Memo

Date: Monday, July 31, 2023

To: Lansing Board of Water & Light

From: HDR Michigan, Inc.

Subject: Erickson Power Station Semiannual Progress Report for Selection of Remedy per 40 CFR §257.97(a)

Erickson Power Station (Erickson or Site) is an electrical power generation facility located at 3725 South Canal Road in Delta Township, Eaton County, Michigan owned and operated by Lansing Board of Water & Light (BWL) (**Figure 1**). Erickson formerly operated a single coal-fired generator capable of producing 165 megawatts of electricity. Erickson has three CCR impoundments that are subject to the U.S. Environmental Protection Agency's (EPA's) Coal Combustion Residuals (CCR) Rule specified in 40 CFR §257: the Forebay, Retention Basin, and Clear Water Pond (CWP) (**Figure 2**). The CCR impoundments triggered assessment of corrective measures and therefore are the subject of this remedy selection semiannual progress report.

In accordance with the CCR Rule, BWL initiated groundwater monitoring in the certified network around the CCR units in 2020. On November 23, 2020, BWL first reported that concentrations of Appendix IV constituents in monitoring wells at the ash impoundments were observed at statistically significant levels (SSLs) above Groundwater Protection Standards (GPS) (HDR, 2020). Subsequently, BWL drilled additional wells, completed additional hydrogeologic investigation, and completed the *Conceptual Site Model and Assessment of Corrective Measures* Report (ACM Report) on November 25, 2021 and posted to BWL's public website (HDR, 2021). Since the ACM Report, a phased program has been implemented to support remedy selection, primarily through plume delineation and aquifer characterization, and progress updates have been made on a semiannual basis.

The purpose of this Memo is to provide an update describing progress in the first half of 2023 toward selecting a remedy for corrective action, as required by 40 CFR §257.97(a) of the CCR Rule.

BWL completed numerous tasks in the first half of 2023 to close the impoundments by performing dewatering and ash removal and further characterize the impact to groundwater to further the assessment of corrective measures. Between January and June 2023, BWL completed the following tasks:

- Approval of the Closure Work Plan for the CCR surface impoundments at Erickson;
- Additional ash sampling and analysis was completed, and a Closure Work Plan Amendment was submitted to the Michigan Department of Environment, Great Lakes, and Energy (EGLE) on May 2, 2023 that included the ash analytical data as well as the microscopy verification thresholds.
- Phase II of Soil Background Study - background soil sampling and analysis (site-specific background soil study) was performed, as well as statistics for soil background values, and the revised Soil Background Report was submitted to EGLE on April 25, 2023 that will be used during verification of ash removal from the CCR impoundments;
- CCR impoundments dewatering and ash removal;
- Installation of ten monitoring wells in 2023 to evaluate the plume extents horizontally and vertically;
- Sampling and analysis of isotopes in groundwater and ash to evaluate if isotopes could help distinguish naturally occurring boron from boron in ash impacted groundwater;
- Semiannual assessment monitoring sampling and analysis; and
- Updates to the groundwater flow and transport model.

Impoundment Closure Status - Source Removal

The CCR Impoundments Closure Work Plan for removal of CCR was completed in April 2022 and approved by EGLE on January 17, 2023, with the intent to later submit an amendment associated with the closure verification objectives or thresholds. Additional ash sampling and analysis was performed, and a Closure Work Plan Amendment was submitted to EGLE on May 2, 2023. The Closure Work Plan Amendment further detailed closure objectives and included the ash analytical data as well as the microscopy verification thresholds. Nine ash samples (three each from the Forebay, Retention Basin, and CWP) were collected and submitted for analysis. The microscopy verification thresholds were determined based on a ratio of CCR to native material that would reduce the expected concentration of the constituent to less than that of the established cleanup criteria.

BWL performed a site-specific background soil study as part of the development of the Closure Work Plan, approved by EGLE on January 17, 2023. Also conditional to this approval was the expansion of the Soil Background Study. BWL performed additional background soil sampling, analysis, and statistics to refine the established-site specific soil background values, and a revised Soil Background Study was submitted to EGLE on April 25, 2023. EGLE returned comments to BWL regarding the Soil Background Study and the Closure Work Plan Amendment on June 28, 2023.

A CCR removal contractor was selected and mobilized to the site in February 2023 to begin dewatering operations from the three impoundments. The water removed from the ponds was treated on site, monitored, and discharged into nearby Lake Delta in compliance with an NPDES permit. Dewatering efforts were completed in May 2023 and ash and liner material removal commenced, with the material being transported to Granger Wood Street Landfill. Through mid-July 2023, approximately 54,200 cubic yards of material (ash, liner, and CCR impacted riprap) have been removed and disposed of offsite from the three impoundments. Closure verification efforts for the Forebay, Retention Basin, and CWP have also been initiated.

HDR previously performed stability and seepage analyses at two selected cross-sections along the embankment of the Retention Basin and Clear Water Pond. The results of the previous analyses determined that the factor of safety for seepage was not adequate for the Retention Basin embankment. HDR subsequently installed two piezometers, RBPZ-1 and RBPZ-2 to further refine the seepage analysis. Data obtained indicates that at the Retention Basin, the upward gradient and heave potential at the toe of the embankment meet the minimum required factor of safety, and additional work to stabilize the embankment was not necessary. Further monitoring of the groundwater levels in the piezometers will continue through the duration of the project as well as daily monitoring of the embankments adjacent to Lake Delta.

Nature and Extent Characterization Progress

In 2020, BWL determined there were statically significant levels of lithium in groundwater over groundwater protection standards (GPS). In response, BWL completed an Assessment of Corrective Measures (ACM) in November 2021. In addition, BWL installed wells in 2021 to evaluate the nature and extent of the GPS exceedances and initiated a groundwater flow and transport model to serve as a predictive evaluation tool and to model corrective measure scenarios for the selection of a remedy. In 2022, BWL installed seven new monitoring wells at the site. Each of the monitoring wells served a specific purpose to further characterize groundwater flow direction in both the glacial and bedrock aquifer, evaluate potential connectivity between the glacial and bedrock aquifers, and evaluate background water quality for both the glacial and bedrock aquifers. These wells also allowed for the expansion of the hydrogeologic conceptual site model to include the bedrock aquifer, and further delineate the GPS exceedances.

BWL has been working with adjacent and nearby landowners requesting agreements to install monitoring wells. Several of these have been turned down by landowners, and have necessitated multiple points of contact, taking time. Meanwhile BWL has been working on “work-arounds” to the extent practical, including wells on narrow BWL-owned strip of land and submitting wetland permit applications for wells proposed to be located in the wetlands near the property boundary. Ten new wells were installed in 2023 for assessment and characterization of the groundwater plume at Erickson to the north, east, and south of the CCR impoundments. In the first half of 2023, BWL installed wells (MW-14, MW-15, MW-16A, MW-16B, MW-16C, MW-16D, MW-100A, MW-100B, MW-100C, and MW-100D) at the site and at adjacent properties to the southeast to further delineate the horizontal and vertical boundaries of the groundwater plume (**Figure 2**). Well MW-14 and MW-15 were installed on January 9, 2023. Wells MW-16A, MW-16B, MW-16C, and MW-16D were installed on January 25, 2023. Wells MW-100A, MW-100B, MW-100C, and MW-100D were installed on May 15, 2023. Well MW-14 was installed immediately east of the CWP to further characterize impacts originating from the CWP. To further delineate the northern extents of the exceedances in groundwater, MW-15 was installed north of MW-3. Similarly, the well series (ABCD) at MW-16 and MW-100 were installed to the east and south, respectively to further delineate the eastern and southern extents of the plume. Additional details regarding the construction of these wells can be found in **Table 1** below.

Table 1. Construction Details for Wells Installed between January and June, 2023

Well	Screen Elevation	Aquifer	Screen Lithology
MW-14	857-867	Glacial	Sand and sandy lean clay
MW-15	862-872	Glacial	Sandy lean clay, sand, and silt
MW-16A	857-867	Glacial	Lean clay with sand
MW-16B	835-845	Glacial	Silt
MW-16C	811-821	Bedrock	Shale (40%) and sandstone (60%)
MW-16D	752-762	Bedrock	Shale (100%)
MW-100A	845-855	Glacial	Clayey sand and sandy silt
MW-100B	829-839	Glacial	Silt with sand and clayey sand
MW-100C	814-824	Bedrock	Shale (90%) and sandstone (10%)
MW-100D	756-766	Bedrock	Shale (100%)

Groundwater data from these new wells currently suggest that the plume is contained within the boundaries of these newly installed wells. Background monitoring at the ten new monitoring wells indicated no GPS exceedances have been observed at the MW-16 series nor MW-100 series glacial wells, and no GPS exceedances have been observed at the MW-16 nor MW-100 bedrock wells. To the north, well MW-15 had no exceedances of GPS. In addition, BWL has proposed two sets of multi-level wells at the wetland area located at the east side of the property boundary. These wells require permitting due to protected wetland status, which has been ongoing throughout the first half of 2023. Currently, eight new wells have been proposed and are anticipated be installed in the second half of 2023, pending permitting:

- MW-17A, MW-17B, MW-17C, and MW-17D will be installed to the north of MW-7 to confirm groundwater flow directions and delineate the northern extents of the plume in the glacial and bedrock aquifers. Access limitations are currently being designed and a permit to access and construct in the protected wetland is in progress.
- MW-18A, MW-18B, MW-18C, and MW-18D will be installed to the east of MW-7 to confirm groundwater flow directions and delineate the eastern extents of the plume in the glacial and bedrock aquifers. Access limitations are currently being designed and a permit to access and construct in the protected wetland is in progress.

Groundwater Model Update

The groundwater and contaminant transport modeling objectives are to simulate the rate of movement, the contaminant delineation, and the potential offsite migration of COCs within the local groundwater system. The modeled plume has helped to site appropriate drilling locations for the proposed additional plume characterization monitoring wells that are in landowner negotiations. In the first half of 2023 the groundwater flow and transport model was calibrated for the five COCs at the site: boron, lithium, calcium, molybdenum, and sulfate.

Ash and Groundwater Sampling for Isotope Study

In March 2023, BWL collected samples of ash leachate from the Forebay and CWP CCR impoundments and groundwater from locations that are known to be impacted and unimpacted by CCR and analyzed isotopic ratios to evaluate if there was a different isotopic signature of naturally occurring boron in the shale in the Saginaw aquifer versus boron in the groundwater from the Erickson CCR impoundments. Groundwater and ash leachate samples were submitted

under Chain of Custody to Covalent Metrology of Sunnyvale, California. Samples were analyzed for ^{7}Li, ^{11}B, ^{87}Rb, ^{86}Sr, $\partial(^{11}B/^{10}B)$, and $\partial(^{87}Sr/^{86}Sr)$.

The $\partial^{11}B$ versus boron concentration of the sampled wells and ash leachate are shown in **Figure 3**. As shown in **Figure 3**, the CCR leachates had lower $\partial^{11}B$ values (<4.05), which is consistent with the literature study on boron isotopic characterization of CCR that showed CCR leachate were lower (Ruhl et al, 2014). Also shown in **Figure 3**, the $\partial^{11}B$ at glacial wells impacted by the CCR impoundments (MW-2, MW-7, and MW-7C) are also lower (<4.05). Background wells (MW-11, MW-11B, MW-12, and MW-12B) and unimpacted glacial wells (MW-16A and MW-16B) have higher $\partial^{11}B$ (>4.05). Therefore, the data indicate that $\partial^{11}B$ higher than 4.05 appear to indicate naturally occurring boron. All of the bedrock wells sampled had $\partial^{11}B$ greater than 4.05 and had the highest measured $\partial^{11}B$ (4.11-4.16) indicating that the ratio of boron isotopes in the bedrock groundwater are more similar to background groundwater and unimpacted groundwater than to ash leachate and impacted groundwater from the ash leachate.

Groundwater Extraction and Treatment and MNA Potential Remedy Progress

Between January and June 2023, BWL began development of a remedial investigation work plan to evaluate feasibility and potentially support future design of an extraction and treatment system and evaluation of monitored natural attenuation (MNA) as part of remedy selection. Implementation of the Work Plan will require coordination with drilling companies and potentially coordination with off-site landowners including landowner access agreements. The Work Plan (in progress) includes the following procedures and tasks to perform site-specific testing and data collection for the potential extraction and treatment system:

- Sampling and analysis from additional wells within the plume for increased spatial concentration data to maximize on extraction effectiveness,
- Aquifer testing procedures to evaluate potential pumping rates and capture zones, which include:
    - Extraction well siting and design and monitoring well siting and design.
    - Pump tests within the plume area. Step drawdown and constant rate tests are planned, and drawdown and recovery will be measured and analyzed.

As MNA will potentially be a component of the remediation strategy at the site the work plan also includes site-specific data collection to assess potential performance and reliability of MNA. Soil property data and additional groundwater monitoring parameters are needed to identify attenuation mechanisms at the site, the capacity for attenuation, and to support estimating the time required to achieve remediation objectives. This Work Plan include the following procedures and tasks to perform site-specific testing and data collection for the MNA study:

- Sediment sampling and analysis at borings to collect core samples.
    - Samples will be analyzed for contaminant concentrations in aquifer solids (COCs include boron, chloride, lithium, selenium, sulfate). Mineralogy of the weathered shale will be identified (clay mineralogy, Fe-Mn-Al oxides, carbonate minerals, sulfides), as well as cation exchange capacity (CEC). Batch attenuation testing for COCs will be completed at a laboratory, which include chemical extractions to

determine probable range of partition coefficient values (K_d) that suggest attenuation is taking place.

- Groundwater sampling and analysis procedures specific to MNA evaluation.

The EPA's tiered approach to MNA requires that information is collected as necessary to identify attenuation mechanisms at the site, the capacity for attenuation, and the estimated time to achieve corrective action objectives. Demonstrating attenuation mechanisms and capacity can be time consuming and take up to 24 months, especially given offsite access limitations.

Drilling for both the pump test and the MNA sample collection is planned for Fall 2023.

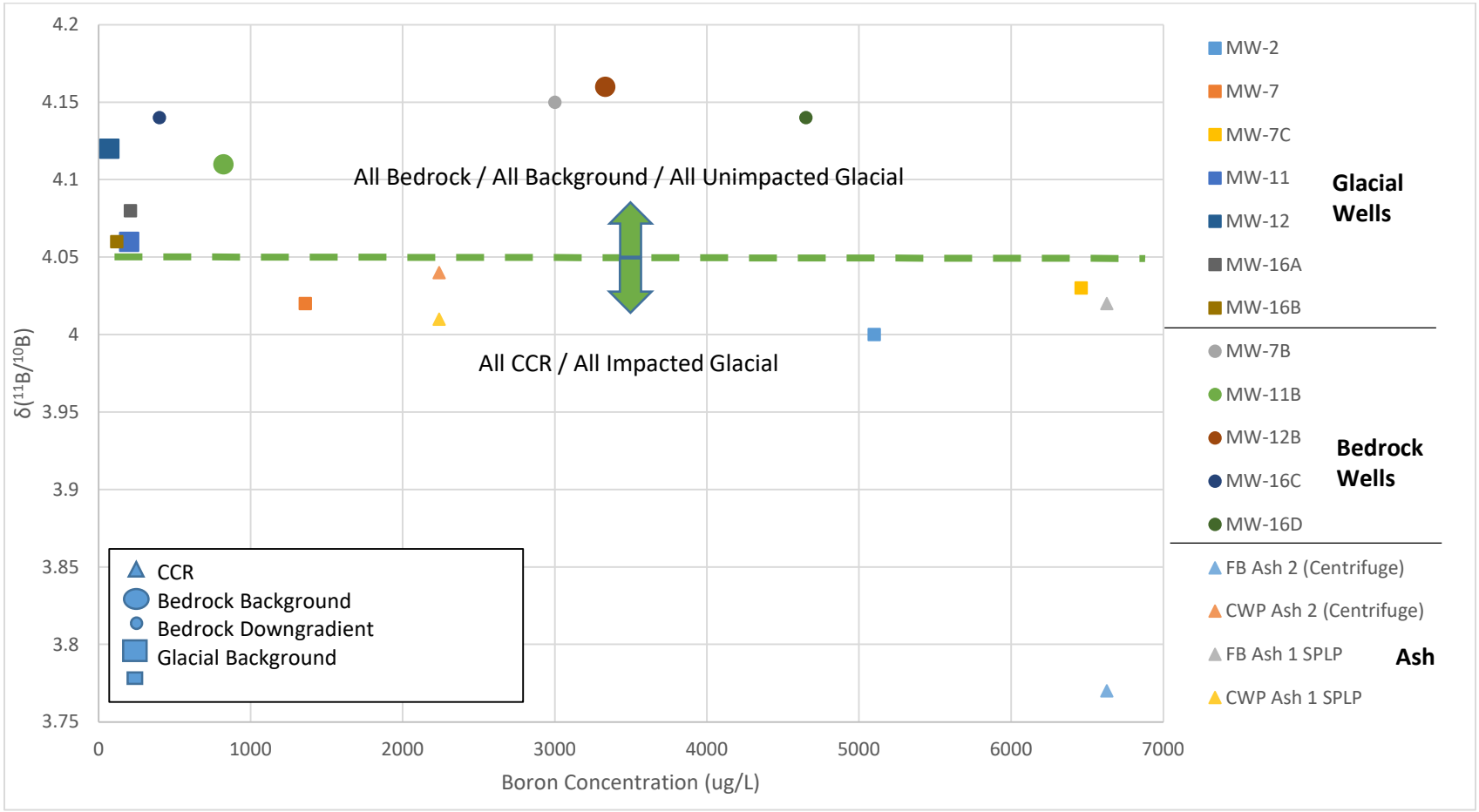

Figure 3. Boron Concentrations and Boron Isotope Ratios of Known Impacted and Unimpacted Wells and Impoundment Ash, Erickson Power Station

Next Steps Towards Remedy Selection

A significant step in remedy selection is determining the extent of the impact to groundwater to ensure that the remedy implemented will manage the impact, minimize or eliminate risks, and is located in an appropriate location. Therefore, BWL has been coordinating land agreements on the eastern Erickson property boundary to install and monitor wells inside and outside of the Erickson property to evaluate the potential extent of contamination. Recent data from newly installed wells (2023 wells) suggests that the plume is contained within the boundaries of these newly installed wells, and also that the groundwater flow direction for the glacial and Saginaw aquifers has changed from previous understandings. Recent data indicates that the glacial aquifer likely flows north under the wetland on the eastern side of the property boundary, and therefore the proposed wells discussed above (MW-17 and MW-18 multi-level wells) placed on the eastern boundary of the site may help determine the flow direction east of the site.

It is anticipated that the remedy selection process for addressing affected groundwater will proceed following the removal of the CCR source materials, estimated to be completed by October 2023, and the impact of the source removal on groundwater quality will be evaluated.

Additionally, BWL will continue implementing CCR groundwater compliance schedule in conformance with §257.90 - §257.98, which includes semiannual assessment monitoring in accordance with §257.95 to monitor groundwater conditions and inform the remedy selection. The final remedy will be formally selected per §257.97 once the selected option is reviewed and commented on by EGLE and a public meeting is conducted at least 30-days prior to the final selection as required under §257.96(e).

The following activities are proposed to be performed or initiated in the next 6-month period:

- continued semiannual groundwater assessment monitoring,
- completion of background monitoring of the ten monitoring wells installed to date in 2023,
- installation of proposed multi-level well series (MW-17 and MW-18) along the eastern property boundary,
- implementation of the Pump Test and MNA Work Plan, including the drilling, testing, sampling, and analysis associated with site-specific data collection for remedial alternatives,
- continued progress associated with ash impoundment closure, including completion of the removal of source materials and closure verification.

References

HDR, 2020. Groundwater Protection Standards and Determination of SSLs per §257.95g [Memorandum]. November 23, 2020.

HDR, 2021. Conceptual Site Model and Assessment of Corrective Measures. November 5, 2021.

Figure 1. Vicinity Map for Erickson Power Station

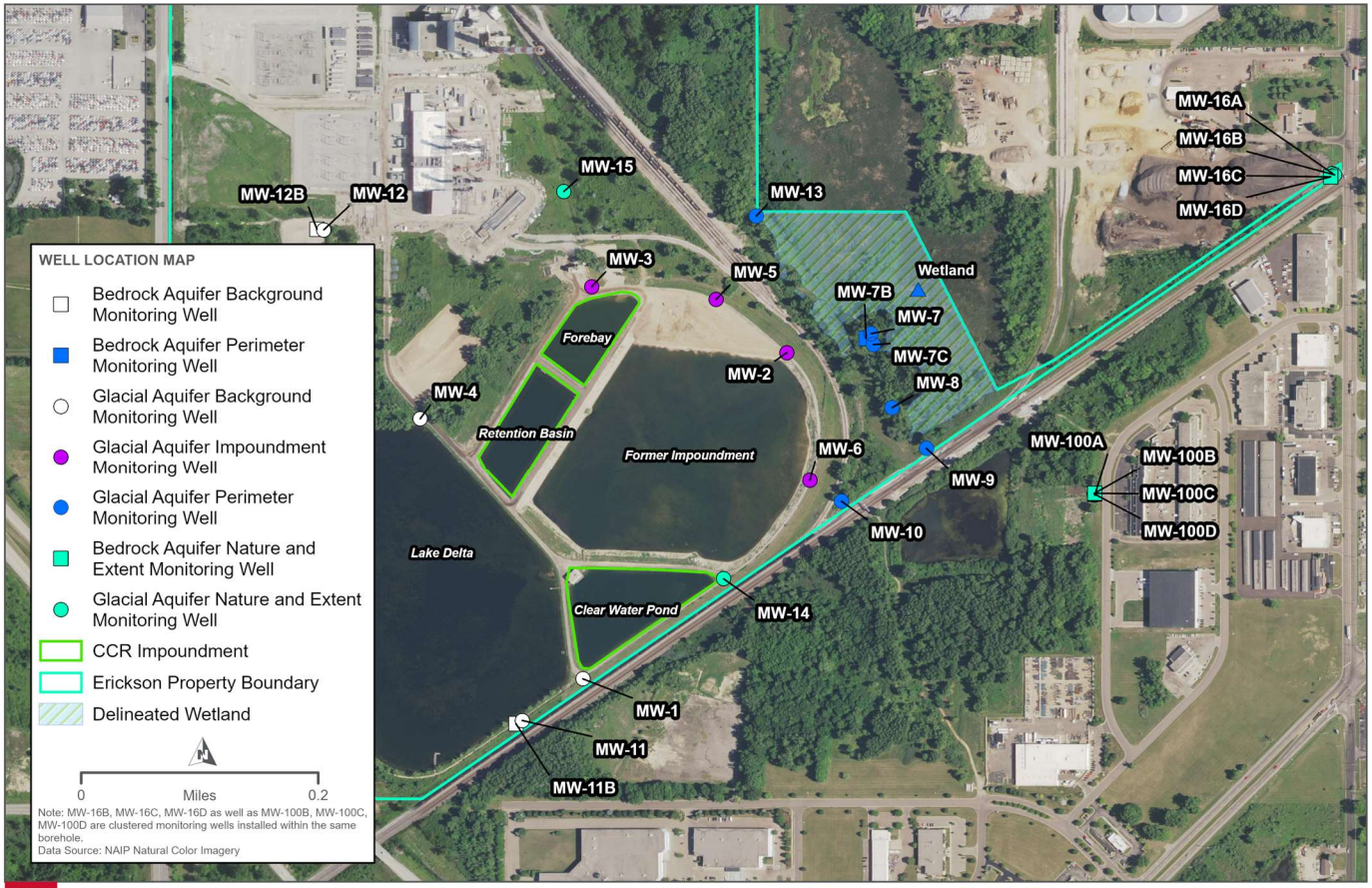

Figure 2. CCR Units and Monitoring Wells