Groundwater Monitoring 2019 Annual Report

for Compliance with the Coal Combustion Residuals (CCR) Rule

Erickson Station

Lansing Board of Water and Light

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Table of Abbreviations and Acronyms

Abbreviation	Definition
BTV	background threshold value
cm/s	centimeters per second
CCR	Coal Combustion Residuals
COI	constituent of interest
EPA	Environmental Protection Agency
LCS	Laboratory Control Samples
MDL	method detection limit
MS/MSD	Matrix Spike/Duplicate
QC	quality control
RPD	Relative Percent Difference
SOP	Standard Operating Procedure
SSI	statistically significant increase
TDS	Total Dissolved Solids
TSS	Total Suspended Solids

1.0 Introduction

The U.S. Environmental Protection Agency's (EPA) final Coal Combustion Residuals (CCR) Rule 40 CFR 257 establishes a comprehensive set of requirements for the management and disposal of CCR (or coal ash) in surface impoundments by electric utilities. 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**). The Erickson Power Station contains a single coal-fired generator capable of producing 165 megawatts of electricity. CCR generated at Erickson is stored in dewatering tanks (hydro-bins) and three active CCR impoundments: the Forebay, Retention Basin, and Clear Water Pond (CWP). A 33-acre impoundment was physically closed by removal of CCR in 2014 (**Figure 2**).

In 2019, BWL completed a hydrogeologic characterization study in order to develop a certified groundwater monitoring networkand has drilled monitoring wells and begun initial groundwater monitoring efforts. This Annual Groundwater Monitoring Report presents the work completed in 2019 to progress compliance with the CCR Rule. The current status of the groundwater monitoring program is in network development prior to background monitoring.

2.0 Facility Description

Erickson Power Station was constructed in 1970. The station generates up to 165 megawatts of electric power from one coal-fired boiler, designated as Unit 1. Historically, fly ash and bottom ash were sluiced from the plant to the 33-acre impoundment system (now physically closed). From the impoundment, the water then flowed hydraulically to the CWP. Water from Clearwater Pond was sent back to the plant for use. From 2009 through 2014, the ash was removed from the 33-acre impoundment, and a new system was installed, which is currently in use.

Currently, bottom ash from the coal-fired boiler is sluiced from the plant to dewatering tanks (hydro-bins). The dewatered bottom ash is trucked to a sanitary landfill and the decant water is hydraulically fed through the current impoundment system, which consists of a series of three impoundments: the Forebay, Retention Basin and Clearwater Pond. The Forebay and Retention Basin were constructed in 2014 (the Clearwater Pond was constructed in 1970). Water in the CWP is sent back to the plant. **Figure 2** depicts the current impoundment system. There are no regulated outfalls associated with the impoundment system. The 5-acre, 2014 Forebay and Retention Basin were installed within the footprint of the excavated 33-acre former impoundment.

The interior embankments and floors of both the Forebay and Retention Basin are lined with a layer of geosynthetic clay overlain with a 40-millimeter-thick flexible polyvinylchloride membrane liner (FML). Each FML is protected with geofabric and a 6- to 12-inch layer of sand. The tops of the embankments that are subject to wave action are protected with an additional layer of geofabric and 6 to 12 inches of stone rip-rap (MD&E, 2018). The tops of the interior

embankments of the CWP are protected with approximately 6 inches of stone rip-rap. The CWP is lined with compacted clay.

2.1 Hydrogeology

In 2019, BWL completed a Hydrogeologic Characterization study to review all available data in literature, State well logs, site specific geotechnical borings, and site-specific well logs to develop the hydrogeologic conceptual model for the site and determine where the monitoring well network for the impoundments should be located. The result of this study is HDR's Hydrogeologic Characterization Report (2019) and the following describes the findings and well installations that resulted.

The Tri-County region, where Erickson is located, is underlain by unconsolidated clay, silt, sand, and gravel of glacial origin that rest upon about 10,000 feet of consolidated bedrock sediments deposited in ancient seas. The glacial deposits are at the ground surface and range in thickness from 0 to over 300 feet (Apple and Reeves, 2007). The consolidated bedrock below glacial deposits are composed of limestone, shale, siltstone, sandstone, salt, and gypsum. According to Vanlier and others (1973) the principal aquifers in northeastern Eaton County, where Erickson is located, are in the glacial deposits and the Saginaw Formation bedrock below the glacial deposits. According to the Michigan Wellogic Database, approximately 18 percent of the wells in Eaton County are completed in the glacial deposits, and 69 percent in the bedrock units (Apple and Reeves, 2007).

According to studies of the area, groundwater flow in the glacial deposits is generally from south to north, away from topographic divides and towards surface water bodies (Holtschlag and others, 1996). Most groundwater flow in the Saginaw aquifer is from south to north, although a small amount is toward local pumping centers (Holtschlag and others, 1996). These flow directions are consistent with the topography and surface water flow direction of the Grand River watershed.

According to the Public Water Supply database, the estimated transmissivity for glacial aquifer wells in Eaton County ranges from approximately 615 to 127,000 feet squared per day (ft^2/d) (Apple and Reeves, 2007). Holtschlag and others (1996) performed significant spatial correlations to compute hydraulic conductivity estimates of the glacial deposits. Initial estimates of horizontal hydraulic conductivity range from 7.06 to 27.5 ft/d. Horizontal hydraulic conductivity is highest in the west-central part of the Tri-state area and lowest in the north and south parts of the Tri-county area.

According to the Michigan Wellogic Database, two wells have been drilled on the Erickson property, one to 380 and one to 420 feet below surface. In well boring logs, the top 36 to 79 feet of subsurface was logged as clay and gravely clay, representing the glacial deposits, overlying sandstone and shale bedrock down to 420 feet below grade, representing the Saginaw Formation. Both on-site wells are screened in the bedrock Saginaw Formation. According to the Erickson water withdrawal file from 2010, the wells were set with 94 and 80 gallon per minute pumps and were used intermittently for operations but have not been pumped since before 2010. Static water levels were recorded as 21 and 26 feet below grade on the logs.

Wells in the well log database within a two-mile radius of Erickson all have geologic logs very similar to those on the property, indicating glacial deposits (clay, sand, and gravel) from 30 to 100 feet below grade overlying shale and sandstone bedrock (HDR 2019). Wells vary in depth between 85 and 460 feet. Of the 141 wells in the vicinity of Erickson, only two are completed in the glacial aquifer (HDR 2019). The remainder of wells are screened in the shale and sandstone of the Saginaw aquifer. Static water levels recorded in the State well database indicate water level between 7 feet below grade near the Grand River to 70 feet below grade; however, these water levels are only for wells screened in the Saginaw aquifer and may be snapshots immediately after drilling that are not representative of static conditions. The two wells completed in the glacial aquifer do not provide static depths in the State well log database.

Geotechnical test pits excavated, and borings drilled at Erickson reveal shallow subsurface lithology is composed of glacial deposits, sandy clay, silt, clayey sand, sand, and sand with gravel to a depth of 36 to 61 feet below ground surface (HDR 2019). The glacial deposits on site lie above the sandstone and shale bedrock of the Saginaw Formation.

Three wells were drilled in October 14-16, 2019 around the impoundments at Erickson to serve multiple purposes:

- Determine the uppermost aquifer under the impoundments (glacial deposits or the deeper bedrock aquifer);
- Determine groundwater flow direction; and
- Serve as monitoring wells for the CCR Rule compliance groundwater monitoring network of the impoundments.

Figure 3 displays the three well locations, MW-1, MW-2, and MW-3. Wells were surveyed, and water level data was collected. Wells are further described below. The depth to the uppermost aquifer under the impoundments was determined to be approximately 14 to 20 feet below surface. The groundwater flow direction was determined to be northeast under the impoundments. Slug tests were conducted in each of the new wells and hydraulic conductivity values ranged from 2.76E-05 to 5.94E-06 centimeters per second (cm/s), with a geomean hydraulic conductivity of 2.19E-05 cm/s.

Table 1. Results of Slug Testing

Well	Test Name	Test Date	Screened Material	Hydraulic Conductivity (cm/sec)
MW-1	Falling Head Slug	10/18/2019	Clayey Sand to Silty Clay	4.16E-05
MW-1	Falling Head Slug	10/18/2019	Clayey Sand to Silty Clay	3.63E-05
MW-1	Rising Head Slug	10/18/2019	Clayey Sand to Silty Clay	2.76E-05
MW-2	Falling Head Slug	10/18/2019	Clayey Sand to Silty Clay	4.62E-06
MW-2	Rising Head Slug	10/18/2019	Clayey Sand to Silty Clay	5.94E-06
MW-3	Falling Head Slug	10/18/2019	Clayey Sand to Silty Clay	3.75E-05

MW-3	Rising Head Slug	10/18/2019	Clayey Sand to Silty Clay	5.55E-05
Geomean				2.19E-05

2.2 Monitoring Well Network

2.2.1 Impoundments

The CCR Rule requires that the groundwater monitoring be conducted on the uppermost aquifer at the site with a regulated CCR facility. The definition of an aquifer, from the CCR Rule (40 CFR 257.53), is a geologic formation, group of formations, or portion of a formation capable of transmitting water fast enough to yield usable quantities of groundwater to wells or springs. Usable quantity can be defined as a sufficient amount of water to supply a single-family home.

In order to develop the certified monitoring network at Erickson, BWL had to first complete the hydrogeologic study. The outcome of the HDR (2019) hydrogeologic study was the recommended locations for three monitoring wells to confirm the uppermost aquifer under the impoundments and determine the groundwater flow direction under the Site. Three wells were installed around the outside of the impoundments to evaluate groundwater conditions at the site in order to advance CCR compliance. The flow of groundwater in the area of the site appeared to be north-northeast before wells were installed. Therefore, wells MW-1, MW-2, and MW-3 were installed in October 2019 around the ash impoundment system boundary for initial site assessment. For initial drilling, the groundwater flow direction is assumed to be north-northeast consistent with literature and location of the Grand River relative to the Site. Well locations are shown on **Figure 3**. The locations of the three wells were chosen to triangulate water table elevations to calculate the groundwater flow direction and gradient. The locations were spaced on the outside boundary of the area containing the Forebay, Retention Basin, CWP, and former impoundment footprint. The locations were also spaced to potentially serve as upgradient (MW-1) and downgradient (MW-2 and MW-3) well locations for the CCR Rule certified network if the groundwater flow direction was north-northeast.

After the wells were installed and surveyed and water levels collected, the potentiometric surface was developed. The flow of groundwater in the immediate vicinity of the impoundments is northeast. Therefore, well MW-1 is in fact upgradient of the impoundments, and MW-2 is downgradient of the impoundments. Based on the site specific groundwater conditions determined by the first few months of data from wells MW-1, MW-2, and MW-3, BWL has installed three new wells (MW-4, MW-5, and MW-6) in January 2020 to comprise a multi-unit monitoring network located along the perimeter of the impoundments to serve as additional upgradient (MW-4) and downgradient wells (MW-5 and MW-6) (**Figure 3**). Therefore, monitoring wells MW-1 and MW-4 will serve as upgradient wells and wells MW-2, MW-5, and MW-6 will serve as downgradient wells. Wells are located to ensure the water quality from these locations will detect CCR constituents in groundwater, if present. The sixth well, MW-3 is more cross gradient to the impoundments and will not be part of the monitoring network.

Figure 1. Vicinity map for Erickson Station

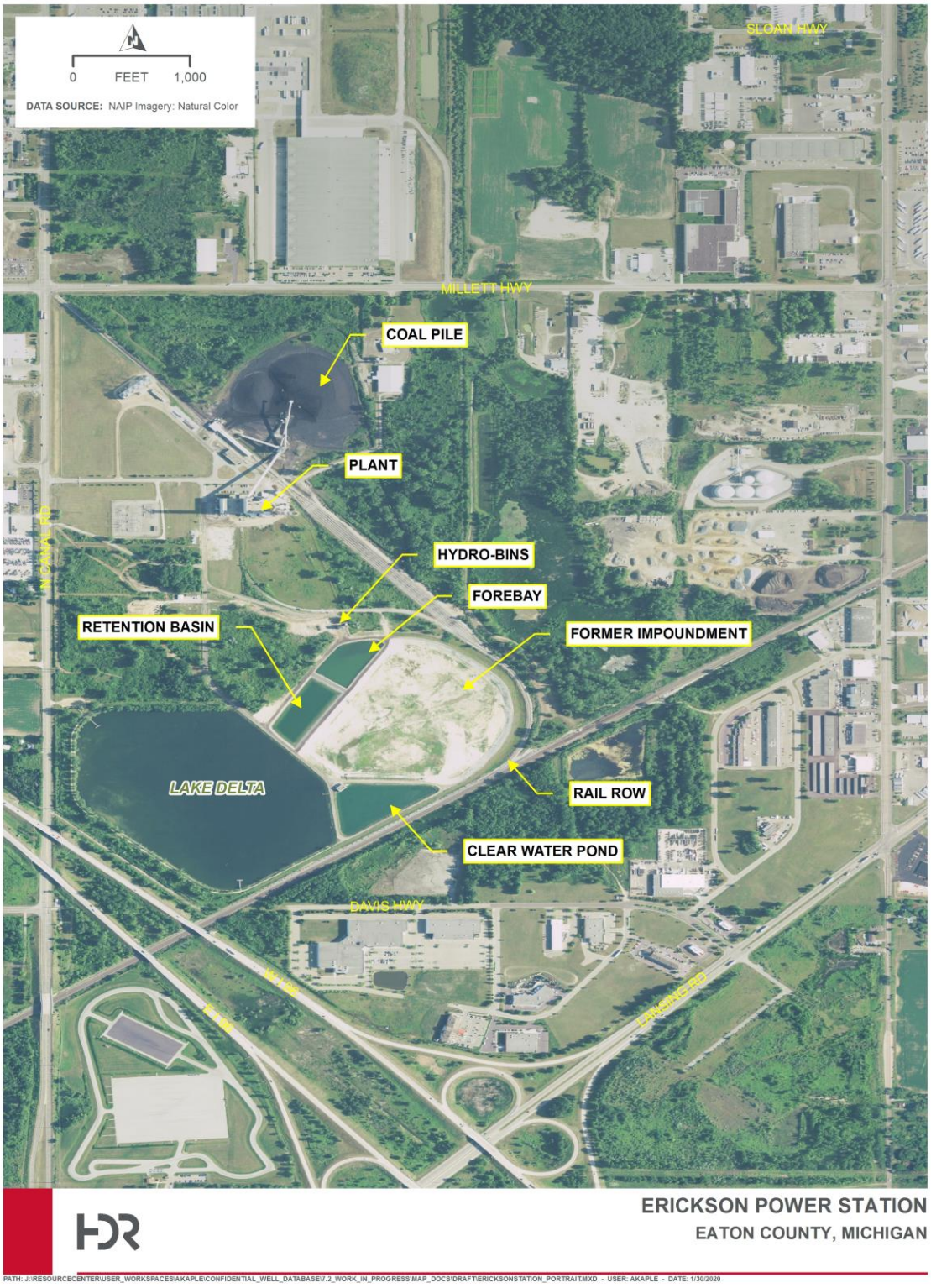

Figure 2. Erickson Station facility layout

Figure 3. Erickson Station CCR units and monitoring wells

3.0 Monitoring

3.1 Frequency

In 2019, monthly water level monitoring was conducted on the three wells installed in October 2019. **Table 1** provides the well identification, number of groundwater levels that were collected from the - impoundment system monitoring wells for each background and downgradient well, the dates the level data were collected, and whether the sample was required by the CCR Rule for the background sampling, detection monitoring or assessment monitoring programs. Due to the lack of prior groundwater level and flow direction data for the site, water level monitoring in the three initial site assessment wells were used to establish the flow direction at the site before additional monitoring wells were installed that will serve as the certified groundwater monitoring network for the CCR unit.

In 2020 BWL will initiate sample collection for background monitoring.

Table 2. Dates of groundwater level data collected for each well in 2019 and the required monitoring programs for the Erickson Impoundments (257.90(e)(3))

Monitoring Well I.D.	Well Location	Dates Monitored	CCR Rule Monitoring Purpose
MW-1	Background/Upgradient	October 17, 2019 November 20, 2019 December 13, 2019	Background Monitoring
MW-2	Downgradient	October 17, 2019 November 20, 2019 December 13, 2019	Background Monitoring
MW-3	Downgradient	October 17, 2019 November 20, 2019 December 13, 2019	Background Monitoring

3.2 Water Levels and Sample Collection

Water levels were collected in each well following the Groundwater Level Monitoring Standard Operating Procedure (SOP) (HDR, 2019a). The results of field measurements were recorded on a field data form, which is maintained as part of the field records.

3.3 Analytical Testing

No groundwater samples have been collected. BWL intends to initiate background groundwater sampling and analysis in 2020. As described above, the new wells were drilled in early January 2020 and the monitoring will begin soon after.

4.0 Monitoring Results

4.1 Water Levels and Groundwater Flow Direction

The water levels at the three monitoring wells installed in 2019 (MW-1, MW-2, and MW-3) were recorded monthly between October and December 2019 and are provided in **Table 3**. Potentiometric surface maps were developed for each month. Maps displaying the groundwater elevations at the three existing wells and the groundwater contours for October, November, and December 2019 are provided in **Appendix A**. Groundwater beneath the area of the impoundments is between 865 to 888 feet amsl.

The water levels and contour maps confirm that the groundwater flow direction under the impoundments is to the northeast. The potentiometric surface maps also indicate that monitoring well MW-1 is located upgradient of the Forebay, Retention Pond, and CWP and is appropriate to sample groundwater that will represent background water quality (**Appendix A**). Monitoring well MW-2 is located downgradient of the impoundments and will become a downgradient well in the certified monitoring well network. Monitoring well MW-3 appears to be more cross gradient to the Forebay and therefore will not serve as a downgradient monitoring well to assess potential for impact to groundwater from the Forebay and Retention Basin. This illustrates the reason it was important to have multiple months of water levels and flow direction data to ensure proper placement of the upgradient and downgradient monitoring wells relative to the CCR impoundments.

Table 3. Groundwater elevations measured in 2019

Well ID	Groundwater Elevation (ft amsl) Oct 17, 2019	Groundwater Elevation (ft amsl) Nov 20, 2019	Groundwater Elevation (ft amsl) Dec 13, 2019	Casing Elevation (ft amsl)	Well Location Relative to Impoundments
MW-1	874.10	874.31	874.53	888.74	Upgradient / Background
MW-2	865.62	866.43	867.19	885.97	Downgradient
MW-3	869.91	871.31	872.38	884.81	Cross gradient

5.0 Summary

The following observations are based on CCR Rule compliance groundwater monitoring program development during 2019:

- A Hydrogeologic Characterization Study was completed in 2019 to develop a conceptual site model and determine appropriate monitoring well network for the CCR Rule groundwater monitoring compliance program.
- Three monitoring wells were installed in October 2019 (MW-1, MW-2, and MW-3).
- The three monitoring wells were monitored monthly between October and December 2019 for water levels. Potentiometric surface was contoured.
- Groundwater in the area of the impoundments is between 865 to 888 feet amsl.
- Groundwater flow direction under the impoundments is northeast.
- Slug testing the three new wells determined that the geomean hydraulic conductivity of the uppermost aquifer is 2.19E-05 cm/s.
- BWL used the groundwater depth and flow direction data from 2019 to site and install three additional monitoring wells (MW-4, MW-5, and MW-6) in early January 2020.
- Erickson Power Station impoundment current status is in groundwater monitoring network development.

In 2020, BWL will complete the Groundwater Monitoring Network Certification and initiate background monitoring for the constituents of interest listed in Appendices III and IV of Part 257. After eight rounds of background monitoring, BWL will initiate detection monitoring to determine if there are any statistically significant increases over background groundwater quality.

6.0 References

Apple, B.A. and Reeves, H.W., 2007, Summary of Hydrogeologic Conditions by County for the State of Michigan: U.S. Geological Survey Open-File Report 2007-1236, 79 p.

HDR, 2019. Hydrogeologic Characterization Report. October 4, 2019.

HDR, 2019a. Groundwater Level Monitoring Standard Operating Procedure (SOP). November 18, 2019.

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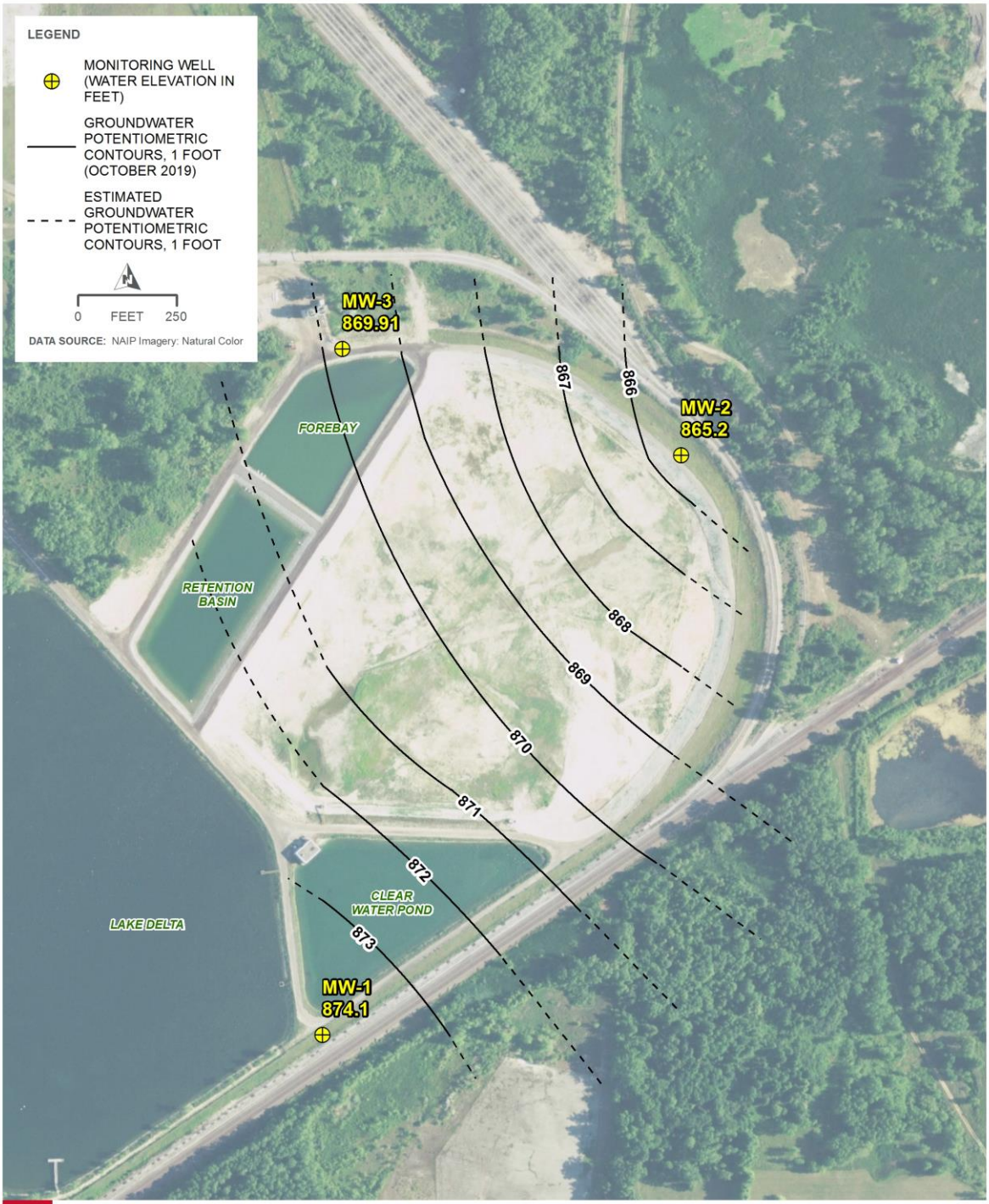
Appendix A

Potentiometric Surface Maps



ERICKSON POWER STATION

EATON COUNTY, MICHIGAN

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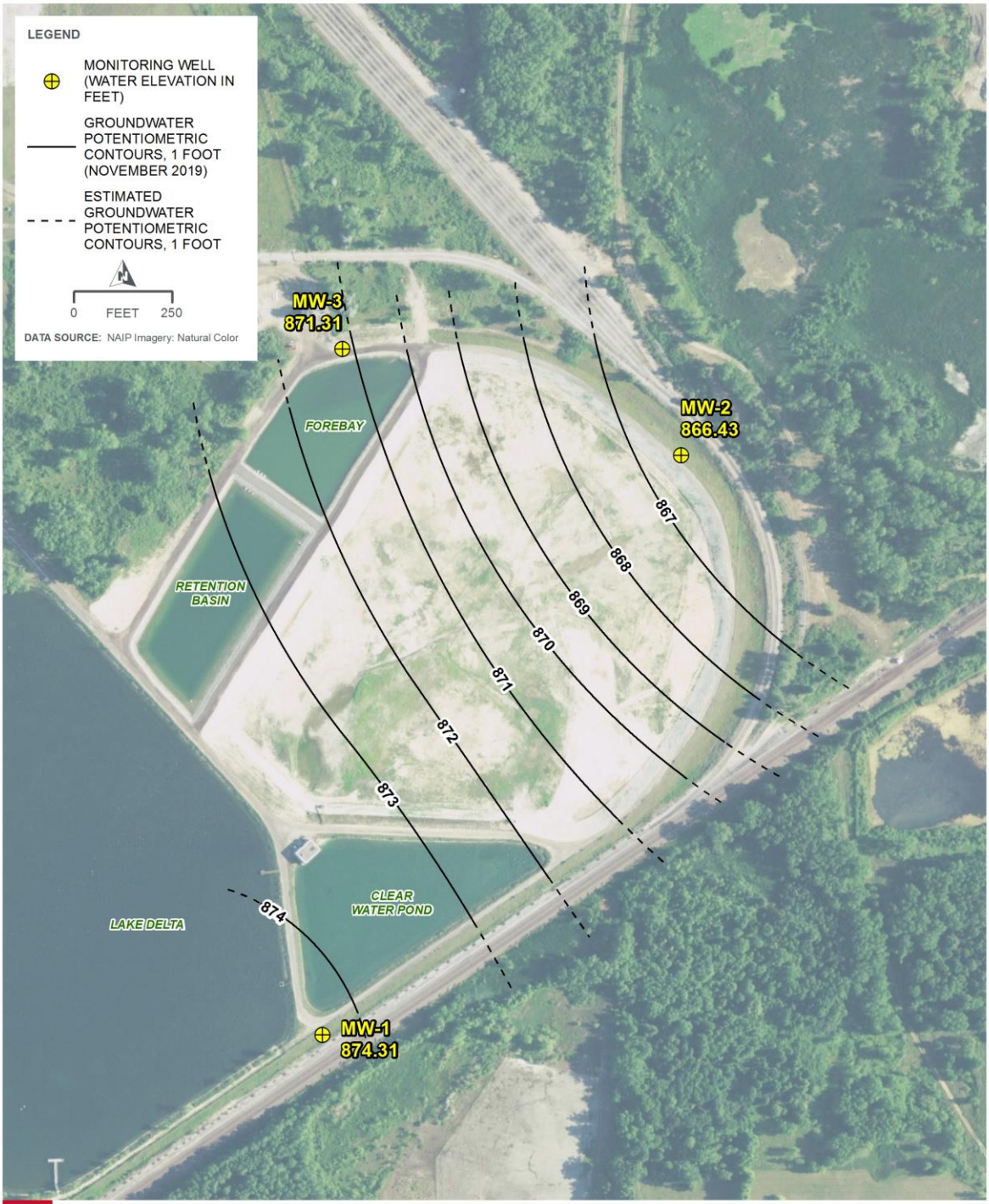

ERICKSON POWER STATION

EATON COUNTY, MICHIGAN

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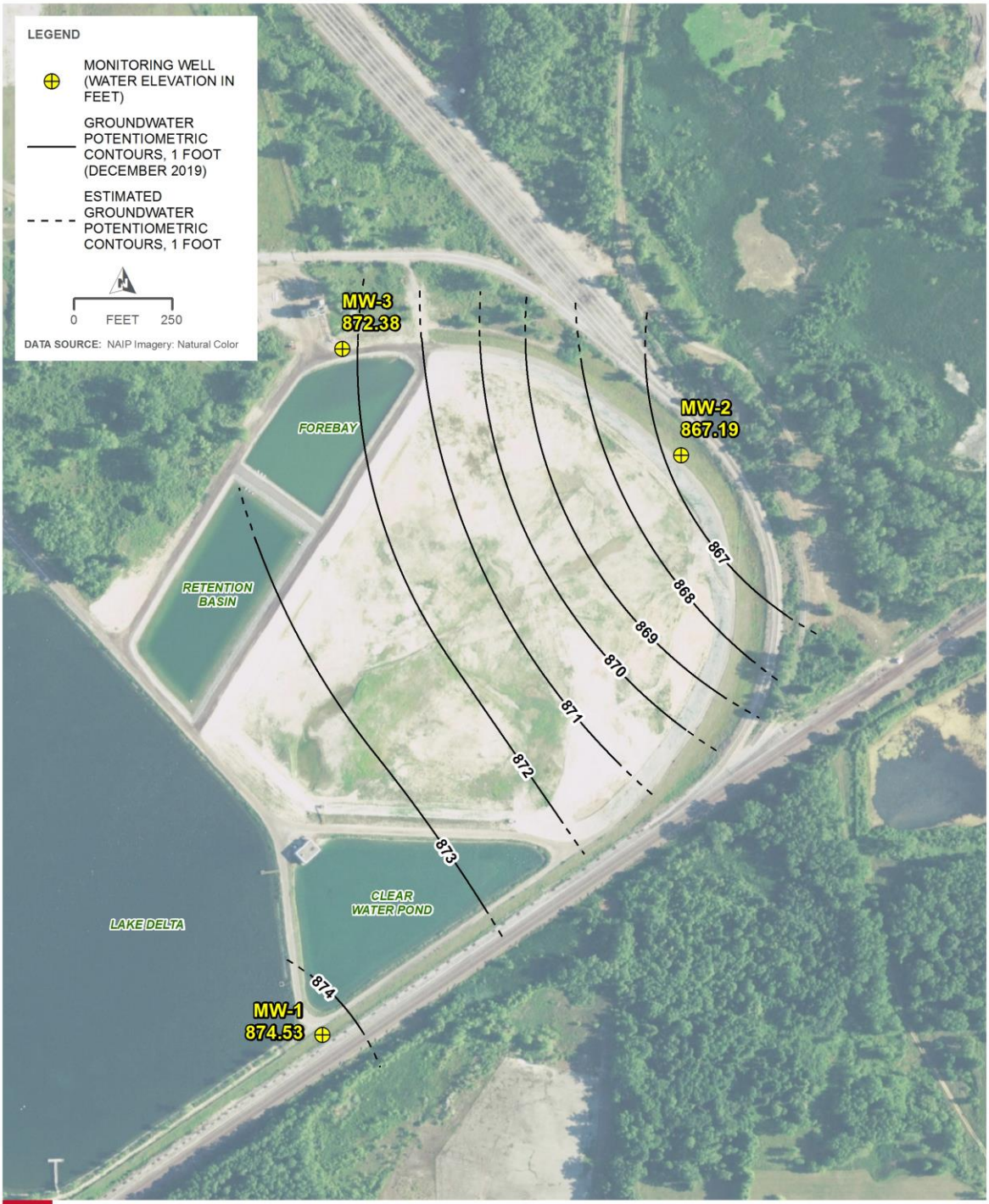

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