REPORT

Annual Groundwater Monitoring & Corrective Action Report

JB Sims Generating Station, Grand Haven Board of Light and Power

Submitted to:

Grand Haven Board of Light and Power

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Submitted by:

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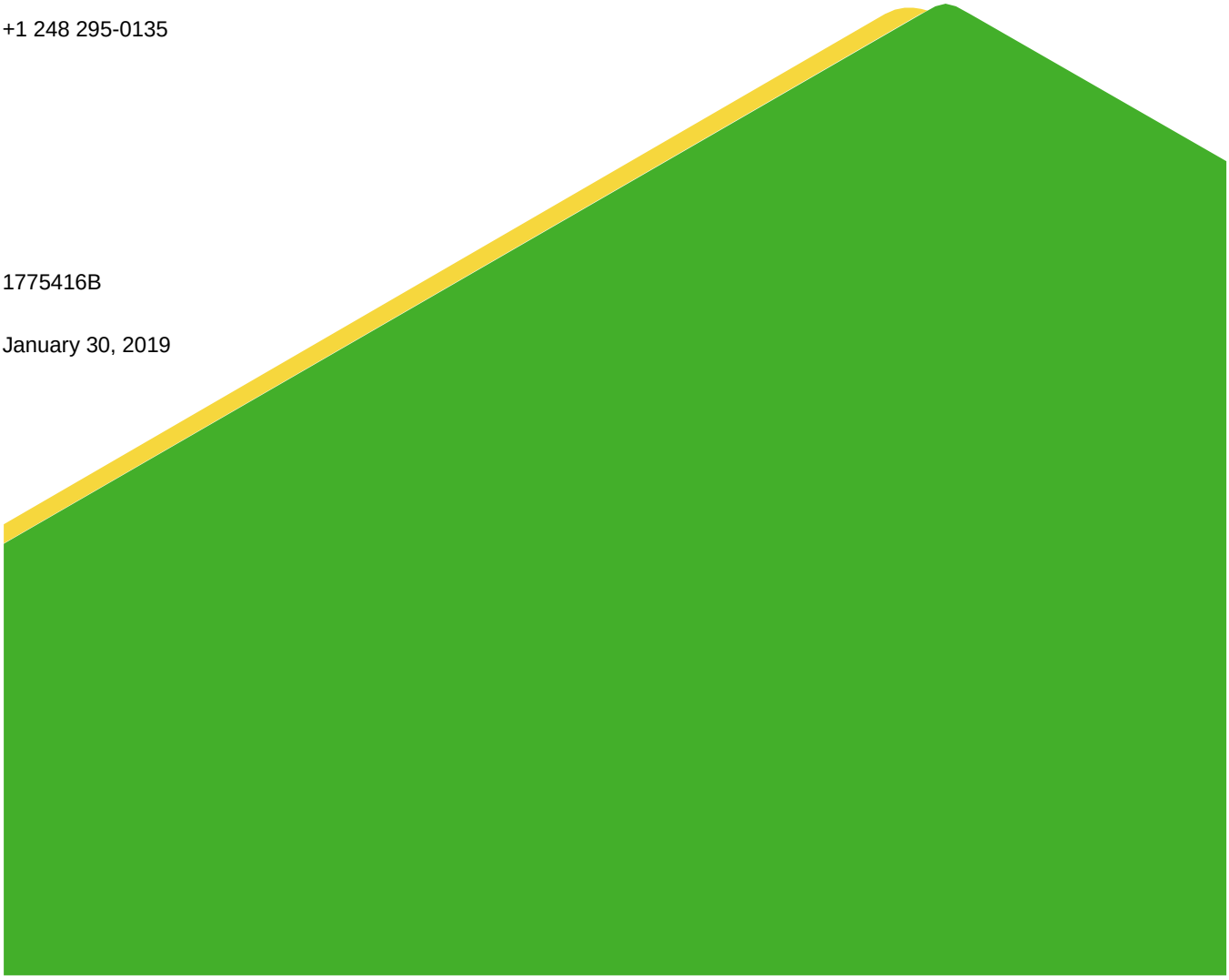

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Distribution List

Paul Cederquist - JB Sims Generating Station

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Certification

This *2018 Annual Groundwater Monitoring & Corrective Action Report, JB Sims Generating Station (JB Sims)* has been prepared to comply with the United States Environmental Protection Agency (USEPA) coal combustion residual (CCR) rule (40 Code of Federal Regulations [CFR] 257 Subpart D; published in 80 FR 21302-21501, April 17, 2015) under the direction of an Engineer licensed in the State of Michigan as well as a certified professional geologist with Golder Associates Inc. (Golder).

Golder Associates Inc.

Dawn L. Prell, CPG
Certified Professional Geologist No. 11222

I hereby certify that this *2018 Annual Groundwater Monitoring & Corrective Action Report, JB Sims Generating Station CCR Units 1/2 inactive Ash Ponds and Unit 3 active East (A) and West (B) Bottom Ash Ponds* located at 1231 North Third Street in Grand Haven, Michigan, has been prepared to meet the requirements of 40 CFR §257.90(e).

Golder Associates Inc.

1/31/19

Tiffany Johnson, PE
Michigan Registered Professional Engineer No. 6201049160

https://golderassociates.sharepoint.com/sites/27317g/deliverables/200 reports/2018 annual gwmcar/final/2018 annual gwmr ghblp_draft-1.30.2019.docx

1.0 INTRODUCTION

In accordance with the United States Environmental Protection Agency (USEPA) coal combustion residual (CCR) rule (40 Code of Federal Regulations [CFR] 257 Subpart D; published in 80 FR 21302-21501, April 17, 2015), this *2018 Annual Groundwater Monitoring and Corrective Action Report* has been prepared to document groundwater monitoring activities conducted at the JB Sims Generating Station CCR surface impoundment units, the Unit 1/2 inactive Ash Ponds and the active Unit 3 East (A) and West (B) Bottom Ash Ponds (Bottom Ash Ponds), and satisfies the requirements of 40 CFR §257.90(e). Groundwater monitoring and reporting for the CCR units is performed in accordance with the requirements of 40 CFR §257.90 through §257.98. This report documents the activities completed to establish the groundwater monitoring program and actions through the 2018 calendar year.

1.1 Site Description and Background

JB Sims Generating Station (Plant) is located on the southwestern portion of Harbor Island in Grand Haven, Michigan, and is operated by the Grand Haven Board of Light and Power (GHBLP). The Plant is situated on Harbor Island with the Grand River and South Channel of the Grand River surrounding the island. The flow of the Grand River and South Channel of the Grand River flow is a westerly direction towards Lake Michigan, which is about one mile west of the site. Figure 1, Site Location Map, depicts the location of the Plant relative to the surrounding area.

The Plant is a coal-fired power generation facility. CCRs are placed into the active Bottom Ash Ponds located onsite. The Bottom Ash Ponds are located adjacent to each other and are formed by earthen embankments or ring dikes with a common embankment between them. The impoundment areas range from 175 to 190 feet long by 71 to 80 feet wide with an approximate surface area of 0.2 and 0.3 acres for the east and west ponds, respectively. The Units 1/2 inactive Ash Ponds no longer receive CCR. Figure 2, Site Plan and Monitoring Well Location Map depicts the general configuration of the CCR units and site monitoring wells.

1.2 Regional Geology and Hydrogeologic Setting

The following paragraphs include a general description of regional geologic and hydrogeologic characteristics of formations that occur beneath the site. Information presented in this section is based on published literature, and Golder's experience working in this geologic terrain.

As described in the Groundwater Monitoring System Certification, prepared by ERM dated November 2017, the Plant is located in an area of glacial drift (consisting of fine to medium sand with occasional beds of gravel) which is underlain by Marshall Sandstone. The glacial drift is between 100 to 200 feet thick in the area.

The CCR unit borings consist of unconsolidated fine sand with intervals of silt and sand within the first 20 feet below ground surface (bgs). The fine sand was underlain by silt and clay to the bottom of each boring. The silt and clay represent the confining unit beneath the CCR units (ERM, 2017).

Groundwater was encountered in the fine sand located above the silt and clay unit. As described in the Groundwater Monitoring System Certification, prepared by Environmental Resources Management Michigan, Inc. (ERM) (ERM, 2017), sand in the uppermost aquifer assumes an effective porosity of 30 percent (%) and consists of poorly-graded fine sand with an estimated hydraulic conductivity of 27 feet per day and well-graded fine sand with an estimated hydraulic conductivity of 53 feet per day.

1.3 Groundwater Monitoring Well Network

Pursuant to 40CFR §257.91, GHBLP installed a groundwater monitoring system within the uppermost aquifer for Units 1/2 inactive Ash Ponds and Unit 3 active East (A) and West (B) Bottom Ash Ponds. The revised multi-unit monitoring system is installed to monitor groundwater passing the CCR unit boundary of the ash ponds within the uppermost aquifer. Wells are located to serve as upgradient, and downgradient wells based on groundwater flow direction as determined by the potentiometric surface elevation contour maps.

The original monitoring well network was certified by ERM in the Groundwater Monitoring System Certification, dated November 2017. A network of four monitoring wells was installed in January 2017 for groundwater monitoring near Unit 3 active East (A) and West (B) Bottom Ash Ponds. It was later determined that in accordance with 40 CFR §257.90(a), Units 1/2 inactive Ash Ponds are subject to the groundwater monitoring and corrective action requirements listed under 40 CFR §257.90 through §257.98. In response a multi-unit monitoring system has been identified for JB Sims. The revised network has been established and is capable of detecting monitored constituents at the waste boundary of the CCR units. The revised multi-unit monitoring well network consisting of seven monitoring wells and one piezometer is in place for groundwater monitoring near Units 1/2 inactive Ash Ponds and Unit 3 active East (A) and West (B) Bottom Ash Ponds. Table 1, Monitoring Well Network Summary, includes the pertinent construction details for the CCR Units monitoring well network at the Plant. The above described revised multi-unit monitoring well network is included in this annual report and therefore has been certified by an Engineer licensed in the State of Michigan to meet the requirements of 40 CFR §257.91.

2.0 GROUNDWATER MONITORING ACTIVITIES

In accordance with 40 CFR §257.90(e), the following describes monitoring-related activities performed during the preceding year and discusses any change in status of the monitoring program. Groundwater sampling was performed in accordance with 40 CFR §257.93. Samples were collected from each well in the certified monitoring system. The location of each of these monitoring wells is shown on Figure 2.

Table 2.1, Groundwater Sampling Event Summary, presents a summary of groundwater sampling events completed for Units 1/2 inactive Ash Ponds and Unit 3 active East (A) and West (B) Bottom Ash Ponds. Groundwater sampling events include background events for newly installed monitoring wells as well as assessment monitoring events for the multi-unit network. Sampling events were conducted between June and December 2018. Results of sampling activities conducted in 2018 are presented in Appendix A, Analytical Results and Field Sampling Forms.

Table 2.1: Groundwater Sampling Event Summary

Well ID	Hydraulic Location	Date of Events	Status of Monitoring Well
Compliance and Assessment Monitoring			
MW-01	Piezometer	August 27, September 26, and October 22	Water Level Monitoring only
MW-02	Downgradient	August 27, September 26, and October 22	Detection / Assessment
MW-03	Downgradient	August 27, September 26, and October 22	Detection / Assessment
MW-04	Downgradient	August 27, September 26, and October 22	Detection / Assessment

Well ID	Hydraulic Location	Date of Events	Status of Monitoring Well
Establish Background			
MW-05	Downgradient	Conducted eight (8) background events between June and December	Detection / Assessment
MW-06	Downgradient	Conducted eight (8) background events between June and December	Detection / Assessment
MW-07	Upgradient	Conducted eight (8) background events between June and December	Upgradient Detection
MW-08	Upgradient	Conducted eight (8) background events between June and December	Upgradient Detection

2.1 Monitoring Well Installation and Maintenance

In accordance with 40 CFR §257.91, a groundwater monitoring system was installed that (1) consists of a sufficient number of wells, (2) installed at appropriate locations and depths to yield groundwater samples from the uppermost aquifer, and (3) meets the performance standards of 40 CFR §257.91(a). In summary, monitoring well-related activities included the following:

- Visual inspection of well conditions prior to sampling, recording the site conditions, and performing exterior maintenance to perform sampling under safe and clean conditions.
- Installation of additional site detection monitoring wells. Specifically, monitoring wells MW-05, MW-06, MW-07, and MW-08 were installed to incorporate Units 1/2 inactive Ash Ponds and to supplemental the upgradient groundwater monitoring network. The additional site monitoring wells and pertinent construction details is presented on Table 1.

2.2 Assessment Monitoring

Pursuant to 40 CFR §257.94(e)(3), an assessment monitoring program has been established for the CCR units at JB Sims based on statistically significant increases documented in the *2017 Annual Groundwater Monitoring and Corrective Action Report,* (Golder, 2018). A notice of assessment monitoring was placed in the operation record on May 15, 2018.

As per the requirements of 40 CFR §257.95, sampling, analyses and statistical evaluation of Appendix IV constituents was completed during 2018. Results of the assessment monitoring are discussed in Section 4.0 and presented in Appendix A.

2.3 Background & Additional Sampling

The revised multi-unit monitoring well network includes the addition of monitoring wells MW-05 through MW-08. Monthly sampling events were conducted June through December 2018 to complete background data collection and to supplement the upgradient data set for statistical monitoring purposes. Additionally, site monitoring wells were sampled for a subset of cations/anions to aid in geochemical fingerprinting of the site groundwater. Results of these analyses are provided in Appendix A.

3.0 SAMPLE METHODOLOGY & ANALYSIS

Sampling events completed during 2018 for the CCR units at JB Sims represent both background data collection and assessment monitoring events. The following sections discuss each of the sampling events conducted during 2018.

3.1 Groundwater Level Measurement

Prior to each sampling event, groundwater elevations were recorded from the certified well. Groundwater elevations are summarized in Table 2, Summary of Groundwater Elevations. The June 2018 and October 2018 elevation data were used to develop potentiometric surface elevation contour maps (Figure 3A, Potentiometric Surface Elevation Contour Map – August 2018, Figure 3B, Potentiometric Surface Elevation Contour Map – September 2018, and Figure 3C, Potentiometric Surface Elevation Contour Map – October 2018). There is a groundwater contour elevation ridge identified between Units 1/2 inactive Ash Ponds and Unit 3 active East (A) and West (B) Bottom Ash Ponds. The general direction of groundwater flow is from the ridge west toward the Grand River and from the ridge east.

3.2 Groundwater Gradient and Flow Velocity

Groundwater flow rates at the site have been calculated based on hydraulic gradients, hydraulic conductivity, and an estimated effective porosity of the screened horizon provided in the Groundwater Monitoring System Certification, prepared by ERM dated November 2017. Based on the information provided in the Groundwater Monitoring System Certification, hydraulic conductivity ranges from 27 to 53 feet per day with an assumed an effective porosity of 30%. The hydraulic gradient was calculated between site monitoring wells shown on Table 3, Groundwater Flow Velocity Calculations - 2018.

Horizontal flow velocity was calculated using the commonly-used derivative of Darcy's Law:

Specifically,

$$V = \frac{K * i}{n_e}$$

V = Groundwater flow velocity

K = Average Permeability of the aquifer

i = Horizontal hydraulic gradient

N_e = Effective porosity

Using this equation, groundwater flow velocities are calculated for various areas of the site and are tabulated on Table 3. Table 3 presents the velocities calculated using groundwater elevation data from August, September and October 2018 sampling events.

As presented on Table 3 groundwater flow velocity at the site ranges from approximately 0.06 feet/day to 0.27 feet/day (or approximately 21 to 99 feet/year) toward the east and 0.28 feet/day to 0.98 feet/day (or approximately 103 to 356 feet/year) toward the west. These calculated groundwater flow velocities across the site are consistent with historical calculations. The observed groundwater flow velocities calculated for this monitoring event confirm the groundwater monitoring system as properly located to monitor the uppermost aquifer for CCR units at JB Sims. However, these calculated velocities are best estimates based on field data and default data for soils, and therefore, these velocities should not be taken as absolute values, but rather as estimated values that may vary with future data collected at the site.

3.3 Groundwater Sampling

Groundwater samples were collected in accordance with 40 CFR §257.93(a). Monitoring wells were purged and sampled using low-flow sampling procedures. Monitoring wells were purged and sampled using a peristaltic pump. A multi parameter meter was used to monitor field parameters, namely: pH, temperature, conductivity,

dissolved oxygen (DO), and oxidation-reduction potential (ORP), during well purging to verify stabilization prior to sampling. Turbidity is also recorded during purging using a field meter to verify stabilization. Groundwater samples were collected when the following general stabilization criteria were met:

- 0.2 standard units for pH
- 5% for specific conductance
- 0.2 milligrams per liter (mg/L) or 10% for DO > 0.5 mg/L (whichever is greater)
- Turbidity measurements less than 5 Nephelometric Turbidity Units (NTU)

Any deviation from stabilization criteria, if applicable, is identified on field sampling forms. Following well stabilization, unfiltered samples were collected directly into appropriately preserved laboratory supplied sample containers, placed in iced coolers, and submitted to the laboratory following standard chain-of-custody protocol. Field information forms as well as chain-of-custody records are included in Appendix A.

3.4 Laboratory Analyses

Groundwater samples collected for each monitoring event included both Appendix III and Appendix IV parameters pursuant to 40 CFR §257.90 through 257.98. Analytical methods used for groundwater sample analysis are listed on the analytical laboratory reports included in Appendix A.

Laboratory analyses for the background events were performed by Trace Laboratories, Inc. (Trace) in Muskegon, Michigan with the radium laboratory analysis subcontracted to Summit Environmental Technologies, Inc. (Summit) in Cuyahoga Falls, Ohio. Groundwater data and chain of custody records for the monitoring events are presented in Appendix A.

3.5 Quality Assurance and Quality Control

The background monitoring events followed the quality assurance and quality control (QA/QC) approach described in the Sampling and Analysis Plan (SAP) prepared by ERM dated March 10, 2017.

Data validation generally consisted of reviewing sample integrity, holding times, laboratory method blanks, laboratory control samples, matrix spikes/matrix spike duplicate recoveries and relative percent differences, post digestions spikes, laboratory RPDs, and reporting limits. Where appropriate, validation qualifiers and flags are applied to the data using the procedures in USEPA National Functional Guidelines for Inorganic Data Review (USEPA, 2014), as guidance. Flagged data is identified in the statistical analysis reports described in the following section.

4.0 STATISTICAL ANALYSES

Statistical analysis of Appendix III and IV groundwater monitoring data was performed on samples collected from the certified groundwater monitoring network pursuant to 40 CFR §257.93 and following the appropriate certified statistical methodology. The statistical methodology used for JB Sims was developed in accordance with 40 CFR §257.93(f) using methods presented in Statistical Analysis of Groundwater Data at RCRA Facilities, Unified Guidance, March 2009, EPA 530/R-09-007 (USEPA, 2009).

4.1 Statistical Methodology

The Sanitas™ groundwater statistical software was used to perform the statistical analyses on Appendix III and Appendix IV constituents in 2018. Sanitas™ is a decision support software package that incorporates the statistical tests required of Subtitle C and D facilities by USEPA regulations. Although assessment monitoring has been implemented, statistical evaluation of Appendix III constituents is performed to determine if constituents have returned to background conditions. Analysis of Appendix IV constituents is performed to determine if the site requires corrective measures.

4.1.1 Appendix III Constituents

Groundwater quality data was evaluated through use of interwell prediction limits for Appendix III parameters. Using these methods, upgradient well data was pooled to establish a background statistical limit. Data are compared to the statistical limit to determine whether any concentrations exceed background levels. The selected statistical methodology uses an optional 1-of-2 verification resample plan. When an initial statistically significant increase (SSI) or questionable result occurs, a second sample may be collected to verify the initial result or determine if the result was an outlier.

If resampling is performed and the initial finding is not verified by resampling, the resampled value replaced the initial finding. When the resample confirms the initial finding, both values remain in the database and an SSI is declared.

The following table provides a summary of the statistical methodology used at JB Sims for routine detection groundwater monitoring.

JB SIMS STATISTICAL METHODOLOGY SUMMARY		
Monitoring Well Network	Upgradient Wells	MW-07, MW-08
	Downgradient Wells	MW-02, MW-03, MW-04, MW-05, MW-06
CCR Monitoring Parameters	Appendix III (Detection Monitoring)	Boron, Calcium, Chloride, Fluoride, pH, Sulfate, and TDS
	Appendix IV (Assessment Monitoring)	Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, combined Radium 226 + 228, Fluoride, Lead, Lithium, Mercury, Molybdenum, Selenium, and Thallium
Statistical Methodology	Data Screening on Proposed Background	Evaluate outliers, trends, and seasonality when sufficient data are available
	Statistical Limits	Interwell statistical limits will be applied on a constituent basis, depending on the appropriateness of the method as determined by the Analysis of Variance
	Prediction Limits	Parametric when data follow a normal or transformed normal distribution and when less than 50% non-detects, utilizing Kaplan Meier non-detect adjustment when applicable; nonparametric when data sets contain greater than 50% non-detects or when data are not normally or transformed-normally distributed.
	Confidence Intervals	Used in Assessment and Corrective Action monitoring.
	No Statistical Testing	Statistical testing is not required for parameters with 100% non-detects.

JB SIMS STATISTICAL METHODOLOGY SUMMARY		
	Verification Resample Plan (Optional)	1-of-2 with minimum of 8 samples per well for interwell testing. ▪ Initial statistical exceedance warrants independent resampling within 90 days. ▪ If resample passes, well/parameter is not a confirmed statistically significant increase (SSI). ▪ If resample exceeds, well/parameter has a confirmed SSI. If no resample is collected, the original result is deem verified.

The following guidance is also applicable to the statistical analysis methods:

- Statistical analyses are not performed on analytes containing 100% non-detects (USEPA Unified Guidance, 2009, Chapter 6).
- When data contain less than or equal to 15% non-detects in background, simple substitution of one-half the reporting limit is utilized in the statistical analysis. The reporting limit utilized for non-detects is the practical quantitation limit (PQL) as reported by the laboratory.
- When data contain between 15-50% non-detects, a non-detect adjustment such as the Kaplan-Meier or Regression on Order Statistics (ROS) method for adjustment of the mean and standard deviation will be used prior to constructing a parametric prediction limit.
- Nonparametric prediction limits are used on data containing greater than 50% non-detects.

4.1.2 Assessment Monitoring Statistics

Following the above statistical methodology, groundwater protection standards (GWPS) have been established for statistical comparison of Appendix IV constituents. Parametric tolerance limits were used to calculate background limits from pooled upgradient well data for Appendix IV parameters with a target of 95% confidence and 95% coverage to determine the Alternate Contaminant Level (ACL). The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. These limits were used to identify the GWPS established under 40 CFR §257.95(h).

As described in 40 CFR §257.95(h)(1-3), the GWPS is:

- The maximum contaminant level (MCL) established under 40 CFR §141.62 and §141.66 of this title;
- Where an MCL has not been established, background concentration for the constituent established in accordance with 40 CFR §257.91; or a rule-identified GWPS specified for Cobalt, Lead, Lithium, or Molybdenum; or
- Background levels for constituents were the background level is higher than the MCL or rule-identified GWPS.

Following the above rule requirements, GWPS have been established for statistical comparison of Appendix IV constituents. Table 4.1.2, Summary of Background Levels and Groundwater Protection Standards summarizes the background limit established at each monitoring well and the GWPS used for statistical comparison.

Confidence intervals were then constructed on downgradient wells for each of the Appendix IV parameters using the highest limit of either the MCL, risk-based screening level (RBSL), or ACL discussed above. Only when the

entire confidence interval is above a GWPS is the well/constituent pair considered to exceed its respective standard.

Table 4.1.2: Groundwater Protection Standards

Analyte	Units	Screening Levels			
		RBSL	MCL	Alternate Contaminant Level (ACL)*	Groundwater Protection Standard (GWPS) Used for Assessment Monitoring
Antimony	mg/L	N/R	0.006	0.0016	0.006
Arsenic	mg/L	N/R	0.01	0.045	0.045
Barium	mg/L	N/R	2	0.56	2
Beryllium	mg/L	N/R	0.004	0.0010	0.004
Cadmium	mg/L	N/R	0.005	0.000051	0.005
Chromium	mg/L	N/R	0.1	0.0028	0.1
Cobalt	mg/L	0.006	N/R	0.0020	0.006
Fluoride	mg/L	N/R	4	0.57	4
Lead	mg/L	0.015	N/R	0.0050	0.015
Lithium	mg/L	0.04	N/R	0.059	0.059
Mercury	mg/L	N/R	0.002	0.00014	0.002
Molybdenum	mg/L	0.100	N/R	0.011	0.1
Radium (226 + 228)	pCi/L	N/R	5	1.36	5
Selenium	mg/L	N/R	0.05	0.00028	0.05
Thallium	mg/L	N/R	0.002	0.000087	0.002

Note: pCi/L = picocuries per liter, mg/L = milligram per liter
* = Updated to incorporate all background data collected in 2018.

4.2 Statistical Analysis Results

Analytical data from the three (3) sitewide 2018 monitoring events in August, September, and October 2018 were statistically analyzed in accordance with the Statistical Analysis Plan. Appendix III statistical analysis was performed to determine if constituents have returned to background levels. Appendix IV assessment monitoring parameters were evaluated to determine if concentrations statistically exceeded the established groundwater protection standard.

Based on review of the Appendix III statistical analysis presented in Appendix B, Appendix III constituents have not returned to background levels and assessment monitoring should continue pursuant to 40 CFR §257.95(f).

4.2.1 2018 Statistical Analyses

Analytical data from the 2018 monitoring events at JB Sims have been statistically analyzed in accordance with the site's certified statistical analysis methods.

Review of the Sanitas™ results indicates that the following verified SSIs were identified in 2018:

JB Sims Inter-Well Prediction Limit Statistically Significant Increase Summary	
Appendix III Parameter	**JB Sims Monitoring Wells**
Boron	MW-2
Calcium	MW-3, MW-4, MW-5, and MW-6
Chloride	MW-2, MW-3, MW-4, MW-6
Fluoride	MW-2, MW-4, MW-5, and MW-6
pH	None
Sulfate	MW-3, MW-4, MW-5, and MW-6
Total Dissolved Solids	MW-2, MW-3, MW-4, MW-5, and MW-6

Pursuant to 40 CFR §257.94(e), following determination of an SSI, JB Sims has implemented assessment monitoring per 40 CFR §257.95.

JB Sims Confidence Interval Exceedance Summary	
Appendix IV Parameter	**JB Sims Monitoring Wells**
Cobalt	MW-2
Fluoride	MW-2
Lithium	MW-2 and MW-6

Pursuant to 40 CFR §257.95(g)(3), following determination of an SSL, JB Sims has implemented an assessment of corrective measures per 40 CFR §257.96.

5.0 MONITORING PROGRAM STATUS

In accordance with 40 CFR §257.94(e), JB Sims implemented assessment monitoring in January 2018 with the first groundwater sampling event conducted in June 2018. SSIs of Appendix III and SSLs of Appendix IV parameters were identified at JB Sims during sampling events conducted in 2018. In accordance with 40 CFR §257.95(g)(3), JB Sims has implemented an assessment of corrective measures.

6.0 CONCLUSIONS AND FUTURE ACTIONS

This *2018 Annual Groundwater Monitoring and Corrective Action Report*, JB Sims Generating Station has been prepared to fulfill the requirements of USEPA CCR rule 40 CFR 257 Subpart D.

Statistical evaluations of the groundwater monitoring data for the JB Sims identified SSIs of Appendix III groundwater monitoring parameters above background and SSLs of Appendix IV groundwater monitoring parameters above groundwater protection standards. In accordance with 40 CFR §257.95(g)(3), JB Sims has implemented an assessment of corrective measures, and will remain in assessment monitoring.

The first 2019 semi-annual assessment monitoring event is planned for April 2019.

Following guidelines presented in 40 CFR §257.96, JB Sims has initiated an assessment of corrective measures. The objectives of this assessment will be performed to prevent further releases, to remediate any releases and to restore the affected area to original conditions.

7.0 REFERENCES

Environmental Resources Management Michigan, Inc. 2017 *Sampling and Analysis Plan* for the Grand Haven Board of Light and Power.

Environmental Resources Management Michigan, Inc. 2017 *Groundwater Monitoring System Certification* for the Grand Haven Board of Light and Power.

Golder Associates. 2017 Statistical Analysis Plan for the Grand Haven Board of Light and Power.

Sanitas: Groundwater Statistical Software (2014), Sanitas Technologies, Shawnee, KS, 2007.

State Waste Management Board. 2016. State Solid Waste Management Regulations – (9VAC20-81 *et seq*.). January.

US EPA, September 2011. Data Validation Standard Operating Procedures

US EPA, November 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual

US EPA. 2015. Federal Register. Volume 80. No. 74. Friday April 17, 2015. Part II. Environmental Protection Agency. 40 CFR Parts 257 and 261. Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule. [EPA-HQ-RCRA–2009–0640; FRL–9919–44–OSWER]. RIN–2050–AE81.

US EPA, 1986 RCRA Groundwater Monitoring Technical Enforcement Guidance Document.

US EPA, 1996 Soil Guidance Manual

US EPA, 1993. Subpart E, Groundwater Monitoring and Corrective Action, in Chapter 5, Solid Waste Disposal Facility Criteria Technical Manual. EA530-R-93-017.

TABLES AND FIGURES

TABLE 1.
MONITORING WELL NETWORK
Grand Haven Board of Light and Power - JB Sims Generating Station
Grand Haven, Michigan

Well ID	Purpose	Hydraulic Location	Northing[2]	Easting[2]	Top of Casing Elevation[3] (feet)	Total Depth[1] (feet)	Screen Interval (feet)	Screen Length (feet)
Unit 1/2 inactive Ash Ponds and Unit 3 East (A) and West (B) active Bottom Ash Ponds								
MW-01	Piezometer	Downgradient	578101.01	12624468.16	587.24	12.32	4-9	5
MW-02	Monitoring Well	Downgradient	578242.33	12624222.40	595.63	23.37	15-20	5
MW-03	Monitoring Well	Downgradient	578125.12	12624180.33	593.11	20.34	12-17	5
MW-04	Monitoring Well	Downgradient	578004.01	12624165.11	591.52	18.00	10-15	5
MW-05	Monitoring Well	Downgradient	577970.13	12624634.02	587.59	11.50	4-9	5
MW-06	Monitoring Well	Downgradient	578229.78	12624525.11	590.37	16.55	9-14	5
MW-07	Monitoring Well	Upgradient	577585.77	12625513.81	586.45	18.80	11-16	5
MW-08	Monitoring Well	Upgradient	578261.26	12625341.33	585.34	11.85	4-9	5

Notes:

1. Total depth was measured from the top of casing to the bottom of the well.

2. Northing and Easting referenced to Michigan State Plane - South (international feet)

3. Elevations referenced to NAVD 88. Elevations based on Driesenga & Associates, Inc. Topographic Survey (October 2017 Coal Pile Survey), Job No. 1710732.5A, Dated 10-18-2017 and Driesenga & Associates, Inc. Monitoring Well Survey, Dated 1-9-2019.

TABLE 2.
Summary of Groundwater Elevations
Grand Haven Board of Light and Power - JB Sims Generating Station
Grand Haven, Michigan

Well ID	Hydraulic Location	Top of Casing Elevation[1]	Groundwater Elevations							
			June 27, 2018	July 30, 2018	August 27, 2018	September 26, 2018	October 22, 2018	November 12, 2018	November 28, 2018	December 7, 2018
Unit 1/2 inactive Ash Ponds and Unit 3 East (A) and West (B) active Bottom Ash Ponds										
MW-01	Downgradient	587.24	NA	NA	582.44	581.94	582.32	NA	NA	NA
MW-02	Downgradient	595.63	NA	NA	581.33	581.00	580.93	NA	NA	NA
MW-03	Downgradient	593.11	NA	NA	581.16	580.94	580.66	NA	NA	NA
MW-04	Downgradient	591.52	NA	NA	581.02	580.82	581.07	NA	NA	NA
MW-05	Downgradient	587.59	581.59	580.99	581.59	581.94	582.14	582.06	581.89	581.91
MW-06	Downgradient	590.37	581.69	581.01	581.77	581.72	581.99	581.84	581.87	581.87
MW-07	Upgradient	586.45	581.58	581.25	581.27	581.02	580.90	580.95	580.65	580.75
MW-08	Upgradient	585.34	581.57	581.24	580.94	580.89	580.94	580.94	580.64	580.66

Notes:

Background events conducted by Trace Laboratories, Inc. (Trace)

TABLE 3.
Groundwater Flow Velocity Calculations - 2018
Grand Haven Board of Light and Power - JB Sims Generating Station
Grand Haven, Michigan

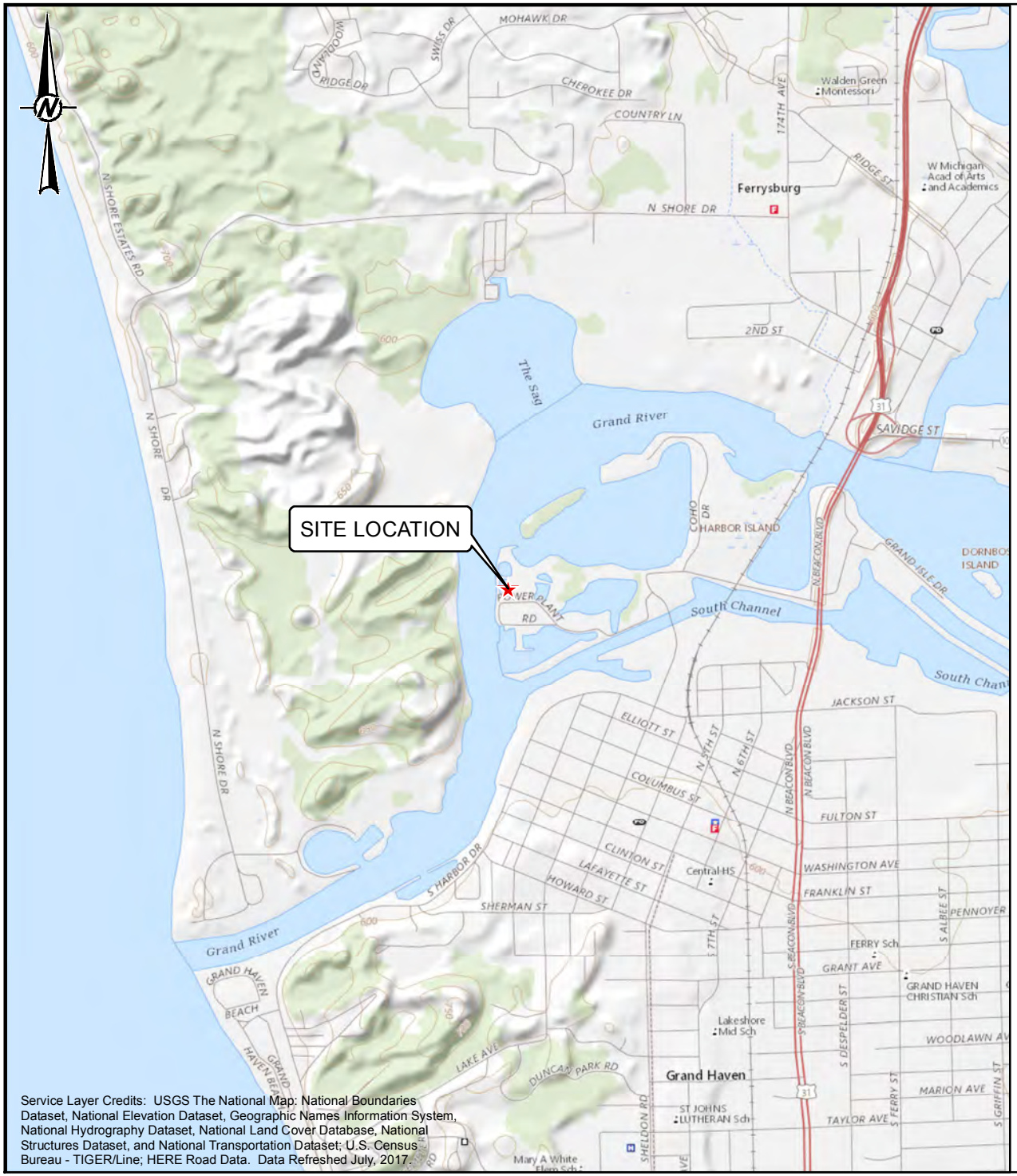
Flow Paths	Date	Groundwater Elevation (feet msl)	Δ h (feet)[2]	Δ l (feet)[3]	Hydraulic Gradient (Δ h/Δ l)	Average Hydraulic Conductivity, K (feet per day)[5]	Assumed Effective Porosity (n_e)	Average Linear Groundwater Velocity	
								(feet per day)[4]	(feet per year)[4]
Unit 1/2 inactive Ash Ponds and Unit 3 East (A) and West (B) active Bottom Ash Ponds									
Flow Path A (Toward the east)	27-Aug-18	581.50 581.00	0.50	789	0.001	27 to 53	0.3	0.06 to 0.11	20.8 to 40.9
	26-Sep-18	581.50 581.00	0.50	406	0.001	27 to 53	0.3	0.11 to 0.22	40.5 to 79.4
	22-Oct-18	582.00 581.00	1.00	653	0.002	27 to 53	0.3	0.14 to 0.27	50.3 to 98.7
Flow Path B (Toward the west)	27-Aug-18	582.00 581.16	0.84	205	0.004	27 to 53	0.3	0.37 to 0.72	134.6 to 264.2
	26-Sep-18	581.50 581.00	0.50	160	0.003	27 to 53	0.3	0.28 to 0.55	102.7 to 201.5
	22-Oct-18	582.00 581.00	1.00	181	0.006	27 to 53	0.3	0.50 to 0.98	181.5 to 356.3

Notes:

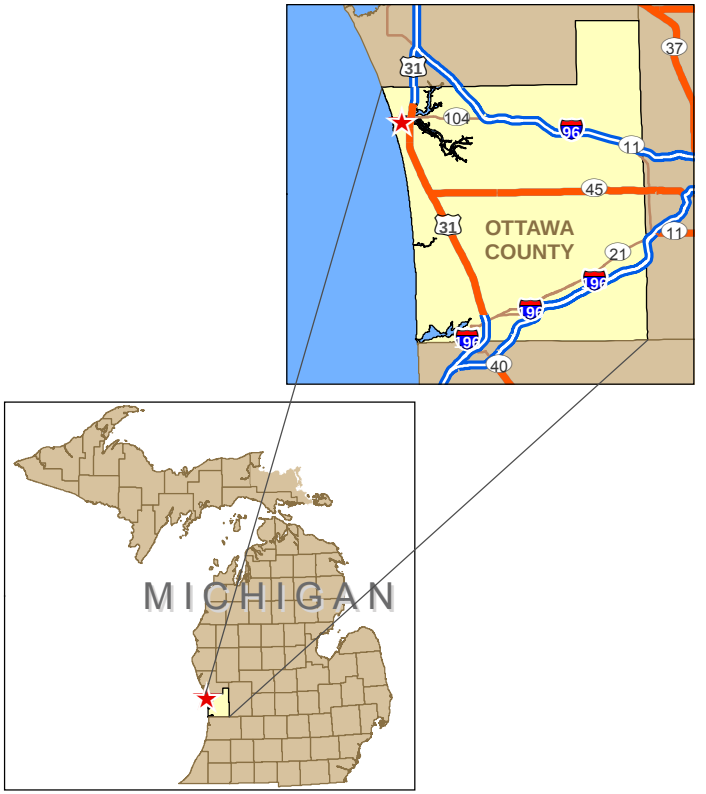
1. Δ H = Change in groundwater elevation.
2. Δ L = Distance along flow path.
3. I = Δ H / Δ L.
4. Velocity = $(I * K)/n_e$.
5. Hydraulic conductivity range and assumed effective porosity based on Groundwater Monitoring System Certification, prepared by ERM dated November 2017.

GOLDER

Path: H:\17x-Projects\1775416B-Grand Haven Board of Light & Power\figures\C-2018 REPORT\1775416BC000-GIS.mxd



Service Layer Credits: USGS The National Map: National Boundaries Dataset, National Elevation Dataset, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; U.S. Census Bureau - TIGER/Line; HERE Road Data. Data Refreshed July, 2017.



CLIENT
GRAND HAVEN BOARD OF LIGHT & POWER
GRAND HAVEN, MICHIGAN

PROJECT
JB SIMS POWER GENERATING PLANT
2018 ANNUAL REPORT

TITLE
SITE LOCATION MAP

CONSULTANT
GOLDER

YYYY-MM-DD	2019-01-25
PREPARED	DJC
DESIGN	CEP
REVIEW	CEP
APPROVED	DLP

PROJECT No.	CONTROL	Rev.	FIGURE
1775416B	1775416CA000-GIS.mxd	0	1

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

REFERENCE(S)

Service Layer Credits: Source: ESRI, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community. Date of imagery, 7/14/2016.

NOTE(S)

1. HORIZONTAL COORDINATE SYSTEM BASED ON MICHIGAN STATE PLANE SOUTH, INTERNATIONAL FEET. VERTICAL DATUM IS NAVD 1988.

LEGEND

MONITOR WELL

CLIENT
GRAND HAVEN BOARD OF LIGHT AND POWER
1231 NORTH 3RD STREET
GRAND HAVEN, MICHIGAN

CONSULTANT
GOLDER

YYYY-MM-DD	2019-01-25
DESIGNED	CEP
PREPARED	DJC
REVIEWED	CEP
APPROVED	DLP

PROJECT
JB SIMS POWER GENERATING PLANT
2018 ANNUAL REPORT

TITLE
SITE PLAN AND MONITORING WELL LOCATION MAP

PROJECT NO.	CONTROL	REV.	FIGURE
1775416	1775416D001.dwg	0	2

REFERENCE(S)

Service Layer Credits: Source: ESRI, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community. Date of imagery, 7/14/2016.

NOTE(S)

1. HORIZONTAL COORDINATE SYSTEM BASED ON MICHIGAN STATE PLANE SOUTH, INTERNATIONAL FEET. VERTICAL DATUM IS NAVD 1988.

LEGEND

MONITOR WELL

CLIENT
GRAND HAVEN BOARD OF LIGHT AND POWER
HARBOR ISLAND DRIVE
GRAND HAVEN, MI

CONSULTANT
GOLDER

YYYY-MM-DD	2019-01-11
DESIGNED	JJS
PREPARED	JJS
REVIEWED	CEP
APPROVED	DLP

PROJECT
2018 GROUNDWATER

TITLE
AUGUST 27, 2018 GROUNDWATER CONTOURS

PROJECT NO.	CONTROL	REV.	FIGURE
1775416B		0	3A

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

Path: \\detroitcad\Projects\17x-Projects\1775416_Grand Haven BWL\PRODUCTION\C-Groundwater Maps\ | File Name: 1775416C001.dwg | Last Edited By: dcoss Date: 2019-01-17 Time:2:22:45 PM | Printed By: DCoss Date: 2019-01-17 Time:3:39:42 PM

REFERENCE(S)

Service Layer Credits: Source: ESRI, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community. Date of imagery, 7/14/2016.

NOTE(S)

1. HORIZONTAL COORDINATE SYSTEM BASED ON MICHIGAN STATE PLANE SOUTH, INTERNATIONAL FEET. VERTICAL DATUM IS NAVD 1988.

LEGEND

MONITOR WELL

CLIENT
GRAND HAVEN BOARD OF LIGHT AND POWER
HARBOR ISLAND DRIVE
GRAND HAVEN, MI

CONSULTANT
GOLDER

YYYY-MM-DD	2019-01-16
DESIGNED	JJS
PREPARED	DJC
REVIEWED	CEP
APPROVED	DLP

PROJECT
2018 GROUNDWATER

TITLE
SEPTEMBER 26, 2018 GROUNDWATER CONTOURS

PROJECT NO.	CONTROL	REV.	FIGURE
1775416		0	3B

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

Path: \\detroitcad\Projects\17x-Projects\1775416_Grand Haven BWL\PRODUCTION\C-Groundwater Maps\ | File Name: 1775416C001.dwg | Last Edited By: dcoss Date: 2019-01-17 Time:3:54:13 PM | Printed By: DCoss Date: 2019-01-25 Time:3:58:38 PM

REFERENCE(S)

Service Layer Credits: Source: ESRI, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community. Date of imagery, 7/14/2016.

NOTE(S)

1. HORIZONTAL COORDINATE SYSTEM BASED ON MICHIGAN STATE PLANE SOUTH, INTERNATIONAL FEET. VERTICAL DATUM IS NAVD 1988.

LEGEND

MONITOR WELL

CLIENT
GRAND HAVEN BOARD OF LIGHT AND POWER
HARBOR ISLAND DRIVE
GRAND HAVEN, MI

CONSULTANT
GOLDER

YYYY-MM-DD	2019-01-11
DESIGNED	JJS
PREPARED	JJS
REVIEWED	CEP
APPROVED	DLP

PROJECT
2018 GROUNDWATER

TITLE
OCTOBER 22, 2018 GROUNDWATER CONTOURS

PROJECT NO.	CONTROL	REV.	FIGURE
1775416B		0	3C

APPENDIX A

Laboratory Analytical & Field Sampling Reports

Summit Environmental Technologies, Inc.
3310 Win St.
Cuyahoga Falls, Ohio 44223
TEL: (330) 253-8211 FAX: (330) 253-4489
Website: http://www.settek.com

December 10, 2018

Jon Mink
Trace Analytical Laboratories, Inc.
2241 Black Creek Road
Muskegon, MI 49444
TEL: (231) 773-5998
FAX: (231) 773-6537

RE: T18K248

Dear Jon Mink:

Order No.: 18110827

Summit Environmental Technologies, Inc. received 4 sample(s) on 11/14/2018 for the analyses presented in the following report.

There were no problems with the analytical events associated with this report unless noted in the Case Narrative.

Quality control data is within laboratory defined or method specified acceptance limits except where noted.

If you have any questions regarding these tests results, please feel free to call the laboratory.

Sincerely,

Holly Florea

Project Manager

3310 Win St.
Cuyahoga Falls, Ohio 44223

Summit Environmental Technologies, Inc.
3310 Win St.
Cuyahoga Falls, Ohio 44223
TEL: (330) 253-8211 FAX: (330) 253-4489
Website: http://www.settek.com

Case Narrative

WO#: **18110827**
Date: **12/10/2018**

CLIENT: Trace Analytical Laboratories, Inc.
Project: T18K248

This report in its entirety consists of the following documents: Cover Letter, Case Narrative, Analytical Results, QC Summary Report, Applicable Accreditation Information, Chain-of-Custody, Cooler Receipt Form, and other applicable forms as necessary. All documents contain the Summit Environmental Technologies, Inc., Work Order Number assigned to this report.

Summit Environmental Technologies, Inc., holds the accreditations/certifications listed at the bottom of the cover letter that may or may not pertain to this report. State Certificates and Scopes of Accreditation are attached as applicable. Results provided in this report for any parameter not listed on the Scope of Accreditation should be considered “not certified.”

 The results contained in this report are only representative of the samples received. Conditions can vary at different times and at different sampling conditions. Summit Environmental Technologies, Inc. is not responsible for use or interpretation of the data included herein.

All results for Solid Samples are reported on an "as received" or "wet weight" basis unless indicated as "dry weight" using the "-dry" designation on the reporting units.

This report is believed to meet all of the requirements of the accrediting agency, where applicable. Any comments or problems with the analytical events associated with this report are noted below.

Summit Environmental Technologies, Inc.
3310 Win St.
Cuyahoga Falls, Ohio 44223
TEL: (330) 253-8211 FAX: (330) 253-4489
Website: http://www.settek.com

Workorder Sample Summary

WO#: **18110827**

11-Dec-18

CLIENT: Trace Analytical Laboratories, Inc.
Project: T18K248

Lab SampleID	Client Sample ID	Tag No	Date Collected	Date Received	Matrix
18110827-001	T18K248-01		11/12/2018 10:50:00 AM	11/14/2018 10:35:00 AM	Non-Potable Water
18110827-002	T18K248-02		11/12/2018 11:40:00 AM	11/14/2018 10:35:00 AM	Non-Potable Water
18110827-003	T18K248-03		11/12/2018 9:50:00 AM	11/14/2018 10:35:00 AM	Non-Potable Water
18110827-004	T18K248-04		11/12/2018 12:25:00 PM	11/14/2018 10:35:00 AM	Non-Potable Water

Summit Environmental Technologies, Inc.
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Website: http://www.settek.com

Analytical Report

(consolidated)

WO#: **18110827**

Date Reported: **12/10/2018**

CLIENT: Trace Analytical Laboratories, Inc. **Collection Date:** 11/12/2018 10:50:00 AM

Project: T18K248

Lab ID: 18110827-001 **Matrix:** NON-POTABLE WATER

Client Sample ID T18K248-01

Analyses	Result	PQL	Qual	Units	Uncertainty	DF	Date Analyzed
COMBINED RADIUM (EPA903+904)				**CALCULATION**			Analyst: **CM**
Radium-226/Radium-228	ND	2.00		pCi/L	± 0.61	1	12/10/2018 11:37:30 A
RADIUM-226 (EPA 903.0)					**E903.0**	**E903-904**	Analyst: **BRD**
Radium-226	ND	1.00	U	pCi/L	± 0.12	1	12/3/2018 1:21:00 PM
Yield	1.00					1	12/3/2018 1:21:00 PM
RADIUM-228 (EPA 904.0)					**E904.0**	**E903-904**	Analyst: **BRD**
Radium-228	ND	1.00	U	pCi/L	± 0.49	1	11/29/2018 2:47:00 PM
Yield	1.00					1	11/29/2018 2:47:00 PM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	M	Manual Integration used to determine area response
MC	Value is below Minimum Compound Limit.	N	Tentatively identified compounds
ND	Not Detected	O	RSD is greater than RSDlimit
P	Second column confirmation exceeds	PL	Permit Limit

Summit Environmental Technologies, Inc.
3310 Win St.
Cuyahoga Falls, Ohio 44223
TEL: (330) 253-8211 FAX: (330) 253-4489
Website: http://www.settek.com

Analytical Report

(consolidated)

WO#: **18110827**

Date Reported: **12/10/2018**

CLIENT: Trace Analytical Laboratories, Inc. **Collection Date:** 11/12/2018 11:40:00 AM

Project: T18K248

Lab ID: 18110827-002 **Matrix:** NON-POTABLE WATER

Client Sample ID T18K248-02

Analyses	Result	PQL	Qual	Units	Uncertainty	DF	Date Analyzed
COMBINED RADIUM (EPA903+904)					**CALCULATION**		Analyst: **CM**
Radium-226/Radium-228	0.86	2.00	J	pCi/L	± 0.68	1	12/10/2018 11:37:30 A
RADIUM-226 (EPA 903.0)					**E903.0**	**E903-904**	Analyst: **BRD**
Radium-226	ND	1.00	U	pCi/L	± 0.09	1	12/3/2018 1:21:00 PM
Yield	1.00					1	12/3/2018 1:21:00 PM
RADIUM-228 (EPA 904.0)					**E904.0**	**E903-904**	Analyst: **BRD**
Radium-228	0.860	1.00	J	pCi/L	± 0.59	1	11/29/2018 2:47:00 PM
Yield	1.00					1	11/29/2018 2:47:00 PM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	M	Manual Integration used to determine area response
MC	Value is below Minimum Compound Limit.	N	Tentatively identified compounds
ND	Not Detected	O	RSD is greater than RSDlimit
P	Second column confirmation exceeds	PL	Permit Limit

Summit Environmental Technologies, Inc.
3310 Win St.
Cuyahoga Falls, Ohio 44223
TEL: (330) 253-8211 FAX: (330) 253-4489
Website: http://www.settek.com

Analytical Report

(consolidated)

WO#: **18110827**

Date Reported: **12/10/2018**

CLIENT: Trace Analytical Laboratories, Inc. **Collection Date:** 11/12/2018 9:50:00 AM

Project: T18K248

Lab ID: 18110827-003 **Matrix:** NON-POTABLE WATER

Client Sample ID T18K248-03

Analyses	Result	PQL	Qual	Units	Uncertainty	DF	Date Analyzed
COMBINED RADIUM (EPA903+904)				**CALCULATION**			Analyst: **CM**
Radium-226/Radium-228	ND	2.00		pCi/L	± 0.63	1	12/10/2018 11:37:30 A
RADIUM-226 (EPA 903.0)					**E903.0**	**E903-904**	Analyst: **BRD**
Radium-226	ND	1.00	U	pCi/L	± 0.12	1	12/3/2018 1:21:00 PM
Yield	1.00					1	12/3/2018 1:21:00 PM
RADIUM-228 (EPA 904.0)					**E904.0**	**E903-904**	Analyst: **BRD**
Radium-228	ND	1.00	U	pCi/L	± 0.51	1	11/29/2018 2:48:00 PM
Yield	1.00					1	11/29/2018 2:48:00 PM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	M	Manual Integration used to determine area response
MC	Value is below Minimum Compound Limit.	N	Tentatively identified compounds
ND	Not Detected	O	RSD is greater than RSDlimit
P	Second column confirmation exceeds	PL	Permit Limit

Summit Environmental Technologies, Inc.
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Cuyahoga Falls, Ohio 44223
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Website: http://www.settek.com

Analytical Report

(consolidated)

WO#: **18110827**

Date Reported: **12/10/2018**

CLIENT: Trace Analytical Laboratories, Inc. **Collection Date:** 11/12/2018 12:25:00 PM

Project: T18K248

Lab ID: 18110827-004 **Matrix:** NON-POTABLE WATER

Client Sample ID T18K248-04

Analyses	Result	PQL	Qual	Units	Uncertainty	DF	Date Analyzed
COMBINED RADIUM (EPA903+904)				**CALCULATION**			Analyst: **CM**
Radium-226/Radium-228	ND	2.00		pCi/L	± 0.62	1	12/10/2018 11:37:30 A
RADIUM-226 (EPA 903.0)					**E903.0**	**E903-904**	Analyst: **BRD**
Radium-226	ND	1.00	U	pCi/L	± 0.09	1	12/3/2018 1:21:00 PM
Yield	1.00					1	12/3/2018 1:21:00 PM
RADIUM-228 (EPA 904.0)					**E904.0**	**E903-904**	Analyst: **BRD**
Radium-228	ND	1.00	U	pCi/L	± 0.53	1	11/29/2018 2:48:00 PM
Yield	1.00					1	11/29/2018 2:48:00 PM

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	M	Manual Integration used to determine area response
MC	Value is below Minimum Compound Limit.	N	Tentatively identified compounds
ND	Not Detected	O	RSD is greater than RSDlimit
P	Second column confirmation exceeds	PL	Permit Limit

Summit Environmental Technologies, Inc.
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Cuyahoga Falls, Ohio 44223
TEL: (330) 253-8211 FAX: (330) 253-4489
Website: http://www.settek.com

QC SUMMARY REPORT

WO#: **18110827**

11-Dec-18

Client: Trace Analytical Laboratories, Inc.

Project: T18K248 **BatchID:** **34927**

Sample ID	**lcs-34927**	SampType:	**LCS**	TestCode:	**Radium-228_**	Units:	**pCi/L**	Prep Date:	**11/26/2018**	RunNo:	**91890**
Client ID:	**LCSW**	Batch ID:	**34927**	TestNo:	**E904.0**		**E903-904**	Analysis Date:	**11/29/2018**	SeqNo:	**1851467**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Radium-228	4.10	1.00	5.000	0	82.0	70	130				
Yield	1.00			0	0						

Sample ID	**lcsd-34927**	SampType:	**LCSD**	TestCode:	**Radium-228_**	Units:	**pCi/L**	Prep Date:	**11/26/2018**	RunNo:	**91890**
Client ID:	**LCSS02**	Batch ID:	**34927**	TestNo:	**E904.0**		**E903-904**	Analysis Date:	**11/29/2018**	SeqNo:	**1851468**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Radium-228	4.51	1.00	5.000	0	90.2	70	130	4.100	9.52	20	
Yield	1.00			0	0			1.000	0		

Sample ID	**rlc-34927**	SampType:	**RLC**	TestCode:	**Radium-228_**	Units:	**pCi/L**	Prep Date:	**11/26/2018**	RunNo:	**91890**
Client ID:	**BatchQC**	Batch ID:	**34927**	TestNo:	**E904.0**		**E903-904**	Analysis Date:	**11/29/2018**	SeqNo:	**1851470**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Radium-228	1.21	1.00	1.000	0	121	50	150				
Yield	0.990			0	0						

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits	M	Manual Integration used to determine
MC	Value is below Minimum Compound Limit.	ND	Not Detected	O	RSD is greater than RSDlimit
P	Second column confirmation exceeds	PL	Permit Limit	R	RPD outside accepted recovery limits

Summit Environmental Technologies, Inc.
3310 Win St.
Cuyahoga Falls, Ohio 44223
TEL: (330) 253-8211 FAX: (330) 253-4489
Website: http://www.settek.com

QC SUMMARY REPORT

WO#: **18110827**

11-Dec-18

Client: Trace Analytical Laboratories, Inc.

Project: T18K248 **BatchID:** **34927**

Sample ID **18110700-001aMS** SampType: **MS** TestCode: **Radium-228_** Units: **pCi/L** Prep Date: **11/26/2018** RunNo: **91890**

Client ID: **BatchQC** Batch ID: **34927** TestNo: **E904.0** **E903-904** Analysis Date: **11/29/2018** SeqNo: **1851471**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Radium-228	4.59	1.00	5.000	0	91.8	70	130				
Yield	1.00			1.000	0						

Sample ID **mb-34927** SampType: **MBLK** TestCode: **Radium-228_** Units: **pCi/L** Prep Date: **11/26/2018** RunNo: **91890**

Client ID: **PBW** Batch ID: **34927** TestNo: **E904.0** **E903-904** Analysis Date: **11/29/2018** SeqNo: **1851492**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Radium-228	ND	1.00		0	0						U
Yield	1.00			0	0						

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits	M	Manual Integration used to determine
MC	Value is below Minimum Compound Limit.	ND	Not Detected	O	RSD is greater than RSDlimit
P	Second column confirmation exceeds	PL	Permit Limit	R	RPD outside accepted recovery limits

Summit Environmental Technologies, Inc.
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TEL: (330) 253-8211 FAX: (330) 253-4489
Website: http://www.settek.com

QC SUMMARY REPORT

WO#: **18110827**

11-Dec-18

Client: Trace Analytical Laboratories, Inc.
Project: T18K248 **BatchID:** **34927**

Sample ID **mb-34927**	SampType: **MBLK**	TestCode: **Radium-226_**	Units: **pCi/L**	Prep Date: **11/26/2018**	RunNo: **91896**
Client ID: **PBW**	Batch ID: **34927**	TestNo: **E903.0**	**E903-904**	Analysis Date: **11/30/2018**	SeqNo: **1851639**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Radium-226	ND	1.00									U
Yield	1.00										

Sample ID **lcs-34927**	SampType: **LCS**	TestCode: **Radium-226_**	Units: **pCi/L**	Prep Date: **11/26/2018**	RunNo: **91896**
Client ID: **LCSW**	Batch ID: **34927**	TestNo: **E903.0**	**E903-904**	Analysis Date: **11/30/2018**	SeqNo: **1851640**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Radium-226	4.96	1.00	5.000	0	99.2	70	130				

Sample ID **lcsd-34927**	SampType: **LCSD**	TestCode: **Radium-226_**	Units: **pCi/L**	Prep Date: **11/26/2018**	RunNo: **91896**
Client ID: **LCSS02**	Batch ID: **34927**	TestNo: **E903.0**	**E903-904**	Analysis Date: **11/30/2018**	SeqNo: **1851641**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Radium-226	5.12	1.00	5.000	0	102	70	130	4.960	3.17	20	

Sample ID **rlc-34927**	SampType: **RLC**	TestCode: **Radium-226_**	Units: **pCi/L**	Prep Date: **11/26/2018**	RunNo: **91896**
Client ID: **BatchQC**	Batch ID: **34927**	TestNo: **E903.0**	**E903-904**	Analysis Date: **11/30/2018**	SeqNo: **1851643**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits	M	Manual Integration used to determine
MC	Value is below Minimum Compound Limit.	ND	Not Detected	O	RSD is greater than RSDlimit
P	Second column confirmation exceeds	PL	Permit Limit	R	RPD outside accepted recovery limits

Summit Environmental Technologies, Inc.
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Website: http://www.settek.com

QC SUMMARY REPORT

WO#: **18110827**

11-Dec-18

Client: Trace Analytical Laboratories, Inc.

Project: T18K248 **BatchID:** **34927**

Sample ID	**rlc-34927**	SampType:	**RLC**	TestCode:	**Radium-226_**	Units:	**pCi/L**	Prep Date:	**11/26/2018**	RunNo:	**91896**
Client ID:	**BatchQC**	Batch ID:	**34927**	TestNo:	**E903.0**		**E903-904**	Analysis Date:	**11/30/2018**	SeqNo:	**1851643**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Radium-226	1.13	1.00	1.000	0	113	50	150				
Yield	1.00										

Sample ID	**18110700-001aMS**	SampType:	**MS**	TestCode:	**Radium-226_**	Units:	**pCi/L**	Prep Date:	**11/26/2018**	RunNo:	**91896**
Client ID:	**BatchQC**	Batch ID:	**34927**	TestNo:	**E903.0**		**E903-904**	Analysis Date:	**11/30/2018**	SeqNo:	**1851644**

Analyte	Result	PQL	SPK value	SPK Ref Val	%REC	LowLimit	HighLimit	RPD Ref Val	%RPD	RPDLimit	Qual
Radium-226	5.16	1.00	5.000	0	103	70	130				

Qualifiers:

*	Value exceeds Maximum Contaminant Level.	B	Analyte detected in the associated Method Blank	E	Value above quantitation range
H	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits	M	Manual Integration used to determine
MC	Value is below Minimum Compound Limit.	ND	Not Detected	O	RSD is greater than RSDlimit
P	Second column confirmation exceeds	PL	Permit Limit	R	RPD outside accepted recovery limits

Summit Environmental Technologies, In
3310 Win S
Cuyahoga Falls, Ohio 4422
TEL: (330) 253-8211 FAX: (330) 253-448
Website: http://www.settek.co

Qualifiers and Acronyms

WO#: **18110827**
Date: **12/10/2018**

These commonly used Qualifiers and Acronyms may or may not be present in this report.

Qualifiers

U	The compound was analyzed for but was not detected.
J	The reported value is greater than the Method Detection Limit but less than the Reporting Limit.
H	The hold time for sample preparation and/or analysis was exceeded.
D	The result is reported from a dilution.
E	The result exceeded the linear range of the calibration or is estimated due to interference.
MC	The result is below the Minimum Compound Limit.
*****	The result exceeds the Regulatory Limit or Maximum Contamination Limit.
m	Manual integration was used to determine the area response.
d	Manual integration in which peak was deleted
N	The result is presumptive based on a Mass Spectral library search assuming a 1:1 response.
P	The second column confirmation exceeded 25% difference.
C	The result has been confirmed by GC/MS.
X	The result was not confirmed when GC/MS Analysis was performed.
B/MB+	The analyte was detected in the associated blank.
G	The ICB or CCB contained reportable amounts of analyte.
QC-/+	The CCV recovery failed low (-) or high (+).
R/QDR	The RPD was outside of accepted recovery limits.
QL-/+	The LCS or LCSD recovery failed low (-) or high (+).
QLR	The LCS/LCSD RPD was outside of accepted recovery limits.
QM-/+	The MS or MSD recovery failed low (-) or high (+).
QMR	The MS/MSD RPD was outside of accepted recovery limits.
QV-/+	The ICV recovery failed low (-) or high (+).
S	The spike result was outside of accepted recovery limits.
Z	Deviation; A deviation from the method was performed; Please refer to the Case Narrative for additional information

Acronyms

ND	Not Detected	**RL**	Reporting Limit
QC	Quality Control	**MDL**	Method Detection Limit
MB	Method Blank	**LOD**	Level of Detection
LCS	Laboratory Control Sample	**LOQ**	Level of Quantitation
LCSD	Laboratory Control Sample Duplicate	**PQL**	Practical Quantitation Limit
QCS	Quality Control Sample	**CRQL**	Contract Required Quantitation Limit
DUP	Duplicate	**PL**	Permit Limit
MS	Matrix Spike	**RegLvl**	Regulatory Limit
MSD	Matrix Spike Duplicate	**MCL**	Maximum Contamination Limit
RPD	Relative Percent Different	**MinCL**	Minimum Compound Limit
ICV	Initial Calibration Verification	**RA**	Reanalysis
ICB	Initial Calibration Blank	**RE**	Reextraction
CCV	Continuing Calibration Verification	**TIC**	Tentatively Identified Compound
CCB	Continuing Calibration Blank	**RT**	Retention Time
RLC	Reporting Limit Check	**CF**	Calibration Factor
DF	Dilution Factor	**RF**	Response Factor

This list of Qualifiers and Acronyms reflects the most commonly utilized Qualifiers and Acronyms for reporting. Please refer to the Analytical Notes in the Case Narrative for any Qualifiers or Acronyms that do not appear in this list or for additional information regarding the use of these Qualifiers on reported data.

Trace Analytical Laboratories, Inc.
2241 Black Creek Road
Muskegon, MI 49444-2673

TRACE ANALYTICAL LABORATORIES, INC.

231-773-5998 Phone
888-979-4469 Fax
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SUBCONTRACT ORDER

T18K248

SENDING LABORATORY:

Trace Analytical Laboratories, Inc.
2241 Black Creek Road
Muskegon, MI 49444
Phone: 231.773.5998
Fax: 888.979.4469
Project Manager: Jon Mink

RECEIVING LABORATORY:

Summit Environmental Technologies, Inc.
3310 Win Street
Cuyahoga Falls, OH 44223
Phone :(330) 253-8211
Fax: (330) 253-4489

PO # 111220BJS2

Accounting Code: _____

				pH	CDM
Sample ID: T18K248-01	**Aqueous**	**Sampled: 11/12/18 10:50**			
Subcontracted Work	11/19/18 15:00	11/12/19 10:50	Radium 226/228 to Summit	2	16
Containers Supplied:					
1-PL1000 pH <2 w/ HNO	1-PL1000 pH <2 w/ HNO	1-PL1000 pH <2 w/ HNO		2	
				2	
Sample ID: T18K248-02	**Aqueous**	**Sampled: 11/12/18 11:40**			
Subcontracted Work	11/19/18 15:00	11/12/19 11:40	Radium 226/228 to Summit	2	16
Containers Supplied:					
1-PL1000 pH <2 w/ HNO	1-PL1000 pH <2 w/ HNO	1-PL1000 pH <2 w/ HNO		2	
				2	
Sample ID: T18K248-03	**Aqueous**	**Sampled: 11/12/18 09:50**			
Subcontracted Work	11/19/18 15:00	11/12/19 09:50	Radium 226/228 to Summit	2	19
Containers Supplied:					
1-PL1000 pH <2 w/ HNO	1-PL1000 pH <2 w/ HNO	1-PL1000 pH <2 w/ HNO		2	
				2	
Sample ID: T18K248-04	**Aqueous**	**Sampled: 11/12/18 12:25**			
Subcontracted Work	11/19/18 15:00	11/12/19 12:25	Radium 226/228 to Summit	2	14
Containers Supplied:					
1-PL1000 pH <2 w/ HNO	1-PL1000 pH <2 w/ HNO	1-PL1000 pH <2 w/ HNO		2	
				2	

1811082 7-001-004

Released By	Date	Received By	Date
[signature]	11/12/18 @ 17:00	[signature]	11-14-18 1035
Released By	Date	Received By	Date

Summit Environmental Technologies, Inc.
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Website: http://www.settek.com

Sample Log-In Check List

Client Name: **TRA-MI-49444** Work Order Number: **18110827** RcptNo: **1**

Logged by:	**Jacqueline Rasile**	**11/14/2018 10:35:00 AM**	
Completed By:	**Christopher Livengood**	**11/15/2018 1:49:53 PM**	Christopher Livengood
Reviewed By:	**Holly Florea**	**11/16/2018 1:06:34 PM**	Holly Florea

Chain of Custody

1.	Is Chain of Custody complete?	Yes ☑	No ☐	Not Present ☐
2.	How was the sample delivered?	UPS		

Log In

3.	Coolers are present?	Yes ☑	No ☐	NA ☐
4.	Shipping container/cooler in good condition?	Yes ☑	No ☐	
	Custody seals intact on shipping container/cooler?	Yes ☐	No ☐	Not Present ☑
	No. Seal Date:	Signed By:		
5.	Was an attempt made to cool the samples?	Yes ☐	No ☑	NA ☐
6.	Were all samples received at a temperature of >0° C to 6.0°C	Yes ☐	No ☑	NA ☐
		Not required		
7.	Sample(s) in proper container(s)?	Yes ☑	No ☐	
8.	Sufficient sample volume for indicated test(s)?	Yes ☑	No ☐	
9.	Are samples (except VOA and ONG) properly preserved?	Yes ☑	No ☐	
10.	Was preservative added to bottles?	Yes ☐	No ☑	NA ☐
11.	Is the headspace in the VOA vials less than 1/4 inch or 6 mm?	Yes ☐	No ☐	No VOA Vials ☑
12.	Were any sample containers received broken?	Yes ☐	No ☑	
13.	Does paperwork match bottle labels? (Note discrepancies on chain of custody)	Yes ☑	No ☐	
14.	Are matrices correctly identified on Chain of Custody?	Yes ☑	No ☐	
15.	Is it clear what analyses were requested?	Yes ☑	No ☐	
16.	Were all holding times able to be met? (If no, notify customer for authorization.)	Yes ☑	No ☐	

Special Handling (if applicable)

17.	Was client notified of all discrepancies with this order?	Yes ☐	No ☐	NA ☑

Person Notified: Date

By Whom: Via: ☐ eMail ☐ Phone ☐ Fax ☐ In Person

Regarding:

Client Instructions:

18. Additional remarks:

Cooler Information

Cooler No	Temp ºC	Condition	Seal Intact	Seal No	Seal Date	Signed By
1	13.0	Good	Not Present			

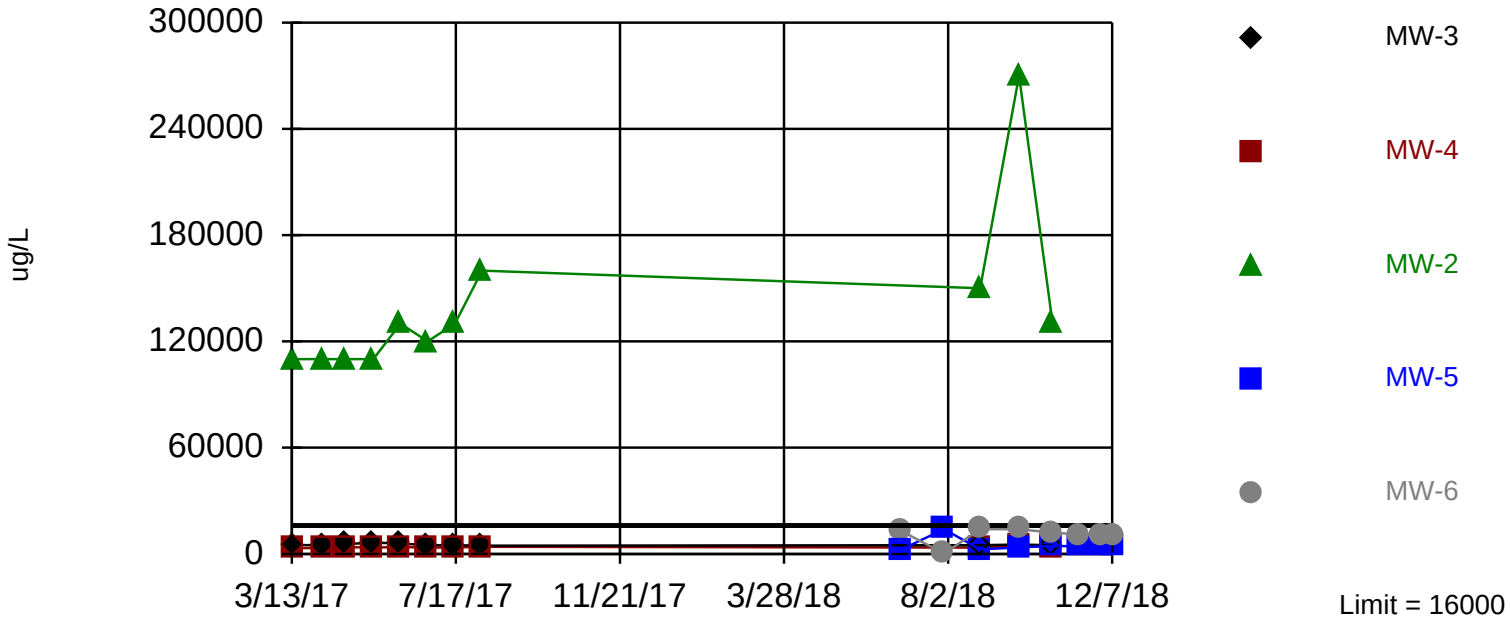
APPENDIX B

Statistical Analyses

Exceeds Limit: MW-2

Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.05 alpha level. Limit is highest of 16 background values. Report alpha = 0.2381. Individual comparison alpha = 0.05293. Most recent point for each compliance well compared to limit. Insufficient data to test for seasonality; data will not be deseasonalized.

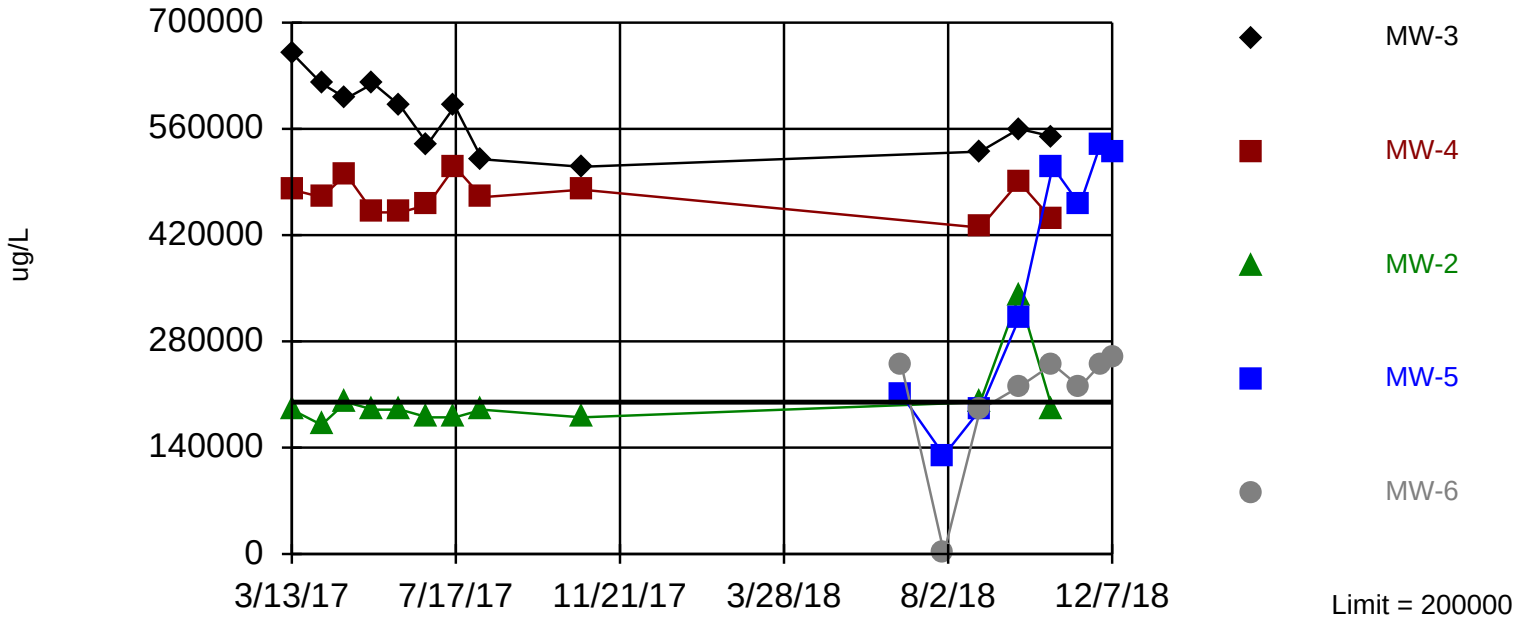
Constituent: Boron Analysis Run 1/15/2019 2:12 PM View: Appendix III

Grand Haven BLP Client: Golder Associates Data: DT-Grand Haven BLP

Exceeds Limit: MW-3, MW-4, MW-5, MW-6

Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.05 alpha level. Limit is highest of 16 background values. Report alpha = 0.2381. Individual comparison alpha = 0.05293. Most recent point for each compliance well compared to limit. Insufficient data to test for seasonality; data will not be deseasonalized.

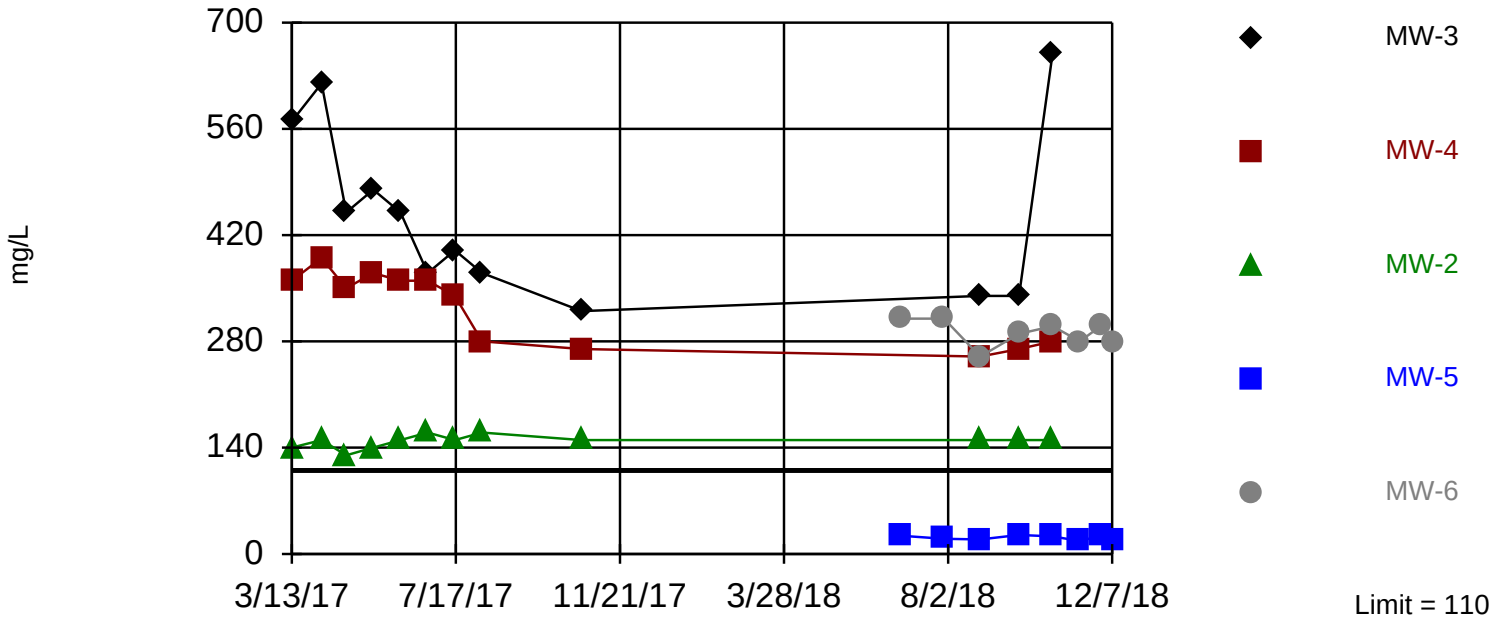
Constituent: Calcium Analysis Run 1/15/2019 2:12 PM View: Appendix III

Grand Haven BLP Client: Golder Associates Data: DT-Grand Haven BLP

Exceeds Limit: MW-3, MW-4, MW-2, MW-6

Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.05 alpha level. Limit is highest of 16 background values. Report alpha = 0.2381. Individual comparison alpha = 0.05293. Most recent point for each compliance well compared to limit. Insufficient data to test for seasonality; data will not be deseasonalized.

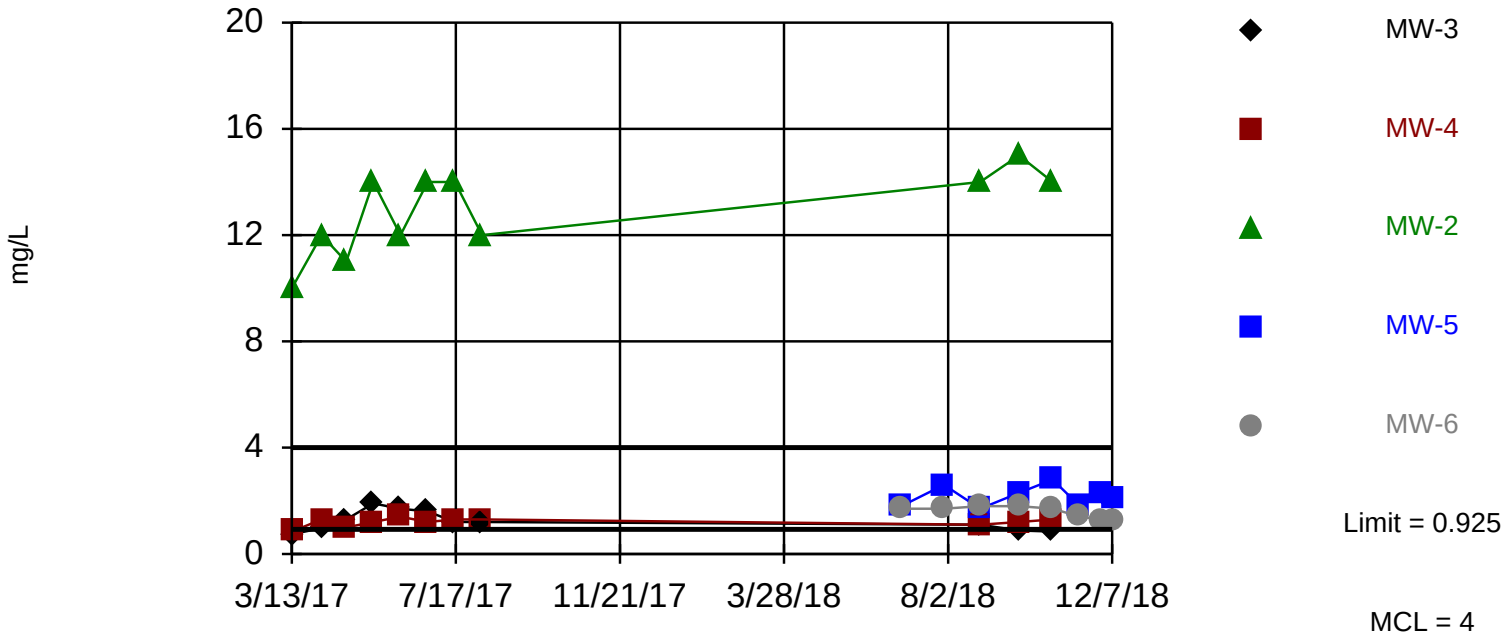
Constituent: Chloride Analysis Run 1/15/2019 2:12 PM View: Appendix III

Grand Haven BLP Client: Golder Associates Data: DT-Grand Haven BLP

Exceeds Limit: MW-4, MW-2, MW-5, MW-6

Prediction Limit

Interwell Parametric



Background Data Summary (based on natural log transformation): Mean=-1.85, Std. Dev.=0.9485, n=16, 12.5% NDs. Insufficient data to test for seasonality; not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.05, calculated = 0.9305, critical = 0.887. Report alpha = 0.2056. Individual comparison alpha = 0.045. Most recent point for each compliance well compared to limit.

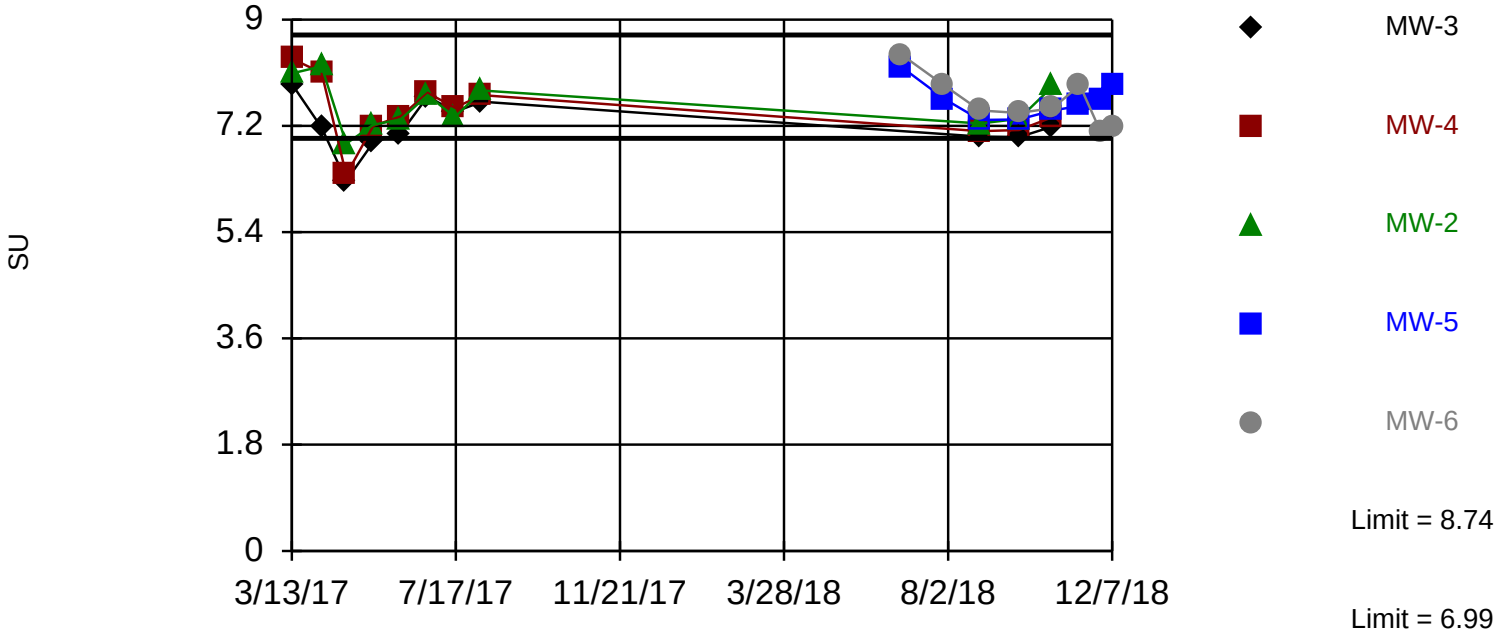
Constituent: Fluoride Analysis Run 1/15/2019 2:12 PM View: Appendix III

Grand Haven BLP Client: Golder Associates Data: DT-Grand Haven BLP

Within Limits

Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.05 alpha level. Limits are highest and lowest of 16 background values. Report alpha = 0.4762. Individual comparison alpha = 0.1059. Most recent point for each compliance well compared to limit. Insufficient data to test for seasonality; data will not be deseasonalized.

Constituent: pH Analysis Run 1/15/2019 2:12 PM View: Appendix III

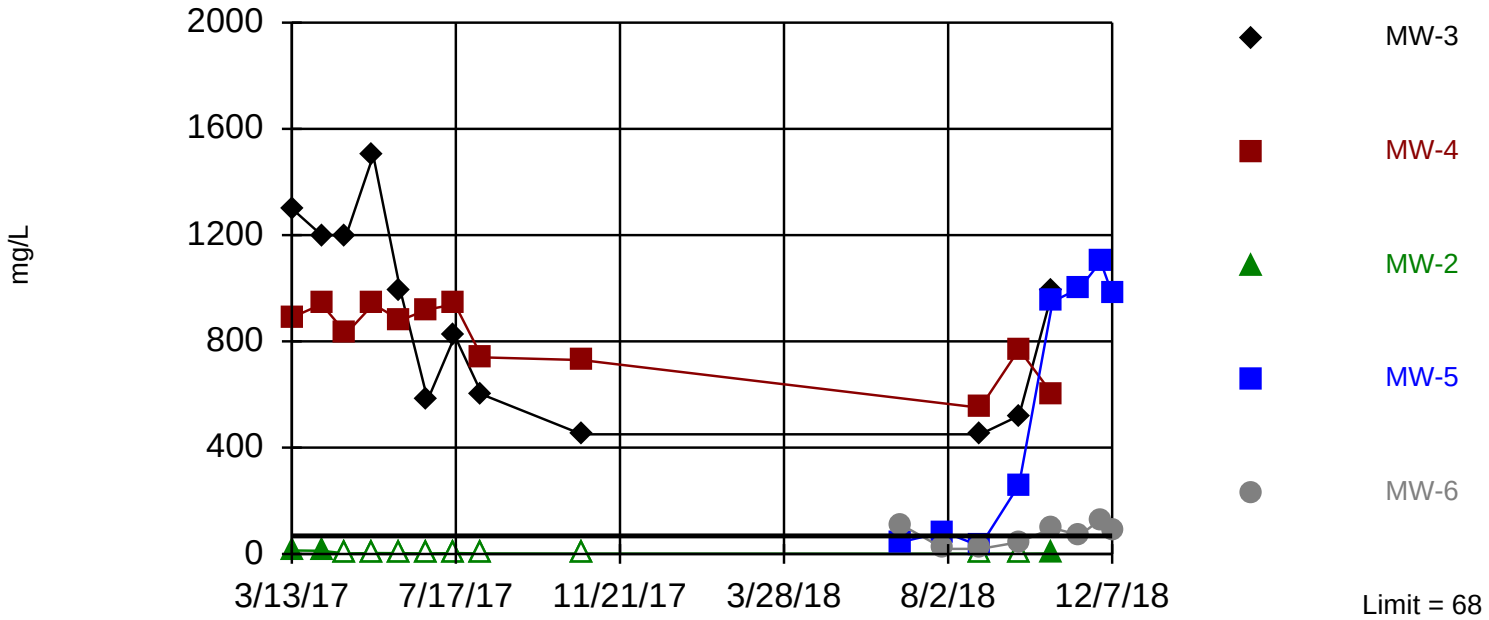
Grand Haven BLP Client: Golder Associates Data: DT-Grand Haven BLP

Sanitas™ v.9.6.12 For the statistical analyses of ground water by Golder Associates only. EPA
Hollow symbols indicate censored values.

Exceeds Limit: MW-3, MW-4, MW-5, MW-6

Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.05 alpha level. Limit is highest of 16 background values. Report alpha = 0.2381. Individual comparison alpha = 0.05293. Most recent point for each compliance well compared to limit. Insufficient data to test for seasonality; data will not be deseasonalized.

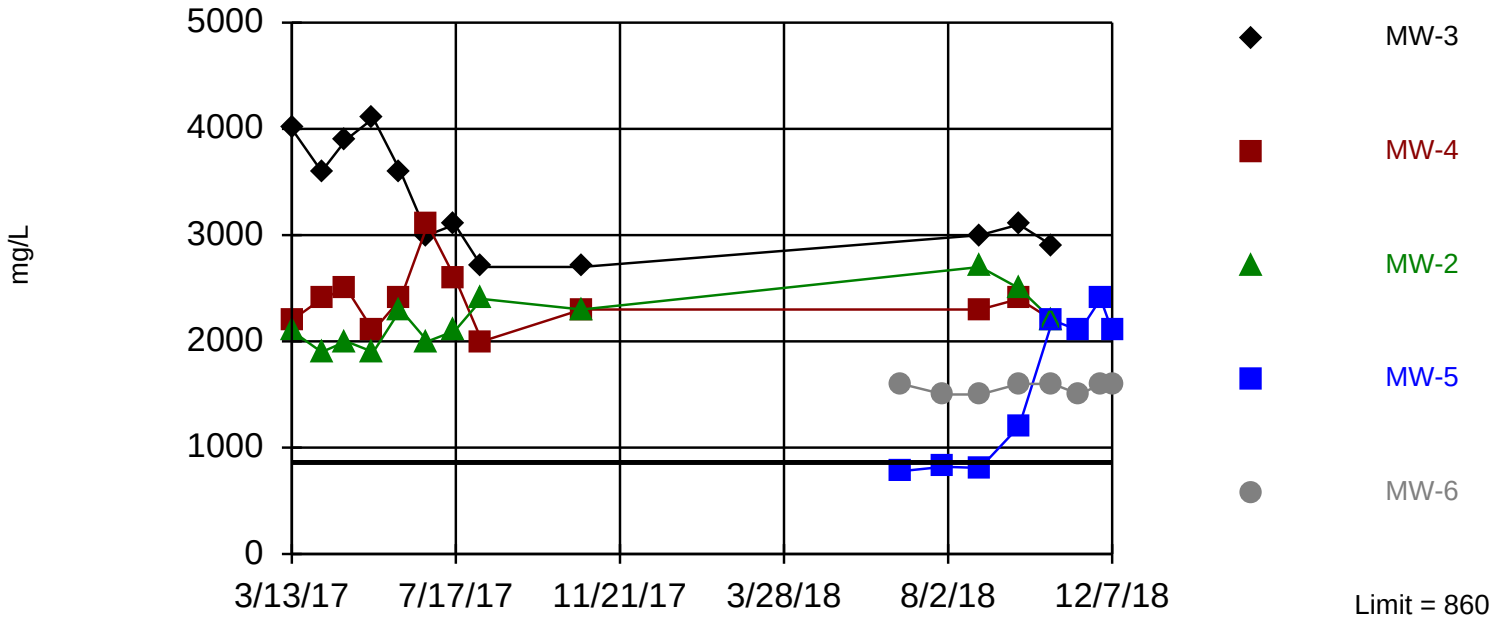
Constituent: Sulfate Analysis Run 1/15/2019 2:12 PM View: Appendix III

Grand Haven BLP Client: Golder Associates Data: DT-Grand Haven BLP

Exceeds Limit: MW-3, MW-4, MW-2, MW-5, MW-6

Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.05 alpha level. Limit is highest of 16 background values. Report alpha = 0.2381. Individual comparison alpha = 0.05293. Most recent point for each compliance well compared to limit. Insufficient data to test for seasonality; data will not be deseasonalized.

Constituent: Total Dissolved Solids Analysis Run 1/15/2019 2:12 PM View: Appendix III

Grand Haven BLP Client: Golder Associates Data: DT-Grand Haven BLP

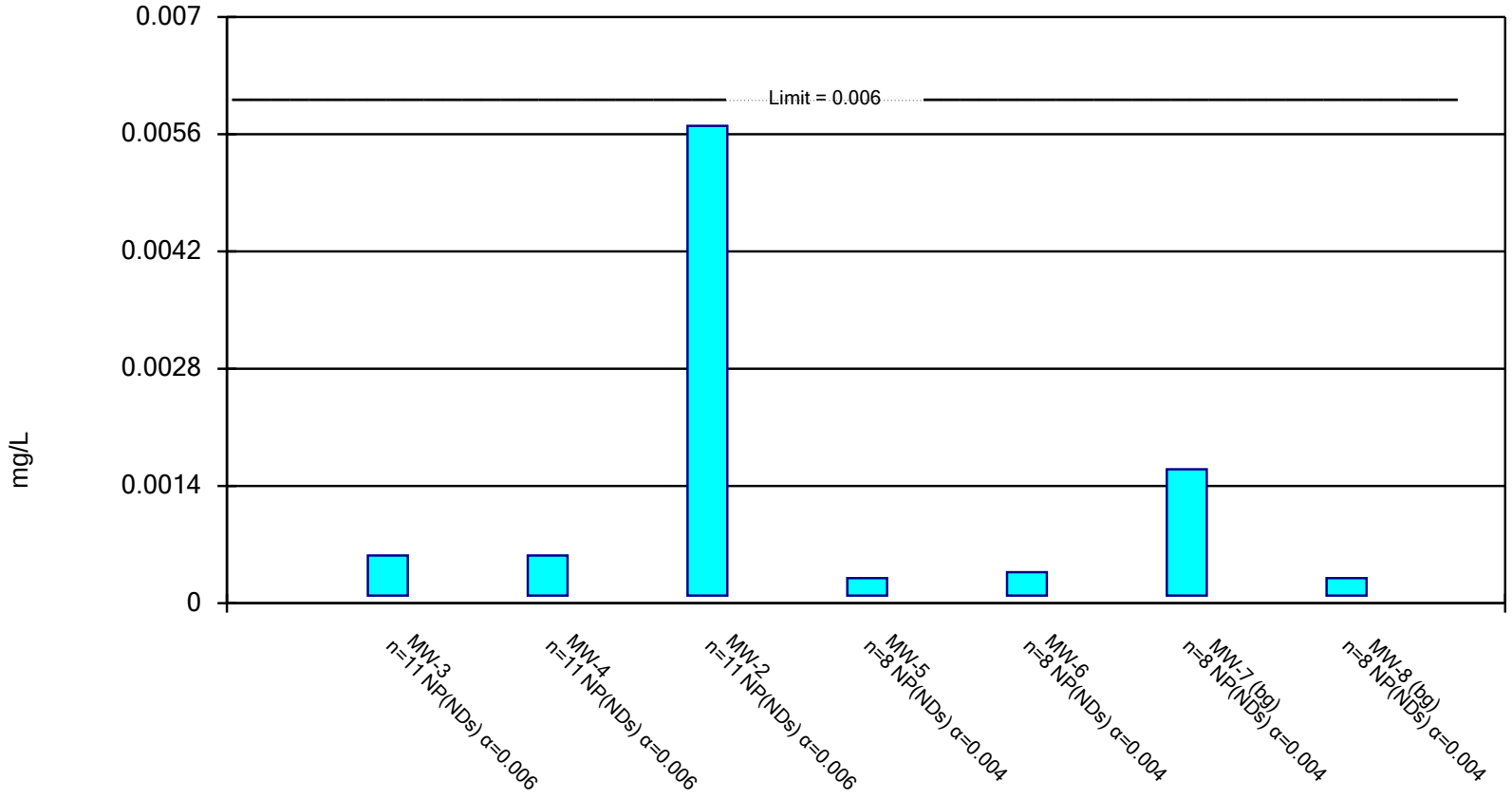
Interwell Prediction Limit

Grand Haven BLP Client: Golder Associates Data: DT-Grand Haven BLP Printed 1/15/2019, 2:14 PM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Wells	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron (ug/L)	MW-3	16000	n/a	10/22/2018	4900	No	16	MW-8,MW-7	n/a	n/a	0	n/a	n/a	0.05293	NP Inter (normality)
Boron (ug/L)	MW-4	16000	n/a	10/22/2018	4100	No	16	MW-8,MW-7	n/a	n/a	0	n/a	n/a	0.05293	NP Inter (normality)
Boron (ug/L)	**MW-2**	**16000**	**n/a**	**10/22/2018**	**130000**	**Yes**	**16**	**MW-8,MW-7**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.05293**	**NP Inter (normality)**
Boron (ug/L)	MW-5	16000	n/a	12/7/2018	4200	No	16	MW-8,MW-7	n/a	n/a	0	n/a	n/a	0.05293	NP Inter (normality)
Boron (ug/L)	MW-6	16000	n/a	12/7/2018	11000	No	16	MW-8,MW-7	n/a	n/a	0	n/a	n/a	0.05293	NP Inter (normality)
Calcium (ug/L)	**MW-3**	**200000**	**n/a**	**10/22/2018**	**550000**	**Yes**	**16**	**MW-8,MW-7**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.05293**	**NP Inter (normality)**
Calcium (ug/L)	**MW-4**	**200000**	**n/a**	**10/22/2018**	**440000**	**Yes**	**16**	**MW-8,MW-7**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.05293**	**NP Inter (normality)**
Calcium (ug/L)	MW-2	200000	n/a	10/22/2018	190000	No	16	MW-8,MW-7	n/a	n/a	0	n/a	n/a	0.05293	NP Inter (normality)
Calcium (ug/L)	**MW-5**	**200000**	**n/a**	**12/7/2018**	**530000**	**Yes**	**16**	**MW-8,MW-7**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.05293**	**NP Inter (normality)**
Calcium (ug/L)	**MW-6**	**200000**	**n/a**	**12/7/2018**	**260000**	**Yes**	**16**	**MW-8,MW-7**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.05293**	**NP Inter (normality)**
Chloride (mg/L)	**MW-3**	**110**	**n/a**	**10/22/2018**	**660**	**Yes**	**16**	**MW-7,MW-8**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.05293**	**NP Inter (normality)**
Chloride (mg/L)	**MW-4**	**110**	**n/a**	**10/22/2018**	**280**	**Yes**	**16**	**MW-7,MW-8**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.05293**	**NP Inter (normality)**
Chloride (mg/L)	**MW-2**	**110**	**n/a**	**10/22/2018**	**150**	**Yes**	**16**	**MW-7,MW-8**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.05293**	**NP Inter (normality)**
Chloride (mg/L)	MW-5	110	n/a	12/7/2018	17	No	16	MW-7,MW-8	n/a	n/a	0	n/a	n/a	0.05293	NP Inter (normality)
Chloride (mg/L)	**MW-6**	**110**	**n/a**	**12/7/2018**	**280**	**Yes**	**16**	**MW-7,MW-8**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.05293**	**NP Inter (normality)**
Fluoride (mg/L)	MW-3	0.925	n/a	10/22/2018	0.84	No	16	MW-7,MW-8	-1.85	0.9485	12.5	None	ln(x)	0.045	Param Inter
Fluoride (mg/L)	**MW-4**	**0.925**	**n/a**	**10/22/2018**	**1.3**	**Yes**	**16**	**MW-7,MW-8**	**-1.85**	**0.9485**	**12.5**	**None**	**ln(x)**	**0.045**	**Param Inter**
Fluoride (mg/L)	**MW-2**	**0.925**	**n/a**	**10/22/2018**	**14**	**Yes**	**16**	**MW-7,MW-8**	**-1.85**	**0.9485**	**12.5**	**None**	**ln(x)**	**0.045**	**Param Inter**
Fluoride (mg/L)	**MW-5**	**0.925**	**n/a**	**12/7/2018**	**2.1**	**Yes**	**16**	**MW-7,MW-8**	**-1.85**	**0.9485**	**12.5**	**None**	**ln(x)**	**0.045**	**Param Inter**
Fluoride (mg/L)	**MW-6**	**0.925**	**n/a**	**12/7/2018**	**1.3**	**Yes**	**16**	**MW-7,MW-8**	**-1.85**	**0.9485**	**12.5**	**None**	**ln(x)**	**0.045**	**Param Inter**
pH (SU)	MW-3	8.74	6.99	10/22/2018	7.19	No	16	MW-7,MW-8	n/a	n/a	0	n/a	n/a	0.1059	NP Inter (normality)
pH (SU)	MW-4	8.74	6.99	10/22/2018	7.35	No	16	MW-7,MW-8	n/a	n/a	0	n/a	n/a	0.1059	NP Inter (normality)
pH (SU)	MW-2	8.74	6.99	10/22/2018	7.87	No	16	MW-7,MW-8	n/a	n/a	0	n/a	n/a	0.1059	NP Inter (normality)
pH (SU)	MW-5	8.74	6.99	12/7/2018	7.9	No	16	MW-7,MW-8	n/a	n/a	0	n/a	n/a	0.1059	NP Inter (normality)
pH (SU)	MW-6	8.74	6.99	12/7/2018	7.16	No	16	MW-7,MW-8	n/a	n/a	0	n/a	n/a	0.1059	NP Inter (normality)
Sulfate (mg/L)	**MW-3**	**68**	**n/a**	**10/22/2018**	**990**	**Yes**	**16**	**MW-8,MW-7**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.05293**	**NP Inter (normality)**
Sulfate (mg/L)	**MW-4**	**68**	**n/a**	**10/22/2018**	**600**	**Yes**	**16**	**MW-8,MW-7**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.05293**	**NP Inter (normality)**
Sulfate (mg/L)	MW-2	68	n/a	10/22/2018	1.4	No	16	MW-8,MW-7	n/a	n/a	0	n/a	n/a	0.05293	NP Inter (normality)
Sulfate (mg/L)	**MW-5**	**68**	**n/a**	**12/7/2018**	**980**	**Yes**	**16**	**MW-8,MW-7**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.05293**	**NP Inter (normality)**
Sulfate (mg/L)	**MW-6**	**68**	**n/a**	**12/7/2018**	**90**	**Yes**	**16**	**MW-8,MW-7**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.05293**	**NP Inter (normality)**
Total Dissolved Solids (mg/L)	**MW-3**	**860**	**n/a**	**10/22/2018**	**2900**	**Yes**	**16**	**MW-8,MW-7**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.05293**	**NP Inter (normality)**
Total Dissolved Solids (mg/L)	**MW-4**	**860**	**n/a**	**10/22/2018**	**2200**	**Yes**	**16**	**MW-8,MW-7**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.05293**	**NP Inter (normality)**
Total Dissolved Solids (mg/L)	**MW-2**	**860**	**n/a**	**10/22/2018**	**2200**	**Yes**	**16**	**MW-8,MW-7**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.05293**	**NP Inter (normality)**
Total Dissolved Solids (mg/L)	**MW-5**	**860**	**n/a**	**12/7/2018**	**2100**	**Yes**	**16**	**MW-8,MW-7**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.05293**	**NP Inter (normality)**
Total Dissolved Solids (mg/L)	**MW-6**	**860**	**n/a**	**12/7/2018**	**1600**	**Yes**	**16**	**MW-8,MW-7**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.05293**	**NP Inter (normality)**

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.

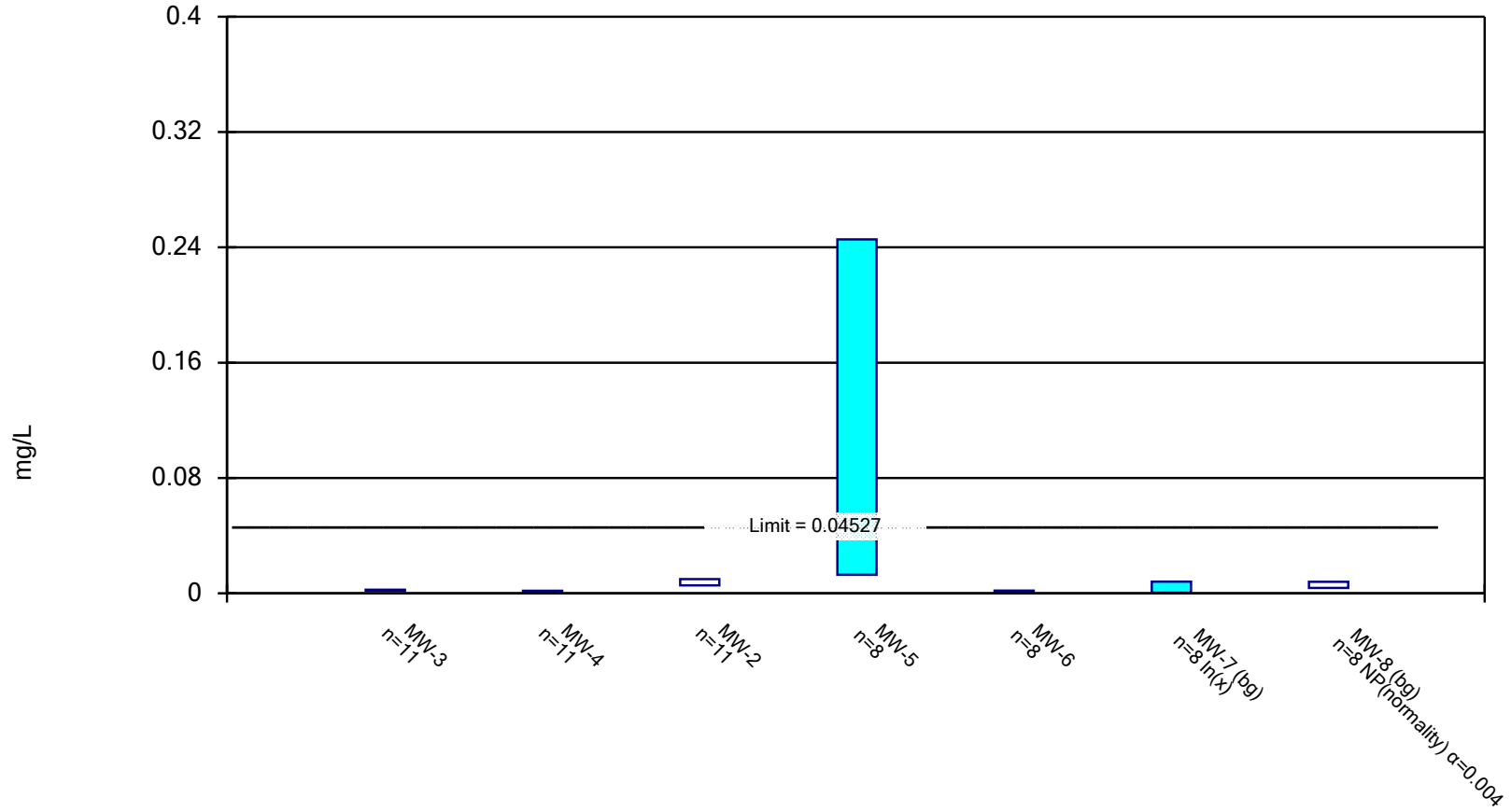


Constituent: Antimony Analysis Run 1/15/2019 1:51 PM View: Appendix IV

Grand Haven BLP Client: Golder Associates Data: DT-Grand Haven BLP

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

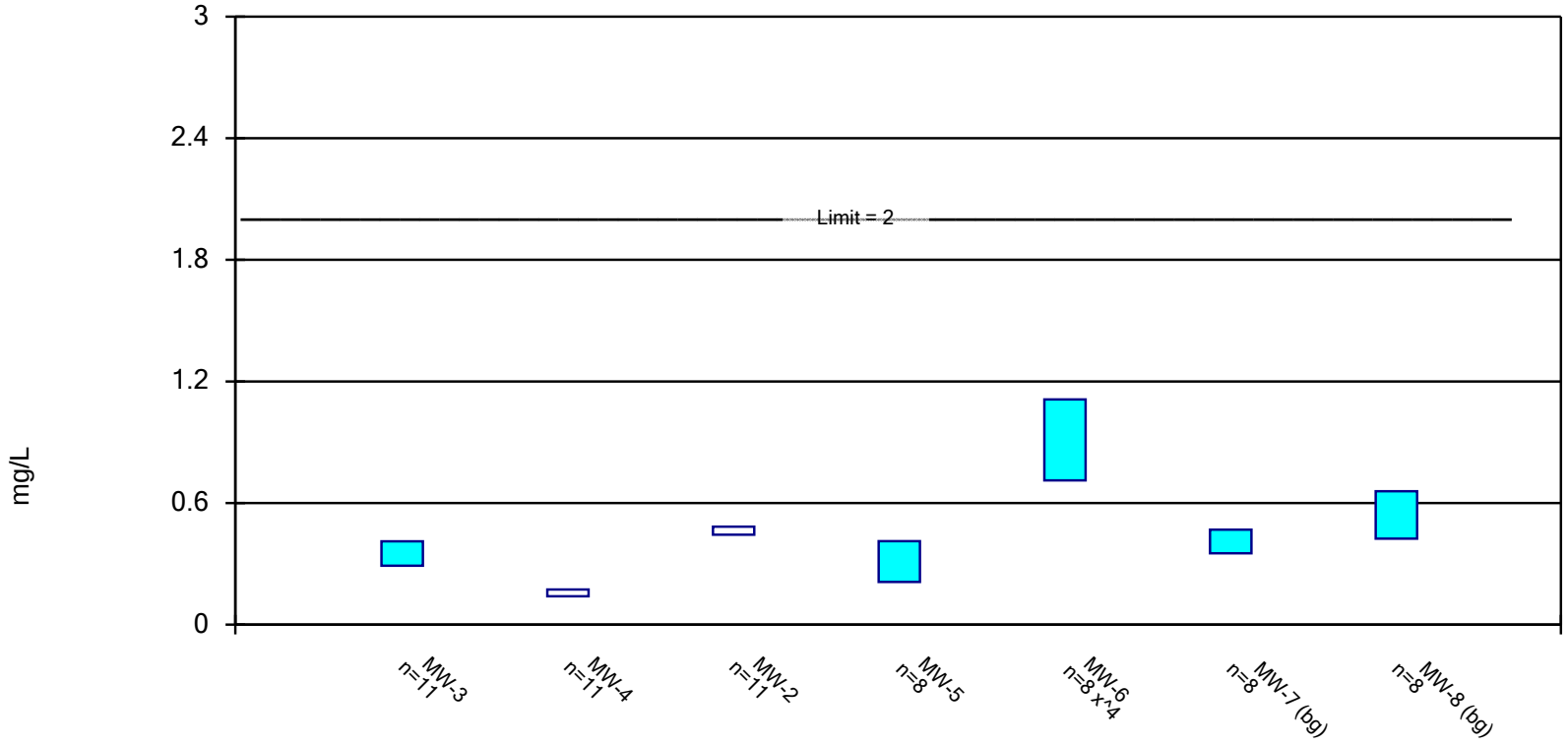


Constituent: Arsenic Analysis Run 1/15/2019 1:51 PM View: Appendix IV

Grand Haven BLP Client: Golder Associates Data: DT-Grand Haven BLP

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

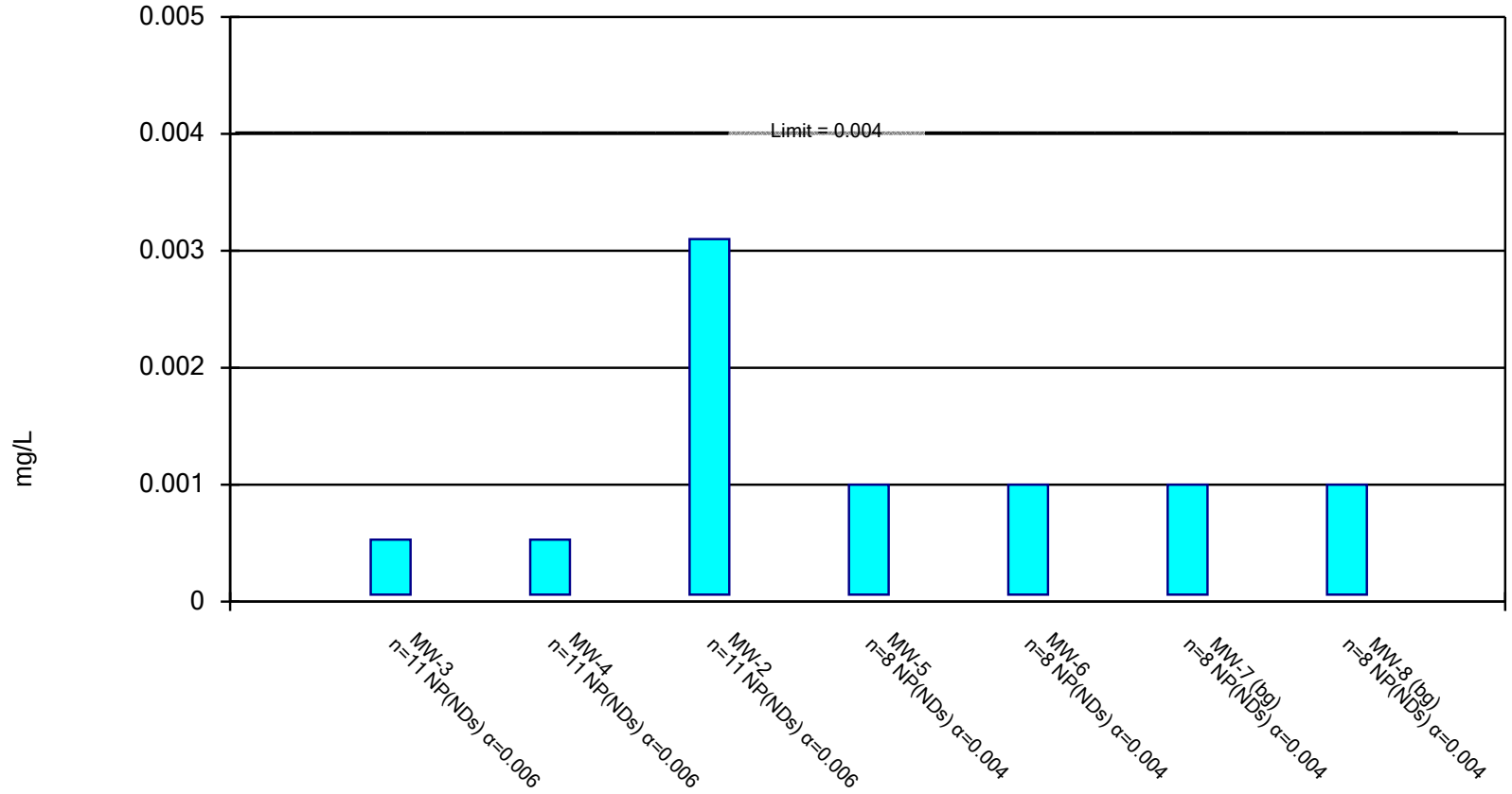


Constituent: Barium Analysis Run 1/15/2019 1:51 PM View: Appendix IV

Grand Haven BLP Client: Golder Associates Data: DT-Grand Haven BLP

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.

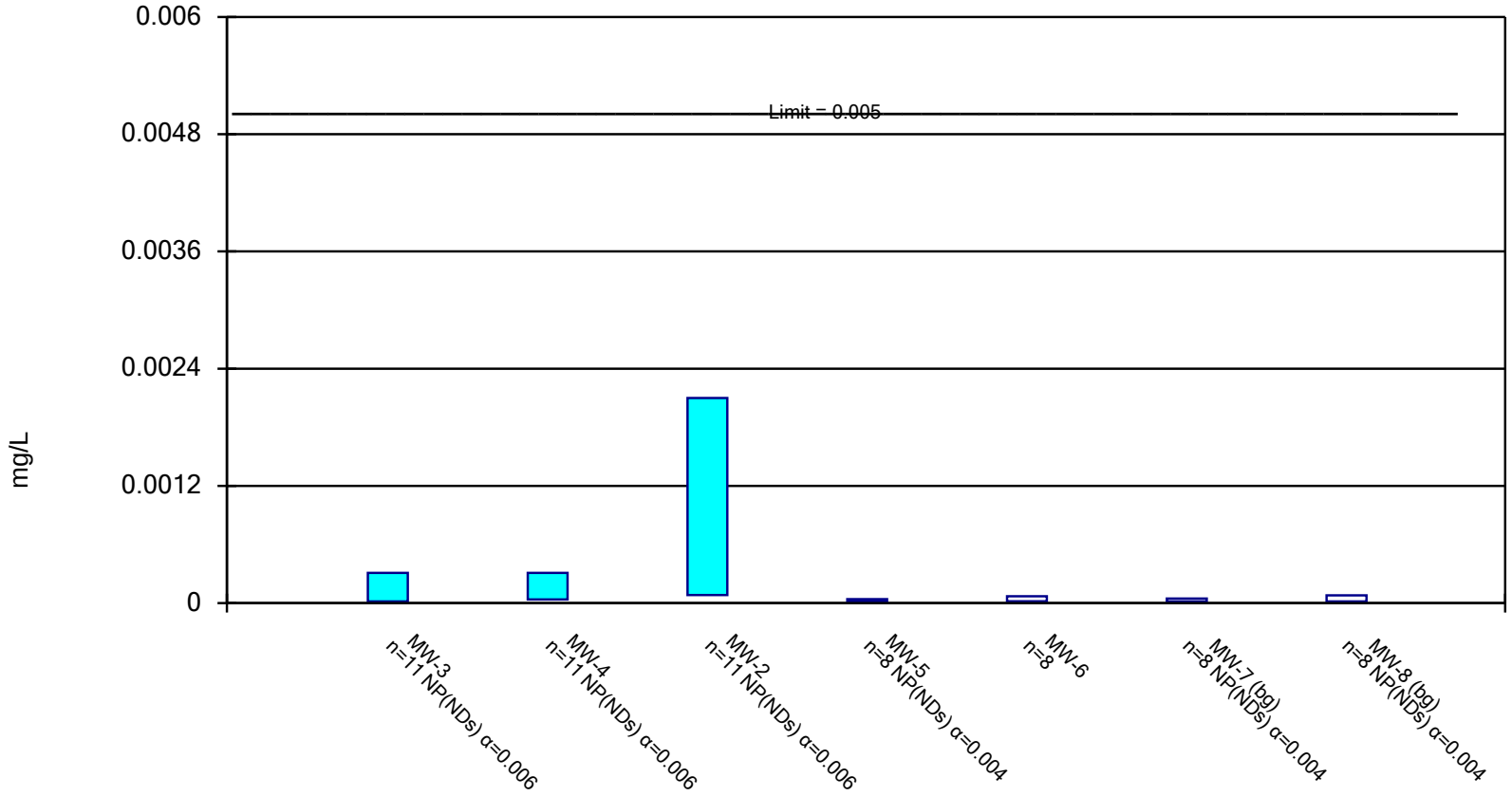


Constituent: Beryllium Analysis Run 1/15/2019 1:51 PM View: Appendix IV

Grand Haven BLP Client: Golder Associates Data: DT-Grand Haven BLP

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

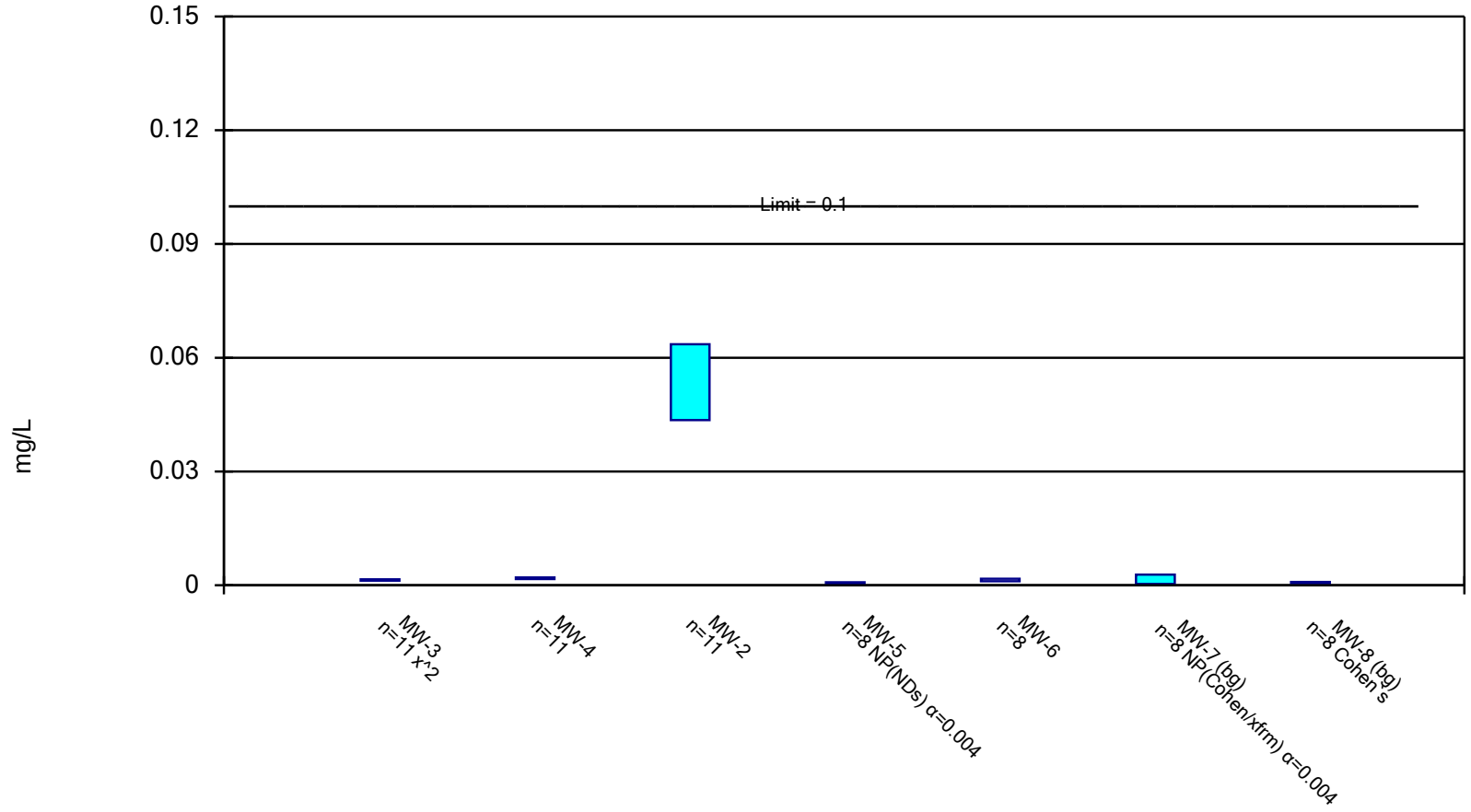


Constituent: Cadmium Analysis Run 1/15/2019 1:51 PM View: Appendix IV

Grand Haven BLP Client: Golder Associates Data: DT-Grand Haven BLP

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

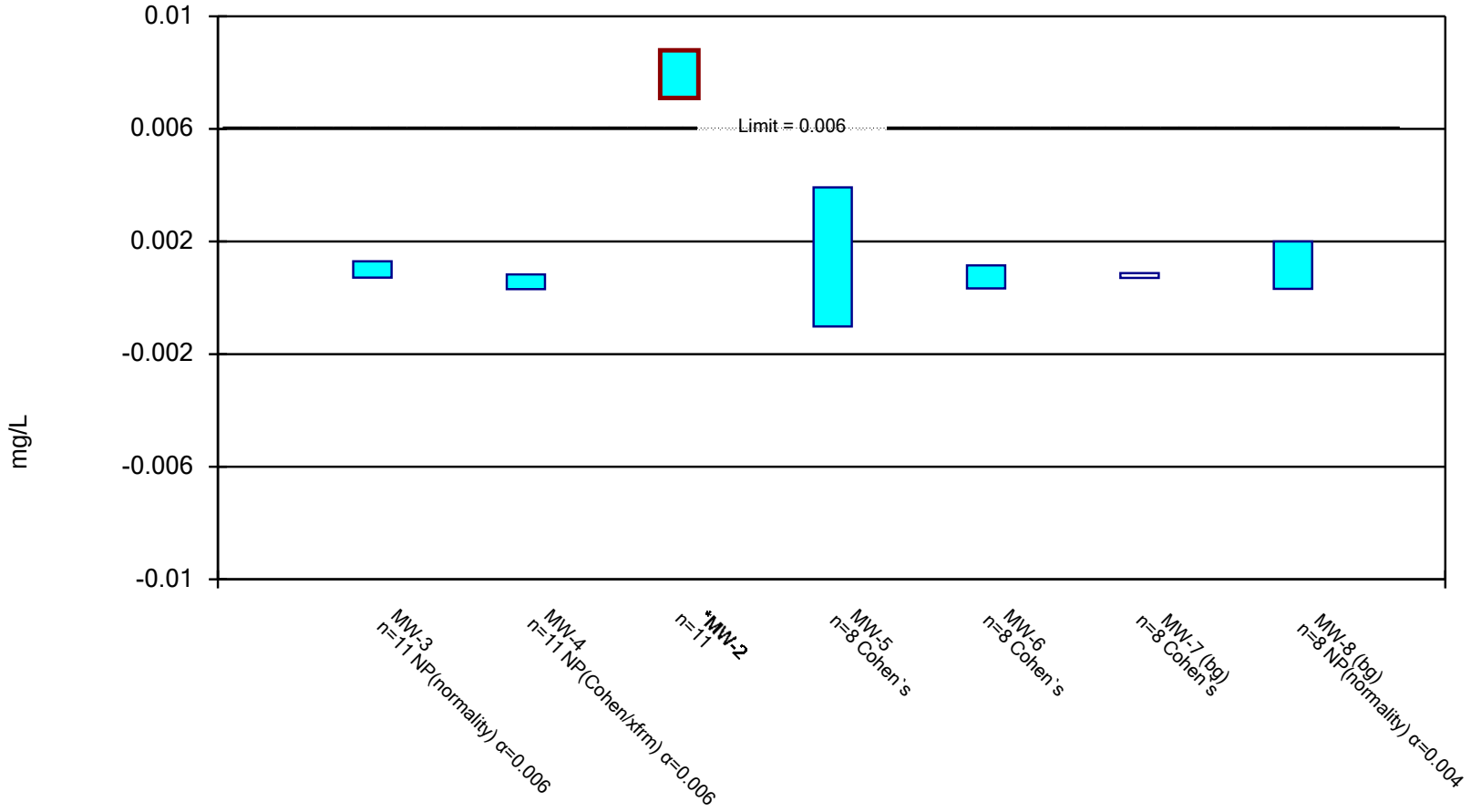


Constituent: Chromium Analysis Run 1/15/2019 1:51 PM View: Appendix IV

Grand Haven BLP Client: Golder Associates Data: DT-Grand Haven BLP

Parametric and Non-Parametric (NP) Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

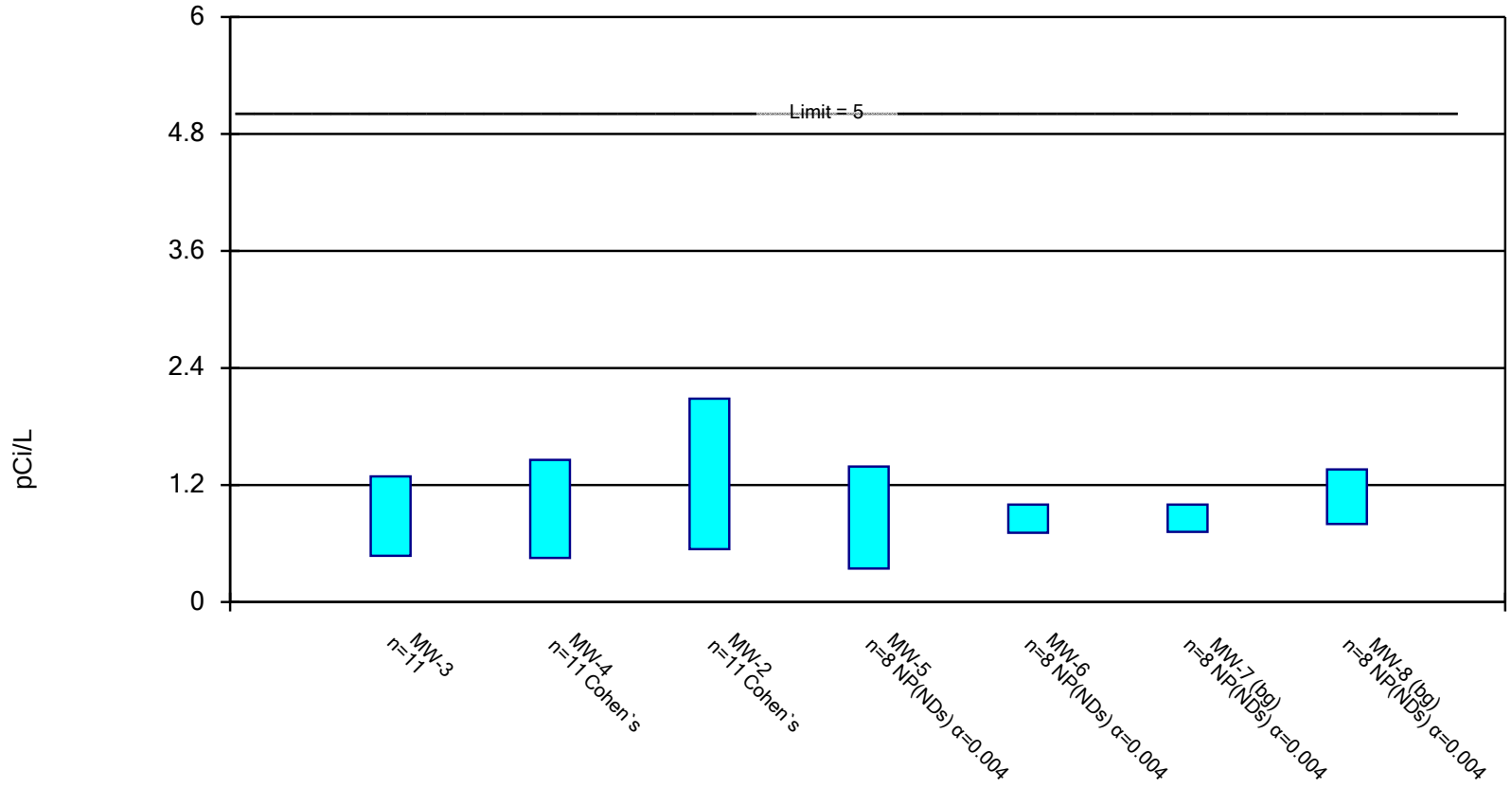


Constituent: Cobalt Analysis Run 1/15/2019 1:51 PM View: Appendix IV

Grand Haven BLP Client: Golder Associates Data: DT-Grand Haven BLP

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

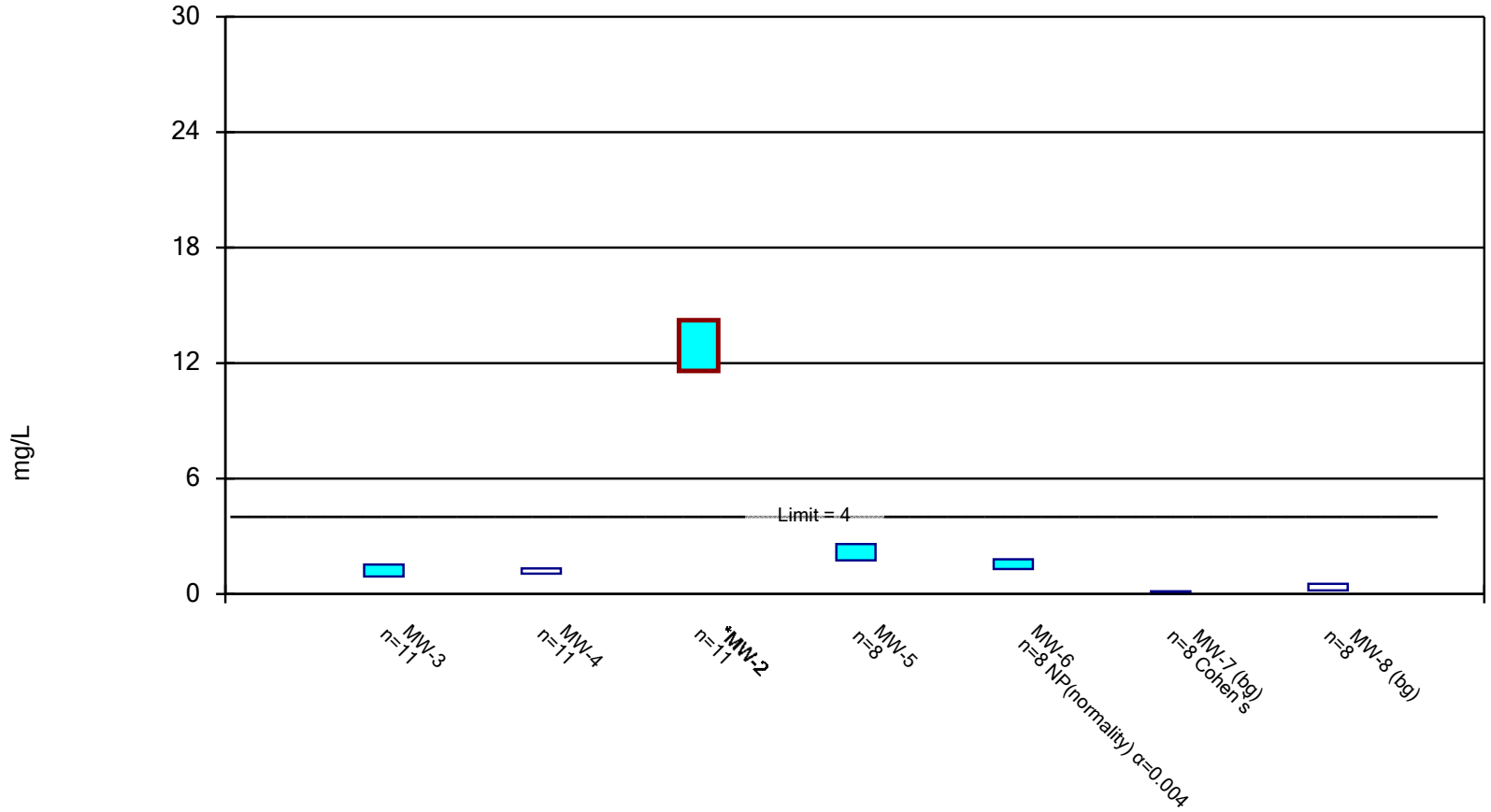


Constituent: Combined Radium 226 + 228 Analysis Run 1/15/2019 1:51 PM View: Appendix IV

Grand Haven BLP Client: Golder Associates Data: DT-Grand Haven BLP

Parametric and Non-Parametric (NP) Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

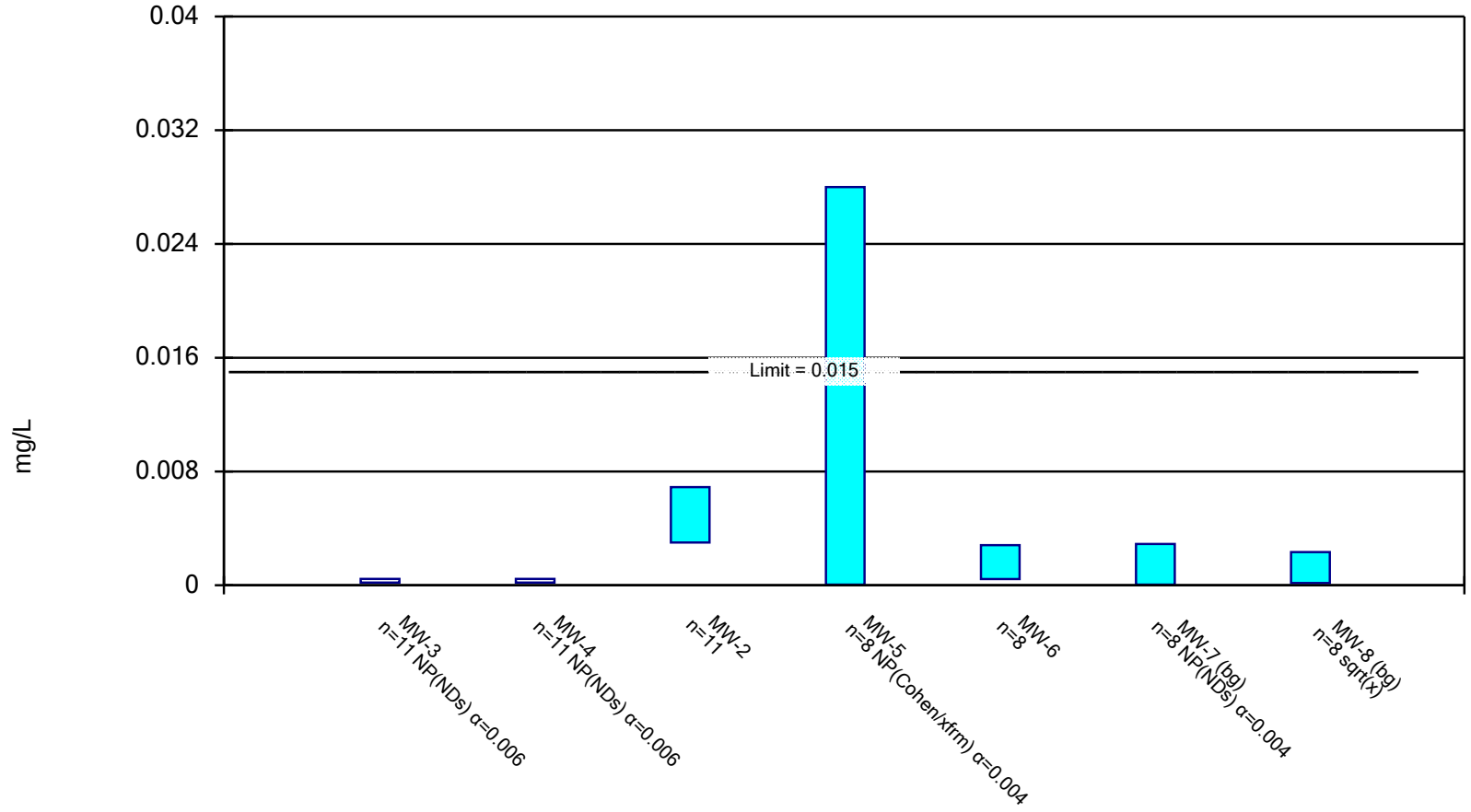


Constituent: Fluoride Analysis Run 1/15/2019 1:51 PM View: Appendix IV

Grand Haven BLP Client: Golder Associates Data: DT-Grand Haven BLP

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

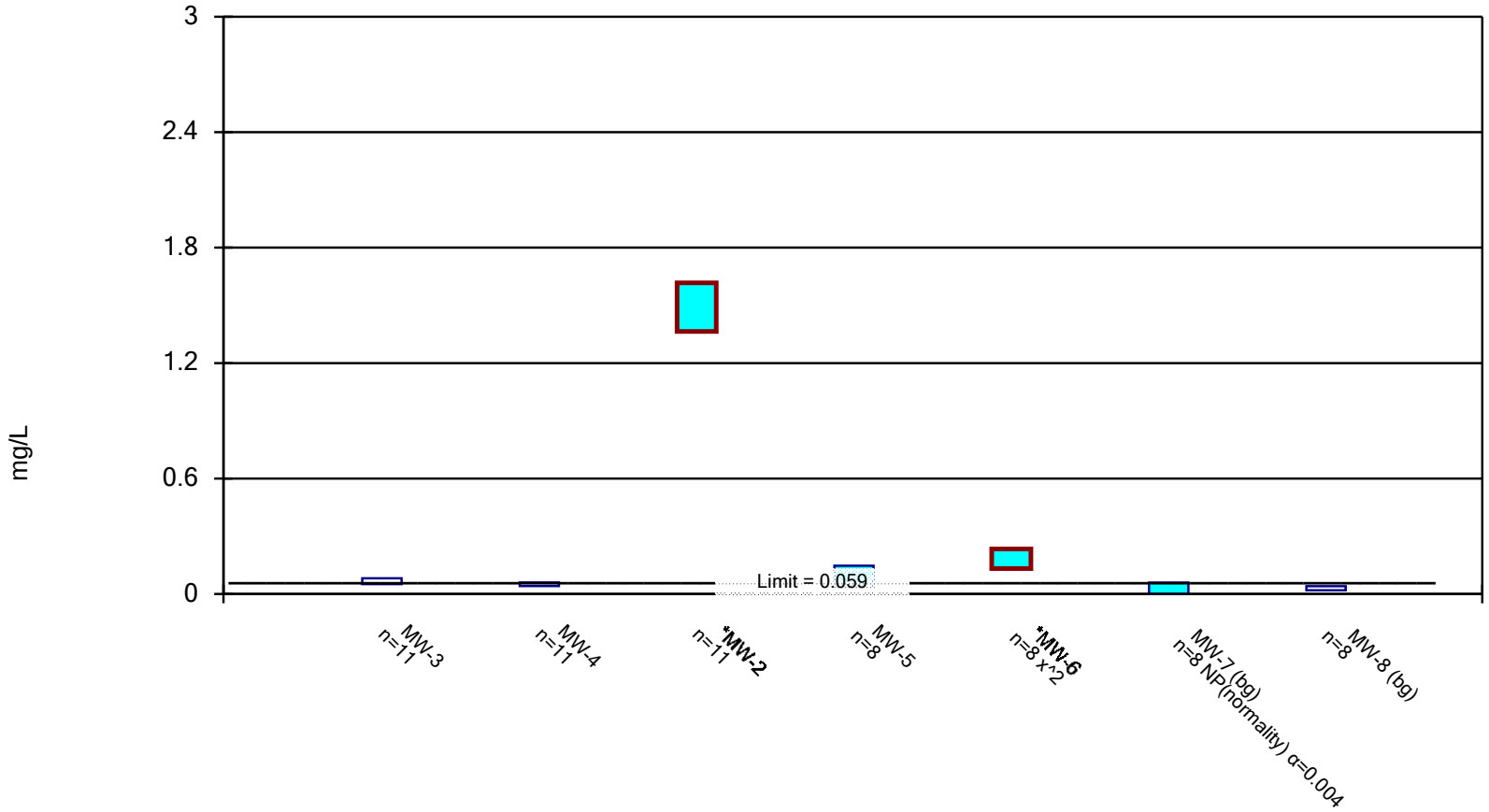


Constituent: Lead Analysis Run 1/15/2019 1:51 PM View: Appendix IV

Grand Haven BLP Client: Golder Associates Data: DT-Grand Haven BLP

Parametric and Non-Parametric (NP) Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

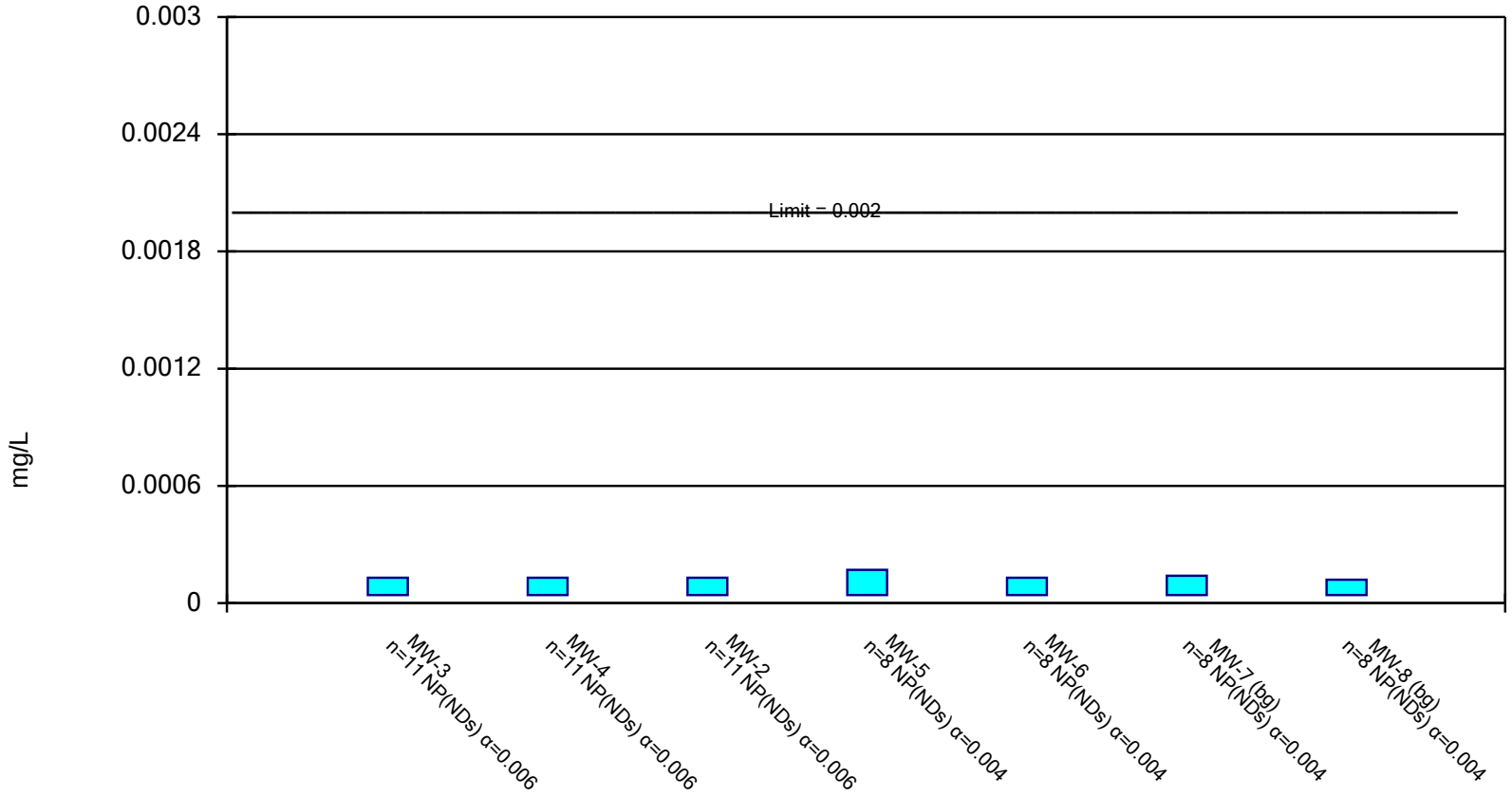


Constituent: Lithium Analysis Run 1/15/2019 1:51 PM View: Appendix IV

Grand Haven BLP Client: Golder Associates Data: DT-Grand Haven BLP

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.

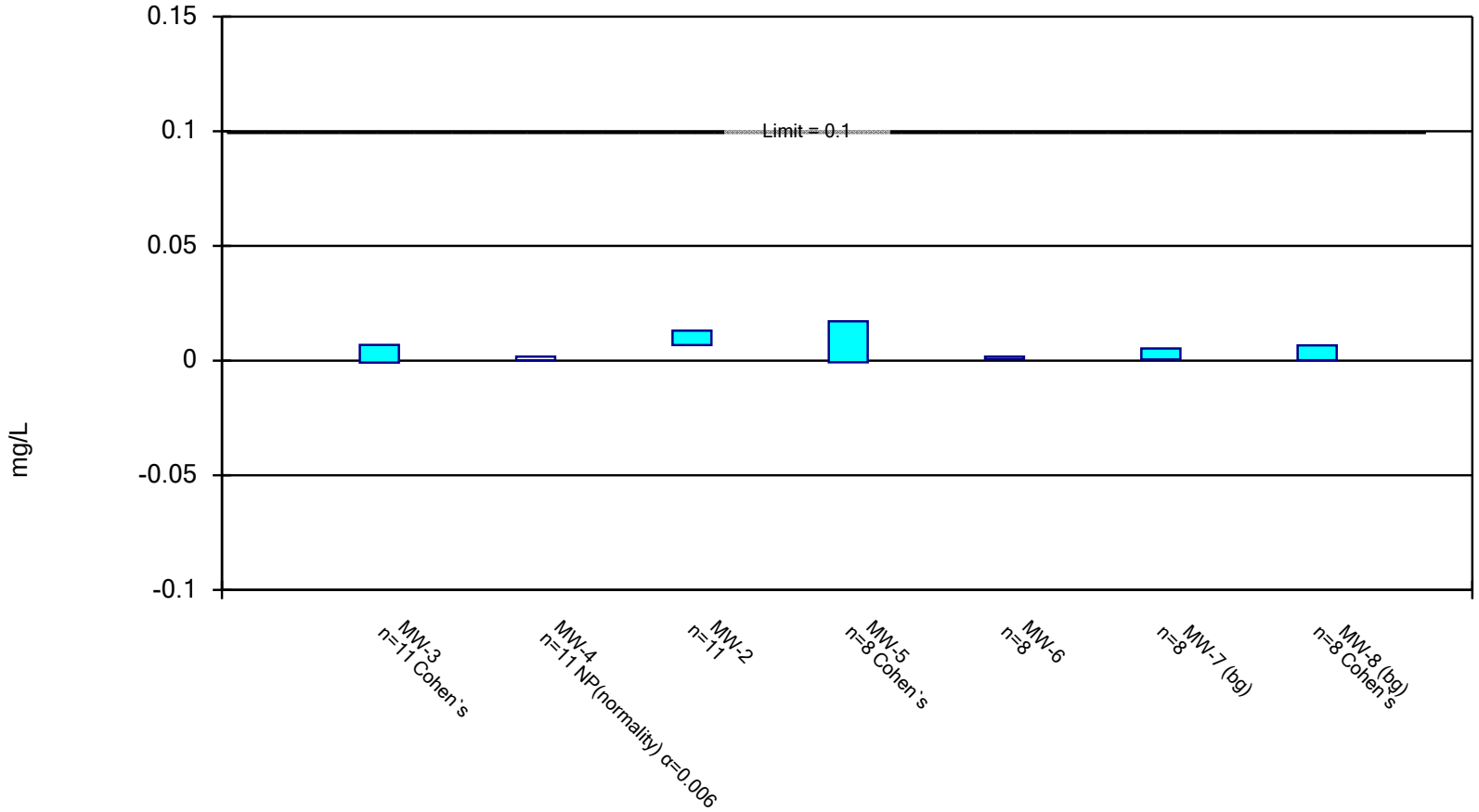


Constituent: Mercury Analysis Run 1/15/2019 1:51 PM View: Appendix IV

Grand Haven BLP Client: Golder Associates Data: DT-Grand Haven BLP

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

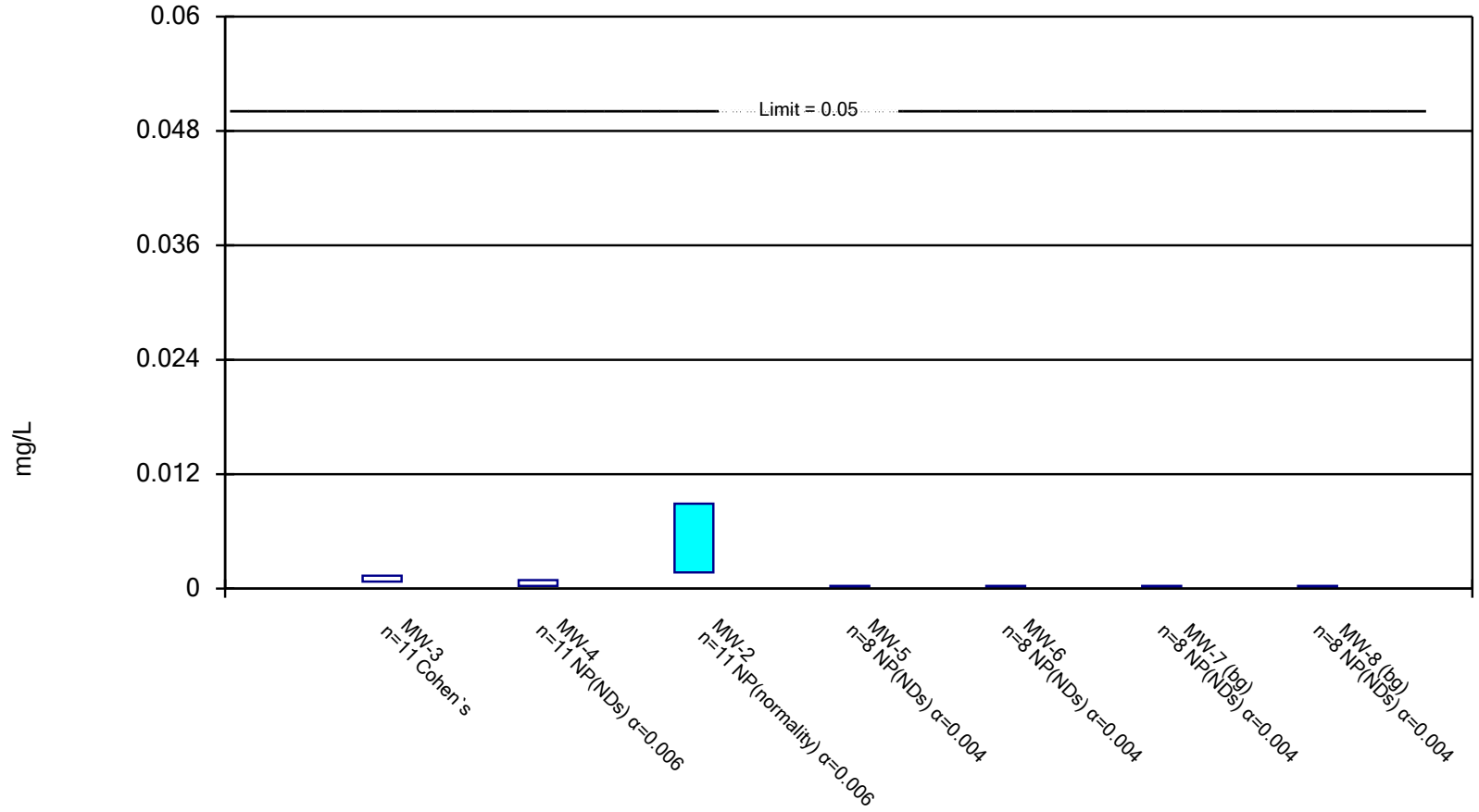


Constituent: Molybdenum Analysis Run 1/15/2019 1:51 PM View: Appendix IV

Grand Haven BLP Client: Golder Associates Data: DT-Grand Haven BLP

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

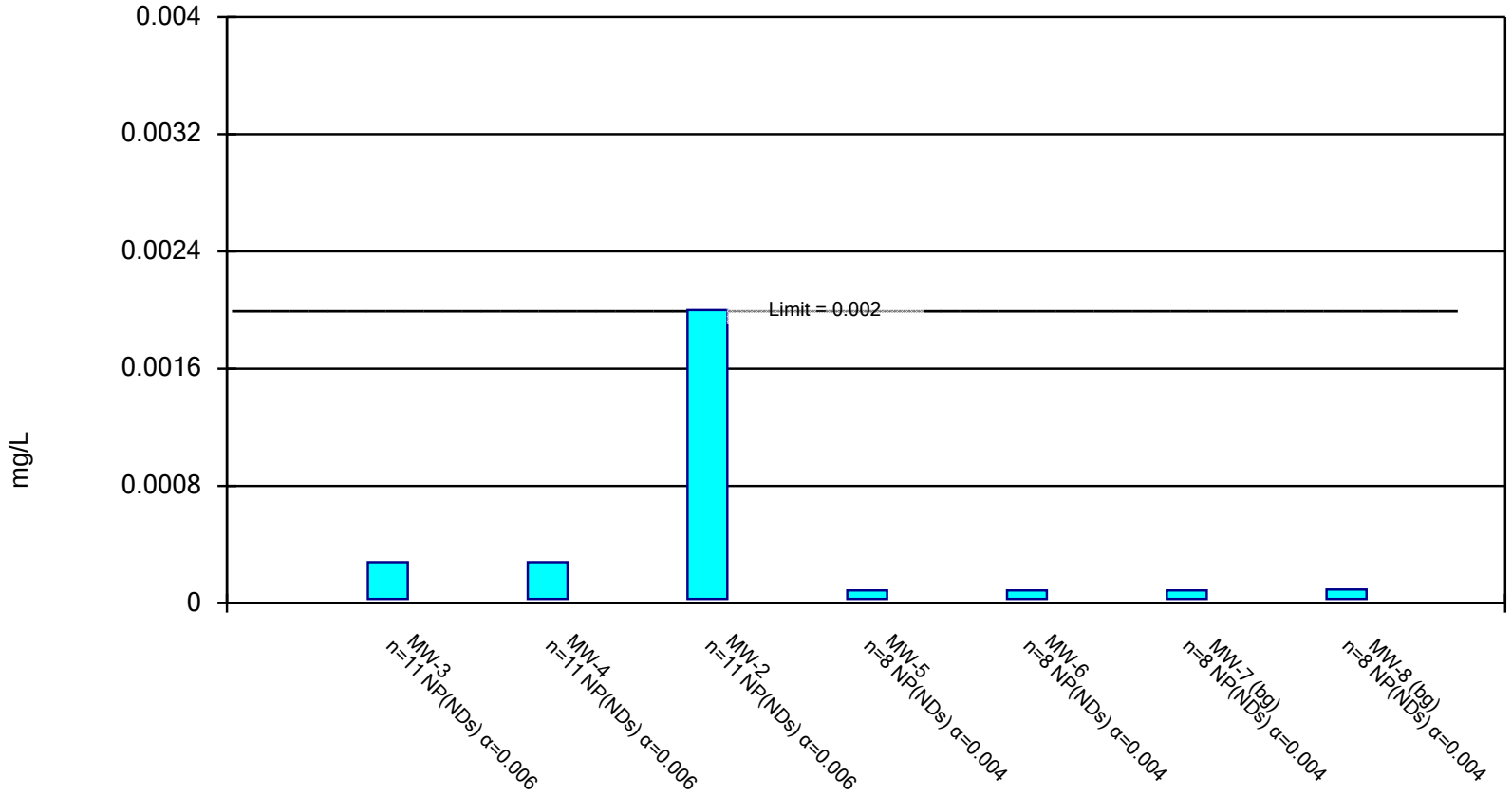


Constituent: Selenium Analysis Run 1/15/2019 1:51 PM View: Appendix IV

Grand Haven BLP Client: Golder Associates Data: DT-Grand Haven BLP

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.



Constituent: Thallium Analysis Run 1/15/2019 1:51 PM View: Appendix IV

Grand Haven BLP Client: Golder Associates Data: DT-Grand Haven BLP

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