH, Field	SU	7.0	6.9	6.8	6.8	7.0	7.0	6.9	7.0	7.0
Sulfate	mg/L	16	30.7	12.9	20.8	25.4	19.5	22.9	10.8	15.0
Total Dissolved Solids	mg/L	800	890	980	850	790	750	910	982	968
Appendix IV										
Antimony	ug/L	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--
Arsenic	ug/L	< 1	< 1	1	< 1	< 1	< 1	< 1	< 1.0	--
Barium	ug/L	95	89	95	94	78	79	103	107	--
Beryllium	ug/L	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--
Cadmium	ug/L	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--
Chromium	ug/L	2	1	2	1	1	1	2	< 1.0	--
Cobalt	ug/L	< 15	< 15	< 15	< 15	< 15	< 15	< 15	< 15.0	--
Fluoride	ug/L	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000	< 1,000
Lead	ug/L	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--
Lithium	ug/L	27.2	21.3	21	23	20	19	23	26	--
Mercury	ug/L	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.20	--
Molybdenum	ug/L	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5.0	--
Radium-226	pCi/L	0.386	0.461	0.485	0.359	< 0.305	0.396	0.431	< 0.878	--
Radium-226/228	pCi/L	1.356	1.395	1.308	1.277	0.962	1.606	1.27	2.15	--
Radium-228	pCi/L	0.97	0.934	0.823	0.918	0.706	1.21	0.836	1.56	--
Selenium	ug/L	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1.0	--
Thallium	ug/L	< 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.

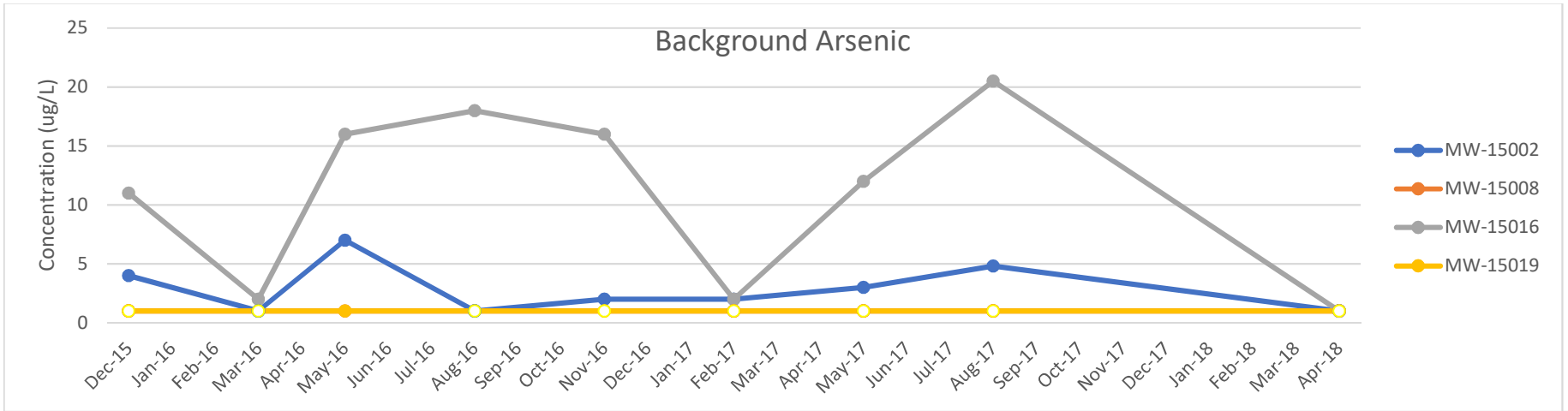
pCi/L - picocuries per liter.

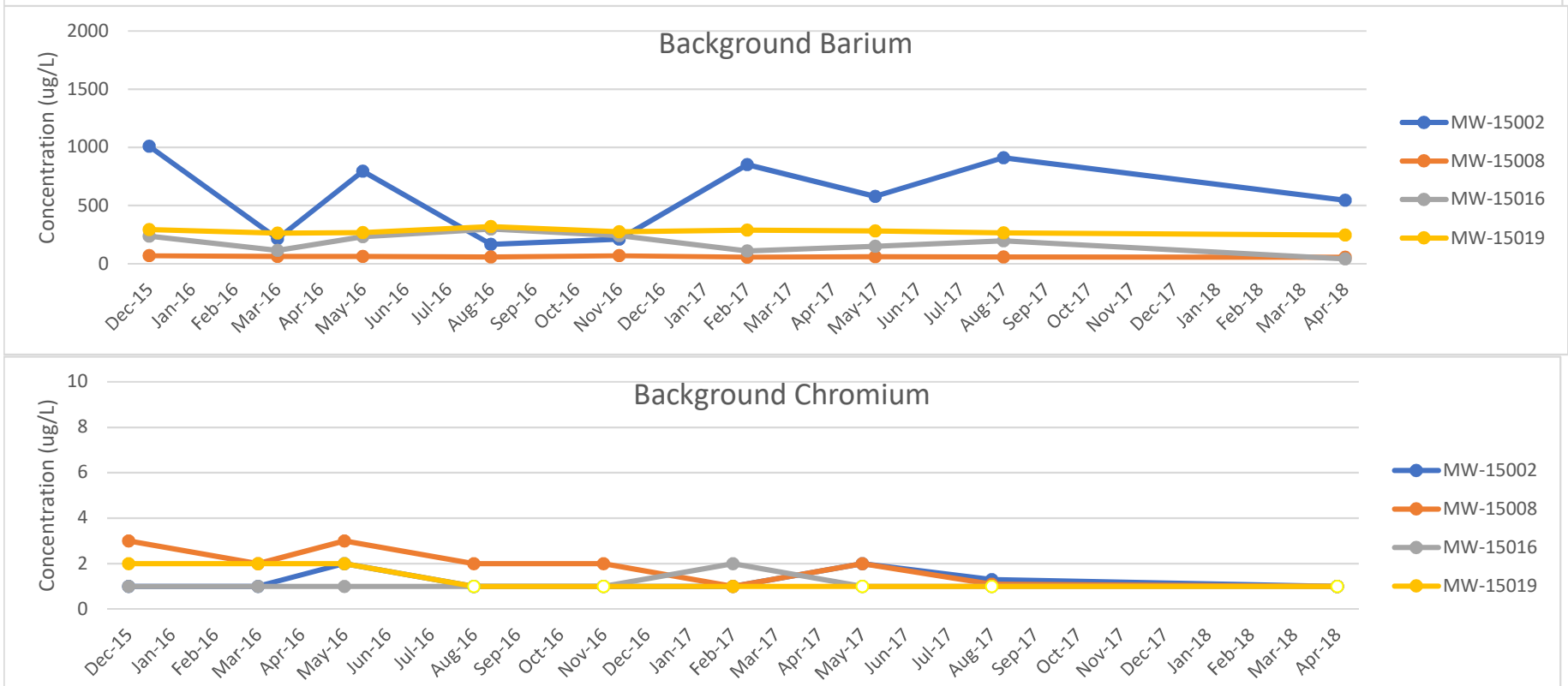
-- - not analyzed.

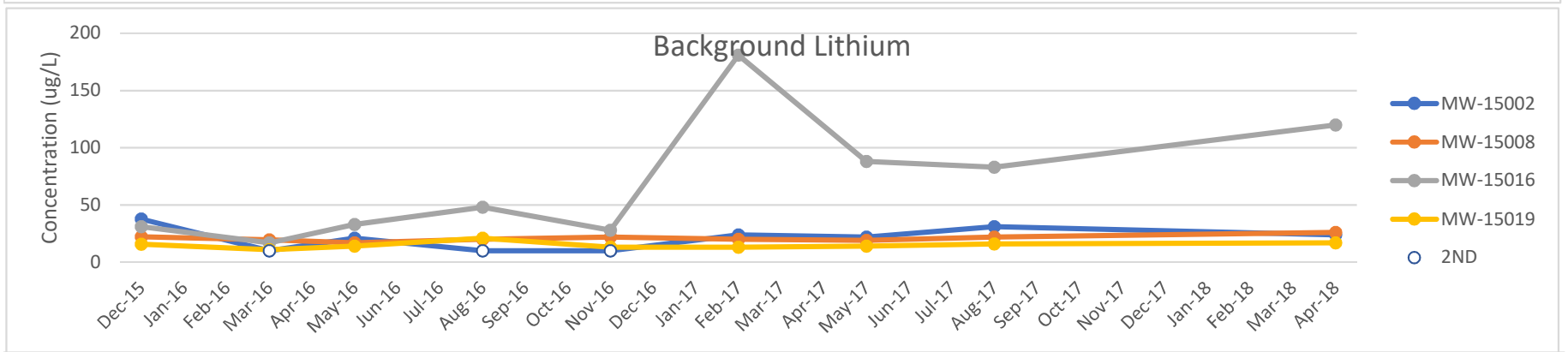
All metals were analyzed as total unless otherwise specified.

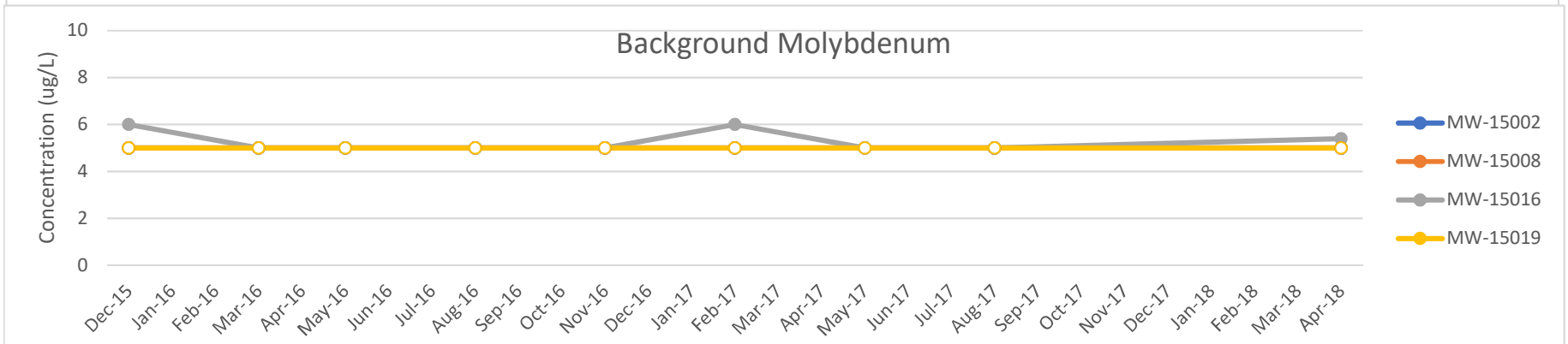
Figures

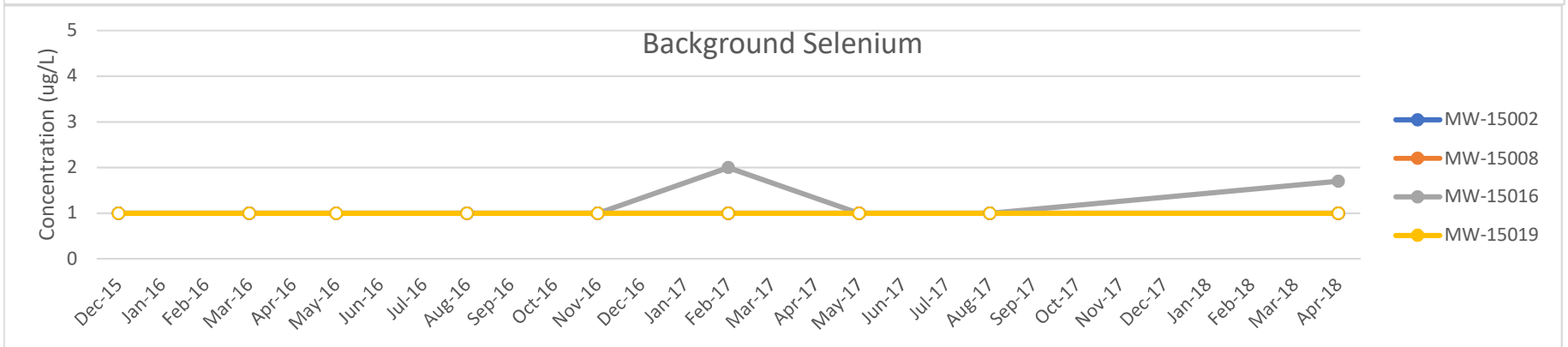
Figure 1
Background Concentration Time-Series Charts
Karn/Weadock Site - Appendix IV Constituents

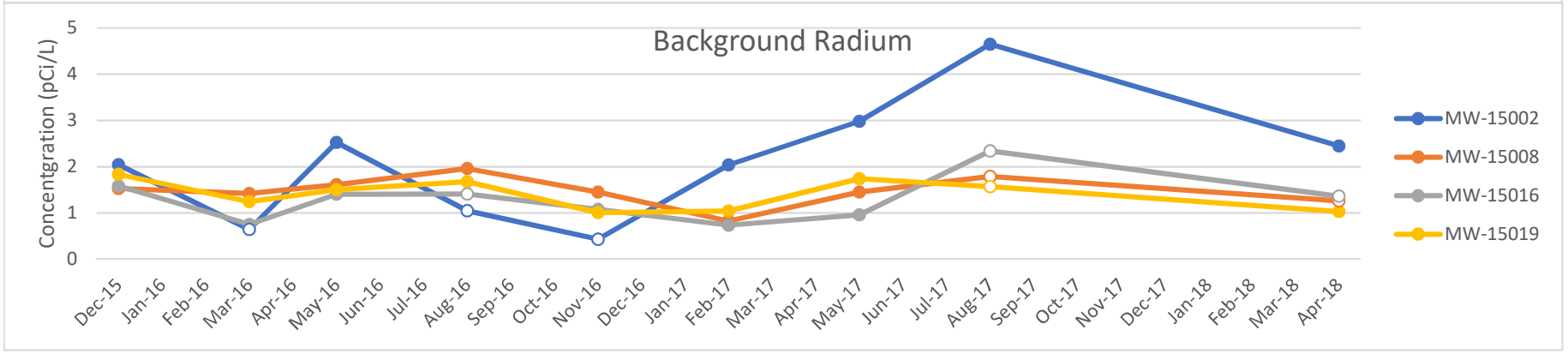






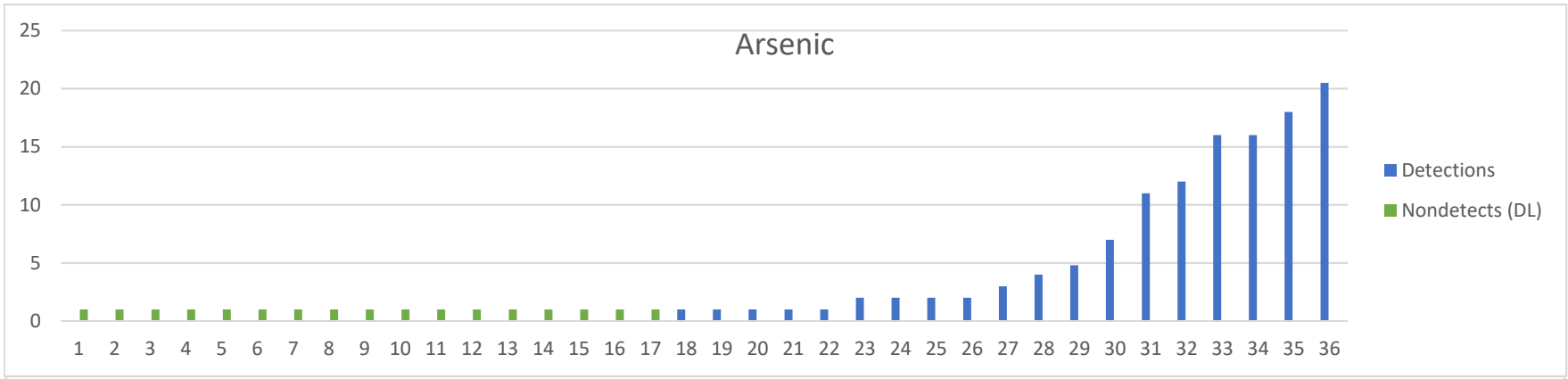


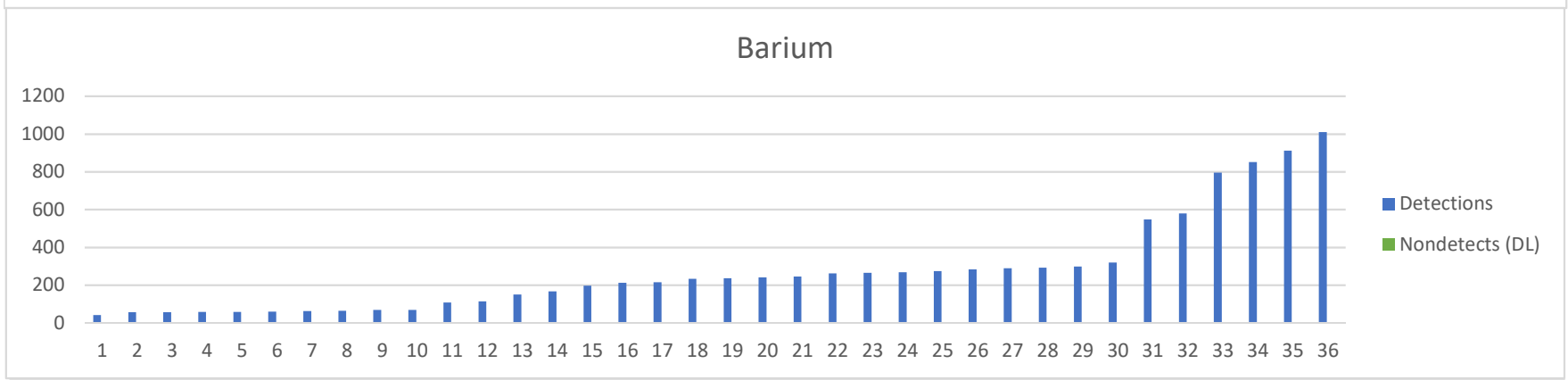


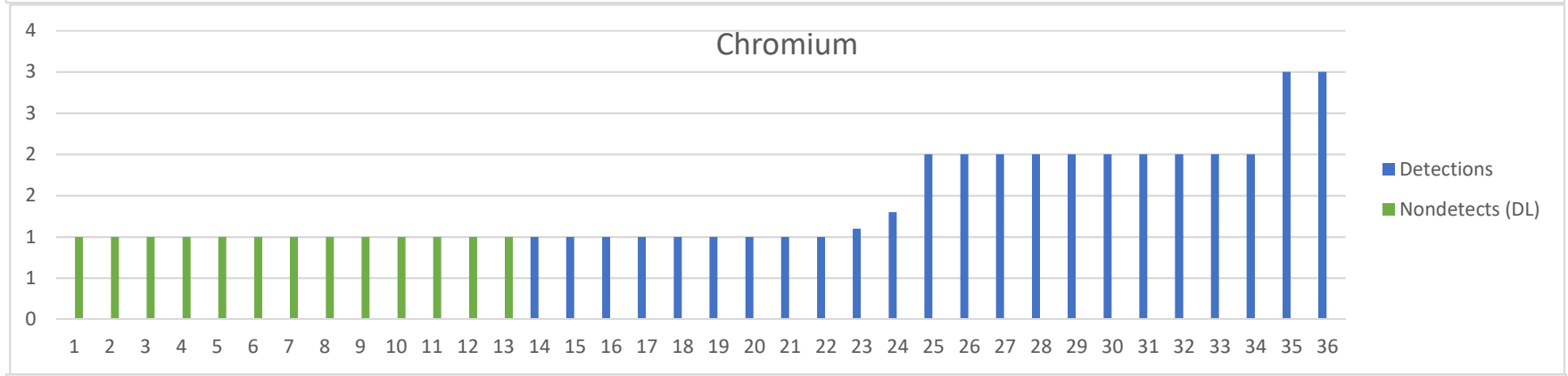


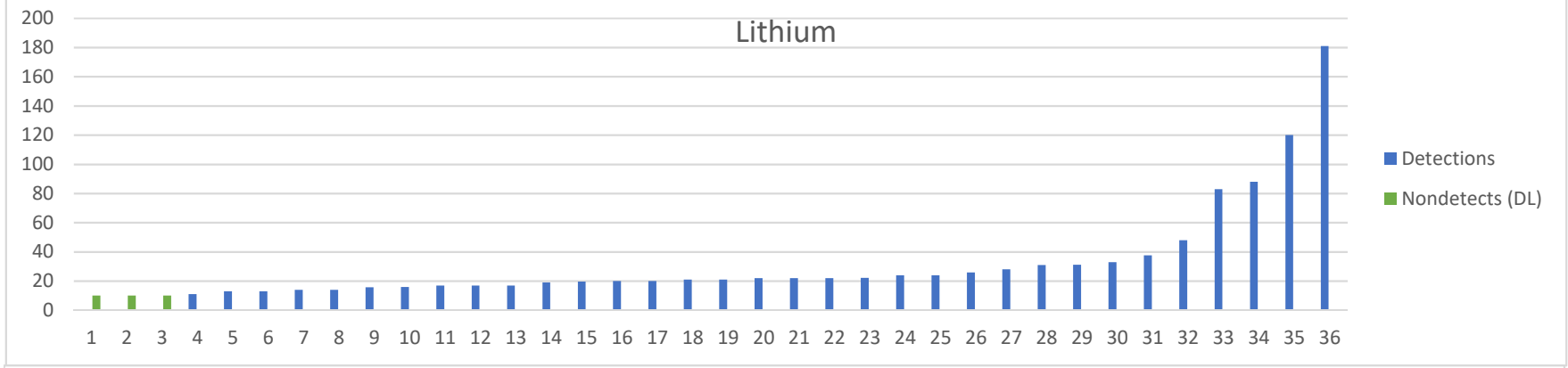
P:\Clients\Consumers Energy\Karn_Weadock\Assessment Monitoring\ProUCL_data_Karn-Weadock_20180516

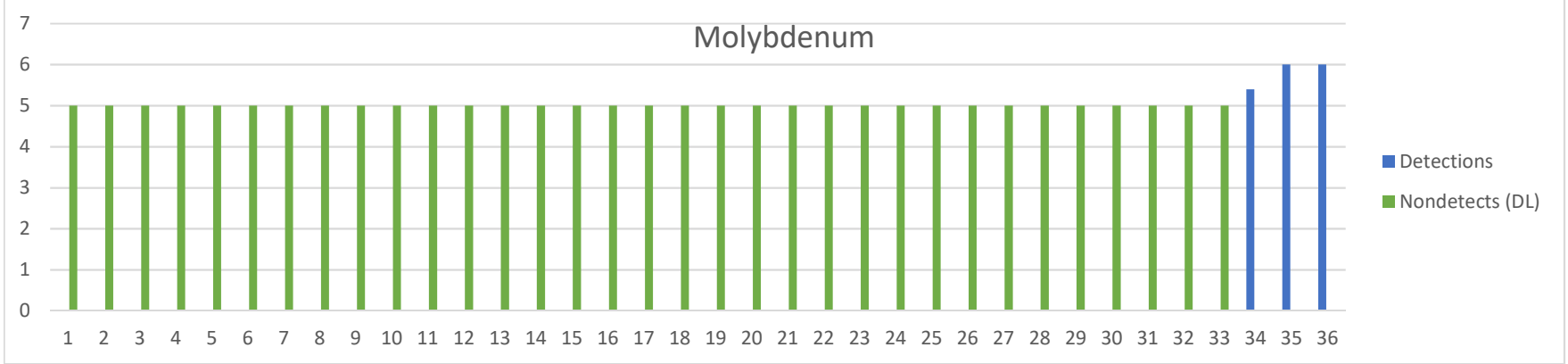
Figure 2
Cumulative Background Concentrations - Appendix IV
Karn/Weadock Complex

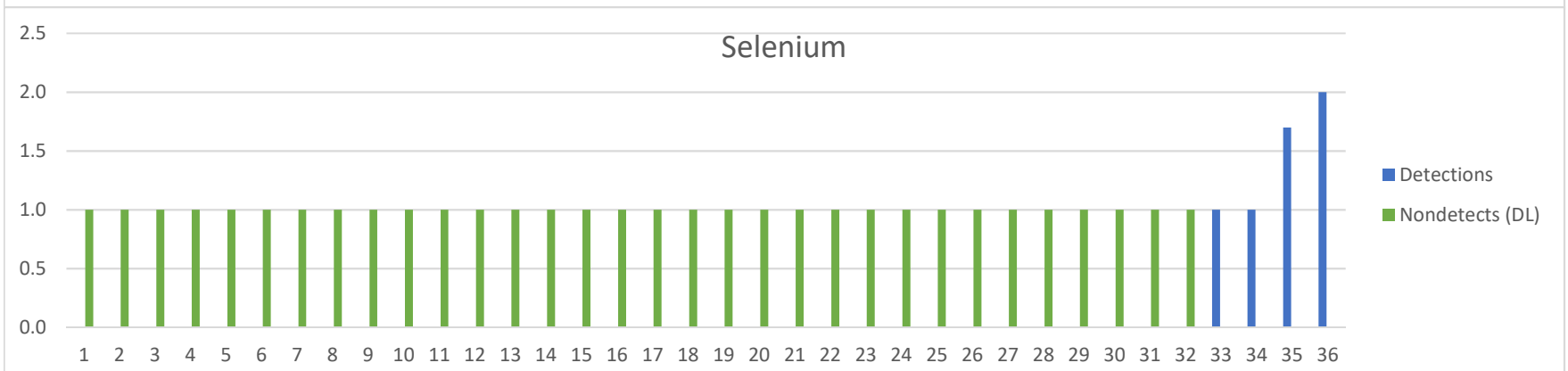


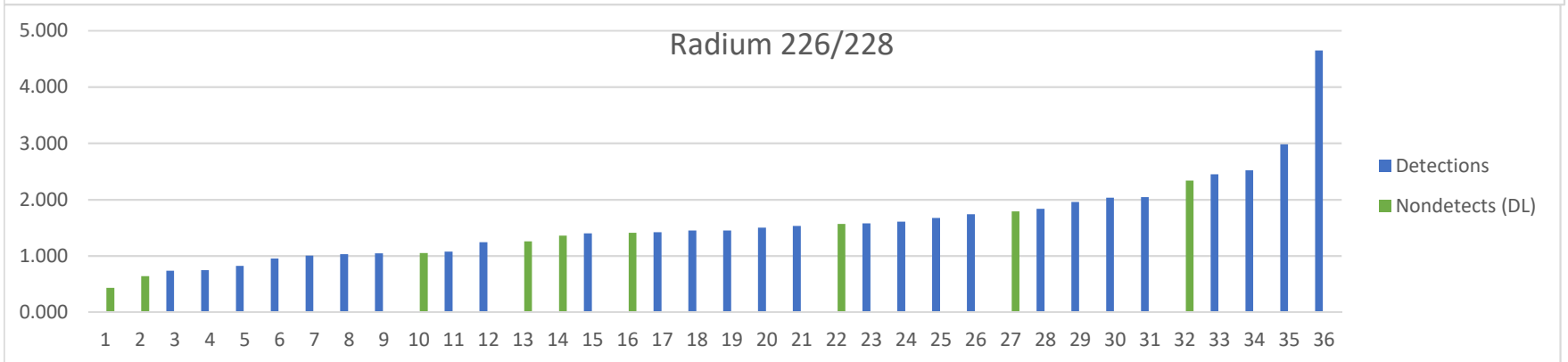










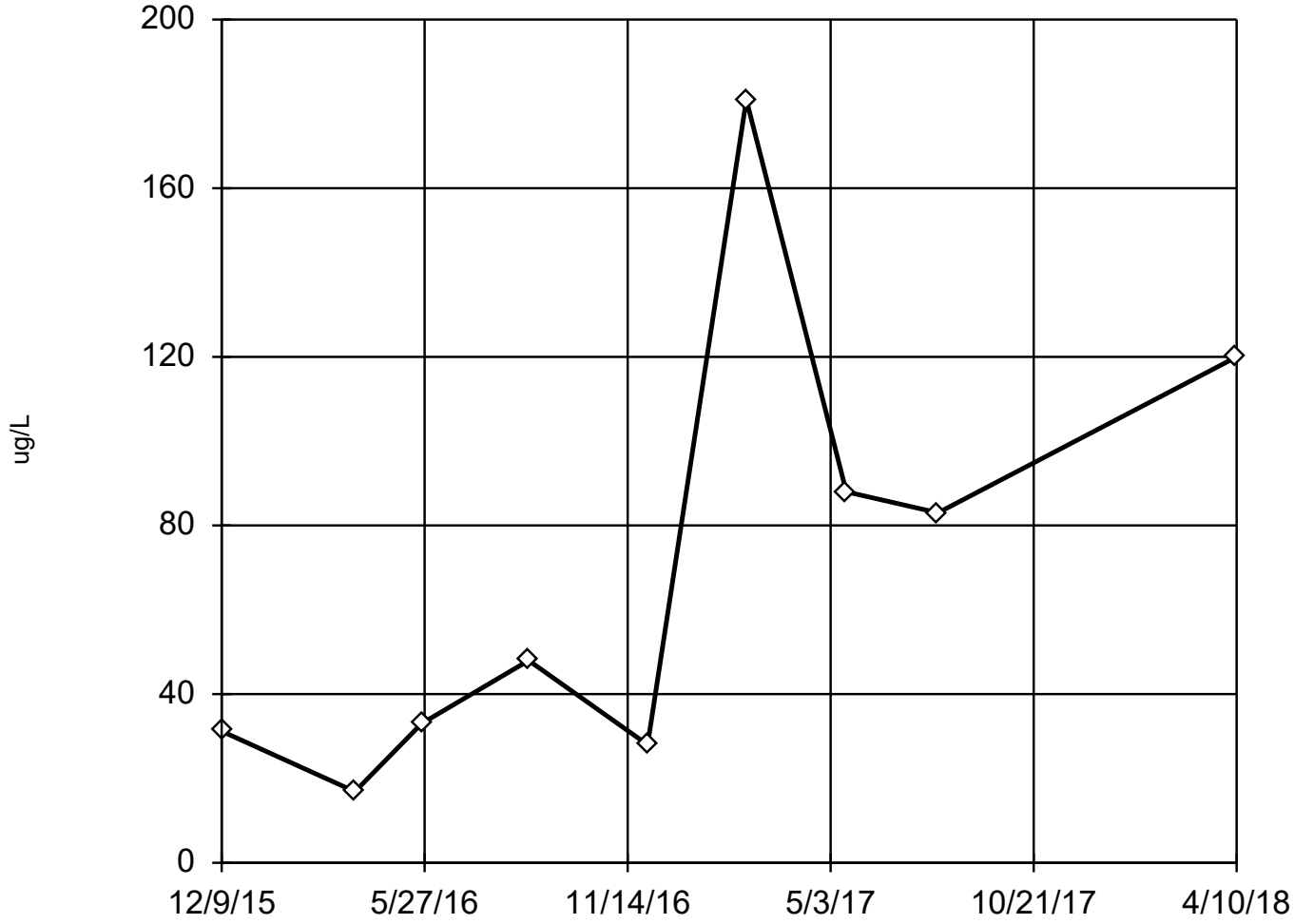


Technical Memorandum

Sanitas™ Output Files

EPA Screening (suspected outliers for Dixon's Test)

MW-15016 (bg)



n = 9

Dixon's will not be run.
Unable to establish suspect values.
Mean 69.9, std. dev. 53.92, critical Tn 2.11

Normality test used:
Shapiro Wilk@alpha = 0.1
Calculated = 0.8723
Critical = 0.859
The distribution was found to be normally distrib-uted.

Constituent: Lithium, Total Analysis Run 8/28/2018 10:45 AM

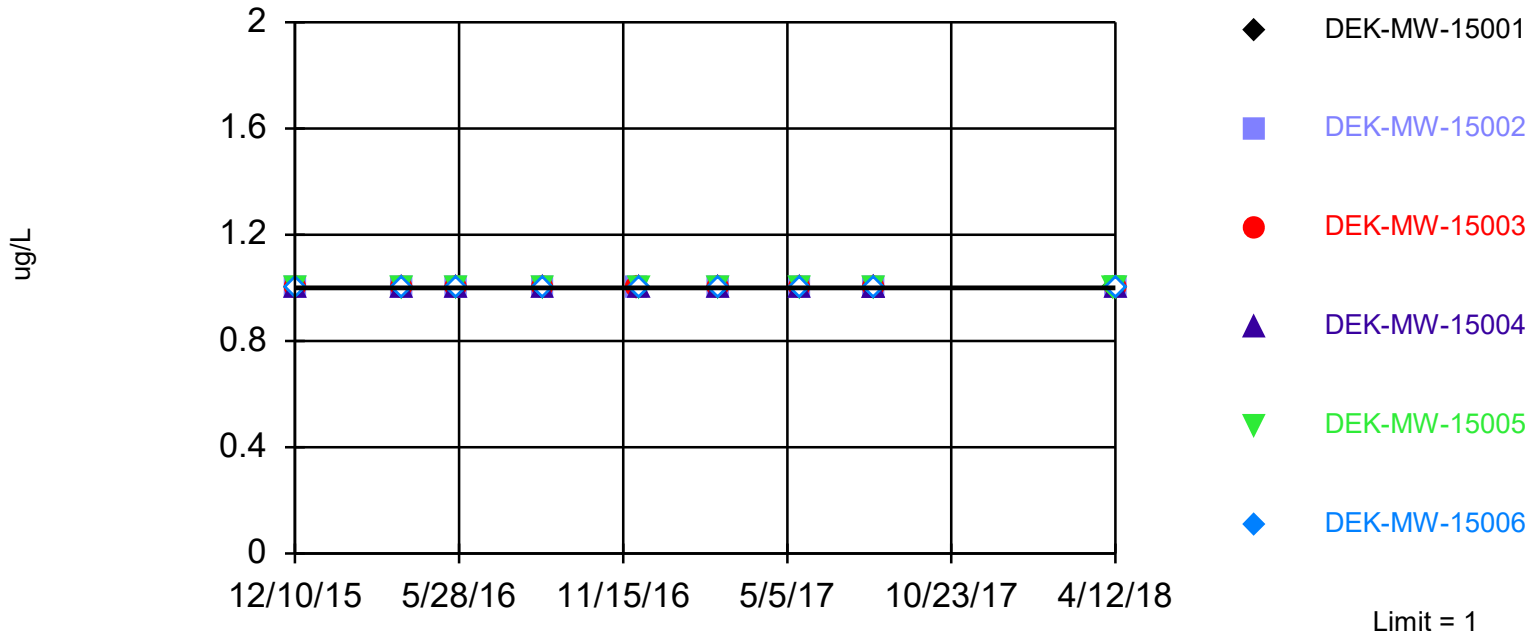
Client: Consumers Energy Data: JCW_BAP_CCR_Sanitas

Hollow symbols indicate censored values.

Within Limit

Tolerance Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric tolerance limit because censored data exceeded 50%. Most recent observation is compared with limit. All background values were censored; limit is most recent reporting limit. 88.09% coverage at alpha=0.01; 91.99% coverage at alpha=0.05; 98.24% coverage at alpha=0.5. Report alpha = 0.1578.

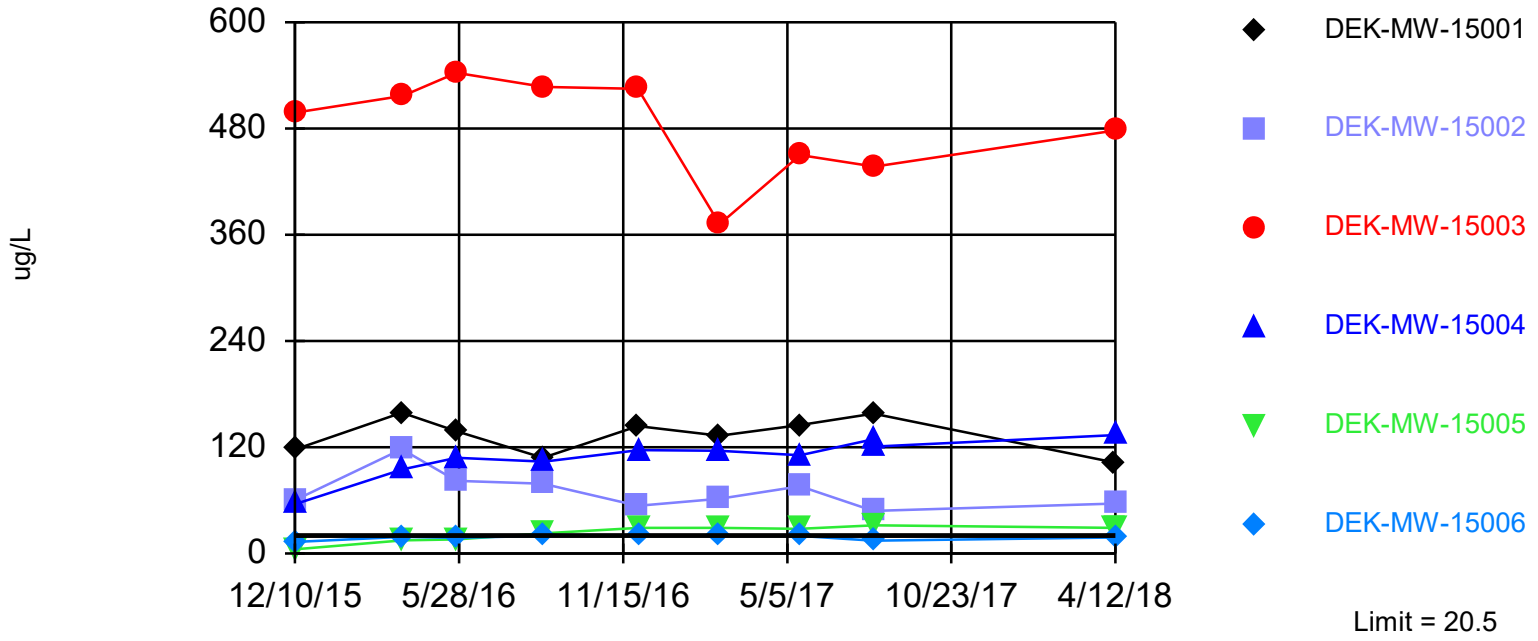
Constituent: Antimony, Total Analysis Run 6/12/2018 11:52 AM

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 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 36 background values. 47.22% NDs. 88.09% coverage at alpha=0.01; 91.99% coverage at alpha=0.05; 98.24% coverage at alpha=0.5. Report alpha = 0.1578.

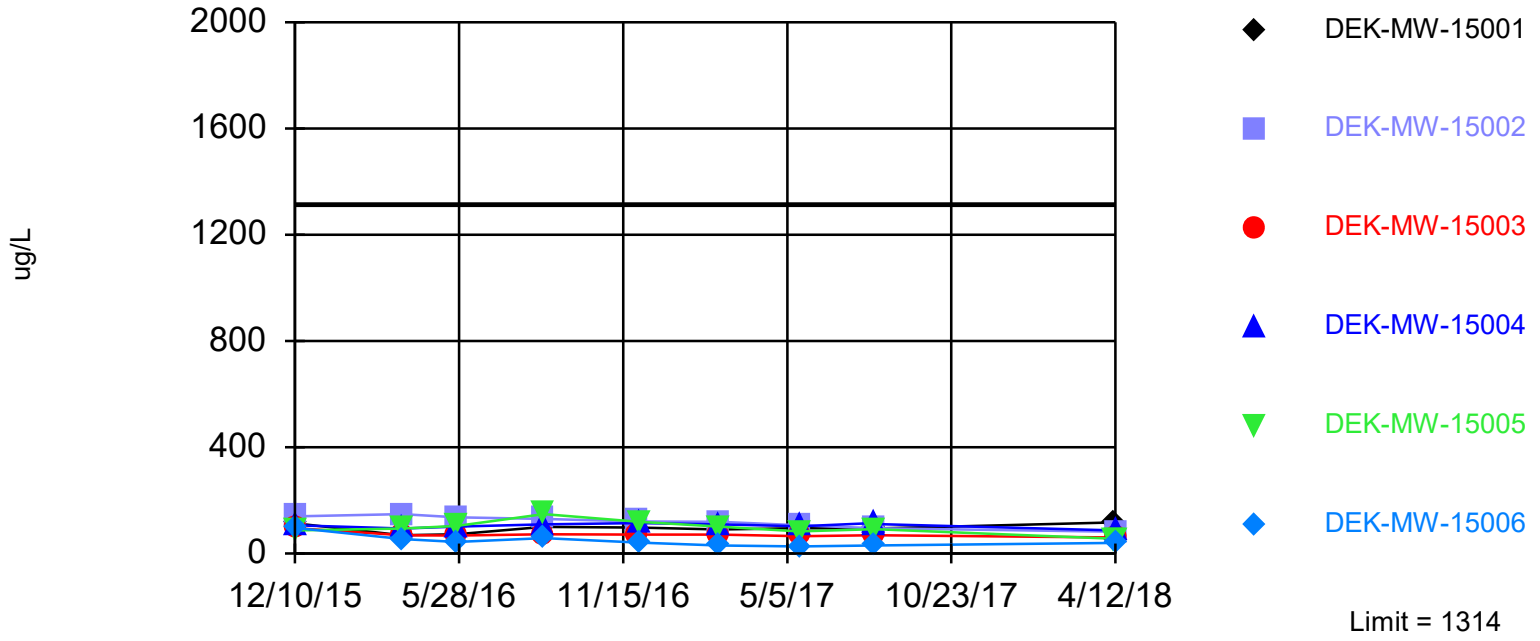
Constituent: Arsenic, Total Analysis Run 5/24/2018 2:11 PM

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=5.248, Std. Dev.=0.8953, n=36. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9227, critical = 0.912. Report alpha = 0.05.

Constituent: Barium, Total Analysis Run 5/24/2018 2:12 PM

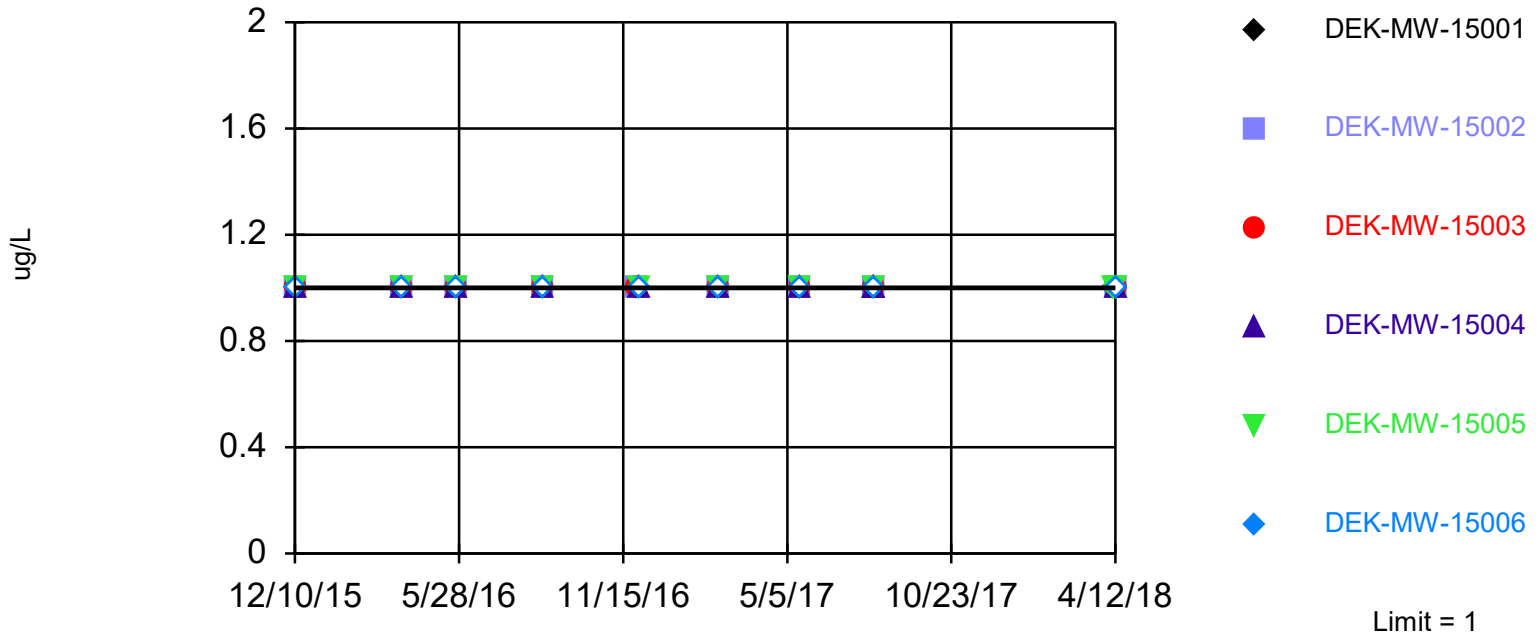
Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas

Hollow symbols indicate censored values.

Within Limit

Tolerance Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric tolerance limit because censored data exceeded 50%. Most recent observation is compared with limit. All background values were censored; limit is most recent reporting limit. 88.09% coverage at alpha=0.01; 91.99% coverage at alpha=0.05; 98.24% coverage at alpha=0.5. Report alpha = 0.1578.

Constituent: Beryllium, Total Analysis Run 6/12/2018 11:52 AM

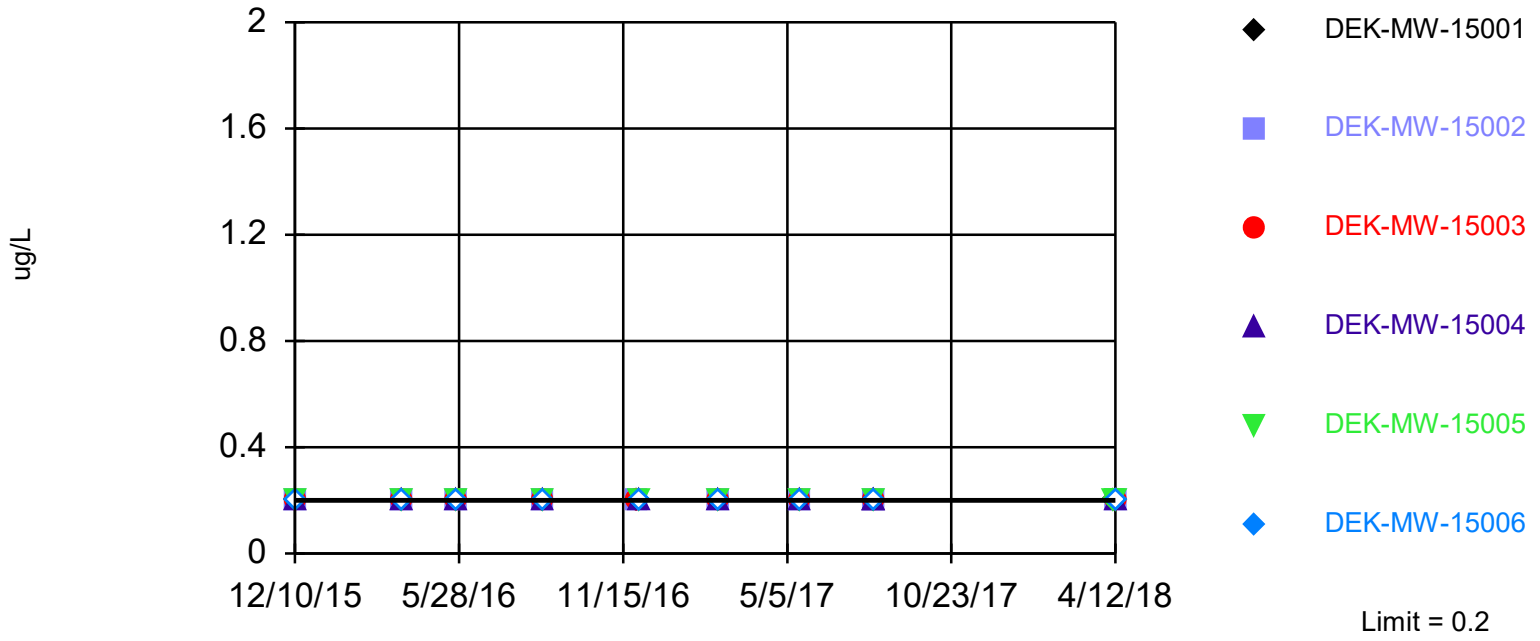
Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas

Hollow symbols indicate censored values.

Within Limit

Tolerance Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric tolerance limit because censored data exceeded 50%. Most recent observation is compared with limit. All background values were censored; limit is most recent reporting limit. 88.09% coverage at alpha=0.01; 91.99% coverage at alpha=0.05; 98.24% coverage at alpha=0.5. Report alpha = 0.1578.

Constituent: Cadmium, Total Analysis Run 6/12/2018 11:52 AM

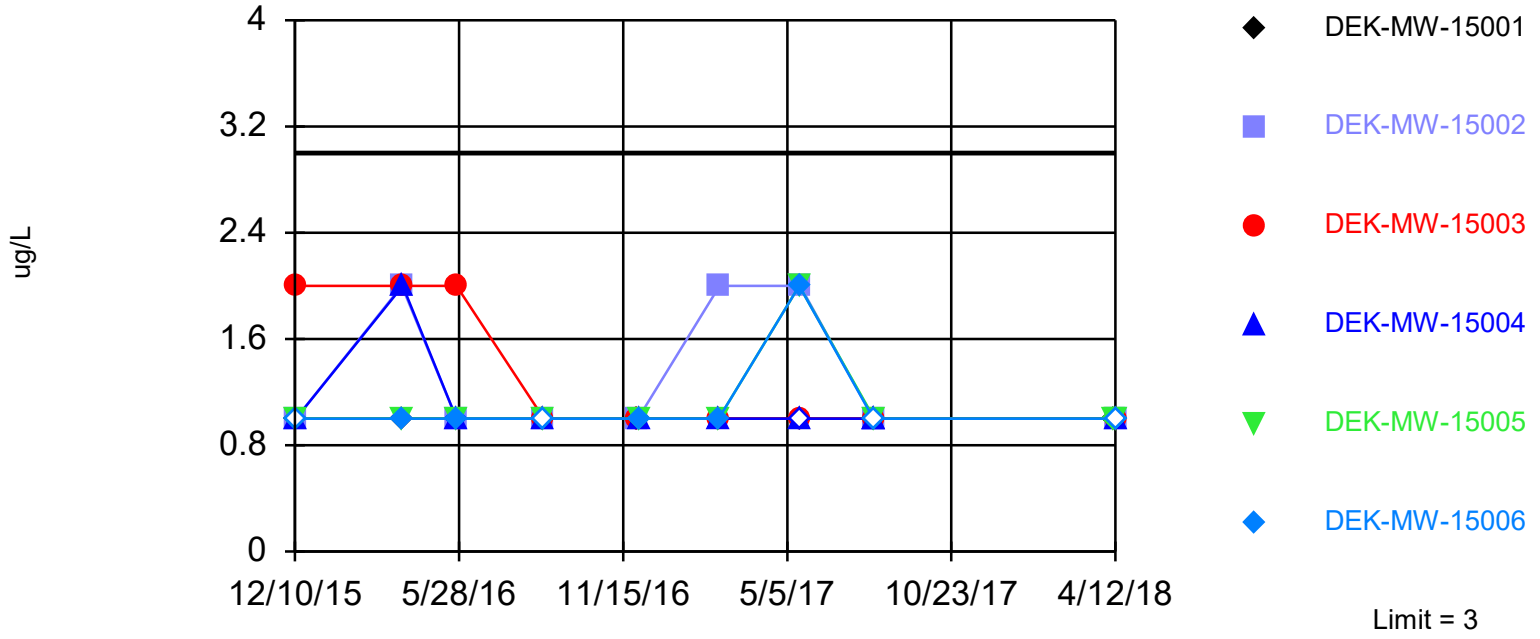
Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas

Hollow symbols indicate censored values.

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 36 background values. 33.33% NDs. 88.09% coverage at alpha=0.01; 91.99% coverage at alpha=0.05; 98.24% coverage at alpha=0.5. Report alpha = 0.1578.

Constituent: Chromium, Total Analysis Run 5/24/2018 2:13 PM

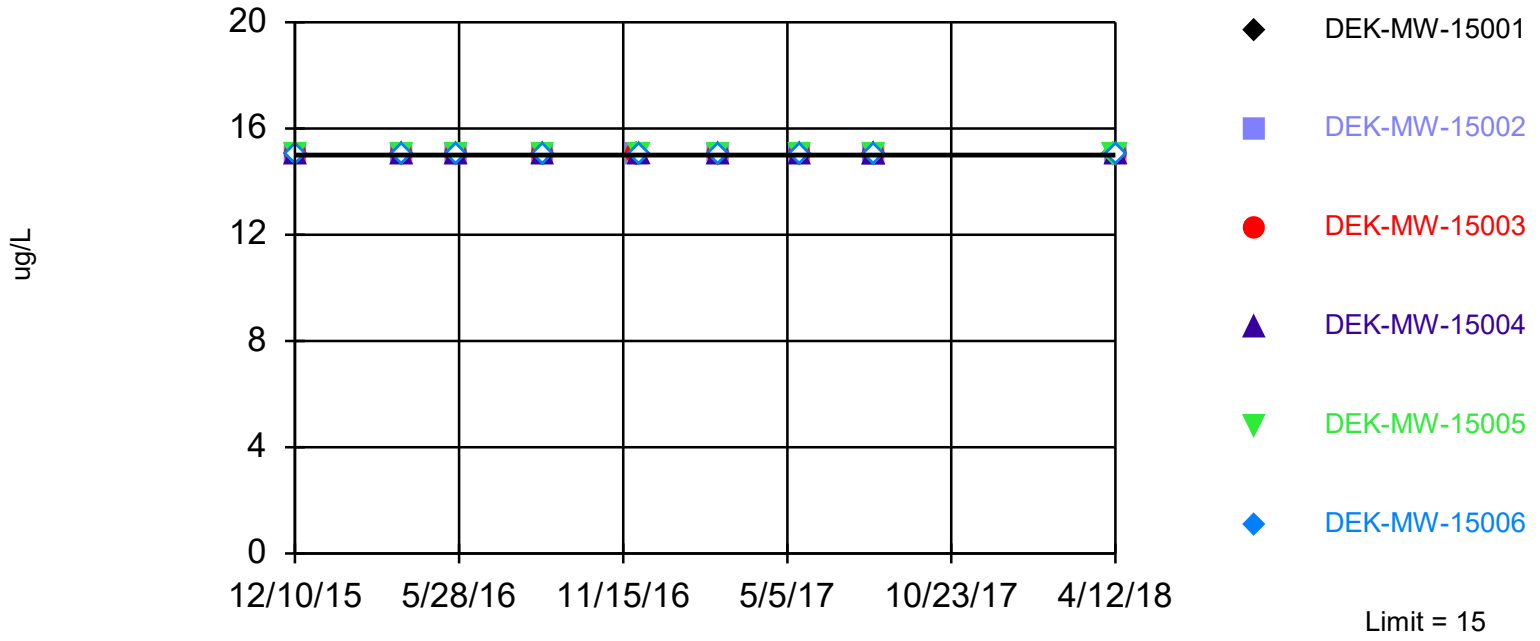
Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas

Hollow symbols indicate censored values.

Within Limit

Tolerance Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric tolerance limit because censored data exceeded 50%. Most recent observation is compared with limit. All background values were censored; limit is most recent reporting limit. 88.09% coverage at alpha=0.01; 91.99% coverage at alpha=0.05; 98.24% coverage at alpha=0.5. Report alpha = 0.1578.

Constituent: Cobalt, Total Analysis Run 6/12/2018 11:53 AM

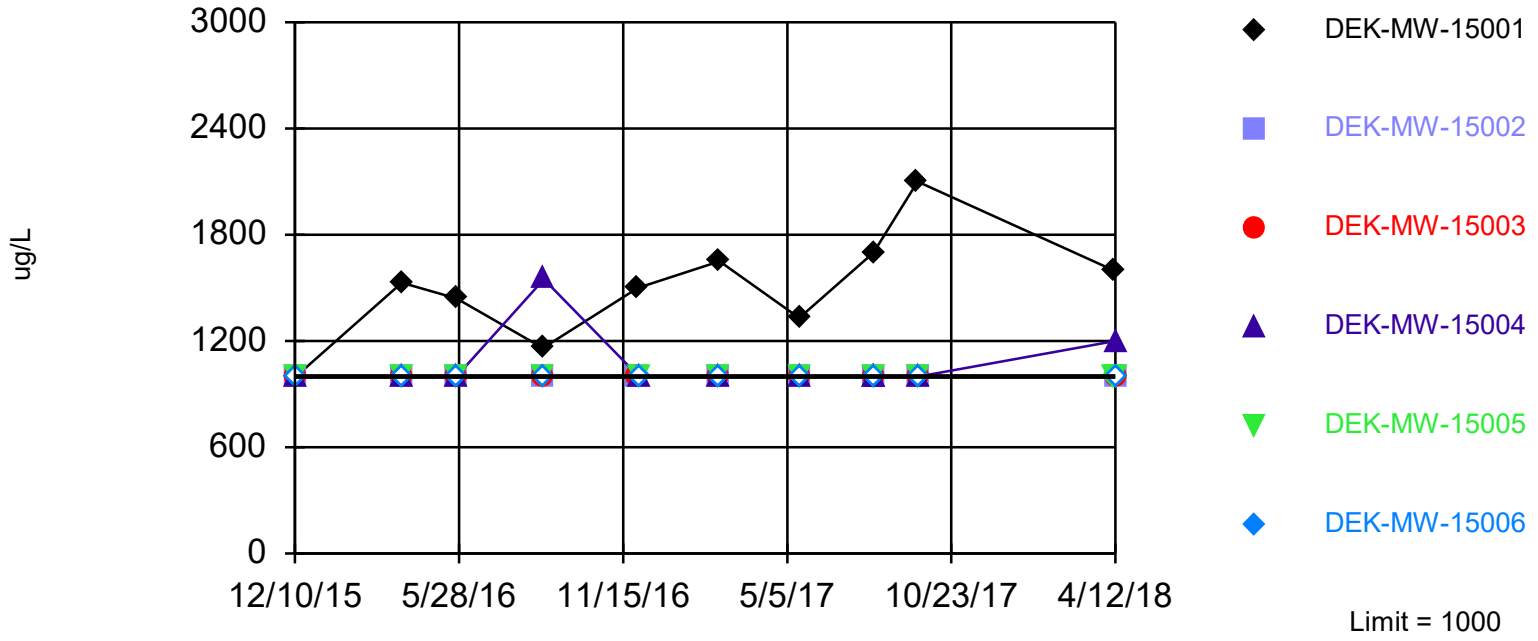
Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas

Hollow symbols indicate censored values.

Exceeds Limit: DEK-MW-15001, DEK-MW-15004

Tolerance Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric tolerance limit because censored data exceeded 50%. Most recent observation is compared with limit. All background values were censored; limit is most recent reporting limit. 89.26% coverage at alpha=0.01; 92.77% coverage at alpha=0.05; 98.24% coverage at alpha=0.5. Report alpha = 0.1285.

Constituent: Fluoride Analysis Run 6/12/2018 11:53 AM

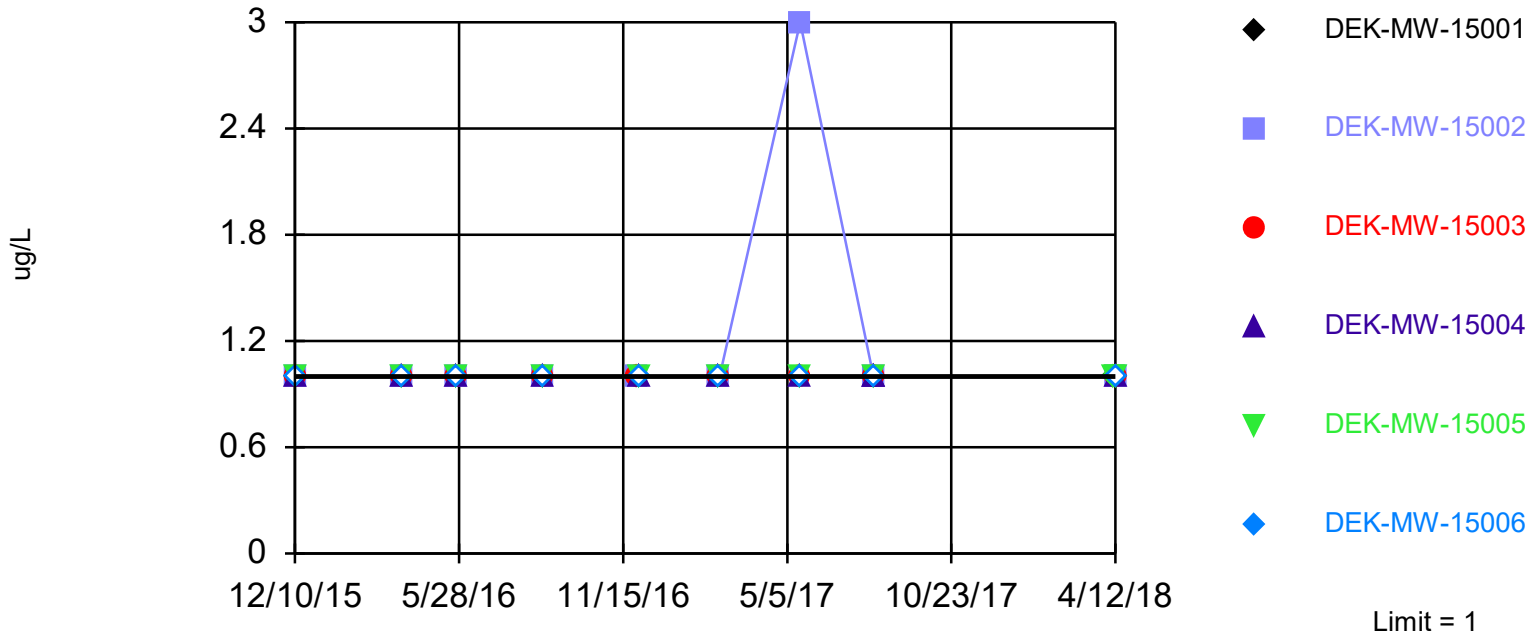
Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas

Hollow symbols indicate censored values.

Within Limit

Tolerance Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric tolerance limit because censored data exceeded 50%. Most recent observation is compared with limit. All background values were censored; limit is most recent reporting limit. 88.09% coverage at alpha=0.01; 91.99% coverage at alpha=0.05; 98.24% coverage at alpha=0.5. Report alpha = 0.1578.

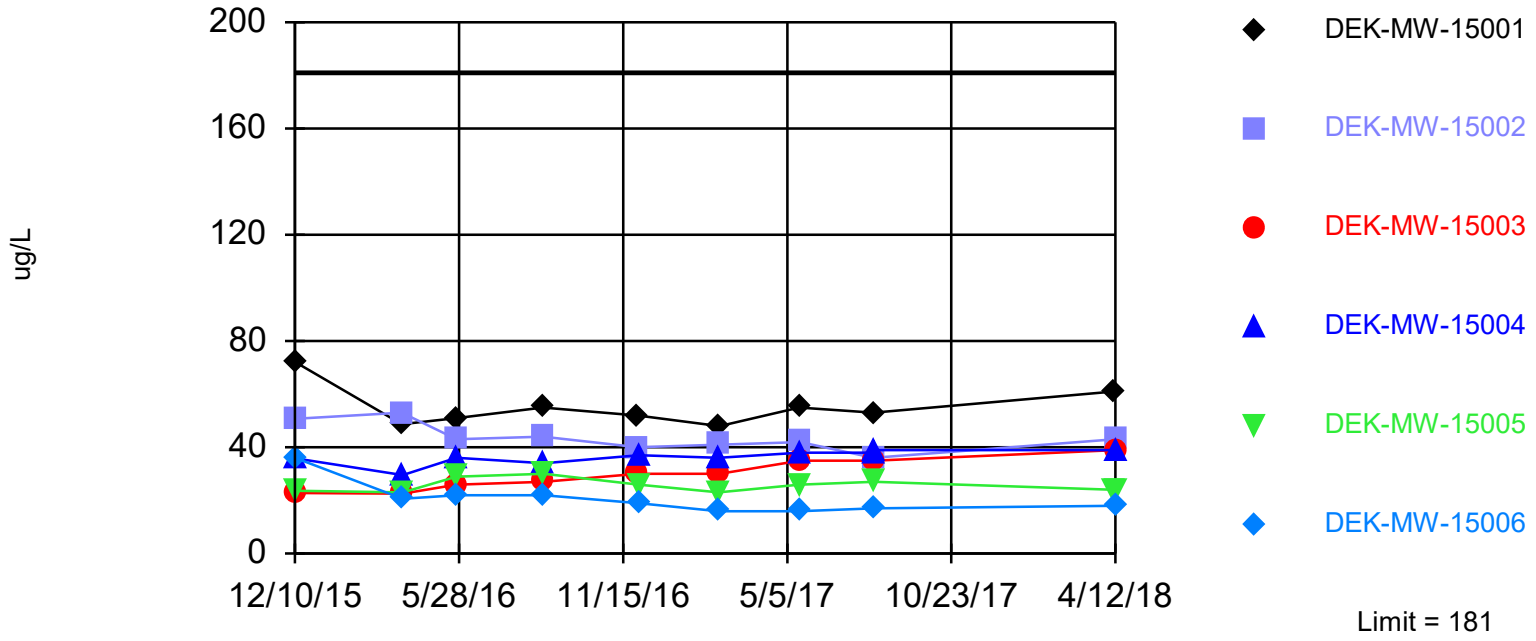
Constituent: Lead, Total Analysis Run 6/12/2018 11:54 AM

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 36 background values. 8.333% NDs. 88.09% coverage at alpha=0.01; 91.99% coverage at alpha=0.05; 98.24% coverage at alpha=0.5. Report alpha = 0.1578.

Constituent: Lithium, Total Analysis Run 5/24/2018 2:13 PM

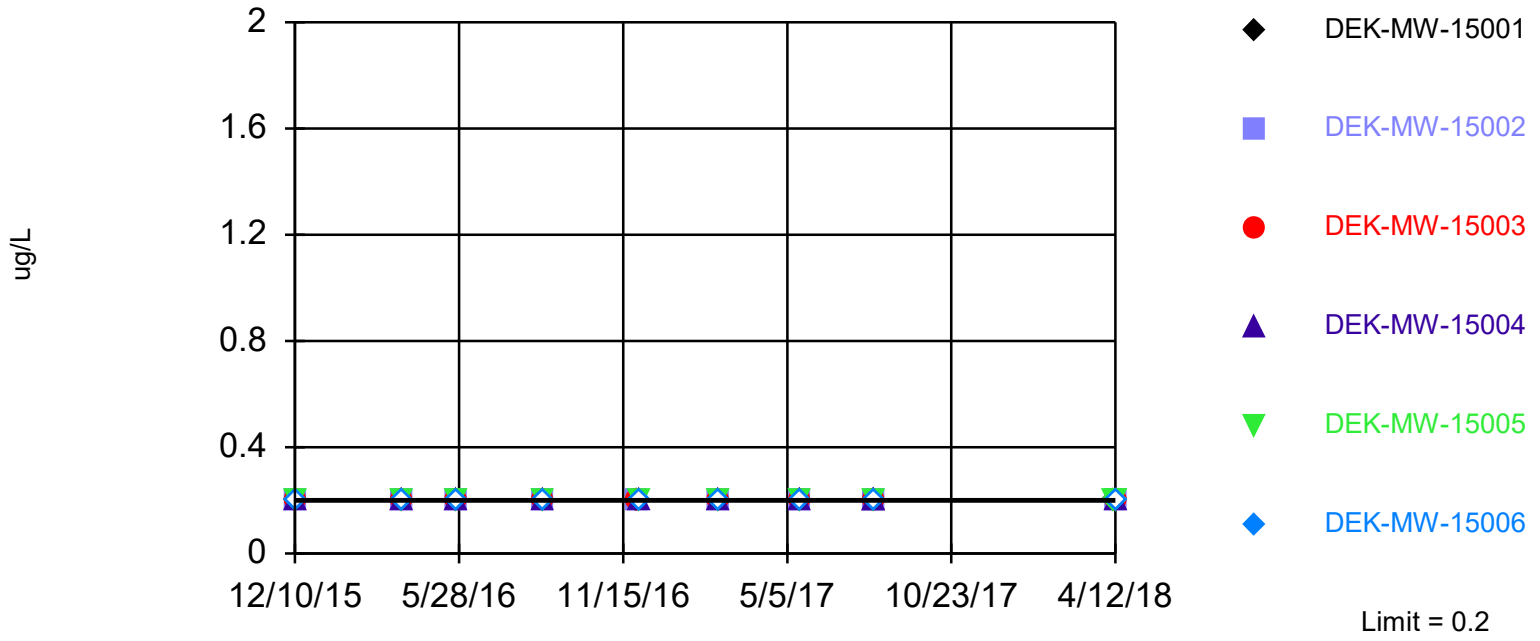
Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas

Hollow symbols indicate censored values.

Within Limit

Tolerance Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric tolerance limit because censored data exceeded 50%. Most recent observation is compared with limit. All background values were censored; limit is most recent reporting limit. 88.09% coverage at alpha=0.01; 91.99% coverage at alpha=0.05; 98.24% coverage at alpha=0.5. Report alpha = 0.1578.

Constituent: Mercury, Total Analysis Run 6/12/2018 11:54 AM

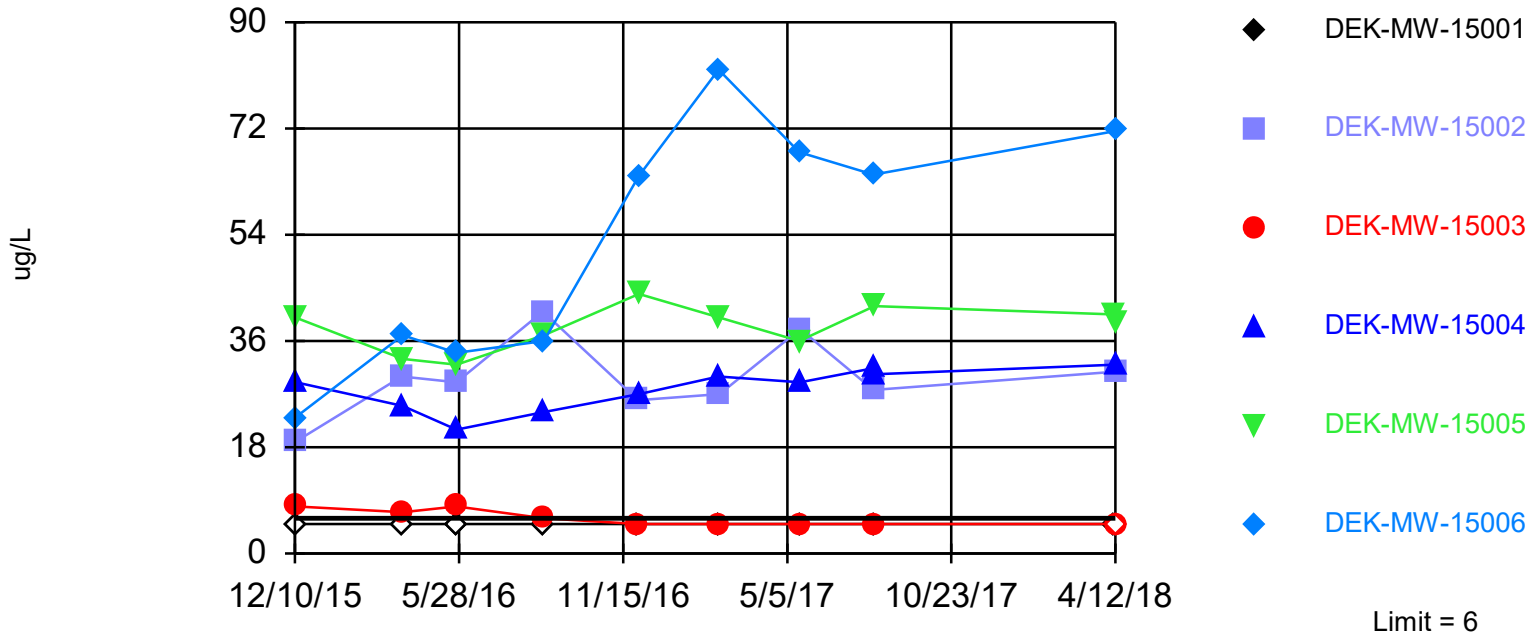
Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas

Hollow symbols indicate censored values.

Exceeds Limit: DEK-MW-15002, DEK-MW-15004, DEK-MW-15005, DEK-MW-15006

Tolerance Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric tolerance limit because censored data exceeded 50%. Most recent observation is compared with limit. Limit is highest of 36 background values. 91.67% NDs. 88.09% coverage at alpha=0.01; 91.99% coverage at alpha=0.05; 98.24% coverage at alpha=0.5. Report alpha = 0.1578.

Constituent: Molybdenum, Total Analysis Run 5/24/2018 2:14 PM

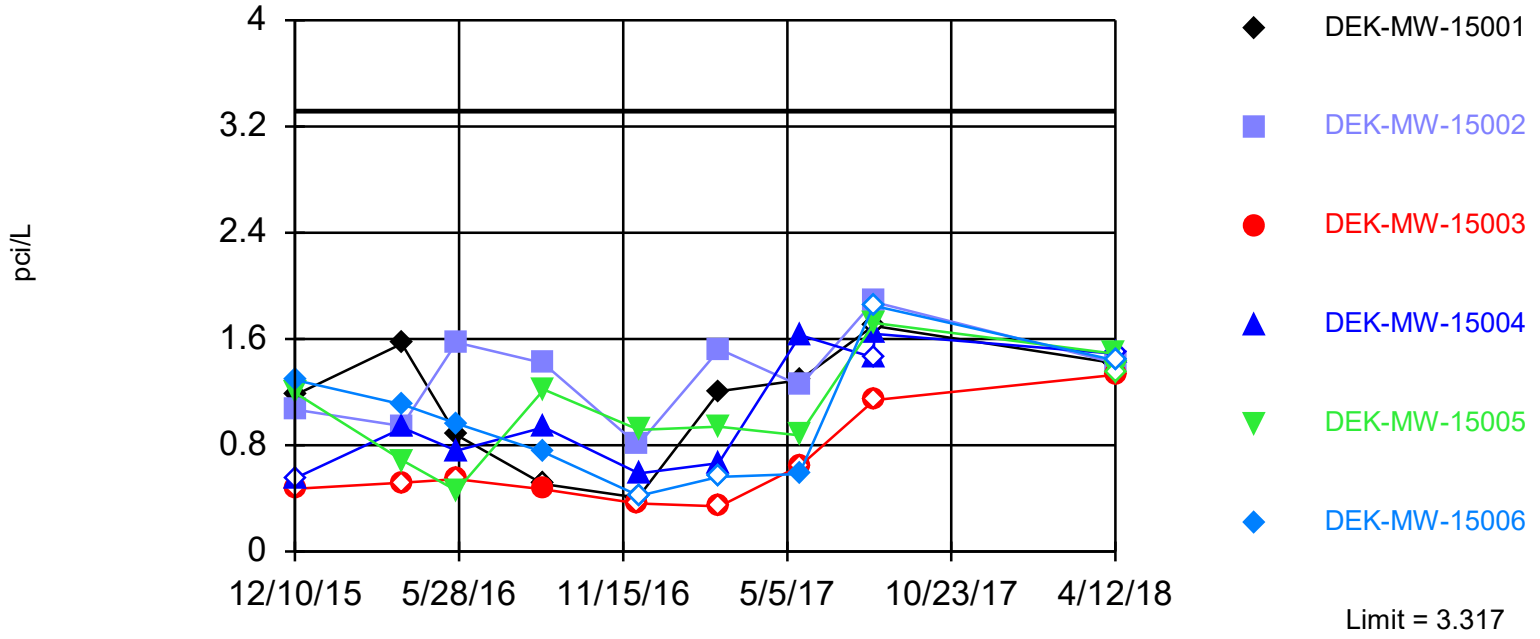
Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas

Hollow symbols indicate censored values.

Within Limit

Tolerance Limit

Interwell Parametric



95% coverage. Most recent observation is compared with limit. Background Data Summary (based on square root transformation) (after Kaplan-Meier Adjustment): Mean=1.165, Std. Dev.=0.304, n=36, 25% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9558, critical = 0.912. Report alpha = 0.05.

Constituent: Radium-226/228 Analysis Run 5/24/2018 2:15 PM

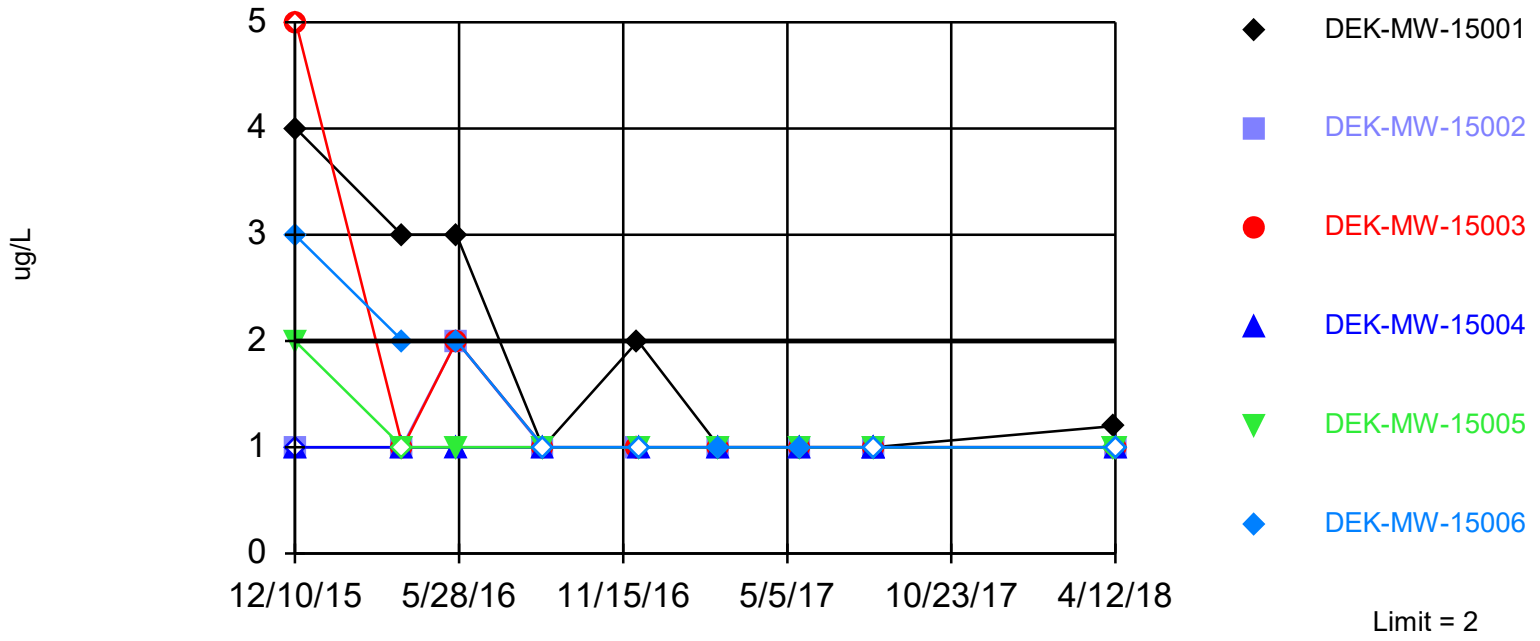
Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas

Hollow symbols indicate censored values.

Within Limit

Tolerance Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric tolerance limit because censored data exceeded 50%. Most recent observation is compared with limit. Limit is highest of 36 background values. 88.89% NDs. 88.09% coverage at alpha=0.01; 91.99% coverage at alpha=0.05; 98.24% coverage at alpha=0.5. Report alpha = 0.1578.

Constituent: Selenium, Total Analysis Run 5/24/2018 2:15 PM

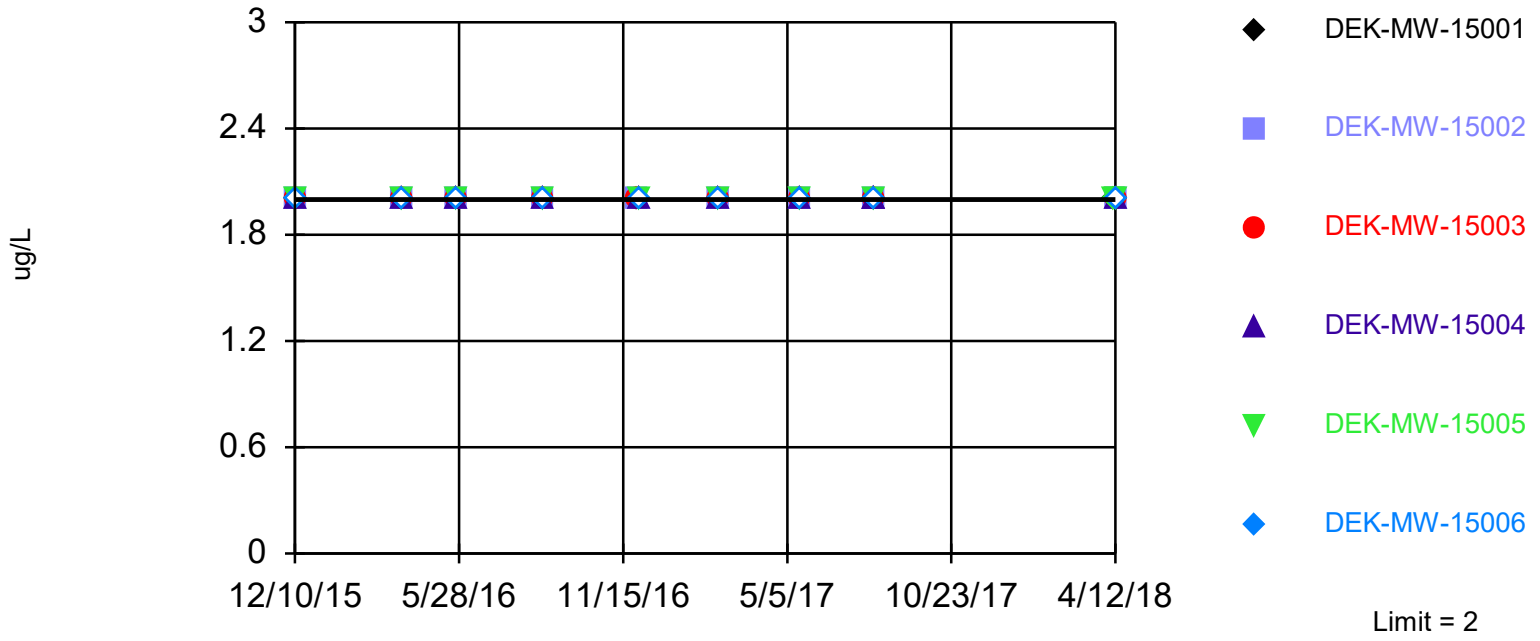
Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas

Hollow symbols indicate censored values.

Within Limit

Tolerance Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric tolerance limit because censored data exceeded 50%. Most recent observation is compared with limit. All background values were censored; limit is most recent reporting limit. 88.09% coverage at alpha=0.01; 91.99% coverage at alpha=0.05; 98.24% coverage at alpha=0.5. Report alpha = 0.1578.

Constituent: Thallium, Total Analysis Run 6/12/2018 11:55 AM

Client: Consumers Energy Data: DEK_BAP_CCR_Sanitas