Prepared by

HDR

Renew Harbor Island

Work today, protect tomorrow.

Hydrogeologic Monitoring Plan

for Compliance with Michigan Part 115 Solid Waste Management Regulation

Former J.B. Sims Generating Station

Grand Haven, MI

June 18, 2024

Revised May 21, 2025

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Former J.B. Sims Generating Station, Grand Haven, Michigan

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1.0 Introduction

This Hydrogeologic Monitoring Plan (HMP) was prepared for the former J.B. Sims Generating Station (Facility or Site) to support compliance with Part 115 of the Michigan Natural Resources and Environmental Protection Act, Act 451 of 1984 (Part 115). Section 11512(a)(1) of Part 115 requires an approved HMP that complies with Rules 299.4440 to 299.4445, if applicable, and Rules 299.4905 to 299.4908 of the Part 115 Rules. It should be noted that Part 115 does not replace the United States Environmental Protection Agency (EPA) Coal Combustion Residuals (CCR) Rule (40 CFR Part 257) as EPA has not authorized Michigan's program.

Therefore, this HMP sets forth the requirements and procedures of the CCR groundwater monitoring program at Site. The HMP was developed in accordance with the EGLE Hydrogeologic Monitoring Plan Checklist in **Appendix A**.

1.1 Facility Description

The facility is located at 1231 North 3rd Street, on Harbor Island, in Grand Haven, Michigan (**Figure 1**). The former J.B. Sims Generating Station was operated by the Grand Haven Board of Light and Power (GHBLP) and ceased operations in February 2020. The former plant was a coal-fired steam-generating power facility with a net capacity of approximately 70.5 megawatts. The CCR generated at the former Site was stored in two CCR units: (1) the inactive Units 1/2 Impoundment and (2) the former Unit 3A/B Impoundments. Operations at the Site ceased in February 2020 and the plant subsequently was decommissioned. During deconstruction, wastewater used to clean out boilers and infrastructure was sent to Unit 3A/B. The waste disposal into Unit 3A/B ceased in July 2020.

1.1.1 Units 1/2 Impoundment

The inactive CCR Units 1/2 Impoundment was a depression in the ground where sluiced ash was disposed. The inactive Units 1/2 Impoundment ceased receiving CCR materials in 2012. Due to the abstract size and lack of defined boundaries, Units 1/2 Impoundment was delineated by Golder in the 2019 report *CCR Impoundment Ash Delineation at the J.B. Sims Generating Station* (Golder, 2019c). Following the submission of the delineation report, a boundary of the inactive Units 1/2 Impoundment was agreed upon by GHBLP, EPA, and EGLE, which includes an area of sluiced ash disposal to the east (**Figure 2**). EGLE and EPA excluded the North Channel from the Units 1/2 Impoundment area stating that ash previously identified in this area aligned with the definition of a CCR Management Unit (CCRMU). (**Figure 2**). A 2016 ash investigation by ERM confirmed that no liner was present beneath the Units 1/2 Impoundment and waste was placed in the topographic low area (Golder, 2019c).

Figure 1. Site Vicinity Map

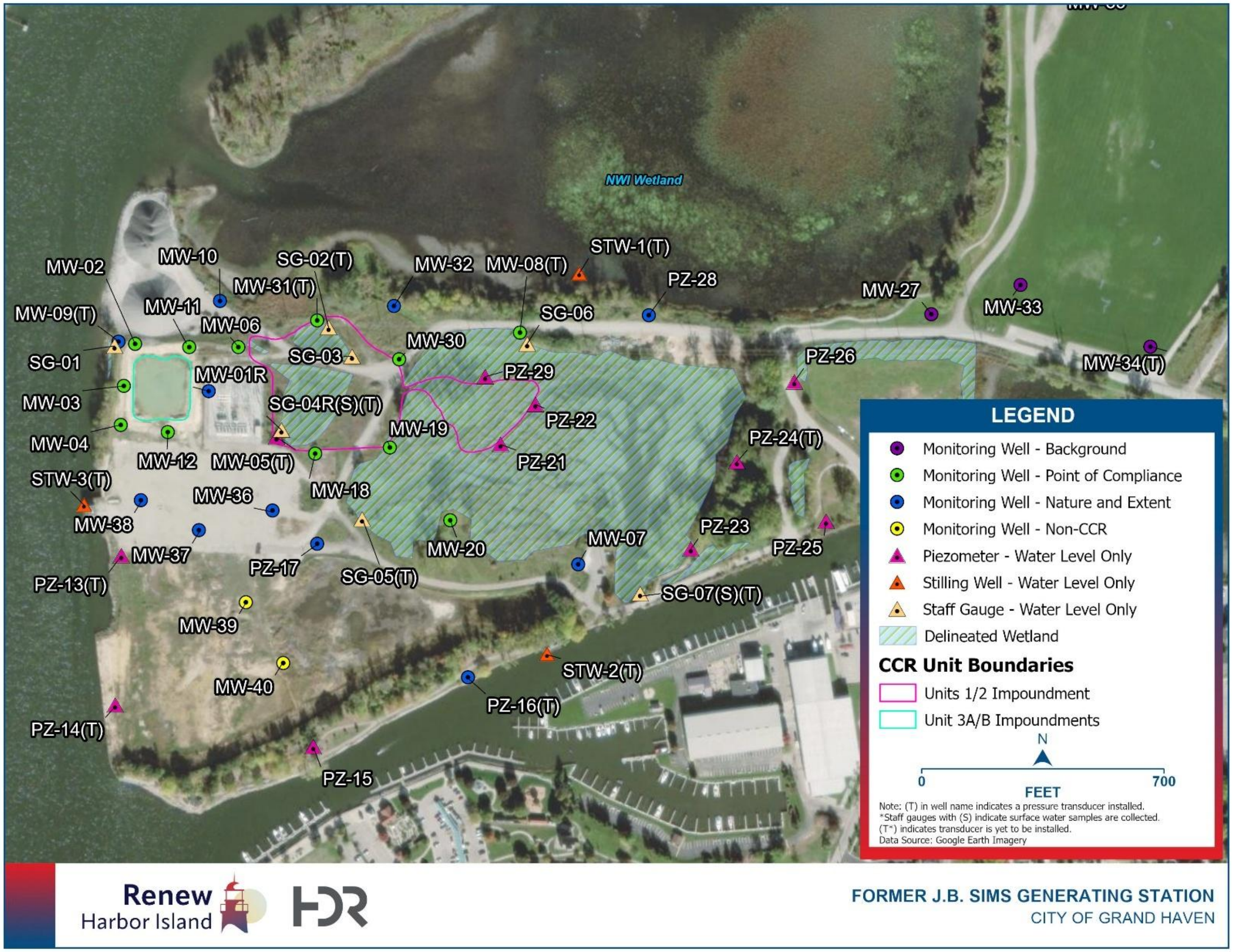

Figure 2. Monitoring Well and CCR Unit Location Map

1.1.2 Unit 3A/B Impoundments

The former CCR Unit 3A/B Impoundments were constructed as two above-ground surface impoundments consisting of a clay liner; however, the engineered clay liner did not meet Part 115 CCR surface impoundment liner criteria. Golder (2020) stated that the former 3A/B Impoundments were built over a “field of ash” that was generated from Boiler Units 1 & 2; however, existing soil borings do not support that a “field of ash” is present under the former impoundments. Although the former coal-fired power generation facility ceased operations in February 2020, the Site continued to use the Unit 3A/B Impoundments to store cleanout materials from the hoppers, vessels, etc. prior to demolition of the buildings. The impoundments ceased receiving waste on July 30, 2020. Removal of CCR from the impoundments was completed on November 6, 2020 and the liner remained. Following the CCR removal, Golder conducted ash removal verification, which is documented in the Units 3A/B Impoundment – CCR Removal Documentation Report (December 11, 2020). The verification methods included:

- Comparison of excavation grades to the original construction documentation of the clay liner.
- Photographic documentation of the CCR removal process and final conditions.
- Colorimetric and microscopic quantification of ash at random grid nodes within the footprint of the impoundments.
- Soil metals analysis of the remaining clay liner.

EGLE denied the request of the GHBLP to close Unit 3A/B Impoundments for the following reasons (EGLE, 2021):

- GHBLP did not submit a certification of completion per 40 CFR §257,
- GHBLP did not have a groundwater monitoring system that represented background water quality,
- GHBLP utilized one of the six obtained soil samples to verify ash removal using colorimetric methods. EGLE stated no demonstration had been made that one sample accurately represented all liner areas,
- The methodology for microscopy did not include preprocessing of samples to ensure bottom ash could properly be identified,
- GHBLP did not address the contamination of the Unit 3A/B clay liner. Analysis of soil sample of the liner showed elevated concentrations of lithium and selenium,
- Based upon a 2014 EPA report showing photographic evidence that coal ash was present outside the Unit 3A/B boundary, EGLE determined that GHBLP did not provide sufficient demonstration that the horizontal extent of coal ash had been defined,
- Photographic evidence collected during the ash removal showed a large amount of cracking observed in the clay liner.

Further ash delineation will be conducted to define the extent of any remaining minor amount of CCR on the areas adjacent to the Unit 3A/B Impoundments.

1.2 Background

The original Groundwater Monitoring System Certification was developed for the 3A/B Impoundments by Environmental Resources Management (ERM) in November 2017 to comply with the Federal CCR Rule. The network consisted of one (1) background well (MW-01) and three (3) downgradient detection monitoring wells (MW-02, MW-03, and MW-04) (ERM, 2017). Initial background monitoring was conducted by Golder between March 13 and August 7, 2017. On May 15, 2018, the Unit 3A/B Impoundments monitoring network entered assessment monitoring after the identification of statistically significant increases (SSIs), as noted in the *Notice of Establishing Assessment Groundwater Monitoring 40 CFR §257.94(e)(3)* (Golder, 2018b). Subsequently, the monitoring network was revised to accommodate the addition of Units 1/2 Impoundment and shifted to a multi-unit network in 2019. During that time, MW-01 was converted to a piezometer, MW-05 and MW-06 were installed as additional downgradient monitoring wells, and MW-07 and MW-08 were installed as new background monitoring wells for the multi-unit network (Golder, 2019). On October 15, 2018, GHBLP published the *Updated Notice of Groundwater Protection Standard Exceedance 40 CFR §257.95(g)*, identifying that cobalt, fluoride, and lithium were detected at statistically significant levels (SSL) for Units 1/2 and Unit 3A/B (Golder, 2018c). On February 2, 2019, GHBLP published the *Notice of Initiating Assessment of Corrective Measures 40 CFR §257.95(g)(3)(i) and 40 CFR §257.95(g)(5)*, announcing that both Units 1/2 Impoundment and Unit 3A/B Impoundments were in assessment of corrective measures (Golder, 2019b). In August 2019, monitoring wells MW-09 and MW-10 were installed as additional downgradient monitoring wells and included in the multi-unit network. In 2020, the monitoring well network was converted from a multi-unit system into two separate monitoring systems, one for Units 1/2 Impoundment and one for Unit 3A/B Impoundments (Golder, 2021). On July 22, 2021, GHBLP published the *Updated Notice of Groundwater Protection Standard Exceedance 40 CFR §257.95(g),* in which arsenic and chromium were added to the list of cobalt, fluoride, and lithium as being observed at SSLs over groundwater protection standards (GPS) (Golder, 2021b).

On January 14, 2021, GHBLP, EPA, and EGLE met to discuss documentation regarding the boundary delineation for Units 1/2 Impoundment and ultimately expanded the boundary to its current location shown on **Figure 2** (Golder, 2021). Following revisions to the Units 1/2 Impoundment boundary, the monitoring well network was expanded. In August 2021, 22 piezometers and three stilling wells were installed to further the understanding of groundwater flow and the groundwater/surface water interaction of Harbor Island to determine appropriate background well locations and monitoring network for the CCR units (Golder, 2022b). Based on groundwater flow direction data collected in 2021 and 2022, as well as boring logs from the *Field Summary Report of Results from Approved Work Plan*, it was determined that the previous background/upgradient monitoring wells (MW-07 and MW-08) were impacted by the CCR units and did not represent background water quality (Golder, 2022b). The monitoring well network was revised in the *2022 Harbor Island Work Plan for CCR Compliance* (HDR, 2022).

While the program compliance status of the CCR units remained in assessment monitoring and assessment of corrective measures, the steps of the monitoring program (background monitoring, detection monitoring, and assessment monitoring) were revisited because of the updated monitoring network. Background water quality sampling at the updated groundwater monitoring well network was conducted over eight events from November 2022 through August 2023. Following the completion of background sampling, as specified in Michigan R 299.4440(8), the *Background Water Quality Statistical Certification* was submitted (HDR, 2024). The water quality data collected from the monitoring wells located upgradient of the CCR units were pooled and statistically analyzed to develop the background threshold values (BTVs) for the impoundments. The Background Report provides the selection of the statistical method for each constituent of interest (COI) for each CCR unit.

The first detection/assessment monitoring event using the updated monitoring network was conducted in October 2023 following completion of the background sampling events. Monitoring data was compared to BTVs. Following review of the first detection monitoring event that used the updated monitoring network, the memorandum *Former J.B. Sims Generating Station Determination of Statistically Significant Increases over Background per §257.93(h)(2) and R 299.4440(8) of the Michigan Part 115 Rules* was submitted to EGLE (HDR, 2024a). The SSIs identified for Units 1/2 Impoundment for the State compliance program include boron, calcium, fluoride, sulfate, and total dissolved solids (TDS). The SSIs identified for Unit 3A/B Impoundments for the State compliance program include boron, calcium, chloride, fluoride, sulfate, and TDS. The SSIs identified from the October 2023 sample event are considered revised SSIs because the updated monitoring network includes different background wells that are not impacted by the CCR units. The identification of SSIs for both CCR units keeps both Units 1/2 Impoundment and Unit 3A/B Impoundments in assessment monitoring status.

Under the assessment monitoring program, as required in Michigan Rule R 299.4441(9), the CCR owner must establish GPS for each constituent detected in the groundwater. The GPS values are discussed further in Section 3.2.3.

The October 2023 sample data from waste boundary wells was compared to the GPS values and several COIs were found to exceed GPS at both CCR units. To determine if an exceedance of a GPS value is statistically significant, the 95% lower confidence limit (LCL) was calculated for each of the downgradient wells. The LCLs that exceeded GPS for Units 1/2 Impoundment under the State compliance program include arsenic, boron, calcium, chloride, fluoride, lithium, sulfate, and total dissolved solids. The LCLs that exceeded GPS identified for Unit 3A/B Impoundments under the State compliance program include boron, calcium, chloride, cobalt, lithium, sulfate, and total dissolved solids. Further detail has been provided in the *Determination of Statistically Significant Levels over Groundwater Protection Standards per §257.95(g) and Michigan Rule R 299.4441* (HDR, 2024c)

1.3 Hydrogeology

The regional direction of groundwater flow is west to southwest towards Lake Michigan (Western Michigan University, 1981). The Grand River is located on the northern and western sides of the Site, and the South Channel is located on the south side of Harbor Island. Internal to the Island there are several influences on groundwater flow and direction, specifically:

- Various fill materials
- Surface water features, such as the inactive Units 1/2 Impoundment and wetlands
- Former coal yard area, which may have lower infiltration rates due to compaction from heavy equipment and stockpiling.

During the water level monitoring events conducted between September 2022 and October 2023, it was determined that the groundwater elevation is highest around monitoring well MW-01R, consistent with observations made by Golder between October and December 2021 (Golder, 2022). Groundwater contour maps from October 2021, September 2022, and June 2023, respectively, show groundwater flow beneath Unit 3A/B Impoundments is consistently west toward the Grand River (**Appendix B**). Groundwater flow beneath Units 1/2 Impoundment is seasonably and spatially variable; flow is generally northward toward the north wetland shown on **Figure 2**, eastward from the ponds of Units 1/2 Impoundment toward the wetland, and potentially southward near MW-05. The wetland east of Units 1/2 Impoundment appears to be a hydraulic sink between the CCR impoundments and the wells situated to the east (PZ-23 through PZ-26, MW-27, MW-33, and MW-34). Groundwater flow in the area east of the internal wetland is consistent with regional groundwater flow and the flow of the Grand River toward the west.

The uppermost aquifer, which extends from the water table approximately 1 to 6 feet below the ground surface to a maximum depth of 45 feet below surface on the western side of the island. The aquifer consists of fine sand with gravel and silt lenses, clay, peat, ash, and municipal solid waste illustrated on the logs within **Appendix C**. All boring logs used to create the cross sections in **Appendix D** are contained within **Appendix C**. A silty clay is observed at 20.8 feet below ground surface at PZ-26 on the eastern side of the island to 45 feet below ground surface at PDR-3 on the western side of the island (see cross sections in **Appendix D**). The clay is assumed to be the bottom of the aquifer and was logged in borings CPT-5, MW-12, MW-17, PZ-16, PZ-26, PZ-24, PZ-25, MW-30, PDR-1, and PDR-3 shown in the geologic cross sections for the Site in **Appendix D**. The Cone Penetration Test (CPT) borings used in cross sections the *Report of Evaluation for Grand Haven Power Plant Ash Impoundment* (Soils and Structures, 2014). The GEI borings shown in cross sections are from the *Geotechnical Exploration and Engineering Evaluation for Harbor Island Reciprocating Engine Generation Site* (GEI, 2019). The term “refuse” was used in the cross sections to map where logs indicated household refuse, concrete, metal, wood fragments, plastic, glass, brick, rubber, paper, and leather.

Slug tests have been performed at monitoring wells MW-01R, MW-02, MW-04, MW-05, MW-07, MW-08, PZ-17, PZ-20, PZ-26, and MW-31 (Golder, 2021). Additional slug tests were performed in 2024 at monitoring wells MW-10, MW-12, MW-16, MW-32, MW-36, and MW-40. Piezometers PZ-17 and PW-20 were also re-tested in 2024 to validate anomalous hydraulic conductivity values initially measured in 2021. Average hydraulic conductivity values (between 2 and 6 tests per well), are provided in **Table 1**.

Table 1. Hydraulic Conductivity Values		
Well ID	Screen Interval Lithology	Average Hydraulic Conductivity (feet/day)
MW-01R	Silty fine sand with trace refuse and silt	5.41
MW-02	Silty clay and poorly graded fine sand	0.19
MW-04	Well graded fine to medium sand and sandy silt	1.70
MW-05	Fine grained ash with refuse	18.76
MW-07	Sandy peat with shell fragments and silty sand	7.99
MW-08	Refuse and clayey sand	7.90
PZ-17	Sand with some gravel and gravelly silt with trace organics	172.5/263.1*
PZ-20	Peaty sand and peaty silt	242.2/327.8*
PZ-26	Very fine to medium sand with organics	8.34
MW-31	Mucky sand with refuse and sandy peat with refuse	0.36
MW-10	Fine to coarse sand with gravel	14.5
PZ-12	Sand, clayey peat	14.0
PZ-16	Fine sand, wood and organics	15.9
PZ-32	Peaty silt, refuse	24.4
MW-36	Poorly graded sand and well graded gravel	23.7
MW-40	Poorly graded sand and silty gravel	1.38
PZ-15	“Mucky” sand	1.54

* Wells were re-tested in 2024 due to anomalous testing results in 2021. Re-testing resulted in similar anomalous results.

Hydraulic conductivity values across the Site range from 0.19 feet per day (ft/d) at MW-02 to 24 ft/d at PZ-32. Analyses from the 2024 slug tests are provided in **Appendix E.**

Anomalously high hydraulic conductivity values were calculated from slug testing data collected at PZ-17 and PZ-20. Similarly high values resulted from re-testing in 2024.

Hydraulic conductivity values are on the lower end when compared to reference values (10^4 to 10^{-1} feet/day) of fine sand according to Freeze and Cherry (1979); however, the calculated values are consistent with hydraulic conductivity ranges for silt (10 to 10^{-3} feet/day) and glacial till (10^2 to 10^{-6} feet/day) (Freeze and Cherry, 1979). Historical land use activities, such as dumping of dredge material and refuse, disposal of ash, and coal storage affect localized hydraulic conductivity and groundwater velocity.

Groundwater velocity calculation inputs are in **Table 2**. To address variable groundwater flow directions observed in the potentiometric contour maps in **Appendix B**, groundwater velocity calculations have been performed using data from both January and May 2023 using Darcy’s Law. To address the heterogenous nature of the lithology, separate groundwater velocity calculations have been performed for the eastern and western sides of Harbor Island. Slug test data provided by Golder was used to calculate average hydraulic conductivity values for the eastern and western regions (Golder, 2022b). Data provided from PZ-26 was used for calculations on the eastern side of the Island. Hydraulic conductivity values from MW-01R, MW-02, MW-04, and MW-05 were averaged for the western side of the Island.

A porosity value of 0.30 was used based on varying amounts of sand, gravel, and silt observed in borings (Freeze and Cherry, 1979). Horizontal hydraulic gradients and groundwater velocities were higher in January than May of 2023. Groundwater velocities on the eastern side of the Island ranged from 0.014 to 0.058 feet/day. Groundwater velocities on the western side of the Island ranged from 0.046 to 0.162 feet/day.

Table 2. Groundwater Velocity Calculations

Well Pair	Area of Harbor Island	Hydraulic Gradient		Porosity[1]	Hydraulic Conductivity (feet/day)	Groundwater Velocity (feet/day)	
		Jan. 2023	May 2023			Jan. 2023	May 2023
PZ-25 to PZ-26	East	0.0021	0.0005	0.30	8.34[2]	0.058	0.014
PZ-25 to PZ-23		0.0008	0.0006	0.30	8.34[2]	0.021	0.016
MW-01R to MW-03	West	0.0078	0.0035	0.30	6.23[3]	0.162	0.073
MW-01R to MW-04		0.0065	0.0029	0.30	6.23[3]	0.134	0.061
MW-01R to MW-05		0.0037	0.0022	0.30	6.23[3]	0.077	0.046
MW-01R to MW-10		0.0055	0.0034	0.30	6.23[3]	0.115	0.070

1. Porosity value estimated using reference values for poorly sorted fine to medium sand (Freeze-Cherry, 1979).
2. Average hydraulic conductivity value from Golder (2022) on PZ-26.
3. Calculated by averaging hydraulic conductivity values from wells MW-01R, MW-02, MW-04, and MW-05 (Golder, 2022).

2.0 Groundwater Monitoring Network

Part 115 Rule 299.4905(1)(a) states an HMP shall include a groundwater monitoring well system that complies with the provisions of Rule 299.4906. The following sections describe the respective groundwater monitoring networks for Units 1/2 Impoundment and Unit 3A/B Impoundments. The placement and construction requirements of R 299.4906 have been met for the groundwater monitoring locations (HDR, 2023).

2.1 Units 1/2 Impoundment Monitoring Well Network

Due to the extent of Units 1/2 Impoundment compared to the limits of Harbor Island, and variable groundwater flow direction, a traditional upgradient/downgradient groundwater monitoring system is not possible. Monitoring well locations, however, have been located on all sides of the unit as described herein.

- Background Wells: MW-27, MW-33, and MW-34
- Point of Compliance Wells (i.e. waste boundary wells): MW-06, MW-08, MW-18, MW-19, MW-20, MW-30, and MW-31
- Nature and Extent Wells: MW-07, MW-10, MW-16, MW-17, MW-28, MW-32, MW-36, and MW-37

2.1.1 Background Monitoring Wells

Potentiometric contour maps provided in **Appendix B** indicate the groundwater flow direction across the Site does not allow for traditional upgradient monitoring well locations. Monitoring locations MW-27, MW-33 and MW-34 located are on the eastern side of the Island in or near the soccer fields and will serve as background wells. A review of groundwater contour maps indicate groundwater does not flow from the CCR units towards the background wells. Therefore, the groundwater monitored at these locations appears to represent groundwater at Harbor Island that has not been impacted by CCR materials. The lithology observed at the screen interval of the background wells is shown in **Table 3**.

Table 3. Background Monitoring Well Screen Lithology	
Well ID	Lithology of Well Screen Interval
MW-27	Poorly graded peaty sand with trace silt and organics
MW-33	Clayey sand and poorly graded fine to medium sand with wood fragments noted at 6.5 feet below ground surface
MW-34	Poorly graded fine to medium sand with refuse noted at 11 feet below ground surface

This material or combination of materials is consistent across the Island. While the background wells are screened in material that includes trace refuse (e.g. bricks, metal, and wood fragments), this refuse has been encountered in numerous borings across the Island. Due to the presence of refuse in the screen intervals of both background and downgradient monitoring wells, the elevated constituents observed in waste boundary wells can be attributed to CCR and not refuse.

2.1.2 Point of Compliance Monitoring Wells

The certified groundwater monitoring system for the inactive Units 1/2 includes the following point of compliance wells: MW-06, MW-08, MW-18, MW-19, MW-20, MW-30, and MW-31. Given the shallow groundwater is located between 1.52 and 8.02 feet below surface, wells screened between 8-14 feet below surface are completely within the uppermost aquifer to detect any impact to groundwater from the CCR units. Monitoring well and piezometer locations are provided in **Figure 2**, and well construction documentation is provided in **Appendix C**. Downgradient compliance well locations are spaced along the waste boundary such that if contaminants are present in the groundwater passing the waste boundary, they would be detected by one or more of the wells. The lithologies across the screened intervals are provided in **Table 4**.

Table 4. Units 1/2 Point of Compliance Well Screen Lithology	
Well ID	Lithology of Well Screen Interval
MW-06	Medium to coarse sand and refuse
MW-08	Clayey medium grained sand and refuse
MW-18	Peaty silt and gravel with sand
MW-19	Peaty silt and peaty sand
MW-20	Peaty silt and peaty sand with refuse

MW-30	Silty sand and peaty sand with refuse
MW-31	Mucky sand and sandy peat with refuse

When the lithologies provided above are compared to screen interval lithologies of the background wells MW-27, MW-33, and MW-34, the materials are consistent and representative of the shallow aquifer. The point of compliance monitoring wells have a screen length of 5 feet and total depths range from 8 to 14 feet below surface. As stated in *CCR Impoundment Ash Delineation at the J.B. Sims Generating Station*, coal ash residuals were observed from surface to approximately 8.5 feet below surface, and groundwater was observed between surface and 13 feet below surface (Golder, 2019c). Monitoring well screen intervals ranging from 3 to 9 feet below surface represent water quality of the uppermost aquifer.

2.1.3 Nature and Extent Monitoring Wells

Because SSLs were identified during the October 2023 sampling event, nature and extent wells are being identified herein to begin to delineate the extent of each contaminant plume on the Island (**Figure 2**). The nature and extent monitoring wells for the Units 1/2 Impoundment are MW-07, MW-10, MW-16, MW-17, MW-28, MW-32, MW-36, and MW-37.

During background monitoring (November 2022 – August 2023), and the first detection/ assessment monitoring event (October 2023), MW-07, MW-10, and MW-32 were utilized as the nature and extent monitoring wells. Following the observation of SSLs in October 2023, the monitoring well network has been expanded to include additional nature and extent wells: MW-16 (previously PZ-16), MW-17 (previously PZ-17), MW-28 (previously PZ-28) and MW-36 (**Figure 2)**. The nature and extent wells were chosen after review of groundwater contour maps in **Appendix B** to sample from areas potentially downgradient of the wells with SSLs.

Monitoring well MW-16 is located south of Units 1/2 Impoundment on the property boundary and south of wells MW-07 and MW-20, which had SSLs during the first detection/assessment monitoring event. As shown in **Figure 3,** and illustrated in groundwater contour maps in **Appendix B**, MW-16 has consistently had the lowest groundwater elevation of the wells nearest to its location. The location has the potential to capture possible contamination along the southern boundary, thus providing additional plume delineation data.

Similar to MW-16, monitoring wells MW-17, MW-36, and MW-37 are south of Units 1/2 and will provide additional data points for plume delineation of identified COIs. As illustrated on **Figure 3**, MW-17, MW-36 and MW-37 have shown consistently high groundwater elevations, however, their locations relative to the southern boundary of Units 1/2 Impoundment is the primary reason for their addition. In relation to MW-18, MW-17 has had consistently higher groundwater elevations during 7 of the 9 monitoring events. As MW-18 has SSLs of arsenic, calcium, fluoride, sulfate, and TDS, and the two events in which groundwater elevation is lower in MW-17, suggest contaminant migration is possible from MW-18 toward MW-17. Therefore, these locations are appropriate for the well network.

Monitoring well MW-28 (formerly PZ-28) is located to the northeast of Units 1/2 Impoundment, near the property boundary. Well MW-08 is the sample location nearest to MW-28 that is sampled. During the October 2023 sampling event, the following SSLs were identified in MW-08: arsenic, chloride, and fluoride. In 8 of the 9 monitoring events, MW-08 had a higher groundwater elevation than MW-28, indicating potential flow from MW-08 toward MW-28, shown in **Figure 4**. MW-28 also has had lower groundwater elevations than MW-30 and MW-32 in 6 of the 9 monitoring events, both of which have SSLs. The location of MW-28 provides data regarding the eastern extent of possible contamination.

2.2 Unit 3A/B Impoundments Monitoring Well Network

The monitoring well network for the inactive Unit 3A/B Impoundments is as follows:

- Background Wells: MW-27, MW-33, and MW-34
- Point of Compliance Wells (i.e. waste boundary wells): MW-02, MW-03, MW-04, MW-11, and MW-12
- Nature and Extent Wells: MW-01R, MW-09, MW-10, and MW-38

2.2.1 Background Monitoring Wells

Potentiometric contour maps provided in **Appendix B** indicate the groundwater flow direction across the Site does not allow for traditional upgradient monitoring well locations, however, EGLE approved monitoring locations MW-27, MW-33 and MW-34 located on the eastern side of the Island in or near the soccer fields as background monitoring wells. A review of groundwater contour maps indicates groundwater does not flow from the CCR units towards the background wells. Therefore, water quality observed at the background monitoring wells represents groundwater that remains unimpacted by CCR materials. The background wells are screened in peaty sand with trace silt and poorly graded sand with trace refuse. This material or combination of materials is consistent across the Island. Due to the presence of refuse in the screen intervals of both background and downgradient monitoring wells, the elevated constituents observed in waste boundary wells can be attributed to CCR and not refuse.

2.2.2 Point of Compliance Wells

The certified groundwater monitoring system for the inactive Unit 3A/B Impoundments includes the following point of compliance wells: MW-02, MW-03, MW-04, MW-11, and MW-12. Since Unit 3A/B was an aboveground CCR impoundment, the target aquifer also is the shallow glacial aquifer as with Units 1/2 Impoundments. Groundwater elevations beneath the Unit 3A/B range from 579.42 to 582.35 feet above mean sea level (feet amsl) and the base elevation of the clay liner is reported at 585.0 feet amsl (Golder, 2020a). Given the proximity of the base of the clay liner to observed groundwater elevations validates the monitoring of the surficial aquifer for potential groundwater impacts.

Monitoring well and piezometer locations are provided in **Figure 2**, and well construction documentation is provided in **Appendix C**. The screened lithology of the downgradient compliance wells is provided in **Table 5**.

A comparison of compliance monitoring well screened lithology to background well screened lithology shows consistency in material type and therefore representative of surficial aquifer water quality. The screen lengths of compliance wells are 5 feet and total depths range from 8 to 20 feet below surface or 575.64 to 580.03 feet amsl. Given the base elevation of the clay liner of Unit 3A/B of 585.0, and the total depths of compliance monitoring wells, the screen depths are appropriate.

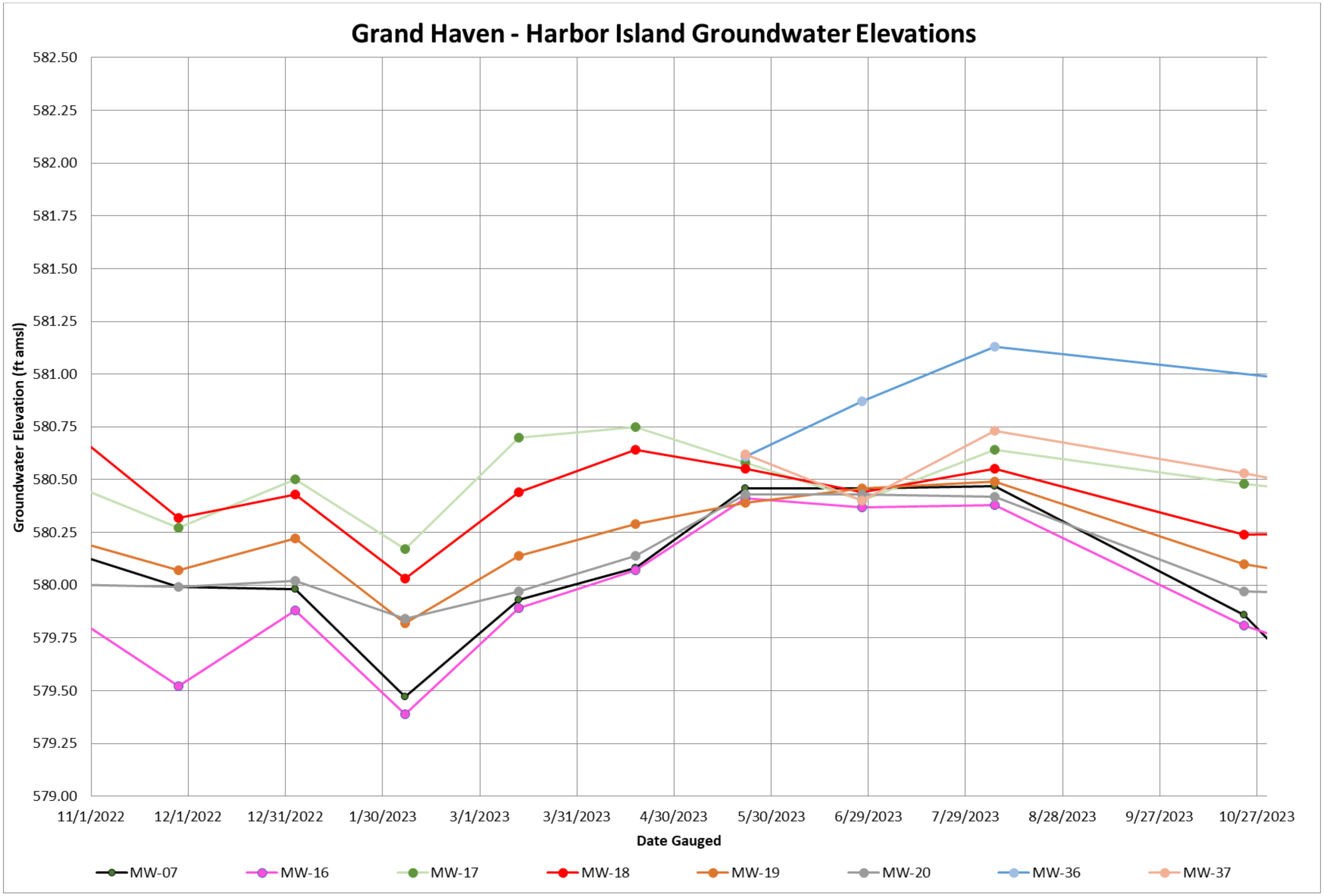

Figure 3. Hydrograph of Monitoring Wells South of Units 1/2 Impoundment

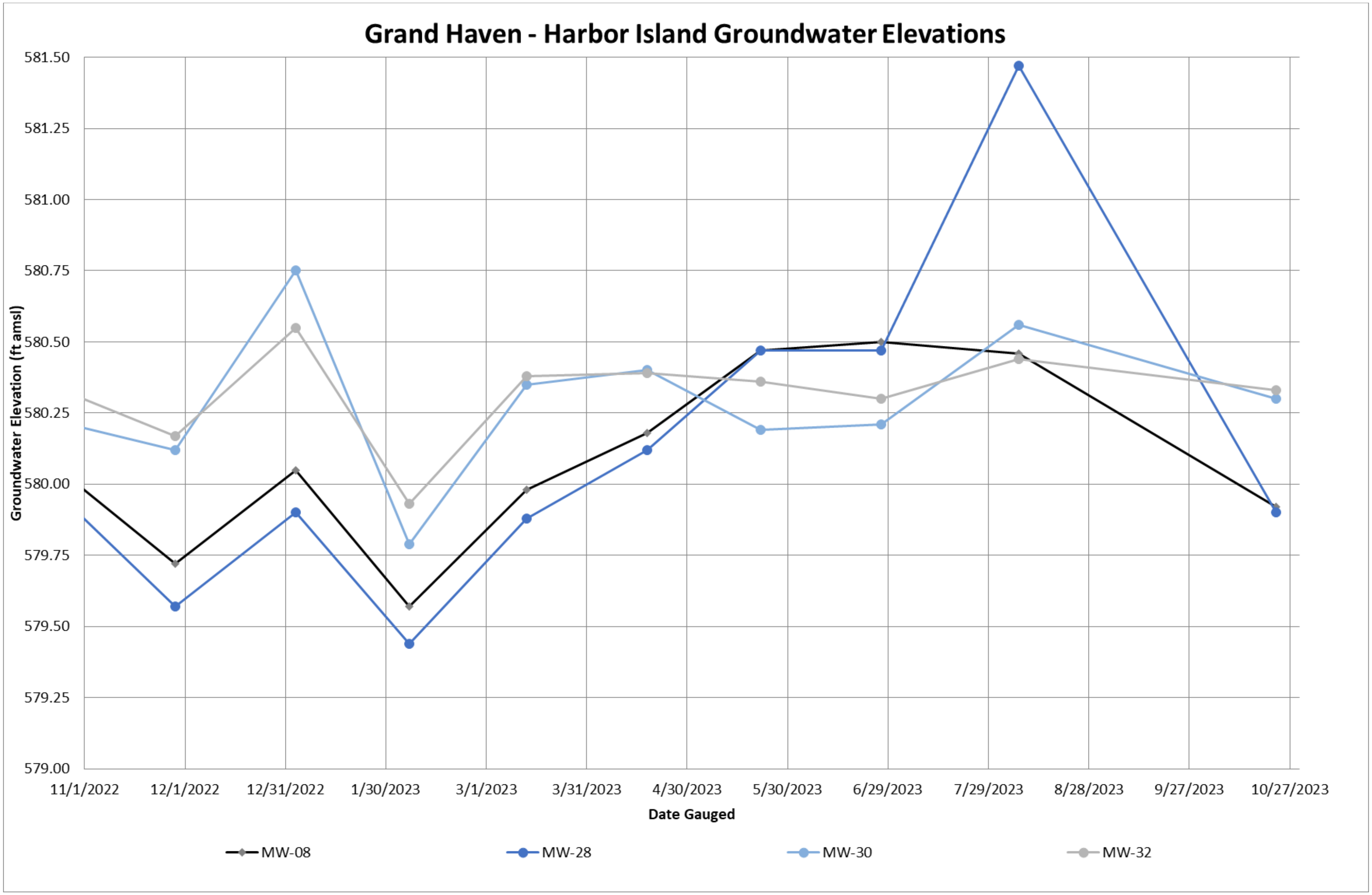

Figure 4. Hydrograph of Monitoring Wells North of Units 1/2 Impoundment

Table 5. Unit 3A/B Impoundment Point of Compliance Well Screen Lithology	
Well ID	Lithology of Well Screen Interval
MW-02	Silty clay and silty sand
MW-03	Clayey silt, poorly graded fine sand, and sandy silt
MW-04	Poorly graded fine sand and sandy silt
MW-11	Sand with refuse, and sandy clay
MW-12	Clayey peat and sand

2.2.3 Nature and Extent Monitoring Wells

The nature and extent monitoring locations for the Unit 3A/B Impoundments are MW-01R, MW-09, MW-10, and MW-38 (**Figure 2**). MW-09 and MW-10 are located within 20 feet from the shoreline. There is no room to locate any additional wells between the existing well location and the shoreline for the purpose of plume delineation. Monitoring well MW-01R has consistently had a higher groundwater elevation than the majority of the compliance wells for Unit 3A/B Impoundment and is unlikely to receive contaminants from Units 1/2 Impoundment, however data from MW-01R will be useful in plume delineation. Potentiometric contour maps provided in **Appendix B** indicate groundwater flow beneath Unit 3A/B is primarily west or northwest. Prior to monitoring MW-36 through MW-40, however, potential groundwater flow to the southwest was illustrated. **Figure 5** indicates that groundwater elevations at MW-38 are consistently lower than MW-01R and MW-12. As both wells have SSLs identified, potential contaminant transport to the southwest is possible.

2.3 Water Level Only

The following piezometers are monitored for water level only: MW-05, PZ-13, PZ-14, PZ-21, PZ-22, PZ-23, PZ-24, PZ-25, PZ-26, PZ-29, MW-35, MW-39, and MW-40, shown on **Figure 2**.

Piezometers PZ-21, PZ-22, and PZ-29 are located on the eastern side of the waste boundary. The Golder Field Summary Report 2022 stated that proper bentonite seals were unable to be verified during well installation and groundwater sampling at PZ-21, PZ-22, and PZ-29 would be unrepresentative of groundwater quality (Golder, 2022b). Due to the locations in the wetland, access to PZ-21, PZ-22, and PZ-29 is limited and water levels will be collected if conditions allow.

Pressure transducers were installed in December 2023 in 17 wells, shown on **Figure 1**. The objective of the transducer installation is to evaluate the seasonal groundwater/surface water interaction. Groundwater contour maps provided in **Appendix B** indicate seasonal variations that cause groundwater to discharge to surface water and surface water contributing to groundwater during various periods of the year. The pressure transducers collect water elevations on an hourly interval and will provide high resolution data to further develop the conceptual site model and aid in the development of remediation alternatives at Harbor Island.

2.4 Surface Water Monitoring Program

As specified in with 299.4905(1)(c), a surface water monitoring plan is required for surface water that may receive runoff from the active working area. Due to the elevated construction of the Unit 3A/B Impoundments and remaining liner, precipitation is contained within the footprint of the unit and is not anticipated to impact surface water. A portion of the Units 1/2 Impoundment boundary is within the internal wetland and could receive runoff, therefore, this section represents a surface water monitoring plan.

Surface water samples are collected at the following staff gauge locations: SG-02, SG-04R, SG-05, and SG-07, shown on **Figure 2**. Locations SG-02 and SG-04R represent the water quality internal to the Units 1/2 Impoundment. Monitoring location SG-05 and SG-07 represent water quality of surface water that may receive runoff from the Impoundment. If SG-05 is dry, the gauge at SG-07 will have a surface water elevation that will represent surface water stage of the internal wetland. To supplement staff gauge SG-07 when the wetland surface water is limited to a narrow channel, an additional staff gauge (SG-07A) will be installed in Spring 2026 near the center of the channel draining the Internal Wetland.

Surface water samples are collected at the same frequency as the groundwater sampling events for the same list of constituents as the groundwater (Section 3.1.1). Samples are collected using a clean container affixed to a pole. As noted in **Appendix F**, before samples are collected, the following water quality parameters are measured and recorded: pH, turbidity, conductivity, dissolved oxygen, temperature, and oxidation reduction potential. The analytical results from surface water samples are provided in the quarterly reports.

In addition to the monitoring wells and piezometers referenced in **Sections 2.2** and **2.3**, ten surface water gauging locations will continue to be monitored for water levels including: seven staff gauges (SG-01, SG-02, SG-03, SG-04R, SG-05, SG-06, and SG-07) and three stilling wells (STW-1, STW-2, STW-3) per R 299.4905(1)(c). The surface water gauging locations are shown on **Figure 2** and are placed to gather water level data on Units 1/2 Impoundment internal surface water, the north wetland, Grand River, and south channel.

During instances when the surface water level is below the bottom of the gauge, the water level will be recorded as “Dry” and an elevation will not be recorded.

2.5 Well Construction

The boreholes for monitoring wells were drilled by a licensed well driller. Each well was constructed with 2-inch diameter, Schedule 40 PVC casing and screen with 0.010-inch screen slots. The wells were constructed using 5 feet of screen interval. In compliance with Michigan R 299.4906, the monitoring well construction included the placement of sieve size 10-20 washed silica sand in the annular space around the well screen, and approximately 2 feet above for the filter pack, to enable the collection of groundwater samples and maintain borehole integrity. Annular space above the sampling interval was sealed using coated bentonite pellets that extend from the top of the filter pack to the surface to prevent contamination of samples and groundwater. Monitoring wells were constructed with a locking steel stick up cover, except for

MW-33, and MW-34 that were installed in the soccer field and were constructed with a flush mount cover. The wells were constructed in a manner that is properly vented and capped per R 299.4906(8). The monitoring wells have signage denoting the well name, designation, and relation to the Former J.B. Sims Generating Station groundwater monitoring program. Monitoring wells were developed and surveyed. See **Table 6** below for construction details for monitoring wells. Borings logs are provided in **Appendix C**. Further well construction details are found in the *Well Installation Report* (HDR, 2023).

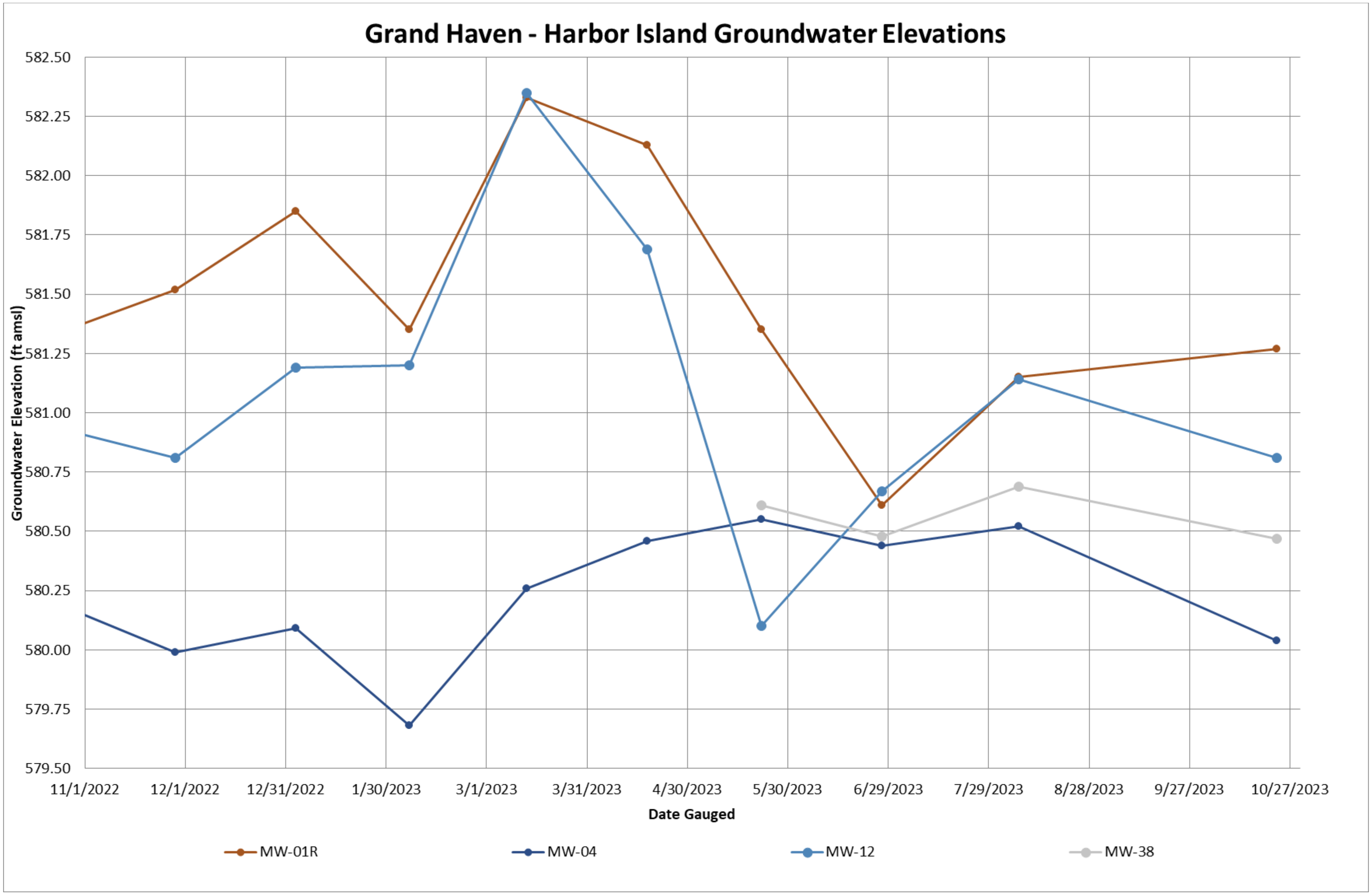

Figure 5. Hydrograph of Monitoring Wells South of Unit 3A/B Impoundment

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Table 6. Well Construction Details

Well I.D.	Northing	Easting	Date Installed	Ground Surface Elevation	Top of Casing (Staff Gauge) Elevation	Total Boring Depth (feet bgs)	Total Well Depth (feet bgs)	Stickup	Screen length (feet)	Screen Interval (feet bgs)	Comments
Monitoring Wells											
MW-01	578100.82	12624468.08	1/18/2017	584.34	587.29	12.3	12.3	2.95	5.0	4.0-9.0	Abandoned
MW-01R	578101.30	12624432.00	5/1/2020	585.73	588.45	10.0	9.0	2.72	5.0	4.0-9.0	
MW-02	578241.91	12624222.64	1/18/2017	592.67	595.64	21.0	20.0	2.97	5.0	15.0-20.0	
MW-03	578125.03	12624180.40	1/18/2017	590.42	593.08	17.0	17.0	2.66	5.0	12.0-17.0	
MW-04	578003.96	12624165.24	1/18/2017	588.66	591.49	17.0	15.0	2.83	5.0	10.0-15.0	
MW-05	577970.06	12624634.16	5/22/2018	585.31	587.62	12.0	9.0	2.31	5.0	4.0-9.0	
MW-06	578229.40	12624525.24	5/22/2018	588.22	590.40	17.0	14.0	2.18	5.0	9.0-14.0	
MW-07	577585.75	12625513.56	5/22/2018	583.65	586.49	16.0	16.0	2.84	5.0	11.0-16.0	
MW-08	578261.14	12625341.26	5/22/2018	582.74	585.34	15.0	9.0	2.60	5.0	4.0-9.0	
MW-09	578241.35	12624185.62	8/12/2019	586.80	589.51	12.0	12.0	2.71	5.0	7.0-12.0	
MW-10	578367.40	12624470.20	8/12/2019	583.71	586.73	10.0	10.0	3.02	5.0	5.0-10.0	
MW-11	578236.87	12624377.19	8/19/2021	592.46	595.27	40.0	15.0	2.81	5.0	10.0-15.0	
MW-12	577987.57	12624312.28	8/17/2021	584.94	588.03	40.0	8.0	3.09	5.0	3.0-8.0	
MW-16	577273.65	12625194.83	8/25/2021	582.18	584.96	35.0	8.0	2.78	5.0	3.0-8.0	
MW-17	577652.81	12624744.16	8/17/2021	584.03	587.02	40.0	8.0	2.99	5.0	3.0-8.0	
MW-18	577919.12	12624742.18	8/18/2021	584.12	587.22	34.0	8.0	3.1	5.0	3.0-8.0	
MW-19	577938.05	12624957.16	8/20/2021	583.06	585.86	25.0	8.0	2.80	5.0	3.0-8.0	
MW-20	577722.50	12625131.40	8/18/2021	582.43	585.74	34.0	8.0	3.31	5.0	3.0-8.0	
MW-27	578303.89	12626551.81	8/23/2021	581.87	585.09	40.0	8.0	3.22	5.0	3.0-8.0	
MW-28	578314.93	12625722.71	8/23/2021	585.11	588.07	29.5	9.0	2.96	5.0	4.0-9.0	
MW-30	578196.17	12624990.23	8/19/2021	583.02	585.80	34.0	8.0	2.78	5.0	3.0-8.0	
MW-31	578307.16	12624752.70	9/1/2021	582.56	585.73	27.0	8.0	3.17	5.0	3.0-8.0	
MW-32	578348.32	12624980.14	8/30/2021	583.08	586.26	40.0	8.0	3.18	5.0	3.0-8.0	
MW-33	578403.66	12626765.24	11/28/2022	583.23	582.81	7.0	7.0	-0.42	5.0	2.0-7.0	
MW-34	578225.86	12627140.54	11/28/2022	584.69	584.44	15.0	13.0	-0.25	5.0	8.0-13.0	

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Table 6. Well Construction Details

Well I.D.	Northing	Easting	Date Installed	Ground Surface Elevation	Top of Casing (Staff Gauge) Elevation	Total Boring Depth (feet bgs)	Total Well Depth (feet bgs)	Stickup	Screen length (feet)	Screen Interval (feet bgs)	Comments
MW-36	577753.42	12624605.70	1/30/2023	589.12	585.62	20.0	9.0	3.51	5.0	4.0-9.0	
MW-37	577696.74	12624393.06	1/30/2023	585.59	589.62	20.0	9.0	4.03	5.0	4.0-9.0	
MW-38	577782.86	12624225.55	1/30/2023	586.26	590.51	20.0	9.0	4.25	5.0	4.0-9.0	
Piezometers											
PZ-13	577623.94	12624190.94	8/17/2021	583.23	585.94	34.0	9.0	2.71	5.0	4.0-9.0	
PZ-14	577191.85	12624160.04	8/16/2021	583.46	586.30	35.0	9.0	2.84	5.0	3.0-8.0	
PZ-15	577062.51	12624730.23	8/25/2021	589.32	592.38	40.0	20.0	3.06	5.0	15.0-20.0	
PZ-21	577941.39	12625280.33	8/30/2021	N/A	583.32	30.0	9.0	N/A	5.0	4.0-9.0	Seal unable to be verified, no groundwater sampling
PZ-22	578056.88	12625387.96	8/31/2021	N/A	583.42	22.0	9.0	N/A	5.0	4.0-9.0	Seal unable to be verified, no groundwater sampling
PZ-23	577627.71	12625841.35	8/25/2021	584.39	587.21	25.0	9.0	2.82	5.0	4.0-9.0	
PZ-24	577884.7	12625979.33	8/24/2021	583.92	587.25	30.0	9.0	3.33	5.0	4.0-9.0	
PZ-25	577703.65	12626240.18	8/24/2021	583.46	586.37	30.0	8.0	2.91	5.0	3.0-8.0	
PZ-26	578114.39	12626145.22	8/23/2021	583.81	586.27	30.0	8.0	2.46	5.0	3.0-8.0	
PZ-29	578138.08	12625241.56	8/30/2021	N/A	583.49	35.0	9.0	N/A	5.0	4.0-9.0	Seal unable to be verified, no groundwater sampling
MW-35	579293.34	12627013.41	1/30/2023	590.42	589.72	18.0	12.30	-0.70	5.0	7.3-12.3	
MW-39	577488.79	12624528.83	1/31/2023	583.27	587.36	20.0	7.0	4.09	5.0	2.0-7.0	
MW-40	577313.68	12624636.21	1/31/2023	582.75	586.78	10.0	6.5	4.03	5.0	1.5-6.5	
Staff Gauges											
SG-01	578234.49	12624159.06	8/12/2019	NA	585.10	NA	NA	NA	NA	NA	
SG-02	578287.85	12624784.61	8/12/2019	NA	583.43	NA	NA	NA	NA	NA	
SG-03	578201.99	12624858.11	8/12/2019	NA	584.37	NA	NA	NA	NA	NA	
SG-04	577984.43	12624649.47	8/12/2019	NA	584.53	NA	NA	NA	NA	NA	

Table 6. Well Construction Details

Well I.D.	Northing	Easting	Date Installed	Ground Surface Elevation	Top of Casing (Staff Gauge) Elevation	Total Boring Depth (feet bgs)	Total Well Depth (feet bgs)	Stickup	Screen length (feet)	Screen Interval (feet bgs)	Comments
SG-04R	577966.13	12624647.67	6/9/2020	NA	585.04	NA	NA	NA	NA	NA	
SG-05	577717.81	12624888.51	8/12/2019	NA	584.83	NA	NA	NA	NA	NA	
SG-06	578227.56	12625365.56	8/12/2019	NA	584.88	NA	NA	NA	NA	NA	
SG-07	577514.07	12625667.88	2/12/2024	NA	577.32	NA	NA	NA	NA	NA	
Stilling Wells											
STW-1	578433.87	12625522.16	4/17/2023	NA	583.03	NA	NA	NA	1	NA	
STW-2	577340.3	12625423.18	4/17/2023	NA	586.16	NA	NA	NA	5	NA	
STW-3	577771.11	12624083.74	4/17/2023	NA	592.49	NA	NA	NA	5	NA	

3.0 Groundwater Sampling and Analysis

3.1 CCR Rule Compliance Monitoring Program

This HMP was prepared in compliance with Michigan Part 115. Section 11512(a)(1) of Part 115 requires an approved HMP that complies with Rules 299.4440 to 299.4445, if applicable, and Rules 299.4905 to 299.4908. Since EPA has not authorized Michigan's CCR program, both the Federal CCR Rule (40 CFR Part 257) and Michigan Part 115 apply and are included in the following sections.

As described in Section 1.2, the status of the site from earlier monitoring is in assessment monitoring and assessment of corrective measures; however, the steps of the monitoring program have been more recently revisited (background, detection, and assessment monitoring) because the monitoring network was updated. The more recent monitoring is described below.

3.1.1 Background Monitoring

To comply with CCR § 257.94, eight rounds of upgradient and downgradient monitoring were performed between November 28, 2022 and August 8, 2023. Samples collected under the background monitoring phase were compliant with CCR Rule §257.94(b). Background monitoring samples were analyzed for the parameters listed in **Table 7**. The data gathered from the eight rounds of background water quality sampling at background monitoring wells MW-27, MW-33, and MW-34 was used to develop BTVs for each COI. The statistical methods for development of the BTV are described in the Statistical Procedures Plan **Appendix G**.

Table 7. Groundwater Quality Parameters in Compliance with the CCR Rule Part §257 and Michigan Part 115
Appendix III Constituents for Detection Monitoring
Boron
Calcium
Chloride
Fluoride
pH
Sulfate
Total Dissolved Solids (TDS)
Appendix IV Constituents for Assessment Monitoring
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Fluoride

Table 7. Groundwater Quality Parameters in Compliance with the CCR Rule Part §257 and Michigan Part 115
Lead
Lithium
Mercury
Molybdenum
Selenium
Thallium
Radium 226 and 228 combined
Additional Parameters
Total Suspended Solids (TSS)
Michigan Part 115 Constituents for Assessment Monitoring
Copper
Iron
Nickel
Vanadium
Silver
Zinc

Upon completion of background sampling, the report *Background Water Quality Statistical Certification* was submitted to EGLE and posted on the CCR compliance website and entered into the operating record (HDR, 2024). That document outlines the statistical methods used to calculated BTVs for Appendix III, Appendix IV, and TSS constituents.

3.1.2 Detection Monitoring

The results of the first detection/assessment monitoring event (October 2023) were compared to the updated BTVs and values that exceeded the BTVs are considered SSIs. The memorandum *Former J.B. Sims Generating Station Determination of Statistically Significant Increases over Background per §257.93(h)(2) and R 299.4440(8) of the Michigan Part 115 Rules* documented the identification of the SSIs (HDR, 2024a). The following list of SSIs were the first identified SSIs after the first detection/assessment monitoring event (October 2023):

- Boron in MW-02, MW-03, MW-04, MW-06, MW-08, MW-11, and MW-31
- Calcium in MW-03, MW-04, MW-18, MW-19, MW-30
- Chloride in MW-02, MW-03, MW-04
- Fluoride in MW-02, MW-03, MW-04, MW-06, MW-08, MW-11, MW-18, MW-19, MW-30, MW-31
- Sulfate in MW-03, MW-04, MW-11, MW-12, MW-18, MW-19, MW-30
- TDS in MW-02, MW-03, MW-04, MW-06, MW-11, MW-18, MW-19, MW-30

As described in **Section 1.2**, both CCR units first initiated assessment monitoring in 2018 when SSIs were identified. The site has remained in assessment monitoring since that time; however, the *Former J.B. Sims Generating Station Determination of Statistically Significant Increases over Background per §257.93(h)(2) and R 299.4440(8) of the Michigan Part 115 Rules* confirmed that the site has SSIs with the updated monitoring network and that the site remains in assessment monitoring.

In compliance with 40 CFR § 257.95(h), GPS were developed. The first CCR Rule compliance assessment monitoring sampling event with the updated monitoring network was conducted in October 2023. Samples were analyzed for COIs in Appendix IV of Part 257. In accordance with 40 CFR § 257.95(e-g), Appendix IV monitoring results were compared to BTVs and the GPS. The results were documented in the *Determination of Statistically Significant Levels over Groundwater Protection Standards per §257.95(g) and Michigan Rule R 299.4441* (HDR, 2024c). Concentrations at SSLs above the GPS at downgradient monitoring locations were identified, which confirmed that the site remains in assessment of corrective measures under the updated monitoring network. The following list of SSLs were identified after the first assessment monitoring (October 2023) sampling event (HDR, 2024c):

- Arsenic – MW-08, MW-18
- Fluoride – MW-01R, MW-02, MW-10, MW-31
- Lithium – MW-01R, MW-02, MW-06, MW-09, MW-10, MW-30, MW-32

According to 40 CFR §257.26(a), the Assessment of Corrective Measures (ACM) is due to be initiated within 90 days of the identification of SSLs. On May 1, 2024 the ACM was initiated and documented as the *Notification of Initiation of Assessment of Corrective Measures 40 CFR §257.96 and Michigan Part 115 R 299.4441(g)* (HDR, 2024d). In compliance with 40 CFR §257.96(d) and Michigan Part 115 R 299.4443 the ACM was placed in the operating record, published to the website, and submitted to EGLE on August 5, 2024. Assessment monitoring will continue quarterly for the foreseeable future.

3.2 Part 115 Compliance Monitoring Program

This section describes the same process as **Section 3.1**, but for compliance with the State Part 115 regulations. The following sections will address the details of background, detection, and ongoing assessment monitoring.

3.2.1 Background Monitoring

Following the update to the groundwater monitoring network, eight rounds of background monitoring were conducted from November 2022 through August 2023. The eighth round of background monitoring was collected in August 2023 for the well networks in **Section 2**. Background monitoring samples were analyzed for the parameters listed in **Table 7**, in compliance with Michigan Part 115 regulation and CFR 40 § 257.94(b). The data gathered for background water quality was used to develop BTVs for each COI listed in **Table 7**.

Following the completion of background sampling, as specified under Michigan R 299.4440(8), the *Background Water Quality Statistical Certification* was submitted (HDR, 2024). That document outlines the approach and selection of the statistical method for each COI listed in **Table 7** for each CCR unit. The water quality data collected from the monitoring wells located upgradient of the CCR units has been compiled and statistically analyzed to develop the original BTVs for the impoundments. The statistical method chosen to represent background water quality for detection monitoring is the upper prediction limit (UPL) and is one of the methods described in Part 115 at §324.11511a(3).

3.2.2 Detection Monitoring

The results of the first detection/assessment monitoring event (October 2023) were compared to the BTVs (UPLs) and values that exceeded BTVs are considered SSIs. The memorandum *Former J.B. Sims Generating Station Determination of Statistically Significant Increases over Background per §257.93(h)(2) and R 299.4440(8) of the Michigan Part 115 Rules* documents the process to identify the SSIs (HDR, 2024a). The SSIs identified for Units 1/2 Impoundment include boron, calcium, fluoride, sulfate, and total dissolved solids (TDS). The SSIs identified for Unit 3A/B include boron, calcium, chloride, fluoride, sulfate, and TDS. The following list of SSIs were identified after the first detection/assessment monitoring event (October 2023): The following SSIs were identified following the October 2024 groundwater monitoring event:

- Boron in MW-02, MW-03, MW-04, MW-06, MW-08, MW-11, and MW-31
- Calcium in MW-03, MW-04, MW-18, MW-19, MW-30
- Chloride in MW-02, MW-03, MW-04
- Fluoride in MW-02, MW-03, MW-04, MW-06, MW-08, MW-11, MW-18, MW-19, MW-30, MW-31
- Sulfate in MW-03, MW-04, MW-11, MW-12, MW-18, MW-19, MW-30
- TDS in MW-02, MW-03, MW-04, MW-06, MW-11, MW-18, MW-19, MW-30

As described in **Section 1.2**, the site groundwater monitoring program was officially considered in assessment monitoring in 2018. Therefore, the documentation of the SSIs confirmed that the site remains in assessment monitoring with the updated monitoring network. In compliance with R299.4440(8)(a), after the SSIs were identified, a notice in the operating record that indicates which constituents have shown statistically significant increases from background levels and EGLE was notified that the notice was placed in the operating record. In compliance with R 299.4440(8)(b), after the SSIs were identified, an assessment monitoring plan that is in compliance with R 299.4441 is required and a Response Action Plan in compliance with R 299.4442 within 45 days is required. Because the site was considered in assessment monitoring back in 2018 and the program status is ongoing, the Assessment Monitoring Program is included herein as **Sections 2.0**, **3.2.3** to **3.7**, **4.0**, and **5.0**. The Response Action Plan was submitted to EGLE on March 24, 2024.

3.2.3 Assessment Monitoring

The identification of SSIs during detection monitoring at both Units 1/2 Impoundment and Unit 3A/B Impoundments indicates both CCR units maintain assessment monitoring status and develop GPS. Under the assessment monitoring program, the Unified Guidance recommends the upper tolerance limit (UTL) to represent the background concentration for this purpose. As required in Michigan R 299.4441(9), the CCR owner must establish GPS for each constituent detected in the groundwater. The GPS for the Part 115 compliance program shall be defined as the lowest of the following:

- U.S. EPA Maximum Contaminant Level (MCL) for constituents for which an MCL has been established;
- The applicable cleanup criteria for that constituent for groundwater as established pursuant to section 20120a of Act 451.
- Constituents for which the background level (UTL) is higher than the MCL or applicable cleanup criteria for groundwater, the background value shall be the GPS.

The UTL, MCLs, applicable state cleanup criteria, and Site GPS for both CCR units are provided in **Appendix G**.

The October 2023 sampling data from compliance wells was compared to the GPS values provided in **Appendix G**, and several COIs were found to exceed GPS at both CCR units. To determine the statistical significance of the observed concentration, the 95LCL was calculated for each of the downgradient wells. The 95LCLs were compared to GPS value and several COIs were found to have exceeded GPS, resulting in SSLs (HDR, 2024b). Concentrations at SSLs above the GPS at downgradient monitoring locations were identified, which confirmed that the site remains in assessment of corrective measures under the updated monitoring network. The following list of COIs had SSLs that were identified after the first assessment monitoring (October 2023) sampling event (HDR, 2024c): arsenic, boron, calcium, chloride, fluoride, lead, lithium, sulfate, and TDS.

The identification of SSLs for both CCR units indicates both will remain in assessment monitoring. In compliance with Part 115 regulations, a Response Action Plan was submitted to EGLE within 45 days of the identification of SSLs. The document demonstrated the understanding of the water quality and the actions that will be taken to mitigate unacceptable risk associated with the identified release from the CCR units. According to Michigan Part 115 R 299.4443(1) the Assessment of Corrective Measures (ACM) is due to be initiated within 90 days of the identification of SSLs. On May 1, 2024 the ACM was initiated and documented as the *Notification of Initiation of Assessment of Corrective Measures 40 CFR §257.96 and Michigan Part 115 R 299.4441(g)* (HDR, 2024d). In compliance with Michigan Part 115 R 299.4443 the ACM was placed in the operating record, published to the website, and submitted to EGLE on August 5, 2024. Assessment monitoring will continue quarterly for the foreseeable future. Following the identification of SSLs, the monitoring well network was revised as noted above to include additional wells for the purpose of delineating the COI plumes.

Assessment monitoring will continue quarterly for the foreseeable future. In compliance with Michigan Part 115 R 299.4441following each assessment monitoring event the LCLs will be calculated and compared to GPS to evaluate for SSLs. If additional wells are identified having SSLs, or additional COIs are identified at SSLs above GPS, a notification will be submitted to EGLE, entered into the operating record, and posted to the Harbor Island website.

3.3 Monitoring Well Schedule and Frequency

The required eight rounds of background monitoring ended in August 2023 and the initial detection/assessment monitoring was performed in October 2023. The current status of the program is in assessment monitoring. Assessment monitoring will continue on a quarterly basis at the designated monitoring wells in the monitoring well network. The monitoring well sample locations are contained in **Table 8**, the monitoring event schedule and frequency are contained in **Table 9**.

Table 8. Groundwater Sample Locations

Background Monitoring Wells (Units 1/2 Impoundment and Unit 3A/B Impoundments)	MW-27, MW-33, MW-34	
Point of Compliance Monitoring Wells	Units 1/2 Impoundments	MW-06, MW-08, MW-18, MW-19, MW-20, MW-30, MW-31
	Unit 3A/B Impoundments	MW-02, MW-03, MW-04, MW-11, MW-12
Nature and extent monitoring wells	MW-01R, MW-07, MW-09, MW-10, MW-16, MW-17, MW-28, MW-32, MW-36, MW-38	
Total monitoring wells to be sampled per event	25	
QC samples to be collected per sample event	2 (Field Duplicate)	
Total samples to be submitted for laboratory analysis per sample event	27	

Table 9. Groundwater Sample Collection Frequency

Type of Monitoring	Year	Frequency	Number of Sample Events	Approximate Sample Collection Schedule	Water Quality Constituents of Interest[1]
Background Monitoring	2022 – 2023 (Completed)	5-Week	8	Completed first 8 events, ongoing quarterly and will be updated biennially	Appendix III, Appendix IV, Part 115, TSS
Detection Monitoring	2023	Quarterly	Continuous until Closure or Initiation of Assessment Monitoring	Initiated October 2023	Appendix III, TSS, Iron
Assessment Monitoring	2023-ongoing	Quarterly	Ongoing until return to Detection Monitoring or until Closure	First event - October 2023 Ongoing	Appendix III, Appendix IV, Part 115, TSS

1.See Table 6 for a list of constituents.

2.Federal CCR Rule and Part 115 require a minimum sampling frequency of semi-annual. Due to the variable nature of the groundwater flow direction, the assessment monitoring will be conducted quarterly for the foreseeable future.

3.4 Sampling Procedures

Appendix F provides the proposed sample collection and safety procedures. Procedures are consistent with the EPA guidelines and R 299.4440-4445 and R 299.4905-4908 of the Part 115 rules. Groundwater samples will be collected by a Contracted Consultant (CC).

3.4.1 Quality Control

Quality Control (QC) checks of both the field procedures and laboratory analyses will be used to assess and document data quality and to identify discrepancies in the measurement process that need correction. Quality control samples will be used to assess various data quality parameters such as representativeness of the environmental samples, the precision of sample collection and handling procedures, the thoroughness of the field equipment decontamination procedures, and the accuracy of laboratory analyses. In addition, sample containers, preservation methods, and holding times will be in accordance with QC requirements.

The analytical laboratory will use a series of QC samples, as identified in the laboratory's Quality Assurance Plan and specified in the standard analytical methods. The types of samples include method blanks, surrogate spikes, laboratory control samples, laboratory control sample duplicates, matrix spikes, and matrix spike duplicates. Analyses of QC samples will be performed for samples of similar matrix type and concentration and for each sample batch. Laboratory accuracy is assessed through the analysis of matrix spike/matrix spike duplicate (MS/MSD) samples. The number of MS/MSD analyses is based on laboratory quality control standards. The approved contract laboratory will run MS/MSD samples at a rate of one per batch analyzed. MS/MSD analysis results reflect the ability of the laboratory and method to accurately determine the quantity of an analyte in a particular sample. The measurement of "standards", or materials of accepted reference values, provides an assessment of the accuracy of laboratory instruments and analytical methods. Accuracy will be evaluated through the use of EPA Quality Control Samples or Standard Reference Materials. Accuracy at the laboratory is expressed as percent recovery of the control sample. Laboratory MS recovery requirement is 80 to 120 percent, and MSD maximum difference is 20 percent.

The precision of field sampling procedures will be evaluated by collection and analysis of field duplicate samples. Duplicate samples are two or more samples collected or processed so that the samples are considered to be essentially identical in composition. Duplicate samples will be used to evaluate the reproducibility (precision) of analyte concentration values reported by the laboratory. Although two replicates are not adequate to assess precision, they can be used to show whether variability of results for the samples is within the range of expected precision.

The number of duplicate samples to be collected would typically be at a rate of ten percent (approximately one for every ten samples). One duplicate sample per CCR unit for each sample event. Sample identification for duplicates will be the same as the sample identification with the addition of a "T" (e.g. MW-5 and MWT-5). The precision will be measured through the evaluation of relative percentage differences (RPDs) between sample and duplicate sample and between matrix spike and matrix spike duplicates and calculated as follows:

Relative Percentage Difference (%) = $\left[\frac{|SA\ concentration - SB\ concentration|}{Average\ concentration\ of\ SA+SB}\right] x\ 100$

Where SA denotes Sample A; SB denotes the duplicate, sample B.

Duplicate RPD requirement is 20 percent. Accuracy is measured by the difference between the measured or observed value and the true or assigned value. Accuracy in the field is assessed through the adherence to sample handling, preservation, and holding times.

Calibration of field equipment is performed by the rental equipment company prior to each rental, and calibration records are included with the equipment. Therefore, calibration of field equipment measuring field parameters (YSI or similar) will be calibrated at the beginning of each sample event. The calibration record from the equipment company will be reviewed for calibration accuracy. The sample crew will photograph the calibration documentation provided with the equipment.

Laboratory data will be reviewed, validated and qualified, if necessary, prior to use. The laboratory data validation procedure is described in **Section 3.5**.

3.5 Monitoring Parameters and Analytical Methods

3.5.1 Sample Parameters

Parameters to be analyzed for each semiannual assessment monitoring event are shown on **Table 10**. These parameters include the constituents required for groundwater sampling by Part 115. Analytical testing of water samples will be performed by the approved contract laboratory. Field measurements will be collected by the sampling team during the purging process. The field measurements are specific conductance, temperature, dissolved oxygen, pH, turbidity, and oxidation/reduction potential (ORP).

Table 10. Groundwater Quality Parameters For Analysis

Constituent	Background Monitoring	Detection Monitoring	Assessment Monitoring
Antimony	✓		✓
Arsenic	✓		✓
Barium	✓		✓
Beryllium	✓		✓
Boron	✓	✓	✓
Cadmium	✓		✓
Calcium	✓	✓	✓
Chloride	✓	✓	✓
Chromium	✓		✓
Cobalt	✓		✓
Copper	✓		✓
Fluoride	✓	✓	✓

Table 10. Groundwater Quality Parameters For Analysis			
Constituent	Background Monitoring	Detection Monitoring	Assessment Monitoring
Iron	✓	✓	✓
Lead	✓		✓
Lithium	✓		✓
Mercury	✓		✓
Molybdenum	✓		✓
Nickel	✓		✓
pH	✓	✓	✓
Radium 226 and 228	✓		✓
Selenium	✓		✓
Silver	✓		✓
Sulfate	✓	✓	✓
Thallium	✓		✓
Total Dissolved Solids	✓	✓	✓
Vanadium	✓		✓
Zinc	✓		✓
Additional Constituents			
Total Suspended Solids	✓	✓	✓

3.5.2 Sample Analysis

Table 11 lists the COIs that will be analyzed by the contracted laboratory and the analytical methods, preservation, and sample holding times.

Table 11. Water Quality Parameters For Analysis						
Parameter	**Sample Bottle***	**Units to be reported**	**Preservation**	**Method**	**Holding Time**	**Laboratory Reporting Limits**
Antimony	250 mL plastic	mg/L	Nitric Acid	200.7	6 mos	0.0001
Arsenic	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.0001
Barium	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.00066
Beryllium	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.000053
Boron	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.0017
Cadmium	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.000075
Calcium	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.078
Chloride	250 mL plastic	mg/L	Chill	300.0	28 d	0.12
Chromium	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.0002
Cobalt	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.0001
Copper	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.0002
Fluoride	250 mL plastic	mg/L	None	9056	28 d	0.011
Iron	250 mL plastic	mg/L	Nitric Acid	300.0	6 mos	0.025
Lead	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.0001
Lithium	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.0019

Table 11. Water Quality Parameters For Analysis						
Parameter	**Sample Bottle***	**Units to be reported**	**Preservation**	**Method**	**Holding Time**	**Laboratory Reporting Limits**
Mercury	8 oz glass	mg/L	None	1631E	28 d	0.0000005
Molybdenum	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.00025
Nickel	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.00065
Radium 226 and 228	(2) 1 L plastic	pCi/L	HNO_3	SM 7500	6 mos	2.0 combined
Selenium	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.0001
Silver	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.00005
Sulfate	250 mL plastic	mg/L	Chill	300.0	28 d	0.22
Thallium	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.000075
Total Dissolved Solids	1 L plastic	mg/L	None	SM 2540C	NA	20
Total Suspended Solids	1 L plastic	mg/L	None	SM 2540D	NA	3
Vanadium	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.00063
Zinc	250 mL plastic	mg/L	Nitric Acid	200.8	6 mos	0.0012

*Bottle volume may differ based on laboratory availability.

3.6 Data Validation

This section describes the process used for data review and validation. The CC will perform the data validation, statistical analysis, interpretation, and reporting. The scanned field forms, laboratory reports (pdf and electronic data deliverable (EDD)), and the chain of custody (COC) used during the sampling process.

3.6.1 Field Data Review

The field data review will be performed by the CC and include verification that QC checks and calibrations are recorded properly in the field data sheets and that any necessary and appropriate corrective actions were implemented and recorded. Such data will be written into field data sheets immediately after measurements are taken. If errors are made, results will be legibly crossed out and corrected in a space adjacent to the original (erroneous) entry. If transcription errors have been made, the Laboratory Supervisor (LS) and Environmental Field Technician (EFT) will address the errors to provide resolution.

Field measurement data will be entered by the CC into electronic files for data validation and data interpretation. **Table 12** lists the field records that will be validated and verified and who is responsible.

Table 12. Data Verification and Validation Inputs				
Item	Description	Verification (Completeness)	Validation (Conformance to Specifications)	Who Will Verify or Validate
Field Records				
1	Field equipment calibration records	X	X	CC
2	Chain-of-Custody forms	X		CC
3	Field decontamination documentation	X		CC

Table 12. Data Verification and Validation Inputs				
Item	Description	Verification (Completeness)	Validation (Conformance to Specifications)	Who Will Verify or Validate
4	Sample collection field forms	X		CC
5	Drilling logs	X		CC
6	Well construction logs	X		CC
7	Well development field forms	X		CC
Analytical Data Package				
9	Cover sheet (laboratory identifying information)	X	X	CC
10	Case narrative	X	X	CC
11	Internal laboratory Chain-of-Custody forms	X	X	CC
12	Sample chronology and consistency (that is, dates and times of receipt, preparation, and analysis)	X	X	CC
13	Communication records with laboratory	X	X	CC
14	EDD format consistency	X		CC
15	Sample identification, results nomenclature, and data qualifier consistency	X		CC
16	Method detection limit consistency	X	X	CC
17	Instrument calibration records	X	X	CC
18	Laboratory Report	X	X	CC
19	Field QC sample results and calculation of accuracy and precision	X	X	CC

3.6.3 Verification

Verification is a completeness check that is performed before the data review process continues in order to determine whether the required information was collected and is available. Verification is not designed for use in qualitative review but ensures the availability of information for subsequent steps of the data review process. Example inputs for conducting the completeness check are listed in **Table 12** above.

The following procedures will be performed by the CC for data verification:

- COC forms and shipping documents will be reviewed and verified for completeness and accuracy against the actual contents of the laboratory report and EDD.
- Field notes will be reviewed for completeness and accuracy.

3.6.4 Data Validation

The purposes of data validation are to review suspect analytical data, designate a data qualifier for any discovered data quality limitation, and eliminate any analytical data that does not pass validation acceptance criteria. A formal data validation will be performed by CC and will include a review of field QC sample analyses and laboratory data. The CC will determine whether the measurement performance criteria have been met and will calculate the data completeness for the project.

Evaluating Field Data

The results of field QC sample analyses associated with each laboratory data package will be reviewed by the CC to evaluate equipment blanks and other field QC samples and further indications of the data quality. If a problem is identified through reviewing field QC data, all related field samples will be identified by the CC, and, if possible, corrective actions will be instituted and documented. If data are compromised because of a problem identified via field QC sample review, appropriate data qualifications will be used by the CC to identify the data for future data users.

The handling, preservation, and storage of samples collected during the sampling program will be monitored by the CC on an ongoing basis. The sample receipt records (a required data package deliverable) as well as the COC documentation will also be assessed by the CC during data validation. Sample handling, storage, or preservation problems identified during data validation will result in appropriate qualification of data.

Evaluating Laboratory Data

Data verification will be performed by the CC on 100 percent of the data to review completeness of the data packages. The purpose of chemistry data validation is to verify that the data are of appropriate quality, are technically valid, are defensible, and are usable for their intended purpose. The objectives of the data validation process are to:

- Verify completeness of data packages and corresponding EDDs.
- Assess compliance with project-specific procedures and programs.
- Evaluate system process control so that that no systematic errors exist within the data sets.
- Assess field QC samples to determine whether sampling has adversely affected the reported results and, therefore, usability.
- Assess both method and laboratory performance through tabulation of QC outliers.
- Provide measures of data quality in terms of precision, accuracy, and completeness so that overall usability can be determined.

Data validation will be performed by CC using the general protocols and processes described in the following documents, as applicable:

- Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (USEPA, 2010) (as a general guidance and using professional judgment for the validation in support of or in the absence of method-specific direction)
- Guidance for Labeling Externally Validated Laboratory Analytical Data (USEPA, 2009a)

One hundred percent of the data will undergo a Stage 2B validation by the CC. The following specific QC elements will be reviewed during the validation:

- Presence and completeness of COC and sample receipt documentation
- Sample index (correlation of field sample identifier [ID] to laboratory sample ID)
- Laboratory case narrative (method deviations and QC anomalies)
- Analytical holding times
- Method blank
- Field duplicate RPD values
- Laboratory duplicate RPD values
- Summaries of instrument blanks (for example, internal calibration blank [ICB] and continuous calibration blank, if specified in the method)
- Interference check samples (ICP and ICP–mass spectrophotometry [ICP-MS])
- Review of LCSs
- Serial dilutions (ICP and ICP-MS)
- Post-digestion spikes
- Summaries of internal standards

Each data package will be accompanied by an EDD prepared by the laboratory. Additional laboratory QC data can be included in the EDD as long as the data fields specified in the EDD are also maintained. EDDs will be cross checked by the CC against corresponding data reports to confirm consistency in the results reported in these two separate formats. The following data qualifiers will be applied during data validation by the CC:

U	The analyte was analyzed for, but was not detected at, a level greater than or equal to the level of the adjusted reporting limit (RL) for the sample and method.
J	The analyte was positively identified, and the associated numerical value is the approximate concentration of the analyte in the sample (due either to the quality of the data generated because certain QC criteria were not met, or to the concentration of the analyte being below the RL).
J+	Same as J, and the reported concentration is potentially biased high.
J–	Same as J, and the reported concentration is potentially biased low.
UJ	The analyte was not detected at a level greater than or equal to the adjusted method detection limit (MDL). However, the reported adjusted MDL is approximate and might be inaccurate or imprecise.
R	The sample results are unusable due to the quality of the data generated because certain criteria were not met. The analyte might or might not be present in the sample.

After the fieldwork and the final analytical data have been performed and reviewed by the CC for each sampling event, a Data Quality Summary Report will be prepared by the CC for the project. The report will summarize quality assurance and audit information, including the results of the data review; will evaluate field QC sample data, such as field duplicates; and will describe corrective actions taken. The Data Quality Summary Reports will be appended to the project report.

3.6.5 Data Useability Assessment

Data collected from the field activities will be evaluated against the following data quality parameters.

Precision

Precision refers to the degree to which repeated measurements are similar to one another when obtained under prescribed conditions. Precision will be assessed by evaluating the results of field duplicates to determine RPD. QC procedures and acceptance criteria are summarized in **Table 13**.

For precision:

RPD for field duplicates percent RPD = $\left[\frac{|Amount\ in\ sample\ 1 - Amount\ in\ Sample\ 2|}{\frac{Amount\ in\ Sample\ 1 + Amount\ in\ sample\ 2}{2}}\right] x\ 100$

Accuracy

Accuracy is defined as the measure of the closeness of an individual measurement or the average of a number of measurements to the actual or "true" value. Laboratory accuracy will be assessed by evaluating LCSs and MSs and calculating the percent recovery (percentR). QC procedures and acceptance criteria are summarized in **Table 13**.

For Accuracy

Percent recovery for MS percentR = $\left(\frac{Spike\ conc. - Sample\ conc.}{Amount\ of\ spike\ added}\right) x\ 100$

Percent recovery for LCS percentR = $\left(\frac{Spike\ conc.}{Amount\ of\ spike\ added}\right) x\ 100$

Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount of data that was expected or planned for. A qualified datum will be considered unless it has been rejected (R), in which case it is unusable. The goal for completeness is 100 percent; however, a rejected (unusable) datum will be evaluated to determine whether data gaps exist or whether the project objectives were met without it.

For Completeness:

Percent completeness = $\left(\frac{Number\ of\ usable\ measurements}{Number\ of\ planned\ measurements}\right) x\ 100$

A brief Data Validation Report will be developed for each semiannual sample event and will document the results of the data verification and validation. This report will describe the conclusions made during the data assessment regarding data usability. Limitations on the usability of the data will be explained, including the reasons for data qualifiers, the definitions of the qualifiers, and a summary of the specific acceptance criteria that were assessed and found to be outside control limits.

Table 13. Minimum QC Procedures for Project Parameters			
Quality Check	Minimum Frequency	Acceptance Criteria	Corrective Action(s)
Metals by ICP-MS			
Laboratory control sample (percent recovery)*	One per analytical batch	85–115	Correct the problem, then reanalyze. If still out, reprep and reanalyze the LCS and all samples in the affected batch.
Laboratory matrix spike/matrix spike duplicate (percent recovery)*	One per analytical batch	70-130	Assess data to determine whether there is a matrix effect or analytical error. Analyze LCS for failed target analytes. Communicate matrix effects to the prime contractor so an evaluation can be made by the PC with respect to the project quality objectives.
Field duplicate relative percent difference	One per sampling event	20	None. Field duplicates are collected to provide information about overall precision and the ability of sampling techniques to produce a representative sample.
Total Suspended Solids and Total Dissolved Solids			
Laboratory control sample (percent recovery)*	One per analytical batch	80-120	Correct the problem, then reanalyze. If still out, re-prep and reanalyze the LCS and all samples in the affected batch.
Laboratory matrix spike/matrix spike duplicate (percent recovery)*	One per analytical batch	RPD<10	Rerun if enough sample and time if not qualify the results
Field duplicate relative percent difference	One per sampling event	20	None. Field duplicates are collected to provide information about overall precision and the ability of sampling techniques to produce a representative sample.
Anions			
Laboratory control sample (percent recovery)*	One per analytical batch	90-110	Correct the problem, then reanalyze. If still out, re-prep and reanalyze the LCS and all samples in the affected batch.
Laboratory matrix spike/matrix spike duplicate (percent recovery)*	One per analytical batch	80-120	Assess data to determine whether there is a matrix effect or analytical error. Analyze LCS for failed target analytes. Communicate matrix effects to the prime contractor so an evaluation can be made by the PC with respect to the project quality objectives.
Field duplicate relative percent difference	One per sampling event	20	None. Field duplicates are collected to provide information about overall precision and the ability of sampling techniques to produce a representative sample.
Radium 226/228			
Laboratory control sample (percent recovery)*	One per analytical batch	73-135	Correct the problem, then reanalyze If still out, re-prep and reanalyze the LCS and all samples in the affected batch.
Laboratory matrix spike/matrix spike duplicate (percent recovery)*	One per analytical batch	71-136	Assess data to determine whether there is a matrix effect or analytical error. Analyze LCS for failed target analytes. Communicate matrix effects to the prime contractor so an evaluation can be made by the PC with respect to the project quality objectives.
Field duplicate relative percent difference	One per sampling event	20	None. Field duplicates are collected to provide information about overall precision and the ability of sampling techniques to produce a representative sample.

* Other laboratory quality controls (for example, method blanks) will be performed following the laboratory quality assurance plan. The laboratory will be responsible for reporting the data verification codes on reports.

3.7 Data Management

Project data and information must be documented in a format that is usable by project personnel. This section describes how project data and information will be documented, tracked, and managed, from generation in the field to final use and storage, in a manner that ensures data integrity and retrieval.

3.7.1 Data Package Deliverables

Data package deliverables for off-site analyses are listed below.

Sample Collection and Field Measurements Data Package Deliverables

Sample collection documentation will include field form entries, field measurements, and COC forms.

Field measurements will be taken by the sampling team for groundwater samples collected by low-flow sampling. The measurements are specific conductance, temperature, dissolved oxygen, pH, turbidity, and oxidation/reduction potential (ORP). All field and QC sample results, calibrations, and calibration verifications will be recorded by the sampling team on field forms. The hard-copy versions of the field data will be scanned by the sampling team and filed with other project data. Field sampling forms will be included in quarterly reports.

Off-site Laboratory Data Package Deliverables

The contract laboratory will provide laboratory data packages for each set of samples analyzed. Data and summary for the data validator to perform verification and data usability assessment are to be sent by email to the CC within 15 business days of receiving the sample. Delivery of a hard-copy data package will not be required.

The laboratory will email the CC an analytical report and an electronic data deliverable (EDD).

The information provided by the laboratory will be to review the data with respect to:

- Holding times and sample conditions
- Calibrations and instrument performance
- Detection/quantitation limits
- Spike and surrogate recoveries
- Duplicate analyses (laboratory duplicates and matrix spike [MS]/MS duplicates [MSD])
- Laboratory control sample (LCS)
- Blank contamination
- Target compound identification and quantitation

A laboratory report will be provided that includes the following hard-copy information for each analytical data package:

- Cover sheet listing the name and number of samples included in the report.
- Narrative comments describing problems encountered in analysis; identification of analyses not meeting QC criteria, including holding times; and cautions regarding unusable data due to QC results that are outside the control limit.

- COC forms.
- Documentation of extraction, clean-up, and analytical methods used.
- Tabulated results of inorganic compounds identified and quantified, with analyte-specific detection limits. Analytes will be reported for each sample as a detected concentration or as not detected above the specific limits of quantitation, which must be stated. The laboratory will also report dilution factors, date of analysis, surrogate percent recoveries, batch run logs, and analytical batch number for each sample, with corresponding sample results.
- Analytical results for QC sample spikes, laboratory duplicates, initial and continuing calibration, verifications of standards and laboratory blanks, standard procedural blanks, LCSs, laboratory reference materials, inductively coupled plasma (ICP) interference check samples, and detection limit check samples.
- Documentation of rationale for the use of method of standard addition, if required.

Corresponding to each individual laboratory report, an EDD will be prepared and submitted along with the laboratory data package.

3.7.2 Data Handling and Management

This section describes computerized and manual procedures that trace the paths of data from generation to final use and storage, as well as the associated quality checks for error detection that are performed to maintain data integrity.

Data Recording

Data recording in the field will be performed as described herein and using the forms and formats in **Appendix F**.

3.7.3 Data Tracking and Control

The project quality records will be maintained by the CC. These records, either electronic or hard copy in form, will include the following:

1. Project work plans with approved modifications, updates, and/or addendums
2. Project Sampling SOP and Statistical Method Certification, with any approved modifications, updates, and/or addendums
3. Field documentation
4. COC records
5. Laboratory documentation (results received from the laboratory will be documented in an electronic format)
6. Data validation and verification reports
7. Final project reports and deliverables

Hard-copy field and laboratory records will be maintained in the project’s central data file, where original field and laboratory documents are filed chronologically for future reference. These records are also scanned to produce electronic copies in portable document format (PDF). The electronic versions of these records will be maintained in the CC network and has a routine backup schedule.

Project records listed above will be provided and maintained on file for a minimum of three years after completion of the work. Besides acting as a central data repository, the database will further facilitate data analysis and reporting. The information stored in the database will consist of sampling information (for example, sample identification, location, and sampling date and time), and analytical chemistry data specified in different fields of the EDD format selected for the project. Field data previously transferred from hard-copy documents into electronic files and laboratory EDDs will be reviewed for completeness and accuracy by the CC.

Recordkeeping

The following groundwater monitoring information will be placed on the operating record as it becomes available:

- Annual groundwater monitoring and corrective action reports
- Quarterly groundwater monitoring reports
- Semiannual Remedy Selection Progress Reports
- Documentation of the design, installation, development, and decommissioning of monitoring wells
- Groundwater monitoring system certification
- Statistical method certification

4.0 Statistical Approach

The statistical procedures use for the groundwater monitoring program will be in accordance with Part 115 Rule 908. These statistical procedures will be consistent with those used for the Federal CCR Rule compliance monitoring program in accordance with 40 CFR §257.93(f) and (g). **Appendix G** provides the *Statistical Procedures Plan*, including components for preliminary data analysis (outliers, distributions, serial correlation, trend analysis, seasonality); approach to computing background threshold values; the test for statistically significant levels above groundwater protection standards for assessment monitoring; and test for closure.

5.0 Groundwater Reporting

Quarterly groundwater monitoring reports will be submitted for the active life of the impoundments, to EGLE not later than 30 days after the end of the calendar quarter, in compliance with R 299.4907(11)). Reports will be submitted January 30, April 30, July 30, and October 30 each year. The quarterly groundwater monitoring report will contain the following information, to the extent available:

1. Statement regarding adherence to (or deviation from) the Hydrogeologic Monitoring Plan, with regard to sampling locations, analytical parameters, sampling technique, lab methodology, etc.
2. Brief description of the sampling event.
3. Groundwater flow direction and map for the current sampling event, pursuant to Rule 907(5).
4. A Groundwater Monitoring Exceedance Summary Table, to contain statistical exceedances from the current reporting event.
5. Discussion of statistical limit exceedances.
6. Alternate source demonstrations for the SSI's, including supporting documentation, unless these will be provided in a separate submittal.
7. Laboratory analytical results.
8. Chain of custody information.
9. Other supporting documentation, as applicable. Laboratory Quality Assurance/ Quality Control data need not be submitted but will be kept in the facility's operating record and supplied upon request. Analytical data from field and sampling blanks should be submitted.

In addition, an annual groundwater monitoring report will be submitted to EGLE not later than 30 days after the end of the calendar year. Annual reports will summarize key monitoring actions performed, describe any problems encountered and any actions to resolve any such problems, and key project activities for the upcoming year. The annual groundwater monitoring report will contain the following information, to the extent available:

1. A map showing the CCR units, background and downgradient monitoring wells;
2. Identification of monitoring wells that were installed or decommissioned during the preceding year, along with a narrative description of why those actions were taken;
3. Determine rate and direction of groundwater flow each time groundwater is sampled; and
4. In addition to the monitoring data, a summary including the number of groundwater samples that were collected for analysis for each background and downgradient well, the dates the samples were collected, and whether the sample was required by the detection monitoring or assessment monitoring programs.

EGLE will be notified prior to undertaking well abandonment, plugging, replacement, or repair at the Site. EGLE will be notified when sampling and analysis program documentation has been placed in the operating record.

6.0 Assessment Monitoring Plan

As required by Part 115 Section 11519b(2) and R 299.4440(8) and (10), if the detection monitoring confirms an SSI over background at one of the impoundments for one or more of the constituents listed in Section 11511a(3), an Assessment Monitoring Plan (AMP) shall be developed and conducted at that impoundment, and any other impoundments would remain in detection monitoring. The AMP is included herein and the following components of the AMP are addressed in the previous sections within the HMP:

AMP Requirement	Section within HMP
Monitoring Well Network	Section 2.0
Groundwater Sampling and Analysis	Section 3.0
Statistical Approach	Section 4.0
Groundwater Reporting	Section 5.0

7.0 Response Action Plan

According to Part 115 Section 11519b(2), if detection monitoring confirms an SSI over background, a Response Action Plan (RAP) in compliance with R 299.4442 of the Part 115 Rules shall be prepared. As stated above, the identification of SSIs was documented January 24, 2024; therefore, the RAP was submitted March 8, 2024. The report documented sources of contamination, interim response activities taken to identify possible sources of contamination and steps taken to prevent additional contamination, and termination of waste schedule. The RAP has been included as **Appendix H**. Should additional SSLs be identified, or changes be proposed to the RAP, a revised RAP will be submitted to EGLE.

8.0 Assessment of Corrective Measures

Following the submission of the RAP, the Assessment of Corrective Measures (ACM) was compiled detailing the proposed strategies to address future mitigation, and includes the components required in Part 115 Rule 299.4443. As described in HDR (2024c), SSLs were identified on February 5, 2024. Therefore, assessment of corrective measures was initiated on August 5, 2024 based on the updated SSL identified using the updated monitoring network and updated background wells and BTVs. As outlined in the ACM, included as **Appendix I**, groundwater remedy selection will require additional data collection to delineate the groundwater exceedances, collect additional hydrogeologic data needed for conceptual planning of remediation alternatives, and to coordinate with the per- and polyfluoroalkyl substances (PFAS) findings.

9.0 Remedy Selection and Remedial Action Plan

Remedy selection progress reports will be submitted on a semi-annual basis as required in §257.97(a) of the CCR Rule. The report will describe progress toward selecting and designing the final remedy for the CCR unit. The final remedy will be formally selected once the options are reviewed and approved by EGLE. A public meeting will be conducted at least 30-days prior to the final selection as required under §257.96(e) and R 299.4443(4). At the time of remedy selection, a Remedial Action Plan in compliance with Michigan Part 115 R 299.4444 and §257.97 of the CCR Rule, will be prepared.

10.0 References

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HDR, 2023. Monitoring Well Installation Report. November 27, 2023.

HDR, 2024. Background Statistical Certification Report. December 11, 2023. Revised January 24, 2024.

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HDR, 2024c. Determination of Statistically Significant Levels over Groundwater Protection Standards per §257.95(g) and Michigan Rule R 299.4441. February 5, 2024.

HDR, 2024d. Notification of Initiation of Assessment of Corrective Measures 40 CFR §257.96 and Michigan Part 115 R 299.4441(g). May 1, 2024.

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Appendix A

Hydrogeologic Monitoring Plan Checklist

2024

PART 115 RULES CHECKLIST
COAL ASH LANDFILL AND COAL ASH IMPOUNDMENTS
HYDROGEOLOGICAL MONITORING PLAN

Facility Name: Former J.B Sims Generating Station Date: 9/4/2024 Initials: TB

Report Name: Former J.B. Sims Generating Station Hydrogeologic Monitoring Plan

Report Date: 9/4/2024

Item No.	Item	Subpart	HMP Section where Item may be Reviewed
No. 1	Design and siting ensure groundwater will not exceed:	R306(1)	Not Applicable (N/A)
	MCLs in 40 CFR Part 257 and Appendix I. (Note: if the design and siting ensure GW will not exceed MCLs identified in Appendix I, it is likely that Michigan's cleanup criteria will not be exceeded)		
	Existing concentrations, where these already exceed 40 CFR Part 257 and Appendix I, unless groundwater has greater than 10,000 mg/L TDS.		
No. 2	Design and siting ensure that requirements of Part 31 and its rules will be met.	R306(2)	N/A
No. 3	Hydrogeologic monitoring plan for the coal ash landfill or coal ash impoundment includes the following components:	R905(1)	--
	A monitoring well system which complies with R906.	R905(1)a	2.0
	Leachate and SCS monitoring programs as specified in R432, if required.	R905(1)b	N/A – Not required, coal ash impoundment
	Surface water monitoring program for surface waters that may receive runoff from the "active work area" (see R101(g)).	R905(1)c	2.4
No. 4	Contains the following specific information:	R905(2)	--
	All GW sampling locations.	R905(2)a	2.0
	Sampling constituents/parameters and frequency.	R905(2)b	3.1, 3.2, 3.3
	Sampling and analysis procedures for each parameter	R905(2)c	3.4, 3.5.2
	Sample collection.	R905(2)	Appendix E
	Sample preservation and shipment.		Appendix E, 3.5.2
	Analytical procedures, including detection limits.		3.5.2
	Chain of custody control.		Appendix E
	Laboratory and field quality assurance and quality control procedures.		3.6, Appendix E
	Procedures for prevention of cross contamination in wells during well installation, purging and sampling.		Appendix E
	Statistical procedures for data evaluation in compliance with R908.	R908	Appendix F
No. 5	Sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer that represent the quality of:	R906(1)	2.0
	Background water quality not affected by leakage from a unit.	R906(1)a	2.1.1, 2.2.1
	Meets conditions for use of wells other than true upgradient.	R906(1)(a) i or ii	2.1.1, 2.2.1
	Downgradient groundwater and ensures detection of groundwater contamination in the uppermost aquifer, and other groundwater specified by the Director.	R906(1)b	2.1, 2.2
	Meets conditions for downgradient monitor well installation at locations other than the solid waste boundary.		2.1.2, 2.1.3 , 2.2.2, 2.2.3
	Wells installed at the closest practicable distance from the solid waste boundary.		2.1.2 , 2.2.2
No. 6	Meets conditions for a multi-unit groundwater monitoring system instead of separate monitoring systems for each landfill unit when the facility has several discrete units.	R906(2)	--

Item No.	Item	Subpart	HMP Section where Item may be Reviewed
	Monitoring wells not more than 150 meters from the solid waste boundary of each unit, located on land owned by the owner of the unit.	R906(2)a	2.1, 2.2
	Sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer.	R906(2)b	2.1, 2.2
	Is as protective of human health and environment as individual monitoring systems for each unit, based on the following:	R906(2)b	--
	Number, spacing and orientation of the units.		1.3
	Hydrogeologic setting.		1.3
	Site history.		1.1, 1.2
	Engineering design of the units.		1.1
	Type of waste accepted at the units.		1.1
No. 7	Monitoring wells cased in a manner that maintains the integrity of the well borehole.	R 906(3)	2.0, 2.5
No. 8	Well casings screened or perforated and packed with gravel or sand, where necessary, to enable the collection of groundwater samples.	R906(3)	2.0, 2.5
No. 9	Annular space in each monitoring well sealed to prevent contamination of the samples and groundwater.	R906(3)	2.0, 2.5
No. 10	Notified the Director that the design, installation, development, and decommission of any monitoring wells, piezometers, and other measurement, sampling, and analytical devises documentation have been placed in the operating record.	R906(4)	5.0
No. 11	All monitoring wells, piezometers, and other measurement, sampling, and analytical devices designed, operated and maintained to perform to design specifications throughout the life of the monitoring program.	R906(5)	2.0, 2.5
No. 12	Monitoring wells designed to minimize the time necessary to recharge well, given hydraulic conductivity of the aquifer.	R906(6)	2.0, 2.5
No. 13	Number, spacing, and depths of monitoring systems in compliance with the following conditions:	R906(7)	2.0
	Site-specific technical information that includes thorough characterization of both of the following:	R906(7)(a)	--
	The uppermost aquifer, including all of the following information:	R906(7)(a)i	1.3, 2.0
	Aquifer thickness.		1.3
	Groundwater flow rate.		1.3
	Groundwater flow direction including seasonal and temporal fluctuations in groundwater flow.		1.3
	Saturated and unsaturated geologic units and fill materials overlying the uppermost aquifer, materials comprising the uppermost aquifer, and materials comprising the confining unit defining the lower boundary of the uppermost aquifer, including all of the following:	R906(7)(a)ii	1.3, 2.0
	Thickness.		1.3
	Stratigraphy.		1.3
	Lithology.		1.3
	Hydraulic conductivities.		1.3
	Porosities.		1.3
	Effective Porosities.		1.3
	Certified by a Geologist.	R906(7)b	Preface
	Approved by the Director. Within 14 days of this approval, the owner or operator shall notify the Director that the certification and approval have been placed in the operating record.	R906(7)c	--
No. 14	All wells clearly labeled, properly vented, capped, and locked when not in use.	R906(8)	2.5
No. 15	All wells visible throughout the year.	R906(8)	2.5

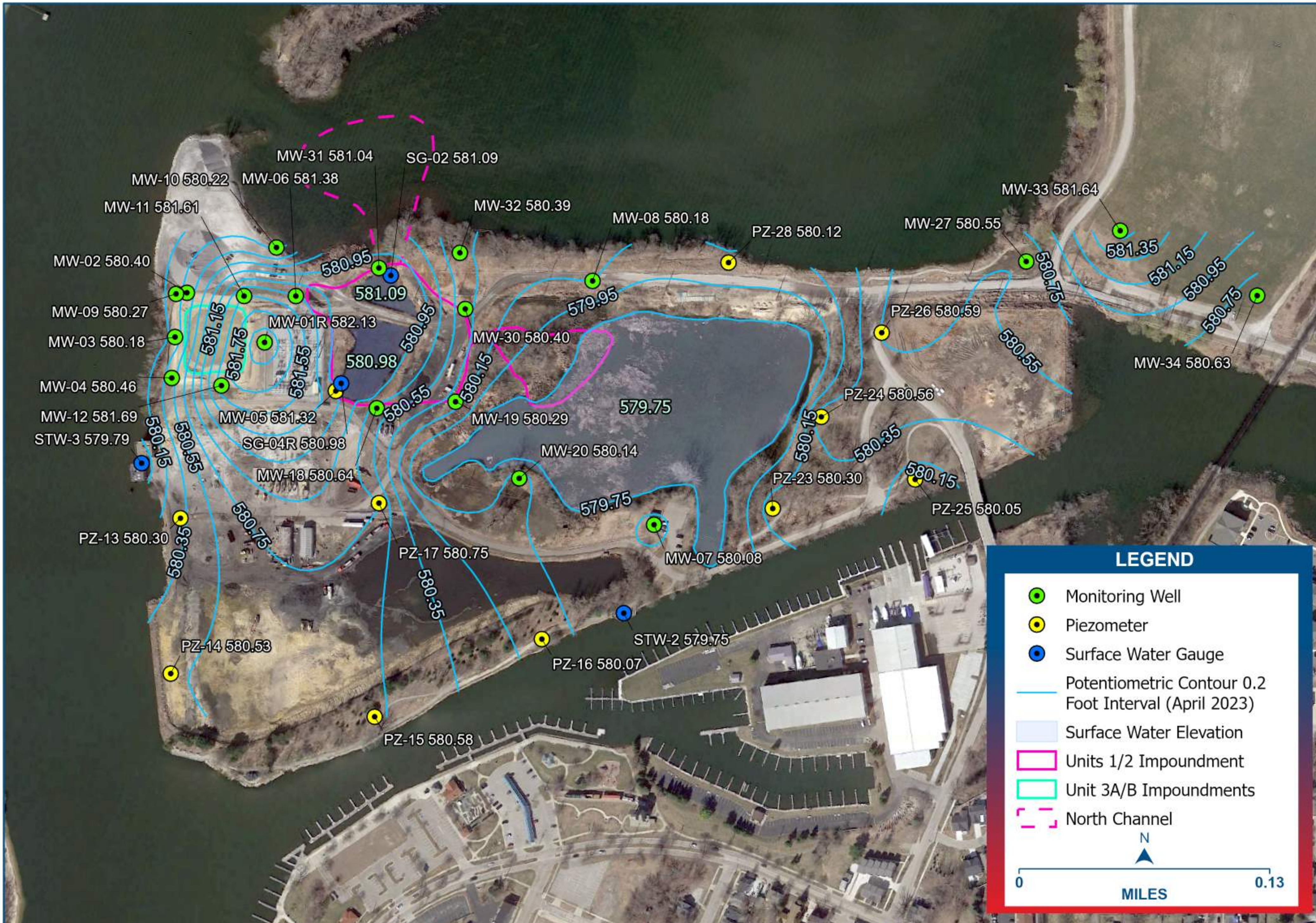
Item No.	Item		Subpart	HMP Section where Item may be Reviewed
No. 16	Owner or operator to notify the Director or designee prior to undertaking well abandonment, plugging, replacement, or repair.		R906(9)	5.0
No. 17	Groundwater monitoring program includes sampling and analysis procedures designed to ensure monitoring results that provide an accurate representation of groundwater quality at the background and downgradient wells installed in compliance with R906.		R907(1)	3.0, Appendix F
No. 18	Owner or operator has notified Director that sampling and analysis program documentation has been placed in the operating record.		R907(1)	5.0
No. 19	The sampling and analysis program shall include all of the following:		R907(1)	--
		Sample collection.	R907(1)a	Appendix E
		Sample preservation and shipment.	R907(1)b	3.5.2, Appendix E
		Analytical procedures.	R907(1)c	3.5
		Chain of custody control.	R907(1)d	Appendix E
		Quality assurance and quality control.	R907(1)e	3.6, Appendix E
No. 20	Sampling and analysis programs include sampling and analytical methods appropriate for groundwater sampling and accurately measure hazardous constituents and other monitoring parameters in groundwater samples.		R907(2)	3.5, Appendix E
No. 21	Groundwater samples shall not be field filtered.		324.11511a(3)e	3.5, Appendix E
No. 22	Sampling procedures and frequency are protective of human health and the environment.		R907(3)	3.3, 3.4, Appendix E
No. 23	Analytical methods and practical quantitation limits for groundwater monitoring are approved by the Director.		R907(4)	3.4, 3.5.2
No. 24	Groundwater elevations measured immediately prior to purging each time groundwater is sampled.		R907(5)	Appendix E
No. 25	Owner or operator to determine rate and direction of groundwater flow each time groundwater is sampled.		R907(5)	5.0
No. 26	Facility to measure groundwater elevations within a period of time short enough to avoid temporal variations in groundwater flow which could preclude accurate determination of groundwater flow rate and direction.		R907(5)	Appendix E
No. 27	Groundwater elevations measured by methods giving precision to 1/8 inch or 0.01 foot, measured from the top of the well reference point using a determined USGS datum point.		R907(6)	Appendix E
No. 28	Facility has established background water quality in a hydraulically upgradient or background well or wells for each of the monitoring parameters or constituents required in groundwater monitoring program. (Background groundwater quality may be established at wells not located hydraulically upgradient from the unit if the well meets R906(1)(a)).		R907(7)	1.2, 3.1.1, 3.2.1
No. 29	Number of samples to establish groundwater quality data consistent with statistical procedures determined per R908. The sampling procedures are those specified pursuant to the provisions of the following:		R907(8)	3.1, 3.2, 3.3, Appendix F
		For detection monitoring	R440	3.1.2, 3.2.2, Appendix F
		For assessment monitoring	R441	3.1.3, 3.2.3, Appendix F
		For response action plan	R442	9.0, Appendix G
		For remedial action	R444	3.1.3, 3.2.3, Appendix F
No. 30	All samples obtained shall be representative of the site's groundwater quality.		R907(9)	2.0
		Each well will be purged until dry or until not less than 3 times the amount of water in the well casing has been removed.		Appendix E
		Monitoring wells will be sampled immediately after purging where recovery rates allow.		Appendix E
		If well pumped dry during purging, samples will be taken within 24 hours.		Appendix E
No. 31	If nondedicated pumps or mobile sampling equipment is used, facility will use the following procedures to minimize the potential for cross -contamination		R907(10)	Appendix E

Item No.	Item		Subpart	HMP Section where Item may be Reviewed
		Sample wells from upgradient to downgradient, except areas of known contamination will be sampled from least contaminated to most contaminated well.	R907(10)a	Appendix E
		Each piece of equipment will be thoroughly cleaned and rinsed with distilled water before use in each well.	R907(10)b	Appendix E
		Other decontamination procedures approved by the Department.	R907(10)c	Appendix E
No. 32	The owner and operator shall submit all monitoring results to the director or designee not later than 30 days after the end of the calendar quarter.		R907(11)	5.0
No. 33	The owner and operator of a landfill will sample and analyze groundwater by methods specified in "Standard Methods for the Examination of Water and Wastewater…. Or other methods approved by the director or his or her designee. (we would accept SW-846 methods).		324.11511a(4)	3.5
No. 34	Detection monitoring parameter list includes:		324.11511a(3)(c)	3.1.1, 3.5.1, 3.5.2
		Boron	324.11511a(3)(c)i	3.5.1
		Calcium	324.11511a(3)(c)ii	3.5.1
		Chloride	324.11511a(3)(c)iii	3.5.1
		Fluoride	324.11511a(3)(c)iv	3.5.1
		Iron	324.11511a(3)(c)v	3.5.1
		pH	324.11511a(3)(c)vi	3.5.1
		Sulfate	324.11511a(3)(c)vii	3.5.1
		Total Dissolved Solids	324.11511a(3)(c)viii	3.5.1
No. 35	Contains a statistics plan or statistical procedures that meets the requirements of Rule 908. (Use Part 115 Rules Checklist – Landfill Groundwater Monitoring Statistical Procedures).		R908	4.0, Appendix F
No. 36	Detection monitoring is conducted quarterly during the active life and semiannually during the post-closure period, except as provided for in R440(5).		R440(1)(a)	3.3
No. 37	Meets conditions for deletion of R452 to R454 parameters.		R440	N/A
		Parameters and breakdown products are not in leachate for not less than 2 consecutive and historic samplings.	R440(4)	N/A
No. 38	Meets conditions for alternative monitoring frequency for R450-451 parameters (at least semiannually) or for R452-454 parameters (at least annually) based on following factors:		R440(5)	N/A
		Lithology of aquifer and unsaturated zone.	R440(5)a	N/A
		Hydraulic conductivity of aquifer and unsaturated zone.	R440(5)b	N/A
		Groundwater flow rates.	R440(5)c	N/A
		Minimum distance from the waste and the closest downgradient well screen, or presence of SCS.	R440(5)d	N/A
		Resource value of aquifer.	R440(5)e	N/A
No. 39	First sampling event includes 4 independent samples from each well. Subsequent events include minimum of 1 sample from each well.		R440(7)	3.1, 3.2, 3.3
No. 40	In case of statistically significant increase over background:		R440(8)	--
		Place notice in operating record within 14 days.	R440(8)a	3.1.3, 3.2.3
		Prepare assessment monitoring plan per R441 and a response action plan within 45 days.	R440(8)b	3.2.3, 7.0
No. 41	If statistically significant increase over background due to other source or is due to an error, has owner:		R440(9)	
		Documented a demonstration of this and placed notice in operating record within 30 days.	R440(9)	3.1-3.2
		If a successful demonstration is made,	R440(9)(a)	3.1-3.2
		Continue detection monitoring.	R440(9)(a)	3.1-3.2

Item No.	Item	Subpart	HMP Section where Item may be Reviewed
	Determined if the unit remains monitorable	R440(9)(b)	3.1-3.2
	If a successful demonstration is not made, then 15 days after notification by the director, prepare an assessment monitoring plan and a response action plan.	R440(10)	3.1, 3.2, 7.0
No. 42	Text in the HMP indicates an assessment monitoring program will be developed if required under R441 or the Assessment Monitoring Program is included with the HMP. (use the assessment monitoring program checklist if the program is provided) or the Assessment Monitoring program has already been approved and is referenced in the HMP. Or a schedule, approved by the department, that leads to compliance by no later than December 28, 2020 has been provided.	R441 or 324.11511a(3)(f)ii	6.0
No. 43	Text in the HMP indicates a response action plan will be developed if required under R442 or the Response Action Plan is included. (use the response action plan checklist if a plan is provided) or the Response Action Plan has already been approved and is referenced in the HMP. Or a schedule, approved by the department, that leads to compliance by no later than December 28, 2020 has been provided.	R442 or 324.11511a(3)(f)ii	7.0
No. 44	Text in the HMP indicates that corrective measures will be assessed if required under R443 or the assessment of corrective measures is included in the HMP or the assessment of corrective measures has already been approved and is referenced in the HMP. Or a schedule, approved by the department, that leads to compliance by no later than December 28, 2020 has been provided.	R443 or 324.11511a(3)(f)ii	8.0
No. 45	Text in the HMP indicates that a remedy will be selected, if required, in compliance with R444 or the remedy selection and remedial action plan is included with the HMP or the remedy selection and remedial action plan has already been approved and is referenced in the HMP. Or a schedule, approved by the department, that leads to compliance by no later than December 28, 2020 has been provided.	R444 or 324.11511a(3)(f)ii	9.0
No. 46	Text in the HMP indicates that a remedial action plan will be implemented, if required, in compliance with R445 or the remedial action plan implementation details are included with the HMP or the remedial action plan has already been implemented and is referenced in the HMP. Or a schedule, approved by the department, that leads to compliance by no later than December 28, 2020 has been provided.	R445 or 324.11511a(3)(f)ii	9.0
COMMENTS:			

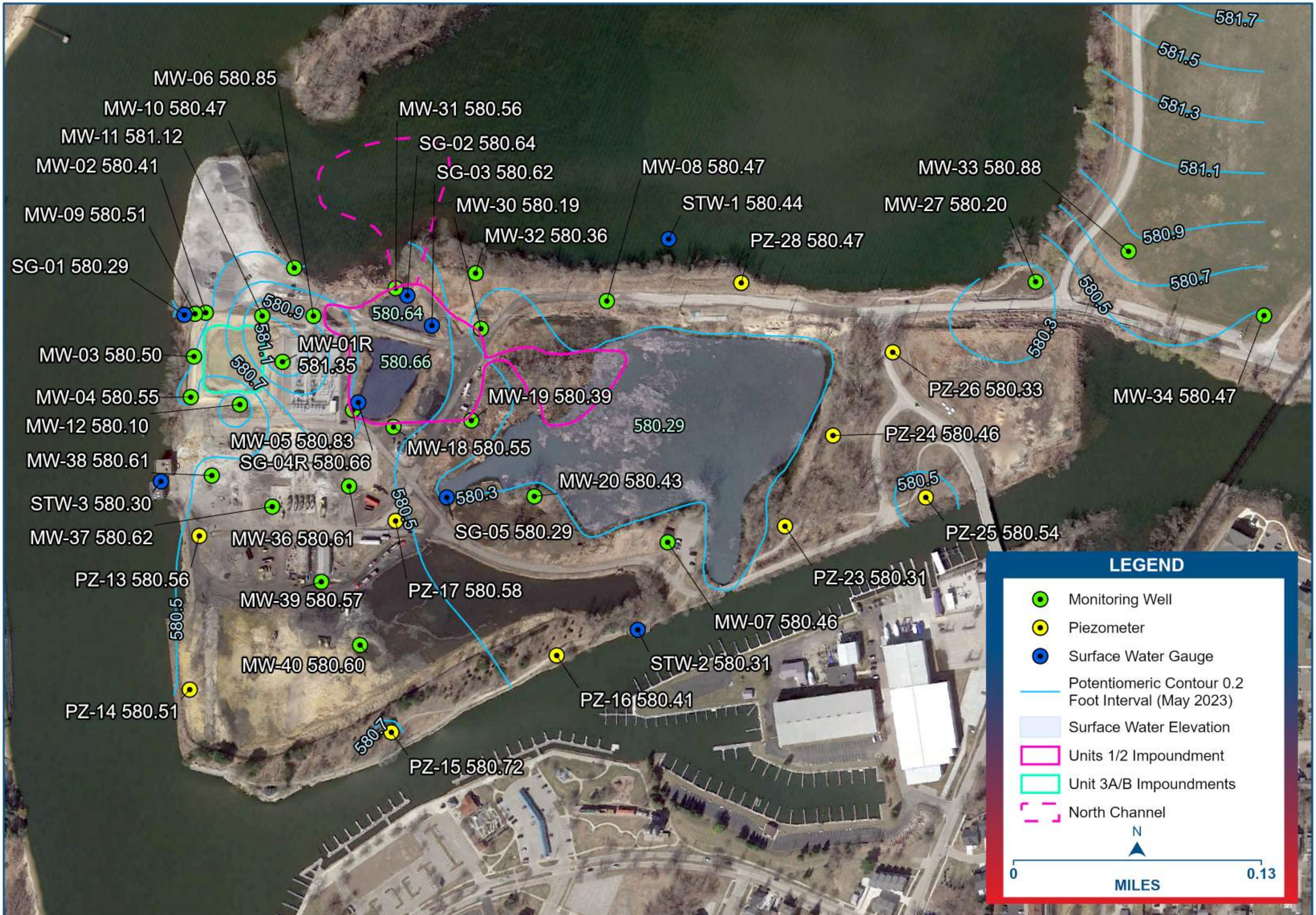
Appendix B

Groundwater Potentiometric Contour Maps



Renew Harbor Island

FORMER J.B. SIMS GENERATING STATION
CITY OF GRAND HAVEN

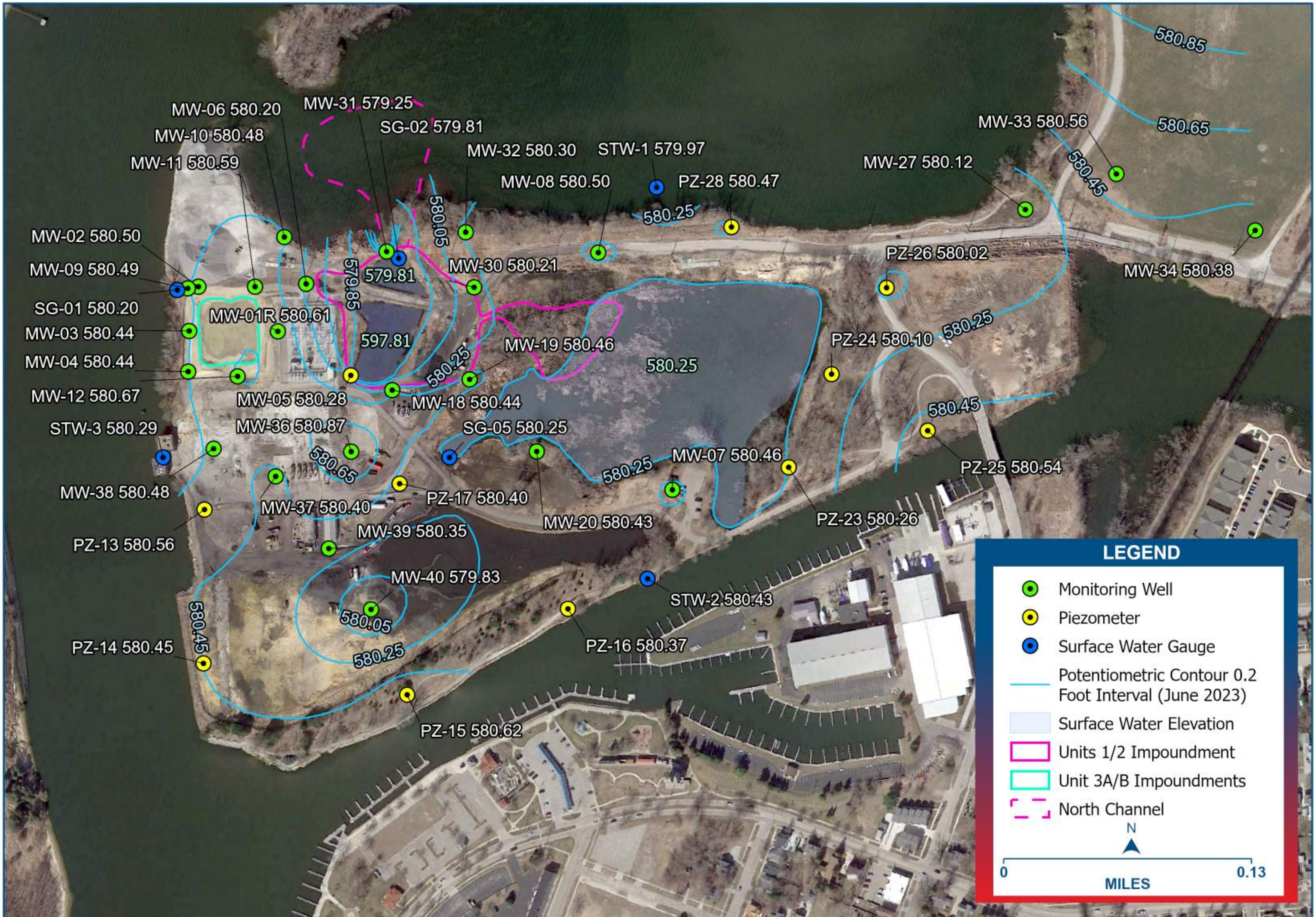


Renew Harbor Island

HDR

FORMER J.B. SIMS GENERATING STATION

CITY OF GRAND HAVEN

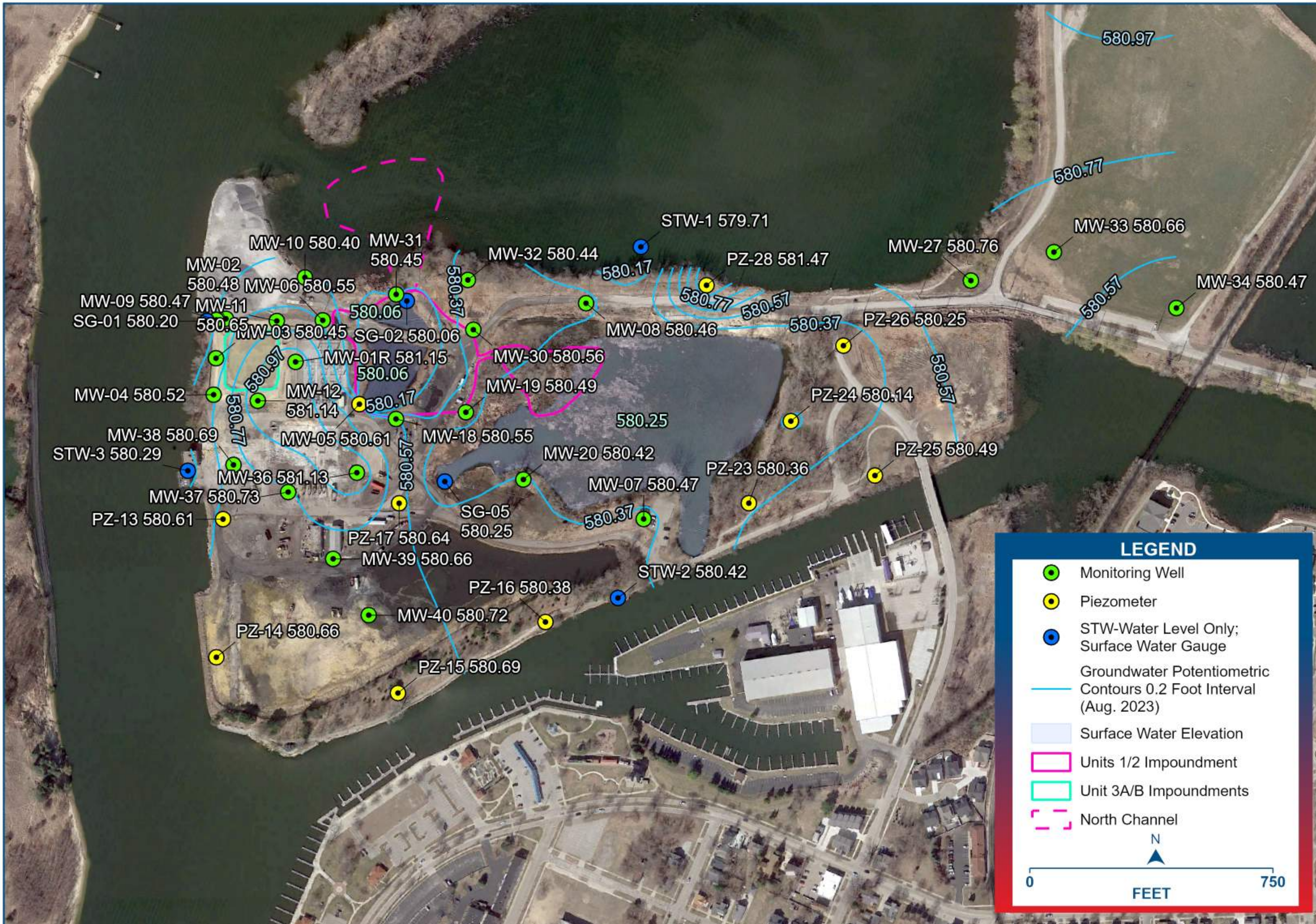


Renew Harbor Island

HDR

FORMER J.B. SIMS GENERATING STATION

CITY OF GRAND HAVEN

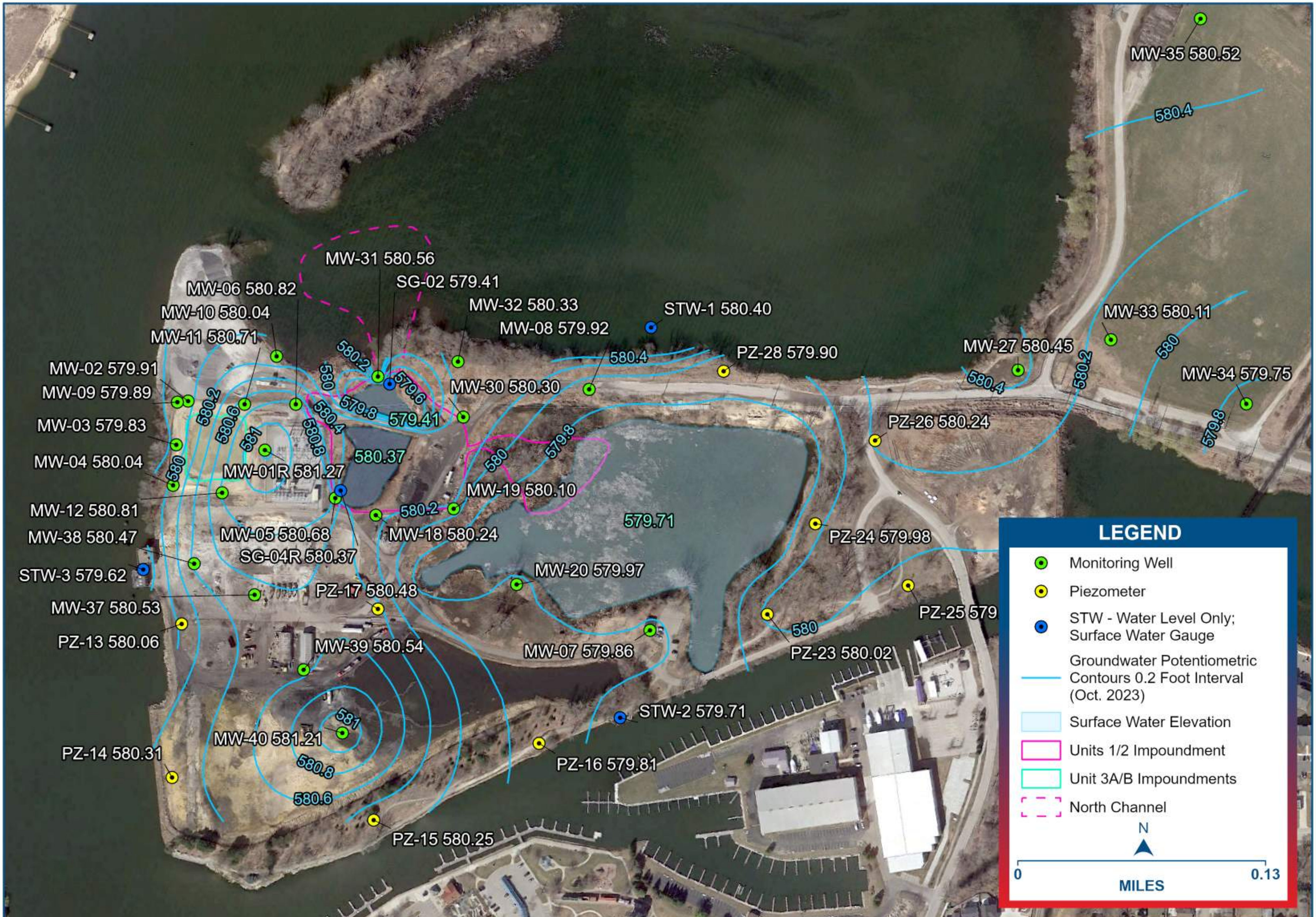


Renew Harbor Island

HDR

FORMER J.B. SIMS GENERATING STATION

CITY OF GRAND HAVEN



Renew Harbor Island

HDR

FORMER J.B. SIMS GENERATING STATION
CITY OF GRAND HAVEN

Renew Harbor Island

HDR

FORMER J.B. SIMS GENERATING STATION
CITY OF GRAND HAVEN

Renew Harbor Island

HDR

FORMER J.B. SIMS GENERATING STATION

CITY OF GRAND HAVEN

Appendix C

Boring Logs

3352 128th Avenue
Holland, MI 49424
P: 616-399-3500

PROJECT:
Grand Haven Board of Light and Power
CCR Well Installation
1231 N 3rd Street
Grand Haven, Michigan

BORING # **MW-01**
ERM PROJECT # 0387368
SHEET 1 OF 1

DRILLING CONTRACTOR	EDAC Holland, MI	ERM REPRESENTATIVE	Brian Beach
		OFFICE LOCATION	Holland, MI
DRILLING FOREMAN	Sean Smith	DATE: START	01/18/2017
DRILLING METHOD	Hollow-Stem Augers	FINISH	01/18/2017
DRILLING EQUIPMENT	Gus Peck		

HORIZONTAL DATUM (NAD 1983 StatePlane Michigan South (US Feet))		BOREHOLE DEPTH	10 ft
NORTHING	176201.037	BOREHOLE DIAMETER	
EASTING	3847934.632	DEPTH TO WATER (INITIAL) ▼	5 ft
VERTICAL DATUM (NGVD 29 (US Feet)) ELEVATION	96.08 ft	DEPTH TO WATER (FINAL) ▽	

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	SAMPLE TYPE	RECOVERY		Observations / Remarks
		SAND (SP) poorly graded, fine grained SAND; loose, little gravel, moist, dark brown to black		SP					
	95	SAND (GW-SW) well graded, fine grained SAND; loose, some gravel, moist, brown to grayish brown	1	GW-SW					
2		SAND (SP) fine grained SAND; loose, moist, black, [Bottom ash.]	2	SP					
		SILTY SAND (SP) poorly graded, fine grained SAND; loose, little clay, moist to wet, dark brown to black, [Concrete, metal and wood fragments. Wet @ 5']	3	SP					
4									
6	90								
8									
		SILT (OL) soft, little clay, trace fine sand, wet to moist, dark grayish brown	9	OL					

REMARKS:
Elevation data established from referenced benchmark set at 100.00'.

LAB ANALYSIS:

ERM
3352 128th Avenue
Holland, MI 49424
P: 616-399-3500

PROJECT:
Grand Haven Board of Light and Power
CCR Well Installation
1231 N 3rd Street
Grand Haven, Michigan

BORING # MW-01
ERM PROJECT # 0387368
SHEET 1 OF 1

DRILLING CONTRACTOR	EDAC Holland, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN	Sean Smith	OFFICE LOCATION	Holland, MI
DRILLING METHOD	Hollow-Stem Augers	DATE: START	01/18/2017
DRILLING EQUIPMENT	Gus Peck	FINISH	01/18/2017

GEOGRAPHIC COORDINATES
(NAD 1983 StatePlane Michigan South (US Feet))
NORTHING 176201.037
EASTING 3847934.632
Elevation/Top of Casing Elev. 96.08 ft/ 99.35 ft

WELL CONSTRUCTION

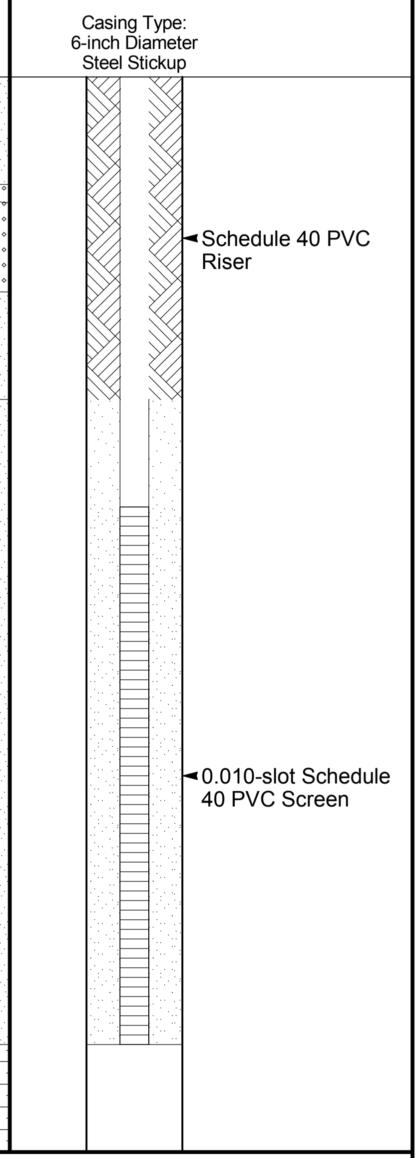
	Riser	Screen
Material:	*Schedule 40 PVC*	*Schedule 40 PVC, 0.010-slot*
Diameter (ID):	*2-inch*	*2-inch*
Coupling:	*Threaded*	*Threaded*

Well Permit #: *No permit required.*

WELL DEVELOPMENT
Method: *Overpumping*
Duration: *0.5 hours*
Gals. Purged: *30*

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS
		SAND (SP) poorly graded, fine grained SAND; loose, little gravel, moist, dark brown to black		SP
	95	SAND (GW-SW) well graded, fine grained SAND; loose, some gravel, moist, brown to grayish brown	1	GW-SW
2		SAND (SP) fine grained SAND; loose, moist, black, [Bottom ash.]	2	SP
4		SILTY SAND (SP) poorly graded, fine grained SAND; loose, little clay, moist to wet, dark brown to black, [Concrete, metal and wood fragments. Wet @ 5']	3	SP
6	90			
8				
		SILT (OL) soft, little clay, trace fine sand, wet to moist, dark grayish brown	9	OL

WELL CONSTRUCTION



REMARKS:
Elevation data established from referenced benchmark set at 100.00'.

WELL INSTALLATION NOTES:

RECORD OF WELL DECOMMISSIONING: MW-01

CLIENT:	Grand Haven BLP	DATE:	May 01, 2020	ELEVATION:	584.3 ft (Ground)
PROJECT:	GHBLP - JB Sims Generating Station			COORDINATES:	N: 176201.0 ft E: 3847934.6 ft
PROJECT NO:	20141048			COORD SYS:	SP MI South FIPS 2113 Ft
LOCATION:	Grand Haven, MI	CONTRACTOR:	EDAC	HORZ DATUM:	NAD83 VERT DATUM: NAVD88

DRILL RIG: GP-1100 ATV Rig

DRILL METHOD: Hollow Stem Auger

Samples: Hammer: ASTM D1586, Blows per 6 in 140-lb hammer, 30-in drop (NUMBER, TYPE, REC %, BLOWS, N-VALUE)

Water Content Percent: Plastic & Liquid Limits (%); Water Content (%); NP Nonplastic (0–100)

Shear Strength: Nat Vane; Rem Vane; Pocket Pen; Q; U (0–100)

DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
0–1	SAND, poorly graded, fine grained, loose, little gravel, moist, dark brown to black.	SP	0.0 / 583.3		0.0 - 10.0 ft bgs: Hydrated Bentonite Chips
1–2	SAND, well graded, fine grained, loose, some gravel, moist, brown to grayish brown.	SW	1.0 / 582.3		
2–3	SAND, poorly graded, fine grained, loose, moist, black (bottom ash).	SP	2.0 / 581.3		
3–9	Silty SAND, poorly graded, fine grained, loose, little clay, moist to wet, dark brown to black (concrete, metal, and wood fragments). Wet at 5 feet.	SC-SM	3.0 / 575.3	▽ (5 ft)	
9–10	SILT, soft, little clay, trace fine sand, wet to moist, dark grayish brown.	ML	9.0 / 574.3		
10	End of hole at 10.0 ft.				

DEPTH SCALE: 1:53

REV:

GOLDER

LOGGED: Adam Near, CPG DATE: May 01, 2020

CHECKED: Dawn Prell, CPG DATE: Jun 11, 2020

RECORD OF BOREHOLE / WELL: MW-01R

CLIENT:	Grand Haven BLP	DATE:	May 01, 2020	ELEVATION:	585.7 ft (Ground)
PROJECT:	GHBLP - JB Sims Generating Station			COORDINATES:	N: 578101.3 ft E: 12624432.0 ft
PROJECT NO:	20141048			COORD SYS:	SP MI South FIPS 2113 Ft
LOCATION:	Grand Haven, MI	CONTRACTOR:	EDAC	HORZ DATUM:	NAD83 VERT DATUM: NAVD88

Drill Rig: GP-1100 ATV Rig
Drill Method: Hollow Stem Auger

Samples: Hammer: ASTM D1586, Blows per 6 in 140-lb hammer, 30-in drop

DESCRIPTION	USCS	ELEV. / DEPTH (ft)	NUMBER	TYPE	REC %	BLOWS	N-VALUE
Fine SAND, loose, dark brown to black, little Gravel, moist.	SP	0.0 – 584.7		Air Knife	100		
Fine to coarse SAND, loose, brown to gray, some Gravel, moist.	SW	1.0 – 583.7					
Fine SAND, loose, black (bottom ash), moist.	SP	2.0 – 582.7					
Silty fine SAND, loose, dark brown to black, some Clay, wood fragments, wet.	SP-SM	3.0 – 577.5	1	SS	98	13-10-16	23
			2	SS	55	5-3-3	8
SILT, loose, dark brown to black, trace Sand, wet.	ML	8.2 – 575.7	3	SS	10	5-2-2	7
End of hole at 10.0 ft.							

Water Content Percent: Plastic & Liquid Limits (%); Water Content (%); NP Nonplastic (0, 20, 40, 60, 80, 100)

Shear Strength: Nat Vane; Rem Vane; Pocket Pen; Q; U (0, 20, 40, 60, 80, 100)

Additional Lab Testing | Additional Observations | Groundwater Observations (water level symbol at approx. 3 ft)

Construction and Installation Details

Pipe Stickup: 2.7 ft
Pipe Elev: 588.4 ft

- 0.0 - 0.5 ft bgs: Concrete
- 0.5 - 2.5 ft bgs: Hydrated Bentonite Chips
- Schedule 40 PVC Riser (2-inch diameter)
- 2.5 - 10.0 ft bgs: Filter Sand
- 0.010-inch slot PVC screen

DEPTH SCALE: 1:53

REV:

GOLDER

LOGGED: Adam Near, CPG — DATE: May 01, 2020
CHECKED: Dawn Prell, CPG — DATE: Jun 11, 2020

ERM
3352 128th Avenue
Holland, MI 49424
P: 616-399-3500

PROJECT:
Grand Haven Board of Light and Power
CCR Well Installation
1231 N 3rd Street
Grand Haven, Michigan

BORING # **MW-02**
ERM PROJECT # 0387368
SHEET 1 OF 1

DRILLING CONTRACTOR	EDAC Holland, MI	ERM REPRESENTATIVE	Brian Beach
		OFFICE LOCATION	Holland, MI
DRILLING FOREMAN	Sean Smith	DATE: START	01/18/2017
DRILLING METHOD	Hollow-Stem Augers	FINISH	01/18/2017
DRILLING EQUIPMENT	Gus Peck		
HORIZONTAL DATUM (NAD 1983 StatePlane Michigan South (US Feet))		BOREHOLE DEPTH	21 ft
NORTHING	176247.026	BOREHOLE DIAMETER	
EASTING	3847865.054	DEPTH TO WATER (INITIAL) ▼	15 ft
VERTICAL DATUM (NGVD 29 (US Feet)) ELEVATION	104.49 ft	DEPTH TO WATER (FINAL) ▽	

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	SAMPLE TYPE	RECOVERY		Observations / Remarks
		SILTY CLAY (CL) medium stiff, some silt, trace fine gravel, trace fine sand; moist, mottled, brown and gray		CL					
5	100								
10	95								
		SAND (GW-SW) well graded, fine grained SAND; loose, some gravel, little silt, trace clay; moist, dark brownish gray to black, [Wood fragments]	11	GW-SW					
		SILTY CLAY (CL) soft, little fine sand, trace gravel, moist, dark gray to black, [Glass, wood, plastic debris]	13	CL					
	90	SILTY CLAY (CL) soft, some silt, trace fine sand, moist, dark gray to dark brownish gray	14	CL					
15		SAND (SP) poorly graded, fine grained SAND; loose, wet, light grayish brown, [silt/clay stringers throughout.]	14.9 ▼	SP					
		SILTY CLAY (CL) soft, some silt, wet, dark gray to dark brownish gray, [Grey fine sand seams throughout]	17.25	CL					
	85	SAND (SP) poorly graded, fine grained SAND; loose, little clay, laminated, gray to dark gray	19	SP					
20		SILTY CLAY (CL) soft, some silt, wet, dark gray to dark brownish gray	20	CL					
			21						
	80								

REMARKS:
Elevation data established from referenced benchmark set at 100.00'.

LAB ANALYSIS:

ERM	3352 128th Avenue Holland, MI 49424 P: 616-399-3500	PROJECT: Grand Haven Board of Light and Power CCR Well Installation 1231 N 3rd Street Grand Haven, Michigan	BORING # **MW-02** ERM PROJECT # 0387368 SHEET 1 OF 1

DRILLING CONTRACTOR	EDAC Holland, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN	Sean Smith	OFFICE LOCATION	Holland, MI
DRILLING METHOD	Hollow-Stem Augers	DATE: START	01/18/2017
DRILLING EQUIPMENT	Gus Peck	FINISH	01/18/2017

GEOGRAPHIC COORDINATES
(NAD 1983 StatePlane Michigan South (US Feet))

NORTHING	176247.026
EASTING	3847865.054
Elevation/Top of Casing Elev.	104.49 ft/ 107.75 ft

WELL CONSTRUCTION

	Riser	Screen
Material:	*Schedule 40 PVC*	*Schedule 40 PVC, 0.010-slot*
Diameter (ID):	*2-inch*	*2-inch*
Coupling:	*Threaded*	*Threaded*

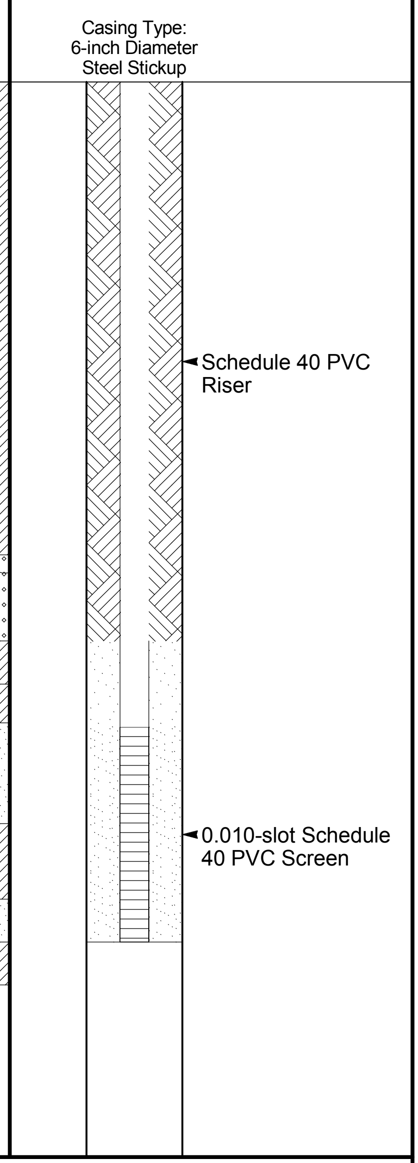
Well Permit #: *No permit required.*

WELL DEVELOPMENT

Method:	*Overpumping*
Duration:	*0.5 hours*
Gals. Purged:	*30*

DEPTH (ft)	STRATA DESCRIPTION	USCS
0 – 11	SILTY CLAY (CL) medium stiff, some silt, trace fine gravel, trace fine sand; moist, mottled, brown and gray	CL
11 – 13	SAND (GW-SW) well graded, fine grained SAND; loose, some gravel, little silt, trace clay; moist, dark brownish gray to black, [Wood fragments]	GW-SW
13 – 14	SILTY CLAY (CL) soft, little fine sand, trace gravel, moist, dark gray to black, [Glass, wood, plastic debris]	CL
14 – 14.9	SILTY CLAY (CL) soft, some silt, trace fine sand, moist, dark gray to dark brownish gray	CL
14.9 – 17.25	SAND (SP) poorly graded, fine grained SAND; loose, wet, light grayish brown, [silt/clay stringers throughout.]	SP
17.25 – 19	SILTY CLAY (CL) soft, some silt, wet, dark gray to dark brownish gray, [Grey fine sand seams throughout]	CL
19 – 20	SAND (SP) poorly graded, fine grained SAND; loose, little clay, laminated, gray to dark gray	SP
20 – 21	SILTY CLAY (CL) soft, some silt, wet, dark gray to dark brownish gray	CL

Depth scale: 5, 10, 15, 20; Elevation scale: 100, 95, 90, 85, 80. Water level symbol at 14.9.



REMARKS:
Elevation data established from referenced benchmark set at 100.00'.

WELL INSTALLATION NOTES:

WELL CONSTRUCTION GHBLP 0387368 CCR WELLS.GPJ ERM DATA TEMPLATE.GDT 11/1/17

ERM
3352 128th Avenue
Holland, MI 49424
P: 616-399-3500

PROJECT:
Grand Haven Board of Light and Power
CCR Well Installation
1231 N 3rd Street
Grand Haven, Michigan

BORING # **MW-03**
ERM PROJECT # 0387368

DRILLING CONTRACTOR	EDAC Holland, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN	Sean Smith	OFFICE LOCATION	Holland, MI
DRILLING METHOD	Hollow-Stem Augers	DATE: START	01/18/2017
DRILLING EQUIPMENT	Gus Peck	FINISH	01/18/2017
HORIZONTAL DATUM (NAD 1983 StatePlane Michigan South (US Feet))		BOREHOLE DEPTH	17 ft
NORTHING	176214.1	BOREHOLE DIAMETER	
EASTING	3847846.674	DEPTH TO WATER (INITIAL) ▼	13 ft
VERTICAL DATUM (NGVD 29 (US Feet)) ELEVATION	102.17 ft	DEPTH TO WATER (FINAL) ▽	

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	SAMPLE TYPE	RECOVERY		Observations / Remarks
0–6	102.17–100	SAND (SW) well graded, fine grained SAND; loose, some silt, little gravel, moist, grayish brown, [Brick and concrete fragments.]	6	SW					
6–8	95	SAND (SW) well graded, fine grained SAND; loose, little silt, little gravel, moist, grayish brown to dark brown	8	SW					
8–12		SAND (SW) well graded, fine grained SAND; loose, some silt, some gravel, trace clay; moist, grayish brown to dark brown, [Wood fragments.]	12	SW					
12–12.75	90	CLAYEY SILT (ML) soft, trace fine sand, moist, dark grayish brown to dark brown	12.75	ML					
12.75–14.5		SAND (SP) poorly graded, fine grained SAND; loose, moist to wet, gray, [Wet @ 13'] ▼	14.5	SP					
14.5–17	85	SANDY SILT (OL) soft, little clay, trace fine sand, moist to wet, dark gray to dark brownish gray, [Silt loam.]	17	OL					

REMARKS:
Elevation data established from referenced benchmark set at 100.00'.

LAB ANALYSIS:

ERM 3352 128th Avenue Holland, MI 49424 P: 616-399-3500	PROJECT: Grand Haven Board of Light and Power CCR Well Installation 1231 N 3rd Street Grand Haven, Michigan	BORING # **MW-03** ERM PROJECT # 0387368 SHEET 1 OF 1

DRILLING CONTRACTOR	EDAC Holland, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN	Sean Smith	OFFICE LOCATION	Holland, MI
DRILLING METHOD	Hollow-Stem Augers	DATE: START	01/18/2017
DRILLING EQUIPMENT	Gus Peck	FINISH	01/18/2017

GEOGRAPHIC COORDINATES
(NAD 1983 StatePlane Michigan South (US Feet))

NORTHING	176214.1
EASTING	3847846.674
Elevation/Top of Casing Elev	102.17 ft/ 105.2 ft

WELL CONSTRUCTION

	Riser	Screen
Material:	*Schedule 40 PVC*	*Schedule 40 PVC, 0.010-slot*
Diameter (ID):	*2-inch*	*2-inch*
Coupling:	*Threaded*	*Threaded*

Well Permit #: *No permit required.*

WELL DEVELOPMENT

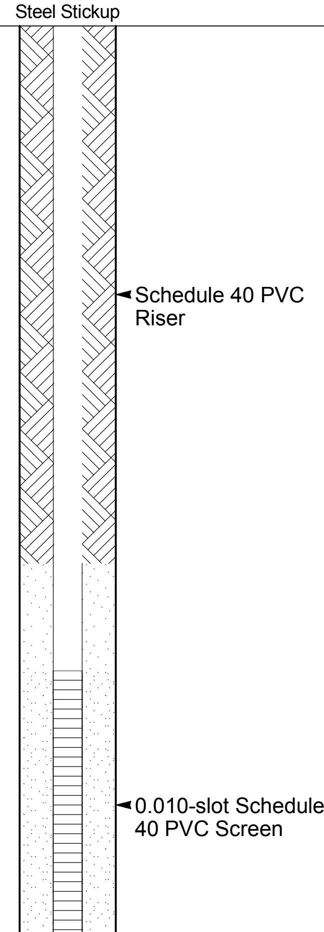
Method:	*Overpumping*
Duration:	*0.5 hours*
Gals. Purged:	*30*

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS
0	102.17	SAND (SW) well graded, fine grained SAND; loose, some silt, little gravel, moist, grayish brown, [Brick and concrete fragments.]		SW
6		SAND (SW) well graded, fine grained SAND; loose, little silt, little gravel, moist, grayish brown to dark brown	6	SW
8		SAND (SW) well graded, fine grained SAND; loose, some silt, some gravel, trace clay; moist, grayish brown to dark brown, [Wood fragments.]	8	SW
12		CLAYEY SILT (ML) soft, trace fine sand, moist, dark grayish brown to dark brown	12	ML
12.75		SAND (SP) poorly graded, fine grained SAND; loose, moist to wet, gray, [Wet @ 13']	12.75	SP
14.5		SANDY SILT (OL) soft, little clay, trace fine sand, moist to wet, dark gray to dark brownish gray, [Silt loam.]	14.5	OL
17			17	

Depth scale: 2, 4, 6, 8, 10, 12, 14, 16, 18. Elevation scale: 100, 95, 90, 85.

WELL CONSTRUCTION

Casing Type:
6-inch Diameter
Steel Stickup



REMARKS:
Elevation data established from referenced benchmark set at 100.00'.

WELL INSTALLATION NOTES:

WELL CONSTRUCTION GHBLP 0387368 CCR WELLS.GPJ ERM DATA TEMPLATE.GDT 11/1/17

ERM 3352 128th Avenue Holland, MI 49424 P: 616-399-3500	PROJECT: Grand Haven Board of Light and Power CCR Well Installation 1231 N 3rd Street Grand Haven, Michigan	BORING # **MW-04** ERM PROJECT # 0387368 SHEET 1 OF 1

DRILLING CONTRACTOR	EDAC Holland, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN	Sean Smith	OFFICE LOCATION	Holland, MI
DRILLING METHOD	Hollow-Stem Augers	DATE: START	01/18/2017
DRILLING EQUIPMENT	Gus Peck	FINISH	01/18/2017
HORIZONTAL DATUM (NAD 1983 StatePlane Michigan South (US Feet))		BOREHOLE DEPTH	17 ft
NORTHING	176182.574	BOREHOLE DIAMETER	
EASTING	3847848.69	DEPTH TO WATER (INITIAL) ▼	8.5 ft
VERTICAL DATUM (NGVD 29 (US Feet)) ELEVATION	100.60 ft	DEPTH TO WATER (FINAL) ▽	

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	SAMPLE TYPE	RECOVERY		Observations / Remarks
	100	GRAVELLY SAND (SW) well graded, fine grained SAND; loose, some gravel, moist, brown, [Concrete fragments]		SW					
2, 4	95	GRAVELLY SAND (SP) poorly graded, fine grained SAND; loose, some gravel, moist, dark brown to black	5.5	SP					
6		SAND (SW) well graded, fine grained SAND; loose, moist, brown	6.5	SW					
		CLAYEY SAND (SC) soft, some silt, little gravel, moist, brown to dark gray, [Roots]	7	SC					
8		SAND (SW) well graded, fine grained SAND; loose, some silt, some gravel, moist, dark brown, [Concrete and wood fragments.]	7.5	SW					
		SAND (SW) well graded, medium to coarse grained SAND; loose, wet, dark grayish brown to black, [Bottom ash and concrete fragments.]	8.5 ▼	SW					
10	90	SAND (SP) poorly graded, fine grained SAND; loose, wet, dark grayish brown	10	SP					
		SANDY SILT (OL) soft, moist, dark grayish brown, [Silt loam.]	10.5	OL					
12		SAND (SP) poorly graded, fine grained SAND; loose, wet, gray	11.5	SP					
		SANDY SILT (OL) soft, trace fine sand, trace clay, moist, dark grayish brown, [Clay stringer (14 - 14.25). Grey fine sand seam (14.25 - 14.5).]	12.5	OL					
14, 16	85	SANDY SILT (MLS) soft, little clay, moist, dark grayish brown, [Wood fragments. Grey fine sand seam (15.75 - 16); (16.25 - 16.5); (16.75 - 17).]	14.5	MLS					
18			17						

REMARKS:
Elevation data established from referenced benchmark set at 100.00'.

LAB ANALYSIS:

ERM 3352 128th Avenue Holland, MI 49424 P: 616-399-3500	PROJECT: Grand Haven Board of Light and Power CCR Well Installation 1231 N 3rd Street Grand Haven, Michigan	BORING # **MW-04** ERM PROJECT # 0387368 SHEET 1 OF 1

DRILLING CONTRACTOR	EDAC Holland, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN	Sean Smith	OFFICE LOCATION	Holland, MI
DRILLING METHOD	Hollow-Stem Augers	DATE: START	01/18/2017
DRILLING EQUIPMENT	Gus Peck	FINISH	01/18/2017

GEOGRAPHIC COORDINATES
(NAD 1983 StatePlane Michigan South (US Feet))

NORTHING	176182.574
EASTING	3847848.69
Elevation/Top of Casing Elev.	100.60 ft/ 103.59 ft

WELL CONSTRUCTION

	Riser	Screen
Material:	*Schedule 40 PVC*	*Schedule 40 PVC, 0.010-slot*
Diameter (ID):	*2-inch*	*2-inch*
Coupling:	*Threaded*	*Threaded*

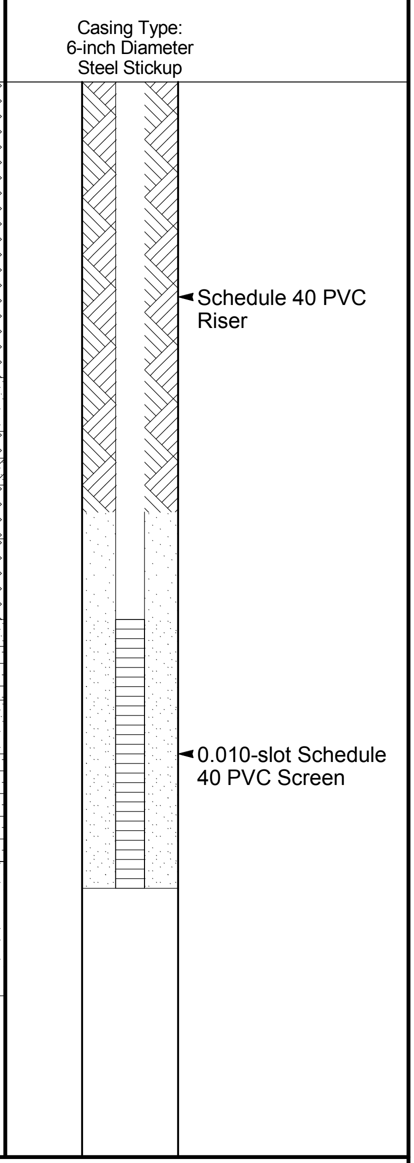
Well Permit #: *No permit required.*

WELL DEVELOPMENT

Method:	*Overpumping*
Duration:	*0.5 hours*
Gals. Purged:	*30*

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS
0	100.60	GRAVELLY SAND (SW) well graded, fine grained SAND; loose, some gravel, moist, brown, [Concrete fragments]		SW
	95	GRAVELLY SAND (SP) poorly graded, fine grained SAND; loose, some gravel, moist, dark brown to black	5.5	SP
		SAND (SW) well graded, fine grained SAND; loose, moist, brown	6.5	SW
		CLAYEY SAND (SC) soft, some silt, little gravel, moist, brown to dark gray, [Roots]	7	SC
		SAND (SW) well graded, fine grained SAND; loose, some silt, some gravel, moist, dark brown, [Concrete and wood fragments.]	7.5	SW
	90	SAND (SW) well graded, medium to coarse grained SAND; loose, wet, dark grayish brown to black, [Bottom ash and concrete fragments.]	8.5	SW
		SAND (SP) poorly graded, fine grained SAND; loose, wet, dark grayish brown	10	SP
		SANDY SILT (OL) soft, moist, dark grayish brown, [Silt loam.]	10.5	OL
		SAND (SP) poorly graded, fine grained SAND; loose, wet, gray	11.5	SP
	85	SANDY SILT (OL) soft, trace fine sand, trace clay, moist, dark grayish brown, [Clay stringer (14 - 14.25). Grey fine sand seam (14.25 - 14.5).]	12.5	OL
		SANDY SILT (MLS) soft, little clay, moist, dark grayish brown, [Wood fragments. Grey fine sand seam (15.75 - 16); (16.25 - 16.5); (16.75 - 17).]	14.5	MLS
			17	

WELL CONSTRUCTION



REMARKS:
Elevation data established from referenced benchmark set at 100.00'.

WELL INSTALLATION NOTES:

WELL CONSTRUCTION GHBLP 0387368 CCR WELLS.GPJ ERM DATA TEMPLATE.GDT 11/1/17

PROJECT: GHBLP 2018 Wells
PROJECT NUMBER: 1775416B
LOCATION: Grand Haven, Michigan
CLIENT: Grand Haven Board of Light and Power

RECORD OF WELL LOG MW-05

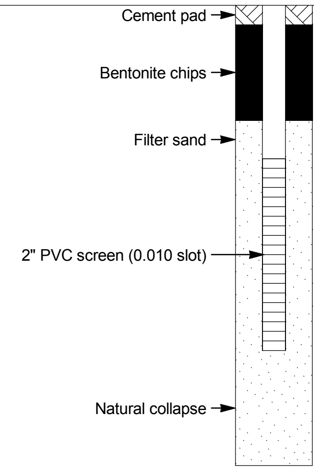
DRILLING METHOD: Hollow-Stem Auger
DRILLING DATE: 5/22/18
DRILL RIG: GP-1100 ATV

DATUM: Ground Surface
AZIMUTH: n/a
COORDS: n/a

GS ELEVATION:
TOC ELEVATION:
INCLINATION: -90

DEPTH (ft)	BORING METHOD	DESCRIPTION (VEGETATION:)	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	REC / ATT
0	Hand auger	0.0 - 8.5 ASH, fine-grained, many small brick fragments, black; wet at 4 ft. More coarse at bottom, some glass and wood fragments	ASH				AG		- 24.0
5	Hollow-stem auger					1	SS	16-13-9-9	18.0 24.0
		8.5 - 10.0 (SC-CL) clayey SAND, fine-medium sand; dark grey, moist, semi-cohesive	SC		8.5	2	SS	1-1-1-2	24.0 24.0
10		10.0 - 12.0 Sandy PEAT, some fibrous material, shell fragments; organic odor, dark grey	OL		10.0	3	SS	H-1-1-1	24.0 24.0
		Boring completed at 12.0 ft.							

NOTES
WATER LEVELS
WELL INSTALLATION
GRAPHIC



GOLDER

DEPTH SCALE:1 in to 5 ft
DRILLING CONTRACTOR: EDAC
DRILLER: SS

LOGGED: AJS
CHECKED: DR
DATE: 07/06/2018

RECORD OF WELL LOG MW-06

PROJECT: GHBLP 2018 Wells
PROJECT NUMBER: 1775416B
LOCATION: Grand Haven, Michigan
CLIENT: Grand Haven Board of Light and Power

DRILLING METHOD: Hollow-Stem Auger
DRILLING DATE: 5/22/18
DRILL RIG: GP-1100 ATV

DATUM: Ground Surface
AZIMUTH: n/a
COORDS: n/a

GS ELEVATION:
TOC ELEVATION:
INCLINATION: -90

DEPTH (ft)	BORING METHOD	DESCRIPTION (VEGETATION:)	USCS	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	REC / ATT
0	Hand auger	0.0 - 7.5 Clayey SAND, medium sand, some 1" clay nodules (brown with reddish mottling), trace small brick fragments; dark brown	SC			AG		- 24.0
5	Hollow-stem auger				1	SS	9-19-24-24	24.0 24.0
		7.5 - 9.0 Refuse, plastic mesh, brick fragments; wet	Refuse	7.5	2	SS	5-2-5-5	24.0 24.0
		9.0 - 10.0 SAND, some black organic fines, rounded; wet	SP	9.0				
10		10.0 - 15.0 Refuse, black, sandy (medium with some angular coarse sand), fiberglass in top and bottom of spoon; wet; steel fragment at 14.5 ft	Refuse	10.0	3	SS	2-2-8-8	- 24.0
					4	SS	6-8-3-3	6.0 24.0
15		15.0 - 17.0 PEAT, black, leaf intact, fibrous wood; wet	OL	15.0	5	SS	2-2-2-3	24.0 24.0
		Boring completed at 17.0 ft.						

NOTES / WATER LEVELS / WELL INSTALLATION / GRAPHIC

DEPTH SCALE:1 in to 5 ft
DRILLING CONTRACTOR: EDAC
DRILLER: SS

LOGGED: AJS
CHECKED: DR
DATE: 07/06/2018

GOLDER

RECORD OF WELL LOG MW-07

PROJECT: GHBLP 2018 Wells
PROJECT NUMBER: 1775416B
LOCATION: Grand Haven, Michigan
CLIENT: Grand Haven Board of Light and Power

DRILLING METHOD: Hollow-Stem Auger
DRILLING DATE: 5/22/18
DRILL RIG: GP-1100 ATV

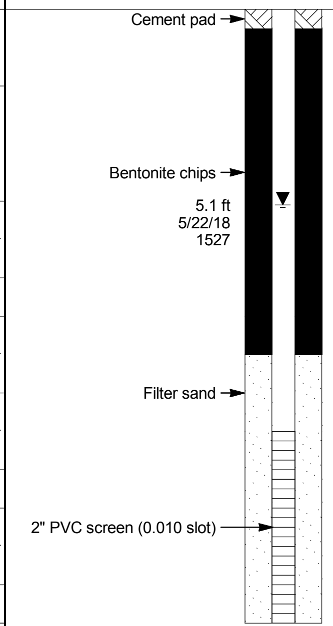
DATUM: Ground Surface
AZIMUTH: n/a
COORDS: n/a

GS ELEVATION:
TOC ELEVATION:
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE: DESCRIPTION (VEGETATION:)	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	REC / ATT
0	Hand auger	0.0 - 7.5 Sandy CLAY, some gravel; brown, stiff, w<PL	CL				AG		-/24.0
5	Hollow-stem auger					1	SS	4-5-7-9	12.0/24.0
		7.5 - 11.5 Sandy PEAT, some shell fragments; black, moist, cohesiv, firm, cannot roll thread	OL		7.5	2	SS	0-1-3-5	24.0/24.0
10						3	SS	1-3-5-8	24.0/24.0
		11.5 - 15.0 Silty SAND, some shell fragments, medium sand; black-brown; wet	SM		11.5	4	SS	6-9-11-16	24.0/24.0
15					15.0				
		Boring completed at 16.0 ft.							

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40

NOTES
WATER LEVELS
WELL INSTALLATION
GRAPHIC



GOLDER

DEPTH SCALE:1 in to 5 ft
DRILLING CONTRACTOR: EDAC
DRILLER: SS

LOGGED: AJS
CHECKED: [signature]
DATE: 07/06/2018

RECORD OF WELL LOG MW-08

SHEET 1 of 1

PROJECT: GHBLP 2018 Wells
PROJECT NUMBER: 1775416B
LOCATION: Grand Haven, Michigan
CLIENT: Grand Haven Board of Light and Power

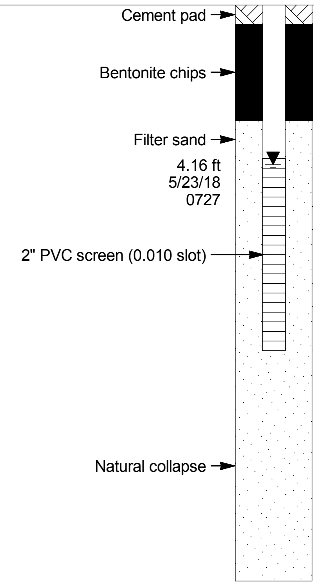
DRILLING METHOD: Hollow-Stem Auger
DRILLING DATE: 5/22/18
DRILL RIG: GP-1100 ATV

DATUM: Ground Surface
AZIMUTH: n/a
COORDS: n/a

GS ELEVATION:
TOC ELEVATION:
INCLINATION: -90

DEPTH (ft)	BORING METHOD	DESCRIPTION (VEGETATION:)	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	REC / ATT
0	Hand auger	0.0 - 3.5 Medium SAND, fill; wet, light brown	SP				AG		- 24.0
	Hand auger	3.5 - 8.5 Refuse, plastic bags	Refuse		3.5				
5	Hollow-stem auger					1	SS	7-2-7-4	0.0 24.0
	Hollow-stem auger	8.5 - 15.0 Clayey SAND, medium sand, some shell fragments; brown, some pockets of cohesion; wet	SC		8.5	2	SS	2-2-2-5	12.0 24.0
10						3	SS	0-1-3-5	3.0 24.0
						4	SS	2-1-2-5	6.0 24.0
15		Boring completed at 15.0 ft.							
20									
25									
30									
35									
40									

NOTES
WATER LEVELS
WELL INSTALLATION
GRAPHIC



DEPTH SCALE:1 in to 5 ft
DRILLING CONTRACTOR: EDAC
DRILLER: SS

LOGGED: AJS
CHECKED: [signature]
DATE: 07/06/2018

GOLDER

RECORD OF WELL LOG MW-09

PROJECT: GHBLP Monitoring Wells
PROJECT NUMBER: 18113500
LOCATION: Grand Haven, Michigan
CLIENT: Grand Haven Board of Light and Power

DRILLING METHOD: Direct-Push
DRILLING DATE: 8/12/2019
DRILL RIG: Geoprobe 7288DT

DATUM: Local
AZIMUTH: n/a
COORDS: N: 578,241.35 E: 12,624,185.62

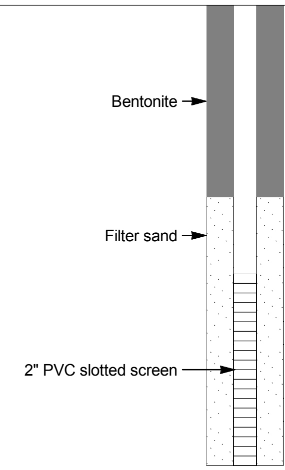
GS ELEVATION: 586.80
TOC ELEVATION: 589.65
INCLINATION: -90

VEGETATION:

DEPTH (ft)	BORING METHOD	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	NUMBER	TYPE	BLOWS per 6 in (lb hammer, 30 inch drop)	REC / ATT
0	Hand Auger	0.0 - 0.3 Brown topsoil w/ organics, dry	Topsoil	0.3		AG		3.0 / 3.0
	Hand Auger	0.3 - 3.8 Brown fine sand, moist	SP	583.0 / 3.8				
5	DPT (macro core)	3.8 - 7.2 Brown fine to coarse sand some gravel, wet at 5'	SW	579.6 / 7.2		MC		1.6 / 2.0
	DPT (macro core)	7.2 - 8.6 Dark brown sandy silt, trace gravel, wet	ML	578.2 / 8.6		MC		4.5 / 5.0
10	DPT (macro core)	8.6 - 10.7 Dark brown silt, some sand, wet	ML	576.1 / 10.7				
	DPT (macro core)	10.7 - 11.7 Fine gray sand, wet	SP	575.1		MC		2.0 / 2.0
		11.7 - 12.0 Dark brown silt, some sand, wet	ML					
		Boring completed at 12.0 ft.						

Depth scale marks: 0, 5, 10, 15, 20, 25, 30, 35, 40

NOTES / WATER LEVELS / WELL INSTALLATION GRAPHIC



GOLDER

DEPTH SCALE:1 in to 5 ft
DRILLING CONTRACTOR: GeoServe
DRILLER: GeoServe

LOGGED: ACN
CHECKED: CEP
DATE: 10/24/2019

RECORD OF WELL LOG MW-10

PROJECT: GHBLP Monitoring Wells
PROJECT NUMBER: 18113500
LOCATION: Grand Haven, Michigan
CLIENT: Grand Haven Board of Light and Power

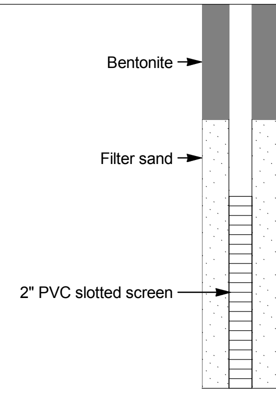
DRILLING METHOD: Direct-Push
DRILLING DATE: 8/12/2019
DRILL RIG: Geoprobe 7288DT

DATUM: Local
AZIMUTH: n/a
COORDS: N: 578,367.40 E: 12,624,470.20

GS ELEVATION: 583.71
TOC ELEVATION: 586.73
INCLINATION: -90

DEPTH (ft)	BORING METHOD	SOIL PROFILE: DESCRIPTION (VEGETATION:)	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	BLOWS per 6 in (lb hammer 30 inch drop)	REC / ATT
0	Hand Auger	0.0 - 0.3 Brown topsoil w/ organics, dry	Topsoil		0.3				
	Hand Auger	0.3 - 4.7 Brown fine sand, trace gravel, wet at 2.8'	SP				AG		3.0 / 3.0
	DPT (macro core)		SP		579.0		MC		0.5 / 2.0
5	DPT (macro core)	4.7 - 5.1 Brown sandy silt, trace gravel, wet	ML		5.1				
	DPT (macro core)	5.1 - 10.0 Brown fine to coarse sand w/ gravel, wet	SW		573.7		MC		1.0 / 5.0
10		Boring completed at 10.0 ft.							
15									
20									
25									
30									
35									
40									

NOTES
WATER LEVELS
WELL INSTALLATION
GRAPHIC



GOLDER

DEPTH SCALE:1 in to 5 ft
DRILLING CONTRACTOR: GeoServe
DRILLER: GeoServe

LOGGED: ACN
CHECKED: CEP
DATE: 10/24/2019

RECORD OF BOREHOLE: PZ-11

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI
DATE: August 19, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS
ELEVATION: 592.5 ft (Ground)
COORDINATES: N: 578236.9 ft E: 12624377.2 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE TYPE	REC %
Brown silty CLAY, dry, firm, brittle.	CL	0.0	SS	100
Brown fine SAND, dry, loose.		587.3 / 5.2		
Dark gray SAND, dry to moist, loose.	SP	587.0 / 5.5	SS	92
Brown and gray mottled CLAY, moist, soft to firm.	CL	584.5 / 8.0		
Brown fine SAND, dry, loose, trace gravel.	SP	582.4 / 10.1	SS	80
Brown and gray sandy mottled CLAY, moist, soft to firm.	CL	581.3 / 11.2		
Gray and black SAND, moist, loose, trace silt, trace gravel, glass fragments, wood present.	SP	580.3 / 12.2		
Black peaty SILT, soft, moist, wood present, plastic present, glass present.	OL	575.7 / 16.8	SS	48
Black and gray fine SAND, wet, loose.	SP	573.5 / 19.0		
Black peaty SILT, moist, soft, wood and glass present, shell fragments. Gray sand seams present from 25' to 30' BGS.	OL	572.5 / 20.0	SS	64

Continued on Next Page

CONSTRUCTION AND INSTALLATION DETAILS

Pipe Stickup: 2.81 ft
Pipe Elev: 595.3 ft

0.0 - 8.0 ft bgs: Bentonite Chips

2" Schedule 40 PVC

8.0 - 15.0 ft bgs: Filter Sand

2" Schedule 40 slotted PVC

HAMMER TYPE: Automatic

REV: 0

GOLDER MEMBER OF WSP

LOGGED: Parker Sutton DATE: Aug 19, 2021
CHECKED: Caroyln Powrozek DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-11

CLIENT:	GHBLP	DATE:	August 19, 2021	ELEVATION:	592.5 ft (Ground)
PROJECT:	J.B. Sims Well Installations			COORDINATES:	N: 578236.9 ft E: 12624377.2 ft
PROJECT NO:	21464427			COORD SYS:	SP MI South FIPS 2113 Ft
LOCATION:	Grand Haven, MI	CONTRACTOR:	MATECO Drilling	HORZ DATUM:	NAD83
		SURVEYOR:	GPS		

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS (Pipe Stickup: 2.81 ft; Pipe Elev: 595.3 ft)
25–31	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Black peaty SILT, moist, soft, wood and glass present, shell fragments. Gray sand seams present from 25' to 30' BGS.	OL		561.5 / 31.0		SS	100					15.0 - 40.0 ft bgs: Material Collapse
31–33.8			Gray fine SAND, wet, loose, shell fragments.	SP		558.7 / 33.8		SS	60					
33.8–34.4			Black peaty SILT, moist, soft, wood present.	OL		558.1 / 34.4								
34.4–40			Gray fine SAND, wet, loose, medium to coarse grained from 36' to E.O.B.	SP		552.5		SS	100					
40			End of hole at 40.0 ft. Target Depth Reached Refer to diagram for well construction details.											

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton — DATE: Aug 19, 2021
CHECKED: Caroyln Powrozek — DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-12

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 17, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 584.9 ft (Ground)
COORDINATES: N: 577987.6 ft E: 12624312.3 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

DESCRIPTION	USCS	ELEV. / DEPTH (ft)
Brown sandy CLAY, dry, firm.	CL	0.0
Brown SAND, wet, loose.	SP	583.9 / 1.0
Brown clayey PEAT, moist to wet, soft, trace sand.		577.9 / 7.0
Gray fine SAND, wet, loose.	SP	570.7 / 14.2
Dark gray clayey PEAT, moist, soft, some gray sand seams present.		569.7 / 15.2
Gray fine SAND, wet, loose, trace medium grained sand.	SP	565.9 / 19.0

SAMPLES

NUMBER	TYPE	REC %	BLOWS	N-VALUE
	SS	100		
	SS	66		
	SS	64		
	SS	64		
	SS	66		

CONSTRUCTION AND INSTALLATION DETAILS

Pipe Stickup: 3.09 ft
Pipe Elev: 588.0 ft
0.0 - 1.0 ft bgs: Bentonite Chips
2" Schedule 40 PVC
1.0 - 8.0 ft bgs: Filter Sand
2" Schedule 40 slotted PVC
8.0 - 40.0 ft bgs: Material Collapse

Continued on Next Page

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Aug 17, 2021
CHECKED: Caroyln Powrozek DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-12

CLIENT:	GHBLP	DATE:	August 17, 2021	ELEVATION:	584.9 ft (Ground)
PROJECT:	J.B. Sims Well Installations			COORDINATES:	N: 577987.6 ft E: 12624312.3 ft
PROJECT NO:	21464427			COORD SYS:	SP MI South FIPS 2113 Ft
LOCATION:	Grand Haven, MI	CONTRACTOR:	MATECO Drilling	HORZ DATUM:	NAD83
		SURVEYOR:	GPS		

Pipe Stickup: 3.09 ft
Pipe Elev: 588.0 ft

DEPTH (ft)	DRILL RIG	DRILL METHOD	DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS
25–31	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Gray fine SAND, wet, loose, trace medium grained sand.	SP		553.9 / 31.0		SS	72				
31–37			Gray silty fine SAND, moist, compact.	SM		547.9 / 37.0		SS	74				
37–39			Gray SILT, moist, hard.	ML		545.9 / 39.0		SS	100				
39–40			Gray CLAY, moist, firm to soft.	CH		544.9							
40			End of hole at 40.0 ft. Target Depth Reached Refer to diagram for well construction details.										

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Aug 17, 2021
CHECKED: Caroyln Powrozek DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-13

CLIENT: GHBLP	DATE: August 17, 2021	ELEVATION: 583.2 ft (Ground)	
PROJECT: J.B. Sims Well Installations		COORDINATES: N: 577623.9 ft E: 12624190.9 ft	
PROJECT NO: 21464427		COORD SYS: SP MI South FIPS 2113 Ft	
LOCATION: Grand Haven, MI	CONTRACTOR: MATECO Drilling	HORZ DATUM: NAD83	
	SURVEYOR: GPS		

Drill Rig: Geoprobe 7822DT
Drill Method: Direct Push - 4-in Hole Dia.

Pipe Stickup: 2.85 ft
Pipe Elev: 586.1 ft

DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE TYPE	REC %
Brown fine SAND, dry, loose.		0.0 / 582.7		
Gray fine SAND, dry to moist, loose, trace silt.	SP	0.5	SS	100
Gray fine to medium SAND, wet, loose.		579.2 / 4.0		
Dark gray silty SAND, wet, loose.	SM	578.2 / 5.0		
Gray fine SAND, wet, loose.	SP	577.5 / 5.7	SS	68
Dark gray GRAVEL & SAND, wet, loose.	GP	572.9 / 10.3	SS	40
Gray silty SAND, wet, cohesive, some organics present.	SM	571.7 / 11.5	SS	66
Gray fine SAND, wet, loose, some medium grained sand present below 20' BGS.	SP	566.2 / 17.0	SS	50

Continued on Next Page

CONSTRUCTION AND INSTALLATION DETAILS:
- 0.0 - 2.0 ft bgs: Bentonite Chips
- 2" Schedule 40 PVC
- 2.0 - 9.0 ft bgs: Filter Sand
- 2" Schedule 40 slotted PVC
- 9.0 - 34.0 ft bgs: Matieral Collapse

HAMMER TYPE: Automatic

REV: 0

GOLDER MEMBER OF WSP

LOGGED: Parker Sutton DATE: Aug 17, 2021
CHECKED: Caroyln Powrozek DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-13

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 17, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 583.2 ft (Ground)
COORDINATES: N: 577623.9 ft E: 12624190.9 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS (Pipe Stickup: 2.85 ft; Pipe Elev: 586.1 ft)
	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Gray fine SAND, wet, loose, some medium grained sand present below 20' BGS.	SP		557.8 / 25.4								
26–32			Gray silty fine SAND, wet, cohesive.	SM		551.2 / 32.0		SS	80					
32–34			Gray fine SAND & SILT, wet, hard.	SP-SM		549.2		SS	100					
34			End of hole at 34.0 ft. Refusal prior to 40-ft target depth. Refer to diagram for well construction details.											

Depth scale: 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Aug 17, 2021
CHECKED: Caroyln Powrozek DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-14

CLIENT: GHBLP
DATE: August 16, 2021
ELEVATION: 583.5 ft (Ground)
PROJECT: J.B. Sims Well Installations
COORDINATES: N: 577191.9 ft E: 12624160.0 ft
PROJECT NO: 21464427
COORD SYS: SP MI South FIPS 2113 Ft
LOCATION: Grand Haven, MI
CONTRACTOR: MATECO Drilling
HORZ DATUM: NAD83
SURVEYOR: GPS

DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE TYPE	REC %
Brown SAND, dry to wet, loose, some medium grained sand.	SP	0.0	SS	100
Brown silty SAND, wet, loose.	SM	577.5 / 6.0	SS	80
Brown fine SAND, wet, loose.	SP	577.2 / 6.3		
Black fine SAND, wet, loose, some organics present.		573.2 / 10.3	SS	54
Black CLAY, moist, soft, some sand, organics present, organic scent.	CL	572.7 / 10.8		
Brown silty SAND, wet, loose.	SM	568.5 / 15.0	SS	50
Dark gray PEAT, wet, soft, some clay present, organic scent.		568.3 / 15.2		
Gray silty SAND, wet, loose, organics present.	SM	563.8 / 19.7	SS	70
Gray medium SAND, wet, loose.	SP	562.5 / 21.0		

Continued on Next Page

CONSTRUCTION AND INSTALLATION DETAILS

Pipe Stickup: 2.93 ft
Pipe Elev: 586.4 ft

0.0 - 1.0 ft bgs: Bentonite Chips

2" Schedule 40 PVC

1.0 - 8.0 ft bgs: Filter Sand

2" Schedule 40 slotted PVC

8.0 - 35.0 ft bgs: Matieral Collapse

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Aug 16, 2021
CHECKED: Caroyln Powrozek DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-14

CLIENT:	GHBLP	DATE:	August 16, 2021	ELEVATION:	583.5 ft (Ground)
PROJECT:	J.B. Sims Well Installations			COORDINATES:	N: 577191.9 ft E: 12624160.0 ft
PROJECT NO:	21464427			COORD SYS:	SP MI South FIPS 2113 Ft
LOCATION:	Grand Haven, MI	CONTRACTOR:	MATECO Drilling	HORZ DATUM:	NAD83
		SURVEYOR:	GPS		

Drill Rig: Geoprobe 7822DT
Drill Method: Direct Push - 4-in Hole Dia.

Construction and Installation Details: Pipe Stickup: 2.93 ft; Pipe Elev: 586.4 ft

DEPTH (ft)	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS
	Gray medium SAND, wet, loose.	SP	558.1 / 25.4							
25.4	Gray sandy SILT, wet, non-cohesive.	ML			SS	100				
					SS	88				
33.5	Gray SILT, wet, cohesive, trace sand.		550.0 / 33.5							
35	End of hole at 35.0 ft. Refusal prior to 40-ft target depth. Refer to diagram for well construction details.		548.5							

Depth scale: 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton — DATE: Aug 16, 2021
CHECKED: Caroyln Powrozek — DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-15

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 25, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 589.3 ft (Ground)
COORDINATES: N: 577062.5 ft E: 12624730.2 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

DESCRIPTION	USCS	ELEV. / DEPTH (ft)
Brown sandy TOPSOIL, dry, loose.		0.0
Light brown SAND, dry to moist, loose.	SP	588.8 / 0.5
COAL.		580.8 / 8.5
Black gravelly SAND, moist, loose.	SP	579.8 / 9.5
Black mucky PEAT, moist, soft, trace silt, some trash present at 14.8' BGS.		577.0 / 12.3
Black fine SAND, wet, loose, some glass present.		574.4 / 14.9
Dark gray mucky SAND, moist to wet, soft.	SP	574.2 / 15.1
Dark gray sandy PEAT, moist, soft, shell fragments present.		567.2 / 22.1
Pale black PEAT, moist, soft. Gray sand seams present @ 24.9', 25.7', and 28.0' BGS.		565.1 / 24.2

SAMPLES

Depth interval (ft)	TYPE	REC %
0 - 5	SS	100
5 - 10	SS	50
10 - 15	SS	76
15 - 20	SS	46
20 - 25	SS	66

CONSTRUCTION AND INSTALLATION DETAILS

Pipe Stickup: 3.05 ft
Pipe Elev: 592.4 ft

0.0 - 10.0 ft bgs: Surface Cuttings

2" Schedule 40 PVC

10.0 - 13.0 ft bgs: Bentonite Chips

13.0 - 20.0 ft bgs: Filter Sand

2" Schedule 40 slotted PVC

Continued on Next Page

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Aug 25, 2021
CHECKED: Caroyln Powrozek DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-15

CLIENT:	GHBLP	DATE:	August 25, 2021	ELEVATION:	589.3 ft (Ground)
PROJECT:	J.B. Sims Well Installations			COORDINATES:	N: 577062.5 ft E: 12624730.2 ft
PROJECT NO:	21464427			COORD SYS:	SP MI South FIPS 2113 Ft
LOCATION:	Grand Haven, MI	CONTRACTOR:	MATECO Drilling	HORZ DATUM:	NAD83
		SURVEYOR:	GPS		

DEPTH (ft)	DRILL RIG	DRILL METHOD	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS (Pipe Stickup: 3.05 ft; Pipe Elev: 592.4 ft)
25–30	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Pale black PEAT, moist, soft. Gray sand seams present @ 24.9', 25.7', and 28.0' BGS.		559.3		SS	74					
30–32.3			Dark gray medium SAND, wet, loose, shell fragments present.		30.0 / 557.0		SS	100					20.0 - 40.0 ft bgs: Material Collapse
32.3–39.6			Gray fine SAND, moist, loose to compact.	SP	32.3 / 549.7		SS	100					
39.6–40			Gray silty SAND, moist, compact.	SM	39.6 / 549.3								
40			End of hole at 40.0 ft. Target Depth Reached Refer to diagram for well construction details.										

HAMMER TYPE: Automatic

REV: 0

LOGGED: Parker Sutton — DATE: Aug 25, 2021

CHECKED: Caroyln Powrozek — DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-16

CLIENT:	GHBLP	DATE:	August 25, 2021	ELEVATION:	582.2 ft (Ground)
PROJECT:	J.B. Sims Well Installations			COORDINATES:	N: 577273.6 ft E: 12625194.8 ft
PROJECT NO:	21464427			COORD SYS:	SP MI South FIPS 2113 Ft
LOCATION:	Grand Haven, MI	CONTRACTOR:	MATECO Drilling	HORZ DATUM:	NAD83
		SURVEYOR:	GPS		

DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE TYPE	REC %
Brown TOPSOIL, moist, loose.		0.0		
Dark gray fine SAND, wet, loose.	SP	581.7 / 0.5		
Black GRAVEL & SAND fill, wet, loose.		581.2 / 1.0		
Black peaty CLAY, moist, soft.	CH	580.7 / 1.5	SS	100
Gray fine SAND, wet, loose.	SP	578.2 / 4.0		
WOOD ORGANICS, mucky fines mixed in.		576.9 / 5.3	SS	42
			SS	6
Black mucky PEAT, moist, soft.		567.2 / 15.0	SS	58
Black mucky fine SAND, some shell fragments present.	SP	562.2 / 20.0	SS	80
Dark gray medium SAND, wet, loose.		559.7 / 22.5		
Gray very fine SAND, moist, compact, trace silt.		557.4 / 24.8		

Continued on Next Page

CONSTRUCTION AND INSTALLATION DETAILS

Pipe Stickup: 2.69 ft
Pipe Elev: 584.9 ft

- 0.0 - 1.0 ft bgs: Bentonite Chips
- 2" Schedule 40 PVC
- 1.0 - 8.0 ft bgs: Filter Sand
- 2" Schedule 40 slotted PVC
- 8.0 - 35.0 ft bgs: Material Collapse

HAMMER TYPE: Automatic

REV: 0

GOLDER MEMBER OF WSP

LOGGED: Parker Sutton DATE: Aug 25, 2021
CHECKED: Caroyln Powrozek DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-16

CLIENT:	GHBLP	DATE:	August 25, 2021	ELEVATION:	582.2 ft (Ground)
PROJECT:	J.B. Sims Well Installations			COORDINATES:	N: 577273.6 ft E: 12625194.8 ft
PROJECT NO:	21464427			COORD SYS:	SP MI South FIPS 2113 Ft
LOCATION:	Grand Haven, MI	CONTRACTOR:	MATECO Drilling	HORZ DATUM:	NAD83
		SURVEYOR:	GPS		

Pipe Stickup: 2.69 ft
Pipe Elev: 584.9 ft

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
25–31.7	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Gray very fine SAND, moist, compact, trace silt.	SP		550.5 / 31.7		SS	80					
31.7–32.0			Gray sandy SILT, moist, firm.	ML		550.2 / 32.0		SS	80					
32.0–35.0			Gray CLAY, moist, soft, sticky, high plasticity.	CH		547.2								
35			End of hole at 35.0 ft. Refusal prior to 40-ft target depth. Refer to diagram for well construction details.											

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton — DATE: Aug 25, 2021
CHECKED: Caroyln Powrozek — DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-17

CLIENT:	GHBLP	DATE:	August 17, 2021	ELEVATION:	584.0 ft (Ground)
PROJECT:	J.B. Sims Well Installations			COORDINATES:	N: 577652.8 ft E: 12624744.2 ft
PROJECT NO:	21464427			COORD SYS:	SP MI South FIPS 2113 Ft
LOCATION:	Grand Haven, MI	CONTRACTOR:	MATECO Drilling	HORZ DATUM:	NAD83
		SURVEYOR:	GPS		

DRILL RIG: Geoprobe 7822DT

DRILL METHOD: Direct Push - 4-in Hole Dia.

MATERIAL PROFILE

DESCRIPTION	USCS	ELEV. / DEPTH (ft)
Brown SAND, dry, loose, some gravel.	SP	0.0
Black SAND, moist, loose, trace organics.		579.3 / 4.7
Brown gravelly SAND, dry, compact.		579.0 / 5.0
Black gravelly SILT, wet, compact, trace organics present.	ML	578.5 / 5.5
Black silty PEAT, moist, soft.		575.5 / 8.5
Black sandy SILT, moist, soft, trace organics.	ML	574.0 / 10.0
Gray fine SAND, wet, loose.	SP	564.5 / 19.5

Continued on Next Page

SAMPLES

Depth interval (ft)	NUMBER	TYPE	REC %	BLOWS	N-VALUE
0.0 - 5.0		SS	100		
5.0 - 10.0		SS	60		
10.0 - 15.0		SS	44		
15.0 - 20.0		SS	50		
20.0 - 25.0		SS	54		

ADDITIONAL OBSERVATIONS

GROUNDWATER OBSERVATIONS

CONSTRUCTION AND INSTALLATION DETAILS

Pipe Stickup: 2.99 ft
Pipe Elev: 587.0 ft

0.0 - 1.0 ft bgs: Bentonite Chips

2" Schedule 40 PVC

1.0 - 8.0 ft bgs: Filter Sand

2" Schedule 40 slotted PVC

8.0 - 40.0 ft bgs: Material Collapse

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Aug 17, 2021

CHECKED: Caroyln Powrozek DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-17

CLIENT:	GHBLP	DATE:	August 17, 2021	ELEVATION:	584.0 ft (Ground)
PROJECT:	J.B. Sims Well Installations			COORDINATES:	N: 577652.8 ft E: 12624744.2 ft
PROJECT NO:	21464427			COORD SYS:	SP MI South FIPS 2113 Ft
LOCATION:	Grand Haven, MI	CONTRACTOR:	MATECO Drilling	HORZ DATUM:	NAD83
		SURVEYOR:	GPS		

Drill Rig: Geoprobe 7822DT
Drill Method: Direct Push - 4-in Hole Dia.

Construction and Installation Details: Pipe Stickup: 2.99 ft; Pipe Elev: 587.0 ft

DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE TYPE	REC %
Gray fine SAND, wet, loose.	SP	557.5 / 26.5	SS	100
Gray silty SAND, wet, loose to compact, trace silt seams.	SM	552.9 / 31.1		
Gray sandy SILT, wet, hard.	ML	552.5 / 31.5	SS	70
Gray silty SAND, wet, hard.	SM	549.4 / 34.6		
Gray sandy SILT, wet, hard.	ML	545.0 / 39.0	SS	84
Gray CLAY, moist, soft, high plasticity.	CH	544.0 / 40.0		

End of hole at 40.0 ft.

Target Depth Reached
Refer to diagram for well construction details.

HAMMER TYPE: Automatic

REV: 0

LOGGED: Parker Sutton — DATE: Aug 17, 2021
CHECKED: Caroyln Powrozek — DATE: Nov 03, 2021

GOLDER MEMBER OF WSP

RECORD OF BOREHOLE: PZ-18

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 18, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 584.1 ft (Ground)
COORDINATES: N: 577919.1 ft E: 12624742.2 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

DESCRIPTION	USCS	ELEV. / DEPTH (ft)
Brown TOPSOIL, dry, loose.		0.0
Brown GRAVEL & SAND, moist to wet, loose.	GW	583.6 / 0.5
Brown peaty SILT, moist, soft, trace sand, cohesive.	ML	577.6 / 6.5
Gray fine to medium SAND, wet, loose.	SP	574.3 / 9.8
Brown peaty sandy SILT, moist, soft, cohesive.	ML	574.0 / 10.1
Gray fine SAND, wet, loose, some organics and shell fragments at 23' BGS.	SP	565.6 / 18.5
Gray silty SAND, wet, loose, some organics and shell fragments present. Compact starting at 28' BGS.	SM	559.9 / 24.2

SAMPLES

NUMBER	TYPE	REC %	BLOWS	N-VALUE
	SS	100		
	SS	60		
	SS	50		
	SS	54		
	SS	42		

CONSTRUCTION AND INSTALLATION DETAILS

Pipe Stickup: 3.10 ft
Pipe Elev: 587.2 ft

0.0 - 1.0 ft bgs: Bentonite Chips

2" Schedule 40 PVC

1.0 - 8.0 ft bgs: Filter Sand

2" Schedule 40 slotted PVC

8.0 - 34.0 ft bgs: Material Collapse

Continued on Next Page

HAMMER TYPE: Automatic

REV: 0

LOGGED: Parker Sutton DATE: Aug 18, 2021
CHECKED: Caroyln Powrozek DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-18

CLIENT: GHBLP
DATE: August 18, 2021
ELEVATION: 584.1 ft (Ground)
PROJECT: J.B. Sims Well Installations
COORDINATES: N: 577919.1 ft E: 12624742.2 ft
PROJECT NO: 21464427
COORD SYS: SP MI South FIPS 2113 Ft
LOCATION: Grand Haven, MI
CONTRACTOR: MATECO Drilling
HORZ DATUM: NAD83
SURVEYOR: GPS

Pipe Stickup: 3.10 ft
Pipe Elev: 587.2 ft

DEPTH (ft)	DRILL RIG	DRILL METHOD	DESCRIPTION	USCS	ELEV. / DEPTH (ft)	NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS
25–33.2	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Gray silty SAND, wet, loose, some organics and shell fragments present. Compact starting at 28' BGS.	SM	550.9 / 33.2		SS	100				
							SS	100				
33.2–34.0			Gray sandy SILT, moist, firm to hard, cohesive.	ML	550.1							
34.0			End of hole at 34.0 ft. Refusal prior to 40-ft target depth. Refer to diagram for well construction details.									

Depth scale: 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Aug 18, 2021
CHECKED: Caroyln Powrozek DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-19

CLIENT:	GHBLP	DATE:	August 20, 2021	ELEVATION:	583.1 ft (Ground)
PROJECT:	J.B. Sims Well Installations			COORDINATES:	N: 577938.0 ft E: 12624957.2 ft
PROJECT NO:	21464427			COORD SYS:	SP MI South FIPS 2113 Ft
LOCATION:	Grand Haven, MI	CONTRACTOR:	MATECO Drilling	HORZ DATUM:	NAD83
		SURVEYOR:	GPS		

DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

MATERIAL PROFILE

DESCRIPTION	USCS	ELEV. / DEPTH (ft)
Black clayey TOPSOIL, moist, soft, organics present.		0.0
Black peaty SAND, wet, loose, trace gravel.	SP	580.6 / 2.5
Black coarse SAND, wet, loose.		577.7 / 5.4
Brown peaty SILT, moist, soft, some sand present, shell fragments present.	ML	577.4 / 5.7
Brown fine SAND, wet, loose, trace organics present until 15' BGS.	SP	571.6 / 11.5
Gray silty fine SAND, wet, compact.	SM	562.5 / 20.6
End of hole at 25.0 ft. Refusal prior to 40-ft target depth. Refer to diagram for well construction details.		558.1 / 25.0

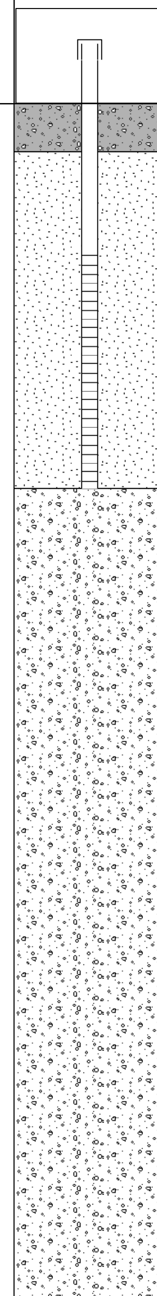
SAMPLES

NUMBER	TYPE	REC %	BLOWS	N-VALUE
	SS	100		
	SS	44		
	SS	52		
	SS	92		
	SS	86		

ADDITIONAL OBSERVATIONS

GROUNDWATER OBSERVATIONS

CONSTRUCTION AND INSTALLATION DETAILS



Pipe Stickup: 2.80 ft
Pipe Elev: 585.9 ft

0.0 - 1.0 ft bgs:	Bentonite Chips
	2" Schedule 40 PVC
1.0 - 8.0 ft bgs:	Filter Sand
	2" Schedule 40 slotted PVC
8.0 - 25.0 ft bgs:	Material Collapse

HAMMER TYPE: Automatic

REV: 0

GOLDER MEMBER OF WSP

LOGGED: Parker Sutton — DATE: Aug 20, 2021
CHECKED: Caroyln Powrozek — DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-20

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI
DATE: August 18, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS
ELEVATION: 582.4 ft (Ground)
COORDINATES: N: 577722.5 ft E: 12625131.4 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE TYPE	REC %
TOPSOIL		0.0		
Brown peaty SAND, wet, soft, trash present (Glass, metal, coal).		581.9 / 0.5	SS	100
Gray fine SAND, wet, loose.	SP	577.2 / 5.2	SS	42
Brown peaty SILT, moist, soft, metal sheet present at 13' BGS.	ML	576.9 / 5.5	SS	58
Gray fine SAND, wet, loose, shell fragments present.	SP	568.9 / 13.5	SS	60
Brown silty SAND, wet, cohesive, shell fragments present, trace organics.	SM	562.4 / 20.0	SS	68
Gray sandy SILT, moist, hard.	ML	559.2 / 23.2		

CONSTRUCTION AND INSTALLATION DETAILS

Pipe Stickup: 3.32 ft
Pipe Elev: 585.7 ft

0.0 - 1.0 ft bgs: Bentonite Chips	2" Schedule 40 PVC
1.0 - 8.0 ft bgs: Filter Sand	2" Schedule 40 slotted PVC
8.0 - 34.0 ft bgs: Material Collapse	

Continued on Next Page

HAMMER TYPE: Automatic

REV: 0

GOLDER MEMBER OF WSP

LOGGED: Parker Sutton DATE: Aug 18, 2021
CHECKED: Caroyln Powrozek DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-20

CLIENT:	GHBLP	DATE:	August 18, 2021	ELEVATION:	582.4 ft (Ground)
PROJECT:	J.B. Sims Well Installations			COORDINATES:	N: 577722.5 ft E: 12625131.4 ft
PROJECT NO:	21464427			COORD SYS:	SP MI South FIPS 2113 Ft
LOCATION:	Grand Haven, MI	CONTRACTOR:	MATECO Drilling	HORZ DATUM:	NAD83
		SURVEYOR:	GPS		

Pipe Stickup: 3.32 ft
Pipe Elev: 585.7 ft

DEPTH (ft)	DRILL RIG	DRILL METHOD	DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
25–30	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Gray sandy SILT, moist, hard.	ML		552.4 / 30.0		SS	66					
30–31.2			Gray medium SAND, wet, loose, shell fragments present.	SP		551.2 / 31.2		SS	100					
31.2–33.5			Gray silty SAND, wet, compact.	SM		548.9 / 33.5								
33.5–34			Gray sandy SILT, moist, firm.	ML		548.4								

End of hole at 34.0 ft.

Refusal prior to 40-ft target depth.
Refer to diagram for well construction details.

Depth scale: 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Aug 18, 2021
CHECKED: Caroyln Powrozek DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-21

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 30, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 580.3 ft (Top of Casing)
COORDINATES: N: 577941.4 ft E: 12625280.3 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DRILL RIG: Marsh Master Geoprobe
DRILL METHOD: Direct Push - 4-in Hole Dia.

DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE TYPE	REC %
Black sandy MUCK, wet, soft, trace organics.		0.0	SS	28
Brown MUCK, wet, soft, some organics.		576.8 / 3.5		
Gray fine SAND, wet, loose, trace silt starting at 13.5' BGS.	SP	575.3 / 5.0	SS	50
			SS	36
Dark gray medium SAND, wet, loose.		565.3 / 15.0	SS	56
Brown fine SAND, wet, loose.		563.3 / 17.0	SS	100

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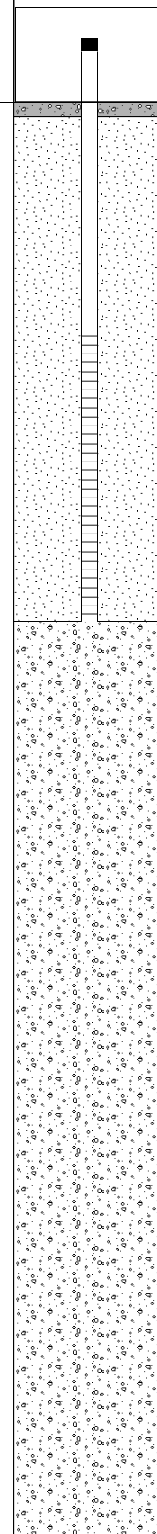
CONSTRUCTION AND INSTALLATION DETAILS



Pipe Elev: 583.3 ft
0.0 - 0.2 ft bgs: Bentonite Chips
2" Schedule 40 PVC
0.2 - 9.0 ft bgs: Filter Sand
2" Schedule 40 slotted PVC
9.0 - 30.0 ft bgs: Material Collapse

HAMMER TYPE: Automatic

REV: 0

LOGGED: Parker Sutton — DATE: Aug 30, 2021
CHECKED: Caroyln Powrozek — DATE: Nov 03, 2021

GOLDER MEMBER OF WSP

RECORD OF BOREHOLE: PZ-21

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 30, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 580.3 ft (Top of Casing)
COORDINATES: N: 577941.4 ft E: 12625280.3 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS (Pipe Elev: 583.3 ft)
25–30	Marsh Master Geoprobe	Direct Push - 4-in Hole Dia.	Brown fine SAND, wet, loose.	SP		550.3		SS	100					
30			End of hole at 30.0 ft. Refusal prior to 40-ft target depth. Refer to diagram for well construction details. Ground elevation survey unable to be collected due to piezometer placement in standing water.											

Depth scale: 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Aug 30, 2021
CHECKED: Caroyln Powrozek DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-22

CLIENT: GHBLP	DATE: August 31, 2021	ELEVATION:	580.4 ft (Top of Casing)
PROJECT: J.B. Sims Well Installations		COORDINATES:	N: 578056.9 ft E: 12625388.0 ft
PROJECT NO: 21464427		COORD SYS:	SP MI South FIPS 2113 Ft
LOCATION: Grand Haven, MI	CONTRACTOR: MATECO Drilling	HORZ DATUM:	NAD83
	SURVEYOR: GPS		

DRILL RIG: Marsh Master Georprobe

DRILL METHOD: Direct Push - 4-in Hole Dia.

MATERIAL PROFILE

DESCRIPTION	USCS	ELEV. / DEPTH (ft)
Black sandy MUCK, wet, soft, some organics present.		0.0
Gray fine SAND, wet, loose, shell fragments present. Trace silt starting at 14' BGS.	SP	575.3 / 5.1
Dark gray medium SAND, wet, compact.	SP	565.9 / 14.5
Gray silty fine SAND, wet, compact.	SM	564.2 / 16.2
		558.4

End of hole at 22.0 ft.

Refusal prior to 40-ft target depth. Refer to diagram for well construction details.

Ground elevation survey unable to be collected due to piezometer placement in standing water.

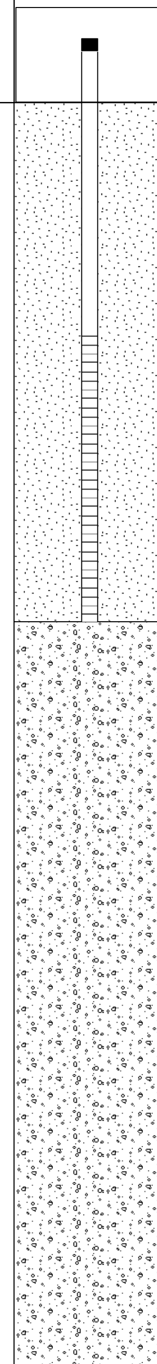
SAMPLES

NUMBER	TYPE	REC %	BLOWS	N-VALUE
	SS	18		
	SS	40		
	SS	58		
	SS	100		
	SS	100		

ADDITIONAL OBSERVATIONS

GROUNDWATER OBSERVATIONS

CONSTRUCTION AND INSTALLATION DETAILS



Pipe Elev: 583.4 ft

2" Schedule 40 PVC

0.0 - 9.0 ft bgs: Filter Sand

2" Schedule 40 slotted PVC

9.0 - 22.0 ft bgs: Material Collapse

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Aug 31, 2021

CHECKED: Caroyln Powrozek DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-23

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 25, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 584.4 ft (Ground)
COORDINATES: N: 577627.7 ft E: 12625841.4 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

DESCRIPTION	USCS	ELEV. / DEPTH (ft)
Brown fine & medium SAND, dry to moist, loose.	SP	0.0
Gray fine SAND, wet, loose, some glass fragments present.		580.4 / 4.0
Black PEAT, moist, loose, trace silt.		578.3 / 6.1
Brown to gray fine SAND, wet, loose.	SP	577.7 / 6.7
Dark brown silty SAND, wet, loose, organics present.	SM	572.3 / 12.1
Brown fine to medium SAND, wet, loose.		571.9 / 12.5
Gray very fine SAND, moist, compact, trace silt.		567.9 / 16.5
Gray fine SAND, wet, loose, trace silt starting at 22' BGS.	SP	566.6 / 17.8
Gray silty SAND, wet, cohesive.	SM	560.4 / 24.0
End of hole at 25.0 ft.		559.4

Refusal
Completed as well - refer to diagram.

SAMPLES

NUMBER	TYPE	REC %	BLOWS	N-VALUE
	SS	100		
	SS	60		
	SS	50		
	SS	100		
	SS	100		

ADDITIONAL OBSERVATIONS

GROUNDWATER OBSERVATIONS

CONSTRUCTION AND INSTALLATION DETAILS

Pipe Stickup: 2.82 ft
Pipe Elev: 587.2 ft

0.0 - 1.0 ft bgs: Cement
1.0 - 2.0 ft bgs: Bentonite Chips
2" Schedule 40 PVC
2.0 - 9.0 ft bgs: Filter Sand
2" Schedule 40 slotted PVC
9.0 - 25.0 ft bgs: Material Collapse

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Aug 25, 2021
CHECKED: Caroyln Powrozek DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-24

CLIENT:	GHBLP	DATE:	August 24, 2021	ELEVATION:	583.9 ft (Ground)
PROJECT:	J.B. Sims Well Installations			COORDINATES:	N: 577884.7 ft E: 12625979.3 ft
PROJECT NO:	21464427			COORD SYS:	SP MI South FIPS 2113 Ft
LOCATION:	Grand Haven, MI	CONTRACTOR:	MATECO Drilling	HORZ DATUM:	NAD83
		SURVEYOR:	GPS		

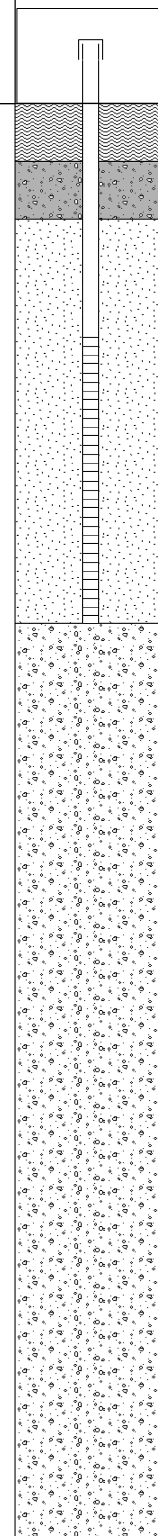
DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE TYPE	REC %	BLOWS	N-VALUE
Brown sandy TOPSOIL, dry, loose.		0.0				
Brown fine SAND, dry, loose, trace gravel.	SP	583.5 / 0.4	SS	100		
Dark brown SAND, moist, loose, leather, glass, metal shavings present	SP	581.4 / 2.5				
Gray fine to medium SAND, wet, loose, shell fragments present.	SP	576.6 / 7.3	SS	70		
Black PEAT, moist, soft, wood organics.		571.9 / 12.0	SS	66		
Gray fine SAND, wet, loose. Silty sand seam from 19-19.2' BGS.	SP	571.7 / 12.2	SS	100		
Gray sandy SILT, moist, firm.	ML	561.9 / 22.0	SS	80		
Gray fine SAND, wet, compact, trace silt.	SP	559.8 / 24.1				

ADDITIONAL OBSERVATIONS

GROUNDWATER OBSERVATIONS

CONSTRUCTION AND INSTALLATION DETAILS



Pipe Stickup: 3.41 ft
Pipe Elev: 587.3 ft

0.0 - 1.0 ft bgs: Cement

1.0 - 2.0 ft bgs: Bentonite Chip

2" Schedule 40 PVC

2.0 - 9.0 ft bgs: Filter Sand

2" Schedule 40 slotted PVC

9.0 - 30.0 ft bgs: Material Collapse

Continued on Next Page

HAMMER TYPE: Automatic

REV: 0

GOLDER MEMBER OF WSP

LOGGED: Parker Sutton DATE: Aug 24, 2021

CHECKED: Caroyln Powrozek DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-24

CLIENT: GHBLP
DATE: August 24, 2021
ELEVATION: 583.9 ft (Ground)
PROJECT: J.B. Sims Well Installations
COORDINATES: N: 577884.7 ft E: 12625979.3 ft
PROJECT NO: 21464427
COORD SYS: SP MI South FIPS 2113 Ft
LOCATION: Grand Haven, MI
CONTRACTOR: MATECO Drilling
HORZ DATUM: NAD83
SURVEYOR: GPS

DEPTH (ft)	DRILL RIG	DRILL METHOD	DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS (Pipe Stickup: 3.41 ft; Pipe Elev: 587.3 ft)
	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Gray fine SAND, wet, compact, trace silt.	SP		558.6								
26–30			Gray CLAY, moist, firm, high plasticity.	CH		25.3		SS	100					
30						553.9								
30			End of hole at 30.0 ft. Refusal prior to 40-ft target depth. Refer to diagram for well construction details.											

Depth scale: 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Aug 24, 2021
CHECKED: Caroyln Powrozek DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-25

CLIENT:	GHBLP	DATE:	August 24, 2021	ELEVATION:	583.5 ft (Ground)
PROJECT:	J.B. Sims Well Installations			COORDINATES:	N: 577703.7 ft E: 12626240.2 ft
PROJECT NO:	21464427			COORD SYS:	SP MI South FIPS 2113 Ft
LOCATION:	Grand Haven, MI	CONTRACTOR:	MATECO Drilling	HORZ DATUM:	NAD83
		SURVEYOR:	GPS		

DRILL RIG: Geoprobe 7822DT

DRILL METHOD: Direct Push - 4-in Hole Dia.

MATERIAL PROFILE

DESCRIPTION	USCS	ELEV. / DEPTH (ft)
Brown TOPSOIL, moist, loose.		0.0
Gray SAND, wet, loose, trace gravel.		583.1 / 0.4
Black peaty SAND, wet, loose.	SP	582.5 / 1.0
Black peaty SILT, wet, loose, hydrocarbon scent, some trash present.	ML	579.5 / 4.0
Dark gray SAND, wet, loose, shell fragments.	SP	575.5 / 8.0
Dark brown peaty SILT, moist, soft.	ML	572.5 / 11.0
Brown fine SAND, wet, loose, shell fragments.	SP	571.1 / 12.4
Gray silty SAND, wet, loose to firm.	SM	568.7 / 14.8
Gray sandy SILT, moist, compact.	ML	561.5 / 22.0
Gray CLAY, moist, firm to hard, trace sand, High plasticity.	CH	560.5 / 23.0

Continued on Next Page

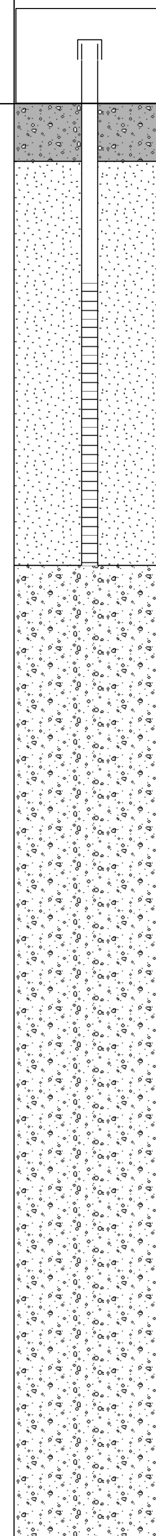
SAMPLES

NUMBER	TYPE	REC %	BLOWS	N-VALUE
	SS	100		
	SS	48		
	SS	60		
	SS	100		
	SS	100		

ADDITIONAL OBSERVATIONS

GROUNDWATER OBSERVATIONS

CONSTRUCTION AND INSTALLATION DETAILS



Pipe Stickup: 2.91 ft
Pipe Elev: 586.4 ft

0.0 - 1.0 ft bgs: Bentonite Chips

2" Schedule 40 PVC

1.0 - 8.0 ft bgs: Filter Sand

2" Schedule 40 slotted PVC

8.0 - 30.0 ft bgs: Material Collapse

HAMMER TYPE: Automatic

REV: 0

GOLDER MEMBER OF WSP

LOGGED: Parker Sutton — DATE: Aug 24, 2021

CHECKED: Caroyln Powrozek — DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-25

CLIENT: GHBLP	DATE: August 24, 2021	ELEVATION: 583.5 ft (Ground)	
PROJECT: J.B. Sims Well Installations		COORDINATES: N: 577703.7 ft E: 12626240.2 ft	
PROJECT NO: 21464427		COORD SYS: SP MI South FIPS 2113 Ft	
LOCATION: Grand Haven, MI	CONTRACTOR: MATECO Drilling	HORZ DATUM: NAD83	
	SURVEYOR: GPS		

DEPTH (ft)	DRILL RIG	DRILL METHOD	DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS (Pipe Stickup: 2.91 ft; Pipe Elev: 586.4 ft)
26–30	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Gray CLAY, moist, firm to hard, trace sand, High plasticity.	CH		553.5		SS	100					
30			End of hole at 30.0 ft. Refusal prior to 40-ft target depth. Refer to diagram for well construction details.											

Depth scale: 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50

HAMMER TYPE: Automatic

REV: 0

LOGGED: Parker Sutton DATE: Aug 24, 2021

CHECKED: Caroyln Powrozek DATE: Nov 03, 2021

GOLDER MEMBER OF WSP

RECORD OF BOREHOLE: PZ-26

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 23, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 583.8 ft (Ground)
COORDINATES: N: 578114.4 ft E: 12626145.2 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

DESCRIPTION	USCS	ELEV. / DEPTH (ft)
Black sandy TOPSOIL		0.0
Brown fine to very fine SAND, moist to wet, loose.	SP	583.3 / 0.5
Dark gray medium SAND, wet, loose, some organics present.	SP	576.3 / 7.5
Brown fine sand, wet, loose, trace gravel.	SP	568.8 / 15.0
Gray SILT, wet, compact.	ML	563.3 / 20.5
Gray CLAY, moist, soft to firm, sticky, high plasticity.	CH	563.0 / 20.8

SAMPLES

NUMBER	TYPE	REC %	BLOWS	N-VALUE
	SS	100		
	SS	50		
	SS	38		
	SS	66		
	SS	80		

CONSTRUCTION AND INSTALLATION DETAILS

Pipe Stickup: 2.46 ft
Pipe Elev: 586.3 ft

0.0 - 1.0 ft bgs: Bentonite Chips

2" Schedule 40 PVC

1.0 - 8.0 ft bgs: Filter Sand

2" Schedule 40 slotted PVC

8.0 - 30.0 ft bgs: Material Collapse

Continued on Next Page

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Aug 23, 2021
CHECKED: Caroyln Powrozek DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-26

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 23, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 583.8 ft (Ground)
COORDINATES: N: 578114.4 ft E: 12626145.2 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

Pipe Stickup: 2.46 ft
Pipe Elev: 586.3 ft

DEPTH (ft)	DRILL RIG	DRILL METHOD	DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS
25–30	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Gray CLAY, moist, soft to firm, sticky, high plasticity.	CH		553.8		SS	82					
30			End of hole at 30.0 ft. Refusal prior to 40-ft target depth. Refer to diagram for well construction details.											

Depth scale: 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50

HAMMER TYPE: Automatic

REV: 0

LOGGED: Parker Sutton — DATE: Aug 23, 2021
CHECKED: Caroyln Powrozek — DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-27

CLIENT:	GHBLP	DATE:	August 23, 2021	ELEVATION:	581.9 ft (Ground)
PROJECT:	J.B. Sims Well Installations			COORDINATES:	N: 578303.9 ft E: 12626551.8 ft
PROJECT NO:	21464427			COORD SYS:	SP MI South FIPS 2113 Ft
LOCATION:	Grand Haven, MI	CONTRACTOR:	MATECO Drilling	HORZ DATUM:	NAD83
		SURVEYOR:	GPS		

DRILL RIG: Geoprobe 7822DT

DRILL METHOD: Direct Push - 4-in Hole Dia.

MATERIAL PROFILE

DESCRIPTION	USCS	ELEV. / DEPTH (ft)
Brown TOPSOIL, moist, soft.		0.0
Gray medium SAND, wet, loose.	SP	581.4 / 0.5
Black SAND, wet, loose, organics present, hydrocarbon scent.	SP	578.4 / 3.5
Black peaty SAND, moist, loose, trace silt.	SP	576.4 / 5.5
Dark gray peaty SILT, moist, soft, trace sand.	ML	573.9 / 8.0
Light black peaty SAND & SILT, moist, soft, trace shell fragments.	SP-SM	573.2 / 8.7
Black peaty SILT, moist, soft, shell fragments present, trace gray sand, organics present.	ML	569.4 / 12.5
Gray fine SAND, wet, loose, trace shell fragments.	SP	561.9 / 20.0
Black peaty SILT, moist, soft, trace gray sand.	ML	561.1 / 20.8

Continued on Next Page

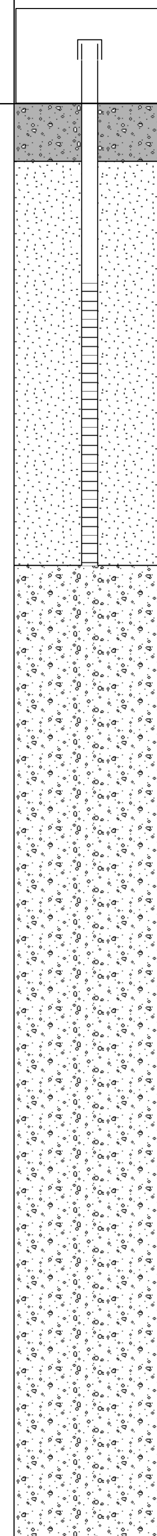
SAMPLES

NUMBER	TYPE	REC %	BLOWS	N-VALUE
	SS	100		
	SS	40		
	SS	54		
	SS	66		
	SS	60		

ADDITIONAL OBSERVATIONS

GROUNDWATER OBSERVATIONS

CONSTRUCTION AND INSTALLATION DETAILS



Pipe Stickup: 3.21 ft
Pipe Elev: 585.1 ft

0.0 - 1.0 ft bgs: Bentonite Chips

2" Schedule 40 slotted PVC

1.0 - 8.0 ft bgs: Filter Sand

2" Schedule 40 slotted PVC

8.0 - 40.0 ft bgs: Material Collapse

HAMMER TYPE: Automatic

REV: 0

GOLDER MEMBER OF WSP

LOGGED: Parker Sutton	DATE: Aug 23, 2021
CHECKED: Caroyln Powrozek	DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-27

CLIENT: GHBLP	DATE: August 23, 2021		ELEVATION: 581.9 ft (Ground)
PROJECT: J.B. Sims Well Installations			COORDINATES: N: 578303.9 ft E: 12626551.8 ft
PROJECT NO: 21464427			COORD SYS: SP MI South FIPS 2113 Ft
LOCATION: Grand Haven, MI	CONTRACTOR: MATECO Drilling		HORZ DATUM: NAD83
	SURVEYOR: GPS		

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS (Pipe Stickup: 3.21 ft; Pipe Elev: 585.1 ft)
25–40	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Black peaty SILT, moist, soft, trace gray sand.	ML		541.9 / 40.0		SS	72					
								SS	76					
								SS	90					
40			End of hole at 40.0 ft. Target Depth Reached Refer to diagram for well construction details.											

Depth scale: 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Aug 23, 2021
CHECKED: Caroyln Powrozek DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-28

CLIENT: GHBLP	DATE: August 23, 2021	ELEVATION: 585.1 ft (Ground)	
PROJECT: J.B. Sims Well Installations		COORDINATES: N: 578314.9 ft E: 12625722.7 ft	
PROJECT NO: 21464427		COORD SYS: SP MI South FIPS 2113 Ft	
LOCATION: Grand Haven, MI	CONTRACTOR: MATECO Drilling	HORZ DATUM: NAD83	
	SURVEYOR: GPS		

DRILL RIG: Geoprobe 7822DT

DRILL METHOD: Direct Push - 4-in Hole Dia.

DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE TYPE	REC %
Brown sandy TOPSOIL, dry, loose, some gravel.		0.0	SS	100
Brown fine SAND, dry, loose, trace gravel.	SP	581.1 / 4.0		
Black peaty SAND, dry, loose.		579.1 / 6.0	SS	54
Gray fine SAND, dry to moist, loose, organics present starting at 9.4' BGS.	SP	578.8 / 6.3		
Gray GRAVEL, wet, loose.	GW	575.4 / 9.7		
Black gravelly SAND, wet, loose, glass and rubber trash present.	SP	575.1 / 10.0	SS	48
Dark gray peaty silty SAND, moist, soft.	SM	574.6 / 10.5		
Black mucky SAND, wet, loose.		570.1 / 15.0	SS	52
Dark gray medium SAND, wet, loose, trace shell fragments.	SP	569.8 / 15.3		
Gray fine SAND, wet, slightly cohesive.		566.5 / 18.6		
Gray silty SAND, moist, firm.	SM	563.7 / 21.4	SS	72
Gray fine to very fine SAND, moist, compact. Wet from 25-28' BGS.	SP	562.5 / 22.6		

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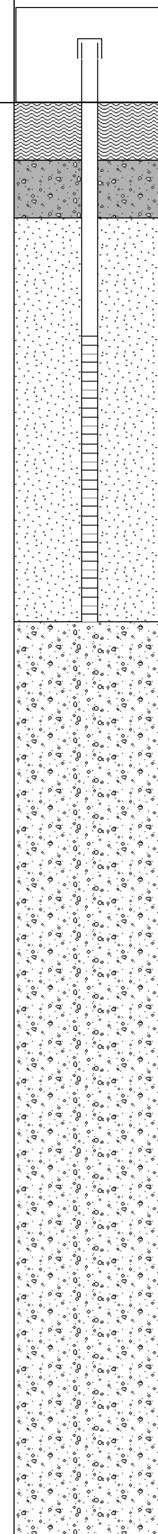
CONSTRUCTION AND INSTALLATION DETAILS



Pipe Stickup: 2.96 ft
Pipe Elev: 588.1 ft

0.0 - 1.0 ft bgs: Cement

1.0 - 2.0 ft bgs: Bentonite Chips

2" Schedule 40 PVC

2.0 - 9.0 ft bgs: Filter Sand

2" Schedule 40 slotted PVC

9.0 - 29.5 ft bgs: Material Collapse

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton — DATE: Aug 23, 2021

CHECKED: Caroyln Powrozek — DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-28

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 23, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 585.1 ft (Ground)
COORDINATES: N: 578314.9 ft E: 12625722.7 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS (Pipe Stickup: 2.96 ft; Pipe Elev: 588.1 ft)
26–29	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Gray fine to very fine SAND, moist, compact. Wet from 25-28' BGS.	SP		555.6		SS	100					
30			End of hole at 29.5 ft. Refusal prior to 40-ft target depth. Refer to diagram for well construction details.											

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton — DATE: Aug 23, 2021
CHECKED: Caroyln Powrozek — DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-29

CLIENT:	GHBLP	DATE:	August 30, 2021	ELEVATION:	580.5 ft (Top of Casing)
PROJECT:	J.B. Sims Well Installations			COORDINATES:	N: 578138.1 ft E: 12625241.6 ft
PROJECT NO:	21464427			COORD SYS:	SP MI South FIPS 2113 Ft
LOCATION:	Grand Haven, MI	CONTRACTOR:	MATECO Drilling	HORZ DATUM:	NAD83
		SURVEYOR:	GPS		

DRILL RIG: Marsh Master Geoprobe

DRILL METHOD: Direct Push - 4-in Hole Dia.

MATERIAL PROFILE

DESCRIPTION	USCS	ELEV. / DEPTH (ft)
Black sandy MUCK, wet, loose / soft.		0.0
Gray fine SAND, wet, loose.		580.0 / 0.5
Black peaty SAND, wet, loose, metal present, glass present, paper present. Hydrocarbon scent and sheen.		576.5 / 4.0
Gray fine SAND, wet, loose, shell fragments present. Silty sand seam present from 11.5-12' BGS.	SP	575.2 / 5.3

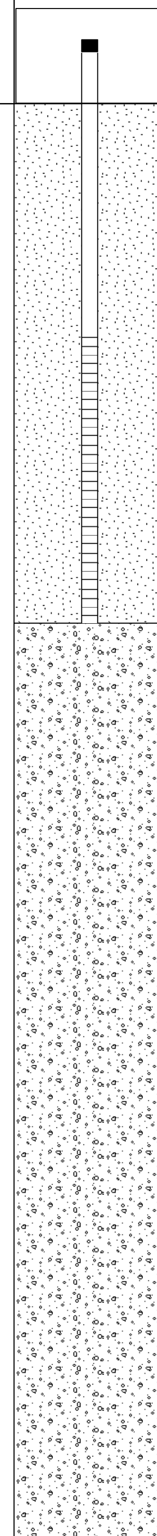
SAMPLES

NUMBER	TYPE	REC %	BLOWS	N-VALUE
	SS	26		
	SS	16		
	SS	52		
	SS	76		
	SS	48		

ADDITIONAL OBSERVATIONS

GROUNDWATER OBSERVATIONS

CONSTRUCTION AND INSTALLATION DETAILS



Pipe Elev: 583.5 ft

2" Schedule 40 PVC

0.0 - 9.0 ft bgs: Filter Sand

2" Schedule 40 slotted PVC

9.0 - 35.0 ft bgs: Material Collapse

Continued on Next Page

HAMMER TYPE: Automatic

REV: 0

LOGGED: Parker Sutton DATE: Aug 30, 2021

CHECKED: Caroyln Powrozek DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-29

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 30, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 580.5 ft (Top of Casing)
COORDINATES: N: 578138.1 ft E: 12625241.6 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DEPTH (ft)	DRILL RIG	DRILL METHOD	DESCRIPTION	USCS	STRATA PLOT	ELEV. / DEPTH (ft)	NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS	CONSTRUCTION AND INSTALLATION DETAILS (Pipe Elev: 583.5 ft)
	Marsh Master Geoprobe	Direct Push - 4-in Hole Dia.	Gray fine SAND, wet, loose, shell fragments present. Silty sand seam present from 11.5-12' BGS.	SP		555.2 / 25.3								
26			Brown SILT, wet, soft, trace sand.	ML		553.5 / 27.0								
27–33			Brown fine SAND, wet, loose, shell fragments present.	SP		547.0 / 33.5		SS	100					
								SS	100					
34			Dark gray to gray silty SAND, wet, compact.	SM		545.5								
35			End of hole at 35.0 ft.											

End of hole at 35.0 ft.

Refusal prior to 40-ft target depth. Refer to diagram for well construction details.

Ground elevation survey unable to be collected due to piezometer placement in standing water.

Depth scale: 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Aug 30, 2021
CHECKED: Caroyln Powrozek DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-30

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 19, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 583.0 ft (Ground)
COORDINATES: N: 578196.2 ft E: 12624990.2 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

MATERIAL PROFILE: DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLES: TYPE	REC %
Black sandy TOPSOIL, moist, soft, organics present.		0.0		
Black peaty SAND, moist to wet, soft, wet @ 1.5' BGS.	SP	582.5 / 0.5	SS	100
Brown silty SAND, wet, loose, some trash present.	SM	580.5 / 2.5		
Gray sandy SILT, moist, firm.	ML	577.0 / 6.0	SS	58
Black peaty SAND, moist, soft, some trash present.	SP	576.5 / 6.5		
Gray silty SAND, moist to wet, loose.	SM	574.3 / 8.7		
Gray silty SAND, wet, loose, some organics present.	SM	572.6 / 10.4	SS	54
Brown fine SAND, wet, loose.	SP	569.0 / 14.0	SS	68
Gray silty SAND, wet, loose to firm.	SM	565.0 / 18.0	SS	82
		558.0 / 25.0		

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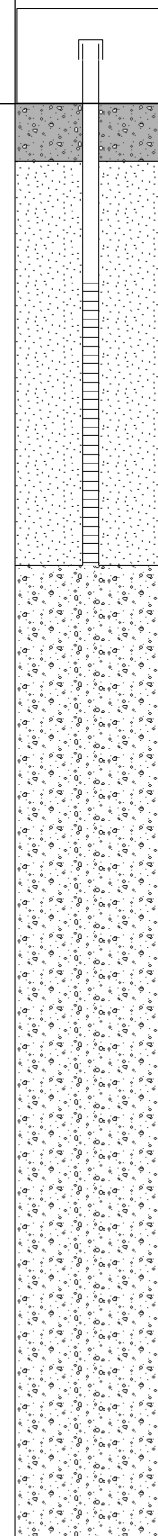
CONSTRUCTION AND INSTALLATION DETAILS



HAMMER TYPE: Automatic

REV: 0

GOLDER MEMBER OF WSP

LOGGED: Parker Sutton DATE: Aug 19, 2021
CHECKED: Caroyln Powrozek DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-30

CLIENT:	GHBLP	DATE:	August 19, 2021	ELEVATION:	583.0 ft (Ground)
PROJECT:	J.B. Sims Well Installations			COORDINATES:	N: 578196.2 ft E: 12624990.2 ft
PROJECT NO:	21464427			COORD SYS:	SP MI South FIPS 2113 Ft
LOCATION:	Grand Haven, MI	CONTRACTOR:	MATECO Drilling	HORZ DATUM:	NAD83
		SURVEYOR:	GPS		

Pipe Stickup: 2.78 ft
Pipe Elev: 585.8 ft

DEPTH (ft)	DRILL RIG	DRILL METHOD	MATERIAL PROFILE: DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLES: NUMBER	TYPE	REC %	BLOWS	N-VALUE	ADDITIONAL OBSERVATIONS	GROUNDWATER OBSERVATIONS
	Geoprobe 7822DT	Direct Push - 4-in Hole Dia.	Gray fine SAND, wet, loose.	SP	557.2 / 25.8							
26			Gray sandy SILT, wet, firm.	ML	550.2 / 32.8		SS	94				
30							SS	100				
33			Gray silty CLAY, moist, firm, high plasticity.	CL-ML	549.0							
34			End of hole at 34.0 ft. Refusal prior to 40-ft target depth. Refer to diagram for well construction details.									

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Aug 19, 2021
CHECKED: Caroyln Powrozek DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-31

CLIENT:	GHBLP	DATE:	September 01, 2021	ELEVATION:	582.6 ft (Ground)
PROJECT:	J.B. Sims Well Installations			COORDINATES:	N: 578307.2 ft E: 12624752.7 ft
PROJECT NO:	21464427			COORD SYS:	SP MI South FIPS 2113 Ft
LOCATION:	Grand Haven, MI	CONTRACTOR:	MATECO Drilling	HORZ DATUM:	NAD83
		SURVEYOR:	GPS		

Drill Rig: Marsh Master Geoprobe
Drill Method: Direct Push - 4-in Hole Dia.

DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLE TYPE	REC %
Black marshy TOPSOIL, moist, soft.		0.0		
Gray fine SAND, moist to wet, loose.	SP	582.2 / 0.4	SS	62
Black mucky SAND, wet, loose, trash present.	SP	579.9 / 2.7		
Black sandy PEAT, moist, loose, shell fragments present, wood and plastic trash present down to 5' BGS.		578.4 / 4.2	SS; SS	46; 50
Gray fine SAND, wet, loose.	SP	567.6 / 15.0	SS; SS	50; 92
Gray coarse SAND, wet, loose.	SP	559.4 / 23.2		
Gray very fine SAND, wet, firm.	SP	558.8 / 23.8	SS	100
End of hole at 27.0 ft.		555.6		

End of hole at 27.0 ft.

Refusal prior to 40-ft target depth. Refer to diagram for well construction details.

CONSTRUCTION AND INSTALLATION DETAILS

Pipe Stickup: 3.29 ft
Pipe Elev: 585.9 ft

- 0.0 - 1.0 ft bgs: Bentonite Chips
- 2" Schedule 40 PVC
- 1.0 - 8.0 ft bgs: Filter Sand
- 2" Schedule 40 slotted PVC
- 8.0 - 27.0 ft bgs: Material Collapse

HAMMER TYPE: Automatic

REV: 0

LOGGED: Parker Sutton — DATE: Sep 01, 2021
CHECKED: Caroyln Powrozek — DATE: Nov 03, 2021

GOLDER MEMBER OF WSP

RECORD OF BOREHOLE: PZ-32

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 20, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 583.1 ft (Ground)
COORDINATES: N: 578348.3 ft E: 12624980.1 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

DRILL RIG: Geoprobe 7822DT
DRILL METHOD: Direct Push - 4-in Hole Dia.

MATERIAL PROFILE

DESCRIPTION	USCS	ELEV. / DEPTH (ft)
Brown sandy TOPSOIL, moist, loose.		0.0
Brown fine SAND, moist to wet, loose.	SP	582.6 / 0.5
Dark brown peaty SILT, moist to wet, soft, trash (glass) present down to 9' BGS. Hydrocarbon scent from 7-9' BGS. Gray sand seams present starting at 9' BGS.	ML	580.1 / 3.0
Gray fine SAND, wet, loose, shell fragments present. trace silt, some medium sand.	SP	569.6 / 13.5
Gray silty fine SAND, wet, loose, small shell fragments.	SM	567.7 / 15.4
Gray fine SAND, wet, loose.	SP	565.1 / 18.0
Gray very fine sandy SILT, wet, soft.	ML	560.8 / 22.3

SAMPLES

NUMBER	TYPE	REC %	BLOWS	N-VALUE
	SS	100		
	SS	40		
	SS	36		
	SS	60		
	SS	76		

CONSTRUCTION AND INSTALLATION DETAILS

Pipe Stickup: 3.18 ft
Pipe Elev: 586.3 ft

0.0 - 1.0 ft bgs: Bentonite Chips
2" Schedule 40 PVC
1.0 - 8.0 ft bgs: Filter Sand
2" Schedule 40 slotted PVC
8.0 - 40.0 ft bgs: Material Collapse

Continued on Next Page

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton — DATE: Aug 20, 2021
CHECKED: Caroyln Powrozek — DATE: Nov 03, 2021

RECORD OF BOREHOLE: PZ-32

CLIENT: GHBLP
PROJECT: J.B. Sims Well Installations
PROJECT NO: 21464427
LOCATION: Grand Haven, MI

DATE: August 20, 2021
CONTRACTOR: MATECO Drilling
SURVEYOR: GPS

ELEVATION: 583.1 ft (Ground)
COORDINATES: N: 578348.3 ft E: 12624980.1 ft
COORD SYS: SP MI South FIPS 2113 Ft
HORZ DATUM: NAD83

Drill Rig: Geoprobe 7822DT
Drill Method: Direct Push - 4-in Hole Dia.

Construction and Installation Details: Pipe Stickup: 3.18 ft; Pipe Elev: 586.3 ft

Description	USCS	Elev. / Depth (ft)	Sample Type	REC %	Blows	N-Value
Gray very fine sandy SILT, wet, soft.	ML	557.7 / 25.4				
Gray very fine SAND, wet, loose.	SP	556.3 / 26.8				
Gray silty SAND, wet, compact, cohesive.	SM	543.1 / 40.0	SS	64		
			SS	80		
			SS	100		

End of hole at 40.0 ft.

Target Depth Reached
Refer to diagram for well construction details.

HAMMER TYPE: Automatic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Aug 20, 2021
CHECKED: Caroyln Powrozek DATE: Nov 03, 2021

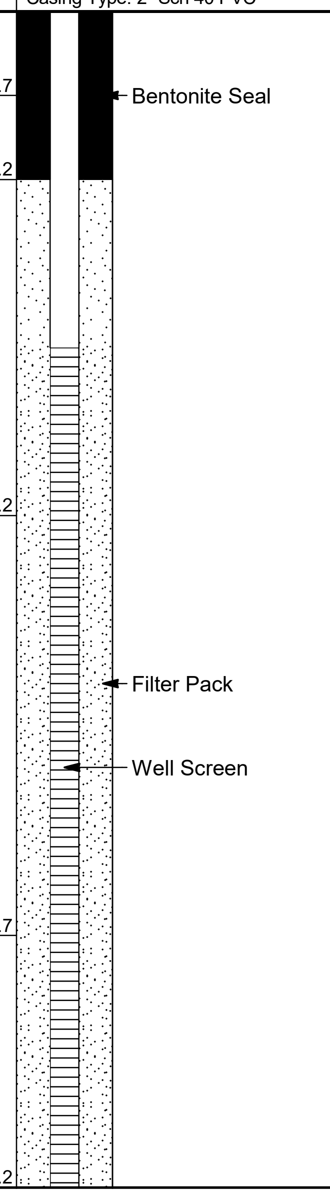
MW-33

CLIENT City of Grand Haven
PROJECT NAME Former J.B. Sims Generating Station
PROJECT NUMBER 10337505
PROJECT LOCATION Harbor Island - Grand Haven, MI
DATE STARTED 11/28/22 00:00 **COMPLETED** 11/28/22 00:00
GROUND ELEVATION 583.23 ft **HOLE DIAMETER** 2
DRILLING CONTRACTOR JSS **DRILLER**
GROUND WATER LEVELS:
DRILLING METHOD DPT **EQUIPMENT**
▽ **AT TIME OF DRILLING** 2.00 ft / Elev 581.23 ft
LOGGED BY Zach McCurley **CHECKED BY** Tanten Buszka
▼ **AFTER DRILLING** 1.68 ft / Elev 581.55 ft
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	Depth	MATERIAL DESCRIPTION	Elev.
0.0				Top Soil	
			0.5	POORLY GRADED SAND, (SP) brown, fine to medium grained, moist, loose	582.7
			1.0	CLAYEY SAND, (SC) very dark brown and gray, moist, medium dense, Saturated at 1.8 ft bgs	582.2
2.5			3.0	POORLY GRADED SAND, (SP) brown, fine to medium grained, saturated, loose	580.2
5.0			5.5	POORLY GRADED SAND, (SP) gray, fine to medium grained, saturated, loose, Wood fragments observed at 6.5 ft bgs	577.7
			7.0		576.2

WELL DIAGRAM

Casing Top Elev: 582.81 (ft)
Casing Type: 2" Sch 40 PVC



Bottom of borehole at 7.0 feet.

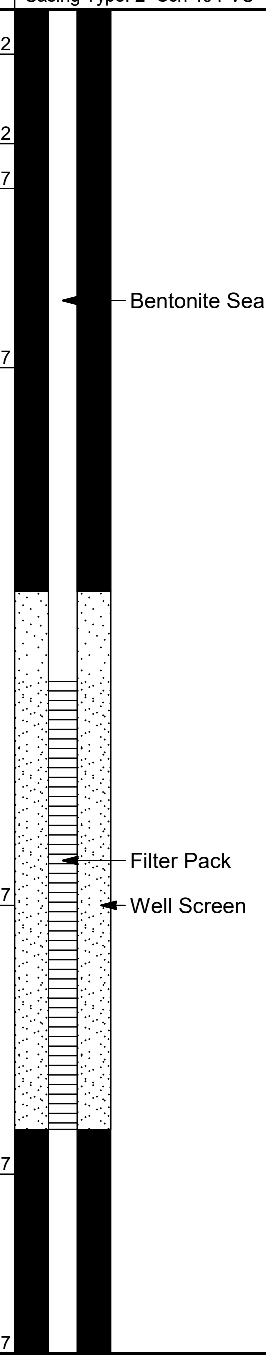
MW-34

CLIENT City of Grand Haven
PROJECT NAME Former J.B. Sims Generating Station
PROJECT NUMBER 10337505
PROJECT LOCATION Harbor Island - Grand Haven, MI
DATE STARTED 01/28/22 00:00 **COMPLETED** 11/28/22 00:00
GROUND ELEVATION 584.69 ft **HOLE DIAMETER** 2
DRILLING CONTRACTOR JSS **DRILLER**
GROUND WATER LEVELS:
DRILLING METHOD DPT **EQUIPMENT**
∇ **AT TIME OF DRILLING** 9.50 ft / Elev 575.19 ft
LOGGED BY Zach McCurley **CHECKED BY** Tanten Buszka
▼ **AFTER DRILLING** 4.21 ft / Elev 580.48 ft
NOTES

DEPTH (ft)	SAMPLE TYPE NUMBER	GRAPHIC LOG	MATERIAL DESCRIPTION	Elev.
0.0 – 0.5			Topsoil	584.2
0.5 – 1.5			POORLY GRADED SAND, (SP) brown, fine to medium grained, moist, loose, Trace gravel	583.2
1.5 – 2.0			POORLY GRADED SAND, (SP) black, fine to medium grained, moist, loose, Trace organics	582.7
2.0 – 4.0			SILTY SAND, (SM) gray, moist, medium dense	580.7
4.0 – 10.0			▼ POORLY GRADED SAND, (SP) gray, fine to medium grained, saturated, medium dense, Trace clay, wood fragments observed at 9.5 ft bgs. ∇ (9.5)	574.7
10.0 – 13.0			POORLY GRADED SAND, (SP) black, saturated, hydrocarbon odor, Observed bricks, metal, and oily sheen at 11 ft bgs.	571.7
13.0 – 15.0			POORLY GRADED SAND, (SP) gray, fine to medium grained, saturated, medium dense, Trace gravel	569.7

WELL DIAGRAM

Casing Top Elev: 584.36 (ft)
Casing Type: 2" Sch 40 PVC



Bottom of borehole at 15.0 feet.

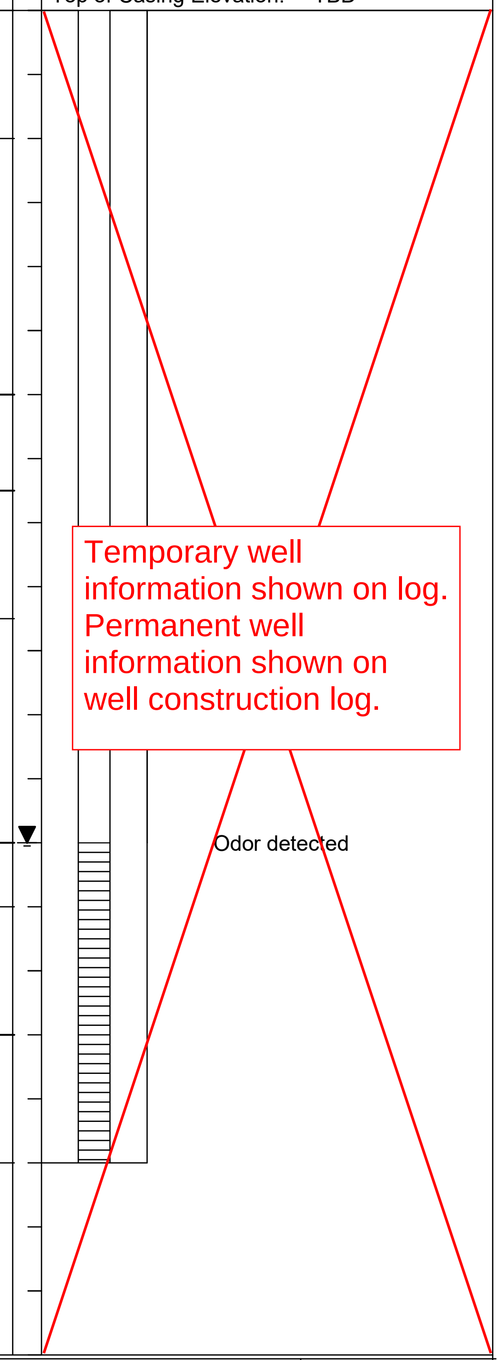
Log of Soil Boring GP-01/MW-35

PROJECT: Former JB Sims Generating Station Harbor Island Grand Haven, Michigan	**Log of Soil Boring GP-01/MW-35**
BORING LOCATION: Harbor Island	SURFACE ELEVATION AND DATUM: TBD
DRILLING CONTRACTOR: Job Site Services	DATE STARTED: 11/29/22 — DATE FINISHED: 11/29/22
DRILLING METHOD: DPT	TOTAL DEPTH (ft.): 18.0 — SCREEN INTERVAL (ft.): 13-18
DRILLING EQUIPMENT: Geoprobe 7822DT	DEPTH TO WATER ATD (ft): 13.0 — CASING: 1", Sch-40 PVC
SAMPLING METHOD: Dual Tube	DEPTH TO WATER ATS (ft): 13.0
HAMMER WEIGHT: NA — DROP: NA	LOGGED BY: Kiersten White — REG. NO. NA

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Recovery (%)	Blow Counts	PID Reading (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plasticity, dilatancy, toughness, dry strength, consistency
0–2				0.0	Fill (GW):
2–6				0.0, 0.0, 0.0, 0.0 (5 ft), 0.0	SILTY SAND (SM): olive, dry, fine to medium silty sand, loose
6–7.5				0.0, 0.0	SILTY SAND (SM): olive, dry, fine to medium silty sand, trace gravel, loose
7.5–9.5				0.0, 0.0	SILTY SAND (SM): gray, dry, fine to medium silty sand, loose
9.5–13				0.0 (10 ft), 0.0, 0.0, 0.0	CLAYEY SAND (SC): gray, moist, slight plasticity
13–14				51.6, NM	CLAYEY SAND (SC): gray, saturated, slight plasticity
14–16	GP-01			NM (15 ft), NM	SILTY SAND (SM): light gray, saturated, loose
16–18				NM, NM	SILTY SAND (SM): light gray, saturated, silty sand with clay, slight plasticity
18					End of boring at 18 ft bgs.

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

Top of Casing Elevation: TBD



SCREENED WELL CONSTRUCTION FORM

Site Name: Former JB Sims Generating Station, Harbor Island, Grand Haven, MI

Project Number: 3650220203.02.02

Well ID: MW-35

Location ID: GP-01

Drilling Subcontractor: Job Site Services

Installation Date: 01/30/2023

Drilling Personnel: David Mokma & Jeremiah Chapman

Decon Performed: Yes

Technician Name: Jared Walbert

Drilling Method: Direct Push

Other Amec Foster Wheeler Representatives: None.

Measurement Point (riser) Elevation (ft msl): 589.724

Land Surface Elevation (ft): 590.421

Approximate Diameter of Borehole (in): 3.75 inches

Depth to Water (ft): 9.20

During Drilling: 8.30

Date: 01/30/2023

Post Development: 8.30

Date: 01/31/2023

Hydrologic Unit: NA

Water added during drilling (gal): .0

Water removed during development (gal): 20

Top of Bentonite Seal (ft): 1.0

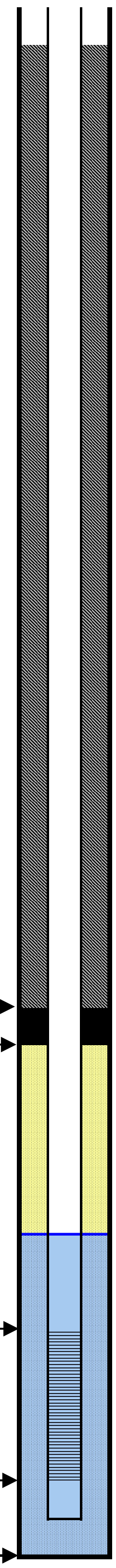
Top of Filter Pack (ft): 5.0

Top of Screen Interval (ft): 7.30

Bottom of Screened Interval (ft): 12.30

Bottom of Filter Pack (ft): 12.30

Bottom of Borehole (ft): 12.30 feet bgs



Protective Casing:

- **Type:** Flush Mount
- **Dimensions (in):** 8
- **Stickup (ft):** 0
- **Length (ft):** 1
- **Guard Post:** None

Surface Pad:

- **Dimensions:** 12"x12"
- **Type:** Concrete

Annular Seal (grout above well seal):

- **Material:** BENTONITE
- **Installation Method:** Gravity

Bentonite Seal:

- **Manufacturer:** Baroid
- **Material:** BENTONITE 3/8"
- **Type:** Chips
- **Installation Method:** Gravity
- **Hydration time (hrs):** 24

Filter Pack Material:

- **Manufacturer:** K&E
- **Material:** #2 Well Gravel
- **Size:** 0.03
- **Installation Method:** Gravity
- **Surging time:** 0.33

Well Casing (Riser):

- **Manufacturer:** ECT Manufacturing Inc
- **Type/Material:** POLYVINYL CHLORIDE (PVC)
- **Length:** 7.3'
- **Diameter (in):** 2

Well Screen:

- **Manufacturer:** Johnson Screens
- **Type/Material:** POLYVINYL CHLORIDE (PVC)
- **Diameter (in):** 2
- **Slot Size (in):** 0.010
- **Slot Type:** Factory Slot

Sump/End Cap: Point

Notes: None.

Technician Signature: Jared Walbert

Depths and heights are referenced to ground surface unless specified TOC.
All elevations are referenced to MSL (NAVD 88).

Technician Name (print): Jared Walbert

QA/QC'd by:

QA/QC Date:

Log of Soil Boring VAS20/MW-36

PROJECT: Former JB Sims Generating Station Harbor Island Grand Haven, Michigan	**Log of Soil Boring VAS20/MW-36**
BORING LOCATION: Harbor Island	SURFACE ELEVATION AND DATUM: TBD
DRILLING CONTRACTOR: Job Site Services	DATE STARTED: 12/7/22 / DATE FINISHED: 12/7/22
DRILLING METHOD: DPT	TOTAL DEPTH (ft.): 20.0 / SCREEN INTERVAL (ft.): 5-9; 16-20
DRILLING EQUIPMENT: Geoprobe 7822DT	DEPTH TO WATER ATD (ft): 5.0 / CASING: 1", stainless steel
SAMPLING METHOD: Dual Tube	DEPTH TO WATER ATS (ft): 5.85
HAMMER WEIGHT: NA / DROP: NA	LOGGED BY: Jared Walbert / REG. NO. NA

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Recovery (%)	Blow Counts	PID Reading (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plasticity, dilatancy, toughness, dry strength, consistency	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS (Top of Casing Elevation: TBD)
0–5				0.0, 0.0, 0.0, 0.0	POORLY-GRADED SAND (SP): yellowish brown (10 YR 5/8), moist	
5	VAS20-5-9			0.0	POORLY-GRADED SAND (SP): yellowish brown (10 YR 5/8), saturated	
				NM	WELL-GRADED SAND with GRAVEL (SW): yellowish brown (10 YR 5/8), saturated	1", stainless steel screen used
				NM, NM, NM, NM	WELL-GRADED GRAVEL (GW): gray (GLEY 1 6/N), saturated	
10				NM, NM		
				NM, NM, NM	SILTY GRAVEL (GM): very dark brown (10 YR 2/2), saturated	
15				NM, NM	CLAYEY SILT (ML): very dark brown (10 YR 2/2), saturated, low plasticity	
	VAS20-16-20			NM	SANDY SILT (ML): dark gray (5 Y 4/1), saturated	
				NM	SILT (ML): very dark brown (10 YR 2/2), saturated	1", stainless steel screen used
				NM	POORLY-GRADED SAND (SP): gray (5 Y 6/1), saturated	
20				NM	End of boring at 20 ft bgs.	

Temporary well information shown on log. Permanent well information shown on well construction log.

WELL10

wsp

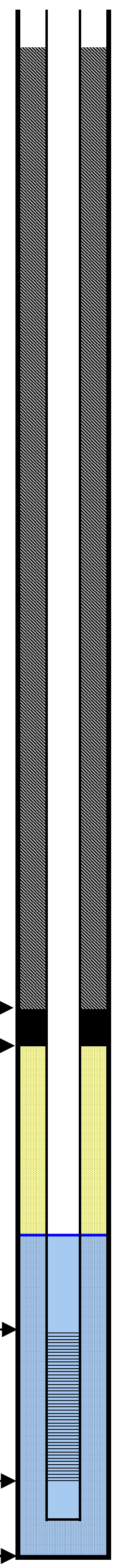
Acronymns
ATD - At Time of Drilling
ATS - At Time of Sampling

Project No. 3650220203

SCREENED WELL CONSTRUCTION FORM

Site Name: Former JB Sims Generating Station, Harbor Island, Grand Haven, MI
Project Number: 3650220203.02.02

Well ID: MW-36
Location ID: VAS20
Drilling Subcontractor: Job Site Services
Installation Date: 01/30/2023
Drilling Personnel: David Mokma & Jeremiah Chapman
Decon Performed: Yes
Technician Name: Jared Walbert
Drilling Method: Direct Push
Other Amec Foster Wheeler Representatives: None



Measurement Point (riser)
Elevation (ft msl): 589.121

Land Surface Elevation (ft): 585.615

Approximate Diameter of Borehole (in): 3.75 Inches

Depth to Water (ft): 5.60
During Drilling: 5.60
Date: 01/30/2023
Post Development: 5.08
Date: 02/01/2023

Hydrologic Unit:

Water added during drilling (gal): .0
Water removed during development (gal): 15

Top of Bentonite Seal (ft): 1.0
Top of Filter Pack (ft): 3.0
Top of Screen Interval (ft): 4.0
Bottom of Screened Interval (ft): 9.0
Bottom of Filter Pack (ft): 9.0
Bottom of Borehole (ft): 9.0 feet bgs

Protective Casing:
- **Type:** Round Well Monument
- **Dimensions (in):** 4
- **Stickup (ft):** 4
- **Length (ft):** 5
- **Guard Post:** None

Surface Pad:
- **Dimensions:** 12"x12"x6"
- **Type:** Concrete

Annular Seal (grout above well seal):
- **Material:** BENTONITE
- **Installation Method:** Gravity

Bentonite Seal:
- **Manufacturer:** Baroid
- **Material:** BENTONITE 3/8"
- **Type:** Chips
- **Installation Method:** Gravity
- **Hydration time (hrs):** 24

Filter Pack Material:
- **Manufacturer:** K&E
- **Material:** #2 Well Gravel
- **Size:** 0.03
- **Installation Method:** Gravity
- **Surging time:** 0.5

Well Casing (Riser):
- **Manufacturer:** ECT Manufacturing Inc
- **Type/Material:** POLYVINYL CHLORIDE (PVC)
- **Length:** 4'
- **Diameter (in):** 2

Well Screen:
- **Manufacturer:** Johnson Screens
- **Type/Material:** POLYVINYL CHLORIDE (PVC)
- **Diameter (in):** 2
- **Slot Size (in):** 0.010
- **Slot Type:** Factory Slot

Sump/End Cap: Point

Notes: None.

Technician Signature: Jared Walbert

Depths and heights are referenced to ground surface unless specified TOC.
All elevations are referenced to MSL (NAVD 88).

Technician Name (print): Jared Walbert

QA/QC'd by:
QA/QC Date:

PROJECT: Former JB Sims Generating Station Harbor Island Grand Haven, Michigan	**Log of Soil Boring VAS21/MW37**	
BORING LOCATION: Harbor Island	SURFACE ELEVATION AND DATUM: TBD	
DRILLING CONTRACTOR: Job Site Services	DATE STARTED: 12/7/22	DATE FINISHED: 12/7/22
DRILLING METHOD: DPT	TOTAL DEPTH (ft.): 20.0	SCREEN INTERVAL (ft.): 5-9; 16-20
DRILLING EQUIPMENT: Geoprobe 7822DT	DEPTH TO WATER ATD (ft): 5.0	CASING: 1", stainless steel
SAMPLING METHOD: Dual Tube	DEPTH TO WATER ATS (ft): 5.58	
HAMMER WEIGHT: NA DROP: NA	LOGGED BY: Jared Walbert	REG. NO. NA

DEPTH (feet)	SAMPLES Sample No.	SAMPLES Recovery (%)	Blow Counts	PID Reading (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plasticity, dilatancy, toughness, dry strength, consistency	Depth (ft)	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS Top of Casing Elevation: TBD
	VAS21-5-9, VAS21-SB-5-7			0.0	SILTY GRAVEL (GM): gray (10 YR 6/1), damp		
				0.0	POORLY-GRADED SAND (SP): yellowish brown (10 YR 5/8), damp		
				0.0	SILTY GRAVEL (GM): very dark brown (10 YR 2/2), damp		
				0.0	POORLY-GRADED SAND (SP): brown (10 YR 5/3), moist		
5				0.0	POORLY-GRADED SAND (SP): brown (10 YR 5/3), wet	▼	
				NM	POORLY-GRADED SAND (SP): brown (10 YR 5/3), saturated, glass fragments at 7 ft bgs		1", stainless steel screen used
				NM	POORLY-GRADED SAND (SP): dark gray (10 YR 4/1), saturated		
				NM	POORLY-GRADED SAND (SP): black (GLEY 1 2.5/N), saturated		Temporary well information shown on log. Permanent well information shown on well construction log.
				NM			
10				NM			
				NM			
				NM			
				NM			
				NM	SILTY GRAVEL (GM): black (GLEY 1 2.5/N), saturated, poorly graded		
15				NM	POORLY-GRADED SAND (SP): black (GLEY 1 2.5/N), saturated		
	VAS21-16-20			NM	SILTY CLAY (CL): very dark brown (10 YR 2/2), wet, plastic		
				NM			1", stainless steel screen used
				NM			
				NM	POORLY-GRADED SAND (SP): dark gray (GLEY 1 4/N), saturated		
20				NM	SILTY CLAY (CL): very dark brown (10 YR 2/2), wet, plastic		
					End of boring at 20 ft bgs.		

SCREENED WELL CONSTRUCTION FORM

wsp

Site Name: Former JB Sims Generating Station, Harbor Island, Grand Haven, MI

Project Number: 3650220203.02.02

Well ID: MW-37

Location ID: VAS21

Drilling Subcontractor: Job Site Services

Installation Date: 01/30/2023

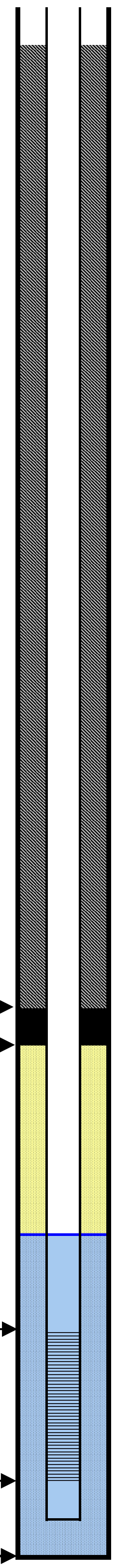
Drilling Personnel: David Mokma & Jeremiah Chapman

Decon Performed: Yes

Technician Name: Jared Walbert

Drilling Method: Direct Push

Other Amec Foster Wheeler Representatives: None.



Measurement Point (riser) Elevation (ft msl): 589.619

Land Surface Elevation (ft): 585.59

Approximate Diameter of Borehole (in): 3.75 inches

Depth to Water (ft): 5.30

During Drilling: 5.30

Date: 01/30/2023

Post Development: 5.60

Date: 02/01/2023

Hydrologic Unit: NA

Water added during drilling (gal): .0

Water removed during development (gal): 15

Top of Bentonite Seal (ft): 1.0

Top of Filter Pack (ft): 3.0

Top of Screen Interval (ft): 4.0

Bottom of Screened Interval (ft): 9.0

Bottom of Filter Pack (ft): 9.0

Bottom of Borehole (ft): 9.0 feet bgs

Protective Casing:

- **Type:** Round Well Monument
- **Dimensions (in):** 4
- **Stickup (ft):** 4
- **Length (ft):** 5
- **Guard Post:** None

Surface Pad:

- **Dimensions:** 12"x12"x6"
- **Type:** Concrete

Annular Seal (grout above well seal):

- **Material:** BENTONITE
- **Installation Method:** Gravity

Bentonite Seal:

- **Manufacturer:** Baroid
- **Material:** BENTONITE 3/8"
- **Type:** Chips
- **Installation Method:** Gravity
- **Hydration time (hrs):** 24

Filter Pack Material:

- **Manufacturer:** K&E
- **Material:** #2 Well Gravel
- **Size:** 0.03
- **Installation Method:** Gravity
- **Surging time:** 0.25

Well Casing (Riser):

- **Manufacturer:** ECT Manufacturing Inc
- **Type/Material:** POLYVINYL CHLORIDE (PVC)
- **Length:** 4
- **Diameter (in):** 2

Well Screen:

- **Manufacturer:** Johnson Screens
- **Type/Material:** POLYVINYL CHLORIDE (PVC)
- **Diameter (in):** 2
- **Slot Size (in):** 0.010
- **Slot Type:** Factory Slot

Sump/End Cap: Point

Notes: None

Technician Signature: [signature]

Depths and heights are referenced to ground surface unless specified TOC.
All elevations are referenced to MSL (NAVD 88).

Technician Name (print): Jared Walbert

QA/QC'd by:

QA/QC Date:

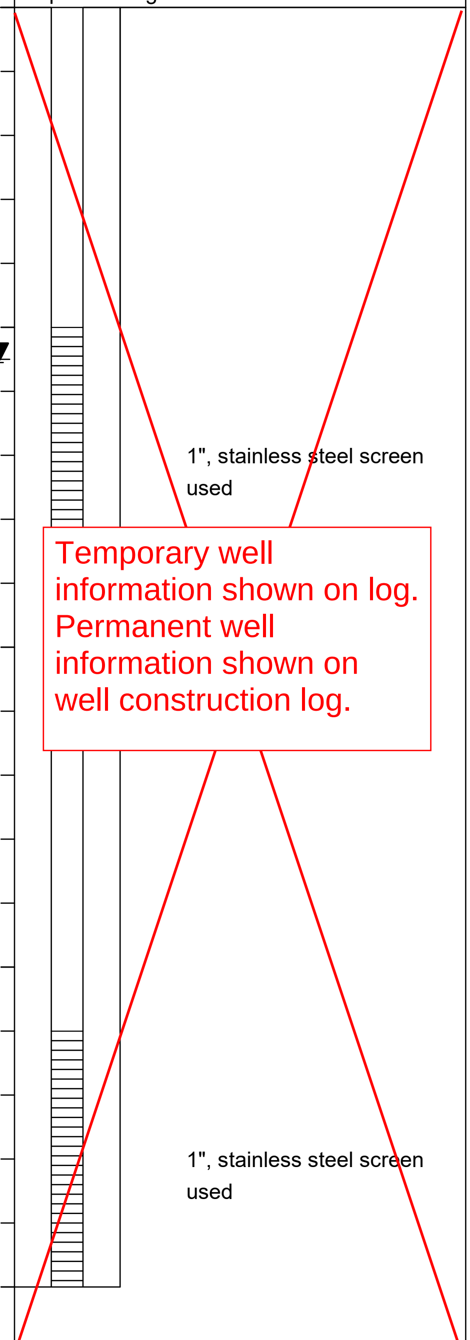
Log of Soil Boring VAS22/MW-38

PROJECT: Former JB Sims Generating Station Harbor Island, Grand Haven, Michigan	
BORING LOCATION: Harbor Island	SURFACE ELEVATION AND DATUM: TBD
DRILLING CONTRACTOR: Job Site Services	DATE STARTED: 12/7/22 / DATE FINISHED: 12/7/22
DRILLING METHOD: DPT	TOTAL DEPTH (ft.): 20.0 / SCREEN INTERVAL (ft.): 5-9; 16-20
DRILLING EQUIPMENT: Geoprobe 7822DT	DEPTH TO WATER ATD (ft): 5.0 / CASING: 1", stainless steel
SAMPLING METHOD: Dual Tube	DEPTH TO WATER ATS (ft): 5.50
HAMMER WEIGHT: NA / DROP: NA	LOGGED BY: Jared Walbert / REG. NO. NA

DEPTH (feet)	Sample No.	Recovery (%)	Blow Counts	PID Reading (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plasticity, dilatancy, toughness, dry strength, consistency
0–4.5				0.0, 0.0, 0.0, 0.0	SILTY GRAVEL (GM): black (GLEY 1 2.5/N), damp
4.5–5.5	VAS22-5-9			0.0	POORLY-GRADED SAND (SP): black (GLEY 1 2.5/N), wet
5.5–6.5				NM	POORLY-GRADED SAND (SP): brownish yellow (10 YR 6/8), saturated
6.5–7.5				NM	CLAYEY SILT (ML): black (GLEY 1 2.5/N), wet, coal fragments, low plasticity
7.5–10				NM, NM, NM	POORLY-GRADED SAND (SP): brownish yellow to black (10 YR 6/8 to GLEY 1 2.5/N), saturated, wood and coal at 9.5-10.0 ft bgs
10–12				NM, NM	CLAYEY SILT (ML): very dark grayish brown (10 YR 3/2), saturated, low plasticity
12–13				NM	POORLY-GRADED SAND (SP): very dark gray (GLEY 1 3/N), saturated
13–14				NM	SILT (ML): very dark gray (GLEY 1 3/N), saturated
14–17				NM, NM, NM	CLAYEY SILT (ML): very dark grayish brown (10 YR 3/2), saturated, leaves and roots at 16.0-17.0 ft bgs, low plasticity
17–20	VAS22-16-20			NM, NM, NM, NM	POORLY-GRADED SAND (SP): gray (GLEY 1 5/N), saturated
20				NM	End of boring at 20 ft bgs.

WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS

Top of Casing Elevation: TBD



Acronymns
ATD - At Time of Drilling
ATS - At Time of Sampling

SCREENED WELL CONSTRUCTION FORM

Site Name: Former JB sims generating station, Harbor Island, Grand Haven, MI
Project Number: 3650220203.02.02

Well ID: MW-38
Location ID: VAS22
Drilling Subcontractor: Job Site Services
Installation Date: 01/30/2023
Drilling Personnel: David Mokma & Jeremiah Chapman
Decon Performed: Yes
Technician Name: Jared Walbert
Drilling Method: Direct Push
Other Amec Foster Wheeler Representatives:

Measurement Point (riser)
Elevation (ft msl): 590.51

Land Surface Elevation (ft): 586.258

Approximate Diameter of Borehole (in): 3.75

Depth to Water (ft): 5.90
During Drilling: 5.90
Date: 01/30/2023
Post Development: 6.37
Date: 02/01/2023

Hydrologic Unit: NA

Water added during drilling (gal): .0
Water removed during development (gal): 10.5

Top of Bentonite Seal (ft): 1.0

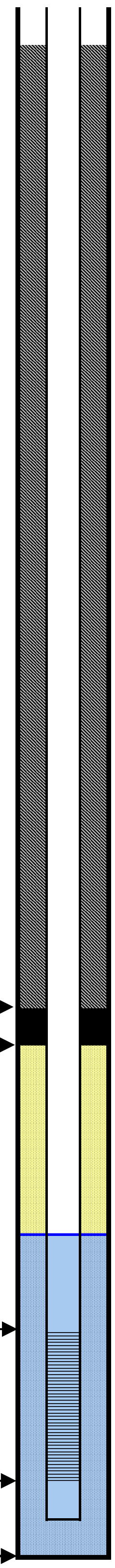
Top of Filter Pack (ft): 3.0

Top of Screen Interval (ft): 4.0

Bottom of Screened Interval (ft): 9.0

Bottom of Filter Pack (ft): 9.0

Bottom of Borehole (ft): 9.37



Protective Casing:
Type: Round Well Monument
Dimensions (in): 4
Stickup (ft): 4
Length (ft): 5
Guard Post: None

Surface Pad:
Dimensions: 12"x12"x6"
Type: Concrete

Annular Seal (grout above well seal):
Material: BENTONITE
Installation Method: Gravity

Bentonite Seal:
Manufacturer: Baroid
Material: BENTONITE 3/8"
Type: Chips
Installation Method: Gravity
Hydration time (hrs): 24

Filter Pack Material:
Manufacturer: K&E
Material: #2 Well Gravel
Size: 0.03
Installation Method: Gravity
Surging time: 0.5

Well Casing (Riser):
Manufacturer: ECT manufacturing inc
Type/Material: POLYVINYL CHLORIDE (PVC)
Length: 4'
Diameter (in): 2

Well Screen:
Manufacturer: Johnson Screens
Type/Material: POLYVINYL CHLORIDE (PVC)
Diameter (in): 2
Slot Size (in): 0.010
Slot Type: Factory Slot

Sump/End Cap: Point

Notes:
None.

Technician Signature: Jared Walbert

Depths and heights are referenced to ground surface unless specified TOC.
All elevations are referenced to MSL (NAVD 88).

Technician Name (print): Jared Walbert

QA/QC'd by:
QA/QC Date:

Log of Soil Boring VAS15/MW-39

PROJECT: Former JB Sims Generating Station Harbor Island, Grand Haven, Michigan	
BORING LOCATION: Harbor Island	SURFACE ELEVATION AND DATUM: TBD
DRILLING CONTRACTOR: Job Site Services	DATE STARTED: 12/5/22 — DATE FINISHED: 12/6/22
DRILLING METHOD: DPT	TOTAL DEPTH (ft.): 20.0 — SCREEN INTERVAL (ft.): 3-7; 16-20
DRILLING EQUIPMENT: Geoprobe 7822DT	DEPTH TO WATER ATD (ft): 3.0 — CASING: 1", stainless steel
SAMPLING METHOD: Dual Tube	DEPTH TO WATER ATS (ft): 3.10
HAMMER WEIGHT: NA — DROP: NA	LOGGED BY: Jared Walbert — REG. NO. NA

DEPTH (feet)	Sample No.	Recovery (%)	Blow Counts	PID Reading (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plasticity, dilatancy, toughness, dry strength, consistency	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS (Top of Casing Elevation: TBD)
0-3	VAS15-3-7, VAS15-SB-3-5			0.0, 0.0, 0.0	POORLY-GRADED SAND (SP): yellowish brown (10 YR 5/8), dry	
3-5				0.6, NM	POORLY-GRADED SAND (SP): very dark brown (10 YR 2/2), saturated, waste consisting of ceramics, glass and metal	Odor detected at 3.0-5.0 ft bgs, low PID reading of saturated soil (0.6 ppm), 1", stainless steel screen used
5-7				NM, NM	SILTY GRAVEL (GM): very dark brown (10 YR 2/2), saturated, waste consisting of ceramic and glass	Odor detected at 5.0-7.0 ft bgs
7-8.5				NM, NM	CLAYEY SILT (ML): black to very dark gray (10 YR 2/1 to 10 YR 3/1), saturated, wood fibers, low plasticity	
8.5-10				NM	SANDY SILT (ML): brown (10 YR 5/3), saturated, shells at 9.0 ft bgs	
10-13				NM, NM, NM	CLAYEY SILT (ML): very dark grayish brown (10 YR 3/2), saturated	
13-14				NM	SILTY CLAY (ML): very dark grayish brown (10 YR 3/2), wet	
14-17				NM, NM, NM	CLAYEY SILT (ML): very dark grayish brown (10 YR 3/2), saturated, leaf and wood debris at 14.0-15.0 ft bgs	
17-20	VAS15-16-20			NM, NM, NM, NM	POORLY-GRADED SAND (SP): gray (10 YR 6/1), saturated	1", stainless steel screen used
20					End of boring at 20 ft bgs.	

Temporary well information shown on log. Permanent well information shown on well construction log.

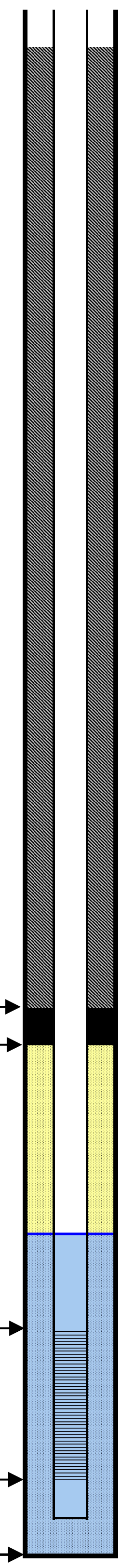
Acronymns
ATD - At Time of Drilling
ATS - At Time of Sampling

WELL10

SCREENED WELL CONSTRUCTION FORM

Site Name:	Former JB Sims Generating Station, Harbor Island, Grand Haven, MI	**Project Number:**	3650220203.02.02
Well ID:	MW-39	**Location ID:**	VAS15
Drilling Subcontractor:	Job Site Services	**Installation Date:**	01/31/2023
Drilling Personnel:	David Mokma & Jeremiah Chapman	**Decon Performed:**	Yes
Technician Name:	Jared Walbert	**Drilling Method:**	Direct Push

Other Amec Foster Wheeler Representatives: None



Measurement Point (riser) Elevation (ft msl):	587.359
Land Surface Elevation (ft):	583.272
Approximate Diameter of Borehole (in):	3.75 inches
Depth to Water (ft):	3.10
During Drilling:	2.76
Date:	01/31/2023
Post Development:	3.17
Date:	02/01/2023
Hydrologic Unit:	NA
Water added during drilling (gal):	.0
Water removed during development (gal):	15
Top of Bentonite Seal (ft):	0.5
Top of Filter Pack (ft):	1.5
Top of Screen Interval (ft):	2.0
Bottom of Screened Interval (ft):	7.0
Bottom of Filter Pack (ft):	7.0
Bottom of Borehole (ft):	7.0

Protective Casing:

Type:	Round Well Monument
Dimensions (in):	4
Stickup (ft):	4.5
Length (ft):	5
Guard Post:	None

Surface Pad:

Dimensions:	12"x12"x6"
Type:	Concrete

Annular Seal (grout above well seal):

Material:	BENTONITE
Installation Method:	Gravity

Bentonite Seal:

Manufacturer:	Baroid
Material:	BENTONITE
Type:	Chips
Installation Method:	Gravity
Hydration time (hrs):	24

Filter Pack Material:

Manufacturer:	K&E
Material:	#2 Well Gravel
Size:	0.03
Installation Method:	Gravity
Surging time:	0.5

Well Casing (Riser):

Manufacturer:	ECT Manufacturing inc
Type/Material:	POLYVINYL CHLORIDE (PVC)
Length:	2'
Diameter (in):	2

Well Screen:

Manufacturer:	Johnson Screens
Type/Material:	POLYVINYL CHLORIDE (PVC)
Diameter (in):	2
Slot Size (in):	0.010
Slot Type:	Factory Slot

Sump/End Cap: Point

Notes: None.

Technician Signature:

Technician Name (print): Jared Walbert

Depths and heights are referenced to ground surface unless specified TOC.
All elevations are referenced to MSL (NAVD 88).

QA/QC'd by: **QA/QC Date:**

Log of Soil Boring VAS16/MW-40

PROJECT: Former JB Sims Generating Station Harbor Island Grand Haven, Michigan	**Log of Soil Boring VAS16/MW-40**
BORING LOCATION: Harbor Island	SURFACE ELEVATION AND DATUM: TBD
DRILLING CONTRACTOR: Job Site Services	DATE STARTED: 12/6/22 / DATE FINISHED: 12/6/22
DRILLING METHOD: DPT	TOTAL DEPTH (ft.): 10.0 / SCREEN INTERVAL (ft.): 3-7
DRILLING EQUIPMENT: Geoprobe 7822DT	DEPTH TO WATER ATD (ft): 3.0 / CASING: 1", stainless steel
SAMPLING METHOD: Dual Tube	DEPTH TO WATER ATS (ft): 3.2
HAMMER WEIGHT: NA / DROP: NA	LOGGED BY: Jared Walbert / REG. NO. NA

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Recovery (%)	Blow Counts	PID Reading (ppm)	DESCRIPTION NAME (USCS): color, moist, % by wt., plasticity, dilatancy, toughness, dry strength, consistency	WELL CONSTRUCTION DETAILS AND/OR DRILLING REMARKS Top of Casing Elevation: TBD
0–2				0.0	POORLY-GRADED SAND (SP): dark grayish brown (10 YR 4/2), damp	
2–3				0.0	SILTY GRAVEL (GM): black (GLEY 1 2.5/N), damp, coal fragments	
3–5				0.0 NM	POORLY-GRADED SAND (SP): dark grayish brown (10 YR 4/2), saturated	
5–10	VAS16-3-7			NM NM NM NM NM NM NM	SILTY GRAVEL (GM): grayish brown (10 YR 5/2), saturated	
10					End of boring at 10 ft bgs.	Multiple location refusal at 10 ft bgs, no deep interval acheived

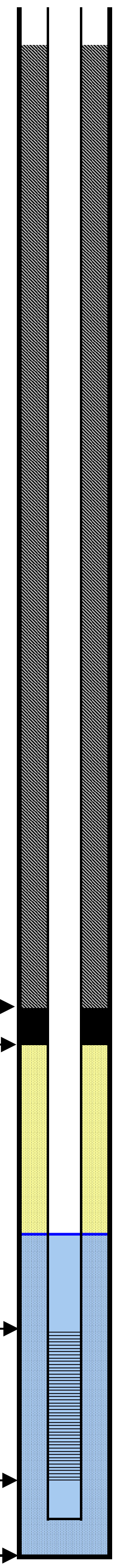
Temporary well information shown on log. Permanent well information shown on well construction log.

Acronymns
ATD - At Time of Drilling
ATS - At Time of Sampling

SCREENED WELL CONSTRUCTION FORM

Site Name: Former JB Sims Generating Station
Project Number: 3650220203.02.02

Well ID: MW-40
Location ID: VAS16
Drilling Subcontractor: Job Site Services
Installation Date: 01/31/2023
Drilling Personnel: David Mokma & Jeremiah Chapman
Decon Performed: Yes
Technician Name: Jared Walbert
Drilling Method: Direct Push
Other Amec Foster Wheeler Representatives: None.



Measurement Point (riser) Elevation (ft msl): 586.783

Land Surface Elevation (ft): 582.748

Approximate Diameter of Borehole (in): 3.75

Depth to Water (ft): 3.10
- **During Drilling:** 1.50
  - **Date:** 01/31/2023
- **Post Development:** 1.46
  - **Date:** 02/01/2023

Hydrologic Unit: NA

Water added during drilling (gal): .0
Water removed during development (gal): 10

Top of Bentonite Seal (ft): 0.5

Top of Filter Pack (ft): 1.25

Top of Screen Interval (ft): 1.5

Bottom of Screened Interval (ft): 6.5

Bottom of Filter Pack (ft): 6.5

Bottom of Borehole (ft): 6.5

Protective Casing:
- **Type:** Round Well Monument
- **Dimensions (in):** 4
- **Stickup (ft):** 4
- **Length (ft):** 5
- **Guard Post:** None

Surface Pad:
- **Dimensions:** 12"x12"x6"
- **Type:** Concrete

Annular Seal (grout above well seal):
- **Material:** BENTONITE
- **Installation Method:** Gravity

Bentonite Seal:
- **Manufacturer:** Baroid
- **Material:** BENTONITE 3/8"
- **Type:** Chips
- **Installation Method:** Gravity
- **Hydration time (hrs):** 24

Filter Pack Material:
- **Manufacturer:** K&E
- **Material:** #2 Well Gravel
- **Size:** 0.03
- **Installation Method:** Gravity
- **Surging time:** 0.5

Well Casing (Riser):
- **Manufacturer:** ECT Manufacturing
- **Type/Material:** POLYVINYL CHLORIDE (PVC)
- **Length:** 1.5
- **Diameter (in):** 2

Well Screen:
- **Manufacturer:** Johnson Screens
- **Type/Material:** POLYVINYL CHLORIDE (PVC)
- **Diameter (in):** 2
- **Slot Size (in):** 0.010
- **Slot Type:** Factory Slot

Sump/End Cap: Point

Notes: None

Technician Signature: [signature]

Depths and heights are referenced to ground surface unless specified TOC.
All elevations are referenced to MSL (NAVD 88).

Technician Name (print): Jared Walbert

QA/QC'd by:
QA/QC Date:

GEI Consultants	CLIENT: **Grand Haven Board of Light & Power**	LOG OF BORING NUMBER **PDR-1**
	PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**	ARCHITECT / ENGINEER **Burns & McDonnell**

DEPTH (FT)	ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	LOCATION: DESCRIPTION OF MATERIAL SURFACE ELEVATION (ft.)	PID	○ UNCONFINED COMPRESSIVE STRENGTH TONS/FT^2 1 2 3 4 5; PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) 10 20 30 40 50; ⊗ STANDARD PENETRATION BLOWS/FT 10 20 30 40 50 60
						See CPT Log		
5								
10								
15								
20								
25								
30								

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

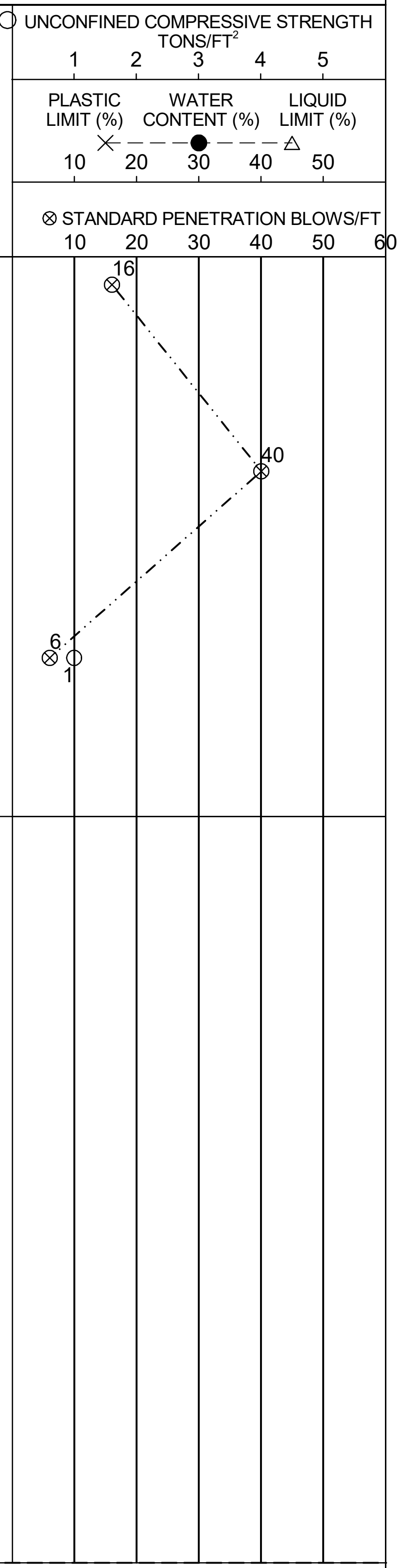
WATER LEVEL: 5.0' ATD	BORING STARTED **4/12/2019**	GEI OFFICE **Lansing, MI**	
	BORING COMPLETED **4/12/2019**	ENTERED BY **D. Elliott**	APPROVED BY
NORTHING EASTING	RIG/FOREMAN **Mobil B57 Track Rig / C. Padar**	GEI PROJECT NO. **1901767**	PAGE NO. **1** OF **3**

GEI Consultants	CLIENT: **Grand Haven Board of Light & Power**	LOG OF BORING NUMBER **PDR-1**
	PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**	ARCHITECT / ENGINEER **Burns & McDonnell**

LOCATION:

SURFACE ELEVATION (ft.)

DEPTH (FT)	ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	PID
35.0		1	SS			35.0 Fine sandy silt - gray - medium dense to dense - wet (ML)	
40		2	SS				
41.5						41.5 Silty clay - gray - stiff (CL)	
45		3	SS				
46.5						46.5 See CPT Log	
50							
55							
60							
65							



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' ATD	BORING STARTED **4/12/2019**	GEI OFFICE **Lansing, MI**	
	BORING COMPLETED **4/12/2019**	ENTERED BY **D. Elliott**	APPROVED BY
NORTHING / EASTING	RIG/FOREMAN **Mobil B57 Track Rig / C. Padar**	GEI PROJECT NO. **1901767**	PAGE NO. **2** OF **3**

GEI Consultants	CLIENT: **Grand Haven Board of Light & Power**	LOG OF BORING NUMBER **PDR-1**
	PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**	ARCHITECT / ENGINEER **Burns & McDonnell**

DEPTH (FT)	ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	LOCATION: DESCRIPTION OF MATERIAL SURFACE ELEVATION (ft.)	PID	UNCONFINED COMPRESSIVE STRENGTH TONS/FT^2 1 2 3 4 5 / PLASTIC LIMIT (%) WATER CONTENT (%) LIQUID LIMIT (%) 10 20 30 40 50 / STANDARD PENETRATION BLOWS/FT 10 20 30 40 50 60
75								
80								
85								
90								
95								
96.3						EOB at 96.3 feet bgs.		
100								

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' ATD	BORING STARTED 4/12/2019	GEI OFFICE Lansing, MI	
	BORING COMPLETED 4/12/2019	ENTERED BY D. Elliott	APPROVED BY
NORTHING EASTING	RIG/FOREMAN Mobil B57 Track Rig / C. Padar	GEI PROJECT NO. 1901767	PAGE NO. 3 OF 3

GEI Consultants

Grand Haven BLP
J.B. Sims Generation Station (Grand Haven,Michigan)

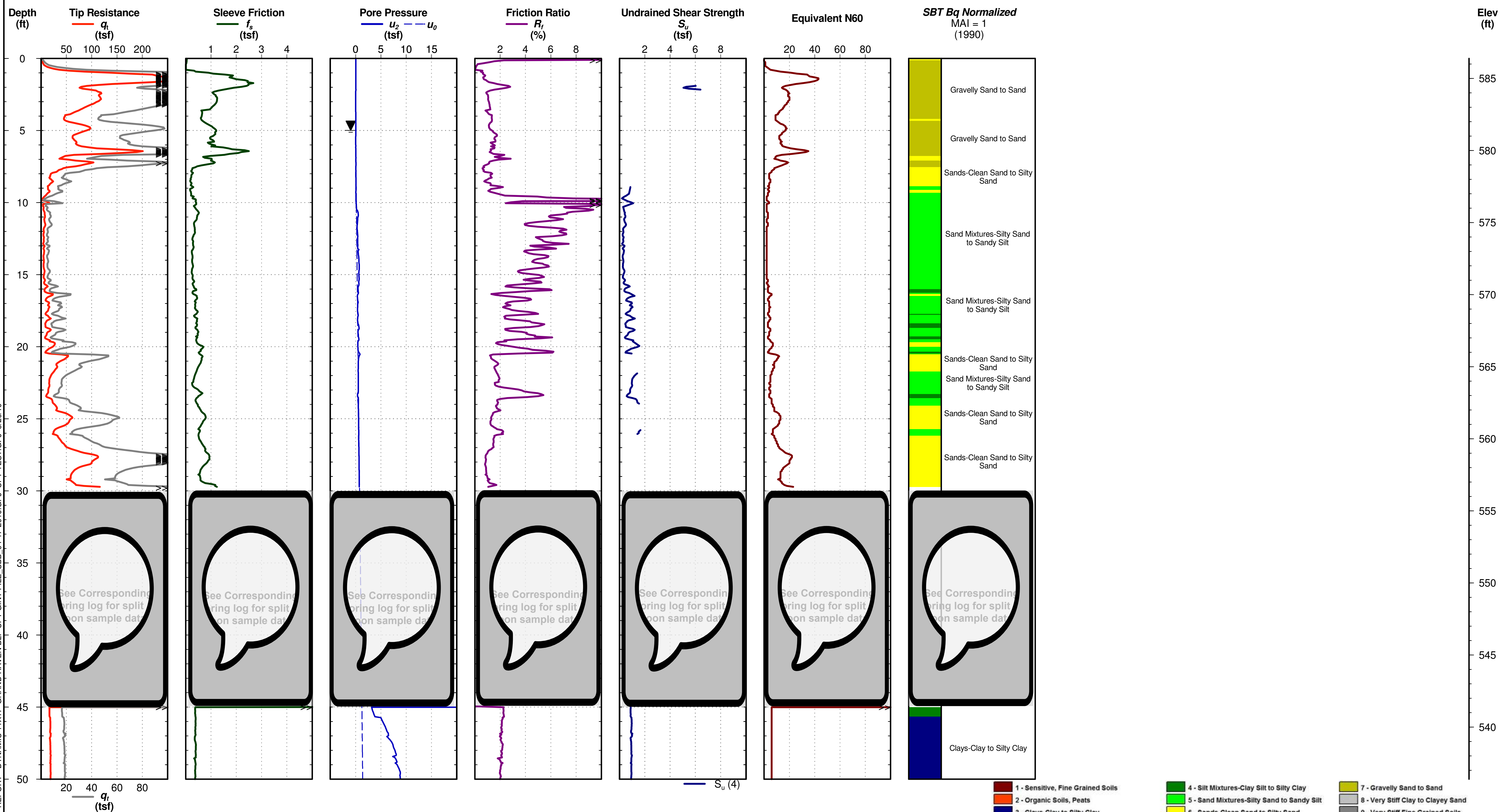
Cone Penetration Test

PDR-1

Date: Apr. 12, 2019 Project No: 1901767
Operator: CAP

Northing: 15645887.4
Easting: 1845035.3
Elevation: 586.4 MSL

Elevation: 586.4
Water Depth: 4.99
Total Depth: 96.3 ft



CPT REPORT - DYNAMIC 11X17 GRAND HAVEN BLP CPT GINT FILE_SBB_04-17-2019.GPJ CPT TEST.GPJ 5/20/19

GEI Consultants

Grand Haven BLP
J.B. Sims Generation Station (Grand Haven,Michigan)

Cone Penetration Test

PDR-1

Date: Apr. 12, 2019 Project No: 1901767
Operator: CAP

Northing: 15645887.4
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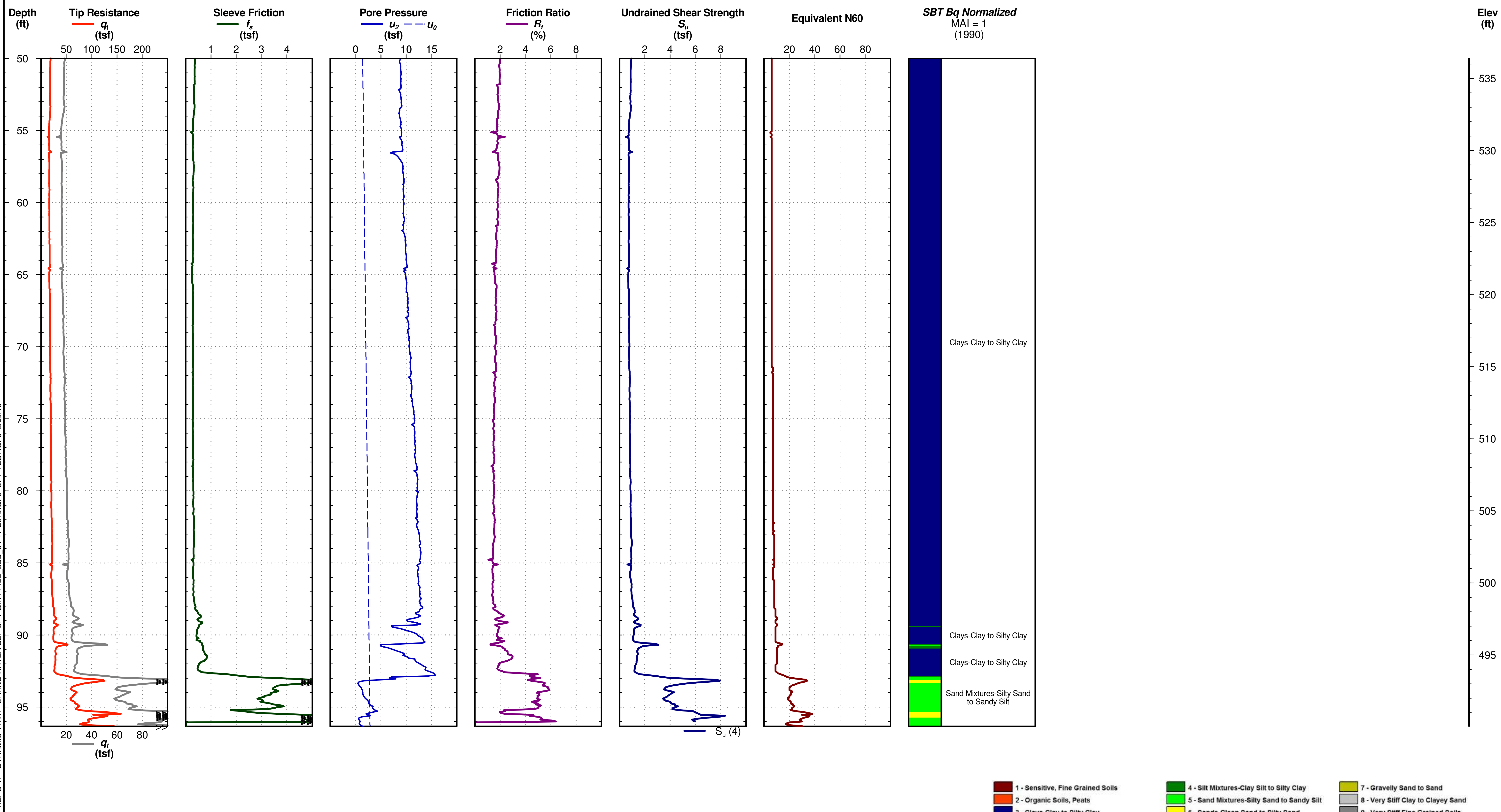
Elevation: 586.4 MSL

Elevation: 586.4
Water Depth: 4.99
Total Depth: 96.3 ft



CPT REPORT - DYNAMIC 11X17 GRAND HAVEN BLP CPT GINT FILE_SBB_04-17-2019.GPJ CPT TEST.GPJ 5/20/19

GEI Consultants	CLIENT: Grand Haven Board of Light & Power	LOG OF BORING NUMBER **PDR-2**
	PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**	ARCHITECT / ENGINEER **Burns & McDonnell**

LOCATION:

SURFACE ELEVATION (ft.)

DEPTH (FT)	ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	PID	UNCONFINED COMPRESSIVE STRENGTH TONS/FT² (1 2 3 4 5) / PLASTIC LIMIT (%) — WATER CONTENT (%) — LIQUID LIMIT (%) (10 20 30 40 50) / STANDARD PENETRATION BLOWS/FT (10 20 30 40 50 60)
0						See CPT Log		
5								
10								
15								
20								
25								
30		1	SS			30.0 Fine sandy silt - gray - extremely dense - wet (ML)		81

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' ATD	BORING STARTED **4/16/2019**	GEI OFFICE **Lansing, MI**	
	BORING COMPLETED **4/16/2019**	ENTERED BY **D. Elliott**	APPROVED BY
NORTHING / EASTING	RIG/FOREMAN **Mobil B57 Track Rig / C. Padar**	GEI PROJECT NO. **1901767**	PAGE NO. **1** OF **3**

MIDWEST BORING LOG - WIGTH PID 1901767 GRAND HAVEN.GPJ GEI DATA TEMPLATE.GDT 4/30/19

GEI Consultants	CLIENT: **Grand Haven Board of Light & Power**	LOG OF BORING NUMBER **PDR-2**
	PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**	ARCHITECT / ENGINEER **Burns & McDonnell**

LOCATION:

SURFACE ELEVATION (ft.)

DEPTH (FT)	ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	PID	STANDARD PENETRATION BLOWS/FT
35		2	SS					95
40		3	SS					65
45		4	SS					82
46.5						46.5 Silty clay - gray - stiff (CL)		
50		5	SS					19
51.5						51.5 See CPT Log		
55								
60								
65								

UNCONFINED COMPRESSIVE STRENGTH TONS/FT^2: 1 2 3 4 5

PLASTIC LIMIT (%) — WATER CONTENT (%) — LIQUID LIMIT (%): 10 20 30 40 50

STANDARD PENETRATION BLOWS/FT: 10 20 30 40 50 60

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' ATD		BORING STARTED **4/16/2019**	GEI OFFICE **Lansing, MI**
		BORING COMPLETED **4/16/2019**	ENTERED BY **D. Elliott** / APPROVED BY
NORTHING	EASTING	RIG/FOREMAN **Mobil B57 Track Rig / C. Padar**	GEI PROJECT NO. **1901767** / PAGE NO. **2** OF **3**

GEI Consultants	CLIENT: **Grand Haven Board of Light & Power**	LOG OF BORING NUMBER **PDR-2**
	PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**	ARCHITECT / ENGINEER **Burns & McDonnell**

DEPTH (FT)	ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	LOCATION: / DESCRIPTION OF MATERIAL / SURFACE ELEVATION (ft.)	PID	UNCONFINED COMPRESSIVE STRENGTH TONS/FT² (1 2 3 4 5); PLASTIC LIMIT (%) / WATER CONTENT (%) / LIQUID LIMIT (%) (10 20 30 40 50); STANDARD PENETRATION BLOWS/FT (10 20 30 40 50 60)
75								
80								
85								
90								
95								
97.2						EOB at 97.2 feet bgs.		
100								

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' ATD		BORING STARTED **4/16/2019**	GEI OFFICE **Lansing, MI**
		BORING COMPLETED **4/16/2019**	ENTERED BY **D. Elliott** / APPROVED BY
NORTHING	EASTING	RIG/FOREMAN **Mobil B57 Track Rig / C. Padar**	GEI PROJECT NO. **1901767** / PAGE NO. **3** OF **3**

MIDWEST BORING LOG - WIGTH PID 1901767 GRAND HAVEN.GPJ GEI DATA TEMPLATE.GDT 4/30/19

Grand Haven BLP
J.B. Sims Generation Station (Grand Haven,Michigan)

GEI Consultants

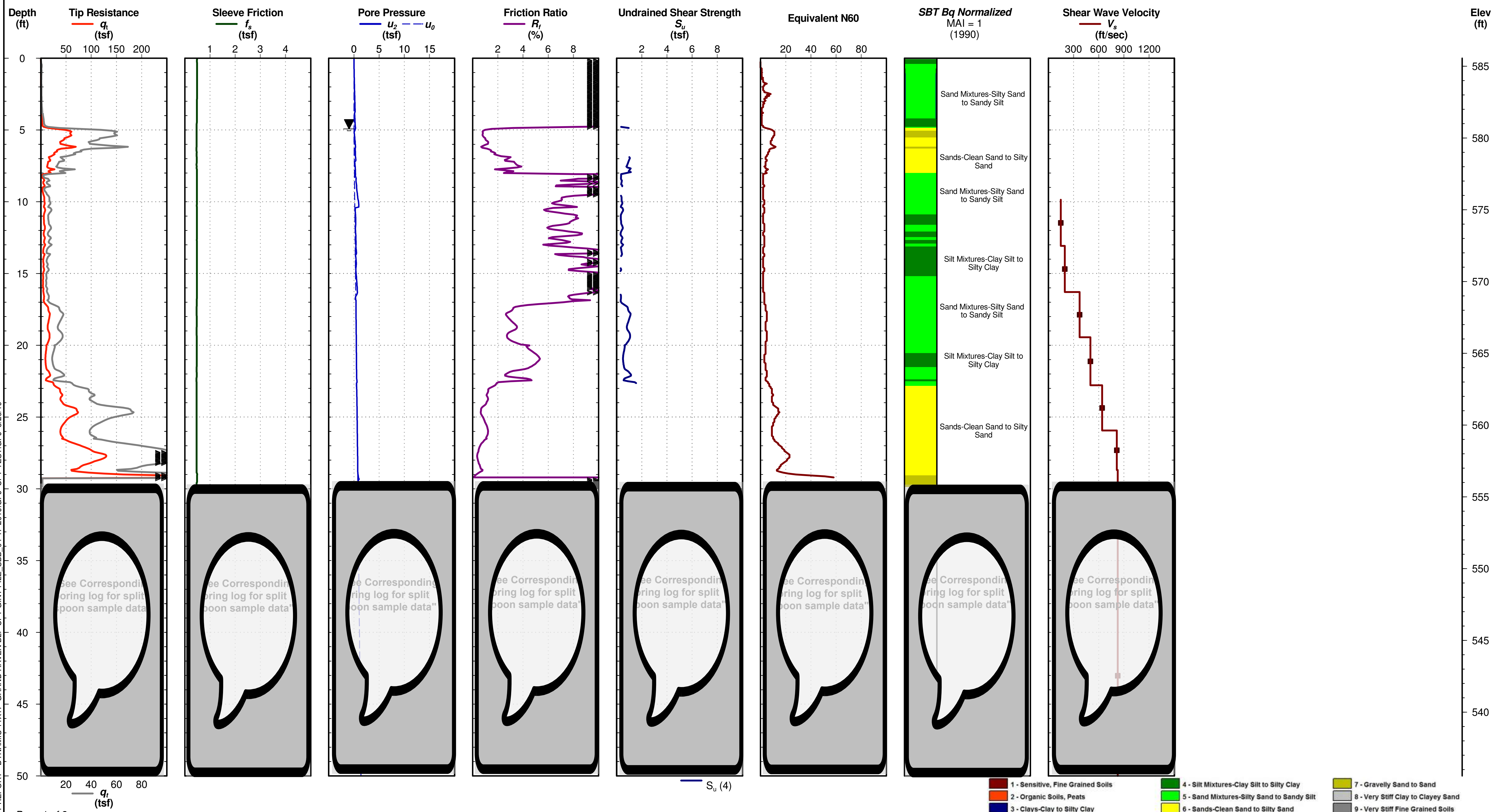
Cone Penetration Test

PDR-2

Date: Apr. 16, 2019 Project No: 1901767
Operator: CAP

Northing: 15646166.0
Easting: 1845094.9
Elevation: 585.6 MSL

Elevation: 585.6
Water Depth: 4.92
Total Depth: 97.2 ft



CPT REPORT - DYNAMIC 11X17 GRAND HAVEN BLP CPT GINT FILE_SBB_04-17-2019.GPJ CPT TEST.GPJ 5/20/19

Grand Haven BLP
J.B. Sims Generation Station (Grand Haven,Michigan)

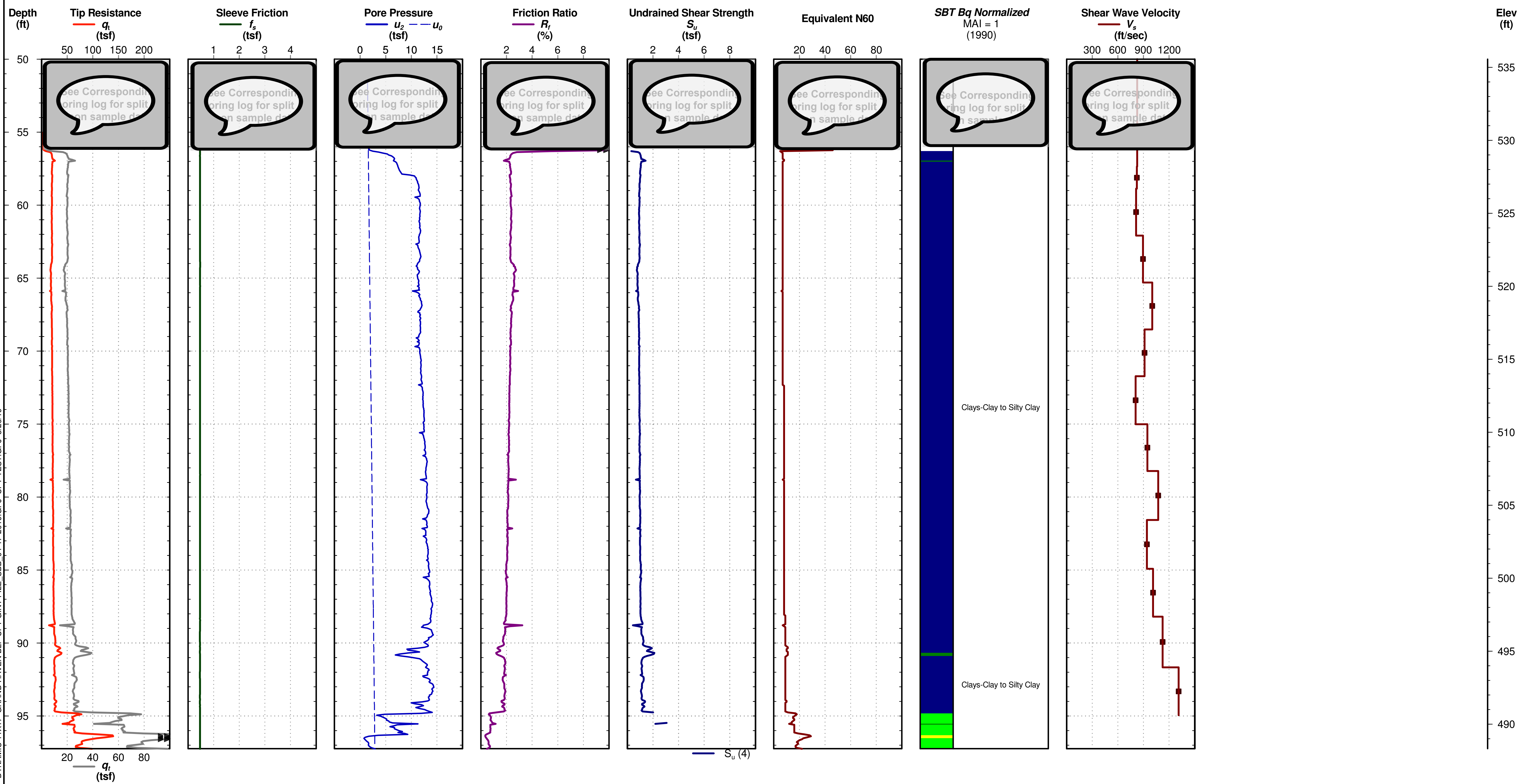
Cone Penetration Test

PDR-2

Date: Apr. 16, 2019 Project No: 1901767
Operator: CAP

Northing: 15646166.0
Easting: 1845094.9
Elevation: 585.6 MSL

Elevation: 585.6
Water Depth: 4.92
Total Depth: 97.2 ft



GEI Consultants

CLIENT: **Grand Haven Board of Light & Power**

LOG OF BORING NUMBER **PDR-3**

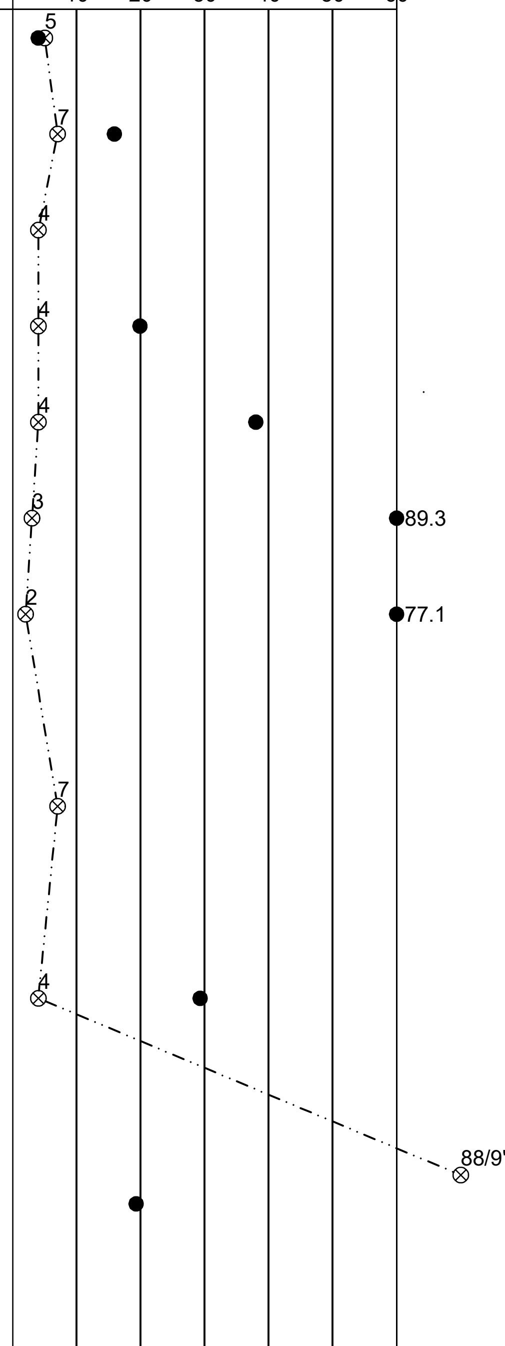
PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**

ARCHITECT / ENGINEER: **Burns & McDonnell**

LOCATION:

SURFACE ELEVATION (ft.)

DEPTH (FT)	ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	DESCRIPTION OF MATERIAL	PID
0		1	SS	Fill: Fine to medium sand, trace to some fine gravel, trace silt and coarse sand - brown - loose - moist to wet (SP)	
		2	SS		
5		3	SS		
		4	SS		
10		5	SS	10.0 Possible Fill: Fine to medium sand, some organic silt and fine gravel, occasional glass pieces - dark gray to black - loose to very loose - wet (SM/OL)	85.1
		6	SS		
15		7	SS		
20		8	SS	20.0 Fine sand - trace silt, coarse sand and fine gravel - gray - loose to extremely dense - wet (SP)	
25		9	SS		
30		10A	SS		
		10B	SS	30.5 Silty fine sand - trace medium to coarse sand and fine gravel - gray - medium dense to extremely dense - wet (SM)	



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

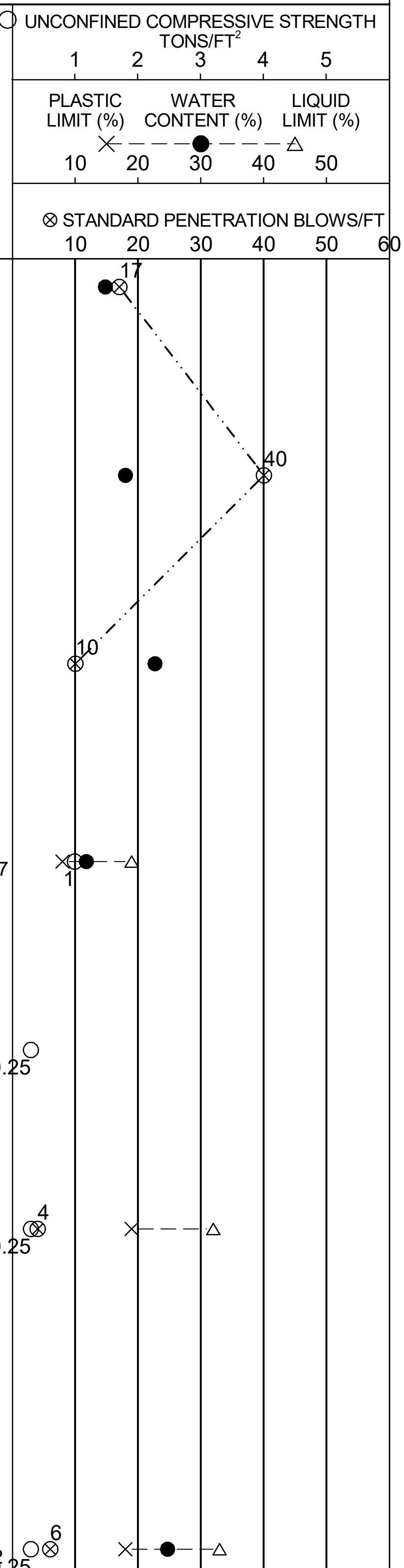
WATER LEVEL: 5.0' ATD		BORING STARTED **4/8/2019**	GEI OFFICE **Lansing, MI**
		BORING COMPLETED **4/10/2019**	ENTERED BY **D. Elliott** / APPROVED BY
NORTHING	EASTING	RIG/FOREMAN **Mobil B57 Track Rig / C. Padar**	GEI PROJECT NO. **1901767** / PAGE NO. **1** OF **5**

GEI Consultants	CLIENT: **Grand Haven Board of Light & Power**	LOG OF BORING NUMBER **PDR-3**
	PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**	ARCHITECT / ENGINEER **Burns & McDonnell**

LOCATION:

SURFACE ELEVATION (ft.)

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	DESCRIPTION OF MATERIAL	PID
	11	SS		
40	12	SS		
45	13	SS		
			48.0 Slity clay - gray - stiff (CL) Pc = 3.1 tsf, Cc = 0.149, Ccr = 0.029	
50	14	ST		122.7
55	15	ST	55.0 Silty clay - some fine sand - trace medium sand - gray - very soft (CL)	0.25
60	16	SS		0.25
65				
	17	SS		98.2 0.25



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

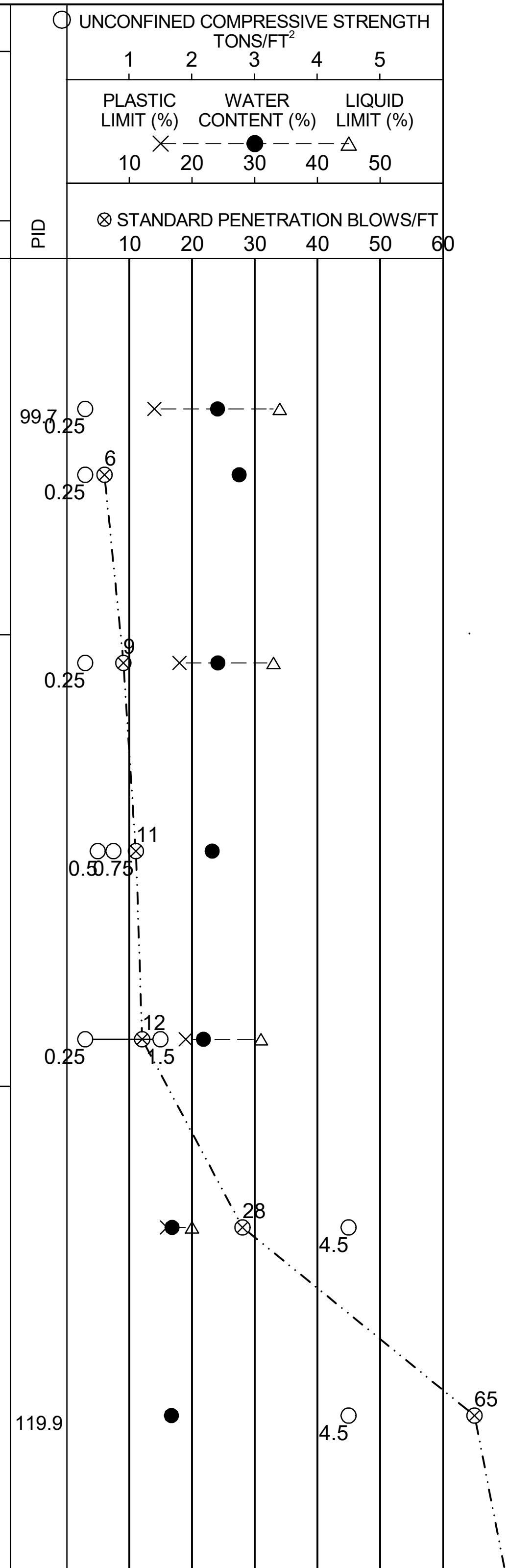
WATER LEVEL: 5.0' ATD	BORING STARTED **4/8/2019**	GEI OFFICE **Lansing, MI**	
	BORING COMPLETED **4/10/2019**	ENTERED BY **D. Elliott**	APPROVED BY
NORTHING / EASTING	RIG/FOREMAN **Mobil B57 Track Rig / C. Padar**	GEI PROJECT NO. **1901767**	PAGE NO. **2** OF **5**

GEI Consultants	CLIENT: **Grand Haven Board of Light & Power**	LOG OF BORING NUMBER **PDR-3**
	PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**	ARCHITECT / ENGINEER **Burns & McDonnell**

LOCATION:

SURFACE ELEVATION (ft.)

DEPTH (FT)	ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	DESCRIPTION OF MATERIAL	PID
		18	ST	Unconsolidated-Undrained Triaxial Compression: c = 0.6 tsf	99.7
75		19	SS		
80		20	SS	80.0 Silty clay - trace fine sand - gray - soft to stiff (CL)	
85		21	SS		
90		22	SS		
				92.0 Silty clay - some fine sand - trace medium to coarse sand - gray - hard to very stiff (CL-ML)	
95		23	SS		
100		24	SS		119.9



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

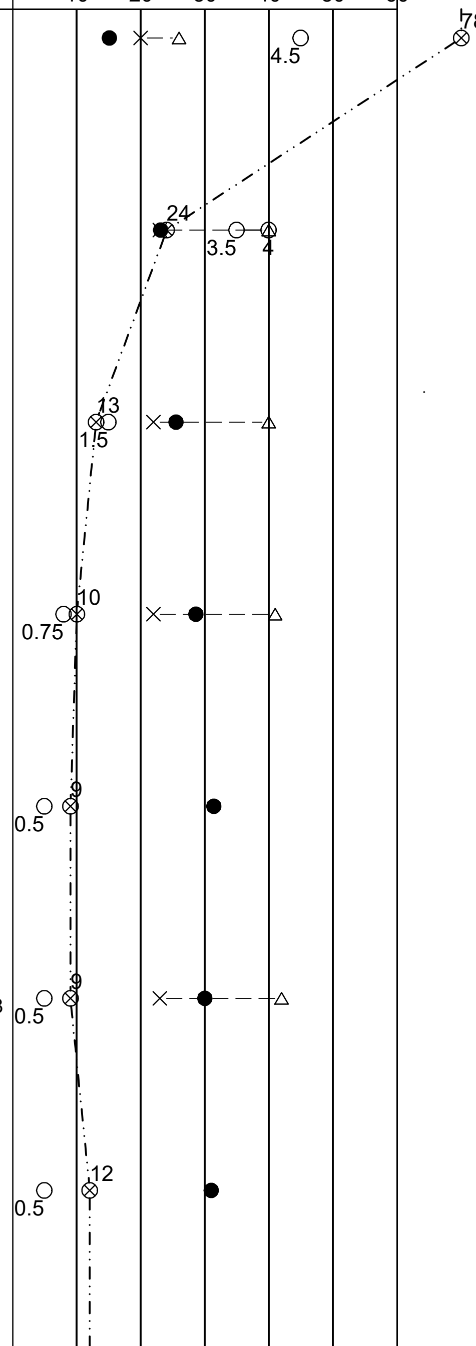
WATER LEVEL: 5.0' ATD	BORING STARTED **4/8/2019**	GEI OFFICE **Lansing, MI**	
	BORING COMPLETED **4/10/2019**	ENTERED BY **D. Elliott**	APPROVED BY
NORTHING EASTING	RIG/FOREMAN **Mobil B57 Track Rig / C. Padar**	GEI PROJECT NO. **1901767**	PAGE NO. **3** OF **5**

GEI Consultants	CLIENT: **Grand Haven Board of Light & Power**	LOG OF BORING NUMBER **PDR-3**
	PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**	ARCHITECT / ENGINEER **Burns & McDonnell**

LOCATION:

SURFACE ELEVATION (ft.)

DEPTH (FT)	ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	PID
		25	SS				
110		26	SS			109.0 Silty clay - some fine sand - trace medium sand - gray (CL)	
115		27	SS			114.0 Silty clay - trace fine sand - gray - stiff to medium (CL)	
120		28	SS				
125		29	SS				
130		30	SS				93.8
135		31	SS				



The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' ATD	BORING STARTED **4/8/2019**	GEI OFFICE **Lansing, MI**
	BORING COMPLETED **4/10/2019**	ENTERED BY **D. Elliott** / APPROVED BY
NORTHING / EASTING	RIG/FOREMAN **Mobil B57 Track Rig / C. Padar**	GEI PROJECT NO. **1901767** / PAGE NO. **4** OF **5**

MIDWEST BORING LOG - WIGTH PID 1901767 GRAND HAVEN.GPJ GEI DATA TEMPLATE.GDT 4/30/19

GEI Consultants	CLIENT: **Grand Haven Board of Light & Power**	LOG OF BORING NUMBER **PDR-3**
	PROJECT NAME: **Grand Haven BLP Geotechnical Exploration**	ARCHITECT / ENGINEER **Burns & McDonnell**

LOCATION:

SURFACE ELEVATION (ft.)

DEPTH (FT)	ELEVATION (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE	RECOVERY	DESCRIPTION OF MATERIAL	PID	UNCONFINED COMPRESSIVE STRENGTH TONS/FT²	PLASTIC LIMIT (%) / WATER CONTENT (%) / LIQUID LIMIT (%)	STANDARD PENETRATION BLOWS/FT
		32	SS					0.5		12
145		33	SS					0.5		8
150		34	SS							13
						151.5 End of Boring @ 151.5 feet below ground surface. Borehole tremie grouted to surface.				
155										
160										
165										
170										

The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.

WATER LEVEL: 5.0' ATD		BORING STARTED **4/8/2019**	GEI OFFICE **Lansing, MI**	
		BORING COMPLETED **4/10/2019**	ENTERED BY **D. Elliott**	APPROVED BY
NORTHING	EASTING	RIG/FOREMAN **Mobil B57 Track Rig / C. Padar**	GEI PROJECT NO. **1901767**	PAGE NO. **5** OF **5**

MIDWEST BORING LOG - WIGTH PID 1901767 GRAND HAVEN.GPJ GEI DATA TEMPLATE.GDT 4/30/19

GEI Consultants

Grand Haven BLP
J.B. Sims Generation Station (Grand Haven,Michigan)

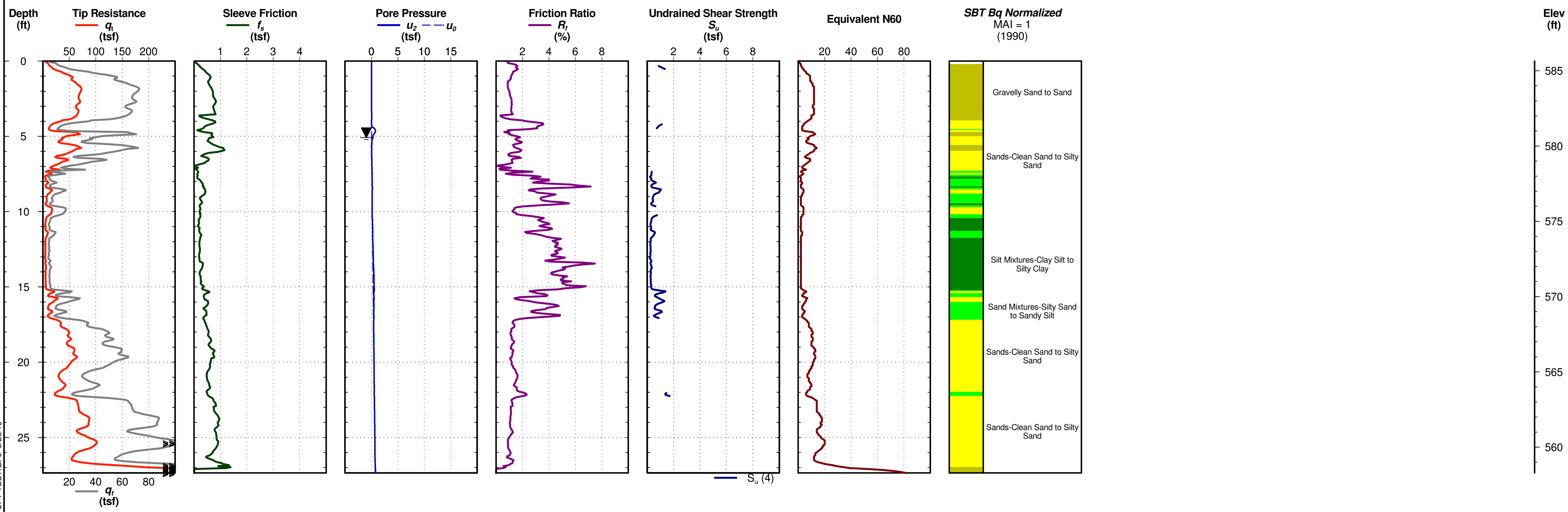
Date: Apr. 11, 2019 Project No: 1901767
Operator: CAP

Cone Penetration Test

Northing: 15645780.8
Easting: 1845173.9
Elevation: 585.6 MSL

PDR-5

Elevation: 585.6
Water Depth: 5.09
Total Depth: 27.4 ft



1 - Sensitive, Fine Grained Soils
2 - Organic Soils, Peats
3 - Clays-Clay to Silty Clay
4 - Silt Mixtures-Clay Silt to Silty Clay
5 - Sand Mixtures-Silty Sand to Sandy Silt
6 - Sands-Clean Sand to Silty Sand
7 - Gravelly Sand to Sand
8 - Very Stiff Clay to Clayey Sand
9 - Very Stiff Fine Grained Soils

RECORD OF BOREHOLE: SB-05

CLIENT:	Grand Haven Board of Light & Power	DATE:	September 02, 2021	ELEVATION:	581.4 ft (Ground)
PROJECT:	GHBLP Coal Removal			COORDINATES:	N: 577416.9 ft E: 12624683.4 ft
PROJECT NO:	21451440			COORD SYS:	SP MI South FIPS 2113 Ft
LOCATION:	Grand Haven, MI	CONTRACTOR:	MATECO Drilling	HORZ DATUM:	NAD83

DRILL RIG: Marsh Master Geoprobe

DRILL METHOD: Direct Push - 4-in Hole Dia.

DESCRIPTION (MATERIAL PROFILE)	USCS	ELEV. / DEPTH (ft)	SAMPLE NUMBER	TYPE	REC %	BLOWS	N-VALUE	GROUNDWATER OBSERVATIONS	ADDITIONAL OBSERVATIONS
Brown CLAY, moist, soft, no coal observed.	CL	0.0							
Brown fine SAND, wet, loose, trace gravel, no coal observed.	SP	581.1 / 0.3	1	5' Tube	46				
Black clayey SAND, wet, loose, glass present, no coal observed.	SP-SC	577.4 / 4.0							
Dark gray sandy PEAT, moist, soft to firm, no coal observed.	PT	576.2 / 5.2	2	5' Tube	44				
Gray fine SAND, wet, loose, no coal observed.	SP	572.3 / 9.1							
End of hole at 10.0 ft.		571.4							

No coal observed in borehole.

HAMMER TYPE: Automatic Historic

REV: 0

GOLDER
MEMBER OF WSP

LOGGED: Parker Sutton DATE: Sep 02, 2021

CHECKED: Kurtis Van Appledorn DATE: Nov 01, 2021

ERM

3352 128th Avenue
Holland, MI 49424
P: 616-399-3500

PROJECT:
Grand Haven Board of Light and Power
Ash Residual Delineation Sampling
1231 N. 3rd Street
Grand Haven, MI

BORING # **SB-03**
ERM PROJECT # 0318810
SHEET 1 OF 1

DRILLING CONTRACTOR	Mateco Rockford, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN		OFFICE LOCATION	Holland
DRILLING METHOD		DATE: START	10/07/2015
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	10/07/2015
HORIZONTAL DATUM		BOREHOLE DEPTH	10 ft
NORTHING		BOREHOLE DIAMETER	3.25 in
EASTING		DEPTH TO WATER (INITIAL) ▼	
VERTICAL DATUM	ELEVATION 99.86 ft	DEPTH TO WATER (FINAL) ▽	

STRATA DESCRIPTION	DEPTH	USCS	SAMPLE TYPE	RECOVERY		Observations / Remarks
GRAVELLY SAND (SW) well graded, fine to medium grained SAND; fine to medium grained GRAVEL; loose, some gravel, some silt, moist, brown to dark grayish brown, [Non-ash bearing.]		SW				
(SP) loose, moist, dark gray to black, [Bottom ash.]	2.75	SP				
SAND (SW) well graded, fine to medium grained SAND; loose, moist to wet, dark gray to black, [Trash dump debris. Trace bottom ash, gravel, silt, wood fragments, ceramic, plastic. Some glass]	3.25	SW				
SANDY SILT (ML) soft, little gravel, trace roots, moist, dark brown to grayish brown, [Loam. Trace glass.]	9	ML				
	10					

Depth scale: 2, 4, 6, 8, 10, 12, 14
Elevation scale: 95, 90, 85

REMARKS:

LAB ANALYSIS:

ERM

3352 128th Avenue
Holland, MI 49424
P: 616-399-3500

PROJECT:
Grand Haven Board of Light and Power
Ash Residual Delineation Sampling
1231 N. 3rd Street
Grand Haven, MI

BORING # **SB-03 70'W**

ERM PROJECT # 0318810

SHEET 1 OF 1

DRILLING CONTRACTOR	Mateco Rockford, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN		OFFICE LOCATION	Holland
DRILLING METHOD		DATE: START	10/07/2015
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	10/07/2015
HORIZONTAL DATUM		BOREHOLE DEPTH	10 ft
NORTHING		BOREHOLE DIAMETER	3.25 in
EASTING		DEPTH TO WATER (INITIAL) ▼	
VERTICAL DATUM	ELEVATION 99.71 ft	DEPTH TO WATER (FINAL) ▽	

STRATA DESCRIPTION	DEPTH	USCS	SAMPLE TYPE	RECOVERY		Observations / Remarks
	0–1.5					Road base.
SAND (SP) poorly graded, subangular, medium to coarse grained SAND; loose, moist, dark gray to black, [Bottom ash.]	1.5	SP				
(GW) very loose	3.25	GW				Pea gravel
GRAVELLY SAND (SW) well graded, fine grained SAND; fine to medium grained GRAVEL; loose, dark brown to grayish brown, [Trace bottom ash, some glass.]	3.5	SW				
SAND (SP) poorly graded, subangular, medium to coarse grained SAND; loose, moist, dark gray to black, [Bottom ash.]	5.5	SP				
SILTY SAND (SW) well graded, fine grained SAND; loose, moist, dark brown to dark gray	7	SW				
SAND (SP) poorly graded, fine grained SAND; loose, trace silt, moist to wet, dark brown to gray, [Wet @ 8.5'.]	8	SP				
	10					

Depth scale: 2, 4, 6, 8, 10, 12, 14. Elevation scale: 95, 90, 85.

REMARKS:

LAB ANALYSIS:

ERM

3352 128th Avenue
Holland, MI 49424
P: 616-399-3500

PROJECT:
Grand Haven Board of Light and Power
Ash Residual Delineation Sampling
1231 N. 3rd Street
Grand Haven, MI

BORING # **SB-06**

ERM PROJECT # 0318810

SHEET 1 OF 1

DRILLING CONTRACTOR	Mateco Rockford, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN		OFFICE LOCATION	Holland
DRILLING METHOD		DATE: START	10/05/2015
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	10/05/2015
HORIZONTAL DATUM		BOREHOLE DEPTH	10 ft
NORTHING		BOREHOLE DIAMETER	3.25 in
EASTING		DEPTH TO WATER (INITIAL) ▼	
VERTICAL DATUM	ELEVATION 96.87 ft	DEPTH TO WATER (FINAL) ▽	

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	SAMPLE TYPE	RECOVERY		Observations / Remarks
0–2		SILTY SAND (SW) fine grained SAND; loose, dry, dark gray to black	2	SW					
2	95	SAND (SW) fine grained SAND; loose, trace gravel, trace clay, moist, dark gray to gray	3	SW					
		SAND (SW) fine grained SAND; loose, trace gravel, moist to wet, dark gray to black, [Low density sand. Wet @ 3.5' bg.]	4	SW					
4		GRAVELLY SAND (SW) angular, coarse grained SAND; very loose, wet, dark gray to black, [Bottom ash.]	5.5	SW					
		SAND (SW) loose, trace silt, trace clay, some wood; moist, dark gray to black, [Organic odor. Trash dump debris.]	6	SW					
6	90	SANDY SILT (ML) soft, trace clay, some wood, moist, grayish brown to dark brown, [Organic odor. Trash dump debris.]	8	ML					
8		SAND (SW) fine grained SAND; loose, wet, gray to light gray	10	SW					
10									
12	85								
14									

REMARKS:

LAB ANALYSIS:

ERM 3352 128th Avenue Holland, MI 49424 P: 616-399-3500	PROJECT: Grand Haven Board of Light and Power Ash Residual Delineation Sampling 1231 N. 3rd Street Grand Haven, MI	BORING # **SB-07** ERM PROJECT # 0318810 SHEET 1 OF 1

DRILLING CONTRACTOR	Mateco Rockford, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN		OFFICE LOCATION	Holland
DRILLING METHOD		DATE: START	10/05/2015
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	10/05/2015
HORIZONTAL DATUM		BOREHOLE DEPTH	10 ft
NORTHING		BOREHOLE DIAMETER	3.25 in
EASTING		DEPTH TO WATER (INITIAL) ▼	
VERTICAL DATUM	ELEVATION 98.33 ft	DEPTH TO WATER (FINAL) ▽	

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	SAMPLE TYPE	RECOVERY		Observations / Remarks
		SAND (SW) fine grained SAND; loose, trace construction debris, dry, dark gray to black		SW					
2		GRAVELLY SAND (SW) fine grained SAND; loose, dry, dark grayish brown	1.5	SW					
		SAND (SW) fine grained SAND; loose, trace construction debris, dry, dark gray to black	2.5	SW					
4, 6	95	SILTY SAND (SW-SM) fine grained SAND; loose, trace clay, dry, brown to light brown	3	SW-SM					
		GRAVELLY SAND (SW) fine to coarse grained SAND; loose, wet, dark gray to black, [Petroleum odors and sheen observed. Glass Fragments present. Trash dump debris.]	7	SW					
8	90	SAND (SP) fine grained SAND; loose, trace gravel, some wood, wet, dark gray to black, [Petroleum odors noted. Trash dump debris.]	7.5	SP					
		SANDY SILT (ML) soft, trace clay, dark brown, [Loam.]	8.5	ML					
		SAND (SP) fine grained SAND; loose, wet, dark grayish brown	9.5	SP					
10			10						
12									
14	85								

Sampling data columns header: SAMPLING DATA

REMARKS:

LAB ANALYSIS:

BORING LOG GHBLP 0318810.GPJ ERM DATA TEMPLATE.GDT 2/5/16

ERM 3352 128th Avenue Holland, MI 49424 P: 616-399-3500	PROJECT: Grand Haven Board of Light and Power Ash Residual Delineation Sampling 1231 N. 3rd Street Grand Haven, MI	BORING # **SB-08** ERM PROJECT # 0318810 SHEET 1 OF 1

DRILLING CONTRACTOR	Mateco Rockford, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN		OFFICE LOCATION	Holland
DRILLING METHOD		DATE: START	10/05/2015
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	10/05/2015
HORIZONTAL DATUM		BOREHOLE DEPTH	10 ft
NORTHING		BOREHOLE DIAMETER	3.25 in
EASTING		DEPTH TO WATER (INITIAL) ▼	
VERTICAL DATUM	ELEVATION 97.59 ft	DEPTH TO WATER (FINAL) ▽	

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	SAMPLE TYPE	RECOVERY		Observations / Remarks
0–3		SAND (SW) fine grained SAND; loose, dry to moist, dark gray to black	3	SW					
3–6.5		SAND (SP) coarse grained SAND; very loose, moist to wet, dark gray to black, [Bottom ash. Wet @ 3.5' bg.]	6.5	SP					
6.5–8		SANDY SILT (ML) soft, some peat, moist, dark grayish brown to dark brown, [Strong organic odors noted. Loam.]	8	ML					
8–10		SAND (SP) fine grained SAND; loose, moist to wet, gray to light gray, [Trace shells noted.]	10	SP					

Depth scale: 2, 4, 6, 8, 10, 12, 14. Elevation scale: 95, 90, 85.

REMARKS:

LAB ANALYSIS:

ERM
3352 128th Avenue
Holland, MI 49424
P: 616-399-3500

PROJECT:
Grand Haven Board of Light and Power
Ash Residual Delineation Sampling
1231 N. 3rd Street
Grand Haven, MI

BORING # **SB-12**
ERM PROJECT # 0318810

DRILLING CONTRACTOR	Mateco Rockford, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN		OFFICE LOCATION	Holland
DRILLING METHOD		DATE: START	10/06/2015
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	10/06/2015
HORIZONTAL DATUM		BOREHOLE DEPTH	10 ft
NORTHING		BOREHOLE DIAMETER	3.25 in
EASTING		DEPTH TO WATER (INITIAL) ▼	
VERTICAL DATUM	ELEVATION 98.2 ft	DEPTH TO WATER (FINAL) ▽	

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	SAMPLE TYPE (SAMPLING DATA)	RECOVERY		Observations / Remarks
		SILTY SAND (SW-SM) fine grained SAND; loose, trace gravel, moist, light gray to black	1	SW-SM					
2		SANDY SILT (ML) soft, trace gravel, some roots, some wood; moist, grayish black to dark brown	2	ML					
	95	GRAVELLY SAND (SW) angular, medium to coarse grained SAND; loose, moist, dark gray to black, [Bottom ash. Trace glass.]	3.5	SW					
4, 6, 8	90	SAND (SW) fine grained SAND; loose, moist to wet, dark gray to black, [Trash dump debris: glass, brick, concrete. Wet @ 5.5' bg.]	8	SW					
10		SANDY SILT (ML) soft, some clay, trace wood, moist, dark grayish brown	10	ML					
12	85								
14									

REMARKS:

LAB ANALYSIS:

ERM 3352 128th Avenue Holland, MI 49424 P: 616-399-3500	PROJECT: Grand Haven Board of Light and Power Ash Residual Delineation Sampling 1231 N. 3rd Street Grand Haven, MI	BORING # **SB-14** ERM PROJECT # 0318810 SHEET 1 OF 1

DRILLING CONTRACTOR	Mateco Rockford, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN		OFFICE LOCATION	Holland
DRILLING METHOD		DATE: START	10/06/2015
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	10/06/2015
HORIZONTAL DATUM		BOREHOLE DEPTH	10 ft
NORTHING		BOREHOLE DIAMETER	3.25 in
EASTING		DEPTH TO WATER (INITIAL) ▼	
VERTICAL DATUM	ELEVATION 95.79 ft	DEPTH TO WATER (FINAL) ▽	

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	SAMPLE TYPE	RECOVERY		Observations / Remarks
	95	SILTY SAND (SW) well graded, fine grained SAND; loose, moist, dark brown to brown, [Trace glass.]	1	SW					
2		SAND (SW) well graded, fine grained SAND; hard, moist to wet, dark gray to black, [Trash dump debris; glass, gravel.]	2.5	SW					
		CLAY medium stiff, trace silt, moist, brown	3						
4		GRAVELLY SAND (SW) well graded, coarse grained SAND; loose, little fine sand, some wood, wet, dark gray to black, [Trash dump debris; concrete, wood.]	5	SW					
6	90	SANDY SILT (ML) soft, some roots, moist, dark brown to brown	6.5	ML					
8		SAND (SP) poorly graded, fine grained SAND; loose, wet, gray, [Shells present.]	10	SP					
10									
12	85								
14									

REMARKS:

LAB ANALYSIS:

3352 128th Avenue
Holland, MI 49424
P: 616-399-3500

PROJECT:
Grand Haven Board of Light and Power
Ash Residual Delineation Sampling
1231 N. 3rd Street
Grand Haven, MI

BORING # **SB-15**
ERM PROJECT # 0318810
SHEET 1 OF 1

DRILLING CONTRACTOR	Mateco Rockford, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN		OFFICE LOCATION	Holland
DRILLING METHOD		DATE: START	10/07/2015
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	10/07/2015
HORIZONTAL DATUM		BOREHOLE DEPTH	10 ft
NORTHING		BOREHOLE DIAMETER	3.25 in
EASTING		DEPTH TO WATER (INITIAL) ▼	
VERTICAL DATUM	ELEVATION	DEPTH TO WATER (FINAL) ▽	

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	SAMPLE TYPE	RECOVERY		Observations / Remarks
0–2		SANDY SILT (ML) soft, some wood, some roots, moist, dark brown to brown, [Organic rich.]		ML					
2		SAND (SP) poorly graded, fine grained SAND; loose, wet, gray to dark gray, [Non ash bearing.]	2	SP					
		SAND (SW) angular, medium to coarse grained SAND; loose, wet, dark gray to black, [Bottom ash.]	2.5	SW					
4									
		SANDY SILT (ML) soft, wet, dark brown to brown	5	ML					
6		SAND (SP) poorly graded, fine grained SAND; loose, trace silt, trace clay, wet, gray	6	SP					
8									
10			10						
12									
14									

SAMPLING DATA

REMARKS:

LAB ANALYSIS:

ERM 3352 128th Avenue Holland, MI 49424 P: 616-399-3500	PROJECT: Grand Haven Board of Light and Power Ash Residual Delineation Sampling 1231 N. 3rd Street Grand Haven, MI	BORING # **SB-16** ERM PROJECT # 0318810 SHEET 1 OF 1

DRILLING CONTRACTOR	Mateco Rockford, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN		OFFICE LOCATION	Holland
DRILLING METHOD		DATE: START	10/07/2015
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	10/07/2015
HORIZONTAL DATUM		BOREHOLE DEPTH	10 ft
NORTHING		BOREHOLE DIAMETER	3.25 in
EASTING		DEPTH TO WATER (INITIAL) ▼	
VERTICAL DATUM	ELEVATION	DEPTH TO WATER (FINAL) ▽	

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	SAMPLE TYPE	RECOVERY		Observations / Remarks
0–1		SAND (SP) fine grained SAND; loose, moist, dark gray to black, [Non ash bearing.]	1	SP					
1–8		SAND (SW) angular, coarse grained SAND; loose, wet, dark gray to black, [Bottom ash.]	8	SW					
8–10		SAND (SP) poorly graded, fine grained SAND; loose, wet, gray	10	SP					

Depth scale: 2, 4, 6, 8, 10, 12, 14

REMARKS:

LAB ANALYSIS:

ERM
3352 128th Avenue
Holland, MI 49424
P: 616-399-3500

PROJECT:
Grand Haven Board of Light and Power
Ash Residual Delineation Sampling
1231 N. 3rd Street
Grand Haven, MI

BORING # **SB-17**
ERM PROJECT # 0318810

DRILLING CONTRACTOR	Mateco Rockford, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN		OFFICE LOCATION	Holland
DRILLING METHOD		DATE: START	10/06/2015
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	10/06/2015
HORIZONTAL DATUM		BOREHOLE DEPTH	10 ft
NORTHING		BOREHOLE DIAMETER	3.25 in
EASTING		DEPTH TO WATER (INITIAL) ▼	
VERTICAL DATUM	ELEVATION 96.91 ft	DEPTH TO WATER (FINAL) ▽	

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	SAMPLE TYPE	RECOVERY		Observations / Remarks
0–2		SAND (SP) poorly graded, fine grained SAND; loose, dry to moist, brown to light brown, [Non ash bearing.]		SP					
2	95	SAND (SW) well graded, fine grained SAND; loose, some wood, some silt, trace gravel; moist to wet, brown to dark brown, [Wet @ 3'. Non ash bearing.]	2	SW					
4									
6		SAND (SP) poorly graded, fine grained SAND; loose, trace wood, wet, dark gray to gray, [Trash dump debris; trace glass.]	5.5	SP					
	90								
8									
10			10						
12	85								
14									

SAMPLING DATA

REMARKS:

LAB ANALYSIS:

ERM 3352 128th Avenue Holland, MI 49424 P: 616-399-3500	PROJECT: Grand Haven Board of Light and Power Ash Residual Delineation Sampling 1231 N. 3rd Street Grand Haven, MI	BORING # **SB-24** ERM PROJECT # 0318810 SHEET 1 OF 1

DRILLING CONTRACTOR	Mateco Rockford, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN		OFFICE LOCATION	Holland
DRILLING METHOD		DATE: START	10/07/2015
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	10/07/2015
HORIZONTAL DATUM		BOREHOLE DEPTH	10 ft
NORTHING		BOREHOLE DIAMETER	3.25 in
EASTING		DEPTH TO WATER (INITIAL) ▼	
VERTICAL DATUM	ELEVATION	DEPTH TO WATER (FINAL) ▽	

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	SAMPLE TYPE	RECOVERY		Observations / Remarks
		Wet, black, [Vegetation and muck.]							Muck
		SAND (SP) fine grained SAND; loose, saturated, dark gray to black, [Trace bottom ash.]	1	SP					
2		SAND (SW) angular, coarse grained SAND; loose, saturated, dark gray to black, [Unnatural.]	2	SW					
4		CLAY (CL) soft, trace silt, wet, gray, [Loam.]	4.5	CL					
6		SAND (SP) poorly graded, fine grained SAND; loose, wet, gray	5	SP					
8									
10			10						
12									
14									

REMARKS:

LAB ANALYSIS:

ERM
3352 128th Avenue
Holland, MI 49424
P: 616-399-3500

PROJECT:
Grand Haven Board of Light and Power
Ash Residual Delineation Sampling
1231 N. 3rd Street
Grand Haven, MI

BORING # **SB-25**
ERM PROJECT # 0318810

DRILLING CONTRACTOR	Mateco Rockford, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN		OFFICE LOCATION	Holland
DRILLING METHOD		DATE: START	10/07/2015
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	10/07/2015
HORIZONTAL DATUM		BOREHOLE DEPTH	10 ft
NORTHING		BOREHOLE DIAMETER	3.25 in
EASTING		DEPTH TO WATER (INITIAL) ▼	
VERTICAL DATUM	ELEVATION	DEPTH TO WATER (FINAL) ▽	

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	SAMPLE TYPE	RECOVERY		Observations / Remarks
		Wet, black, [Vegetation and muck.]							Muck
		SAND (SP) fine grained SAND; loose, saturated, dark gray to black, [Trace bottom ash.]	1	SP					
2		SAND (SW) angular, coarse grained SAND; loose, saturated, dark gray to black, [Trace bottom ash.]	2	SW					
4									
		CLAY (CL) soft, trace silt, wet, gray, [Loam.]	4.5	CL					
		SAND (SP) poorly graded, fine grained SAND; loose, wet, gray	5	SP					
6									
8									
10			10						
12									
14									

REMARKS:

LAB ANALYSIS:

ERM	3352 128th Avenue Holland, MI 49424 P: 616-399-3500	PROJECT: Grand Haven Board of Light and Power Ash Residual Delineation Sampling 1231 N. 3rd Street Grand Haven, MI	BORING # **SB-26** ERM PROJECT # 0318810 SHEET 1 OF 1

DRILLING CONTRACTOR	Mateco Rockford, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN		OFFICE LOCATION	Holland
DRILLING METHOD		DATE: START	10/07/2015
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	10/07/2015
HORIZONTAL DATUM		BOREHOLE DEPTH	10 ft
NORTHING		BOREHOLE DIAMETER	3.25 in
EASTING		DEPTH TO WATER (INITIAL) ▼	
VERTICAL DATUM	ELEVATION	DEPTH TO WATER (FINAL) ▽	

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	SAMPLE TYPE	RECOVERY		Observations / Remarks
		Wet, black, [Vegetation and muck.]							Muck
1		SAND (SP) fine grained SAND; loose, saturated, dark gray to black	1	SP					
2		SAND (SW) angular, coarse grained SAND; loose, saturated, dark gray to black	2	SW					
3									
4									
		CLAY (CL) soft, trace silt, wet, gray, [Loam.]	4.5	CL					

REMARKS:

LAB ANALYSIS:

BORING LOG GHBLP 0318810.GPJ ERM DATA TEMPLATE.GDT 2/5/16

ERM 3352 128th Avenue Holland, MI 49424 P: 616-399-3500	PROJECT: Grand Haven Board of Light and Power Ash Residual Delineation Sampling 1231 N. 3rd Street Grand Haven, MI	BORING # **SB-32** ERM PROJECT # 0318810 SHEET 1 OF 2

DRILLING CONTRACTOR	Mateco Rockford, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN		OFFICE LOCATION	Holland
DRILLING METHOD		DATE: START	10/08/2015
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	10/08/2015
HORIZONTAL DATUM		BOREHOLE DEPTH	10 ft
NORTHING		BOREHOLE DIAMETER	3.25 in
EASTING		DEPTH TO WATER (INITIAL) ▼	
VERTICAL DATUM	ELEVATION	DEPTH TO WATER (FINAL) ▽	

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	SAMPLE TYPE	RECOVERY		Observations / Remarks
0–12		SAND (SP) fine grained SAND; loose, trace silt, dry, dark gray to black, [fine grained to coarse grained ash material. Interbedded brown to ligt brown sandy silt.]		SP					
12		SAND (SW) angular, medium to coarse grained SAND; loose, dry to wet, dark gray to black, [Bottom ash. Wet @ 13' bg.]	12	SW					
14		SANDY SILT (ML) soft, moist, dark brown to brown, [Loam.]	14	ML					

Depth scale: 2, 4, 6, 8, 10, 12, 14

REMARKS:

LAB ANALYSIS:

ERM	3352 128th Avenue Holland, MI 49424 P: 616-399-3500	PROJECT: Grand Haven Board of Light and Power Ash Residual Delineation Sampling 1231 N. 3rd Street Grand Haven, MI	BORING # **SB-32** ERM PROJECT # 0318810 SHEET 2 OF 2

DRILLING CONTRACTOR	Mateco Rockford, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN		OFFICE LOCATION	Holland
DRILLING METHOD		DATE: START	10/08/2015
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	10/08/2015
HORIZONTAL DATUM		BOREHOLE DEPTH	10 ft
NORTHING		BOREHOLE DIAMETER	3.25 in
EASTING		DEPTH TO WATER (INITIAL) ▼	
VERTICAL DATUM	ELEVATION	DEPTH TO WATER (FINAL) ▽	

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	SAMPLE TYPE	RECOVERY		Observations / Remarks
		SANDY SILT (ML) soft, moist, dark brown to brown, [Loam.]*(Continued)*		ML					
16			16						
18									
20									
22									
24									
26									
28									

SAMPLING DATA

REMARKS:

LAB ANALYSIS:

ERM 3352 128th Avenue Holland, MI 49424 P: 616-399-3500	PROJECT: Grand Haven Board of Light and Power Ash Residual Delineation Sampling 1231 N. 3rd Street Grand Haven, MI	BORING # **SB-33** ERM PROJECT # 0318810 SHEET 1 OF 1

DRILLING CONTRACTOR	Mateco Rockford, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN		OFFICE LOCATION	Holland
DRILLING METHOD		DATE: START	10/08/2015
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	10/08/2015
HORIZONTAL DATUM		BOREHOLE DEPTH	10 ft
NORTHING		BOREHOLE DIAMETER	3.25 in
EASTING		DEPTH TO WATER (INITIAL) ▼	
VERTICAL DATUM	ELEVATION	DEPTH TO WATER (FINAL) ▽	

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	SAMPLE TYPE (SAMPLING DATA)	RECOVERY		Observations / Remarks
		SILTY SAND (SW) fine grained SAND; loose, saturated, black, [Trash dump debris; concrete, wood, glass.]		SW					
1									
2									
		SANDY SILT soft, saturated, dark grayish brown to dark brown, [clayey loam. Shells.]	2.25						
3									
4									
		SAND (SP) poorly graded, fine grained SAND; loose, saturated, gray	4.75	SP					

REMARKS:

LAB ANALYSIS:

3352 128th Avenue Holland, MI 49424 P: 616-399-3500	PROJECT: Grand Haven Board of Light and Power Ash Residual Delineation Sampling 1231 N. 3rd Street Grand Haven, MI	BORING # **SB-34** ERM PROJECT # 0318810 SHEET 1 OF 1

DRILLING CONTRACTOR	Mateco Rockford, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN		OFFICE LOCATION	Holland
DRILLING METHOD		DATE: START	10/08/2015
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	10/08/2015
HORIZONTAL DATUM		BOREHOLE DEPTH	10 ft
NORTHING		BOREHOLE DIAMETER	3.25 in
EASTING		DEPTH TO WATER (INITIAL) ▼	
VERTICAL DATUM	ELEVATION	DEPTH TO WATER (FINAL) ▽	

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	SAMPLE TYPE	RECOVERY		Observations / Remarks
		SILTY SAND (SP) fine grained SAND; loose, trace gravel, saturated, black		SP					
1									
		GRAVEL (GW) coarse grained SAND; saturated, dark gray to black, [Trash dump debris; concrete, glass, wood. Petroleum odor, sheen noted. Trace metal.]	1.25	GW					
2		SANDY SILT soft, trace fine sand, moist, dark grayish brown to dark brown, [Loam with shells.]	2						
3									
4									
		SAND (SP) poorly graded, fine grained SAND; loose, wet, gray	4.25	SP					

(SAMPLING DATA spans SAMPLE TYPE through Observations / Remarks)

REMARKS:

LAB ANALYSIS:

ERM
3352 128th Avenue
Holland, MI 49424
P: 616-399-3500

PROJECT:
Grand Haven Board of Light and Power
Ash Residual Delineation Sampling
1231 N. 3rd Street
Grand Haven, MI

BORING # **SB-35**

ERM PROJECT # 0318810

DRILLING CONTRACTOR	Mateco Rockford, MI	ERM REPRESENTATIVE	Brian Beach
DRILLING FOREMAN		OFFICE LOCATION	Holland
DRILLING METHOD		DATE: START	10/08/2015
DRILLING EQUIPMENT	Geoprobe 6600	FINISH	10/08/2015
HORIZONTAL DATUM		BOREHOLE DEPTH	10 ft
NORTHING		BOREHOLE DIAMETER	3.25 in
EASTING		DEPTH TO WATER (INITIAL) ▼	
VERTICAL DATUM	ELEVATION	DEPTH TO WATER (FINAL) ▽	

DEPTH	ELEVATION	STRATA DESCRIPTION	DEPTH	USCS	GRAPHIC LOG	SAMPLE TYPE	RECOVERY		Observations / Remarks
		GRAVELLY SAND (SW) angular, fine to medium grained SAND; fine to coarse grained GRAVEL; loose, saturated, grayish brown to dark brown, [Some bottom ash. Trace glass. Trash dump debris.]		SW					
1									
2		SAND (SP) fine grained SAND; loose, some wood, wet, dark gray to black, [Trace bottom ash.]	2	SP					
		SANDY SILT (ML) soft, trace clay, trace roots, moist, dark brown, [Loam with shells.]	2.5	ML					
3									
4									
		SAND (SP) poorly graded, fine grained SAND; loose, wet, gray	4.75	SP					

REMARKS:

LAB ANALYSIS:

Log of Test Boring

Soils & Structures, Inc.

Muskegon 1-800-933-3959 Traverse City

Project: Grand Haven Power Plant

Ash Pond Evaluation

Location: Grand Haven, Michigan

Job Number: 2014.0265

Boring Number: 1
Depth Drilled: 25 ft.
Surface Elev.: 591.2 ft.
Date Started: 5-16-14
Date Completed: 5-16-14

Crew Chief: B. Fritz
Helper: B. Warg
Drill Rig: D-50 Truck
Boring Method: 3 1/4" ID Hollow Stem Auger

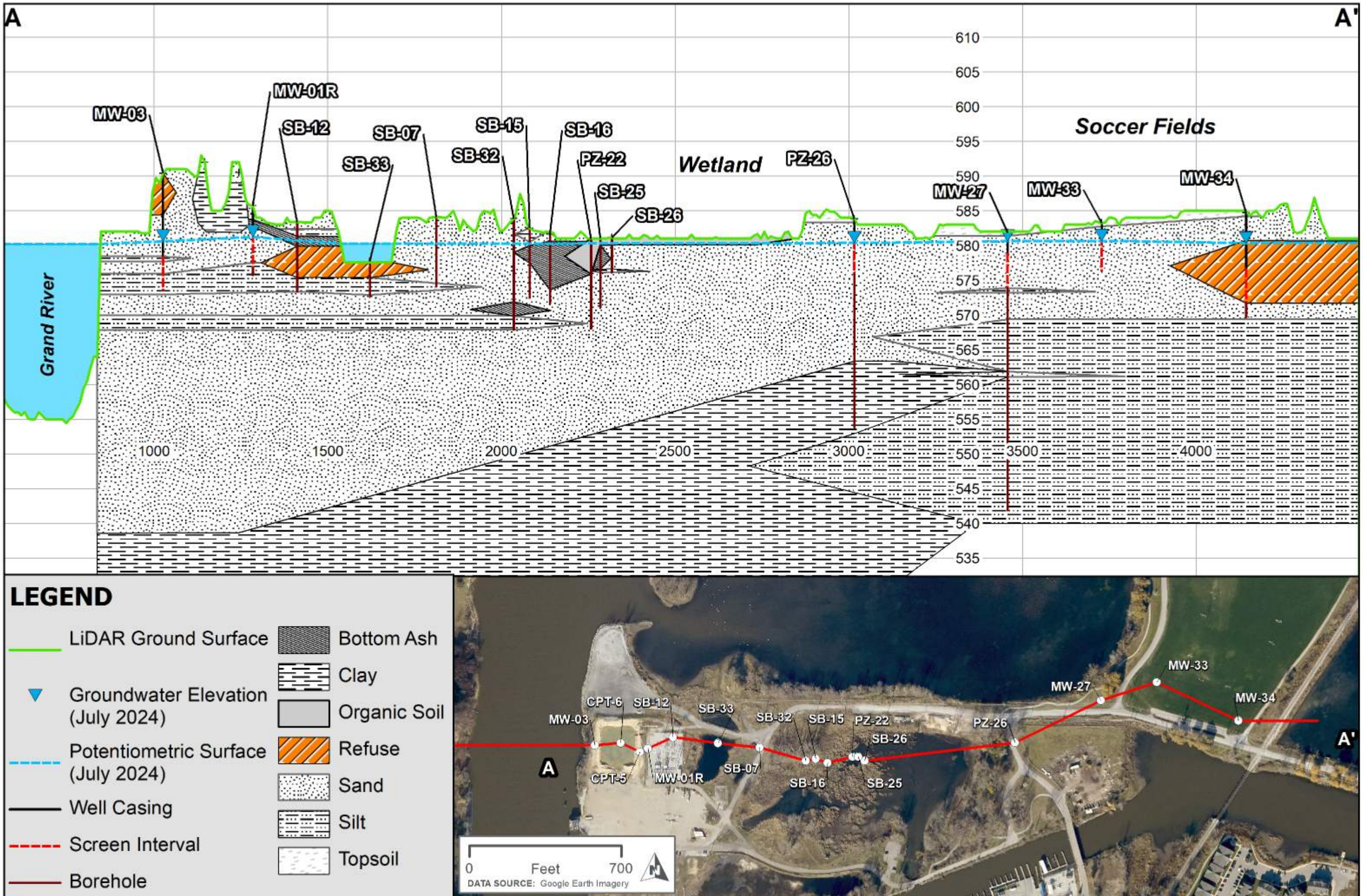
Ground Water
Encountered: 18.0 ft.
After Completion: 18.0 ft.
After 1/4 hrs. 18.0 ft.
Volume: Heavy
Seepage at: 18.0 ft.

Plugging Record
Boring Sealed with: Excavated Soil
____ between 0.0 ft. & 25.0 ft.
____ between ____ ft. & ____ ft.

Depth in Feet	Soil Description	Penetration ASTM D 1586	"N" (BPF)	Laboratory Data: Water Content (%)	Dry Density (pcf)	Shear Strength (psf)	Unified Soil Classif.
0.3'	CLAY - brown with ash and gravel (4.0")						
		5-5-5	10				CL
		4-5-9	14	19.1	110	2900	CL
	CLAY - stiff brown silty with a trace of sand and gravel						
		3-4-6	10				CL
		3-5-8	13	19.0	115	1900	CL
13.0'	SAND - loose to slightly compact brown fine with a trace of fine roots						
15.5'		2-2-5	7				CL
	SAND - loose brown fine						
18.0'							
		1-1-2	3				SP
	SAND - loose brown fine with peat seams						
24.0'	SAND - slightly compact brown fine to medium with a trace of gravel	2-2-5	7				SP
25.0'	End of Boring						
	.						
	.						
	.						
	Northwest corner of ash ponds						

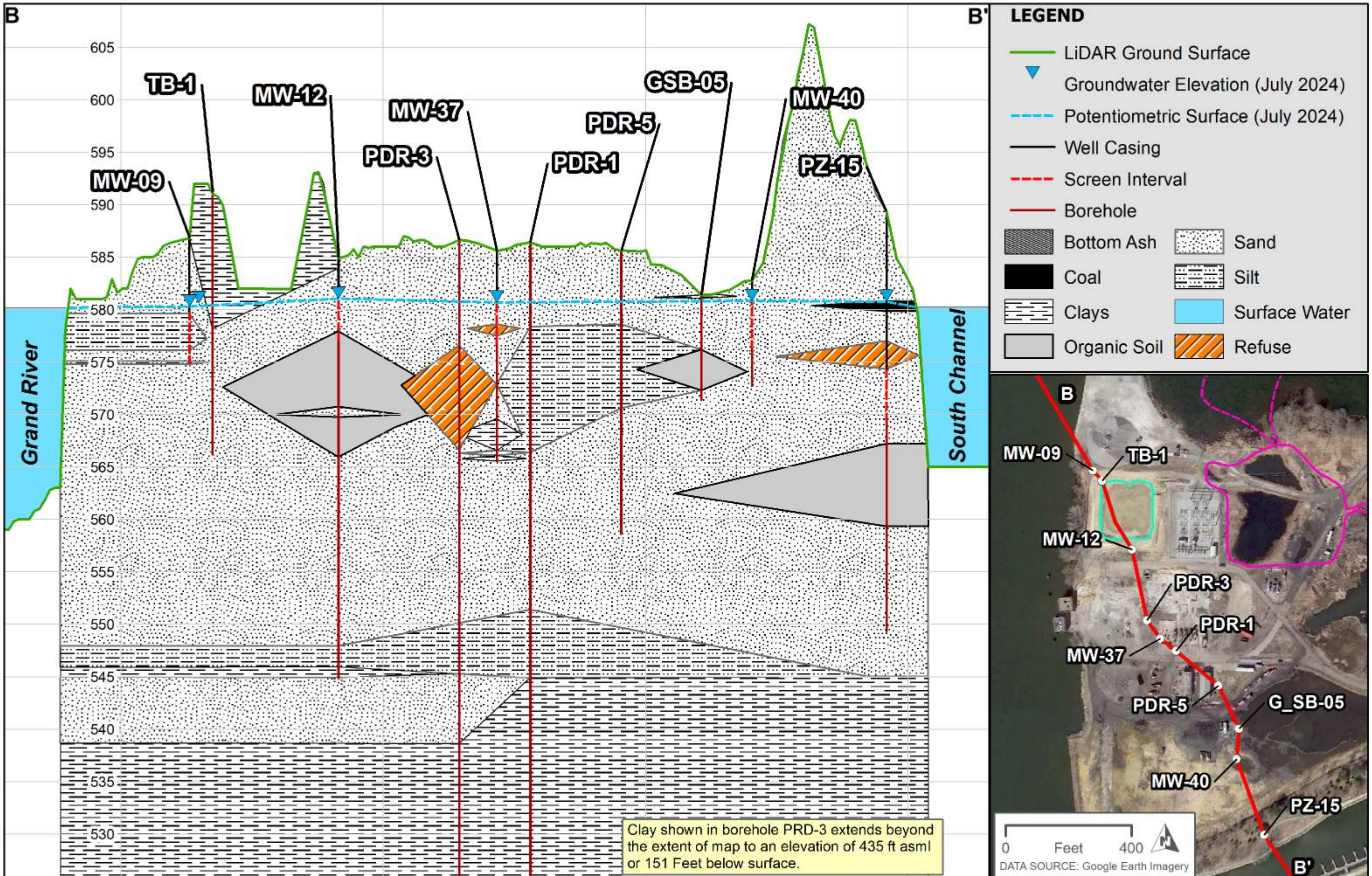
Appendix D

Cross Sections



FORMER J.B. SIMS GENERATING STATION

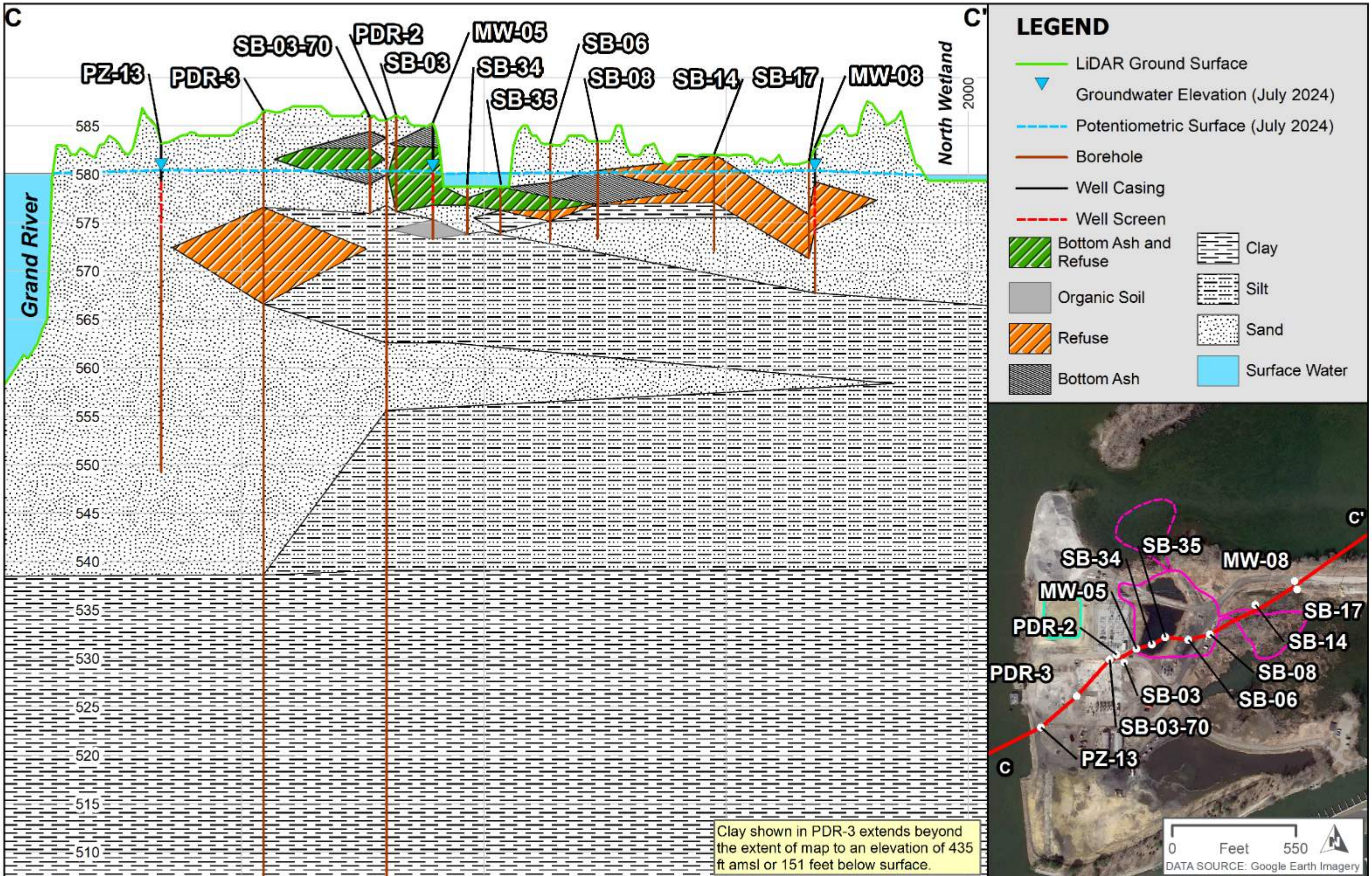
GRAND HAVEN, MI



HDR

FORMER J.B. SIMS GENERATING STATION

GRAND HAVEN, MI

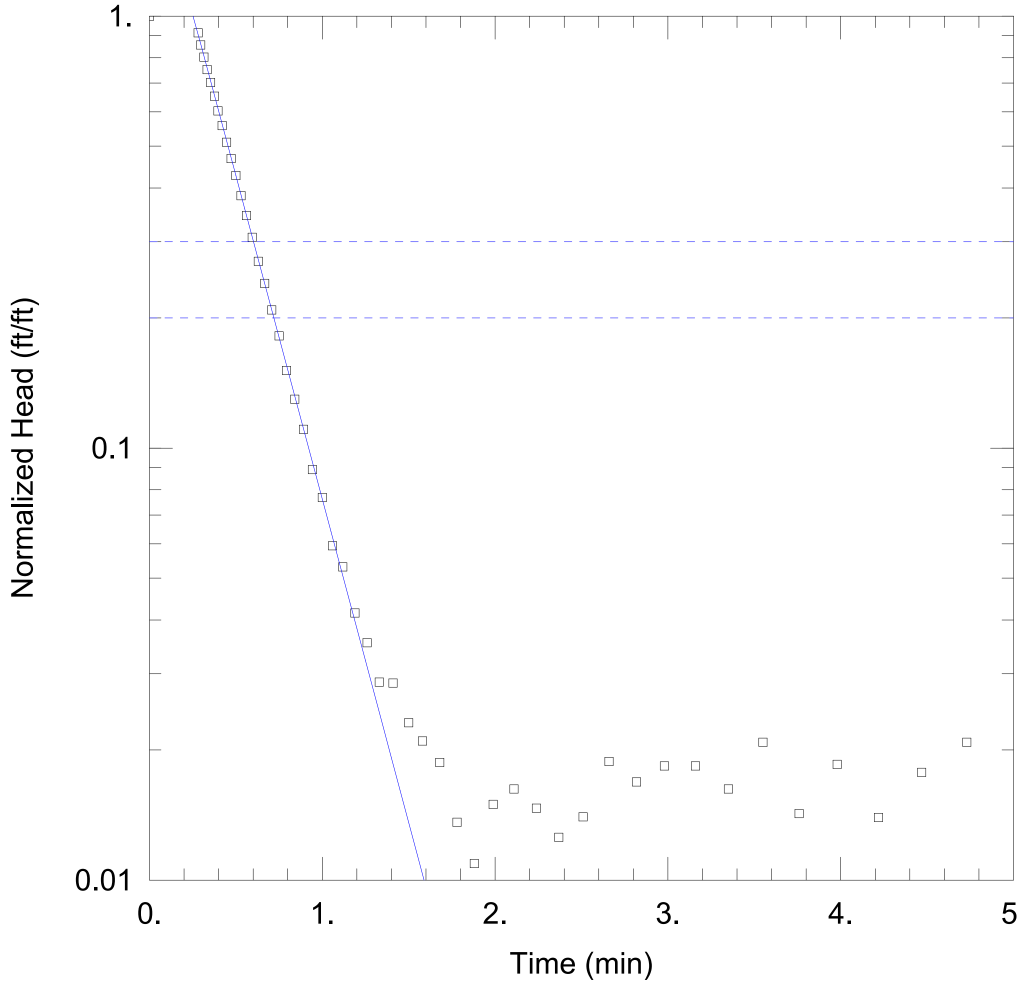


FORMER J.B. SIMS GENERATING STATION

GRAND HAVEN, MI

Appendix E

2024 Slug Test Analyses



WELL TEST ANALYSIS

Data Set: C:\...\MW-10 Test1_BR.aqt
Date: 04/01/25
Time: 08:26:57

PROJECT INFORMATION

Company: HDR
Client: Grand_Haven
Test Well: MW-10
Test Date: 6/19/2024

AQUIFER DATA

Saturated Thickness: 5. ft
Anisotropy Ratio (Kz/Kr): 1.

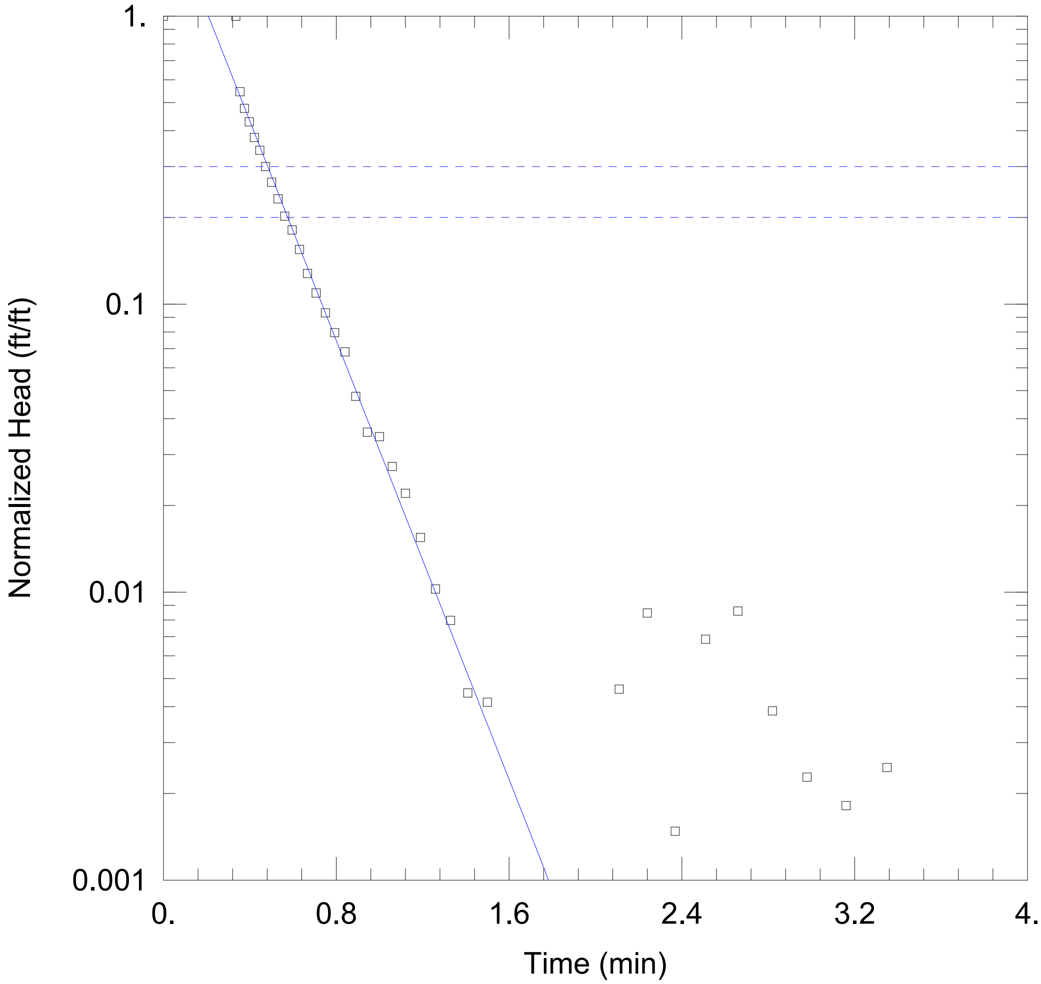
WELL DATA (MW-10 Test 1)

Initial Displacement: 0.7031 ft
Total Well Penetration Depth: 10. ft
Casing Radius: 0.08333 ft
Static Water Column Height: 6.431 ft
Screen Length: 5. ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 12.33 ft/day
y0 = 1.683 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW-10 Test2_BR.aqt
Date: 04/01/25 Time: 08:27:55

PROJECT INFORMATION

Company: HDR
Client: Grand_Haven
Test Well: MW-10
Test Date: 6/19/2024

AQUIFER DATA

Saturated Thickness: 5. ft Anisotropy Ratio (Kz/Kr): 1.

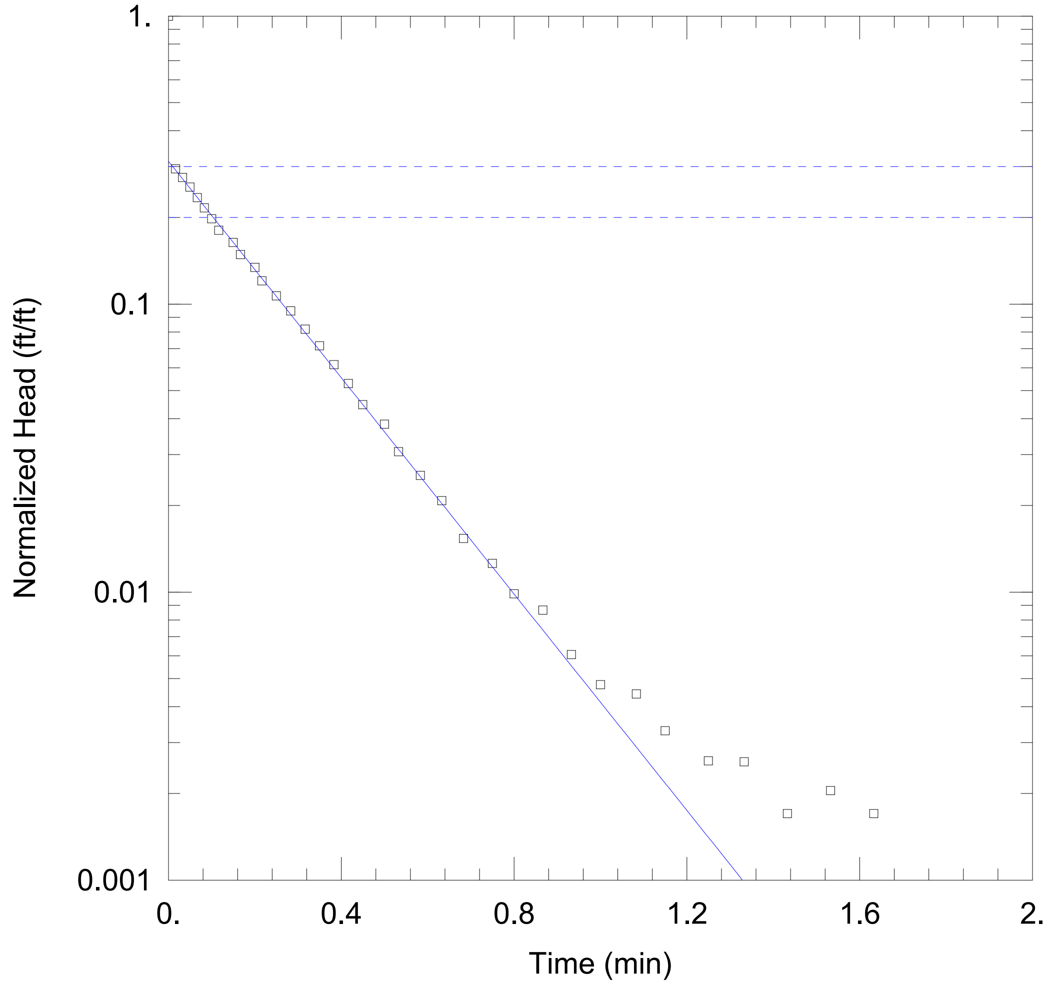
WELL DATA (MW-10 Test 2)

Initial Displacement: 0.4931 ft
Total Well Penetration Depth: 10. ft
Casing Radius: 0.08333 ft
Static Water Column Height: 6.407 ft
Screen Length: 5. ft
Well Radius: 0.0833 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 15.69 ft/day
y0 = 1.229 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW-10 Test3_BR.aqt
Date: 04/01/25 Time: 08:28:43

PROJECT INFORMATION

Company: HDR
Client: Grand_Haven
Test Well: MW-10
Test Date: 6/19/2024

AQUIFER DATA

Saturated Thickness: 5. ft Anisotropy Ratio (Kz/Kr): 1.

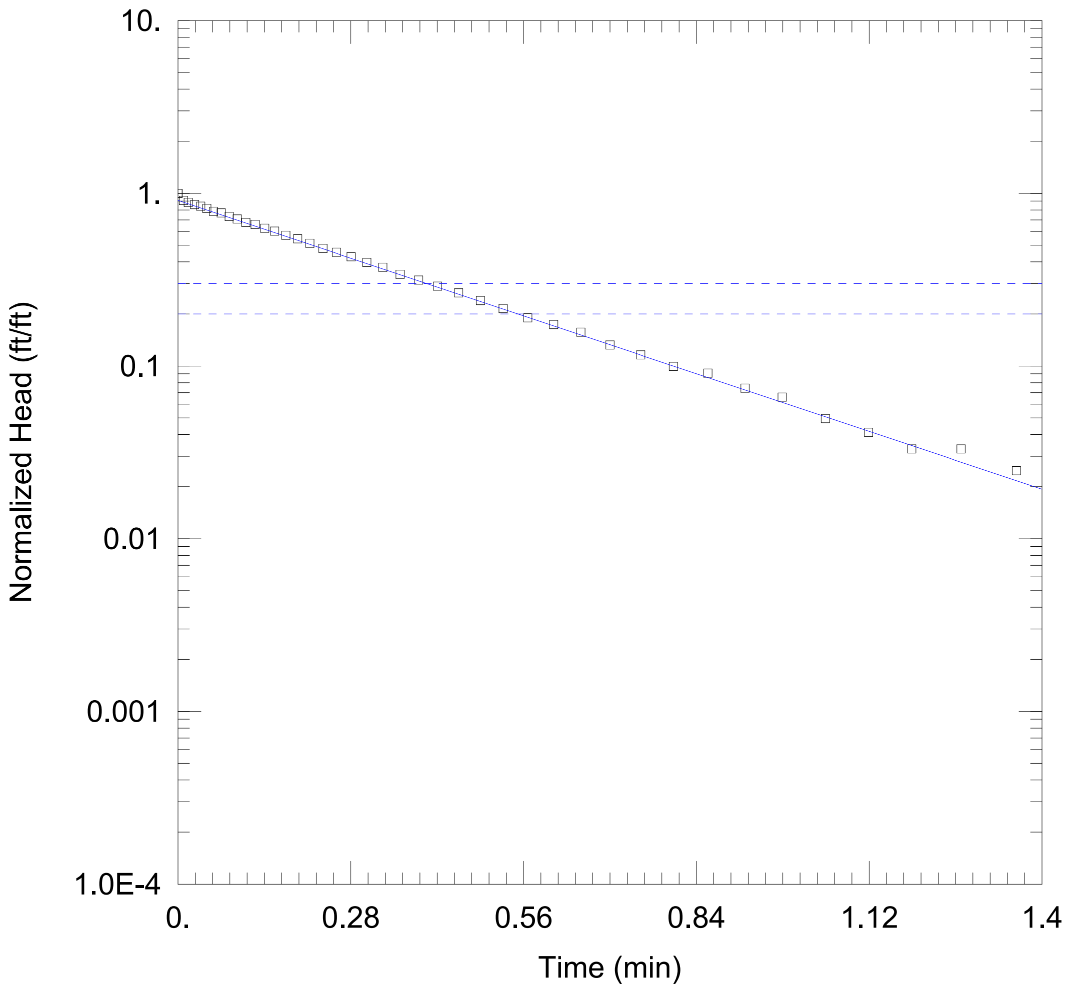
WELL DATA (MW-10 Test 3)

Initial Displacement: 1.827 ft Static Water Column Height: 6.399 ft
Total Well Penetration Depth: 10. ft Screen Length: 5. ft
Casing Radius: 0.08333 ft Well Radius: 0.0833 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 15.47 ft/day y0 = 0.5715 ft



WELL TEST ANALYSIS

Data Set: C:\Users\JOEHENRY\Desktop\Grand Haven\Slug Tests\MW-12\Aqtesolv\MW12_S01_B.aqt
Date: 04/01/25 Time: 13:28:16

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-12
Test Date: 5/19/2024

AQUIFER DATA

Saturated Thickness: 3.98 ft Anisotropy Ratio (Kz/Kr): 1.

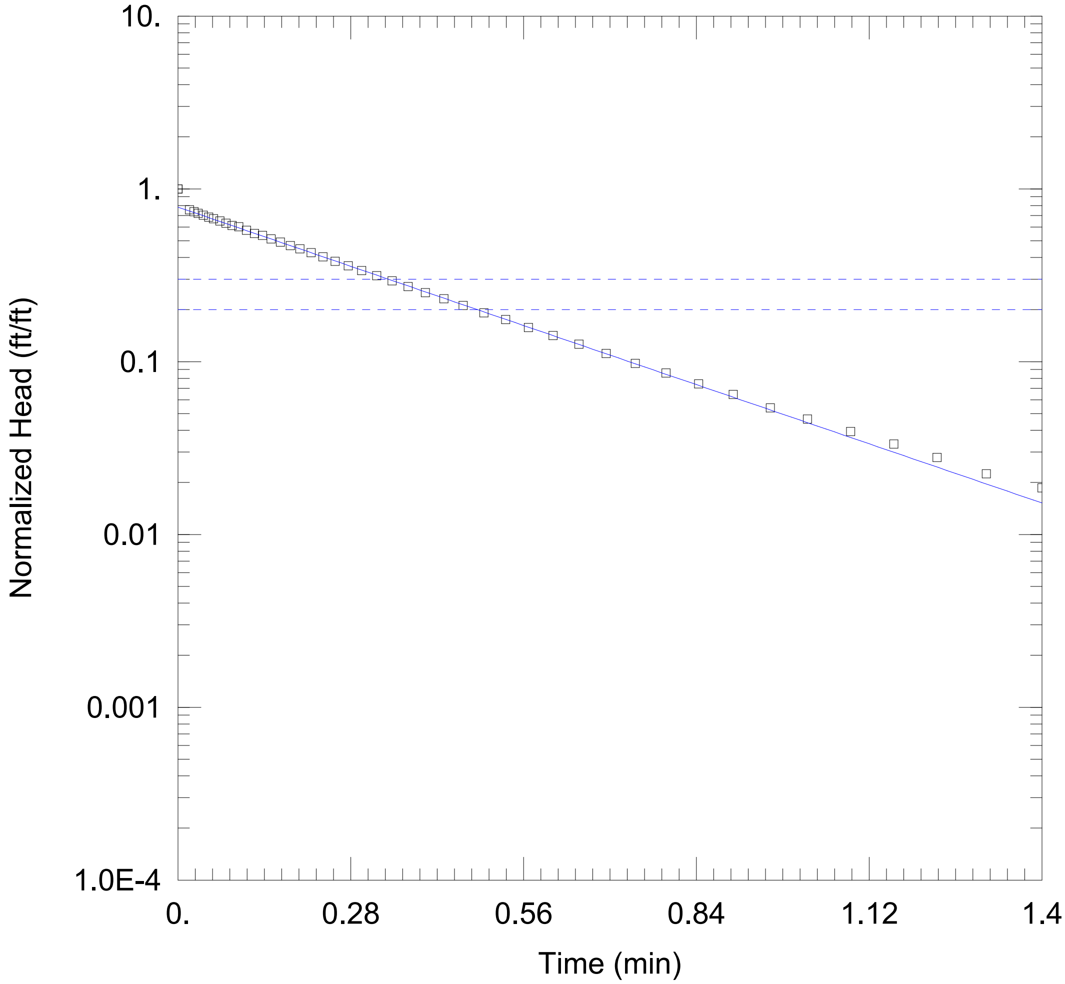
WELL DATA (MW-12 Slug Out - 1)

Initial Displacement: 1.21 ft Static Water Column Height: 3.98 ft
Total Well Penetration Depth: 8. ft Screen Length: 5. ft
Casing Radius: 0.083 ft Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 11.64 ft/day y0 = 1.099 ft



WELL TEST ANALYSIS

Data Set: C:\Users\JOEHENRY\Desktop\Grand Haven\Slug Tests\MW-12\Aqtesolv\MW12_S02_B.aqt
Date: 04/01/25 Time: 13:29:08

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-12
Test Date: 5/19/2024

AQUIFER DATA

Saturated Thickness: 3.98 ft
Anisotropy Ratio (Kz/Kr): 1.

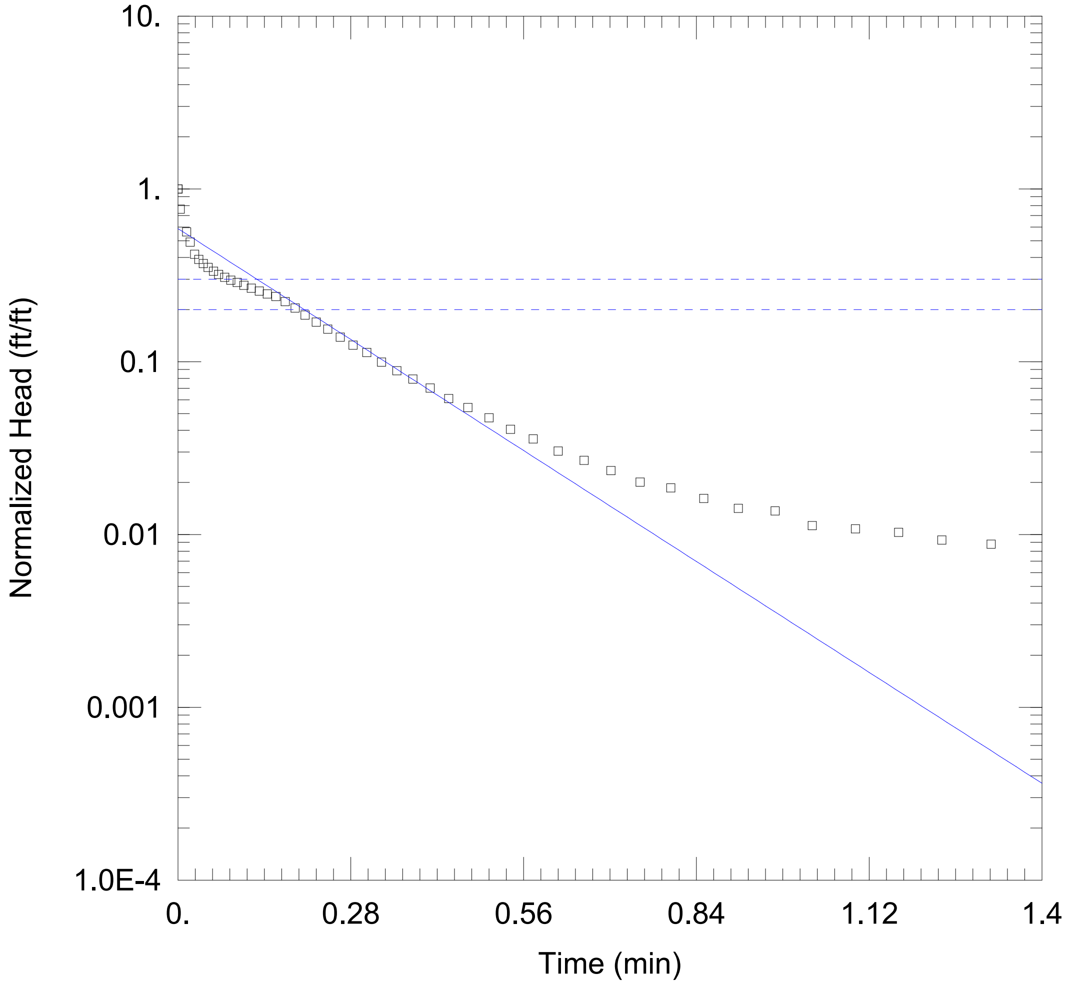
WELL DATA (MW-12 - Slug Out - 2)

Initial Displacement: 1.83 ft
Static Water Column Height: 3.98 ft
Total Well Penetration Depth: 8. ft
Screen Length: 5. ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 11.92 ft/day
y0 = 1.434 ft



WELL TEST ANALYSIS

Data Set: C:\Users\JOEHENRY\Desktop\Grand Haven\Slug Tests\MW-12\Aqtesolv\MW12_SI1_B.aqt
Date: 04/01/25 Time: 13:30:24

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-12
Test Date: 5/19/2024

AQUIFER DATA

Saturated Thickness: 3.98 ft
Anisotropy Ratio (Kz/Kr): 1.

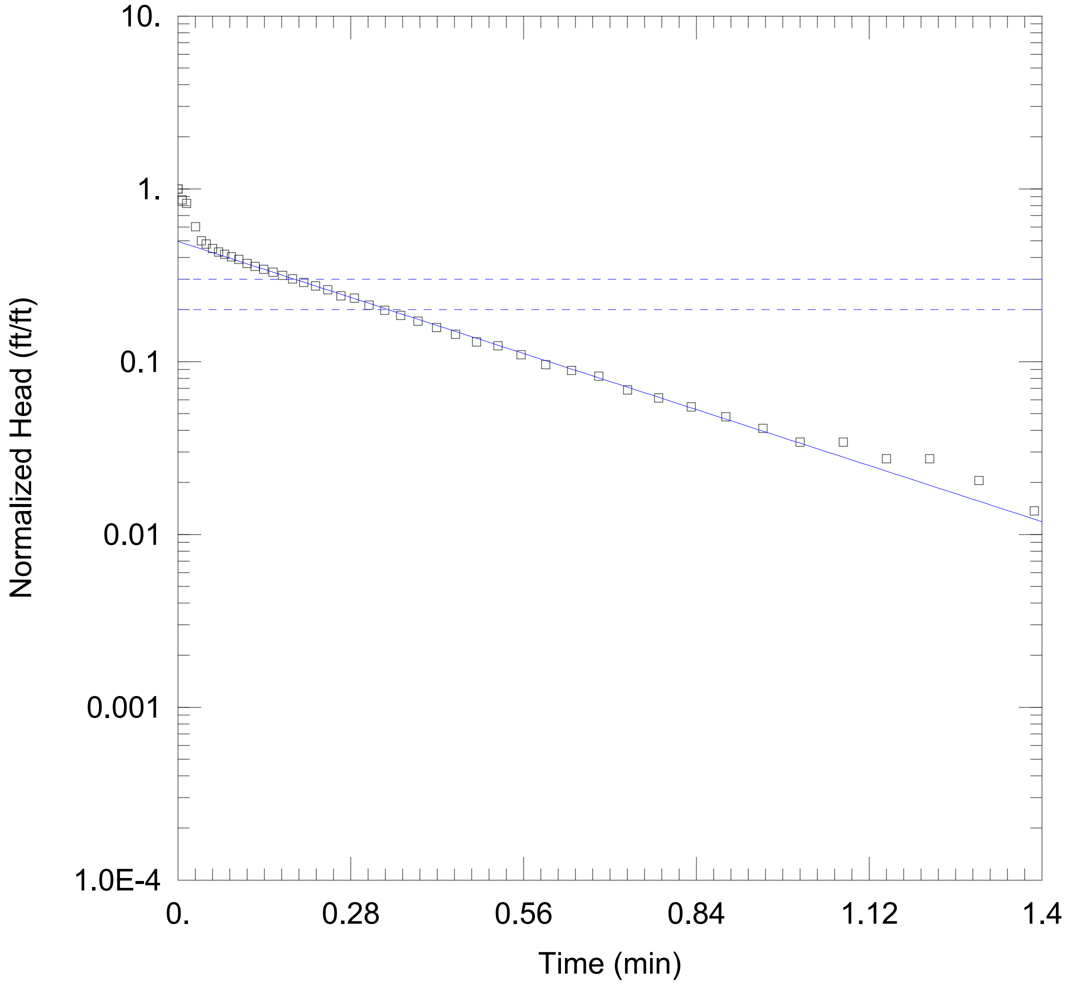
WELL DATA (MW-12 - Slug In - 1)

Initial Displacement: 2.046 ft
Static Water Column Height: 3.98 ft
Total Well Penetration Depth: 8. ft
Screen Length: 5. ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 22.36 ft/day
y0 = 1.205 ft



WELL TEST ANALYSIS

Data Set: C:\Users\JOEHENRY\Desktop\Grand Haven\Slug Tests\MW-12\Aqtesolv\MW12_SI2_B.aqt
Date: 04/01/25 Time: 14:02:13

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-12
Test Date: 5/19/2024

AQUIFER DATA

Saturated Thickness: 3.98 ft
Anisotropy Ratio (Kz/Kr): 1.

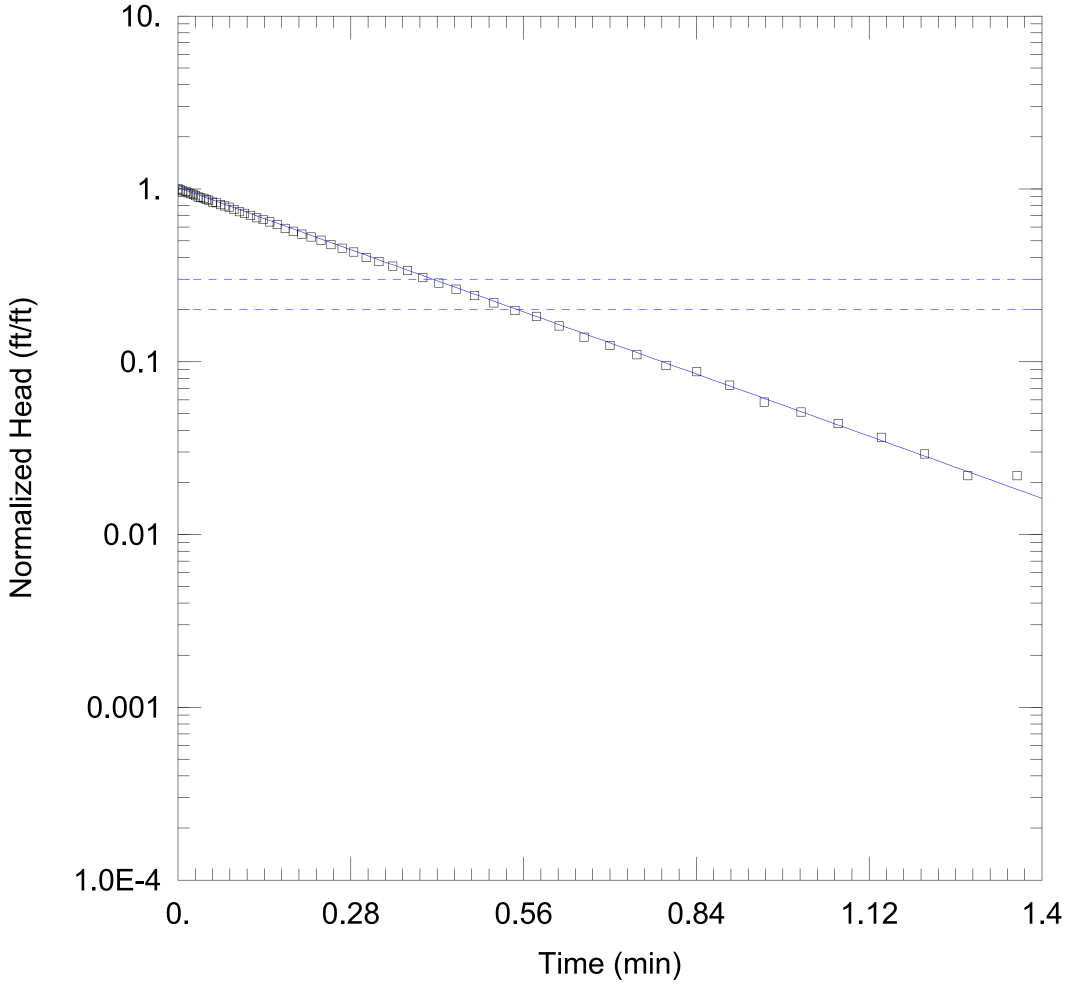
WELL DATA (MW-12 - Slug In - 2)

Initial Displacement: 1.46 ft
Static Water Column Height: 3.98 ft
Total Well Penetration Depth: 8. ft
Screen Length: 5. ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 11.29 ft/day
y0 = 0.7246 ft



WELL TEST ANALYSIS

Data Set: C:\Users\JOEHENRY\Desktop\Grand Haven\Slug Tests\MW-12\Aqtesolv\MW12_SO3_B.aqt
Date: 04/01/25 Time: 13:32:26

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-12
Test Date: 5/19/2024

AQUIFER DATA

Saturated Thickness: 3.98 ft Anisotropy Ratio (Kz/Kr): 1.

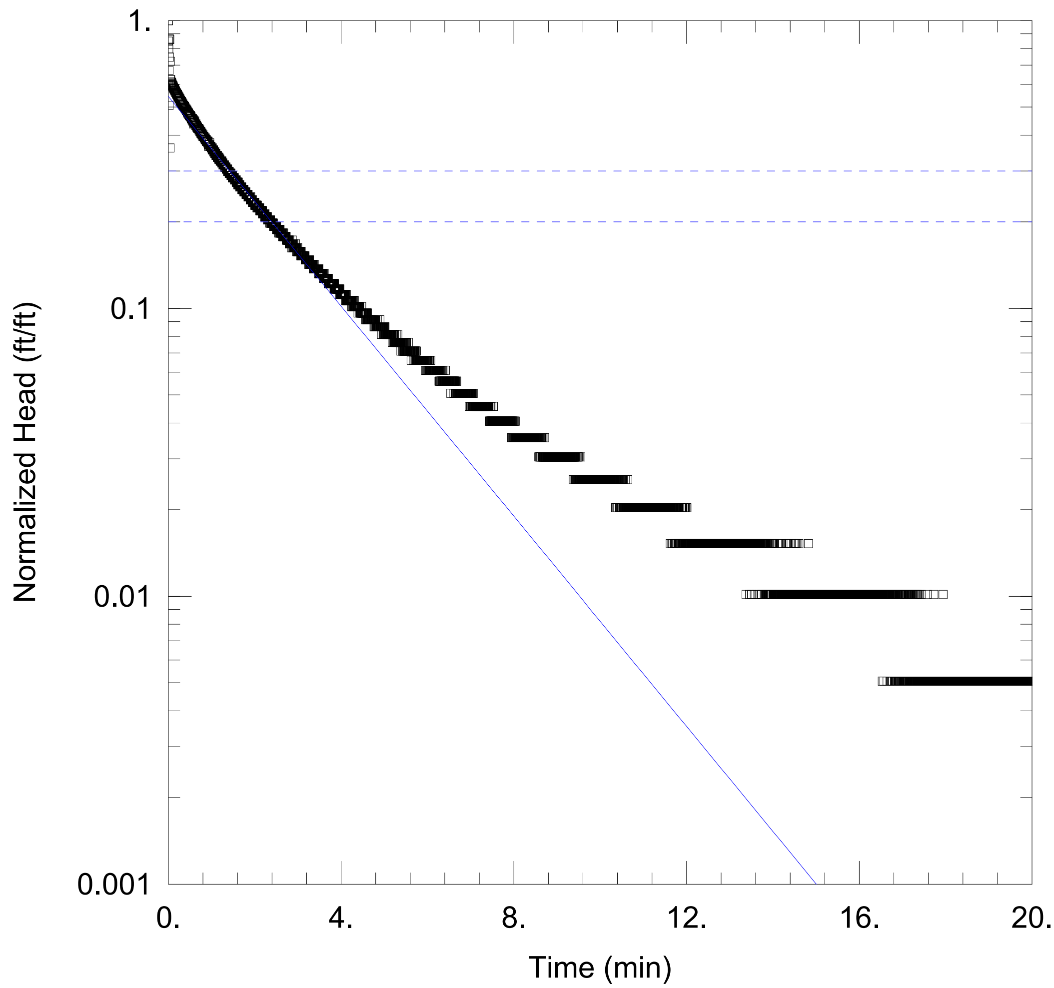
WELL DATA (MW-12 - Slug Out - 3)

Initial Displacement: 1.37 ft
Total Well Penetration Depth: 8. ft
Casing Radius: 0.083 ft
Static Water Column Height: 3.98 ft
Screen Length: 5. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 12.52 ft/day
y0 = 1.394 ft



WELL TEST ANALYSIS

Data Set: C:\...\PZ15_SlugIn_1_BR.aqt
Date: 04/01/25 Time: 10:00:32

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: PZ-15
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 9.41 ft Anisotropy Ratio (Kz/Kr): 1.

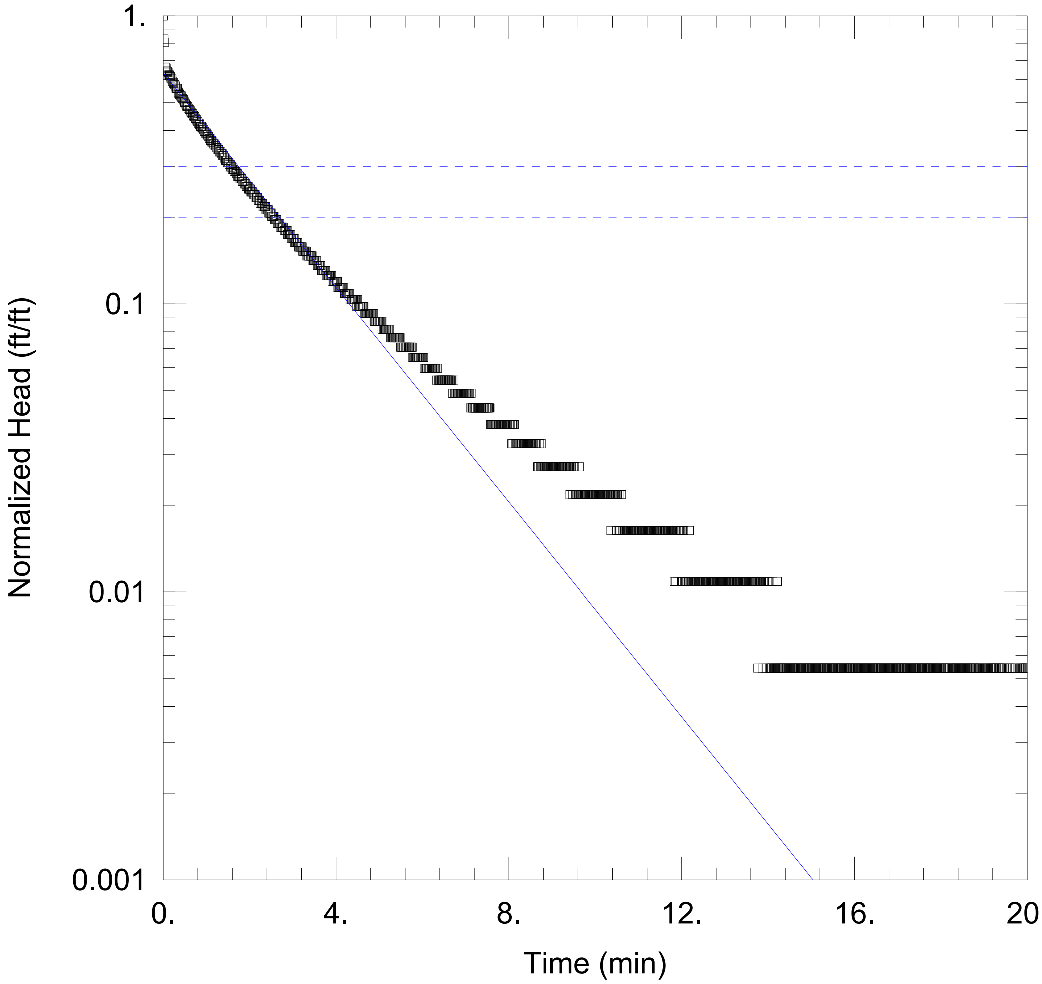
WELL DATA (PZ-15 Slug In 1)

Initial Displacement: 1.97 ft Static Water Column Height: 9.41 ft
Total Well Penetration Depth: 18.21 ft Screen Length: 5. ft
Casing Radius: 0.083 ft Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.64 ft/day y0 = 1.073 ft



WELL TEST ANALYSIS

Data Set: C:\...\PZ15_SlugIn_2_BR.aqt
Date: 04/01/25 Time: 10:01:23

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: PZ-15
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 9.41 ft
Anisotropy Ratio (Kz/Kr): 1.

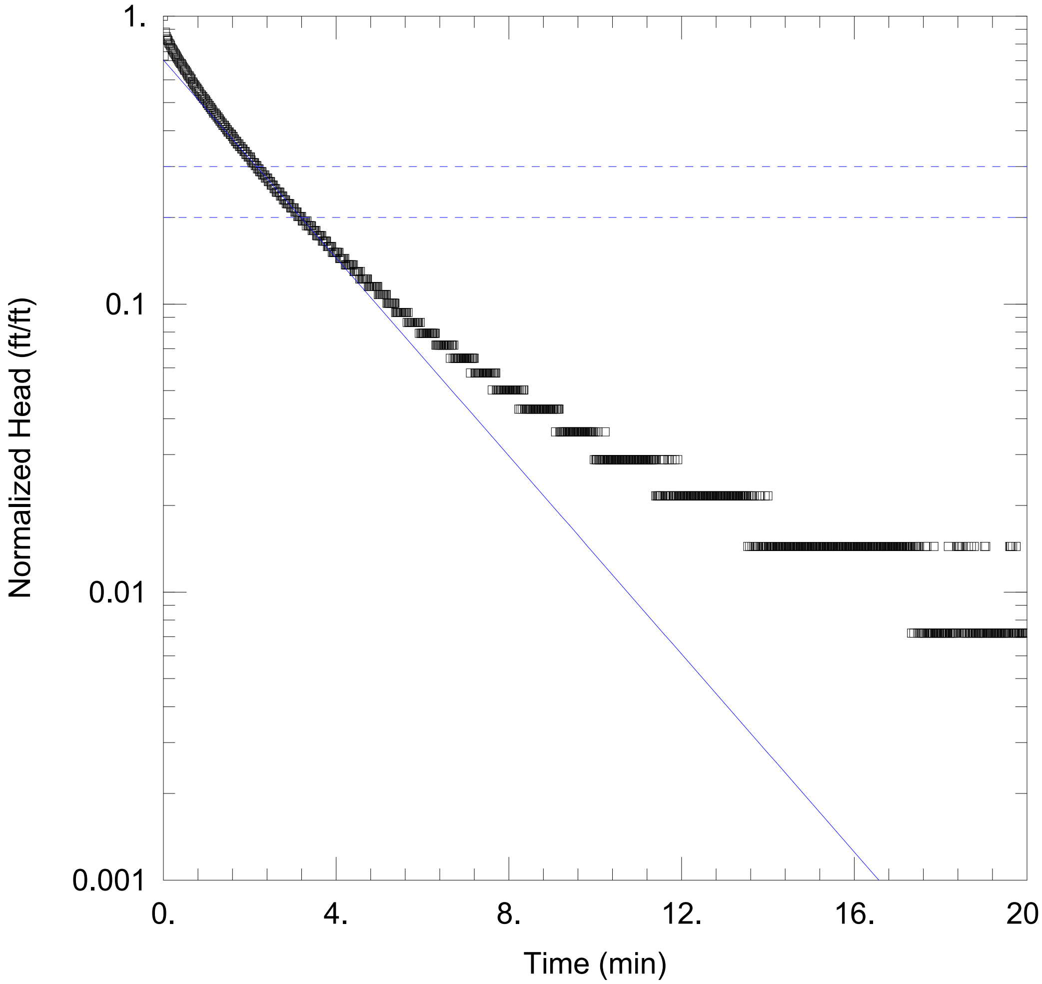
WELL DATA (PZ-15 Slug In 2)

Initial Displacement: 1.84 ft
Static Water Column Height: 9.41 ft
Total Well Penetration Depth: 18.21 ft
Screen Length: 5. ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 1.676 ft/day
y0 = 1.165 ft



WELL TEST ANALYSIS

Data Set: C:\...\PZ15_SlugIn_3_BR.aqt
Date: 04/01/25 Time: 10:04:09

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: PZ-15
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 9.41 ft Anisotropy Ratio (Kz/Kr): 1.

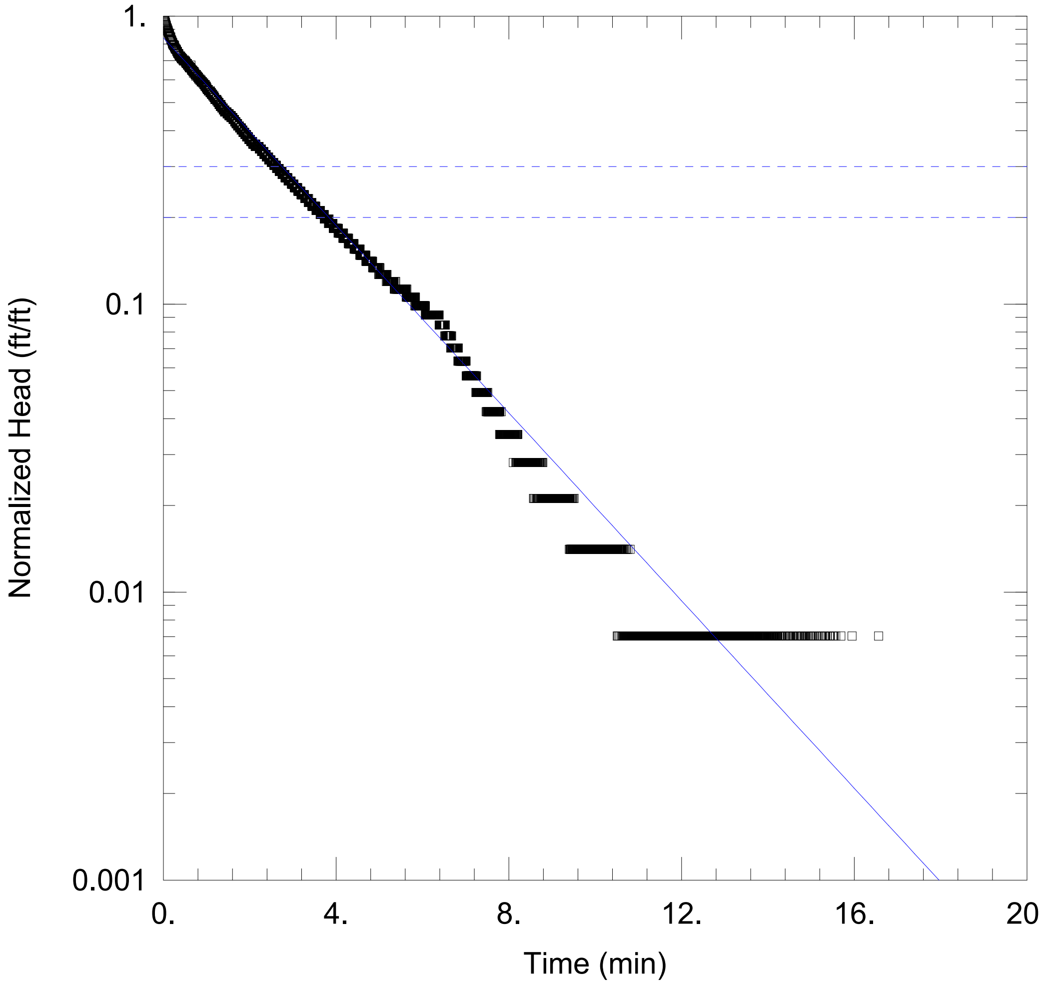
WELL DATA (PZ-15 Slug In 3)

Initial Displacement: 1.39 ft Static Water Column Height: 9.41 ft
Total Well Penetration Depth: 18.21 ft Screen Length: 5. ft
Casing Radius: 0.083 ft Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.546 ft/day y0 = 0.9771 ft



WELL TEST ANALYSIS

Data Set: C:\...\PZ15_SlugOut_1_BR.aqt
Date: 04/01/25 Time: 10:02:33

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: PZ-15
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 9.41 ft Anisotropy Ratio (Kz/Kr): 1.

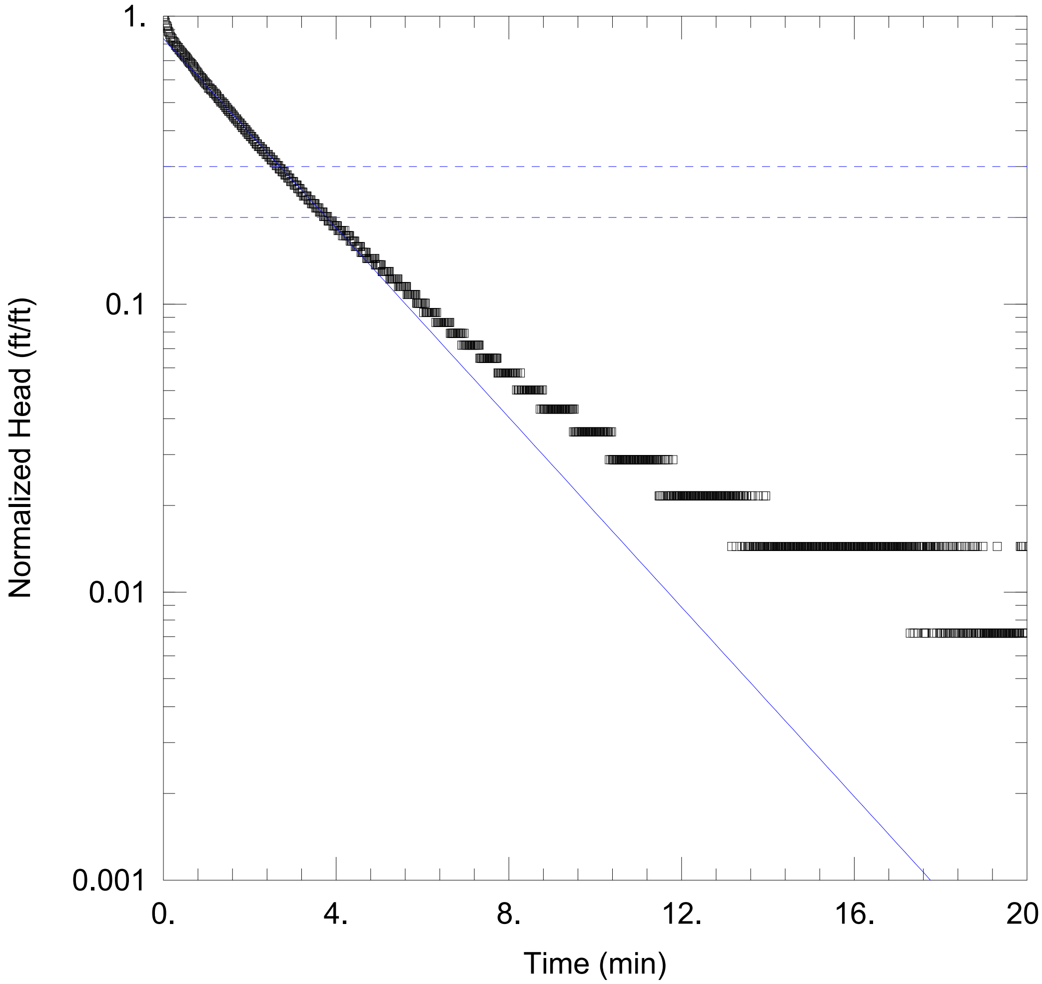
WELL DATA (PZ-15 Slug Out 1)

Initial Displacement: 1.42 ft
Total Well Penetration Depth: 18.21 ft
Casing Radius: 0.083 ft
Static Water Column Height: 9.41 ft
Screen Length: 5. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.465 ft/day y0 = 1.193 ft



WELL TEST ANALYSIS

Data Set: C:\...\PZ15_SlugOut_2_BR.aqt
Date: 04/01/25 Time: 10:04:50

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: PZ-15
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 9.41 ft Anisotropy Ratio (Kz/Kr): 1.

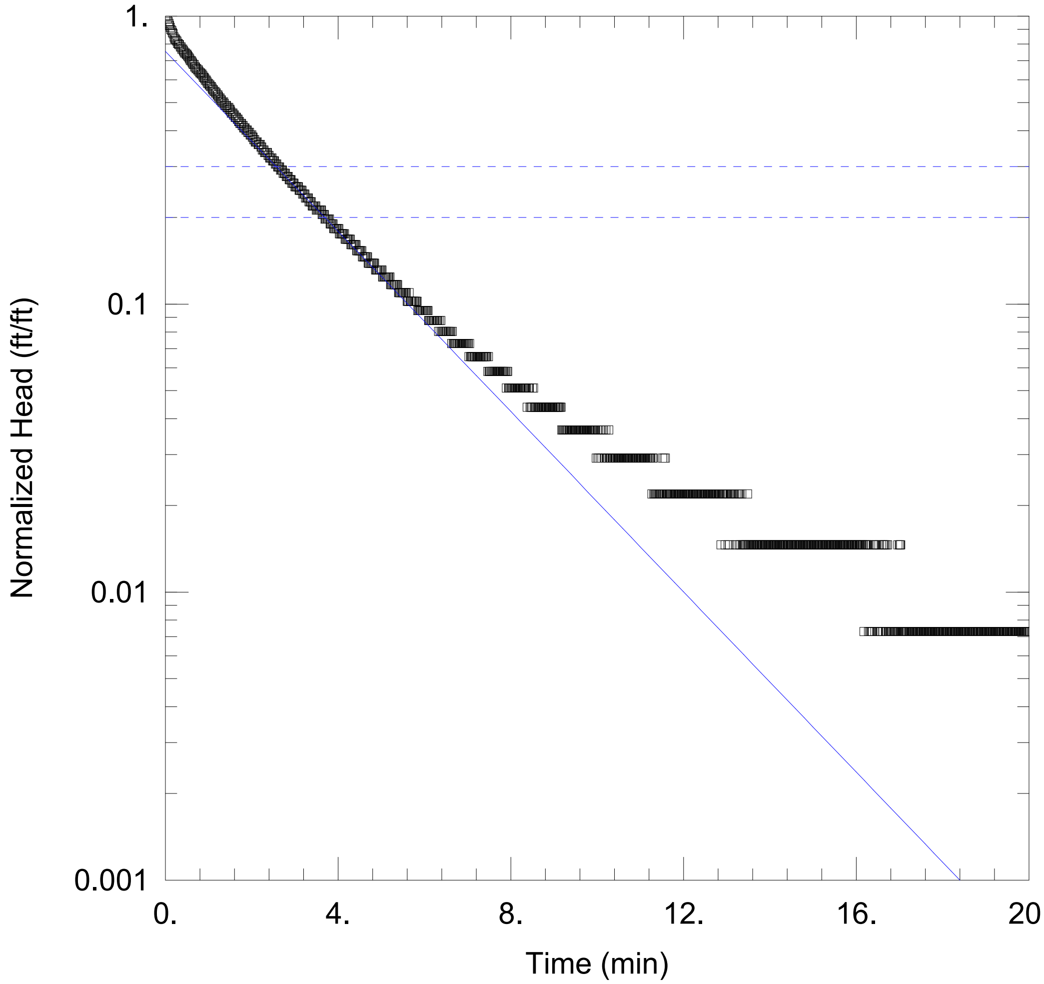
WELL DATA (PZ-15 Slug Out 2)

Initial Displacement: 1.39 ft Static Water Column Height: 9.41 ft
Total Well Penetration Depth: 18.21 ft Screen Length: 5. ft
Casing Radius: 0.083 ft Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.48 ft/day y0 = 1.161 ft



WELL TEST ANALYSIS

Data Set: C:\...\PZ15_SlugOut_3_BR.aqt
Date: 04/01/25 Time: 10:05:45

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: PZ-15
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 9.41 ft Anisotropy Ratio (Kz/Kr): 1.

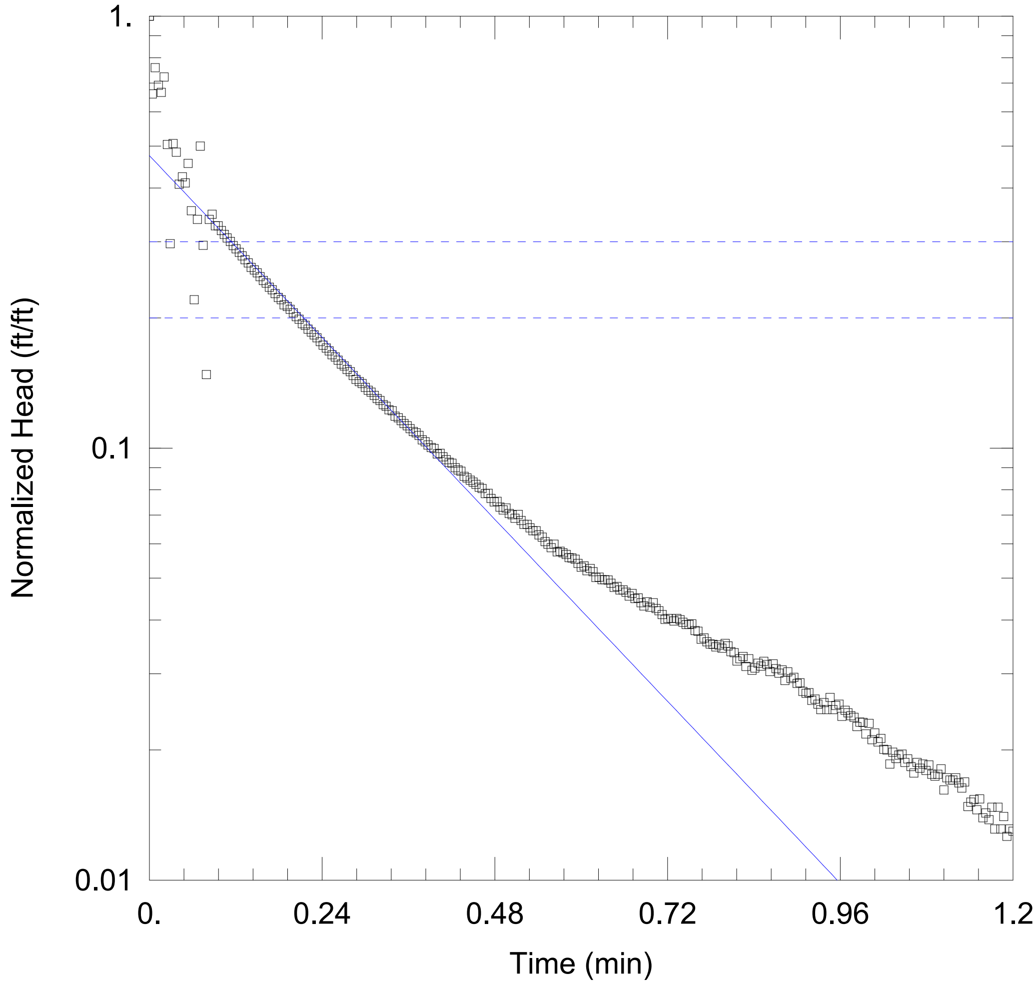
WELL DATA (PZ-15 Slug Out 3)

Initial Displacement: 1.37 ft
Total Well Penetration Depth: 18.21 ft
Casing Radius: 0.083 ft
Static Water Column Height: 9.41 ft
Screen Length: 5. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 1.407 ft/day
y0 = 1.034 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW16_SlugIn_1_BR.aqt
Date: 04/01/25 Time: 13:34:44

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-16
Test Date: 8/15/2024

AQUIFER DATA

Saturated Thickness: 6.62 ft Anisotropy Ratio (Kz/Kr): 1.

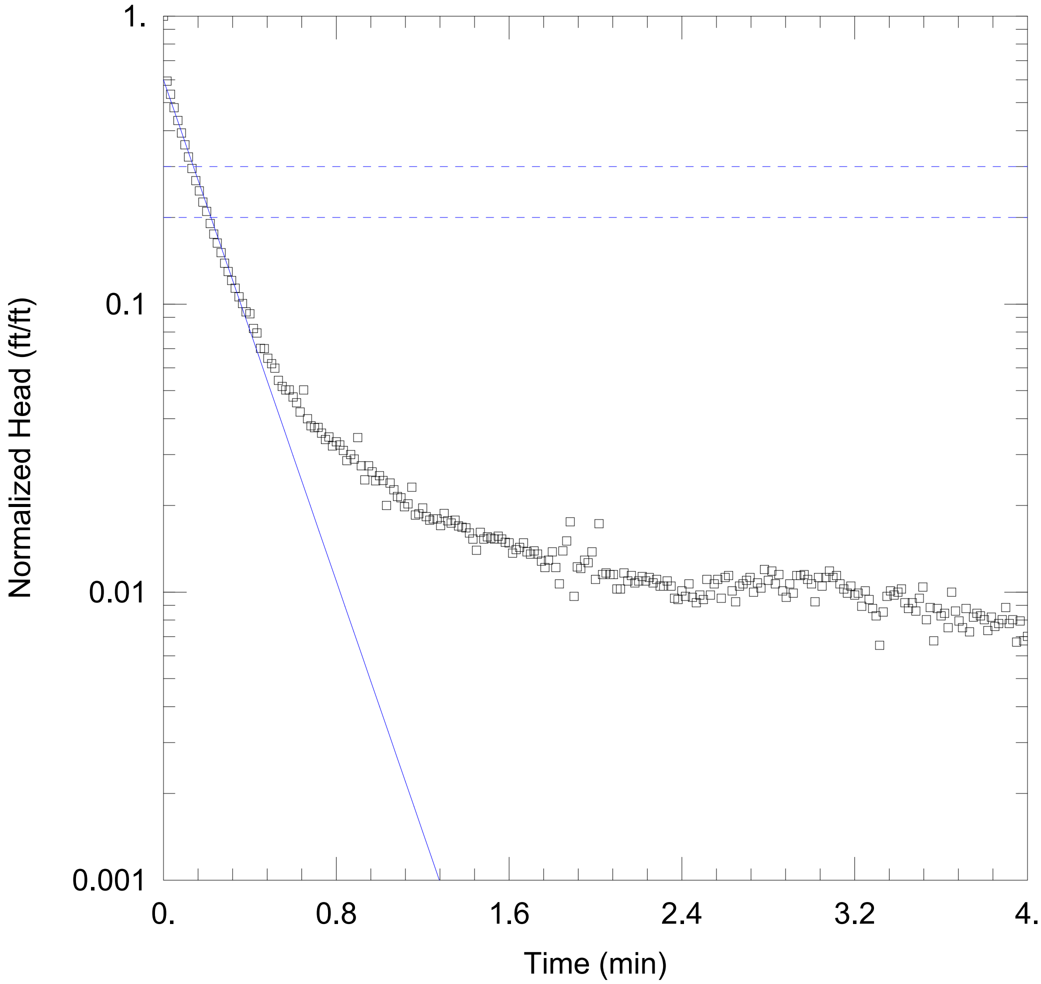
WELL DATA (MW-16)

Initial Displacement: 1.973 ft Static Water Column Height: 6.62 ft
Total Well Penetration Depth: 6.62 ft Screen Length: 5. ft
Casing Radius: 0.083 ft Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 13.32 ft/day y0 = 0.9376 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW16_SlugIn_2_BR.aqt
Date: 04/01/25 Time: 13:35:33

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-16
Test Date: 8/15/2024

AQUIFER DATA

Saturated Thickness: 6.62 ft Anisotropy Ratio (Kz/Kr): 1.

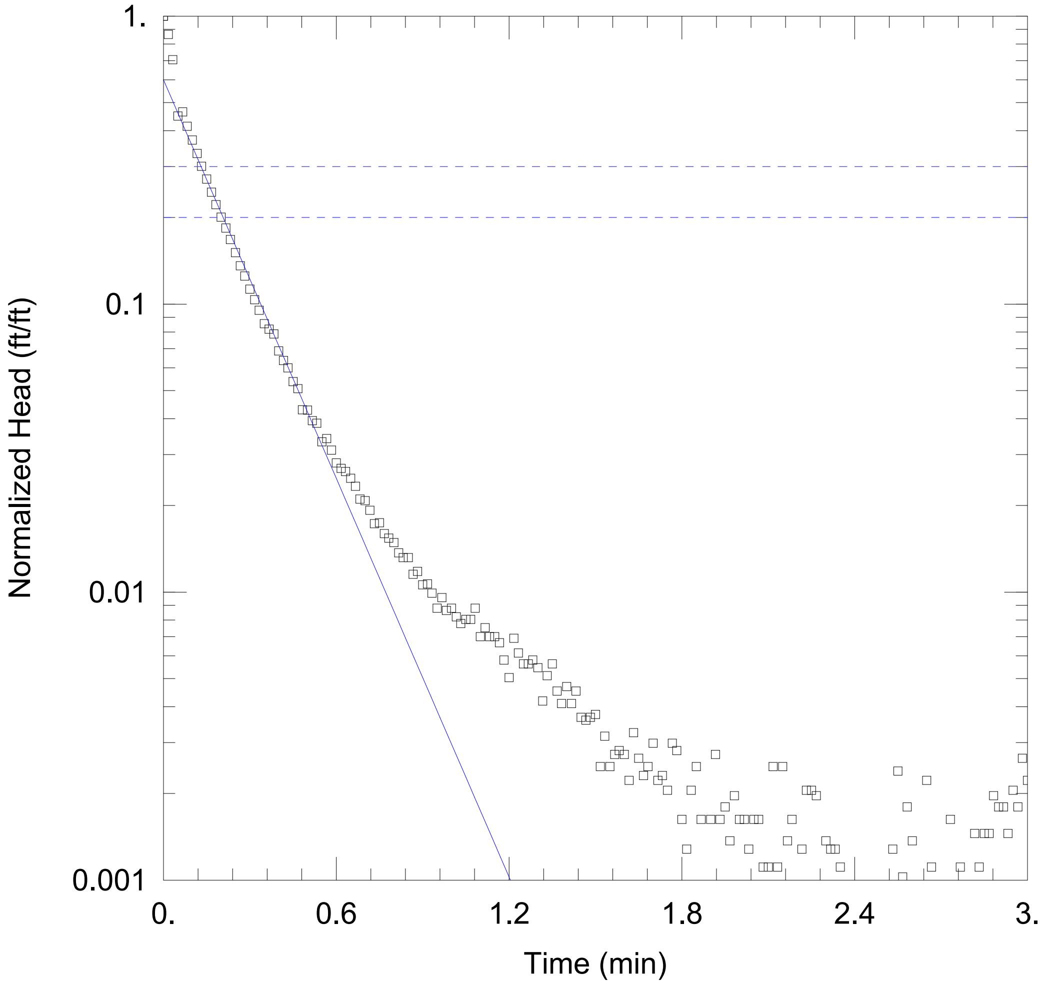
WELL DATA (MW-16 - Slug In 2)

Initial Displacement: 1.21 ft Static Water Column Height: 6.62 ft
Total Well Penetration Depth: 6.62 ft Screen Length: 5. ft
Casing Radius: 0.083 ft Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 16.51 ft/day y0 = 0.727 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW16_SlugIn_3_BR.aqt
Date: 04/01/25 Time: 13:37:00

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-16
Test Date: 8/15/2024

AQUIFER DATA

Saturated Thickness: 6.62 ft Anisotropy Ratio (Kz/Kr): 1.

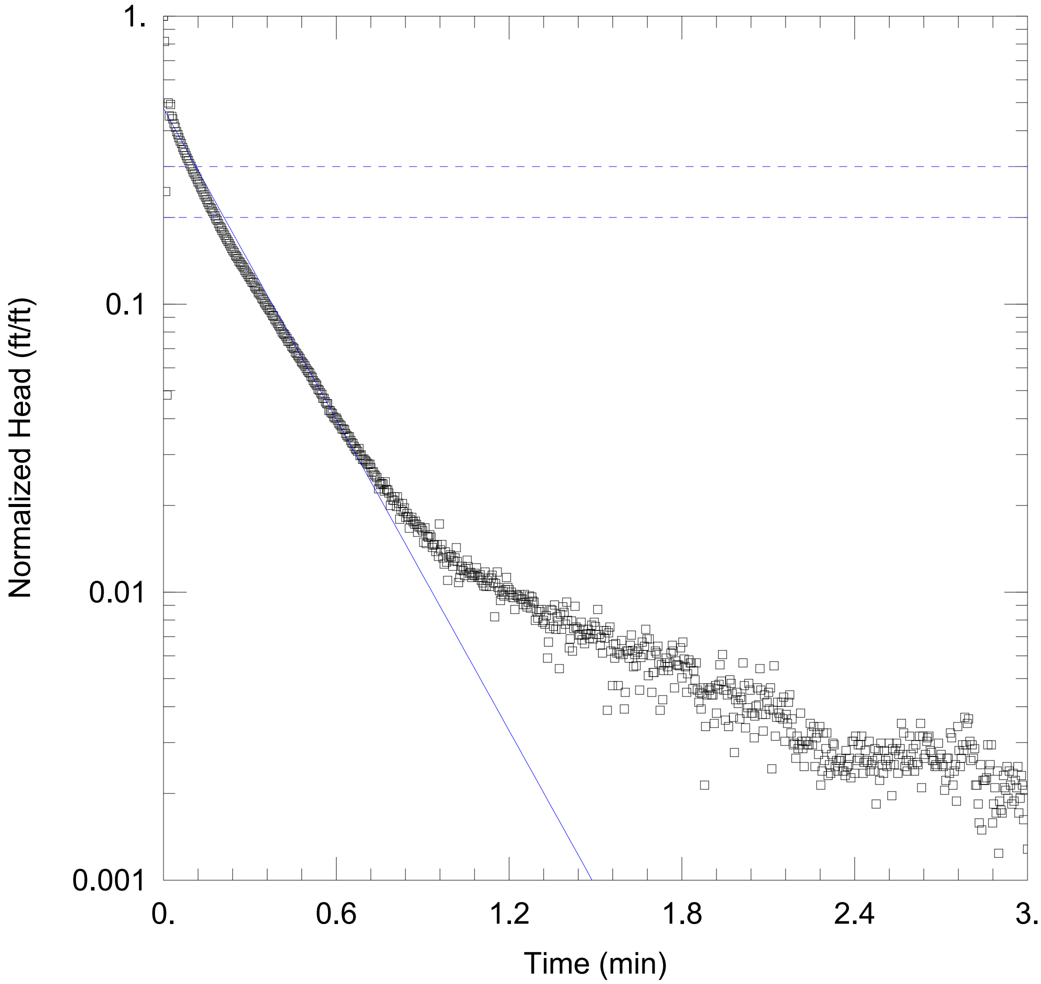
WELL DATA (MW-16 - Slug In 3)

Initial Displacement: 1.171 ft Static Water Column Height: 6.62 ft
Total Well Penetration Depth: 6.62 ft Screen Length: 5. ft
Casing Radius: 0.083 ft Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 17.5 ft/day y0 = 0.7026 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW16_SlugOut_1_BR.aqt
Date: 04/01/25 Time: 13:38:11

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-16
Test Date: 8/15/2024

AQUIFER DATA

Saturated Thickness: 6.62 ft
Anisotropy Ratio (Kz/Kr): 1.

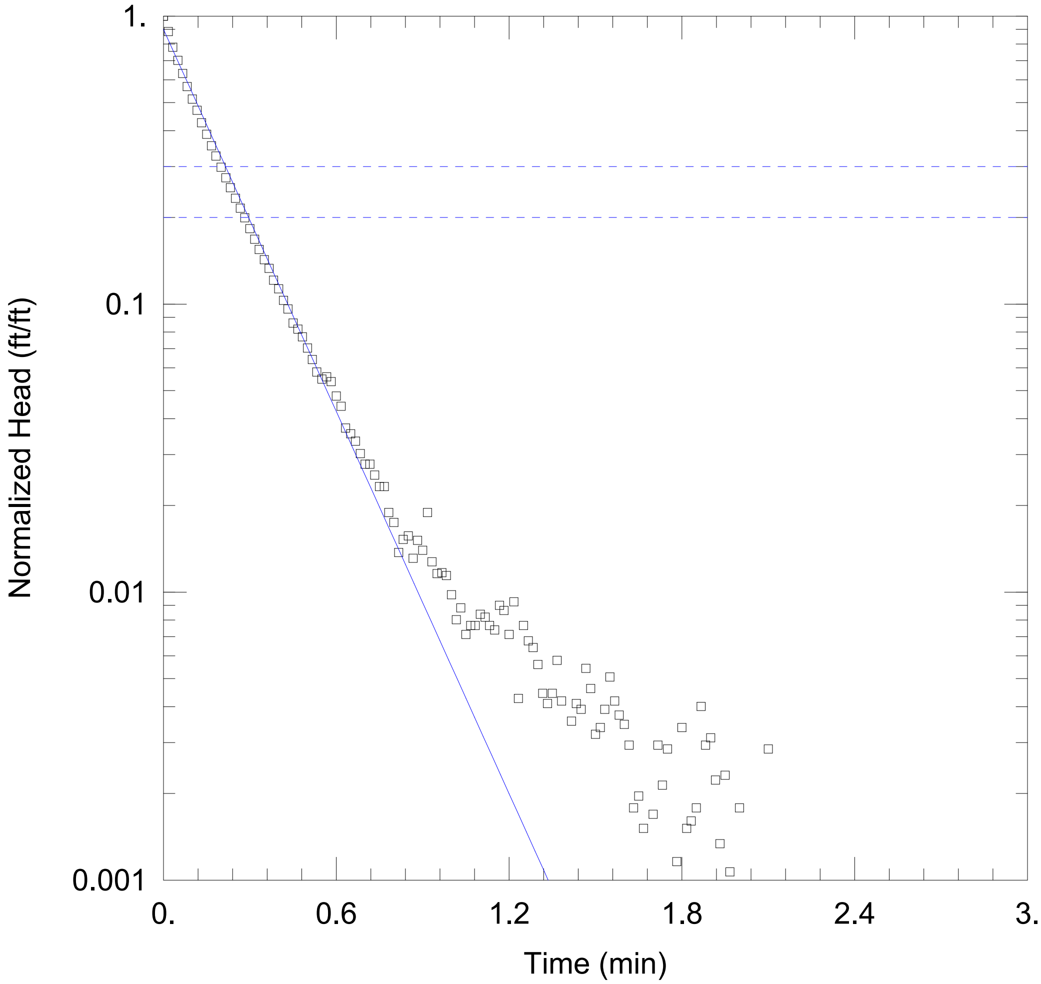
WELL DATA (MW-16 - Slug Out 1)

Initial Displacement: 2.343 ft
Static Water Column Height: 6.62 ft
Total Well Penetration Depth: 6.62 ft
Screen Length: 5. ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 13.66 ft/day
y0 = 1.119 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW16_SlugOut_2_BR.aqt
Date: 04/01/25 Time: 13:39:11

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-16
Test Date: 8/15/2024

AQUIFER DATA

Saturated Thickness: 6.62 ft Anisotropy Ratio (Kz/Kr): 1.

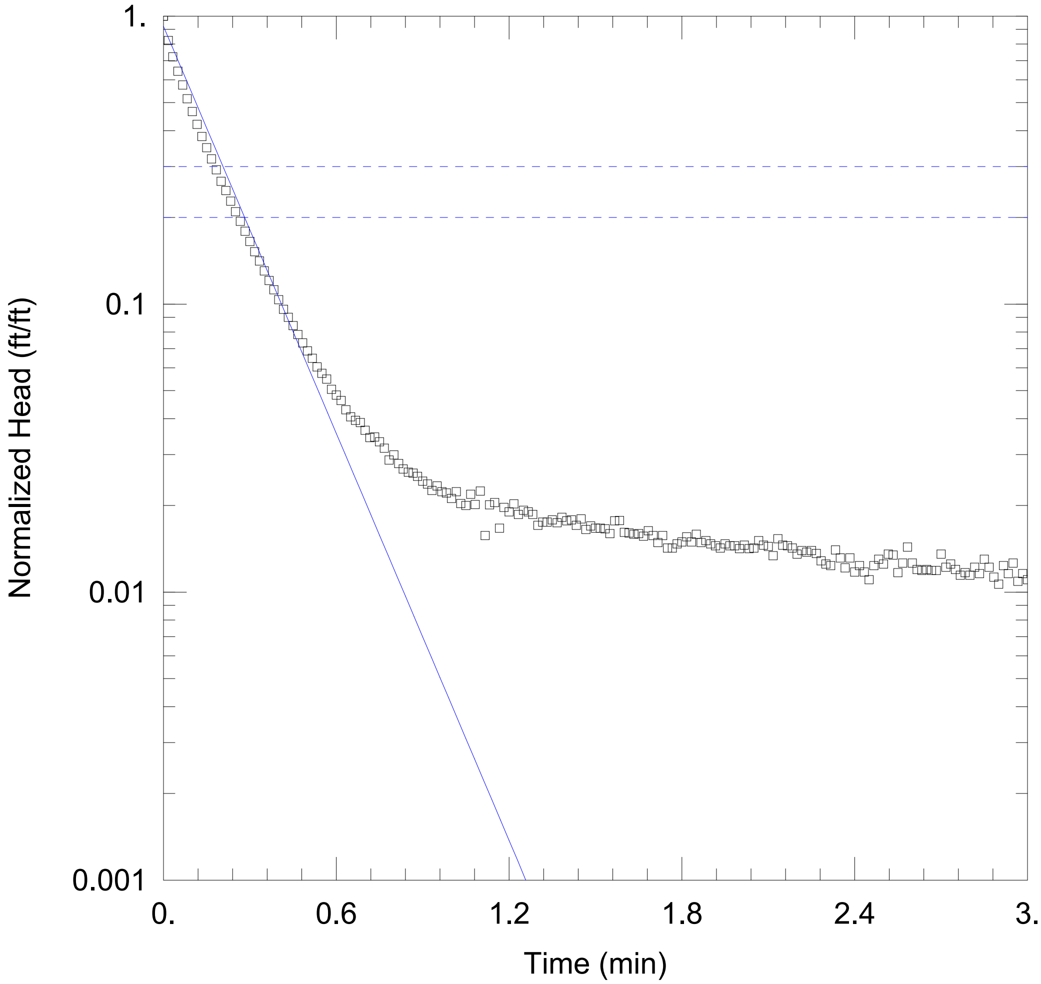
WELL DATA (MW-16 - Slug Out 2)

Initial Displacement: 1.123 ft Static Water Column Height: 6.62 ft
Total Well Penetration Depth: 6.62 ft Screen Length: 5. ft
Casing Radius: 0.083 ft Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 16.78 ft/day y0 = 1.009 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW16_SlugOut_3_BR.aqt
Date: 04/01/25 Time: 13:40:02

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-16
Test Date: 8/15/2024

AQUIFER DATA

Saturated Thickness: 6.62 ft Anisotropy Ratio (Kz/Kr): 1.

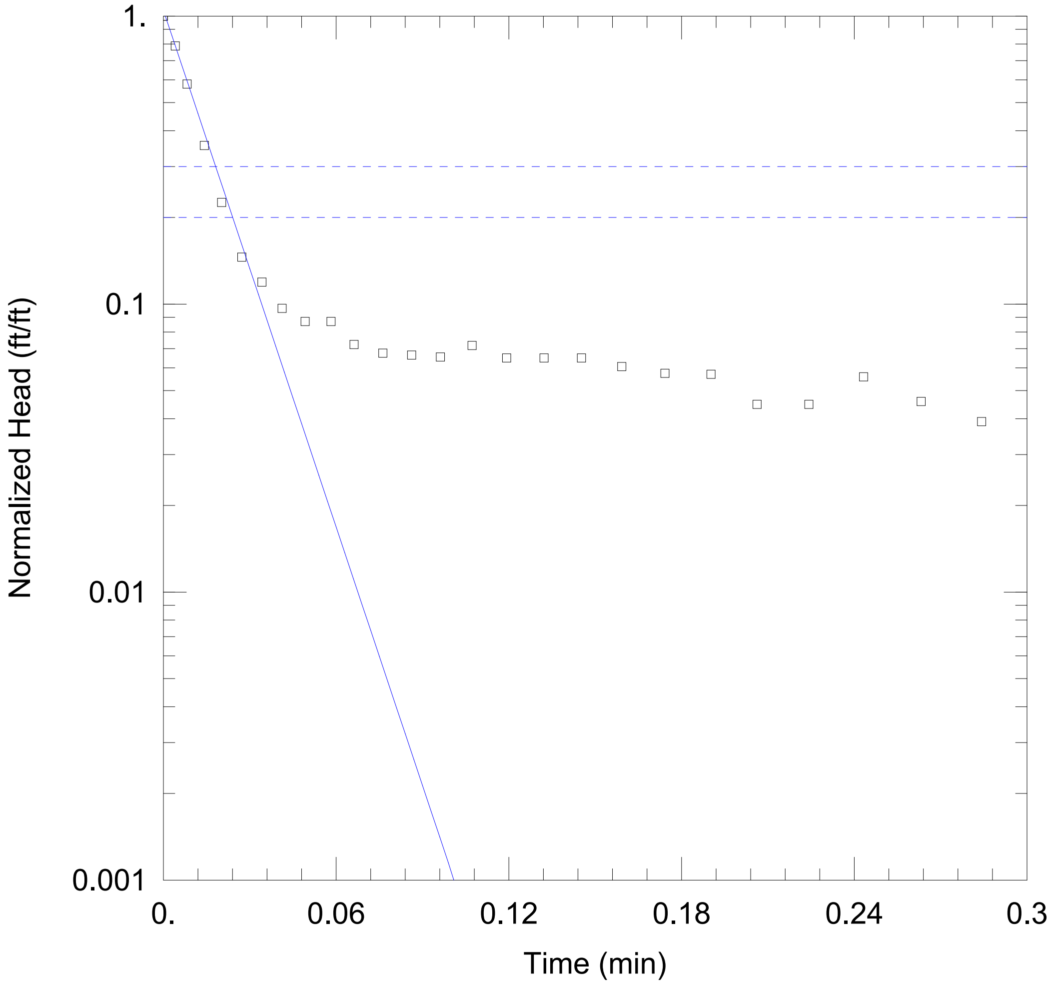
WELL DATA (MW-16 - Slug Out 3)

Initial Displacement: 1.286 ft Static Water Column Height: 6.62 ft
Total Well Penetration Depth: 6.62 ft Screen Length: 5. ft
Casing Radius: 0.083 ft Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 17.88 ft/day y0 = 1.184 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW17_SlugIn_1_BR.aqt
Date: 04/01/25 Time: 13:42:20

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-17
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 4.63 ft Anisotropy Ratio (Kz/Kr): 1.

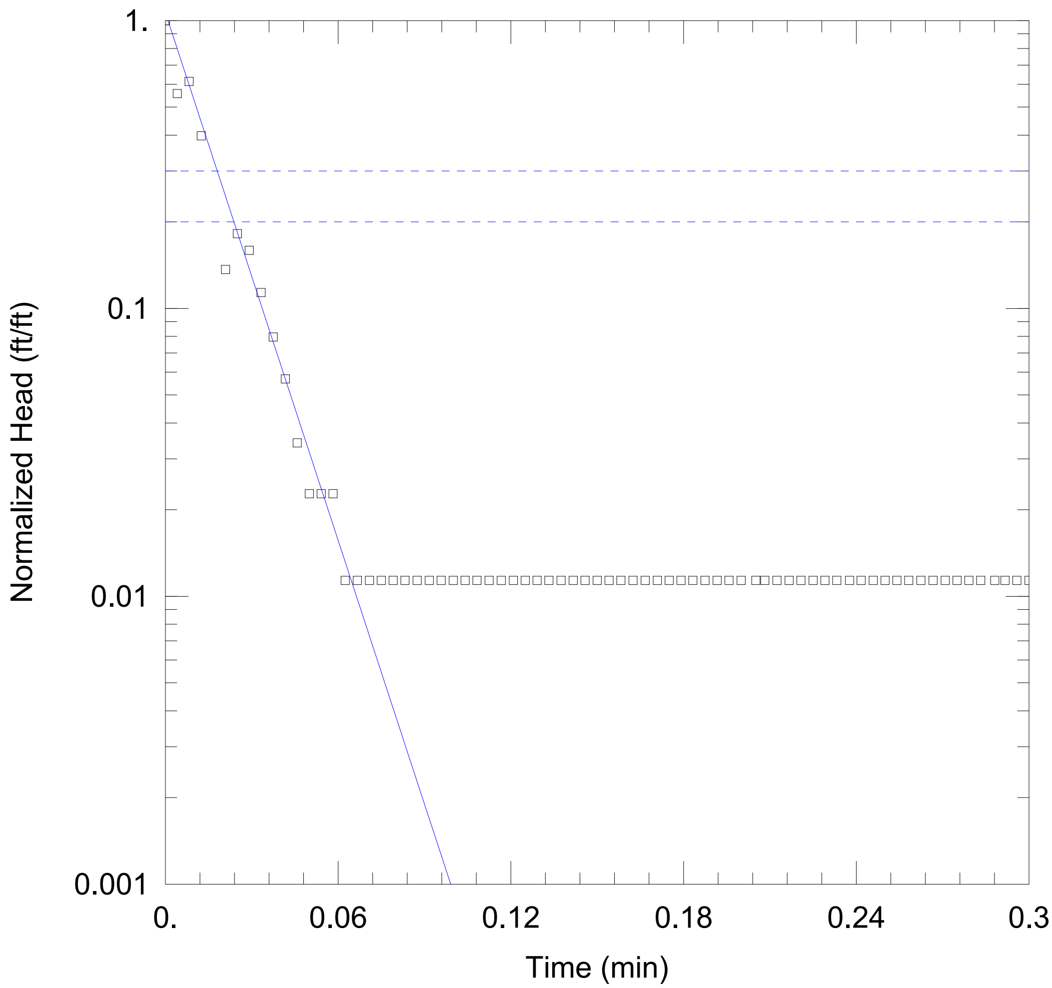
WELL DATA (MW-17 Slug In 1)

Initial Displacement: 0.1895 ft Static Water Column Height: 4.63 ft
Total Well Penetration Depth: 8.36 ft Screen Length: 5. ft
Casing Radius: 0.083 ft Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 254.9 ft/day y0 = 0.1986 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW17_SlugIn_2_BR.aqt
Date: 04/01/25 Time: 13:00:07

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-17
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 4.63 ft Anisotropy Ratio (Kz/Kr): 1.

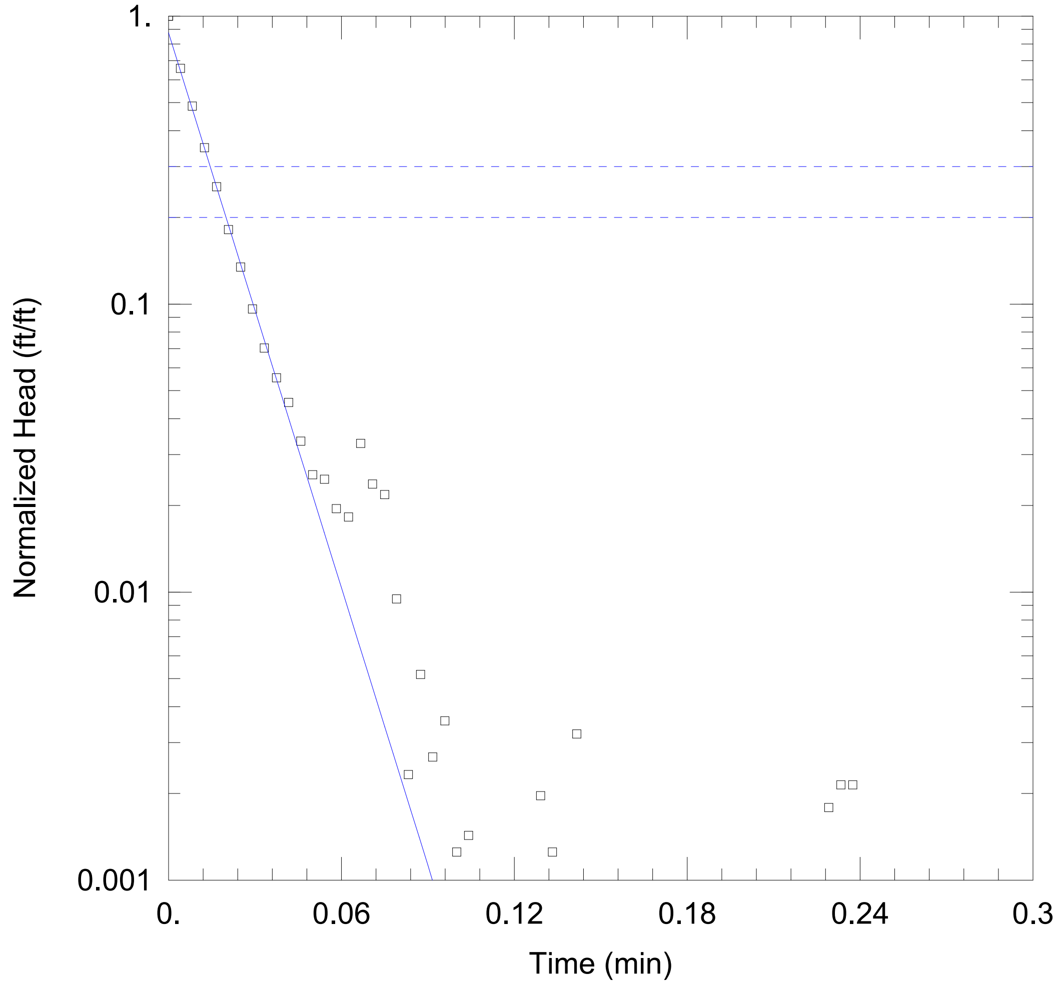
WELL DATA (MW-17 Slug In 2)

Initial Displacement: 0.88 ft Static Water Column Height: 4.63 ft
Total Well Penetration Depth: 8.36 ft Screen Length: 5. ft
Casing Radius: 0.083 ft Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 260.4 ft/day y0 = 0.9372 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW17_SlugOut_1_BR.aqt
Date: 04/01/25 Time: 14:31:22

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-17
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 4.63 ft Anisotropy Ratio (Kz/Kr): 1.

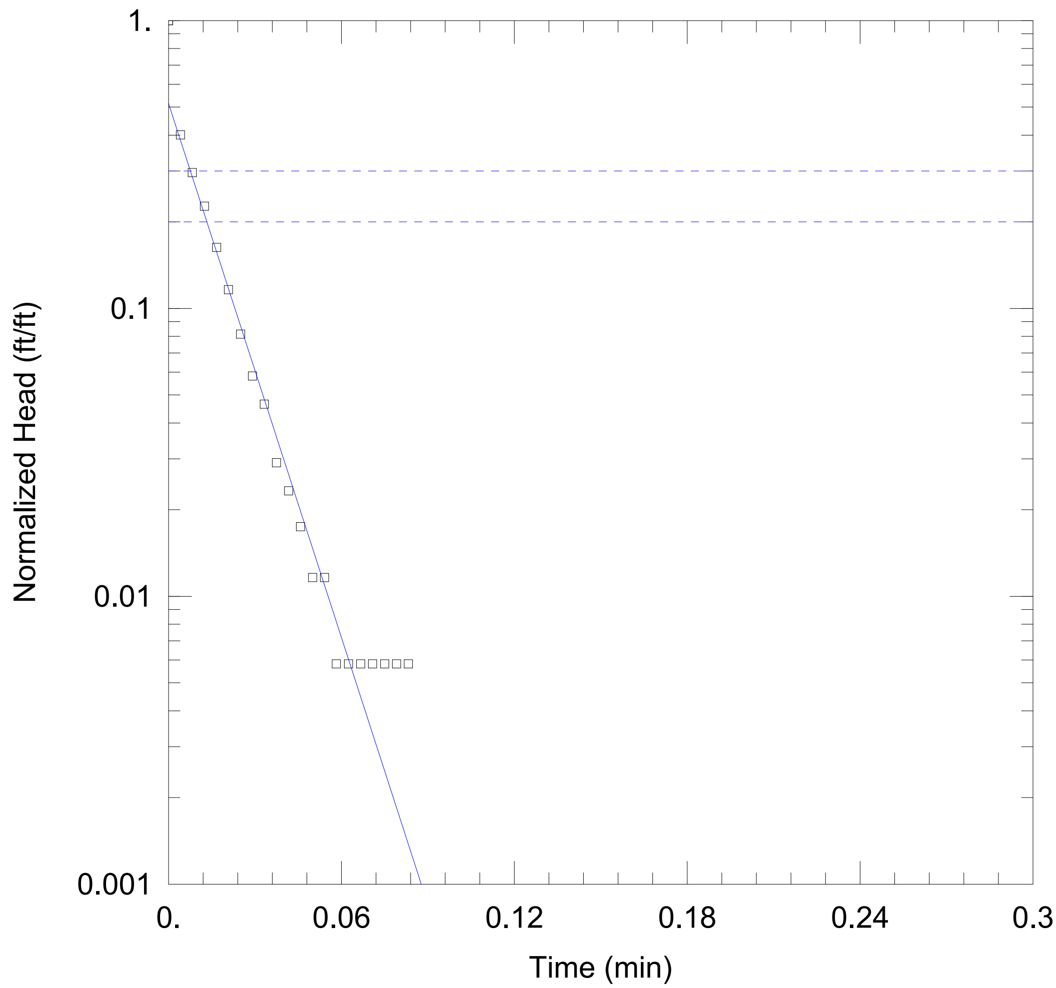
WELL DATA (MW-17 Slug Out 1)

Initial Displacement: 0.5602 ft Static Water Column Height: 4.63 ft
Total Well Penetration Depth: 8.36 ft Screen Length: 5. ft
Casing Radius: 0.083 ft Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 273.6 ft/day y0 = 0.4893 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW17_SlugOut_2_BR.aqt
Date: 04/01/25 Time: 13:02:49

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-17
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 4.63 ft
Anisotropy Ratio (Kz/Kr): 1.

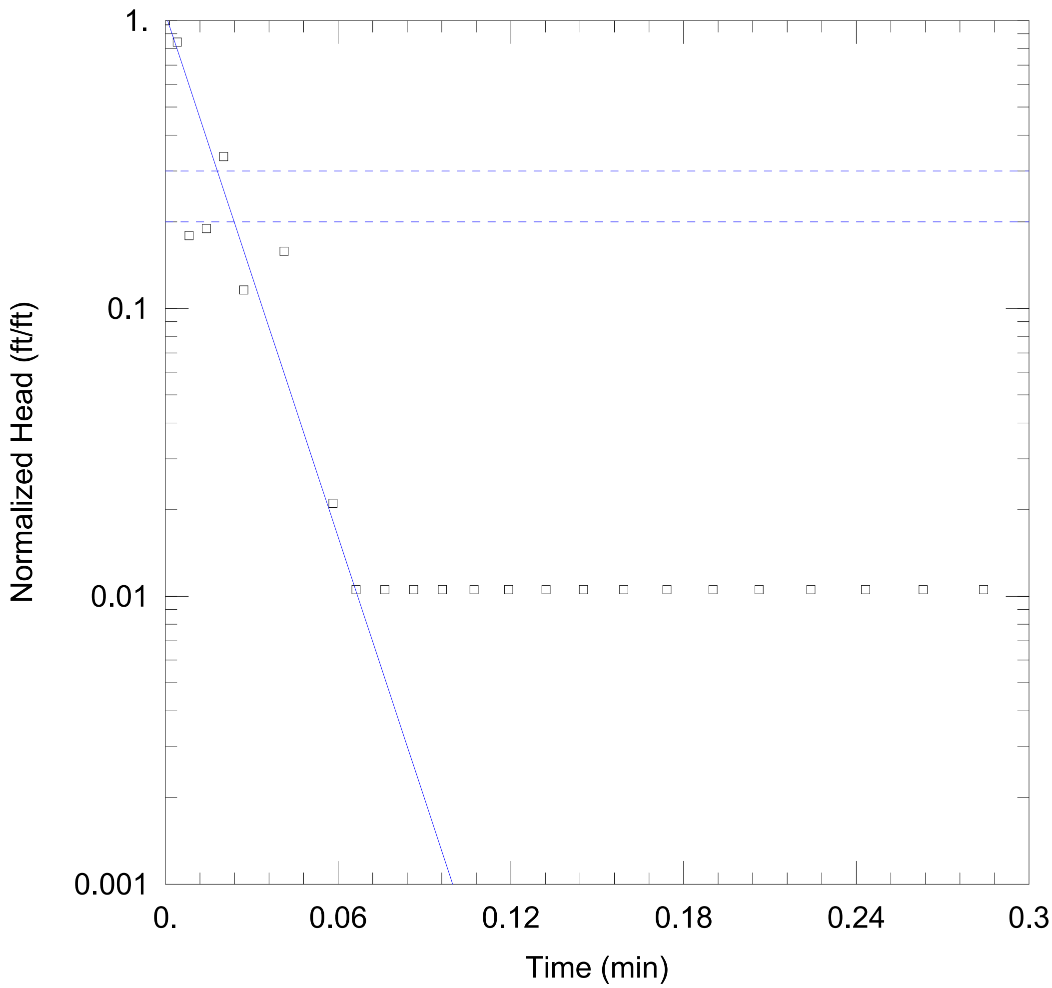
WELL DATA (MW-17 Slug Out 2)

Initial Displacement: 1.72 ft
Static Water Column Height: 4.63 ft
Total Well Penetration Depth: 8.36 ft
Screen Length: 5. ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 263.5 ft/day
y0 = 0.8844 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW20_SlugIn_1_BR.aqt
Date: 04/01/25 Time: 13:03:33

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-20
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 5.89 ft Anisotropy Ratio (Kz/Kr): 1.

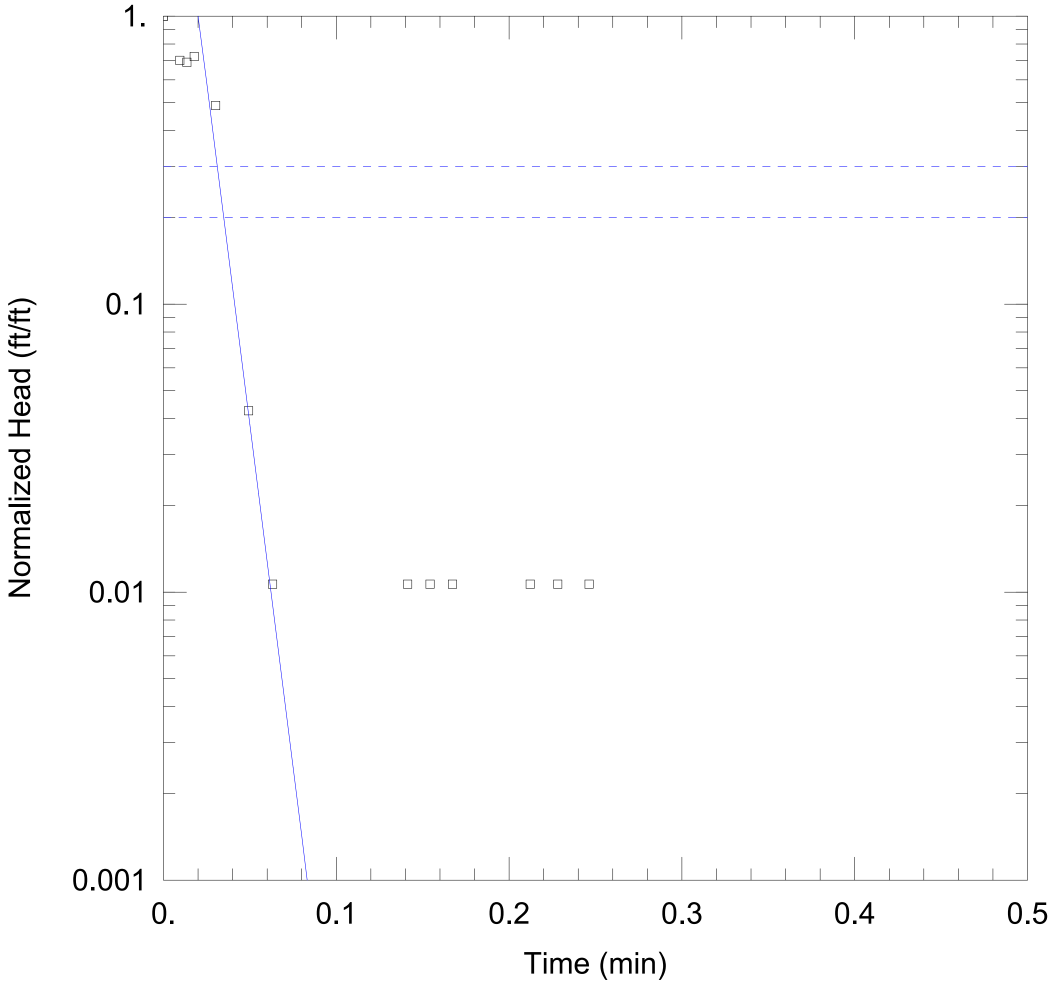
WELL DATA (MW-20 Slug In 1)

Initial Displacement: 0.95 ft Static Water Column Height: 5.89 ft
Total Well Penetration Depth: 7.95 ft Screen Length: 5. ft
Casing Radius: 0.083 ft Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 238. ft/day y0 = 1.004 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW20_SlugIn_2_BR.aqt
Date: 04/01/25 Time: 13:04:29

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-20
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 5.89 ft Anisotropy Ratio (Kz/Kr): 1.

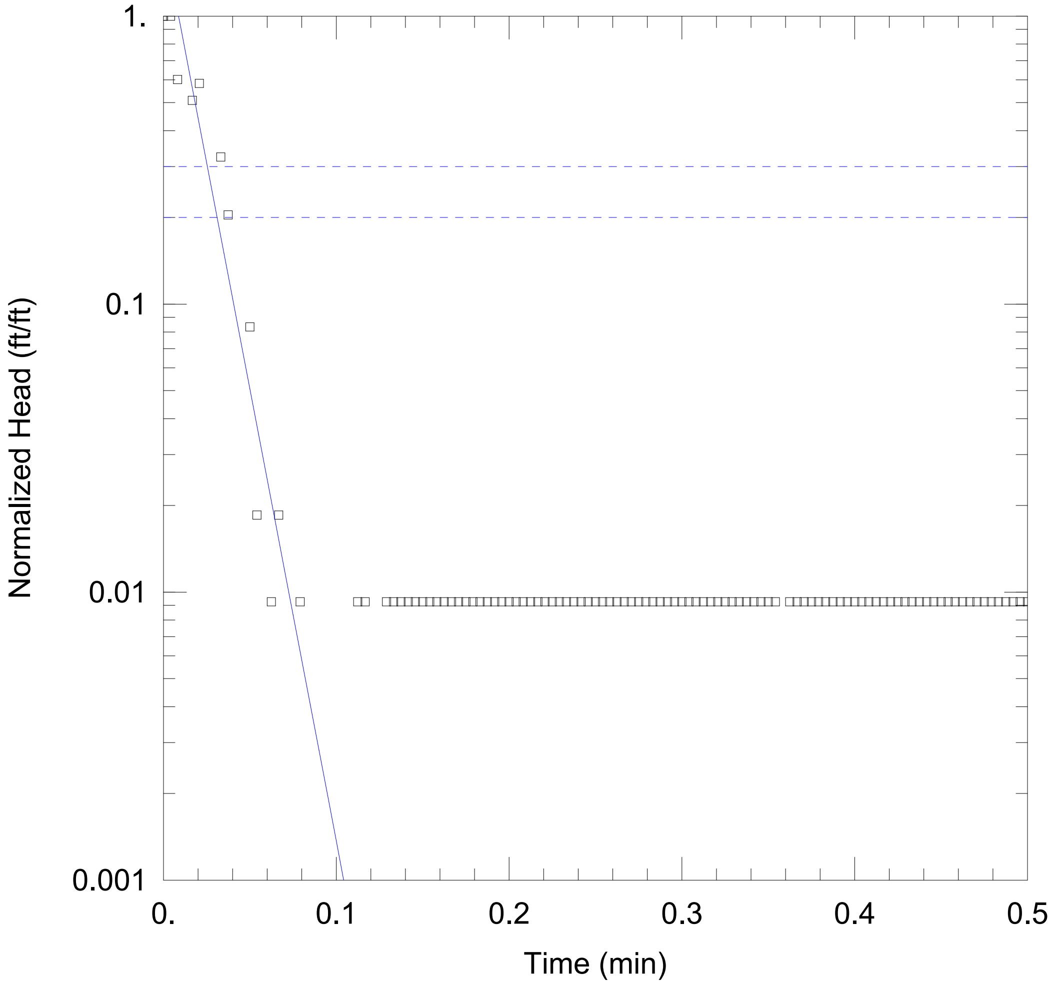
WELL DATA (MW-20 Slug In 2)

Initial Displacement: 0.94 ft Static Water Column Height: 5.89 ft
Total Well Penetration Depth: 7.95 ft Screen Length: 5. ft
Casing Radius: 0.083 ft Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 373.4 ft/day y0 = 8.526 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW20_SlugIn_3_BR.aqt
Date: 04/01/25 Time: 13:05:37

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-20
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 5.89 ft Anisotropy Ratio (Kz/Kr): 1.

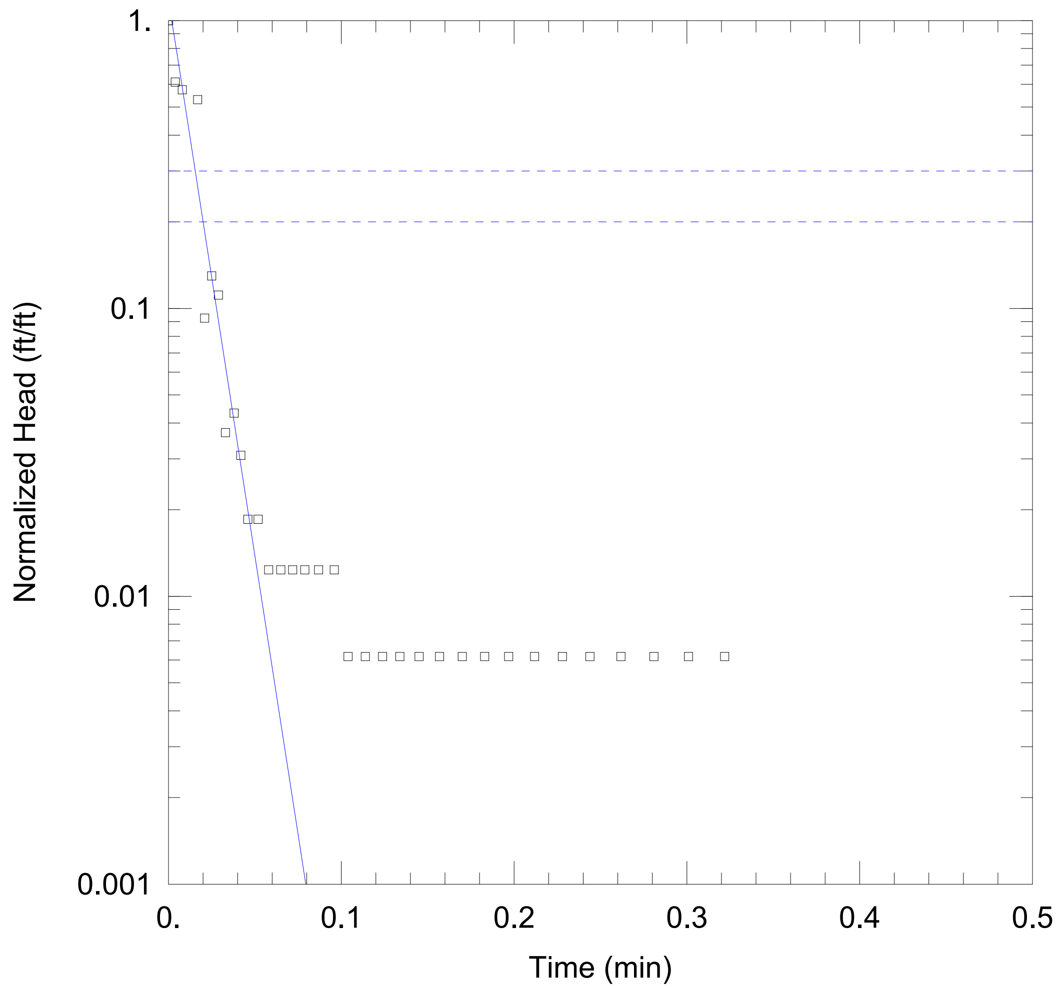
WELL DATA (MW-20 Slug In 3)

Initial Displacement: 1.08 ft
Total Well Penetration Depth: 7.95 ft
Casing Radius: 0.083 ft
Static Water Column Height: 5.89 ft
Screen Length: 5. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 246.4 ft/day y0 = 2.029 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW20_SlugOut_1_BR.aqt
Date: 04/01/25 Time: 13:04:58

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-20
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 5.89 ft Anisotropy Ratio (Kz/Kr): 1.

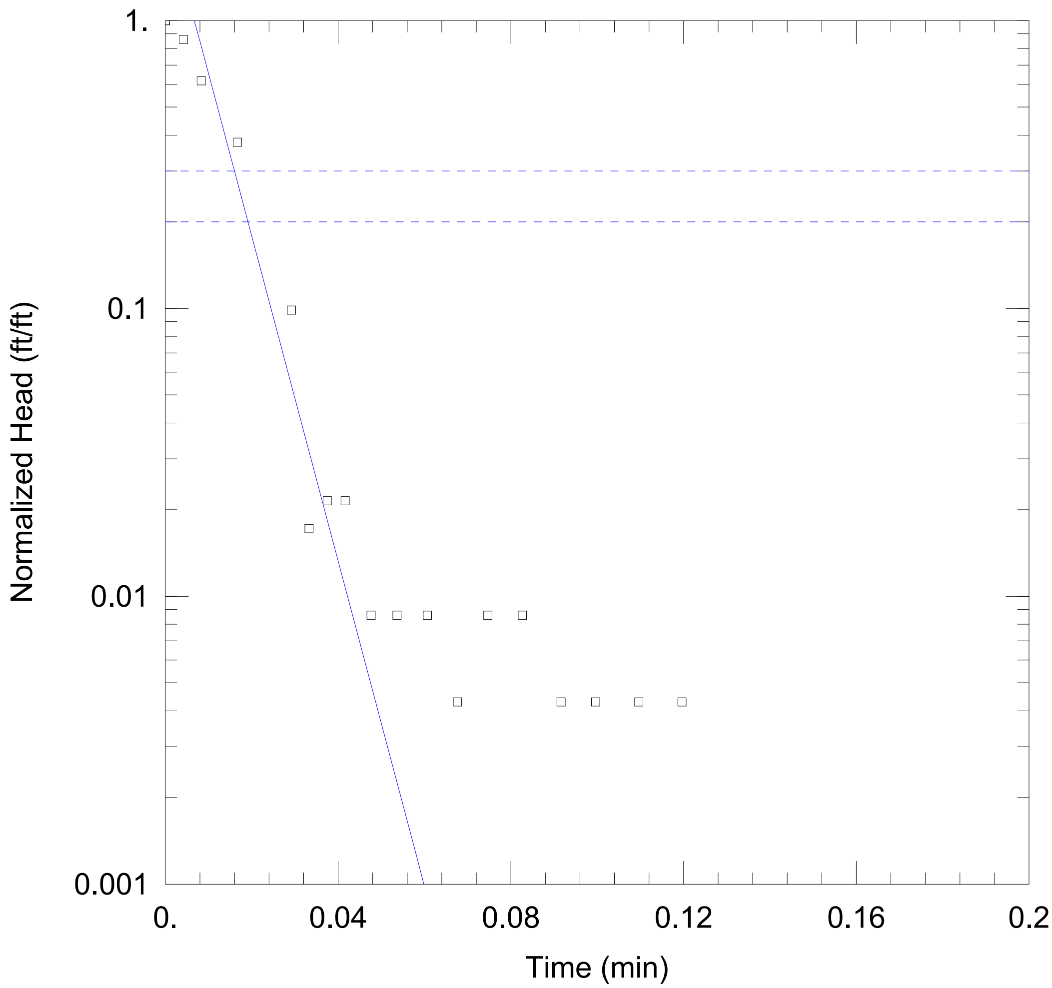
WELL DATA (MW-20 Slug Out 1)

Initial Displacement: 1.62 ft Static Water Column Height: 5.89 ft
Total Well Penetration Depth: 7.95 ft Screen Length: 5. ft
Casing Radius: 0.083 ft Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 304.1 ft/day y0 = 1.932 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW20_SlugOut_2_BR.aqt
Date: 04/01/25 Time: 13:06:06

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-20
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 5.89 ft Anisotropy Ratio (Kz/Kr): 1.

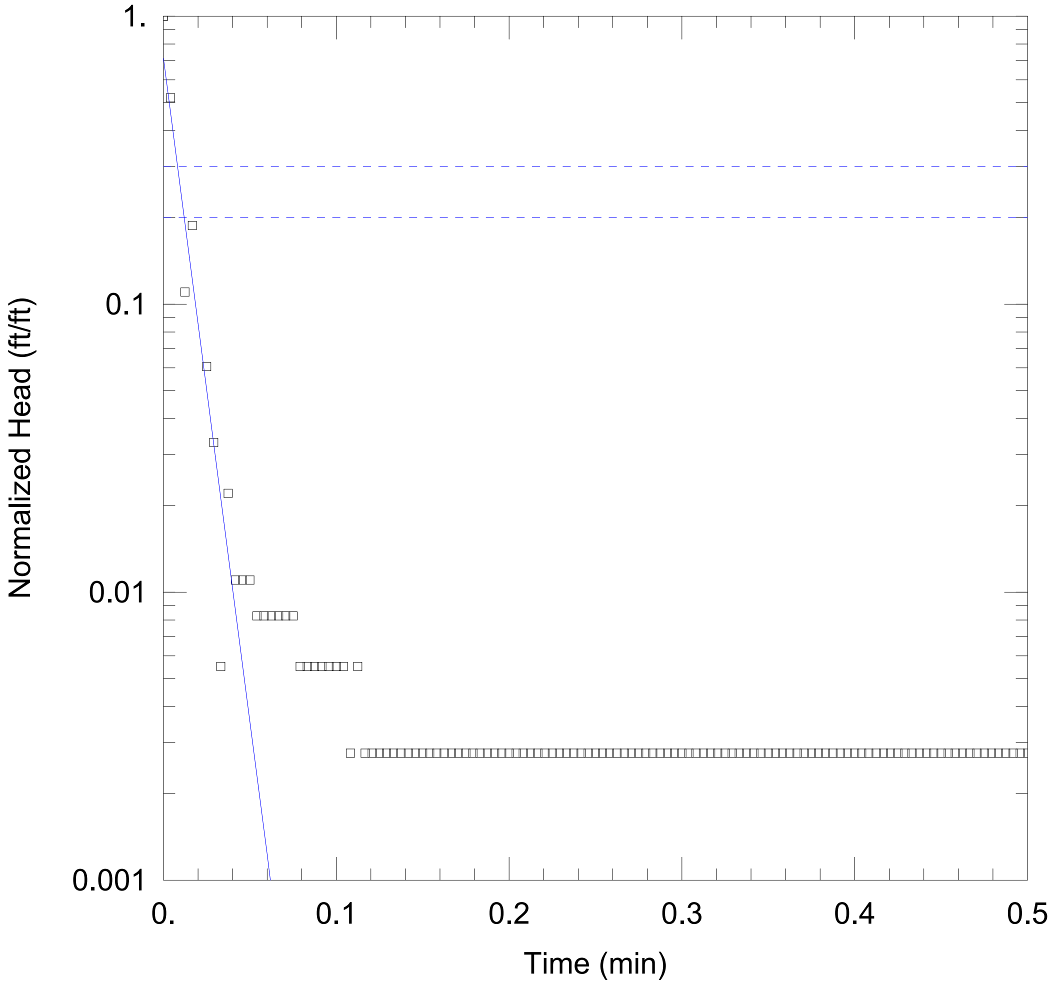
WELL DATA (MW-20 Slug Out 2)

Initial Displacement: 2.33 ft Static Water Column Height: 5.89 ft
Total Well Penetration Depth: 7.95 ft Screen Length: 5. ft
Casing Radius: 0.083 ft Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 443.1 ft/day y0 = 5.584 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW20_SlugOut_3_BR.aqt
Date: 04/01/25 Time: 13:06:44

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-20
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 5.89 ft Anisotropy Ratio (Kz/Kr): 1.

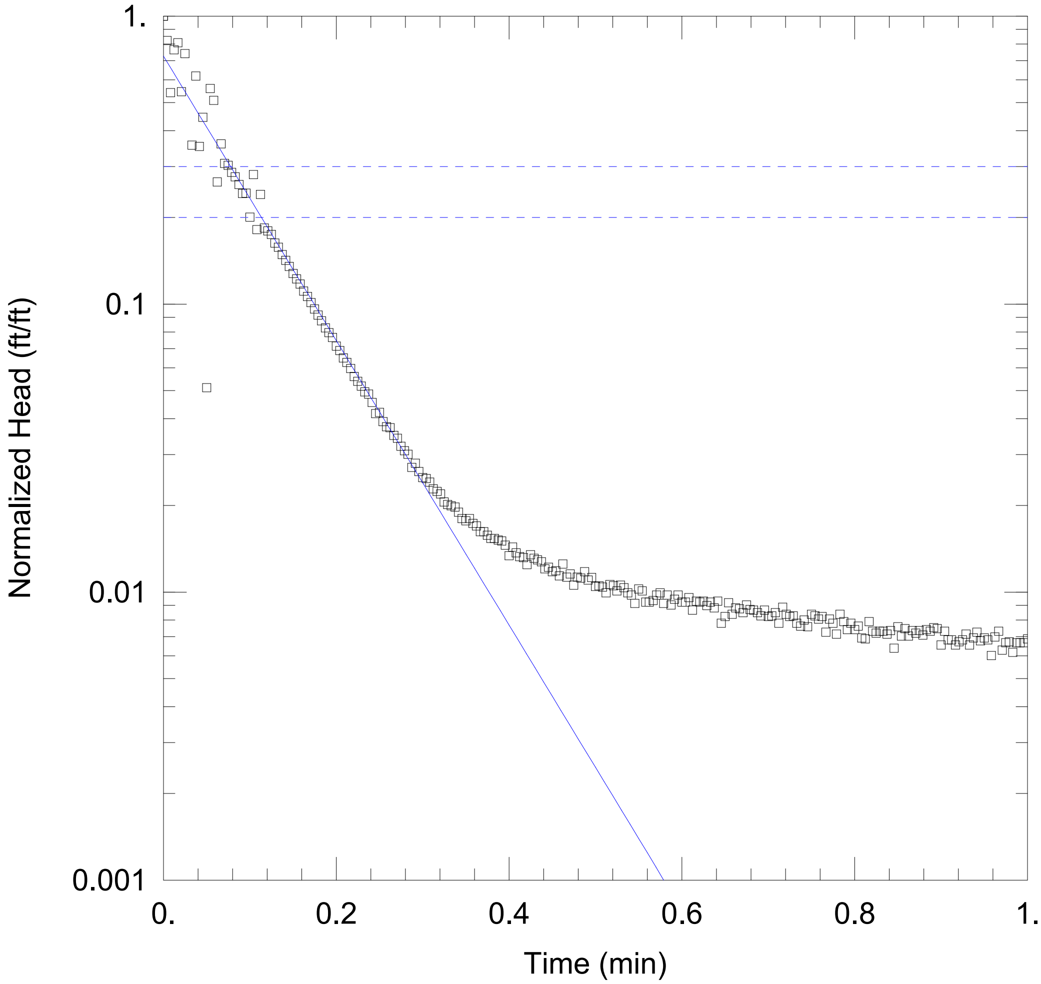
WELL DATA (MW-20 Slug Out 3)

Initial Displacement: 3.63 ft Static Water Column Height: 5.89 ft
Total Well Penetration Depth: 7.95 ft Screen Length: 5. ft
Casing Radius: 0.083 ft Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 361.7 ft/day y0 = 2.586 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW32_SlugIn_1_BR.aqt
Date: 04/01/25
Time: 13:46:02

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-32
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 5.58 ft
Anisotropy Ratio (Kz/Kr): 1.

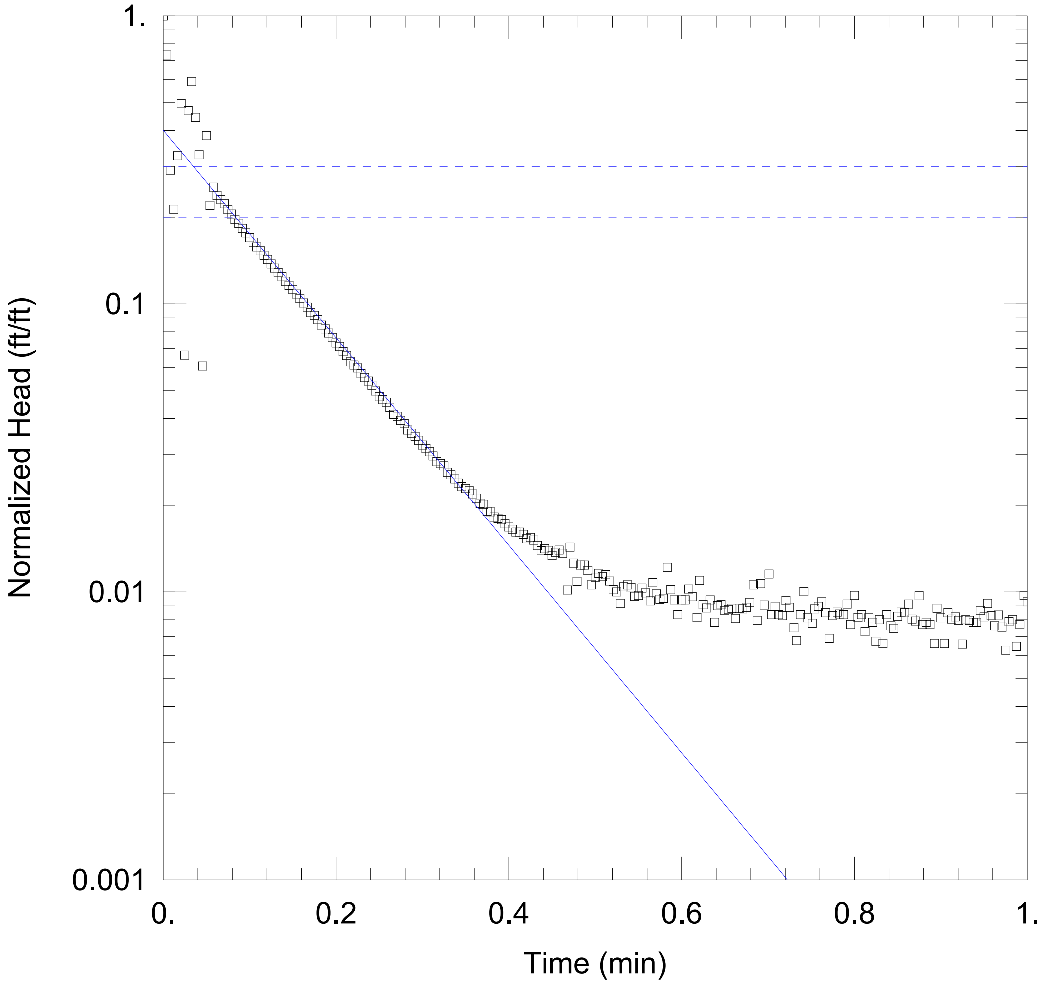
WELL DATA (MW-32 Slug In 1)

Initial Displacement: 1.862 ft
Static Water Column Height: 5.58 ft
Total Well Penetration Depth: 8.5 ft
Screen Length: 5. ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 39.26 ft/day
y0 = 1.352 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW32_SlugIn_2_BR.aqt
Date: 04/01/25 Time: 13:46:49

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-32
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 5.58 ft
Anisotropy Ratio (Kz/Kr): 1.

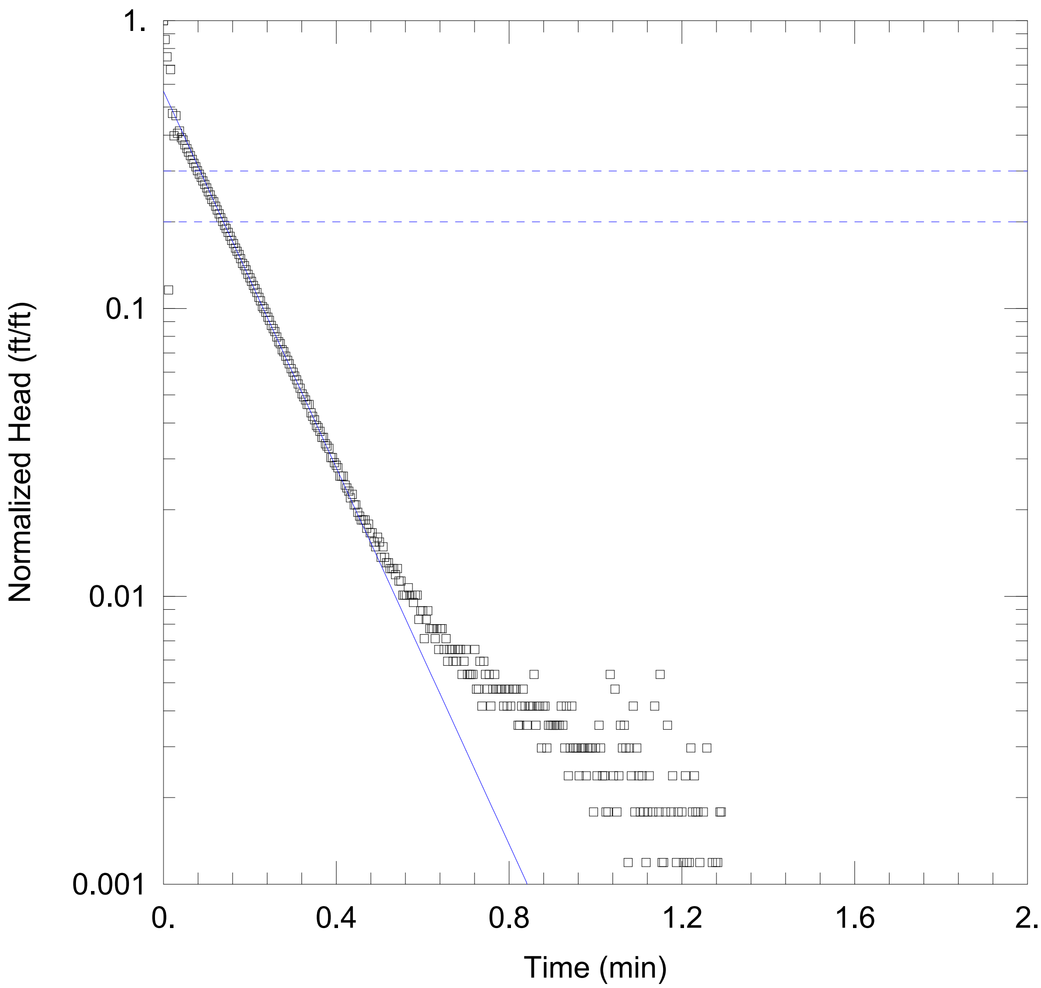
WELL DATA (MW-32 Slug In 2)

Initial Displacement: 2.615 ft
Total Well Penetration Depth: 8.5 ft
Casing Radius: 0.083 ft
Static Water Column Height: 5.58 ft
Screen Length: 5. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 28.63 ft/day
y0 = 1.047 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW32_SlugIn_3_BR.aqt
Date: 04/01/25 Time: 13:47:45

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-32
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 5.58 ft Anisotropy Ratio (Kz/Kr): 1.

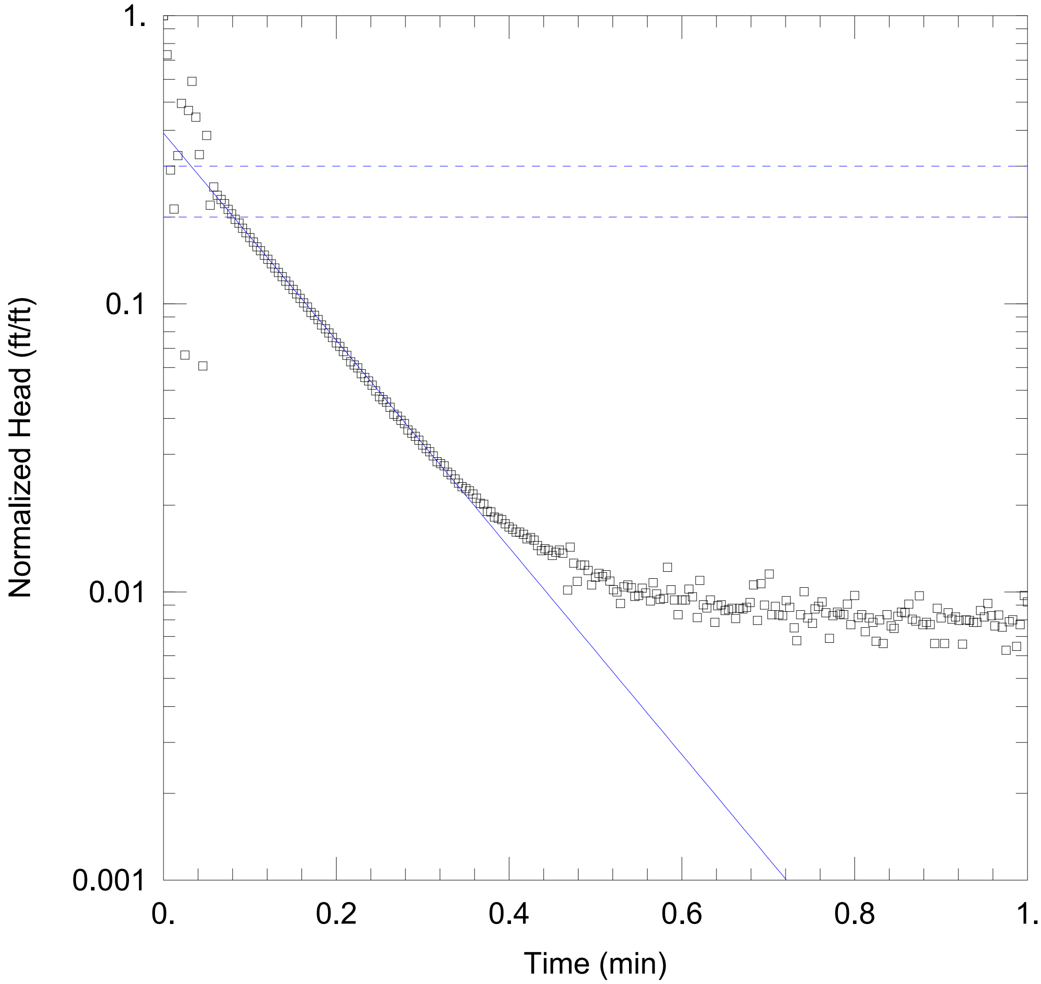
WELL DATA (MW-32 Slug In 3)

Initial Displacement: 1.684 ft Static Water Column Height: 5.58 ft
Total Well Penetration Depth: 8.5 ft Screen Length: 5. ft
Casing Radius: 0.083 ft Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 25.99 ft/day y0 = 0.9567 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW32_SlugOut_1_BR.aqt
Date: 04/01/25 Time: 13:48:51

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-32
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 5.58 ft Anisotropy Ratio (Kz/Kr): 1.

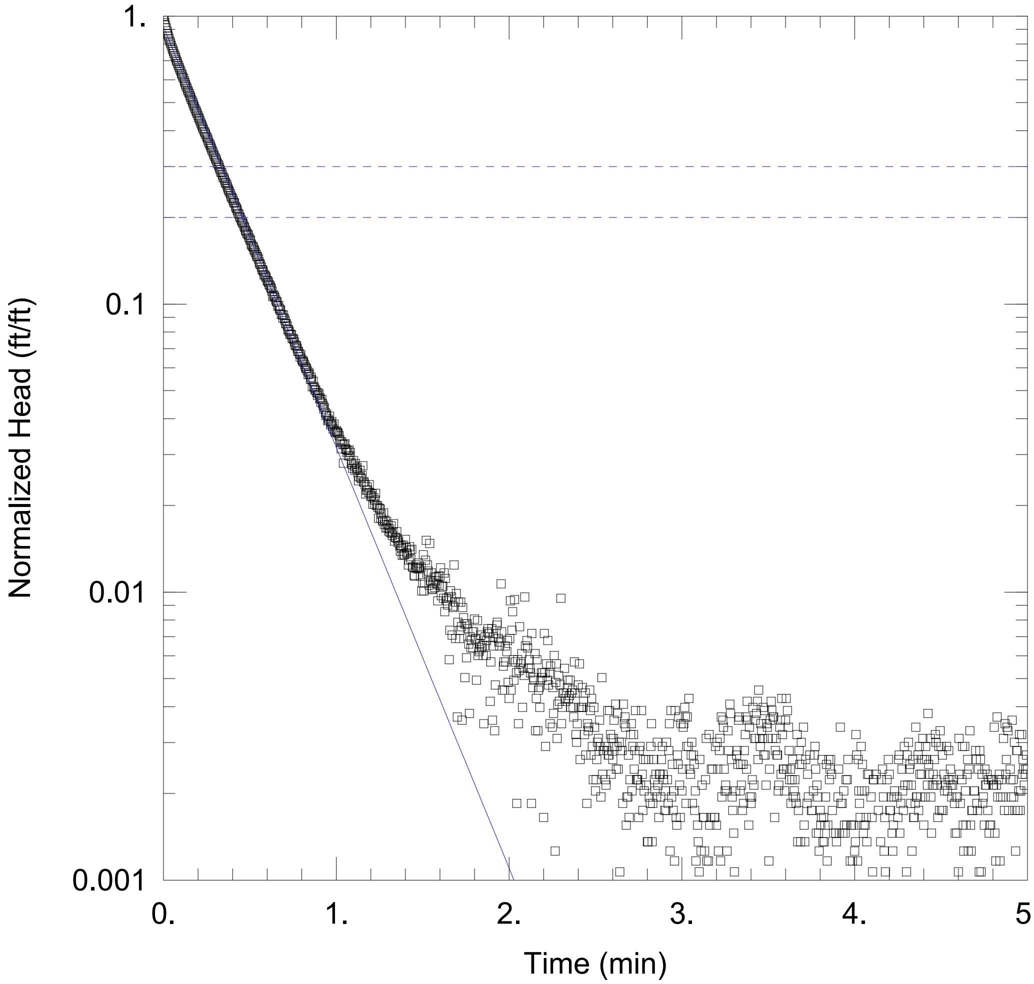
WELL DATA (MW-32 Slug Out 1)

Initial Displacement: 2.615 ft
Total Well Penetration Depth: 8.5 ft
Casing Radius: 0.083 ft
Static Water Column Height: 5.58 ft
Screen Length: 5. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 28.58 ft/day y0 = 1.022 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW32_SlugOut_2_BR.aqt
Date: 04/01/25 Time: 13:49:53

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-32
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 5.58 ft Anisotropy Ratio (Kz/Kr): 1.

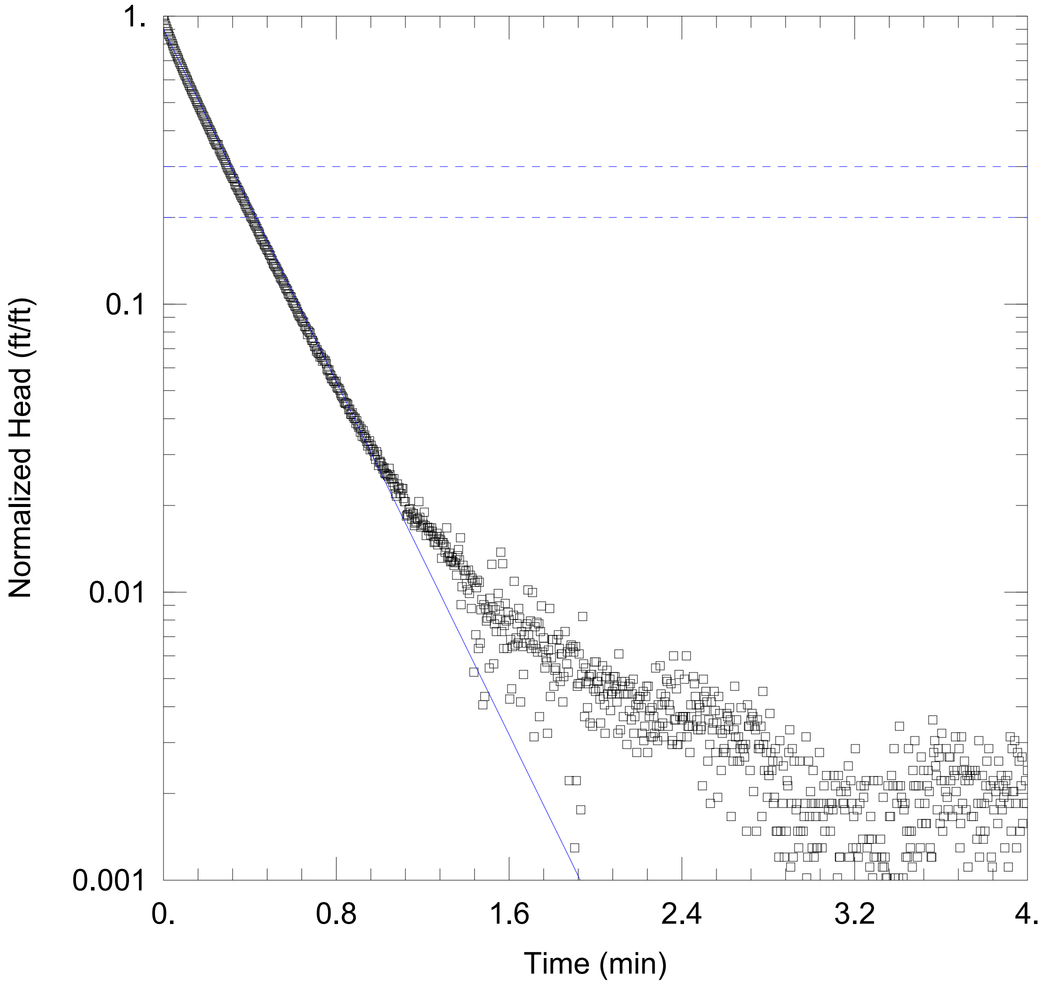
WELL DATA (MW-32 Slug Out 2)

Initial Displacement: 1.031 ft
Total Well Penetration Depth: 8.5 ft
Casing Radius: 0.083 ft
Static Water Column Height: 5.58 ft
Screen Length: 5. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 11.6 ft/day y0 = 0.9443 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW32_SlugOut_3_BR.aqt
Date: 04/01/25 Time: 13:50:47

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-32
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 5.58 ft Anisotropy Ratio (Kz/Kr): 1.

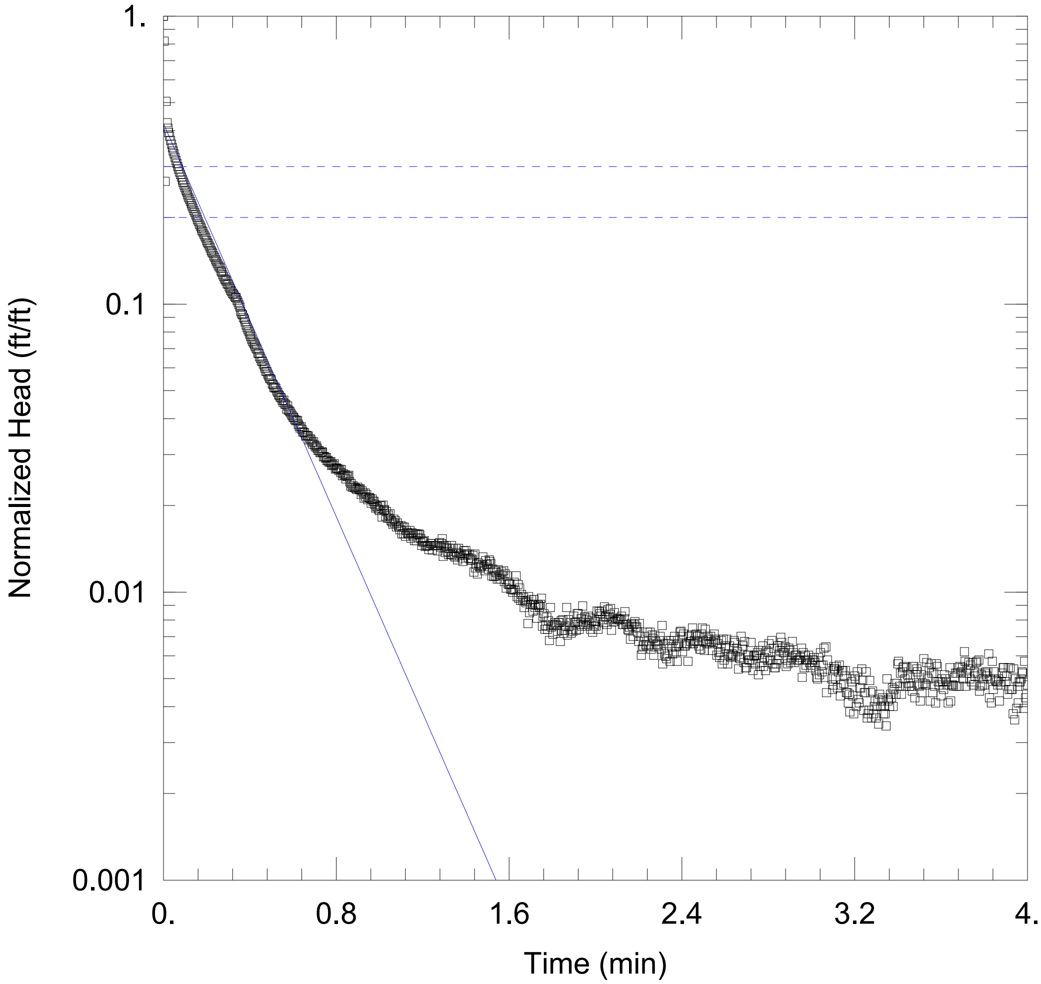
WELL DATA (MW-32 Slug Out 3)

Initial Displacement: 1.083 ft Static Water Column Height: 5.58 ft
Total Well Penetration Depth: 8.5 ft Screen Length: 5. ft
Casing Radius: 0.083 ft Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 12.17 ft/day y0 = 0.9755 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW36_SlugIn_1.aqt
Date: 04/01/25
Time: 13:52:01

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-36
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 3.76 ft
Anisotropy Ratio (Kz/Kr): 1.

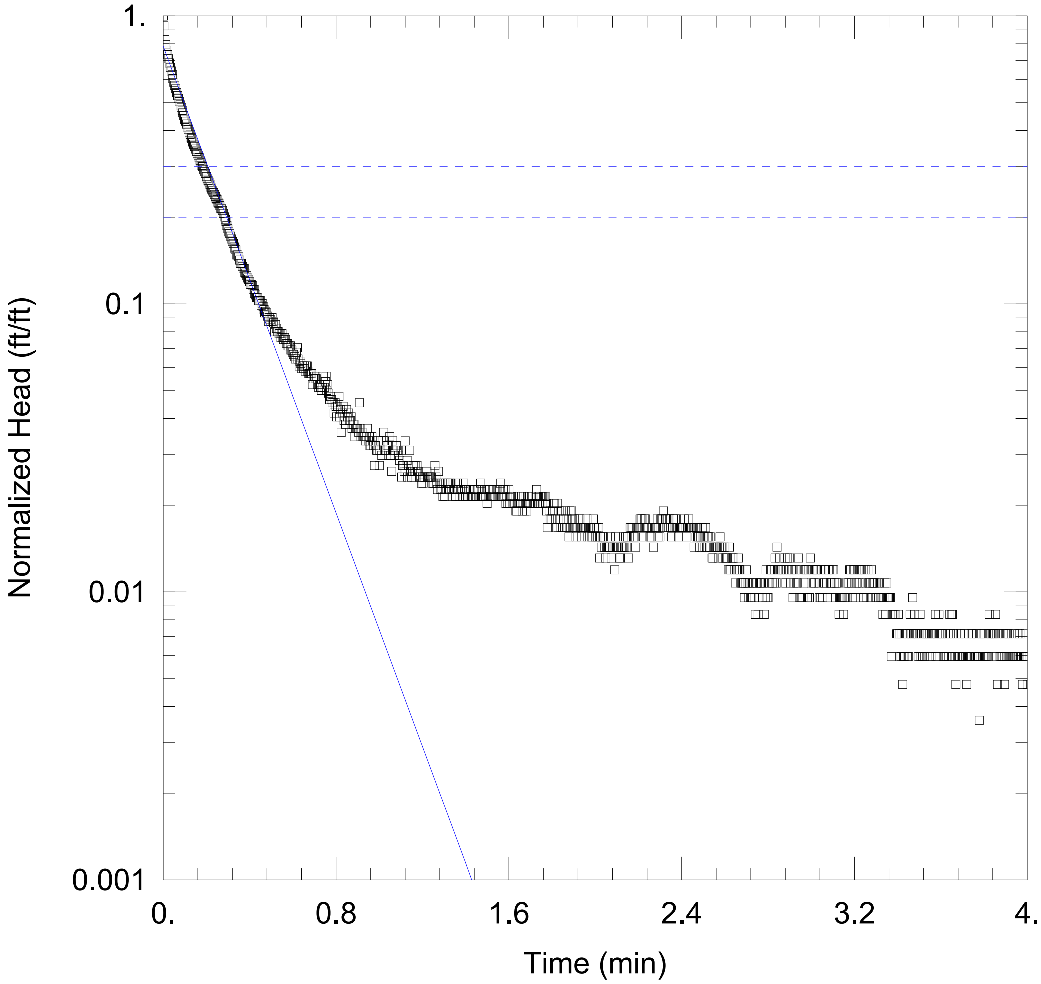
WELL DATA (MW-36 Slug In 1)

Initial Displacement: 1.722 ft
Static Water Column Height: 3.76 ft
Total Well Penetration Depth: 8.54 ft
Screen Length: 5. ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 17.74 ft/day
y0 = 0.7289 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW36_SlugIn_2_BR.aqt
Date: 04/01/25 Time: 13:53:02

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-36
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 3.76 ft Anisotropy Ratio (Kz/Kr): 1.

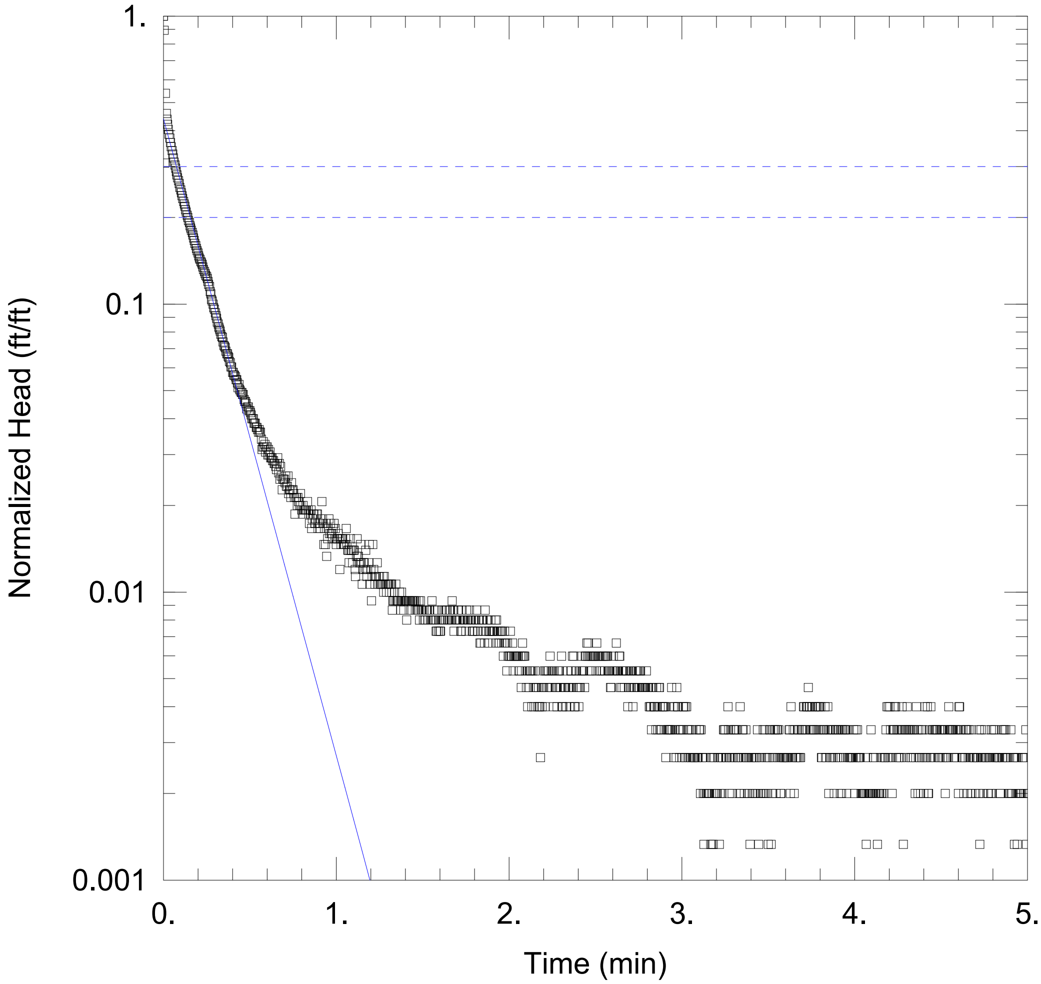
WELL DATA (MW-36 Slug In 2)

Initial Displacement: 0.839 ft Static Water Column Height: 3.76 ft
Total Well Penetration Depth: 8.54 ft Screen Length: 5. ft
Casing Radius: 0.083 ft Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 21.07 ft/day y0 = 0.6576 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW36_SlugIn_3_BR.aqt
Date: 04/01/25
Time: 13:53:54

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-36
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 3.76 ft
Anisotropy Ratio (Kz/Kr): 1.

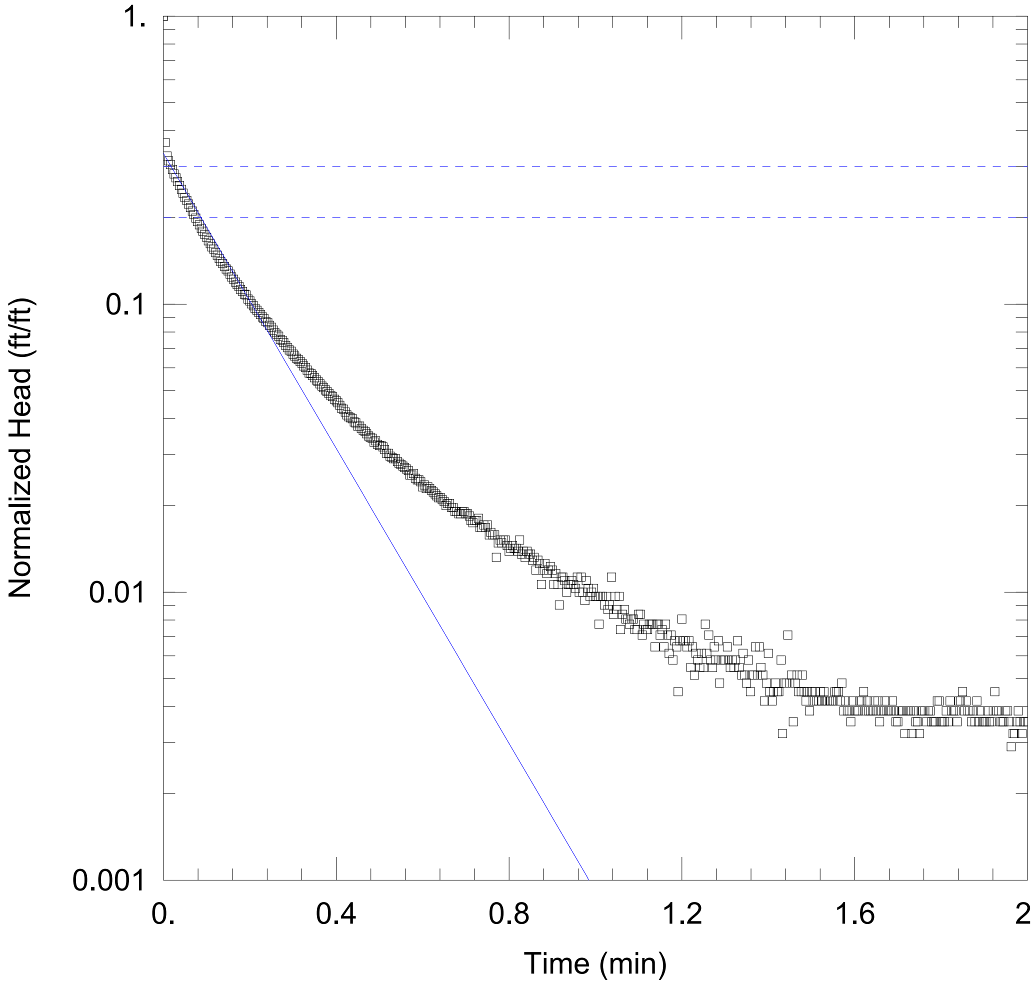
WELL DATA (MW-36 Slug In 3)

Initial Displacement: 1.503 ft
Static Water Column Height: 3.76 ft
Total Well Penetration Depth: 8.54 ft
Screen Length: 5. ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 23. ft/day
y0 = 0.661 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW36_SlugOut_1_BR.aqt
Date: 04/01/25 Time: 13:55:10

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-36
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 3.76 ft Anisotropy Ratio (Kz/Kr): 1.

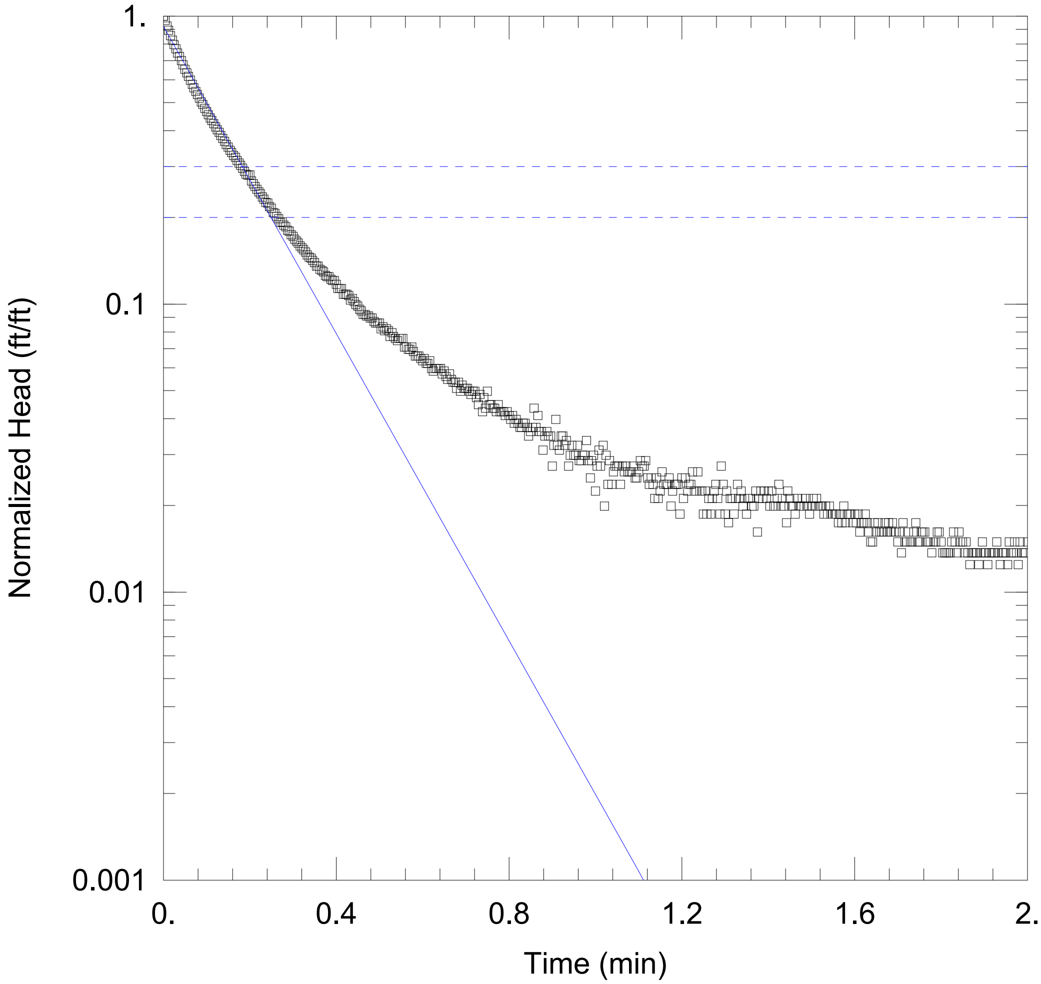
WELL DATA (MW-36 Slug Out 1)

Initial Displacement: 3.104 ft
Total Well Penetration Depth: 8.54 ft
Casing Radius: 0.083 ft
Static Water Column Height: 3.76 ft
Screen Length: 5. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 26.63 ft/day y0 = 1.034 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW36_SlugOut_2_BR.aqt
Date: 04/01/25 Time: 13:56:28

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-36
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 3.76 ft
Anisotropy Ratio (Kz/Kr): 1.

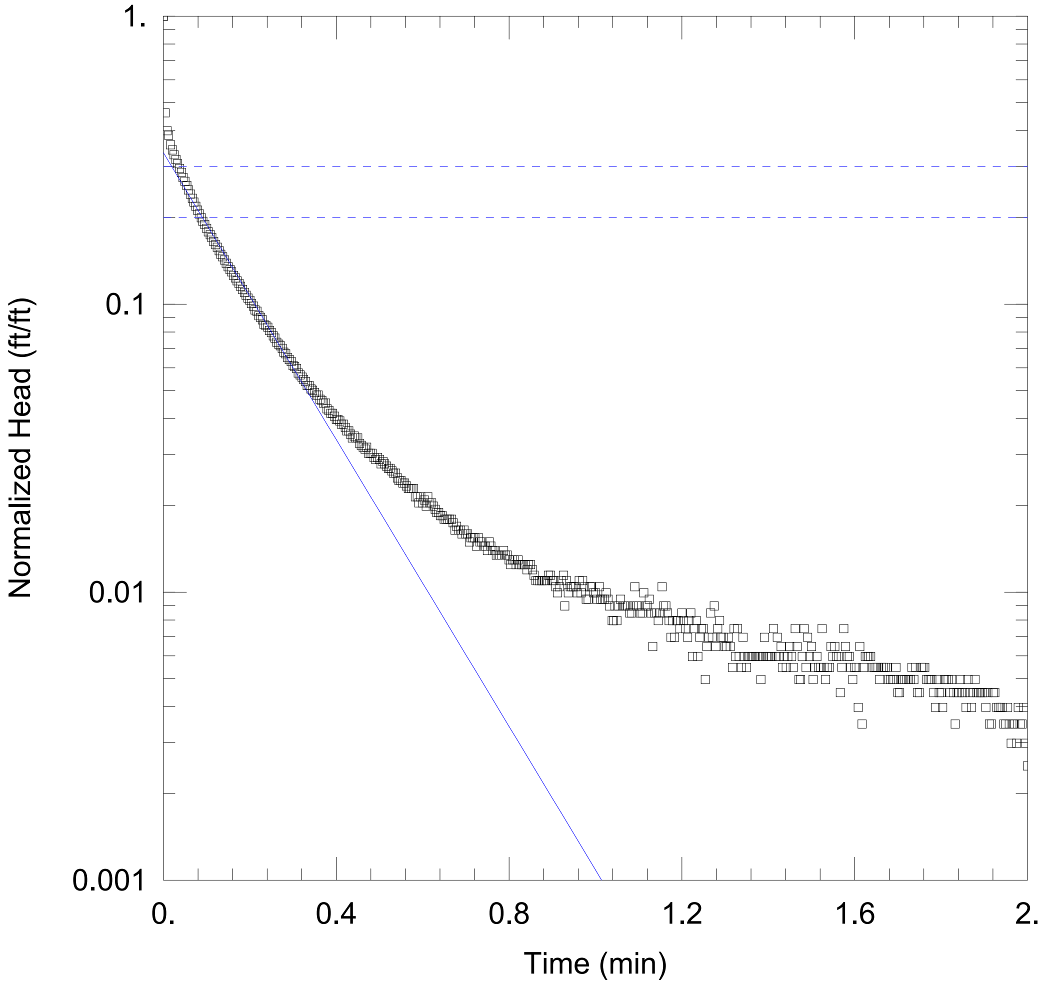
WELL DATA (MW-36 Slug Out 2)

Initial Displacement: 0.804 ft
Static Water Column Height: 3.76 ft
Total Well Penetration Depth: 8.54 ft
Screen Length: 5. ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 27.72 ft/day
y0 = 0.739 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW36_SlugOut_3_BR.aqt
Date: 04/01/25 Time: 13:57:52

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-36
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 3.76 ft Anisotropy Ratio (Kz/Kr): 1.

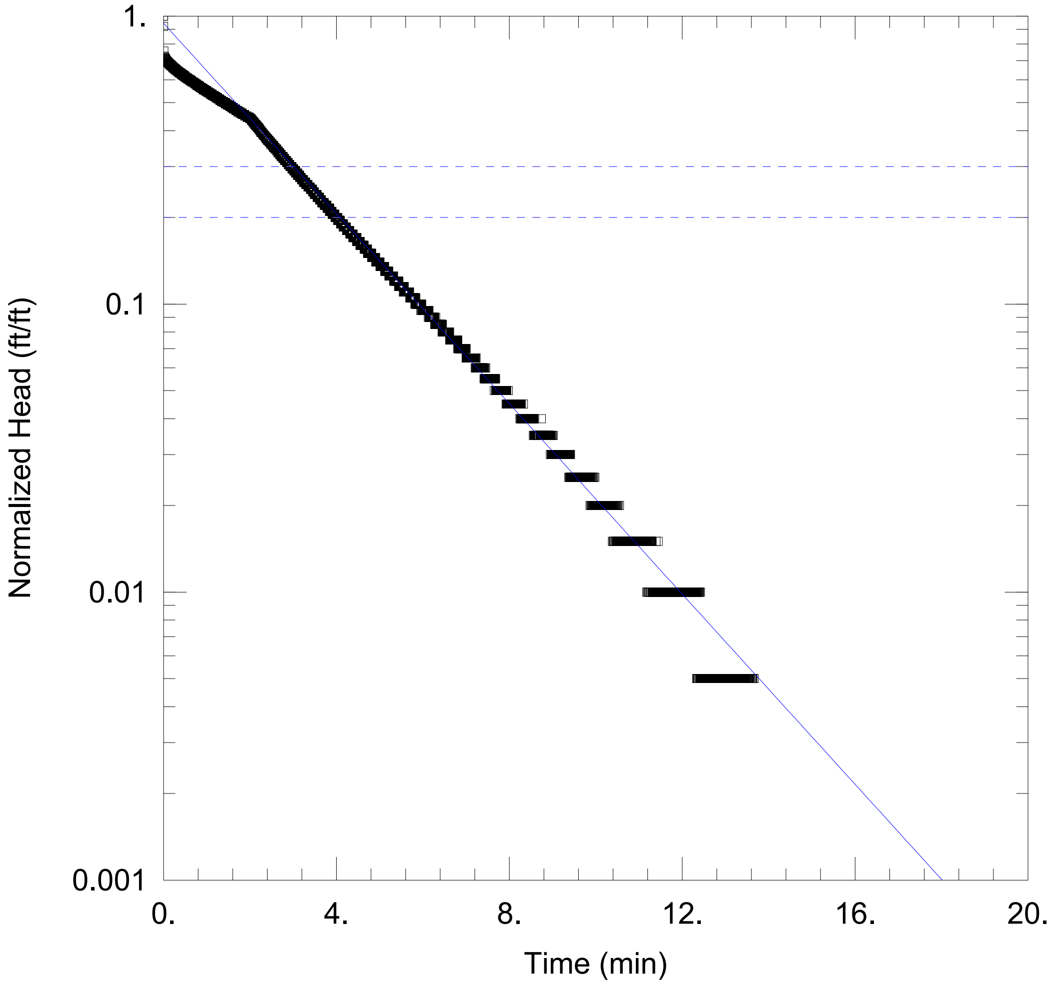
WELL DATA (MW-36 Slug Out 3)

Initial Displacement: 2.011 ft
Total Well Penetration Depth: 8.54 ft
Casing Radius: 0.083 ft
Static Water Column Height: 3.76 ft
Screen Length: 5. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 25.89 ft/day
y0 = 0.673 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW40_SlugIn_1_BR.aqt
Date: 04/01/25 Time: 09:52:41

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-40
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 3.5 ft
Anisotropy Ratio (Kz/Kr): 1.

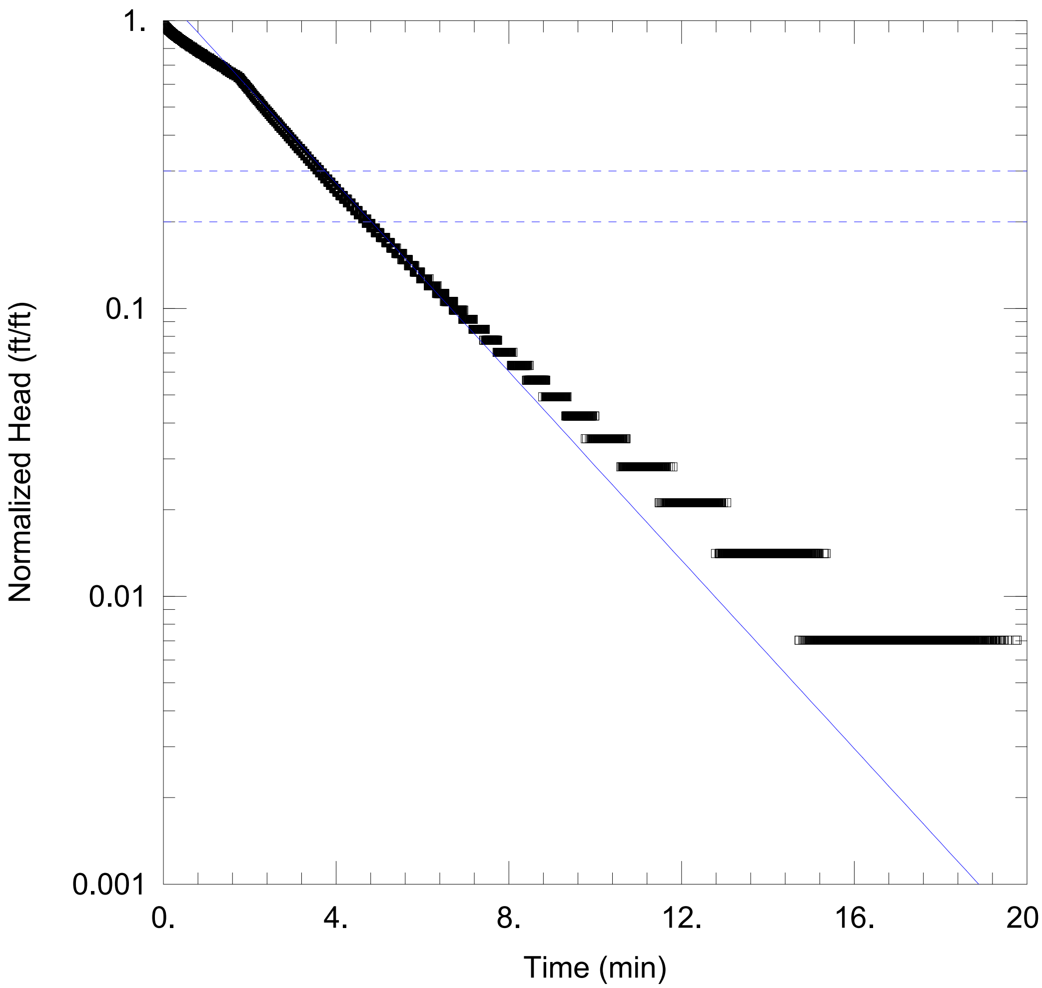
WELL DATA (MW-40 Slug In 1)

Initial Displacement: 2. ft
Total Well Penetration Depth: 6.44 ft
Casing Radius: 0.083 ft
Static Water Column Height: 3.5 ft
Screen Length: 5. ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 1.743 ft/day
y0 = 1.886 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW40_SlugIn_2_BR.aqt
Date: 04/01/25 Time: 09:54:50

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-40
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 3.5 ft Anisotropy Ratio (Kz/Kr): 1.

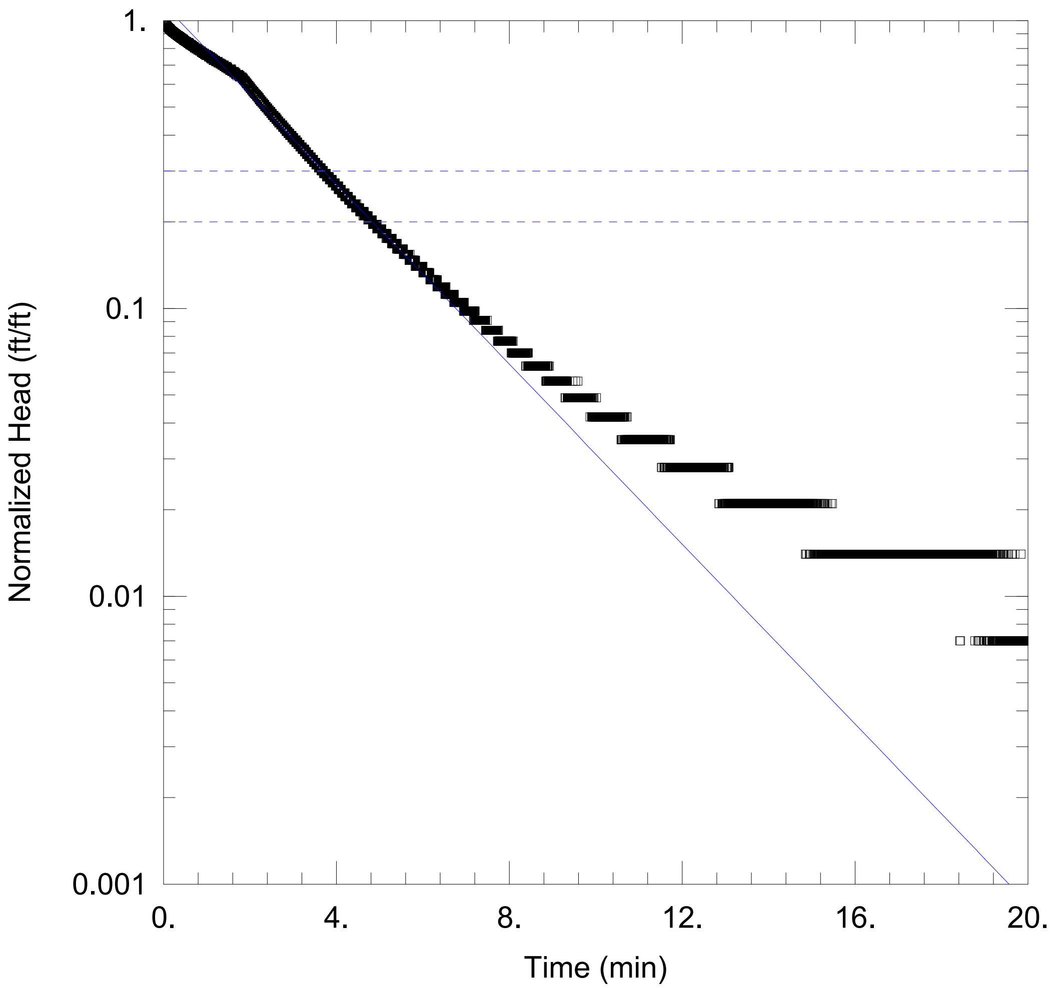
WELL DATA (MW-40 Slug In 2)

Initial Displacement: 1.42 ft Static Water Column Height: 3.5 ft
Total Well Penetration Depth: 6.44 ft Screen Length: 5. ft
Casing Radius: 0.083 ft Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice

K = 1.727 ft/day y0 = 1.742 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW40_SlugIn_3_BR.aqt
Date: 04/01/25 Time: 09:55:45

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-40
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 3.5 ft
Anisotropy Ratio (Kz/Kr): 1.

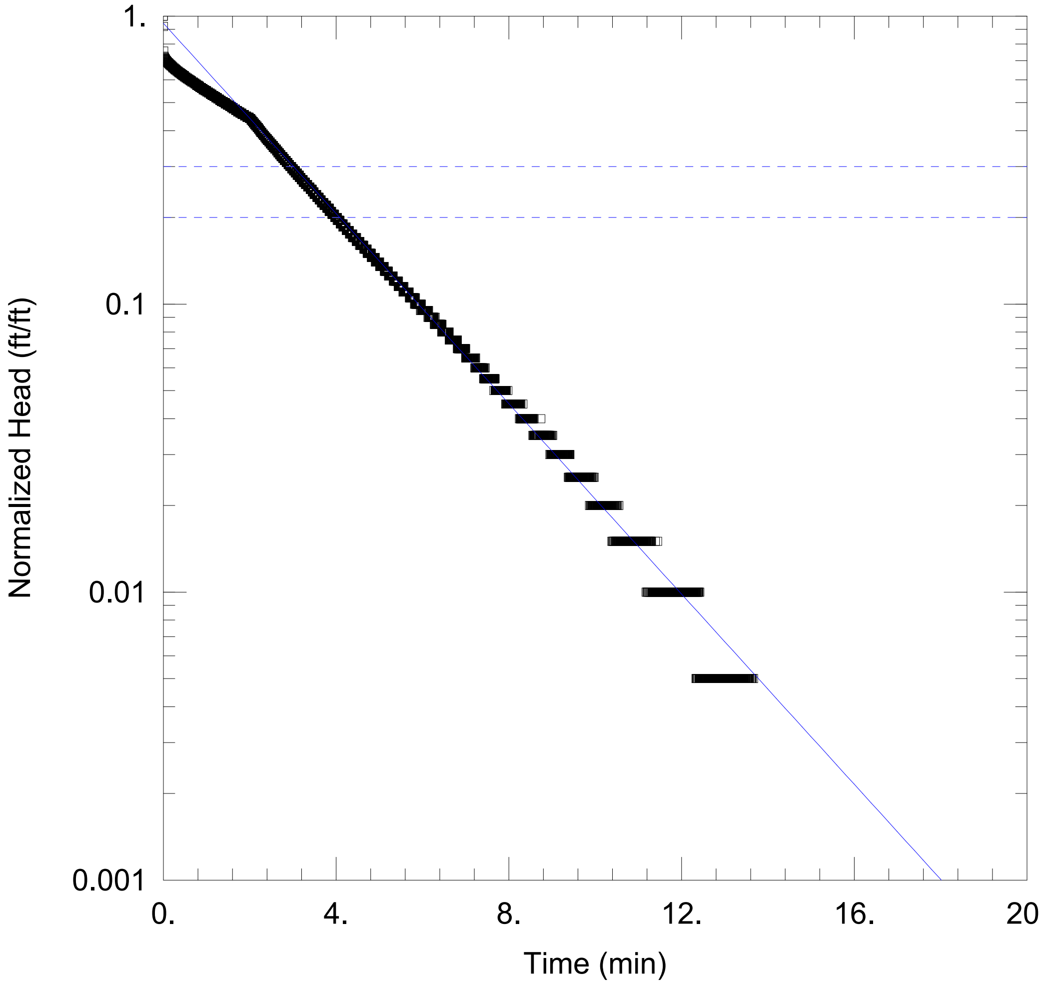
WELL DATA (MW-40 Slug In 3)

Initial Displacement: 1.43 ft
Static Water Column Height: 3.5 ft
Total Well Penetration Depth: 6.44 ft
Screen Length: 5. ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 1.649 ft/day
y0 = 1.625 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW40_SlugOut_1_BR.aqt
Date: 04/01/25 Time: 09:56:22

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-40
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 3.5 ft Anisotropy Ratio (Kz/Kr): 1.

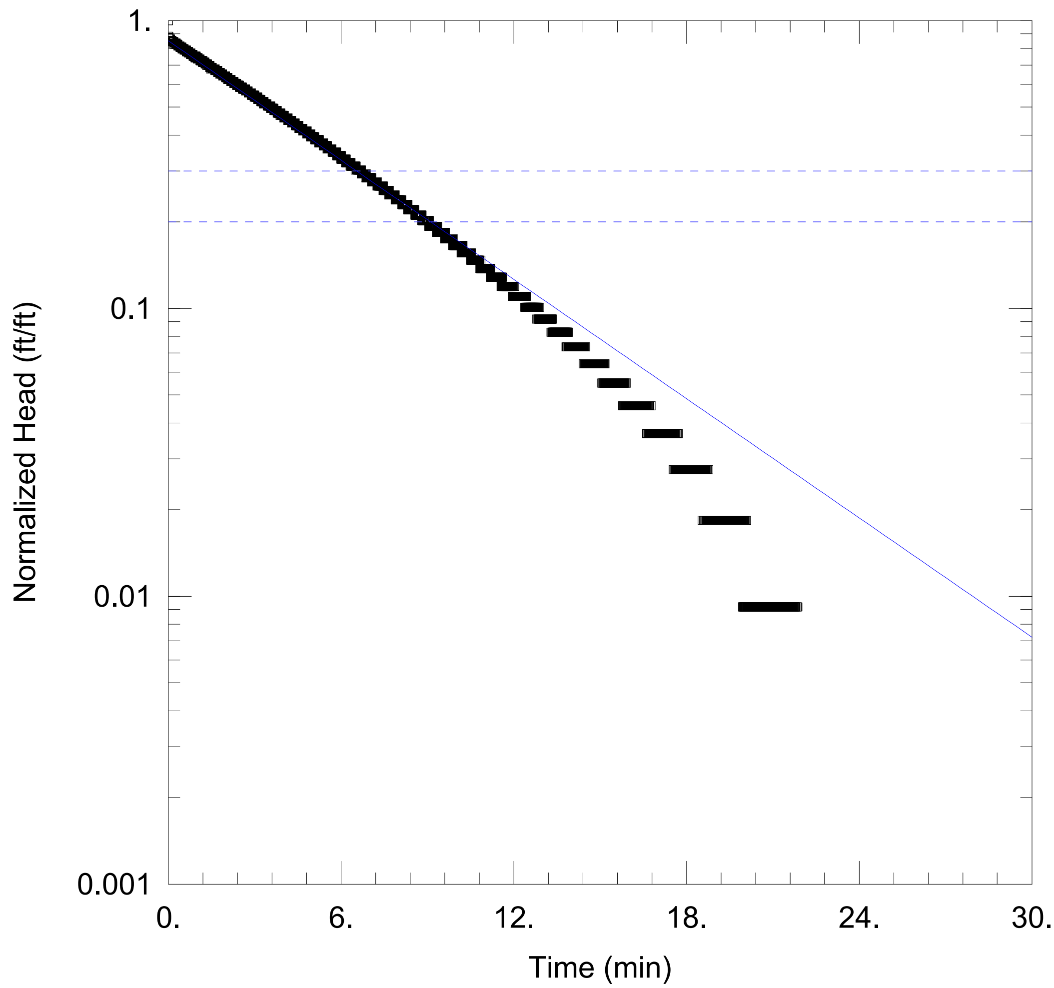
WELL DATA (MW-40 Slug In 1)

Initial Displacement: 2. ft
Static Water Column Height: 3.5 ft
Total Well Penetration Depth: 6.44 ft
Screen Length: 5. ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 1.743 ft/day
y0 = 1.886 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW40_SlugOut_2_BR.aqt
Date: 04/01/25
Time: 09:57:59

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-40
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 3.5 ft
Anisotropy Ratio (Kz/Kr): 1.

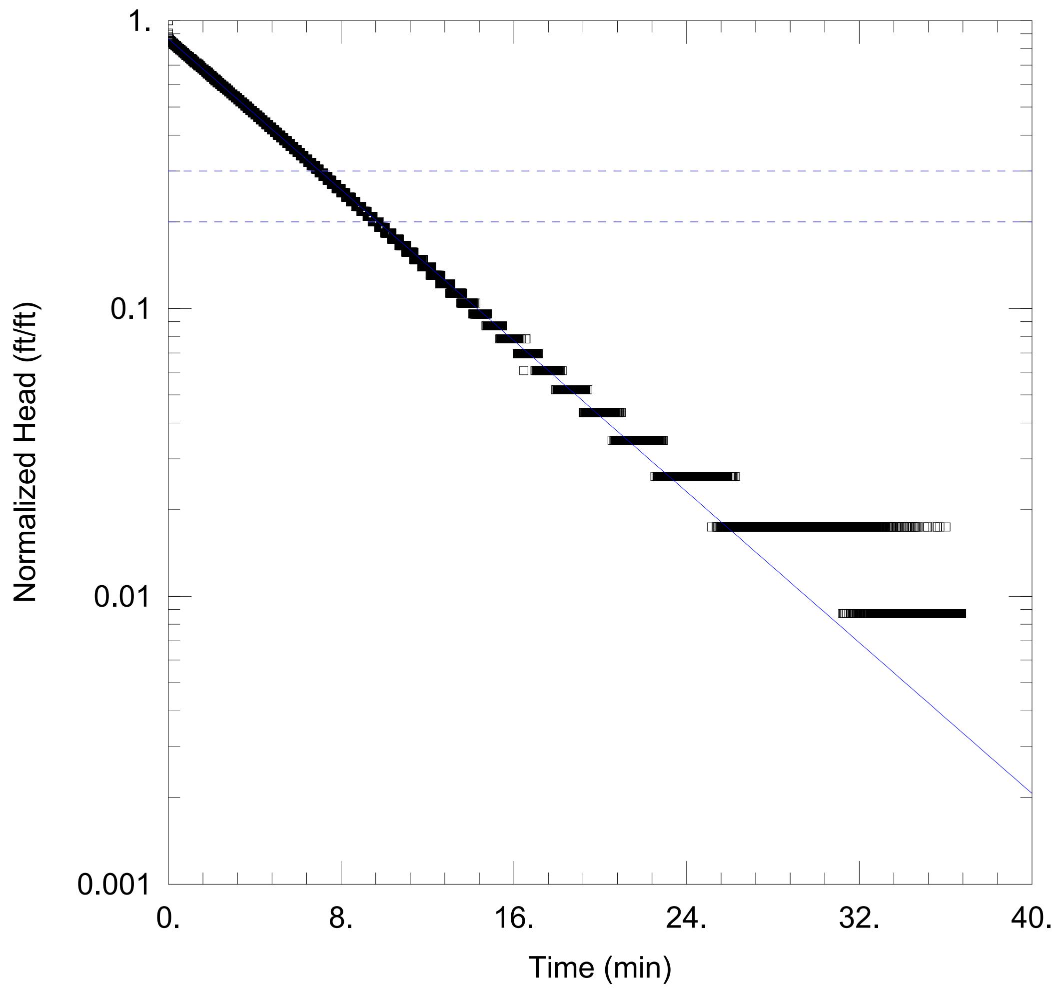
WELL DATA (MW-40 Slug Out 2)

Initial Displacement: 1.09 ft
Static Water Column Height: 3.5 ft
Total Well Penetration Depth: 6.44 ft
Screen Length: 5. ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.7294 ft/day
y0 = 0.9266 ft



WELL TEST ANALYSIS

Data Set: C:\...\MW40_SlugOut_3_BR.aqt
Date: 04/01/25 Time: 09:58:52

PROJECT INFORMATION

Company: HDR
Client: GHHI
Project: 10337505
Location: Grand Haven, MI
Test Well: MW-40
Test Date: 8/14/2024

AQUIFER DATA

Saturated Thickness: 3.5 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-40 Slug Out 3)

Initial Displacement: 1.15 ft
Static Water Column Height: 3.5 ft
Total Well Penetration Depth: 6.44 ft
Screen Length: 5. ft
Casing Radius: 0.083 ft
Well Radius: 0.083 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.692 ft/day
y0 = 0.9938 ft

Appendix F

Groundwater Sampling Collection Standard Operating Procedure

Water Sample Collection Standard Operating Procedure

Former JB Sims Generating Station

City of Grand Haven

March 31, 2022

Revised April 30, 2025

1.0 Introduction

This Standard Operating Procedure (SOP) provides guidance for groundwater sample collection at the former JB Sims Generating Station at Harbor Island located in Grand Haven, Michigan. Groundwater monitoring will support compliance with U.S. Environmental Protection Agency's (EPA) CCR Rule (40 CFR Part §257) and the solid waste regulations under Michigan Statute Part 115 for CCR ash impoundments. This SOP addresses procedures for the groundwater and surface water monitoring requirement.

1.1 Groundwater Method Applicability

The following sections outline the general method for collecting low stress/low flow groundwater samples from monitoring wells. The low flow method is the preferred technique for groundwater monitoring. This technique is appropriate for this Site due to the following characteristics:

- Casing diameter is greater than 1.0 inch
- Screen interval is ten feet or less
- Samples are analyzed for total metals
- Low turbidity is desired in sample containers
- Purge water requiring disposal is minimized, and
- Analytes are repeatable.

The proposed sample collection and safety procedures below are consistent with EPA guidelines and CCR Rule. The City of Grand Haven (the City) or their Consultant will collect all samples.

In order to compare the groundwater concentrations measured through this sampling effort to the Michigan Groundwater Surface Water Interface (GSI) criteria for mercury, the laboratory analysis for mercury will need to be the low-level mercury method 1631E. To achieve the low-level detection limits associated with this methods, special protocols for the sampling for low-level mercury (LL Hg) are outlined in the Michigan Department of Environment, Great Lakes, and Energy (EGLE) Remediation and Redevelopment Division (RRD) Standard Operating Procedure 36 (SOP-36). The SOP-36 references USEPA Method 1669, Sampling Ambient Water for Trace Metals at USEPA Water Criteria Levels, which is a two-person team approach (the "Clean Hands / Dirty Hands" method). Sampling protocol for the former JB Sims Generating Station will utilize this approach to sampling, as described in the equipment and protocols below.

1.2 Groundwater Summary of Method

Depth to water is measured prior to purging. Due to dynamic groundwater conditions at the site, water level collection should be completed in one day, or prior to any significant precipitation event, if possible. After depth to water is measured, tubing is placed approximately mid-screen in the well. A peristaltic pump is used to purge water from the well at a rate of approximately 100-500 mL/minute. The purged water moves through a flow cell that contains probes to measure stabilization parameters such as pH and conductivity. Once parameters have stabilized, the purged water stream is disconnected from the flow cell and used to fill sample containers for lab analysis. A detailed explanation of this procedure is in Section 5.0.

2.0 Health and Safety

2.1 Safety Documentation

Job Hazard Analyses (JHAs) must be developed prior to arriving on Site. JHAs identify potential hazards that may be present on the Site or while executing the work. JHAs are used to provide methods to minimize hazards.

The site-specific Health and Safety Plan (H&SP) is used to identify actions and precautions to prevent injury. The H&SP also includes essential emergency service contacts in case of incident. Each individual is required to have read and understood the Health and Safety Plan (HASP) for the specific project activity and signed the acknowledgement sheet confirming their review.

2.2 Safety Procedures

A safety briefing must be conducted between Site personnel and the sampling team before the start of the work each day. No sampling shall commence until all personnel have completed site specific safety training.

Complete equipment and supply checklists and verify that required documentation and equipment for field activities are on site.

Review locations for planned field activities for hazards. Each sampling site will be characterized by the following factors:

- Location of work
- Weather conditions: rainfall, temperature, and wind direction
- Ongoing activities that may influence or disrupt sampling efforts
- Accessibility to the sampling locations (e.g. road maintenance, rough terrain, fallen trees, flooding, etc.)

View monitoring well locations and confirm the monitoring wells are accessible and well identifications are clearly marked. Select location for disposal of decontamination and purge waters.

3.0 Equipment and Supplies

A complete list of equipment and supplies for surface and groundwater sampling at the Former JB Sims site are provided as Appendix A. Primary equipment needs are detailed below:

- YSI water quality meter, or similar, with flow cell and hand-held monitor. In-line probes calibrated to measure dissolved oxygen, oxidation-reduction potential (ORP), conductivity, pH, and temperature are required. Turbidity may be included as an additional probe or a separate turbidity meter may be used.
- Peristaltic pump with pump head and external power source. Bladder pump may be used if water levels are >25 feet below top of casing.
- Water level measurement tape. Must have a minimum of 0.01-foot accuracy.
- Pump head tubing (silicone) and well tubing (polyethylene, or fluoridated ethylene propylene (FEP)). Each well is equipped with dedicated tubing; extra tubing on hand is recommended if replacement is deemed necessary.

- When sampling for low-level mercury (LL Hg): Use pre-cleaned and certified FEP or FEP-lined polyethylene tubing, and pre-cleaned and certified silicone tubing. Cleaning and certification may be completed by Trace Analytical in Muskegon, Michigan.
- Large SUV. An initial safety check should be performed at the start of each shift to confirm the vehicle is in good working condition. The vehicle should then be checked daily for damage or required maintenance.
- Decontamination supplies.
- Sample containers with appropriate preservatives.
- Personal protective equipment.
- Tools and materials as listed in Appendix A.

All equipment must be calibrated according to manufacturer's instructions. Calibration of field equipment is completed by the rental equipment company prior to each rental, and calibration records are included with the equipment. Therefore, equipment measuring field parameters (YSI or similar) will be checked to evaluate if it needs to be calibrated at the beginning of each sample event. The calibration record from the equipment company will be reviewed to ensure accurate calibration. At the end of each day, a calibration verification check will be performed to verify that water quality parameters remained in calibration throughout the day. The post-use verification check will be recorded in field notes. The sample crew will photograph the calibration documentation provided with the equipment.

Cleaning and Certification of Tubing for LL Hg sampling

FEP and silicone tubing used to collect water samples for analysis of LL Hg must be cleaned and certified as mercury-free. Tubing may be purchased from Geotech (Lansing, MI) but Geotech does not clean the tubing or certify as mercury-free. Trace Analytical will clean and dry the tubing, and collect a rinsate blank to certify that mercury contributed to a sample from the tubing is less than 0.2 ng/L.

Trace Analytical requires at least one week prior to the sampling event to complete the cleaning protocol, and to collect and analyze the rinsate blank.

4.0 Quality Control Documents and Records

The following documentation and records must be taken to the jobsite and maintained for every sampling event:

- Historical documentation, including:
  - Well construction data,
  - Well location map
  - Field data from the previous sampling event
- Material Safety Data Sheets (MSDSs) for any reagents taken to the Site
- Field log book/field worksheet to document:
  - Field instrument calibration verification data
  - Monitoring well identification number and condition
  - Well depth and depth to water, including date and time of measurement
  - Sample tubing material, diameter, length, placement, and pump type
  - Pumping rate, water level, water quality indicator values, and date and time of measurement

- Identification and explanation of any unacceptable water quality indicator values
- Time and date of sample collection
- Sample ID
- Field observations
- Sampler's name or initials

See Appendix B for the Field Data Sheet to be used to record the above information.

- Chain of Custody (COC) form must include:
  - Analytical parameters requested
  - Sample time and date
  - Sampler's name or initials
  - Site location
  - Sample ID
  - Preservatives added

  See Appendix C for a sample COC form.
- Sample labels must include:
  - Sample ID
  - Sample time and date
  - Sampler's initials
  - Preservatives
  - Analysis requested

Sample bottle labels, COC form data, and information on Field Data Sheets must match *exactly*.

5.0 Sampling Procedures

5.1 Groundwater

Prior to beginning, one team member is designated as "Dirty Hands" and the second team member is designated "Clean Hands". The individual designated as Clean Hands will handle all operations involving contact with the sample bottle and transfer of the samples from the sample collection device to the sample bottle. The individual designated as Dirty Hands is responsible for the preparation of the sample (except the sample container itself), operation of any machinery, and for all other activities that do not involve direct contact with the sample. It is feasible for one person to complete the sampling and use one hand as "Clean Hand" and the other hand as "Dirty Hand".

5.1.1 Sequencing of Wells

Based on previous sampling results or site knowledge, sequence the gauging and sampling from wells of lowest levels or likelihood of mercury contamination, to wells with the highest levels of known or likely mercury contamination.

5.1.2 Determination of Depth-to-Groundwater (DTW)

The following initial steps will be followed before purging each monitoring well and collecting groundwater samples in the field. The protocol assumes that all water levels will be opened and gauged before sampling to capture a single "snapshot" of hydrologic conditions on a single day.

1. Begin with the well that has the least contaminated groundwater (if known) and proceed in increasing order of contamination such that the well with the highest contamination is sampled last.
2. Locate the monitoring well to be sampled, confirm monitoring well ID and record the condition of the monitoring well (casing protector, lock, locking cap, and well casing). Record any abnormal observations or evidence of damage or tampering.
3. A sheet of plastic or tarp may be laid around the casing protector to provide a clean area for equipment and minimizing contamination from the ground.
4. Remove the well cap.
5. If the well casing does not have a reference point, make one. The reference point is typically a V-cut or a mark on the top of the PVC well casing.
6. Hold the water level measuring tape against the reference point to measure the DTW to 0.01 feet. Duplicate the reading. Every measurement should be taken from the same reference point. Minimize disturbance of the water column while measuring.
7. Record the DTW on the Field Data Sheet (Appendix B).
8. Decontaminate the water-level indicator and tape prior to each use. The decontamination procedure for the water level indicator is: Hand wash the calibrated tape and probe that contacted groundwater with Alconox solution (or equivalent) and rinse with deionized water.
9. Monitoring well depth can be obtained from monitoring well construction logs. Measuring total depth of monitoring wells prior to sampling should be avoided; measuring to the bottom of the monitoring well casing may cause re-suspension of settled solids.
10. Continue on to purging if sampling is to occur on the same day. Lock well casing and pack up equipment if sampling is to occur at a later date.

5.1.3 Purging Procedure

The type of pump used for sampling is dependent upon the casing diameter, depth to groundwater, depth of the monitoring well screen, and anticipated volume required for purge. A peristaltic pump is recommended for the Site. A bladder pump may be used if groundwater levels are greater than 25 feet below the top of the casing. Decontamination of portable pumps is required prior to each use.

A peristaltic pump is appropriate for monitoring wells with groundwater depths less than 25 feet below the top of the casing. The sampling protocol will be as follows for the collection of groundwater samples using a peristaltic pump (such as the Geopump-2 or similar).

1. Sampling teams must wear clean non-talc gloves as well as clean, lint-free outer clothing (i.e., Tyvek wind suit) to protect samples from contamination by lint and dust. Use clean nitrile gloves for each well prior to handling any sample bottles. Dirty Hands opens the well.
2. Dirty Hands opens bag containing static water level meter. Clean Hands removes water level meter. Clean Hands sets up the water level meter.
3. Dirty Hands removes the pump from its storage bag and opens the bags containing the cleaned and certified tubing.

4. Clean Hands - cuts FEP-lined polyethylene tubing to the appropriate length, based on known well construction, such that the tubing end can be lowered to the middle of the screen, and there is at least three to four feet of tubing at the surface to run through the pump and run into a bucket.
5. Clean Hands slowly and carefully lowers the tubing to the mid-point of the screened interval. In cases where the entire screen is not saturated, place the tubing inlet near the middle of the saturated screen. Take care not to allow the tubing to touch the ground and introduce contamination into the well. When possible, do not place the tubing less than two feet above the bottom of the well, as this may cause the mobilization of bottom sediments. Allow at least one foot of water above the inlet so there is little risk of entrainment or air in the sample
6. Clean Hands threads the tubing to the pump, and connects the tubing to the multi-parameter meter flow-through cell. The flow-cell will be used to monitor the indicator parameters so as not to expose the water to the atmosphere prior to measurement. During purging, water quality indicator parameters (pH, ORP, turbidity, specific conductivity, and DO) will be measured every 3-5 minutes until the parameters have stabilized. Measurement should be recorded on Appendix B. A minimum of 5 sets of water quality indicator parameters should be recorded.
7. Dirty hands clamps the tubing, turns on the peristaltic pump, adjusts the flow rate, and records multi-parameter measurements.
8. Purge the monitoring well at a rate of approximately 100 mL/minute. Flow rate can range from 100 to 500 mL/min. All purge water will be put in a bucket. The buckets will be disposed of on the ground surface at least 100 feet from the well. Record the pumping rate on the Field Data Sheet (Appendix B). Stabilization is achieved after three successive readings are within ± 0.1 for pH, ± 10 mV for ORP, ± 3% for specific conductance, ± 10% for DO and turbidity. Temperature will also be measured and recorded, but will not be used as a stabilization parameter. Sampling may begin once the well has stabilized.
9. Turbidity and DO usually take the longest to stabilize. Up to 2 hours of purging may be required to reach stabilization. Stabilized purge indicator trends are generally obvious and follow either an exponential or asymptotic change to stable parameter values during purging. If stabilization does not occur or turbidity is >10 NTU after two hours of purging, the ES should be contacted for direction. When turbidity is deemed stable above 10 NTU, an additional sample volume will be collected and analyzed for dissolved metals.
10. After stabilization, Clean Hands disconnects the meter.
11. Both team members remove and dispose of gloves, and don new gloves.

5.1.4 Sample Collection Procedure (Low-Level Mercury)

1. Dirty Hands opens the cooler containing the sample bottles and unzips the other bag containing the sample container. If the sample is to be split, a larger size container is required at least twice the size of normal samples. If filtering is necessary, a field blank is being generated or a duplicate sample is to be taken, Dirty Hands unzips the outer bag of another sample container

2. Dirty Hands prepares the sample labels. Bottle labels will be completed for each sample container collected for analysis, using ink or permanent marker. Each label will include the following:

- Site Location
- Well identification number (MW-#);
- Sample collection date: month, day, year;
- Sample collection time;
- Sample preservation method (e.g. nitric acid); and
- Initials of personnel collecting the sample.

It is critical that both the sample bottle monitoring well identification and sample times match exactly the sample name and collection time written on both the Field Data Sheet and the Chain of Custody.

3. Samples will be collected in sample containers described in Section 3.5 of the HMP. Clean Hands opens the inner bag, removes the sample container, and reseals the inner bag. Clean Hands unscrews the cap, rinses the sample bottle and cap three times with the purging stream of groundwater, collects the sample, and replaces the cap.
4. For LL Hg sampling – fill the 250 mL glass container to approximately 1 inch below the top (fill volume of approximately 200 mL). The headspace allows the addition of oxidation agents at the laboratory.
5. For other analytes, fill sample containers to approximately ¼" below the bottle threads.
6. While sampling, hold the tubing approximately 1/8" outside of the open bottle. Do not place the sample tubing within the bottle or allow it to dip into the collected sample. Collect samples at the same flow rate as the purging rate. Minimize potential contamination by shielding the open bottles as needed. Minimize aeration by allowing the water to flow down the side of the bottle instead of against the bottom.
7. If a duplicate, or a sample that requires filtration, or a Field Blank is to be collected, a second container is filled. For the collection of Field Blanks, see additional directions in Section 5.17, Quality Control.
8. Clean Hands opens the inner bags for the samples, places the sample bottles into the inner bags, and seals the inner bags.
9. Dirty Hands seals the outer bags, writes sample he inner bag(s). 25. Dirty Hands seals the outer bag(s), writes sample identification information on the outer bag(s), places the sample(s) in the cooler (on ice), and closes the cooler.
10. Dirty Hands measures and records the depth to the bottom of the well.
11. Dirty Hands records the sample number(s) in the sampling log, water quality parameters, and notes any unusual observations.
12. Clean Hands removes the equipment from the well, removes the water level meter, and places them into bags for transportation.
13. Both Dirty and Clean Hands move to the decontamination area with the equipment.
14. Both team members remove and dispose of gloves, and don new gloves.

5.1.5 Additional Considerations

15. If recharge is low, the drawdown in the well may approach the pump depth. Purge the well to within one foot of the pump depth, and remove the pump, close the well, and determine the time to let the well recharge prior to returning to collect the sample.
16. If the well is recently constructed, sampling will be performed no less than 24 hours after well development is completed. Observations made during sample collection will be recorded on the water quality sample collection form in Appendix B.
17. After all samples from a monitoring well are collected, remove the tubing unless the tubing is dedicated to the well and remains in place. Tuck any extra length of tubing down into the well casing with care not to permanently pinch the tubing.
18. Cap and lock the monitoring well protective casing.
19. Pour collected purge water on the ground, away from any wells that are to be sampled next.
20. Repeat procedure for remaining monitoring wells.

Samples will be stored in a cooler with ice. The coolers from the field will be delivered back to the lab each day that samples are collected.

5.1.6 Decontamination Procedure

The purpose of decontamination is: (1) to eliminate the transfer of contaminants from one groundwater monitor well to another, and (2) to protect the health and safety of personnel who may come in contact with contaminated equipment. Decontamination procedures described in this section will be performed at the beginning of each day of field work and between each monitor point, and whenever the equipment is suspected of having been contaminated.

All non-dedicated sampling equipment must be decontaminated before its reuse. All disposable tubing will be properly discarded and new tubing used in its place. The peristaltic pump tubing will be replaced and discarded before each sample location, or dedicated tubing will remain in each well. Former J.B. Sims Generating Station wells are equipped with dedicated tubing.

Flow cell shall be rinsed with deionized water if debris is not flushed out during purging. If the probes are not fouled, no further action is necessary since the flow cell does not contact the sample. The cell must be filled with tap water and stored overnight.

5.1.7 Quality Control

Quality Control (QC) checks of both the field procedures and laboratory analyses will be used to assess and document data quality and to identify discrepancies in the measurement process that need correction. Quality control samples will be used to assess various data quality parameters such as representativeness of the environmental samples, the precision of sample collection and handling procedures, the thoroughness of the field equipment decontamination procedures, and the accuracy of laboratory analyses. In addition, all sample containers, preservation methods, and holding times will be in accordance with QC requirements.

The analytical laboratory will use a series of QC samples, as identified in the laboratory's Quality Assurance Plan and specified in the standard analytical methods. The types of samples include method blanks, surrogate spikes, laboratory control samples, laboratory control sample duplicates, matrix spikes, and matrix spike duplicates. The primary type used for Site is a sample duplicate. One monitoring well for every 10 will be selected to collect a duplicate sample. It requires an additional sample to be collected in the same manner as the original sample. This sample type is used by the laboratory to determine precision. Sample identification for duplicates will be the same as the sample identification with the addition of a "Duplicate" (e.g. MW-15018 and MWT-15018).

Field Blanks

Field blanks are used to demonstrate that samples have not been contaminated by the sample collection and transportation activities. Field blanks should be collected in the same manner as samples using the same equipment. Field blanks should be collected first.

- Frequency of Collection: One per facility, per day, or 10% per sampling event, whichever is greater.
- Evaluation: If the mercury concentration in the field blank is greater or equal to 0.5 ng/L, or greater than one-fifth of the sample concentration, whichever is greater, the associated sample result is an estimate and may be unusable for regulatory application.

For each field blank:

- Clean Hands empties the second sample bottle, collected for the purpose of creating a Field Blank.
- opens the inner bag and places the emptied sample bottle and its cap in its inner bag. This bottle is to be identified as the field blank. b. Clean Hands obtains another sample bottle from its inner bag, removes, and discards its cap. c. Clean Hands retrieves the field blank bottle and pours the contents of the sample bottle into the field blank bottle

Rinsate Blanks (certification samples)

Rinsate blanks will be collected by the laboratory (Trace Analytical) after both types of tubing are cleaned and dried. The purpose of the rinsate blanks is to demonstrate that no greater than 0.2 ng/L of mercury is contributed by the tubing to samples collected through that tubing.

- Frequency of Collection: One per spool of tubing
- Evaluation: If the mercury concentration in the rinsate blank is greater or equal to 0.2 ng/L, the tubing will be re-cleaned and another rinsate blank collected and analyzed.

Samples requiring filtration due to elevated turbidity will be filtered at the laboratory. If filtration is performed, the laboratory will additionally collect a rinsate blank from a representative filter in the filter lot. Note that if multiple samples require filtration, but all the filters used are from the same lot, only one rinsate blank from a filter is required. The pump tubing is dedicated in each well; therefore, an equipment blank to test decontamination effectiveness is not required. In the event a bailer is used for sampling, a new bailer will be used for each well and never reused.

Relative Percentage Difference (RPD) Calculation

The precision will be measured through the evaluation of relative percentage differences (RPDs) between sample and duplicate samples and calculated as follows:

$$\text{Relative Percentage Difference (\%)} = \frac{\text{concentration SA} - \text{concentration SB}}{\text{Average concentration of SA+SB}} \times 100$$

Where SA denotes Sample A; SB denotes the duplicate, sample B.

Duplicate RPD requirement is 20 percent. Refer to Section 5.4 of the 2022 CCR Work Plan for additional information regarding data quality objectives.

Accuracy is measured by the difference between the measured or observed value and the true or assigned value. Accuracy in the field is assessed through the adherence to all sample handling, preservation, and holding times.

Laboratory data will be reviewed, validated and qualified if necessary prior to use. The laboratory data validation procedure is described in Section 5.4 of the 2022 CCR Work Plan.

5.2 Surface Water

5.2.1 Sample Collection Procedure

All field documentation and observations must be recorded in a field book and on field observation sheets before leaving the site (see Appendix B for field observation sheet). The following information should be documented:

- Your name and the names of those who accompany you
- Date and time of sample collection
- Sample observations should be included as well and describes anything unusual about the water (dead fish, foam, odors, unusual water color, debris, turbulence and presence of suspended sediment or surface matter).
- Collect field parameters pH, temperature, ORP, conductivity, and turbidity.

Each time a sample is taken the following steps should be followed in order to prevent contamination:

- The sampler's hands should be clean, free of grease, debris, or other substances.
- Do not smoke, eat or drink immediately before or during sampling.
- The caps must be kept on the sampling bottle until the sample is taken.
- Nothing should be placed inside the bottle except the water sample.
- Bacteria samples are sensitive to contamination and the inside of the bottles and the lids must not contact any surface during the course of sample collection.
- After removing the caps, they must be held so that the inside is not touching any surface at any time including your fingers. Do not set caps down so that the inside surfaces are touching any other surface.

Enter the water to minimize sediment disturbance. Bottles should be 6 inches below the water's surface (when possible). Bottles require no rinsing. Fill all other bottles completely. Be careful when approaching high flowing water; avoid the water if the site is unsafe. Safety is the first priority.

5.3 Sample Handling and Chain of Custody

The sample team shall be provided with COC forms prior to sampling. The Chain of Custody (COC) form should be completed in the field as the sampling progresses and signed upon transfer of custody at the laboratory. Chain of custody procedures comprise the following elements: (1) maintaining custody of samples, and (2) documentation of the requested analysis. To document chain of custody, an accurate record must be maintained to trace the possession of each sample from the moment of collection through analysis and reporting. The field chain of custody record is used to record the custody of all samples collected and maintained by investigators. All sample sets will be accompanied by a chain of custody record. It also serves as a sample logging mechanism for the laboratory sample custodian. The following rules apply to chain of custody records:

- All information must be supplied in the indicated spaces to complete the field chain of custody record. It is critical that the proper contact information is provided to the laboratory. This should always be the sampler or ES.
- Every person who maintained custody of the samples must sign in the designated signature block.
- The sample ID, date, and time on the chain of custody must match the sample bottle exactly.
- The total number of sample containers for each sample must be listed in the appropriate column. Total sample bottles need to be counted and double checked. Required analyses should be circled or entered in the appropriate location on the form and double checked.
- If expedited turnaround is requested, this needs to be noted clearly.
- Electronic results are required as EDDs and PDF files of the laboratory report.
- The last person receiving the samples should be the laboratory sample custodian or their designee(s).
- The chain of custody record is an accountability document and should be filled out thoughtfully.
- In cases where the samples leave the sampler’s custody into an intermediate carrier, such as shipment, a seal should be placed on the container to detect unauthorized entry to the samples. Containers that arrive at the laboratory with compromised seals must be evaluated to determine if the chain of custody has been invalidated.
- If samples arrive at the laboratory without the COC document, it shall be completed by the laboratory under the supervision of the laboratory project manager. The person completing the COC at the lab shall enter the statement “COC completed by the laboratory upon receipt of sample(s)” in the remarks section of the COC and initial the entry.

A sample COC is included as Appendix C.

5.4 Closeout

Upon the completion of groundwater sampling activities, the sampler will perform the following activities:

- Check condition of field equipment.
- Review field documentation.
- Record field data sheet information into electronic project database.
- Make arrangements for shipment of samples (if applicable).
- Confirm logged analyses with the laboratory.

Appendix A

Groundwater Sampling Equipment Checklist

Former JB Sims Generating Station

Groundwater Sampling Equipment Checklist

- "Wind Suit", i.e. disposable Tyvek coveralls for LL Hg sampling
- Monitoring well keys
- Map of wells
- List of well names, well construction logs, water level data
- Field data forms
- Field logbook
- YSI (or similar) water quality meter
- Water level indicator tape (check that the depth is in feet and length is adequate for the site conditions)
- Nitrile gloves
- Trash bags
- Storage bags (i.e., Ziploc bags), 1 gallon and 2 gallon sizes
- Plastic wrap
- Watch/timer
- Camera
- Purge water bucket
- Toolbox/wrenches (for well access)
- Hose or extra tubing (may be useful for purge water for certain submersible pump/reel rental setups)
- Knife/boxcutter, scissors for slicing tubing
- Graduated cylinder or graduated bucket (for flow measurement)
- Sample bottles
- Permanent Marker
- Cooler
- Ice/Ice packs
- Black electrical tape
- Decontamination bucket(s)
- Tap water source for decontamination
- Distilled water
- Deionized water

- Alconox
- Scrub brush
    - Peristaltic Pump, such as the Geotech Geopump (groundwater <25 feet below top of casing)
    - Modular battery and clips for vehicle battery and power cord
    - Tubing, sufficient footage for disposal after each well or decontamination between wells (polyethylene well tubing, silicone pump head tubing)

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Appendix B

Sampling Field Data Sheet

Former JB Sims Generating Station

Water Sample Collection Field Data Sheet

Site Name:_______________________________ Well ID.:____________________

Sample I.D.(match bottle and COC form exactly):________________________________

Personnel:__________________

Date: ______________________ Static Depth to Water (ft, btoc) ________________

Date/Time Sample Collected (match bottle and COC form exactly):_____________________

Sample Method: __________________

Water level meter, pump, and tubing decontaminated prior: Yes No

Sample QC: Duplicate Yes No Duplicate Sample ID: ____________

Sample QC: Equipment Blank Yes No Equip Blank Sample ID: ____________

Well Purging Data (Fill In All Blanks)

Depth of Sample Collection (pump depth) (ft, btoc) __________________

Time Completed: ______________________ Total Purge __________ Units______

Field Measurements:

Time (24 hour)	Amount purged (ml)	pH	COND (mS/cm)	TURB (NTU)	DO (mg/L)	TEMP (Cº)	ORP (mV)	Water Depth (ft, btoc)

Flow Rate______________

Pump controller setting______________

General Comments:

Appendix C

Example Chain of Custody Form

Former JB Sims Generating Station

Pace Analytical®
www.pacelabs.com

CHAIN-OF-CUSTODY / Analytical Request

The Chain-of-Custody is a LEGAL DOCUMENT. All relevant fields m[ust be completed accurately]

WO# : 50256085

50256085

Section A
Required Client Information:
Company: HDR, Inc.
Address: 3321 Bronson Blvd
Kalamazoo, MI 49008
Email: molly.reeves@hdrinc.com
Phone: 734-751-1790 Fax:
Requested Due Date

Section B
Required Project Information:
Report To: Molly Reeves
Copy To:
Purchase Order #:
Project Name: Muskegon Site
Project #:

Section C
Invoice Information:
Attention:
Company Name:
Address:
Pace Quote:
Pace Project Manager: melanie.booms@pacelabs.com,
Pace Profile #: 9219

Regulatory Agency:
State / Location: MI

SAMPLE ID
One Character per box.
(A-Z, 0-9 / , -)
Sample Ids must be unique

MATRIX	CODE
Drinking Water	DW
Water	WT
Waste Water	WW
Product	P
Soil/Solid	SL
Oil	OL
Wipe	WP
Air	AR
Other	OT
Tissue	TS

ITEM #	SAMPLE ID	MATRIX CODE (see valid codes to left)	SAMPLE TYPE (G=GRAB C=COMP)	COLLECTED START DATE	COLLECTED START TIME	COLLECTED END DATE	COLLECTED END TIME	SAMPLE TEMP AT COLLECTION	# OF CONTAINERS	Unpreserved	H2SO4	HNO3	HCl	NaOH	Na2S2O3	Methanol	Other	Analyses Test Y/N	IN Metals, Total	IN pH	IN TDS/F,Cl,SO4	IN TSS	IN Rad-226	IN Rad-228	Residual Chlorine (Y/N)
1	MW-15002	WT	G	5-4-20	11:10a				6										X					X	
2	MW-15003				12:00p				6										X						
3	MW-15004				12:40p				6										X						
4	MW-15005				1:40p				6										X						
5	MW-15006				2:40p				6										X						
6	MW-15007				3:25p				6										X						
7	MW-15008				4:10p				6										X						
8	MW-15010				4:55p				6										X					X	
9																									
10																									
11																									
12																									

ADDITIONAL COMMENTS	RELINQUISHED BY / AFFILIATION	DATE	TIME	ACCEPTED BY / AFFILIATION	DATE	TIME	SAMPLE CONDITIONS
	[signature] / HDR	5/5/20	8:33am	[signature]	5-5-20	0833	

SAMPLER NAME AND SIGNATURE
PRINT Name of SAMPLER:
SIGNATURE of SAMPLER: DATE Signed:

TEMP in C | Received on Ice (Y/N) | Custody Sealed Cooler (Y/N) | Samples Intact (Y/N)

Appendix G

Statistical Procedures Plan

Former J.B. Sims Generating Station
Statistical Procedures Plan

1.0 Project Management

This Statistical Procedures Plan provides the procedures for analysis for the data generated during groundwater monitoring at the Former J.B. Sims Generating Station (Site or Harbor Island). The Site must comply with the U.S. Environmental Protection Agency's (USEPA) Coal Combustion Residuals Rule (CCR) and the Michigan Part 115 Solid Waste Regulations for CCR units. Groundwater monitoring of CCR facilities is an integral part of compliance with the federal CCR Rule and State solid waste permit.

This document addresses the statistical procedures for evaluating data to select statistical method(s) required for evaluating groundwater monitoring data, as required by Part 115 Rule 908 and 40 CFR 257.23 (g).

2.0 Statistical Analysis

Monitoring will include analyzing groundwater data and groundwater levels from wells upgradient and downgradient of the CCR facilities at Harbor Island. The Groundwater Monitoring System Certification for the facility describes the hydrogeologic characterization and rationale for the upgradient and downgradient sample locations for Federal CCR Rule compliance and the Hydrogeologic Monitoring Plan has been prepared in compliance with the Michigan Part 115 regulations.

This section provides the methodology to statistically evaluate the groundwater data, select appropriate statistical method(s), and develop the appropriate background threshold values (BTVs)[1] for required constituents of interest (COIs) from Part 115 Sections 11511a(3) and 11519b(2), referred to herein as the COIs. The 40 CFR §257.93(f) includes a list of statistical methods from which to choose for evaluating the groundwater monitoring data from CCR management areas. The options include:

- A parametric analysis of variance followed by multiple comparison.
- An analysis of variance based on ranks followed by multiple comparison procedures.
- A tolerance or prediction interval procedure, in which an interval for each constituent is established from the distribution of the background data and the level of each constituent in each compliance well is compared to the upper tolerance or prediction limit.
- A control chart approach that gives control limits for each constituent.

[1] The CCR Rule does not include the term "background threshold value" or any specific term to represent the upper tolerance limit, or the control limit other than references to the "background value", "background constituent concentration levels" or "background concentration". The EPA's ProUCL documentation uses the term "background threshold value" with explicit reference to upper tolerance limits throughout the documentation. For ease of reference in our planning document, we chose to use the EPA's terminology. Note that a BTV is not a fixed value. It is a statistical test for determining if there is an SSI from a groundwater sample taken at a downgradient well. Its value may change as background sample sizes change over time or if changes are made to the number of downgradient wells.

- Another statistical test method that meets the performance of 40 CFR §257.93(g).

The goal of statistical analysis is to provide a quantified means to evaluate whether a CCR management unit has released contaminants into the groundwater. Following the collection of groundwater monitoring data, detected constituents will be statistically evaluated to identify if a statistically significant increase (SSI) over background has occurred. The software application R[2], including use of its Envstats[3] R package and SPSS[4] will be used to conduct statistical analysis of groundwater analytical data collected for the Site. However, if during the period of the groundwater monitoring program at the Site an updated or more comprehensive statistical software program is available or may become available, a different software program may be used.

The steps for this process are summarized in **Figure 1** and are described in **Sections 2.1** and **2.2**. As groundwater monitoring progresses, the use of the selected statistical method will be subject to ongoing review. Other statistical tests may be used in place of, or in addition to, the methods specified in this Statistical Procedures Plan if such methods are better suited for analysis of future results. If test methods are changed, this Statistical Procedures Plan will be revised, as appropriate, and its certification updated.

When developing the BTVs for the Appendix III, IV, and Part 115 constituents at sites with multiple background wells, the data from the background wells will be evaluated to determine if it is appropriate to conduct an interwell analysis and pool the background groundwater data from multiple wells to develop a single BTV for each constituent. The assumption for pooling groundwater data is that the constituent concentrations sampled at multiple background wells, when pooled, serve as an estimate of overall well field conditions for Appendix III, IV, and Part 115 constituents at a given site.

Section 2.1 describes the statistical analyses used to assess and transform the groundwater data from the background monitoring wells where necessary such that the data can be used to produce appropriate BTVs and conduct statistical tests. This stage is referred to as the preliminary data analysis. Consideration is given to issues related to outliers, serial correlation, seasonality, spatial variability, and trends. It may be necessary to test for differences in group means across sub-groups of samples to verify assumptions or to add new groundwater samples to existing samples. For example, sub-group testing can be used to determine if background groundwater concentrations are changing over time or background groundwater concentrations are different by season. These differences are important since they determine if new background data can be pooled with historical data or if deseasonalization of the data is required.

Section 2.2 contains the steps to estimate statistically significant increases (SSIs) over background or statistically significant levels (SSLs) over a groundwater protection standard (GPS) where relevant for each of the detection, assessment, and closure phases. A suite of

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[2] R: A Language and Environment for Statistical Computing, R Core Team, R Foundation for Statistical Computing, Vienna, Austria, 2022, R version 4.2.1 (2022-06-23 ucrt), https://www.R-project.org .

[3] Millard, S. (2013). EnvStats: An R Package for Environmental Statistics. Springer, New York. ISBN 978-1-4614-8455-4

[4] IBM Corp. Released 2022. IBM SPSS Statistics for Windows, Version 29.0. Armonk, NY: IBM Corp.

prediction limits, tolerance limits, and confidence limits are used to address the statistical test requirements.

As recommended by the EPA Unified Guidance (2009b) and pending confirmation as appropriate after evaluation of site-specific background water quality data, upper prediction limits (UPLs) are proposed to establish BTVs for each of the detection monitoring constituents for the purposes of complying with the detection monitoring requirements to confirm SSIs.

The assessment monitoring phase also includes a requirement to compare assessment monitoring constituents from downgradient wells to the groundwater protection standards (GPS). Under the federal CCR Rule compliance program, the GPS value is the maximum contaminant levels (MCLs) or the background value (using the 95% upper tolerance limits (UTLs)), whichever is higher, estimated from the background samples as statistically equivalent BTVs. The results of the evaluation as to whether a COI is above its GPS based on SSLs determines if the CCR Unit remains in assessment monitoring or moves into corrective action. However, under the Part 115 compliance program described herein, the GPS value is the lowest of the MCL or the applicable cleanup criteria for that constituent for groundwater as established pursuant to section 20120a of Act 451. Or for constituents for which the background level (UTL) is higher than the MCL or applicable cleanup criteria for groundwater, the background concentration will be the GPS. Therefore, at this Site, there may be a different GPS value for the Part 115 compliance program than the federal compliance program.

A decision flow chart which summarizes the logic and statistical methods used to determine which groundwater data are suitable to establish or update background and which types of BTVs can be used to describe background levels is shown in **Figure 1** below.

The decision flow diagram allows for updates to the BTVs as samples from the background wells continue to be collected at either the scheduled quarterly sampling events, depending on the quality or quantity of the samples. While the initial required 8 sampling events in 2020 will provide the minimum number of samples from which to estimate BTVs, as additional samples are collected, the BTVs may be updated at scheduled time intervals. In that way, the BTVs may change periodically. [5]

[5] "The Unified Guidance recommends that a minimum of at least 8 to 10 independent background observations be collected before running most statistical tests. Although still a small sample size by statistical standards, these levels allow for minimally acceptable estimates of variability and evaluation of trend and goodness-of fit. However, this recommendation should be considered a temporary minimum until additional background sampling can be conducted and the background sample size enlarged", page 5-3.

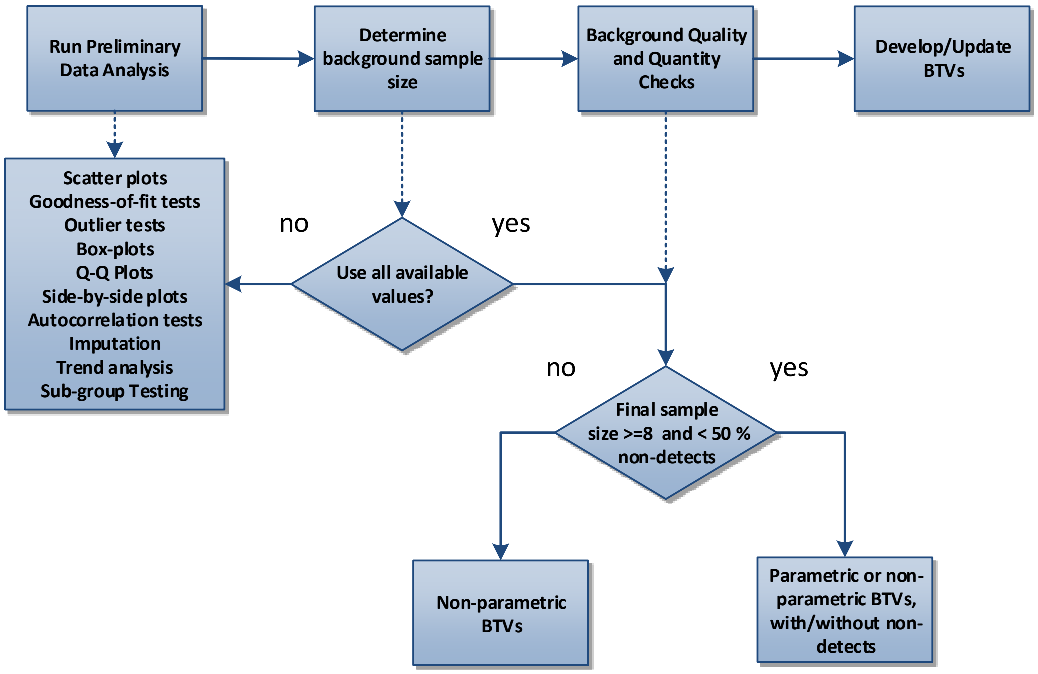

Figure 1: Decision Flow Chart for Preliminary Data Analysis and BTVs

2.1 Preliminary Data Analysis

The CCR Rule references requirements that statistical assumptions and data quality conditions associated with the test procedures are validated as described in 40 CFR 257.93 (g)(5)(6) and required by Part 115 Rule 908. A preliminary data analysis (PDA) is conducted to confirm such assumptions and bring awareness to the quality of data at the time background concentrations are estimated. A type of statistical analyses to support sub-group testing of differences in population means and medians is given special treatment at the end of this section as different aspects of the PDA will draw from it depending on the purpose of the statistical testing collected from the upgradient and downgradient wells.

2.1.1 Descriptive Statistics

Descriptive statistics will be developed per constituent from the background monitoring well and where there are multiple background wells, from the data pooled across the multiple wells. With respect to the downgradient monitoring wells, descriptive statistics will be developed per well per constituent within a location. The purpose of descriptive analysis is to characterize data and assess quality of information. The following descriptive statistics will be produced.

- Sample size
- Number of detects
- Percentage of detects
- Number of non-detects
- Percentage of non-detects
- Mean
- Median
- Minimum
- Maximum
- Standard deviation

- Number of distinct observations
- Number of distinct MDLs
- Range of collection period
- Coefficient of variation
- Skewness
- Kurtosis

2.1.2 Graphical Analysis

Scatter plots of observations will be produced as a function of time. Different colors will be used to differentiate detects from non-detects (NDs). The graphs visually provide clues as to whether the period of record is reflective of a steady-state baseline period. The graphs should be evaluated to determine if all data can be incorporated into analysis or if older historical data may need to be dropped (multiple detection limits over time may affect usability of the data). Outliers and seasonality can also be visually detected. Further statistical tests will need to be conducted to confirm assumptions from visual inspections.

2.1.3 Identify Outliers

A statistical outlier is defined as a value originating from a different statistical population than the rest of the sample. Outliers or observations not derived from the same population as the rest of the sample violate the basic statistical assumption of identically distributed measurements. If an outlier is suspected, options such as producing a probability plot of the ordered sample data versus the standardized normal distribution can be helpful, as well as, identifying observations that are greater than three standard deviations from the mean or visually inspecting box-and-whisker plots for values that are greater than three times the interquartile range above the third quartile. Such exceedances can be flagged as potential outliers.

Two tests will be used to test for possible outliers. Dixon's Outlier Test is appropriate for data series with sample sizes less than 25, and Rosner's Outlier Test is applicable to those with a sample size larger than 25. These outlier tests assume that the rest of the data except for the suspect observation(s) are normally distributed.

If outliers are found from the tests, the anomalous numbers will be investigated. If they are correct values and collected under standard, consistent protocols, they should remain in the data series. Otherwise, they can be dropped before proceeding. Some distributions naturally have anomalously low or high values. The subsequent tests for distribution types should find the best fitting distribution that can explain the anomalous values.

While some literature suggests repeating the statistical procedures with and without the outliers, the risk of this method is that the estimated distributions and statistics tend to be chosen to suit a goal. After a comparison of the estimates is made, a decision needs to be made as to which data set is representative. The decision to use or reject outliers will be done at the data collection and assessment stage. An example would be where a sample was qualified as "J+" (biased high), due to equipment blank contamination. If such a sample was seen as an outlier, it may be possible to eliminate it from further analysis for this reason. If there is a doubt as to the authenticity and reliability of the measured value, it should not be used. Otherwise, it is a value that was generated by the system regulating the water quality conditions of the tested groundwater well. Should outliers be excluded from the dataset, reasoning will be provided in the corresponding report.

2.1.4 Identify Distributions

Since many tests make an explicit assumption concerning the distribution represented by the sample data, the form and exact type of distribution must be checked using a goodness-of-fit (GOF) test. A goodness-of-fit test assesses how closely the observed sample data resemble a proposed distributional model. The best goodness-of-fit tests attempt to assess whether the sample data closely resemble the tails of the candidate distributional model. The models under consideration for water quality samples are normal, lognormal, or gamma distributions.

The Shapiro-Wilk and Lilliefors tests will be used to test for normal distribution. Note that these two tests can be used to test for lognormal distributions after the data are transformed using the natural log function. The empirical distribution function (EDF) based methods, the Kolmogorov-Smirnov (K-S) and Anderson-Darling (A-D) test, are used to test for a gamma distribution. For determining whether the data fit an assumed distribution, the five percent level of significance is used. If all GOF tests fail, a non-parametric estimation method will be used.

The process of conducing GOF tests can produce results that show more than one parametric distribution fits the data. A decision logic is proposed that balances research that the gamma distribution is an appropriate distribution to describe variability in groundwater constituent concentrations with the risk of using small sample sizes (with often high levels of variability) to identify the appropriate distribution based on GOF tests.

With respect to small samples with less than 10 observations, GOF tests have sufficient data on which to calculate tests statistics such as critical values and probability values. Since tests are conducted at the five percent test significance level, the statistical power to correctly reject that the distribution is not parametric (in particular for tests of normality) may be low. HDR will review outcomes where parametric distributions have fit the data with small sample sizes by assessing the probability values and measure of sample skewness supplemented by visual adds such as histograms and boxplots to assess distributional fit.

Table 1 contains the logic used to determine which distribution is used to model sample statistics such as upper prediction or tolerance limits. When multiple distributions can appropriately fit the data, a determining factor is the level of sample skewness. USEPA's ProUCL Technical Guide (Singh and Singh 2015) has categorized skewness levels based on the standard deviation (sd) of the natural- logarithm (logged) of the detected data. When the sd of the logged data is less than one (<1), then the data set is symmetrically to mildly skewed; otherwise, it is moderately to highly skewed. When sample sets have symmetric to mild skewness and multiple distributions fit the data at the 5 percent level of significance, the normal takes presence as the recommended distribution. Sample sets with moderate or higher skewness levels are better described by a skewed distribution such as the gamma or lognormal distributions. However, the ProUCL Technical Guide has cautioned against using the lognormal distribution when the sd of logged values is greater than one due to the possibility of extremely high estimates for upper limits. This guidance is also considered for this procedures plan. In

Table 1 below, a FALSE indicates that the sample does not exhibit the column specific condition, while a TRUE indicates that is does. For example, for conditions one and two, since none of the three tested distributions pass the GOF test and regardless of the sd of logged detected data, a nonparametric distribution is assumed. For condition 11, since both gamma and normal pass the GOF test and the sd of the logged detected data is less than one, the normal distribution is recommended.

Table 1. Distribution Decision Logic

Condition	Gamma	Lognormal	Normal	sd logged detected data >= 1	Recommended Distribution
1	FALSE	FALSE	FALSE	FALSE	Nonparametric
2	FALSE	FALSE	FALSE	TRUE	Nonparametric
3	FALSE	FALSE	TRUE	FALSE	Normal
4	FALSE	FALSE	TRUE	TRUE	Normal
5	FALSE	TRUE	FALSE	FALSE	Lognormal
6	FALSE	TRUE	FALSE	TRUE	Nonparametric
7	FALSE	TRUE	TRUE	FALSE	Normal
8	FALSE	TRUE	TRUE	TRUE	Normal
9	TRUE	FALSE	FALSE	FALSE	Gamma
10	TRUE	FALSE	FALSE	TRUE	Gamma
11	TRUE	FALSE	TRUE	FALSE	Normal
12	TRUE	FALSE	TRUE	TRUE	Gamma
13	TRUE	TRUE	FALSE	FALSE	Gamma
14	TRUE	TRUE	FALSE	TRUE	Gamma
15	TRUE	TRUE	TRUE	FALSE	Normal
16	TRUE	TRUE	TRUE	TRUE	Gamma

2.1.5 Test for Spatial Variability

Spatial variability exists when the distribution or pattern of concentration measurements changes from well location to well location, either from natural or anthropogenic factors. Natural spatial variability refers to a pattern of changing mean levels in groundwater associated with normal geochemical conditions unaffected by human activities such as variation in contents of COIs in the soil and variation in geochemical conditions resulting in different solubility of COIs. Natural spatial variability is not an indication of groundwater contamination, even if concentrations at one or more compliance wells exceed (upgradient) background concentrations. Sources of anthropogenic spatial variability can include recent or historic releases from an on-site source or migration of contaminants from off-site sources. In groundwater monitoring, mean or median levels of a given constituent are usually compared from one well to the next to determine if natural or anthropogenic spatial variability is present.[6] [6]Side-by-side box-and-whisker plots will be developed for each constituent at each well where data permit to evaluate the potential for natural spatial variability in the upgradient wells. If sufficient data are available on a per well basis, sub-group testing for differences in population means and medians will be conducted as described in section (i) below. Results indicating statistically significant differences among the multiple background wells will be noted; however, these results alone, and especially in light of the smaller sample sizes available from groundwater monitoring, are not sufficient to rule out a well or wells for the purpose of conducting an interwell analysis for the reasons explained above.

2.1.6 Test for Serial Correlation

Sources for serial correlation in water samples can be due to seasonal effects or temporal effects related to the timing of the sample collections. Trend analysis using regression techniques of a water quality constituent sampled over time is confounded if the data exhibits serial correlation. The regression errors from adjacent observations may be correlated. For example, if the residual from a given month's observation is high, then it is likely that the residual from the next month's observation will also be high. The same logic follows for low residuals giving rise to other low residuals. This type of correlation is referred to as serial correlation or autocorrelation. The autocorrelation function test will be run at the 1 percent level of significance.

2.1.7 Test for Seasonality

As explained in the previous paragraph, there are different reasons why a series of water quality constituent samples exhibit serial correlation. A common reason arises from changes in season as evidenced from varying temperatures and precipitation. These changes impact water quality constituents in a predictable and cyclical manner over the months. The study of water quality changes over time is focused on the ability to discern true trend through regression analysis amidst the cyclical nature of the data or its "seasonality". The correct use of these regression analyses rests on the crucial assumption that regression errors or residuals arising from the model fitting are independent of each other. This is often not the case with data that is seasonal in nature. If seasonality exists, then the autocorrelation function test described in step "f" will pick up the pattern. To better understand the type of seasonality (monthly, quarterly, bi-annually) which factors into the observed variability of data, a visual inspection of the data as a function of time is recommended.

Box-and-whisker plots of observations on a monthly or quarterly basis will be developed (provided one has at least 8-10 observations per sampling period). These results will be used to

[6] Analysis of variance (ANOVA) techniques (see Section 5.1 for details on these techniques) can also be used to establish evidence of spatial variation. If there is evidence of spatial variation, the Unified Guidance recommends using an intrawell statistical analysis instead of an interwell analysis. For an intrawell analysis to be meaningful at the downgradient sites, samples would have had to be taken prior to human activity such the installation of ash basins or ponds. Since the activity has occurred, it is important that the selection of groundwater wells at both upgradient and downgradient sites be done to minimize spatial variability to the extent possible for the purpose of conducting an interwell analysis.

determine how to group the data into seasons. If sufficient data are available on a per season basis, sub-group testing for differences in population means and medians will be conducted as described in sub-section (i) below.

2.1.8 Test for Trend

The samples from background wells represent water quality conditions exhibiting natural variability and unaffected by anthropogenic activities. As such, the measurements taken at regular intervals over time (three or more years) are expected to demonstrate a steady or stationary time series. Provided the data has more than 50 percent detected observations, the data from the background wells will be tested to determine whether trends exist (values steadily increasing or steadily decreasing). Depending on whether the data follow parametric or non-parametric distributions), one of the following linear regression tests will be selected:

- Maximum Likelihood Estimation (MLE) Regression (parametric, with or without NDs)
- Mann-Kendall (non-parametric, with or without NDs, 1 distinct value for MDL)

Both methods assume there is no seasonality in the data or if there is, the data have been deseasonalized prior to estimating average trend.

After the first initial one or two years of sampling from background wells in which a minimum of eight samples is collected, initial trends based on the first eight sampling events may change over time as additional sampling is completed. Generally, linear regression approaches detect monotonic trends and do not account for the existence of structural breaks in a parameter's time-series of observations. Linear regression attempts to fit an "average" trend based on the patterns in the observations.

A structural break may occur when the trend changes its magnitude, direction, or significance over time. As with the case with samples of groundwater quality data, the patterns can be highly erratic and generally do not follow strictly linear trends over time. A statistically significant upwards or downwards trend does not as a rule identify when groundwater quality conditions changed. The piece-wise polynomial regression approach can augment the results of the trend analysis.

Piece-wise polynomial regression has proven useful in circumstances when changes in trend may occur within the time-series for a constituent. The model provides another line of evidence that may be performed should environmental conditions or other factors indicate shifts in trends may have occurred. This approach attempts to find an appropriate mathematical model to express the relationship between the constituent's values and the sampling dates by using piece-wise regressions.

Examples of two types of piece-wise models for studying trends include the: linear-linear model and linear-linear-linear model. The linear-linear regression model assumes and identifies one structural break in a constituent's data series, in which the two portions of the data separated by the break point follow two different trends as modeled by two different linear equations. Similarly, the linear-linear-linear model attempts to identify two structural breaks to separate three different linear trends.

The piece-wise models since they do not account for censorship or if the data follow non-parametric distributions can be applied mainly as a visual guide to identify changes in trend that may have occurred within the time-series of a constituent.

For the breaks in a time-series to be meaningful, at least eight observations per segment are available. Assessment to changes in the average trend will be done at a minimum after the second set of eight observations are collected from the background site. The pooled data will be evaluated for overall average linear trend (i.e., linear regression) and for structural breaks (i.e., piece-wise linear regression) in the pooled data over time.

The approximate date of a structural break should one be statistically significant will be used to determine if factors post-structural break date may have contributed to the change in the trend relative to the initial background data trend.

A risk in using linear or piece-wise regression analyses for the small datasets available to assess variability of overall well field conditions is that trends or structural breaks may be outcomes of spurious, shorter-term trends and that a longer time-series (e.g., 10 years or more of sampling events) would better represent overall trend patterns.

To mitigate this risk, anthropogenic, environmental, well installation methods, laboratory measurement protocols, or other factors will be determining factors as to whether or not older background sampling events should be removed, and background data is updated with the latest data.

If such external factors can be corroborated, provided there are at least eight observations in the latest available data post-structural break date, and the average of that data is statistically different from the average of previous background reference values (see Section 5.1i for statistical methods to test for differences in sub-groups), background data will be updated using the latest available data.

2.1.9 Test for Sub-Group Testing

When assessing if concentration means or medians are statistically different across wells, seasons or between two different background collection periods, various statistical procedures are available. This section describes the tests which may be used depending on the nature of the data and number of tests required. A significance level of 1 percent is used to decide whether to accept or reject the null hypothesis that there are no differences across the sub-group means or medians. In instances where multiple comparisons are made, adjustments will be incorporated to control for false positive rate (e.g., Bonferroni's adjustment) or statistical tests used with built-in functionality to address the multiple comparison issue (e.g., Tukey-Kramer test).

Before proceeding to test for differences across the sub-group means, one needs a sufficient sample size of at least 8-10 samples per sub-group. Testing for sub-groups can be done in three steps: 1. Graphical analysis, 2. Hypothesis tests for sub-group differences, and 3. Tests to identify which sub-groups are different.

Graphical Analysis

Background groundwater data can be assessed for sub-groups using graphical representation tools such as box-and-whisker plots. Multiple box-and-whisker plots can be constructed for comparing constituent concentrations and variability across potential sub-groups. Investigations may be done using Q-Q plots, if necessary, to supplement findings based on box-and-whisker plots.

Hypothesis Tests for Sub-Group Differences

The following methods can be used to detect for population differences across the sub-groups:

- ANOVA (under normal distribution assumptions)
- Log-ANOVA (under log-normal distribution assumptions)
- Kruskal-Wallis One-Way Analysis on Ranks (distribution free assumptions/non-parametric, presence of non-detects, corrected for ties)
- Kaplan-Meir (non-parametric, useful with heavy censoring).

The decision as to which test to use is predicated on the presence of censorship and whether the distribution follows a parametric distribution of either normal, log-normal, or gamma type or does not have a discernible distribution and hence is non-parametric. Note that the Log-ANOVA is simply the ANOVA approach applied to the natural-logarithm of the time series.

The ANOVA tests require that normality assumptions are valid for each sub-group. In addition, the variances across the groups should be approximately equal.

Testing for potential sub-groups within background groundwater data sets will be performed using a significance level of 1 percent.

Tests to Identify Which Sub-Groups Are Different

Provided any of the tests described above show sub-group differences, further tests may be performed to identify which sub-group(s) is different from the others provided each sub-group has at least 20-30 observations.

- Post-Hoc Test for Multiple Comparisons
  - Tukey-Kramer Test (parametric)
  - Dunn's Test (non-parametric)

2.2 Background Threshold Values

Using data from the three upgradient background well(s), MW-27, MW-33, and MW-34, to represent background field conditions for both CCR Units, the appropriate BTVs will be computed for each constituent. Since the Site has more than one background well, the upgradient data are defined by pooled samples over the wells, as appropriate.

As recommended in the Unified Guidance (2009b), background values should be updated every four to eight measurements (e.g., every one to two years if samples are collected quarterly). New background groundwater data will be evaluated against the existing background dataset, as appropriate. If the new background data does not indicate a statistically significant difference using the approaches described in the sub-group testing **Section 2.1(i)**, the new data will be combined with the existing background data to calculate updated BTVs. Increasing the background dataset will increase the power of subsequent statistical tests. If the new background data does indicate a significant difference between the two populations, the data should be reviewed to evaluate the cause of the difference. In the absence of evidence of a release, the combined dataset should be considered more representative of present-day groundwater conditions and used for background. Should changes to BTVs be proposed, justifications will be provided in an updated report and EGLE shall be notified.

2.2.1 Updating Background Threshold Values

Analysis to update published BTVs will be done at a minimum after eight sampling events have been collected per well or if there is a change to the background wells.

The analysis includes tests of differences in averages between the previously established background sampling events and the newer sampling events per constituent. An evaluation of the concentration trends over time using all data collected to date will be done. To provide context to observed patterns in the concentrations over time and with interest in differences in patterns since the establishment of published BTVs, investigations will be done to check if anthropogenic activities, changes to laboratory protocols, climate events or other factors have occurred during the time since the publication of the current BTVs.

Given the smaller sample sizes available for updating and that the sample size may not capture the full natural variability in concentrations over time, interpretation of inferential test results will be informed by outlier tests (Section 2.1.3) and trend tests (Section 2.1.8) of the pooled data, sub-group testing (Section 2.1.9) between the data from the sampling events pre- and post-current BTV publication.

A discussion will be included that evaluates the sets of constituents that had statistically significant differences as to whether the differences are due to a change in the hydrogeology of the site's groundwater system or reflect the natural variability in concentrations or trends. Changes to the inclusion or exclusion of sampling events will be consistently applied across the constituent-well pairs at the site. This does not preclude removal of specific data observations that are deemed to be erroneous or not representative of groundwater conditions (e.g., observation collected during high turbidity).

If both statistical and environmental evidence suggests a shift in the background reference values at the site level at some point since the initial background sampling event (including the point in time since the publication of the current BTVs), the most recent data (with a minimum of eight samples) will be combined with previously collected data should the shift in site conditions occurred during the last background reference period. If not, the latest set of sampling events will be used exclusively to update the BTVs.

If there is not sufficient evidence to support field conditions shift in concentrations since the publication of the current BTVs, the background reference concentrations will be updated to include data from the latest set of eight or more sampling events.

For the situation where there are changes to the background wells the process to establish BTVs will anew, and all the data collected for the new background wells will be used.

Whichever sampling events or wells are used to define the background reference period, the statistical process described in this plan will be applied to that data.

2.2.2 Detection Monitoring

Under the detection monitoring programs of 40 CFR §257.94 and Michigan Part 115 Section 324.11511a(3), COI monitoring results will be statistically compared to BTVs through interwell statistical methods. As recommended by the Unified Guidance (2009b), the statistical test to define the BTV for detection monitoring is the upper prediction limit. The formulation of the prediction limit may vary slightly with the particulars of the test to be made and the characteristics of the data involved such as whether the data follow parametric or non-parametric distributions and the percentage of NDs. For example, if the recommended distribution follows a normal distribution, a normal-based parametric prediction interval is used. If the recommended distribution follows a gamma distribution, then a gamma-based parametric prediction interval is used, and if the recommended distribution is lognormal, then a lognormal-parametric prediction interval is used. If the data cannot be explained by parametric distributions, a non-parametric prediction interval on the median is used.

The confidence level associated with each upper prediction limit test is selected such that the site-wide false positive rate does not exceed 10 percent as recommended by the Unified Guidance (2009b). The achieved per-test confidence levels will typically range between 95 and 99 percent. Whatever the formula specification, prediction limits represent a range where a future result is expected to lie at a given confidence level. Both the upper and lower prediction limits (LPL) will be produced for pH since lower and higher pH values relative to background are of concern.

<u>Determination of Statistically Significant Increases above Background</u>

If the groundwater concentration of any detection monitoring COI at any downgradient well is greater than the UPL, then that concentration represents an SSI over background for that CCR impoundment. One exception is pH, which can exhibit an SSI if the concentration in a monitoring well is either greater than the UPL or less than the LPL. As written in Federal CCR Rule 40 CFR 257.94(e) and Part 115 Rule R 299.4440(8), if an SSI over background is identified in a downgradient well for one or more detection monitoring COI, then the owner or operator of the CCR unit must: 1) Within 14 days of the determination, place a notice in the operating record that indicates which constituents have shown statistically significant increases from background levels and notify the director that the notice is placed in the operating record, and 2) prepare and submit to the director an assessment monitoring plan that is in compliance with R 299.4441 and a response action plan that is in compliance with R 299.4442 within 45 days of the determination; or demonstrate that a source other than the CCR unit caused the SSI over background, or demonstrate that the SSI over background resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality.

If sources other than the CCR Unit, natural variability or errors have been ruled out as the reason for the SSI, a type of verification sampling method called the one-of-m pass method, as described in the Unified Guidance (2009b), allows for an efficient plan to confirm if an SSI over background identified during detection monitoring resulted from the CCR unit. Resampling of wells where an SSI has occurred can either verify the initial SSI determination or disconfirm it, thereby avoiding false positives. Depending on the number of background samples, the selected site-wide false positive rate, and the available time period in which to do the resampling, either a 1-of-2 or 3 pass method is recommended should verification sampling be considered. Initial exceedances are technically not SSIs until the verification sampling is initiated. However, as a conservative measure, the first exceedance will represent an SSI. Verification sampling will occur at the next quarterly sampling event if appropriate. For example, if prior samples had similar concentrations, the concentration may be identified as an SSI without a resample.

2.2.3 Assessment Monitoring

Under the assessment monitoring program in 40 CFR 257.95 and Michigan Part 115 Section 324.11519b(2), Appendix III, IV, monitoring results are compared to BTVs as described in 40 CFR 257.95(e). The UPLs discussed in Section 2.2.1 are also used to compare Appendix III, IV, and Part 115 assessment monitoring results to background values.

According to 40 CFR 257.95(e), the CCR unit may return from assessment monitoring to detection monitoring when all Appendix III and Appendix IV constituents are "shown to be at or below background values, using the statistical procedures in paragraph 40 CFR 257.93(g) for two consecutive sampling events." A notification letter stating that detection monitoring is resuming for the CCR unit will be placed in the facility's operating record as required by 257.105(h)(7).

<u>Determination of Federal GPS</u>

According to 40 CFR 257.95(f), if assessment monitoring concentrations of all Appendix III and Appendix IV constituents are above background concentrations (UPLs), and Appendix IV constituents are below the groundwater protection standard (GPS), then assessment monitoring will continue. As required in 40 CFR 257.95(h), the CCR owner must establish GPS for each constituent in Appendix IV detected in the groundwater. The GPS shall be defined as the following:

- The U.S. EPA Maximum Contaminant Level (MCL) for constituents for which an MCL has been established;
- for cobalt, lead, lithium, and molybdenum the concentrations established in §257.95(h)(2) (6, 15, 40, and 100 ug/L, respectively); or
- the background concentration for constituents for which the background level is higher than the MCL or concentrations in §257.95(h)(2).

The Unified Guidance recommends the upper tolerance limit (UTL) to represent the background concentration for this purpose. The limits can be considered as statistically equivalent BTVs to an MCL or other health-based numbers. The UTLs are derived from the same background data sourced to produce the UPLs and are used in these situations to represent the GPS. Tolerance intervals represent a range where a proportion of the population is expected at a given confidence level. For the purpose of this certification plan, a 95 percent confidence level is assumed. Similarly to the specification for prediction limits, specification for tolerance limits vary depending on whether the background data follow parametric or non-parametric distributions and the incidence of NDs. For example, if the recommended distribution follows a normal distribution, a normal-based parametric tolerance interval is used. If the recommended distribution follows a gamma distribution, then a gamma-based parametric tolerance interval is used, and if the recommended distribution is lognormal, then a lognormal-parametric tolerance interval is used. If the data cannot be explained by parametric distributions, a non-parametric tolerance interval on the median is used. Both the upper and lower tolerance limits will be produced for pH to establish lower and upper GPS. The Federal program GPS values are provided in **Table 2**.

Table 2. Federal Program Background Threshold Values and Groundwater Protection Standards

Parameter	Site-Specific Background Level Upper Tolerance Limit (UTL) (mg/L)	Federal Maximum Contaminant Level (mg/L)	Federal Program Groundwater Protection Standards (mg/L)
Antimony	0.0012	0.0060	0.0060
Arsenic	0.0040	0.010	0.010
Barium	0.58	2.0	2.0
Beryllium	0.000059	0.0040	0.0040
Cadmium	0.00015	0.0050	0.0050
Chromium	0.042	0.10	0.10
Cobalt	0.0021	0.0060*	0.0060
Fluoride	0.45	4.0	4.0
Lead	0.0016	0.015*	0.015
Lithium	0.10	0.040*	0.10
Mercury	0.00016	0.0020	0.0020
Molybdenum	0.0093	0.10*	0.10
Radium-226/228	2.6	5.0	5.0
Selenium	0.00089	0.050	0.050
Thallium	0.000075	0.0020	0.0020

*EPA adopted health-based value for constituents with no MCL.

Determination of State GPS

As required in Michigan Part 115 Rule R 299.4441(9), the CCR owner must establish GPS for each constituent detected in the groundwater. The GPS for the Part 115 compliance program shall be defined as the lowest of the following:

- U.S. EPA Maximum Contaminant Level (MCL) for constituents for which an MCL has been established;
- The applicable cleanup criteria for that constituent for groundwater as established pursuant to Section 20120a of Act 451.

Or for constituents for which the background level (UTL) is higher than the MCL or applicable cleanup criteria for groundwater, the background concentration will be the GPS. **Table 3** provides the background level, the MCL, the cleanup criteria, and the State program GPS values for the Site.

According to Part 115 Rule R 299.4441(6), if assessment monitoring concentrations of any assessment monitoring COIs are above background concentrations (UTLs) but all constituents are below the GPS, then:

- Assessment monitoring will continue in accordance with this rule.
- The nature and extent of the release will be characterized by installing additional monitoring wells as necessary.
- At least 1 additional monitoring well will be installed at the facility boundary in the direction of contaminant migration and sample the well.
- All persons who own the land or reside on the land that directly overlies any part of the plume of contamination if contaminants have migrated off-site as indicated by the sampling of wells in accordance with this rule will be notified.

Table 3. State Program Background Threshold Values and Groundwater Protection Standards

Parameter**	Site-Specific Background Level (UTL)	MCL	State Non-Res. Drinking Water Cleanup Criteria for Groundwater*	GSI*	GPS
Unit	mg/L	mg/L	mg/L	mg/L	mg/L
Boron	4.0	NV	0.50	7.20	4.0
Calcium	250	NV	N/A	N/A	N/A
Chloride	120	NV	250	50	120
Fluoride	0.45	4.0	2.0	NV	2.0
Sulfate	100	250	250	NV	250
Total Dissolved Solids	950	500	500	500	950
Antimony	0.0012	0.0060	0.0060	0.13	0.0060
Arsenic	0.0040	0.010	0.010	0.010	0.010
Barium	0.58	2.0	2.0	1.3[1]	1.3
Beryllium	0.000059	0.0040	0.0040	0.036[1]	0.0040
Cadmium	0.00015	0.0050	0.0050	0.0025[1]	0.0025[1]
Chromium	0.042	0.10	0.10	0.12[1]	0.10
Cobalt	0.0021	0.0060	0.10	0.10	0.0060
Fluoride	0.45	4.0	2.0	NV	2.0
Lead	0.0016	0.015	0.0040	0.014[1]	0.0040
Lithium	0.10	0.040	0.35	0.44	0.10
Mercury	0.00016	0.0020	0.0020	0.0000013	0.0000013
Molybdenum	0.0093	0.10	0.210	3.2	0.10
Radium 226 and 228 combined	2.6	5.0	NV	NV	5.0
Selenium	0.00089	0.050	0.050	0.0050	0.0050

Table 3. State Program Background Threshold Values and Groundwater Protection Standards					
Parameter**	**Site-Specific Background Level (UTL)**	**MCL**	**State Non-Res. Drinking Water Cleanup Criteria for Groundwater***	**GSI***	**GPS**
Unit	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
Thallium	0.000075	0.0020	0.0020	0.0037	0.0020
Copper	0.020	1.30	1.0	0.021[1]	0.021[1]
Iron	83	0.30	0.30	NV	83
Nickel	0.023	NV	0.10	0.12[1]	0.10
Silver	0.00011	0.10	0.098	0.00020	0.00020
Vanadium	0.00093	NV	0.0062	0.027	0.0062
Zinc	0.038	5.00	5.00	0.27[1]	0.27[1]

*Cleanup Criteria Requirements for Response Activity (Formerly the Part 201 Generic Cleanup Criteria and Screening Levels) found in R 299.44 Generic groundwater cleanup criteria.

**Metals data is analyzed and reported as total metals.

NV=no value

[1]Per Footnote G of Table 1 Cleanup Criteria Requirements for Response Activity (Formerly the Part 201 Generic Cleanup Criteria and Screening Levels) of the Groundwater Surface Water (GSI) criteria list, values noted are calculated based on the hardness (expressed as $CaCO_3$) of the receiving waters. Surface water sample from the Grand River (SG-01) had a hardness of 270 mg/L was used in the calculation of specific GSI values. The Grand River discharges into Lake Michigan, thus the GSI Criteria for Surface Water Protected for Drinking Water Use, is provided above.

Federal Program Determination of Statistically Significant Levels above GPS

The CCR Rule stipulates in 40 CFR 257.95(g) that if Appendix IV constituents are detected at statistically significant levels (SSLs) above the GPS, the following actions are required to be taken:

- Place a notification in the operating record identifying the GPS exceedances.
- Characterize the nature and extent of the release and any relevant site conditions that may affect the remedy ultimately selected in accordance with 40 CFR 257.97.
- Notify all persons who own the land or reside on the land that directly overlies any part of the plume of contamination.
- Within 90 days:
  - Prepare an alternative source determination for the exceedance, or
  - Initiate an assessment of corrective measures in accordance with 40 CFR 257.96.

Therefore, if Appendix III and detected IV COIs exceed BTVs according to 40 CFR 257.95(e), and detected Appendix IV COIs exceed GPS pursuant to 40 CFR 257.95(f), then detected Appendix IV constituents will be statistically compared to the GPS to identify SSLs above the GPS pursuant to 40 CFR 257.95(g). In order to evaluate if an exceedance of the GPS is statistically significant, the lower confidence limit of the sample mean or median concentrations from downgradient monitoring wells are used.

During the statistical analysis of confidence intervals from each detected Appendix IV constituent, if the lower confidence limit exceeds the GPS at the 95 percent confidence level, then the constituent has been detected at a SSL above the GPS at a particular monitoring well. As with the UPL and UTLs, the particularities of the lower confidence limit are based on whether parametric or non-parametric distributions best fit the data and the incidence of NDs observed in the monitoring data. For example, if the recommended distribution follows a normal distribution according to Table 4, a normal-based parametric confidence interval is used. If the recommended distribution follows a gamma distribution, then a gamma-based parametric confidence interval is used, and if the recommended distribution is lognormal, then a lognormal-parametric confidence interval is used. If the data cannot be explained by parametric distributions, a non-parametric confidence interval on the median is used. To maintain statistical power in correctly rejecting that the average (mean or median) of downgradient concentrations is less than the GPS when the average is higher than the GPS, a minimum of eight samples will be used.

Table 22-3, page D-258 of the Unified Guidance (2009b) indicates that for detecting a true mean 50 percent higher than the GPS, a sample size of 8 achieves 50 percent power with a minimum individual test significance level of 19 percent when conservatively assuming that the population coefficient of variation is 1. Increasing the true mean by 100 percent over the GPS, a sample of eight has 80 percent power of correctly rejecting the null hypothesis when the true population mean is twice the GPS with a test significance of 31 percent. Note that the lowering the test significance level increases power for a fixed sample size and increasing sample size while holding the test significance level constant, also increases statistical power.

If waste boundary well SSLs are identified, nature and extent wells will be installed as needed to define the contaminant plume(s) including at least one well at the facility boundary in the direction of contaminant migration pursuant to 40 CFR 257.95(g)(1). These nature and extent wells will be sampled at an increased frequency (5-week frequency) immediately after installation in effort to have sufficient samples (minimum 8) from each new well (as soon as possible) to complete the statistical comparison against the GPS. Once a nature and extent well has 8 or more sample events, the entire available data set from that well is used to calculate the LCLs, and if the LCL is below the GPS then the well will not be considered part of the plume and if the LCL is above the GPS then the well will be considered part of the plume. Between the time a new nature and extent well has been installed and 8 samples have been collected (approximately a 10-month window), concentrations from each sample event will be compared to the GPS on a single event basis and the exceedance will be described in any reporting documents as single event exceedances. Determination for whether additional nature and extent wells are warranted to define the plume will not require a statistical comparison (8 sample events), nor should be made after a single sample event, but may be completed with approximately two sample events singe event comparisons to the GPS. For example, if two sample events have GPS exceedances, that will be an indication that additional nature and extent wells are warranted to define the plume, and conversely if two sample events do not have GPS exceedances, that will be an indication that additional nature and extent wells are not warranted at that time.

<u>Michigan Program Determination of Statistically Significant Levels above GPS</u>

If any assessment monitoring COIs exceed BTVs and exceed GPS, then COIs will be statistically compared to the GPS to identify SSLs above the GPS. In order to evaluate if an exceedance of the GPS is statistically significant, the lower confidence limit (LCL) concentrations from downgradient monitoring wells are used.

During the statistical analysis of confidence intervals from each COI, if the LCL exceeds the GPS at the 95 percent confidence level, then the constituent has been detected at a SSL above the GPS at a particular monitoring well. As with the UPL and UTLs, the particularities of the LCL are based on whether parametric or non-parametric distributions best fit the data and the incidence of NDs observed in the monitoring data. For example, in the case of normally distributed data, a normal-based parametric confidence interval is used. If the data cannot be explained by parametric distributions, a non-parametric confidence interval on the median is used.

According to Part 115 Rule R 299.4441(7), if assessment monitoring concentrations of any assessment monitoring COIs are detected at statistically significant levels above the GPS, then:

a. Within 14 days of the detection, a notice will be placed in the operating record that identifies the hazardous substances that have exceeded any criteria for groundwater established pursuant to Section 20120a of Act 451.
b. The director and all appropriate local government officials will be notified that the notice has been placed in the operating record.
c. Assessment monitoring in accordance with this rule will be continued.
d. At least 1 additional monitoring well at the facility boundary in the direction of contaminant migration will be installed and sampled.
e. The nature and extent of the release will be characterized by installing additional monitoring wells as necessary.
f. All persons who own the land or reside on the land that directly overlies any part of the plume of contamination will be notified if contaminants have migrated off-site as indicated by the sampling of wells in accordance with this rule.
g. Except as provided by R 299.4441(8), initiate an assessment of corrective measures as required by R 299.4443 within 90 days of the detection.

2.2.4 Criteria for Clean Closure

40 CFR 257.102(c) of the CCR Rule and 11519b(9)(b) of the State Part 115 regulations address criteria to close a CCR unit by removing and decontaminating all areas affected by releases from the CCR unit. CCR removal and decontamination of the CCR unit are complete when constituent concentrations throughout the CCR unit and any areas affected by releases from the CCR unit have been removed and groundwater monitoring concentrations do not exceed the GPS. The following paragraphs address the groundwater monitoring criteria.

If the site is in assessment monitoring, post-clean-out Appendix IV groundwater concentrations are compared to GPS and if concentrations are below GPS, the site will be re-sampled semi-annually pursuant to the guidance in §257.95(e,f). According to §257.95(e), if two consecutive sample event concentrations of Appendix III and IV constituents are below BTVs the operator may return to detection monitoring but because the site has been closed it will be considered clean closed. If such groundwater concentrations are above GPS, the site will be re-sampled following assessment monitoring semi-annual monitoring protocols and will follow the assessment monitoring guidance in §257.95(g).

If a corrective measures program is implemented to achieve remedy completion in accordance with 40 CFR 257.98(c)(2) and Michigan Part 115 R 299.4445, it must be demonstrated that groundwater concentrations of constituents listed in Appendix IV have not exceeded the GPS for a period of three consecutive years using the statistical procedures and performance standards in §257.93(f) and (g). The statistical test after corrective measures have been implemented compares the downgradient wells upper control limits (UCL) to the GPS.

3.0 References

Singh, Anita and Ashok K. Singh. 2015. ProUCL Version 5.1 Technical Guide: Statistical Software for Environmental Applications for Data Sets with and without Nondetect Observations. U.S. Environmental Protection Agency, EPA/600/R-07/041.

USEPA. 1992. Supplemental Guidance to RAGS: Calculating the Concentration Term. Publication EPA 9285.7-081, May 1992.

USEPA (U.S. Environmental Protection Agency). 2009a. Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use, USEPA 540-R-08-005. January 13 2009.

USEPA. 2009b. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities: Unified Guidance. Office of Resource Conservation and Recovery, Program Implementation and Information Division, U.S. Environmental Protection Agency. EPA 530/R-09-007.

USEPA. 2010. National Functional Guidelines for Inorganic Data Review, USEPA-540-R-10-011. January 2010.

USEPA, 2015. 40 CFR parts §257 and §261; Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule, Federal Register vol. 80, no. 74. Environmental Protection Agency. April 17, 2015.

Appendix H

Response Action Plan

Prepared by

HDR

Renew
Harbor Island
Work today, protect tomorrow.

Response Action Plan

for Compliance with Michigan R 299.4442

March 8, 2024

Renew Harbor Island
Work today, protect tomorrow.

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Michigan R 299.4442 Requirement - The owner and operator of a type II landfill unit that is required to prepare a response action plan shall identify all of the following:		**Inactive Units 1/2 Impoundment**	**Former Unit 3A/B Impoundments**
4442 (1)(a)	Possible sources of contamination	See Section 3.1	See Section 3.2
4442 (1)(b)	Interim response activities take or to be taken to control possible sources of contamination.	See Section 4.0	See Section 4.0
4442 (1)(c)	For units that the owner or operator concludes are probable sources of contamination, a schedule for terminating waste receipt, for initiating closure at units, and for redesigning and constructing new units that have leak detection systems. The schedule shall be based on all of the following: I. The concentration of hazardous substances. II. The rate of migration. III. Risks to human health and environment, including the proximity of drinking water supplies. IV. The practicality of initiating closure. V. The availability of other disposal locations. VI. Other relevant factors.	See Section 6.0 and Section 7.0	See Section 6.0 and Section 7.0

1.0 Introduction

This Response Action Plan (RAP) was prepared for the Former J.B. Sims Generating Station located on Harbor Island (Island or Site) to support compliance with Part 115 of the Michigan Natural Resources and Environmental Protection Act, Act 451 of 1984 (Part 115). The facility is located at 1231 North 3rd Street, on Harbor Island, in Grand Haven, Michigan. The former J.B. Sims Generating Station was a coal-fired, steam-generating power facility with a net capacity of approximately 70.5 megawatts operated by the Grand Haven Board of Light and Power (GHBLP). Coal Combustion Residuals (CCR) generated at the former Site was stored in two CCR units: (1) the inactive Units 1/2 Impoundment and (2) the former Unit 3A/B Impoundments.

According to Section 324.11519b(2) of Part 115, if detection monitoring confirms a statistically significant increase over background at a CCR unit, the owner shall develop a RAP. This RAP was prepared in compliance with Part 115 Rule R 299.4442. The proposed response activities set forth in the RAP are designed to address:

- Possible sources of contamination,
- Interim response activities taken or to be taken to control identified possible sources of contamination and,
- A schedule for terminating waste receipt and for initiating closure at units

2.0 Background

The initial groundwater monitoring system at the Site was installed by ERM in 2017. This well network was expanded by Golder & Associates (Golder) in 2021, and again by HDR in 2022 (HDR, 2023). Background water quality sampling, for the revised groundwater monitoring well network, was conducted over eight events from November 2022 through August 2023 and the first detection/assessment monitoring event was conducted in October 2023. Following the completion of background sampling as specified in R 299.4440(8), the *Background Water Quality Statistical Certification* was placed into the operating record (HDR, 2024). That document outlines the approach and selection of the statistical method for each Appendix III, Appendix IV, and Part 115 constituent of interest (COI) for each CCR unit. The water quality data collected from the monitoring wells located upgradient of the CCR units has been compiled and statistically analyzed to develop the background threshold values (BTVs) for the impoundments. The statistical method chosen to represent background water quality is the upper prediction limit (UPL) and is one of the methods described in Part 115 Section 324.11511a(3).

Following the submission of the *Background Water Quality Statistical Certification*, the memorandum *Former J.B. Sims Generating Station Determination of Statistically Significant Increases over Background per §257.93(h)(2) and R 299.4440(8) of the Michigan Part 115 Rules* was placed in the operating record (HDR, 2024a). That memorandum outlines the process undertaken to compare groundwater samples collected in October 2023 against UPLs where the resulting exceedances are considered Statistically Significant Increases (SSIs) (HDR, 2024a). The SSIs identified for the Units 1/2 Impoundment include boron, calcium, fluoride, sulfate, and total dissolved solids (TDS). SSIs identified for the Unit 3A/B Impoundments include boron, calcium, chloride, fluoride, sulfate, and TDS. Because there were SSIs for both CCR units following the well network update in 2022, both Units 1/2 Impoundment and Unit 3A/B Impoundments will maintain the status of assessment monitoring.

These SSIs trigger the assessment monitoring program for the impoundments. According to Section 324.11519b(2), if detection monitoring confirms an SSI over background at one of the impoundments for one or more of the constituents listed in Section 324.11511a(3), the owner shall develop an Assessment Monitoring Plan, a RAP, and initiate assessment monitoring at that impoundment. The Assessment Monitoring Plan is a section of the Hydrogeologic Monitoring Plan and will be submitted to EGLE in the first quarter of 2024.

3.0 Identification of Contamination Source

3.1 Units 1/2 Impoundment

Documented in the Golder report *Preliminary Groundwater Data Summary Through October 2020*, historical records indicate the Island operated as a municipal dump site in the 1950s and 1960s. During this period, waste was pushed into the low interior marshland (Golder, 2020a). When the J.B. Sims Generating Station began operation in the early 1960s, the CCR was disposed into the internal marshland which was later delineated as the Units 1/2 Impoundment. According to Golder's *2021 Annual Groundwater Monitoring and Corrective Action Report*, CCR waste streams into the units ceased in 2012 (Golder, 2022).

No formal historical documentation regarding the construction of the Units 1/2 Impoundment is available that could verify whether a liner may be present beneath the impoundment. However, the following reports document borings completed within the footprint of the units:

- Environmental Resources Management (ERM) - Coal Ash Delineation Sampling Results published February 8, 2016.
- Soils & Structures (S&S) - Grand Haven BLP – Ash Impoundment Evaluation published July 17, 2014.
- Superior Environmental Corp (Superior) - Ash Pond Assessment published August 1, 2014.

Borings from all three studies determined no liner is present beneath the Units 1/2 Impoundment, indicating the source of contamination is CCR and historical municipal solid waste.

3.2 Unit 3A/B Impoundments

Documented in the 1983 report, the Unit 3A/B Impoundments was constructed as an above-ground ash impoundment consisting of clay dikes and a minimum 3-foot compacted clay bottom (Black and Veatch, 1983). The liner was verified in the 2014 S&S report, in which borings were completed through the impoundment berms and sediment samples were tested for permeability.

According to Golder's *Documentation of Liner Construction*, however, no composite liner is present and thus the liner design criteria of 40 CFR 257.71 have not been met (Golder, 2017).

The GHBLP ceased all waste disposal into Unit 3A/B Impoundments on July 30, 2020. The GHBLP commenced removal of CCR from Unit 3A/B in July 2020. On December 10, 2020, Golder considered the unit at final closure to 95 percent confidence of CCR removal (Golder, 2020). Following the submission of closure documentation on January 27, 2021, EGLE denied the closure certification for the following reasons:

- GHBLP did not have a groundwater monitoring system that represented background water quality. The monitoring well network has since been expanded to accurately represent the background water quality and address groundwater exiting the waste boundary.
- GHBLP only utilized one of six total soil samples to verify ash removal using colorimetric methods. EGLE stated no demonstration had been made that would justify how one sample could represent all liner areas accurately.
- The methodology for microscopy did not include preprocessing of samples to ensure bottom ash could properly be identified.
- GHBLP did not address the contamination of the clay liner beneath Unit 3A/B. Soil sample analysis showed elevated concentrations of lithium and selenium have impacted the liner, consistent with coal ash or coal ash leachate.
- GHBLP did not provide sufficient demonstration that the horizontal extent of coal ash had been defined, noting a 2014 EPA report showing photographic evidence that coal ash was present outside the Unit 3A/B boundary (e.g. on roadways).
- Photographic evidence collected during the ash removal showed a large amount of cracking observed in the clay liner, which could indicate contaminated water was able to enter groundwater beneath the impoundment.

Based on the information provided above, the likely sources of contamination from the Unit 3A/B Impoundments is remaining CCR material within the unit footprint, CCR on areas adjacent to the impoundment, and the contaminated clay liner left in place following the impoundment cleanout.

4.0 Interim Response Activities

This section describes the tasks being initiated to further evaluate the potential for impact to groundwater and to characterize the extent of possible groundwater contamination.

4.1 Groundwater Flow Direction

Since July 2018, 59 groundwater monitoring events have been conducted and continue on a quarterly schedule. However, due to low the hydraulic gradient and proximity to the Grand River, the observed flow direction is highly variable. Variations in flow direction complicate the remedial approach in the following ways:

- Additional flow paths for contamination to travel
- Irregularities in plume size and shape
- Variable volume of contaminated water
- Instances of reverse flow (groundwater flowing from the river into the Island vs. groundwater flowing from the Island to the river)
- Groundwater discharging to surface water or surface water draining into groundwater

In December 2023, 16 pressure transducers were deployed at the locations shown on **Figure 1** to address the issues noted above. Groundwater level measurements are being monitored on an hourly basis and recorded on the transducers. The recorded data is collected during each quarterly groundwater monitoring event. Understanding groundwater flow direction is vital in selecting an effective remedial alternative as it allows for targeting areas in which contamination is or will be present.

4.2 Assessment Monitoring

Groundwater samples collected during quarterly monitoring events will continue to be analyzed for the list of assessment monitoring COIs required by Section 324.11519b. This groundwater monitoring program is described in detail in the HMP that will be submitted to EGLE in the first quarter of 2024. The first assessment monitoring sampling event with the updated monitoring well network was performed in October 2023 and will continue on a quarterly basis (HDR, 2024).

4.3 Nature and Extent of Contamination

As GPS exceedances have been identified at the current nature and extent monitoring wells for both CCR units (see **Figure 2**), additional monitoring wells are being added to each well network. Due to the proximity of the Units 1/2 Impoundment and the Unit 3A/B Impoundments to the edges of Harbor Island, and limiting features such as wetlands and surface water bodies, expansion of the monitoring well network is not possible in certain areas. **Table 1** contains the current and additional nature and extent wells that have been added to each monitoring well network. The additional nature and extent wells have been selected due to their location being further from the CCR unit boundary allowing for the delineation of the contaminant plume, shown in **Figure 1**. The wells will be sampled during the second quarter 2024 monitoring event for assessment monitoring constituents.

Table 1. Nature and Extent Monitoring Wells for Units 1/2 and Unit 3A/B	
Units 1/2 Impoundment	**Unit 3A/B Impoundments**
Existing Nature and Extent Monitoring Wells	
• MW-07 • MW-10 • MW-28 • MW-32	• MW-01R • MW-09 • MW-10
Additional Nature and Extent Monitoring Wells	
• MW-16 • MW-17 • MW-36 • MW-37	• MW-38

4.4 Site-Specific Data Collection for Remediation

The following tasks are being written into a work plan designed to further the investigation of the sources of groundwater contamination, study the nature and extent of groundwater exceedances, and collect the data required to evaluate remediation alternatives. Tasks related to the CCR program include the following:

- Unit 3A/B Ash Delineation – Due to EGLE's previous denial of the closure of the Unit 3A/B Impoundments, further ash delineation is required to identify any remaining ash on/near the roads adjacent to the impoundment.
- Aquifer Test – The data collected from the aquifer test is needed to accurately estimate the hydrologic properties of the Island. As the groundwater is at or near the surface on most of the Island, dewatering likely will be required to remove source material for both impoundments.
- Nested Wells – The interaction between the clay unit and glacial aquifer is unknow. Nested wells will be utilized to measure the vertical hydraulic gradient between the Grand River and South Channel.
- Clay Characterization – Sediment samples will be collected during the nested well installation and analyzed for hydraulic conductivity and permeability.

The tasks below are being conducted as part of the Non-CCR data collection work plan, but the resulting data also will be utilized in the remedy alternative selection process.

- Limited wetland sediment sampling – This data will be used to evaluate the need for additional investigation to identify areas where sediment may be acting as a secondary source of PFAS in surface water and/or groundwater. This data will also be used to assess the need for an ecological risk assessment.

Figure 1. Transducer Deployment Map

Figure 2. Monitoring Well Exceedance Map

- Installation of two permanent monitoring wells in the former locations of vertical aquifer sampling (VAS) location 07 and VAS 10 - near the groundwater-surface water interface (GSI) of wetlands interior to Harbor Island. The purpose of these wells is to confirm the groundwater sampling results from the two VAS locations.
- Subsurface Utility Exploration (SUE) – The purpose of the SUE is to identify any preferential pathways for migration of impacted groundwater to surface water.
- Resample surface water at the SW-06 location that was sampled in May 2023 – This sampling will be conducted to verify previous sampling results.

5.0 Reporting

The results of the well installation and groundwater and surface water monitoring described herein will be provided in the quarterly groundwater monitoring reporting already scheduled as part of the assessment monitoring program. Groundwater sampling is being conducted quarterly, therefore a quarterly groundwater monitoring report will be submitted to EGLE by April 30, July 31, October 31, and January 31 of each year in compliance with Part 115 R 299.4907(11). Each quarterly report will include an evaluation and discussion of all completed Site investigation activities; an evaluation of the nature and extent of the potential groundwater plume, if appropriate, based on available information; and recommendations for additional investigation activities, if necessary.

6.0 Termination of Waste Schedule

According to Part 115 R 299.4442(c), for any units that the owner concludes are probable sources of contamination, the RAP must include "a schedule for terminating waste receipt, for initiating closure at units, and for redesigning and constructing new units that have leak detection systems."

The GHBLP ceased all waste disposal into the Unit 3A/B Impoundments on July 30, 2020. The GHBLP commenced removal of CCR from Unit 3A/B in July 2020. Removal of CCR and CCR containing materials from the Impoundments was considered completed by GHBLP on December 10, 2020. EGLE stated on January 21, 2021, that additional ash removal is needed on the roads adjacent to the Impoundment. An investigation regarding the extent of CCR that may be present on the roads adjacent to the Impoundment will occur in the fourth quarter 2024. Any required removal of ash located above the water table will occur following the ash delineation. Finally, any additional soils removal that requires dewatering will occur following the remedial investigation. Additionally, as the site is confined by surface water on the north, south, and west, a fence and gates were installed to prevent unintended contact with potentially contaminated soil and surface water.

7.0 Response Action Schedule

The following sets forth the proposed schedule for the investigation of the sources of groundwater contamination, the study of the nature and extent of groundwater exceedances at Harbor Island, and for the data collection required to evaluate remediation alternatives. All of these steps are required before remediation alternatives can be evaluated and selected.

Table 2. Response Action Schedule

Task	Completion Date[1]
Background Sampling*	November 30, 2022 – August 30, 2023
Initial Assessment/Detection Monitoring Event*	October 24, 2024
Background Statistical Memorandum*	January 24, 2024
SSI Memo submitted to EGLE*	January 24, 2024
Response Action Plan	March 8, 2024
Hydrogeologic Monitoring Plan	March 22, 2024
Initiation of Assessment of Corrective Measures - Placement into Operating Record	May 5, 2024
Site Specific Data Collection Work Plan for Remediation – CCR	July 2024
Site Specific Data Collection Work Plan for Remediation – Non-CCR (aka Remedial Investigation Work Plan)	July 2024
Implementation of Data Collection Tasks CCR	2024 - 2025
Unit 3A/B Impoundments Ash Delineation and Removal (above water table)	2024 - 2025
Implementation of Data Collection Tasks Non-CCR	2024-2025
Non-CCR Remedial Investigation Report	2025
Assessment of Corrective Measures Development	March 2024 – July 2024
Assessment of Corrective Measures (ACM) Deadline	August 3, 2024
Additional Data Collection required for Remediation Conceptual Design	2025 - 2026
Evaluation of Remediation Alternatives	2025 -2026
Public Meeting of Remediation Alternatives	30 Days before Remedy Selection
Remedy Selection Report and Remedial Action Plan	2026
Closure Plan – Units 1/2 Impoundment	2026
Closure Plan – Unit 3A/B Impoundments	2026
Remediation Final Design and Remedy Implementation	2026 +

Footnotes:
*Indicates item has been completed
1. Schedule may be affected by the following items: Additional investigations that may become required by EPA regarding historical ash, significant involvement by the public, City Council and Community Action Group, or entry of an Administrative Consent Order (ACO) that provides an alternative schedule.

8.0 References

Black and Veatch, 1983. City of Grand Haven, Michigan Board of Light and Power J.B. Sims Station, Unit 3 Ash Pond Construction. August 19, 1983.

Environmental Resources Management., 2016. Coal Ash Delineation Sampling Results. February 8, 2016.

Golder Associates, Inc., 2017. J.B. Sims Generating Station Document of Liner Construction. April 10, 2017. Revised January 24, 2018

Golder Associates, Inc., 2020. 2019 Annual Groundwater Monitoring & Corrective Action Report. January 31, 2020.

Golder Associates, Inc., 2020a. Preliminary Groundwater Data Summary Through October 2020. November 17, 2020.

Golder Associates, Inc., 2020b. J.B. Sims Generating Station Unit 3 Impoundments – CCR Removal Documentation Report. December 11, 2020.

Golder Associates, Inc., 2022. 2021 Annual Groundwater Monitoring & Corrective Action Report. January 28, 2022.

HDR, 2023., Monitoring Well Installation Report. November 27, 2023.

HDR, 2024., Background Statistical Certification Report. December 11, 2023. Revised January 24, 2024.

HDR, 2024a., Former J.B. Sims Generating Station Determination of Statistically Significant Increases over Background per §257.93(h)(2) and R 299.4440(8) of the Michigan Part 115 Rules. January 24, 2024.

HDR, 2024b., 4th Quarter 2023 Annual Groundwater Monitoring Report for Michigan Part 115 Solid Waste Regulations. January 31, 2024.

HDR, 2024c., Determination of Statistically Significant Levels over Groundwater Protection Standards per §257.95(g) and Michigan Rule R 299.4441. February 5, 2024.

Soils & Structures, 2014., Grand Haven BLP – Ash Impoundment Evaluation. July 17, 2014.

Superior Environmental Corp., 2014., Ash Pond Assessment. August 1, 2014.

Appendix I

Assessment of Corrective Measures

Prepared by

Assessment of Corrective Measures

Compliance with 40 CFR §257.96 and Michigan Administrative Code R 299.4443

Former J.B. Sims Generating Station

August 5, 2024

Revised November 1, 2024

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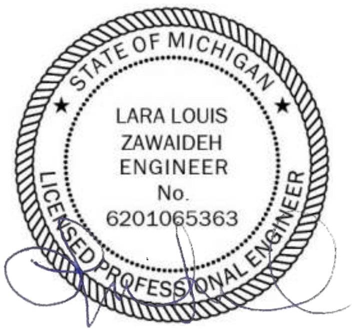
List of Appendices

Former J.B. Sims Generating Station Assessment of Corrective Measures Report

I hereby certify to the best of my knowledge that this assessment of corrective measures for the Former J.B. Sims Generating Station impoundments is an accurate demonstration of the potential corrective measures under consideration for the impoundments and is in general compliance with 40 CFR Part §257.96 and Michigan Administrative Code R 299.4443.

I am a duly licensed Professional Engineer under the laws of the State of Michigan.



Lara Louis Zawaideh, PE ENV SP

Michigan PE License: 6201065363

License Renewal Date: 02/03/2026

1.0 Introduction

This Assessment of Corrective Measures (ACM) was performed for groundwater conditions at the former J.B. Sims Generating Station (Facility or Site). The Facility is located at 1231 North 3rd Street, on Harbor Island, in Grand Haven, Michigan (**Figure 1**). The area denoted as the "Soccer Fields" on **Figure 1** are outside of the study area and are considered a separate facility under Part 201 regulation, therefore it will not be addressed herein.

The former J.B. Sims Generating Station was a coal-fired, steam generating power facility operated by the Grand Haven Board of Light and Power (GHBLP) which ceased operations in February 2020. The former Facility had a net capacity of approximately 70.5 megawatts. The coal combustion residuals (CCR) generated at the former Facility were disposed in two CCR units that are subject to the United States Environmental Protection Agency (EPA) CCR Rule (40 CFR Part 257) and Part 115 of the Michigan Natural Resources and Environmental Protection Act, Act 451 of 1994 (Part 115) and the Part 115 rules, Michigan Administrative Code R 299.4101 et seq. The two regulated CCR surface impoundments are the inactive Units 1/2 Impoundment and the former Unit 3A/B Impoundments (**Figure 2**).

Historical records indicate portions of the Island were utilized for fishing, shipbuilding, and lumber storage prior to and into the 1900s. The use of the Island remained industrial through the 1960s with uses such as power generation, coal docks, and petroleum storage. An undefined portion of the Island operated as a municipal dump site from the 1950s until 1970 when disposal operations ceased (WSP, 2023). When the J.B. Sims Generating Station began operation in the early 1960s, CCR from boiler units 1 and 2 was sluiced into the internal marshland which was later delineated as the Units 1/2 Impoundment. This unit ceased receiving CCR material in 2012. The Unit 3A/B Impoundments were clay-lined, above-ground impoundments that ceased receiving CCR material in July 2020. Excavation of CCR material from Unit 3A/B Impoundments for physical closure was completed in December 2020.

This ACM was prepared in response to the determination that one or more constituents listed in Appendix IV to 40 CFR Part §257 and Michigan Administrative Code R 299.4440 has been detected at statistically significant levels (SSL) exceeding groundwater protection standards (GPS).

On February 2, 2019, GHBLP published the *Notice of Initiating Assessment of Corrective Measures 40 CFR §257.95(g)(3)(i) and 40 CFR §257.95(g)(5)*, announcing that both Units 1/2 Impoundment and Unit 3A/B Impoundments were in assessment of corrective measures (Golder, 2019). A change to the groundwater monitoring network, including new background wells, resulted in a reevaluation of background water quality and GPS values for each unit, as documented in the Hydrogeologic Monitoring Plan (HDR, 2024c). Due to the well network revisions, the program status of the updated (current) well network restarted with background monitoring in November 2022. Background values for the current monitoring well network were recalculated in December 2023, and in February 2024, the *Determination of Statistically Significant Levels over Groundwater Protection Standards per §257.95(g) and Michigan* Administrative Code *R 299.4441* was published describing that downgradient wells at both CCR units had constituents that were observed at Statistically Significant Levels (SSLs) over GPS (HDR, 2024c). In May 2024, the *Notification of Initiation of Assessment of Corrective Measures 40 CFR §257.96 and Michigan Administrative Code R 299.4441(7)(g)* was placed in the operating record and posted to the website indicating the initiation of ACM (HDR, 2024 and HDR, 2024b).

Three critical factors impacting the corrective measures for groundwater at this Site are:

- Historical records indicate the Island operated as a municipal dump site from the 1950s through 1970 (WSP, 2023). Boring logs indicate the presence of various waste materials such as household waste, industrial waste, and ash. These materials have the potential to impact groundwater flow and water quality.
- Some of these municipal waste materials may contain per-and polyfluoroalkyl substances (collectively referred to as “PFAS”). PFAS constituents have been detected in groundwater, although the source of the detected PFAS is unknown. PFAS compounds in groundwater were first observed in May 2021 by GHBLP. A study was performed by Golder that collected soil and groundwater samples across the Site and certain PFAS constituents were observed at concentrations above EGLE Part 201 Residential & Non-Residential Drinking Water Criteria, as well as Groundwater Surface Water Interface Criteria, in numerous locations around the Site (WSP, 2023).
- The groundwater is hydraulically connected to the Grand River that surrounds the Island, the surface water ponds internal to the Island, the wetland internal to the Island and on the north side of the Island. These surface waters have an impact on the groundwater flow and represent a contaminant pathway via groundwater surface water interface boundaries. The surface waters also limit the number of viable corrective measure alternatives because in many locations there is minimal space between the Island and the surface water that could serve as the location for any corrective measure implementation. The corrective measures must be accomplished in the footprint of the Island and be protective of surface waters.

Figure 1 | Site Vicinity Map

Figure 2 | Former J.B. Sims CCR Units and Monitoring Wells

1.1 Purpose and Approach

The purpose of the ACM is to identify and evaluate potential groundwater corrective measures for the inactive Units 1/2 Impoundment and the former Unit 3A/B Impoundments, and to discuss the benefits and limitations associated with each alternative. In accordance with 40 CFR §257.96(c) and Michigan Administrative Code R 299.4443, this assessment of corrective measures includes a preliminary analysis of the feasibility of potential corrective measures to meet the requirements and objectives of the remedy.

A timeline of state and federal compliance steps leading to the ACM is outlined below:

- January 24, 2024 - The memorandum *Determination of Statistically Significant Increases over Background per §257.93(h)(2) and Michigan Administrative Code R 299.4440(8) of the Michigan Part 115 Rules*, was placed into the operating record and initiated the assessment monitoring program.
- February 5, 2024 - The memorandum *Determination of Statistically Significant Levels over Groundwater Protection Standards Per §257.95(g) and Michigan Administrative Code R 299.4441,* was placed into the operating record.
- March 8, 2024 – In compliance with Michigan Administrative Code R 299.4442, the *Response Action Plan* (RAP) was published. The RAP documented sources of contamination, interim response activities taken to identify possible sources of contamination and steps taken to prevent additional contamination, and termination of waste schedule.
- May 1, 2024, the *Notification of Initiation of Assessment of Corrective Measures 40 CFR §257.96 and Michigan Administrative Code R 299.4441(7)(g)* was placed in the operating record formally initiating the assessment of corrective measures.

This ACM details the proposed strategies to address future mitigation, and includes components required in Michigan Administrative Code R 299.4443.

Potential corrective measure alternatives are being evaluated for the CCR impoundments to identify a remedy (or remedies) that may be implemented as part of the long-term corrective action plan. As outlined in 40 CFR §257.96 and Michigan Administrative Code R299.4443, corrective measure alternatives are evaluated using the following criteria to assess the effectiveness of potential corrective measures:

- Performance.
- Reliability.
- Ease of implementation.
- Potential impacts of the alternative.
- Time required to begin and complete the alternative.
- Institutional requirements.

These evaluation criteria are discussed in more detail in **Section 5.1**. While this ACM is developed to comply with State and Federal regulations applicable to CCR, the corrective measures alternatives for the Former J.B. Sims Generating Station must also address the non-CCR groundwater contamination that is regulated under Michigan Part 201. Due to the comingling of the CCR and non-CCR impacts at the Site, the goal is to identify a holistic approach that meets all applicable regulatory closure requirements.

Remedy selection progress reports will be submitted on a semiannual basis as required in §257.97(a) of the CCR Rule. The reports will describe progress toward selecting and designing a remedy for the Site. The remedy will be formally selected once the alternatives are vetted for site-specific feasibility, reviewed, and approved by EPA and EGLE. Additionally, a public meeting will be conducted at least 30-days prior to the remedy selection as required under §257.96(e) and Michigan Administrative Code R 299.4443(4) to seek public input. At the time of remedy selection, a Remedial Action Plan will be prepared and submitted to EGLE that meets the requirements of Part 201, as required by Michigan Administrative Code R 299.4319(7). A Remedy Selection Report in compliance with §257.97 of the CCR Rule also will be prepared.

2.0 Site Description

2.1 Units 1/2 Impoundment

The inactive CCR Units 1/2 Impoundment was a depression in the ground where sluiced ash was disposed. A 2016 ash investigation by ERM confirmed that no liner was present beneath the Units 1/2 Impoundment and waste was placed into the topographic low area (ERM, 2016). Limited information is available on the early operation of the unit. It is estimated that ash disposal began in the early 1960’s when the plant was constructed, and ceased in 2012, which coincides with the estimated 50-year active life of the impoundment. Due to the abstract size and lack of any formally defined boundaries, the boundary of the Units 1/2 Impoundment was delineated by GHBLP and agreed to EPA, and EGLE. The boundary of this unit includes an area of sluiced ash disposal to the east of the MW-19 and MW-30 as depicted on **Figure 2** (HDR, 2024c). The parties also agreed that the former northern outlet channel from the Units 1/2 Impoundment, where ash was known to have been released and deposited into the wetland to the north (referred to as the “North Channel”), would be included in the unit boundary. Based on additional data collected, EGLE and EPA determined that the former north outlet channel would not be considered part of the Units 1/2 Impoundment, nor would the presence of any CCR in the North Channel be considered a release from the Units 1/2 Impoundment (see EPA and EGLE excerpts below). Therefore, the North Channel will be investigated under the expanded coverage of the §257 rule (see **Section 2.3**).

> *Anika Mandelia (EPA) - “… We have reviewed the results of the sampling and the information regarding the CCR generation activities you have provided to answer your question regarding continued sampling to establish the northern boundary of Units 1/2 at JB Sims.*

As you know, according to 40 CFR 257.53, a CCR surface impoundment means "a natural topographic depression, man-made excavation, or diked area, which is designed to hold an accumulation of CCR and liquids, and the unit treats, stores, or disposes of CCR." Defining the Units 1/2 boundary has been a point of discussion in the past. In 2020, EPA, EGLE, and the facility agreed to a unit boundary relying on the visual presence of coal ash using aerial photos, with the understanding that further sampling would be done to find its northernmost extent.

The data confirm that there are CCR present in all the sampling conducted to-date. Given the hydraulic nature of this area and the fact that it is a flood plain (which is sometimes under-water), we suspect the presence of CCR may extend beyond the sampled area further into the flood plain (and further, into Grand River). However, the hydraulic nature of this area, combined with the sampling results and the knowledge of historical CCR disposal activities, also makes it difficult either to determine how much farther out sampling should be extended to support potentially extending the Units 1/2 boundary, or to cease sampling at this point and include what has been sampled to-date as part of the unit.

We do not believe it is necessary to conduct further sampling to delineate the Units 1/2 boundary. The weir that separates the pond from the North Channel provides a distinct physical boundary for Units 1/2 in this area, therefore the Unit boundary remains unchanged. The facility will need to ensure this unit and any releases or newly identified units and connecting structures in the vicinity are appropriately managed under the regulations. …"

Kent Walters (EGLE) - "… EGLE points out that while EPA has determined the unit boundary for 1 and 2 does not need to extend out further than previously determined, the ash identified in the northern channel borings seems to fall under the definition of a CCRMU under the new legacy rule and would need to be managed accordingly. …"

2.2 Unit 3A/B Impoundments

The former CCR Unit 3A/B Impoundments were constructed as two above-ground surface impoundments that included a clay liner; however, the engineered clay liner did not meet Part 115 or §257.71(a)(1) surface impoundment liner criteria. The unit was constructed in late 1983 and ceased receiving waste approximately 36 years later in July 2020. Golder (2020) stated that the former Unit 3A/B Impoundments were built over a "field of ash" that was generated from Boiler Units 1 & 2; however, existing soil borings do not support that a "field of ash" is present under the former impoundments. As stated in Golder's 2020 report - *Permanent Cessation of a Coal Fired Boiler by Date Certain Notification per 40 CFR §257.103* placed into the operating record February 14, 2020, the operation of J.B. Sims Generating station ceased on February 13, 2020. Although the plant ceased operations in February 2020, the Site continued to use the Unit 3A/B Impoundments to store cleanout materials from the hoppers, vessels, etc. prior to demolition of the buildings.

The impoundments ceased receiving waste on July 30, 2020 following the decommissioning of the plant buildings (HDR, 2024c). Removal of CCR from the impoundments was completed on November 6, 2020, and the liner remains in place. Following the CCR removal, Golder conducted ash removal verification and submitted a report to EGLE that was ultimately denied (EGLE, 2021). In 2020, it was determined that any additional removal of liner or subsurface material for decontamination potentially could expose solid waste and PFAS impacted groundwater. Therefore, the closure by removal process was suspended to investigate the non-CCR contamination at the Site. The closure by removal initiated in 2020 will be continued if additional site investigation work identifies any areas of remaining ash and if the "field of ash" purported to be beneath the unit is confirmed and delineated.

2.3 Recent Regulatory Changes

In May 2024, EPA finalized revisions to the CCR Rule that expand coverage of the CCR Rule to include what are referred to as legacy CCR surface impoundments and CCR management units (CCRMU). The new Rule requires that active facilities, including the Former J.B. Sims Generating Station, perform a Facility Evaluation to determine if there are any CCRMU[1] at the facility and conduct field investigations to establish the boundaries of any identified CCRMU. As required by the new Rule, a Facility Evaluation will be conducted at the Site that includes a records review and field investigation with borings. Based on existing information regarding ash in the north outlet channel, the potential "field of ash" beneath the Unit 3A/B impoundments, ash used in the roads, and ash storage in the vicinity of the former tank farm (southeast side of Harbor Island), the presence of a CCRMU is likely. Owners or operators of any CCRMU that contains more than 1,000 tons of CCR are required to comply with the requirements in §257 for fugitive dust, groundwater monitoring, corrective action, closure, post-closure care, recordkeeping, notification, and internet posting.

Due to the additional requirements applicable to CCRMU, it is anticipated that closure and groundwater remediation requirements for CCR may increase beyond what is identified herein once the Facility Evaluation, associated field work, and groundwater monitoring are completed. The results of the Facility Evaluation may alter the corrective measure alternatives and certainly will alter any cost estimates. Michigan Administrative Code R 299.4443(3) requires that the ACM include cost estimates. Since it is likely the costs will increase after the CCRMU work is incorporated, cost estimates are not included in this ACM but will be provided after the Facility Evaluation has been conducted.

[1] §257.53 Definition: Any area of land on which any noncontainerized accumulation of CCR is received, is placed, or is otherwise managed, that is not a regulated CCR unit. This includes inactive CCR landfills and CCR units that closed prior to October 19, 2015, but does not include roadbed and associated embankments in which CCR is used unless the facility or a permitting authority determines that the roadbed is causing or contributing to a statistically significant level above the groundwater protection standard established under § 257.95(h)

3.0 Conceptual Site Model

3.1 Hydrogeology

The uppermost aquifer across the Site is located between the surface and 39 feet below surface and consists of fine sand with gravel and silt lenses, clay, peat, ash, and municipal solid waste. From 2022 through 1st quarter 2024, groundwater was encountered between 0.58 and 16.22 feet below ground surface within the unconsolidated fill material. The bottom of the aquifer is believed to consist of continuous clay and dense silt observed between 20.5 – 48.0 feet below surface (HDR, 2024c).

The regional general direction of groundwater flow across Harbor Island is west to southwest towards Lake Michigan (Western Michigan University, 1981). The Grand River is located on the northern and western sides of the Site, and the South Channel is located on the south side of Harbor Island. Internal to the Island there are several influences on groundwater flow, including the following features:

- Various fill materials observed in boring logs and cross-sections as shown in **Appendix A**.
- Surface water features, such as the inactive Units 1/2 Impoundment and internal wetland shown in **Figure 2**.
- The former coal yard area, shown in **Figure 2**, which may have lower infiltration rates due to compaction from heavy equipment and stockpiling.

Groundwater contour maps from April 2023 through April 2024, provided in **Appendix B**, show groundwater flow beneath Unit 3A/B Impoundments is consistently west toward the Grand River. Groundwater flow beneath Units 1/2 Impoundment is seasonably and spatially variable. However, more generally, flow appears to be fairly consistent in the following areas where flow is generally:

- North from SG-02 toward the northern wetland (MW-31), however flow in this area appears to be south between August and November.
- East from wells MW-05, MW-18, MW-19, and MW-30 toward the internal wetland.
- Potentially south from MW-05 towards PZ-17 and MW-36.
- The presence of the internal wetland east of the Units 1/2 Impoundment appears to provide a hydraulic sink between the CCR impoundments and the wells situated to the east (PZ-23 through PZ-26, MW-27, MW-33, and MW-34) (**Figure 2**).

The uppermost aquifer, which extends from the surface to approximately 39 feet below surface, consists of fine sand with gravel and silt lenses, clay, peat, ash, and municipal solid waste. Silty clay is observed at 20.8 feet below ground surface at PZ-26 to 45 feet below ground surface at PDR-3 (**Appendix A**). The clay is assumed to be the bottom of the aquifer and was logged in borings CPT-5, MW-12, MW-17, PZ-16, PZ-26, PZ-24, PZ-25, MW-30, PDR-1, and PDR-3 as shown in the developed cross-sections for the Site. The "CPT" borings used in cross sections are from the *Report of Evaluation for Grand Haven Power Plant Ash Impoundment* (Soils and Structures, 2014). The "PDR" borings shown in cross sections are from the *Geotechnical*

Exploration and Engineering Evaluation for Harbor Island Reciprocating Engine Generation Site (GEI, 2019). The cross-sections are provided in **Appendix A**.

Slug tests were performed at monitoring wells MW-01R, MW-02, MW-04, MW-05, MW-07, MW-08, PZ-17, PZ-20, PZ-26, and MW-31 by Golder in 2021. The results of the slug testing were consistent in 25 of the 29 tests performed. The average hydraulic conductivity value, based on tests completed by Golder in 2021, is provided in **Table 1**. Generally, hydraulic conductivity values across the Site range from 0.19 feet per day (feet/day) at MW-02 to 18.76 feet/day at MW-05. Higher hydraulic conductivity values were calculated at PZ-17 and PZ-20 (172.51 and 242.25 feet/day, respectively). Due to the unusually high values measured at PZ-17 and PZ-20, these wells will be re-tested. Additional slug tests at MW-10, MW-12, PZ-17 MW-20 were completed in the 2nd quarter 2024 and analysis of the results will be completed in the 3rd quarter of 2024.

Table 1. Hydraulic Conductivity Values (Golder 2021)

Well ID	Screen Interval Lithology	Average Hydraulic Conductivity (feet/day)
MW-01R	Silty fine sand with trace refuse and silt	5.41
MW-02	Silty clay and poorly graded fine sand	0.19
MW-04	Well graded fine to medium sand and sandy silt	1.70
MW-05	Fine grained ash with refuse	18.76
MW-07	Sandy peat with shell fragments and silty sand	7.99
MW-08	Refuse and clayey sand	7.90
PZ-17	Sand with some gravel and gravelly silt with trace organics	172.51*
PZ-20	Peaty sand and peaty silt	242.25*
PZ-26	Very fine to medium sand with organics	8.34
MW-31	Mucky sand with refuse and sandy peat with refuse	0.36

*This analysis is in question and these wells will be reanalyzed in 3rd quarter 2024 after the testing in 2nd quarter 2024.

Hydraulic conductivity values are on the lower end when compared to reference values of fine sand according to the Freeze and Cherry (1979) (10^4 to 10^{-1} feet/day); however, the calculated values are consistent with hydraulic conductivity ranges for silt (10 to 10^{-3} feet/day) and glacial till (10^2 to 10^{-6} feet/day) (Freeze and Cherry, 1979). Historical land use activities, such as dumping of dredge material and refuse, disposal of ash, and coal storage affect localized hydraulic conductivity.

Groundwater velocity calculations were performed using data from January and May 2023, as well as February and April 2024, using Darcy's Law. Groundwater velocity calculations are in **Table 2**. Groundwater flow directions across the Site are presented in potentiometric contour maps in **Appendix B**. To address the heterogenous nature of the lithology, separate groundwater velocity calculations were performed for the eastern and western sides of Harbor Island. Slug test data provided by Golder was used to calculate average hydraulic conductivity values for the eastern and western regions (Golder, 2022). Data provided from PZ-26 was used for calculations on the eastern side of the Island. Hydraulic conductivity values from MW-01R, MW-02, MW-04, and MW-05 were averaged for the western side of the Island.

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Table 2. Groundwater Velocity Calculations

Well Pair	Area of Harbor Island	Hydraulic Gradient				Porosity[1]	Hydraulic Conductivity (feet/day)	Groundwater Velocity (feet/day)			
		Jan. 2023	May 2023	Feb. 2024	Apr. 2024			Jan. 2023	May 2023	Feb. 2024	Apr. 2024
PZ-25 to PZ-26	East	0.0021	0.0005	0.0022	0.0007	0.30	8.34[2]	0.058	0.014	0.061	0.020
PZ-25 to PZ-23	East	0.0008	0.0006	0.0004	0.0006	0.30	8.34[2]	0.021	0.016	0.012	0.017
MW-01R to MW-03	West	0.0078	0.0035	0.0094	0.0025	0.30	6.23[3]	0.162	0.073	0.195	0.052
MW-01R to MW-04	West	0.0065	0.0029	0.0077	0.0020	0.30	6.23[3]	0.134	0.061	0.159	0.042
MW-01R to MW-05	West	0.0037	0.0022	0.0054	0.0039	0.30	6.23[3]	0.077	0.046	0.112	0.082
MW-01R to MW-10	West	0.0055	0.0034	0.0085	0.0026	0.30	6.23[3]	0.115	0.070	0.178	0.054

1. Porosity value estimated using reference values for poorly sorted fine to medium sand (Freeze-Cherry, 1979).
2. Average hydraulic conductivity value from Golder (2022) on PZ-26.
3. Calculated by averaging hydraulic conductivity values from wells MW-01R, MW-02, MW-04, and MW-05 (Golder, 2022).

A porosity value of 0.30 was used based on varying amounts of sand, gravel, and silt observed in borings (Freeze and Cherry, 1979). Horizontal hydraulic gradients and groundwater velocities were higher in January than May of 2023. Groundwater velocities on the eastern side of the Island ranged from 0.012 to 0.061 (feet/day). Groundwater velocities on the western side of the Island ranged from 0.042 to 0.195 (feet/day).

3.2 Water Quality

As required in the CCR Rule and Part 115, eight rounds of background groundwater sampling and detection monitoring were completed between November 2022 and August 2023. On October 15, 2018, GHBLP published the *Updated Notice of Groundwater Protection Standard Exceedance 40 CFR §257.95(g)*, identifying that cobalt, fluoride, and lithium were detected at statistically significant levels (SSL) for Units 1/2 Impoundment and Unit 3A/B Impoundments (Golder, 2018). On February 2, 2019, GHBLP published the *Notice of Initiating Assessment of Corrective Measures 40 CFR §257.95(g)(3)(i) and 40 CFR §257.95(g)(5)*, announcing that both Units 1/2 Impoundment and Unit 3A/B Impoundments were in assessment monitoring (Golder, 2019). In August 2019, monitoring wells MW-09 and MW-10 were installed as additional downgradient monitoring wells and included in the multi-unit network. In 2020, the monitoring well network was converted from a multi-unit system into two separate units, one for Units 1/2 Impoundment and one for Unit 3A/B Impoundments (Golder, 2021). On July 22, 2021, GHBLP published the *Updated Notice of Groundwater Protection Standard Exceedance 40 CFR §257.95(g),* in which the additional constituents such as arsenic and chromium were added to the list of cobalt, fluoride, and lithium as being observed at SSLs (Golder, 2021b).

On January 14, 2021, GHBLP, EPA, and EGLE met to discuss documentation regarding the boundary delineation for Units 1/2 Impoundment and ultimately expanded the boundary to the current location shown on **Figure 2** (Golder, 2021). Following revisions to the Units 1/2 Impoundment boundary, however, the monitoring well network was deemed insufficient.

In August 2021, 22 piezometers and three stilling wells were installed to better understand groundwater flow and the groundwater/surface water interaction of Harbor Island to determine appropriate background well locations and the monitoring network for the CCR units (Golder, 2022b). Based on groundwater flow direction data collected in 2021 and 2022, as well as boring logs from the *Field Summary Report of Results from Approved Work Plan*, it was determined that the previous background monitoring wells (MW-07 and MW-08) were impacted by the CCR units and did not represent background water quality (Golder, 2022b). The monitoring well network was revised in the *Hydrogeologic Monitoring Plan* (HDR, 2024c).

Background water quality sampling of the updated groundwater monitoring well network was conducted over eight events from November 2022 through August 2023. Following the completion of background sampling, the *Background Water Quality Statistical Certification* was submitted (HDR, 2023), as specified in §257.94 and Michigan Administrative Code R 299.4440(8). The water quality data collected from the monitoring wells located upgradient of the CCR units were pooled and statistically analyzed to develop the background threshold values (BTVs) for the impoundments. The background report provides the selection of the statistical method for each constituent of interest (COI) for each CCR unit.

The first detection/assessment monitoring event of the updated monitoring network was conducted in October 2023, following completion of the background sampling events using the updated monitoring network. Monitoring data was compared to BTVs and the memorandum *Former J.B. Sims Generating Station Determination of Statistically Significant Increases over Background per §257.93(h)(2) and Michigan Administrative Code R 299.4440(8) of the Michigan Part 115 Rules* was submitted to EGLE. The SSIs identified for Units 1/2 Impoundment included boron, calcium, fluoride, sulfate, and total dissolved solids (TDS). The SSIs identified for Unit 3A/B Impoundments include boron, calcium, chloride, fluoride, sulfate, and TDS. The SSIs identified from the October 2023 sample event are considered revised SSIs from the 2019 SSIs because the updated monitoring network includes different background wells that are not impacted by the CCR units. The identification of these SSIs for both CCR units means both Units 1/2 Impoundment and Unit 3A/B Impoundments are in assessment monitoring. Under the assessment monitoring program, as required in §257.25 and Michigan Administrative Code R 299.4441(9), the CCR owner must establish groundwater protection standards (GPS) for each constituent detected in the groundwater. The federal and state GPS values are included as Table 3 and 4, respectively. The October 2023 sampling event served as the initial assessment monitoring event. Sampling data from waste boundary wells was compared to the GPS values and several COIs were found to exceed GPS at both CCR units. To determine if an exceedance of a GPS value is statistically significant, the 95% lower confidence limit (LCL) was calculated for each of the downgradient wells. A comparison of state and federal GPS values to the LCLs SSLs was conducted. At the Units 1/2 Impoundment, one or more COIs exceeded state and federal GPS values at SSLs at the following waste boundary wells: MW-06, MW-08, MW-18, MW-19, MW-30, and MW-31. At the Unit 3A/B Impoundments, one or more COIs exceeded state and federal GPS values at SSLs at the following waste boundary wells: MW-02, MW-03, and MW-04. Following the identification of SSLs at waste boundary wells, the monitoring well network was expanded to include nature and extent monitoring wells to further delineate the extent of the contamination. The nature and extent wells for each unit are listed below:

- Units 1/2 Impoundment – MW-07, MW-10, and MW-32
- Unit 3A/B Impoundments – MW-01R, MW-09, and MW-10

In February 2024, the monitoring well network was expanded a second time in response to identification of SSLs at the nature and extent wells listed above. The revised nature and extent monitoring wells for each CCR unit are listed below:

- Units 1/2 Impoundment – MW-07, MW-10, MW-16, MW-17, MW-28, MW-32, MW-36, and MW-37
- Unit 3A/B Impoundments – MW-01R, MW-09, MW-10, and MW-38

The most recent assessment monitoring event for which analytical results are available was conducted in April 2024. Sampling data from waste boundary wells was compared to the GPS values and several COIs were found to exceed GPS at both CCR units. To determine if an exceedance of a GPS value is statistically significant, the 95% lower confidence limit (LCL) was calculated for each of the downgradient wells. The LCLs that exceed GPS for Units 1/2 Impoundment are shown in **Table 5** and include arsenic, boron, calcium, chloride, fluoride, lithium, sulfate, and total dissolved solids. The LCLs that exceed GPS at SSLs identified for Unit 3A/B Impoundments are shown in **Table 6** and include boron, calcium, chloride, cobalt, lithium, sulfate, and total dissolved solids. These LCL values include 11 sample events collected between November 2022 and April 2024.

The calculation of SSLs requires at least 4 sampling events to account for temporal and seasonal variability. As the additional nature and extent monitoring wells for each unit have only been sampled during one assessment monitoring event, SSLs were not calculated for the following wells from each unit:

- Units 1/2 Impoundment – MW-16, MW-17, MW-28, MW-36, and MW-37
- Unit 3A/B Impoundments – MW-38

However, when the water quality values from the wells listed above are compared to state and federal GPS, several are found to exceed. This indicates that the existing monitoring well network will need to be expanded further to completely delineate the extent of contamination.

Table 3. Federal Compliance Program Groundwater Protection Standards			
Parameter	Site-Specific Background Level Upper Tolerance Limit (UTL) (mg/L)	Federal Maximum Contaminant Level (mg/L)	Federal Program Groundwater Protection Standards (mg/L)
Antimony	0.0012	0.0060	0.0060
Arsenic	0.0040	0.010	0.010
Barium	0.58	2.0	2.0
Beryllium	0.000059	0.0040	0.0040
Cadmium	0.00015	0.0050	0.0050
Chromium	0.042	0.10	0.10
Cobalt	0.0021	0.0060*	0.0060
Fluoride	0.45	4.0	4.0
Lead	0.0016	0.015*	0.015
Lithium	0.10	0.040*	0.10
Mercury	0.00016	0.0020	0.0020
Molybdenum	0.0093	0.10*	0.10
Radium-226/228	2.6	5.0	5.0
Selenium	0.00089	0.050	0.050
Thallium	0.000075	0.0020	0.0020

*EPA adopted health-based value for constituents with no MCL.

Table 4. State Compliance Program Groundwater Protection Standards					
Parameter	Site-Specific Background Level Upper Tolerance Limit (UTL) (mg/L)	Federal Maximum Contaminant Level (mg/L)	State Non-Residential Drinking Water Cleanup Criteria for Groundwater (mg/L)*	State Groundwater Surface Water Interface (mg/L)*	Groundwater Protection Standards for Site (mg/L)
Boron	4.0	NV	0.50	7.20	4.0
Calcium	250	NV	N/A	N/A	250
Chloride	120	NV	250	50	120
Fluoride	0.45	4.00	2.00	NV	2.00
Sulfate	100	NV	250	NV	250
Total Dissolved Solids	950	500	500	500	950
Antimony	0.0012	0.0060	0.0060	0.13	0.0060
Arsenic	0.0040	0.010	0.010	0.010	0.010
Barium	0.58	2.00	2.00	1.3[1]	1.3[1]
Beryllium	0.000059	0.0040	0.0040	0.036[1]	0.0040
Cadmium	0.00015	0.0050	0.0050	0.0025[1]	0.0025[1]
Chromium	0.042	0.10	0.10	0.12[1]	0.10
Cobalt	0.0021	0.0060	0.10	0.10	0.0060
Fluoride	0.45	4.0	2.0	NV	2.0
Lead	0.0016	0.015	0.0040	0.014[1]	0.0040
Lithium	0.10	0.040	0.35	0.44	0.10
Mercury	0.00016	0.0020	0.0020	0.0000013	0.00016
Molybdenum	0.0093	0.10	0.210	3.20	0.10
Radium 226 and 228	2.6	5.0	NV	NV	5.0
Selenium	0.00089	0.050	0.050	0.0050	0.0050
Thallium	0.000075	0.0020	0.0020	0.0037	0.0020
Copper	0.020	1.3	1.0	0.021[1]	0.021[1]
Iron	83	0.30	0.30	NV	83
Nickel	0.023	NV	0.10	0.12[1]	0.10
Silver	0.00011	0.10	0.0098	0.00020	0.00020
Vanadium	0.00093	NV	0.0062	0.027	0.0062
Zinc	0.038	5.0	5.0	0.27[1]	0.27[1]

*Cleanup Criteria Requirements for Response Activity (Formerly the Part 201 Generic Cleanup Criteria and Screening Levels) found in Michigan Administrative Code R 299.44 Generic groundwater cleanup criteria.
NV=no value
[1]Per Footnote G of Table 1 Cleanup Criteria Requirements for Response Activity (Formerly the Part 201 Generic Cleanup Criteria and Screening Levels) of the Groundwater Surface Water (GSI) criteria list, values noted are calculated based on the hardness (expressed as $CaCO_3$) of the receiving waters. Surface water sample from the Grand River (SG-01) had a hardness of 270 mg/L was used in the calculation of specific GSI values. The Grand River discharges into Lake Michigan, thus the GSI Criteria for Surface Water Protected for Drinking Water Use, is provided above.

Table 5. April 2024 LCLs that Exceed State and Federal GPS for the Units 1/2 Impoundment

Constituent	Federal GPS (mg/L)	State GPS (mg/L)	Well	95LCL (mg/L)
Arsenic	0.010	0.010	MW-08	0.025
			MW-18	0.022
Boron	None	4.0	MW-06	8.3
			MW-07	11
			MW-08	5.3
			MW-31	4.2
			MW-10	11
Calcium	None	250	MW-18	310
			MW-19	450
			MW-30	430
Chloride	None	120	MW-10	160
Fluoride	4.0	2.0	MW-18	3.4
			MW-31	4.7
			MW-10	4.2
Lithium	0.10	0.10	MW-06	0.16
			MW-30	0.11
			MW-10	0.77
			MW-32	0.11
Sulfate	None	250	MW-18	700
			MW-19	910
			MW-30	810
			MW-10	380
Total Dissolved Solids	None	950	MW-06	1,200
			MW-18	1,300
			MW-19	1,800
			MW-30	2,100
			MW-10	1,700

Table 6. April 2024 LCLs that Exceed State and Federal GPS for Unit 3A/B Impoundments

Constituent	Federal GPS (mg/L)	State GPS (mg/L)	Well	95LCL (mg/L)
Boron	None	4.0	MW-01R	78

Table 6. April 2024 LCLs that Exceed State and Federal GPS for Unit 3A/B Impoundments				
Constituent	Federal GPS (mg/L)	State GPS (mg/L)	Well	95LCL (mg/L)
			MW-02	91
			MW-09	5.5
			MW-10	11
Calcium	None	250	MW-03	350
			MW-04	350
			MW-09	320
Chloride	None	120	MW-02	140
			MW-03	150
			MW-04	160
			MW-10	160
Fluoride	4.0	2.0	MW-01R	8.9
			MW-02	9.2
			MW-09	2.4
			MW-10	4.2
Lithium	0.10	0.10	MW-01R	1.7
			MW-02	1.2
			MW-09	0.29
			MW-10	0.77
Sulfate	None	250	MW-01R	310
			MW-03	320
			MW-04	530
			MW-09	300
			MW-10	380
Total Dissolved Solids	None	950	MW-01R	2,300
			MW-02	1,700
			MW-03	2,000
			MW-04	1,800
			MW-09	1,200
			MW-10	1,700

4.0 Constituents of Concern in Groundwater

4.1 Constituents Exceeding Groundwater Protection Standards

4.1.1 CCR Constituents of Concern

In accordance with CCR Rule §257.95(f) and Michigan Administrative Code R 299.4441(1), downgradient well concentrations from the assessment monitoring events were compared against GPS and found to exceed GPS. Therefore, following CCR Rule §257.95(g) and Michigan Administrative Code R 299.4441(7), downgradient well data for April 2024 was statistically compared against GPS. Downgradient monitoring wells for Units 1/2 Impoundment have SSLs above the state and or federal GPS for arsenic, boron, calcium, chloride, fluoride, lead, lithium, sulfate, and total dissolved solids (TDS). Downgradient monitoring wells for Unit 3A/B Impoundments have SSLs above the GPS for boron, calcium, chloride, fluoride, lithium, sulfate, and total dissolved solids (TDS).

Constituents of Concern (COCs) are the analytical parameters that exceed GPS at statistically significant levels and trigger corrective measures. Therefore, arsenic, boron, calcium, chloride, fluoride, lead, lithium, sulfate, and TDS are considered the CCR COCs. Corrective measures assessment will be focused on evaluating attainment of GPS for these 9 CCR COCs plus the non-CCR groundwater impacts.

4.1.2 Non-CCR Constituents of Concern

Non-CCR constituents of concern include specific PFAS compounds. Groundwater elevations indicate that groundwater is discharging to surface water, including to the Grand River on the west side of the Island, to the South Channel on the south side of the Island, to the north wetland area, to the interior wetland areas, and to the Units 1/2 Impoundment. Therefore, the groundwater-surface water interface pathway is relevant because impacted groundwater can reasonably be expected to discharge to surface waters at the Site. Based on the concentrations of PFOS, PFOA, and PFHxS in monitoring wells located near the groundwater-surface water interface at the Grand River and at Harbor Island wetlands, as well as the groundwater flow directions measured during 2022 and 2023, there is the potential for PFOS, PFOA, PFHxS in groundwater to discharge to surface water at concentrations exceeding the Groundwater Surface Water Interface (GSI) Criteria. WSP (2023) identified PFAS compounds that exceed the Part 201 GSI cleanup criteria (shown in **Table 7**) and the distribution PFAS across the Island (see maps in **Appendix D** (WSP, 2023)).

Corrective measures assessment will be focused on evaluating attainment of GSI for PFOS, PFOA, and PFHxS as the non-CCR COC compounds, as well as the CCR COCs. The GSI will be considered the GPS for the non-CCR COCs.

Table 7. Summary of Vertical Aquifer Sampling of Shallow Groundwater Results with GSI Exceedances (WSP, 2023)

PFAS Compounds with GSI are Exceedances	Total Number of Groundwater Samples Collected	Number of Samples with Detections	Maximum Detection (Location)	GSI Criteria (ng/L)	Number of Results > GSI	Residential &Non-Residential Drinking Water Criteria (ng/L)	Number of Results > DWC
PFOA	40	35	110 ng/L (VAS34-3-7)	66	4	8	24
PFOS	40	36	250 ng/L (VAS34-3-7)	11	17	16	14
PFHxS	40	29	110 ng/L (VAS21-5-9)	59	1	51	1

4.2 Source Areas and Source Characterization

Data suggests that inactive Units 1/2 Impoundment and Unit 3A/B Impoundments may be the source for the CCR COCs in groundwater due to leaching of coal ash.

4.2.1 Units 1/2 Impoundment

Documented in the Golder report *Preliminary Groundwater Data Summary Through October 2020*, historical records indicate the Island operated as a municipal dump site in the 1950s and 1960s. During this period, waste was placed into the low interior marshland (Golder, 2020b). When the J.B. Sims Generating Station began operation in the early 1960s, the CCR also was disposed into the internal marshland, which was later delineated as the Units 1/2 Impoundment. According to Golder's *2021 Annual Groundwater Monitoring and Corrective Action Report*, CCR waste streams into the units ceased in 2012 (Golder, 2022).

The Units 1/2 Impoundment was not formally constructed but existed as a depression within the Island into which CCR was sluiced. Therefore, no formal historical documentation regarding the construction of the Units 1/2 Impoundment is available. Boring logs from ERM (2016) were completed within the footprint of the unit boundary and confirm no liner is present. Additionally, based on cross-sections, deposits of ash within the unit are in contact and below the water table (ERM, 2016). Further delineation of the vertical and horizontal extent of the ash will be done prior to remedy selection.

The following reports document borings completed within the footprint of the units and provide analytical characterization data for the coal ash within the unit:

Superior Environmental Corp (Superior) - Ash Pond Assessment published August 1, 2014.
A total of 10 ash samples from within the Units 1/2 Impoundment ponds on the western side of the unit were analyzed for a subset of the CCR metals required for groundwater monitoring under the state and federal compliance programs. A summary of analytical data for ash samples is provided in **Table 8**. Additionally, Synthetic Precipitation Leaching Procedure (SPLP) samples were analyzed to evaluate the leaching potential of the ash. A subset of CCR constituents were run that included arsenic, lithium, mercury, selenium, and silver. Of the SPLP results, arsenic was detected in one of ten samples and did not exceed GSI criteria. Selenium was detected in three of ten samples and exceeded GSI criteria at one sample location. The remaining constituents of mercury, lithium, and silver were non-detect in all samples. The sampling locations are shown on
Figure 3.

Table 8. Summary of Superior Environmental (2014) and ERM (2016) Coal Ash Characterization						
Constituent	Statewide Default Background Levels (mg/kg)	Direct Contact Criteria (mg/kg)	Groundwater/ Surface Water Interface Protection Criteria for Reference (mg/kg)	Superior Environmental (2014) Ash Samples – Total Metals (mg/kg)	Superior Environmental (2014) Ash Samples - SPLP (mg/L)	ERM (2016) Soil Samples with Ash - Total Metals (mg/kg)
Aluminum	6900	50,000	None	5800-16000	NA	NA
Antimony	None	180	94	NA	NA	ND
Arsenic	5.8	7.6	4.6	6.8-56	ND-0.0053	5-29

Table 8. Summary of Superior Environmental (2014) and ERM (2016) Coal Ash Characterization

Constituent	Statewide Default Background Levels (mg/kg)	Direct Contact Criteria (mg/kg)	Groundwater/ Surface Water Interface Protection Criteria for Reference (mg/kg)	Superior Environmental (2014) Ash Samples – Total Metals (mg/kg)	Superior Environmental (2014) Ash Samples - SPLP (mg/L)	ERM (2016) Soil Samples with Ash - Total Metals (mg/kg)
Barium	75	37,000	4,400	45-670	NA	28-170
Beryllium	None	410	85	NA	NA	ND-1.5
Boron	None	48,000	140	32-130	NA	ND-72
Cadmium	1.2	550	3.6	0.93-46	NA	ND-1.7
Chromium	18	790,000	2,900,000	15-260	NA	9.2-54
Cobalt	6.8	2,600	2	NA	NA	2.4-7.0
Copper	32	20,000	75	17-320	NA	16-95
Fluoride	None	9,000	None	NA	ND	2.7-4.6
Iron	12000	160,000	None	14000-44000	NA	7200-21000
Lead	21	400	5,100	15-6500	NA	16-260
Lithium	9.8	4,200	8.8	4.4-12	ND	4.0-15
Manganese	440	25,000	56	120-960	NA	39-400
Molybdenum	None	2,600	64	4-34	NA	ND-64
Mercury	0.130	160	0.0010	0.25-1.7	NA	0.046-0.55
Nickel	20	40,000	76	25-550	NA	9.2-33
Radium 226	None	None	None	NA	NA	ND-3.16
Radium 228	None	None	None	NA	NA	ND-1.76
Selenium	0.410	2,600	0.4	2.6-29	0.0039-0.072	ND-3.4
Silver	1	2,500	0.027	0.25-1.6	ND	ND
Thallium	None	35	4.2	NA	NA	ND
Vanadium	None	750	430	NA	NA	9-35
Zinc	47	170,000	170	80-1000	NA	36-300

*ERM 2016 results only reflect soil samples with ash noted on boring log.
NA – Not analyzed, ND – Non-detect

Environmental Resources Management (ERM) (2016) - Coal Ash Delineation Sampling Results published February 8, 2016.

In total, 25 soil samples were collected from various locations within or near the Units 1/2 Impoundment and analyzed for some of the CCR metals regulated under state and federal compliance programs. Of the 25 total soil samples collected, five were collected directly from ash encountered in the subsurface. The sampling locations are shown on **Figure 3**. Results of the coal ash solids total metals data are in **Table 8**. Samples collected above and below the water table had similar concentrations. Data collected by ERM was compared to, and is consistent with, the Superior ash analytical results.

Borings from both studies determined no liner is present beneath the Units 1/2 Impoundment, indicating the source of contamination is CCR and historical municipal solid waste.

4.2.2 Unit 3A/B Impoundments

Documented in the 1983 report, Unit 3A/B Impoundments was constructed as an above-ground ash impoundment consisting of clay dikes and a minimum 3-foot compacted clay bottom (Black and Veatch, 1983). The liner was verified in the 2014 S&S report, in which borings were completed through the impoundment berms and sediment samples were tested for permeability. According to Golder's *Documentation of Liner Construction*, however, no composite liner is present and thus the liner design criteria of 40 CFR 257.71 have not been met (Golder, 2017).

The GHBLP ceased all waste disposal into Unit 3A/B Impoundments on July 30, 2020. The GHBLP commenced removal of CCR from Unit 3A/B in July 2020. On December 10, 2020, Golder considered the unit at final closure to 95 percent confidence of CCR removal (Golder, 2020b). Following the submission of closure documentation on January 27, 2021, EGLE denied the closure certification for the following reasons:

- GHBLP did not have a groundwater monitoring system that represented background water quality. [As discussed, the monitoring well network has been expanded to represent the background water quality and to address groundwater exiting the waste boundary.]
- GHBLP only utilized one of six total soil samples to verify ash removal using colorimetric methods. EGLE stated no demonstration had been made that would justify how one sample could represent all liner areas accurately.
- The methodology for microscopy did not include preprocessing of samples to ensure bottom ash could properly be identified.
- GHBLP did not address the contamination of the clay liner itself beneath Unit 3A/B Impoundments. Soil sample analysis showed elevated concentrations of lithium and selenium have impacted the liner, consistent with coal ash or coal ash leachate.
- GHBLP did not provide sufficient demonstration that the horizontal extent of coal ash had been defined, noting a 2014 EPA report showing photographic evidence that coal ash was present outside the Unit 3A/B Impoundments boundary (e.g. on roadways).
- Photographic evidence collected during the ash removal showed a large amount of cracking observed in the clay liner, which could indicate a pathway for impacted water to enter groundwater beneath the impoundment.

Based on available information, the potential sources of contamination detected in groundwater surrounding the Unit 3A/B Impoundments are leaching of coal ash historically present in the impoundments to groundwater, the suspected "field of ash" below the Unit 3A/B Impoundments, and any remaining CCR impacted material within the unit footprint, any CCR on areas adjacent to the impoundment, and the impacted clay liner of Unit 3A/B Impoundments. A summary of the ash analysis is summarized in **Table 9**.

Table 9. Summary of Golder (2020) Coal Sampling Results			
Constituent	Statewide Default Background Levels (mg/kg)	Groundwater/ Surface Water Interface Protection Criteria for Reference (mg/kg)	Golder (2020a) Ash Samples - SPLP (mg/L)
Aluminum	6900	None	ND
Antimony	None	94	ND
Arsenic	5.8	4.6	ND
Barium	75	4,400	0.043
Beryllium	None	85	ND
Boron	None	140	0.069
Cadmium	1.2	3.6	280
Chromium	18	2,900,000	ND
Cobalt	6.8	2	ND
Copper	32	75	NA
Fluoride	None	None	1.8
Iron	12000	None	NA
Lead	21	5,100	ND
Lithium	9.8	8.8	ND
Manganese	440	56	NA
Molybdenum	None	64	ND
Mercury	0.130	0.0010	ND
Nickel	20	76	NA
Radium 226	None	None	NA
Radium 228	None	None	NA
Selenium	0.410	0.4	ND
Silver	1	0.027	NA
Thallium	None	4.2	ND
Vanadium	None	430	NA
Zinc	47	170	NA

NA – Not analyzed, ND – Non-detect

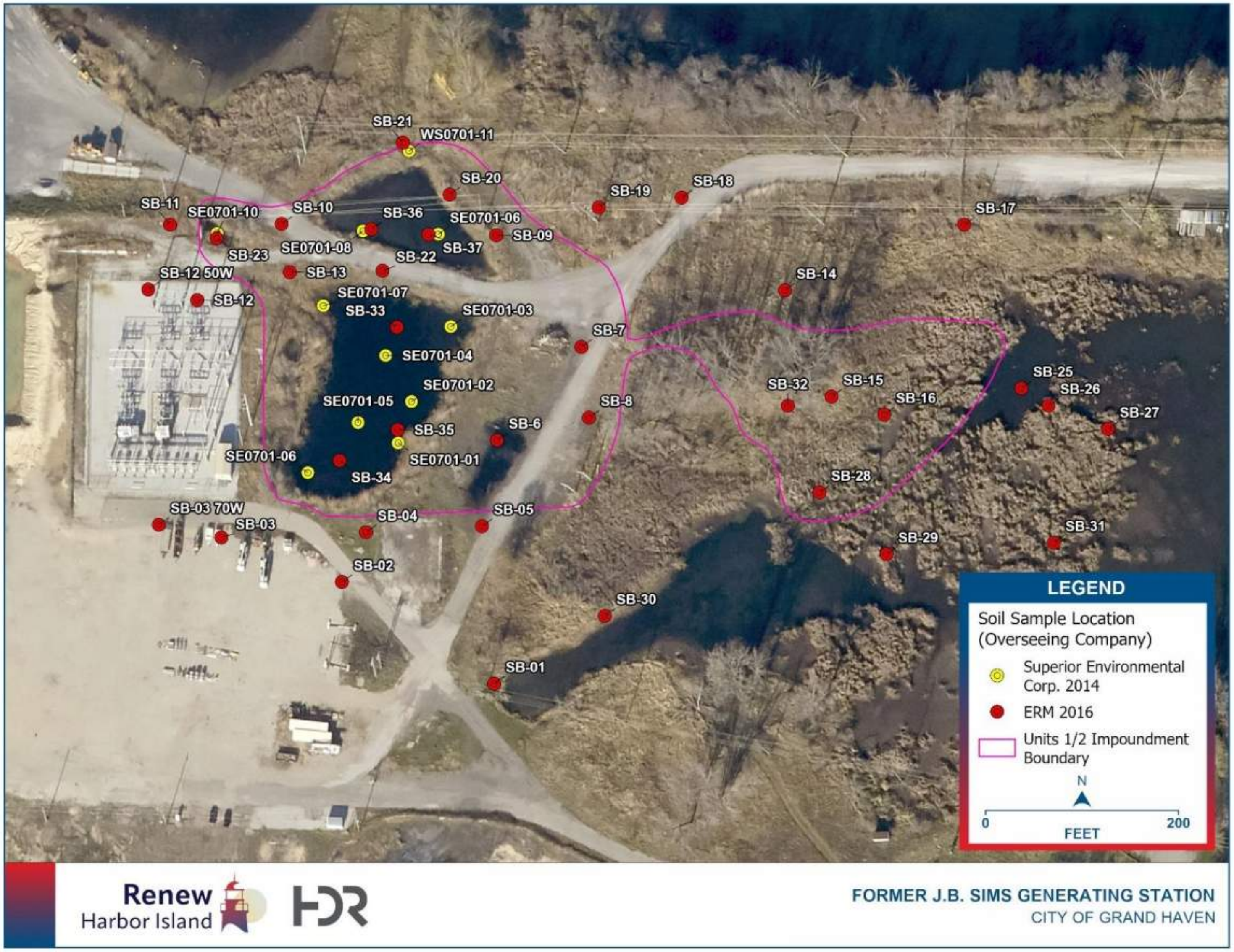

Figure 3 | Locations of Ash Characterization Sampling for Units 1/2 Impoundment

4.2.3 Non-CCR

Concentration maps representing PFOS and PFOA, the PFAS compounds that exceeded Part 201 criteria, are provided in **Appendix D**. A map showing PFHxS was not developed because there was only one exceedance and it is located at MW-37, the same location of PFOS and PFOA exceedances. The following PFAS observations were made:

- PFOA – The highest concentration observed is on the northern side of the Island near MW-08; however nearby sampling locations are noticeably lower in concentration. Wells MW-36, MW-37, and MW-38 exceed the GSI in the footprint of the former J.B. Sims plant.
- PFOS –GSI exceedances are widespread across the Island, with the highest concentrations observed along the road between the internal wetland and the north wetland, and along the western edge near the Grand River.

Based on limited research to date, no historical information regarding any specific PFAS source areas on Harbor Island has been identified. Potential PFAS sources could be associated with historical filling, including municipal and industrial waste, dredge materials, and other unknown fill activities, as well as the historical operations of the J.B. Sims Generating Station.

Certain PFAS compounds that have been detected at Harbor Island first were manufactured and used after the municipal landfill activities ceased. For example, 6:2 fluorotelomer sulfonic acid (6:2 FTS) was detected on the western portion of the Site in the area of the former J.B. Sims plant. The 6:2 FTS compound was developed after the municipal waste dump was closed in 1970, which indicates a newer release of PFAS on the Island not related to the City's dump. Researching historical activities at Harbor Island, and the development and use of different compounds, may provide information about additional potential sources.

Limited soil samples were collected at VAS locations along the northern access road (just south of the northern wetland) and in the area of the former J.B. Sims Generating Station. Soil samples had detections of various PFAS compounds, however, there currently are no Part 201 Generic Cleanup Criteria for PFAS in soil.

4.3 Plume Delineation

In accordance with 40 CFR §257.95(g)(1)(i) and Michigan R 299.4441(6)(c) additional monitoring wells will be installed to define the areas where groundwater exceeds GPS, these areas are referred to as "plumes". The potential groundwater plume is defined as an area inside of which concentrations of COCs in groundwater are present at concentrations exceeding the respective GPS. Maps have been developed for COCs that have been observed exceeding GPS at SSLs. (**Appendix C**). The majority of the plumes have been delineated and there remain only a few locations that require additional investigation.

Units 1/2 Impoundment Monitoring Well Network

The monitoring well network justification for the Units 1/2 Impoundment is provided in the Hydraulic Monitoring Plan (HDR, 2024c). The following wells are utilized as the groundwater monitoring network:

- Background Wells: MW-27, MW-33, and MW-34.
- Point of Compliance Wells (i.e. waste boundary wells): MW-06, MW-08, MW-18, MW-19, MW-20, MW-30, and MW-31.
- Nature and Extent Wells: MW-07, MW-10, MW-16, MW-17, MW-28, MW-32, MW-36, and MW-37.

Unit 3A/B Impoundments Monitoring Well Network

The monitoring well network justification for the Unit 3A/B Impoundments is provided in the Hydrologic Monitoring Plan (HDR, 2024c). The well network utilized is as follows:

- Background Wells: MW-27, MW-33, and MW-34.
- Point of Compliance Wells (i.e. waste boundary wells): MW-02, MW-03, MW-04, MW-11, and MW-12.
- Nature and Extent Wells: MW-01R, MW-09, MW-10, and MW-38.

Data from these nature and extent wells was used to evaluate the nature and extent of exceedances and define the plume, which is an important component of an ACM. Following the statistical evaluation of February 2024 assessment monitoring sampling data, SSLs were identified in nature and extent wells shown below:

- Units 1/2 Impoundment: MW-10 and MW-32.
- Unit 3A/B Impoundments: MW-01R, MW-09, and MW-10.

During the 2nd quarter 2024 sampling event in April 2024, the following additional nature and extent wells were added to each unit to further delineate the COC plumes:

- Units 1/2 Impoundment: MW-16, MW-17, MW-28, MW-36, and MW-37.
- Unit 3A/B Impoundments: MW-38.

As of July 2024, the newly added nature and extent wells listed above have been sampled during two events (April and July 2024). The GPS exceedances to date indicate that further expansion of the monitoring well network may be necessary in a few locations to further delineate and refine the contaminant plume if SSLs are identified. Potential expansions of the monitoring well network would include the following areas:

- MW-39 and MW-13 will be added as nature and extent wells for Unit 3A/B Impoundments; and
- North of MW-10 for Units 1/2 Impoundment and Unit 3A/B Impoundments.
- The area around MW-07 and MW-08 may need further investigation to determine the source and extent of CCR COCs.

The existing well locations of MW-13 and MW-39 will be sampled during the 4th quarter assessment monitoring event. Monitoring wells deemed necessary to refine the CCR contaminant plumes will be installed in the 1st quarter 2025. This work will be completed as additional data is gathered for remedy selection.

4.4 Potential for Offsite Contaminant Transport

40 CFR §257.95(g)(1)(iii) and Michigan R 299.4441(6)(c) require that at least one additional monitoring well be installed at the facility boundary in the direction of plume migration and sampled in accordance with 40 CFR §257.95(d)(1) and Michigan R 299.4441(4), respectively. At Harbor Island, the Facility boundary is the surface water or wetland in all directions, and there are existing monitoring wells along the Facility boundary in the well network as shown in **Figure 2**.

Groundwater elevations indicate that groundwater is discharging to surface water, including the Grand River on the west side of the Island, the South Channel on the south side of the Island, the north wetland area, the interior wetland areas, and Units 1/2 Impoundment (**Figure 2**). Groundwater flow patterns on the Island are generally consistent and change seasonally. Shallow (ranging from 1 to 9 ft bgs) groundwater is migrating offsite into the surface waters.

The potential for deeper (16 to 20 ft bgs) groundwater to migrate offsite under the surface water is not yet understood and is a data gap. A Data Gap Work Plan is in progress and includes a plan to install additional deeper wells at the groundwater/surface water interface to characterize the potential for deeper groundwater flow under the Island (**Figure 2**).

4.5 Potential Receptors and Exposure Pathways

The conceptual site model for groundwater is complex due to the extensive fill and the groundwater/surface water interactions on Harbor Island resulting in groundwater flow that has temporal and spatial variability. As shown in **Figure 1**, Harbor Island is surrounded by surface water bodies including the Grand River to the west, the South Channel on the south and east, as well as a wetland to the north that appears to be connected to the Grand River. The rise and fall of the Grand River's water level influences the groundwater flow rate and direction throughout the Island. Groundwater level monitoring shows that localized flow direction and gradients are variable and influenced by surface water levels, precipitation, and the seasonal freeze thaw cycle.

The Groundwater-Surface Water Interface (GSI) pathway is relevant when hazardous substances in groundwater can reasonably be expected to discharge to surface waters of the State. Based on the concentrations of PFOS, PFOA, and PFHxS in monitoring wells located near the groundwater-surface water interface at the Grand River and Harbor Island wetlands, as well as the groundwater flow directions measured during 2023 and 2024, there is the potential for PFOS, PFOA, and PFHxS in groundwater to discharge to surface water at concentrations exceeding the GSI criteria. Similarly, based on the concentrations of CCR COCs in monitoring wells located near the GSI at the Grand River and Harbor Island wetlands, there is the potential for CCR COCs in groundwater to discharge to surface water at concentrations exceeding the GSI criteria. Grand Haven's municipal water intake is located in Lake Michigan, just south of the mouth of the Grand River. As such, all groundwater concentrations were compared to the generic GSI criteria for a drinking water source.

According to the EGLE's *Wellogic* online database, there are no groundwater wells located on Harbor Island. There are, however, 21 groundwater wells that are located within one mile of the Harbor Island study area boundary. Construction details for these wells are listed in **Table 10** and locations are provided in **Figure 4**. According to *Wellogic*, most of the water wells located closest to Harbor Island are not used for drinking water. One water well located northwest of Harbor Island is identified as a household use water well. This well is screened from 38 to 43 ft bgs. Based on the flow of the Grand River, this water well is likely located upgradient of the groundwater impacts on Harbor Island (WSP 2023). Despite being located within the one-mile buffer, the wells are all separated from Harbor Island by the Grand River or South Channel. An investigation of potential flow beneath the Island utilizing deep monitoring wells is currently being proposed and is anticipated to be completed by the 4th quarter 2024.

Wetlands are also regulated as surface waters of the State and are subject to GSI statutory provisions. The wetlands on Harbor Island are not used as a drinking water source, however, they are hydraulically connected to the Grand River.

Table 10. Public Wells within One Mile of Study Area

Wellogic ID Number	Well Depth (ft. bgs)	Date of Construction	Static Water Level (ft. bgs)	Latitude	Longitude	Elevation (ft)	Well Type
70000002390	87	4/30/1971	68	43.085	-86.231	610	Residential
70000002391	83	6/30/1971	63	43.084	-86.227	591	Residential
70000007379	30	10/19/2006	4	43.086	-86.225	587	Residential
70000009583	50	7/25/2012	0	43.069	-86.229	582	Commercial
70000009584	21	8/15/2012	6	43.069	-86.229	582	Commercial
70000009733	30	2/12/2013	2	43.086	-86.226	592	Residential
70000009941	63	9/10/2013	43	43.062	-86.236	605	Commercial
70000012737	58	1/25/2019	26	43.058	-86.234	614	Residential
70000015545	65	10/20/1971	37	43.061	-86.228	611	Residential
70000017244	52	3/31/1972	30	43.066	-86.250	597	Residential
70000018690	52	Not Provided	0	43.063	-86.236	595	Commercial
70000018789	35	2/14/1972	22	43.078	-86.252	595	Residential
70000018907	43	6/11/1990	6	43.078	-86.239	586	Residential
70000018967	42	7/12/1990	9	43.086	-86.232	607	Commercial
70000019132	53	8/18/1966	17	43.084	-86.235	609	Public Supply
70000019882	42	4/24/1972	5	43.086	-86.241	607	Residential
70000020443	35	10/7/1967	10	43.084	-86.232	600	Residential
70000020445	38	5/1/1997	3	43.086	-86.236	602	Commercial
70000020454	21	6/10/1972	9	43.078	-86.252	596	Residential
70000020524	37	6/6/1973	10	43.075	-86.251	593	Residential
70000020527	40	5/25/1971	0	43.076	-86.252	599	Residential

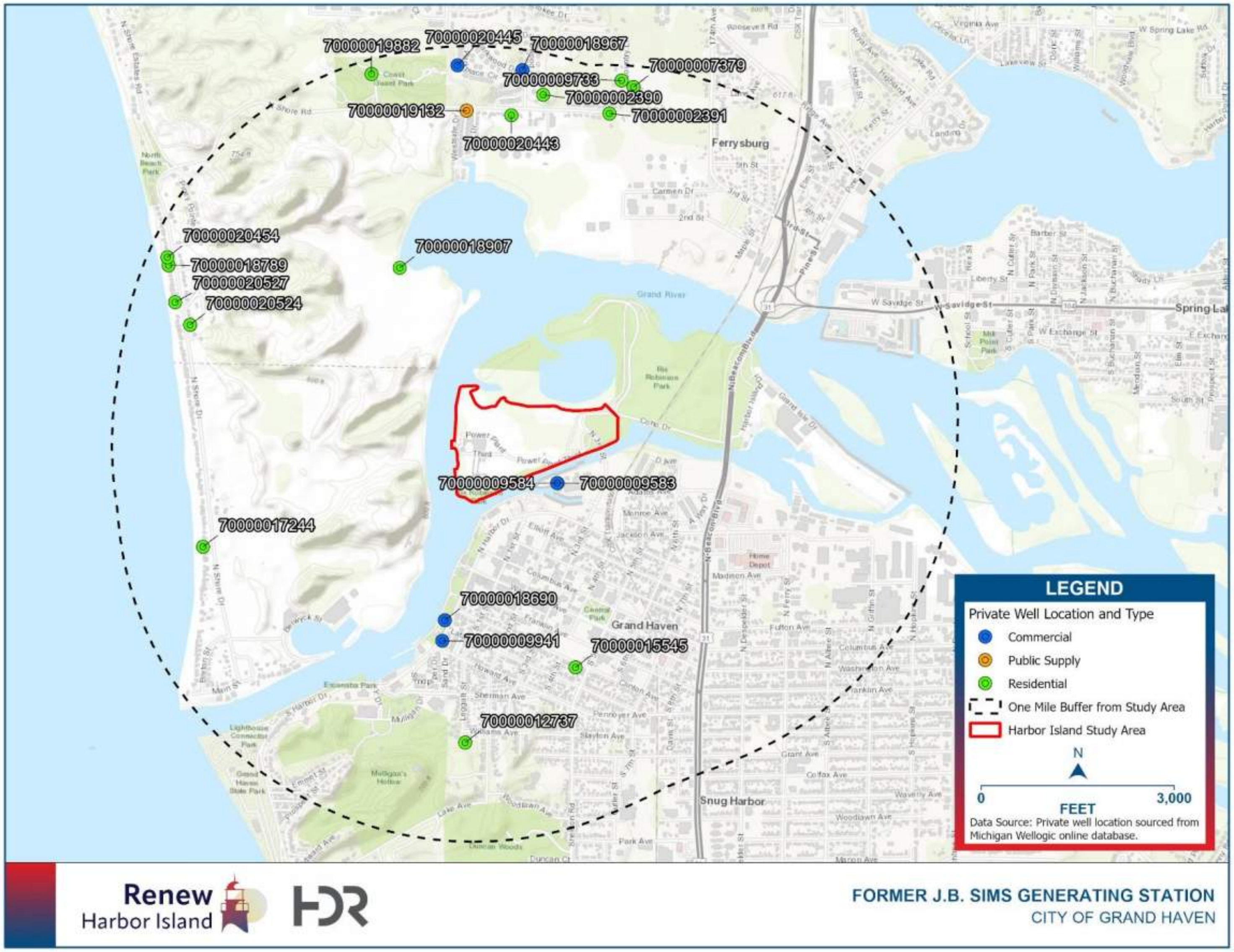

Figure 4 | Private Wells within One Mile of Study Area

5.0 Corrective Measures Alternatives Evaluation

Consideration of corrective measures to address both the CCR related groundwater impacts from the two CCR units and the non-CCR related groundwater impacts are discussed in this section. Included below are the descriptions of the evaluation criteria, shared components of the corrective measure alternatives, each potential alternative, screening of the alternatives, and a summary of additional data needs to support the future remedy selection.

5.1 Evaluation Criteria

Consistent with 40 CFR §257.96 and Michigan Administrative Code R 299.4443, evaluation criteria considered in the assessment of corrective measures are discussed below.

Performance

Factors considered for evaluating performance of a corrective measure alternative include the degree to which the alternative removes COCs from the environment; and the ability of the alternative to achieve GPS for these constituents at point(s) of compliance.

Reliability

Factors considered for evaluating the reliability of a corrective measure alternative include the effectiveness of engineering and institutional controls to maintain the alternative; potential need for replacement or maintenance of components of the alternative; and any other operational reliability issues that may arise for the alternative that will limit its use or effectiveness in meeting corrective action objectives.

Ease of Implementation

Factors considered for evaluating ease of implementation of a corrective measure alternative include the degree of difficulty associated with installing or constructing the alternative given site conditions, including the need to obtain necessary access, approvals and/or permits; the availability of necessary equipment and/or specialists to implement; and the available capacity and location of treatment, storage, or disposal services needed.

Potential Impacts of the Alternative

Factors considered for evaluating potential impacts of a corrective measure alternative include risks that may impact the community or environment during implementation of the alternative (e.g., due to excavation, transportation, disposal, or containment of CCR material), potential human health or environmental receptor exposure to COC material following implementation, and cross-media impacts due to the corrective measure alternative implementation.

Time Required to Begin and Complete the Alternative

Factors considered for evaluating the time to begin and complete the corrective measure alternative include the time needed to completely design and implement (i.e., begin) the alternative; and the time it will take to achieve applicable GPS at point(s) of compliance.

Institutional Requirements

Factors considered for evaluating the time to begin and complete the corrective measure alternative include the time needed to completely design and implement (i.e., begin) the alternative; and the time it will take to achieve applicable GPS at point(s) of compliance.

Michigan Administrative Code R 299.4443 also requires that the analyses address the costs of remedy implementation. Due to the potential additional requirements associated with CCRMU at the Site, it is anticipated that closure and groundwater remediation requirements for CCR may increase beyond what is identified herein. These costs cannot be quantified until the Facility Evaluation, associated field work, and groundwater monitoring are completed. Additional information derived from the CCRMU evaluation may alter the corrective measure alternatives and will alter any cost estimates. Because there is knowledge that the costs may increase after the CCRMU are incorporated, this ACM does not include cost estimates and will be revised after this information is available.

5.2 Potential Groundwater Corrective Measure Alternative Evaluation

This section presents potential corrective measures alternatives and an evaluation of each in accordance with 40 CFR §257.96 and Parts 115 and 201 to address CCR constituents in groundwater at SSLs exceeding GPS and non-CCR constituents in groundwater at levels exceeding the GPS at the Site. There are no stand-alone corrective measure alternatives for this Site. However, by grouping individual corrective measures together, a holistic remedy for the Site can be assembled to remediate CCR and PFAS.

The presence of non-CCR constituents may require different or additional measures be implemented. Treatment of groundwater and surface water collected during the corrective measures must address both the CCR constituents and the PFAS before discharge. PFAS compounds present challenges to the corrective measures used to address CCR constituents because no alternative is available to separate the CCR constituents from the PFAS in the groundwater that will be extracted for treatment. Emphasis will be placed on alternatives that consider both the CCR COCs and the co-mingled PFAS so as to save time and conserve financial resources. This is referred to as a holistic approach to remediation at the Site.

Other considerations include the requirement to close the CCR units as part of source control. Source control would include either CCR removal and decontamination, or closure in place and elimination, to the maximum extent feasible, of post-closure infiltration of liquids into the waste, including groundwater infiltration.

Sections 5.2.1 through **5.2.5** describe the corrective measure alternatives evaluated, and **Table 11** provides a summary of each potential alternative compared to the evaluation criteria. Each potential alternative is assigned a numerical ranking of 1 to 3; 1 indicating least favorable and 3 is most favorable. This ranking has been assigned to each criterion for each alternative based on the evaluation of each alternative and site-specific conditions. An evaluation of each potential alternative and a summary of the results are presented below.

In addition to the evaluation criteria, corrective measure alternatives determined to be viable for the Site were also evaluated considering the following remedy selection standards from 40 CFR §257.97(b):

- Be protective of human health and the environment.
- Attain groundwater protection standard(s) pursuant to 40 CFR §257.95(h).
- Control the source(s) of releases to reduce or eliminate, to the maximum extent feasible, further releases of Appendix IV constituents into the environment; and
- Comply with standards for management of wastes as specified in 40 CFR §257.98(d).

A cross-check summary of how each alternative compares to these remedy selection standards is provided in **Table 11**.

5.2.1 Source Control – Removal and In-situ Solidification and Stabilization

Source control of the CCR will be a key component of any corrective measures approach and will be one of the initial steps of the remediation. Closure is required under §257 for the CCR units and includes either closure by removal or closure in place. Removal and In-Situ Solidification and Stabilization (ISS) are the two source control alternatives being evaluated. It is likely that a combination of both removal and ISS may be used to accomplish source control because the majority of the ash previously was removed from the Unit 3A/B impoundments. Minimal amounts of ash may be present around the periphery of the unit that was associated with ash removal truck loading. In addition, if any PFAS source material is identified, then such sources may be removed. PFAS source locations are not well defined. Groundwater with exceedances of PFAS compounds could have migrated from an as yet unknown source. There are locations, however, where groundwater concentrations appear higher than others that in some cases coincide with solid waste in borings. Therefore, removal of waste and soil in those areas may be considered. Demolition, removal and relocation of on-site structure and utilities could also be part of this remedy.

Source Removal

Removal of CCR and PFAS containing waste prevents the ongoing potential migration of contaminants to the groundwater and surface water. Source removal maximizes the groundwater cleanup effectiveness of the other alternative components for this corrective measure discussed below. The corrective measures will continue to target the removal of the CCR and PFAS containing waste wherever possible. Excavation and offsite disposal will be used to accomplish this removal.

Excavation of source materials is straightforward and uses common construction equipment to eliminate the ongoing migration of contaminants to the air, groundwater and surface water. Removal of these sources reduces the time to achieve GPS at compliance points, reduces corrective action costs and reduces potential risk human health and the environment. Removal can be implemented concurrently with implementation of other alternatives for groundwater remediation. Excavation is a relatively quick form of source control, taking the least amount of time of all the alternative components to complete. The high groundwater table at the Site, however, potentially means that extensive and costly dewatering may be required during any removal.

The GHBLP ceased all waste disposal into Unit 3A/B Impoundments on July 30, 2020. The GHBLP commenced removal of CCR from Unit 3A/B Impoundments in July 2020 and excavated the CCR down to the clay liner. On December 10, 2020, Golder considered the unit at final closure to 95 percent confidence of CCR removal (Golder, 2020a). However, the closure documentation was denied by EGLE on January 27, 2021. Additional data collection is planned to delineate the areas that require additional excavation.

CCR dewatering and excavation of source material from the inactive Units 1/2 Impoundment and the former Unit 3 A/B Impoundments is one method of source control and closure for the CCR impoundment. Demolition, removal and relocation of on-site structures and utilities could be part of this remedy. Under a removal closure strategy, the ash from the impoundment will be dewatered, excavated and disposed of at an off-site landfill or beneficially used offsite pursuant to any applicable federal and state regulatory requirements. Confirmation samples will be collected from the impoundment's footprint after CCR removal and statistically evaluated to demonstrate that all areas affected by releases of CCR have been removed. A preliminary report documenting the closure by removal will be prepared and certified by an HDR Professional Engineer. The closure report will be finalized once the COC concentrations in groundwater are confirmed to meet the GPS according to the requirements of the CCR Rule and Part 115.

Source control using removal will be retained for further site-specific evaluation.

Site Considerations: The performance and effectiveness of a removal action is based on the ability to characterize the areas where CCR and PFAS are located and to excavate to the horizontal and vertical depth of the waste. Further PFAS delineation to identify potential source areas for removal may be conducted for costing purposes. Sources of PFAS are unknown. It is possible that historical fill material, prior operation of the power plant and/or other historical activities may have resulted in the PFAS contamination.

The Site geology (as described above) is not expected to present any obstacle to excavation. However, the high-water table and surrounding surface water could cause the hydraulic control of the groundwater and surface water infiltration to be burdensome, increasing the cost and time to complete this task. Removal will be retained for further site-specific evaluations to determine how best to apply this alternative at the Site.

Solidification and Stabilization

Solidification and stabilization (SS) are a group of cleanup methods that can prevent the release of harmful chemicals from waste, such as contaminated ash, soils, sediments, and sludge. Solidification binds waste in a solid block of material and traps it in place. This block is also less permeable to water than the waste. Stabilization causes a chemical reaction that makes contaminants less likely to leach into the environment. These methods do not destroy the contaminants but keep them from migrating as air born particles or leaching into surface water and groundwater. SS can be conducted while the waste is still in the ground (in-situ) (ISS) or excavated (ex-situ) and mixed with an agent above ground. When used in-situ, these methods can replace the need for excavation. Controlling the source with ISS also avoids time-consuming and costly dewatering required by excavation and may result in expedited groundwater remediation at a potentially lower cost.

These alternatives are simple construction activities using heavy equipment like a crane and auger to mix a binding agent such as cement into the waste material. ISS leaves areas of contamination in place as a solid block in the ground providing a relatively quick and lower cost way to control a source and prevent human and ecological exposure to contaminants. Currently, proven technology exists to perform ISS for the CCR COCs, but such technologies are still in the experimental stage for PFAS.

These methods are reliable remediation methods and have been successfully used at several CCR sites across the Country. Under the ISS closure strategy, the ash would be mechanically mixed with a binding agent to form a block on-site. Confirmation samples would be collected from the impoundment’s footprint after the SS process is complete to determine if the process was successful. Leaching tests are performed on the treated material to confirm that the CCR has been encapsulated. Statistical evaluation would be conducted to demonstrate that areas affected by releases of CCR are stable. A preliminary report documenting the closure by SS would be prepared.

Site Considerations: The performance and effectiveness of this alternative technology is based on the ability to characterize the areas where CCR is located, select the appropriate agent and deliver the agent to those impacted areas. The site geology should not be an impediment to mixing. Knowing the horizontal and vertical depth of the CCR impacted materials is critical because as the vertical depth increases, it becomes more difficult to mix the agent with the waste materials. Compatibility with the Site material is also a key concern and may require bench testing to determine which agents are the most effective in binding the contaminants. It is not known if these alternative technologies would effectively bind PFAS constituents, however the addition of a binder for CCR also may effectively bind PFAS. SS will be retained for further site-specific evaluations at the Site.

Source control is recommended as one component of the assembly of corrective measures alternatives used to achieve the corrective action objectives and should be retained for further evaluation. The ACM will retain source control for further site-specific evaluation.

5.2.2 Containment Wall

Containment walls provide a hydraulic barrier that can be used for groundwater cutoff, controlling groundwater flow or completely encircling a contaminated area and preventing contaminated groundwater migration off-site. Containment walls are a proven technology. The containment wall alternative can be effective in containing the CCR and PFAS comingled contamination and controlling contaminant migration. Containment walls are very effective when paired with an extraction and treatment system for the remediation of groundwater. Two types of containment walls are being evaluated for this corrective measure: (1) interlocking steel sheet pile wall and (2) slurry wall.

Interlocking sealed steel sheet pile containment wall

Interlocking sealed steel sheet pile containment wall (sheet pile wall) can be used to provide a barrier to impacted groundwater flow, preventing off-site migration of dissolved COCs. A sheet pile wall also provides a barrier preventing clean surface water and groundwater from entering the treatment system, thus reducing the volume of water being treated and consequently reducing the time and cost of corrective action.

Construction of a sheet pile wall entails driving steel sheet piles through the soil column and into the top portion of a low permeability geological barrier to groundwater movement such as a clay material. The sheet pile wall would be composed of sheets of steel approximately 45 feet long, 3 feet wide and 1.5 to 2 inches thick with an interlocking sealed edge between each steel sheet making it watertight. These steel sheets are driven into the top of the clay by a crane using an impact hammer or vibratory hammer. The permeability of the sheet piles is essentially zero and they are compatible with both the CCR and non-CCRCOCs at this Site.

Site Considerations: Interlocking sealed steel sheet pile walls perform well when installed properly. The Harbor Island Site presents several challenges. If the COCs exceeding GPSs are located both on- and off-site, the containment wall may need to encapsulate areas off Harbor Island and out into the river. It must be determined if there is sufficient land area between the shoreline and the areas where the wall needs to be installed.

Sheet pile walls are useful because they are not hindered by surface or groundwater. Their installation requires no excavation or associated costly dewatering. They possess structural integrity and can be installed at the water's edge or beyond if necessary to capture a plume. Sheet pile walls have a permeability of essentially zero, making them excellent for groundwater containment and are compatible with the COCs on this Site, including PFAS.

A steel sheet pile wall is superior to a slurry wall option (discussed next) in most applications because of its versatility and ease of construction. Unlike slurry walls, sheet pile walls allow for pinpoint placement in tight areas (e.g., between Island and river), COC compatibility and require no excavation or associated costly groundwater management. Also, if construction is required at or beyond the edge of the Island such due to a plume extending beyond the Island property boundary and into the river, only the sheet pile can address this situation.

Slurry wall

The second type of containment wall under consideration is the slurry wall. The construction of a slurry wall involves excavating a narrow trench or trenches approximately 4 feet wide by 35 feet deep and injecting a high slump slurry that when solidified forms a wall. The slurry wall would also be keyed at least 3 feet into the low permeability underlying barrier such as clay. The slurry used for wall construction is typically a combination of excavated trench soils, bentonite, and other potential additives depending on the COCs at the Site. The slurry mixture forms into a material similar to soft, clayey soil. This method typically results in a cutoff wall with a permeability ranging from $1x10^{-6}$ to $1x10^{-8}$ cm/sec.

Site Considerations: Slurry walls have a good track record when installed properly. As discussed above, the Harbor Island Site presents several challenges. A competent slurry wall would be difficult to construct under these conditions without significant additional efforts and cost.

The construction of a slurry wall is limited to areas where excavation can be completed without side wall collapses, where the infiltration of groundwater and surface water can be controlled, and where the soil of the trench provides the structural integrity. The historical fill material used to construct the Island may not possess the structural integrity needed for the trench and may not be suitable as a slurry component.

Installation at the edge or out into the river may not be possible. Slurry wall construction at this Site requires trenching through approximately 35 feet of overburden soil and then approximately 3 feet of confining clay layer. There may not be room to construct a slurry wall on the property due to the limitation imposed by the surrounding surface water. Because the Site is an island, placement of the slurry wall at the edge of land would be difficult because surface water and groundwater infiltration into the trench would be continuous and difficult to control.

Containment walls can be a reliable vertical barrier for cutting off groundwater flow and generally are coupled with a groundwater treatment technology, such as groundwater extraction and treatment. Another consideration is managing groundwater within the containment wall which may be required in the overall corrective action strategy due to groundwater mounding. Groundwater extraction alternatives would provide greater versatility in dealing with groundwater mounding.

Containment walls are recommended as one component of the assembly of corrective measures alternatives used to achieve the corrective action objectives and should be retained for further evaluation. The ACM will retain both types of walls for further site-specific evaluation.

5.2.3 Hydraulic Containment - Extraction and Treatment

Extraction and Treatment (E&T) is an effective type of hydraulic containment used to capture and control the migration of impacted groundwater. E&T is considered a reliable corrective action technology for application at CCR sites as it has been used to address metals-contaminated groundwater for decades at sites with varying geologies across the Country. It is also one of the few technologies that also is applicable for remediation of PFAS. The approach consists of using extraction wells to capture groundwater for ex-situ treatment prior to being discharged to a receiving water body (like the Grand River), reinjection to the aquifer, beneficial reuse, discharge to a publicly owned treatment works, or evaporation. E&T has successfully been employed as a stand-alone remedy, in combination with other corrective measure alternatives, or as an interim measure to provide hydraulic containment and prevent migration of constituents toward a potential receptor.

Site Considerations: The viability of this technology is dependent on the ability to characterize the extent of the groundwater contamination. Modeling of the impacted groundwater is typically used to design a network of extraction wells to capture the groundwater. Bench or pilot testing is often necessary to design a water treatment plant that can effectively remove contaminants (CCR and PFAS) from the extracted groundwater and develop a long-term monitoring program to track the success of the corrective action. Groundwater evaluations collected to date identified the uppermost aquifer as high conductivity which is ideal for E&T. The geology is described as fine sand with gravel, silt lenses, clay, peat, ash, and municipal solid waste in the uppermost aquifer. Geology impacts how groundwater can effectively be extracted from the subsurface.

Evaluation of the use of extraction wells will require additional site-specific data by conducting pump tests in the immediate vicinity of existing monitoring wells. The pump test results will be used to estimate the zone of capture for extraction wells screened in the upper aquifer so as to determine the extraction wells needed to intercept groundwater flowing from the impacted area. Reporting for the pump tests would be provided under separate cover in the semi-annual remedy selection progress report.

Once groundwater is collected, reliability of treatment will be dependent on the performance of the above ground treatment system to remove the CCR and PFAS contaminants from groundwater. The contaminants of concern for Units 1/2 Impoundment include arsenic, boron, calcium, chloride, fluoride, lead, lithium, sulfate, and total dissolved solids (TDS) and for Unit 3A/B Impoundments include boron, calcium, chloride, fluoride, sulfate, and TDS. These CCR constituents and PFAS can be removed from extracted groundwater using currently available technology.

The hydraulic containment technology will be retained for further site-specific evaluation. Hydraulic containment should be used in combination with other corrective measure alternatives such as a cap and containment wall to achieve the corrective action objectives.

5.2.4 Monitored Natural Attenuation

Monitored Natural Attenuation (MNA) refers to the reliance on natural attenuation processes (within the context of a carefully controlled and monitored site cleanup approach) to achieve GPS within a time frame that is reasonable compared to active methods. Natural attenuation processes that are at work in such a remediation approach include a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil or groundwater (USEPA, 1999). Attenuation mechanisms for inorganic constituents can include physical (e.g., dilution, dispersion, flushing, and related processes) or biological/ chemical (e.g., adsorption, sorption (co-precipitation) processes (EPRI 2015a; USEPA 2015). MNA is relatively efficient to implement.

Evaluating the performance and reliability of MNA requires a detailed understanding of hydrogeologic conditions and a monitoring and assessment program. While model predictions can simulate long-term attenuation using soil-water partitioning coefficients to estimate adsorption, natural conditions will dictate how COCs migrate through the strata and how much is intrinsically removed or immobilized. Empirical data are good indicators of natural attenuation mechanisms, but long-term groundwater monitoring is required. (EPRI, 2015; USEPA, 1999, 2007a,b).

To assess MNA's potential performance and reliability at a site, the USEPA has established a tiered lines of evidence approach where information is collected as necessary to identify attenuation mechanisms at a site, the capacity for attenuation, and the estimated time to achieve corrective action objectives. The four tiers to establish whether MNA may be successfully implemented for inorganics at a given site are summarized below (USEPA, 2015):

Tier 1: Demonstration that COCs above GPS in groundwater are delineated and stable.

Tier 2: Determination of the mechanisms and rates of attenuation.

Tier 3: Determination of the aquifer's capacity to sufficiently attenuate the mass of constituents in groundwater and whether the stability of the immobilized constituents is sufficient to resist re-mobilization.

Tier 4: Design of a performance monitoring program based on the mechanisms of attenuation and establishment of contingency remedies tailored to site-specific conditions should MNA not perform adequately.

MNA is well-accepted by state and federal regulators as an appropriate mitigation factor that should be considered when evaluating passive and active remedial options (USEPA, 1999, 2007a,b).

Site Considerations: MNA requires a long time to achieve GPS and, during that retention period, impacted groundwater must not vent to surface water. At Harbor Island, the groundwater is not retained for a period sufficient to achieve MNA before it discharges to surface water or wetland. Additionally, there is no known MNA for PFAS which is a COC at the Site.

For these two reasons MNA is not retained for further evaluation.

5.2.5 Capping

Capping is the placement of a cover over contaminated materials to prevent the movement of contaminants. For example, a cap can 1) stop infiltration of rain and snowmelt from seeping through the material and carrying contaminants to the groundwater, 2) keep stormwater runoff from carrying contaminants off-site into lakes and rivers, 3) prevent wind from blowing contaminants off-site, and 4) keep people and wildlife from coming into contact with contaminants. A cap on this Site would primarily serve to minimize infiltration of precipitation. Preventing infiltration and recharge is critical for achieving hydraulic control and containment and would increase the efficiency of the E&T, resulting in the reduction of both cost of water treatment, and potentially less time for remediation.

A cap design must take into consideration several factors, including the type and concentrations of contaminants present, size of the site, the amount of rainfall at the site, and future use of the property. Construction of a cap can be as simple as placing a single layer of material over the area as a contact barrier, or a solid waste cap requiring several engineered layers to prevent precipitation infiltration. The cap for this Site would need to be the later design. Design and construction of a cap takes several months, depending on the size of the area, the complexity of the design and the availability of materials and equipment.

The primary benefit of a cap is its ability to prevent precipitation from infiltrating into an E&T system and thus decreasing the amount of contaminated groundwater to be extracted and treated. The more impacted groundwater that needs extraction and treatment, the longer a corrective action will take to meet the GPS and the more it will cost.

Site Considerations: The performance and effectiveness of a cap are based on design, appropriate construction materials and complete coverage of waste area. Low areas in the topography will need to be filled before capping to provide the proper slope for drainage.

Depending on the footprint of the waste and groundwater contamination, capping may require the elimination of the ponds and wetlands on Harbor Island. Removal of these features would eliminate significant areas of surface water infiltration, eliminate both human health and ecological exposure pathways, and provide source control, while also decreasing both the cost and time needed for the cleanup.

When used in combination with other corrective measure alternatives to help achieve the corrective action objectives, capping is an effective method and will be retained for further evaluation.

5.3 Summary of Potential Corrective Measures Alternative Evaluation

Following consideration of the evaluation criteria for each potential alternative in **Section 5.2**, this section presents the recommended groundwater corrective measure alternatives to be evaluated further to support remedy selection.

It should be noted that in-situ treatment by injection or via permeable reactive barrier (PRB) was also considered. The remediation team for the site met with the EGLE Remediation and Redevelopment In-Situ Remediation Technical and Program Support (TAPS) team to discuss the most up-to-date implementations and findings from in-situ projects in Michigan. This meeting confirmed that there are no proven in-situ technologies to treat PFAS, nor any guidance documents for such technologies at this time. Therefore, in-situ technologies are not evaluated in this ACM. Should a technology be identified in the future that would be appropriate for consideration at the site, the same evaluation criteria will be considered at that time.

As stated in **Section 5.2**, a common component of the alternatives is source removal or SS of CCR from the inactive Units 1/2 Impoundment and the former Unit 3 A/B Impoundments. Combined with source control, the following corrective measure alternatives were retained for further evaluation and potential remedy selection:

- Source control through removal and/or SS of source material from Units 1/2 Impoundment, Unit 3 A/B Impoundments and other areas as needed.
- Containment wall (Interlocking sealed steel sheet pile wall and/or slurry wall).
- Hydraulic containment by Extraction and Treatment (E&T).
- Capping.

Additionally, an adaptive management strategy will be implemented at the Site focused on continual plume management, remedy performance evaluation, and improvements. As data collection, source control, and groundwater corrective measures are implemented, groundwater conditions will continue to be monitored and results interpreted. Provided in **Table 12** is a cross check of each proposed remedy with the federal standards set forth at 40 CFR 257.97(b). Any additional data collection needs will be identified, and corrective measure adjustments will be made as necessary to achieve corrective action objectives within a reasonable time frame.

There are no stand-alone alternatives available to address the CCR and PFAS groundwater impact. However, by assembling several alternatives that work together a remedy may be developed. The corrective measure alternatives listed in **Table 12** is that assemblage of alternatives and must be evaluated accordingly.

Table 11. Evaluation of Potential Remedial Alternative Measures

Corrective Measure Alternative	Description	Performance	Reliability	Ease of Implementation	Potential Impacts of the Alternative	Time to Implement Alternative	Time to Achieve GPS at Compliance Points	Institutional Requirements	Overall Score	Screening Outcome
Hydraulic Containment by Extraction and Treatment (E&T)	Hydraulic containment with extraction and treatment (E&T) is the use of groundwater extraction to induce a hydraulic gradient for capture or control of impacted groundwater. Extraction wells and/or trenches can be used to capture groundwater for ex-situ treatment prior to being discharged to a receiving water feature, reinjection to the aquifer, evaporation, or reuse. Groundwater extraction is applicable as a means of hydraulic control in the site geology and treatment of impacted groundwater.	E&T removes Appendix IV constituents and PFAS from the environment and has been proven to actively provide hydraulic control and have the ability to achieve GPS for these constituents at point(s) of compliance. E&T removes constituents in groundwater through treatment. Additional assessment activities are needed to assess potential performance of E&T, including performing pump tests capture zone analysis in additional areas of collection and treatment and flow model simulations for optimization. Effective PFAS removal processes will be identified during design. These processes include granular activated carbon, ion exchange resins, and high-pressure membrane systems.	E&T is a reliable hydraulic containment and treatment technology. This alternative is dependent on engineering and institutional controls. System operations and maintenance is key to providing optimal performance and uninterrupted operation, This alternative has no operational reliability issues that may arise for the alternative that will limit its use or effectiveness in meeting corrective action objectives. There is sufficient access for installation of extraction wells onsite. No offsite wells are anticipated to be needed at this time. Treatment of groundwater may be conducted onsite, offsite at the POTW or a combination of both. The location of a treatment system may need to be onsite so source removal and other site activities will need to be considered when locating an onsite treatment system.	Design and installation of E&T system is straight forward. E&T has a low degree of difficulty associated with its construction. Access to the Site is under the control of the city. Approvals and/or permits can be obtained for these activities as needed. The construction equipment needed is common and locally availability. Extraction wells may be both under and outside the impoundment footprint as prescribed by modeling. The hydraulic conductivity and the relatively shallow depth of the upper aquifer and Island geology are well suited for effective E&T. This will allow the remedy to meet performance criteria everywhere in the plume. Both onsite and offsite treatment services are possible and available.	Removal of ponds and wetland areas may be necessary to prevent infiltration of precipitation/surface water which will make the E&T less effective and increase both cost and time or remediation. Access to areas of Harbor Island will be restricted. Road and area closures with fencing to restrict access. NPDES permit for discharge to the river may be necessary or a permit for discharge through the POTW or offsite treatment.	12 to 24 months Time to implement will largely depend on pre-design investigation activities, modeling, and engineering as well as permitting and Agency approvals. Time required to obtain permit approval for selected discharge method of treated water could extend implementation time frame.	>30 years Can be implemented concurrently with removal source control to expedite groundwater remediation. Remedy completion is dependent on removal of sources and implementing a combination of alternatives that work together to provide hydraulic control and groundwater treatment.	May require environmental covenant or deed restrictions to control groundwater use until GPS have been achieved. Fencing will be necessary on a temporary basis during construction and possibly duration of remediation in some areas. NPDES permits may be necessary and permits for wetlands work as well.	19	Retained for further analysis. Not stand-alone alternative.
	Evaluation Score (1-3):	3	3	3	2	2	3	3		

Table 11. Evaluation of Potential Remedial Alternative Measures

Corrective Measure Alternative	Description	Performance	Reliability	Ease of Implementation	Potential Impacts of the Alternative	Time to Implement Alternative	Time to Achieve GPS at Compliance Points	Institutional Requirements	Overall Score	Screening Outcome
Surface Capping	Capping involves placing a cover over contaminated materials such as contaminated soils or sediments. Caps don't destroy or remove contaminants. Instead, they isolate the contamination and keep them in place to avoid the spread of contamination. Capping prevents infiltration of precipitation and will increase the efficiency of the E&T, reduce the cost of water treatment, and reduce the time of remediation.	Caps are a proven method to inhibit contaminant movement through the environment Caps prevent infiltration of rain and snow melt from seeping through the material and carrying contaminants to the groundwater. Caps prevent stormwater runoff from carrying contaminants off-site into lakes and rivers and prevents wind from blowing contaminants off-site. Keeps people and wildlife from coming into contact with contaminants.	When properly built and maintained, a cap can safely keep contaminants in place and prevent contaminant migration to groundwater. This alternative is dependent on engineering and institutional controls to maintain the alternative. It requires ongoing general minimum maintenance of the cover but has no operational reliability issues that may arise for the alternative that will limit its use or effectiveness in meeting corrective action objectives.	Cap design and implementation are straight forward. Capping has a low degree of difficulty associated with its construction. Access to the areas is under the control of the city. Approvals and/or permits can be obtained for these activities. The construction equipment needed is common and locally availability. The materials for construction are also readily available.	Potential impacts to the community or environment from cap construction will be low. Access restrictions, dust suppression, erosion controls will be in place to minimize any potential impacts. Transportation routes for equipment and materials will all be controlled and monitored. Caps will eliminate the possibility of direct contact to waste, reducing or eliminating both human health and ecological risk pathways. Construction of the cap will modify the surface of Harbor Island eliminating potential contact with contamination and would eliminate the contaminated ponds and wetlands that act as attractive nuisance to humans and animals.	10 to 20 months The design and construction of the cap is straight forward. However, remedy completion is dependent on implementing a combination of alternatives that work together to provide hydraulic control and treatment.	> 30 years Will reduce time of compliance and cost of remedy. Can be implemented concurrently with removal source control to expedite groundwater remediation.	Fencing may be necessary on at least a temporary basis during construction and possibly for the duration of remediation in some areas. Wetland delineation and rehabilitation or removal and replacement may be needed.	20	Retained for further analysis. Not stand alone alternative.
	Evaluation Score (1-3):	3	3	3	3	3	3	2		

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Table 11. Evaluation of Potential Remedial Alternative Measures

Corrective Measure Alternative	Description	Performance	Reliability	Ease of Implementation	Potential Impacts of the Alternative	Time to Implement Alternative	Time to Achieve GPS at Compliance Points	Institutional Requirements	Overall Score	Screening Outcome
Monitored Natural Attenuation (MNA)	MNA relies on natural attenuation processes to achieve corrective action objectives within a reasonable time period at lower cost relative to more active methods. Depending on site-specific conditions, MNA can effectively reduce dissolved concentrations of inorganic constituents in groundwater through sorption, mineral precipitation, or oxidation-reduction reactions. Regular monitoring of select groundwater monitoring wells for specific parameters is required to ensure COC concentrations in groundwater are attenuating over time. Dilution from recharge to shallow groundwater, mineral precipitation, and COC adsorption will occur over time, thus reducing COC concentrations through attenuation.	MNA is a way to remove CCR constituents from the environment through natural attenuation processes. The processes are likely to be more physical than chemical. Chemical attenuation is not typically as prominent in the Site geology. MNA removes CCR constituents from the environment and under certain conditions has the ability to achieve GPS for these constituents at point(s) of compliance. Short retention time of impacted groundwater in the aquifer before discharging to the river may not be suitable for MNA processes to be successful. Another consideration is PFAS contamination in the CCR impacted groundwater. There is no data that supports MNA for PFAS.	Under appropriate aquifer conditions, MNA is reliable and can be used as either a stand-alone corrective measure or in combination with other technologies. However, the unique Island setting and groundwater flow to surface water at the site is not ideal for MNA. MNA alternative is dependent on engineering and institutional controls to maintain the alternative. System operations and maintenance is key to providing optimal performance and uninterrupted operation, Fowling of well points and equipment issues will limit its use or effectiveness in meeting corrective action objectives. No PFAS treatment.	Easily implementable but requires additional upfront data and documentation to confirm attenuation capacity is sufficient to meet GPS within a reasonable time frame. New groundwater monitoring network will be needed for MNA performance monitoring. However, some of the existing network may be used. Access to the Site is under the control of the city. Approvals and/or permits can be obtained for these activities as needed. Will require environmental covenants or deed restrictions for areas where groundwater is above GPS for CCR and PFAS.	MNA potential impacts to the community or environment will be low. Access restrictions, dust suppression, erosion controls will be in place to minimize any potential impacts. Transportation routes for equipment and materials will be controlled and monitored. MNA relies on natural processes in the aquifer matrix to reduce COCs in groundwater without additional site disturbance but cannot address PFAS.	12 to 24 months New monitoring infrastructure will be needed. Demonstrating attenuation mechanisms and capacity can be time consuming especially given the complex groundwater flow.	>30 years Following source control and pending a tiered MNA evaluation, MNA may not be successful within a reasonable time frame. Intensive groundwater monitoring will be necessary to verify COC concentrations in groundwater are decreasing over time. Will not achieve GPS for PFAS at compliance points.	Will require environmental covenant or deed restrictions if there are areas where groundwater is above GPS for CCR or PFAS.	10	Not retained for further analysis.
	Evaluation Score (1-3):	1	1	2	1	2	1	2		

Table 11. Evaluation of Potential Remedial Alternative Measures

Corrective Measure Alternative	Description	Performance	Reliability	Ease of Implementation	Potential Impacts of the Alternative	Time to Implement Alternative	Time to Achieve GPS at Compliance Points	Institutional Requirements	Overall Score	Screening Outcome
Source Control (Removal and/or Solidification & Stabilization)	The key component to any corrective measure is source control. This is accomplished by removal and/or Solidification & Stabilization (ISS) of the CCR waste from the (1) inactive Units 1 / 2 Impoundment, (2) the former Unit 3 A/B Impoundments, and (3) other areas such as PFAS source areas. This is one of the first corrective measure alternative implemented. Both removal and ISS may be used to meet the corrective action objectives at the Site. Solidification involves injecting a binding agent and water into the waste while mixing it together with a large auger driven by a crane. The binding agent is a cement-like substance that makes loose material stick together and form a block trapping the contaminants inside the block. Stabilization uses the same process only the agent causes a chemical reaction changing their form preventing them from migrating.	Removal of the waste removes the source of the CCR COCs and PFAS COCs from the environment preventing any future leaching into groundwater. Eliminating the source of CCR and PFAS COCs helps maximize the groundwater cleanup effectiveness of other measures such as E&T.	The removal or ISS of the source material is a key component to any successful corrective action. It is permanent and eliminates ongoing migration of CCR constituents from known sources. This alternative is not dependent on engineering and institutional controls to maintain the alternative, does not require replacement or maintenance of components of the alternative and has no operational reliability issues that may arise for the alternative that will limit its use or effectiveness in meeting corrective action objectives. Removal can eliminate PFAS from known sources, but ISS will not address the PFAS in groundwater.	Source control has a low degree of difficulty associated with its construction. Access to the areas is under the control of the city. Approvals and/or permits can be obtained for these activities. The construction equipment needed is common and locally available. There is available capacity at local disposal services. The excavation of source materials is straightforward and uses common construction equipment to eliminate the ongoing migration of contaminants and risk pathways. Source removal would likely require dewatering, water treatment for PFAS and CCR COCs, and potentially an NPDES permit for discharge or permit to discharge into a POTW. This alternative could include the installation of a hydraulic barrier like sheet piling in order to decrease the volume of water required to be managed. ISS uses mechanical mixing of agents such as cement. It uses common construction equipment to eliminate the ongoing migration of contaminants.	Potential impacts to the community or environment will be low. Access restrictions, dust suppression, erosion controls will be in place to minimize any potential impacts. Transportation routes for equipment, materials and waste will all be controlled and monitored. Removal and ISS can eliminate the potential ecological risk and human health risk pathways that potentially exist. Removal may modify the surface of Harbor Island and could result in faster cleanup at less cost. ISS will leave the CCR or solid waste in place as a cemented block preventing impacts to groundwater resulting in faster cleanup at less cost.	9 to 18 months The removal is straight forward and takes the least amount of time of all the alternative to complete. ISS is also straightforward and relatively quick to implement. The most significant time component for implementation is associated with permitting, such as discharge permitting from dewatering or wetland disturbance.	>30 years Removal of the sources will reduce the time to achieve GPS at compliance points, reduce the cost of other corrective actions and eliminate the direct contact risk pathway. Removal can be implemented concurrently with implementation of other alternatives addressing groundwater remediation. ISS will reduce the time to achieve GPS at compliance points for CCR, reduce the cost of other corrective actions and eliminate the direct contact risk pathway. ISS also eliminates the need for excavation and costly dewatering, further reducing the overall cost of corrective measures. ISS can also be implemented concurrently with implementation of other alternatives addressing groundwater remediation.	Fencing may be necessary, at least on a temporary basis during construction and possibly for the duration of corrective action in some areas. CCR removal in a delineated wetland would require wetland disturbance permits from EGLE, which can take a year or more.	19	Retained for further analysis. Not a stand-alone alternative.
	Evaluation Score (1-3):	3	3	3	3	3	2	2		

Table 11. Evaluation of Potential Remedial Alternative Measures

Corrective Measure Alternative	Description	Performance	Reliability	Ease of Implementation	Potential Impacts of the Alternative	Time to Implement Alternative	Time to Achieve GPS at Compliance Points	Institutional Requirements	Overall Score	Screening Outcome
Containment Wall (Interlocking Sealed Steel Sheet Pile and/or Slurry Wall)	Two types of containment walls are under consideration. Interlocking sealed steel sheet pile containment wall or slurry wall (Walls) will provide a barrier to impacted groundwater flow and prevent future off-site migration of dissolved COCs. These Walls will also provide a barrier to unimpacted surface and groundwater reducing the volume of water being treated by the E&T to achieve corrective action objectives within a reasonable period at lower cost. In general, a wall keyed into the top of the confining layer would be designed to provide containment and would be combined with groundwater extraction (E&T) for hydraulic control and treatment.	Hydraulic barriers remove Appendix IV constituents and PFAS from the environment through isolation provided by containment walls such as interlocking sealed steel sheet pile containment wall or slurry wall. These alternatives are a proven technology for groundwater cutoff and containment having the ability to achieve GPS for these constituents at point(s) of compliance when teamed with E&T and given the proper site conditions (i.e., site geology, depth to low permeability key-in layer). These favorable conditions exist at the Site.	Reliability of the containment wall is dependent on proper engineering. Institutional controls to maintain the alternative are not anticipated to be necessary. Wall maintenance is key to providing optimal performance and uninterrupted operation. This alternative has no operational reliability issues that may arise for the alternative that will limit its use or effectiveness in meeting corrective action objectives. Hydraulic containment will require E&T to manage groundwater mounding. Another benefit to the wall is the prevention of surface water from the river and unimpacted groundwater entering the groundwater capture area, becoming impacted, and requiring treatment. The interlocking sealed steel sheet pile containment wall and slurry walls both have provide performance records.	Containment walls have a low degree of difficulty associated with their construction. Access to the Site is under the control of the city. Approvals and/or permits can be obtained for these activities as needed. The construction equipment needed is common and locally available. The interlocking sealed steel sheet pile is the most versatile and easiest to implement of all the containment walls technologies. This type of wall can be constructed at the edge of the island or in the river and requires no excavation or hydraulic management. Slurry wall construction will require hydraulic control of groundwater and surface water infiltration. This is a routine activity with the potential to increase the cost because the Site is on an island.	Containment walls are intended to change groundwater flow patterns. However, there are no wells on the island for this change to effect. Wetland hydrology may be affected by changes in groundwater flow patterns.	12 -18 months Time to implement will depend on per-design investigation activities, modeling, and engineering as well as permitting and Agency approvals.	>30 years Remedy completion is dependent on implementing a combination of alternatives that work together to provide hydraulic control.	May require environmental permits for work in wetlands or river. Fencing will be necessary on a temporary bases during construction and possibly duration of remediation in some areas.	19	Retained for further analysis. Not stand-alone alternative
	Evaluation Score (1-3):	3	3	3	3	2	2	3		

Table 12. Checklist of Requirements Per 40 CFR §257.97(b)		
Corrective Measure Alternative	Remedy Selection Standards per 40 CFR §258.97(b)	Standards Met by Remedy? (Y/N)
CCR Source Control (Removal and/or Solidification and Stabilization)	Protective of human health and the environment	Y
	Attain groundwater protection standard(s)	Y
	Control the source(s) of releases to reduce or eliminate, to the maximum extent practicable	Y
	Removal of released constituents that may pose a threat to human health and the environment	Y
	Comply with standards for management of wastes as specified in 40 CFR 258.58(D)	Y
Hydraulic Containment and Treatment (Extraction and Treat (E&T))	Protective of human health and the environment	Y
	Attain groundwater protection standard(s)	Y
	Control the source(s) of releases to reduce or eliminate, to the maximum extent practicable	Y
	Removal of released constituents that may pose a threat to human health and the environment	Y
	Comply with standards for management of wastes as specified in 40 CFR 258.58(D)	Y
Containment Wall (Steel Sheet Pile Wall and/or Slurry Wall)	Protective of human health and the environment	Y
	Attain groundwater protection standard(s)	Y
	Control the source(s) of releases to reduce or eliminate, to the maximum extent practicable	Y
	Removal of released constituents that may pose a threat to human health and the environment	Y
	Comply with standards for management of wastes as specified in 40 CFR 258.58(D)	Y
Capping	Protective of human health and the environment	Y
	Attain groundwater protection standard(s)	Y
	Control the source(s) of releases to reduce or eliminate, to the maximum extent practicable	Y
	Removal of released constituents that may pose a threat to human health and the environment	Y
	Comply with standards for management of wastes as specified in 40 CFR 258.58(D)	Y

5.4 Remedial Investigation Needs

Collection of data to date has been for the Site investigation and characterization. Additional data and analysis may be required to perform a thorough Site-specific evaluation of the potential groundwater corrective measures prior to remedy selection. The measures described herein are included for consideration. In order to determine site-specific feasibility of these alternatives, remedial investigation data will be collected. Priority will be given to fill data gaps for the recommended corrective measure alternatives to support remedy selection. Below is a summary of additional data needs that have been identified to date. The anticipated timelines provided may be impacted by available funding and approvals. A summary of the anticipated timeline to conduct the remedial investigation needs is provided in **Table 13**.

Potential Ash Characterization and Ash Delineation

As noted in **Section 4.2.1**, the characterization of the ash within Units 1/2 Impoundment was limited. Analysis of additional ash samples may be needed to develop remedial alternatives. Samples may be collected and analyzed for leachate and sediment properties by a contracted laboratory. Sample volume will also be provided to contractors for bench testing for design of ISS methods. The anticipated timeline of this task is 4th quarter 2024.

Facility Evaluation for Potential CCRMU

As discussed above, the boundaries of the Units 1/2 Impoundment were unclear and potentially could include parts of the North Channel. Recently, in a July 12, 2024 email, EGLE and EPA determined that the former north outlet channel would not be considered part of the Units 1/2 Impoundment, and would not be considered a release from the Units 1/2 Impoundment. This area will be evaluated under the new the CCR Legacy Rule, and that is anticipated to be conducted 4th quarter 2024.

Aquifer Testing

Additional slug testing was completed in the 3rd quarter of 2024, however the analysis is incomplete and further analysis is anticipated for late 3rd quarter 2024. In order to design an efficient aquifer pump test, slug test data is required. A pump test will be implemented to collect hydrogeologic data to evaluate the feasibility of groundwater extraction at the Site and later to support design of a groundwater extraction and treatment (GWET) system. Initial information needed to support design of a GWET system includes determining sustainable yield, determining potential capture zone for extraction wells, and obtaining additional aquifer characterization data. The anticipated timeline for this task is 2nd quarter 2025.

Subsurface Utility Exploration

A survey will be conducted to locate subsurface utilities that may provide preferential pathways for migration of impacted groundwater. The anticipated timeline for this task is the 4th quarter 2024.

Expansion of the Monitoring Well Network

As noted in **Section 4.3**, the GPS exceedances to date indicate that further expansion of the monitoring well network may be necessary in few locations to further delineate and refine the plume location, including the following areas:

- MW-39 and MW-13 will be added as nature and extent wells for Unit 3A/B Impoundments; and
- North of MW-10 for Units 1/2 Impoundment and Unit 3A/B Impoundments.
- The area around MW-07 and MW-08 may need further investigation to determine the source and extent of CCR COCs.

The existing well locations of MW-13 and MW-39 will be sampled during the 4th quarter assessment monitoring event. Monitoring wells deemed necessary to refine the CCR contaminant plumes will be installed in the 1st quarter 2025. This work will be completed as additional data is gathered for remedy selection.

Further Delineation of CCR Source Materials

Due to the distribution of groundwater concentrations exceeding GPS, further delineation of source material is required to ensure all potential source areas are addressed prior to selecting a remedial option. The anticipated timeline of this task is 1st quarter 2025.

Nested Monitoring Wells

Since the existing monitoring wells are screened at shallow depths, little is known about the properties of the deep aquifer. The following objectives will be addressed as part of the deep well installation:

- During drilling, soil samples will be collected for containment wall bench testing. Analysis of these samples will include permeability, porosity, and hydraulic conductivity conducted by a subcontracted lab.
- The borehole will be advanced through the shallow aquifer into the anticipated confining unit. Samples of the confining unit material will be retained for permeability, porosity and grain size analysis testing by a subcontracted laboratory for use in development of groundwater modeling.
- At least two monitoring wells will be screened deep within the aquifer and above the confining unit to monitor groundwater flow beneath the Island.
- One monitoring well will be screened within the confining unit to assess the groundwater flow within the suspected confining unit.
- Deep monitoring wells will be paired with existing shallow monitoring wells to evaluate the horizontal hydraulic gradient.

The anticipated timeline for the task above is 1st quarter 2025.

Sediment Bench Testing

Bench testing of onsite sediment will be conducted to evaluate in-situ stabilization agents, to inform CCR and PFAS treatment methods, and selection of slurry wall materials. The anticipated timeline to collect material and submit for bench testing is 2nd quarter 2025.

Potential PFAS Delineation

Further delineation of PFAS is anticipated to ensure the selected remedy addresses the areas of potential PFAS contamination. The anticipated timeline for this task is 2nd quarter 2025.

Wetland Function Assessment

Delineation of wetlands on the Island was completed in the 2nd quarter 2024, however additional data may be required to better understand the function of the wetland as a potential contaminant sink, area of surface water infiltration, and understanding the needs and requirements for removal and rehabilitation. The anticipated timeline of this task is 2nd quarter 2025.

Topographical, Light Detecting and Ranging (LiDAR), and Bathymetric Survey

Survey data is required to determine the following:

- Surface configuration of the Island.
- The location and volume of clean fill material.
- Estimate the land surface for designing potential remedial alternative measures.
- The size and depth of each internal water body and wetland as well as depths for the northern wetland, Grand River, and south channel.

The anticipated timeline for this task is 2nd quarter 2025.

Groundwater Model

Due to the heterogeneous nature of the lithology encountered, and the variable flow observed, a groundwater model will be necessary to efficiently design remedial alternatives. The data collection tasks above will be utilized for the refinement of this model. The anticipated timeline of this task is 3rd quarter 2025.

Table 13. Additional Data Need Anticipated Timeline

Data Collection Task	Initiated*
Potential Ash Characterization and Ash Delineation	4th quarter 2024
Facility Evaluation for Potential CCRMU	4th quarter 2024
Aquifer Testing	Pump Test: 4th quarter 2024 Slug Tests: performed in 2nd quarter 2024
Subsurface Utility Exploration	4th quarter 2024
Expansion of Monitoring Well Network	1st quarter 2025
Further Delineation of Source Materials	1st quarter 2025
Nested Monitoring Wells	1st quarter 2025
Sediment Bench Testing	2nd quarter 2025
Potential PFAS Delineation	2nd quarter 2025
Wetland Function Assessment	Initial delineation done in 2nd quarter 2024. Follow on studies to be performed in 2nd quarter 2025.
Topographical, Light Detecting and Ranging (LiDAR), and Bathymetric Survey	2nd quarter 2025
Groundwater Model	3rd quarter 2025

*Dates may be impacted by available funding and city council & GHBLP approvals

5.5 Estimated Schedule

The general conceptual schedule for evaluating additional information to support remedy selection is provided below in **Table 14**. Note, the estimated completion dates may change due to regulatory approvals or unexpected circumstances.

Table 14. Estimated Schedule of Remedy Selection

Action	Estimated Completion Date
Collecting data to fill data gaps	3rd quarter 2025
Remedial Action Plan	4th quarter 2026
Closure Plans and Closure Work Plans for Units 1/2 Impoundment and Unit 3A/B Impoundment.	3rd quarter 2027
Submit Remedy Selection Report	2nd quarter 2027
Additional Data Collection required for Remediation Conceptual Design	2025 - 2026
Evaluation of Remediation Alternatives	2025 -2026
Public Meeting of Remediation Alternatives	30 Days before Remedy Selection
Remedy Selection Report and Remedial Action Plan	2026
Closure Plan – Units 1/2 Impoundment	2026
Closure Plan – Unit 3A/B Impoundments	2026
Remediation Final Design and Remedy Implementation	2026 +

6.0 Next Steps

To select a groundwater remedy, additional data collection and analyses are required to understand COC concentrations and potential onsite and offsite human and ecological receptors. It was determined that the risk from exposure associated with private wells is considered extremely low because there are no drinking water wells on the Island and off-site wells were not in use for drinking water or they are a great distance from the Site. During additional off-site investigation sampling may need to be conducted to confirm the extent of plume stops at the river. Monitoring well installation is scheduled for the second half of 2024 and collection of additional data needs identified for the corrective measure alternatives is being carried forward. Updates will be provided in semi-annual remedy selection progress reports. EGLE and EPA will select a remedy that meets the performance standards listed in 40 CFR §257.97(b) and the evaluation factors listed in 40 CFR §257.97(c) along with applicable provisions of Part 115.

The anticipated schedule and process for remedy selection is as follows, however, this may be impacted by the CCRMU Rule implementation:

- Public meeting pursuant to 40 CFR §257.96(e) and Michigan Administrative Code R 299.4443(4) will be held at least 30 days prior to remedy selection.
- Publish a Remedy Selection Report (RSR). The RSR will include a schedule for final design and how the remedy will be implemented.

- Preparation of a proposed Remedial Action Plan in compliance with R 299.4319(7) of the Part 115 Rules and in compliance with the provisions of Part 201.
- Begin the remedy implementation within 90 days of Remedy Selection Report.
- Once selected, the remedy will be designed, implemented, and continually evaluated in accordance with the adaptive management strategy. Based on evaluation during the phased implementation, additional site characterization needs may be identified, and remedy implementation adjustments will be made as necessary, leading to continuous improvement and optimal remedy performance.

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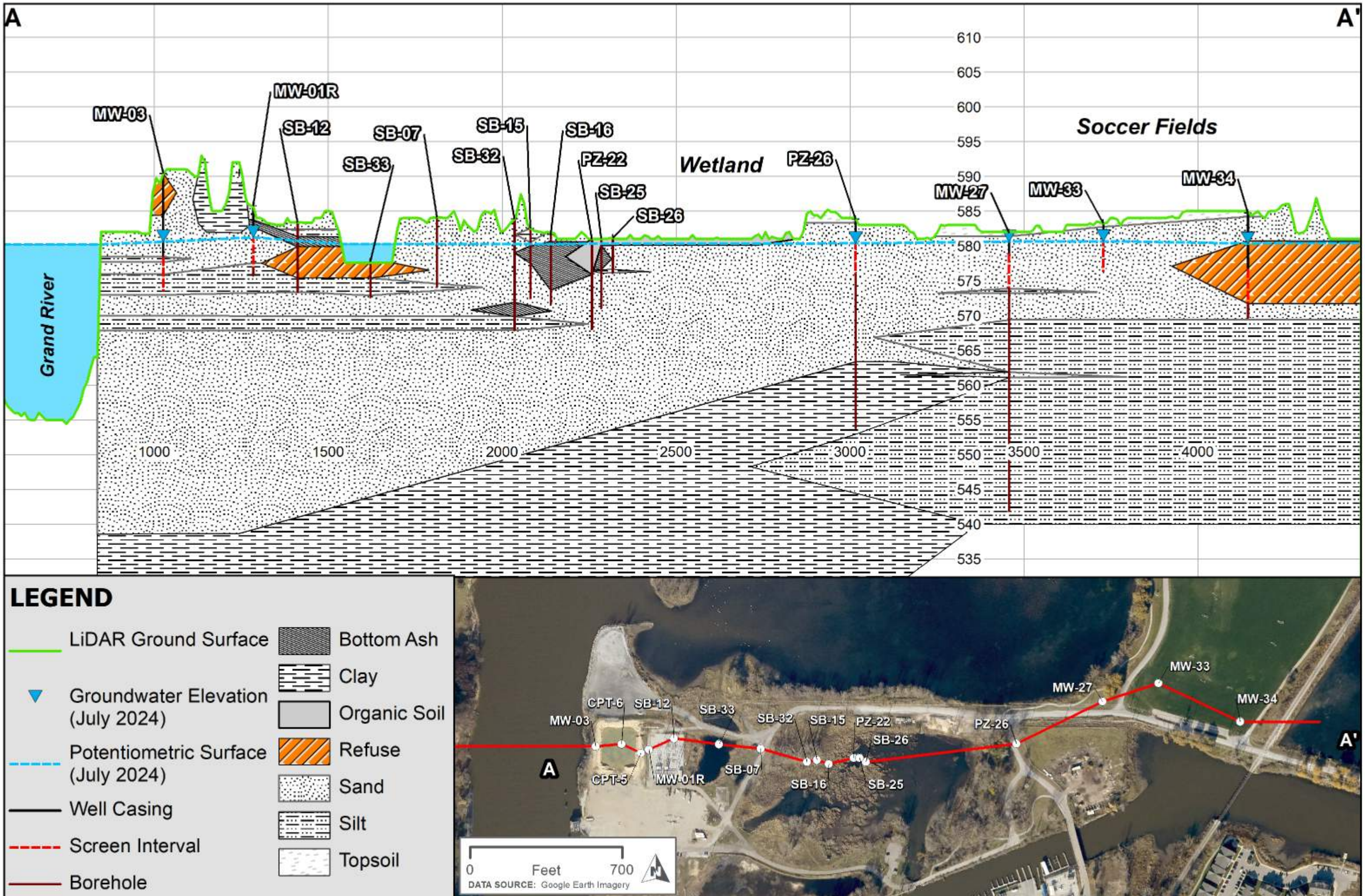
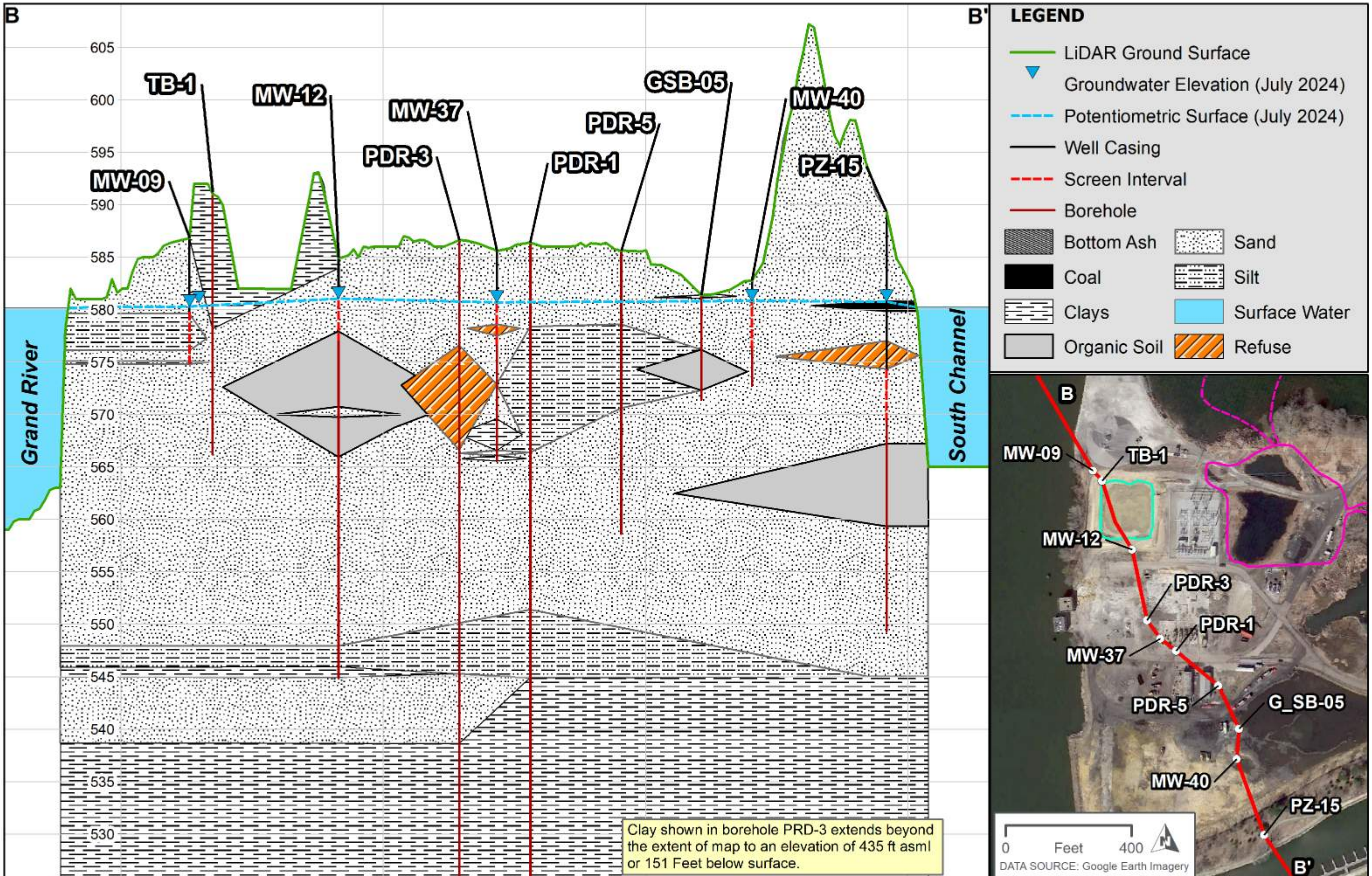
Appendix A

Geologic Cross Sections



FORMER J.B. SIMS GENERATING STATION

GRAND HAVEN, MI



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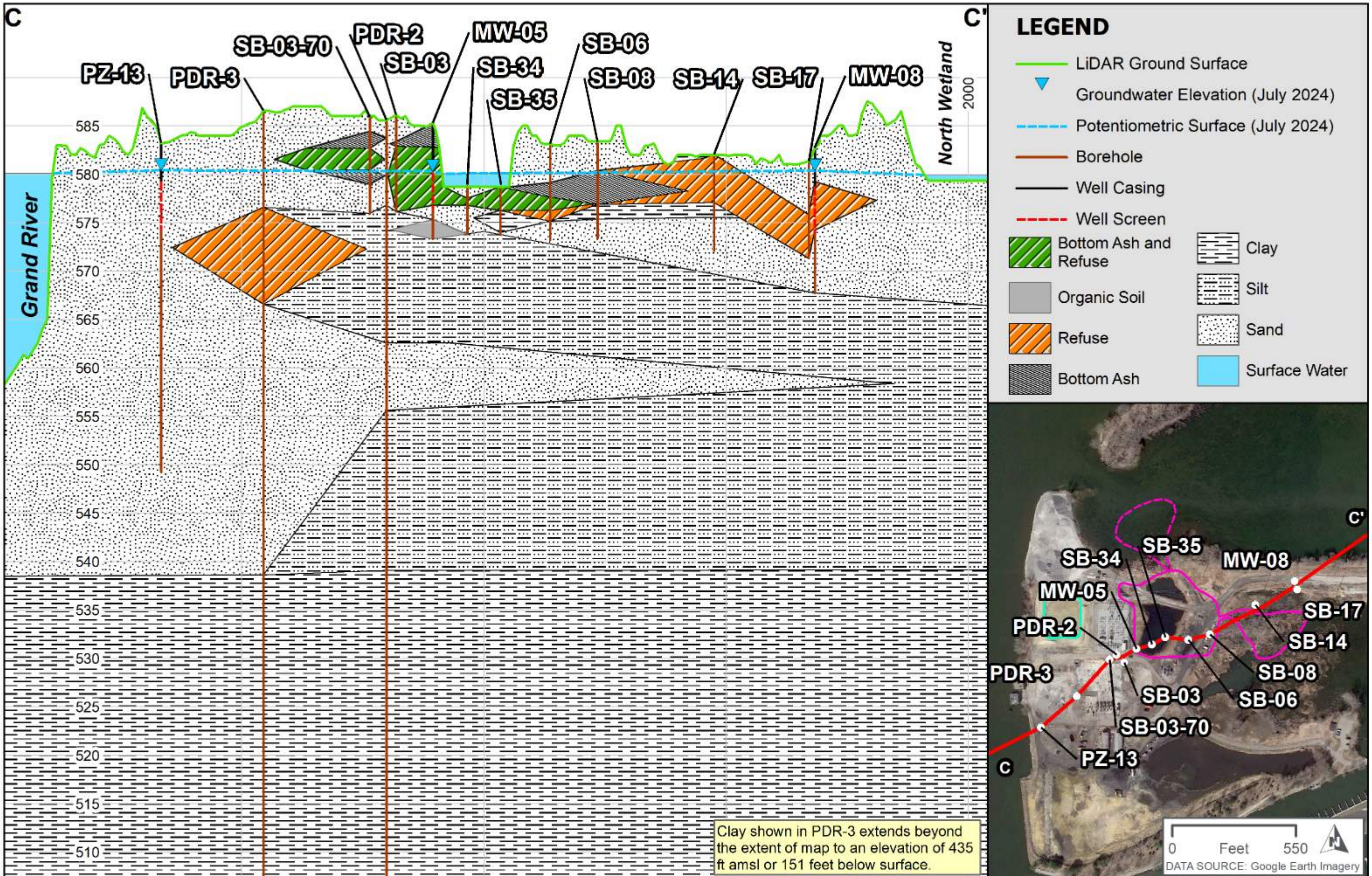

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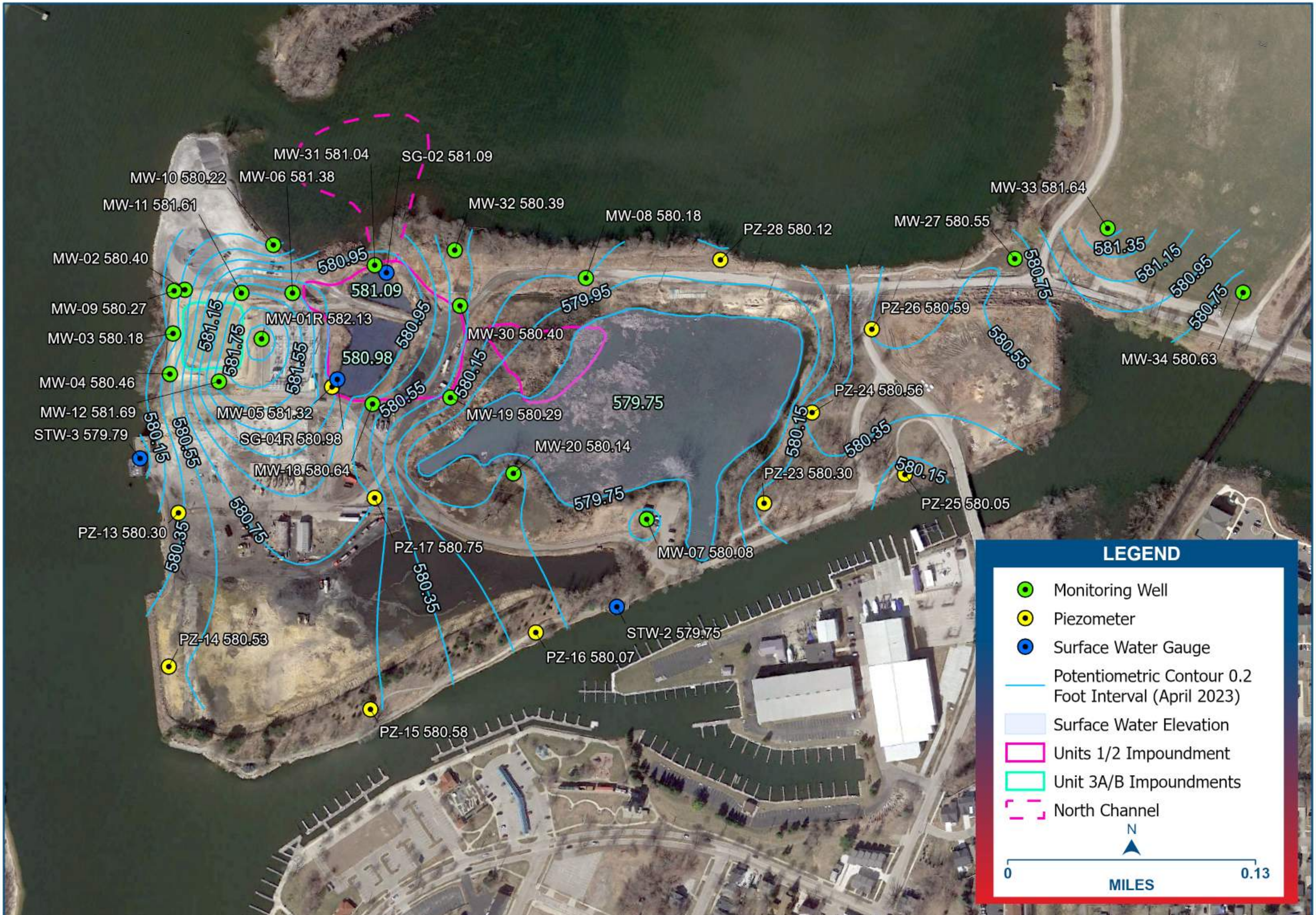
Appendix B

Potentiometric Contour Maps



Renew Harbor Island

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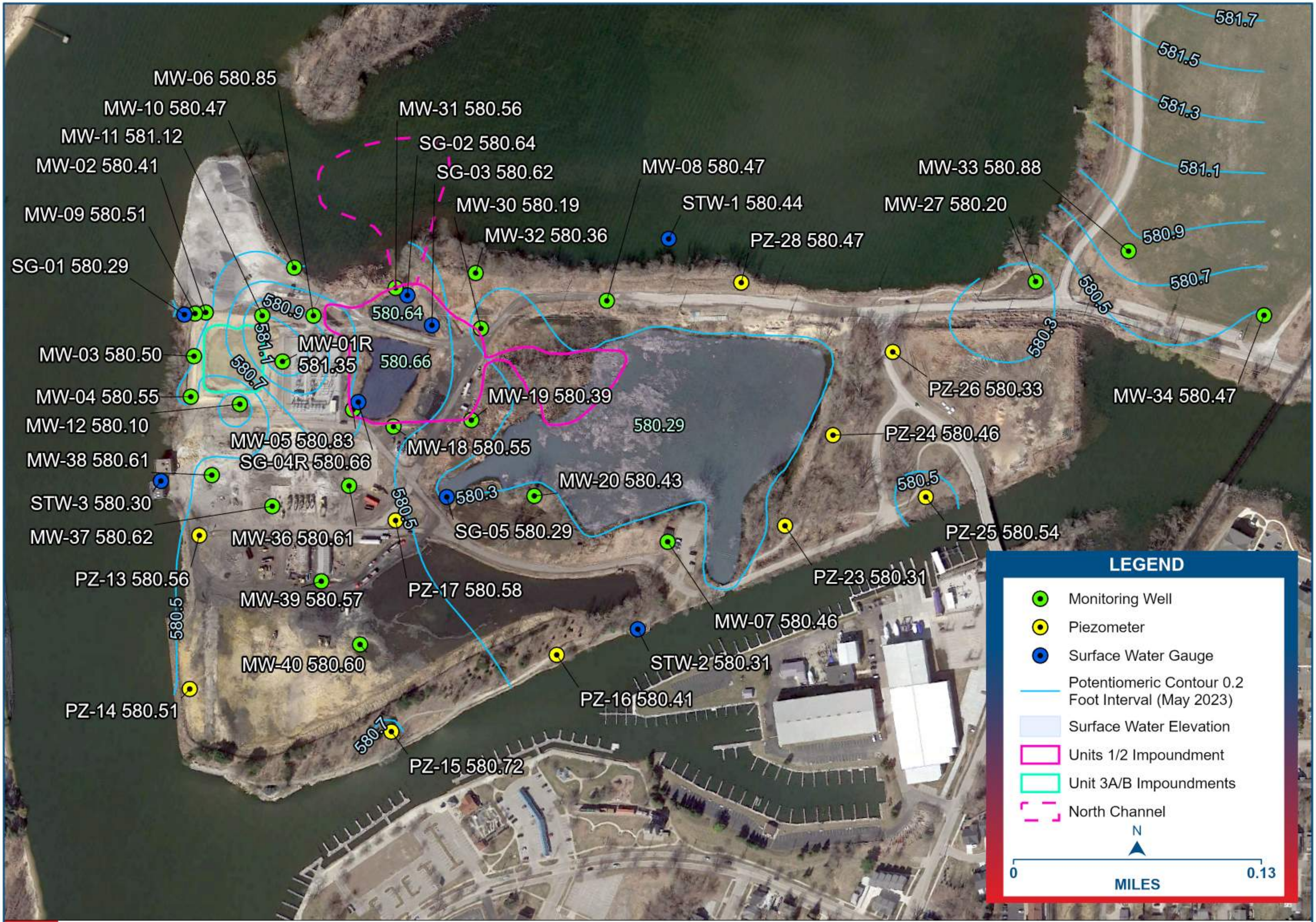
CITY OF GRAND HAVEN



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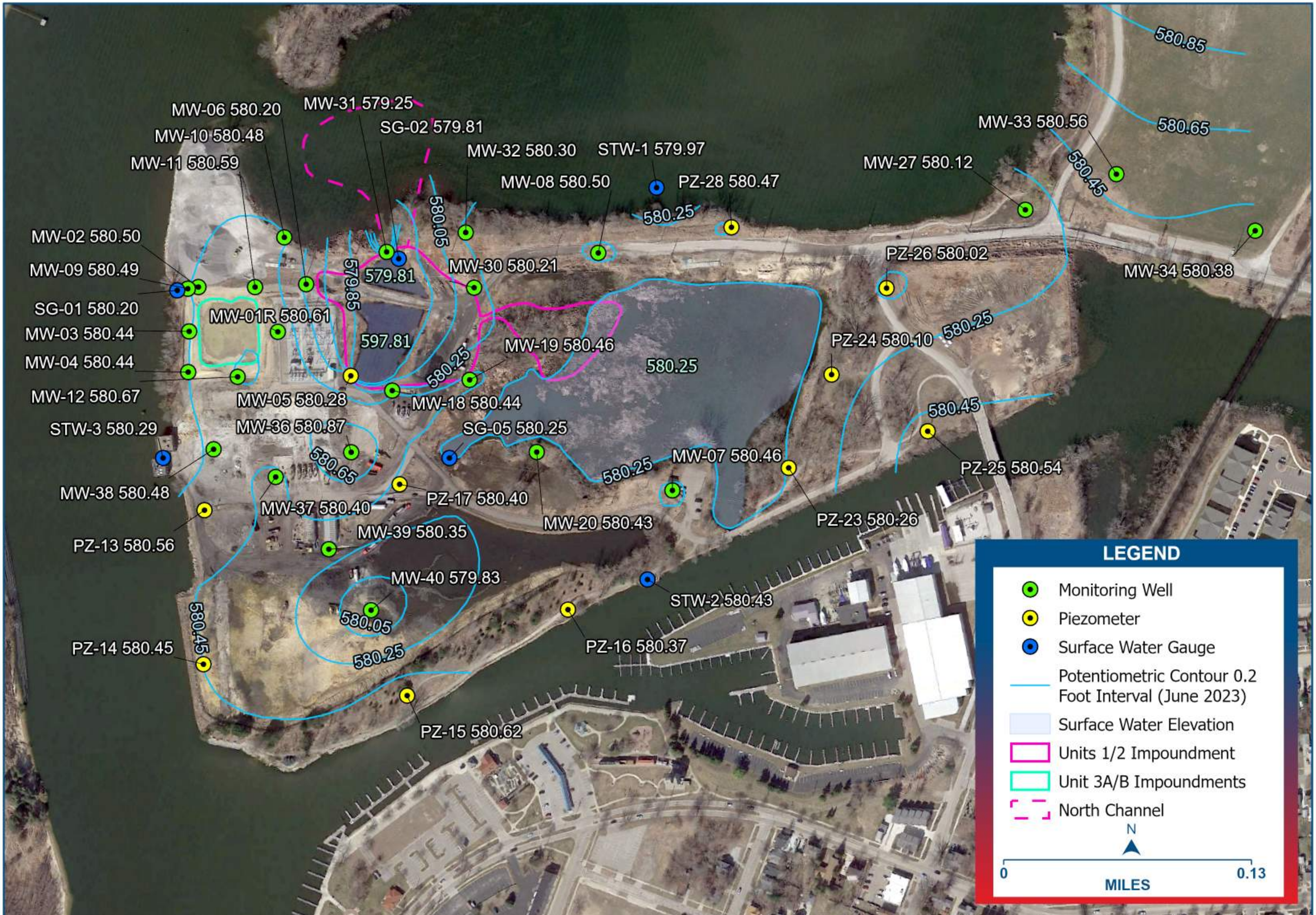

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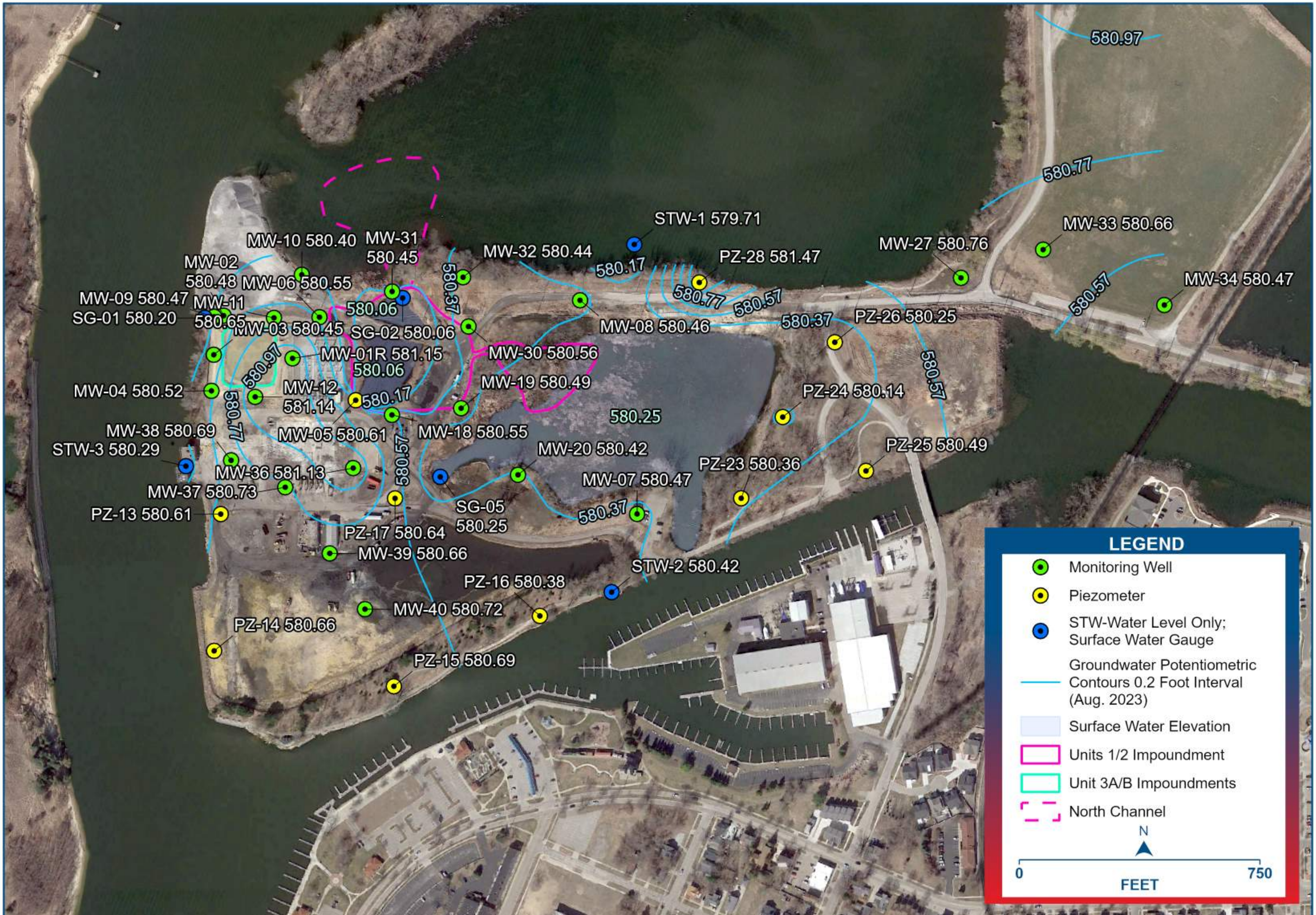

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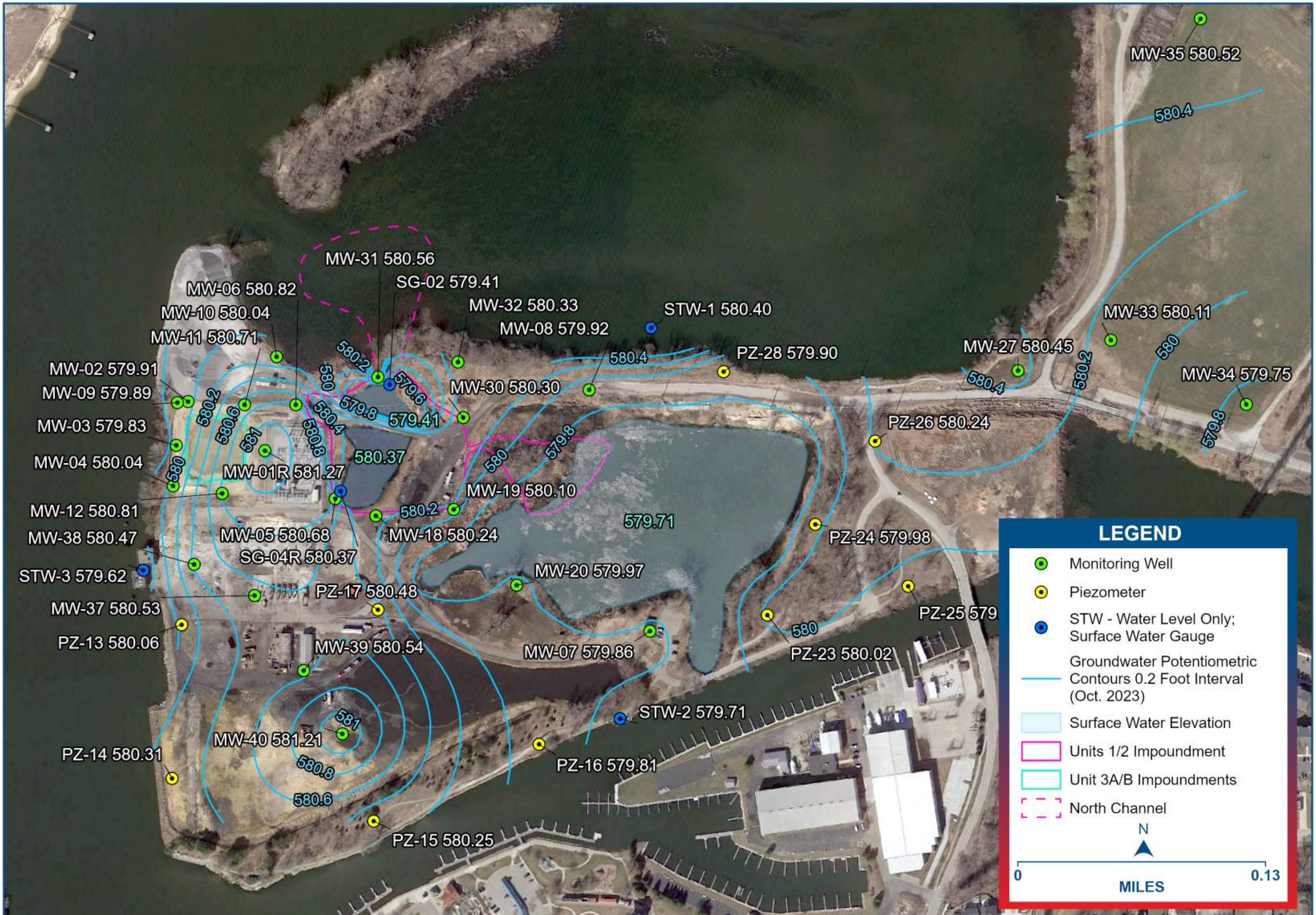

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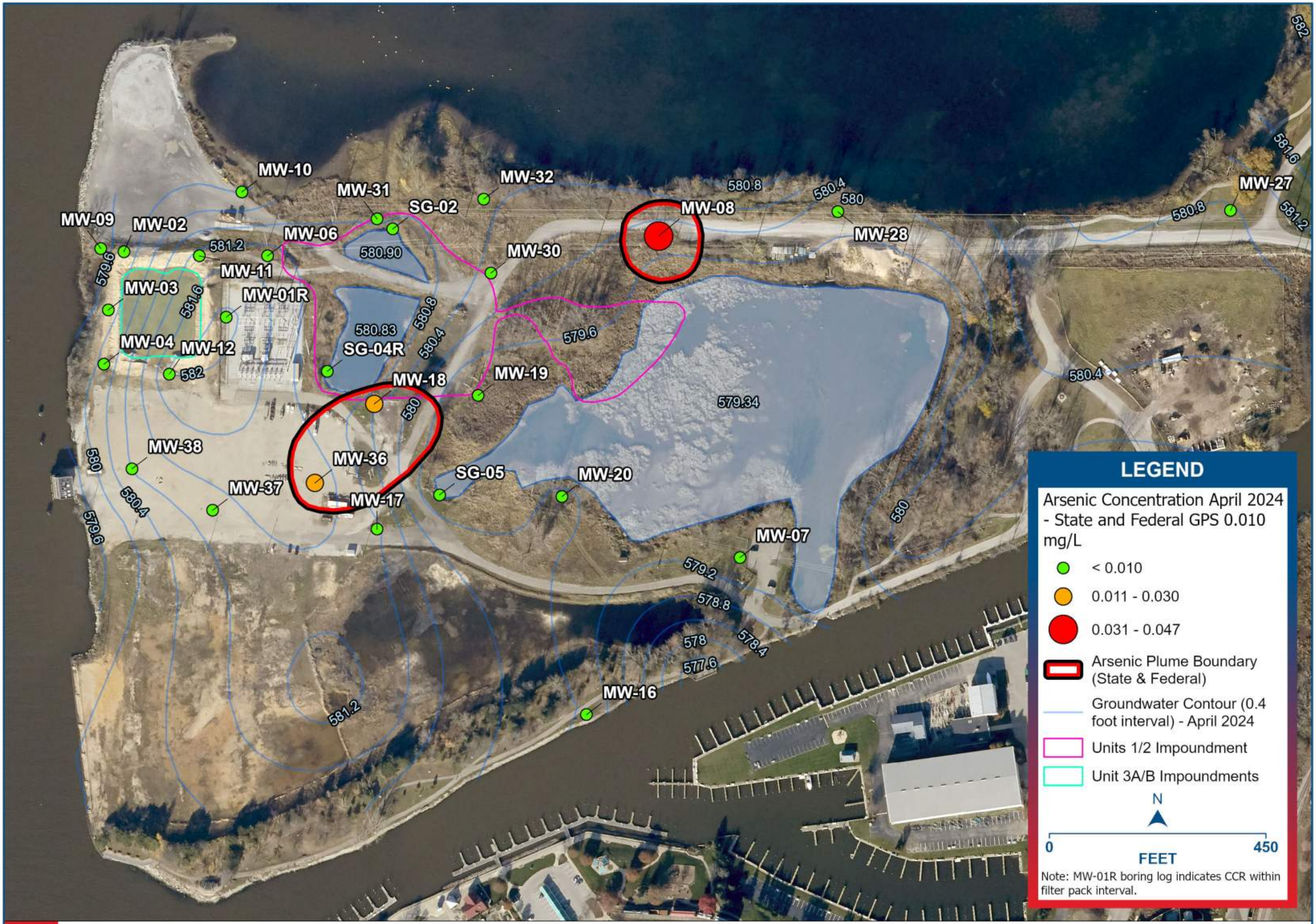
Appendix C

CCR Constituents of Concern GPS Exceedance Maps



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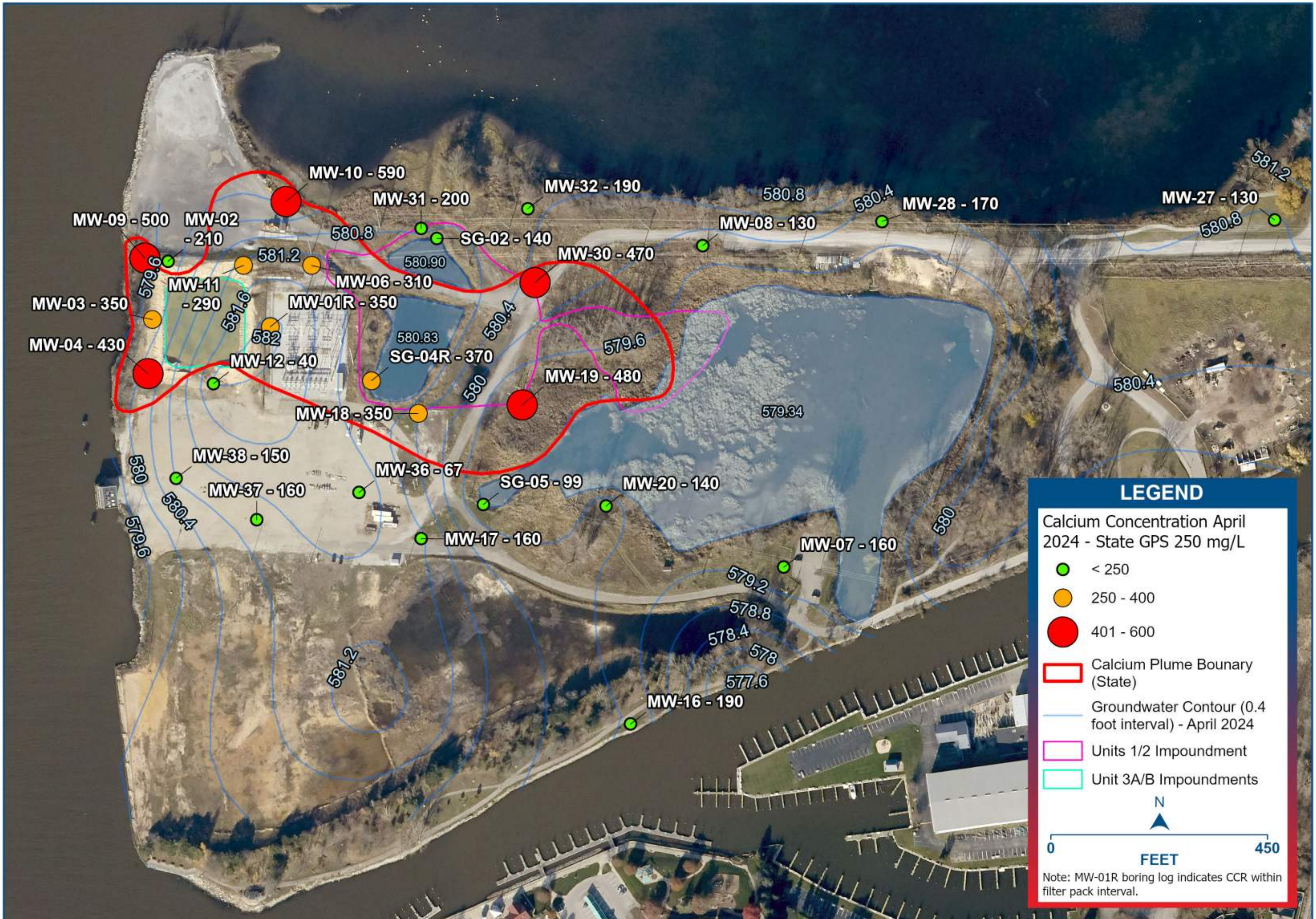

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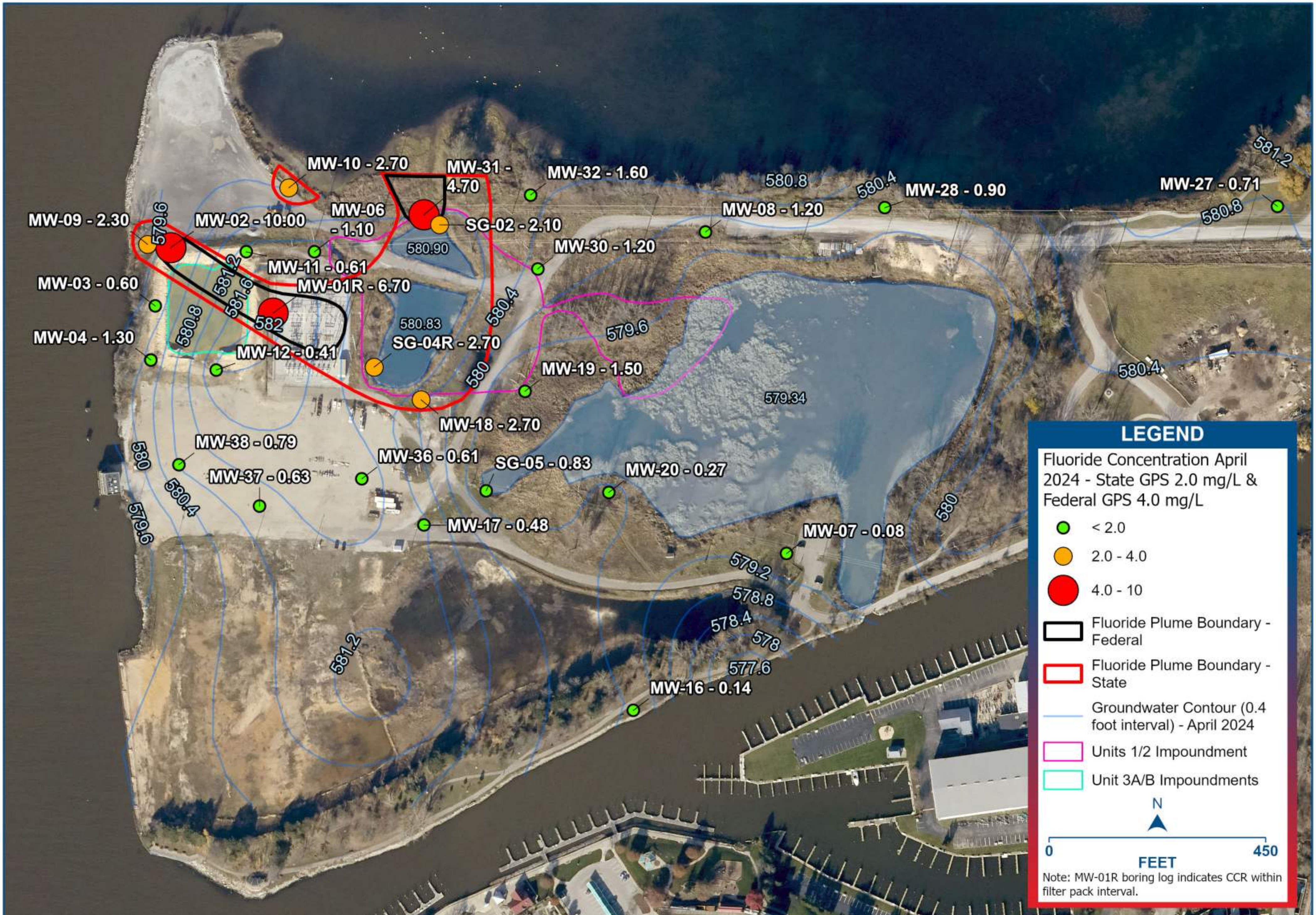

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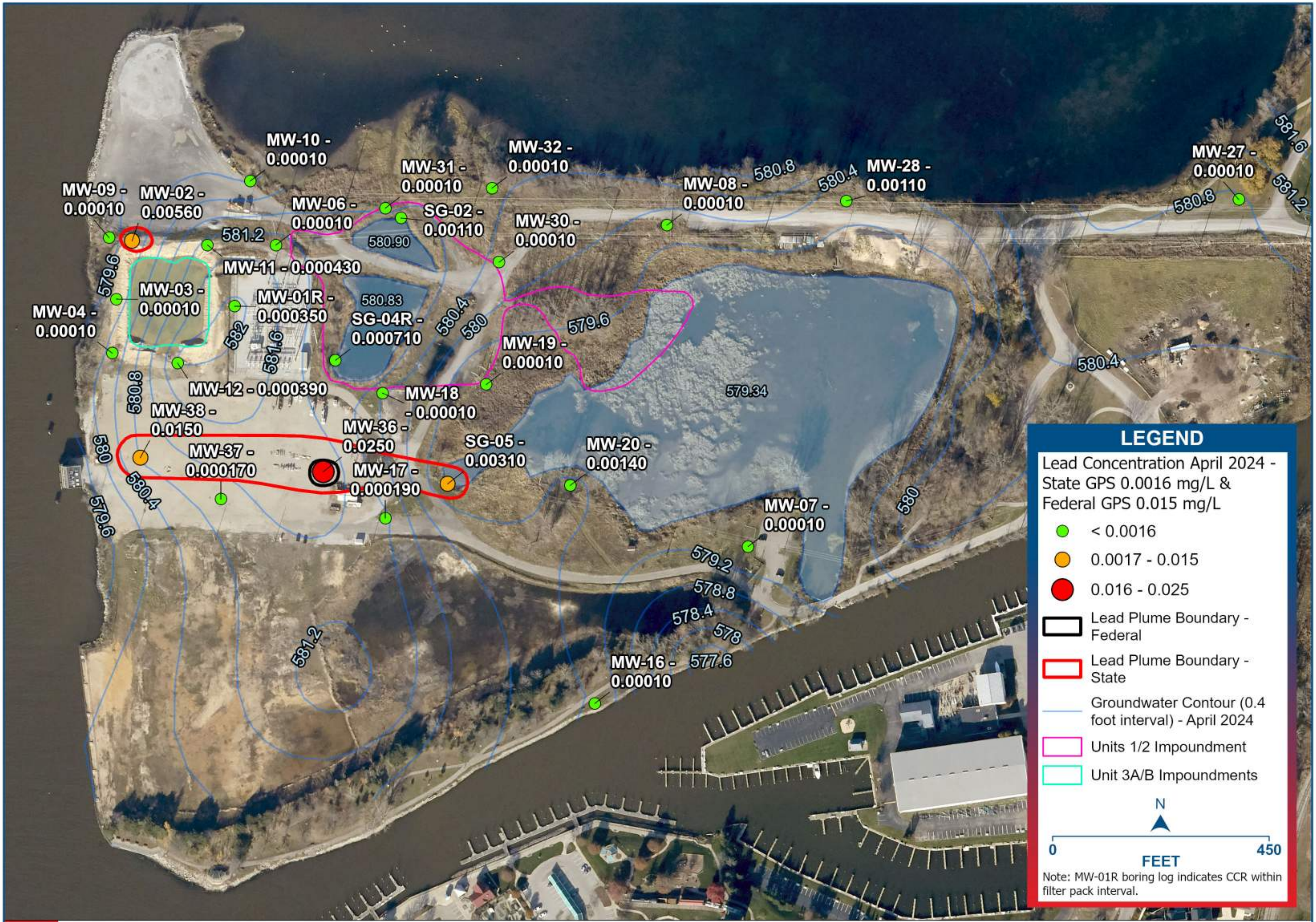

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FORMER J.B. SIMS GENERATING STATION

CITY OF GRAND HAVEN

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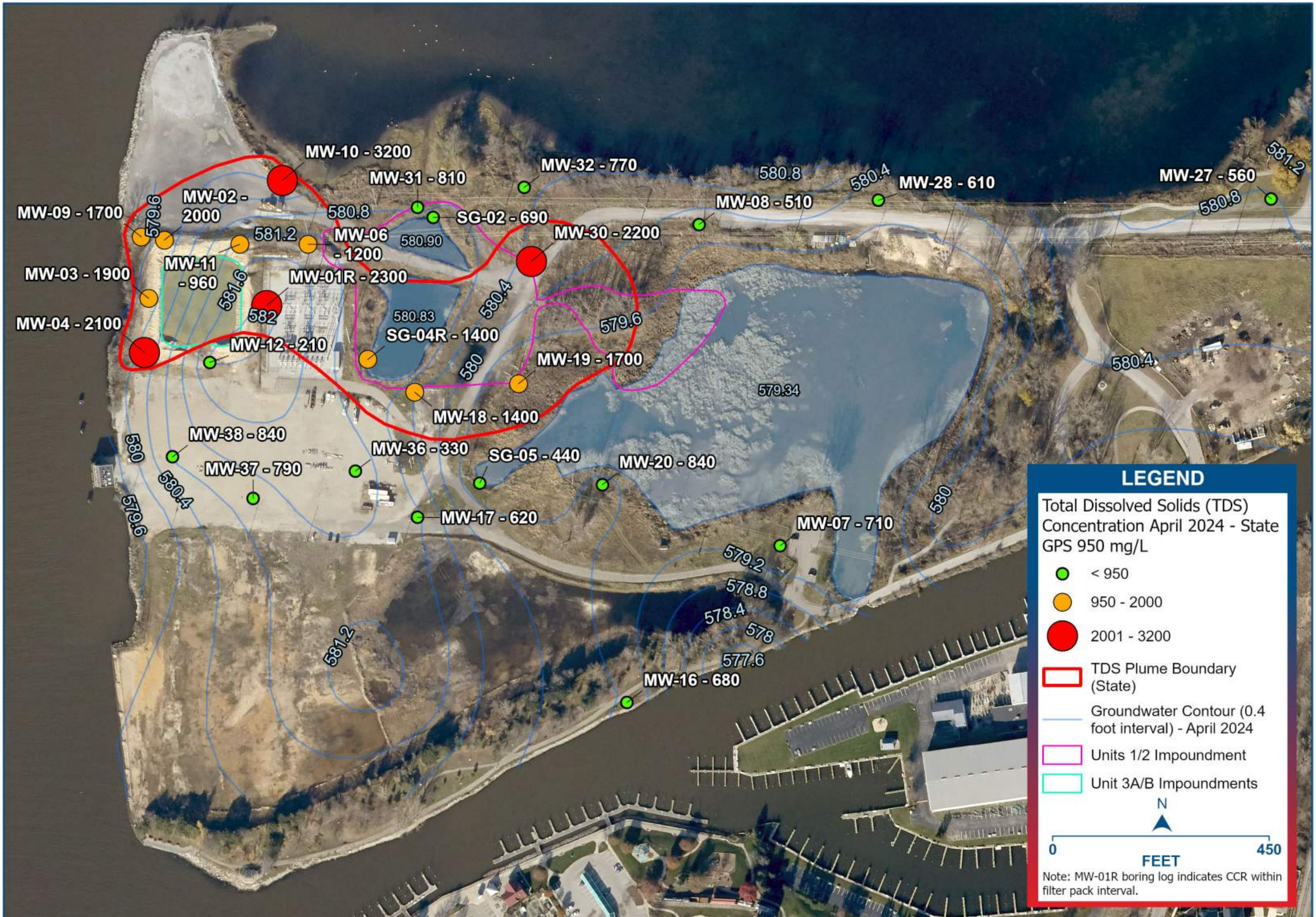

Renew Harbor Island

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CITY OF GRAND HAVEN

Appendix D

PFAS Concentration Maps

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Imagery provided by google

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Imagery provided by google