Rockport Power Plant – East Bottom Ash Pond

Location Restriction Report

The location restriction report for the Rockport East Bottom Ash Pond following retrofit consist of the attached documents:

Evaluation of Location Restrictions, Rockport East Bottom Ash Pond by WSP USA, Inc (October 12, 2023) covering the following criteria:

40 CFR §257.60 – Placement above uppermost aquifer
40 CFR §257.61 – Wetlands
40 CFR §257.62 – Fault Areas
40 CFR §257.64 – Unstable Areas

Seismic Impact Zone Demonstration, Addendum for East Bottom Ash Pond by Worley (October 16, 2023 covers 40 CFR §257.63 – Seismic Impact Zone

Evaluation of Location Restrictions, Rockport East Bottom Ash Pond

American Electric Power Service Corporation
Rockport Generating Station, Rockport, Spencer County, Indiana
Project # 7382233458

Prepared for:

American Electric Power Service Corporation
1 Riverside Plaza, Columbus, Ohio 43215

12 October 2023

12 October 2023
Brian Palmer
American Electric Power Service Corporation
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WSP USA, Inc.
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USA
T: 502-267-0700

Dear Mr. Palmer:

WSP USA, Inc. (WSP) is pleased to provide American Electric Power (AEP) with this Evaluation of Location Restrictions Report. We have prepared this report on behalf of American Electric Power (AEP) to document the results of the location restrictions evaluation conducted for the East Bottom Ash Pond retrofit at the Rockport Plant in Rockport, Indiana.

We very much appreciate working with AEP on this project. If you require additional information about this report, please feel free to contact me at (502) 836-4429.

Sincerely,

WSP USA Inc.

M. Brian Cole, PE
Senior Civil Engineer

Attachments

Evaluation of Location Restrictions

Rockport East Bottom Ash Pond

American Electric Power Service Corporation
Rockport Generating Station, Rockport, Spencer County, Indiana
Project # 7382153161

Prepared for:

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12 October 2023

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1.0 Objective

This Evaluation of Location Restrictions Report has been prepared by WSP USA, Inc. (WSP), on behalf of American Electric Power (AEP), to document the results of the location restrictions evaluation conducted for the East Bottom Ash Pond at the Rockport Plant in Rockport, Indiana. The East Bottom Ash Pond has been retrofitted under the CCR Rule per 40 CFR 257.102(k). The Location Restrictions Evaluation was conducted to evaluate the compliance of this CCR unit following retrofit with the coal combustion residuals (CCR) Final Rule issued by the U.S. Environmental Protection Agency (USEPA) on 17 April 2015. Regulations pertaining to the location restrictions for CCR units are contained in the Code of Federal Regulations (CFR) 40 CFR 257.60 through 64. The seismic impact zone certification per 40 CFR 257.63 has been provided by others in a separate report.

2.0 Background Information

2.1 Facility Location Description

The Rockport Power Plant is located in southwest Indiana (**Figure 1**) in Spencer County, on property extending into three Townships: Ohio, Hammond and Grass. The plant is situated on the north bank of the Ohio River, just northeast of the intersection of State Route (SR) 66, and United States (US) Highway 231. SR 66 runs along the river between the Town of Grandview (about 1.5 miles to the east) and the City of Rockport (about 1 mile to the southwest), and US 231 runs south from Interstate 64 (about 20 miles north of the plant), crossing the Ohio River into Kentucky via the William H. Natcher Bridge just southwest of the Power Plant.

The site is owned and operated by Indiana-Michigan Power Company, a regional unit of AEP. The property was developed in the late 1970s and early 1980s. The facility consists of two coal-fired 1,300-megawatt (MW) power generating units. The first unit went into operation in December 1984, and the second in December 1989. The facility has two existing CCR storage/disposal units consisting of the ash landfill located north-northeast of the generating plant, and two adjacent bottom ash (BA) ponds located just south of the generating plant at the north end of a wastewater pond complex. The general layout of the property and the locations of the CCR units are shown on **Figure 2**.

The following description of CCR generation and handling processes at the Rockport Plant is summarized from a letter sent by AEP to the Indiana Department of Environmental Management (IDEM) on 6 May 2009:

The plant burns about 9-10 million tons of coal per year. The coal, delivered by barge, is off-loaded to the coal storage yard then transported by conveyor into one of the two generating units, where it is pulverized to a powder then injected and burned. The heat produced in burning coal converts water to steam used to drive the turbine generators which produce electricity. The burning of coal produces two types of ash - fly ash and bottom ash. The Rockport Plant produces about 400,000 tons of fly ash and 140,000 tons of bottom ash per year.

Fly ash is the fine particulate matter entrained in the hot flue gases. To remove the fly ash prior to the gases exiting through the plant stack, the flue gas is routed through an electrostatic precipitator (ESP), where the ash particles adhere to electrically charged plates. Mechanical rappers knock the fly ash off the plates down into a series of collection hoppers. From the hoppers, the fly ash is pneumatically conveyed to a storage silo. From the silo, the ash is either loaded dry into closed trucks and shipped offsite for various uses, or conditioned with a small quantity of water and hauled by truck to the onsite landfill for disposal.

Bottom ash (BA) includes the heavier coal ash particles that fall to the bottom of the steam generator and are collected into refractory-lined hoppers. The hoppers are kept full of water to protect the lining and break the fall of large pieces of hot slag which shatter upon contact with the relatively cool water. From the hoppers, the BA-water mixture is routed to a crusher station where the ash is crushed to a size suitable for pumping. The BA will be pumped to the retrofitted East Bottom Ash Pond where BA will accumulate in the forebay portion and the plant will excavate, stackout to dewater, and load for transport to the landfill.

2.2 Description of CCR Unit

2.2.1 General

The East Bottom Ash Pond is located at the north end of the wastewater pond complex for the plant (**Figure 3**). Historically bottom ash was managed at the Rockport Plant, in two contiguous ponds, referred to as the East and West BA Ponds, The West Bottom Ash Pond will commence closure when the retrofitted East Bottom Ash Pond goes into service and will become a stormwater pond after closure. Other ponds in the complex include the east and west wastewater ponds, the reclaim pond, and the clearwater pond. The wastewater pond complex has a total surface area of 137 acres and a design storage capacity of 1,640 acre-feet (O&G 2011). The East BA Pond has been retrofitted under the criteria of 40 CFR 257.101 and 257.102, with the base liner system subgrade elevation raised to 378.5 feet at its lowest point, to insure 5 feet of groundwater separation per 40 CFR 257.60 and the installation of an alternative composite liner system per 40 CFR 257.70.

2.2.2 Embankment Configuration

The wastewater pond complex is a combination incised and diked earthen embankment impoundment. It is incised below grade along most of its perimeter and is diked only on the west side of the West BA Pond, where the topography decreases in elevation toward a remnant drainage channel.

The embankments, including the west dike, have a crest elevation of 399 feet, and are approximately 30 feet wide. The west dike has a maximum height (from crest to outboard toe) of 13 feet. The inboard slope was constructed at a slope of 2 horizontal to 1 vertical (2H:1V), and the outboard slope at 2.5H:1V. The outer west dike, and the internal splitter dikes (constructed between the BA Ponds, and between each of the BA Ponds and the wastewater ponds to the south) were constructed of natural clayey soils excavated from the interior of the ponds. The inboard slopes of the West BA pond and the other ponds were armored with rock riprap. No engineered liner systems are present in the former BA Ponds or the other ponds in the wastewater pond complex.

The retrofitted East Bottom Ash Pond has an engineered liner system consisting of compacted fill with a hydraulic conductivity of less than 1×10^{-5} cm/sec, geotextile soil gas venting layer, geosynthetic clay liner, and 40-mil LLDPE liner. The retrofitted East Bottom Ash Pond includes a berm in the north end with crest elev. of 393.75 to form an approximate 5-acre forebay that has a 3-in grouted concrete revetment over the engineered liner system.

2.2.3 Area

The East Bottom Ash Pond has a rough dimensions (at the crest) of 2,000 feet x 650 feet, corresponding to a surface area of approximately 30 acres each.

2.2.4 Construction and Operational History

The wastewater pond complex was constructed in the late 1970s, commissioned in 1981. The East and West BA Ponds were previously used alternately. Bottom ash generated at the plant was hydraulically sluiced to one of the ponds (the active pond) until it is close to full. Bottom ash in the inactive pond was drained and dewatered, and then moved by bulldozer to stockpiles on the north end of the pond. Dry ash in the stockpiles was then loaded into trucks and transported to other locations for beneficial use. Now the East BA Pond has had the CCR removed and retrofitted with a liner that meets the requirements of a *new CCR surface impoundment*, per 40 CFR 257.72. Structural fill was placed prior to liner construction to insure that the lowest base elevation of the liner system is 378.5 feet, which meets the groundwater separation criteria found in 40 CFR 257.60.

2.3 Previous Investigations

Site investigations were performed on the Plant property in the late 1970s and early 1980s to support design, construction and permitting in advance of plant start-up, which occurred in December 1984.

The following documents were provided by AEP for a previous review:

- Portions of a report titled Foundation Investigations for Rockport Site, by Casagrande Consultants, dated 25 April 1977. The portions provided included a boring location map and boring logs for nine soil borings (BH-361 to BH-369) performed in March 1977 along the proposed alignment for the perimeter and splitter dikes in the wastewater pond complex. The boring location map and boring logs are provided in **Appendix A**.
- Well construction and lithologic logs for four monitoring wells installed by AEP on the perimeter of the wastewater pond complex in June-July 2010. Copies of these logs are provided in **Appendix B**.

2.4 Hydrogeologic Setting

The following sections provide information on the hydrogeologic setting of the AEP Rockport Plant, including climate, physiography and drainage, geology, hydraulic properties of the principal groundwater flow zone, surface water and interactions between surface water and groundwater, and water users.

2.4.1 Climate and Water Budget

The area of Rockport has a continental climate regime. As described by Ray (1965), summers are long hot and humid, and winters are damp and relatively mild, with brief periods of intense cold. Mean monthly temperatures vary from 35 degrees Fahrenheit (ºF) in January to 79ºF in July.

The closest meteorological station with long-term data is Owensboro, Kentucky. Based on National Climatic Data Center (NCDC) data for the period from 1971 through 2000, as reported by the Midwest Regional Climate Center (MRCC, http://mrcc.isws.illinois.edu/), the normal annual precipitation in Owensboro is 45.07 inches. Precipitation is well distributed throughout the year, on average, but can be highly variable from month-to-month. Monthly normal precipitation varies from 2.67 inches in October to 4.66 inches in May. However, monthly extremes during the period from 1928 through 1990 ranged from 0.06 inches in October 1987 to 16.15 inches in March 1964.

Mean annual potential evapotranspiration in Owensboro is between 31 and 33 inches, according to mapped data available from the Kentucky Climate Center (http://www.kyclimate.org/index.html). The adjusted annual potential evaporation estimated in the Landfill Application Package (AEP 1984, Table 10), based on climatic data from Tell City, was 32.22 inches per year. The mean monthly water balance developed for the landfill resulted in the following breakdown (Table 11) for an estimated annual precipitation of 44.27 Inches:

- Surface Runoff – 13.23 inches (30%);
- Actual Evapotranspiration – 25.69 inches (58%);

- Percolation (groundwater recharge) – 5.44 inches (12%).

2.4.2 Regional and Local Geologic Setting

Physiography and Drainage

The area of Rockport lies in the western Interior Low Plateau physiographic province of the United States, in a subarea referred to as the Wabash Lowland. It is an area of broad alluviated valleys and dissected uplands of rolling to hilly terrain with gentle slopes and moderate relief (Ray 1965). The topography in the vicinity of the Rockport Plant is shown on the U.S. Geological Survey (USGS) topographic map reproduced in **Figure 4**. Elevations on the map are shown relative to Mean Seal Level (MSL, also known as the National Geodetic Vertical Datum of 1929, or NGVD29).

Drainage in the area is provided by the Ohio River, which is adjacent to the plant property on the southeast, is over 2,000 feet wide in the vicinity of the plant, and flows to the southwest toward Owensboro, Kentucky. The plant property slopes gently across a terraced surface from elevations greater than 410 feet on its northern edge, where it is bordered by low hills and an upper terrace, to about 390 feet along the top of the bank of the Ohio River. Much of the property is drained by Honey Creek, which flows south-southeast to the Ohio River and is incised down to an elevation of about 380 feet. The power generation plant was developed on the portion of the property between US 231 on the west and Honey Creek on the east. It is located on a watershed divide between Honey Creek and an unnamed tributary offsite to the southwest.

The natural topography over most of the property (outside the channel of Honey Creek) prior to development of the power plant consisted of a relatively flat terrace surface marked by east-west oriented crests and swales. Multiple low-gradient drainage ditches crossed the area, connecting the two watersheds (Honey Creek and the watershed to the west). Regrading for development of the power plant and associated facilities (including construction of the wastewater pond complex) disrupted some of the existing natural drainage as well as the man-made drainage that existed on the surface of the terrace and is still depicted on the USGS topographic map in **Figure 4**.

Geology

The area of the site lies in the southern portion of a broad shallow downwarp structure referred to as the Illinois Basin (also known as the Eastern Interior Basin), and is underlain by sedimentary bedrock of Pennsylvanian age. The bedrock underlying the site and most of Spencer County is the Pennsylvanian age Raccoon Group, consisting of sandstone and shale with minor amounts of mudstone, coal and limestone (Grove 2006). The rock reported from onsite borings that extended through the unconsolidated overburden into bedrock has been described primarily as shale. The boring for bedrock wells finished at the MW-5 location (at the landfill) encountered interbedded sandy claystone, sandy shale, limestone, coal and claystone.

The bedrock surface beneath the overburden is uneven, and includes rounded hills, ridges and valleys (draining southeast) representing the erosional surface that existed prior to filling of the valley with glaciofluvial sediments.

The geology of the near-surface unconsolidated Quaternary sediments associated with the Ohio River valley is depicted on the geology map in **Figure 5** (which excludes the far east portion of the Plant property), and described in detail by Ray (1965). These sediments range in thickness from about 20 feet on northern sections of the property, to as much as 130 feet along the Ohio River west of the mouth of Honey Creek. They include windblown sediments (loess) up to 30 feet thick that mantle bedrock on the northeast perimeter of the property, possibly merging with lacustrine deposits in the tributary valley at the northwest corner of the property, and two series of Wisconsin age valley-train deposits (Tazewell and Cary) under most of the property. The valley-train sediments that fill the broad river valley were deposited by meltwater from retreating continental glaciers to the north and northeast, and were subsequently reworked by modern drainage systems, including the Ohio River and the Honey Creek drainage on the plant property.

Generally, the valley train deposits thicken and coarsen to the southeast, from the loess-mantled bedrock hills along the valley wall, toward and beyond the course of the modern Ohio River. In the subsurface, the valley train sediments typically coarsen downward, and can be classified generally into finer-grained sediments near the surface (including silt, sandy silt, silty clay and clay), and coarser-grained sediments (fine to coarse sand and some gravel) at depth.

Interpretive cross-sections of the subsurface were generated by AEP from data collected in the 1983 Site Investigation of the landfill area. In the report of the Site Investigation included in the Landfill Application Package (AEP 1984), the unconsolidated sediments encountered above bedrock were grouped into four units, described below in descending order:

- Unit No. 1 – surficial silt and clay. This unit was found to be 2 to more than 15 feet thick. The upper section is predominantly silty, sandy clay that is stiff, and of low to medium plasticity. Very fine-grained sand and silt are stratified with the clay toward the bottom of the unit, suggesting a lacustrine depositional environment where these finer-grained deposits are thickest.
- Unit No.2 – well sorted sand. This unit, where present, was found to extend from the bottom of the fine-grained surficial unit to elevations of 373-376 feet. It was found to consist of fine to medium-grained, well-sorted subangular to subrounded quartz sand.
- Unit No. 3 – poorly sorted sand. This lower sand unit, consisting of poorly sorted, very fine to very coarse-grained sand, is the dominant unit between elevations of 373-376 feet and the underlying bedrock, which is typically found at elevations of 290 to 300 feet under most of the property, and at shallower depths in the north and northwest portions.
- Unit No. 4 – sand and gravel. Unit No. 4, consisting of poorly sorted sand, gravel and gravelly sand, was found to be gradational with Unit No. 3, and to occur as lenses within Unit No. 3. Gravel in this unit is subangular to rounded, ranges in size from 3/8 to 1 inch in diameter, and commonly contains coal particles.

In 2010, AEP installed four monitoring wells at the perimeter of the wastewater pond complex. The lithologic borings for those wells were extended 39 to 46 feet below ground surface (BGS), at elevations of 351 to 359 feet, and did not encounter bedrock. The surficial silt and clay in these borings was found to be 16 to 24 feet thick, extending down to elevations of 373 to 381 feet. The underlying sand was described as primarily fine, grading downward to medium in one boring, and with gravel occurring in the sandy matrix below depths of 28 to 40 feet BGS in three borings.

Monitoring wells installed in 2016 around the BA Ponds extended to bedrock and confirmed the lithology described above. Details of the 2016 well installations, along with interpretive cross-sections, are provided in the report in **Appendix D**. Based on the data available from the 2016 subsurface explorations the fine-grained sediments corresponding to Unit No. 1 extend down to elevations of 369 to 385 feet in the vicinity of the ponds. The well-sorted sand unit corresponding to Unit No. 2 occurs below the fine-grained surficial sediments, extending down to elevations of 356 to 369 feet. Units No. 3 and 4 (interlayered) were found to extend down to shale bedrock at elevations of 274 to 299 feet.

Hydraulic Properties of Principal Groundwater Flow Zone

The saturated section of the unconsolidated sand and sand and gravel body comprising subsurface Unit Nos. 2, 3 and 4 (as described in the preceding section) makes up the principal groundwater flow zone underlying the site. This zone is hydraulically connected to the Ohio River but the connection is buffered by lower-permeability sediments that line the river bottom. Because of its relatively high permeability and its connection to the Ohio River, this zone represents an aquifer capable of supplying large yields to pumping wells. The depth to water in this zone typically ranges from 20 to 35 feet BGS, and the saturated thickness (which generally increases toward the river) ranges from less than 15 feet to more than 80 feet. Groundwater occurs in this zone under unconfined conditions, or semi-confined conditions where the surficial silt and clay directly overlies the saturated zone.

AEP provided information concerning pumping tests of varying lengths performed in this zone using onsite supply wells, including a pumping test performed in 1977 that was documented in the Landfill Application Package (AEP 1984), a pumping test performed in 2004 at a new supply well installed at the landfill, and yield tests performed in 2011 and 2012 at two new replacement wells used for fire water supply. Based on the information reviewed, the principal groundwater flow zone underlying the site has a transmissivity ranging from 126,000 to 250,000 gallons per day per foot (gpd/ft), corresponding to 17,000 to 34,000 square feet per day (ft2/day). The hydraulic conductivity of the formation ranges from 420 to 560 feet per day (ft/day), and the storage capacity (specific yield) ranges from 0.07 to 0.22. Pumping well yields range up to 1,000 gallons per minute (GPM), and specific capacities range from 48 to 121 GPM per foot of drawdown (GPM/ft).

2.4.3 Surface Water and Surface Water-Groundwater Interactions

The Ohio River at Owensboro drains a watershed of 97,000 square miles and the average flow is 121,200 cubic feet per second (CFS), according to Ray (1965). The stage in this section of the river is maintained by a downstream dam in Newburgh, Indiana above a minimum pool elevation of about 357.4 feet MSL (358 feet relative to the Ohio River Datum). The AEP Rockport Plant, located at River Mile (RM) 744-745, is halfway between the Newburgh Dam (RM 776) and the upstream Dam at Cannelton (RM 721). The river level at the Rockport Plant can be estimated by averaging the gauge data reported by the US Army Corps of Engineers (USACE) at Newburgh and Cannelton. A hydrograph (graph of water level over time) of the estimated daily stage in the Ohio River at the Rockport Plant from 2011 through 2022 is provided in **Appendix C-1**.

The water level in the Ohio River typically remains close to pool elevation in the summer and fall, and fluctuates at a relatively high frequency (for a few days to weeks), up to 20 feet above pool elevation, in the winter and spring months. The river stage typically reaches an elevation of 377 feet at least once in most years. The elevation of the 10-year flood is 387.7 feet, the 100-year flood level is 393 feet, and the level of the highest floods of record in the area (the floods of 1937 and 2018) is 397 feet. The river level has been at or near the 100-year flood mark four times in the past ten years.

Groundwater levels and gradients in the glaciofluvial sediments that fill the valley are strongly influenced by the Ohio River. Under low-water (pool) conditions, groundwater in the sediments flows under a low gradient toward the Ohio River. As the river level fluctuates in winter and spring, groundwater levels fluctuate along with it, although the effects are increasingly dampened with distance from the river. During rapid rises in river level, the groundwater gradient can be temporarily reversed to some distance from the riverbank, resulting in excess groundwater being stored in the sediment (bank storage), and then draining slowly back toward the river again as the river stage falls. Shifting potentiometric flow can be seen in the various maps included in **Appendix C-2.**

2.4.4 Water Users

The Indiana Department of Natural Resources (IDNR) Division of Water maintains an online database of Significant Water Withdrawal Facilities (http://www.in.gov/dnr/water/4841.htm). A Significant Water Withdrawal Facility (SWWF) is defined as a facility that has the capacity to withdraw more than 100,000 gallons per day (gpd) in aggregate from surface water and/or groundwater, through one or more registered “sources” (individual pumping wells or stations). There are 10 SWWFs registered in Spencer County, of which the AEP Rockport Plant has the highest capacity.

Onsite Water Use

The main source of water used at the plant is the Ohio River. The plant's registered capacity for surface water is 80,000 GPM. According to the IDNR database, in 2011 the plant's actual average usage of river water was 22.3 million gallons per day (MGD), corresponding to an average surface water withdrawal of 15,500 GPM.

The plant also has seven registered water withdrawal wells. The locations of these supply wells are shown on **Figure 2**. The combined average withdrawal from these wells in 2011 was 0.59 MGD (410 GPM). Information available for the onsite water supply wells is summarized below (withdrawal rates are based on 2011 data available in the IDNR database):

- Wells PW-1 and PW-2 are used for plant potable supply. The combined average withdrawal rate for these two wells is approximately 120 GPM.
- Wells PW-3 and PW-4 are used for fire water supply as well as industrial supply. The combined average withdrawal rate for these two wells is approximately 120 GPM.
- Well PW-5 was installed on the west side of US 231 and was intended to be used for landscape watering around an energy education center constructed by AEP at that location. The well is inactive (no withdrawals since it was installed).
- PW-6 is a well installed immediately east of the landfill to fill water trucks used for dust control. The average water withdrawal rate for this well is 17 GPM.
- PW-7 is a well installed southeast of the landfill to provide water for treating landfill leachate prior to discharge, as required under the plant's NPDES permit. The average water withdrawal rate for this well is 39 GPM.

Offsite Water Users

The other nine SWWFs in Spencer County include the following:

- The City of Rockport public supply (five wells with a combined capacity of 1,163 GPM).
- The Town of Grandview public supply (two wells with a combined capacity of 970 GPM).
- Reo Water, Inc., public supply for the City of Richland, west of Rockport (five wells with a combined capacity of 1,130 GPM).
- The City of Boonville public supply, northwest of Rockport (four wells with a combined capacity of 2,050 GPM).
- Corn Island Shipyard, a marine barge manufacturer on the Ohio River in Grandview (one well with a capacity of 450 GPM).
- Three agricultural irrigation users (Christmas Lake GC, Loehr Farms and Allen Gray LP II), all located remotely from the AEP Rockport Plant.
- One coal washing operation (Buckhorn Processing) using surface water, located in Lamar, Indiana north-northwest of the AEP Plant.

The Ohio River navigation charts (USACE 2014) show surface water intakes and other major structures along the river. The charts for sections of the river adjacent to and immediately downstream of the AEP Rockport Plant show the industrial intakes for the AEP plant and Rockport Terminals (a coal barging facility), and shoreline facilities in Rockport for one commercial marina, two crushed stone operations, and two loading facilities (ADM and Coal Inland).

3.0 Required Isolation From Uppermost Aquifer

The following sections describe WSP's evaluation of the uppermost aquifer and the required separation between the base of the CCR unit and the uppermost aquifer per the CCR Rule.

3.1 Aquifer Description and Piezometric Analysis

3.1.1 Hydrostratigraphic Units

Based on the available information, two generalized hydrostratigraphic units can be distinguished within the unconsolidated subsurface materials of the AEP Rockport Plant:

- The upper unit (corresponding to the unit identified as Unit No. 1 in previous work by AEP, discussed above in Section 2.4.2.2), consists of surficial silt and clay (locally containing sand). It is typically 8 to 25 thick, and is generally not saturated. However, it can serve as a perching layer above which water can accumulate in surface depressions or in more permeable surface fill. Soil sampling and permeability testing performed as part of the 1983 landfill Site Investigation indicates the bulk vertical permeability of the material in this unit is on the order of 10-7 to 10-6 centimeters per second (cm/sec), or 0.003 to 0.0003 ft/day.
- The lower unit (corresponding to combined Unit Nos. 2, 3 and 4, as discussed above in Section 2.4.2.2) extends from the bottom of the surficial silt and clay to the top of bedrock, and consists of granular outwash deposits. These deposits consist primarily of sand, ranging from well-sorted fine sand to poorly- sorted fine to coarse sand, with lenses of gravelly sand and sandy gravel. This unit has an uneven bottom surface, but generally thickens to the southeast, toward the Ohio River. The lower section of this unit is saturated and represents the principal groundwater flow zone beneath the property. The saturated thickness in this unit ranges from less than 15 to more than 80 feet, and the bulk permeability (hydraulic conductivity) of this unit is on the order of 500 ft/day.

Bedrock underlying the unconsolidated deposits consists predominantly of shale, and is expected to have low permeability. Bedrock in the area of the Rockport Plant does not represent a significant medium for flow or storage of recently recharged (meteoric) groundwater, and is not a reliable source of fresh water supply, relative to the much more available source in the sandy overburden.

3.1.2 Horizontal and Vertical Position Relative to CCR Unit

The East Bottom Ash Pond has a designed bottom elevation of 378.5 feet, as indicated in **Figure 9A**). Confirmation that the liner system was constructed with all subgrade elevations above 378.5 feet is contained in **Figures 9B and 9C**. After the removal of CCR from the East BA Pond, additional structural fill was imported to raise the subgrade in order to achieve the necessary 5 foot of groundwater separation, as demonstrated in the potentiometric maps found in **Appendix C-2**. The groundwater levels rose above 372' multiple times in piezometers adjacent to the East BAP after the previous certification was posted in 2018; but, as demonstrated in Table 1, they did not rise above 373 feet except for one reading of 373.03 feet at MW-1603S and readings of 374 feet and 373.85 feet at MW-1001 in May and June of 2019, during a period when the river was at the 100-year flood stage, as demonstrated in **Appendix C1**.

Table 1. Piezometric Levels at East Bottom Ash Pond

Date	MW-1001	MW-1002	MW-1603S	MW-1604S	MW-1605S
5/17/2011	371.61	373.2			
11/17/2011	370.77	369.17			
11/15/2012	368.91	367.48			
5/20/2013	369.11	367.95			
11/13/2013	368.38	366.99			
5/12/2014	370.06	369.55			
11/12/2014	368.57	367.03			
5/7/2015	370.75	371.16			
1/14/2016	369.34	368.55			
3/17/2016	369.79	369.15	369.15	369.22	369.48
6/6/2016	370.6	369.5	369.51	369.03	369.45
6/7-8/2016	370.6	369.5	369.51	369.03	369.45
7/18/2016	370.29	368.87	369.06	368.34	368.85
7/19-20/2016				368.34	368.85
9/19/2016	369.79	368.34	368.5	367.78	368.27
9/20/2016		368.34	368.5		
11/15-16/2016	369.31	367.99	368.15	367.28	367.78
1/9-10/2017	368.92	368.01	368.05	367.39	367.79
3/6/2017	369.30	368.73	368.47	368.36	368.56
3/7/2017		368.73	368.47	368.36	368.56
5/18/2017		368.68	368.6	368.52	368.76
7/17/2017		368.29	368.3	367.87	368.28
10/3/2017		367.1	367.33	366.56	367.16
11/13/2017	368.16	365.61	366.98	366.48	366.96
12/12/2017		366.94	366.96	366.41	366.89
1/3/2018		366.83	366.93	366.32	366.58
6/4/2018	372.31	371.54	371.54	371.16	371.44
6/5-6/2018		371.54	371.54	371.16	371.44
8/11-13/2018	371.51	370.02	370.08	369.36	369.88
8/15/2018		370.02			369.88
5/20/2019	374.00	372.98	373.03	372.62	372.96
6/24/2019	373.85	372.81	372.9	372.44	372.8
9/9/2019	372.74	371.02	371.2	370.3	370.78
3/9/2020	371.57	371.22	371.07	371.09	371.24
5/18/2020	372.98	372.6	372.43	372.39	372.61
11/10/2020	370.62	369.12	369.23	368.39	368.95
2/1/2021	369.73	368.37	368.39	367.91	368.38
5/24/2021	370.85	369.88	370	369.34	369.77
11/8/2021	369.25	367.72	367.83	367.11	367.6

Date	MW-1001	MW-1002	MW-1603S	MW-1604S	MW-1605S
2/14/2022	369.25	368.44	368.42	368.23	368.5
5/9/2022	364.65	369.85	369.85	369.5	369.54
5/9/2022	364.65	369.85	369.85	369.5	369.54

As demonstrated in **Appendix C-2**, based on the typical potentiometric surface (i.e. eastward/southeastward flow), it appears that the "upper limit to which the aquifer rises during the wet season" in the vicinity of the East Bottom Ash Pond is 373.5'. The elevation 5 feet above that is 378.5', in order to satisfy the separation requirement in 40 CFR 257.60.

Stratigraphic information for the subsurface in the area of the wastewater pond complex is provided in the logs available for several soil borings advanced in 1977 (**Appendix A**) and 2010 (**Appendix B**) and early 2016 (**Appendix D**). Subsurface stratigraphy is also illustrated in the cross-sections developed from the boring logs for the new monitoring wells installed in 2016 (**Figures 5-7** in **Appendix D**).

Three borings were advanced through the bottom of the north end of the East BA Pond on 27 January 2016. After logging, the borings were abandoned by sealing them from bottom to surface with hydrated bentonite pellets. A location map and field logs are provided in **Appendix E**. Based on surveyed elevations at the boring locations, CCR mixed with silt, clay and some sands were found to extend down to elevations of 376.2 to 378.8 feet. These fill materials were underlain by 0.5 to 2.5 feet of fine-grained sediments (clayey silt and clay) over sandy sediments.

3.1.3 Piezometric Conditions

Groundwater level data are available from piezometric measurements made in four monitoring wells (MW-1001 through MW-1004) installed in 2010 at the perimeter of the wastewater pond complex. Well construction details are summarized in Table 1, and well construction logs are provided in **Appendix B**.

The piezometric data are provided in **Appendix C**, along with hydrographs (graphs of water levels over time) for the wells and the Ohio River, and piezometric maps for selected events.

The piezometric data for the four initial monitoring wells show that water levels vary seasonally, typically fluctuating between 1 and 2.5 feet in an individual well, with higher water levels in May and lower water levels in November. This is consistent with river levels, which are low in summer and autumn, and spike to higher levels for short periods in winter and spring. In most of the monitoring events, the hydraulic gradient was toward the river, to the east-southeast. In some events, there was a shallow divide.
most likely related to a spike in river level that in some cases subsiding at the time of the monitoring. The water levels in the wells often lag behind the river rise. In early 2016, 20 new monitoring wells were installed in seven clusters of three wells each (including well MW-1002 installed in 2010).

Based on the available data and the analysis described above, a water level elevation of 373.5 feet can be considered a typical seasonal high water level in the sandy outwash deposits beneath the East Bottom Ash Pond.

3.2 CCR Rule Definition

As defined in the federal CCR Rule (§257.53 Definitions):

- Aquifer means a geologic formation, group of formations, or a portion of a formation capable of yielding useable quantities of groundwater to wells or springs.
- Groundwater means water below the land surface in a zone of saturation.
- Uppermost aquifer means the geologic formation nearest the natural ground surface that is an

aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary. Upper limit is measured at a point nearest to the natural ground surface to which the aquifer rises during the wet season.

3.3 Compliance

Consistent with the definition in the CCR Rule, the hydrostratigraphic unit identified as the uppermost aquifer in this case is the saturated granular outwash deposit that underlies the Rockport Plant property, including the East Bottom Ash Pond. The top of this unit would be the typical seasonal high water level of 373.5 feet. The minimum designed and as-built bottom elevation of the East Bottom Ash Pond liner system was constructed at 378.5 feet, as demonstrated in **Figures 9A, 9B and 9C**. Based on the information reviewed during this study, the design elevations indicate the East Bottom Ash Pond should have 5 feet of separation from the uppermost aquifer, the minimum set forth in 40 CFR §257.60.

4.0 Wetlands Impact

The USFWS National Wetlands Inventory (NWI) Wetlands Mapper was reviewed to evaluate the potential for wetlands adjacent to or in close proximity to the East Bottom Ash Pond, as shown in **Figure 6**. No historic or other state wetlands mapping is available for the project area.

Current NWI mapping characterizes the BA Ponds as lakes. Based on current Federal Emergency Management Agency (FEMA) floodplain mapping, the BA Ponds are situated within the 100-year floodplain of the Ohio River (FEMA 2015), a traditionally navigable waterway (TNW), as illustrated in **Figure 7**.

The U.S. Environmental Protection Agency (USEPA) and U.S. Army Corps of Engineers (USACE) issued a final rule (effective August 28, 2015) redefining jurisdictional "waters of the U.S.", which includes wetlands. Under the new CWA rule, the BA Ponds would not be deemed jurisdictional by rule because they are not within 1,500 feet of an Ordinary High Water Mark of a TNW. However, they are within the 100-year floodplain of the Ohio River. Consequently, the East Bottom Ash Pond would be subject to case-specific analysis by the USACE to determine if a significant nexus exists. If a significant nexus is deemed to exist, these waters would be considered jurisdictional waters of the U.S. and would be subject to Section 404 and 401 of the CWA. The USACE Louisville District is responsible for making final jurisdictional determinations for the subject property.

4.1 Review of Local Wetlands

Two intermittent, blue-lined streams are depicted on the USGS topographic map (**Figure 4**) on the western and eastern side of the BA Ponds; these streams are mapped as unnamed tributaries to Huffman Ditch and Honey Creek, respectively; however, these streams were filled during construction of the plant.

USFWS NWI mapping denotes the remaining impoundments associated with the wastewater pond complex as Freshwater Ponds (**Figure 6**). A Palustrine Forested wetland is also mapped 200 feet west of the westernmost ash pond; however, based on aerial coverage and a previous site visit, this area appears to be composed of maintained grassland.

4.2 Compliance

Based on WSP's review of available data, the East Bottom Ash Pond is not located in wetlands as defined by the EPA in 40 CFR §230.3 and §232.2. Based on aerial photography and NWI mapping data, the pond complex appears to be hydrologically isolated and does not appear to have a significant nexus to a navigable waterway. The ponds are designed as a closed system. No discharges should occur prior to treatment and discharges should only occur through approved NPDES outfalls. Further, these artificially-created, isolated impoundments were built for the reduction or control of pollution and are therefore anticipated to be exempt from the Indiana Isolated Wetland Law per IC 13-11-2-265(b)(3). The USGS topographic map indicates this pond complex occurs at the headwaters of

Huffman Ditch and Honey Creek (tributaries of the Ohio River), and is connected to these named streams via unnamed, intermittent tributaries. These tributaries are not visible in aerial photography (**Figures 2 and 3**) and no longer exist based on a previous site visit. It appears the USGS topographic mapping (**Figure 4**) may not accurately portray existing surface water conditions in the immediate area of the BA Ponds. At this location, the USACE Louisville District would be responsible for making final jurisdictional determinations.

The subject property is not located in a marine environment and is therefore not subject to the Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA). The East Bottom Ash Pond is not anticipated to cause a violation of the Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA), Endangered Species Act of 1973 (ESA), or CWA.

Federally-listed endangered least terns (Sterna antillarum) have been nesting at the Rockport Plant since 2000/2001. Least terns typically nest on the road between the two wastewater ponds immediately south of the BA Ponds. However, in some years they have been found to nest on the road between the BA Ponds. Since 2003, the Rockport Plant has been managing the least terns and regularly coordinating with Indiana Department of Natural Resources (IDNR). Management of the least terns is documented and conducted in accordance with the Least Tern Management Plan (AEP 2009). Work in the area of the least tern nests is restricted from May 15 to August 31, and "No Trespassing" signs are posted for further protection. No other listed species or critical habitat is known to occur on the subject property. Operation of the facility in accordance with the approved plans and applicable regulations should minimize the potential for adverse effects to this ESA-listed species. Therefore, operation of the BA Ponds is not anticipated to jeopardize the continued existence of listed species.

Because the East Bottom Ash Pond is believed to be an isolated impoundment, it is not anticipated to cause significant degradation of wetlands or a violation of the CWA. The pond operates under an engineered containment system designed to control discharge and is part of a closed system which prevents runoff of surface water to downstream areas. All discharges leaving the Rockport Plant are permitted and monitored under the NPDES / IDEM Rule 6 stormwater program (Permit No. IN0051845). Any violation of state or federal water quality standards would be addressed through state review of the monitoring data. In the event of a discharge from the pond complex, Outfall 001 is on the bank of the Ohio River. Therefore no wetlands would be impacted.

No net loss of wetlands has occurred as no wetlands are present within the project area. Continued operation of the East Bottom Ash Pond is not anticipated to result in the loss of wetlands outside the footprint of the pond. Based on WSP's review of available published data, a site visit conducted on September 28, 2023, and a previous site visit conducted on 30 July 2015, the East Bottom Ash Pond does not impact jurisdictional wetlands, and therefore meets the requirements of 40 CFR §257.61.

5.0 Fault Areas

5.1 Description of Regional Geologic Structural Features and Tectonic History

The East Bottom Ash Pond lies in the southern portion of a broad shallow downwarp structure referred to as the Illinois Basin (also known as the Eastern Interior Basin), and is underlain by sedimentary bedrock of Pennsylvanian Age.

The Illinois Basin is an oval shaped structural basin centered in southern Illinois and filled with Paleozoic sediments. The basin is bounded by the Cincinnati Arch to the east, the Kankakee Arch to the north, and the Nashville Dome in the south. The bedrock surface beneath the overburden is uneven, and includes rounded hills, ridges and valleys (draining southeast) representing the erosional surface that existed prior to filling of the valley with glaciofluvial sediments. The dominant surface geomorphological features are the result of the erosion and redeposition of these glaciofluvial valley fill sediments.

Our research included a review of the online database of Quaternary faults and folds maintained by the U.S. Geological Survey (USGS). The Wabash Valley Fault System is centered approximately 50 miles west of the BA Ponds and represents the most prominent Quaternary fault system in southern Indiana. The fault system occurs in Precambrian basement rock but is mapped at the surface in unconsolidated Quaternary deposits. The faults associated with this system are listed as Class A faults on the basis of mapped liquefaction features formed as the result of paleoevents that occurred in the Holocene (Obermeier and Crone 1994). However, all of the mapped faults in this system are located 35 miles or more from the Rockport Plant.

The nearest mapped faults to the East Bottom Ash Pond are the Little Hurricane Island Fault and the Africa Fault located approximately 4.1 and 4.9 miles south-southwest (**Figure 8**). Both faults trend northeast to southwest and are downthrown on the southeast side. These faults were mapped using stratigraphic data collected from approximately 3,000 petroleum test holes drilled in Spencer County. Faulting of Pennsylvanian age rocks and a lack of visible surface expression indicates that faulting occurred in the post-Pennsylvanian to pre-Pleistocene time range (Sullivan et al., 1980). There is little additional information available about these faults; however, neither appear in the USGS database of Quaternary faults.

5.2 Compliance

Based on WSP's review of available published data, the closest mapped faults to the site are the Little Hurricane Island Fault and the Africa Fault located several miles to the south and west of the BA Ponds. Neither of these faults exhibits evidence of displacement in Holocene time. The closest faults exhibiting evidence of displacement in Holocene time are faults in the Wabash Valley Fault System located more than 35 miles away. Based on available information, it is our opinion that the East Bottom Ash Pond meets the criterion of being located more than 200 feet from the outermost damage zone of a fault with displacement in Holocene time, as set forth in 40 CFR §257.62.

6.0 Seismic Impact Zone

6.1 Seismic Impact Zone – Definition and Regional Information

The certification for 40 CFR §257.63 will be provided by others in a separate report.

7.0 Unstable Areas

7.1 Unstable Areas – Definition and Review of Local Conditions

40 CFR §257.64 in the CCR Rule states that new or existing CCR units must not be located in an unstable area unless the owner or operator demonstrates that recognized and generally accepted good engineering practice has been incorporated into the design of the CCR unit to ensure that the integrity of the structural components of the CCR unit will not be disrupted. Unsuitable areas addressed in the CCR Rule include on-site or local soil conditions that may result in significant differential settling, on-site or local geologic or geomorphologic features, and on-site or local human-made features or events that could disrupt the integrity of the structural components of the CCR unit.

The BA Ponds are incised below grade along most of their perimeter and diked only on the west side of the West BA Pond, with a maximum dike height of 13 feet. The outer west dike and the internal dikes of the pond complex are constructed of natural clayey soils excavated from the interior of the ponds and the interior slopes are armored with riprap. Outlet structures include surface water adjustable weirs and subgrade piping to drain sluice water to the adjacent wastewater ponds. There is now an engineered liner system in the East Bottom Ash Pond.

The wastewater pond complex was constructed in the late 1970s and, other than the closure and retrofitting of the East BA Pond, has not been significantly modified since original construction (O&G 2011). Historical geotechnical borings completed at the wastewater pond complex indicate the native soils at the pond complex consist of a surficial stratum of stiff, mostly unsaturated silts and clays which extend to depths of about 8 to 15 feet, underlain by loose to firm fine sands, grading to firm medium to coarse sands with traces of gravel near the termination depths of the borings of 51.5 feet. AEP personnel have indicated that the soils underlying the ponds have not exhibited signs of differential settlement over the service life of the pond complex, and no indications of settlement were identified during a site visit conducted on September 28, 2023. It is my opinion that the soils underlying the pond will not exhibit compressibility that would result in significant long-term differential settlement, or that would impact the structural integrity of the East Bottom Ash Pond.

Review of historical aerial photos and published geologic information indicates that the BA Ponds were not constructed over underlying geomorphologic features such as ground subsidence or naturally occurring landslides, and the shale bedrock beneath the site is typically not susceptible to the formation of sinkholes. Based on our review, no local geologic or geomorphologic features were identified that would impact the integrity of the structural components of the East Bottom Ash Pond.

No on-site or local human-made features or events were identified during our review or previous site visit that would impact the integrity of the structural components of the unit.

7.2 Compliance

Based on the information reviewed during this study, a site visit conducted on September 28, 2023, and a previous site visit conducted on July 30, 2015, WSP finds no evidence indicating the existence of “unstable ground” conditions that would disrupt the integrity of the structural components of the East Bottom Ash Pond. Therefore, the unit meets the requirements of 40 CFR §257.64.

8.0 Summary

Based on the information WSP has reviewed for this study and observations made during a site visit on September 28, 2023, the East Bottom Ash Pond meets the location restrictions set forth in 40 CFR 257 for hydraulic separation from the uppermost aquifer (40 CFR §257.60), wetlands (40 CFR§257.61), fault areas (40 CFR §257.62) and unstable areas (40 CFR §257.64). The seismic impact zone certification will be provided by others in a separate report.

9.0 PE Certification

By means of this certification, I certify that I have completed a review of the available documents (as discussed in this report) for the retrofitted East Bottom Ash Pond at the AEP Rockport Generating Station located in Rockport, Indiana, for compliance with the Location Restrictions in 40 CFR §257.60, §257.61, §257.62, and §257.64, and have found that the East Bottom Ash Pond meets the requirements. The certification for 40 CFR §257.63 (seismic impact zones) will be provided by others in another document.

M. Brian Cole, P.E.
Printed name of Registered Professional Engineer

MICHAEL BRIAN COLE
REGISTERED
No. PE12300276
STATE OF
INDIANA
PROFESSIONAL ENGINEER
10/12/23

12300276	Indiana	12 October 2023
Registration No.	Registration State	Date

10.0 References

American Electric Power Company (AEP), April 1984. Application Package for Construction/Operating Permit for Solid Waste Management Facilities for Indiana and Michigan Electric Company's Ash Disposal Landfill for the Rockport Plant. Submitted to Indiana Environmental Management Board. (AEP 1984).

AEP, 18 July 1977. Design drawings No. 12-30013-15 and 12-30018-1 from *Unit No. 1 & 2 Wastewater & Bottom Ash Pond Area* (AEP 1977).

AEP, May 2009, Interior Least Tern Management Plan (AEP 2009).

AEP, 21 June 2010. *Stability Analysis of Bottom Ash Pond West Dike*, AEP Internal Memo. (AEP 2010).

AMEC Foster Wheeler, *Evaluation of Location Restrictions, Bottom Ash Ponds, Rockport Plant.* (AFW 2016).

Casagrande Consultants, 25 April 1977. *Foundation Investigations for Rockport Site*. Report prepared for AEP (Casagrande 1977).

Federal Emergency Management Agency (FEMA) National Flood Insurance Program (NFIP), March 18, 2015. *Flood Insurance Rate Map, Spencer County Indiana and Incorporated Areas*. Panels 245C and 250C of 375 (Map Nos. 18147C0245C and 18147C0250C). (FEMA 2015).

Grove, Glenn E., May 2006. *Bedrock Aquifer Systems of Spencer County, Indiana.* Indiana Department of Natural Resources (IDNR) map. (Grove, 2006).

Obermeier, S.F., and Crone, A.J., compilers, 1994. Fault Number 1024, Wabash Valley liquefaction features, in: *Quaternary fault and fold database of the United States*. U.S. Geological Survey website, http://earthquakes.usgs.gov/hazards/qfaults. (Obermeier and Crone 1994).

O'Brien & Gere Engineers, Inc., 24 March 2011. *Dam Safety Assessment of CCW Impoundments, Rockport Power Plant*. Report prepared for USEPA. (O&G 2011).

Ray, Louis L., 1965. *Geomorphology and Quaternary Geology of Owensboro Quadrangle, Indiana and Kentucky.* U.S. Geological Survey (USGS) Professional Paper 488, 72 p. (Ray 1965).

Sullivan, D.M., Ault, C.H., and Tanner, G.F., 1980. *Faulting in Perry and Spencer Counties, Indiana.* Proceedings of the Indiana Academy of Sciences. (Sullivan 1980).

United States Army Corps of Engineers (USACE), March 2014. *Ohio River Navigation Charts - Cairo, Illinois to Foster, Kentucky*. (USACE 2014)

United States Department of Agriculture–Soil Conservation Service (USDA-SCS), 1973. *Soil Survey of Spencer County, Indiana.* (USDA 1973).

Wood, *Evaluation of Location Restrictions, Bottom Ash Ponds.* (Wood 2018).

WorleyParsons, 7 November 2011. Design drawing No. 12-300410, *Boring Location – Overall Plan*. (WP 2011).

Tables

Table 2
Monitoring Well Construction Details
Wastewater Pond Complex
AEP Rockport Plant, Rockport, Indiana

Well ID	Date Installed	Northing SPCS NAD27 (ft)	Easting SPCS NAD27 (ft)	Length of Screen (ft)	Casing Type	Casing Diameter (in)	Borehole Diameter (in)	Total Depth to Bottom of Well (ft BMP)	Total Depth to Bottom of Well (ft BGS)	Total Depth of Bore Hole (ft BGS)	Depth to Bedrock (ft BGS)
MW-1001	6/2/2010	153488.0	513047.6	9.7	PVC	2	6.25	42.3	40.0	41	no refusal
MW-1002	6/2/2010	152307.4	514231.0	9.7	PVC	2	6.25	47.8	45.5	46.5	no refusal
MW-1003	6/2/2010	151208.1	512820.7	9.7	PVC	2	6.25	40.4	38.0	39	no refusal
MW-1004	6/3/2010	150013.4	514264.7	9.7	PVC	2	6.25	44.8	42.5	43.5	no refusal

Well ID	Ground Surface Elevation (ft APD)	Top of Casing Elevation (ft APD)	Casing Stickup (ft AGS)	Top of Seal Elevation (ft APD)	Top of Sand Elevation (ft APD)	Top of Screen Elevation (ft APD)	Bottom of Screen Elevation (ft APD)	Bottom of Well Elevation (ft APD)	Bottom of Sand Elevation (ft APD)	Bottom of Borehole Elevation (ft APD)	Bedrock Elevation (ft APD)
MW-1001	400.03	402.35	2.3	374.33	372.33	370.33	360.63	360.03	359.03	359.03	no refusal
MW-1002	399.09	401.42	2.3	368.19	366.09	363.89	354.19	353.59	352.59	352.59	no refusal
MW-1003	390.84	393.23	2.4	368.04	365.14	363.14	353.44	352.84	351.84	351.84	no refusal
MW-1004	394.25	396.55	2.3	366.55	364.55	362.05	352.35	351.75	350.75	350.75	no refusal

Notes:
ft = feet
in = inches
BMP = below measuring point (top of casing)
BGS = below ground surface
APD = above plant datum
AGS = above ground surface

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Figures

AMERICAN ELECTRIC POWER

Legend

Site Location

Service Layer Credits: DeLorme Specialty

0 40

Miles

NORTH

11003 Bluegrass Parkway, Suite 690
Louisville, Kentucky 40299
Phone: (502) 267-0700

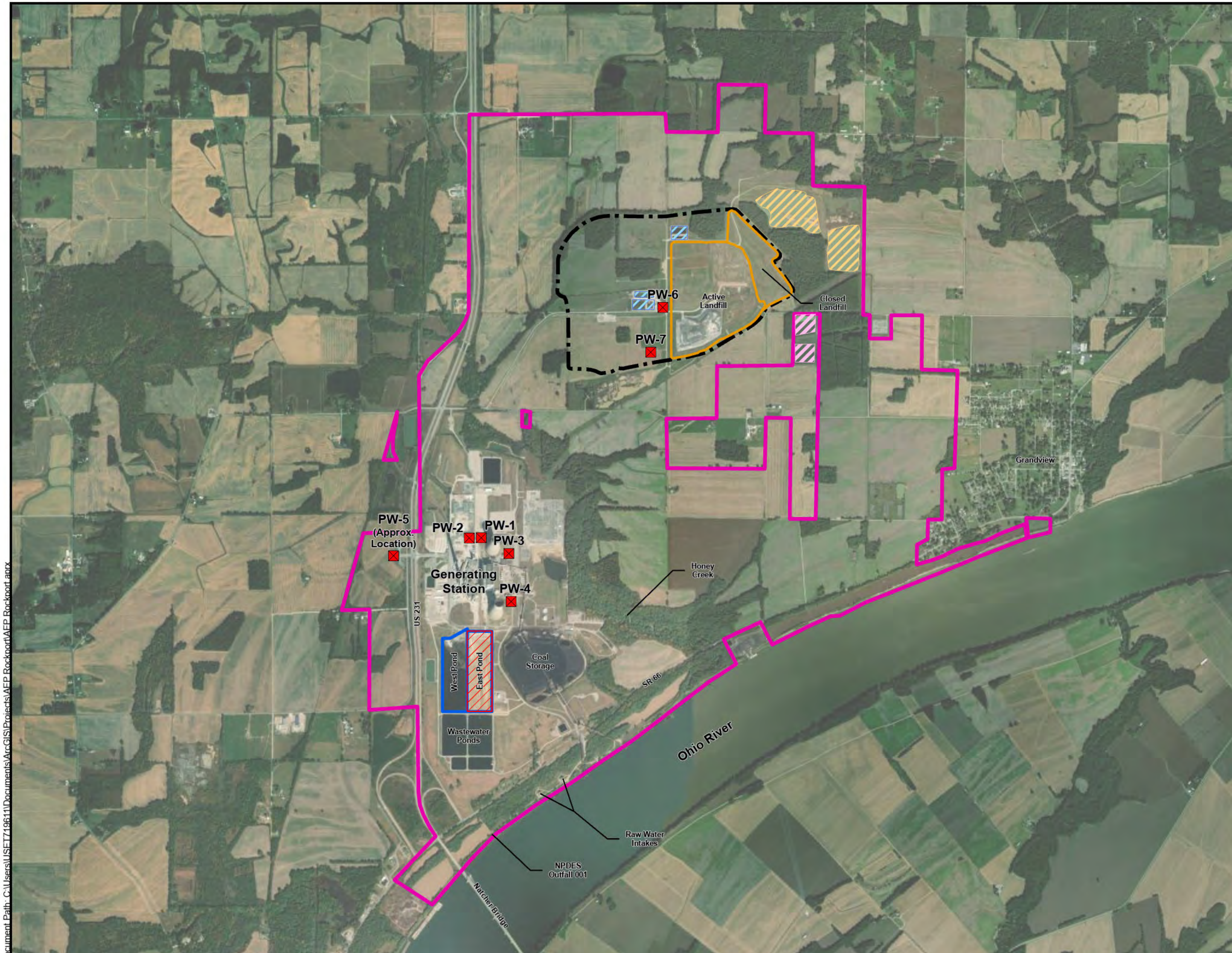
SITE LOCATION MAP

AEP - Rockport, IN

PROJECT NUMBER: 7382233458

SCALE	1" = 40 miles
DATE	9/18/2023
DRAWN BY	ET
APPROVED BY	MBC

FIG. 1



SITE LAYOUT MAP

AEP - ROCKPORT, IN

PROJECT NUMBER: 7382233458

SCALE	1" = 2,400'	FIG. 2
DATE	9/20/2023	
DRAWN BY	ET	
APPROVED BY	MBC	

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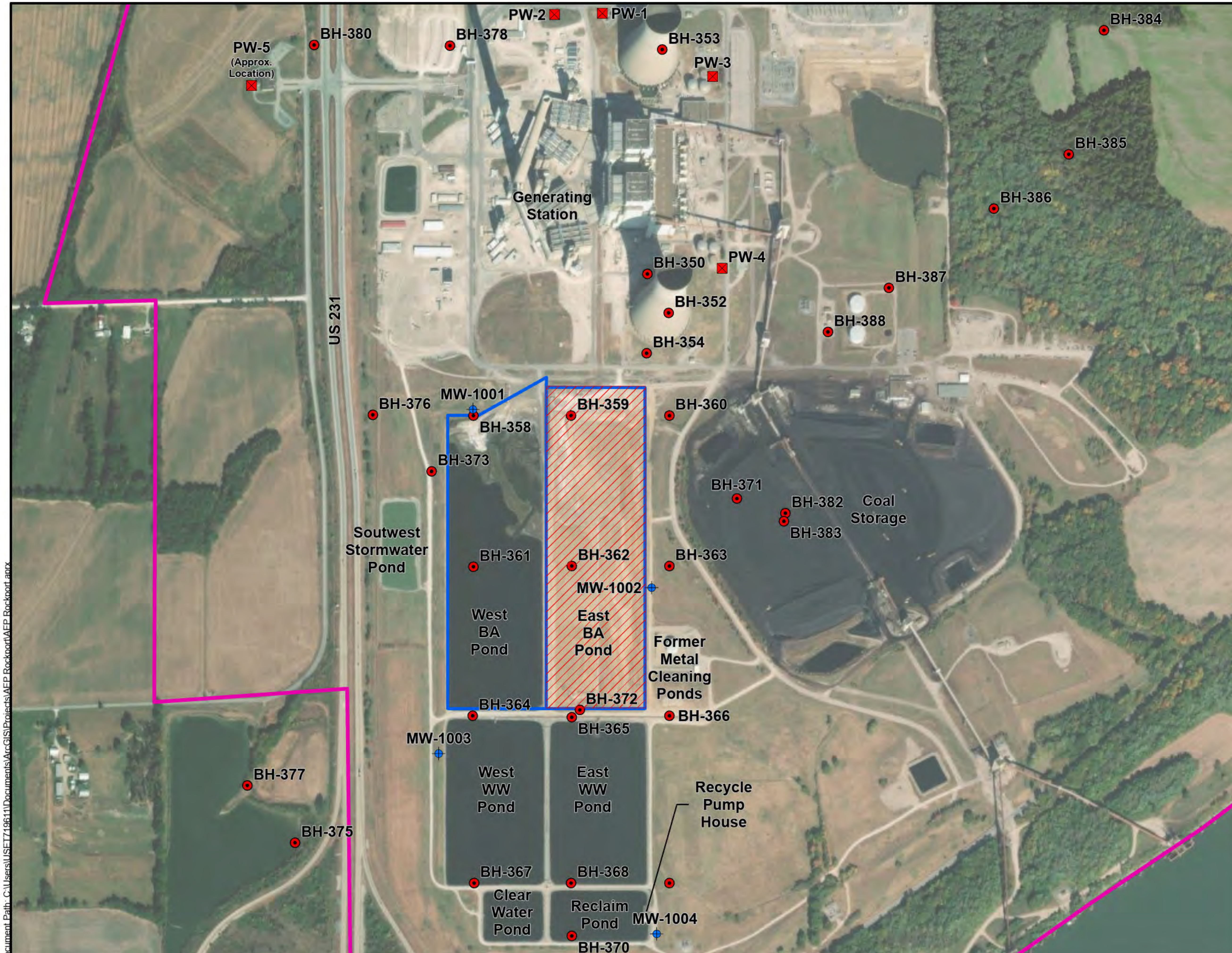
Louisville, Kentucky 40299
Phone: (502) 267-0700

Document Path: C:\Users\USET719611\Documents\ArcGIS\Projects\AEP Rockport\AEP Rockport.aprx



Legend

- Property Boundary
- USWAG Monitoring Well
- Water Supply Well
- Geotechnical Boring
- West Bottom Ash Pond
- East Bottom Ash Pond

Data Sources

Service Layer Credits: World Imagery: Maxar

Date of Photography: May-June 2016
Source of Photography: U.S. Department of Agriculture, National Agriculture Imagery Program (NAIP)

0 300 600
SCALE IN FEET

WASTEWATER POND COMPLEX

AEP - ROCKPORT, IN

PROJECT NUMBER: 7382233458

SCALE	1" = 600'	FIG. 3
DATE	9/20/2023	
DRAWN BY	ET	
APPROVED BY	MBC	

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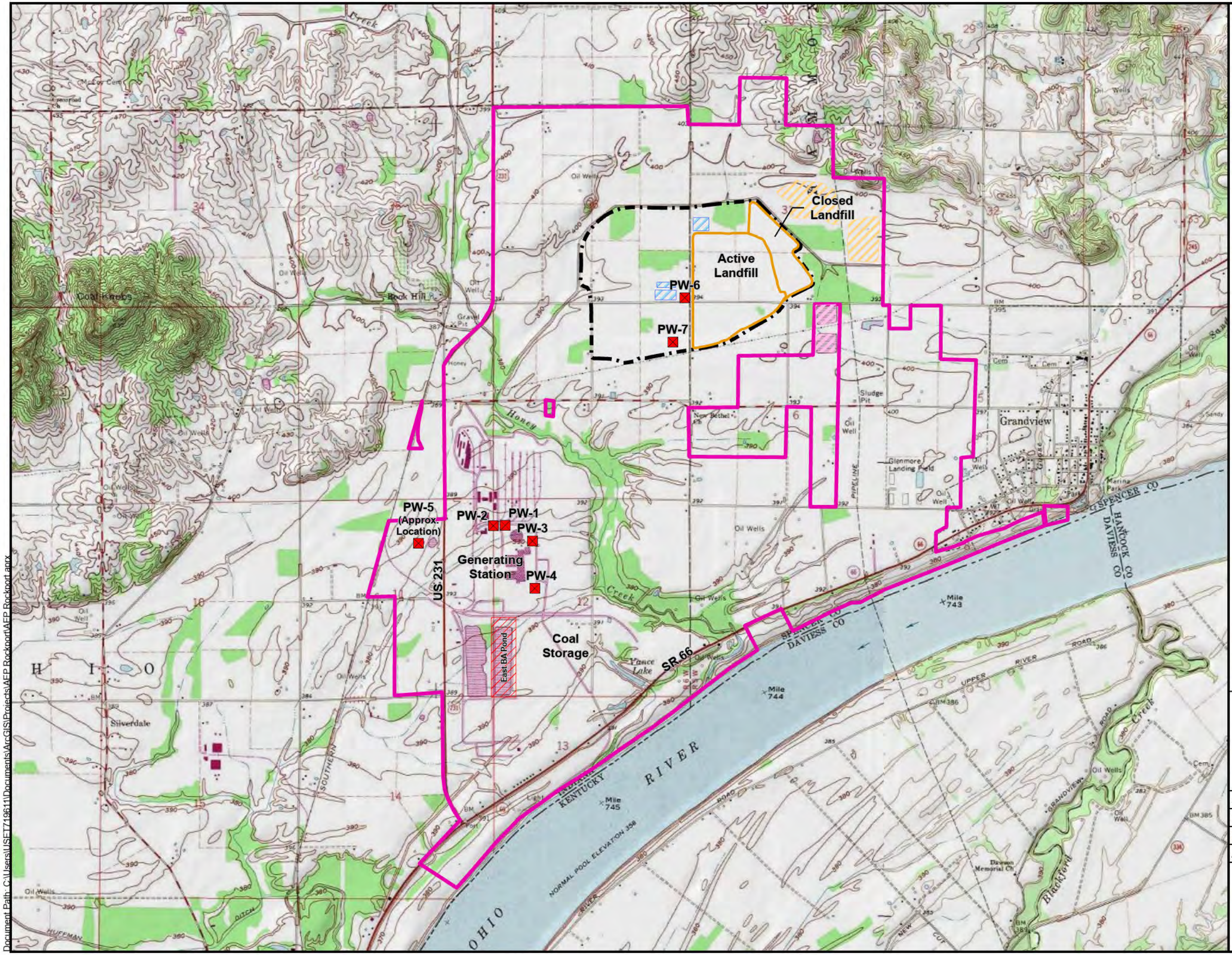

Legend

- Stormwater Ponds
- Landfill Leachate Ponds
- Grandview Wastewater Ponds
- Property Boundary
- Landfill Area 1A (Active and Closed)
- 1984 Landfill Permit Boundary (Area 1)
- Water Supply Well
- East Bottom Ash Pond

Data Sources

Source: USGS Rockport and Lewisport (IN/KY) Topographic Quadrangle Maps, 1964, photorevised 1982

0 1,200 2,400
SCALE IN FEET

TOPOGRAPHIC MAP

AEP - ROCKPORT, IN

PROJECT NUMBER: 7382233458

SCALE	1" = 2,400'	**FIG. 4**
DATE	9/20/2023	
DRAWN BY	ET	
APPROVED BY	MBC	

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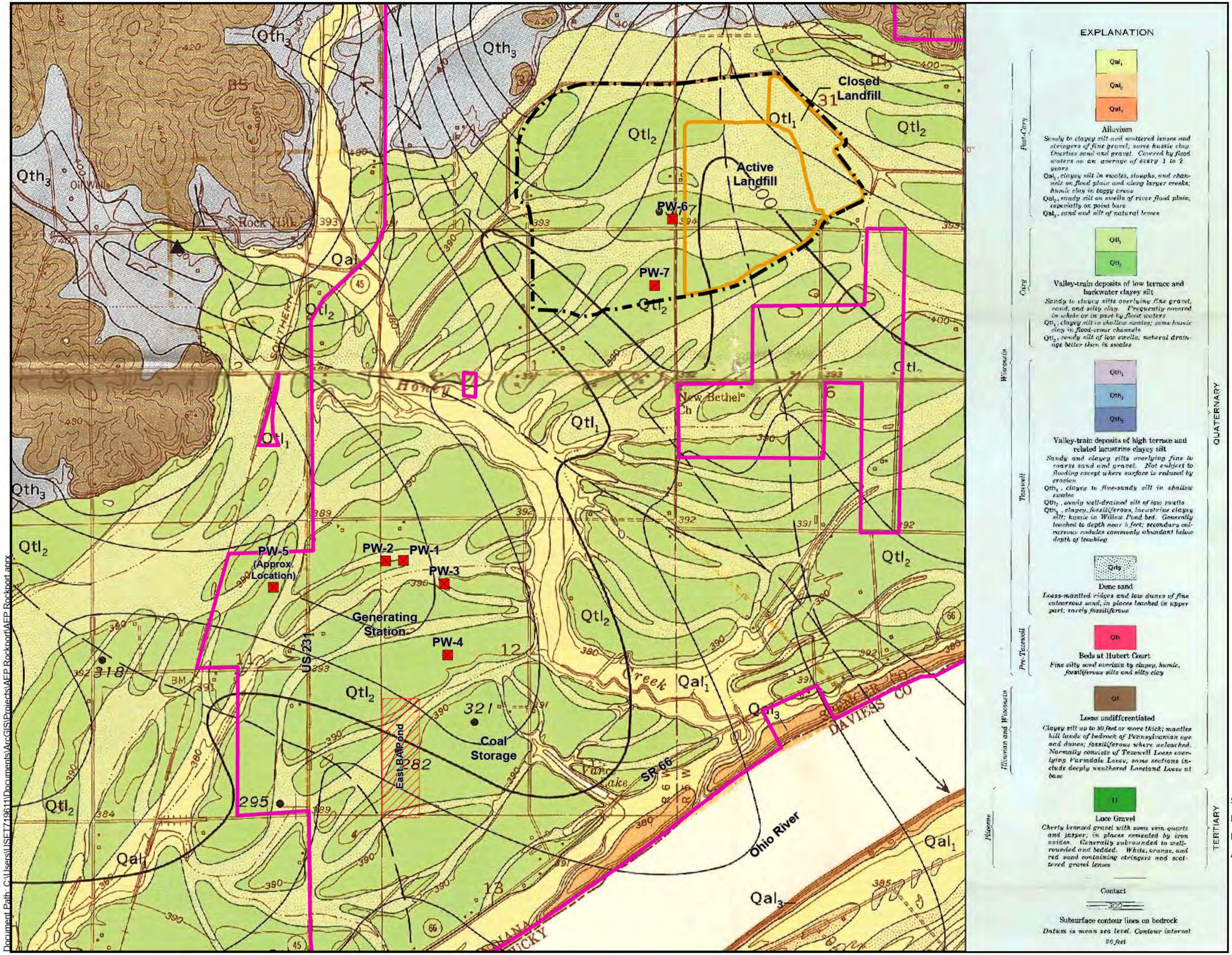

Legend

- Property Boundary
- 1984 Landfill Permit Boundary (Area 1)
- Landfill Area 1A (Active and Closed)
- Water Supply Well
- East Bottom Ash Pond

Data Sources

Source: Geologic Map of the Owensboro Quadrangle, Indiana and Kentucky, USGS Professional Paper 488, 1965

0 800 1,600
SCALE IN FEET

SURFACE GEOLOGY MAP

AEP - ROCKPORT, IN

PROJECT NUMBER: 7382233458

SCALE	1" = 1,600'	FIG. 5
DATE	9/20/2023	
DRAWN BY	ET	
APPROVED BY	MBC	

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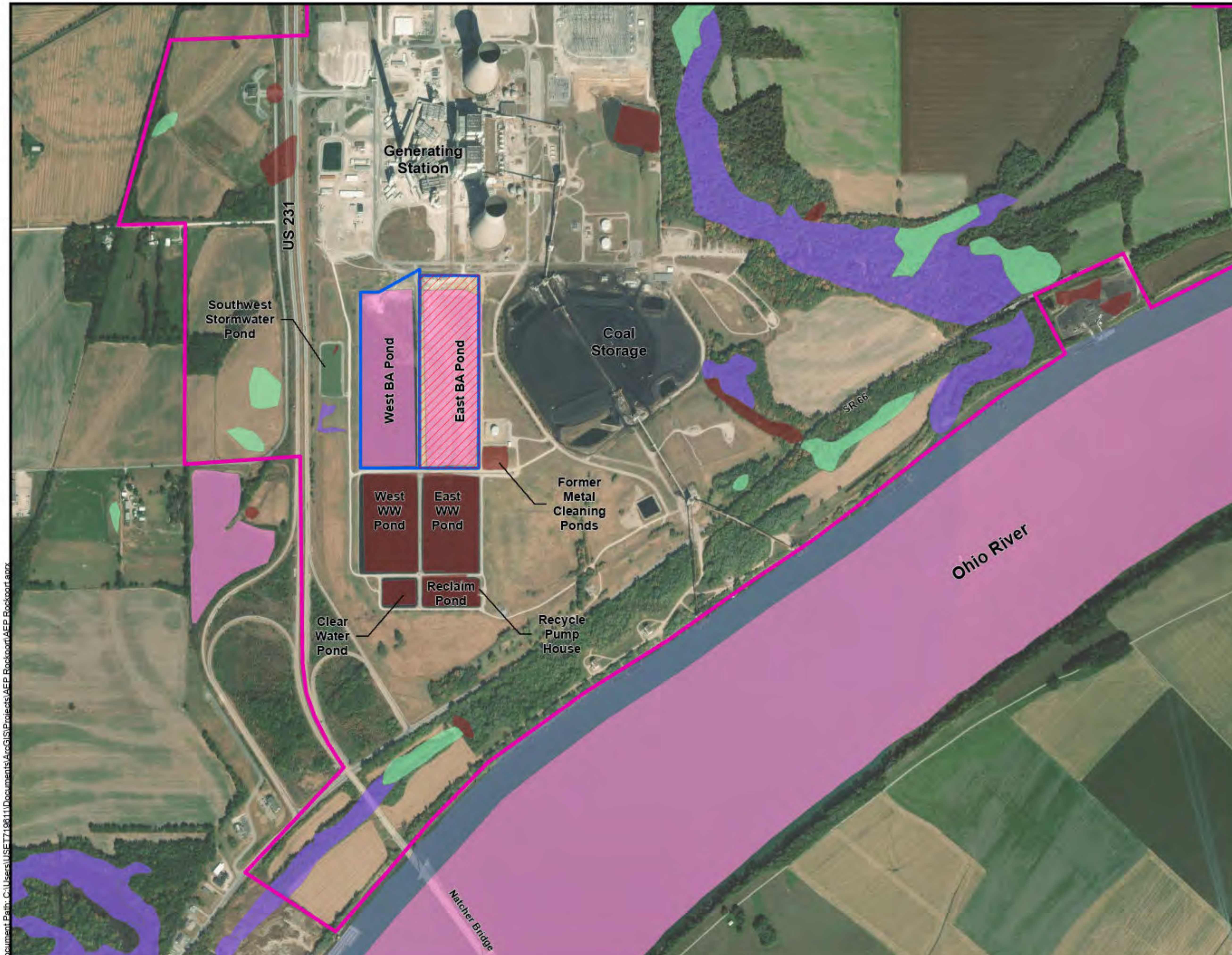

Legend

- Property Boundary
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine
- West BA Pond
- East BA Pond

Data Sources

Service Layer Credits: World_Imagery: Maxar

Date of Photography: May-June 2016
Source of Photography: U.S. Department of Agriculture, National Agriculture Imagery Program (NAIP)

Source of Wetland Mapping: Updating the National Wetlands Inventory (NWI) for Indiana - Final Report, 11 November 2010

0 500 1,000
SCALE IN FEET

WETLANDS MAP

AEP - ROCKPORT, IN

PROJECT NUMBER: 7382233458

SCALE	1" = 1,000'	FIG. 6
DATE	9/20/2023	
DRAWN BY	ET	
APPROVED BY	MBC	

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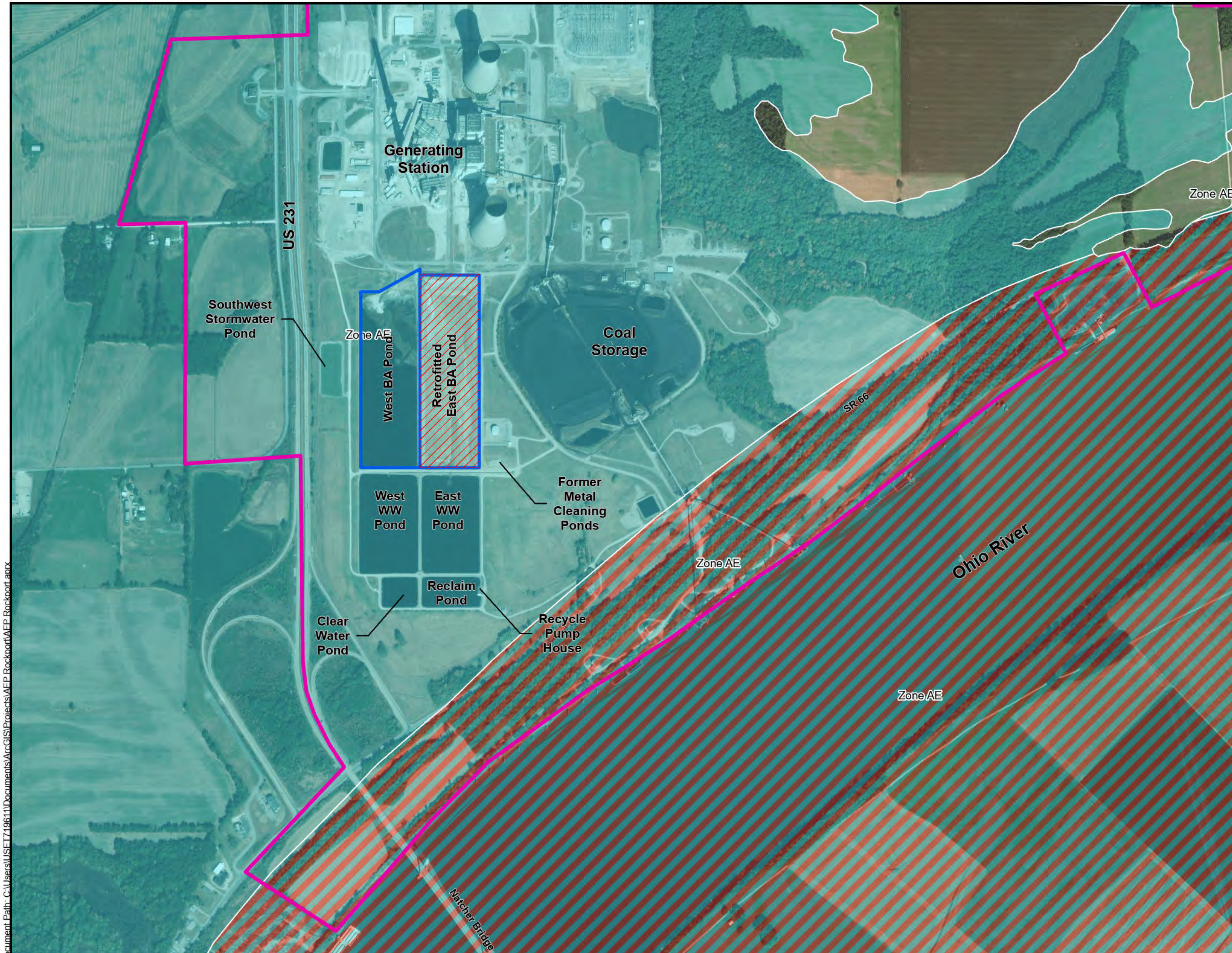

Legend

Property Boundary
West BA Pond
East BA Pond

Flood Hazard Boundaries

Limit Lines
NP
SFHA / Flood Zone Boundary
Flowage Easement Boundary

Flood Hazard Zones

1% Annual Chance Flood
Regulatory Floodway
Special Floodway
Area of Undetermined Flood Hazard
0.2% Annual Chance Flood Hazard
Future Conditions 1%

Data Sources

Service Layer Credits: FEMA National Flood Hazard Layer : FEMA
World_Imagery: Maxar

Date of Photography: May-June 2016
Source of Photography: U.S. Department of Agriculture, National Agriculture Imagery Program (NAIP)

Source of Floodplain Mapping: Floodplains - Flood Rate Insurance Maps (FIRM), 20140210 (1:12,000), 2014

0 500 1,000
SCALE IN FEET

FEMA FLOODPLAIN MAP

AEP - ROCKPORT, IN

PROJECT NUMBER: 7382233458

SCALE	1" = 1,000'	FIG. 7
DATE	9/20/2023	
DRAWN BY	ET	
APPROVED BY	MBC	

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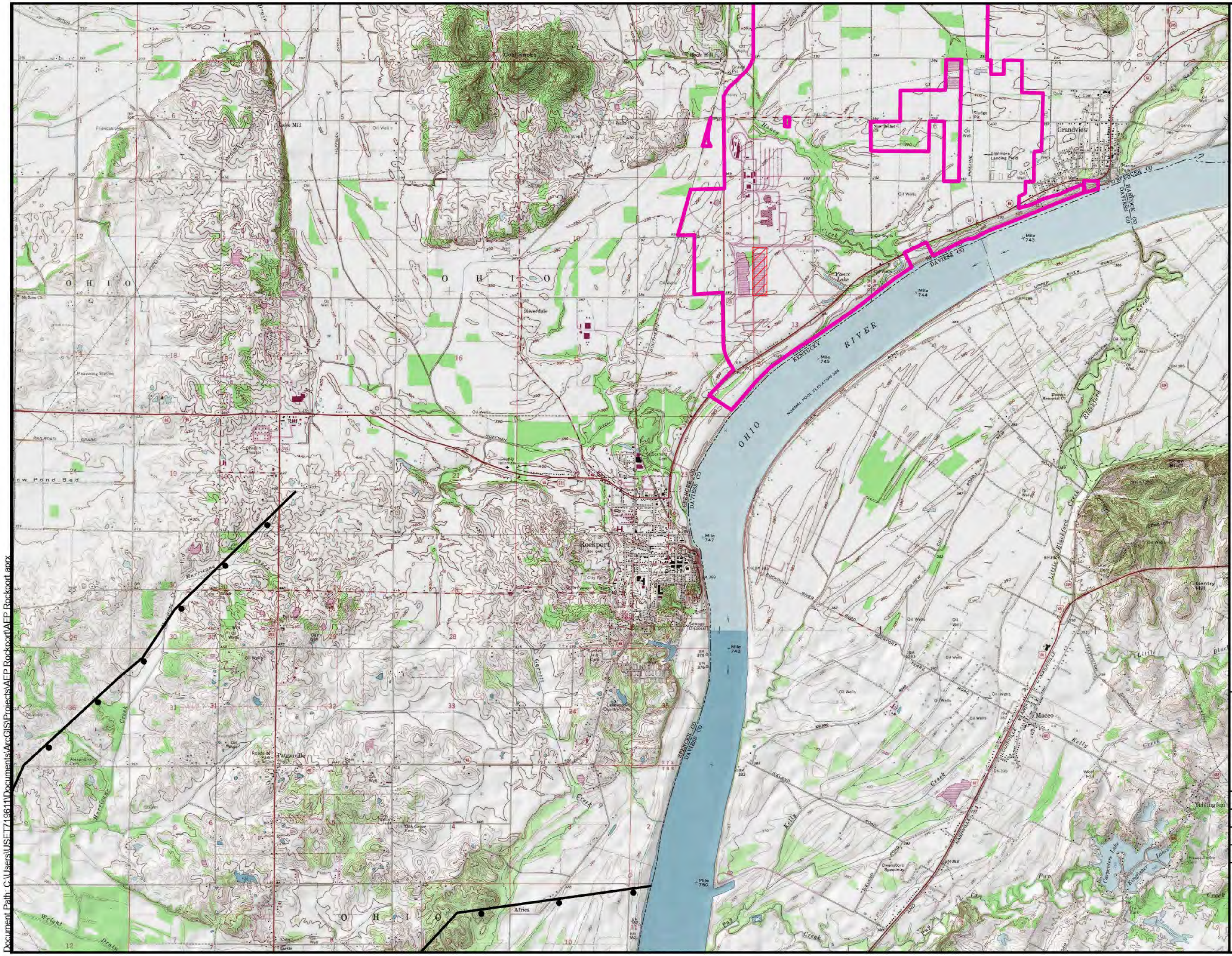
Louisville, Kentucky 40299
Phone: (502) 267-0700

Document Path: C:\Users\USET719611\Documents\ArcGIS\Projects\AEP Rockport\AEP Rockport.aprx



Legend

- Property Boundary
- East Bottom Ash Pond
- structural_features_in
- Fault (downthrown indicated)

Data Sources

Service Layer Credits: USA_Topo_Maps: Copyright:© 2013 National Geographic Society, i-cubed

Source: USGS Rockport and Lewisport (IN/KY) Topographic Quadrangle Maps, 1964, photorevised 1982.

0 2,000 4,000
SCALE IN FEET

MAPPED FAULTS

AEP - ROCKPORT, IN

PROJECT NUMBER: 7382233458

SCALE	1" = 4,000'	FIG. 8
DATE	9/20/2023	
DRAWN BY	ET	
APPROVED BY	MBC	

wsp

11003 Bluegrass Parkway, Suite 690
Louisville, Kentucky 40299
Phone: (502) 267-0700

Document Path: C:\Users\USET719611\Documents\ArcGIS\Projects\AEP Rockport\AEP Rockport.aprx

GENERAL NOTES

1. BACKGROUND LAND SURFACE TOPOGRAPHY AND FEATURES ARE FROM A SURVEY BY PRECISION SURVEYING, INC. DATED 02-08-21. HORIZONTAL AND VERTICAL DATUM BASED ON AEP ROCKPORT SITE CONTROL SYSTEM.
2. COORDINATE GRID SHOWN IS SITE COORDINATE SYSTEM. FOR SITE MONUMENTATION SEE DRAWING 12-300418.
3. CONTRACTOR TO PLACE FILL MATERIALS IN EXISTING EAST BOTTOM ASH POND (EXCAVATED AND HAULED FROM ON-SITE BORROW AREA) TO ESTABLISH PREPARED LINER SYSTEM SUBGRADE, AS INDICATED ON LINER DETAILS (OPTION 1) ON REF. DWG 12-301205.
4. FOR LINER SYSTEM SUBGRADE ELEVATIONS SEE DRAWING 12-301203A.
5. INSTALL 25 GAS FLAP VENTS AROUND BOTTOM ASH POND (5 ON SOUTH SIDE, 10 ON EAST SIDE, AND 10 ON WEST SIDE).
6. INSTALL 7 GAS RISER VENTS AROUND POND FOREBAY AREA (3 ON NORTH SIDE, 2 ON EAST SIDE, AND 2 ON WEST SIDE).
7. ALL WORK SHALL BE PERFORMED IN ACCORDANCE WITH A SEQUENCE AND WORK PLAN SUBMITTED BY THE CONTRACTOR AND ACCEPTED BY THE OWNER AND ENGINEER.
8. WORK SHALL NOT BEGIN UNTIL ALL EXISTING EAST BOTTOM ASH POND INFLOWS/OUTFLOWS ARE DIVERTED OR PERMANENTLY PLUGGED.
9. POND LINER SYSTEM SHALL BE ATTACHED TO ALL EXISTING POND STRUCTURES, PIPES, ETC. TO ASSURE NO AREAS OF LEAKING EXIST FOR THE INSTALLED LINER SYSTEM. TYPICAL LINER CONNECTION DETAILS AREA INDICATED ON REF. DWG'S 12-301205 AND 12-301206.
10. MAINTAIN ACCESS TO AND PROTECT ALL EXISTING MONITORING WELLS DURING THE WORK. MAINTAIN A MINIMUM 10 FOOT BUFFER AROUND ANY WELL (NO EARTH DISTURBANCE) WHEN POSSIBLE. IF 10 FOOT BUFFER IS NOT POSSIBLE, GET DOCUMENTED APPROVAL FROM AEP ENVIRONMENTAL SERVICES ON ACCEPTABLE BUFFER, IF SHORING IS REQUIRED, OR ANY OTHER REQUIRED WELL PROTECTION CRITERIA, PRIOR TO THE WORK.
11. REFER TO AND COMPLY WITH THE FOLLOWING AEP SPECIFICATIONS UNLESS INDICATED OTHERWISE ON DRAWINGS:
    A. CE-004 EXCAVATION
    B. CE-006 FILL
    C. CE-006A EARTHWORK (BACKFILL) TESTING
    D. CE-008 SUBSURFACE DRAINAGE SYSTEMS
    E. CE-013A NON-WOVEN GEOTEXTILES
    F. CE-018 SURVEY SERVICES
    G. CE-021 AERIAL PHOTOGRAPHY AND TOPOGRAPHIC MAPPING
    H. CE-026LL GEOMEMBRANE (LLDPE)
    I. CE-035 GEOSYNTHETIC CLAY LINER
    J. CE-036 DEMOLITION REMOVALS AND ALTERATIONS
    K. CE-037 EXCAVATION AND BACKFILL FOR UNDERGROUND UTILITIES
    L. CE-038 FLOWABLE BACKFILL (CONTROLLED LOW-STRENGTH MATERIAL)
    M. CE-040 MATERIALS FOR UNDERGROUND PIPING AND SEWERS
    N. CE-042 INSTALLATION OF UNDERGROUND HDPE PRESSURE PIPING
12. ENSURE PIPES ARE OUT OF THE WAY FOR CCR REMOVAL FOR WEST BOTTOM ASH POND OR CCR MATERIAL IS REMOVED PRIOR TO PLACING PIPES.

LEGEND:

400	EXISTING GRADE CONTOUR
	EXISTING PIPE
TOP / TOE	POND SIDE SLOPE
	EXISTING ELECTRIC MANHOLE
	EXISTING PIPE BOLLARD
	EXISTING WATER VALVE
	LIMIT OF LINER SYSTEM
	NEW LINER ANCHOR TRENCH

REFERENCE DRAWINGS

12-300418	UNITS 1 AND 2 SURVEY CONTROL AND MONUMENTATION PLAN
12-301203A	EAST BOTTOM ASH POND LINER SUBGRADE PLAN
12-301204	EAST BOTTOM ASH POND LINER SYSTEM SECTIONS AND DETAILS
12-301205	EAST BOTTOM ASH POND LINER SYSTEM SECTIONS AND DETAILS
12-301206	EAST BOTTOM ASH POND LINER SYSTEM SECTIONS AND DETAILS
12-301215	EAST BOTTOM ASH POND BORROW AREA CIVIL SITE PLAN
12-301220	POND COMPLEX EROSION AND SEDIMENT CONTROL PLAN
12-30027	UNIT No. 1 & 2 WASTEWATER & BOTTOM ASH POND AREA SECTIONS & DETAILS
12-5123	YARD PIPING UNIT No. 1 & 2 SHEET No. 2 OF 39
12-5137XA	ARRG'T OF CHEM TREATMENT & COAL PILE RUNOFF PIPING

60 0 60 120 180
SCALE: 1"=60'

REV	DATE	DESCRIPTION	DRAWN	CHECKED	REVIEWED	LEAD DESIGNER	ENGINEER/TECH. SPEC.	LEAD DISC ENGINEER	PROJ ENGR MANAGER
2	08 JUN 23	ISSUED FOR CONSTRUCTION; REVISED AS INDICATED	RES	KJF	EDL	KJF	EDL	EDL	MHN
1	28 JUL 22	ISSUED FOR CONSTRUCTION; REMOVED HOLD, REV DISCH STRUCT CALLOUT	KJF	EDL	EDL	KJF	EDL	EDL	MHN
0	31 MAR 22	ISSUED FOR CONSTRUCTION	KPF	RES	EDL	KJF	EDL	EDL	MHN

Worley energy | chemicals | resources
OneWay empowered | enabled | ethical

PRELIMINARY STATUS — DATE - - — INFORMATION ONLY - NOT TO BE USED FOR CONSTRUCTION.
LDE
APPROVED STATUS — DATE — REPRESENTS REVIEWED AND APPROVED DESIGN. ANY PORTION MARKED "HOLD" RETAINS PRELIMINARY STATUS.
LDE ED LEIBY 31-MAR-22

ORIGINATING PERSONNEL
DRAWN BY: KPF
CHECKED BY: RE STOUDT
LEAD DESIGNER: KJ FRITZ
ENGINEER/TECH SPECIALIST: ED LEIBY
PROJECT ENGINEERING MANAGER: MH NACEY

PROFESSIONAL ENGINEER'S SEAL
YINGWU XU REGISTERED No. 12000238 STATE OF INDIANA PROFESSIONAL ENGINEER
ORIGINALLY PREPARED UNDER THE RESPONSIBLE SUPERVISION OF
PE: YINGWU XU STATE: INDIANA
LIC. NO.: PE 12000238 DATE: 31-MAR-22

Figure 9 A

SEE WORLEY REVISION BLOCK

DATE	NO.	DESCRIPTION	APPD.

REVISIONS

THIS DRAWING IS CLASSIFIED AS:
AEP CONFIDENTIAL
REFERENCE AEP's CORPORATE INFORMATION SECURITY POLICY

INDIANA MICHIGAN POWER COMPANY
ROCKPORT PLANT
ROCKPORT INDIANA
CCR/ELG PROJECT
EAST BOTTOM ASH POND LINER SYSTEM PLAN

UNIT: 12 | DRAWING NUMBER: 301203 | REV: 2
SCALE: 1"=60' | CIVIL ENGINEERING
DR: CH: SUP: ENG: DATE: | APPROVED BY | DOCUMENT PREPARED BY WORLEY

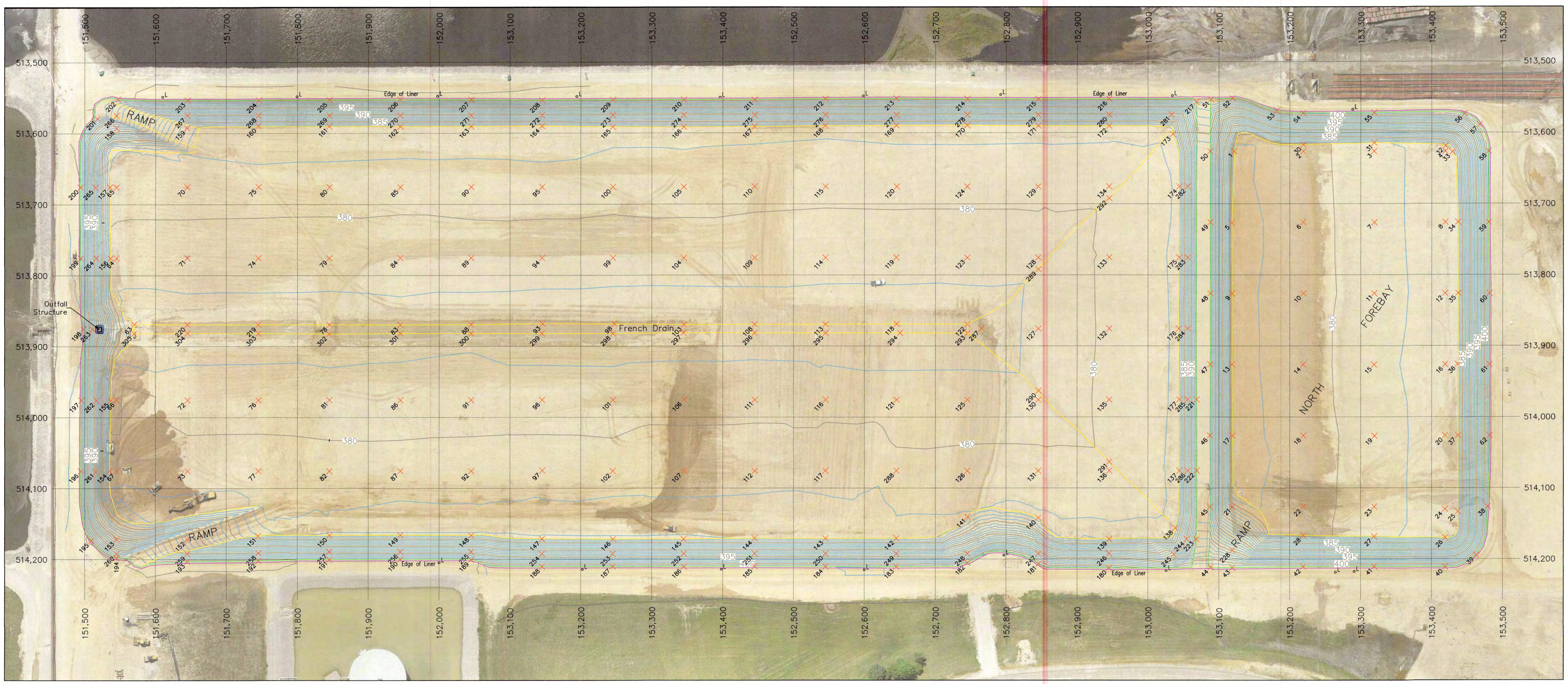
AMERICAN ELECTRIC POWER
AEP SERVICE CORP. 1 RIVERSIDE PLAZA COLUMBUS, OH 43215

PLOT DATE: 6/8/2023 PLOT TIME: 10:37:59 AM BY: Robert.Stoudt
CROSS REFS:
...\RKP_12_AEP_301203_CAD.dgn 6/8/2023 10:37:59 AM
DRAWING NUMBER 12-301203

AEP Rockport Station

NE POND AS-BUILT

0 75 150 225



LEGEND

LEAK DETECTION

ELEVATION SHOT

EDGE OF LINER

Notes:

1. Horizontal & Vertical Control system used: Indiana West State Plane Horizontal Datum NAD27 & Vertical Datum NGVD29.
2. Units: US survey feet.
3. Survey method: Trimble R8 GPS Unit and DJI Phantom 4 RTK UAV
4. Surveyed by: KLL.
5. Photo date: 7/13/2023
6. Propeller images are high-accuracy geotags. Errors of up to ± 3cm (1/10ft) are to be expected.
7. Trimble R8 GNSS surveying Horizontal 3mm+0.5ppm RMS, Vertical 5mm+0.5ppm RMS

KEVIN L. LAUTNER REGISTERED No. LS20400006 STATE OF INDIANA LAND SURVEYOR

10/5/23

Kevin L. Lautner, L.S.
Indiana Reg. #LS20400006

Figure 9 B

REV	DATE	DESCRIPTION
1	7/14/23	Updated Grid Points
2	7/21/23	Updated Grid Points
3	8/2/23	Updated Grid Points
4	8/8/23	Updated Grid Points
5	8/28/23	Updated Grid Points
6	10/3/23	Added edge of liner

PROJECT ASSOCIATES CONSULTING ENGINEERS

PRECISION SURVEYING

A SUBSIDIARY OF PROJECT ASSOCIATES

PROJECT NO.: 230290

DRAWN BY: DAB

SCALE: 1"=75'

PROJECT: AEP Rockport NE Pond As-built

ADDRESS: 2791 US- 231 Rockport, IN

DRAWING TITLE: AEP Rockport NE Ash Pond As-built

Date: 7/19/2023

SHEET NO.: 1 of 2

AEP Rockport Station

NE POND AS-BUILT

Entact Survey Grid															
Grid #	Northing	Easting	Elevation	Grid #	Northing	Easting	Elevation	Grid #	Northing	Easting	Elevation	Grid #	Northing	Easting	Elevation
1	153,121.5'	513,626.4'	378.5'	74	151,745.1'	513,775.6'	379.4'	144	152,445.3'	514,170.4'	381.8'	216	152,945.1'	513,552.4'	400.7'
2	153,219.1'	513,626.3'	379.6'	75	151,745.5'	513,675.3'	380.4'	145	152,345.1'	514,171.6'	382.4'	217	153,068.6'	513,557.0'	399.1'
3	153,318.8'	513,626.2'	380.6'	76	151,745.2'	513,975.6'	379.5'	146	152,245.4'	514,171.8'	382.5'	219	151,744.9'	513,869.4'	378.6'
4	153,419.1'	513,626.3'	381.6'	77	151,745.1'	514,075.5'	380.5'	147	152,145.3'	514,171.2'	382.4'	220	151,645.1'	513,869.3'	378.6'
5	153,118.0'	513,726.9'	378.6'	78	151,845.2'	513,869.5'	378.6'	148	152,045.4'	514,166.3'	382.4'	221	153,068.7'	513,975.6'	393.7'
6	153,219.0'	513,726.1'	379.5'	79	151,845.2'	513,775.5'	379.4'	149	151,945.3'	514,165.8'	382.3'	222	153,068.9'	514,075.5'	393.7'
7	153,319.2'	513,726.3'	380.6'	80	151,845.5'	513,675.7'	380.4'	150	151,845.3'	514,166.1'	382.3'	223	153,067.9'	514,171.7'	396.0'
8	153,419.1'	513,726.1'	381.6'	81	151,845.3'	513,975.5'	379.4'	151	151,744.6'	514,167.1'	383.1'	228	153,119.1'	514,187.5'	394.7'
9	153,118.6'	513,826.1'	378.7'	82	151,845.1'	514,075.7'	380.5'	152	151,645.1'	514,171.5'	392.2'	244	153,054.9'	514,171.7'	390.3'
10	153,219.1'	513,826.0'	379.5'	83	151,945.3'	513,869.7'	378.7'	153	151,545.1'	514,171.6'	390.5'	245	153,036.4'	514,193.4'	392.8'
11	153,319.0'	513,826.2'	380.5'	84	151,945.2'	513,775.5'	379.4'	154	151,534.9'	514,075.6'	380.5'	246	152,945.2'	514,192.2'	392.2'
12	153,418.8'	513,826.2'	381.5'	85	151,945.5'	513,675.8'	380.4'	155	151,537.0'	513,975.7'	379.6'	247	152,845.2'	514,192.2'	396.4'
13	153,118.5'	513,925.9'	378.7'	86	151,945.3'	513,975.7'	379.4'	156	151,536.5'	513,775.6'	379.6'	248	152,745.2'	514,192.2'	396.0'
14	153,219.0'	513,926.2'	379.5'	87	151,945.2'	514,075.5'	380.4'	157	151,535.7'	513,675.6'	380.7'	249	152,645.2'	514,192.2'	393.0'
15	153,318.8'	513,926.3'	380.7'	88	152,045.1'	513,869.4'	378.6'	158	151,545.2'	513,592.3'	391.8'	250	152,545.2'	514,192.2'	392.7'
16	153,419.0'	513,926.3'	381.6'	89	152,045.3'	513,775.5'	379.4'	159	151,645.0'	513,592.3'	382.7'	251	152,445.2'	514,192.2'	392.8'
17	153,118.9'	514,026.1'	378.6'	90	152,045.3'	513,675.6'	380.5'	160	151,745.3'	513,589.4'	382.0'	252	152,345.2'	514,192.2'	392.8'
18	153,219.2'	514,026.0'	379.5'	91	152,044.9'	513,975.6'	379.5'	161	151,845.2'	513,590.2'	381.7'	253	152,245.2'	514,192.2'	392.7'
19	153,319.6'	514,026.6'	380.5'	92	152,045.3'	514,075.6'	380.5'	162	151,945.4'	513,590.6'	381.9'	254	152,145.2'	514,192.2'	392.6'
20	153,418.9'	514,026.3'	381.5'	93	152,146.1'	513,868.4'	378.5'	163	152,045.3'	513,590.3'	381.8'	255	152,045.2'	514,189.2'	393.9'
21	153,119.1'	514,126.2'	379.1'	94	152,145.3'	513,775.7'	379.4'	164	152,145.3'	513,589.9'	382.0'	256	151,945.2'	514,189.2'	394.1'
22	153,219.2'	514,126.1'	379.5'	95	152,145.4'	513,675.7'	380.5'	165	152,245.2'	513,591.2'	381.8'	257	151,845.2'	514,189.2'	394.1'
23	153,319.1'	514,126.1'	380.5'	96	152,145.3'	513,975.6'	379.5'	166	152,345.3'	513,591.3'	381.7'	258	151,745.3'	514,191.0'	395.0'
24	153,418.7'	514,129.8'	381.5'	97	152,145.4'	514,075.0'	380.5'	167	152,445.1'	513,590.8'	381.6'	259	151,645.2'	514,192.0'	395.4'
25	153,436.8'	514,133.3'	381.9'	98	152,247.3'	513,868.6'	378.5'	168	152,544.9'	513,590.0'	381.9'	260	151,545.2'	514,192.2'	397.5'
26	153,419.1'	514,170.1'	381.9'	99	152,245.3'	513,775.6'	379.4'	169	152,645.1'	513,589.5'	382.0'	261	151,515.5'	514,076.1'	389.4'
27	153,319.0'	514,168.2'	380.5'	100	152,245.5'	513,675.5'	380.4'	170	152,745.2'	513,589.6'	381.9'	262	151,516.6'	513,975.7'	388.8'
28	153,219.0'	514,166.8'	379.6'	101	152,245.3'	513,975.7'	379.5'	171	152,845.3'	513,590.1'	381.9'	263	151,511.4'	513,875.8'	393.2'
30	153,219.2'	513,616.9'	379.7'	102	152,245.1'	514,075.8'	380.4'	172	152,945.3'	513,590.4'	381.8'	264	151,516.5'	513,775.5'	388.8'
31	153,319.0'	513,614.4'	380.8'	103	152,345.3'	513,869.6'	378.5'	173	153,035.2'	513,602.1'	381.7'	265	151,515.5'	513,675.8'	389.3'
32	153,419.4'	513,618.5'	381.6'	104	152,345.4'	513,775.7'	379.4'	174	153,044.3'	513,675.6'	381.5'	266	151,545.2'	513,574.8'	397.0'
33	153,429.1'	513,627.2'	381.7'	105	152,345.2'	513,675.8'	380.5'	175	153,044.2'	513,775.6'	381.7'	267	151,645.4'	513,574.7'	389.5'
34	153,437.0'	513,726.0'	381.9'	106	152,345.6'	513,975.3'	379.6'	176	153,043.6'	513,875.8'	381.5'	268	151,745.2'	513,574.7'	389.4'
35	153,437.4'	513,826.1'	381.9'	107	152,345.3'	514,075.6'	380.7'	177	153,044.5'	513,975.3'	381.7'	269	151,845.2'	513,574.7'	389.4'
36	153,436.7'	513,925.7'	382.0'	108	152,445.1'	513,869.4'	378.5'	180	152,944.7'	514,212.4'	401.8'	270	151,945.2'	513,574.7'	389.4'
37	153,437.2'	514,026.2'	381.8'	109	152,445.3'	513,775.7'	379.4'	181	152,845.4'	514,206.9'	401.6'	271	152,045.2'	513,574.7'	389.3'
38	153,479.1'	514,126.1'	402.6'	110	152,445.1'	513,675.3'	380.4'	182	152,745.1'	514,205.3'	401.8'	272	152,145.2'	513,574.7'	389.4'
39	153,462.8'	514,194.5'	401.9'	111	152,445.2'	513,975.6'	379.7'	183	152,644.9'	514,210.6'	401.8'	273	152,245.2'	513,574.7'	389.4'
40	153,419.1'	514,211.1'	402.2'	112	152,445.4'	514,075.7'	380.7'	184	152,545.1'	514,210.3'	401.9'	274	152,345.2'	513,574.7'	389.3'
41	153,319.0'	514,210.5'	401.9'	113	152,545.0'	513,869.5'	378.5'	185	152,445.2'	514,210.1'	401.8'	275	152,445.2'	513,574.7'	389.4'
42	153,219.0'	514,210.5'	402.0'	114	152,545.2'	513,775.5'	379.3'	186	152,345.2'	514,210.4'	401.8'	276	152,545.2'	513,574.7'	389.4'
43	153,118.9'	514,212.0'	402.0'	115	152,545.3'	513,675.5'	380.3'	187	152,244.9'	514,210.0'	401.7'	277	152,645.2'	513,574.7'	389.4'
44	153,088.7'	514,211.1'	401.9'	116	152,545.3'	513,975.5'	379.5'	188	152,145.3'	514,210.1'	401.8'	278	152,745.2'	513,574.7'	389.4'
45	153,087.7'	514,126.2'	393.7'	117	152,545.0'	514,075.5'	380.7'	189	152,045.2'	514,200.4'	399.9'	279	152,845.2'	513,574.7'	389.2'
46	153,087.5'	514,026.1'	393.7'	118	152,645.3'	513,868.8'	378.5'	190	151,945.1'	514,199.9'	399.7'	280	152,945.2'	513,574.7'	389.4'
47	153,087.9'	513,926.0'	393.6'	119	152,645.1'	513,775.6'	379.3'	191	151,845.3'	514,200.2'	399.8'	281	153,033.0'	513,574.7'	389.2'
48	153,087.9'	513,826.1'	393.6'	120	152,645.7'	513,675.6'	380.3'	192	151,745.1'	514,202.0'	400.8'	282	153,056.1'	513,675.6'	387.4'
49	153,087.8'	513,726.1'	393.6'	121	152,645.3'	513,975.7'	379.4'	193	151,645.1'	514,203.0'	401.0'	283	153,056.1'	513,775.6'	387.3'
50	153,087.7'	513,626.2'	393.5'	122	152,745.2'	513,869.5'	378.6'	194	151,545.0'	514,197.9'	400.4'	284	153,056.1'	513,875.6'	387.4'
51	153,088.7'	513,553.3'	399.9'	123	152,745.2'	513,775.5'	379.3'	195	151,509.1'	514,173.7'	400.3'	285	153,056.1'	513,975.6'	387.2'
52	153,119.1'	513,551.6'	400.4'	124	152,745.1'	513,675.7'	380.3'	196	151,494.6'	514,075.6'	399.9'	286	153,056.1'	514,075.6'	387.5'
53	153,181.6'	513,569.1'	401.4'	125	152,745.2'	513,975.6'	379.4'	197	151,495.5'	513,975.8'	399.6'	287	152,764.8'	513,875.4'	378.5'
54	153,219.0'	513,572.5'	401.4'	126	152,745.2'	514,075.7'	380.4'	198	151,498.3'	513,875.6'	399.1'	288	152,645.1'	514,075.5'	380.4'
55	153,318.9'	513,571.8'	401.8'	127	152,845.3'	513,875.7'	379.2'	199	151,494.6'	513,775.6'	400.1'	289	152,845.4'	513,792.1'	379.2'
56	153,446.2'	513,573.6'	402.7'	128	152,845.2'	513,775.6'	379.4'	200	151,494.5'	513,675.6'	400.0'	290	152,845.5'	513,962.8'	379.2'
57	153,467.9'	513,588.7'	402.4'	129	152,845.2'	513,675.6'	380.3'	201	151,518.2'	513,579.0'	399.5'	291	152,945.2'	514,063.0'	380.2'
58	153,480.4'	513,626.2'	402.2'	130	152,845.2'	513,975.7'	379.4'	202	151,547.1'	513,551.8'	399.7'	292	152,945.2'	513,692.1'	380.2'
59	153,480.4'	513,726.3'	402.8'	131	152,845.2'	514,075.6'	380.4'	203	151,645.4'	513,553.3'	400.3'	293	152,745.4'	513,881.8'	378.5'
60	153,481.5'	513,826.1'	403.3'	132	152,945.2'	513,875.7'	380.2'	204	151,745.8'	513,553.4'	400.4'	294	152,650.3'	513,881.5'	378.5'
61	153,481.5'	513,926.3'	403.3'	133	152,945.2'	513,775.4'	380.2'	205	151,845.4'	513,553.1'	400.2'	295	152,545.3'	513,881.6'	378.5'
62	153,481.7'	514,026.2'	403.4'	134	152,945.2'	513,675.5'	380.4'	206	151,945.2'	513,552.4'	400.2'	296	152,445.0'	513,881.3'	378.5'
63	151,570.0'	513,868.6'	378.6'	135	152,945.2'	513,975.6'	380.3'	207	152,045.2'	513,552.8'	400.4'	297	152,344.8'	513,881.0'	378.5'
64	151,545.2'	513,775.6'	379.5'	136	152,945.2'	514,075.5'	380.3'	208	152,145.2'	513,553.7'	400.3'	298	152,245.0'	513,882.1'	378.5'
65	151,545.2'	513,675.6'	380.5'	137	153,044.4'	514,075.8'	381.7'	209	152,245.2'	513,553.2'	400.5'	299	152,145.0'	513,882.2'	378.5'
66	151,545.2'	513,975.6'	379.6'	138	153,038.6'	514,156.3'	381.9'	210	152,345.4'	513,553.0'	400.6'	300	152,045.1'	513,881.9'	378.8'
67	151,545.2'	514,075.6'	380.5'	139	152,945.4'	514,171.9'	382.2'	211	152,445.1'	513,553.2'	400.6'	301	151,945.2'	513,881.7'	378.7'
70	151,645.1'	513,675.5'	380.5'	140	152,845.3'	514,141.9'	381.5'	212	152,545.1'	513,552.1'	400.6'	302	151,844.8'	513,882.6'	378.6'
71	151,645.2'	513,775.4'	379.5'	141	152,745.4'	514,140.4'	381.7'	213	152,645.0'	513,551.7'	400.6'	303	151,745.2'	513,881.8'	378.6'
72	151,645.3'	513,975.7'	379.5'	142	152,645.3'	514,170.5'	382.0'	214	152,745.2'	513,552.3'	400.7'	304	151,645.2'	513,881.4'	378.5'
73	151,645.2'	514,075.7'	380.5'	143	152,545.2'	514,170.7'	381.9'	215	152,845.2'	513,552.7'	400.7'	305	151,569.4'	513,881.8'	378.6'

Notes:
1. Horizontal & Vertical Control system used:Indiana West State Plane Horizontal Datum NAD27 & Vertical Datum NGVD29.
2. Units:US survey feet.
3. Survey method:Trimble R8 GPS Unit and DJI Phantom 4 RTK UAV
4. Surveyed by: KLL.
5. Photo date: 7/13/2023
6. Propeller images are high-accuracy geotags. Errors of up to ± 3cm (1/10ft) are to be expected.
7. Trimble R8 GNSS surveying Horizontal 3mm+0.5ppm RMS, Vertical 5mm+0.5ppm RMS

Figure 9 C

REV	DATE	DESCRIPTION
1	7/14/23	Updated Grid Points
2	7/21/23	Updated Grid Points
3	8/2/23	Updated Grid Points
4	8/8/23	Updated Grid Points
5	8/28/23	Updated Grid Points
6	9/3/23	Added edge of liner

PROJECT ASSOCIATES
CONSULTING ENGINEERS
PRECISION SURVEYING
A SUBSIDIARY OF PROJECT ASSOCIATES
333 North Plaza East BLVD Evansville, IN 47715 (812-868-8011)

PROJECT NO: 230290
DRAWN BY: DAB
SCALE: 1"=75'

PROJECT: AEP Rockport NE Pond As-built
ADDRESS: 2791 US- 231 Rockport, IN
DRAWING TITLE: AEP Rockport NE Ash Pond As-built

Date: 7/19/2023
SHEET NO.: 2 Of 2

Appendix A
Map and Boring Logs, 1977 Soil Borings at Wastewater Pond Complex

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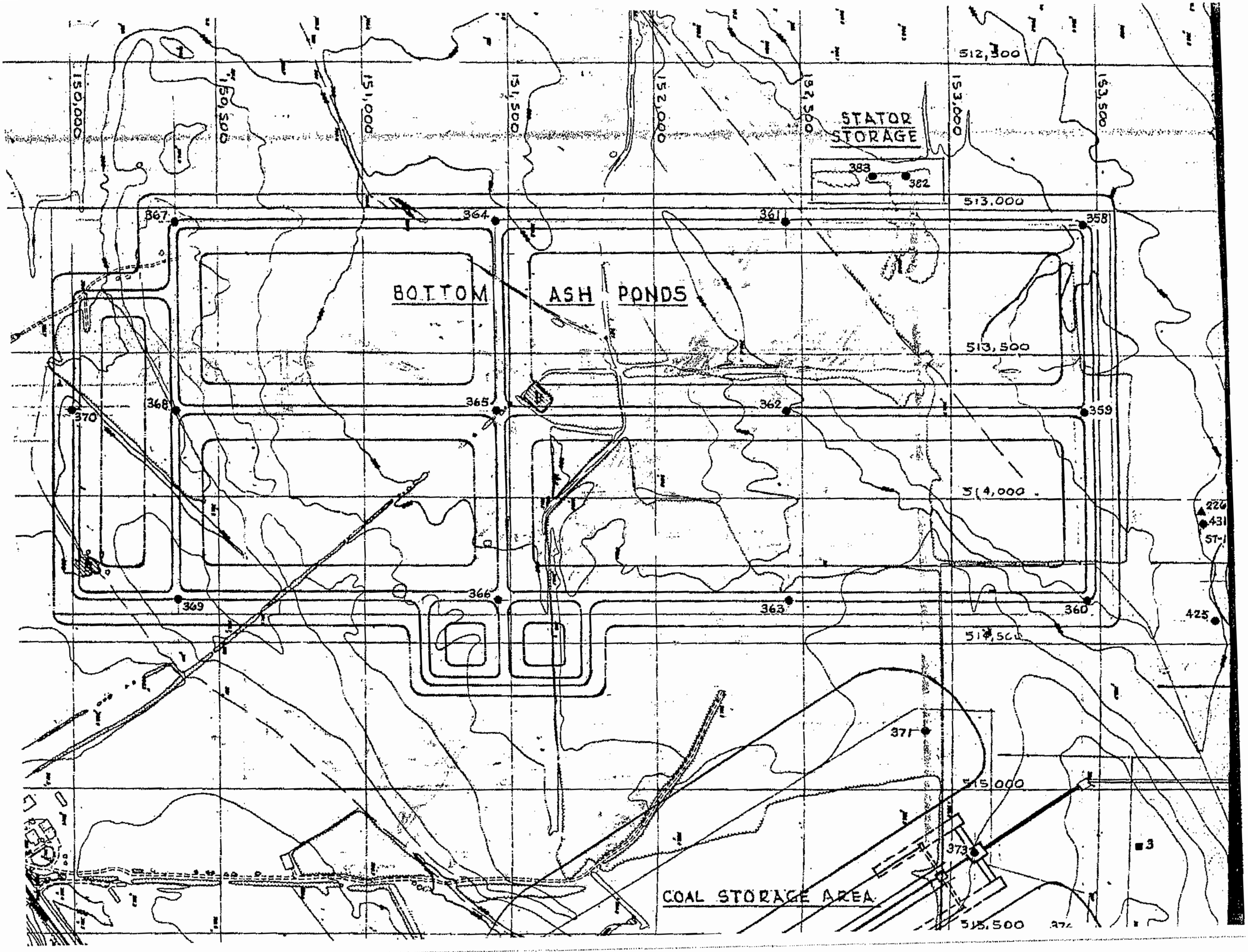

STATOR STORAGE
BOTTOM ASH PONDS
COAL STORAGE AREA
150,000
150,500
151,000
151,500
152,000
152,500
153,000
153,500
512,500
513,000
513,500
514,000
514,500
515,000
515,500
383
382
367
364
361
358
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365
362
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369
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373
425
431
57-1
226
3

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PROJECT: Rockport Site PROJECT NO W6-1482 BORING: BH-361

DATE: 3/17/77 DRILLER: G. Powers CREW: J. Hardman/J. Selbe SURFACE ELEV.

DEPTH		SOIL STRATA				DEPTH					
FROM	TO	SOIL DESCRIPTION AND REMARKS	TIME	TYPE	NO.	FROM	TO	FIRST 6"	2ND 6"	3RD 6"	REC
		Topsoil									
	1.0										
1.0		Very stiff brown and gray silty clay		SS	1	5.0	6.5	5	8	11	10
		Very stiff brown and gray silty clay		SS	2	10.0	11.5	8	13	14	9
	13.0										
13.0		Firm brown silty fine sand		SS	3	15.0	16.5	5	5	6	8
	19.0										
19.0		Very loose brown silty fine sand		SS	4	20.0	21.5	1	2	2	1[illegible]
		Very loose brown silty fine sand		SS	5	25.0	26.5	1	2	2	16
	30.0										
30.0		Very dense dark brown silty fine sand		SS	6	30.0	31.5	66	43	30	16
	34.0										
34.0		Firm brown medium to coarse silty sand		SS	7	35.0	36.5	9	10	13	8
	41.0										
41.0		Firm brown silty fine sand		SS	8	40.0	41.5	9	11	13	16
	44.0										
44.0		Firm brown medium and coarse sand		SS	9	45.0	46.5	8	11	19	16
	48.0										
48.0	51.5	Dense grayish brown silty fine to medium sand		SS	10	50.0	51.5	21	21	24	14
		Boring Terminated @ 51.5 ~~3/17/77~~									

METHOD OF DRILLING (Check One)

a. AUGER ~~XXXXX~~ ~~Rod~~ SIZE A

b. WASH XX WATER MUD XX

BORING SIZE BIT USED 2-7/8" Side Discharge

[illegible] SIZE N/W LENGTH 5.0

[illegible]TURBED SAMPLES: NO. SIZE

[illegible] SAMPLES: NO.

[illegible]TER LOSSES % DEPTH

[illegible]ECIAL TESTS (Hrs. & Explain)

WEATHER Overcast 45 degrees

NON-DRILLING TIME (Hrs.)

BORING LAYOUT MOVING

HAULING WATER STANDBY

WATER LEVEL: @ DATE TIME

@ DATE TIME

CAVE-IN DEPTH: @ DATE TIME

REMARKS: (All remarks should be explained on the back of white copy) THIS IS A DRILLER'S LOG AND THE CLASSIFICATIONS HAVE NOT BEEN REVIEWED BY AN ENGINEER

PROJECT: Rockport Site PROJECT NO. W6-1482 BORING: BE-362

DATE: 3/18/77 DRILLER: G. Powers CREW: J. Hardman/J. Selbe SURFACE ELEV. 392.7

Depth From	Depth To	Soil Strata – Soil Description and Remarks	Time	Type	No.	Depth From	Depth To	First 6"	2nd 6"	3rd 6"	Rec
0		Topsoil									
	1.2										
1.2		Very stiff brown and gray fine sandy silty		SS	1	5.0	6.5	7	10	12	15
	7.5	clay									
7.5		Stiff brown fine sandy silt		SS	2	10.0	11.5	4	4	6	16
	13.0										
13.0		Firm brown silty fine sand		SS	3	15.0	16.5	4	5	6	12
		Firm brown silty fine sand		SS	4	20.0	21.5	4	5	7	4
	23.5										
23.5		Loose brown silty fine to medium sand		SS	5	25.0	26.5	4	3	4	5
	29.0										
29.0		Firm brown silty fine to medium sand		SS	6	30.0	31.5	4	5	8	10
		Firm brown silty fine to medium sand		SS	7	35.0	36.5	7	6	10	9
	37.0										
37.0		Dense brown medium to coarse sand		SS	8	40.0	41.5	12	14	22	10
	44.0										
44.0		Firm brownish gray fine to medium silty		SS	9	45.0	46.5	12	12	11	10
		sand									
51.5		Firm brownish gray fine to medium silty		SS	10	50.0	51.5	8	8	12	9
		Boring Terminated @ 51.5 3/18/77									

METHOD OF DRILLING (Check One)

a. AXXXXX Rod SIZE A

b. WASH XX WATER MUD XX

BORING SIZE BIT USED

CASING: SIZE N/W LENGTH 5'

UNDISTURBED SAMPLES: NO. SIZE

BAG SAMPLES: NO.

WATER LOSSES @ DEPTH

SPECIAL TESTS (Hrs & Explain)

WEATHER 45 degrees Overcast & windy

NON-DRILLING TIME (Hrs.)

BORING LAYOUT MOVING

HAULING WATER STANDBY

WATER LEVEL: @ DATE TIME

@ DATE TIME

CAVE IN DEPTH: @ DATE TIME

REMARKS: (All remarks should be explained on the back of white copy) THIS IS A DRILLER'S LOG AND THE CLASSIFICATIONS HAVE NOT BEEN REVIEWED BY AN ENGINEER

BORING FIELD RECOR

PROJECT: Rockport Site PROJECT NO. W6-1482 BORING: BH-363

DATE: 3/18/77 DRILLER: G. Powers CREW: J. Hardman/J. Selbe SURFACE ELEV. 392

DEPTH FROM	DEPTH TO	SOIL STRATA — SOIL DESCRIPTION AND REMARKS	TIME	TYPE	NO.	DEPTH FROM	DEPTH TO	FIRST 6"	2ND 6"	3RD 6"	RE
0		Topsoil									
	0.8										
0.8		Very stiff brown fine sandy silty clay		SS	1	5.0	6.5	6	9	12	14
	8.0										
8.0		Loose brown silty fine sand		SS	2	10.0	11.5	4	4	5	15
		Loose brown silty fine sand		SS	3	15.0	16.5	4	5	5	12
	20.5										
20.5		Firm brown silty fine sand		SS	4	20.0	21.5	2	5	8	10
	23.5										
23.5		Firm brown fine to medium sand		SS	5	25.0	26.5	5	6	6	8
		Firm brown fine to medium sand		SS	6	30.0	31.5	6	7	9	10
		Firm brown fine to medium sand		SS	7	35.0	26.5	8	8	14	7
	38.0										
38.0		Firm brown medium to coarse sand		SS	8	40.0	41.5	9	10	16	12
		Firm brown medium to coarse sand		SS	9	45.0	46.5	8	14	13	8
	47.0										
47.0	51.5	Firm grayish brown silty fine to medium sand		SS	10	50.0	51.5	7	10	10	12
		Boring Terminated @ 51.5 3/18/77									

METHOD OF DRILLING (Check One)

a. AUGER Rod SIZE A

b. WASH XX WATER MUD XX

BORING SIZE BIT USED 2-7/8" Side Discharge

CASING: SIZE N/W LENGTH 5.0

UNDISTURBED SAMPLES: NO. SIZE

BAG SAMPLES: NO.

WATER LOSSES % DEPTH

SPECIAL TESTS (Hrs & Explain)

WEATHER 45 degrees Overcast Windy

NON-DRILLING TIME (Hrs.)

BORING LAYOUT MOVING

HAULING WATER STANDBY

WATER LEVEL: @ DATE TIME

@ DATE TIME

CAVE-IN DEPTH: @ DATE TIME

REMARKS: (All remarks should be explained on the back of white copy) THIS IS A DRILLER'S LOG AI THE CLASSIFICATIONS HAVE

AW ENGINEERING TESTING COMPANY

TEST BORING FIELD RECORD

ROJECT: Rockport Site PROJECT NO. W6-1482 BORING: BH=364

DATE: 3/15/77 DRILLER: G. Powers CREW: J. Hardman/J. Selbe SURFACE ELEV. 389.5

DEPTH FROM	DEPTH TO	SOIL STRATA SOIL DESCRIPTION AND REMARKS	TIME	TYPE	NO.	DEPTH FROM	DEPTH TO	FIRST 6"	2ND 6"	3RD 6"	REC.
0		Topsoil									
	1.4										
1.4		Stiff brown and gray silty clay traces fine sand		SS	1	5.0	6.5	4	6	7	16
		Stiff brown and gray silty clay traces		SS	2	10.0	11.5	3	4	6	12
	13.0	fine sand									
13.0		Loose brown silty fine sand		SS	3	15.0	16.5	3	4	3	17
		Loose brown silty fine sand		SS	4	20.0	21.5	3	3	3	8
	24.0										
24.0		Firm brown fine to medium sand		SS	5	25.0	26.5	6	8	8	7
		Firm brown fine to medium sand		SS	6	30.0	31.5	6	8	9	8
	34.5										
34.5		Firm brown medium to coarse sand		SS	7	35.0	36.5	5	8	10	8
		Firm brown medium to coarse sand		SS	8	40.0	41.5	5	6	8	7
	43.0										
43.0		Loose brown medium to coarse sand & gravel		SS	9	45.0	46.5	4	3	3	8
	47.0										
47.0	51.5	Firm brown medium to coarse sand traces gravel		SS	10	50.0	51.5	8	9	13	8
		Boring Terminated @ 51.5 3/15/77									

METHOD OF DRILLING (Check One)

a. AUGER ~~XXXXX~~ Rod SIZE A

b. WASH XX WATER MUD XX

BORING SIZE BIT USED 2-7/8" Side Discharge

CASING: SIZE NW LENGTH 5'

UNDISTURBED SAMPLES: NO. SIZE

BAG SAMPLES: NO.

WATER LOSSES @ DEPTH

SPECIAL TESTS (Hrs & Explain)

WEATHER 70 degrees clear

NON-DRILLING TIME (Hrs.)

BORING LAYOUT MOVING

HAULING WATER STANDBY

WATER LEVEL: @ DATE TIME

@ DATE TIME

CAVE-IN DEPTH: @ DATE TIME

REMARKS (All remarks should be explained on the back of white copy) THIS IS A DRILLER'S LOG THE CLASSIFICATIONS HAVE

W ENGINEERING TESTING COMPANY

OJECT: Rockport Site PROJECT NO. W6-1482 BORING: BH=365

ATE: 3/15/77 DRILLER: G. Powers CREW: J. Hardman/J. Selbe SURFACE ELEV.

DEPTH		SOIL STRATA	TIME	TYPE	NO.	DEPTH		FIRST 6"	2ND 6"	3RD 6"	REC.
	TO	SOIL DESCRIPTION AND REMARKS				FROM	TO				
0		Topsoil									
	1.3										
				SS	1	5.0	6.5	3	5	9	18
1.3		Stiff brown and gray silty clay traces									
	11.0										
				SS	2	10.0	11.5	4	4	8	18
11.0		Stiff brown fine sandy silty tan clay									
	13.5										
				SS	3	15.0	16.5	2	3	4	12
13.5		Loose brown silty fine sand									
	19.0										
				SS	4	20.0	21.5	3	2	3	14
19.0		Firm brown fine sand silt traces clay									
	25.5										
				SS	5	25.0	26.5	2	5	8	12
25.5		Firm brown and gray silty fine sand									
	28.0										
				SS	6	30.0	31.5	8	10	10	6
28.0		Firm brown silty fine sand									
	35.5										
				SS	7	35.0	36.5	6	11	10	9
35.5		Firm brown silty medium to coarse sand									
	38.0										
				SS	8	40.0	41.5	13	25	25	10
.0		Dense brown silty medium tocoarse sand									
	42.0	traces gravel									
42.0		Firm brown silty medium to coarse sand traces		SS	9	45.0	46.5	10	12	12	8
	47.5	gravel									
				SS	10	50.0	51.5	8	7	9	8
47.5	51.5	Firm gray fine to medium silty sand									
		traces gravel									
		Boring Terminated @ 51.5 3/15/77									

WEATHER 65 degrees clear

METHOD OF DRILLING (Check One)

a. AUGER Rod SIZE A

b. WASH XX WATER MUD XX

NON-DRILLING TIME (Hrs.)

BORING LAYOUT MOVING

HAULING WATER STANDBY

BORING SIZE BIT USED 2-7/8" Side Discharge

CASING: SIZE NW LENGTH 5.0'

WATER LEVEL: @ DATE TIME

@ DATE TIME

UNDISTURBED SAMPLES: NO. SIZE

BAG SAMPLES: NO.

CAVE-IN DEPTH: @ DATE TIME

WATER LOSSES % DEPTH

REMARKS: (All remarks should be explained on the back of white copy)

SPECIAL TESTS (Hrs. & Explain)

THIS IS A DRILLER'S LOG A! THE CLASSIFICATIONS HAVE N BEEN REVIEWED BY AN ENGINE

ROJECT: Rockport Site PROJECT NO. W6-1482 BORING: BH-366

DATE: 3/15/77 DRILLER: G. Powers CREW: J. Hardman/J. Selbe SURFACE ELEV.

DEPTH FROM	DEPTH TO	SOIL STRATA SOIL DESCRIPTION AND REMARKS	TIME	TYPE	NO.	DEPTH FROM	DEPTH TO	FIRST 6"	2ND 6"	3RD 6"	REC
—	1.5	Topsoil									
1.5	9.0	Very stiff brown and gray silty clay traces fine sand		SS	1	5.0	6.5	3	7	14	18
9.0	15.0	Firm brown silty fine sand traces clay		SS	2	10.0	11.5	4	5	8	16
15.0	17.0	Loose brown silty fine sand traces clay		SS	3	15.0	16.5	2	4	6	16
17.0	24.0	loose brown silty fine sand		SS	4	20.0	21.5	4	4	6	8
24.0		Firm brown fine to medium fine sand		SS	5	25.0	26.5	4	7	12	7
	33.5	Firm brown fine to medium fine sand		SS	6	30.0	31.5	5	8	9	7
33.5	37.0	Firm brown fine to medium sand traces		SS	7	35.0	36.5	5	8	9	6
37.0		Firm brown medium to coarse silty sand		SS	8	40.0	41.5	8	11	12	7
	47.5	Firm brown medium to coarse silty sand		SS	9	45.0	46.5	7	12	16	11
47.5	51.5	Firm brown medium to coarse sand some gravel		SS	10	50.0	51.5	7	7	9	8
		Boring Terminated @ 51.5 3/15/77									

[illegible] OF DRILLING (Check One)

[illegible] XX Rod SIZE A

[illegible] XX WATER MUD XX

ORING S[illegible] BIT USED 2-7/8" Side [illegible]scharge

AS[illegible]G: [illegible] NW LENGTH 5.0

[illegible] SAMPLES: NO SIZE

G SA[illegible] NO.

ATER [illegible] DEPTH

[illegible] (Hrs & Explain)

WEATHER 50 degrees [illegible]ercast

NON-DRILLING TIME [illegible]

BORING LAYOUT MOVING

HAULING WATER STANDBY

WATER LEVEL: @ DATE TIME

@ DATE TIME

CAVE IN DEPTH @ DATE TIME

REMARKS (All remarks should be explained on the back of white copy) THIS IS A DRILLER'S LOG AND THE CLASSIFICATIONS HAVE NOT BEEN REVIEWED BY [illegible]

PROJECT: Rockport Site PROJECT NO. W6-1482 BORING: Bh-367

DATE: 3/16/77 DRILLER: G. Powers CREW: J. Hardman/J. Selbe SURFACE ELEV.

DEPTH FROM	DEPTH TO	SOIL STRATA SOIL DESCRIPTION AND REMARKS	TIME	TYPE	NO.	DEPTH FROM	DEPTH TO	FIRST 6"	2ND 6"	3RD 6"	REC
0		Topsoil									
	1.2										
1.2		Firm brown silty fine sand traces clay		SS	1	5.0	6.5	3	4	7	14
	8.0										
8.0		Loose brown silty fine sand		SS	2	10.0	11.5	3	3	5	12
		Loose brown silty fine sand		SS	3	15.0	16.5	3	3	4	10
		Loose brown silty fine sand		SS	4	20.0	21.5	3	5	5	8
	23.0										
23.0		Firm brown silty fine to medium sand		SS	5	25.0	26.5	7	10	14	7
		Firm brown silty fine to medium sand		SS	6	30.0	31.5	7	8	9	6
		Firm brown silty fine to medium sand		SS	7	35.0	36.5	5	7	10	6
		Firm brown silty fine to medium sand		SS	8	40.0	41.5	8	11	14	6
	44.0										
44.0		Firm brown silty medium to coarse sand		SS	9	45.0	46.5	10	15	13	8
	51.5	Firm brown silty medium to coarse sand		SS	10	50.0	51.5	7	12	11	10
		Boring Terminated @ 51.5									

ETHOD OF DRILLING (Check One)

a. ~~A&R~~ XXXX Rod SIZE A

b. WASH XX WATER MUD XX

ORING SIZE BIT USED 2-7/8" Side Discharge

ASING: SIZE NW LENGTH 5.0'

INL TURBED SAMPLES: NO. SIZE

AG SAMPLES: NO.

ATER LOSSES % DEPTH

ECIAL TESTS (Hrs & Explain)

WEATHER Clear 60 degrees

NON-DRILLING TIME (Hrs.)

BORING LAYOUT MOVING

HAULING WATER STANDBY

WATER LEVEL: @ DATE TIME

@ DATE TIME

CAVE-IN DEPTH: @ DATE TIME

REMARKS: (All remarks should be explained on the back of white copy) THIS IS A DRILLER'S LOG AND THE CLASSIFICATIONS HAVE NOT BEEN REVIEWED BY AN ENGINEER

PROJECT: Rockport Site PROJECT NO. W6-1482 BORING: BH-368

DATE: 3/16/77 DRILLER: G. Powers CREW: J. Hardman/J. Selbe SURFACE ELEV. 392.3

DEPTH FROM	DEPTH TO	SOIL STRATA SOIL DESCRIPTION AND REMARKS	TIME	TYPE	NO.	DEPTH FROM	DEPTH TO	FIRST 6"	2ND 6"	3RD 6"	REC
0		Topsoil									
	0.7										
0.7		Very stiff brown silty clay		SS	1	5.0	6.5	3	12	15	18
	9.0										
9.0		Firm brown silty fine sand		SS	2	10.0	11.5	7	7	8	14
		Firm brown silty fine sand		SS	3	15.0	16.5	5	5	6	9
		Firm brown silty fine sand		SS	4	20.0	21.5	5	6	8	8
	24.0										
24.0		Firm brown silty fine to medium sand		SS	5	25.0	26.5	8	10	13	6
		Firm brown silty fine to medium sand		SS	6	30.0	31.5	5	7	7	7
	33.0										
33.0		Firm brown medium to coarse sand		SS	7	35.0	36.5	6	6	8	5
	37.5										
37.5		Firm brown fine to medium silty sand		SS	8	40.0	41.5	5	7	8	6
	44.0										
44.0		Firm brown medium to coarse sand		SS	9	45.0	46.5	5	10	13	9
	51.5										
51.5		Firm brown medium to coarse sand		SS	10	50.0	51.5	10	12	12	12
		Boring Terminated @ 51.5'									

ETHOD OF DRILLING (Check One)

a. ~~XXXXXX~~ Rod SIZE A

b. WASH XX WATER MUD XX

ORING SIZE BIT USED 2-7/8" Side Discharge

CA G: SIZE NW LENGTH 5.0'

NDISTURBED SAMPLES: NO. SIZE

AG SAMPLES: NO.

ATER LOSSES, % DEPTH

PECIAL TESTS (Hrs. & Explain)

WEATHER Clear 45 degrees

NON-DRILLING TIME (Hrs.)

BORING LAYOUT MOVING

HAULING WATER STANDBY

WATER LEVEL: @ DATE TIME

@ DATE TIME

CAVE-IN DEPTH: @ DATE TIME

REMARKS: (All remarks should be explained on the back of white copy) THIS IS A DRILLER'S LOG AN THE CLASSIFICATIONS HAVE NO

PROJECT: Rockport Site PROJECT NO. W6-1482 BORING: BH-369

DATE: 3/18/77 DRILLER: R. Stevens CREW: B. Blackford/D. Wooden SURFACE ELEV. 394.3

DEPTH FROM	DEPTH TO	SOIL STRATA — SOIL DESCRIPTION AND REMARKS	TIME	TYPE	NO.	DEPTH FROM	DEPTH TO	FIRST 6"	2ND 6"	3RD 6"	REC.
0	12"	Topsoil									
		Very stiff brown and tan clay		SS	1	5	6.5	8	12	15	18
	9.0										
9.0		Loose brown very silty fine sand		SS	2	10	11.5	3	3	4	12
	12.7										
12.7		Firm brown medium sand		SS	3	15	16.5	5	6	7	5
	18.0										
18.0		Loose gray and brown silty fine to medium		SS	4	20	21.5	3	4	5	6
	22.1	sand									
22.1		Firm brown medium sand		SS	5	25.	26.5	9	10	10	6
	28.5										
28.5		Loose brown medium sand w/traces fine		SS	6	30	31.5	3	4	4	5
		gravel									
	32.0										
32.0		Firm brown medium to coarse sand		SS	7	35	36.5	7	10	16	8
		Firm brown medium to coarse sand		SS	8	40	41.5	10	11	13	7
	44.0										
44.0		Dense brown medium to coarse sand		SS	9	45	46.5	11	15	18	10
	47.5										
47.5		Dense brown medium to coarse sand w/fine		SS	10	50	51.5	11	19	26	10
		gravel									
		Boring Terminated @ 51.5'									

THOD OF DRILLING (Check One)

a ~~AUGER~~ Rod SIZE A

b WASH XX WATER MUD XX

ORING SIZE 2-7/8" BIT USED 2-7/8" Side Discharge

CA G: SIZE NW 5' LENGTH

NDISTURBED SAMPLES: NO. SIZE

AG SAMPLES: NO.

VATER LOSSES % DEPTH

PECIAL TESTS (Hrs. & Explain)

WEATHER Cloudy 50 degrees

NON-DRILLING TIME (Hrs.)

BORING LAYOUT MOVING

HAULING WATER STANDBY

WATER LEVEL: @ DATE TIME

@ DATE TIME

CAVE-IN DEPTH: @ DATE TIME

REMARKS: (All remarks should be explained on the back of white copy) THIS IS A DRILLER'S LOG AND THE CLASSIFICATIONS HAVE NOT BEEN REVIEWED BY AN ENGINEER

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Appendix B
Well Construction and Lithologic Logs, 2010 Wastewater Pond Complex Monitoring Wells

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER **41510694-01**

COMPANY **AMERICAN ELECTRIC POWER**

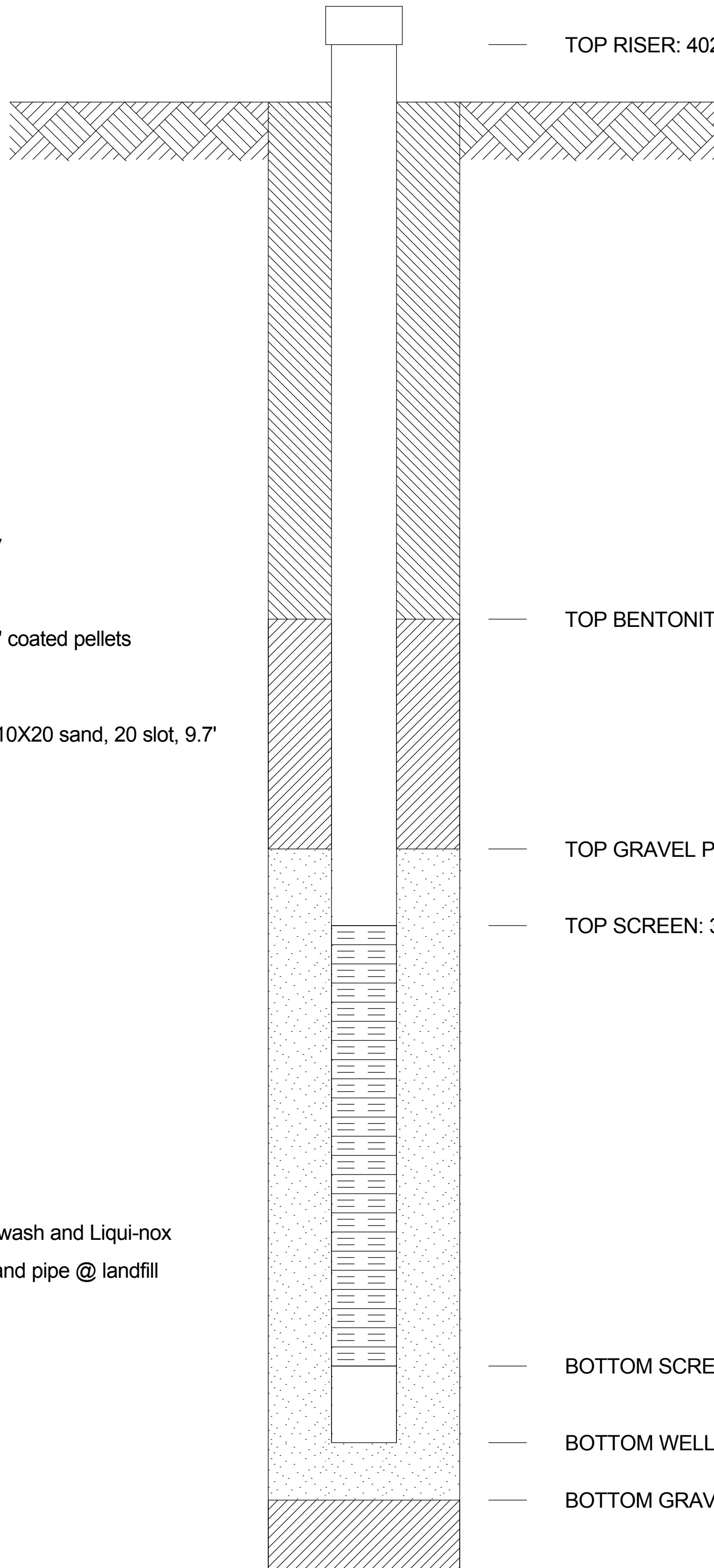
WELL No. **MW-1001** BORING No. **MW-1001** INSTALLED **6/2/10**

PROJECT **Rockport Bottom Ash Pond USWAG**

COORDINATES **N 153,488.0 E 513,047.6**

SYSTEM **State Plane using NAD27/29**

GROUND ELEVATION 400.03 FT.



GROUT SEAL: 200 gal Volclay

BENTONITE SEAL: 75 lbs 3/8" coated pellets

SCREEN: 2" dia., Prepacked, 10X20 sand, 20 slot, 9.7'

GRAVEL PACK: #5 sand

RISER PIPE: 2", dia., PVC

SPACERS, DEPTH: 20'

Notes:
-Deconned with high pressure wash and Liqui-nox
-Drilled w/ 6.25" augers
- Drill and decon water from stand pipe @ landfill
- Well installed 6/2/10
-SWL @ install = 25.5'

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER **41510694-01**

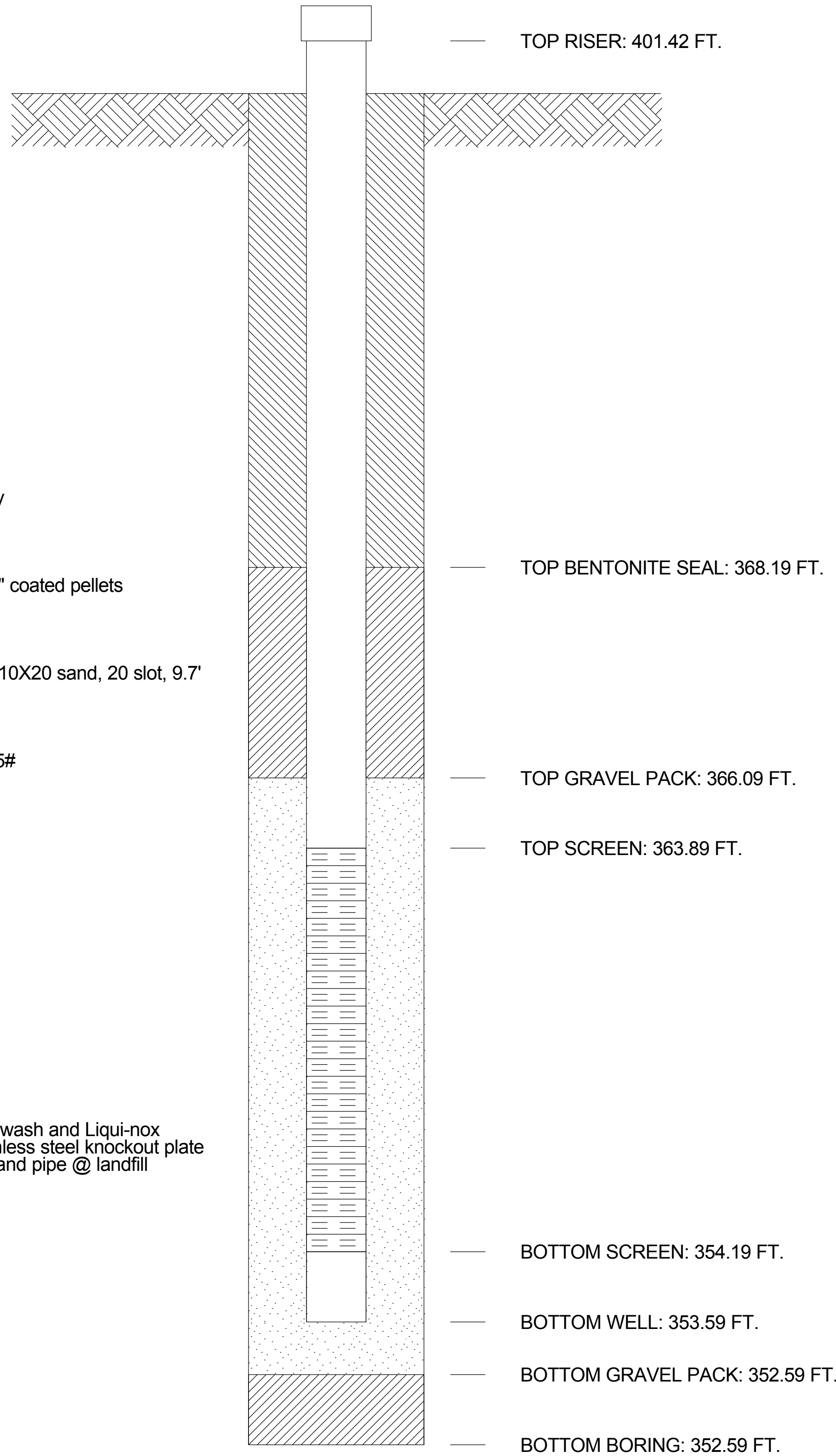
COMPANY **AMERICAN ELECTRIC POWER** WELL No. **MW-1002** BORING No. **MW-1002** INSTALLED **6/2/10**

PROJECT **Rockport Bottom Ash Pond USWAG**

COORDINATES **N 152,307.4 E 514,231.0**

SYSTEM **State Plane using NAD27/29**

GROUND ELEVATION 399.09 FT.



GROUT SEAL: 150 gal Volclay

BENTONITE SEAL: 50 lbs 3/8" coated pellets

SCREEN: 2" dia., Prepacked, 10X20 sand, 20 slot, 9.7'

GRAVEL PACK: #5 sand - 375#

RISER PIPE: 2", dia., PVC

SPACERS, DEPTH: 25'

Notes:
-Deconned with high pressure wash and Liqui-nox
-Drilled w/ 6.25" augers & stainless steel knockout plate
- Drill and decon water from stand pipe @ landfill
- Well installed 6/2/10
-SWL @ install = 29.8'

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER **41510694-01**

COMPANY **AMERICAN ELECTRIC POWER**

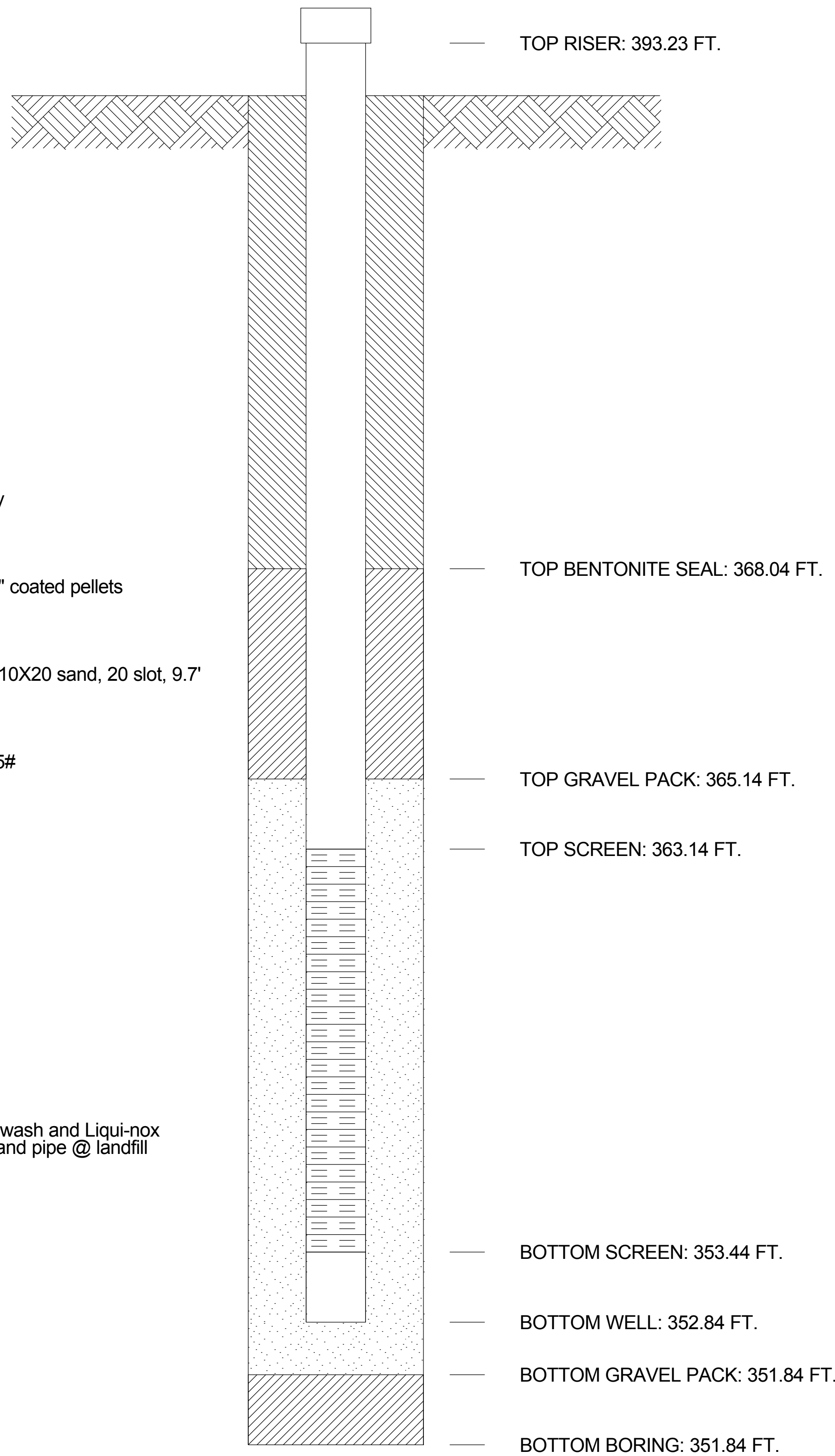
WELL No. **MW-1003** BORING No. **MW-1003** INSTALLED **6/2/10**

PROJECT **Rockport Bottom Ash Pond USWAG**

COORDINATES **N 151,208.1 E 512,820.7**

SYSTEM **State Plane using NAD27/29**

GROUND ELEVATION 390.84 FT.



GROUT SEAL: 100 gal Volclay

BENTONITE SEAL: 75 lbs 3/8" coated pellets

SCREEN: 2" dia., Prepacked, 10X20 sand, 20 slot, 9.7'

GRAVEL PACK: #5 sand - 375#

RISER PIPE: 2", dia., PVC

SPACERS, DEPTH: 18'

Notes:
-Deconned with high pressure wash and Liqui-nox
- Drill and decon water from stand pipe @ landfill
- Well installed 6/2/10
-SWL @ install = 23.5'

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER **41510694-01**

COMPANY **AMERICAN ELECTRIC POWER**

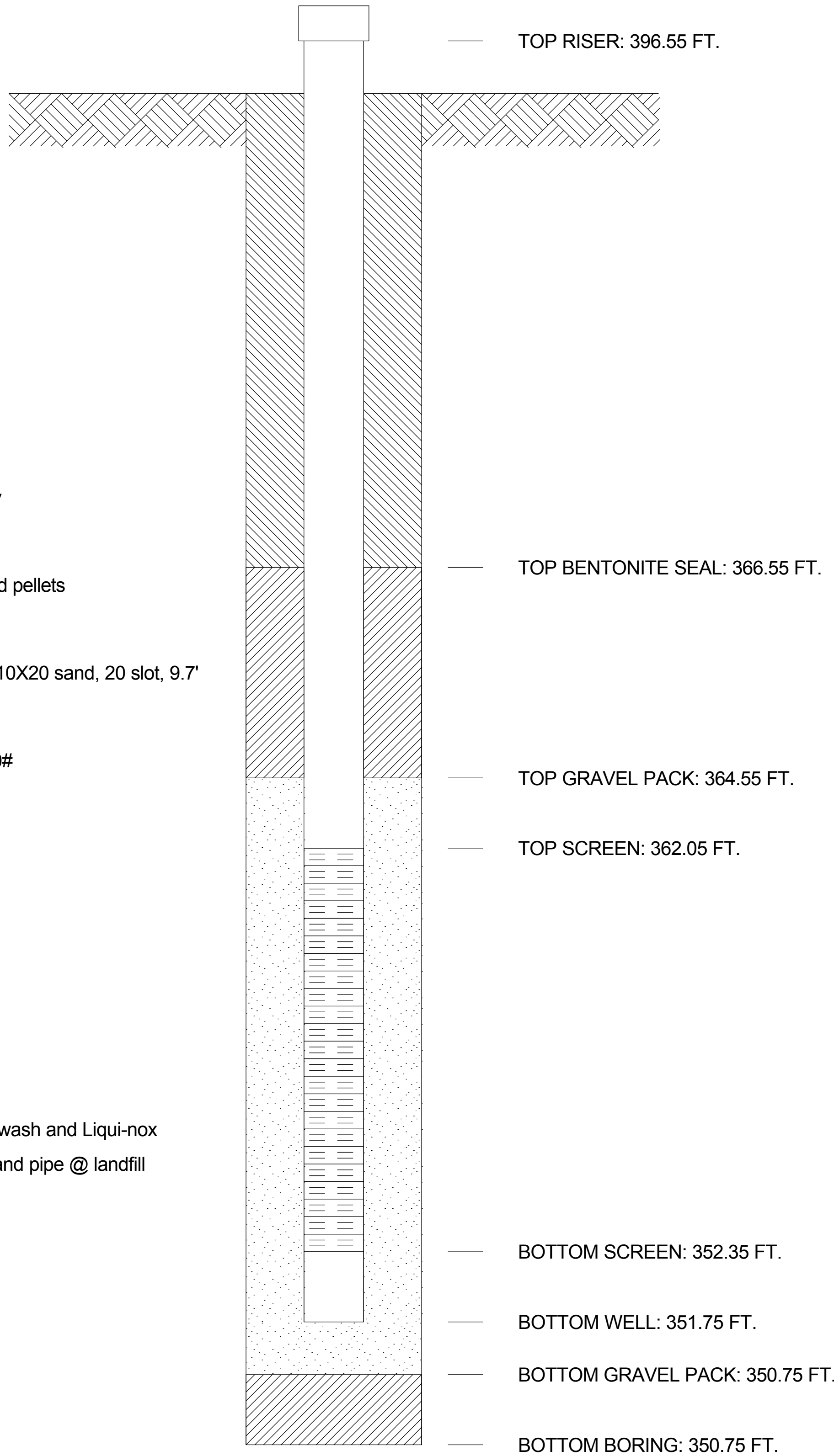
WELL No. **MW-1004** BORING No. **MW-1004** INSTALLED **6/3/10**

PROJECT **Rockport Bottom Ash Pond USWAG**

COORDINATES **N 150,013.4 E 514,264.7**

SYSTEM **State Plane using NAD27/29**

GROUND ELEVATION 394.25 FT.



GROUT SEAL: 125 gal Volclay

BENTONITE SEAL: 3/8" coated pellets

SCREEN: 2" dia., Prepacked, 10X20 sand, 20 slot, 9.7'

GRAVEL PACK: #5 sand - 350#

RISER PIPE: 2", dia., PVC

SPACERS, DEPTH: 22'

Notes:
-Deconned with high pressure wash and Liqui-nox
-Drilled w/ 6.25" augers
- Drill and decon water from stand pipe @ landfill
- Well installed 6/3/10
-SWL @ install = 27.0'

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 41510694-01

COMPANY AMERICAN ELECTRIC POWER

PROJECT Rockport Bottom Ash Pond USWAG

COORDINATES N 153,488.0 E 513,047.6

GROUND ELEVATION 400.0 SYSTEM State Plane using NAD27/29

BORING NO. MW-1001 DATE 7/16/10 SHEET 1 OF 2

BORING START 5/25/10 BORING FINISH 6/2/10

PIEZOMETER TYPE NA WELL TYPE OW

HGT. RISER ABOVE GROUND 2.32 DIA 2"

DEPTH TO TOP OF WELL SCREEN 29.7 BOTTOM 39.4

WELL DEVELOPMENT BACKFILL VOLCLAY

FIELD PARTY ZLR / REB RIG D-120

Water Level, ft	▽ 31.5	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	SOIL / ROCK IDENTIFICATION	DRILLER'S NOTES
1	SPT	0.0	1.5	4-8-13	1.4			**MODERATE YELLOWISH BROWN 10YR 5/4 FINE SAND** w/some clay	GROUNDING PROCEDURE NOT IN USE / WATER FROM STANDPIPE @ LANDFILL / DECONED 05/25/10 / DRILLED w/ 4.25 HSA
2	SPT	1.5	3.0	6-9-10	1.5				
3	SPT	3.0	4.5	3-4-7	1.3			**MODERATE YELLOWISH BROWN 10YR 5/4 FINE SAND** w/medium stiff clay mixed	
4	SPT	4.5	6.0	3-6-9	1.3		5		
5	SPT	6.0	7.5	2-4-6	1.2			**SOFT MODERATE YELLOWISH BROWN 10YR 5/4 CLAY** tsf 0.5	
6	SPT	7.5	9.0	3-6-8	1.5			**SOFT MODERATE YELLOWISH BROWN 10YR 5/4 CLAY** w/some fine sands mixed	
7	SPT	9.0	10.5	3-4-6	1.5		10	**GREENISH GRAY 5G 6/1 BOTTOM ASH**	
8	SPT	10.5	12.0	1-1-3	1.4			**SOFT MODERATE YELLOWISH BROWN 10YR 5/4 CLAY**	
9	SPT	12.0	13.5	2-2-4	1.4			**SOFT MODERATE YELLOWISH BROWN 10YR 5/4 CLAY** tsf 0.5 **SOFT GRAYISH ORANGE 10YR 7/4 CLAY** tsf 0.5, wet	
10	SPT	13.5	15.0	4-4-6	1.4		15	**MEDIUM STIFF MODERATE YELLOWISH BROWN 10YR 5/4 CLAY** tsf 1.5	
11	SPT	15.0	16.5	4-4-7	1.5			**MEDIUM STIFF MODERATE YELLOWISH BROWN 10YR 5/4 CLAY** tsf 1.0	
12	SPT	16.5	18.0	4-4-8	1.4			**MEDIUM STIFF MODERATE YELLOWISH BROWN 10YR 5/4 CLAY** tsf 2.0	
13	SPT	18.0	19.5	4-4-4	1.4			**MODERATE YELLOWISH BROWN 10YR 5/4 FINE SAND**	
14	SPT	19.5	21.0	2-3-4	1.5			**SOFT MODERATE YELLOWISH BROWN**	

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TYPE OF CASING USED

	NQ-2 ROCK CORE	
X	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER REB

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **41510694-01**

COMPANY **AMERICAN ELECTRIC POWER** BORING NO. **MW-1001** DATE **7/16/10** SHEET **2** OF **2**

PROJECT **Rockport Bottom Ash Pond USWAG** BORING START **5/25/10** BORING FINISH **6/2/10**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										CLAYEY SAND tsf 1.0		
15	SPT	21.0	22.5	2-4-7	1.4					**MODERATE YELLOWISH BROWN 10YR 5/4 FINE SAND**		
16	SPT	22.5	24.0	4-5-5	1.5					**DARK YELLOWISH ORANGE 10YR 6/6 MEDIUM SAND**		
17	SPT	24.0	25.5	3-6-7	1.5		25					
18	SPT	25.5	27.0	3-5-5	1.4							
19	SPT	27.0	28.5	4-4-5	1.5							
20	SPT	28.5	30.0	5-7-7	1.4		30					
21	SPT	30.0	31.5	5-7-7	1.5					**DARK YELLOWISH ORANGE 10YR 6/6 MEDIUM SAND** moist	▽	
22	SPT	31.5	33.0	5-6-8	1.5					**DARK YELLOWISH ORANGE 10YR 6/6 MEDIUM SAND** wet		
23	SPT	33.0	34.5	4-6-6	1.5					**DARK YELLOWISH ORANGE 10YR 6/6 MEDIUM SAND**		
24	SPT	34.5	36.0	4-6-6	1.5		35					
25	SPT	36.0	37.5	5-5-6	1.4							
26	SPT	37.5	39.0	6-6-6	1.4							
27	SPT	39.0	40.5	4-4-5	1.5		40					

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 41510694-01

COMPANY AMERICAN ELECTRIC POWER

PROJECT Rockport Bottom Ash Pond USWAG

COORDINATES N 152,307.4 E 514,231.0

GROUND ELEVATION 399.1 SYSTEM State Plane using NAD27/29

BORING NO. MW-1002 DATE 7/16/10 SHEET 1 OF 3

BORING START 5/27/10 BORING FINISH 6/2/10

PIEZOMETER TYPE NA WELL TYPE OW

HGT. RISER ABOVE GROUND 2.33 DIA 2"

DEPTH TO TOP OF WELL SCREEN 35.2 BOTTOM 44.9

WELL DEVELOPMENT BACKFILL VOLCLAY

FIELD PARTY ZLR / REB RIG D-120

Water Level, ft	▽ 30.0	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SPT	0.0	1.5	4-4-6	1.4					**YELLOWISH ORANGE 10YR 6/6 SAND CLAY** dry		NO GROUNDING PROCEDURE IN USE / WATER FROM STAND PIPE @ LANDFILL / DECON 05/27/10
2	SPT	1.5	3.0	8-10-13	1.3					**STIFF MODERATE YELLOWISH BROWN 10YR 5/4 SANDY CLAY** dry		
3	SPT	3.0	4.5	4-7-7	1.5					**MEDIUM STIFF MODERATE YELLOWISH BROWN 10YR 5/4 SANDY CLAY** dry		
4	SPT	4.5	6.0	4-4-7	1.3		5			**MEDIUM STIFF MEDIUM LIGHT GRAY N6 CLAY** tsf 1.5		
5	SPT	6.0	7.5	4-4-5	1.4					**MEDIUM STIFF MODERATE YELLOWISH BROWN 10YR 5/4 SANDY CLAY** tsf 1.5, dry		
6	SPT	7.5	9.0	4-4-4	1.3					**MEDIUM STIFF MEDIUM LIGHT GRAY N6 CLAY** tsf 1.5		
7	SPT	9.0	10.5				10			**MEDIUM STIFF MIXTURE OF BROWN & GRAY CLAY** tsf 2.0		
8	SPT	10.5	12.0	4-6-6	1.4							
9	SPT	12.0	13.5	5-6-10	1.3					**MEDIUM STIFF MODERATE YELLOWISH BROWN 10YR 5/4 SANDY CLAY**		
10	SPT	13.5	15.0	5-7-9	1.5					**MEDIUM STIFF MODERATE YELLOWISH BROWN 10YR 5/4 W/MIXTURE OF MEDIUM LIGHT GRAY N6 SANDY CLAY**		
11	SPT	15.0	16.5	5-6-7	1.4		15			**MEDIUM STIFF MODERATE YELLOWISH BROWN 10YR 5/4 SANDY CLAY** tsf 1.5		
12	SPT	16.5	18.0	3-3-5	1.5					**SOFT MODERATE YELLOWISH BROWN 10YR 5/4 SANDY CLAY** tsf 1.0		
13	SPT	18.0	19.5	2-3-4	1.5					**SOFT MODERATE YELLOWISH BROWN 10YR 5/4 SANDY CLAY** tsf .5		
14	SPT	19.5	21.0	2-2-4	1.3					**YELLOWISH ORANGE 10YR 6/6 SAND FINE**		

TYPE OF CASING USED

	NQ-2 ROCK CORE	
X	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER REB

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **41510694-01**

COMPANY **AMERICAN ELECTRIC POWER** BORING NO. **MW-1002** DATE **7/16/10** SHEET **2** OF **3**

PROJECT **Rockport Bottom Ash Pond USWAG** BORING START **5/27/10** BORING FINISH **6/2/10**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
15	SPT	21.0	22.5	2-2-2	1.4					**SOFT YELLOWISH ORANGE 10YR 6/6 SANDY CLAY** tsf .5, moist		
16	SPT	22.5	24.0	2-2-2	1.3							
17	SPT	24.0	25.5	5-6-7	1.2		25			**YELLOWISH ORANGE 10YR 6/6 SAND FINE**		
18	SPT	25.5	27.0	3-4-7	1.5					**YELLOWISH ORANGE 10YR 6/6 SAND FINE** moist		
19	SPT	27.0	28.5	2-2-4	1.4							
20	SPT	28.5	30.0	2-2-2	1.4		30			**YELLOWISH ORANGE 10YR 6/6 SAND FINE** wet	▽	
21	SPT	30.0	31.5	3-3-3	1.2					**YELLOWISH ORANGE 10YR 6/6 SAND FINE**		
22	SPT	31.5	33.0	2-2-4	1.4							
23	SPT	33.0	34.5	4-4-4	1.3							
24	SPT	34.5	36.0	5-6-6	1.4		35					
25	SPT	36.0	37.5	5-5-6	1.4							
26	SPT	37.5	39.0	4-4-8	1.3					**YELLOWISH ORANGE 10YR 6/6 SAND FINE** w/some pebbles		
27	SPT	39.0	40.5	4-6-9	1.5		40			**YELLOWISH ORANGE 10YR 6/6 SAND FINE**		
28	SPT	40.5	42.0	6-8-10	1.3					**YELLOWISH ORANGE 10YR 6/6 SAND FINE** w/some pebbles		
29	SPT	42.0	43.5	7-6-10	1.4							
30	SPT	43.5	45.0	6-8-11	1.4		45					
31	SPT	45.0	46.5	7-9-11	1.4							

Continued Next Page

JOB NUMBER 41510694-01

COMPANY AMERICAN ELECTRIC POWER BORING NO. MW-1002 DATE 7/16/10 SHEET 3 OF 3

PROJECT Rockport Bottom Ash Pond USWAG BORING START 5/27/10 BORING FINISH 6/2/10

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER 41510694-01

COMPANY AMERICAN ELECTRIC POWER

PROJECT Rockport Bottom Ash Pond USWAG

COORDINATES N 151,208.1 E 512,820.7

GROUND ELEVATION 390.8 SYSTEM State Plane using NAD27/29

BORING NO. MW-1003 DATE 7/16/10 SHEET 1 OF 2

BORING START 5/26/10 BORING FINISH 6/2/10

PIEZOMETER TYPE NA WELL TYPE OW

HGT. RISER ABOVE GROUND 2.39 DIA 2"

DEPTH TO TOP OF WELL SCREEN 27.7 BOTTOM 37.4

WELL DEVELOPMENT BACKFILL VOLCLAY

FIELD PARTY ZLR / REB RIG D-120

Water Level, ft	▽ 23.1	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SPT	0.0	1.5	5-12-13	1.5					**DARK YELLOWISH ORANGE 10RY 6/6 CLAYSHALE** dry		NO GROUNDING IN USE / WATER FROM STAND PIPE @ LANDFILL / DECON 05/26/10
2	SPT	1.5	3.0	4-7-11	1.5					**DARK YELLOWISH ORANGE 10RY 6/6 CLAYSHALE**		
3	SPT	3.0	4.5	3-4-5	1.4					**MEDIUM STIFF DARK YELLOWISH ORANGE 10YR 6/6 SANDY CLAY** tsf 2.0		
4	SPT	4.5	6.0	3-4-6	1.4		5			**MEDIUM STIFF DARK YELLOWISH ORANGE 10YR 6/6 SANDY CLAY** tsf 2.5		
5	SPT	6.0	7.5	2-3-5	1.4					**MEDIUM STIFF DARK YELLOWISH ORANGE 10YR 6/6 SANDY CLAY** tsf 1.5		
6	SPT	7.5	9.0	3-3-5	1.5							
7	SPT	9.0	10.5	4-4-4	1.5		10			**SOFT DARK YELLOWISH ORANGE 10YR 6/6 SANDY CLAY** tsf 1.0		
8	SPT	10.5	12.0	2-2-4	1.4					**SOFT DARK YELLOWISH ORANGE 10YR 6/6 SANDY CLAY** tsf 1.5		
9	SPT	12.0	13.5	2-3-4	1.5					**SOFT DARK YELLOWISH ORANGE 10YR 6/6 SANDY CLAY** tsf .5		
10	SPT	13.5	15.0	2-2-4	1.5							
11	SPT	15.0	16.5	2-2-2	1.5		15					
12	SPT	16.5	18.0	2-4-6	1.3					**YELLOWISH ORANGE 10YR 6/6 SAND FINE**		
13	SPT	18.0	19.5	4-4-4	1.4							
14	SPT	19.5	21.0	4-4-6	1.5							

TYPE OF CASING USED

	NQ-2 ROCK CORE	
X	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER REB

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **41510694-01**

COMPANY **AMERICAN ELECTRIC POWER** BORING NO. **MW-1003** DATE **7/16/10** SHEET **2** OF **2**

PROJECT **Rockport Bottom Ash Pond USWAG** BORING START **5/26/10** BORING FINISH **6/2/10**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
15	SPT	21.0	22.5	3-8-10	1.5					**MODERATE YELLOWISH BROWN 10YR 5/4 SAND FINE** moist		
16	SPT	22.5	24.0	4-4-6	1.4					**MODERATE YELLOWISH BROWN 10YR 5/4 SAND FINE** wet	▽	
17	SPT	24.0	25.5	4-6-6	1.5		25					
18	SPT	25.5	27.0	3-5-7	1.4							
19	SPT	27.0	28.5	4-5-7	1.4							
20	SPT	28.5	30.0	6-6-8	1.4		30					
21	SPT	30.0	31.5	4-5-9	1.3							
22	SPT	31.5	33.0	2-2-3	1.4							
23	SPT	33.0	34.5	5-6-8	1.3							
24	SPT	34.5	36.0	5-6-7	1.4		35					
25	SPT	36.0	37.5	5-5-5	1.3					**MODERATE YELLOWISH BROWN 10YR 5/4 SAND FINE** w/pebbles, wet		
26	SPT	37.5	39.0	6-6-6	1.4							

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER 41510694-01

COMPANY AMERICAN ELECTRIC POWER

PROJECT Rockport Bottom Ash Pond USWAG

COORDINATES N 150,013.4 E 514,264.7

GROUND ELEVATION 394.3 SYSTEM State Plane using NAD27/29

BORING NO. MW-1004 DATE 7/16/10 SHEET 1 OF 2

BORING START 6/3/10 BORING FINISH 6/3/10

PIEZOMETER TYPE NA WELL TYPE OW

HGT. RISER ABOVE GROUND 2.30 DIA 2"

DEPTH TO TOP OF WELL SCREEN 32.2 BOTTOM 41.9

WELL DEVELOPMENT BACKFILL VOLCLAY

FIELD PARTY ZLR / REB RIG D-120

Water Level, ft	▽ 28.8	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SPT	0.0	1.5	10-11-10	1.3					**MODERATE YELLOWISH BROWN 10YR 5/6 CLAYSHALE** dry		NO GROUNDING IN USE / WATER FROM STAND PIPE @ LANDFILL / DECON 06/03/10
2	SPT	1.5	3.0	5-6-7	1.4					**MODERATE YELLOWISH BROWN 10YR 5/6 SANDY CLAY** tsf 1.5, dry		
3	SPT	3.0	4.5	4-6-8						**MODERATE YELLOWISH BROWN 10YR 5/6 SANDY CLAY** tsf 1.5, w/limestone mixed, dry		
4	SPT	4.5	6.0	4-4-6	1.4		5			**GRAY N6 CLAY** tsf 1.5, dry		
5	SPT	6.0	7.5	3-4-4	1.3					**GRAY N6 SANDY CLAY** tsf 1.5, dry		
6	SPT	7.5	9.0	4-4-8	1.4					**MEDIUM STIFF MODERATE YELLOWISH BROWN 10YR 5/6 SANDY CLAY** tsf 2.0		
7	SPT	9.0	10.5	3-6-9	1.4		10			**MEDIUM STIFF MODERATE YELLOWISH BROWN 10YR 5/6 SANDY CLAY** tsf 3.0		
8	SPT	10.5	12.0	3-6-9	1.4							
9	SPT	12.0	13.5	3-5-8	1.4							
10	SPT	13.5	15.0	4-6-6	1.3		15					
11	SPT	15.0	16.5	3-5-9	1.5							
12	SPT	16.5	18.0	4-4-8	1.3					**MEDIUM STIFF MODERATE YELLOWISH BROWN 10YR 5/6 SANDY CLAY** tsf 3.0, w/more sand		
13	SPT	18.0	19.5	4-4-6	1.5					**MEDIUM STIFF MODERATE YELLOWISH BROWN 10YR 5/6 SANDY CLAY** tsf 2.5, moist		
14	SPT	19.5	21.0	2-3-5	1.4					**STIFF MODERATE YELLOWISH BROWN**		

TYPE OF CASING USED

	NQ-2 ROCK CORE	
X	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER REB

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **41510694-01**

COMPANY **AMERICAN ELECTRIC POWER** BORING NO. **MW-1004** DATE **7/16/10** SHEET **2** OF **2**

PROJECT **Rockport Bottom Ash Pond USWAG** BORING START **6/3/10** BORING FINISH **6/3/10**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										10YR 5/6 SANDY CLAY tsf 2.0		
15	SPT	21.0	22.5	2-4-7	1.4					**YELLOWISH ORANGE 10YR 6/6 SAND FINE**		
16	SPT	22.5	24.0	2-4-7	1.4							
17	SPT	24.0	25.5	2-4-6	1.5		25					
18	SPT	25.5	27.0	3-4-7	1.4					**YELLOWISH ORANGE 10YR 6/6 SAND FINE** w/some pebbles, wet		
19	SPT	27.0	28.5	4-4-8	1.5					**YELLOWISH ORANGE 10YR 6/6 SAND FINE**		
20	SPT	28.5	30.0	2-3-5	1.2					**YELLOWISH ORANGE 10YR 6/6 SAND FINE** w/pebbles, wet	▽	
21	SPT	30.0	31.5	5-7-7	1.3		30			**YELLOWISH ORANGE 10YR 6/6 SAND FINE** w/pebbles		
22	SPT	31.5	33.0	3-4-6	1.4					**YELLOWISH ORANGE 10YR 6/6 SAND FINE** w/gravels		
23	SPT	33.0	34.5	6-7-9	1.2					**YELLOWISH ORANGE 10YR 6/6 SAND FINE** w/gravels, wet		
24	SPT	34.5	36.0	4-5-5	1.3		35			**YELLOWISH ORANGE 10YR 6/6 SAND FINE**		
25	SPT	36.0	37.5	3-4-6	1.4					**YELLOWISH ORANGE 10YR 6/6 SAND FINE** w/pebbles, wet		
26	SPT	37.5	39.0	3-4-5	1.2							
27	SPT	39.0	40.5	3-4-4	1.3		40			**YELLOWISH ORANGE 10YR 6/6 SAND FINE** wet		
28	SPT	40.5	42.0	3-4-5	1.1							
29	SPT	42.0	43.5	5-6-9								

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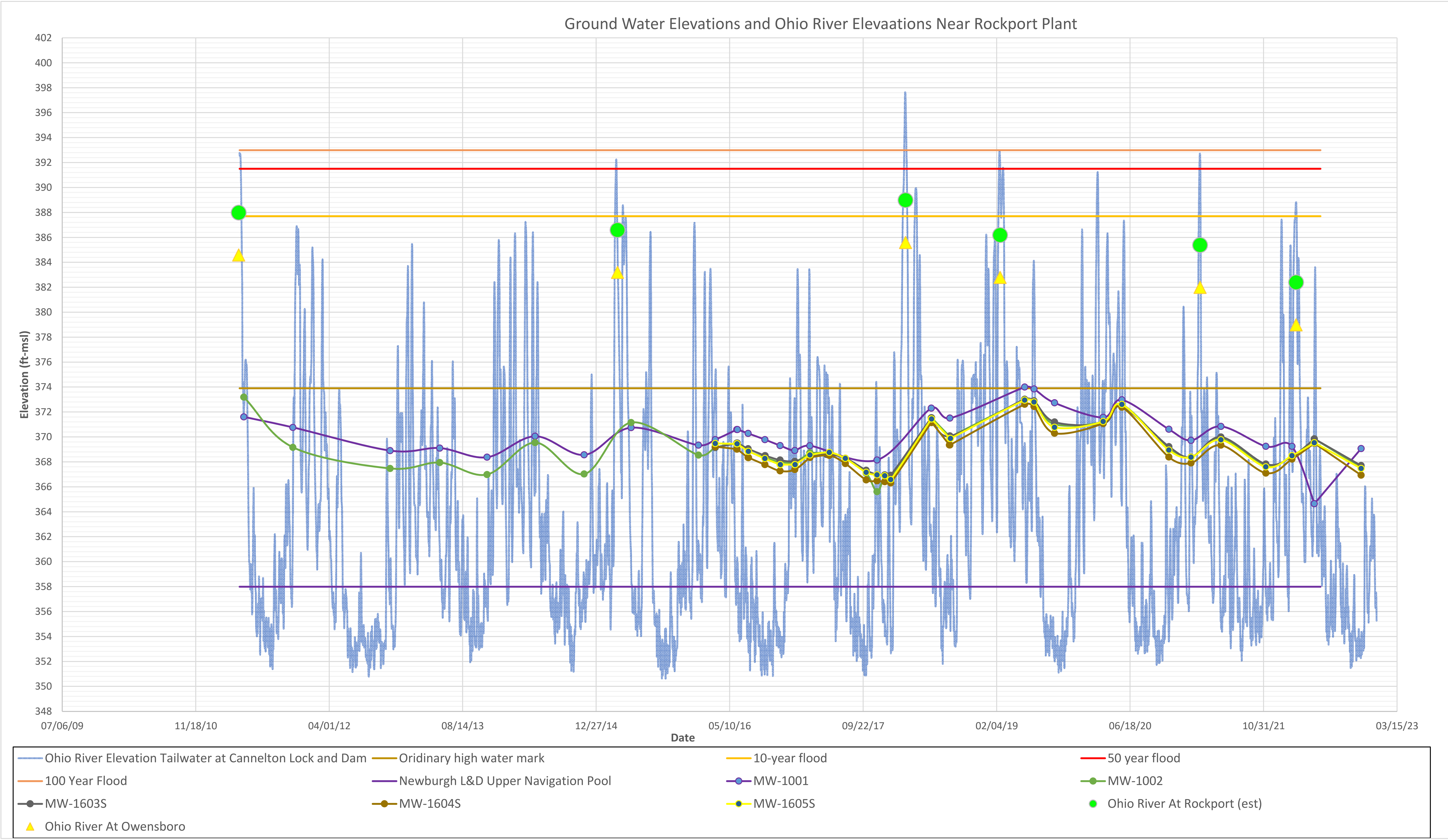
Appendix C
Piezometric Data

Appendix C-1
Ohio River Hydrograph, 2010-2023



Ground Water Elevations and Ohio River Elevaations Near Rockport Plant
Elevation (ft-msl)
402
400
398
396
394
392
390
388
386
384
382
380
378
376
374
372
370
368
366
364
362
360
358
356
354
352
350
348
07/06/09
11/18/10
04/01/12
08/14/13
12/27/14
05/10/16
09/22/17
02/04/19
06/18/20
10/31/21
03/15/23
Date
Ohio River Elevation Tailwater at Cannelton Lock and Dam
Oridinary high water mark
10-year flood
50 year flood
100 Year Flood
Newburgh L&D Upper Navigation Pool
MW-1001
MW-1002
MW-1603S
MW-1604S
MW-1605S
Ohio River At Rockport (est)
Ohio River At Owensboro

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Appendix C-2
Wastewater Pond Complex Monitoring Well Piezometric Maps

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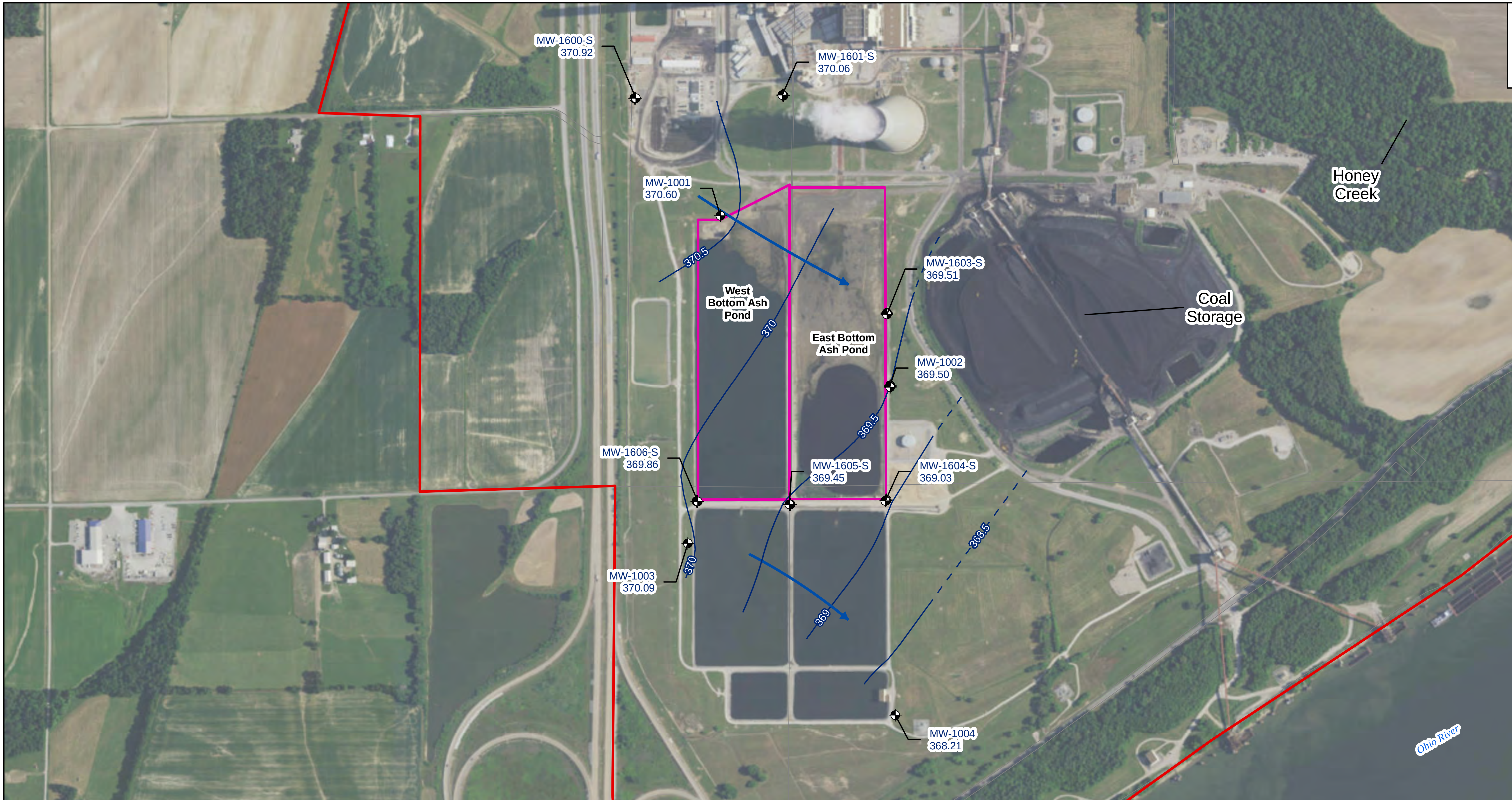


Legend
- Groundwater Monitoring Well
- Approximate Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Bottom Ash Ponds
- Property Boundary
- Parcel Boundaries

Notes
- Monitoring well coordinates and water level data (collected on June 6, 2016) provided by AEP.
- Approximate Ohio River elevation was 359.79 feet at the Rockport Power Plant on June 6, 2016. Elevation calculated by averaging measurements at Cannelton Dam and Newburgh Dam. Data source: USACE.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (AMEC, 2016) provided by AEP.
- Property and parcel boundaries taken from Spencer County Assessor.
- Groundwater and river elevation units are feet above mean sea level.

1,000 500 0 1,000 Feet

Potentiometric Surface Map - Uppermost Aquifer
June 2016

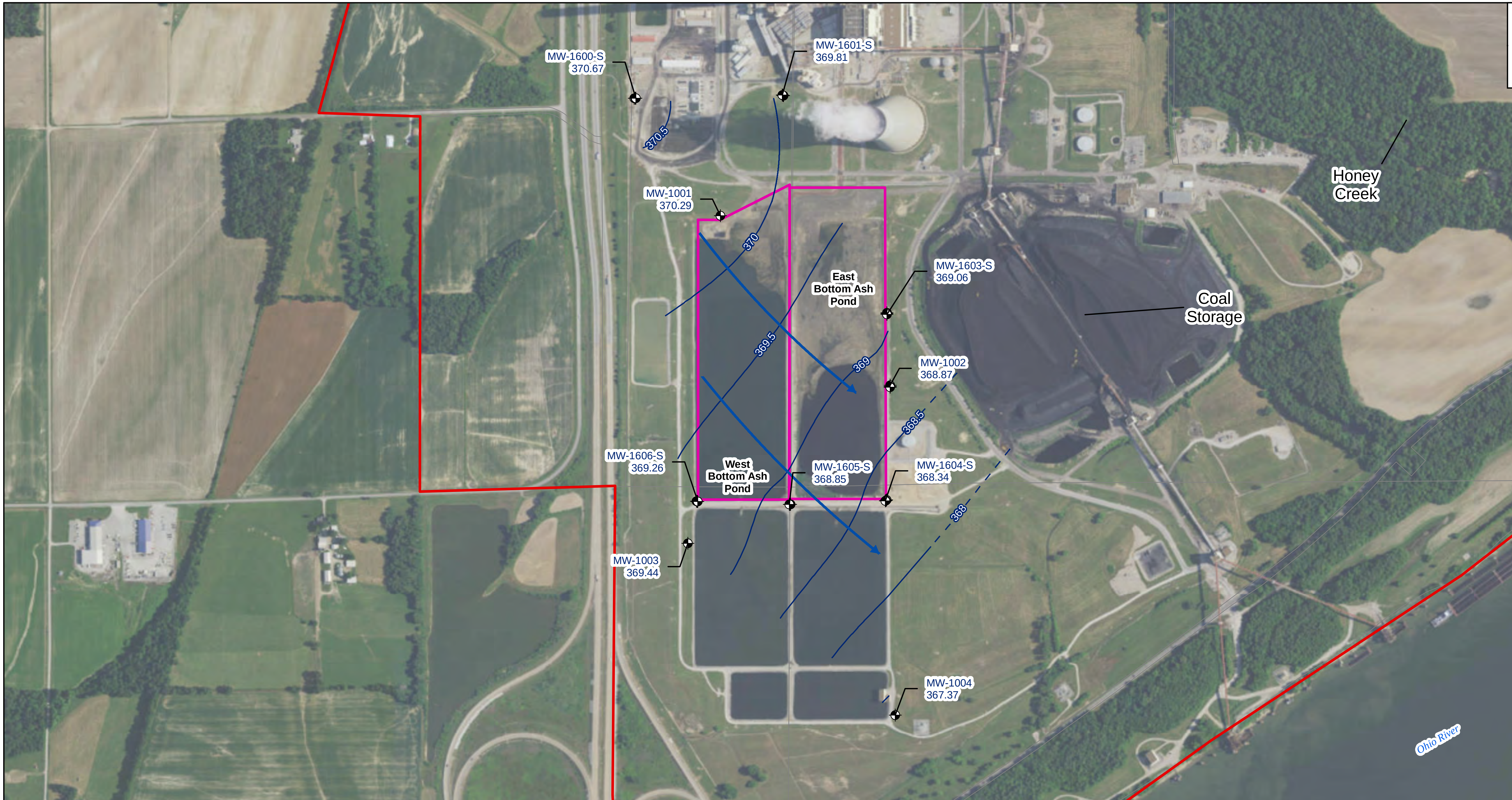
AEP-Rockport Power Plant - Bottom Ash Ponds
Rockport, Indiana

Geosyntec consultants

Columbus, Ohio | 2018/01/03

Figure 1

C:\Users\mmuenich\Documents\local_projects\AEP_GIS\Rockport\MXDs\BAP\Rockport_Pond_GW_Elev_2016_06Jun.mxd. MMuenich. 1/3/2018. CHA8423/08/08.



Legend

- Groundwater Monitoring Well
- Approximate Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Bottom Ash Ponds
- Property Boundary
- Parcel Boundaries

Notes

- Monitoring well coordinates and water level data (collected on July 18, 2016) provided by AEP.
- Approximate Ohio River elevation was 358.22 feet at the Rockport Power Plant on July 18, 2016. Elevation calculated by averaging measurements at Cannelton Dam and Newburgh Dam. Data source: USACE.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (AMEC, 2016) provided by AEP.
- Property and parcel boundaries taken from Spencer County Assessor.
- Groundwater and river elevation units are feet above mean sea level.

1,000 500 0 1,000 Feet

Potentiometric Surface Map - Uppermost Aquifer
July 2016

AEP-Rockport Power Plant - Bottom Ash Ponds
Rockport, Indiana

Geosyntec consultants

Columbus, Ohio | 2018/01/03

Figure 2

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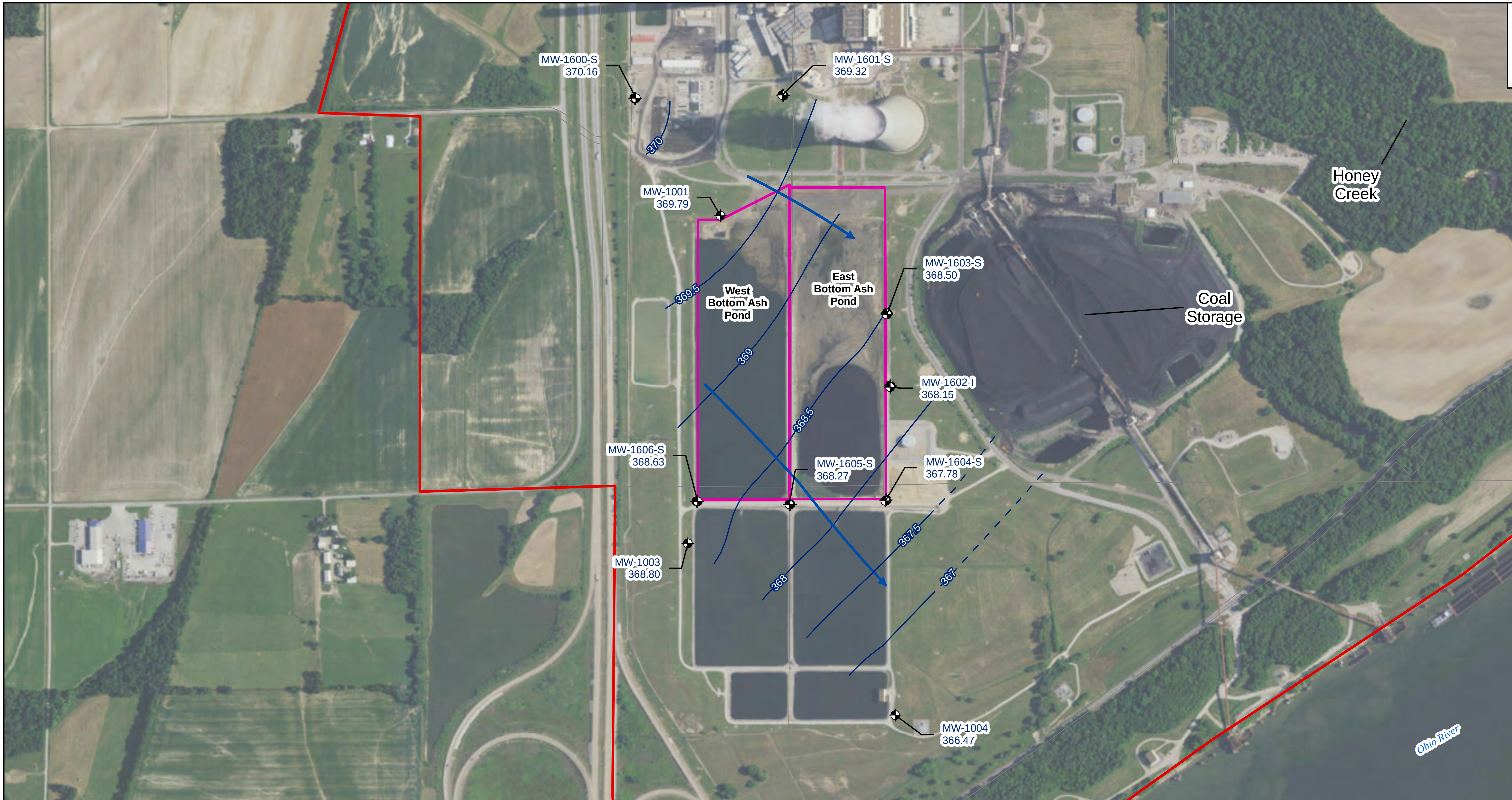

Legend
- Groundwater Monitoring Well
- Approximate Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Bottom Ash Ponds
- Property Boundary
- Parcel Boundaries

Notes
- Monitoring well coordinates and water level data (collected on September 19, 2016) provided by AEP.
- Approximate Ohio River elevation was 355.97 feet at the Rockport Power Plant on September 19, 2016. Elevation calculated by averaging measurements at Cannelton Dam and Newburgh Dam. Data source: USACE.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (AMEC, 2016) provided by AEP.
- Property and parcel boundaries taken from Spencer County Assessor.
- Groundwater and river elevation units are feet above mean sea level.

1,000 500 0 1,000 Feet

Potentiometric Surface Map - Uppermost Aquifer
September 2016

AEP-Rockport Power Plant - Bottom Ash Ponds
Rockport, Indiana

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Figure 3

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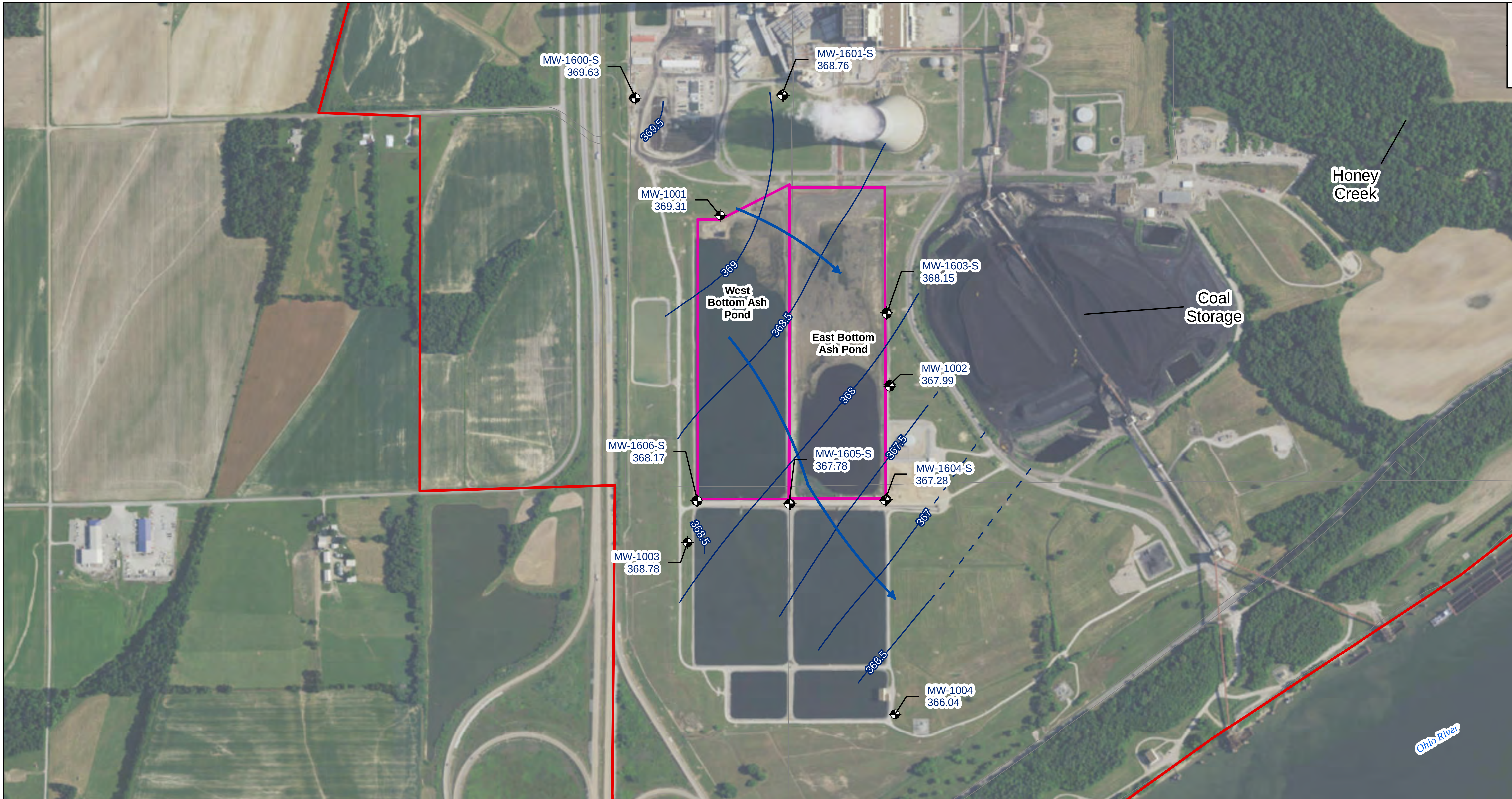
C:\Users\mmuenich\Documents\local_projects\AEP_GIS\Rockport\MXDs\BAP\Rockport_Pond_GW_Elev_2016_09Sep.mxd. MMuenich. 1/3/2018. CHA8423/08/08.



Legend

- Groundwater Monitoring Well
- Approximate Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Bottom Ash Ponds
- Property Boundary
- Parcel Boundaries

Notes

- Monitoring well coordinates and water level data (collected on November 15, 2016) provided by AEP.
- Approximate Ohio River elevation was 356.87 feet at the Rockport Power Plant on November 15, 2016. Elevation calculated by averaging measurements at Cannelton Dam and Newburgh Dam. Data source: USACE.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (AMEC, 2016) provided by AEP.
- Property and parcel boundaries taken from Spencer County Assessor.
- Groundwater and river elevation units are feet above mean sea level.

Potentiometric Surface Map - Uppermost Aquifer
November 2016

AEP-Rockport Power Plant - Bottom Ash Ponds
Rockport, Indiana

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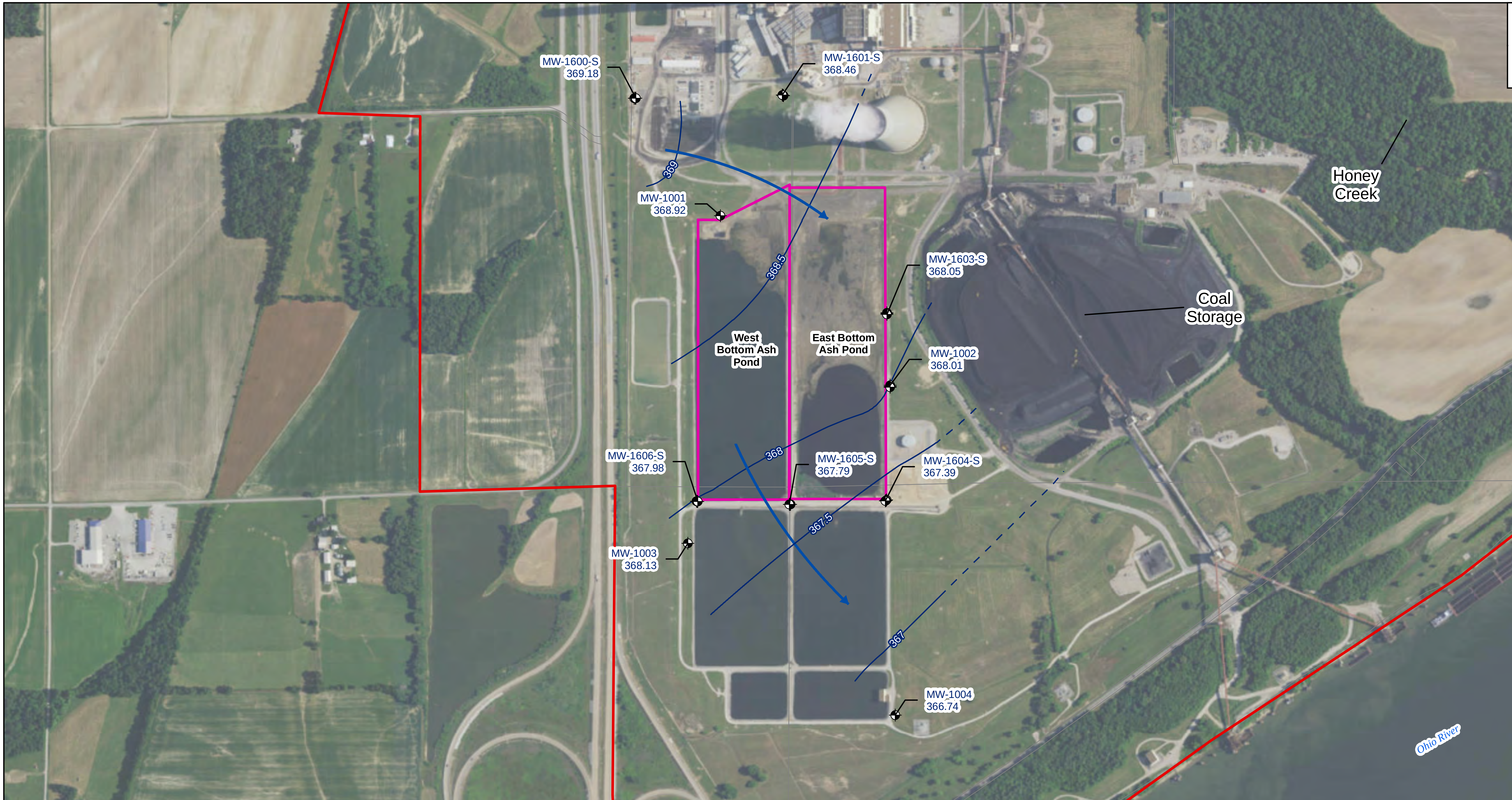
Columbus, Ohio | 2018/01/03

Figure 4

C:\Users\mmuenich\Documents\local_projects\AEP_GIS\Rockport\MXDs\BAP\Rockport_Pond_GW_Elev_2016_11Nov.mxd. MMuenich. 1/3/2018. CHA8423/08/08.



Legend
- Groundwater Monitoring Well
- Approximate Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Bottom Ash Ponds
- Property Boundary
- Parcel Boundaries

Notes
- Monitoring well coordinates and water level data (collected on January 9, 2017) provided by AEP.
- Approximate Ohio River elevation was 376.45 feet at the Rockport Power Plant on January 9, 2017. Elevation calculated by averaging measurements at Cannelton Dam and Newburgh Dam. Data source: USACE.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (AMEC, 2016) provided by AEP.
- Property and parcel boundaries taken from Spencer County Assessor.
- Groundwater and river elevation units are feet above mean sea level.

1,000 500 0 1,000
Feet

Potentiometric Surface Map - Uppermost Aquifer
January 2017

AEP-Rockport Power Plant - Bottom Ash Ponds
Rockport, Indiana

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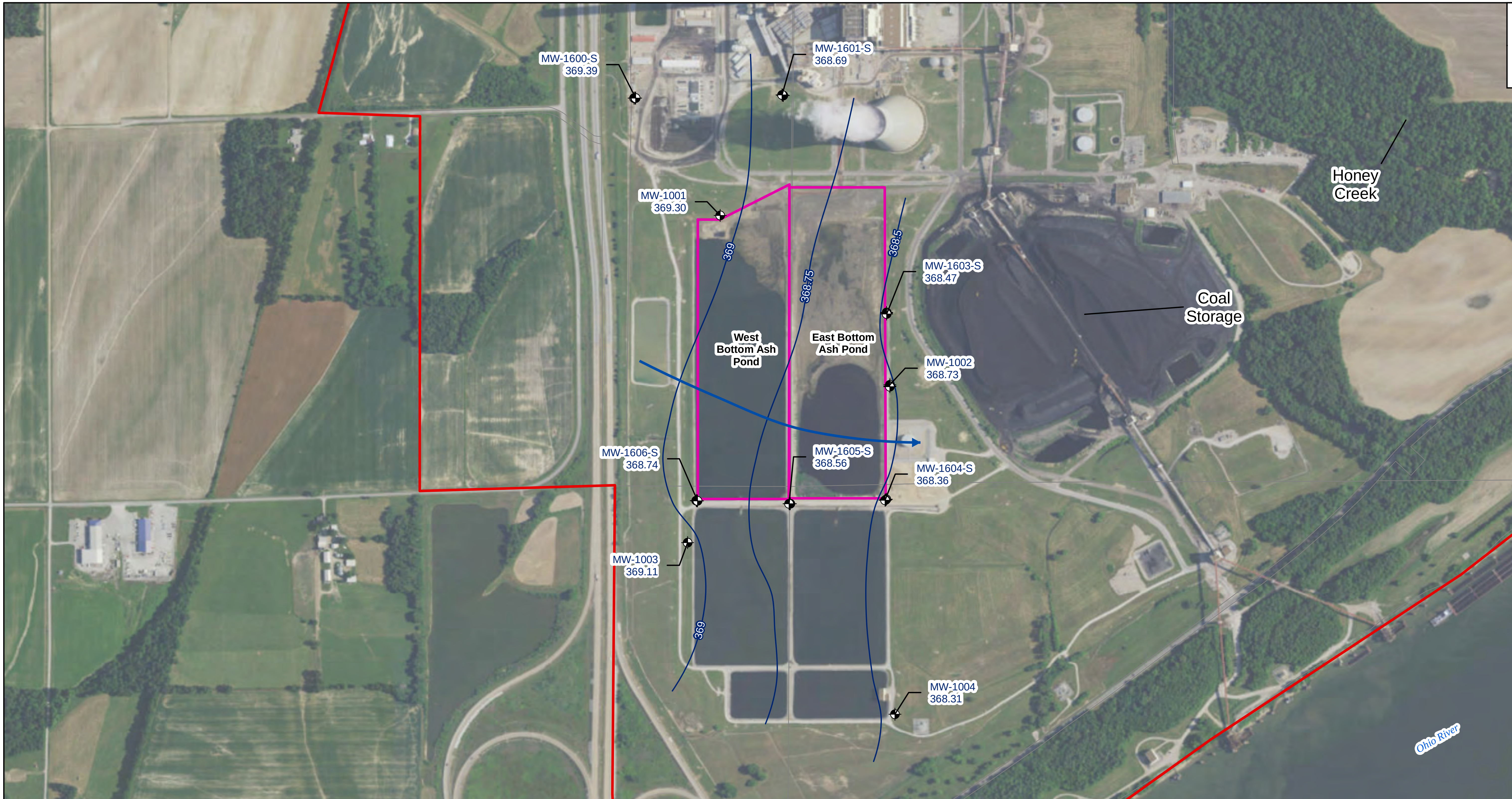
consultants

Columbus, Ohio | 2017/10/06

Figure
5

C:\Users\mmuenich\Documents\local_projects\AEP_GIS\Rockport\MXDs\BAP\Rockport_Pond_GW_Elev_2017_01Jan.mxd. MMuenich. 10/6/2017. CHA8423/08/08.



Legend

- Groundwater Monitoring Well
- Approximate Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Bottom Ash Ponds
- Property Boundary
- Parcel Boundaries

Notes

- Monitoring well coordinates and water level data (collected on March 6, 2017) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (AMEC, 2016) provided by AEP.
- Property and parcel boundaries taken from Spencer County Assessor.
- Groundwater and river elevation units are feet above mean sea level.

1,000 500 0 1,000 Feet

Potentiometric Surface Map - Uppermost Aquifer
March 2017

AEP-Rockport Power Plant - Bottom Ash Ponds
Rockport, Indiana

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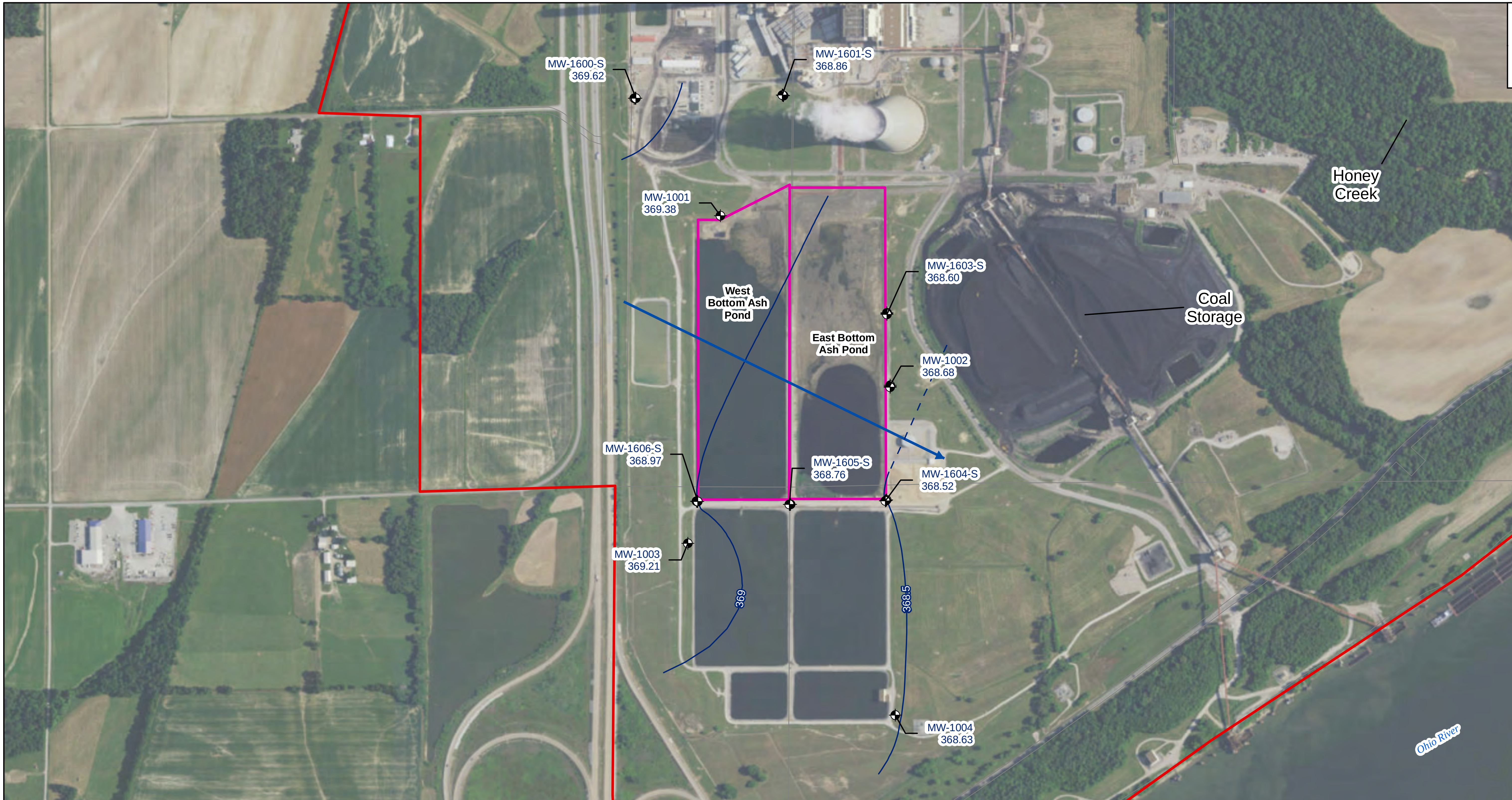
Figure 6

C:\Users\mmuenich\Documents\local_projects\AEP_GIS\Rockport\MXDs\BAP\Rockport_Pond_GW_Elev_2017_03Mar.mxd. MMuenich. 1/3/2018. CHA8423/08/08.



Legend
- Groundwater Monitoring Well
- Approximate Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Bottom Ash Ponds
- Property Boundary
- Parcel Boundaries

Notes
- Monitoring well coordinates and water level data (collected on May 8, 2017) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (AMEC, 2016) provided by AEP.
- Property and parcel boundaries taken from Spencer County Assessor.
- Groundwater and river elevation units are feet above mean sea level.

1,000 500 0 1,000 Feet

Potentiometric Surface Map - Uppermost Aquifer
May 2017

AEP-Rockport Power Plant - Bottom Ash Ponds
Rockport, Indiana

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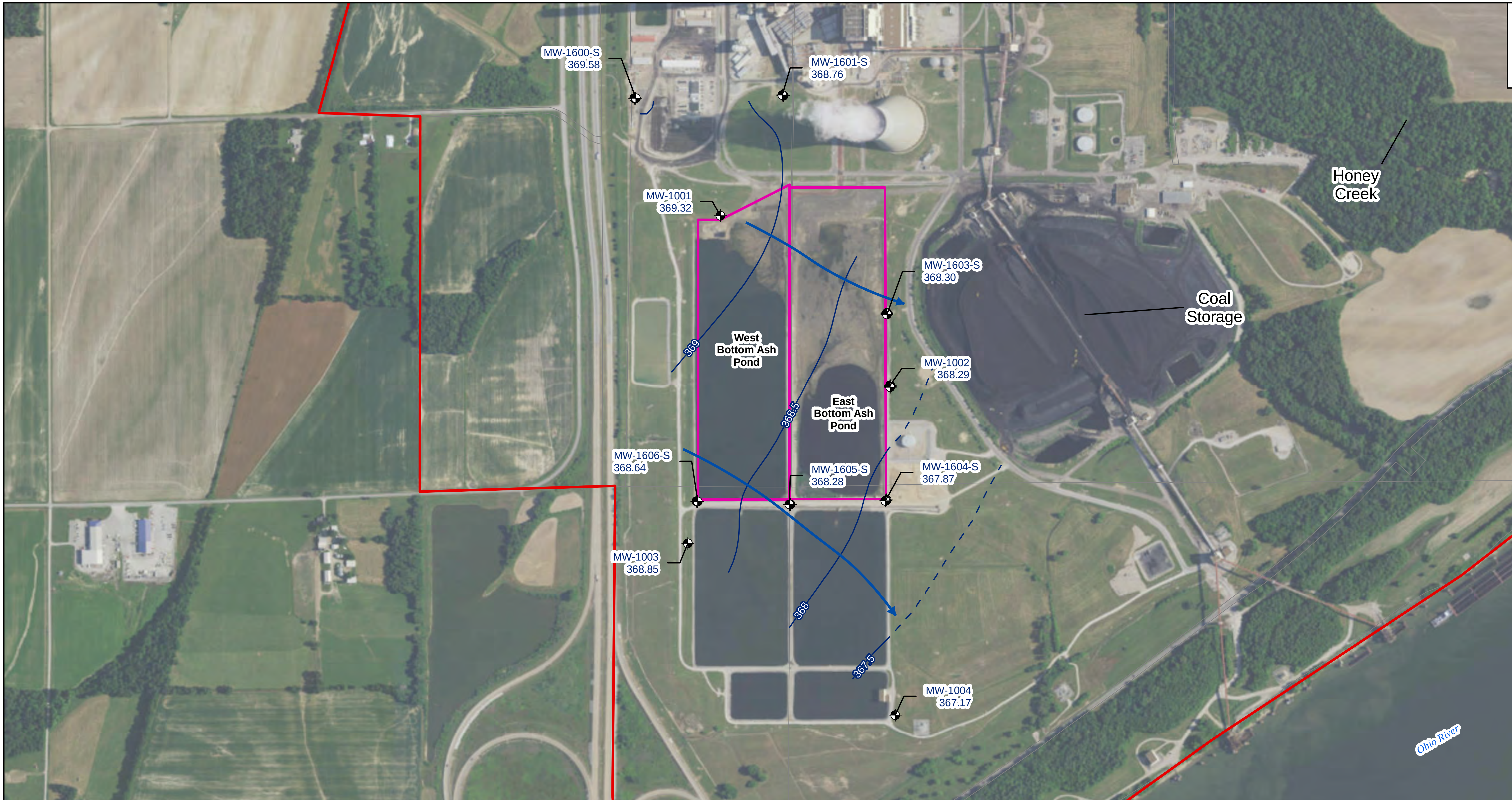
Figure 7

C:\Users\mmuenich\Documents\local_projects\AEP_GIS\Rockport\MXDs\BAP\Rockport_Pond_GW_Elev_2017_05May.mxd. MMuenich. 1/3/2018. CHA8423/08/08.



Legend

- Groundwater Monitoring Well
- Approximate Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Bottom Ash Ponds
- Property Boundary
- Parcel Boundaries

Notes

- Monitoring well coordinates and water level data (collected on May 8, 2017) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (AMEC, 2016) provided by AEP.
- Property and parcel boundaries taken from Spencer County Assessor.
- Groundwater and river elevation units are feet above mean sea level.

1,000 500 0 1,000 Feet

Potentiometric Surface Map - Uppermost Aquifer
July 2017

AEP-Rockport Power Plant - Bottom Ash Ponds
Rockport, Indiana

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Figure 8

Columbus, Ohio | 2018/01/03

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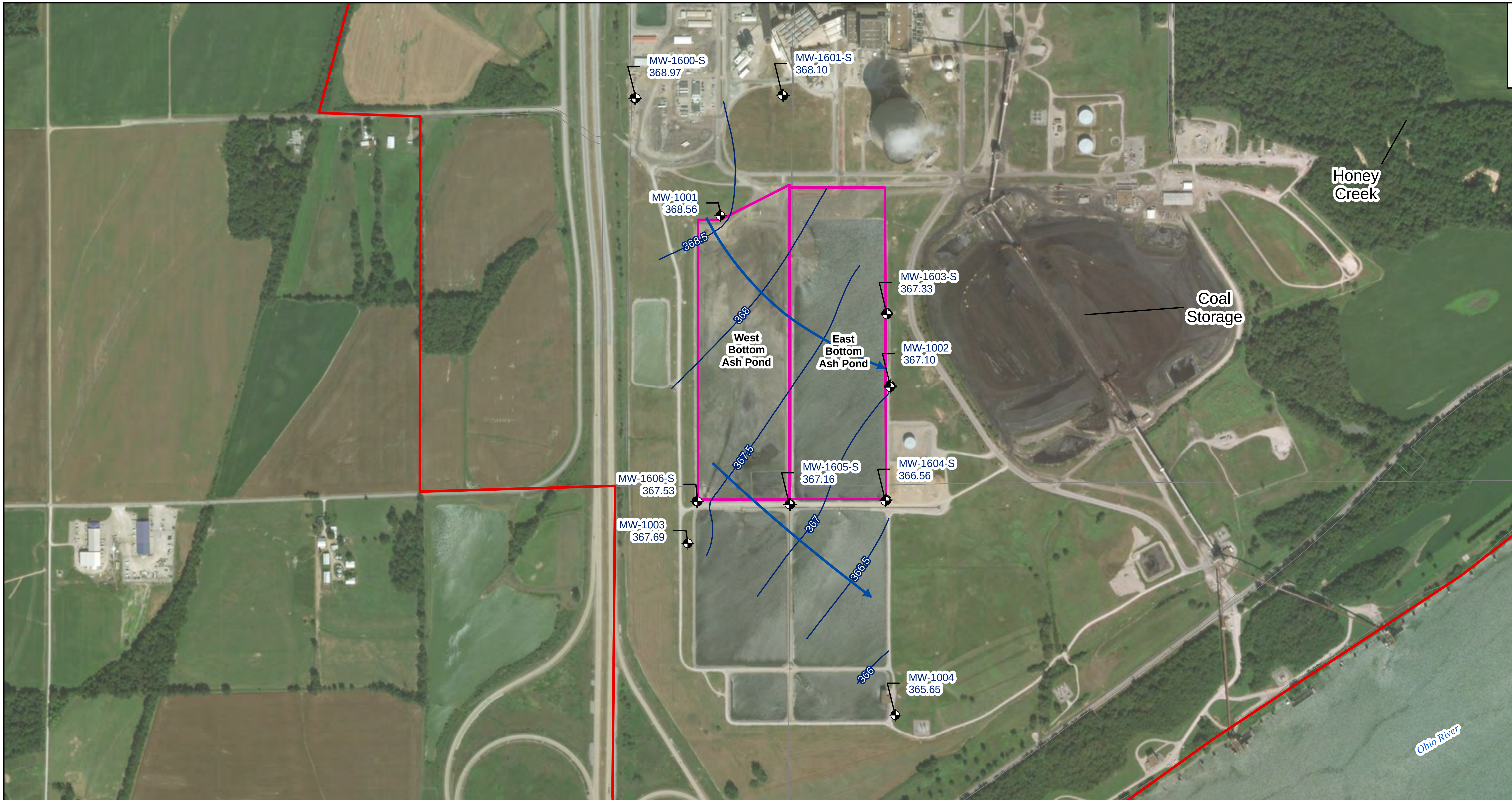

Legend

- Groundwater Monitoring Well
- Approximate Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Bottom Ash Ponds
- Property Boundary
- Parcel Boundaries

Notes

- Monitoring well coordinates and water level data (collected on October 3, 2017) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (AMEC, 2016) provided by AEP.
- Property and parcel boundaries taken from Spencer County Assessor.
- Only shallow screened wells were used for generating groundwater contours.
- Groundwater elevation units are feet above mean sea level.

1,000 500 0 1,000 Feet

Potentiometric Surface Map - Uppermost Aquifer
October 2017

AEP-Rockport Power Plant - Bottom Ash Ponds
Rockport, Indiana

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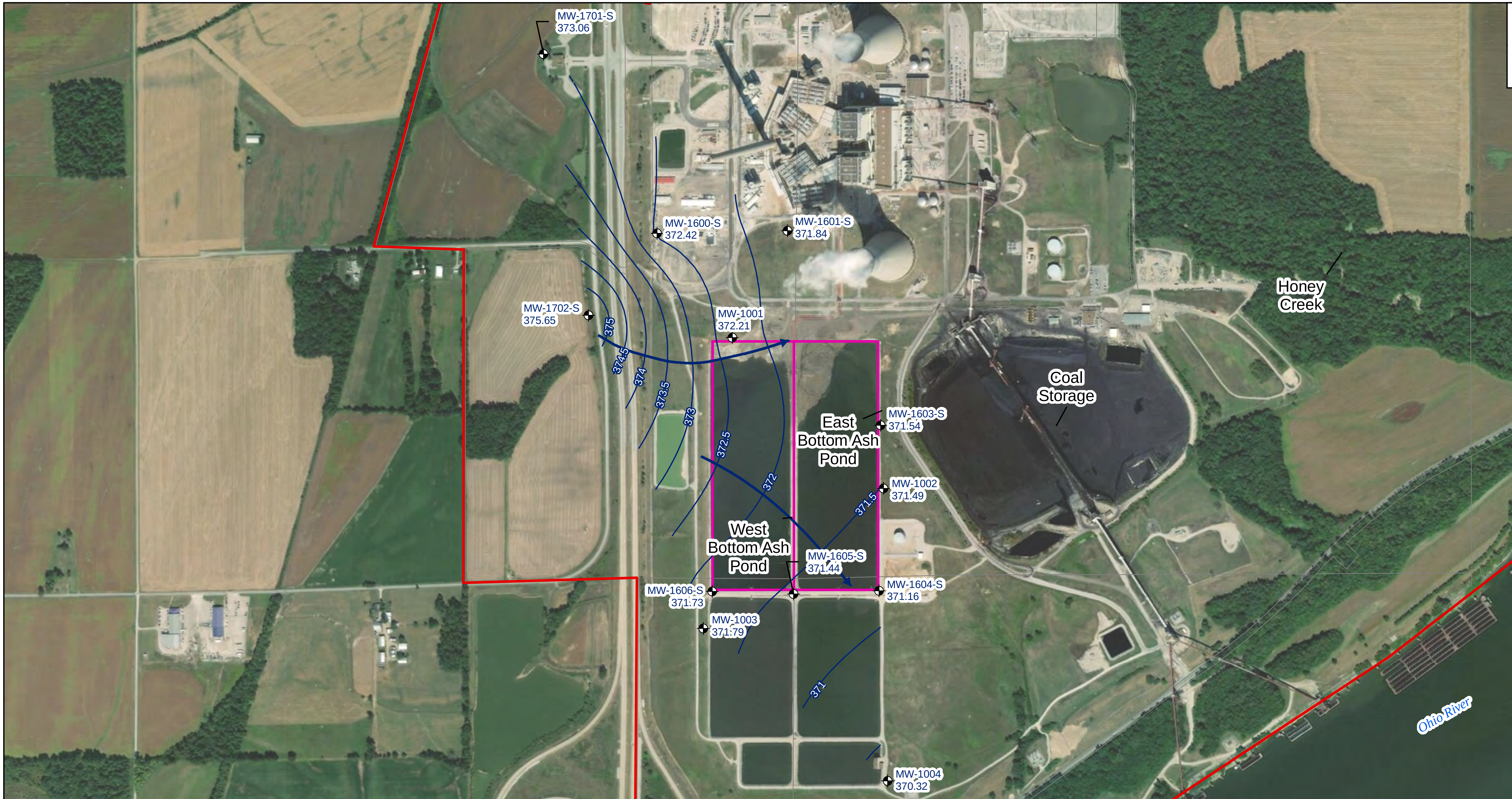
Columbus, Ohio | 2018/01/27

Figure 9

C:\Users\mmuenich\Documents\local_projects\AEP_GIS\Rockport\MXDs\BAP\Rockport_Pond_GW_Elev_2017_10.mxd. MMuenich. 1/27/2018. CHA8423/08/08.



Legend
- Groundwater Monitoring Well
- Approximate Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Bottom Ash Ponds
- Property Boundary
- Parcel Boundaries

Notes
- Monitoring well coordinates and water level data (collected on June 4, 2018) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (AMEC, 2016) provided by AEP.
- Property and parcel boundaries taken from Spencer County Assessor.
- Only shallow screened wells were used for generating groundwater contours.
- Groundwater elevation units are feet above mean sea level.

750 375 0 750 Feet

Potentiometric Surface Map - Uppermost Aquifer
June 2018

AEP-Rockport Power Plant - Bottom Ash Ponds
Rockport, Indiana

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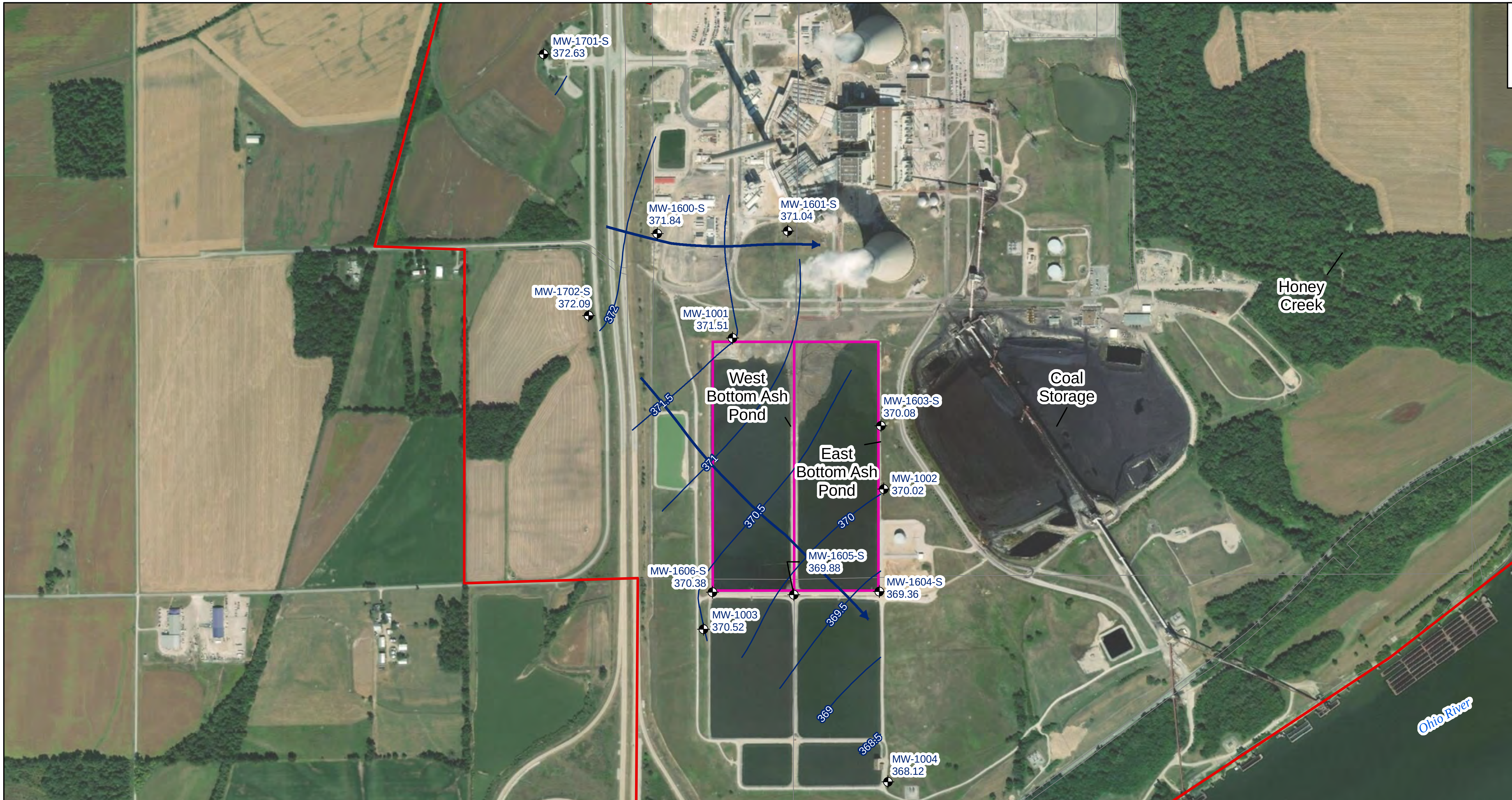
Columbus, Ohio | 2018/08/29

Figure 1

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Rockport\2018\Rockport_Pond_GW_Elev_June2018.mxd. ARevezzo. 8/29/2018. CHA8423/08/08.



Legend

- Groundwater Monitoring Well
- Rockport_GW_Elev_August2018
- Approximate Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Bottom Ash Ponds
- Property Boundary
- Parcel Boundaries

Notes
- Monitoring well coordinates and water level data (collected on August 13, 2018) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (AMEC, 2016) provided by AEP.
- Property and parcel boundaries taken from Spencer County Assessor.
- Only shallow screened wells were used for generating groundwater contours.
- Groundwater elevation units are feet above mean sea level.

750 375 0 750 Feet

Potentiometric Surface Map - Uppermost Aquifer
August 2018

AEP-Rockport Power Plant - Bottom Ash Ponds
Rockport, Indiana

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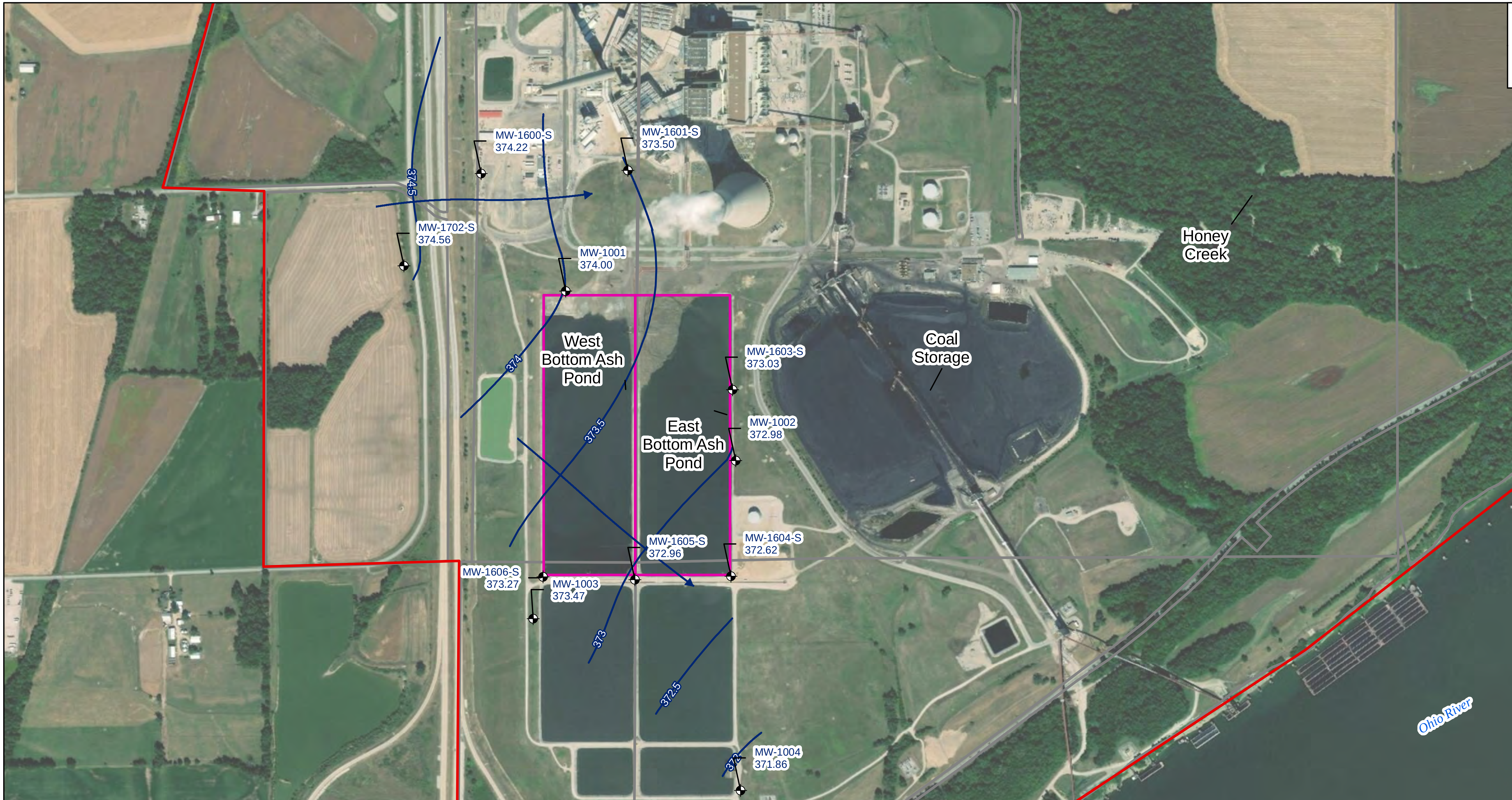
Figure 2

Columbus, Ohio | 2018/11/26

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Rockport\2018\Rockport_Pond_GW_Elev_Aug2018.mxd. ARevezzo. 11/26/2018. CHA8423/08/08.



Legend
- Groundwater Monitoring Well
- Approximate Groundwater Flow Direction
- Groundwater Elevation Contour
- Property Boundary
- Parcel Boundaries
- Bottom Ash Ponds

Notes
- Monitoring well coordinates and water level data (collected on May 20, 2019) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (AMEC, 2016) provided by AEP.
- Property and parcel boundaries taken from Spencer County Assessor.
- Only shallow screened wells were used for generating groundwater contours.
- Groundwater elevation units are feet above mean sea level.

Potentiometric Surface Map - Uppermost Aquifer
May 2019

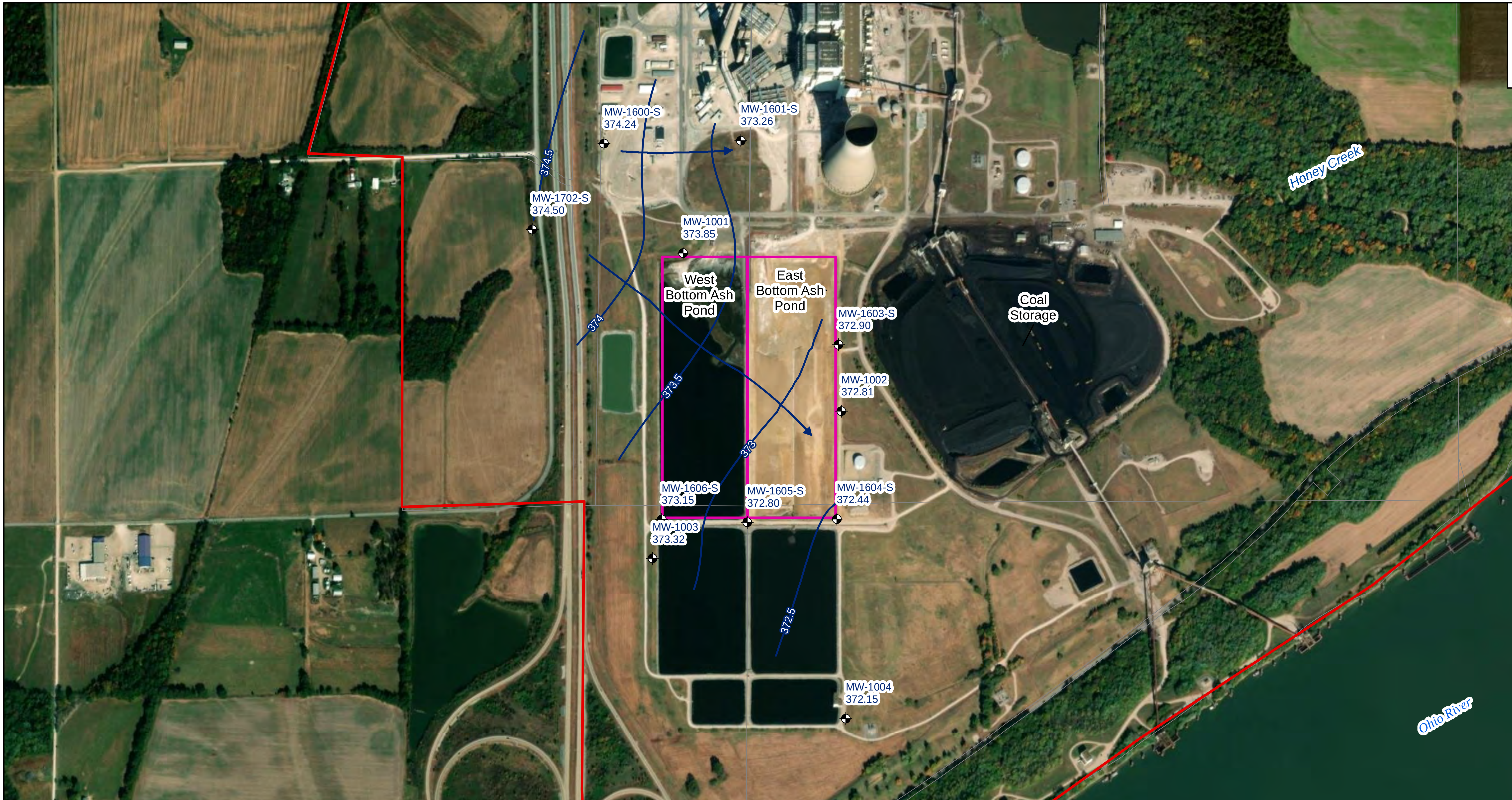
AEP-Rockport Power Plant - Bottom Ash Ponds
Rockport, Indiana

Geosyntec consultants

Columbus, Ohio | 2019/12/11

Figure X

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Rockport\2019\Rockport_Pond_GW_Elev_May2019.mxd. ARevezzo. 12/11/2019. CHA8423/08/08.



Legend

- Groundwater Monitoring Well
- Approximate Groundwater Flow Direction
- Groundwater Elevation Contour
- Bottom Ash Ponds
- Property Boundary
- Parcel Boundaries

Notes

- Monitoring well coordinates and water level data (collected on June 24, 2019) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (AMEC, 2016) provided by AEP.
- Property and parcel boundaries taken from Spencer County Assessor.
- Only shallow screened wells were used for generating groundwater contours.
- Groundwater elevation units are feet above mean sea level.

750 375 0 750 Feet

Potentiometric Surface Map - Uppermost Aquifer
June 2019

AEP-Rockport Power Plant - Bottom Ash Ponds
Rockport, Indiana

Geosyntec consultants

Figure X

Columbus, Ohio

2023/10/10

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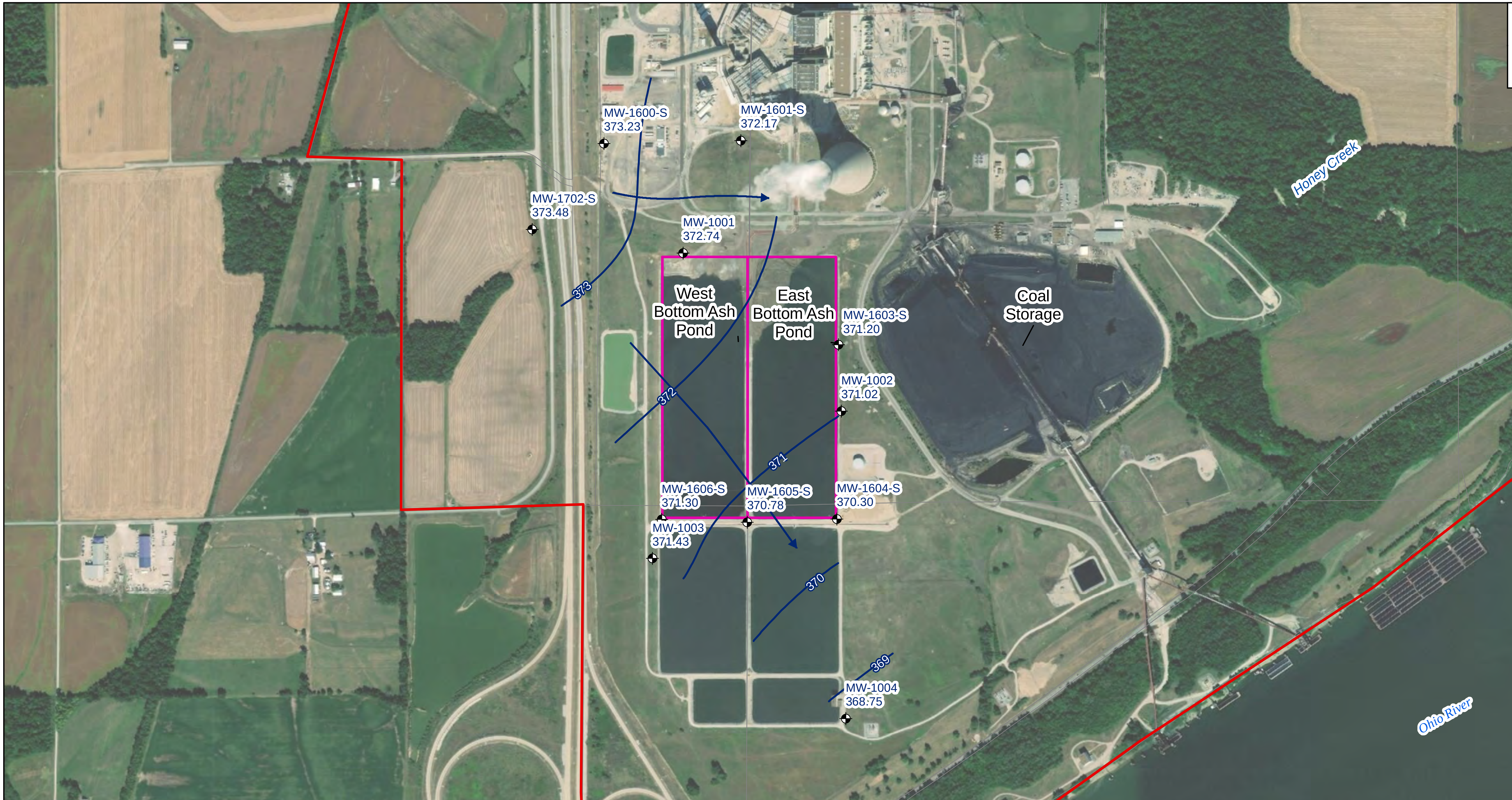

Legend
- Groundwater Monitoring Well
- Approximate Groundwater Flow Direction
- Groundwater Elevation Contour
- Bottom Ash Ponds
- Property Boundary
- Parcel Boundaries

Notes
- Monitoring well coordinates and water level data (collected on September 9, 2019) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (AMEC, 2016) provided by AEP.
- Property and parcel boundaries taken from Spencer County Assessor.
- Only shallow screened wells were used for generating groundwater contours.
- Groundwater elevation units are feet above mean sea level.

750 375 0 750 Feet

Potentiometric Surface Map - Uppermost Aquifer
September 2019

AEP-Rockport Power Plant - Bottom Ash Ponds
Rockport, Indiana

Geosyntec consultants

Columbus, Ohio | 2019/12/12

Figure
X

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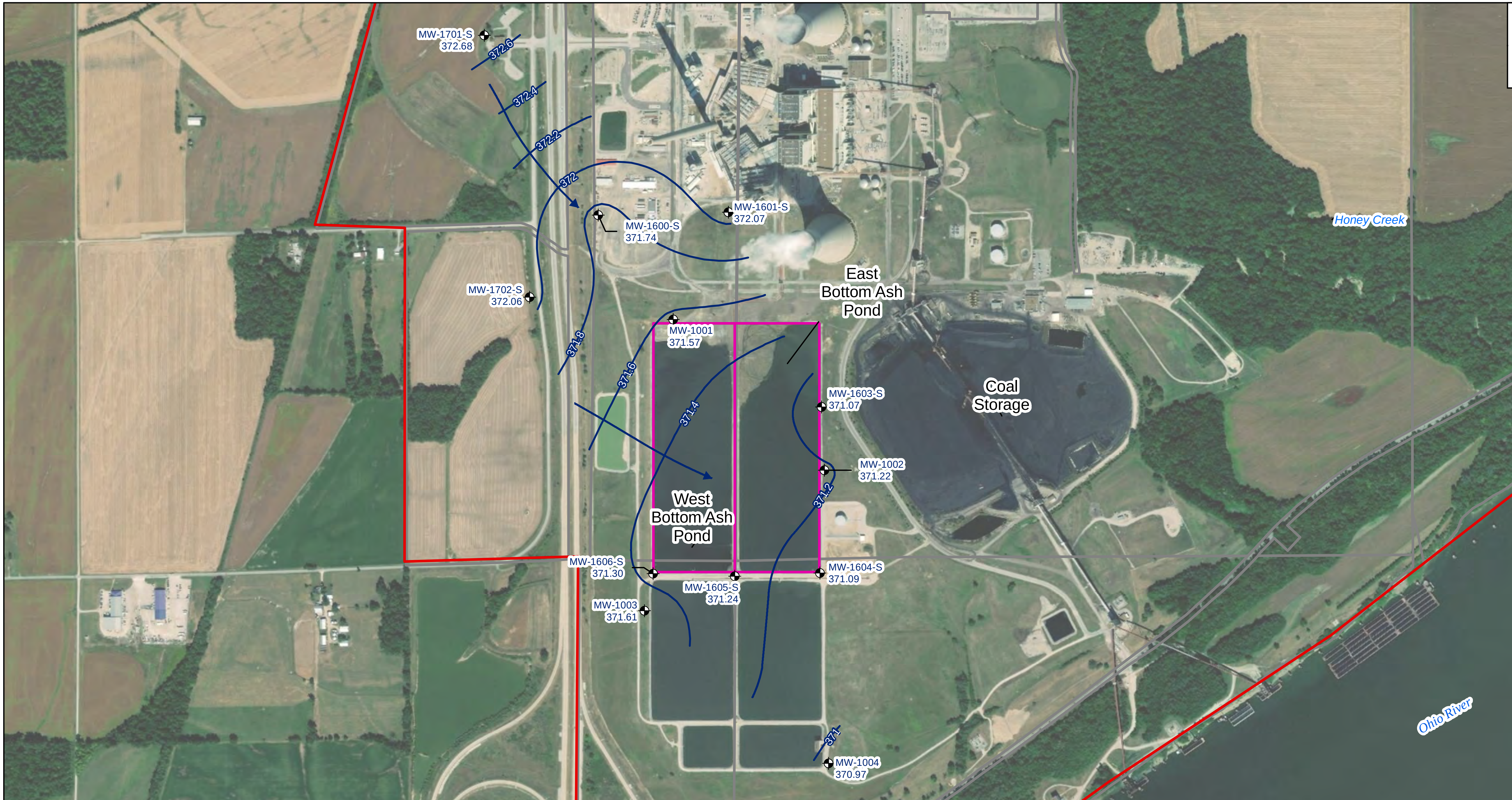

Legend
- Groundwater Monitoring Well
- Approximate Groundwater Flow Direction
- Groundwater Elevation Contour
- Property Boundary
- Parcel Boundaries
- Bottom Ash Ponds

Notes
- Monitoring well coordinates and water level data (collected on March 9, 2020) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (AMEC, 2016) provided by AEP.
- Property and parcel boundaries taken from Spencer County Assessor.
- Only shallow screened wells were used for generating groundwater contours.
- Groundwater elevation units are feet above mean sea level.

750 375 0 750
Feet

Potentiometric Surface Map - Uppermost Aquifer
March 2020

AEP-Rockport Power Plant - Bottom Ash Ponds
Rockport, Indiana

Geosyntec
consultants

Figure
X

Columbus, Ohio | 2020/06/12

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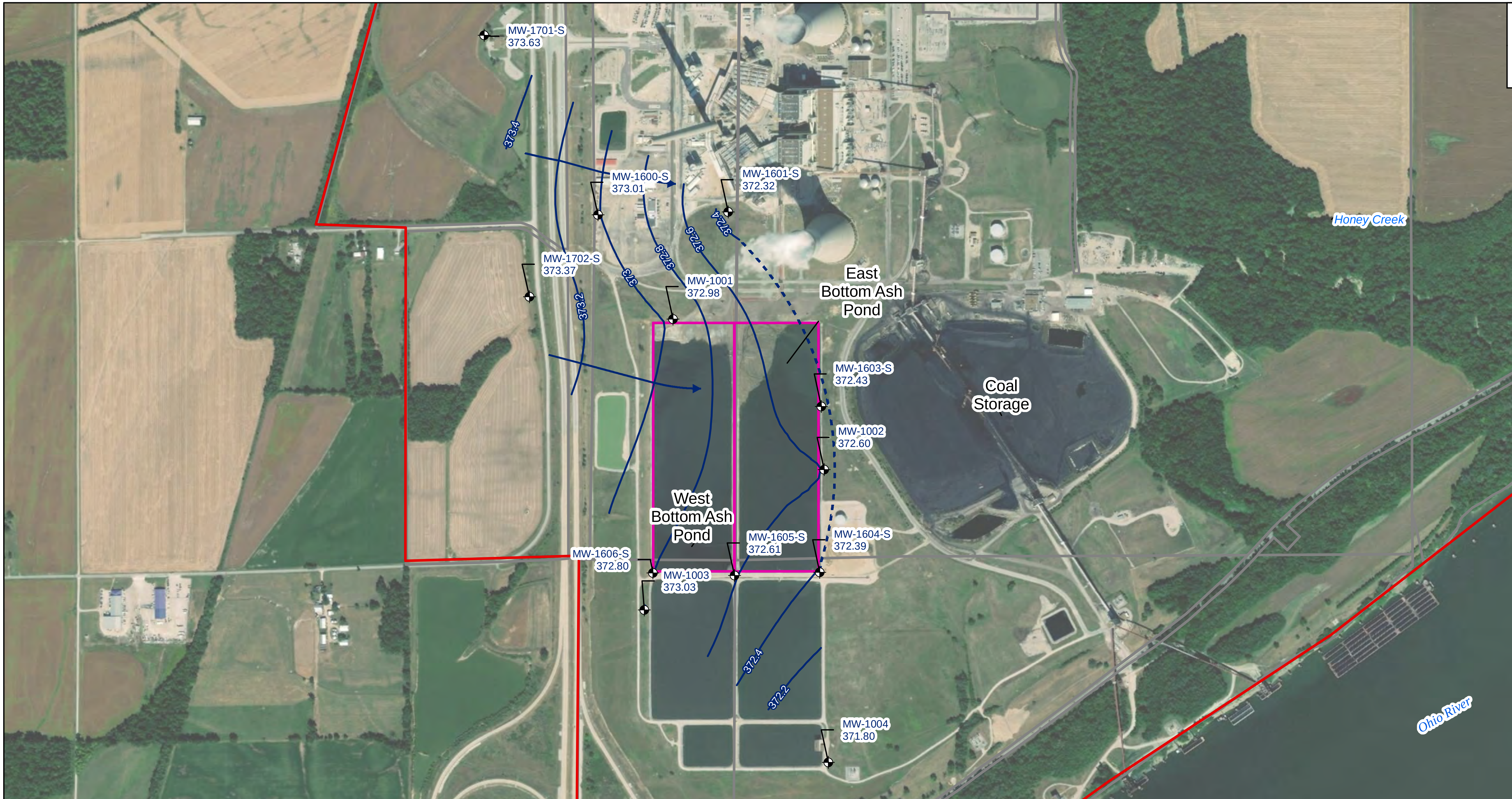

Legend
- Groundwater Monitoring Well
- Groundwater Elevation Contour (Inferred)
- Approximate Groundwater Flow Direction
- Groundwater Elevation Contour
- Property Boundary
- Parcel Boundaries
- Bottom Ash Ponds

Notes:
- Monitoring well coordinates and water level data (collected on May 18, 2020) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (AMEC, 2016) provided by AEP.
- Property and parcel boundaries taken from Spencer County Assessor.
- Only shallow screened wells were used for generating groundwater contours.
- Groundwater elevation units are feet above mean sea level.

750 375 0 750
Feet

Potentiometric Surface Map - Uppermost Aquifer
May 2020

AEP-Rockport Power Plant - Bottom Ash Ponds
Rockport, Indiana

Geosyntec
consultants

Figure X

Columbus, Ohio | 2020/06/19

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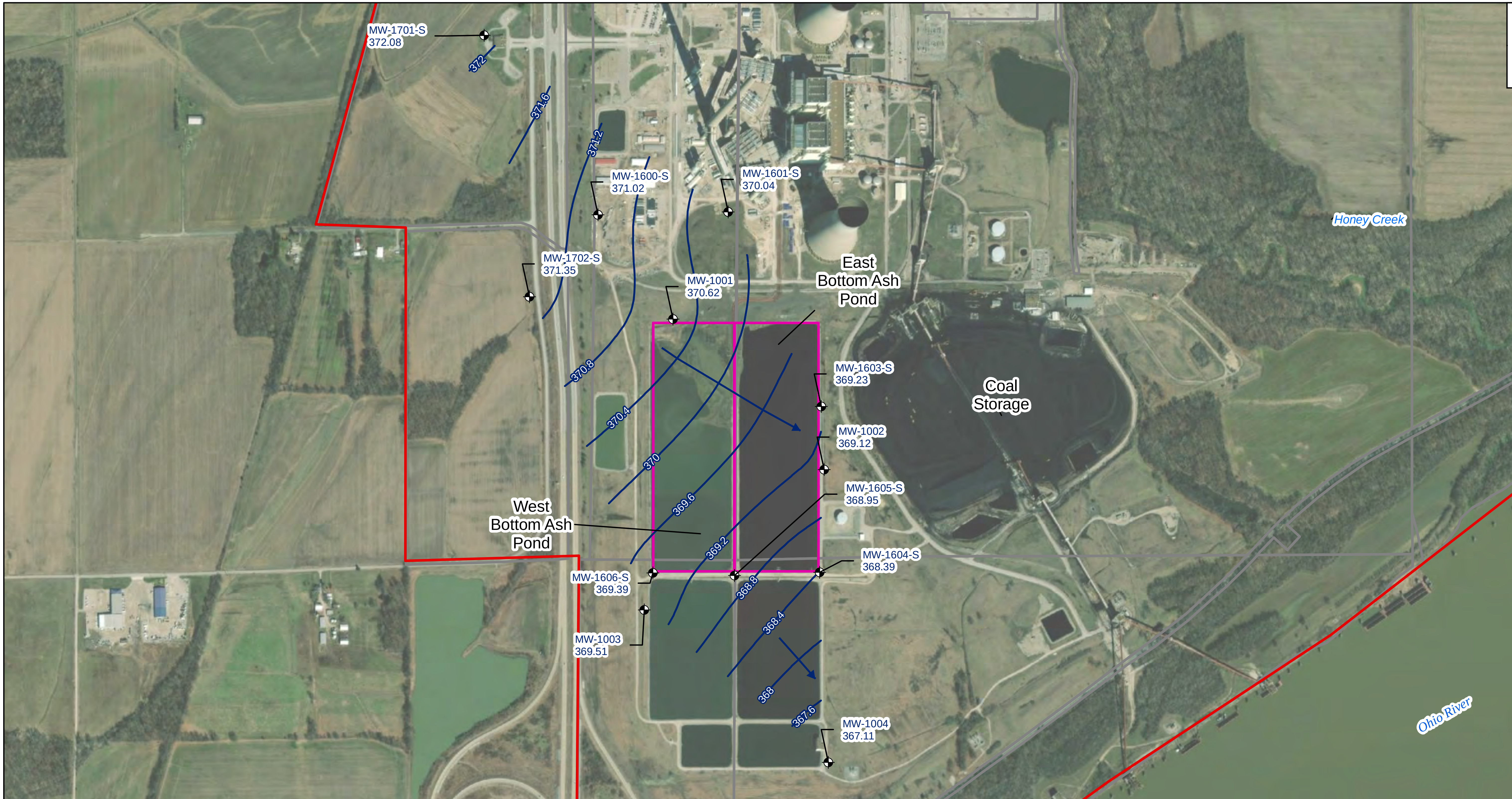

Legend
- Groundwater Monitoring Well
- Groundwater Elevation Contour (Inferred)
- Approximate Groundwater Flow Direction
- Groundwater Elevation Contour
- Property Boundary
- Parcel Boundaries
- Bottom Ash Ponds

Notes:
- Monitoring well coordinates and water level data (collected on November 10, 2020) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (AMEC, 2016) provided by AEP.
- Property and parcel boundaries taken from Spencer County Assessor.
- Only shallow screened wells were used for generating groundwater contours.
- Groundwater elevation units are feet above mean sea level.

750 375 0 750
Feet

Potentiometric Surface Map - Uppermost Aquifer
November 2020

AEP-Rockport Power Plant - Bottom Ash Ponds
Rockport, Indiana

Geosyntec consultants

Figure X

Columbus, Ohio | 2021/01/14

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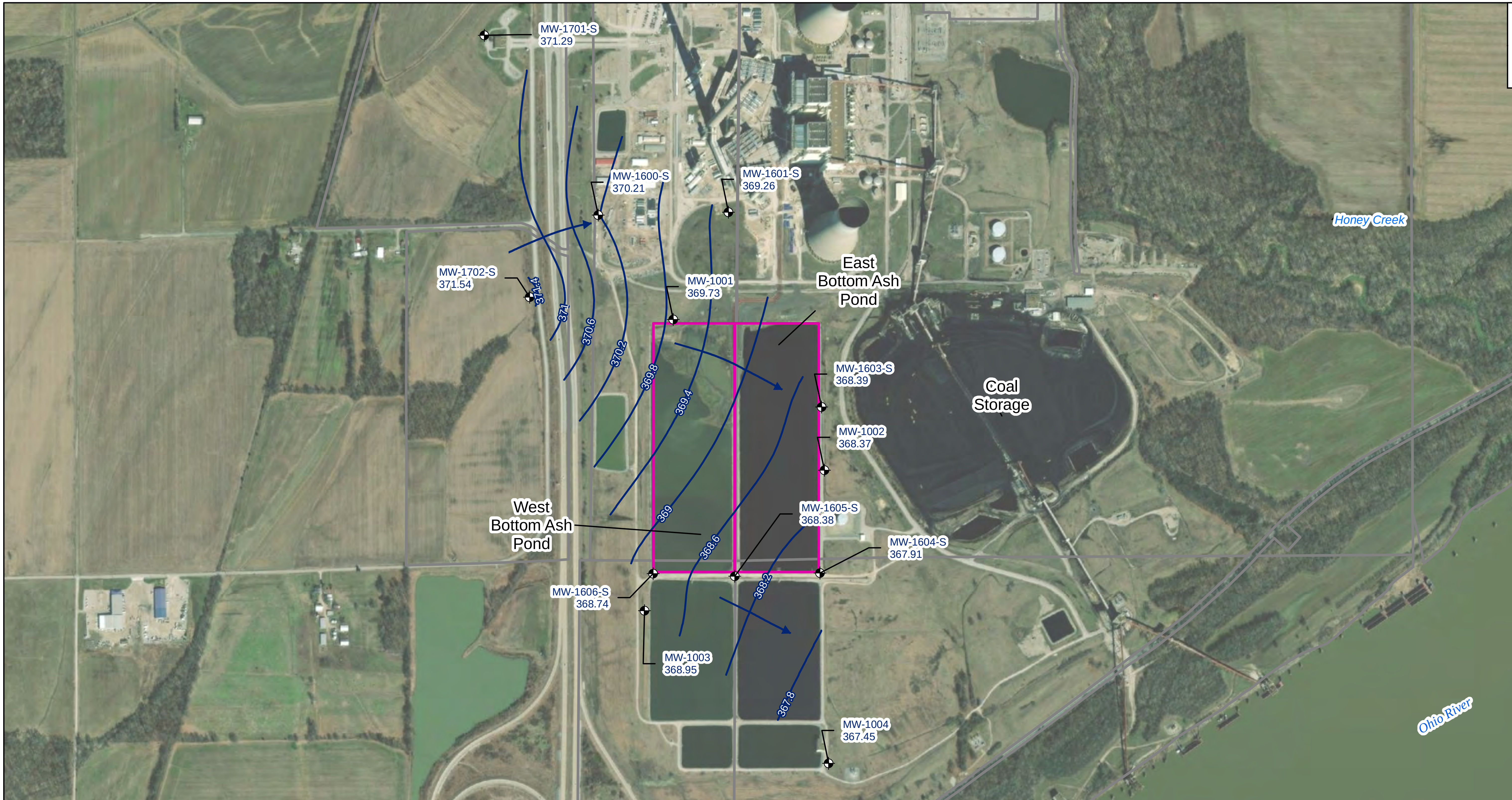

Legend
- Groundwater Monitoring Well
- Groundwater Elevation Contour
- Approximate Groundwater Flow Direction
- Parcel Boundaries
- Bottom Ash Ponds

Notes:
- Monitoring well coordinates and water level data (collected on February 1, 2021) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (AMEC, 2016) provided by AEP.
- Property and parcel boundaries taken from Spencer County Assessor.
- Only shallow screened wells were used for generating groundwater contours.
- Groundwater elevation units are feet above mean sea level.

750 375 0 750 Feet

Potentiometric Surface Map - Uppermost Aquifer
February 2021

AEP-Rockport Power Plant - Bottom Ash Ponds
Rockport, Indiana

Geosyntec consultants

Columbus, Ohio | 2021/06/25

Figure X

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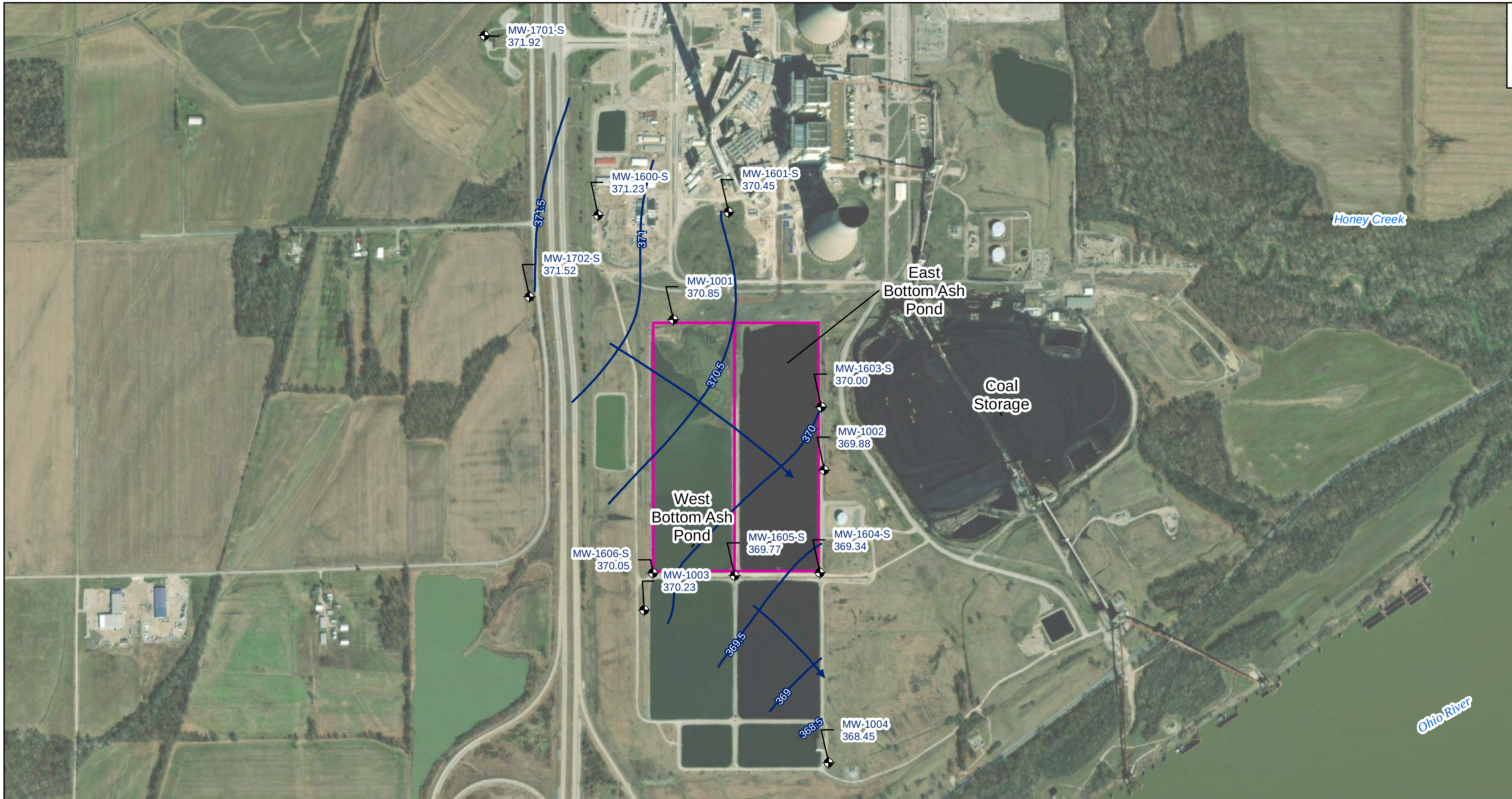

Legend

- Groundwater Monitoring Well
- Groundwater Elevation Contour (Inferred)
- Approximate Groundwater Flow Direction
- Groundwater Elevation Contour
- Bottom Ash Ponds

Notes:
- Monitoring well coordinates and water level data (collected on May 24, 2021) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (AMEC, 2016) provided by AEP.
- Only shallow screened wells were used for generating groundwater contours.
- Groundwater elevation units are feet above mean sea level.

750 375 0 750 Feet

Potentiometric Surface Map - Uppermost Aquifer
May 2021

AEP-Rockport Power Plant - Bottom Ash Ponds
Rockport, Indiana

Geosyntec consultants

Columbus, Ohio | 2021/08/09

Figure
1

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Legend
- Groundwater Monitoring Well
- Groundwater Elevation Contour
- Approximate Groundwater Flow Direction
- Groundwater Elevation Contour (Inferred)
- Bottom Ash Ponds

Notes:
- Monitoring well coordinates and water level data (collected on November 8, 2021) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (AMEC, 2016) provided by AEP.
- Only shallow screened wells were used for generating groundwater contours.
- Groundwater elevation units are feet above mean sea level.

Potentiometric Surface Map - Uppermost Aquifer November 2021 AEP-Rockport Power Plant - Bottom Ash Ponds Rockport, Indiana	
Geosyntec consultants	Figure X
Columbus, Ohio 2022/01/19	

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Legend
- Groundwater Monitoring Well
- Groundwater Elevation Contour
- Approximate Groundwater Flow Direction
- Bottom Ash Ponds

Notes:
- Monitoring well coordinates and water level data (collected on February 14, 2022) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (AMEC, 2016) provided by AEP.
- Only shallow screened wells were used for generating groundwater contours.
- Groundwater elevation units are feet above mean sea level.

750 375 0 750
Feet

Potentiometric Surface Map - Uppermost Aquifer
February 2022

AEP-Rockport Power Plant - Bottom Ash Ponds
Rockport, Indiana

Geosyntec consultants

Columbus, Ohio | 2022/05/06

Figure
X

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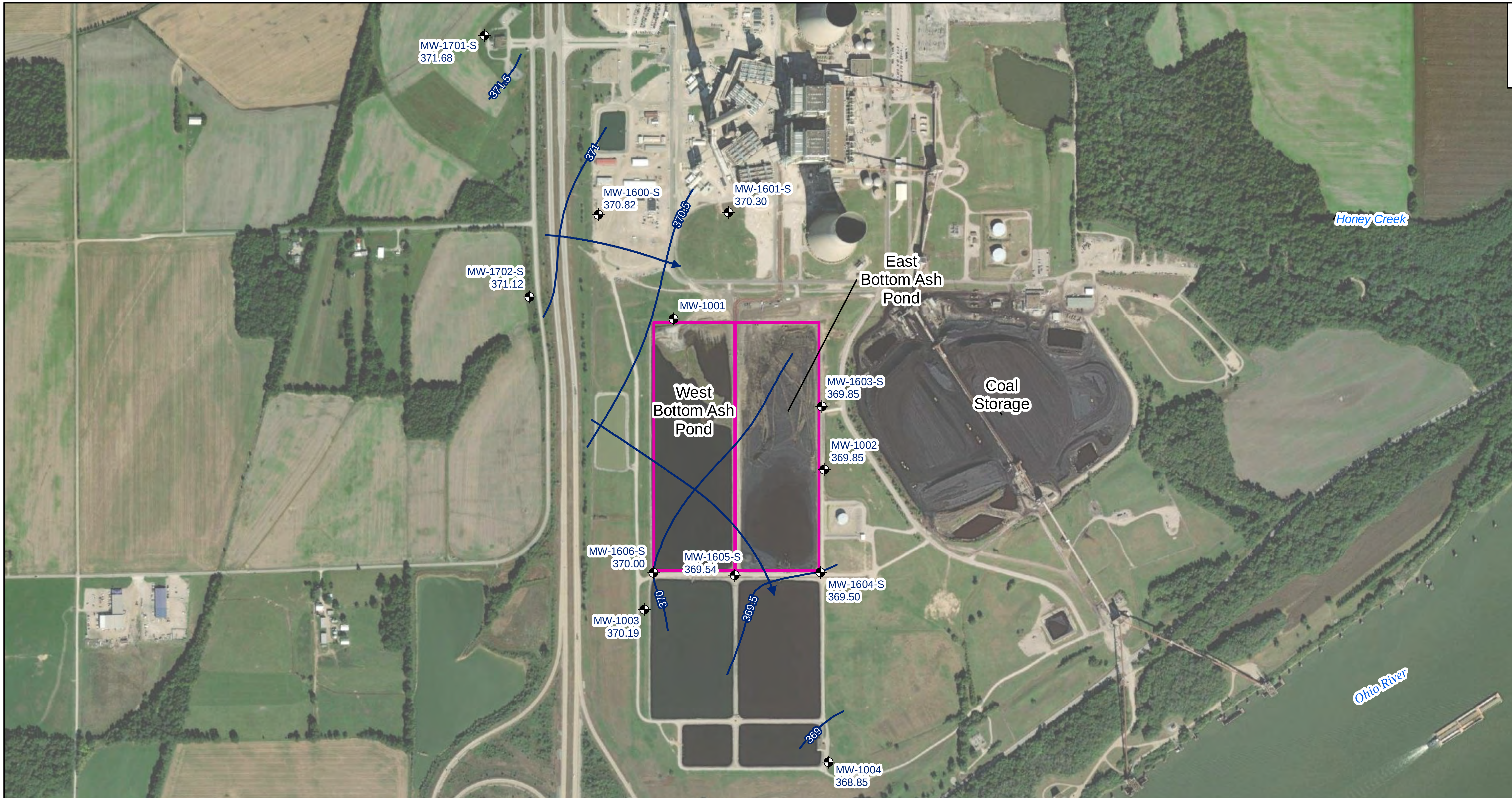

Legend
- Groundwater Monitoring Well
- Groundwater Elevation Contour
- Approximate Groundwater Flow Direction
- Bottom Ash Ponds

Notes:
- Monitoring well coordinates and water level data (collected on May 9, 2022) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (AMEC, 2016) provided by AEP.
- Only shallow screened wells were used for generating groundwater contours.
- MW-1001 (364.65 ft) was not used to generate groundwater contours due to inconsistent or anamalous readings.
- Groundwater elevation units are feet above mean sea level.

750 375 0 750
Feet

Potentiometric Surface Map - Uppermost Aquifer
May 2022

AEP-Rockport Power Plant - Bottom Ash Ponds
Rockport, Indiana

Geosyntec
consultants

Figure
X

Columbus, Ohio | 2022/08/15

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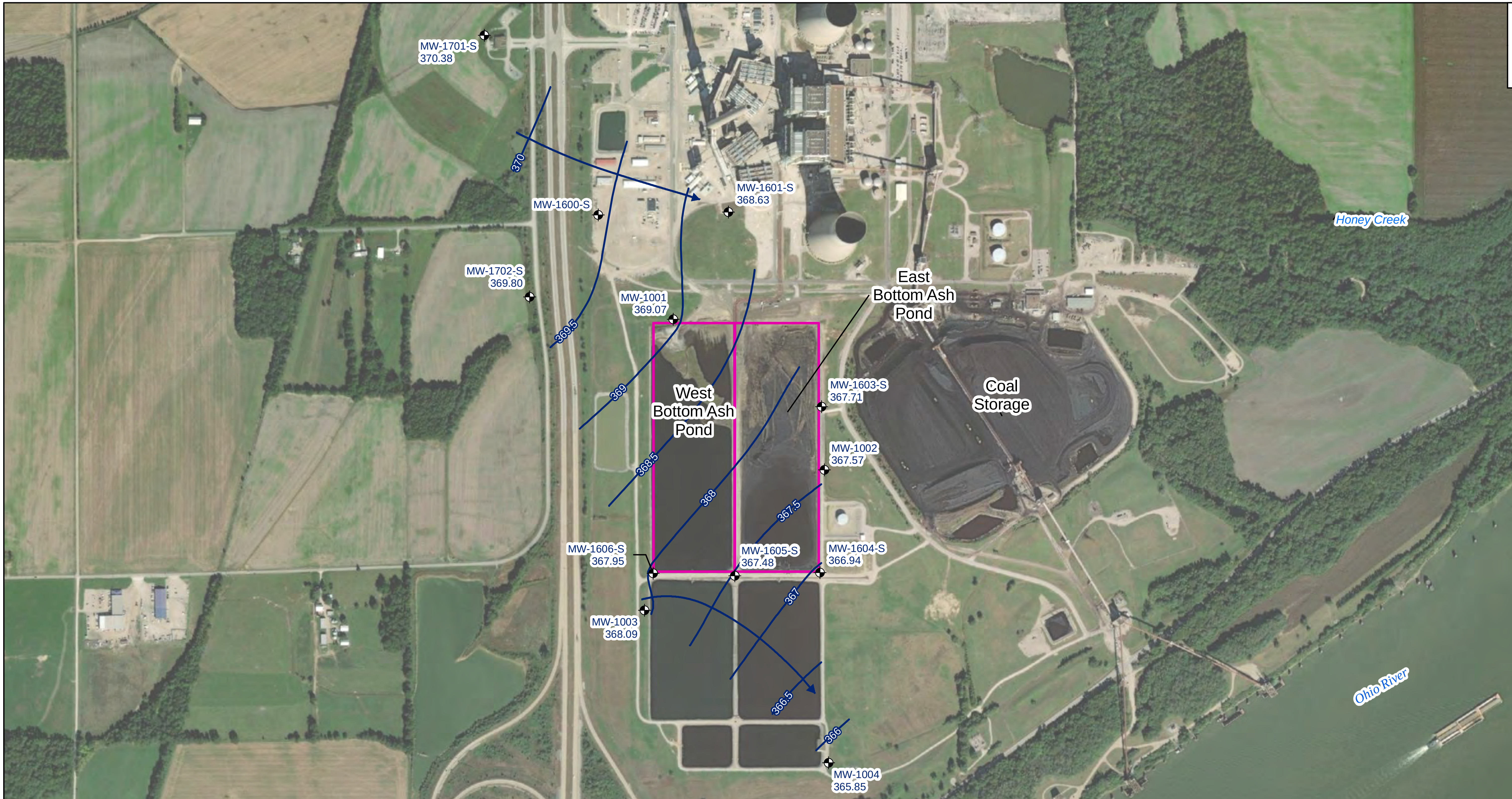

Legend
- Groundwater Monitoring Well
- Groundwater Elevation Contour
- Approximate Groundwater Flow Direction
- Bottom Ash Ponds

Notes:
- Monitoring well coordinates and water level data (collected on October 31, 2022) provided by AEP.
- Site features based on information available in the Groundwater Monitoring Network Evaluation (AMEC, 2016) provided by AEP.
- Only shallow screened wells were used for generating groundwater contours.
- MW-1600S (362.83 ft) was not used to generate groundwater contours due to inconsistent or anamalous readings.
- Groundwater elevation units are feet above mean sea level.

750 375 0 750
Feet

Potentiometric Surface Map - Uppermost Aquifer
October 2022

AEP-Rockport Power Plant - Bottom Ash Ponds
Rockport, Indiana

Geosyntec
consultants

Columbus, Ohio | 2023/01/10

Figure
X

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Appendix D
2016 Monitoring Well Installation Report

2016 MONITORING WELL INSTALLATION REPORT
Bottom Ash Ponds
Rockport Plant
Indiana-Michigan Power Company
Rockport, Indiana

Prepared for:
American Electric Power Service Corporation
and Indiana-Michigan Power Company
1 Riverside Plaza
Columbus, Ohio 43215

Prepared by:
Amec Foster Wheeler Environment & Infrastructure, Inc.
11003 Bluegrass Parkway, Suite 690
Louisville, Kentucky 40299

20 May 2016

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1.0 INTRODUCTION

Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) was retained by American Electric Power Service Corporation (AEP) to observe and document drilling and monitoring well installation activities in the vicinity of the Bottom Ash (BA) Ponds at the AEP Rockport Plant.

The BA Ponds are located at the north end of the wastewater pond complex for the plant. The two contiguous ponds, referred to as the East and West BA Ponds, receive CCR on an alternating schedule. The ponds each have rough dimensions (at the crest of the embankments) of 2,000 feet x 650 feet, corresponding to a surface area of approximately 30 acres each (60 acres total).

Four shallow monitoring wells (MW-1001 through MW-1004) were installed in 2010 at the perimeter of the wastewater pond complex. Based on data collected from those wells, the dominant direction of groundwater flow beneath the ponds is to the east-southeast.

For the purpose of groundwater monitoring under the federal CCR Rule (40 CFR Part 257), AEP has elected to monitor groundwater at the BA Ponds using a multiunit groundwater monitoring system. The long-term groundwater monitoring network (GWMN) for the BA Ponds (including potentiometric and water quality monitoring) will consist of seven clusters of three wells each, installed at shallow, intermediate and deep levels in the unconsolidated overburden above bedrock. Five locations are along the downgradient sections of the pond perimeter, and two are at upgradient locations north of the BA Ponds. One of the existing shallow wells (MW-1002) has been incorporated into the GWMN. The other three existing wells (MW-1001, MW-1003, and MW-1004) have also been retained for water level monitoring (also known as potentiometric or piezometric monitoring) only. Twenty new monitoring wells were installed in early 2016 to complete the GWMN.

Monitoring well locations are shown on the map in **Figure 1**. Drilling, well construction and well development activities related to the new monitoring wells installed in 2016 are documented in this report.

2.0 FIELD ACTIVITIES

2.1 Schedule

Amec Foster Wheeler along with an AEP drilling crew mobilized to the site to kickoff drilling, well installation, and well development activities on 12 January 2016. A summary of key dates related to specific activities is provided below.

1) Amec Foster Wheeler and drill crew personnel attended safety orientation on 12 January 2016.
2) All drilling locations were identified and staked on 12 January 2016.
3) Locations and ground surface elevations were surveyed on 21 January 2016.

4) Drilling and monitoring well installation began on 13 January 2016 and was completed on 3 March 2016.
5) Locations, ground surface elevations, and top of casing elevations were surveyed on 3-4 March 2016.
6) Well Development began on 8 March 2016 and was completed by AEP on 29 March 2016. Amec Foster Wheeler observed well development activities 17 March 2016.

2.2 Staking, Surveying and Utility Clearances

1) All boring and monitoring well locations were staked prior to drilling.
2) All boring and monitoring well locations were surveyed both horizontally (northing and easting) and vertically (elevation) before and after installation, by AEP surveyors.
3) Coordinates were provided in the North American Datum of 1927 (NAD27), State Plane Coordinate System (SPCS) Indiana West Zone and elevations were provided in the North Geodetic Vertical Datum of 1929 (NGVD29), also known as Mean Sea Level (MSL).
4) Ground surface elevations were provided for all boring and monitoring well locations before and after well installation. Top of PVC casing elevations were provided for all monitoring well locations after well installation.
5) Prior to drilling activities, AEP located underground utilities near the new boring and monitoring well locations. Amec Foster Wheeler coordinated with onsite AEP personnel and drillers to make sure drilling locations were sufficiently removed from the located utilities to avoid damage.

2.3 Drilling and Soil Sampling

1) At each multi-level well location, three monitoring wells (shallow, intermediate, and deep) were installed. Because one shallow monitoring well already existed at the location for MW-1602 (MW-1002), only intermediate and deep wells were installed.
2) Drilling and monitoring well installation was performed by a drill rig equipped with hollow-stem augers with an inside diameter of 4¼ inches. Mud-rotary drilling was used below the water table due to running sands infiltrating the auger.
3) Continuous standard penetration testing (SPT) was performed from ground surface to refusal at all deep monitoring wells. Blow counts were recorded and used to develop N values for each sampled interval. For SPTs, AEP provided the hammer calibration record for review by Amec Foster Wheeler.
4) Recovered samples were described by Amec Foster Wheeler personnel and retained by AEP for laboratory analysis.

5) At each location, the deep monitoring well was installed first. Descriptions of subsurface materials recorded during the installation of the deep monitoring well were used to determine the depths of the screened intervals in the shallow and intermediate wells.

6) Boring logs including lithologic descriptions, blow counts, N values, and field observations are included as **Attachment 1.**

2.4 Geotechnical Sample Testing

1) AEP retained and transported samples collected during drilling to the AEP's Civil Engineering laboratory in Groveport, Ohio for geotechnical testing.

2) AEP tested selected samples from the screened intervals for gradation (ASTM D6913) and percent passing #200 sieve (ASTM D1140).

3) Gradation curves are provided as **Attachment 2**.

2.5 Monitoring Well Construction

1) Final well construction dimensions are provided in **Table 1**.

2) Monitoring wells were constructed of 2-inch schedule 40 PVC casing and 2-inch schedule 40 PVC 0.010-inch factory slotted screen.

3) A filter pack was placed in the annular space extending from a minimum of 6 inches below the bottom of the well to a minimum of 1 foot above the top of the screen.

4) A bentonite pellet seal was placed in the annular space above the filter pack and extended to a minimum of 2 feet above the filter pack. The bentonite pellets were hydrated as they were installed.

5) High solids bentonite grout was placed in the annular space from the bentonite seal to within 2 feet of ground surface using a tremie pipe.

6) A lockable steel protective casing, extending 2.5 to 3 ft above ground surface) was set in a concrete pad measuring 2 feet by 2 feet in area and 6 inches in thickness. The pad was constructed to slope away from the protective casing.

2.6 Well Development

1) Well development began on 8 March 2016 and was completed on 29 March 2016.

2) Well development was conducted by pumping using two Geotech Reclaimer pumps powered by a compressor. During pumping, each well was gently surged by moving the pump up and down the screened interval to mobilize fine-grained sediment and facilitate its removal.

3) Water quality parameters (discussed in **Section 2.8**) were monitored using a multi-parameter sonde, water quality meter, and flow-through cell (Geotech YSI ProDSS) in the final period of development.

4) During development, depth to water and flow rate measurements were also collected.

5) Pumping rates during well development ranged from 0.3 to 0.7 gallons per minute (gpm).

2.7 Water Level Gauging

1) Water level readings were collected periodically during drilling activities and during well development, using an electronic water level indicator, by measuring depth to water from the top of the inside casing.
2) Following well installation, while development of selected wells was still being conducted, a full round of water levels was collected on 17 March 2016.
3) All water level readings were converted to elevations relative to MSL using the surveyed top of casing elevations.
4) A summary of measured depths to water and water level elevations is provided in **Table 2**. The data in **Table 2** include historical water level elevations in the existing wells provided by AEP, two rounds of readings collected in existing wells by Amec Foster Wheeler on 14 January and 17 March 2016, and one round of water levels collected from the new wells on 17 March 2016. Updated hydrographs for the existing wells are provided in **Attachment 3**.

2.8 Water Quality Parameters

1) Water quality field parameters were collected during well development in a flow-through cell using a Geotech multiparameter digital sampling system (YSI ProDSS).
2) Water quality parameters monitored included temperature, pH, specific conductance (SC), dissolved oxygen (DO), oxidation-reduction potential (ORP), and turbidity.
3) Water quality parameters were monitored in the final period of well development at a reduced flow rate.
4) A summary of stabilized water quality parameters is provided in **Table 3**.

3.0 SUMMARY AND FINDINGS

Figure 1 is a map showing the locations of the monitoring wells as installed. Full boring and well construction logs are provided in **Attachment 1**. **Table 1** is a summary of well construction details. **Table 2** summarizes water level measurements collected over multiple events in the four monitoring wells installed in 2010, as well as measurements collected on 17 March 2016. **Table 2** also includes water level measurements collected on 17 March 2016, from the 20 new monitoring wells installed in 2016.

Geologic and hydraulic interpretations are provided in **Figures 2 through 7**. **Figure 2** is a contour map of the bedrock surface in the vicinity of the BA Ponds, and **Figure 3** is a contour map of the potentiometric surface on 17 March 2016, based on the water level measurements collected on that date from the wells installed in the shallow zone. **Figure 4** shows the lines of three geologic cross-sections through the area of the BA Ponds, provided in **Figures 5, 6 and 7**.

The information obtained during drilling and installation of the new monitoring wells has been compared to background information (published data for the area, as well as site documents provided for review by AEP) summarized in the report titled *Groundwater Monitoring Network Evaluation, Bottom Ash Ponds, Rockport Plant, Indiana-Michigan Power Company, Rockport, Indiana* (GWMN Report) prepared for AEP by Amec Foster Wheeler. Full citations are provided in that report for sources referenced in this discussion.

The bedrock elevations encountered in the deep soil borings near the BA Ponds, which ranged in elevation from 274.1 to 298.8 ft MSL, along with the east-southeasterly slope of the bedrock surface (in the direction of the Ohio River), are generally consistent with the site information and published documents reviewed in the GWMN Report.

Core samples from bedrock were not obtained, but fragments recovered in split spoons and cuttings indicate that bedrock beneath the area of the BA Ponds consists of gray shale. This is consistent with the information from other site borings, and with published geologic mapping (Grove 2006), which indicates that the bedrock underlying the site and most of Spencer County is the Pennsylvanian Age Raccoon Group, consisting of sandstone and shale with minor amounts of mudstone, coal and limestone.

The unconsolidated overburden materials above bedrock generally agreed with historical information available for the site and discussed in Section 2.4.2.2 of the Groundwater Monitoring Network Evaluation Report, which grouped unconsolidated material into four units. This terminology has been maintained for the discussion of unconsolidated materials encountered during monitoring well installation and has been carried over to the cross sections presented in **Figures 5 through 7**.

- Fill – silt and clay (presumed to be reworked native soils) associated with the pond dikes. Because all but two locations (MW-1600 S,I,D and MW-1601 S,I,D) were positioned on top of the dikes, a substantial amount of fill material was encountered from ground surface to depths up to 15 BGS. Fill material generally consisted of silty clay, clay, and small amounts of sand.
- Unit No. 1 – surficial silt and clay. This unit was encountered beneath the fill material extending to a depth of between 15 and 29 feet BGS. The unit is a stiff silty to sandy clay with small amounts of interbedded sand layers.
- Unit No. 2 – well sorted sand. Below the surficial silts and clays was a poorly graded (well sorted) fine to medium grained sand to a maximum depth of approximately 32 to 43 feet BGS.
- Unit No. 3 – poorly sorted sand. This unit was encountered below Unit No. 2 and extended (along with Unit No. 4) to bedrock. Unit No. 3 consists of fine to coarse grained sand grading to sand and gravel of Unit No. 4.

- Unit No. 4 – sand and gravel. This unit was encountered interbedded within Unit No. 3 and consisted of fine to coarse, poorly to well sorted sand with variable amounts of gravel and coal particles.

At each well location a shallow, intermediate, and deep monitoring well was installed. Because one shallow monitoring well already existed at the location for MW-1602, only two new wells (an intermediate and a deep well) were installed. Screening intervals for each well were selected based on lithology described from the deep boring and are provided in **Table 1**. Elevations of screened intervals for shallow and intermediate were generally consistent across all locations. Top of screen elevations ranged from 362.9 to 363.2 ft MSL for shallow wells and 330.7 to 332.3 ft MSL for intermediate wells. Screened intervals for deep wells varied more than the other wells due to differences in the depth to bedrock. Top of screen elevations ranged from 284.3 to 308.8 ft MSL.

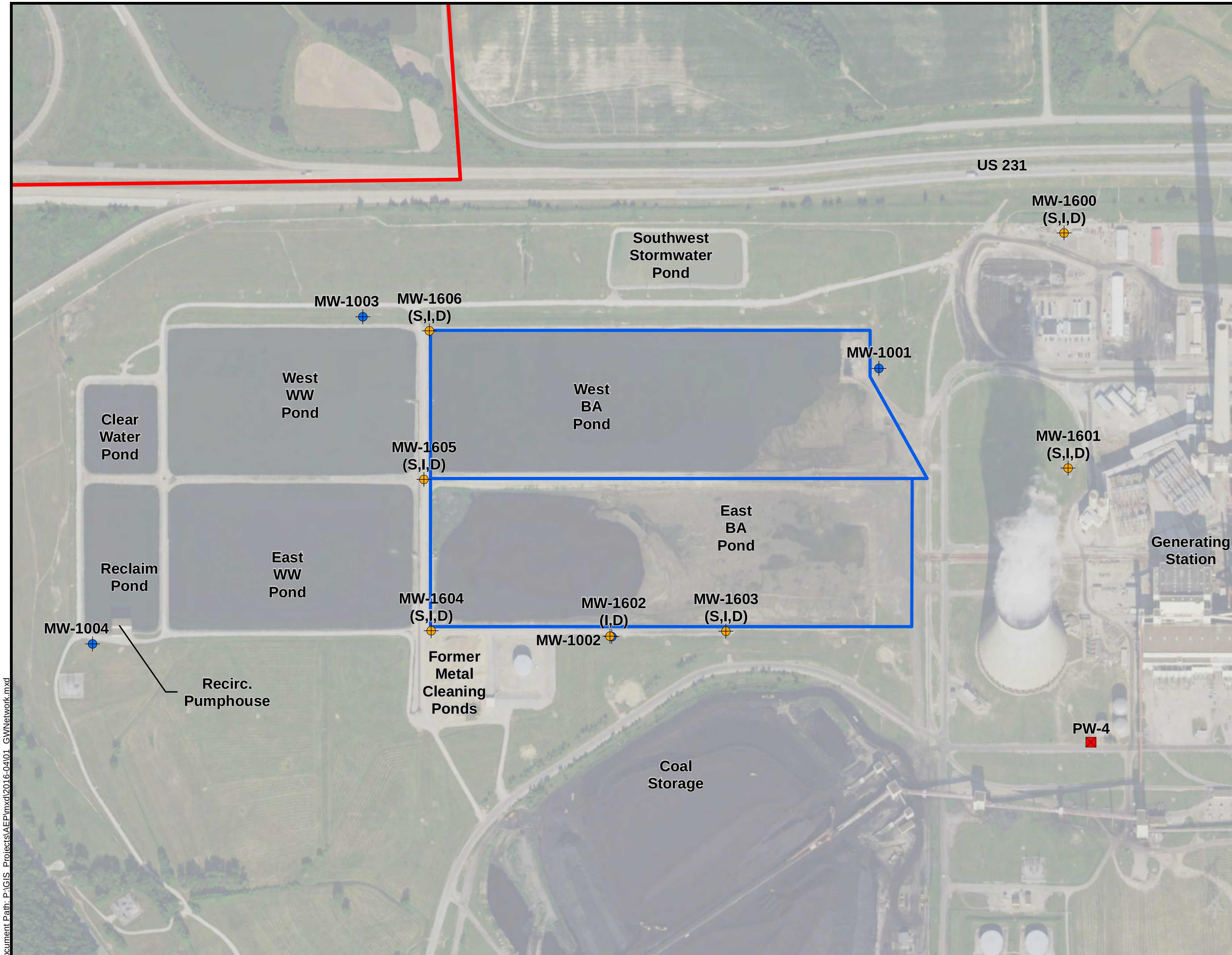
Following installation and during development, water levels were collected from all wells. Previous data from the four monitoring wells installed in 2010 indicate that the horizontal hydraulic gradient and groundwater flow direction beneath the ponds is typically to the east-southeast, toward the Ohio River. However, the historical data also indicate that temporary gradient reversals can occur in response to rapidly rising river stage conditions. The elevation of the water table can be expected to range between 366 and 372 ft MSL, with occasional (less than annual frequency) rises up to 376 ft MSL. The horizontal hydraulic gradient measured on 17 March 2016, as depicted in **Figure 3** based on the water levels in the shallow wells, was low (on the order of 0.0003 ft/ft) with a slope to the east.

Water level measurements collected in the three-well clusters installed in 2016 indicate there is very little difference in water levels between the three levels (shallow, intermediate and deep) at any location, and the direction of the vertical gradient is variable. Water level elevation differences on 17 March 2016, between wells in any cluster ranged from 0.01 to 0.33 ft, averaging 0.08 feet.

Field water quality data collected during well development is summarized in **Table 3**. Groundwater temperature ranged from 13.7° C in MW-1606I to 20.3° C in MW-1602D. The pH was neutral, ranging from 6.74 standard units (S.U.) in MW-1600S to 7.37 S.U. in MW-1604I. Specific Conductance (SC) ranged from 553 µS/cm in MW-1604D to 1,365 µS/cm in MW-1605D. Dissolved oxygen (DO) and oxidation-reduction potential (ORP) indicate a reducing to slightly oxidizing environment. DO ranged from 0.18 mg/L at MW-1606I to 6.61 at MW-1601I, while ORP ranged from -126 mV at MW-1606D to 219 mV at MW-1606S. Turbidity, stabilized at or below 5 NTU at all but one well and ranged from 0.7 NTU at MW-1604D to 5.8 NTU MW-1606S.

During well development, pumping rate and drawdown were recorded in the field notes. These data were used to calculate the specific capacity of each well to determine if additional hydraulic testing would be necessary. The specific capacity is the discharge in gallons per minute (gpm) per foot of drawdown. Specific capacity ranged from 0.2 gpm/ft at MW-1601D and MW-1603D to a maximum of 11 gpm/ft at MW-1600D. In 11 out of 20 wells there was no drawdown so specific capacity, which was essentially too high to measure from available pumping rates, could not be calculated.

FIGURES



Legend

- Monitoring Well Cluster (2016)
- USWAG Monitoring Well (2010)
- Water Supply Well
- Property Boundary
- Bottom Ash

Data Sources

Date of Photography: May-June 2016
Source of Photography: U.S. Department of Agriculture, National Agriculture Imagery Program (NAIP)

0 200 400
SCALE IN FEET

GROUNDWATER MONITORING NETWORK BOTTOM ASH PONDS

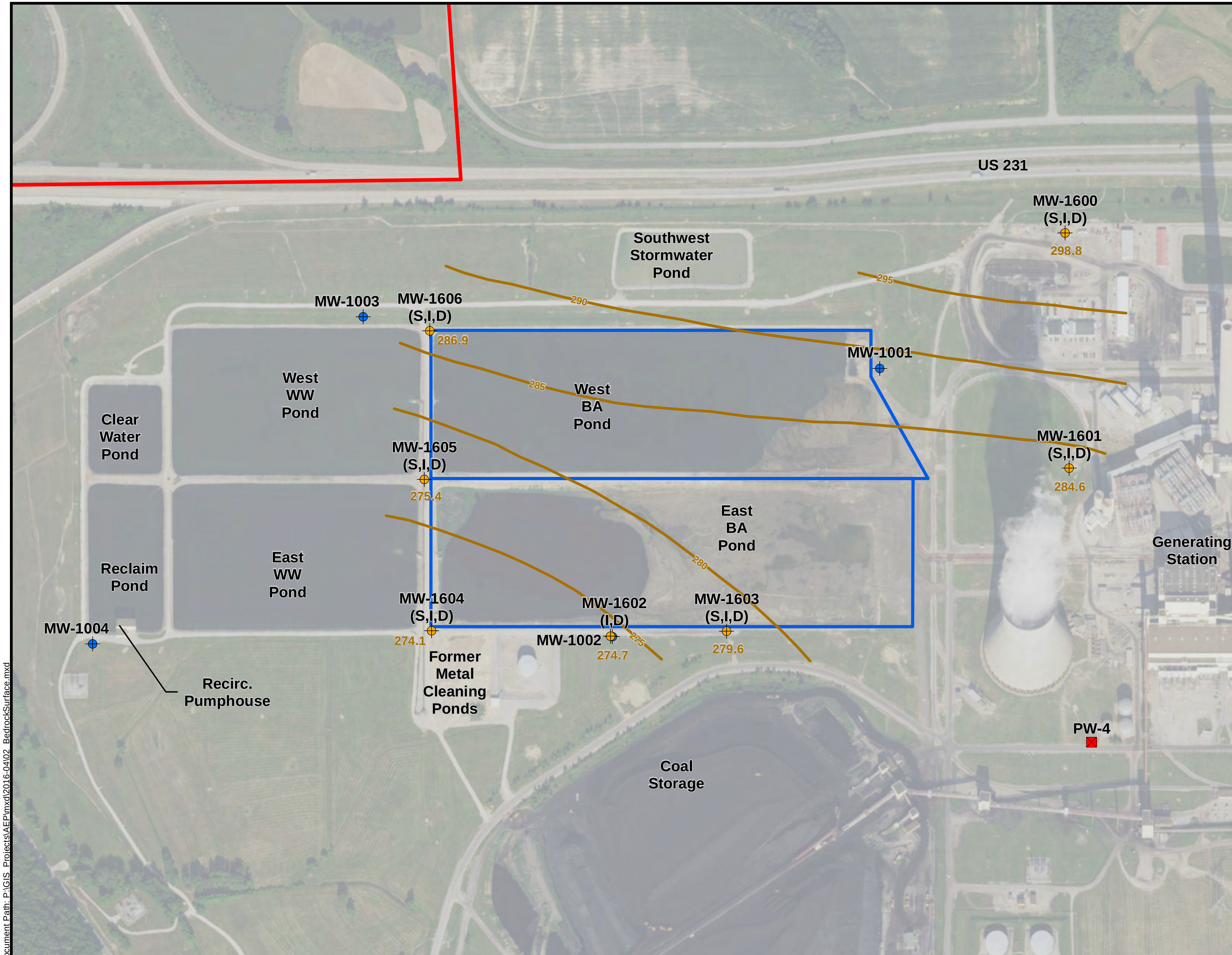
AEP - ROCKPORT, IN

PROJECT NUMBER: 7382153161

SCALE	1" = 400'	FIG. 1
DATE	9/14/2017	
DRAWN BY	TMR	
APPROVED BY	ALD	

amec foster wheeler
2456 Fortune Drive, Suite 100
Lexington, Kentucky 40509
Phone: (859) 255-3308

Document Path: P:\GIS_Projects\AEP\mxd\2016-04101_GWNetwork.mxd



Legend

- Monitoring Well Cluster
- USWAG Monitoring Well
- Water Supply Well
- Bedrock Elevation Contour (FT
- Property Boundary
- Bottom Ash

Bedrock Elevation (FT MSL)

298.8 Bedrock elevation in the deep monitoring well boring

Data Sources

Date of Photography: May-June 2016
Source of Photography: U.S. Department of Agriculture, National Agriculture Imagery Program (NAIP)

0 200 400
SCALE IN FEET

BEDROCK SURFACE CONTOUR MAP BOTTOM ASH PONDS

AEP - ROCKPORT, IN

PROJECT NUMBER: 7382153161

SCALE	1" = 400'
DATE	9/14/2017
DRAWN BY	TMR
APPROVED BY	ALD

FIG. 2

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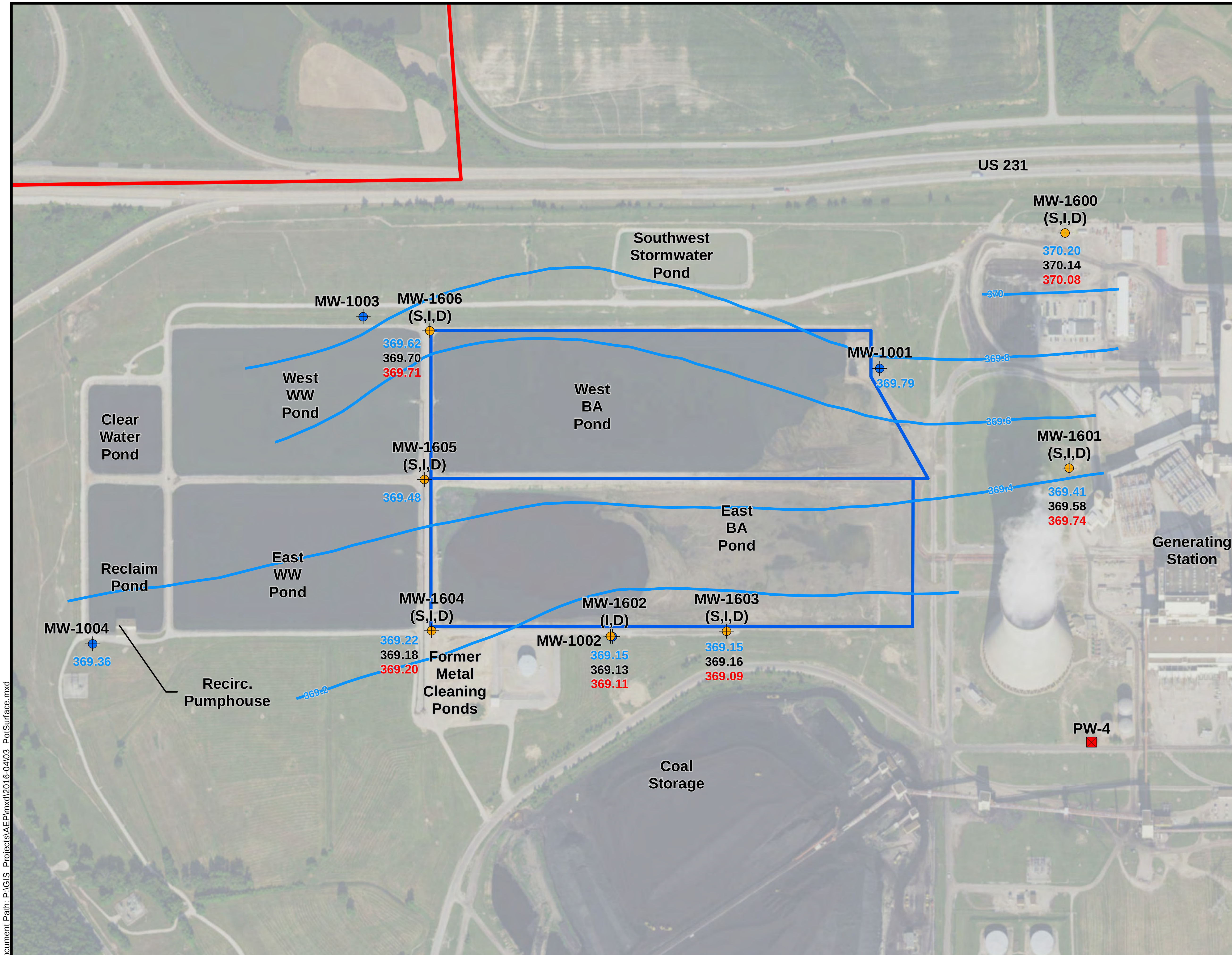
Document Path: P:\GIS_Projects\AEP\mxd\2016-04102_BedrockSurface.mxd



Legend

- Monitoring Well Cluster
- USWAG Monitoring Well
- Water Supply Well
- Potentiometric Elevation Contour (FT MSL) Contour Interval: 0.2 FT
- Property Boundary
- Bottom Ash

Groundwater Potentiometric Elevation (FT MSL)

369.22 Shallow Well
369.18 Intermediate Well
369.20 Deep Well

Data Sources

Date of Photography: May-June 2016
Source of Photography: U.S. Department of Agriculture, National Agriculture Imagery Program (NAIP)

0 200 400
SCALE IN FEET

POTENTIOMETRIC SURFACE CONTOUR MAP 17 MARCH 2016

AEP - ROCKPORT, IN

PROJECT NUMBER: 7382153161

SCALE	1" = 400'	FIG. 3
DATE	9/14/2017	
DRAWN BY	TMR	
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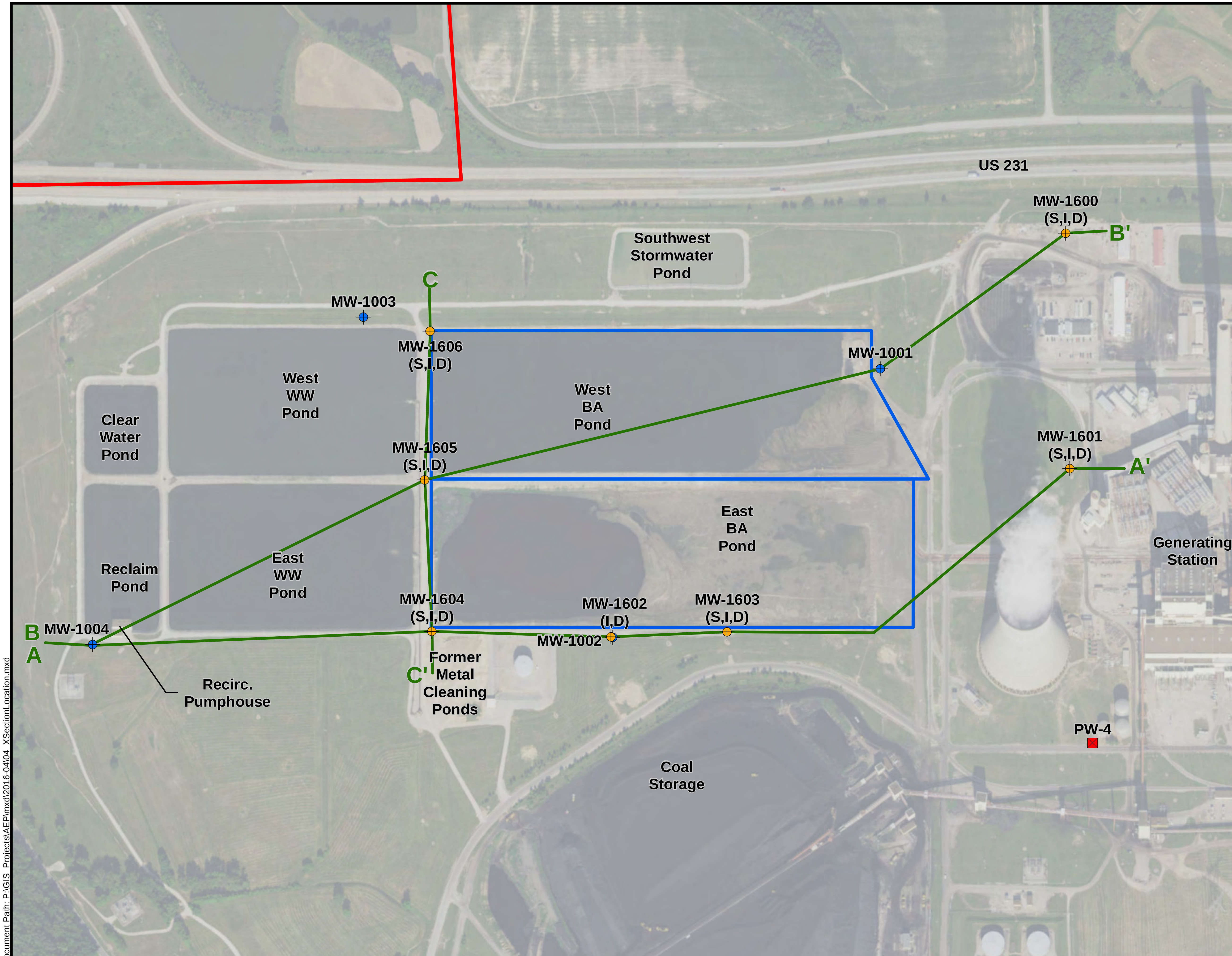

Legend

- Monitoring Well Cluster
- USWAG Monitoring Well
- Water Supply Well
- Cross Section Lines
- Property Boundary
- Bottom Ash

Data Sources

Date of Photography: May-June 2016
Source of Photography: U.S. Department of Agriculture, National Agriculture Imagery Program (NAIP)

0 200 400
SCALE IN FEET

CROSS SECTION LOCATION MAP BOTTOM ASH PONDS

AEP - ROCKPORT, IN

PROJECT NUMBER: 7382153161

SCALE	1" = 400'	FIG. 4
DATE	9/14/2017	
DRAWN BY	TMR	
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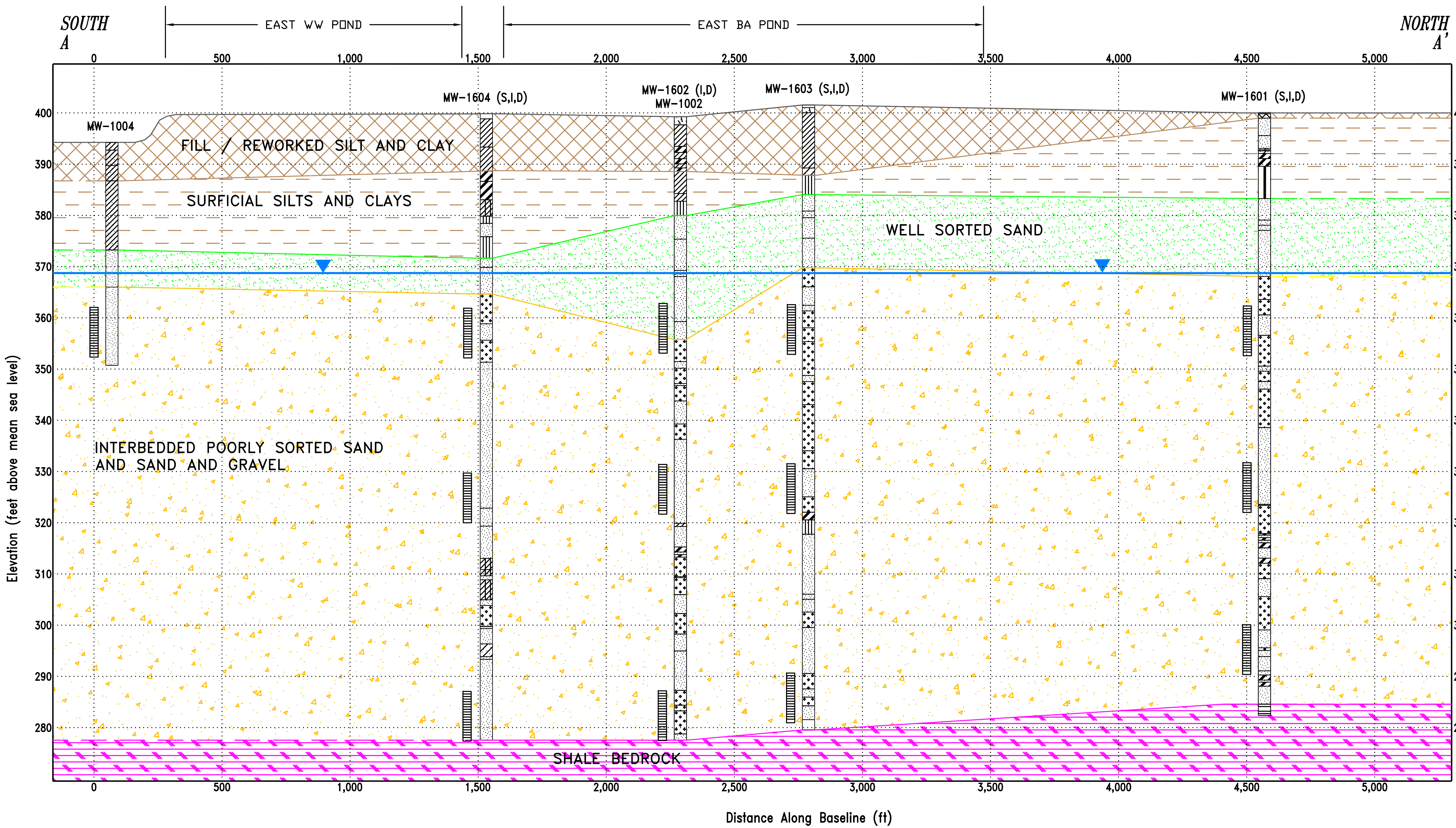

0' 400'

SCALE: 1"=400'
VERTICAL EXAGGERATION: 20X

N

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BOTTOM ASH PONDS
AEP - ROCKPORT, INDIANA

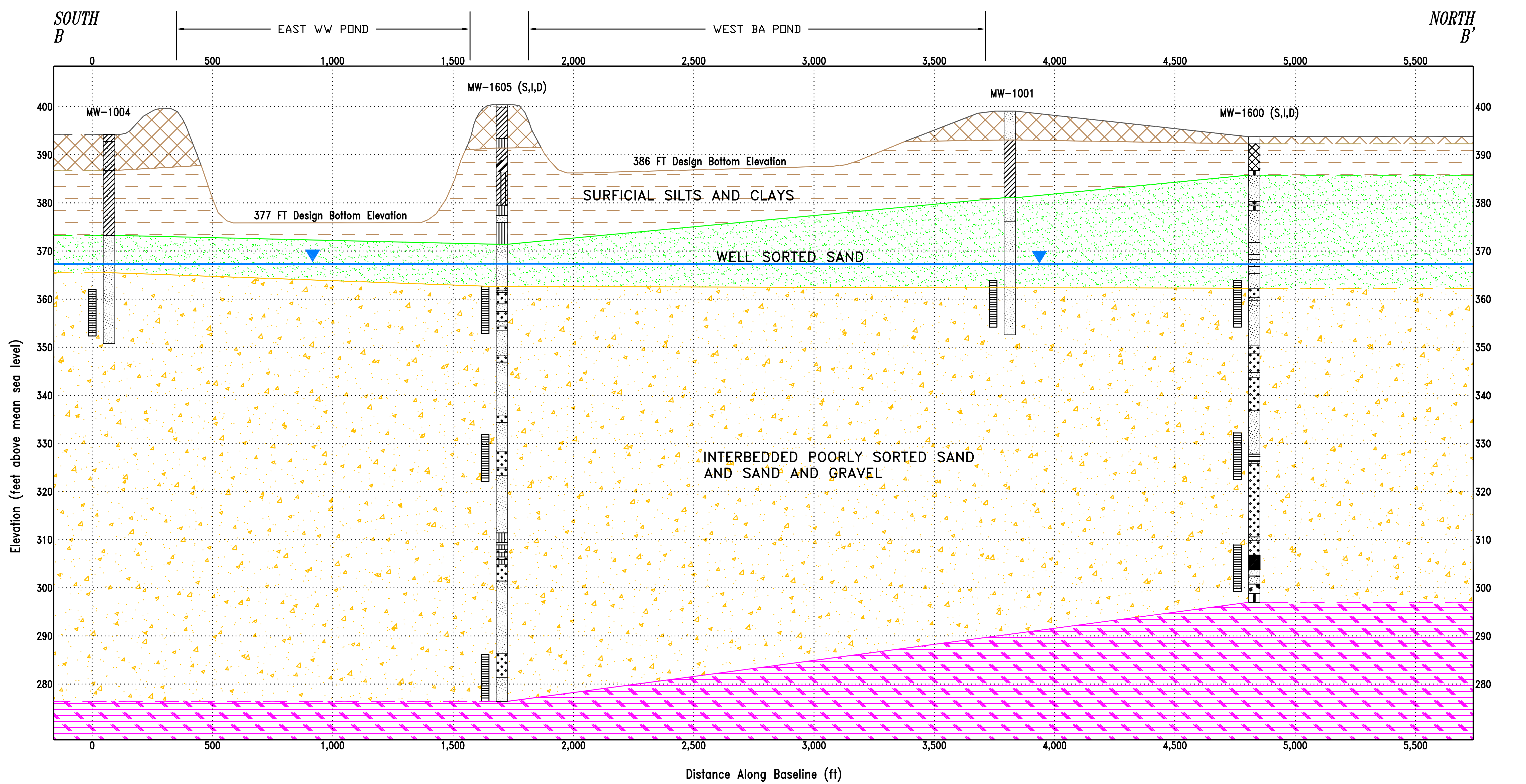
CROSS SECTION A - A'

PROJECT NUMBER: 7382-15-3161

SCALE	1" = 400'
DATE	05/20/2016
DRAWN BY	VM / TMR
APPROVED BY	ALD

FIG. 5

P:\Projects\15 projects\7382153161 AEP CCR Rockport IN\Drawings\AEP_ROCKPORT_SECTION_A.dwg May. 20, 2016 tom.reed



0' 400'

SCALE: 1"=400'
VERTICAL EXAGGERATION: 20X

N

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BOTTOM ASH PONDS
AEP - ROCKPORT, INDIANA

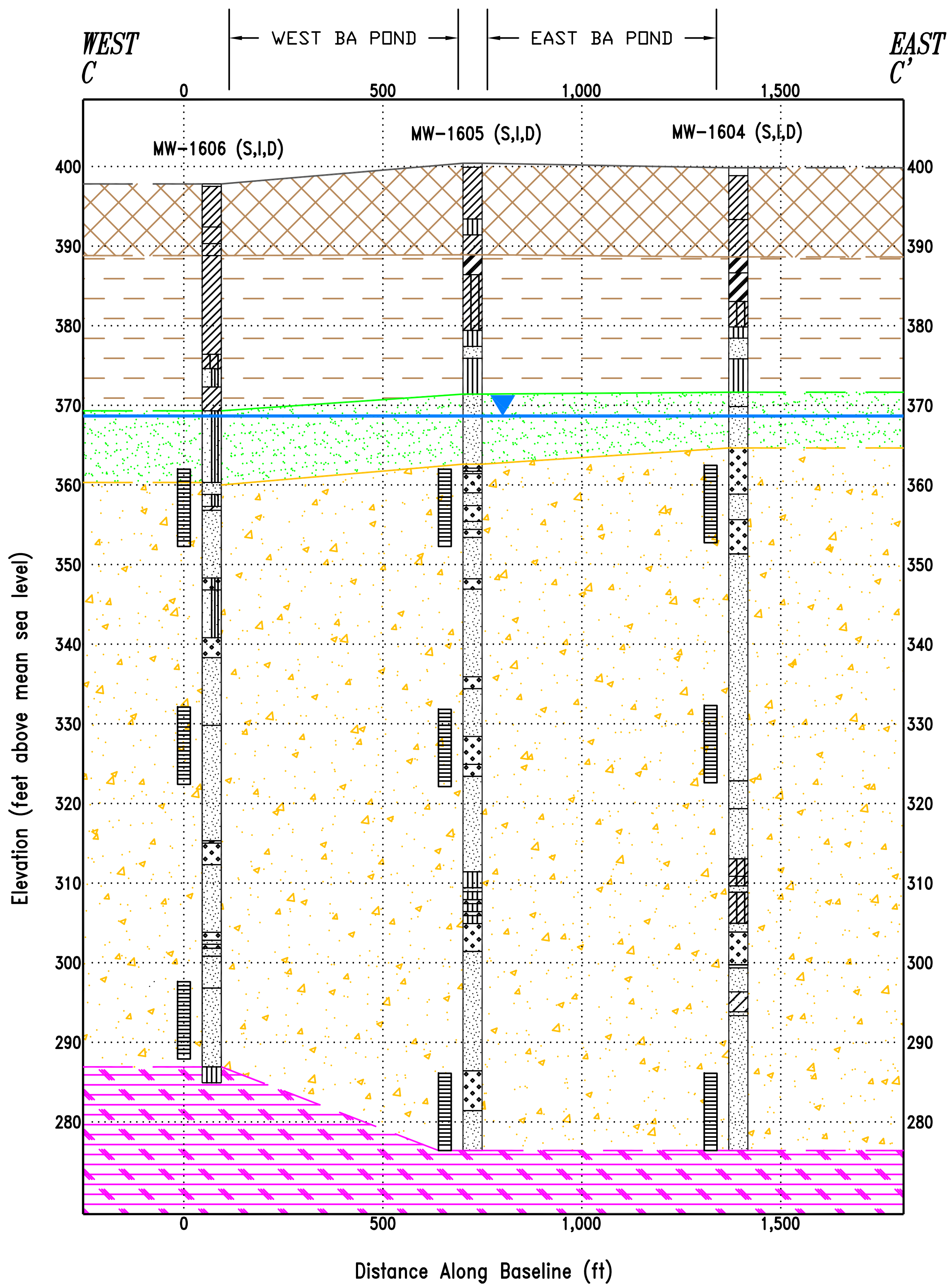
CROSS SECTION B - B'

PROJECT NUMBER: 7362-15-3161

SCALE	1" = 400'
DATE	05/20/2016
DRAWN BY	VM / TMR
APPROVED BY	ALD

FIG. 6

P:\Projects\15 projects\7382153161 AEP CCR Rockport IN\Drawings\AEP_ROCKPORT_SECTION_B.dwg May. 20, 2016 tom.reed



LEGEND:

- USCS Low Plasticity Clay
- USCS Silt
- USCS Clayey Sand
- USCS High Plasticity Clay
- USCS Poorly-graded Sand
- USCS Poorly-graded Sand with Silt
- USCS Low Plasticity Silty Clay
- USCS Well-graded Sand
- USCS Well-graded Sand with Silt
- Shale
- USCS Well-graded Gravel
- Fill or Reworked Soil
- Surficial Silt and Clay
- Well Sorted Sand
- Interbedded Poorly Sorted Sand and Sand and Gravel
- Shale Bedrock
- Screened Interval
- Water level elevation measured in shallow wells on 17 March 2016

0' 400'

SCALE: 1"=400'
VERTICAL EXAGGERATION: 20X

N

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BOTTOM ASH PONDS
AEP - ROCKPORT, INDIANA

CROSS SECTION C - C'

PROJECT NUMBER: 7382-15-3161

SCALE	1" = 400'
DATE	05/20/2016
DRAWN BY	VM / TMR
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FIG. 7

P:\Projects\15 projects\7382153161 AEP CCR Rockport IN\Drawings\AEP_ROCKPORT_SECTION_C.dwg May. 20, 2016 tom.reed

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TABLES

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Table 1
Monitoring Well Construction Details
Bottom Ash Pond Complex
AEP Rockport Plant, Rockport, Indiana

Well ID	Date Installed	Northing SPCS NAD27	Easting SPCS NAD27	Top of Casing (TOC) Elevation*	Ground Surface Elevation	Casing Stick-Up	Length of Screen	Type of Screen	Total Depth of Boring	Depth to Top of Bedrock	Sounded Depth of Well	Depth to Top of Screen	Bottom of Boring Elevation	Top of Bedrock Elevation	Bottom of Well Elevation	Bottom of Screen Elevation	Top of Screen Elevation
		(ft)	(ft)	(ft MSL)	(ft MSL)	(ft AGS)	(ft)	(PVC)	(ft BGS)	(ft BGS)	(ft BMP)	(ft BGS)	(ft MSL)	(ft MSL)	(ft MSL)	(ft MSL)	(ft MSL)
MW-1001	6/2/2010	153488.0	513047.6	402.35	400.03	2.3	9.7	2" x 0.010"	41.0	---	---	29.7	359.0	---	360.0	360.6	370.3
MW-1002	6/2/2010	152307.4	514231.0	401.42	399.09	2.3	9.7	2" x 0.010"	46.5	---	---	35.2	352.6	---	353.6	354.2	363.9
MW-1003	6/2/2010	151208.1	512820.7	393.23	390.84	2.4	9.7	2" x 0.010"	39.0	---	---	27.7	351.8	---	352.8	353.4	363.1
MW-1004	6/3/2010	150013.4	514264.7	396.55	394.25	2.3	9.7	2" x 0.010"	43.5	---	---	32.2	350.8	---	351.8	352.4	362.1
MW-1600-S	2/29/2016	154305.946	512458.043	396.73	393.69	3.0	9.6	2" x 0.010"	41.6	---	43.59	30.6	352.1	---	353.1	353.5	363.1
MW-1600-I	2/29/2016	154306.008	512454.030	396.65	393.72	2.9	9.6	2" x 0.010"	73.0	---	74.59	61.7	320.7	---	322.1	322.5	332.1
MW-1600-D	2/17/2016	154306.313	512448.952	396.31	393.79	2.5	9.6	2" x 0.010"	96.8	95.0	97.52	85.0	297.0	298.8	298.8	299.2	308.8
MW-1601-S	2/27/2016	154327.617	513479.660	402.65	399.77	2.9	9.6	2" x 0.010"	48.0	---	49.74	36.9	351.8	---	352.9	353.3	362.9
MW-1601-I	2/26/2016	154325.290	513483.510	402.83	399.96	2.9	9.6	2" x 0.010"	79.8	---	80.95	68.1	320.2	---	321.9	322.3	331.9
MW-1601-D	2/26/2016	154323.168	513487.454	402.84	400.09	2.8	9.6	2" x 0.010"	117.7	115.5	112.77	100.0	282.4	284.6	290.1	290.5	300.1
MW-1602-I	2/9/2016	152295.035	514229.173	402.03	399.38	2.6	9.6	2" x 0.010"	78.7	---	80.45	67.8	320.7	---	321.6	322.0	331.6
MW-1602-D	1/26/2016	152300.217	514229.384	401.91	399.28	2.6	9.6	2" x 0.010"	125.0	124.6	126.96	114.3	274.3	274.7	275.0	275.4	285.0
MW-1603-S	2/3/2016	152802.696	514206.885	403.85	401.46	2.4	9.6	2" x 0.010"	49.3	---	50.63	38.2	352.2	---	353.2	353.6	363.2
MW-1603-I	2/1/2016	152807.294	519207.223	404.15	401.41	2.7	9.6	2" x 0.010"	79.6	---	81.67	68.9	321.8	---	322.5	322.9	332.5
MW-1603-D	1/29/2016	152811.949	514207.457	403.85	401.56	2.3	9.6	2" x 0.010"	122.0	122.0	123.14	110.9	279.6	279.6	280.7	281.1	290.7
MW-1604-S	1/29/2016	151503.132	514197.320	402.46	399.76	2.7	9.6	2" x 0.010"	48.0	---	49.35	36.7	351.8	---	353.1	353.5	363.1
MW-1604-I	1/28/2016	151506.473	514201.037	402.19	399.74	2.4	9.6	2" x 0.010"	79.0	---	81.46	69.0	320.7	---	320.7	321.1	330.7
MW-1604-D	1/15/2016	151510.165	514204.869	402.44	399.85	2.6	9.6	2" x 0.010"	126.6	125.8	128.15	115.6	273.3	274.1	274.3	274.7	284.3
MW-1605-S	3/1/2016	151478.765	513528.386	403.38	400.33	3.1	9.6	2" x 0.010"	49.0	---	50.60	37.6	351.3	---	352.8	353.2	362.8
MW-1605-I	3/2/2016	151478.914	513532.565	403.22	400.60	2.6	9.6	2" x 0.010"	80.0	---	81.50	68.9	320.6	---	321.7	322.1	331.7
MW-1605-D	2/3/2016	151478.903	513537.066	403.78	400.42	3.4	9.6	2" x 0.010"	127.5	125.0	128.00	114.6	272.9	275.4	275.8	276.2	285.8
MW-1606-S	3/2/2016	151498.907	512889.413	400.65	397.62	3.0	9.6	2" x 0.010"	46.0	---	47.62	34.6	351.6	---	353.0	353.4	363.0
MW-1606-I	3/1/2016	151500.402	512885.504	400.75	397.75	3.0	9.6	2" x 0.010"	77.0	---	78.41	65.4	320.8	---	322.3	322.7	332.3
MW-1606-D	2/12/2016	151502.092	512881.487	400.73	397.82	2.9	9.6	2" x 0.010"	112.9	110.9	113.15	100.2	284.9	286.9	287.6	288.0	297.6

Prepared By: TMR 4/19/16
Checked By: SGW 4/21/2016

Notes:
* Top of casing on new wells surveyed 3-4 March 2016.

--- = Data not available or not applicable
ft = feet
in = inches
BMP = below measuring point (top of casing)
BGS = below ground surface
MSL = above Mean Sea Level, equivalent to the National Geodetic Vertical Datum of 1929 (NGVD29)
AGS = above ground surface
TOC = top of casing (PVC pipe)
SPCS = State Plane Coordinate System
NAD27 = North American Datum of 1927

Table 2
Groundwater Elevation Summary
Bottom Ash Pond Complex
AEP Rockport Plant, Rockport, Indiana

Well No.	**MW 1001**	**MW 1002**	**MW 1003**	**MW 1004**	**MW-1600-S**	**MW-1600-I**	**MW-1600-D**	**MW-1601-S**
Date Installed	6/2/2010	6/2/2010	6/2/2010	6/2/2010	2/29/2016	2/29/2016	2/17/2016	2/27/2016
MP Elevation (ft MSL)*	402.35	401.42	393.23	396.55	396.73	396.65	396.31	402.65
Depth to Well Bottom (ft BMP)	42.32	47.83	40.39	44.80	43.59	74.59	97.52	49.74
Well Bottom Elevation (ft MSL)	360.0	353.6	352.8	351.8	353.1	322.1	298.8	352.9
Depth to Water (ft BMP)								
5/17/2011	---	---	---	---	---	---	---	---
11/17/2011	---	---	---	---	---	---	---	---
11/15/2012	---	---	---	---	---	---	---	---
5/20/2013	---	---	---	---	---	---	---	---
11/13/2013	---	---	---	---	---	---	---	---
5/12/2014	---	---	---	---	---	---	---	---
11/12/2014	---	---	---	---	---	---	---	---
5/7/2015	---	---	---	---	---	---	---	---
1/14/2016	33.01	32.87	24.20	28.58	---	---	---	---
3/17/2016	32.56	32.27	23.40	27.19	26.53	26.51	26.23	33.24
Water Level Elevation (ft MSL)								
5/17/2011	371.61	373.20	373.72	376.13	---	---	---	---
11/17/2011	370.77	369.17	369.64	367.35	---	---	---	---
11/15/2012	368.91	367.48	367.83	365.93	---	---	---	---
5/20/2013	369.11	367.95	368.61	367.38	---	---	---	---
11/13/2013	368.38	366.99	367.49	366.43	---	---	---	---
5/12/2014	370.06	369.55	369.93	368.84	---	---	---	---
11/12/2014	368.57	367.03	367.64	365.57	---	---	---	---
5/7/2015	370.75	371.16	371.35	370.93	---	---	---	---
1/14/2016	369.34	368.55	369.03	367.97	---	---	---	---
3/17/2016	369.79	369.15	369.83	369.36	370.20	370.14	370.08	369.41

Table 2
Groundwater Elevation Summary
Bottom Ash Pond Complex
AEP Rockport Plant, Rockport, Indiana

Well No.	MW-1601-I	MW-1601-D	MW-1602-I	MW-1602-D	MW-1603-S	MW-1603-I	MW-1603-D	MW-1604-S
Date Installed	2/26/2016	2/26/2016	2/9/2016	1/26/2016	2/3/2016	2/1/2016	1/29/2016	1/29/2016
MP Elevation (ft MSL)*	402.83	402.84	402.03	401.91	403.85	404.15	403.85	402.46
Depth to Well Bottom (ft BMP)	80.95	112.77	80.45	126.96	50.63	81.67	123.14	49.35
Well Bottom Elevation (ft MSL)	321.9	290.1	321.6	275.0	353.2	322.5	280.7	353.1
Depth to Water (ft BMP)								
5/17/2011	---	---	---	---	---	---	---	---
11/17/2011	---	---	---	---	---	---	---	---
11/15/2012	---	---	---	---	---	---	---	---
5/20/2013	---	---	---	---	---	---	---	---
11/13/2013	---	---	---	---	---	---	---	---
5/12/2014	---	---	---	---	---	---	---	---
11/12/2014	---	---	---	---	---	---	---	---
5/7/2015	---	---	---	---	---	---	---	---
1/14/2016	---	---	---	---	---	---	---	---
3/17/2016	33.25	33.10	32.90	32.80	34.70	34.99	34.76	33.24
Water Level Elevation (ft MSL)								
5/17/2011	---	---	---	---	---	---	---	---
11/17/2011	---	---	---	---	---	---	---	---
11/15/2012	---	---	---	---	---	---	---	---
5/20/2013	---	---	---	---	---	---	---	---
11/13/2013	---	---	---	---	---	---	---	---
5/12/2014	---	---	---	---	---	---	---	---
11/12/2014	---	---	---	---	---	---	---	---
5/7/2015	---	---	---	---	---	---	---	---
1/14/2016	---	---	---	---	---	---	---	---
3/17/2016	369.58	369.74	369.13	369.11	369.15	369.16	369.09	369.22

Table 2
Groundwater Elevation Summary
Bottom Ash Pond Complex
AEP Rockport Plant, Rockport, Indiana

Well No.	MW-1604-I	MW-1604-D	MW-1605-S	MW-1605-I	MW-1605-D	MW-1606-S	MW-1606-I	MW-1606-D
Date Installed	1/28/2016	1/15/2016	3/1/2016	3/2/2016	2/3/2016	3/2/2016	3/1/2016	2/12/2016
MP Elevation (ft MSL)*	402.19	402.44	403.38	403.22	403.78	400.65	400.75	400.73
Depth to Well Bottom (ft BMP)	81.46	128.15	50.60	81.50	128.00	47.62	78.41	113.15
Well Bottom Elevation (ft MSL)	320.7	274.3	352.8	321.7	275.8	353.0	322.3	287.6
Depth to Water (ft BMP)								
5/17/2011	---	---	---	---	---	---	---	---
11/17/2011	---	---	---	---	---	---	---	---
11/15/2012	---	---	---	---	---	---	---	---
5/20/2013	---	---	---	---	---	---	---	---
11/13/2013	---	---	---	---	---	---	---	---
5/12/2014	---	---	---	---	---	---	---	---
11/12/2014	---	---	---	---	---	---	---	---
5/7/2015	---	---	---	---	---	---	---	---
1/14/2016	---	---	---	---	---	---	---	---
3/17/2016	33.01	33.24	33.90	34.0	35.0	31.03	31.05	31.02
Water Level Elevation (ft MSL)								
5/17/2011	---	---	---	---	---	---	---	---
11/17/2011	---	---	---	---	---	---	---	---
11/15/2012	---	---	---	---	---	---	---	---
5/20/2013	---	---	---	---	---	---	---	---
11/13/2013	---	---	---	---	---	---	---	---
5/12/2014	---	---	---	---	---	---	---	---
11/12/2014	---	---	---	---	---	---	---	---
5/7/2015	---	---	---	---	---	---	---	---
1/14/2016	---	---	---	---	---	---	---	---
3/17/2016	369.18	369.20	369.48	369.22	368.78	369.62	369.70	369.71

Prepared by: TMR 4/19/16
Checked by: SGW 4/21/16

Notes:
* Top of casing on new wells surveyed 3-4 March 2016.
--- = Data not available or not applicable
ft = feet
BMP = below measuring point (top of casing)
MSL = above Mean Sea Level, equivalent to the National Geodetic Vertical Datum of 1929 (NGVD29)

Table 3
Field Water Quality Data
Bottom Ash Pond Complex
AEP Rockport Plant, Rockport, Indiana

Well ID	Date	Time	Static DTW (ft BMP)	pH (S.U.)	Temp (°C)	SC (µS/cm)	DO (mg/L)	ORP (mV)	Turb (NTU)
MW-1600-S	3/22/2016	10:15	26.53	6.74	15.5	735	0.8	103	1.6
MW-1600-I	3/22/2016	12:00	26.51	6.97	15.5	703	4.22	-64.3	5.0*
MW-1600-D	3/22/2016	9:40	26.23	6.88	14.3	715	0.52	-104	1.8
MW-1601-S	3/10/2016	15:05	33.36	7.17	16.0	725	0.89	---	1.6
MW-1601-I	3/10/2016	13:45	33.35	6.78	15.9	788	6.61	-59.0	3.9
MW-1601-D	3/30/2016	9:05	33.1	6.97	15.6	759	1.91	-102.6	4.0
MW-1602-I	3/15/2016	16:40	33.21	7.18	18.8	738	0.6	---	4.8
MW-1602-D	3/15/2016	15:45	32.51	7.18	20.3	919	0.58	---	5.0
MW-1603-S	3/20/2016	15:40	34.70	7.15	17.0	792	0.42	-90.2	1.8
MW-1603-I	3/20/2016	16:25	34.99	7.04	14.4	835	2.48	-71.6	5.0
MW-1603-D	3/20/2016	15:00	34.76	6.95	14.4	739	0.75	-98.3	2.1
MW-1604-S	3/14/2016	14:25	33.21	7.33	18.9	876	0.39	---	2.3
MW-1604-I	3/12/2016	12:50	33.40	7.37	16.9	782	1.58	---	1.9
MW-1604-D	3/12/2016	11:30	33.59	7.23	16.2	553	0.57	---	0.69
MW-1605-S	3/17/2016	14:05	33.62	7.11	18.3	978	0.25	157	2.1
MW-1605-I	3/17/2016	13:15	33.51	7.16	16.3	790	0.39	-90.7	4.9
MW-1605-D	3/17/2016	10:45	33.73	7.12	17.1	1,365	0.45	-95.2	3.3
MW-1606-S	3/19/2016	13:10	31.03	7.00	14.0	788	2.75	219	5.8
MW-1606-I	3/19/2016	9:55	31.50	7.21	13.7	631	0.18	-93.2	1.5
MW-1606-D	3/19/2016	10:35	31.20	7.11	13.8	568	0.71	-126	3.1

Prepared By: TMR 4/25/16

Checked By: ALD 4/26/2016

Notes:

* = Final turbidity measurement collected at 14:00 after an additional 2 hours of pumping.
--- = Data not available or not applicable
ft = feet
S.U. = Standard Units
°C = degrees Celcius
µS/cm = microSiemens per centimeter
mg/L = milligrams per liter
mV = milliVolts
NTU = Nephelometric Turbidity Units
DTW = Depth to Water
BMP = Below Measuring Point (top of casing)
Temp = Temperature
SC = Specific Conductance
DO = Dissolved Oxygen
ORP = Oxidation-Reduction Potential
Turb = Turbidity

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ATTACHMENTS

ATTACHMENT 1

WELL CONSTRUCTION AND LITHOLOGIC LOGS
2016 BA POND MONITORING WELLS

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER 42393125-01
COMPANY INDIANA MICHIGAN POWER COMPANY
PROJECT ROCKPORT PLANT
COORDINATES N 154,306.3 E 512,449.0
GROUND ELEVATION 393.8 SYSTEM State Plane using NAD27/29

BORING NO. MW-1600D DATE 4/27/16 SHEET 1 OF 4
BORING START 2/17/16 BORING FINISH 2/17/16
PIEZOMETER TYPE WELL TYPE OW
HGT. RISER ABOVE GROUND 2.52 DIA 2.0
DEPTH TO TOP OF WELL SCREEN 84.99 BOTTOM 94.59
WELL DEVELOPMENT YES BACKFILL
FIELD PARTY ZLR / REB RIG D-120

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	33-14-10	1.5					Gravel = 18 inches		
2	SS	1.5	3.0	3-5-6	1.5					Silty clay, l. brown 5YR 6/4 and l. grey N7 mottled, dry, stiff, FILL @ 3' sl. stiff @ 4.2' w/dusky brown 5YR 2/2 silt @ 4.5' stiff, some iron oxide particles, moist		
3	SS	3.0	4.5	2-3-4	1.5							
4	SS	4.5	6.0	4-4-6	1.5		5					
5	SS	6.0	7.5	3-6-9	1.5							
6	SS	7.5	9.0	2-5-6	1.5				MH	Clayey silt, moderate brown 5YR 4/4 and l. grey N7 fat clay mottled, moist, med. dense, trace oxide particles, likely fill		
									SP	Poorly graded sand, fine grained, l. brown 5YR 5/6, dry to moist, med. dense @ 9' v. fine grained, loose		
7	SS	9.0	10.5	3-4-4	1.4		10					
8	SS	10.5	12.0	3-4-4	1.4							
9	SS	12.0	13.5	2-3-5	1.5							
10	SS	13.5	15.0	2-4-5	1.5				MH	Clayey silt, moderate brown 5YR 4/4, moist, loose		
									SP	Poorly graded sand, fine grained pale yellowish brown 10YR 6/2, moist, loose		
							15		MH	Clayey silt, moderate brown 5YR 4/4, moist, loose		
11	SS	15.0	16.5	3-8-10	1.5				SP	Poorly graded sand, fine grained, pale yellowish brown 10YR 6/2, moist, med. dense @ 16' 3" layer - clayey silt (prev. material) @ 19' 4" layer - poorly graded sand (l. brown, v. fine grained) prev. material @ 21' loose @ 21.3' w/black silt		
12	SS	16.5	18.0	4-6-8	1.5							
13	SS	18.0	19.5	5-6-5	1.5							
14	SS	19.5	21.0	3-5-4	1.5							

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER AMEC FOSTER WHEELER

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1600D** DATE **4/27/16** SHEET **2** OF **4**

PROJECT **ROCKPORT PLANT** BORING START **2/17/16** BORING FINISH **2/17/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET
15	SS	21.0	22.5	3-3-5	1.5		
16	SS	22.5	24.0	2-3-3	1.5		
17	SS	24.0	25.5	4-6-6	1.5		
							25
18	SS	25.5	27.0	2-2-4	1.0		
19	SS	27.0	28.5	2-2-2	1.2		
20	SS	28.5	30.0	4-8-11	1.5		
							30
21	SS	30.0	31.5	6-6-8	1.0		
22	SS	31.5	33.0	4-6-9	1.5		
23	SS	33.0	34.5	8-9-12	1.5		
24	SS	34.5	36.0	13-16-12	1.5		
							35
25	SS	36.0	37.5	6-7-7	1.5		
26	SS	37.5	39.0	5-8-12	1.5		
27	SS	39.0	40.5	6-12-17	1.5		
							40
28	SS	40.5	42.0	6-11-19	1.5		
29	SS	42.0	43.5	7-15-24	1.5		
30	SS	43.5	45.0	3-10-16	1.4		
							45
31	SS	45.0	46.5	10-13-16	1.5		

USCS	SOIL / ROCK IDENTIFICATION
SP	Poorly graded sand, v. fine grained, l. brown 5YR 5/6, moist, loose @ 22.8' 3" layer - PG sand, fine, pale yellowish br. prev. material @ 23.2' w/black silt @ 23.5' no black silt @ 24' moderate red 5R 4/6
SP	Poorly graded sand, med. grained, d. yellowish brown 10YR 4/2, moist, med. dense, some black silt
SP	Poorly graded sand, v. fine grained, pale yellowish brown 10YR 6/2, wet, loose, trace clay (l. brown 5YR 6/4), trace coarse gravel, water in spoon
SP	Poorly graded sand, fine grained, pale yellowish brown 10YR 6/2, wet, v. loose, w/lean clay (mod. brown 5YR 4/4)
SP	Poorly graded sand, fine grained, mod. yellowish brown 10YR 5/4, wet, med. dense, w/fine gravel @ 30.5' w/black silt @ 30.7' no black silt
SW	Well graded sand, coarse grained, dark reddish brown 10R 3/4, wet, med. dense, w/fine gravel @ 32' 5" layer pg sand, fine, mod. yellowish brown, prev. material
SP	Poorly graded sand, fine grained, mod. yellowish brown 10YR 5/4, wet, med. dense, w/fine gravel, trace black silt
SP	Poorly graded sand, fine to med. grained, dusky red 5R 3/4, wet, med. dense, w/fine gravel, trace coarse gravel
SP	Poorly graded sand, fine grained, mod. yellowish brown 10YR 5/4, wet, med. dense, w/fine gravel @ 36' trace coarse gavel @ 37.5' well graded SW @ 40' poorly graded SP @ 41' trace fine gravel, no coarse gravel @ 42' dense @ 43.1' 1" seam black silt and fine gravel - possible coal
SW	Well graded sand, fine to med. grained, pale yellowish brown 10YR 6/2 wet, med. dense, w/fine gravel @ 44' trace lean clay mod. brown 5YR 4/4 @ 44.4' no clay

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY   BORING NO. MW-1600D   DATE 4/27/16   SHEET 3 OF 4

PROJECT ROCKPORT PLANT   BORING START 2/17/16   BORING FINISH 2/17/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
32	SS	46.5	48.0	6-9-14	1.4					Well graded sand, coarse grained, mod. yellowish brown 10YR 5/4, wet, med. dense, w/fine gravel, trace coarse gravel @ 46.5' med. to coarse grained		
33	SS	48.0	49.5	9-16-20	1.5							
34	SS	49.5	51.0	12-11-15	1.4		50		SP	Poorly graded sand, fine grained, pale brown 5YR 5/4, wet, dense, trace coarse gravel		
35	SS	51.0	52.5	7-12-12	1.5				SW	Well graded sand, fine to med. grained, d. yellowish brown 10YR 4/2, wet, med. dense, some fine gravel, some black silt @ 51' trace coarse gravel @ 52.5' fine grained, no coarse gravel @ 54' no fine gravel @ 55.5' brownish grey 5YR 4/1 w/fine gravel		
36	SS	52.5	54.0	4-9-12	1.5							
37	SS	54.0	55.5	9-10-14	1.4		55					
38	SS	55.5	57.0	6-12-16	1.5							
39	SS	57.0	58.5	7-9-11	1.4				SP	Poorly graded sand, fine grained, brownish grey 5YR 4/1, wet, med. dense, w/black silt @ 60' dense @ 60.6' 1.5" shale fragment @ 62.1' w/fine gravel @ 63' v. dense @ 64.2' 3" layer shale, l. grey N7 @ 64.5' some coarse gravel @ 65' 2" layer shale, l. grey N7		
40	SS	58.5	60.0	7-10-16	1.2		60					
41	SS	60.0	61.5	13-16-16	1.5							
42	SS	61.5	63.0	6-14-25	1.4							
43	SS	63.0	64.5	11-20-38	1.5							
44	SS	64.5	66.0	22-24-29	1.4		65					
45	SS	66.0	67.5	50/3						Shale, l. grey, dry, hard		
46	SS	67.5	69.0	13-13-14	1.5				SP SW	Indeterminate layer transition due to 3" recovery (spoon refusal) in prev. sample Poorly graded sand, v. fine grained, brownish grey 5YR 4/1, wet, med. dense, w/fine gravel		
47	SS	69.0	70.5	12-16-16	1.4		70			Well graded sand, med. grained, d. yellowish brown 10YR 4/2, wet, med. dense, w/fine gravel, some coarse gravel @ 69' dense, fine to med. grained @ 70.5' med. grained @ 71' 3" layer fat clay, l. grey N7 (w/shale),		
48	SS	70.5	72.0	6-13-21	1.3							

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY BORING NO. MW-1600D DATE 4/27/16 SHEET 4 OF 4

PROJECT ROCKPORT PLANT BORING START 2/17/16 BORING FINISH 2/17/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
49	SS	72.0	73.5	8-13-24	1.1					w/coarse gravel @ 72' no coarse gravel @ 73.5' mod. dense, sample washed out @76' 2.5" layer coal fragments @ 79' 1" seam fat clay, l. grey N7 @ 79.5' trace black silt		
50	SS	73.5	75.0	10-9-17	0							
51	SS	75.0	76.5	5-13-14	1.4		75					
52	SS	76.5	78.0	9-12-18	1.1							
53	SS	78.0	79.5	6-6-15	1.4							
54	SS	79.5	81.0	6-7-13	1.2		80					
55	SS	81.0	82.5	6-6-8	1.1							
56	SS	82.5	84.0	7-8-9	1.3				SP	Poorly graded sand, v. fine grained, pale yellowish brown 10YR 6/2, wet, med. dense, trace black silt		
57	SS	84.0	85.5	10-12-21	1.5		85		SW	Well graded sand, med. grained, d. yellowish brown 10YR 4/2, wet, dense, w/fine gravel, trace coarse gravel, trace black silt @ 84.6' 2.5" layer coal w/~30% above material SW @ 85.5' med. dense, no coarse gravel, no black silt		
58	SS	85.5	87.0	14-11-10	1.5							
59	SS	87.0	88.5	6-7-8	1.4				GW	Well graded gravel, brownish grey 5YR 4/1, wet, med. dense, fine rounded, w/med. grained sand (l. yellowish brown 10YR 4.2, prev. material) @ 88.5' dense, sample washed out/blocket, cobble fragment in spoon tip		
60	SS	88.5	90.0	15-19-24	.08							
61	SS	90.0	91.5	11-25-21	1.5		90		SP	Poorly graded sand, fine grained, mod. yellowish brown 10YR 5/4, wet, dense, some fine gravel, trace coarse gravel		
62	SS	91.5	93.0	16-13-12	1.5				GW	Well graded gravel, brownish grey 5YR 4/1, wet, dense, fine to coarse, rounded, w/fine grained sand (mod. yellowish brown 10YR 5/4)		
									SP	Poorly graded sand, fine grained, mod. yellowish brown 10YR 5/4, wet, med. dense, w/fine gravel, some coarse gravel		
63	SS	93.0	94.5	10-11-12	1.0				GW	Well graded gravel, brownish grey 5YR 4/1, wet, med. dense, fine to coarse, rounded, w/fine grained sand @ 94.5' hard		
64	SS	94.5	96.0	9-26-50/5	1.4		95		MH	Clayey silt, l. grey moist, hard non-durable shale		
65	SS	96.0	97.5	35-50/4						Spoon refusal @ 96.8' Auger refusal @ 96.8' BT @ 96.8'		

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY | BORING NO. MW-1600I | DATE 4/27/16 | SHEET 1 OF 4

PROJECT ROCKPORT PLANT | BORING START 2/29/16 | BORING FINISH 2/29/16

COORDINATES N 154,306.0 E 512,454.0 | PIEZOMETER TYPE | WELL TYPE OW

GROUND ELEVATION 393.7 | SYSTEM State Plane using NAD27/29 | HGT. RISER ABOVE GROUND 2.93 | DIA 2.0

DEPTH TO TOP OF WELL SCREEN 61.7 BOTTOM 71.22

WELL DEVELOPMENT YES | BACKFILL

FIELD PARTY ZLR / REB | RIG D-120

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	33-14-10	1.5					Gravel = 18 inches		
2	SS	1.5	3.0	3-5-6	1.5					Silty clay, l. brown 5YR 6/4 and l. grey N7 mottled, dry, stiff, FILL @ 3' sl. stiff @ 4.2' w/dusky brown 5YR 2/2 silt @ 4.5' stiff, some iron oxide particles, moist		
3	SS	3.0	4.5	2-3-4	1.5							
4	SS	4.5	6.0	4-4-6	1.5		5					
5	SS	6.0	7.5	3-6-9	1.5							
6	SS	7.5	9.0	2-5-6	1.5				MH	Clayey silt, moderate brown 5YR 4/4 and l. grey N7 fat clay mottled, moist, med. dense, trace oxide particles, likely fill		
									SP	Poorly graded sand, fine grained, l. brown 5YR 5/6, dry to moist, med. dense @ 9' v. fine grained, loose		
7	SS	9.0	10.5	3-4-4	1.4		10					
8	SS	10.5	12.0	3-4-4	1.4							
9	SS	12.0	13.5	2-3-5	1.5							
10	SS	13.5	15.0	2-4-5	1.5				MH	Clayey silt, moderate brown 5YR 4/4, moist, loose		
									SP	Poorly graded sand, fine grained pale yellowish brown 10YR 6/2, moist, loose		
							15		MH	Clayey silt, moderate brown 5YR 4/4, moist, loose		
11	SS	15.0	16.5	3-8-10	1.5				SP	Poorly graded sand, fine grained, pale yellowish brown 10YR 6/2, moist, med. dense @ 16' 3" layer - clayey silt (prev. material) @ 19' 4" layer - poorly graded sand (l. brown, v. fine grained) prev. material @ 21' loose @ 21.3' w/black silt		
12	SS	16.5	18.0	4-6-8	1.5							
13	SS	18.0	19.5	5-6-5	1.5							
14	SS	19.5	21.0	3-5-4	1.5							

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER AMEC FOSTER WHEELER

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1600I** DATE **4/27/16** SHEET **2** OF **4**

PROJECT **ROCKPORT PLANT** BORING START **2/29/16** BORING FINISH **2/29/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
15	SS	21.0	22.5	3-3-5	1.5							
16	SS	22.5	24.0	2-3-3	1.5				SP	Poorly graded sand, v. fine grained, l. brown 5YR 5/6, moist, loose @ 22.8' 3" layer - PG sand, fine, pale yellowish br. prev. material @ 23.2' w/black silt @ 23.5' no black silt		
17	SS	24.0	25.5	4-6-6	1.5				SP	@ 24' moderate red 5R 4/6		
18	SS	25.5	27.0	2-2-4	1.0		25		SP	Poorly graded sand, med. grained, d. yellowish brown 10YR 4/2, moist, med. dense, some black silt		Water @ 25.5'
19	SS	27.0	28.5	2-2-2	1.2				SP	Poorly graded sand, v. fine grained, pale yellowish brown 10YR 6/2, wet, loose, trace clay (l. brown 5YR 6/4), trace coarse gravel, water in spoon		
20	SS	28.5	30.0	4-8-11	1.5				SP	Poorly graded sand, fine grained, pale yellowish brown 10YR 6/2, wet, v. loose, w/lean clay (mod. brown 5YR 4/4)		Began Mud Rotary @ 28.5'
21	SS	30.0	31.5	6-6-8	1.0		30			Poorly graded sand, fine grained, mod. yellowish brown 10YR 5/4, wet, med. dense, w/fine gravel @ 30.5' w/black silt @ 30.7' no black silt		
22	SS	31.5	33.0	4-6-9	1.5				SW	Well graded sand, coarse grained, dark reddish brown 10R 3/4, wet, med. dense, w/fine gravel @ 32' 5" layer pg sand, fine, mod. yellowish brown, prev. material		
23	SS	33.0	34.5	8-9-12	1.5				SP	Poorly graded sand, fine grained, mod. yellowish		
24	SS	34.5	36.0	13-16-12	1.5				SP	brown 10YR 5/4, wet, med. dense, w/fine gravel, trace black silt		
25	SS	36.0	37.5	6-7-7	1.5		35		SP	Poorly graded sand, fine to med. grained, dusky red 5R 3/4, wet, med. dense, w/fine gravel, trace coarse gravel		
26	SS	37.5	39.0	5-8-12	1.5					Poorly graded sand, fine grained, mod. yellowish brown 10YR 5/4, wet, med. dense, w/fine gravel @ 36' trace coarse gavel @ 37.5' well graded SW @ 40' poorly graded SP @ 41' trace fine gravel, no coarse gravel @ 42' dense @ 43.1' 1" seam black silt and fine gravel - possible coal		
27	SS	39.0	40.5	6-12-17	1.5							
28	SS	40.5	42.0	6-11-19	1.5		40					
29	SS	42.0	43.5	7-15-24	1.5							
30	SS	43.5	45.0	3-10-16	1.4				SW	Well graded sand, fine to med. grained, pale yellowish brown 10YR 6/2 wet, med. dense, w/fine gravel		
31	SS	45.0	46.5	10-13-16	1.5		45		SW	@ 44' trace lean clay mod. brown 5YR 4/4 @ 44.4' no clay		

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1600I** DATE **4/27/16**

PROJECT **ROCKPORT PLANT** BORING START **2/29/16** BORING FINISH **2/29/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	SAMPLE DEPTH IN FEET TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
32	SS	46.5	48.0	6-9-14	1.4					Well graded sand, coarse grained, mod. yellowish brown 10YR 5/4, wet, med. dense, w/fine gravel, trace coarse gravel @ 46.5' med. to coarse grained		
33	SS	48.0	49.5	9-16-20	1.5							
34	SS	49.5	51.0	12-11-15	1.4				SP	Poorly graded sand, fine grained, pale brown 5YR 5/4, wet, dense, trace coarse gravel		
							50		SW	Well graded sand, fine to med. grained, d. yellowish brown 10YR 4/2, wet, med. dense, some fine gravel, some black silt @ 51' trace coarse gravel @ 52.5' fine grained, no coarse gravel @ 54' no fine gravel @ 55.5' brownish grey 5YR 4/1 w/fine gravel		
35	SS	51.0	52.5	7-12-12	1.5							
36	SS	52.5	54.0	4-9-12	1.5							
37	SS	54.0	55.5	9-10-14	1.4							
							55					
38	SS	55.5	57.0	6-12-16	1.5							
39	SS	57.0	58.5	7-9-11	1.4				SP	Poorly graded sand, fine grained, brownish grey 5YR 4/1, wet, med. dense, w/black silt @ 60' dense @ 60.6' 1.5" shale fragment @ 62.1' w/fine gravel @ 63' v. dense @ 64.2' 3" layer shale, l. grey N7 @ 64.5' some coarse gravel @ 65' 2" layer shale, l. grey N7		
40	SS	58.5	60.0	7-10-16	1.2							
41	SS	60.0	61.5	13-16-16	1.5		60					
42	SS	61.5	63.0	6-14-25	1.4							
43	SS	63.0	64.5	11-20-38	1.5							
44	SS	64.5	66.0	22-24-29	1.4		65					
45	SS	66.0	67.5	50/3						Shale, l. grey, dry, hard		
46	SS	67.5	69.0	13-13-14	1.5				SP SW	Indeterminate layer transition due to 3" recovery (spoon refusal) in prev. sample Poorly graded sand, v. fine grained, brownish grey 5YR 4/1, wet, med. dense, w/fine gravel		
47	SS	69.0	70.5	12-16-16	1.4					Well graded sand, med. grained, d. yellowish brown 10YR 4/2, wet, med. dense, w/fine gravel, some coarse gravel @ 69' dense, fine to med. grained @ 70.5' med. grained @ 71' 3" layer fat clay, l. grey N7 (w/shale),		
							70					
48	SS	70.5	72.0	6-13-21	1.3							

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY BORING NO. MW-1600I DATE 4/27/16 SHEET 4 OF 4

PROJECT ROCKPORT PLANT BORING START 2/29/16 BORING FINISH 2/29/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
49	SS	72.0	73.5	8-13-24	1.1					w/coarse gravel @ 72' no coarse gravel @ 73.5' mod. dense, sample washed out @76' 2.5" layer coal fragments @ 79' 1" seam fat clay, l. grey N7 @ 79.5' trace black silt		

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY | BORING NO. MW-1600S | DATE 4/27/16 | SHEET 1 OF 2

PROJECT ROCKPORT PLANT | BORING START 2/29/16 | BORING FINISH 2/29/16

COORDINATES N 154,305.9 E 512,458.0 | PIEZOMETER TYPE | WELL TYPE OW

GROUND ELEVATION 393.7 | SYSTEM State Plane using NAD27/29 | HGT. RISER ABOVE GROUND 3.04 | DIA 2.0

DEPTH TO TOP OF WELL SCREEN 30.6 BOTTOM 40.19

WELL DEVELOPMENT YES | BACKFILL

FIELD PARTY ZLR / REB | RIG D-120

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	33-14-10	1.5					Gravel = 18 inches		
2	SS	1.5	3.0	3-5-6	1.5					Silty clay, l. brown 5YR 6/4 and l. grey N7 mottled, dry, stiff, FILL @ 3' sl. stiff @ 4.2' w/dusky brown 5YR 2/2 silt @ 4.5' stiff, some iron oxide particles, moist		
3	SS	3.0	4.5	2-3-4	1.5							
4	SS	4.5	6.0	4-4-6	1.5		5					
5	SS	6.0	7.5	3-6-9	1.5							
6	SS	7.5	9.0	2-5-6	1.5				MH	Clayey silt, moderate brown 5YR 4/4 and l. grey N7 fat clay mottled, moist, med. dense, trace oxide particles, likely fill		
									SP	Poorly graded sand, fine grained, l. brown 5YR 5/6, dry to moist, med. dense @ 9' v. fine grained, loose		
7	SS	9.0	10.5	3-4-4	1.4		10					
8	SS	10.5	12.0	3-4-4	1.4							
9	SS	12.0	13.5	2-3-5	1.5							
10	SS	13.5	15.0	2-4-5	1.5				MH	Clayey silt, moderate brown 5YR 4/4, moist, loose		
									SP	Poorly graded sand, fine grained pale yellowish brown 10YR 6/2, moist, loose		
							15		MH	Clayey silt, moderate brown 5YR 4/4, moist, loose		
11	SS	15.0	16.5	3-8-10	1.5				SP	Poorly graded sand, fine grained, pale yellowish brown 10YR 6/2, moist, med. dense @ 16' 3" layer - clayey silt (prev. material) @ 19' 4" layer - poorly graded sand (l. brown, v. fine grained) prev. material @ 21' loose @ 21.3' w/black silt		
12	SS	16.5	18.0	4-6-8	1.5							
13	SS	18.0	19.5	5-6-5	1.5							
14	SS	19.5	21.0	3-5-4	1.5							

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER AMEC FOSTER WHEELER

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1600S** DATE **4/27/16** SHEET **2** OF **2**

PROJECT **ROCKPORT PLANT** BORING START **2/29/16** BORING FINISH **2/29/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
15	SS	21.0	22.5	3-3-5	1.5							
16	SS	22.5	24.0	2-3-3	1.5				SP	Poorly graded sand, v. fine grained, l. brown 5YR 5/6, moist, loose @ 22.8' 3" layer - PG sand, fine, pale yellowish br. prev. material		
17	SS	24.0	25.5	4-6-6	1.5		25		SP	@ 23.2' w/black silt @ 23.5' no black silt @ 24' moderate red 5R 4/6		
18	SS	25.5	27.0	2-2-4	1.0				SP	Poorly graded sand, med. grained, d. yellowish brown 10YR 4/2, moist, med. dense, some black silt		Water @ 25.5'
19	SS	27.0	28.5	2-2-2	1.2				SP	Poorly graded sand, v. fine grained, pale yellowish brown 10YR 6/2, wet, loose, trace clay (l. brown 5YR 6/4), trace coarse gravel, water in spoon		
20	SS	28.5	30.0	4-8-11	1.5				SP	Poorly graded sand, fine grained, pale yellowish brown 10YR 6/2, wet, v. loose, w/lean clay (mod. brown 5YR 4/4)		Began Mud Rotary @ 28.5'
21	SS	30.0	31.5	6-6-8	1.0		30			Poorly graded sand, fine grained, mod. yellowish brown 10YR 5/4, wet, med. dense, w/fine gravel @ 30.5' w/black silt @ 30.7' no black silt		
22	SS	31.5	33.0	4-6-9	1.5				SW	Well graded sand, coarse grained, dark reddish brown 10R 3/4, wet, med. dense, w/fine gravel @ 32' 5" layer pg sand, fine, mod. yellowish brown, prev. material		
23	SS	33.0	34.5	8-9-12	1.5							
24	SS	34.5	36.0	13-16-12	1.5		35		SP SP	Poorly graded sand, fine grained, mod. yellowish brown 10YR 5/4, wet, med. dense, w/fine gravel, trace black silt		
25	SS	36.0	37.5	6-7-7	1.5				SP	Poorly graded sand, fine to med. grained, dusky red 5R 3/4, wet, med. dense, w/fine gravel, trace coarse gravel		
26	SS	37.5	39.0	5-8-12	1.5					Poorly graded sand, fine grained, mod. yellowish brown 10YR 5/4, wet, med. dense, w/fine gravel @ 36' trace coarse gavel @ 37.5' well graded SW		
27	SS	39.0	40.5	6-12-17	1.5		40			@ 40' poorly graded SP @ 41' trace fine gravel, no coarse gravel @ 42' dense @ 43.1' 1" seam black silt and fine gravel - possible coal		
28	SS	40.5	42.0	6-11-19	1.5							

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER **42393125-01**

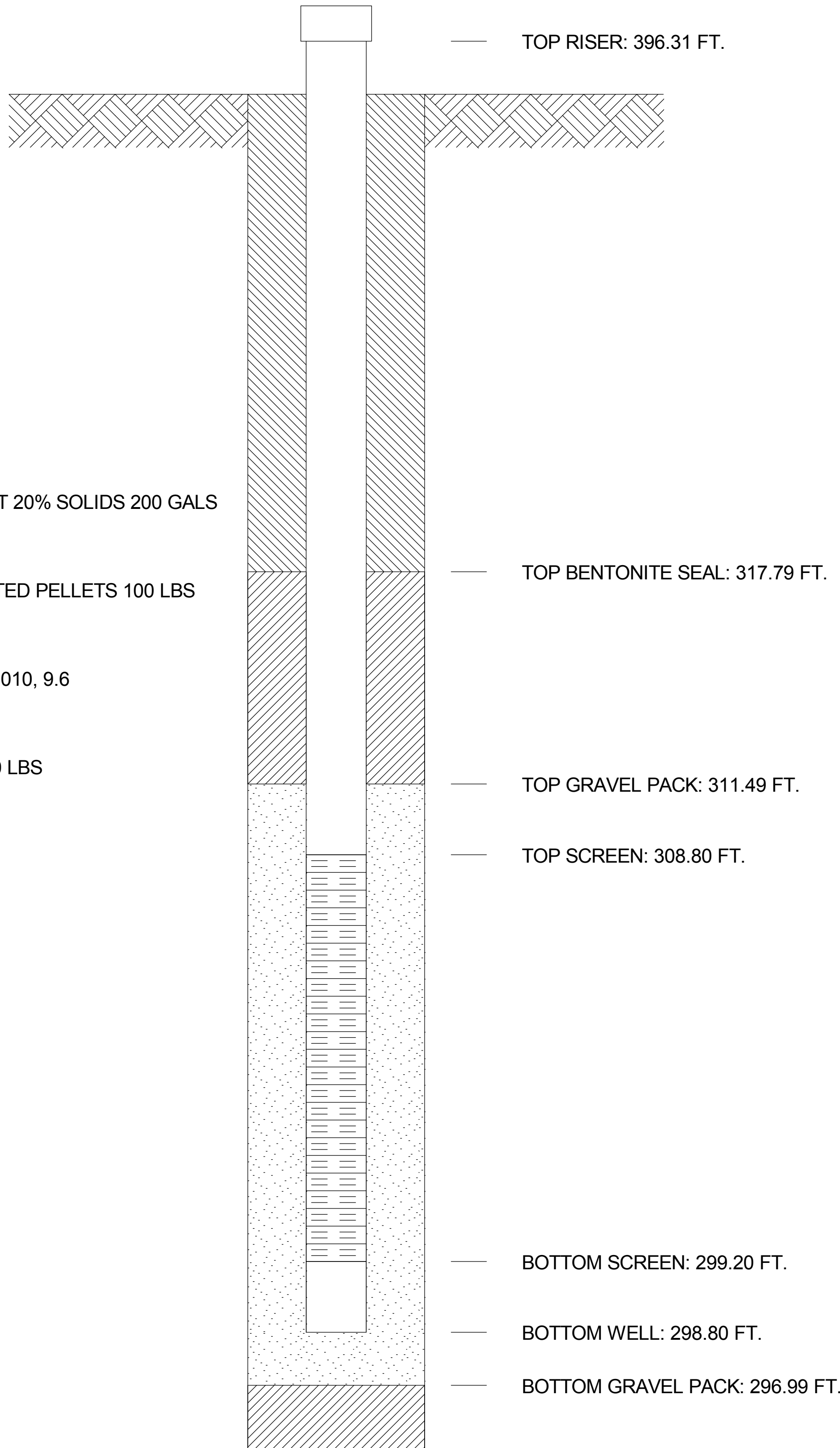
COMPANY **INDIANA MICHIGAN POWER COMPANY** WELL No. **MW-1600D** BORING No. **MW-1600D** INSTALLED **2/17/16**

PROJECT **ROCKPORT PLANT**

COORDINATES **N 154,306.3 E 512,449.0**

SYSTEM **State Plane using NAD27/29**

GROUND ELEVATION 393.79 FT.



GROUT SEAL: QUICK GROUT 20% SOLIDS 200 GALS

BENTONITE SEAL: 3/8" COATED PELLETS 100 LBS

SCREEN: 2.0 dia., SLOTTED .010, 9.6

GRAVEL PACK: #5 SAND 300 LBS

RISER PIPE: 2.0, dia., PVC

SPACERS, DEPTH:

GEOMCNST RK BAP CCR COMPLIANCE.GPJ AEP.GDT 4/27/16

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

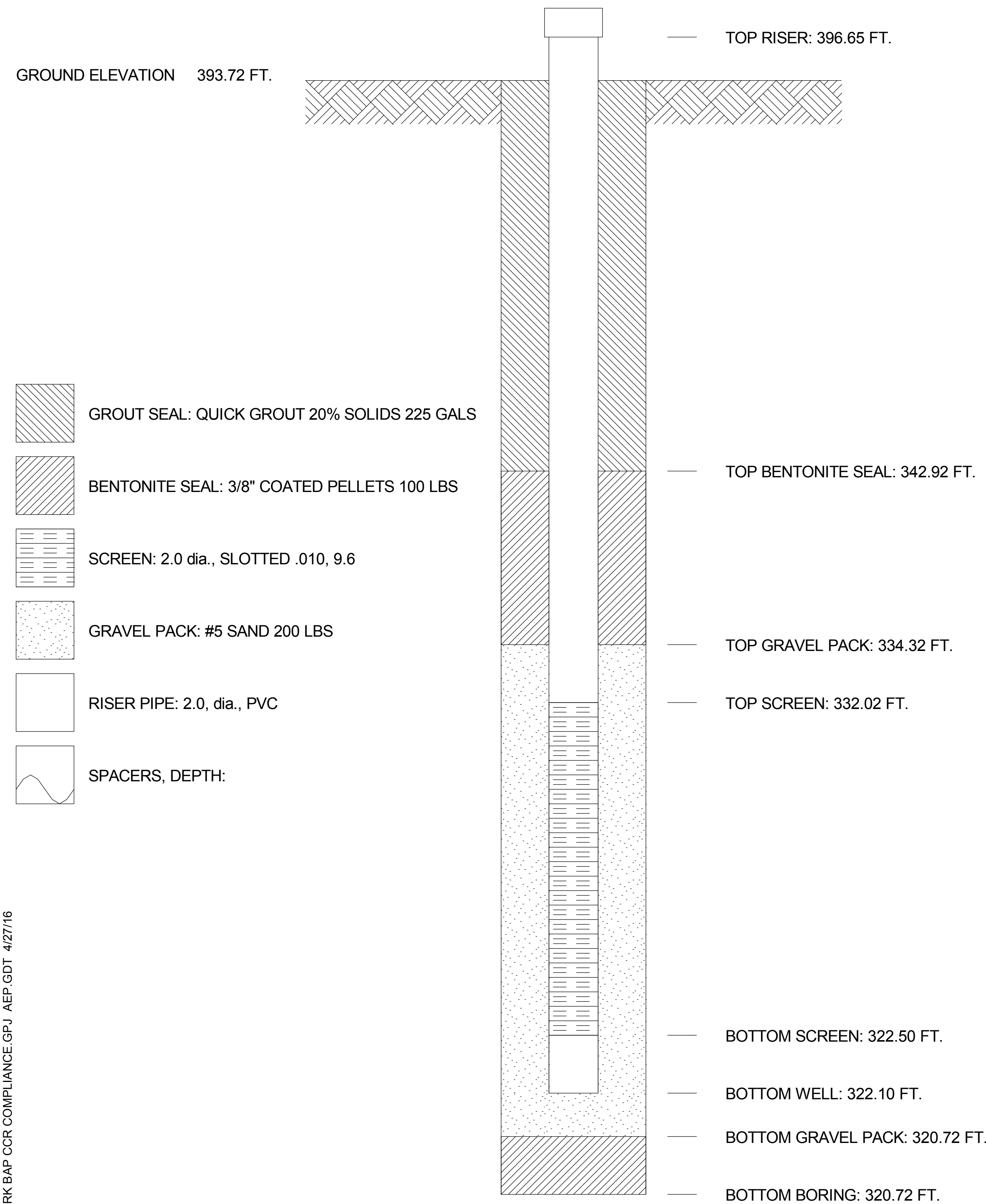
JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** WELL No. **MW-1600I** BORING No. **MW-1600I** INSTALLED **2/29/16**

PROJECT **ROCKPORT PLANT**

COORDINATES **N 154,306.0 E 512,454.0**

SYSTEM **State Plane using NAD27/29**



GEOMCNST RK BAP CCR COMPLIANCE.GPJ AEP.GDT 4/27/16

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER **42393125-01**

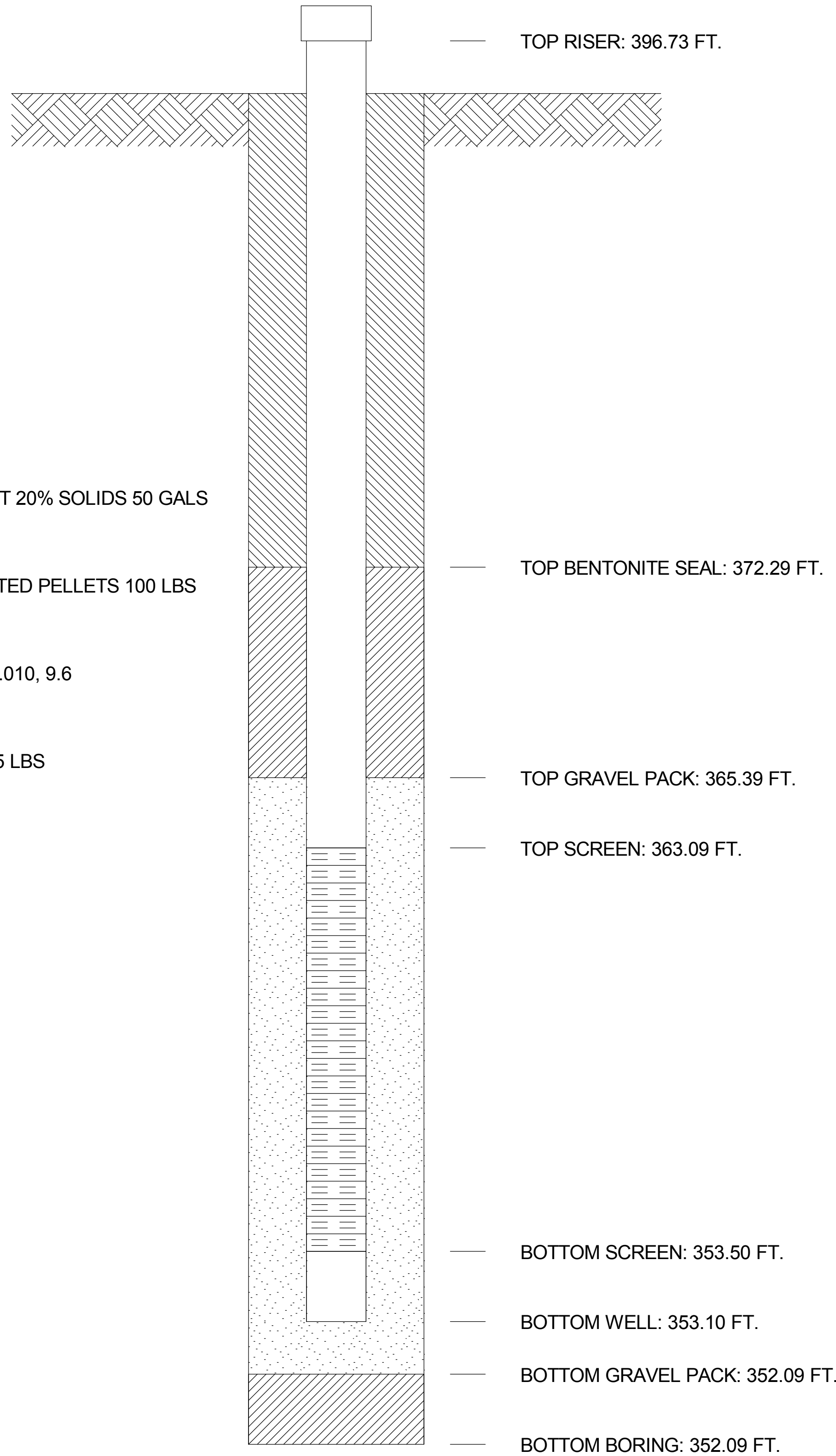
COMPANY **INDIANA MICHIGAN POWER COMPANY** WELL No. **MW-1600S** BORING No. **MW-1600S** INSTALLED **2/29/16**

PROJECT **ROCKPORT PLANT**

COORDINATES **N 154,305.9 E 512,458.0**

SYSTEM **State Plane using NAD27/29**

GROUND ELEVATION 393.69 FT.



GROUT SEAL: QUICK GROUT 20% SOLIDS 50 GALS

BENTONITE SEAL: 3/8" COATED PELLETS 100 LBS

SCREEN: 2.0 dia., SLOTTED .010, 9.6

GRAVEL PACK: #5 SAND 225 LBS

RISER PIPE: 2.0, dia., PVC

SPACERS, DEPTH:

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY | BORING NO. MW-1601D | DATE 4/27/16 | SHEET 1 OF 5

PROJECT ROCKPORT PLANT | BORING START 2/26/16 | BORING FINISH 2/26/16

COORDINATES N 154,323.2 E 513,487.5 | PIEZOMETER TYPE | WELL TYPE OW

GROUND ELEVATION 400.1 | SYSTEM State Plane using NAD27/29 | HGT. RISER ABOVE GROUND 2.75 | DIA 2.0

DEPTH TO TOP OF WELL SCREEN 100.0 BOTTOM 109.59

WELL DEVELOPMENT YES | BACKFILL

FIELD PARTY ZLR / REB | RIG D-120

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	4-5-8	1.5					Topsoil = 3 inches		
										Silty clay, l. brown 5YR 6/4 and l. grey N7 mottled, dry, stiff *FILL		
2	SS	1.5	3.0	3-8-15	1.5				SP	Poorly graded sand, fine grained, mod. yellowish brown 10YR 5/4, dry, med. dense @ 2' 2" layer - silty clay (prev. material) @ 4' some black silt		
3	SS	3.0	4.5	3-13-16	1.4							
4	SS	4.5	6.0	4-8-8	1.5		5		SP	Poorly graded sand, fine grained, d. yellowish brown 10YR 4/2, moist, med. dense, trace fine gravel @ 6' water in spoon, loose		
5	SS	6.0	7.5	2-3-4	1.5							
6	SS	7.5	9.0	2-3-5	1.5				SC	Clayey sand, fine grained, med. bluish gray 5B 5/1, moist, loose		
									SP	Poorly graded sand, fine grained, d. yellowish brown 10YR 4/2, moist, loose		
									SC	Clayey sand, fine grained, med. bluish grey SB 5/1, moist, loose		
									CH	Fat clay, l. grey N7, moist, firm		
7	SS	9.0	10.5	4-7-10	1.5				CH	Fat clay, l. grey N7 and poorly graded sand, fine grained d. yellowish brown 10YR 4/2, moist, med. dense, 50/50 mix		
8	SS	10.5	12.0	4-6-5	1.5		10		MH	Clayey silt, pale yellowish brown 10YR 6/2 and l. grey N7, moist, med. dense, mottled @ 12' loose @ 18.5' pale yellowish brown 10YR 6/2		
9	SS	12.0	13.5	3-5-5	1.5							
10	SS	13.5	15.0	3-4-6	1.5							
11	SS	15.0	16.5	3-4-4	1.5		15					
12	SS	16.5	18.0	3-5-5	1.5				SP	Poorly graded sand, v. fine grained greyish orange 10YR 7/4, moist, loose @ 20.7' trace black silt		
13	SS	18.0	19.5	4-4-5	1.5							
14	SS	19.5	21.0	3-4-4	1.5							

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER AMEC FOSTER WHEELER

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1601D** DATE **4/27/16** SHEET **2** OF **5**

PROJECT **ROCKPORT PLANT** BORING START **2/26/16** BORING FINISH **2/26/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	SAMPLE DEPTH IN FEET TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
15	SS	21.0	22.5	3-6-6	1.5				SP	Poorly graded sand, fine grained, pale yellowish brown 10YR 6/2 moist, med. dense		
16	SS	22.5	24.0	4-5-8	1.5				SP	Poorly graded sand, v. fine grained, greyish orange 10YR 7/4, moist, med. dense		
17	SS	24.0	25.5	3-7-10	1.5				SP	Poorly graded sand, fine grained, pale yellowish brown 10YR 6/2 moist to wet, med. dense @ 23.8' fine to med. grained, trace black silt @ 24' fine grained, no black, silt, trace fine gravel @ 26' coal fragment (2") (bl. silt) @ 29.1' 1" layer - lean clay, d. yellowish brown 10YR 4/2 @ 31' trace black silt		
18	SS	25.5	27.0	4-6-7	1.5		25					
19	SS	27.0	28.5	3-5-10	1.5							
20	SS	28.5	30.0	3-6-8	1.5							
21	SS	30.0	31.5	4-4-9	1.5		30					
22	SS	31.5	33.0	4-5-6	1.5							
23	SS	33.0	34.5	3-3-4	1.3				SW	Well graded sand, fine to med. grained, d. yellowish brown 10YR 4/2, wet, med. dense, trace fine gravel @ 33' loose @ 34.5' med. dense, w/fine gravel		
24	SS	34.5	36.0	6-6-7	1.3		35					
25	SS	36.0	37.5	4-4-5	1.2							
26	SS	37.5	39.0	5-6-12	1.4				SW	Well graded sand, coarse grained, dusky brown 5YR 2/2, wet, loose, w/fine gravel @ 37.5' med. dense @ 39' trace coarse gravel		
27	SS	39.0	40.5	11-10-12	1.5							
28	SS	40.5	42.0	6-11-15	1.5		40		SP	Poorly graded sand, fine gained, l. brown 5YR 5/6, wet, med. dense, trace fine gravel @ 40.5' w/fine gravel, trace coarse gravel @ 42' some fine gravel, no coarse gravel		
29	SS	42.0	43.5	6-10-10	1.3							
30	SS	43.5	45.0	6-11-12	1.5				SW	Well graded sand, coarse grained, dusky brown 5YR 2/2, wet, med. dense, w/fine gravel, trace coarse gravel (rounded) @ 46.5' coarse gravel, plug in spoon @ 48' some coarse gravel, dense		
31	SS	45.0	46.5	9-8-8	1.4		45					

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1601D** DATE **4/27/16** SHEET **3** OF **5**

PROJECT **ROCKPORT PLANT** BORING START **2/26/16** BORING FINISH **2/26/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
32	SS	46.5	48.0	10-9-16	.2							
33	SS	48.0	49.5	11-15-21	1.4							
34	SS	49.5	51.0	11-15-15	1.4		50		SP	Poorly graded sand, fine grained, mod. yellowish brown 10YR 5/4, wet, med. dense, w/fine gravel @ 50' 1" layer - coal (angular fragments)		
35	SS	51.0	52.5	9-15-19	1.5				SW	Well graded sand, med. to coarse grained, d. yellowish brown 10YR 4/2, wet, med. dense, w/fine gravel, trace coarse gravel @ 51' dense @ 51.5' 1" layer - coal (angular fragments)		
36	SS	52.5	54.0	8-13-16	1.4				SP	Poorly graded sand, fine grained, olive grey 5Y 4/1, wet, med. dense, w/fine gravel @ 53.3' 1.5" layer - coal (angular fragments)		
37	SS	54.0	55.5	8-9-11	1.3		55		SW	Well graded sand, med. to coarse grained, d. yellowish brown 10YR 4/2, wet, med. dense, w/fine gravel @ 55.5' trace coarse gravel @ 57' no coarse gravel @ 59.7' w/coal fragments, angular @ 60.3' no coal fragments, some fine gravel		
38	SS	55.5	57.0	9-14-16	1.4							
39	SS	57.0	58.5	7-10-10	1.3							
40	SS	58.5	60.0	6-7-13	1.5							
41	SS	60.0	61.5	9-13-14	1.5		60					
42	SS	61.5	63.0	6-8-11	1.5				SP	Poorly graded sand, med. grained, pale yellowish brown 10YR 6/2, wet, med. dense, trace fine gravel @ 64.5' fine to med. grained @ 67.5' dense @ 69' med. dense @ 70.5' dense @ 71' some coarse gravel @ 72' w/coarse gravel		
43	SS	63.0	64.5	5-9-12	1.4							
44	SS	64.5	66.0	8-9-12	1.4		65					
45	SS	66.0	67.5	5-9-17	1.5							
46	SS	67.5	69.0	7-15-23	1.4							
47	SS	69.0	70.5	6-9-14	1.3		70					
48	SS	70.5	72.0	8-19-21	1.4							

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JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1601D** DATE **4/27/16** SHEET **4** OF **5**

PROJECT **ROCKPORT PLANT** BORING START **2/26/16** BORING FINISH **2/26/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
49	SS	72.0	73.5	14-22-19	1.4						
50	SS	73.5	75.0	10-13-19	1.5		75				
51	SS	75.0	76.5	9-15-36	1.5						
52	SS	76.5	78.0	17-13-14	1.4			SP	Poorly graded sand, fine grained, yellowish brown 10YR 5/4, wet, med. dense, some fine gravel, trace coarse gravel @ 75' v. dense, trace fine gravel, no coarse gravel		
53	SS	78.0	79.5	9-18-18	1.2			SW	Well graded sand, coarse grained, d. yellowish brown 10YR 4/2, wet, med. dense, w/fine gravel, some coarse gravel @ 78' dense @ 80' 4" layer - coarse gravel @ 81' 3" layer - poorly graded sand, fine grained, mod. yellowish brown (prev. material) @ 81.9' w/coal fragments		
54	SS	79.5	81.0	13-11-12	1.4		80				
55	SS	81.0	82.5	6-8-14	1.5						
56	SS	82.5	84.0	7-6-16	1.5			CH	Fat clay, l. grey N7, wet, v. stiff (shale)		
								SP	Poorly graded sand, fine grained, mod. yellowish brown 10YR 5/4, wet, med. dense		
								CH	Fat clay, l. grey N7, wet, v. stiff		
57	SS	84.0	85.5	9-12-14	1.5			SP	Poorly graded sand, fine grained, l. grey N7, wet, med. dense		
								CH	Fat clay, l. grey N7, wet, v. stiff (shale)		
58	SS	85.5	87.0	4-9-9	1.5		85	SP	Poorly graded sand, fine grained, olive grey 5Y 4/1, wet, med. dense, some fat clay (l. grey, prev. material) @ 85.5' l. grey N7		
59	SS	87.0	88.5	7-14-18	1.5			CH	Fat clay, l. grey N7, wet, v. stiff		
60	SS	88.5	90.0	10-11-17	1.5			SW	Well graded sand, med. grained, med. l. grey N6, wet, dense, trace fine gravel @ 88.5' 3.5" layer - fat clay N7, prev. material @ 89' some fat clay N7, prev. material @ 90' 3.5" layer - fat clay N7, prev. material		
61	SS	90.0	91.5	7-10-13	1.5		90				
62	SS	91.5	93.0	9-13-16	1.4			SP	Poorly graded sand, fine to med. gained, med. d. grey N4, wet, med. dense @ 91.5' 1.5" layer - fat clay N7, prev. material @ 92' some fine gravel, trace black silt, trace fat clay (N7, prev. material) @ 93' w/fine gravel, trace coarse gravel, med. grained		
63	SS	93.0	94.5	8-8-9	1.4						
64	SS	94.5	96.0	10-15-17	1.4		95	SW	Well graded sand, med. grained, med. d. grey N4, wet, dense, w/fine gravel @ 96' med. to coarse gained, mod. dense @ 99' dense, trace coarse gravel @ 100.5' med. dense		
65	SS	96.0	97.5	10-11-12	1.2						
66	SS	97.5	99.0	9-13-14	1.5						

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY BORING NO. MW-1601D DATE 4/27/16 SHEET 5 OF 5

PROJECT ROCKPORT PLANT BORING START 2/26/16 BORING FINISH 2/26/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
67	SS	99.0	100.5	10-15-19	1.5		100					
68	SS	100.5	102.0	10-12-10	1.4				SP	Poorly graded sand, v. fine grained, brownish grey 5YR 4/1, wet, med. dense, some fine gravel @ 102' loose, no fine gravel, water in spoon @ 103.5 med. dense		
69	SS	102.0	103.5	7-2-6	1.5							
70	SS	103.5	105.0	5-5-9	1.5				MH	Clayey silt MH, l. grey N7, moist to wet, med. dense		
71	SS	105.0	106.5	5-6-13	1.5		105		SP	Poorly graded sand v. fine grained, med. l. grey N6, wet, med. dense		
72	SS	106.5	108.0	10-11-14	1.4				SP	Poorly graded sand, fine grained, mod. yellowish brown 10YR 5/4, wet, med. dense, trace fine gravel		
73	SS	108.0	109.5	7-8-9	1.5							
74	SS	109.5	111.0	4-4-10	1.5		110		SP	Poorly graded sand, v. fine grained, med. l. grey N6, wet, med. dense, trace fat clay (CH - l. grey, prev. material)		
									CH	Fat clay, l. grey N7, wet, stiff		
75	SS	111.0	112.5	7-9-20	1.5				SP	Poorly graded sand, v. fine grained, med. l. grey N6, wet, mod. dense		
									CH	Fat clay, l. grey N7, wet, v. stiff		
76	SS	112.5	114.0	50/3	0				SP	Poorly graded sand, v. fine grained, med. l. grey N6, wet, med. dense, w/fat clay (l. grey, prev. material) @ 112.5' no recovery - possible cobble or rock fragment @ 114' dense @ 114.5' 2" layer - fat clay (N7), prev. material @ 115' w/coarse gravel, shale fragments @ 115.2' 1" layer - coal fragments		
77	SS	114.0	115.5	12-13-20	1.1		115					
78	SS	115.5	117.0	50/5	.3					Shale, l. grey N7, dry, hard, some siltstone (olive grey - 5Y 4/1) @117' no siltstone		
79	SS	117.0	118.5	46-50/3	.5					Spoon refusal @ 117.7' Auger refusal @ 117.7 BT @ 117.7'		

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER	42393125-01		
COMPANY	INDIANA MICHIGAN POWER COMPANY	BORING NO. MW-1601I	DATE 4/27/16 SHEET 1 OF 4
PROJECT	ROCKPORT PLANT	BORING START 2/26/16	BORING FINISH 2/26/16
COORDINATES	N 154,325.3 E 513,483.5	PIEZOMETER TYPE	WELL TYPE OW
GROUND ELEVATION	400.0 SYSTEM State Plane using NAD27/29	HGT. RISER ABOVE GROUND 2.87	DIA 2.0
		DEPTH TO TOP OF WELL SCREEN 68.1	BOTTOM 77.6
		WELL DEVELOPMENT YES	BACKFILL
		FIELD PARTY ZLR / REB	RIG D-120

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %
1	SS	0.0	1.5	4-5-8	1.5	
2	SS	1.5	3.0	3-8-15	1.5	
3	SS	3.0	4.5	3-13-16	1.4	
4	SS	4.5	6.0	4-8-8	1.5	
5	SS	6.0	7.5	2-3-4	1.5	
6	SS	7.5	9.0	2-3-5	1.5	
7	SS	9.0	10.5	4-7-10	1.5	
8	SS	10.5	12.0	4-6-5	1.5	
9	SS	12.0	13.5	3-5-5	1.5	
10	SS	13.5	15.0	3-4-6	1.5	
11	SS	15.0	16.5	3-4-4	1.5	
12	SS	16.5	18.0	3-5-5	1.5	
13	SS	18.0	19.5	4-4-5	1.5	
14	SS	19.5	21.0	3-4-4	1.5	

DEPTH IN FEET: 5, 10, 15

U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
	Topsoil = 3 inches		
	Silty clay, l. brown 5YR 6/4 and l. grey N7 mottled, dry, stiff *FILL		
SP	Poorly graded sand, fine grained, mod. yellowish brown 10YR 5/4, dry, med. dense @ 2' 2" layer - silty clay (prev. material) @ 4' some black silt		
SP	Poorly graded sand, fine grained, d. yellowish brown 10YR 4/2, moist, med. dense, trace fine gravel @ 6' water in spoon, loose		
SC	Clayey sand, fine grained, med. bluish gray 5B 5/1, moist, loose		
SP	Poorly graded sand, fine grained, d. yellowish brown 10YR 4/2, moist, loose		
SC	Clayey sand, fine grained, med. bluish grey SB 5/1, moist, loose		
CH	Fat clay, l. grey N7, moist, firm		
CH	Fat clay, l. grey N7 and poorly graded sand, fine grained d. yellowish brown 10YR 4/2, moist, med. dense, 50/50 mix		
MH	Clayey silt, pale yellowish brown 10YR 6/2 and l. grey N7, moist, med. dense, mottled @ 12' loose @ 18.5' pale yellowish brown 10YR 6/2		
SP	Poorly graded sand, v. fine grained greyish orange 10YR 7/4, moist, loose @ 20.7' trace black silt		

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER AMEC FOSTER WHEELER

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1601I** DATE **4/27/16** SHEET **2** OF **4**

PROJECT **ROCKPORT PLANT** BORING START **2/26/16** BORING FINISH **2/26/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
15	SS	21.0	22.5	3-6-6	1.5				SP	Poorly graded sand, fine grained, pale yellowish brown 10YR 6/2 moist, med. dense		
16	SS	22.5	24.0	4-5-8	1.5				SP	Poorly graded sand, v. fine grained, greyish orange 10YR 7/4, moist, med. dense		
17	SS	24.0	25.5	3-7-10	1.5				SP	Poorly graded sand, fine grained, pale yellowish brown 10YR 6/2 moist to wet, med. dense @ 23.8' fine to med. grained, trace black silt @ 24' fine grained, no black, silt, trace fine gravel @ 26' coal fragment (2") (bl. silt) @ 29.1' 1" layer - lean clay, d. yellowish brown 10YR 4/2 @ 31' trace black silt		
18	SS	25.5	27.0	4-6-7	1.5		25					
19	SS	27.0	28.5	3-5-10	1.5							
20	SS	28.5	30.0	3-6-8	1.5							
21	SS	30.0	31.5	4-4-9	1.5		30					
22	SS	31.5	33.0	4-5-6	1.5				SW	Well graded sand, fine to med. grained, d. yellowish brown 10YR 4/2, wet, med. dense, trace fine gravel @ 33' loose @ 34.5' med. dense, w/fine gravel		
23	SS	33.0	34.5	3-3-4	1.3							
24	SS	34.5	36.0	6-6-7	1.3		35					
25	SS	36.0	37.5	4-4-5	1.2				SW	Well graded sand, coarse grained, dusky brown 5YR 2/2, wet, loose, w/fine gravel @ 37.5' med. dense @ 39' trace coarse gravel		
26	SS	37.5	39.0	5-6-12	1.4							
27	SS	39.0	40.5	11-10-12	1.5				SP	Poorly graded sand, fine gained, l. brown 5YR 5/6, wet, med. dense, trace fine gravel @ 40.5' w/fine gravel, trace coarse gravel @ 42' some fine gravel, no coarse gravel		
28	SS	40.5	42.0	6-11-15	1.5		40					
29	SS	42.0	43.5	6-10-10	1.3							
30	SS	43.5	45.0	6-11-12	1.5				SW	Well graded sand, coarse grained, dusky brown 5YR 2/2, wet, med. dense, w/fine gravel, trace coarse gravel (rounded) @ 46.5' coarse gravel, plug in spoon @ 48' some coarse gravel, dense		
31	SS	45.0	46.5	9-8-8	1.4		45					

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AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER 42393125-01
COMPANY INDIANA MICHIGAN POWER COMPANY BORING NO. MW-1601I DATE 4/27/16 SHEET 3 OF 4
PROJECT ROCKPORT PLANT BORING START 2/26/16 BORING FINISH 2/26/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
32	SS	46.5	48.0	10-9-16	.2							
33	SS	48.0	49.5	11-15-21	1.4							
34	SS	49.5	51.0	11-15-15	1.4		50		SP	Poorly graded sand, fine grained, mod. yellowish brown 10YR 5/4, wet, med. dense, w/fine gravel @ 50' 1" layer - coal (angular fragments)		
35	SS	51.0	52.5	9-15-19	1.5				SW	Well graded sand, med. to coarse grained, d. yellowish brown 10YR 4/2, wet, med. dense, w/fine gravel, trace coarse gravel @ 51' dense @ 51.5' 1" layer - coal (angular fragments)		
36	SS	52.5	54.0	8-13-16	1.4				SP	Poorly graded sand, fine grained, olive grey 5Y 4/1, wet, med. dense, w/fine gravel @ 53.3' 1.5" layer - coal (angular fragments)		
37	SS	54.0	55.5	8-9-11	1.3		55		SW	Well graded sand, med. to coarse grained, d. yellowish brown 10YR 4/2, wet, med. dense, w/fine gravel @ 55.5' trace coarse gravel @ 57' no coarse gravel @ 59.7' w/coal fragments, angular @ 60.3' no coal fragments, some fine gravel		
38	SS	55.5	57.0	9-14-16	1.4							
39	SS	57.0	58.5	7-10-10	1.3							
40	SS	58.5	60.0	6-7-13	1.5							
41	SS	60.0	61.5	9-13-14	1.5		60					
42	SS	61.5	63.0	6-8-11	1.5				SP	Poorly graded sand, med. grained, pale yellowish brown 10YR 6/2, wet, med. dense, trace fine gravel @ 64.5' fine to med. grained @ 67.5' dense @ 69' med. dense @ 70.5' dense @ 71' some coarse gravel @ 72' w/coarse gravel		
43	SS	63.0	64.5	5-9-12	1.4							
44	SS	64.5	66.0	8-9-12	1.4		65					
45	SS	66.0	67.5	5-9-17	1.5							
46	SS	67.5	69.0	7-15-23	1.4							
47	SS	69.0	70.5	6-9-14	1.3		70					
48	SS	70.5	72.0	8-19-21	1.4							

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY | BORING NO. MW-1601I | DATE 4/27/16 | SHEET 4 OF 4

PROJECT ROCKPORT PLANT | BORING START 2/26/16 | BORING FINISH 2/26/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
49	SS	72.0	73.5	14-22-19	1.4							
50	SS	73.5	75.0	10-13-19	1.5							
51	SS	75.0	76.5	9-15-36	1.5		75					
52	SS	76.5	78.0	17-13-14	1.4				SP	Poorly graded sand, fine grained, yellowish brown 10YR 5/4, wet, med. dense, some fine gravel, trace coarse gravel @ 75' v. dense, trace fine gravel, no coarse gravel		
53	SS	78.0	79.5	9-18-18	1.2				SW	Well graded sand, coarse grained, d. yellowish brown 10YR 4/2, wet, med. dense, w/fine gravel, some coarse gravel @ 78' dense @ 80' 4" layer - coarse gravel @ 81' 3" layer - poorly graded sand, fine grained, mod. yellowish brown (prev. material) @ 81.9' w/coal fragments		
54	SS	79.5	81.0	13-11-12	1.4							

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY	**INDIANA MICHIGAN POWER COMPANY**	BORING NO. **MW-1601S**	DATE **4/27/16** SHEET **1** OF **3**
PROJECT	**ROCKPORT PLANT**	BORING START **2/27/16**	BORING FINISH **2/27/16**
COORDINATES	**N 154,327.6 E 513,479.7**	PIEZOMETER TYPE	WELL TYPE **OW**
GROUND ELEVATION	**399.8** SYSTEM **State Plane using NAD27/29**	HGT. RISER ABOVE GROUND **2.88**	DIA **2.0**
		DEPTH TO TOP OF WELL SCREEN **36.9**	BOTTOM **46.47**
		WELL DEVELOPMENT **YES**	BACKFILL
		FIELD PARTY **ZLR / REB**	RIG **D-120**

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	4-5-8	1.5					Topsoil = 3 inches Silty clay, l. brown 5YR 6/4 and l. grey N7 mottled, dry, stiff *FILL		
2	SS	1.5	3.0	3-8-15	1.5				SP	Poorly graded sand, fine grained, mod. yellowish brown 10YR 5/4, dry, med. dense @ 2' 2" layer - silty clay (prev. material) @ 4' some black silt		
3	SS	3.0	4.5	3-13-16	1.4							
4	SS	4.5	6.0	4-8-8	1.5		5		SP	Poorly graded sand, fine grained, d. yellowish brown 10YR 4/2, moist, med. dense, trace fine gravel @ 6' water in spoon, loose		
5	SS	6.0	7.5	2-3-4	1.5							
6	SS	7.5	9.0	2-3-5	1.5				SC SP SC CH	Clayey sand, fine grained, med. bluish gray 5B 5/1, moist, loose Poorly graded sand, fine grained, d. yellowish brown 10YR 4/2, moist, loose		
7	SS	9.0	10.5	4-7-10	1.5		10		CH	Clayey sand, fine grained, med. bluish grey SB 5/1, moist, loose Fat clay, l. grey N7, moist, firm		
8	SS	10.5	12.0	4-6-5	1.5				MH	Fat clay, l. grey N7 and poorly graded sand, fine grained d. yellowish brown 10YR 4/2, moist, med. dense, 50/50 mix Clayey silt, pale yellowish brown 10YR 6/2 and l. grey N7, moist, med. dense, mottled @ 12' loose @ 18.5' pale yellowish brown 10YR 6/2		
9	SS	12.0	13.5	3-5-5	1.5							
10	SS	13.5	15.0	3-4-6	1.5							
11	SS	15.0	16.5	3-4-4	1.5		15					
12	SS	16.5	18.0	3-5-5	1.5				SP	Poorly graded sand, v. fine grained greyish orange 10YR 7/4, moist, loose @ 20.7' trace black silt		
13	SS	18.0	19.5	4-4-5	1.5							
14	SS	19.5	21.0	3-4-4	1.5							

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **AMEC FOSTER WHEELER**

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY BORING NO. MW-1601S DATE 4/27/16 SHEET 2 OF 3

PROJECT ROCKPORT PLANT BORING START 2/27/16 BORING FINISH 2/27/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
15	SS	21.0	22.5	3-6-6	1.5				SP	Poorly graded sand, fine grained, pale yellowish brown 10YR 6/2 moist, med. dense		
16	SS	22.5	24.0	4-5-8	1.5				SP	Poorly graded sand, v. fine grained, greyish orange 10YR 7/4, moist, med. dense		
17	SS	24.0	25.5	3-7-10	1.5		25		SP	Poorly graded sand, fine grained, pale yellowish brown 10YR 6/2 moist to wet, med. dense @ 23.8' fine to med. grained, trace black silt @ 24' fine grained, no black, silt, trace fine gravel @ 26' coal fragment (2") (bl. silt) @ 29.1' 1" layer - lean clay, d. yellowish brown 10YR 4/2 @ 31' trace black silt		
18	SS	25.5	27.0	4-6-7	1.5							
19	SS	27.0	28.5	3-5-10	1.5							
20	SS	28.5	30.0	3-6-8	1.5							
21	SS	30.0	31.5	4-4-9	1.5		30					
22	SS	31.5	33.0	4-5-6	1.5				SW	Well graded sand, fine to med. grained, d. yellowish brown 10YR 4/2, wet, med. dense, trace fine gravel @ 33' loose @ 34.5' med. dense, w/fine gravel		
23	SS	33.0	34.5	3-3-4	1.3							
24	SS	34.5	36.0	6-6-7	1.3		35					
25	SS	36.0	37.5	4-4-5	1.2				SW	Well graded sand, coarse grained, dusky brown 5YR 2/2, wet, loose, w/fine gravel @ 37.5' med. dense @ 39' trace coarse gravel		
26	SS	37.5	39.0	5-6-12	1.4							
27	SS	39.0	40.5	11-10-12	1.5				SP	Poorly graded sand, fine gained, l. brown 5YR 5/6, wet, med. dense, trace fine gravel @ 40.5' w/fine gravel, trace coarse gravel @ 42' some fine gravel, no coarse gravel		
28	SS	40.5	42.0	6-11-15	1.5		40					
29	SS	42.0	43.5	6-10-10	1.3							
30	SS	43.5	45.0	6-11-12	1.5				SW	Well graded sand, coarse grained, dusky brown 5YR 2/2, wet, med. dense, w/fine gravel, trace coarse gravel (rounded) @ 46.5' coarse gravel, plug in spoon @ 48' some coarse gravel, dense		
31	SS	45.0	46.5	9-8-8	1.4		45					

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY BORING NO. MW-1601S DATE 4/27/16 SHEET 3 OF 3

PROJECT ROCKPORT PLANT BORING START 2/27/16 BORING FINISH 2/27/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
32	SS	46.5	48.0	10-9-16	.2							

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER **42393125-01**

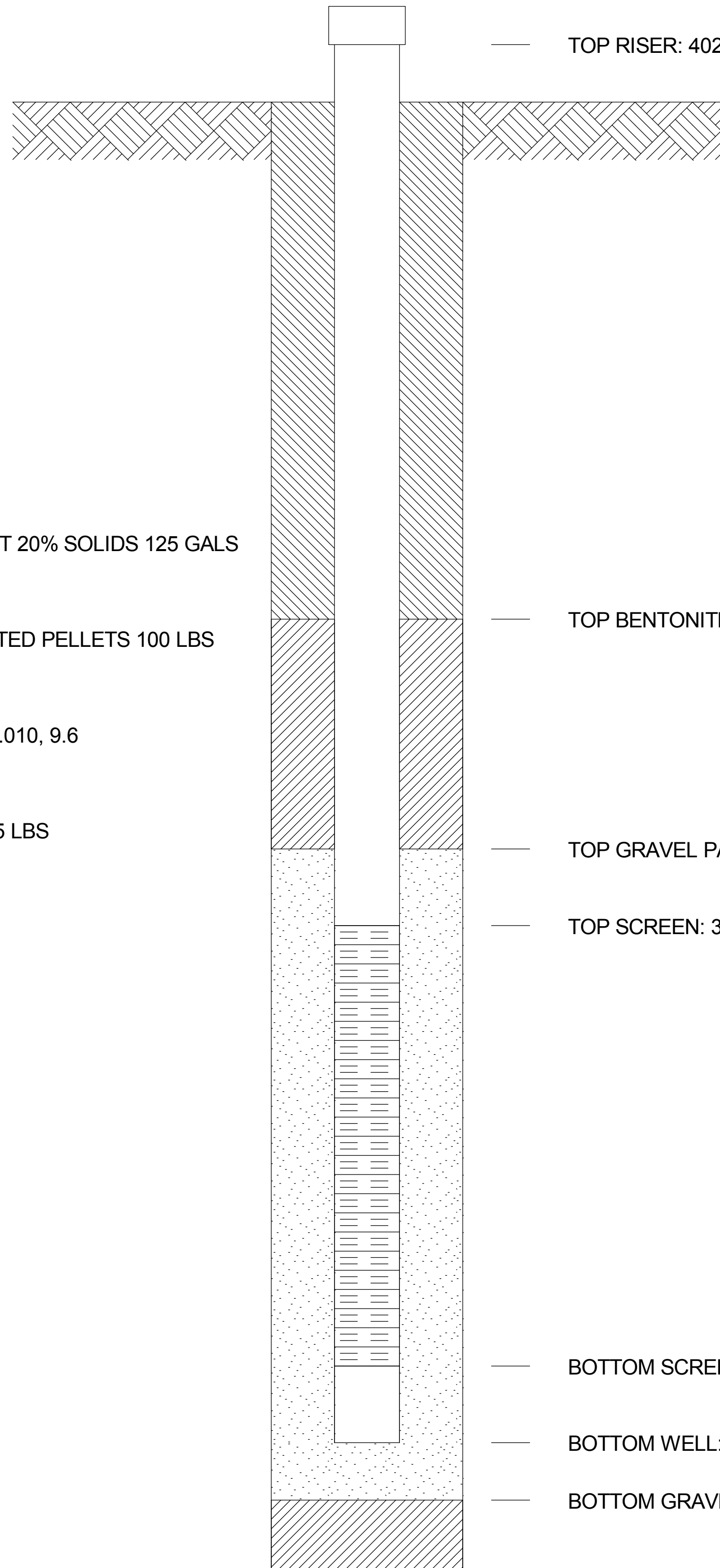
COMPANY **INDIANA MICHIGAN POWER COMPANY** WELL No. **MW-1601D** BORING No. **MW-1601D** INSTALLED **2/26/16**

PROJECT **ROCKPORT PLANT**

COORDINATES **N 154,323.2 E 513,487.5**

SYSTEM **State Plane using NAD27/29**

GROUND ELEVATION 400.09 FT.



TOP RISER: 402.84 FT.

TOP BENTONITE SEAL: 307.39 FT.

TOP GRAVEL PACK: 302.29 FT.

TOP SCREEN: 300.09 FT.

BOTTOM SCREEN: 290.50 FT.

BOTTOM WELL: 290.10 FT.

BOTTOM GRAVEL PACK: 282.39 FT.

BOTTOM BORING: 282.39 FT.

GROUT SEAL: QUICK GROUT 20% SOLIDS 125 GALS

BENTONITE SEAL: 3/8" COATED PELLETS 100 LBS

SCREEN: 2.0 dia., SLOTTED .010, 9.6

GRAVEL PACK: #5 SAND 475 LBS

RISER PIPE: 2.0, dia., PVC

SPACERS, DEPTH:

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER **42393125-01**

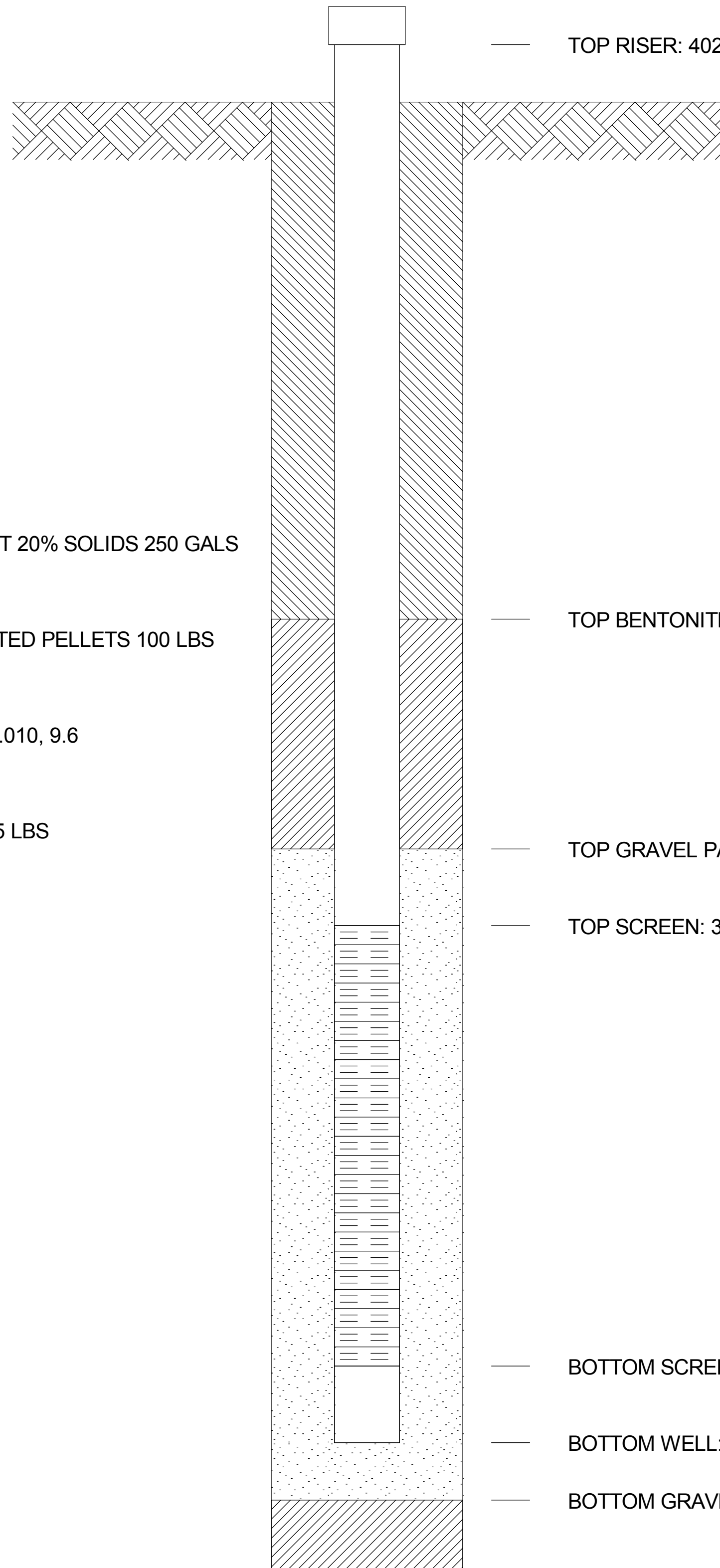
COMPANY **INDIANA MICHIGAN POWER COMPANY** WELL No. **MW-1601I** BORING No. **MW-1601I** INSTALLED **2/26/16**

PROJECT **ROCKPORT PLANT**

COORDINATES **N 154,325.3 E 513,483.5**

SYSTEM **State Plane using NAD27/29**

GROUND ELEVATION 399.96 FT.



TOP RISER: 402.83 FT.

TOP BENTONITE SEAL: 345.76 FT.

TOP GRAVEL PACK: 334.36 FT.

TOP SCREEN: 331.86 FT.

BOTTOM SCREEN: 322.36 FT.

BOTTOM WELL: 321.90 FT.

BOTTOM GRAVEL PACK: 320.16 FT.

BOTTOM BORING: 320.16 FT.

GROUT SEAL: QUICK GROUT 20% SOLIDS 250 GALS

BENTONITE SEAL: 3/8" COATED PELLETS 100 LBS

SCREEN: 2.0 dia., SLOTTED .010, 9.6

GRAVEL PACK: #5 SAND 175 LBS

RISER PIPE: 2.0, dia., PVC

SPACERS, DEPTH:

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
MONITORING WELL CONSTRUCTION

JOB NUMBER **42393125-01**

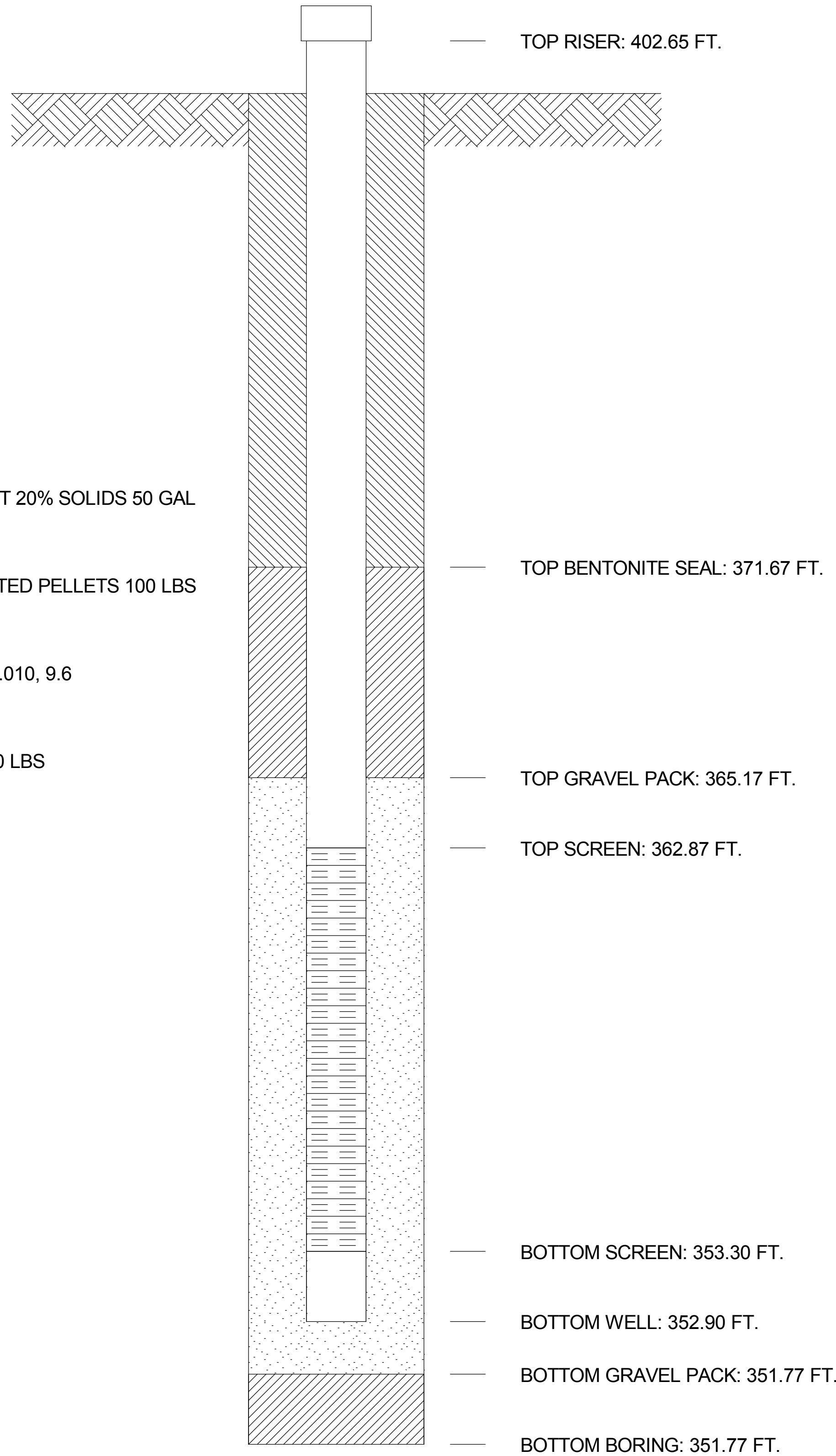
COMPANY **INDIANA MICHIGAN POWER COMPANY** WELL No. **MW-1601S** BORING No. **MW-1601S** INSTALLED **2/27/16**

PROJECT **ROCKPORT PLANT**

COORDINATES **N 154,327.6 E 513,479.7**

SYSTEM **State Plane using NAD27/29**

GROUND ELEVATION 399.77 FT.



GROUT SEAL: QUICK GROUT 20% SOLIDS 50 GAL

BENTONITE SEAL: 3/8" COATED PELLETS 100 LBS

SCREEN: 2.0 dia., SLOTTED .010, 9.6

GRAVEL PACK: #5 SAND 200 LBS

RISER PIPE: 2.0, dia., PVC

SPACERS, DEPTH:

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER 42393125-01

COMPANY	INDIANA MICHIGAN POWER COMPANY	BORING NO.	MW-1602D	DATE 4/27/16	SHEET 1 OF 6
PROJECT	ROCKPORT PLANT	BORING START	1/26/16	BORING FINISH	1/26/16
COORDINATES	N 152,300.2 E 514,229.4	PIEZOMETER TYPE		WELL TYPE	OW
GROUND ELEVATION	399.3 SYSTEM State Plane using NAD27/29	HGT. RISER ABOVE GROUND	2.63	DIA	2.0
		DEPTH TO TOP OF WELL SCREEN	114.3	BOTTOM	123.88
		WELL DEVELOPMENT	YES	BACKFILL	
		FIELD PARTY	ZLR / REB	RIG	D-120

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	3-2-5	1.5					Topsoil = 20 inches		
2	SS	1.5	3.0	6-9-9	1.25				CL	Silty lean clay, light brown 5YR 5/6 moderate brown 5YR 4/4 & medium light gray N5 fat clay seam, mottled, moist, v. stiff, trace organic *possible mud/grout/fill from nearby (~10') MW =>*FILL*		
3	SS	3.0	4.5	4-6-7	1.25					@ 3' stiff no organic, some moderate yellowish brown 10YR 5/4 silt		
4	SS	4.5	6.0	3-3-4	1.16		5					
5	SS	6.0	7.5	3-3-4	1.5				CH	Fat clay, medium light gray N6, moist to moist, firm *FILL* @ 6' w/lean clay, dark yellowish brown 10YR 4/2 mottled		
6	SS	7.5	9.0	2-2-3	1.5				CL	Silty lean clay, dark yellowish brown 10YR 4/2, moist, firm, some water in spoon *FILL*		
7	SS	9.0	10.5	4-5-6	1.5				CH	Fat clay, olive gray 5Y 4/1, dry to moist, firm *FILL*		
							10		CL	Silty lean clay, dark yellowish brown 10YR 4/2 with olive gray 5Y 4/1 fat clay mottled, moist, stiff, some moderate yellowish brown 10YR 5/4 silt, trace organic (wood, roots) *FILL*		
8	SS	10.5	12.0	5-6-9	1.5				CH	Fat clay, olive gray 5Y 4/1, dry to moist, stiff, trace organic *FILL*		
9	SS	12.0	13.5	2-5-8	1.41				CL	Silty lean clay, dark yellowish brown 10YR 4/2 with olive gray 5Y 4/1 fat clay heavily mottled, moist, stiff, some moderate yellowish brown 10YR 5/4 and dark reddish brown 10R 3/4 silty *FILL* @ 12' trace sandstone to 1/4" @ 13.5' no sandstone, trace black oxide		
10	SS	13.5	15.0	2-5-8	1.33							
11	SS	15.0	16.5	4-5-7	1.5		15		CL	Lean silty clay, dark yellowish brown 10YR 4/2, moist, stiff, trace moderate yellowish brown 10YR 5/4 silt, trace medium light gray N6 fat clay		
12	SS	16.5	18.0	3-3-5	1.5				ML	Clayey silt, dark yellowish brown 10YR 4/2, moist, loose @ 18.5' .5" sand seam		
13	SS	18.0	19.5	4-3-5	1.5							
14	SS	19.5	21.0	3-3-4	1.5				SP	Very fine grained sand, moderate yellowish brown		

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER AMEC FOSTER WHEELER

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1602D** DATE **4/27/16** SHEET **2** OF **6**

PROJECT **ROCKPORT PLANT** BORING START **1/26/16** BORING FINISH **1/26/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	SAMPLE DEPTH IN FEET TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
15	SS	21.0	22.5	2-2-3	1.5					10YR 5/4 to dark yellowish brown 10YR 4/2, moist, loose, poorly graded @ 19.8' clay, silt seam (prev. material) 4.5" @ 21.2' clayey silt seam (prev. material) 3" @ 22' fat clay seam, medium light gray N6 and dark yellowish orange 10YR 6/6 mottled, 2" @ 22.8' clay silt seam (prev. material) 8"		
16	SS	22.5	24.0	2-3-3	1.41							
17	SS	24.0	25.5	4-6-11	.91				SP	Med. grained sand, dark yellowish brown 10YR 4/2 to moderate yellowish brown 10YR 5/4, moist, med. dense @ 25.1' 25.3' fine grained sand seam (prev. material) .5" @ 27' loose @ 28.9' clayey silt seam (prev. material) 2.5" @ 29.7' coarse sand seam dark reddish brown 10R 3/4 w/black oxide, 2"		
18	SS	25.5	27.0	5-5-8	.83		25					
19	SS	27.0	28.5	3-5-5	1.0							
20	SS	28.5	30.0	2-4-5	1.25							
21	SS	30.0	31.5	4-5-7	1.08		30		SP	Coarse sand, dark reddish brown 10R 3/4, moist, med. dense		
22	SS	31.5	33.0	2-2-3	1.33				SP SP	Med. grain to coarse sand, dark yellowish brown 10YR 4/2, moist, med. dense, w/gravel to 1/4" Fine to med. grained sand, grayish brown 5YR 3/2, moist, med. dense, poorly graded @ 31.5' loose @ 33' moist to wet, water in spoon @ 34.5' v. loose @ 35.5' 6" silty clay seam ~50% medium light gray N6 @ 36' loose @ 37.5' trace gravel to 1/4"		
23	SS	33.0	34.5	1-2-3	1.33							
24	SS	34.5	36.0	3-1-3	.83		35					
25	SS	36.0	37.5	2-4-5	.91							
26	SS	37.5	39.0	7-4-4	.41							
27	SS	39.0	40.5	3-5-11	.83							
28	SS	40.5	42.0	6-7-9	.91		40		SP	Very fine grain to fine grained sand, dark yellowish brown 10YR 4/2, moist to wet, med. dense, poorly graded, trace gravel to 1/4", some black, @ 42' fine to med. grained		
29	SS	42.0	43.5	3-6-9	.75							
30	SS	43.5	45.0	3-6-8	.66				SW	Coarse sand, dark yellowish brown 10YR 4/2, moist to wet, med. dense, well graded, with gravel to 1/4", trace black silt @ 4' moderate brown 5YR 3/4 to grayish brown 5YR 3/2		
31	SS	45.0	46.5	11-9-13	1.08		45					

Continued Next Page

JOB NUMBER 42393125-01

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1602D** DATE **4/27/16**

PROJECT **ROCKPORT PLANT** BORING START **1/26/16** BORING FINISH **1/26/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
32	SS	46.5	48.0	5-11-13	1.0					@ 47.6' coal fragments (2")		
33	SS	48.0	49.5	11-12-13	1.0				SP	Fine to med. grain sand, grayish brown 5YR 3/2, moist to wet, med. dense, some gravel to 1/4"		
34	SS	49.5	51.0	5-5-8	1.16		50		SW	Coarse sand, grayish brown 5YR 3/2, moist to wet, med. dense, well graded with gravel to 1/4" @ 51.3' 2" coal seam @ 51.8' 3" med. grain sand seam, moderate brown 5YR 4/4, w/gravel to 1/4"		
35	SS	51.0	52.5	5-5-7	1.16							
36	SS	52.5	54.0	5-7-11	.75				SP	Fine to med. grain sand, grayish brown 5YR 3/2, moist to wet, med. dense, poorly graded, trace gravel to 1/4"		
									SW	Coarse sand, grayish brown 5YR 3/2, moist to wet, well graded, with gravel med. dense to 1/4" @ 54.5' 2" sandstone plug		
37	SS	54.0	55.5	9-8-11	.50		55					
38	SS	55.5	57.0	5-12-16	1.41				SP	Fine grained sand, grayish brown 5YR 3/2, moist to wet, med. dense, poorly graded @ 56' 1.5" coal seam @ 57' med. grained, with gravel (riverstone) to 1/4", well graded		
39	SS	57.0	58.5	10-14-14	1.08							
40	SS	58.5	60.0	6-10-17	1.25		60					
41	SS	60.0	61.5	10-13-16	1.16				SW	Coarse sand, grayish brown 5YR 3/2, wet, med. dense, well graded w/well rounded, fine to coarse gravel to 1"		
42	SS	61.5	63.0	7-11-20	1.25							
43	SS	63.0	64.5	7-13-15	1.25				SP	Med. grained sand, grayish brown 5YR 3/2, moist to wet, med. dense, poorly graded, trace gravel to 1/4" @ 64.5' fine grained @ 67.1' 1/5" coal fragments @ 67.5' dense, w/well rounded fine gravel @ 69' med. dense, well rounded fine gravel @ 70.5' dense @ 72' med. dense @ 73.5' dense @ 74.5' w/well rounded fine gravel @ 75' w/well rounded fine gravel @ 76.5 w/well rounded fine to coarse gravel @ 79.3' 2" shale fragment		
44	SS	64.5	66.0	6-10-14	1.33		65					
45	SS	66.0	67.5	8-10-13	1.16							
46	SS	67.5	69.0	10-19-22	1.25							
47	SS	69.0	70.5	9-10-12	1.08		70					
48	SS	70.5	72.0	10-15-18	1.16							

Continued Next Page

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY | BORING NO. MW-1602D | DATE 4/27/16 | SHEET 4 OF 6

PROJECT ROCKPORT PLANT | BORING START 1/26/16 | BORING FINISH 1/26/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	USCS
49	SS	72.0	73.5	8-10-12	1.16			
50	SS	73.5	75.0	7-15-19	1.1			
51	SS	75.0	76.5	12-18-21	1.33		75	
52	SS	76.5	78.0	8-16-29	1.41			
53	SS	78.0	79.5	27-18-15	1..5			
54	SS	79.5	81.0	11-16-26	1.5		80	CL, SP
55	SS	81.0	82.5	9-18-23	1.41			
56	SS	82.5	84.0	8-14-14	1.16			
57	SS	84.0	85.5	10-13-18	1.5		85	CH
58	SS	85.5	87.0	15-14-20	1.5			SP, CH, SW
59	SS	87.0	88.5	10-12-12	1.08			
60	SS	88.5	90.0	15-13-24	1.33		90	
61	SS	90.0	91.5	15-17-21	1.75			SP, SW
62	SS	91.5	93.0	11-17-20	1.08			
63	SS	93.0	94.5	8-11-16	1.33			SP
64	SS	94.5	96.0	1-11-17	1.41		95	
65	SS	96.0	97.5	7-10-18	1.41			
66	SS	97.5	99.0	6-11-13	1.16			SW

SOIL / ROCK IDENTIFICATION:

CL — Silty clay, olive gray 5Y 3/2, wet, stiff (N values from shale)

SP — Fine grained sand, olive gray 5Y 3/2, wet, dense, poorly graded
@ 81' silty clay seam (prev. material)

CH — Silty fat clay, brownish gray 5YR 4/1, wet, stiff

SP — Med. grained sand, moderate yellowish brown 10YR 5/4, wet, dense, trace well rounded fine gravel
@ 85.2' 1" coal fragments

CH — Silty fat clay, moderate yellowish brown 10YR 5/4, wet, v. stiff

SW — Coarse sand, moderate yellowish brown 10YR 5/4, moist, dense, well graded, w/well rounded fine to coarse gravel to 1"
@ 87' med. dense
@ 88.5' clay plug (prev. material), 3"

SP — Med. grained sand, moderate yellowish brown 10YR 5/4, moist, dense, well rounded fine gravel

SW — Coarse sand, moderate yellowish brown 10YR 5/4, moist to wet, dense, well graded, w/gravel to 1.25'

SP — Med. grained sand, moderate yellowish brown 10YR 5/4, moist to wet, med. dense, trace fine gravel
@ 95.5' mostly brown
@ 96.3' .5" coal seam

SW — Coarse sand, moderate yellowish brown 10YR 5/4 to moderate brown 5YR 4/4, moist, med. dense,

WELL:

DRILLER'S NOTES:

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1602D** DATE **4/27/16** SHEET **5** OF **6**

PROJECT **ROCKPORT PLANT** BORING START **1/26/16** BORING FINISH **1/26/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										well graded, w/fine to coarse gravel @ 100.3' shale fragment 2"		
67	SS	99.0	100.5	8-13-21	1.25		100					
68	SS	100.5	102.0	6-6-13	1.5				SP	V. fine to fine sand, grayish brown 5YR 3/2, moist to wet, med. dense, poorly graded @ 102.2' 3" coarse sand seam (prev. material)		
69	SS	102.0	103.5	6-8-17	1.5							
70	SS	103.5	105.0	10-12-15	1.25				SP	Fine to med. grained sand, grayish brown 5YR 3/2, moist to wet, med. dense, trace fine gravel @ 105' no gravel @ 106.5' dense @ 107.7' 1" shale fragment @ 109' 3" shale fragment @110.8' trace shale @ 111' no shale		
71	SS	105.0	106.5	8-11-19	1.41		105					
72	SS	106.5	108.0	8-12-20	1.33							
73	SS	108.0	109.5	13-21-17	1.33							
74	SS	109.5	111.0	8-16-31	1.5		110					
75	SS	111.0	112.5	12-20-31	1.41							
76	SS	112.5	114.0	17-27-28	1.41				SW	Coarse sand, grayish brown 5YR 3/2, moist to wet, v. dense, w/fine to coarse gravel (~50%), well graded @ 114.1' 1.5" clay seam (prev. material, gray fat)		
77	SS	114.0	115.5	12-26-22	1.5		115		SW	Fine grained sand, grayish brown 5YR 3/2, wet, dense, well graded, w/gravel to 1.75"		
78	SS	115.5	117.0	8-7-7	1.41				SW	Coarse sand, grayish brown 5YR 3/2, moist, med. dense, well graded w/fine gravel (~50%), some black silt		
79	SS	117.0	118.5	13-12-15	1.25							
80	SS	118.5	120.0	8-9-14	1.25		120					
81	SS	120.0	121.5	11-11-21	1.33				SP	Med. grained sand, grayish brown 5YR 3/2, moist to wet, dense, some gravel to 1/4" @ 122.8' gravel plug, 1.5" v. dense @ 123' w/gravel to 1.75" (~50%)		
82	SS	121.5	123.0	12-21-43	1.25							
83	SS	123.0	124.5	32-50/5	.91							

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY | BORING NO. MW-1602D | DATE 4/27/16 | SHEET 6 OF 6

PROJECT ROCKPORT PLANT | BORING START 1/26/16 | BORING FINISH 1/26/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
84	SS	124.5	126.0	50/5	.41		125			Shale, olive gray 5Y 4/1, moist, hard Spoon refusal @ 125' Auger refusal @ 125' TOR 124.6' Boring terminated @ 125'		

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY
PROJECT ROCKPORT PLANT
COORDINATES N 152,295.0 E 514,229.2
GROUND ELEVATION 399.4 SYSTEM State Plane using NAD27/29

BORING NO. MW-1602I DATE 4/27/16 SHEET 1 OF 4
BORING START 2/9/16 BORING FINISH 2/9/16
PIEZOMETER TYPE WELL TYPE OW
HGT. RISER ABOVE GROUND 2.65 DIA 2.0
DEPTH TO TOP OF WELL SCREEN 67.8 BOTTOM 77.38
WELL DEVELOPMENT YES BACKFILL
FIELD PARTY ZLR / REB RIG D-120

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	3-2-5	1.5					Topsoil = 20 inches		
2	SS	1.5	3.0	6-9-9	1.25				CL	Silty lean clay, light brown 5YR 5/6 moderate brown 5YR 4/4 & medium light gray N5 fat clay seam, mottled, moist, v. stiff, trace organic *possible mud/grout/fill from nearby (~10') MW =>*FILL* @ 3' stiff no organic, some moderate yellowish brown 10YR 5/4 silt		
3	SS	3.0	4.5	4-6-7	1.25							
4	SS	4.5	6.0	3-3-4	1.16		5					
5	SS	6.0	7.5	3-3-4	1.5				CH	Fat clay, medium light gray N6, moist to moist, firm *FILL* @ 6' w/lean clay, dark yellowish brown 10YR 4/2 mottled		
6	SS	7.5	9.0	2-2-3	1.5				CL	Silty lean clay, dark yellowish brown 10YR 4/2, moist, firm, some water in spoon *FILL*		
									CH	Fat clay, olive gray 5Y 4/1, dry to moist, firm *FILL*		
7	SS	9.0	10.5	4-5-6	1.5				CL	Silty lean clay, dark yellowish brown 10YR 4/2 with olive gray 5Y 4/1 fat clay mottled, moist, stiff, some moderate yellowish brown 10YR 5/4 silt, trace organic (wood, roots) *FILL*		
8	SS	10.5	12.0	5-6-9	1.5		10		CH	Fat clay, olive gray 5Y 4/1, dry to moist, stiff, trace organic *FILL*		
9	SS	12.0	13.5	2-5-8	1.41				CL	Silty lean clay, dark yellowish brown 10YR 4/2 with olive gray 5Y 4/1 fat clay heavily mottled, moist, stiff, some moderate yellowish brown 10YR 5/4 and dark reddish brown 10R 3/4 silty *FILL* @ 12' trace sandstone to 1/4" @ 13.5' no sandstone, trace black oxide		
10	SS	13.5	15.0	2-5-8	1.33							
11	SS	15.0	16.5	4-5-7	1.5		15		CL	Lean silty clay, dark yellowish brown 10YR 4/2, moist, stiff, trace moderate yellowish brown 10YR 5/4 silt, trace medium light gray N6 fat clay		
12	SS	16.5	18.0	3-3-5	1.5				ML	Clayey silt, dark yellowish brown 10YR 4/2, moist, loose @ 18.5' .5" sand seam		
13	SS	18.0	19.5	4-3-5	1.5							
14	SS	19.5	21.0	3-3-4	1.5				SP	Very fine grained sand, moderate yellowish brown		

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER AMEC FOSTER WHEELER

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY BORING NO. MW-1602I DATE 4/27/16 SHEET 2 OF 4

PROJECT ROCKPORT PLANT BORING START 2/9/16 BORING FINISH 2/9/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
15	SS	21.0	22.5	2-2-3	1.5					10YR 5/4 to dark yellowish brown 10YR 4/2, moist, loose, poorly graded @ 19.8' clay, silt seam (prev. material) 4.5" @ 21.2' clayey silt seam (prev. material) 3" @ 22' fat clay seam, medium light gray N6 and dark yellowish orange 10YR 6/6 mottled, 2" @ 22.8' clay silt seam (prev. material) 8"		
16	SS	22.5	24.0	2-3-3	1.41							
17	SS	24.0	25.5	4-6-11	.91				SP	Med. grained sand, dark yellowish brown 10YR 4/2 to moderate yellowish brown 10YR 5/4, moist, med. dense @ 25.1' 25.3' fine grained sand seam (prev. material) .5" @ 27' loose @ 28.9' clayey silt seam (prev. material) 2.5" @ 29.7' coarse sand seam dark reddish brown 10R 3/4 w/black oxide, 2"		
18	SS	25.5	27.0	5-5-8	.83		25					
19	SS	27.0	28.5	3-5-5	1.0							
20	SS	28.5	30.0	2-4-5	1.25							
21	SS	30.0	31.5	4-5-7	1.08		30		SP	Coarse sand, dark reddish brown 10R 3/4, moist, med. dense		
									SP	Med. grain to coarse sand, dark yellowish brown 10YR 4/2, moist, med. dense, w/gravel to 1/4"		
22	SS	31.5	33.0	2-2-3	1.33				SP	Fine to med. grained sand, grayish brown 5YR 3/2, moist, med. dense, poorly graded @ 31.5' loose @ 33' moist to wet, water in spoon @ 34.5' v. loose @ 35.5' 6" silty clay seam ~50% medium light gray N6 @ 36' loose @ 37.5' trace gravel to 1/4"		
23	SS	33.0	34.5	1-2-3	1.33							
24	SS	34.5	36.0	3-1-3	.83		35					
25	SS	36.0	37.5	2-4-5	.91							
26	SS	37.5	39.0	7-4-4	.41							Began Mud Rotary @ 37.5'
27	SS	39.0	40.5	3-5-11	.83							
28	SS	40.5	42.0	6-7-9	.91		40		SP	Very fine grain to fine grained sand, dark yellowish brown 10YR 4/2, moist to wet, med. dense, poorly graded, trace gravel to 1/4", some black, @ 42' fine to med. grained		
29	SS	42.0	43.5	3-6-9	.75							
30	SS	43.5	45.0	3-6-8	.66				SW	Coarse sand, dark yellowish brown 10YR 4/2, moist to wet, med. dense, well graded, with gravel to 1/4", trace black silt @ 4' moderate brown 5YR 3/4 to grayish brown 5YR 3/2		
31	SS	45.0	46.5	11-9-13	1.08		45					

Continued Next Page

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY BORING NO. MW-1602I DATE 4/27/16 SHEET 3 OF 4

PROJECT ROCKPORT PLANT BORING START 2/9/16 BORING FINISH 2/9/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	SAMPLE DEPTH IN FEET TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
32	SS	46.5	48.0	5-11-13	1.0				@ 47.6' coal fragments (2")		
33	SS	48.0	49.5	11-12-13	1.0			SP	Fine to med. grain sand, grayish brown 5YR 3/2, moist to wet, med. dense, some gravel to 1/4"		
34	SS	49.5	51.0	5-5-8	1.16		50	SW	Coarse sand, grayish brown 5YR 3/2, moist to wet, med. dense, well graded with gravel to 1/4" @ 51.3' 2" coal seam @ 51.8' 3" med. grain sand seam, moderate brown 5YR 4/4, w/gravel to 1/4"		
35	SS	51.0	52.5	5-5-7	1.16						
36	SS	52.5	54.0	5-7-11	.75			SP SW	Fine to med. grain sand, grayish brown 5YR 3/2, moist to wet, med. dense, poorly graded, trace gravel to 1/4"		
37	SS	54.0	55.5	9-8-11	.50		55		Coarse sand, grayish brown 5YR 3/2, moist to wet, well graded, with gravel med. dense to 1/4" @ 54.5' 2" sandstone plug		
38	SS	55.5	57.0	5-12-16	1.41			SP	Fine grained sand, grayish brown 5YR 3/2, moist to wet, med. dense, poorly graded @ 56' 1.5" coal seam @ 57' med. grained, with gravel (riverstone) to 1/4", well graded		
39	SS	57.0	58.5	10-14-14	1.08						
40	SS	58.5	60.0	6-10-17	1.25		60				
41	SS	60.0	61.5	10-13-16	1.16			SW	Coarse sand, grayish brown 5YR 3/2, wet, med. dense, well graded w/well rounded, fine to coarse gravel to 1"		
42	SS	61.5	63.0	7-11-20	1.25						
43	SS	63.0	64.5	7-13-15	1.25			SP	Med. grained sand, grayish brown 5YR 3/2, moist to wet, med. dense, poorly graded, trace gravel to 1/4" @ 64.5' fine grained @ 67.1' 1/5" coal fragments @ 67.5' dense, w/well rounded fine gravel @ 69' med. dense, well rounded fine gravel @ 70.5' dense @ 72' med. dense @ 73.5' dense @ 74.5' w/well rounded fine gravel @ 75' w/well rounded fine gravel @ 76.5 w/well rounded fine to coarse gravel @ 79.3' 2" shale fragment		
44	SS	64.5	66.0	6-10-14	1.33		65				
45	SS	66.0	67.5	8-10-13	1.16						
46	SS	67.5	69.0	10-19-22	1.25						
47	SS	69.0	70.5	9-10-12	1.08		70				
48	SS	70.5	72.0	10-15-18	1.16						

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1602I** DATE **4/27/16** SHEET **4** OF **4**

PROJECT **ROCKPORT PLANT** BORING START **2/9/16** BORING FINISH **2/9/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
49	SS	72.0	73.5	8-10-12	1.16							
50	SS	73.5	75.0	7-15-19	1.1							
51	SS	75.0	76.5	12-18-21	1.33		75					
52	SS	76.5	78.0	8-16-29	1.41							
53	SS	78.0	79.5	27-18-15	1..5							

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

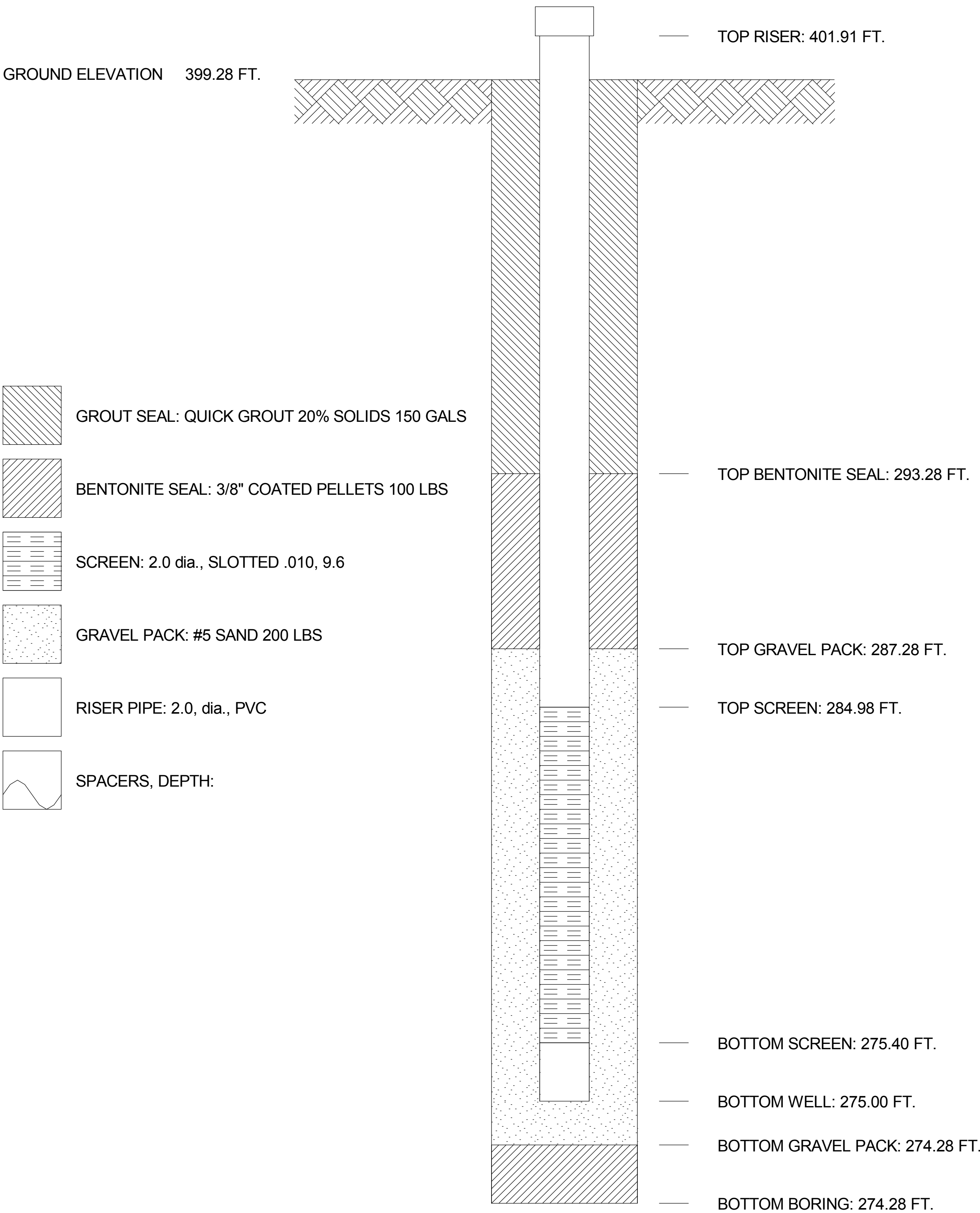
JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** WELL No. **MW-1602D** BORING No. **MW-1602D** INSTALLED **1/26/16**

PROJECT **ROCKPORT PLANT**

COORDINATES **N 152,300.2 E 514,229.4**

SYSTEM **State Plane using NAD27/29**



AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER **42393125-01**

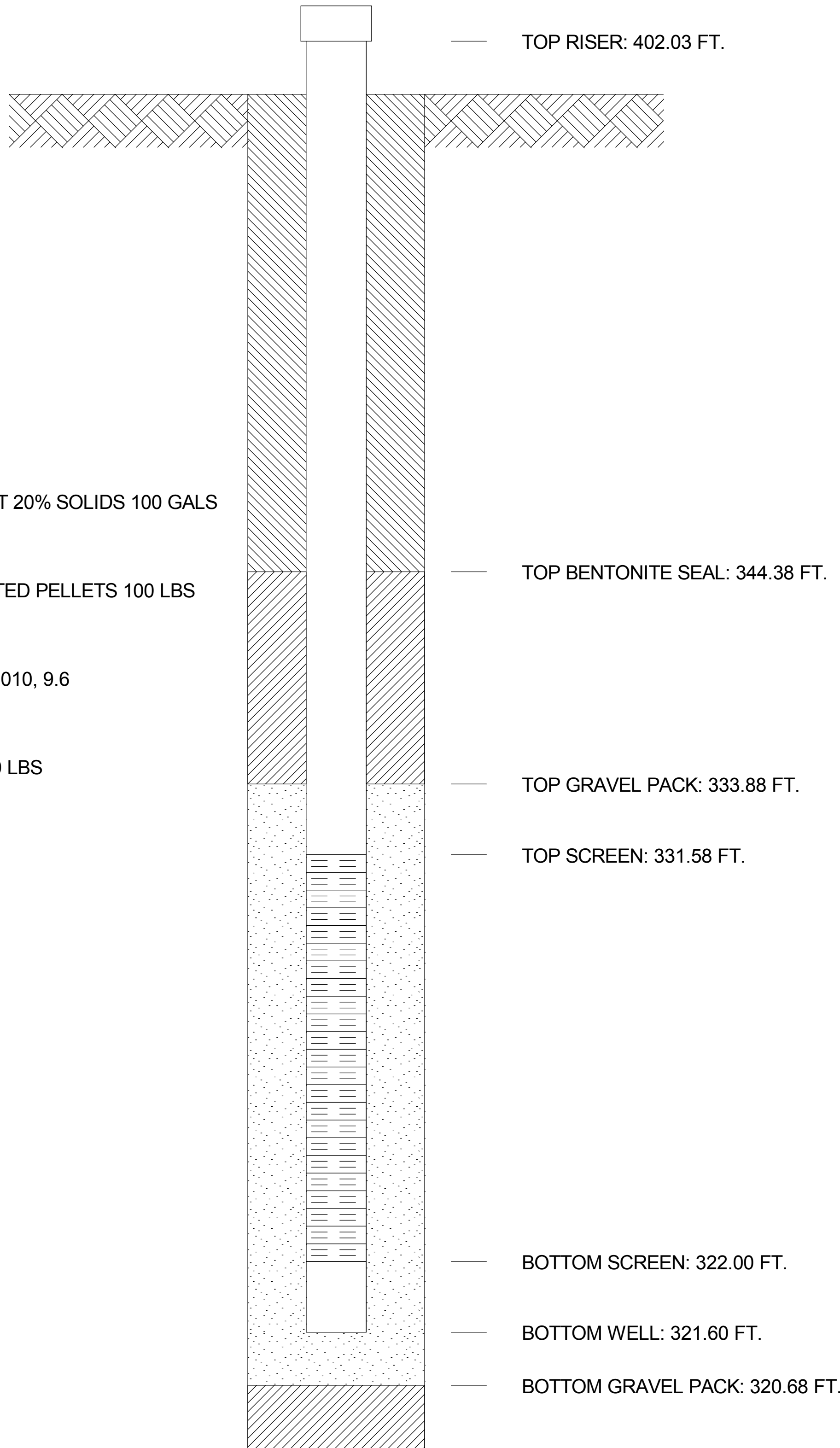
COMPANY **INDIANA MICHIGAN POWER COMPANY** WELL No. **MW-1602I** BORING No. **MW-1602I** INSTALLED **2/9/16**

PROJECT **ROCKPORT PLANT**

COORDINATES **N 152,295.0 E 514,229.2**

SYSTEM **State Plane using NAD27/29**

GROUND ELEVATION 399.38 FT.



GROUT SEAL: QUICK GROUT 20% SOLIDS 100 GALS

BENTONITE SEAL: 3/8" COATED PELLETS 100 LBS

SCREEN: 2.0 dia., SLOTTED .010, 9.6

GRAVEL PACK: #5 SAND 150 LBS

RISER PIPE: 2.0, dia., PVC

SPACERS, DEPTH:

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

AEP

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** — BORING NO. **MW-1603D** — DATE **4/27/16** — SHEET **1** OF **5**

PROJECT **ROCKPORT PLANT** — BORING START **1/29/16** — BORING FINISH **1/29/16**

COORDINATES **N 152,811.9 E 514,207.5** — PIEZOMETER TYPE ____ — WELL TYPE **OW**

GROUND ELEVATION **401.6** SYSTEM **State Plane using NAD27/29** — HGT. RISER ABOVE GROUND **2.29** — DIA **2.0**

DEPTH TO TOP OF WELL SCREEN **110.9** BOTTOM **120.46**

WELL DEVELOPMENT **YES** BACKFILL ____

FIELD PARTY **ZLR / REB** RIG **D-120**

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	3-3-6	.5					Gravel = 6 inches		
										Topsoil = 12 inches		
2	SS	1.5	3.0	4-11-14	.75				CL	Silty clay, l. brown 5YR 6/4 and l. grey N7 mottled, dry to moist, v. stiff @ 3' trace moderate red 5R 4/6 silt @ 6' stiff, geofabric in spoon @ 7.5' v. stiff, wood debris @ 9' w/pale yellowish brown 10YR 6/2 fat clay, stiff		
3	SS	3.0	4.5	5-9-12	1.0							
4	SS	4.5	6.0	7-10-13	.92		5					
5	SS	6.0	7.5	4-6-9	1.08							
6	SS	7.5	9.0	4-8-12	1.5							
7	SS	9.0	10.5	2-3-7	1.33		10					
8	SS	10.5	12.0	2-4-9	1.5							
9	SS	12.0	13.5	4-5-7	1.33				SC	Clayey sand, moderate brown 5YR 4/4, moist, med. dense, w/l. grey N7 clay, fine grained, trace black N1 silt		
10	SS	13.5	15.0	3-5-9	1.5				ML	Clayey silt, moderate yellowish brown 10YR 5/4, moist, med. dense, some l. grey N7 fat clay @ 15' trace l. grey N7 fat clay		
11	SS	15.0	16.5	3-4-7	1.5		15					
12	SS	16.5	18.0	3-4-6	1.16							
13	SS	18.0	19.5	3-4-4	1.5				SP	Poorly graded sand, moderate yellowish brown 10YR 5/4, fine grained, moist, loose @ 18' v. fine to fine grained		
14	SS	19.5	21.0	4-6-8	1.5							

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TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **AMEC FOSTER WHEELER**

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1603D** DATE **4/27/16** SHEET **2** OF **5**

PROJECT **ROCKPORT PLANT** BORING START **1/29/16** BORING FINISH **1/29/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
15	SS	21.0	22.5	2-2-3	1.42				SP	Poorly graded sand, grayish orange 10YR 7/4, moist, med. dense, fine grained, trace blacK N1 silt @ 21.5' 2" clay seam, moderate brown 5YR 4/4		
16	SS	22.5	24.0	1-3-4	1.5				SP	Poorly graded sand, moderate yellowish brown 10YR 5/4, moist, v. fine grained, loose @ 22.8' 2.5" clayey silt seam (prev. material) @ 23.6' 2" grayish orange 10YR 7/4 sand seam (prev. material) @ 24' 3" shale fragment, med. l. grey N6 @ 25.5' 2" shale fragments		
17	SS	24.0	25.5	4-7-8	.33							
18	SS	25.5	27.0	3-6-9	1.5		25		SP	Poorly graded sand, grayish orange 10YR 7/4, moist, med. dense, fine grained, trace black N1 silt @ 26.6' 1" coarse sand seam, dark yellowish brown 10YR 4/2, w/rounded fine gravel, well graded @ 27.9' 2" coarse sand seam (prev. material) @ 28.7' clay seam, 1.5" (prev. material @ 29.5' .5" coarse sand seam, moderate red 5R4/6, w/black N1 silt, poorly graded @ 31.1' 1/4" coal fragments and black N1 silt @ 31.3' 1/4" coal fragment and black, N1 silt		
19	SS	27.0	28.5	5-6-9	1.5							
20	SS	28.5	30.0	4-7-12	1.5							
21	SS	30.0	31.5	5-6-8	1.5		30					
22	SS	31.5	33.0	5-6-10	1.5				SW	Well graded sand, coarse grained, pale yellowish brown 10YR 6/2, moist, med. dense, trace black N1 silt @ 32.5' .5" coarse sand seam, moderate red (prev. material) @ 33' med. grained @ 35 1/4" coal fragments		
23	SS	33.0	34.5	3-5-8	1.25							
24	SS	34.5	36.0	5-7-9	1.41		35					
25	SS	36.0	37.5	6-5-7	1.25				SP	Poorly graded sand, moderate yellowish brown 10YR 5/4, moist to wet, med. dense, fine grained, some fine gravel, water in spoon @ 36' fine to med. grained @ 38.6' 2" coarse sand seam dark yellowish brown 10YR 4/2 w/black N1 silt (50%)		
26	SS	37.5	39.0	2-3-7	1.33							
27	SS	39.0	40.5	6-8-8	1.41		40		SP	Poorly graded sand, pale reddish brown 10R 5/4, fine grained, moist to wet, med, dense @ 40' 1/4" coal fragments		
28	SS	40.5	42.0	3-6-9	1.16				SW	Well graded sand, moderate, yellowish brown 10YR 5/4, fine grained, moist to wet, med. dense, some fine gravel @ 41' coarse sand seam, 3", d. yellowish brown 10YR 4/2, prev. material @ 42.5' coarse sand seam, 3.5", d. yellowish brown 10YR 4/2, w/black N1 silt and fine gravel		
29	SS	42.0	43.5	5-8-8	1.25							
30	SS	43.5	45.0	5-4-7	.83				SW	Well graded sand, d. yelllowish brown 10YR 4/2, coarse grained, moist to wet, med. dense, with fine gravel @ 43.8' trace coal fragments, angular @ 44' no coal fragments		
31	SS	45.0	46.5	6-8-14	1.16		45					

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY — BORING NO. MW-1603D — DATE 4/27/16 — SHEET 3 OF 5

PROJECT ROCKPORT PLANT — BORING START 1/29/16 — BORING FINISH 1/29/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
32	SS	46.5	48.0	13-10-18	1.33			SW	@ 45.5' some coarse gravel, rounded @ 45.7' .5" coal fragments @ 46' 1.5" coal fragments		
33	SS	48.0	49.5	9-14-19	1.41				Well graded sand, moderate yellowish brown 10YR 5/4, fine grained, moist to wet, med. dense, some fine gravel @ 46.9' 1.5" shale seam @ 47.6' 1" coal fragment and black N1 silt, angular @ 47.8' 1.5" rounded fine gravel, clean, poorly graded @ 48' 1" shale fragment @ 48.1' dense, poorly graded, trace fine gravel @ 49.5' w/fine gravel @ 51' well graded, med. dense @ 52.5' trace shale fragments to 1.5"		
34	SS	49.5	51.0	11-15-18	1.33		50				
35	SS	51.0	52.5	6-9-16	1.41						
36	SS	52.5	54.0	7-14-21	1.41			SP	Poorly graded sand, med. grained, pale yellowish brown 10YR 6/2, moist to wet, dense, trace fine gravel		
37	SS	54.0	55.5	10-12-12	1.5			SW	Well graded sand, pale yellowish brown 10YR 6/2, fine grained, moist to wet, med. dense, some fine gravel, trace coarse gravel @ 55.5' dense, no coarse gravel @57' med. dense @ 58' 2.5" shale seam, med. l. grey N6		
38	SS	55.5	57.0	9-12-31	1.41		55				
39	SS	57.0	58.5	10-10-15	1.16						
40	SS	58.5	60.0	8-10-15	1.5			SW	Well graded sand, l. olive grey 5Y 6/1, fine to med. grained, moist to wet, med. dense, with fine gravel (rounded) @ 61.5' fine grained @ 63' trace fine gravel @ 64.5' d. yellowish brown 10YR 4/2 @ 66' fine to med. grained, some fine gravel (rounded)		
41	SS	60.0	61.5	7-10-11	1.25		60				
42	SS	61.5	63.0	8-13-13	1.25						
43	SS	63.0	64.5	7-9-17	1.16						
44	SS	64.5	66.0	6-9-10	1.33		65				
45	SS	66.0	67.5	10-11-15	1.16						
46	SS	67.5	69.0	10-11-15	1.33			SW	Well graded sand, d. yellowish brown 10YR 4/2, coarse grained, moist to wet, med. dense, with fine gravel		
47	SS	69.0	70.5	9-13-15	1.5		70				
48	SS	70.5	72.0	9-12-18	1.33			SP	Poorly graded sand, pale yellowish brown 10YR 6/2, fine grained, moist to wet, dense		

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JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY BORING NO. MW-1603D DATE 4/27/16 SHEET 4 OF 5

PROJECT ROCKPORT PLANT BORING START 1/29/16 BORING FINISH 1/29/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
49	SS	72.0	73.5	5-8-16	1.41					@ 72' med. dense @ 73' v. fine grained, moist @ 75.5' silty clay seam (~50%), moderate brown 5YR 3/4, moist, stiff to v. stiff @ 76.2' shale fragment, 3"		
50	SS	73.5	75.0	8-8-12	1.33							
51	SS	75.0	76.5	9-11-13	1.5		75					
52	SS	76.5	78.0	8-12-18	1.0				SW	Well graded sand, d. yellowish brown 10YR 4/2, coarse grained, moist to wet, dense, w/fine gavel, trace coarse gravel (rounded) @ 78' 3.5" shale fragment @ 78.4' coarse gravel seam 3" @ 78.6' 3" shale fragment		
53	SS	78.0	79.5	21-21-15	.75							
54	SS	79.5	81.0	3-6-6	1.41		80		CH	Fat clay, l. grey N7, wet, stiff		
55	SS	81.0	82.5	5-4-6	1.5				ML	Clayey silt, l. grey N7, moist to wet, loose @ 83' 2.5" fine grained sand seam, med. d. grey N4		
56	SS	82.5	84.0	5-6-11	1.5							
57	SS	84.0	85.5	5-6-15	1.5		85		SP	Poorly graded sand, med. d. grey N4, fine grained, moist to wet, med. dense @ 85' 4" clayey silt seam, prev. material @ 85.5' dense @ 86' 3.5" clayey silt seam, prev. material @ 88.5' v. dense @ 91.5' med. dense @ 92' some fine gravel @ 92.2' 1" coal fragments seam @ 93' d. yellowish brown 10YR 4/2, 4" clayey silt seam (prev. material) (50%) @ 94.4' 2" coal fragments seam @ 95' 6" coal fragments (75%) and above material (25%)		
58	SS	85.5	87.0	11-15-19	1.5							
59	SS	87.0	88.5	9-13-29	.41							
60	SS	88.5	90.0	15-21-34	1.5		90					
61	SS	90.0	91.5	12-22-30	1.5							
62	SS	91.5	93.0	7-12-17	1.33							
63	SS	93.0	94.5	8-11-12	1.5							
65	SS	94.0	95.5	12-22-17	1.5							
64	SS	94.5	96.0	7-14-19	1.5		95					
									SP	Poorly graded sand, coarse grained, moderate reddish brown 10R 4/6, moist to wet, dense, trace coal fragments @ 96' with coal fragements (~50%)		
66	SS	97.5	99.0	9-9-12	1.5				SP	Poorly graded sand, fine to med. grained, dusky		

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AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER 42393125-01
COMPANY INDIANA MICHIGAN POWER COMPANY BORING NO. MW-1603D DATE 4/27/16 SHEET 5 OF 5
PROJECT ROCKPORT PLANT BORING START 1/29/16 BORING FINISH 1/29/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										yellow 5Y 6/4, moist to wet, dense, some coarse gravel		
67	SS	99.0	100.5	8-9-15	1.5				SW	@ 97.5' med. dense @ 97.7' 1" clayey silt plug (prev. material)		
							100			Well graded sand, coarse grained, dusky yellowish brown 10YR 2/2, moist to wet, med. dense, with fine gravel, trace coarse gravel		
68	SS	100.5	102.0	16-20-12	.50					@ 100.5' dense @ 101.8' 2.5" shale fragment		
69	SS	102.0	103.5	6-5-8	1.16				SP	Poorly graded sand, very fine grained, dark yellowish orange 10YR 6/6, wet, med. dense, trace fine gravel @ 105' grey 5Y 4/1 @ 108.5' moderate reddish brown 10R 4/6 @ 109' grey 5Y 4/1 @ 109.5' moist to wet		
70	SS	103.5	105.0	9-8-10	1.41							
71	SS	105.0	106.5	7-10-12	1.41		105					
72	SS	106.5	108.0	6-9-12	1.33							
73	SS	108.0	109.5	6-8-13	1.25							
74	SS	109.5	111.0	7-9-15	1.5		110					
75	SS	111.0	112.5	17-16-20	1.41				SW	Well graded sand, coarse grained, olive grey 5Y 3/2, moist to wet, dense, w/fine gravel, trace coarse gravel @ 112.5' med. dense		
76	SS	112.5	114.0	8-10-17	1.33							
77	SS	114.0	115.5	14-22-26	1.41				SP	Poorly graded sand, fine grained, medium grey N5, moist to wet, dense, some fine gravel		
							115					
78	SS	115.5	117.0	12-20-31	1.33				SW	Well graded sand, coarse grained, light olive grey 5Y 6/1, moist to wet, v. dense, with fine gravel, some coarse gravel		
79	SS	117.0	118.5	15-13-16	1.25				SP	Poorly graded sand, fine grained, light olive grey 5Y 6/1, moist to wet, med. dense, some fine gravel @ 118.5' dense, with fine gravel, some coarse gravel		
80	SS	118.5	120.0	13-15-16	1.25							
81	SS	120.0	121.5	10-16-20	1.25		120					
82	SS	121.5	123.0	25-50/4	1.33							
										Shale, med. l. grey N6, dry to moist, hard Spoon refusal @ 122' Auger refusal @ 122' Boring terminated @ 122'		

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

AEP

JOB NUMBER 42393125-01

COMPANY	INDIANA MICHIGAN POWER COMPANY	BORING NO.	MW-1603I	DATE 4/27/16	SHEET 1 OF 4
PROJECT	ROCKPORT PLANT	BORING START	2/1/16	BORING FINISH	2/1/16
COORDINATES	N 152,807.3 E 519,207.2	PIEZOMETER TYPE		WELL TYPE	OW
GROUND ELEVATION	401.4 SYSTEM State Plane using NAD27/29	HGT. RISER ABOVE GROUND	2.74	DIA	2.0
		DEPTH TO TOP OF WELL SCREEN	68.9	BOTTOM	78.51
		WELL DEVELOPMENT	YES	BACKFILL	
		FIELD PARTY	MWJ / TAS	RIG	D-50

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	3-3-6	.5					Gravel = 6 inches		
										Topsoil = 12 inches		
2	SS	1.5	3.0	4-11-14	.75				CL	Silty clay, l. brown 5YR 6/4 and l. grey N7 mottled, dry to moist, v. stiff @ 3' trace moderate red 5R 4/6 silt @ 6' stiff, geofabric in spoon @ 7.5' v. stiff, wood debris @ 9' w/pale yellowish brown 10YR 6/2 fat clay, stiff		
3	SS	3.0	4.5	5-9-12	1.0							
4	SS	4.5	6.0	7-10-13	.92		5					
5	SS	6.0	7.5	4-6-9	1.08							
6	SS	7.5	9.0	4-8-12	1.5							
7	SS	9.0	10.5	2-3-7	1.33		10					
8	SS	10.5	12.0	2-4-9	1.5							
9	SS	12.0	13.5	4-5-7	1.33				SC	Clayey sand, moderate brown 5YR 4/4, moist, med. dense, w/l. grey N7 clay, fine grained, trace black N1 silt		
10	SS	13.5	15.0	3-5-9	1.5				ML	Clayey silt, moderate yellowish brown 10YR 5/4, moist, med. dense, some l. grey N7 fat clay @ 15' trace l. grey N7 fat clay		
11	SS	15.0	16.5	3-4-7	1.5		15					
12	SS	16.5	18.0	3-4-6	1.16							
13	SS	18.0	19.5	3-4-4	1.5				SP	Poorly graded sand, moderate yellowish brown 10YR 5/4, fine grained, moist, loose @ 18' v. fine to fine grained		
14	SS	19.5	21.0	4-6-8	1.5							

Continued Next Page

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER AMEC FOSTER WHEELER

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER 42393125-01
COMPANY INDIANA MICHIGAN POWER COMPANY BORING NO. MW-1603I DATE 4/27/16 SHEET 2 OF 4
PROJECT ROCKPORT PLANT BORING START 2/1/16 BORING FINISH 2/1/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
15	SS	21.0	22.5	2-2-3	1.42				SP	Poorly graded sand, grayish orange 10YR 7/4, moist, med. dense, fine grained, trace blacK N1 silt		
										@ 21.5' 2" clay seam, moderate brown 5YR 4/4		
16	SS	22.5	24.0	1-3-4	1.5				SP	Poorly graded sand, moderate yellowish brown 10YR 5/4, moist, v. fine grained, loose @ 22.8' 2.5" clayey silt seam (prev. material) @ 23.6' 2" grayish orange 10YR 7/4 sand seam (prev. material) @ 24' 3" shale fragment, med. l. grey N6 @ 25.5' 2" shale fragments		
17	SS	24.0	25.5	4-7-8	.33		25					
18	SS	25.5	27.0	3-6-9	1.5							
19	SS	27.0	28.5	5-6-9	1.5				SP	Poorly graded sand, grayish orange 10YR 7/4, moist, med. dense, fine grained, trace black N1 silt @ 26.6' 1" coarse sand seam, dark yellowish brown 10YR 4/2, w/rounded fine gravel, well graded @ 27.9' 2" coarse sand seam (prev. material) @ 28.7' clay seam, 1.5" (prev. material @ 29.5' .5" coarse sand seam, moderate red 5R4/6, w/black N1 silt, poorly graded @ 31.1' 1/4" coal fragments and black N1 silt @ 31.3' 1/4" coal fragment and black, N1 silt		
20	SS	28.5	30.0	4-7-12	1.5		30					
21	SS	30.0	31.5	5-6-8	1.5							
22	SS	31.5	33.0	5-6-10	1.5				SW	Well graded sand, coarse grained, pale yellowish brown 10YR 6/2, moist, med. dense, trace black N1 silt @ 32.5' .5" coarse sand seam, moderate red (prev. material) @ 33' med. grained @ 35 1/4" coal fragments		
23	SS	33.0	34.5	3-5-8	1.25							
24	SS	34.5	36.0	5-7-9	1.41		35					
25	SS	36.0	37.5	6-5-7	1.25				SP	Poorly graded sand, moderate yellowish brown 10YR 5/4, moist to wet, med. dense, fine grained, some fine gravel, water in spoon @ 36' fine to med. grained @ 38.6' 2" coarse sand seam dark yellowish brown 10YR 4/2 w/black N1 silt (50%)		
26	SS	37.5	39.0	2-3-7	1.33							
27	SS	39.0	40.5	6-8-8	1.41		40		SP	Poorly graded sand, pale reddish brown 10R 5/4, fine grained, moist to wet, med, dense @ 40' 1/4" coal fragments		
28	SS	40.5	42.0	3-6-9	1.16				SW	Well graded sand, moderate, yellowish brown 10YR 5/4, fine grained, moist to wet, med. dense, some fine gravel @ 41' coarse sand seam, 3", d. yellowish brown 10YR 4/2, prev. material @ 42.5' coarse sand seam, 3.5", d. yellowish brown 10YR 4/2, w/black N1 silt and fine gravel		
29	SS	42.0	43.5	5-8-8	1.25							
30	SS	43.5	45.0	5-4-7	.83				SW	Well graded sand, d. yelllowish brown 10YR 4/2, coarse grained, moist to wet, med. dense, with fine gravel @ 43.8' trace coal fragments, angular @ 44' no coal fragments		
31	SS	45.0	46.5	6-8-14	1.16		45					

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY BORING NO. MW-1603I DATE 4/27/16 SHEET 3 OF 4

PROJECT ROCKPORT PLANT BORING START 2/1/16 BORING FINISH 2/1/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
32	SS	46.5	48.0	13-10-18	1.33				SW	@ 45.5' some coarse gravel, rounded @ 45.7' .5" coal fragments @ 46' 1.5" coal fragments		
33	SS	48.0	49.5	9-14-19	1.41					Well graded sand, moderate yellowish brown 10YR 5/4, fine grained, moist to wet, med. dense, some fine gravel @ 46.9' 1.5" shale seam @ 47.6' 1" coal fragment and black N1 silt, angular		
34	SS	49.5	51.0	11-15-18	1.33		50			@ 47.8' 1.5" rounded fine gravel, clean, poorly graded		
35	SS	51.0	52.5	6-9-16	1.41					@ 48' 1" shale fragment @ 48.1' dense, poorly graded, trace fine gravel @ 49.5' w/fine gravel		
36	SS	52.5	54.0	7-14-21	1.41				SP	@ 51' well graded, med. dense @ 52.5' trace shale fragments to 1.5" Poorly graded sand, med. grained, pale yellowish brown 10YR 6/2, moist to wet, dense, trace fine gravel		
37	SS	54.0	55.5	10-12-12	1.5		55		SW	Well graded sand, pale yellowish brown 10YR 6/2, fine grained, moist to wet, med. dense, some fine gravel, trace coarse gravel		
38	SS	55.5	57.0	9-12-31	1.41					@ 55.5' dense, no coarse gravel @57' med. dense		
39	SS	57.0	58.5	10-10-15	1.16					@ 58' 2.5" shale seam, med. l. grey N6		
40	SS	58.5	60.0	8-10-15	1.5				SW	Well graded sand, l. olive grey 5Y 6/1, fine to med. grained, moist to wet, med. dense, with fine gravel (rounded)		
41	SS	60.0	61.5	7-10-11	1.25		60			@ 61.5' fine grained @ 63' trace fine gravel		
42	SS	61.5	63.0	8-13-13	1.25					@ 64.5' d. yellowish brown 10YR 4/2 @ 66' fine to med. grained, some fine gravel (rounded)		
43	SS	63.0	64.5	7-9-17	1.16							
44	SS	64.5	66.0	6-9-10	1.33		65					
45	SS	66.0	67.5	10-11-15	1.16							
46	SS	67.5	69.0	10-11-15	1.33				SW	Well graded sand, d. yellowish brown 10YR 4/2, coarse grained, moist to wet, med. dense, with fine gravel		
47	SS	69.0	70.5	9-13-15	1.5		70					
48	SS	70.5	72.0	9-12-18	1.33				SP	Poorly graded sand, pale yellowish brown 10YR 6/2, fine grained, moist to wet, dense		

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JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY BORING NO. MW-1603I DATE 4/27/16 SHEET 4 OF 4

PROJECT ROCKPORT PLANT BORING START 2/1/16 BORING FINISH 2/1/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
49	SS	72.0	73.5	5-8-16	1.41					@ 72' med. dense @ 73' v. fine grained, moist @ 75.5' silty clay seam (~50%), moderate brown 5YR 3/4, moist, stiff to v. stiff @ 76.2' shale fragment, 3"		
50	SS	73.5	75.0	8-8-12	1.33							
51	SS	75.0	76.5	9-11-13	1.5		75					
52	SS	76.5	78.0	8-12-18	1.0				SW	Well graded sand, d. yellowish brown 10YR 4/2, coarse grained, moist to wet, dense, w/fine gavel, trace coarse gravel (rounded) @ 78' 3.5" shale fragment @ 78.4' coarse gravel seam 3" @ 78.6' 3" shale fragment		
53	SS	78.0	79.5	21-21-15	.75							
54	SS	79.5	81.0	3-6-6	1.41				CH	Fat clay, l. grey N7, wet, stiff		

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY

PROJECT ROCKPORT PLANT

COORDINATES N 152,802.7 E 514,206.9

GROUND ELEVATION 401.5 SYSTEM State Plane using NAD27/29

BORING NO. MW-1603S DATE 4/27/16 SHEET 1 OF 3

BORING START 2/3/16 BORING FINISH 2/3/16

PIEZOMETER TYPE WELL TYPE OW

HGT. RISER ABOVE GROUND 2.39 DIA 2.0

DEPTH TO TOP OF WELL SCREEN 38.2 BOTTOM 47.86

WELL DEVELOPMENT YES BACKFILL

FIELD PARTY MJW / TAS RIG D-50

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	3-3-6	.5				Gravel = 6 inches		
									Topsoil = 12 inches		
2	SS	1.5	3.0	4-11-14	.75			CL	Silty clay, l. brown 5YR 6/4 and l. grey N7 mottled, dry to moist, v. stiff @ 3' trace moderate red 5R 4/6 silt @ 6' stiff, geofabric in spoon @ 7.5' v. stiff, wood debris @ 9' w/pale yellowish brown 10YR 6/2 fat clay, stiff		
3	SS	3.0	4.5	5-9-12	1.0						
4	SS	4.5	6.0	7-10-13	.92		5				
5	SS	6.0	7.5	4-6-9	1.08						
6	SS	7.5	9.0	4-8-12	1.5						
7	SS	9.0	10.5	2-3-7	1.33		10				
8	SS	10.5	12.0	2-4-9	1.5						
9	SS	12.0	13.5	4-5-7	1.33			SC	Clayey sand, moderate brown 5YR 4/4, moist, med. dense, w/l. grey N7 clay, fine grained, trace black N1 silt		
10	SS	13.5	15.0	3-5-9	1.5			ML	Clayey silt, moderate yellowish brown 10YR 5/4, moist, med. dense, some l. grey N7 fat clay @ 15' trace l. grey N7 fat clay		
11	SS	15.0	16.5	3-4-7	1.5		15				
12	SS	16.5	18.0	3-4-6	1.16						
13	SS	18.0	19.5	3-4-4	1.5			SP	Poorly graded sand, moderate yellowish brown 10YR 5/4, fine grained, moist, loose @ 18' v. fine to fine grained		
14	SS	19.5	21.0	4-6-8	1.5						

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER AMEC FOSTER WHEELER

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1603S** DATE **4/27/16** SHEET **2** OF **3**

PROJECT **ROCKPORT PLANT** BORING START **2/3/16** BORING FINISH **2/3/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	SAMPLE DEPTH IN FEET TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %
15	SS	21.0	22.5	2-2-3	1.42	
16	SS	22.5	24.0	1-3-4	1.5	
17	SS	24.0	25.5	4-7-8	.33	
18	SS	25.5	27.0	3-6-9	1.5	
19	SS	27.0	28.5	5-6-9	1.5	
20	SS	28.5	30.0	4-7-12	1.5	
21	SS	30.0	31.5	5-6-8	1.5	
22	SS	31.5	33.0	5-6-10	1.5	
23	SS	33.0	34.5	3-5-8	1.25	
24	SS	34.5	36.0	5-7-9	1.41	
25	SS	36.0	37.5	6-5-7	1.25	
26	SS	37.5	39.0	2-3-7	1.33	
27	SS	39.0	40.5	6-8-8	1.41	
28	SS	40.5	42.0	3-6-9	1.16	
29	SS	42.0	43.5	5-8-8	1.25	
30	SS	43.5	45.0	5-4-7	.83	
31	SS	45.0	46.5	6-8-14	1.16	

U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
SP	Poorly graded sand, grayish orange 10YR 7/4, moist, med. dense, fine grained, trace blacK N1 silt @ 21.5' 2" clay seam, moderate brown 5YR 4/4		
SP	Poorly graded sand, moderate yellowish brown 10YR 5/4, moist, v. fine grained, loose @ 22.8' 2.5" clayey silt seam (prev. material) @ 23.6' 2" grayish orange 10YR 7/4 sand seam (prev. material) @ 24' 3" shale fragment, med. l. grey N6 @ 25.5' 2" shale fragments		
SP	Poorly graded sand, grayish orange 10YR 7/4, moist, med. dense, fine grained, trace black N1 silt @ 26.6' 1" coarse sand seam, dark yellowish brown 10YR 4/2, w/rounded fine gravel, well graded @ 27.9' 2" coarse sand seam (prev. material) @ 28.7' clay seam, 1.5" (prev. material @ 29.5' .5" coarse sand seam, moderate red 5R4/6, w/black N1 silt, poorly graded @ 31.1' 1/4" coal fragments and black N1 silt @ 31.3' 1/4" coal fragment and black, N1 silt		
SW	Well graded sand, coarse grained, pale yellowish brown 10YR 6/2, moist, med. dense, trace black N1 silt @ 32.5' .5" coarse sand seam, moderate red (prev. material) @ 33' med. grained @ 35 1/4" coal fragments		
SP	Poorly graded sand, moderate yellowish brown 10YR 5/4, moist to wet, med. dense, fine grained, some fine gravel, water in spoon @ 36' fine to med. grained @ 38.6' 2" coarse sand seam dark yellowish brown 10YR 4/2 w/black N1 silt (50%)		
SP	Poorly graded sand, pale reddish brown 10R 5/4, fine grained, moist to wet, med, dense @ 40' 1/4" coal fragments		
SW	Well graded sand, moderate, yellowish brown 10YR 5/4, fine grained, moist to wet, med. dense, some fine gravel @ 41' coarse sand seam, 3", d. yellowish brown 10YR 4/2, prev. material @ 42.5' coarse sand seam, 3.5", d. yellowish brown 10YR 4/2, w/black N1 silt and fine gravel		
SW	Well graded sand, d. yelllowish brown 10YR 4/2, coarse grained, moist to wet, med. dense, with fine gravel @ 43.8' trace coal fragments, angular @ 44' no coal fragments		

Continued Next Page

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY BORING NO. MW-1603S DATE 4/27/16 SHEET 3 OF 3

PROJECT ROCKPORT PLANT BORING START 2/3/16 BORING FINISH 2/3/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
32	SS	46.5	48.0	13-10-18	1.33				SW	@ 45.5' some coarse gravel, rounded @ 45.7' .5" coal fragments @ 46' 1.5" coal fragments		
33	SS	48.0	49.5	9-14-19	1.41					Well graded sand, moderate yellowish brown 10YR 5/4, fine grained, moist to wet, med. dense, some fine gravel @ 46.9' 1.5" shale seam @ 47.6' 1" coal fragment and black N1 silt, angular @ 47.8' 1.5" rounded fine gravel, clean, poorly graded @ 48' 1" shale fragment @ 48.1' dense, poorly graded, trace fine gravel @ 49.5' w/fine gravel @ 51' well graded, med. dense @ 52.5' trace shale fragments to 1.5"		

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER **42393125-01**

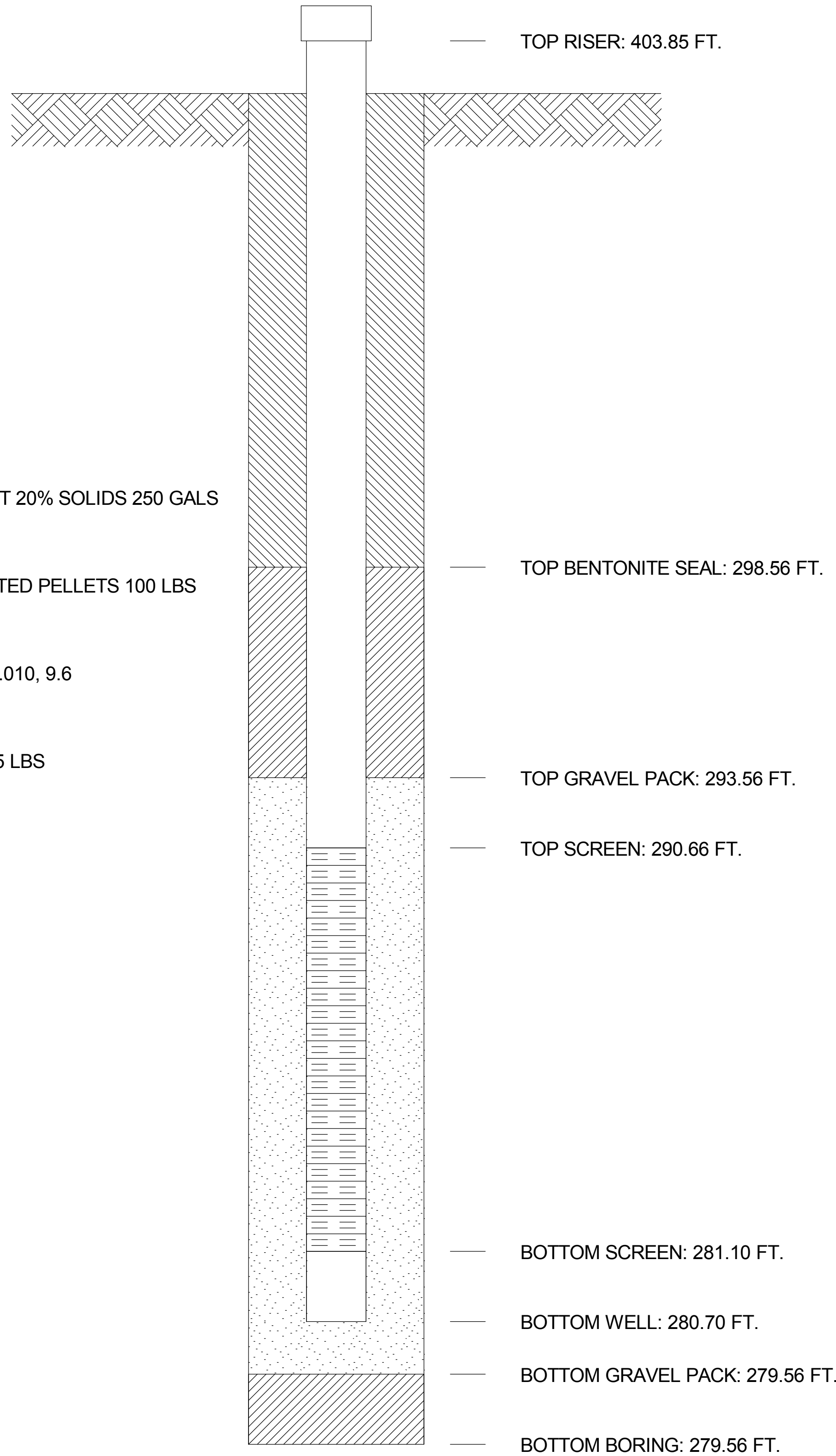
COMPANY **INDIANA MICHIGAN POWER COMPANY** WELL No. **MW-1603D** BORING No. **MW-1603D** INSTALLED **1/29/16**

PROJECT **ROCKPORT PLANT**

COORDINATES **N 152,811.9 E 514,207.5**

SYSTEM **State Plane using NAD27/29**

GROUND ELEVATION 401.56 FT.



GROUT SEAL: QUICK GROUT 20% SOLIDS 250 GALS

BENTONITE SEAL: 3/8" COATED PELLETS 100 LBS

SCREEN: 2.0 dia., SLOTTED .010, 9.6

GRAVEL PACK: #5 SAND 325 LBS

RISER PIPE: 2.0, dia., PVC

SPACERS, DEPTH:

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER **42393125-01**

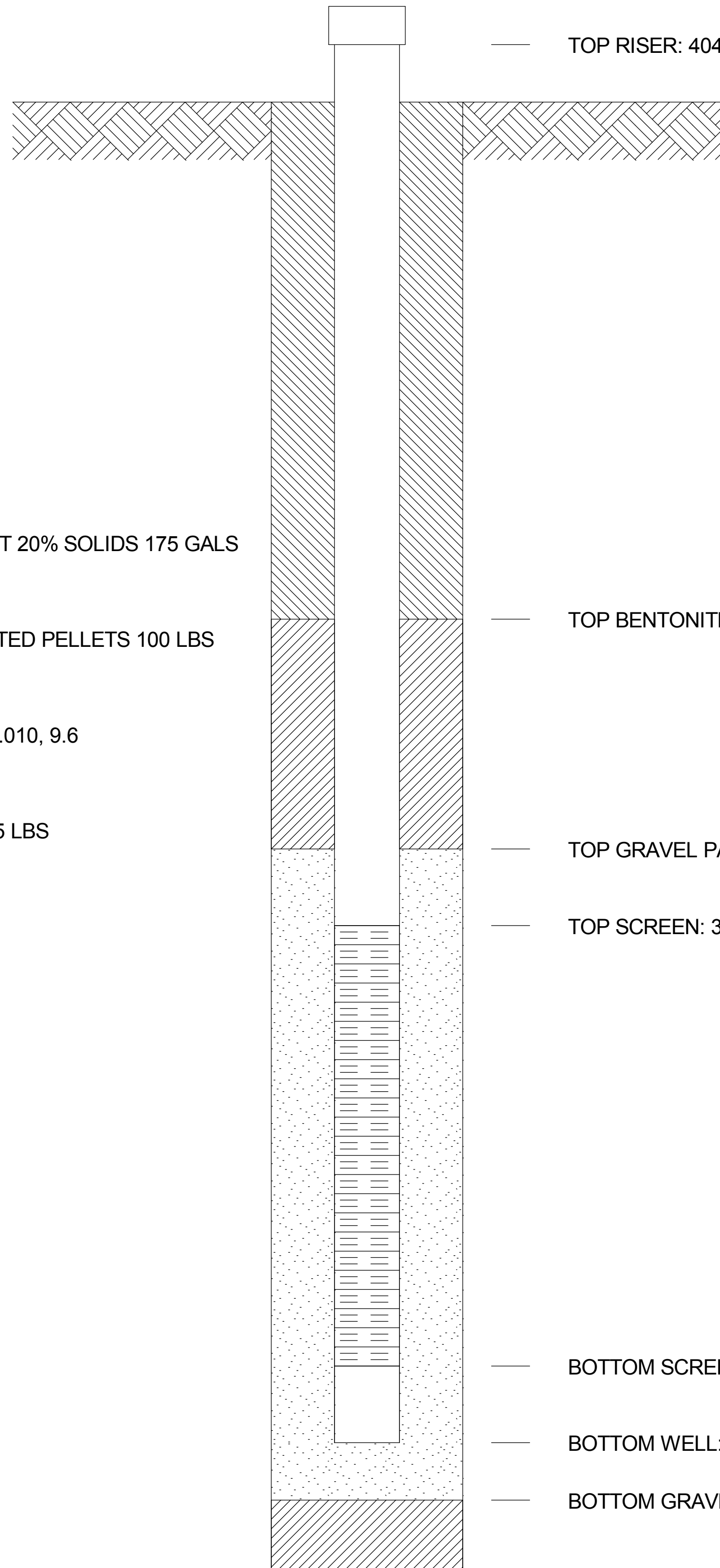
COMPANY **INDIANA MICHIGAN POWER COMPANY** WELL No. **MW-1603I** BORING No. **MW-1603I** INSTALLED **2/1/16**

PROJECT **ROCKPORT PLANT**

COORDINATES **N 152,807.3 E 519,207.2**

SYSTEM **State Plane using NAD27/29**

GROUND ELEVATION 401.41 FT.



GROUT SEAL: QUICK GROUT 20% SOLIDS 175 GALS

BENTONITE SEAL: 3/8" COATED PELLETS 100 LBS

SCREEN: 2.0 dia., SLOTTED .010, 9.6

GRAVEL PACK: #5 SAND 175 LBS

RISER PIPE: 2.0, dia., PVC

SPACERS, DEPTH:

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER **42393125-01**

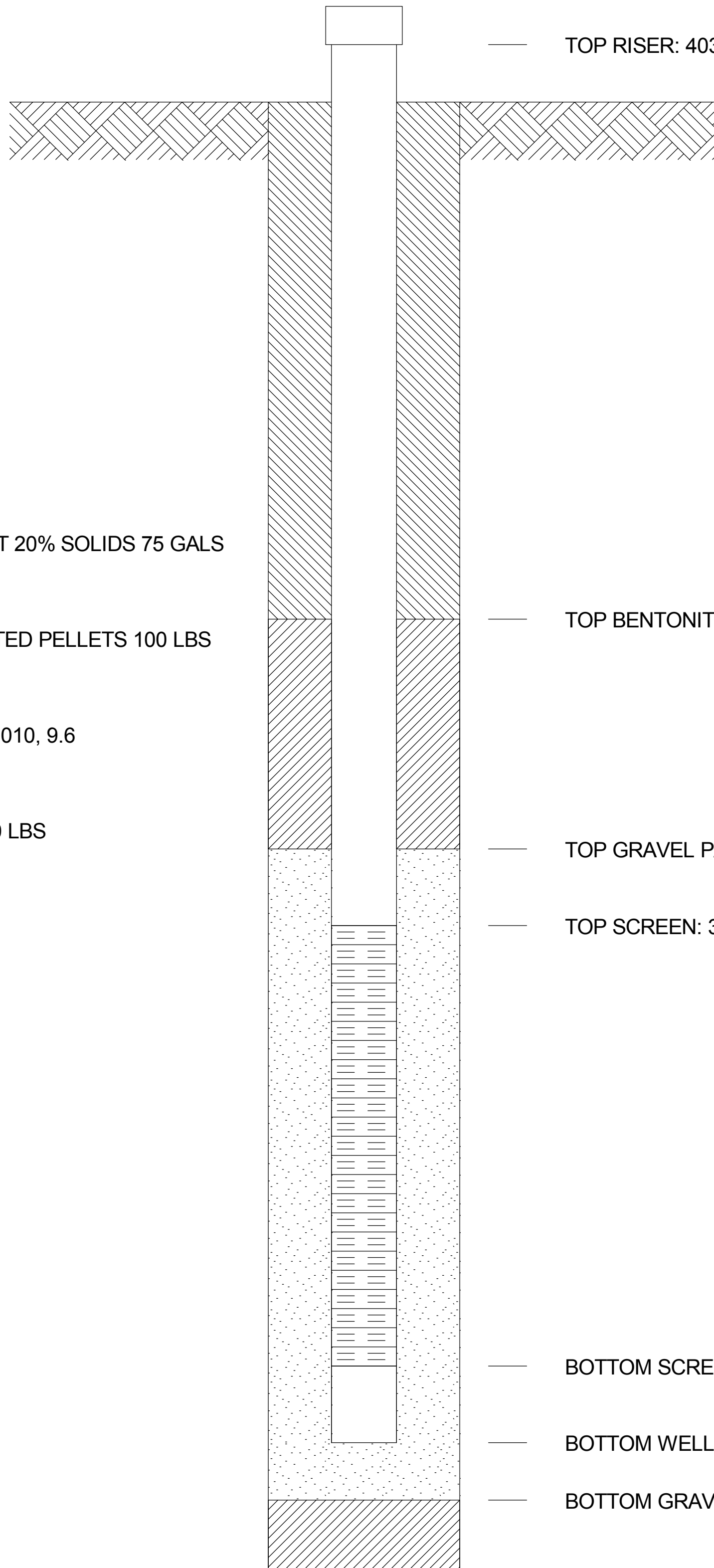
COMPANY **INDIANA MICHIGAN POWER COMPANY** WELL No. **MW-1603S** BORING No. **MW-1603S** INSTALLED **2/3/16**

PROJECT **ROCKPORT PLANT**

COORDINATES **N 152,802.7 E 514,206.9**

SYSTEM **State Plane using NAD27/29**

GROUND ELEVATION 401.46 FT.



TOP RISER: 403.85 FT.

TOP BENTONITE SEAL: 369.76 FT.

TOP GRAVEL PACK: 365.86 FT.

TOP SCREEN: 363.26 FT.

BOTTOM SCREEN: 353.60 FT.

BOTTOM WELL: 353.20 FT.

BOTTOM GRAVEL PACK: 352.16 FT.

BOTTOM BORING: 352.16 FT.

GROUT SEAL: QUICK GROUT 20% SOLIDS 75 GALS

BENTONITE SEAL: 3/8" COATED PELLETS 100 LBS

SCREEN: 2.0 dia., SLOTTED .010, 9.6

GRAVEL PACK: #5 SAND 250 LBS

RISER PIPE: 2.0, dia., PVC

SPACERS, DEPTH:

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY

PROJECT ROCKPORT PLANT

COORDINATES N 151,510.2 E 514,204.9

GROUND ELEVATION 399.9 SYSTEM State Plane using NAD27/29

BORING NO. MW-1604D DATE 4/27/16 SHEET 1 OF 6

BORING START 1/15/16 BORING FINISH 1/15/16

PIEZOMETER TYPE WELL TYPE OW

HGT. RISER ABOVE GROUND 2.59 DIA 2.0

DEPTH TO TOP OF WELL SCREEN 115.6 BOTTOM 125.15

WELL DEVELOPMENT YES BACKFILL

FIELD PARTY ZLR / REB RIG D-120

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	17-29-28	.6					Surface gravel		
2	SS	1.5	3.0	8-10-10	1.0				CL	Lean silty clay, dark yellowish brown 10YR 4/2, dry to moist, v. stiff @ 3' trace black oxide nodules, some l. brown silt seams, hard		
3	SS	3.0	4.5	10-19-30	1.0							
4	SS	4.5	6.0	5-15-15	1.2		5					
5	SS	5.0	6.5	5-5-9	1.1							
									CL	Lean silty clay, dark yellowish brown 10YR 4/2, moist, stiff, some medium dark gray N4 silt seams @ 9' wood (~1")		
6	SS	7.5	9.0	7-6-9	1.2							
7	SS	9.0	10.5	6-5-9	1.2							
8	SS	10.0	11.5	4-2-3	1.3		10					
									CH	Fat clay, olive gray 5Y 4/1, moist, firm, trace black oxide nodules @ 12' stiff @ 13' some moderate yellowish brown 10YR 5/4 silty clay mottled		
9	SS	12.0	13.5	5-5-7	1.5							
10	SS	13.5	15.0	4-5-9	1.5				CH	Fat clay, medium dark gray N4, and silty lean clay, dark yellowish brown 10YR 4/2, mottled, moist, stiff @ 15' tools sunk / 1" spoon driven / material same, pp same, N value inferred @ 15.5' trace black oxide		
11	SS	15.0	16.5	5-6-5	1.0		15					
12	SS	16.5	18.0	2-3-5	1.5				CL ML	Lean silty clay, moderate yellowish brown 10YR 5/4, moist, firm to stiff, w/medium dark gray N4 fat clay seams (~15%)		
13	SS	18.0	19.5	3-4-7	1.5							
14	SS	19.5	21.0	2-3-4	1.4							

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER AMEC FOSTER WHEELER

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1604D** DATE **4/27/16** SHEET **2** OF **6**

PROJECT **ROCKPORT PLANT** BORING START **1/15/16** BORING FINISH **1/15/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
15	SS	21.0	22.5	4-4-4	1.5				ML	Clayey silt, moderate yellowish brown 10YR 5/4, moist, loose		
16	SS	22.5	24.0	2-3-3	1.5				SP	Fine grained sand, moderate yellowish brown 10YR 5/4, moist, loose, poorly graded @ 22.2' ~3" seam clayey silt, moderate yellowish brown 10YR 5/4, moist, loose @ 23.8' ~ 2" silt seam		
17	SS	24.0	25.5	1-1-2	1.0		25		ML	Sandy silt to silty sand, light brown 5YR 5/6, moist, v. loose		
18	SS	25.5	27.0	1-1-2	1.0							
19	SS	27.0	28.5	1-1-5	.83							
20	SS	28.5	30.0	1-5-7	.6		30		SP	Fine sand, dark yellowish orange 10YR 6/6, moist, loose, poorly graded @ 29' transitioning to moderate yellowish brown 10YR 5/4, moist, sample SS20 spilled		
21	SS	30.0	31.5	5-11-12	.8				SP	Fine sand, moderate yellowish brown 10YR 5/4, moist, med. dense, poorly graded @ 31.5' moist, dark yellowish brown 10YR 4/2, loose @ 33' v. loose, water in spoon, wet		
22	SS	31.5	33.0	2-4-3	1.1							
23	SS	33.0	34.5	4-1-3	.8							
24	SS	34.5	36.0	4-3-5	.7		35					
25	SS	36.0	37.5	10-6-9	1.5				SW	Coarse grained sand, dark yellowish brown 10YR 4/2, wet loose, well rounded fine gravel, well graded @ 36.5' v. stiff lean clay moderate yellowish brown 10YR 5/4 seam, higher N value likely due to clay, ~30% clay over last 12" longitudinally @ 38' clay seam @ 40' sand sample mostly washed out clay seam (lean clay, moderate yellowish brown 10YR 5/4, wet, v. stiff) ~50%		
26	SS	37.5	39.0	12-10-12	1.5							
27	SS	39.0	40.5	14-14-16	.6		40					
28	SS	40.5	42.0	5-12-19	1.5				SP	Medium grained sand, moderate yellowish brown 10YR 5/4, wet, dense, poorly graded, well rounded fine gravel @ 42' med dense, well rounded fine gravel		
29	SS	42.0	43.5	8-10-10	1.5							
30	SS	43.5	45.0	14-16-11	1.5		45		SW	Coarse grained sand, moderate yellowish brown 10YR 5/4, wet med. dense, w/well rounded fine gravel (to 1/2"), well graded		
31	SS	45.0	46.5	3-9-12	1.5							

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY   BORING NO. MW-1604D   DATE 4/27/16   SHEET 3 OF 6

PROJECT ROCKPORT PLANT   BORING START 1/15/16   BORING FINISH 1/15/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
32	SS	46.5	48.0	17-8-9	1.1							
33	SS	48.0	49.5	5-10-11	1.5				SP	Fine to med. grained sand, moderate yellowish brown 10YR 5/4, wet, med. dense, poorly graded, w/well rounded fine gravel @ 49.5' trace well rounded fine gravel @ 51' dense, moist @ 55.5' med. dense, transitioning to med. grain @ 57' w/well rounded fine to coarse gravel and rounded sandstone to ~1" @ 60' fully med. grained @ 61.5' w/well rounded fine to coarse gravel and rounded sandstone to 2" @ 63' fine to med. grain, well rounded fine gravel @ 67.5' trace black silt @ 70.5' mostly fine grained, no stone, wet @ 74.8' 1" seam, potential coal or slate, black N1, wet, coarse black N1 silt @ 75' back to fine to med. grain, trace small gravel (~1/4")		
34	SS	49.5	51.0	10-11-12	1.5		50					
35	SS	51.0	52.5	8-17-18	1.2							
36	SS	52.5	54.0	15-16-16	1.3							
37	SS	54.0	55.5	5-11-19	1.5		55					
38	SS	55.5	57.0	8-10-12	1.0							
39	SS	57.0	58.5	8-12-13	1.1							
40	SS	58.5	60.0	13-9-9	1.1		60					
41	SS	60.0	61.5	12-9-14	.8							
42	SS	61.5	63.0	10-10-11	.8							
43	SS	63.0	64.5	6-10-11	.8							
44	SS	64.5	66.0	7-9-13	1.0		65					
45	SS	66.0	67.5	7-10-16	.7							
46	SS	67.5	69.0	9-10-13	.8							
47	SS	69.0	70.5	8-12-14	.8		70					
48	SS	70.5	72.0	9-9-12	1.0							

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1604D** DATE **4/27/16** SHEET **4** OF **6**

PROJECT **ROCKPORT PLANT** BORING START **1/15/16** BORING FINISH **1/15/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
49	SS	72.0	73.5	7-10-13	1.0							
50	SS	73.5	75.0	6-10-20	1.3							
51	SS	75.0	76.5	11-13-17	1.2		75					
52	SS	76.5	78.0	8-29-47	.8							
53	SS	78.0	79.5	16-23-19	1.0				SP	Coarse sand with gravel (~50%) to 15", moderate yellowish brown 10YR 5/4, moist, v. dense, well graded @ 78' fine gravel, dense		
54	SS	79.5	81.0	10-13-19	1.5		80					
55	SS	81.0	82.5	7-13-18	1.0				SP	Fine grained sand, moderate yellowish brown 10YR 5/4 to dark yellowish brown 10YR 4/2, moist, dense, trace fine gravel, poorly graded @ 81' moist to wet, no gravel @ 82.5' med. dense, trace gravel @ 84' dense, no gravel @ 85.5' med. dense		
56	SS	82.5	84.0	6-12-17	.9							
57	SS	84.0	85.5	10-16-20	.8							
58	SS	85.5	87.0	11-11-17	1.2		85					
59	SS	87.0	88.5	12-15-13	1.3				CL ML	Lean silty clay, dark yellowish brown 10YR 4/2 to medium dark gray N4, moist to wet, v. stiff, w/sand @ 87.2' fine grained sand, moist med. dense, poorly graded		
60	SS	88.5	90.0	11-8-10	1.3				CL ML	Lean silty clay, dark yellowish brown 10YR 4/2 to medium dark gray N4, moist to wet, v. stiff, w/sand		
61	SS	90.0	91.5	7-6-14	1.2		90		SP	Fine grained sand, dark yellowish brown 10YR 4/2, wet, med. dense, poorly graded		
62	SS	91.5	93.0	6-12-9	1.5				CL ML	Lean silty clay, dark yellowish brown 10YR 4/2, moist to wet, v. stiff, w/sand @ 92.3' 5" sand seam (prev material) @ 93.5' 4" sand seam (prev material)		
63	SS	93.0	94.5	7-6-16	1.3							
64	SS	94.5	96.0	9-11-12	1.5		95		SP	Fine grained sand, dark yellowish brown 10YR 4/2, wet, med. dense, poorly graded, trace pea gravel		
65	SS	96.0	97.5	9-8-9	.8				SW	Coarse sand and gravel, dark yellowish brown 10YR 4/2, moist to wet, med. dense, well graded, gravel to 1.5"		
66	SS	97.5	99.0	13-13-14	.8							

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JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1604D** DATE **4/27/16** SHEET **5** OF **6**

PROJECT **ROCKPORT PLANT** BORING START **1/15/16** BORING FINISH **1/15/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
67	SS	99.0	100.5	13-21-15	1.0							
							100			Shale, medium dark gray N4, moist, v. stiff to hard, dark yellowish brown 10YR 4/2 w/sand		
68	SS	100.5	102.0	5-8-12	1.3				SP	Fine grained sand, dark yellowish brown 10YR 4/2, v. moist med. dense		
69	SS	102.0	103.5	9-13-13	1.1							
70	SS	103.5	105.0	5-3-8	1.4				SC	Clayey sand, fine grained, dark yellowish brown 10YR 4/2, wet, loose		
71	SS	105.0	106.5	7-11-17	1.4		105					
									SP	Very fine grain sand, moderate yellowish brown 10YR 5/4, moist to wet, med. dense, poorly graded		
72	SS	106.5	108.0	10-15-15	1.3				SP	Fine to med. grained sand, moderate yellowish brown 10YR 5/4 to medium dark gray N4, moist to wet, med. dense, poorly graded @ 100' dense @ 111' trace rock to 1.5" @ 112.5' no stone @ 114' med. dense @ 115.5' loose, moist to wet @ 117' med. dense @ 118.5' d. grey, w/black silt @ 120' trace gravel to 1/4", dense @ 121.5' med. dense @ 123' wet, dense		
73	SS	108.0	109.5	6-11-18	1.3							
74	SS	109.5	111.0	9-17-18	1.2		110					
75	SS	111.0	112.5	8-17-24	1.2							
76	SS	112.5	114.0	14-23-23	1.3							
77	SS	114.0	115.5	6-7-10	1.3							
78	SS	115.5	117.0	5-5-5	1.3		115					
79	SS	117.0	118.5	5-5-6	1.4							
80	SS	118.5	120.0	6-9-15	1.3							
81	SS	120.0	121.5	8-15-20	1.5		120					
82	SS	121.5	123.0	8-10-17	1.5							
83	SS	123.0	124.5	7-12-38	1.5							

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY

BORING NO. MW-1604D DATE 4/27/16 SHEET 6 OF 6

PROJECT ROCKPORT PLANT

BORING START 1/15/16 BORING FINISH 1/15/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
84	SS	124.5	126.0	10-13-35	1.4		125		SW	Coarse sand, medium dark gray N4, moist to wet, dense, with gravel moist to wet graded @ 125.3' 2" coal seam (black, dry, coarse)		
85	SS	126.0	127.5	37-50/2	.5					Shale, medium dark gray N4, dry, hard TOR @ 125.8' Spoon refusal @ 126.6' BT @ 126.6'		

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1604I** DATE **4/27/16** SHEET **1** OF **4**

PROJECT **ROCKPORT PLANT** BORING START **1/28/16** BORING FINISH **1/28/16**

COORDINATES **N 151,506.5 E 514,201.0** PIEZOMETER TYPE WELL TYPE **OW**

GROUND ELEVATION **399.7** SYSTEM **State Plane using NAD27/29** HGT. RISER ABOVE GROUND **2.45** DIA **2.0**

DEPTH TO TOP OF WELL SCREEN **69** BOTTOM **78.64**

WELL DEVELOPMENT **YES** BACKFILL

FIELD PARTY **MWJ / TAS** RIG **D-50**

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	17-29-28	.6					Surface gravel		
2	SS	1.5	3.0	8-10-10	1.0				CL	Lean silty clay, dark yellowish brown 10YR 4/2, dry to moist, v. stiff @ 3' trace black oxide nodules, some l. brown silt seams, hard		
3	SS	3.0	4.5	10-19-30	1.0							
4	SS	4.5	6.0	5-15-15	1.2		5					
5	SS	5.0	6.5	5-5-9	1.1							
6	SS	7.5	9.0	7-6-9	1.2				CL	Lean silty clay, dark yellowish brown 10YR 4/2, moist, stiff, some medium dark gray N4 silt seams @ 9' wood (~1")		
7	SS	9.0	10.5	6-5-9	1.2		10					
8	SS	10.0	11.5	4-2-3	1.3							
9	SS	12.0	13.5	5-5-7	1.5				CH	Fat clay, olive gray 5Y 4/1, moist, firm, trace black oxide nodules @ 12' stiff @ 13' some moderate yellowish brown 10YR 5/4 silty clay mottled		
10	SS	13.5	15.0	4-5-9	1.5		15		CH	Fat clay, medium dark gray N4, and silty lean clay, dark yellowish brown 10YR 4/2, mottled, moist, stiff @ 15' tools sunk / 1" spoon driven / material same, pp same, N value inferred @ 15.5' trace black oxide		
11	SS	15.0	16.5	5-6-5	1.0							
12	SS	16.5	18.0	2-3-5	1.5				CL ML	Lean silty clay, moderate yellowish brown 10YR 5/4, moist, firm to stiff, w/medium dark gray N4 fat clay seams (~15%)		
13	SS	18.0	19.5	3-4-7	1.5							
14	SS	19.5	21.0	2-3-4	1.4							

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TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **AMEC FOSTER WHEELER**

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1604I** DATE **4/27/16** SHEET **2** OF **4**

PROJECT **ROCKPORT PLANT** BORING START **1/28/16** BORING FINISH **1/28/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
									ML	Clayey silt, moderate yellowish brown 10YR 5/4, moist, loose		
15	SS	21.0	22.5	4-4-4	1.5							
									SP	Fine grained sand, moderate yellowish brown 10YR 5/4, moist, loose, poorly graded @ 22.2' ~3" seam clayey silt, moderate yellowish brown 10YR 5/4, moist, loose @ 23.8' ~ 2" silt seam		
16	SS	22.5	24.0	2-3-3	1.5							
17	SS	24.0	25.5	1-1-2	1.0				ML	Sandy silt to silty sand, light brown 5YR 5/6, moist, v. loose		
							25					
18	SS	25.5	27.0	1-1-2	1.0							
19	SS	27.0	28.5	1-1-5	.83							
20	SS	28.5	30.0	1-5-7	.6				SP	Fine sand, dark yellowish orange 10YR 6/6, moist, loose, poorly graded @ 29' transitioning to moderate yellowish brown 10YR 5/4, moist, sample SS20 spilled		
							30					
21	SS	30.0	31.5	5-11-12	.8				SP	Fine sand, moderate yellowish brown 10YR 5/4, moist, med. dense, poorly graded @ 31.5' moist, dark yellowish brown 10YR 4/2, loose @ 33' v. loose, water in spoon, wet		
22	SS	31.5	33.0	2-4-3	1.1							
23	SS	33.0	34.5	4-1-3	.8							
24	SS	34.5	36.0	4-3-5	.7							
							35					
25	SS	36.0	37.5	10-6-9	1.5				SW	Coarse grained sand, dark yellowish brown 10YR 4/2, wet loose, well rounded fine gravel, well graded @ 36.5' v. stiff lean clay moderate yellowish brown 10YR 5/4 seam, higher N value likely due to clay, ~30% clay over last 12" longitudinally @ 38' clay seam @ 40' sand sample mostly washed out clay seam (lean clay, moderate yellowish brown 10YR 5/4, wet, v. stiff) ~50%		
26	SS	37.5	39.0	12-10-12	1.5							
27	SS	39.0	40.5	14-14-16	.6							
							40					
28	SS	40.5	42.0	5-12-19	1.5							
									SP	Medium grained sand, moderate yellowish brown 10YR 5/4, wet, dense, poorly graded, well rounded fine gravel @ 42' med dense, well rounded fine gravel		
29	SS	42.0	43.5	8-10-10	1.5							
30	SS	43.5	45.0	14-16-11	1.5							
									SW	Coarse grained sand, moderate yellowish brown 10YR 5/4, wet med. dense, w/well rounded fine gravel (to 1/2"), well graded		
							45					
31	SS	45.0	46.5	3-9-12	1.5							

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JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY BORING NO. MW-1604I DATE 4/27/16 SHEET 3 OF 4

PROJECT ROCKPORT PLANT BORING START 1/28/16 BORING FINISH 1/28/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
32	SS	46.5	48.0	17-8-9	1.1							
33	SS	48.0	49.5	5-10-11	1.5				SP	Fine to med. grained sand, moderate yellowish brown 10YR 5/4, wet, med. dense, poorly graded, w/well rounded fine gravel @ 49.5' trace well rounded fine gravel @ 51' dense, moist @ 55.5' med. dense, transitioning to med. grain @ 57' w/well rounded fine to coarse gravel and rounded sandstone to ~1" @ 60' fully med. grained @ 61.5' w/well rounded fine to coarse gravel and rounded sandstone to 2" @ 63' fine to med. grain, well rounded fine gravel @ 67.5' trace black silt @ 70.5' mostly fine grained, no stone, wet @ 74.8' 1" seam, potential coal or slate, black N1, wet, coarse black N1 silt @ 75' back to fine to med. grain, trace small gravel (~1/4")		
34	SS	49.5	51.0	10-11-12	1.5		50					
35	SS	51.0	52.5	8-17-18	1.2							
36	SS	52.5	54.0	15-16-16	1.3							
37	SS	54.0	55.5	5-11-19	1.5		55					
38	SS	55.5	57.0	8-10-12	1.0							
39	SS	57.0	58.5	8-12-13	1.1							
40	SS	58.5	60.0	13-9-9	1.1		60					
41	SS	60.0	61.5	12-9-14	.8							
42	SS	61.5	63.0	10-10-11	.8							
43	SS	63.0	64.5	6-10-11	.8							
44	SS	64.5	66.0	7-9-13	1.0		65					
45	SS	66.0	67.5	7-10-16	.7							
46	SS	67.5	69.0	9-10-13	.8							
47	SS	69.0	70.5	8-12-14	.8		70					
48	SS	70.5	72.0	9-9-12	1.0							

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1604I** DATE **4/27/16** SHEET **4** OF **4**

PROJECT **ROCKPORT PLANT** BORING START **1/28/16** BORING FINISH **1/28/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
49	SS	72.0	73.5	7-10-13	1.0							
50	SS	73.5	75.0	6-10-20	1.3							
51	SS	75.0	76.5	11-13-17	1.2		75					
52	SS	76.5	78.0	8-29-47	.8							
									SP	Coarse sand with gravel (~50%) to 15", moderate yellowish brown 10YR 5/4, moist, v. dense, well graded @ 78' fine gravel, dense		
53	SS	78.0	79.5	16-23-19	1.0							

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY

PROJECT ROCKPORT PLANT

COORDINATES N 151,503.1 E 514,197.3

GROUND ELEVATION 399.8 SYSTEM State Plane using NAD27/29

BORING NO. MW-1604S DATE 4/27/16 SHEET 1 OF 3

BORING START 1/29/16 BORING FINISH 1/29/16

PIEZOMETER TYPE WELL TYPE OW

HGT. RISER ABOVE GROUND 2.70 DIA 2.0

DEPTH TO TOP OF WELL SCREEN 36.7 BOTTOM 46.26

WELL DEVELOPMENT YES BACKFILL

FIELD PARTY MWJ / TAS RIG D-50

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	17-29-28	.6					Surface gravel		
2	SS	1.5	3.0	8-10-10	1.0				CL	Lean silty clay, dark yellowish brown 10YR 4/2, dry to moist, v. stiff @ 3' trace black oxide nodules, some l. brown silt seams, hard		
3	SS	3.0	4.5	10-19-30	1.0							
4	SS	4.5	6.0	5-15-15	1.2		5					
5	SS	5.0	6.5	5-5-9	1.1							
6	SS	7.5	9.0	7-6-9	1.2				CL	Lean silty clay, dark yellowish brown 10YR 4/2, moist, stiff, some medium dark gray N4 silt seams @ 9' wood (~1")		
7	SS	9.0	10.5	6-5-9	1.2							
8	SS	10.0	11.5	4-2-3	1.3		10					
9	SS	12.0	13.5	5-5-7	1.5				CH	Fat clay, olive gray 5Y 4/1, moist, firm, trace black oxide nodules @ 12' stiff @ 13' some moderate yellowish brown 10YR 5/4 silty clay mottled		
10	SS	13.5	15.0	4-5-9	1.5				CH	Fat clay, medium dark gray N4, and silty lean clay, dark yellowish brown 10YR 4/2, mottled, moist, stiff @ 15' tools sunk / 1" spoon driven / material same, pp same, N value inferred @ 15.5' trace black oxide		
11	SS	15.0	16.5	5-6-5	1.0		15					
12	SS	16.5	18.0	2-3-5	1.5				CL ML	Lean silty clay, moderate yellowish brown 10YR 5/4, moist, firm to stiff, w/medium dark gray N4 fat clay seams (~15%)		
13	SS	18.0	19.5	3-4-7	1.5							
14	SS	19.5	21.0	2-3-4	1.4							

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TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER AMEC FOSTER WHEELER

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1604S** DATE **4/27/16** SHEET **2** OF **3**

PROJECT **ROCKPORT PLANT** BORING START **1/29/16** BORING FINISH **1/29/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
15	SS	21.0	22.5	4-4-4	1.5				ML	Clayey silt, moderate yellowish brown 10YR 5/4, moist, loose		
16	SS	22.5	24.0	2-3-3	1.5				SP	Fine grained sand, moderate yellowish brown 10YR 5/4, moist, loose, poorly graded @ 22.2' ~3" seam clayey silt, moderate yellowish brown 10YR 5/4, moist, loose @ 23.8' ~ 2" silt seam		
17	SS	24.0	25.5	1-1-2	1.0		25		ML	Sandy silt to silty sand, light brown 5YR 5/6, moist, v. loose		
18	SS	25.5	27.0	1-1-2	1.0							
19	SS	27.0	28.5	1-1-5	.83							
20	SS	28.5	30.0	1-5-7	.6		30		SP	Fine sand, dark yellowish orange 10YR 6/6, moist, loose, poorly graded @ 29' transitioning to moderate yellowish brown 10YR 5/4, moist, sample SS20 spilled		
21	SS	30.0	31.5	5-11-12	.8				SP	Fine sand, moderate yellowish brown 10YR 5/4, moist, med. dense, poorly graded @ 31.5' moist, dark yellowish brown 10YR 4/2, loose @ 33' v. loose, water in spoon, wet		
22	SS	31.5	33.0	2-4-3	1.1							
23	SS	33.0	34.5	4-1-3	.8							
24	SS	34.5	36.0	4-3-5	.7		35					
25	SS	36.0	37.5	10-6-9	1.5				SW	Coarse grained sand, dark yellowish brown 10YR 4/2, wet loose, well rounded fine gravel, well graded @ 36.5' v. stiff lean clay moderate yellowish brown 10YR 5/4 seam, higher N value likely due to clay, ~30% clay over last 12" longitudinally @ 38' clay seam @ 40' sand sample mostly washed out clay seam (lean clay, moderate yellowish brown 10YR 5/4, wet, v. stiff) ~50%		
26	SS	37.5	39.0	12-10-12	1.5							
27	SS	39.0	40.5	14-14-16	.6		40					
28	SS	40.5	42.0	5-12-19	1.5				SP	Medium grained sand, moderate yellowish brown 10YR 5/4, wet, dense, poorly graded, well rounded fine gravel @ 42' med dense, well rounded fine gravel		
29	SS	42.0	43.5	8-10-10	1.5							
30	SS	43.5	45.0	14-16-11	1.5		45		SW	Coarse grained sand, moderate yellowish brown 10YR 5/4, wet med. dense, w/well rounded fine gravel (to 1/2"), well graded		
31	SS	45.0	46.5	3-9-12	1.5							

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY | BORING NO. MW-1604S | DATE 4/27/16 | SHEET 3 OF 3

PROJECT ROCKPORT PLANT | BORING START 1/29/16 | BORING FINISH 1/29/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
32	SS	46.5	48.0	17-8-9	1.1							

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER **42393125-01**

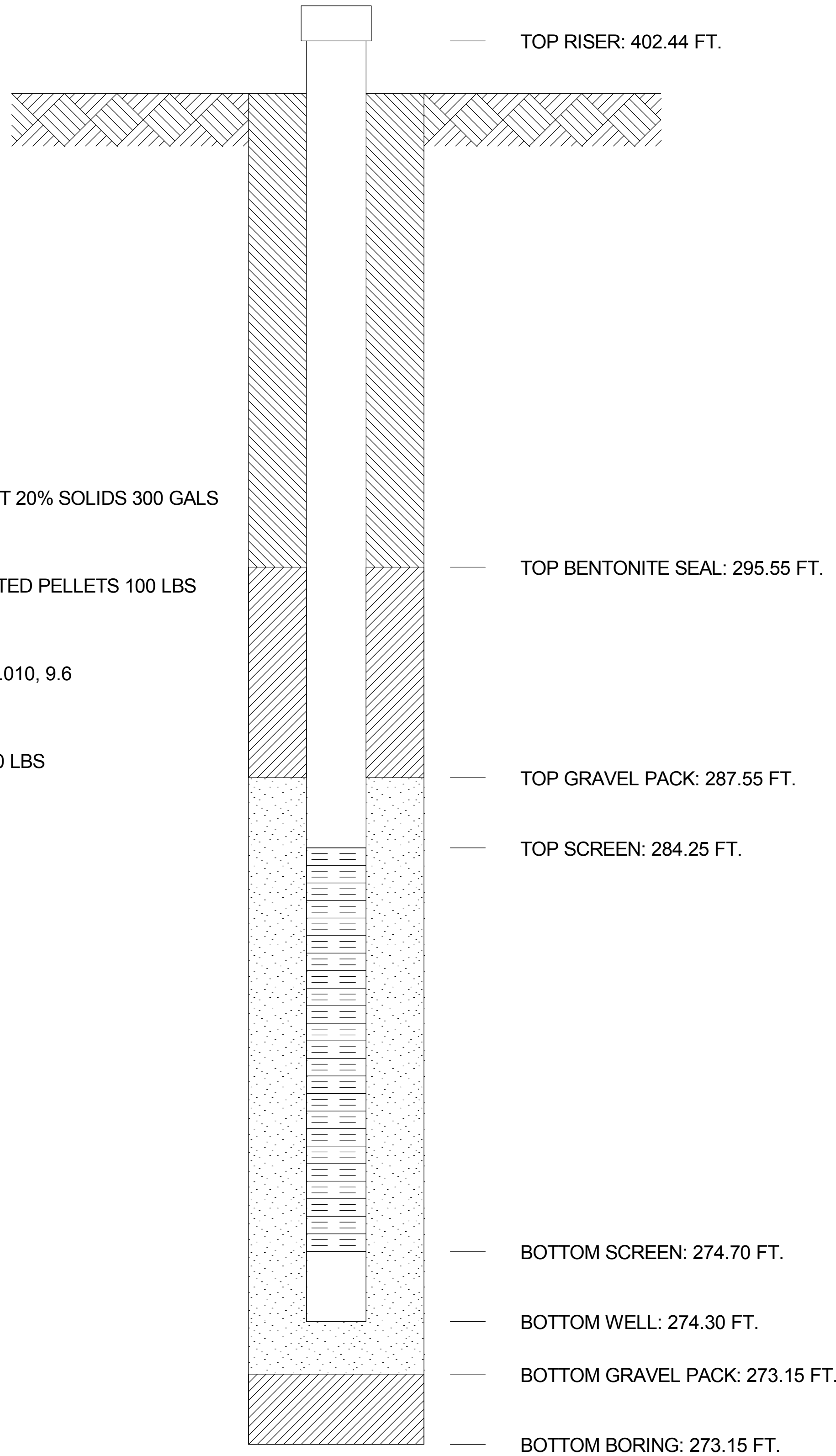
COMPANY **INDIANA MICHIGAN POWER COMPANY** WELL No. **MW-1604D** BORING No. **MW-1604D** INSTALLED **1/15/16**

PROJECT **ROCKPORT PLANT**

COORDINATES **N 151,510.2 E 514,204.9**

SYSTEM **State Plane using NAD27/29**

GROUND ELEVATION 399.85 FT.



GROUT SEAL: QUICK GROUT 20% SOLIDS 300 GALS

BENTONITE SEAL: 3/8" COATED PELLETS 100 LBS

SCREEN: 2.0 dia., SLOTTED .010, 9.6

GRAVEL PACK: #5 SAND 200 LBS

RISER PIPE: 2.0, dia., PVC

SPACERS, DEPTH:

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER **42393125-01**

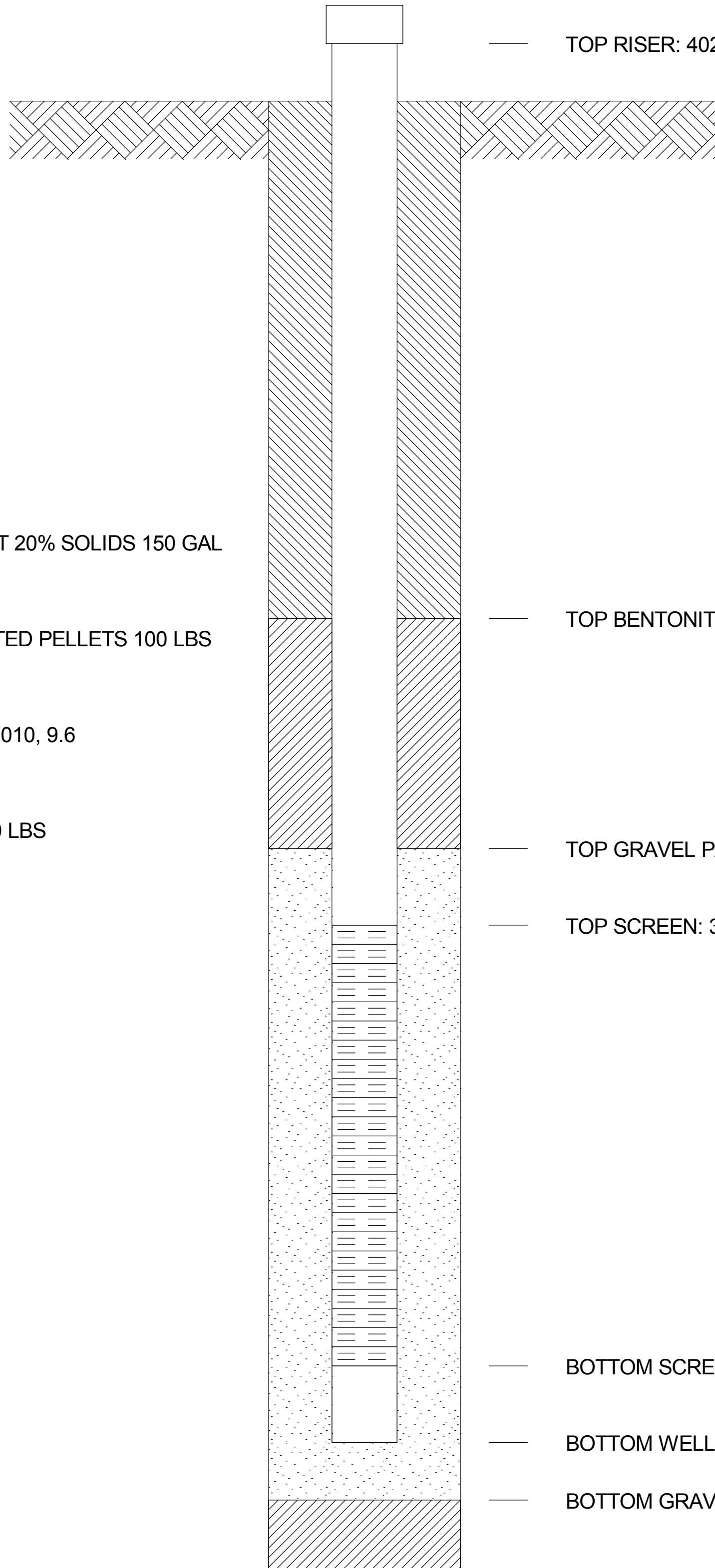
COMPANY **INDIANA MICHIGAN POWER COMPANY** WELL No. **MW-1604I** BORING No. **MW-1604I** INSTALLED **1/28/16**

PROJECT **ROCKPORT PLANT**

COORDINATES **N 151,506.5 E 514,201.0**

SYSTEM **State Plane using NAD27/29**

GROUND ELEVATION 399.74 FT.



TOP RISER: 402.19 FT.

TOP BENTONITE SEAL: 342.44 FT.

TOP GRAVEL PACK: 334.44 FT.

TOP SCREEN: 330.74 FT.

BOTTOM SCREEN: 321.10 FT.

BOTTOM WELL: 320.70 FT.

BOTTOM GRAVEL PACK: 320.70 FT.

BOTTOM BORING: 320.74 FT.

GROUT SEAL: QUICK GROUT 20% SOLIDS 150 GAL

BENTONITE SEAL: 3/8" COATED PELLETS 100 LBS

SCREEN: 2.0 dia., SLOTTED .010, 9.6

GRAVEL PACK: #5 SAND 100 LBS

RISER PIPE: 2.0, dia., PVC

SPACERS, DEPTH:

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY**

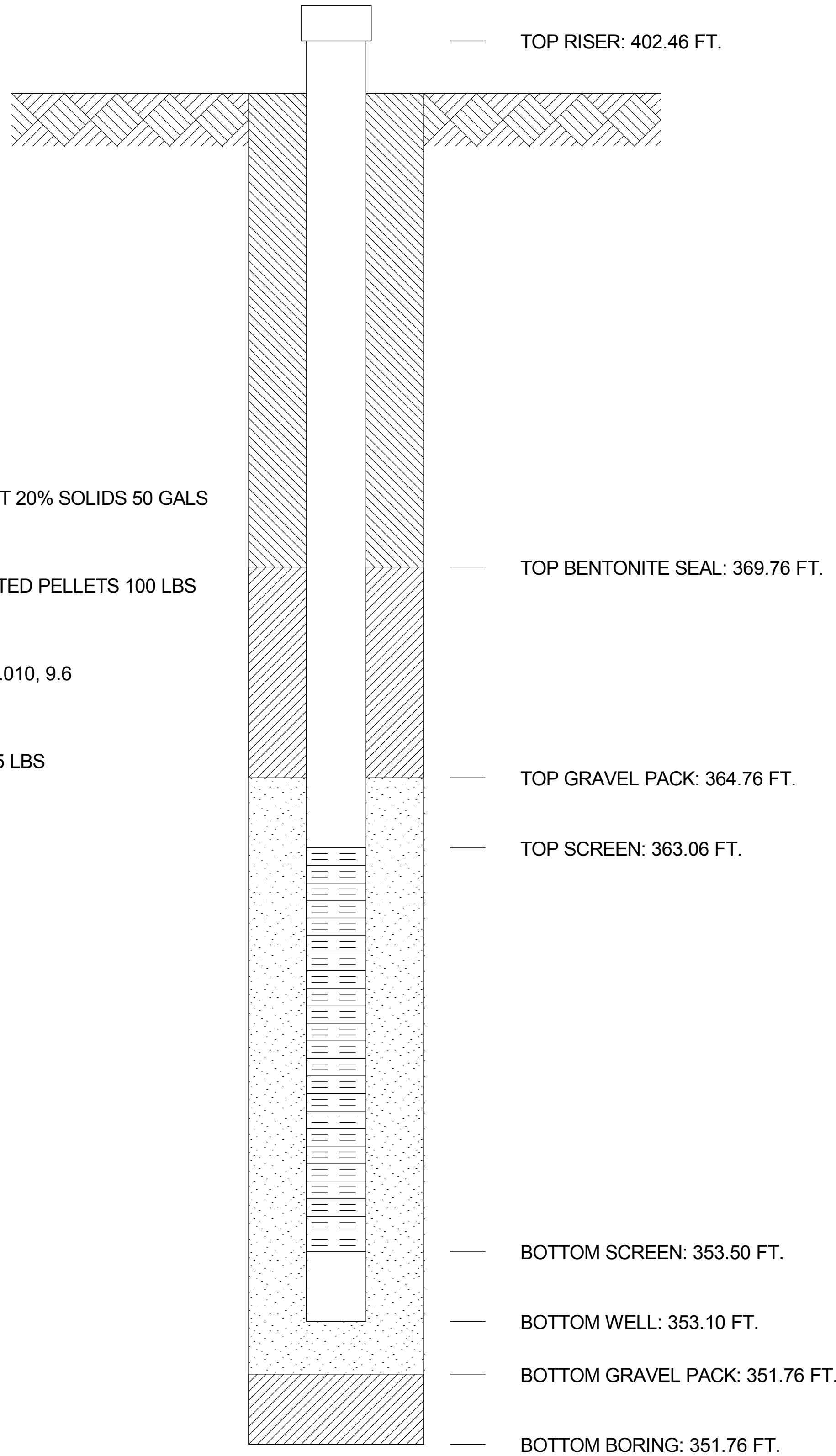
WELL No. **MW-1604S** BORING No. **MW-1604S** INSTALLED **1/29/16**

PROJECT **ROCKPORT PLANT**

COORDINATES **N 151,503.1 E 514,197.3**

SYSTEM **State Plane using NAD27/29**

GROUND ELEVATION 399.76 FT.



GROUT SEAL: QUICK GROUT 20% SOLIDS 50 GALS

BENTONITE SEAL: 3/8" COATED PELLETS 100 LBS

SCREEN: 2.0 dia., SLOTTED .010, 9.6

GRAVEL PACK: #5 SAND 275 LBS

RISER PIPE: 2.0, dia., PVC

SPACERS, DEPTH:

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY

PROJECT ROCKPORT PLANT

COORDINATES N 151,478.9 E 513,537.1

GROUND ELEVATION 400.4 SYSTEM State Plane using NAD27/29

BORING NO. MW-1605D DATE 4/27/16 SHEET 1 OF 6

BORING START 2/3/16 BORING FINISH 2/3/16

PIEZOMETER TYPE WELL TYPE OW

HGT. RISER ABOVE GROUND 3.36 DIA 2.0

DEPTH TO TOP OF WELL SCREEN 114.6 BOTTOM 124.22

WELL DEVELOPMENT YES BACKFILL

FIELD PARTY ZLR / REB RIG D-50

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	20-13-10	1.25					Gravel = 6 inches		
									CL	Silty clay, moderate yellowish brown 10R 5/4 and med l. grey N6 mottled, moist, v. stiff @ 1.5' hard @ 3' v. stiff		
2	SS	1.5	3.0	5-15-18	1.25							
3	SS	3.0	4.5	7-9-15	1.41							
4	SS	4.5	6.0	11-12-14	1.5		5					
5	SS	6.0	7.5	4-8-11	1.41							
6	SS	7.5	9.0	3-6-11	1.33				ML	Clayey silt, medium grey N5, moist, med. dense, w/mod. yellowish brown 10R 5/4 silty clay mottled		
7	SS	9.0	10.5	3-4-7	1.41		10		CL	Silty clay, mod. yellowish brown 10R 5/4, moist, stiff, w/med. grey N5 clayey silt mottled		
8	SS	10.5	12.0	3-4-6	1.5							
9	SS	12.0	13.5	2-2-4	1.5				CH	Fat to lean clay, med. l. grey N6, moist, firm		
10	SS	13.5	15.0	2-2-5	1.41							
							15		CL ML	Silty clay, mod. reddish brown 10R 4/6 w/med. l. grey N6 fat clay heavily mottled, moist, firm @ 15' stiff @ 15.5' l" shale fragment, angular @ 18' very silty @ 20' trace to some pale yellowish brown 10YR 6/2 silt		
11	SS	15.0	16.5	2-4-5	1.5							
12	SS	16.5	18.0	3-5-9	1.5							
13	SS	18.0	19.5	3-6-8	1.41							
14	SS	19.5	21.0	3-5-7	1.41							

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER AMEC FOSTER WHEELER

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY — BORING NO. MW-1605D — DATE 4/27/16 — SHEET 2 OF 6

PROJECT ROCKPORT PLANT — BORING START 2/3/16 — BORING FINISH 2/3/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	SAMPLE DEPTH IN FEET TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %
15	SS	21.0	22.5	3-4-7	1.5	
16	SS	22.5	24.0	4-4-5	1.5	
17	SS	24.0	25.5	1-1-3	1.5	
18	SS	25.5	27.0	1-1-1	1.5	
19	SS	27.0	28.5	2-1-4	1.5	
20	SS	28.5	30.0	5-6-7	1.33	
21	SS	30.0	31.5	3-5-7	1.25	
22	SS	31.5	33.0	5-7-8	1.5	
23	SS	33.0	34.5	3-3-6	1.41	
24	SS	34.5	36.0	2-4-5	1.5	
25	SS	36.0	37.5	2-4-6	1.33	
26	SS	37.5	39.0	4-3-8	1.5	
27	SS	39.0	40.5	3-3-5	1.5	
28	SS	40.5	42.0	11-8-10	1.25	
29	SS	42.0	43.5	4-5-11	1.5	
30	SS	43.5	45.0	8-9-9	1.16	
31	SS	45.0	46.5	6-9-14	1.5	

DEPTH IN FEET: 25, 30, 35, 40, 45

USCS	SOIL / ROCK IDENTIFICATION
ML	Clayey silt, pale yellowish brown 10YR 6/2, moist, med. dense, w/silty clay (prev. material), trace sand
SP	Poorly graded sand, v. fine to fine grained, l. brown 5YR 5/6, moist, loose @ 23.2' 2" clayey silt seam (prev. material)
ML	Clayey silt, pale yellowish brown 10YR 6/2, moist to wet, v. loose @ 25' 2" l. brown sand seam (prev. material) @ 26' 2" l. brown sand seam @ 26.4' 15" l. brown sand seam @ 26.8' l" l. brown sand seam @ 27' loose @ 28' 2" l. brown sand seam
SP	Poorly graded sand, fine grained, l. brown 5YR 5/6, moist, med. dense @ 30' d. yellowish orange 10YR 6/6 @ 31' 3" clayey silt seam (prev. material) @ 32.3' trace fine gravel and black silt @ 32.5' no fine gravel or silt @ 33' moist, loose @ 34.1' 2" clayey silt seam (prev. material) @ 34.5' moist to wet, water in spoon @ 34.9' 2.5' clayey silt seam (prev. material)
SW	Well graded sand, fine grained, l. brown 5YR 5/6, moist to wet, med. dense, w/fine gravel
SW	Well graded sand, coarse grained, grayish black N2, moist to wet, med. dense, trace fine gravel
SP	Poorly graded sand, v. fine grained, l. brown 5YR 5/6, moist to wet, med. dense
SW	Well graded sand, fine to med. grained, moderate yellowish brown 10YR 5/4, moist to wet, loose @ 40.5' med. dense @ 41' 1.5" shale seam w/clay
SP	Poorly graded sand, v. fine to fine grained, mod. yellowish brown 10YR 5/4, moist to wet, med. dense
SW	Well graded sand, med. grained, mod. reddish brown 10R 4/6, moist to wet, med. dense @ 44' med. to coarse grained
SP	Poorly graded sand, fine grained, mod. yellowish

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY — BORING NO. MW-1605D — DATE 4/27/16 — SHEET 3 OF 6

PROJECT ROCKPORT PLANT — BORING START 2/3/16 — BORING FINISH 2/3/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
32	SS	46.5	48.0	6-8-11	1.5				SW	brown 10YR 5/4, moist to wet, mod. dense, some fine gravel		
33	SS	48.0	49.5	6-10-14	1.5				SP	Well graded sand, med. to coarse grained, mod. reddish brown 10R 4/6, moist to wet, med. dense, trace fine gravel		
34	SS	49.5	51.0	8-12-18	1.33		50			Poorly graded sand, fine grained, mod. yellowish brown 10YR 5/4, moist to wet, med. dense, trace fine gravel @ 48' w/fine gravel, trace coarse gravel @ 49.5' no coarse gravel		
35	SS	51.0	52.5	8-11-18	1.41							
36	SS	52.5	54.0	8-9-13	.91				SW	Well graded sand, med. to coarse grained, mod. reddish brown 10R 4/6, moist to wet, mod. dense, trace fine gravel		
37	SS	54.0	55.5	11-20-26	1.25		55		SP	Poorly graded sand, fine grained, mod. yellowish brown 10YR 5/4, moist to wet, mod. dense, trace fine gravel @ 54' no fine gravel, dense @ 57' wet, mod. dense @ 60' dense @ 63' mod. dense		
38	SS	55.5	57.0	10-15-16	1.5							
39	SS	57.0	58.5	6-12-16	1.33							
40	SS	58.5	60.0	7-10-18	1.33							
41	SS	60.0	61.5	8-9-12	1.33		60					
42	SS	61.5	63.0	10-13-19	1.25							
43	SS	63.0	64.5	9-11-18	1.33							
44	SS	64.5	66.0	9-11-15	1.08		65		SW	Well graded sand, med. to coarse grained, mod. yellowish brown 10YR 5/4, moist to wet, mod. dense, trace black silt		
45	SS	66.0	67.5	7-8-13	1.41				SP	Poorly graded sand, fine grained, mod. yellowish brown 10YR 5/4, moist to wet, mod. dense @ 68.5' trace fine gravel, trace coal fragments @ 70' no fine gravel, no coal fragments @ 70.9' trace fine gravel @ 71.6' no fine gravel, wet		
46	SS	67.5	69.0	5-5-8	1.5							
47	SS	69.0	70.5	6-8-12	1.5		70					
48	SS	70.5	72.0	0-12-16	1.5							

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1605D** DATE **4/27/16** SHEET **4** OF **6**

PROJECT **ROCKPORT PLANT** BORING START **2/3/16** BORING FINISH **2/3/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
49	SS	72.0	73.5	8-8-10	1.25				SW	Well graded sand, fine grained d. yellowish brown 10YR 4/2, moist to wet, mod. dense, trace fine gravel @ 73.5' w/fine gravel, trace coarse gravel		
50	SS	73.5	75.0	9-12-17	1.41							
51	SS	75.0	76.5	8-7-9	1.5		75					
									SW	Well graded sand, coarse grained, brownish grey 5YR 4/1, moist to wet, mod. dense, w/fine gravel, trace coarse gravel		
52	SS	76.5	78.0	10-15-25	1.5							
									SP	Poorly graded sand, fine grained, pale yellowish brown 10YR 6/2, wet, dense, trace fine gravel @ 78' mod. dense @ 81' v. fine to fine grained @ 82.5' no fine gravel @ 84' dense @ 85' 2" shale fragment @ 85.2' v. fine grained @ 85.5' 3.5" shale fragment @ 87' fine grained, d. yellowish brown 10YR 4/2 @ 88.5' v. fine grained, mod. dense		
53	SS	78.0	79.5	7-13-12	1.33							
54	SS	79.5	81.0	5-7-12	1.5		80					
55	SS	81.0	82.5	6-12-13	1.5							
56	SS	82.5	84.0	8-10-16	1.41							
57	SS	84.0	85.5	10-21-22	1.41		85					
58	SS	85.5	87.0	14-21-14	.5							
59	SS	87.0	88.5	6-13-25	1.41							
60	SS	88.5	90.0	8-9-9	1.16							
									ML	Clayey silt, med. l. grey N6, moist to wet, mod. dense		
61	SS	90.0	91.5	15-24-7	1.41		90					
									SP	Poorly graded sand, fine grained, d. yellowish brown 10YR 4/2, moist, dense		
62	SS	91.5	93.0	7-21-28	1.5				ML	Clayey silt, med. l. grey N6, moist to wet, dense		
									SW	Well graded sand, coarse grained, med. grey N5, w/fine gravel, some coarse gravel		
63	SS	93.0	94.5	14-18-21	1.5				ML	Clayey silt, med. l. grey N6, moist to wet, dense		
									SW	Well graded sand, fine grained, med. grey N5, moist to wet, dense, w/fine gravel		
64	SS	94.5	96.0	12-17-25	1.5		95		ML	Clayey silt, med. l. grey N6, moist to wet, dense		
									SW	Well graded sand, coarse grained, med. grey N5, moist to wet, dense, w/fine gravel @ 98.7' coal fragments		
65	SS	96.0	97.5	20-21-19	1.33							
66	SS	97.5	99.0	13-11-18	1.41							

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY BORING NO. MW-1605D DATE 4/27/16 SHEET 5 OF 6

PROJECT ROCKPORT PLANT BORING START 2/3/16 BORING FINISH 2/3/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
67	SS	99.0	100.5	15-22-28	1.5		100		SP	Poorly graded sand, v. fine to fine grained, pale yellowish brown 10YR 6/2, moist to wet, dense, w/fine gravel @ 100.5' no fine gravel, mod. dense @ 102' v. fine, dense @ 105' mod. dense @ 106' trace coal fragments @ 106.3' no coal fragments @ 109.5' moist @ 111' v. moist to wet @ 112.5' moist to wet, dense @ 113' trace fine gravel, trace coarse gravel @ 113.5' no fine gravel, no coarse gravel		
68	SS	100.5	102.0	8-8-9	1.5							
69	SS	102.0	103.5	10-16-18	1.5							
70	SS	103.5	105.0	9-13-18	1.41							
71	SS	105.0	106.5	8-12-16	1.5		105					
72	SS	106.5	108.0	6-9-13	1.5							
73	SS	108.0	109.5	7-8-12	1.25							
74	SS	109.5	111.0	6-8-10	1.41		110					
75	SS	111.0	112.5	5-10-12	1.25							
76	SS	112.5	114.0	6-11-27	1.33							
77	SS	114.0	115.5	13-21-13	1.25		115		SW	Well graded sand, med. to coarse grained, med. grey N5, moist to wet, dense, w/fine gravel, some coarse gavel @ 115.5' coarse grained, mod. dense, trace coarse gravel @ 118.5' v. dense		
78	SS	115.5	117.0	7-7-9	1.33							
79	SS	117.0	118.5	9-9-8	1.16							
80	SS	118.5	120.0	12-36-22	1.5		120		SP	Poorly graded sand, v. fine grained, med. l. grey N6, moist to wet, v. dense @ 120' med. dense, sl. moist @ 122' fine grained, w/fine gravel, dense @ 124.5' trace coarse gravel		
81	SS	120.0	121.5	10-11-19	1.41							
82	SS	121.5	123.0	12-20-29	1.5							
83	SS	123.0	124.5	14-16-19	1.5							

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY   BORING NO. MW-1605D   DATE 4/27/16   SHEET 6 OF 6

PROJECT ROCKPORT PLANT   BORING START 2/3/16   BORING FINISH 2/3/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
84	SS	124.5	126.0	18-12-25	1.5		125					
85	SS	126.0	127.5	17-28-50/5	1.5				ML	Clayey silt, l. grey N7, moist, hard, non-durable shale @ 126' flaky, dry to moist Spoon refusal @ 127.4' Auger refusal @127.5' (shale)		
86	SS	127.5	129.0	27-50/2	.66							

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY

PROJECT ROCKPORT PLANT

COORDINATES N 151,478.9 E 513,532.6

GROUND ELEVATION 400.6 SYSTEM State Plane using NAD27/29

BORING NO. MW-1605I DATE 4/27/16 SHEET 1 OF 4

BORING START 3/2/16 BORING FINISH 3/2/16

PIEZOMETER TYPE WELL TYPE OW

HGT. RISER ABOVE GROUND 2.62 DIA 2.0

DEPTH TO TOP OF WELL SCREEN 68.9 BOTTOM 78.5

WELL DEVELOPMENT YES BACKFILL

FIELD PARTY ZLR / REB RIG D-120

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	20-13-10	1.25					Gravel = 6 inches		
									CL	Silty clay, moderate yellowish brown 10R 5/4 and med l. grey N6 mottled, moist, v. stiff @ 1.5' hard @ 3' v. stiff		
2	SS	1.5	3.0	5-15-18	1.25							
3	SS	3.0	4.5	7-9-15	1.41							
4	SS	4.5	6.0	11-12-14	1.5		5					
5	SS	6.0	7.5	4-8-11	1.41							
									ML	Clayey silt, medium grey N5, moist, med. dense, w/mod. yellowish brown 10R 5/4 silty clay mottled		
6	SS	7.5	9.0	3-6-11	1.33							
7	SS	9.0	10.5	3-4-7	1.41				CL	Silty clay, mod. yellowish brown 10R 5/4, moist, stiff, w/med. grey N5 clayey silt mottled		
8	SS	10.5	12.0	3-4-6	1.5		10					
									CH	Fat to lean clay, med. l. grey N6, moist, firm		
9	SS	12.0	13.5	2-2-4	1.5							
10	SS	13.5	15.0	2-2-5	1.41							
									CL ML	Silty clay, mod. reddish brown 10R 4/6 w/med. l. grey N6 fat clay heavily mottled, moist, firm @ 15' stiff @ 15.5' l" shale fragment, angular @ 18' very silty @ 20' trace to some pale yellowish brown 10YR 6/2 silt		
11	SS	15.0	16.5	2-4-5	1.5		15					
12	SS	16.5	18.0	3-5-9	1.5							
13	SS	18.0	19.5	3-6-8	1.41							
14	SS	19.5	21.0	3-5-7	1.41							

Continued Next Page

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER AMEC FOSTER WHEELER

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1605I** DATE **4/27/16** SHEET **2** OF **4**

PROJECT **ROCKPORT PLANT** BORING START **3/2/16** BORING FINISH **3/2/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	SAMPLE DEPTH IN FEET TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DRILLER'S NOTES
15	SS	21.0	22.5	3-4-7	1.5		
16	SS	22.5	24.0	4-4-5	1.5		
17	SS	24.0	25.5	1-1-3	1.5		
18	SS	25.5	27.0	1-1-1	1.5		
19	SS	27.0	28.5	2-1-4	1.5		
20	SS	28.5	30.0	5-6-7	1.33		
21	SS	30.0	31.5	3-5-7	1.25		
22	SS	31.5	33.0	5-7-8	1.5		
23	SS	33.0	34.5	3-3-6	1.41		
24	SS	34.5	36.0	2-4-5	1.5		
25	SS	36.0	37.5	2-4-6	1.33		
26	SS	37.5	39.0	4-3-8	1.5		
27	SS	39.0	40.5	3-3-5	1.5		
28	SS	40.5	42.0	11-8-10	1.25		Begin Mud Rotary @ 40.5'
29	SS	42.0	43.5	4-5-11	1.5		
30	SS	43.5	45.0	8-9-9	1.16		
31	SS	45.0	46.5	6-9-14	1.5		

DEPTH IN FEET: 25, 30, 35, 40, 45

U S C S	SOIL / ROCK IDENTIFICATION
ML	Clayey silt, pale yellowish brown 10YR 6/2, moist, med. dense, w/silty clay (prev. material), trace sand
SP	Poorly graded sand, v. fine to fine grained, l. brown 5YR 5/6, moist, loose @ 23.2' 2" clayey silt seam (prev. material)
ML	Clayey silt, pale yellowish brown 10YR 6/2, moist to wet, v. loose @ 25' 2" l. brown sand seam (prev. material) @ 26' 2" l. brown sand seam @ 26.4' 15" l. brown sand seam @ 26.8' l" l. brown sand seam @ 27' loose @ 28' 2" l. brown sand seam
SP	Poorly graded sand, fine grained, l. brown 5YR 5/6, moist, med. dense @ 30' d. yellowish orange 10YR 6/6 @ 31' 3" clayey silt seam (prev. material) @ 32.3' trace fine gravel and black silt @ 32.5' no fine gravel or silt @ 33' moist, loose @ 34.1' 2" clayey silt seam (prev. material) @ 34.5' moist to wet, water in spoon @ 34.9' 2.5' clayey silt seam (prev. material)
SW	Well graded sand, fine grained, l. brown 5YR 5/6, moist to wet, med. dense, w/fine gravel
SW	Well graded sand, coarse grained, grayish black N2, moist to wet, med. dense, trace fine gravel
SP	Poorly graded sand, v. fine grained, l. brown 5YR 5/6, moist to wet, med. dense
SW	Well graded sand, fine to med. grained, moderate yellowish brown 10YR 5/4, moist to wet, loose @ 40.5' med. dense @ 41' 1.5" shale seam w/clay
SP	Poorly graded sand, v. fine to fine grained, mod. yellowish brown 10YR 5/4, moist to wet, med. dense
SW	Well graded sand, med. grained, mod. reddish brown 10R 4/6, moist to wet, med. dense @ 44' med. to coarse grained
SP	Poorly graded sand, fine grained, mod. yellowish

Continued Next Page

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY BORING NO. MW-1605I DATE 4/27/16 SHEET 3 OF 4

PROJECT ROCKPORT PLANT BORING START 3/2/16 BORING FINISH 3/2/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
32	SS	46.5	48.0	6-8-11	1.5				SW	brown 10YR 5/4, moist to wet, mod. dense, some fine gravel		
33	SS	48.0	49.5	6-10-14	1.5				SP	Well graded sand, med. to coarse grained, mod. reddish brown 10R 4/6, moist to wet, med. dense, trace fine gravel Poorly graded sand, fine grained, mod. yellowish brown 10YR 5/4, moist to wet, med. dense, trace fine gravel @ 48' w/fine gravel, trace coarse gravel @ 49.5' no coarse gravel		
34	SS	49.5	51.0	8-12-18	1.33		50					
35	SS	51.0	52.5	8-11-18	1.41							
36	SS	52.5	54.0	8-9-13	.91				SW	Well graded sand, med. to coarse grained, mod. reddish brown 10R 4/6, moist to wet, mod. dense, trace fine gravel		
37	SS	54.0	55.5	11-20-26	1.25				SP	Poorly graded sand, fine grained, mod. yellowish brown 10YR 5/4, moist to wet, mod. dense, trace fine gravel @ 54' no fine gravel, dense @ 57' wet, mod. dense @ 60' dense @ 63' mod. dense		
38	SS	55.5	57.0	10-15-16	1.5		55					
39	SS	57.0	58.5	6-12-16	1.33							
40	SS	58.5	60.0	7-10-18	1.33							
41	SS	60.0	61.5	8-9-12	1.33		60					
42	SS	61.5	63.0	10-13-19	1.25							
43	SS	63.0	64.5	9-11-18	1.33							
44	SS	64.5	66.0	9-11-15	1.08		65		SW	Well graded sand, med. to coarse grained, mod. yellowish brown 10YR 5/4, moist to wet, mod. dense, trace black silt		
45	SS	66.0	67.5	7-8-13	1.41				SP	Poorly graded sand, fine grained, mod. yellowish brown 10YR 5/4, moist to wet, mod. dense @ 68.5' trace fine gravel, trace coal fragments @ 70' no fine gravel, no coal fragments @ 70.9' trace fine gravel @ 71.6' no fine gravel, wet		
46	SS	67.5	69.0	5-5-8	1.5							
47	SS	69.0	70.5	6-8-12	1.5		70					
48	SS	70.5	72.0	0-12-16	1.5							

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY BORING NO. MW-1605I DATE 4/27/16 SHEET 4 OF 4

PROJECT ROCKPORT PLANT BORING START 3/2/16 BORING FINISH 3/2/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
49	SS	72.0	73.5	8-8-10	1.25				SW	Well graded sand, fine grained d. yellowish brown 10YR 4/2, moist to wet, mod. dense, trace fine gravel		
50	SS	73.5	75.0	9-12-17	1.41					@ 73.5' w/fine gravel, trace coarse gravel		
51	SS	75.0	76.5	8-7-9	1.5		75					
									SW	Well graded sand, coarse grained, brownish grey 5YR 4/1, moist to wet, mod. dense, w/fine gravel, trace coarse gravel		
52	SS	76.5	78.0	10-15-25	1.5				SP	Poorly graded sand, fine grained, pale yellowish brown 10YR 6/2, wet, dense, trace fine gravel		
53	SS	78.0	79.5	7-13-12	1.33					@ 78' mod. dense @ 81' v. fine to fine grained @ 82.5' no fine gravel @ 84' dense		
54	SS	79.5	81.0	5-7-12	1.5		80			@ 85' 2" shale fragment @ 85.2' v. fine grained @ 85.5' 3.5" shale fragment @ 87' fine grained, d. yellowish brown 10YR 4/2 @ 88.5' v. fine grained, mod. dense		

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1605S** DATE **4/27/16** SHEET **1** OF **3**

PROJECT **ROCKPORT PLANT** BORING START **3/1/16** BORING FINISH **3/1/16**

COORDINATES **N 151,478.8 E 513,528.4** PIEZOMETER TYPE WELL TYPE **OW**

GROUND ELEVATION **400.3** SYSTEM **State Plane using NAD27/29** HGT. RISER ABOVE GROUND **3.05** DIA **2.0**

DEPTH TO TOP OF WELL SCREEN **37.6** BOTTOM **47.13**

WELL DEVELOPMENT **YES** BACKFILL

FIELD PARTY **ZLR / REB** RIG **D-120**

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	20-13-10	1.25				Gravel = 6 inches		
								CL	Silty clay, moderate yellowish brown 10R 5/4 and med l. grey N6 mottled, moist, v. stiff @ 1.5' hard @ 3' v. stiff		
2	SS	1.5	3.0	5-15-18	1.25						
3	SS	3.0	4.5	7-9-15	1.41						
4	SS	4.5	6.0	11-12-14	1.5		5				
5	SS	6.0	7.5	4-8-11	1.41						
								ML	Clayey silt, medium grey N5, moist, med. dense, w/mod. yellowish brown 10R 5/4 silty clay mottled		
6	SS	7.5	9.0	3-6-11	1.33						
7	SS	9.0	10.5	3-4-7	1.41			CL	Silty clay, mod. yellowish brown 10R 5/4, moist, stiff, w/med. grey N5 clayey silt mottled		
8	SS	10.5	12.0	3-4-6	1.5		10				
								CH	Fat to lean clay, med. l. grey N6, moist, firm		
9	SS	12.0	13.5	2-2-4	1.5						
10	SS	13.5	15.0	2-2-5	1.41						
								CL ML	Silty clay, mod. reddish brown 10R 4/6 w/med. l. grey N6 fat clay heavily mottled, moist, firm @ 15' stiff @ 15.5' l" shale fragment, angular @ 18' very silty @ 20' trace to some pale yellowish brown 10YR 6/2 silt		
11	SS	15.0	16.5	2-4-5	1.5		15				
12	SS	16.5	18.0	3-5-9	1.5						
13	SS	18.0	19.5	3-6-8	1.41						
14	SS	19.5	21.0	3-5-7	1.41						

Continued Next Page

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **AMEC FOSTER WHEELER**

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY — BORING NO. MW-1605S — DATE 4/27/16 — SHEET 2 OF 3

PROJECT ROCKPORT PLANT — BORING START 3/1/16 — BORING FINISH 3/1/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DRILLER'S NOTES
15	SS	21.0	22.5	3-4-7	1.5		
16	SS	22.5	24.0	4-4-5	1.5		
17	SS	24.0	25.5	1-1-3	1.5		
18	SS	25.5	27.0	1-1-1	1.5		
19	SS	27.0	28.5	2-1-4	1.5		
20	SS	28.5	30.0	5-6-7	1.33		
21	SS	30.0	31.5	3-5-7	1.25		
22	SS	31.5	33.0	5-7-8	1.5		
23	SS	33.0	34.5	3-3-6	1.41		
24	SS	34.5	36.0	2-4-5	1.5		
25	SS	36.0	37.5	2-4-6	1.33		
26	SS	37.5	39.0	4-3-8	1.5		
27	SS	39.0	40.5	3-3-5	1.5		
28	SS	40.5	42.0	11-8-10	1.25		Begin Mud Rotary @ 40.5'
29	SS	42.0	43.5	4-5-11	1.5		
30	SS	43.5	45.0	8-9-9	1.16		
31	SS	45.0	46.5	6-9-14	1.5		

Depth in feet: 25, 30, 35, 40, 45

USCS	SOIL / ROCK IDENTIFICATION
ML	Clayey silt, pale yellowish brown 10YR 6/2, moist, med. dense, w/silty clay (prev. material), trace sand
SP	Poorly graded sand, v. fine to fine grained, l. brown 5YR 5/6, moist, loose @ 23.2' 2" clayey silt seam (prev. material)
ML	Clayey silt, pale yellowish brown 10YR 6/2, moist to wet, v. loose @ 25' 2" l. brown sand seam (prev. material) @ 26' 2" l. brown sand seam @ 26.4' 15" l. brown sand seam @ 26.8' l" l. brown sand seam @ 27' loose @ 28' 2" l. brown sand seam
SP	Poorly graded sand, fine grained, l. brown 5YR 5/6, moist, med. dense @ 30' d. yellowish orange 10YR 6/6 @ 31' 3" clayey silt seam (prev. material) @ 32.3' trace fine gravel and black silt @ 32.5' no fine gravel or silt @ 33' moist, loose @ 34.1' 2" clayey silt seam (prev. material) @ 34.5' moist to wet, water in spoon @ 34.9' 2.5' clayey silt seam (prev. material)
SW	Well graded sand, fine grained, l. brown 5YR 5/6, moist to wet, med. dense, w/fine gravel
SW	Well graded sand, coarse grained, grayish black N2, moist to wet, med. dense, trace fine gravel
SP	Poorly graded sand, v. fine grained, l. brown 5YR 5/6, moist to wet, med. dense
SW	Well graded sand, fine to med. grained, moderate yellowish brown 10YR 5/4, moist to wet, loose @ 40.5' med. dense @ 41' 1.5" shale seam w/clay
SP	Poorly graded sand, v. fine to fine grained, mod. yellowish brown 10YR 5/4, moist to wet, med. dense
SW	Well graded sand, med. grained, mod. reddish brown 10R 4/6, moist to wet, med. dense @ 44' med. to coarse grained
SP	Poorly graded sand, fine grained, mod. yellowish

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1605S** DATE **4/27/16** SHEET **3** OF **3**

PROJECT **ROCKPORT PLANT** BORING START **3/1/16** BORING FINISH **3/1/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
32	SS	46.5	48.0	6-8-11	1.5				SW	brown 10YR 5/4, moist to wet, mod. dense, some fine gravel		
									SP	Well graded sand, med. to coarse grained, mod. reddish brown 10R 4/6, moist to wet, med. dense, trace fine gravel		
33	SS	48.0	49.5	6-10-14	1.5					Poorly graded sand, fine grained, mod. yellowish brown 10YR 5/4, moist to wet, med. dense, trace fine gravel @ 48' w/fine gravel, trace coarse gravel @ 49.5' no coarse gravel		

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER **42393125-01**

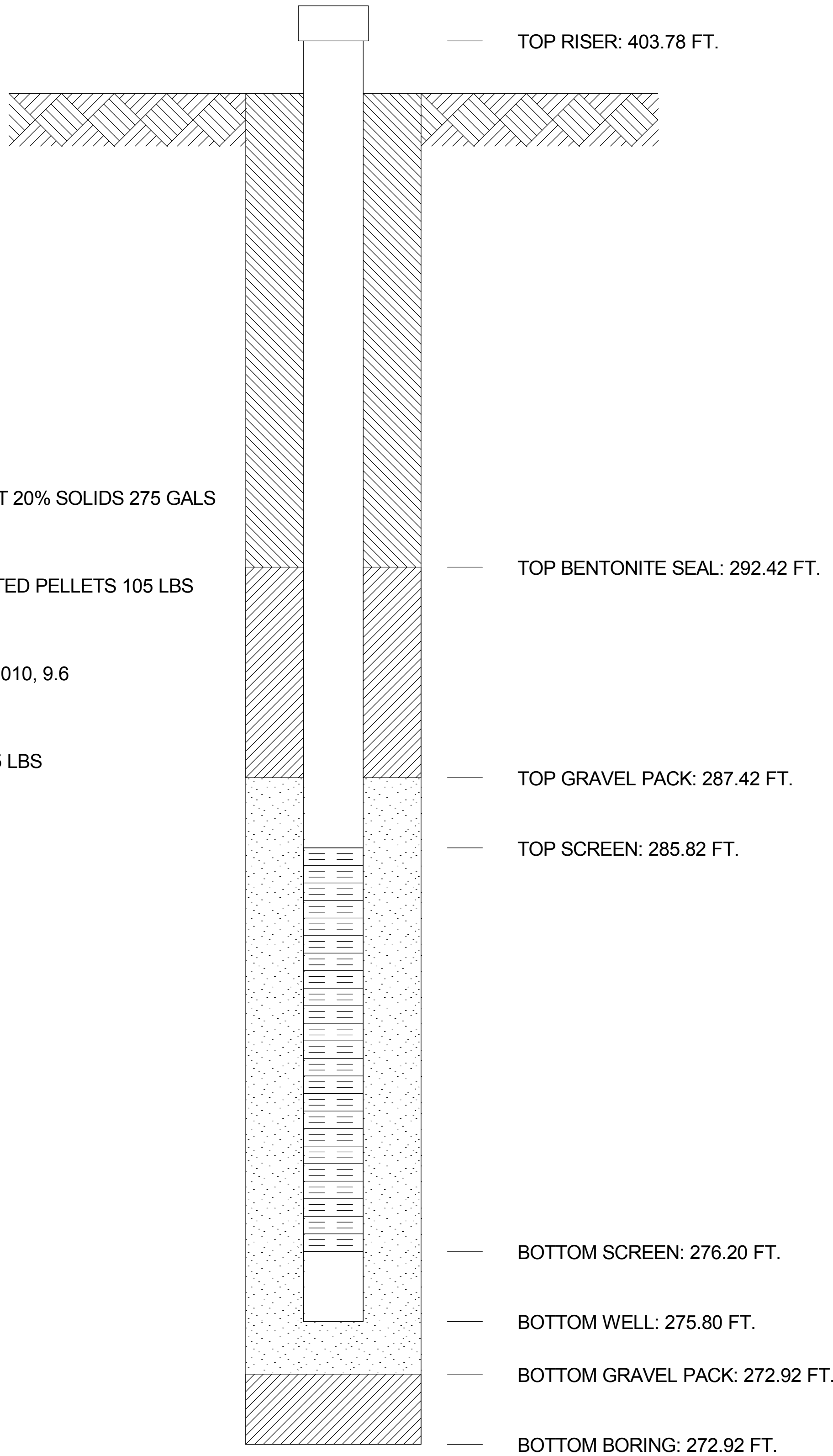
COMPANY **INDIANA MICHIGAN POWER COMPANY** WELL No. **MW-1605D** BORING No. **MW-1605D** INSTALLED **2/3/16**

PROJECT **ROCKPORT PLANT**

COORDINATES **N 151,478.9 E 513,537.1**

SYSTEM **State Plane using NAD27/29**

GROUND ELEVATION 400.42 FT.



GROUT SEAL: QUICK GROUT 20% SOLIDS 275 GALS

BENTONITE SEAL: 3/8" COATED PELLETS 105 LBS

SCREEN: 2.0 dia., SLOTTED .010, 9.6

GRAVEL PACK: #5 SAND 375 LBS

RISER PIPE: 2.0, dia., PVC

SPACERS, DEPTH:

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

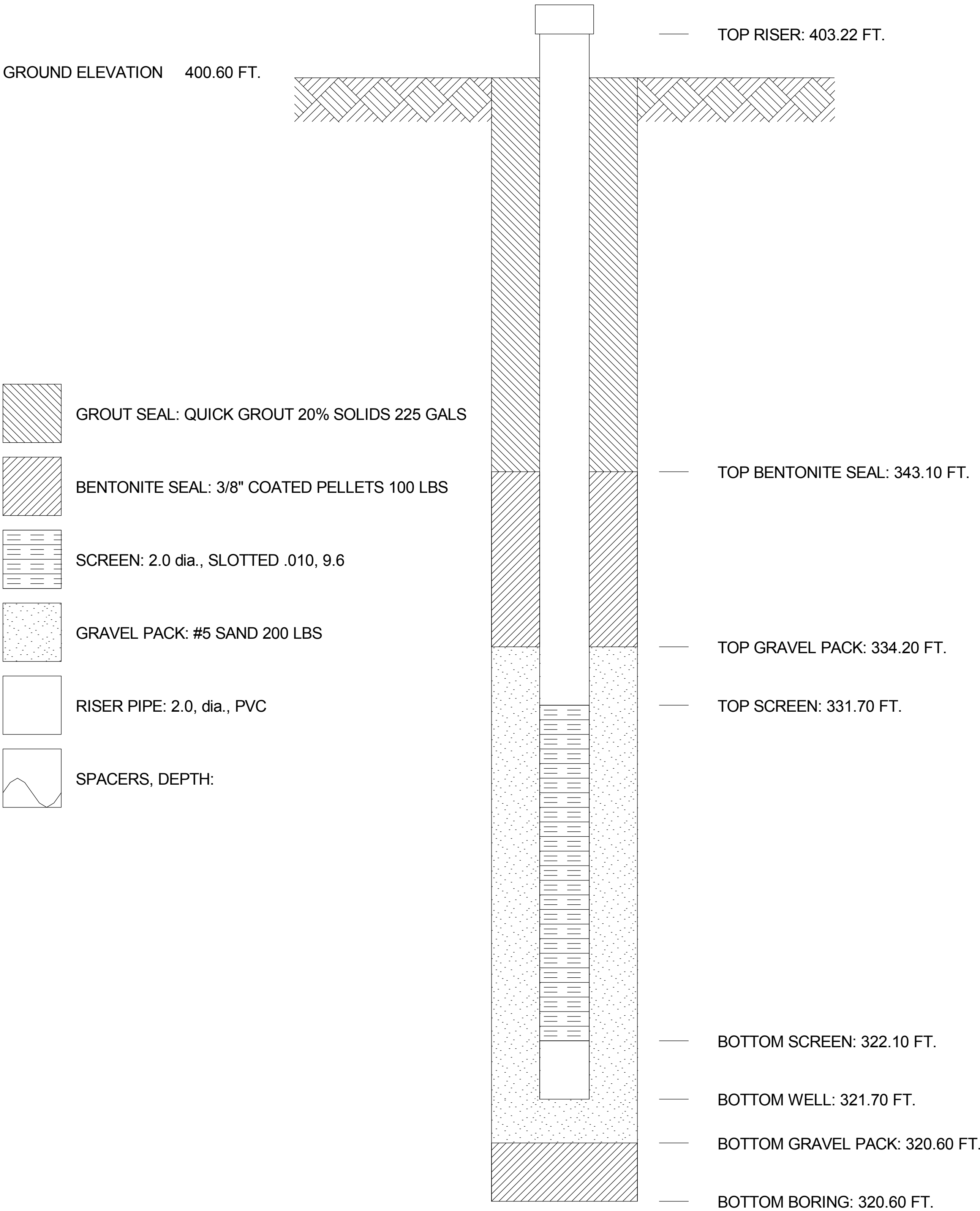
JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** WELL No. **MW-1605I** BORING No. **MW-1605I** INSTALLED **3/2/16**

PROJECT **ROCKPORT PLANT**

COORDINATES **N 151,478.9 E 513,532.6**

SYSTEM **State Plane using NAD27/29**



GEOMCNST RK BAP CCR COMPLIANCE.GPJ AEP.GDT 4/27/16

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER **42393125-01**

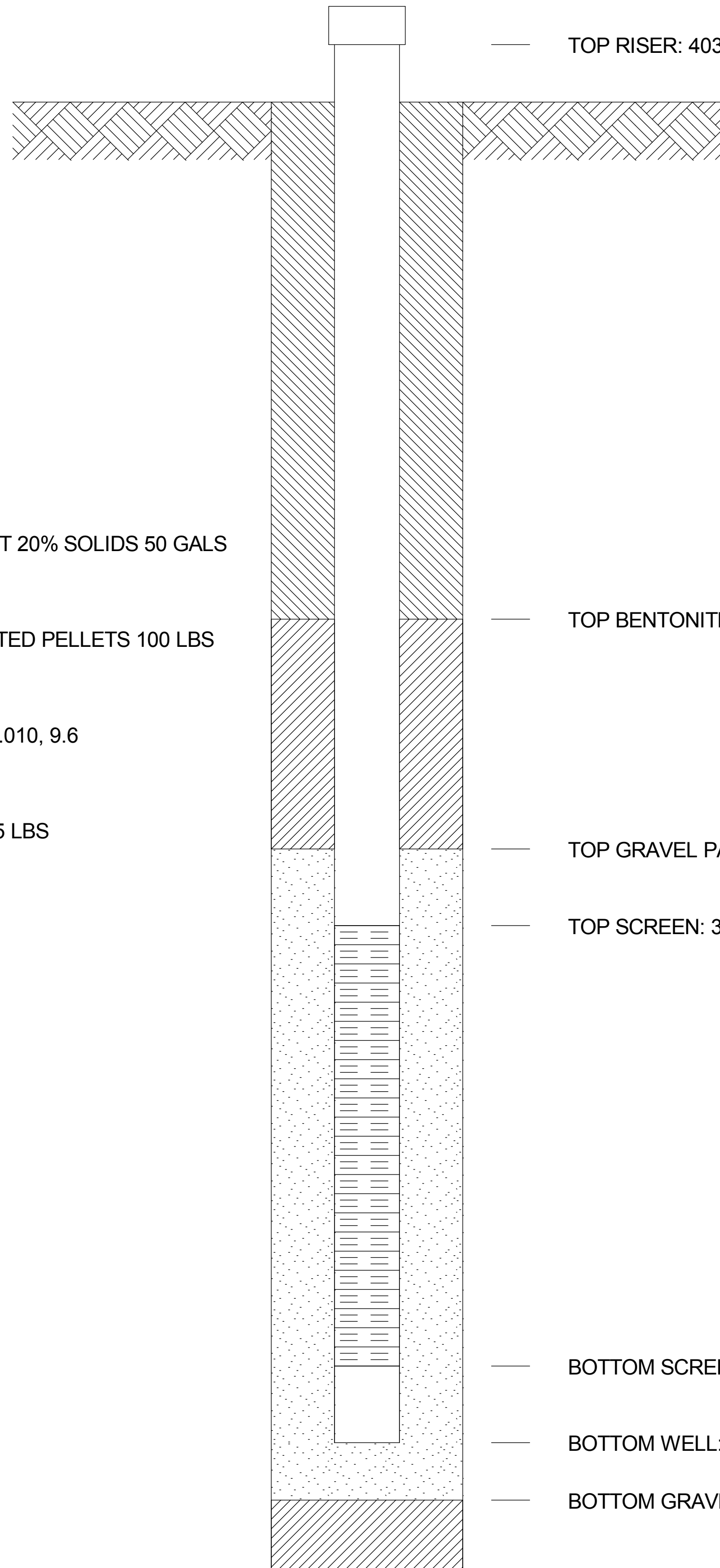
COMPANY **INDIANA MICHIGAN POWER COMPANY** WELL No. **MW-1605S** BORING No. **MW-1605S** INSTALLED **3/1/16**

PROJECT **ROCKPORT PLANT**

COORDINATES **N 151,478.8 E 513,528.4**

SYSTEM **State Plane using NAD27/29**

GROUND ELEVATION 400.33 FT.



TOP RISER: 403.38 FT.

TOP BENTONITE SEAL: 370.43 FT.

TOP GRAVEL PACK: 365.03 FT.

TOP SCREEN: 362.73 FT.

BOTTOM SCREEN: 353.20 FT.

BOTTOM WELL: 352.80 FT.

BOTTOM GRAVEL PACK: 351.33 FT.

BOTTOM BORING: 351.33 FT.

GROUT SEAL: QUICK GROUT 20% SOLIDS 50 GALS

BENTONITE SEAL: 3/8" COATED PELLETS 100 LBS

SCREEN: 2.0 dia., SLOTTED .010, 9.6

GRAVEL PACK: #5 SAND 245 LBS

RISER PIPE: 2.0, dia., PVC

SPACERS, DEPTH:

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1606D** DATE **4/27/16** SHEET **1** OF **5**

PROJECT **ROCKPORT PLANT** BORING START **2/12/16** BORING FINISH **2/12/16**

COORDINATES **N 151,502.1 E 512,881.5** PIEZOMETER TYPE ______ WELL TYPE **OW**

GROUND ELEVATION **397.8** SYSTEM **State Plane using NAD27/29** HGT. RISER ABOVE GROUND **2.91** DIA **2.0**

DEPTH TO TOP OF WELL SCREEN **100.2** BOTTOM **109.82**

WELL DEVELOPMENT **YES** BACKFILL ______

FIELD PARTY **ZLR / REB** RIG **D-120**

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	3-5-9	1.5					Crushed stone gravel (limestone)		
									CL	Lean clay, moderate yellowish brown 10YR 5/4, moist, trace fine grained sand, stiff		
2	SS	1.5	3.0	4-7-9	1.5					@ 1.5' as above, trace coarse grain sand and black decomposed organic staining @ 3' trace fine gravel		
3	SS	3.0	4.5	3-4-6	1.3							
4	SS	4.5	6.0	1-2-8	1.3		5					
									CL	Lean clay, pale yellow brown 10YR 6/2, moist, some light brown oxide staining @ 6.0' yellow brown and brown 10YR 5/4 @ 7.5' pale yellow brown 10YR 6/2, trace fine roots, trace fine grained sand		
5	SS	6.0	7.5	5-9-10	1.5							
6	SS	7.5	9.0	3-6-9	1.5				CL	Lean clay w/sand, dark yellow brown 10YR 4/2, moist, little fine grained sand		
7	SS	9.0	10.5	2-4-5	1.5				CL	Lean clay, light bluish gray 5B 7/1, moist, some brown oxide staining, trace coarse grained sand @ 12.5' as above, becomes moderate brown in color 5YR 4/4 @ 13.5' moderate yellow brown 10YR 5/4 and pale yellow brown 10YR 6/2) mottled @ 13.5' - 15' trace fine grained sand, trace fine gravel @ 19.5' mostly 10YR 6/2 in color		
							10					
8	SS	10.5	12.0	3-4-6	1.5							
9	SS	12.0	13.5	3-5-9	1.5							
10	SS	13.5	15.0	4-5-7	1.5							
11	SS	15.0	16.5	3-5-6	1.5		15					
12	SS	16.5	18.0	3-4-6	1.5							
13	SS	18.0	19.5	2-5-7	1.5							
14	SS	19.5	21.0	3-3-6	1.5							

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TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **AMEC FOSTER WHEELER**

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1606D** DATE **4/27/16**

PROJECT **ROCKPORT PLANT** BORING START **2/12/16** BORING FINISH **2/12/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
15	SS	21.0	22.5	3-4-5	1.5						
16	SS	22.5	24.0	2-4-6	1.5			CL ML	Silty clay, pale yellow brown 10YR 6/2, moist, trace to little fine grained sand		
17	SS	24.0	25.5	1-2-5	1.2		25	SP SM	Poorly graded sand w/silt, pale yellow brown 10YR 6/2, moist, fine to medium grained sand @ 24.9' 3" silt layer		
18	SS	25.5	27.0	2-4-6	1.5			CL	Lean clay, moderate yellowish brown 10YR 5/4, moist, few sandy layers <1" thick @ 28.3' SP-SM layer (~3" thick)		
19	SS	27.0	28.5	1-5-9	1.3						
20	SS	28.5	30.0	4-4-5	1.3			SP SM	Poorly graded sand w/silt, dark yellowish orange 10YR 6/6, wet, fine to medium grained sand, little coarse grained sand @ 31.5' trace fine gravel @ 34.5' trace fine gravel		
21	SS	30.0	31.5	5-7-8	1.5		30				
22	SS	31.5	33.0	3-3-4	1.1						
23	SS	33.0	34.5	1-2-5	0						
24	SS	34.5	36.0	3-4-8	.8		35				
25	SS	36.0	37.5	3-5-7	1.0						
26	SS	37.5	39.0	5-6-7	.9			SP	Poorly graded sand, dark yellowish orange 10YR 6/6, wet, fine to medium grained sand, trace to little coarse grained sand @ 37.5' trace gravel		
27	SS	39.0	40.5	4-7-20	1.2		40	SP SM	Poorly graded sand w/silt, dark yellowish orange 10YR 6/6, wet, fine to medium grained sand, trace coarse grained sand		
28	SS	40.5	42.0	7-7-8	1.1			SC	Clayey sand, moderate brown 5YR 3/4, wet, fine to medium grained sand		
29	SS	42.0	43.5	4-6-10	1.0			SP	Poorly graded sand, dark yellowish orange 10YR 6/6, wet, fine to medium grained sand, trace coarse grained sand & fine gravel @ 42.0' - 43.5' increase in coarse grained sand @ 45.2' - 45.5' color change to moderate brown 5YR 4/4 @ 46.5' increase in coarse grained sand, trace wood fragments (tree bark) @ 48' color change to pale yellowish brown 10YR		
30	SS	43.5	45.0	4-5-7	1.0		45				
31	SS	45.0	46.5	4-6-10	1.2						

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JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY BORING NO. MW-1606D DATE 4/27/16 SHEET 3 OF 5

PROJECT ROCKPORT PLANT BORING START 2/12/16 BORING FINISH 2/12/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										6/2, few black decomposed organic layers		
32	SS	46.5	48.0	8-9-11	1.1							
33	SS	48.0	49.5	6-10-13	1.1							
34	SS	49.5	51.0	18-13-13	.9		50		SW SM	Well graded sand w/silt & gravel, wet, pale yellowish brown 10YR 6/2, fine to coarse grained sand, little to some fine gravel, trace coarse gravel		
35	SS	51.0	52.5	7-14-16	1.1				SP SM	Poorly graded sand w/silt, moderate yellowish brown 10YR 5/4, wet, fine to medium grained sand, trace coarse grained sand, few layers of decomposed organics (from 51' - 52.5') @ 54' trace coarse gravel, fines between 5 - 10% @ 55.5' trace fine gravel		
36	SS	52.5	54.0	7-9-15	1.0							
37	SS	54.0	55.5	10-10-14	1.2		55					
38	SS	55.5	57.0	8-10-13	1.2							
39	SS	57.0	58.5	7-9-9	1.3				SW	Well graded sand, med. to coarse grained, dark yellowish brown 10YR 4/2), wet, med. dense, trace fine gravel @ 59' trace coarse gravel		
40	SS	58.5	60.0	4-5-9	1.2							
41	SS	60.0	61.5	6-6-9	1.5		60		SP	Poorly graded sand, fine grained, dusky yellowish brown 10YR 2/2, wet, med. dense, w/fine gravel @ 60.5' 2" shale fragment @ 61.5' dark yellowish brown 10YR 4/2, dense @ 61.8' 2" shale fragment @ 62' some lean clay, pale yellowish brown (prev. material) @ 62.5' no clay, trace fine gravel @ 63' no fine gravel @ 64.5' med. dense @ 65.8' 15" coarse sand seam (prev. material) @ 66' dense @ 67.2' 3" shale seam, med. l. grey N6 @ 67.7' med. grained		
42	SS	61.5	63.0	6-13-21	1.5							
43	SS	63.0	64.5	10-17-31	1.3							
44	SS	64.5	66.0	13-13-17	1.4		65					
45	SS	66.0	67.5	6-14-18	1.5							
46	SS	67.5	69.0	9-14-17	1.5				SP	Poorly graded sand, fine gravel, pale yellowish brown 10YR 6.2, wet, dense @ 69' moist to v. moist @ 72' med. dense, fine grained @ 75' dense, d. yellowish brown 10YR 4.2 @ 76.5' med. dense, trace black silt @ 80.6 3" shale plug (responsible for increase in N value (same material)) @ 81.3' 1.5" shale plug, dense		
47	SS	69.0	70.5	10-20-20	1.1							
48	SS	70.5	72.0	10-19-26	1.4		70					

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1606D** DATE **4/27/16** SHEET **4** OF **5**

PROJECT **ROCKPORT PLANT** BORING START **2/12/16** BORING FINISH **2/12/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
49	SS	72.0	73.5	7-10-17	1.3					@ 81.5' no recovery, potential cobble blocking during sampling		
50	SS	73.5	75.0	8-9-13	1.2							
51	SS	75.0	76.5	10-16-25	1.4		75					
52	SS	76.5	78.0	9-10-14	1.4							
53	SS	78.0	79.5	6-9-18	1.5							
54	SS	79.5	81.0	10-17-34	1.5		80					
55	SS	81.0	82.5	31-19-14	1.3							
56	SS	82.5	84.0	10-16-21	1.5				CH	Fat clay, med. l. grey N6, moist, firm		
									SW	Well graded sand, med. grained, dark yellowish brown 10YR 4/2, wet, dense, w/fine gravel @ 83' coal fragment (2" diam., 1" thick) @ 83.6' coal fragment (2" diam, 1" thick)		
57	SS	84.0	85.5	9-19-21	1.5		85					
58	SS	85.5	87.0	7-15-24	1.3				SP	Poorly graded sand, fine grained, pale yellowish brown 10YR 6/2, wet, dense @ 88.5' trace fine gravel @ 91.5' with fine gravel		
59	SS	87.0	88.5	10-13-20	1.2							
60	SS	88.5	90.0	8-14-23	1.4							
61	SS	90.0	91.5	8-13-27	1.3		90					
62	SS	91.5	93.0	8-7-16	1.5							
63	SS	93.0	94.5	7-9-15	1.5							
									SW	Well graded sand, med. to coarse grained, dark yellowish brown 10YR 4/2, wet, med. dense, w/fine gravel		
64	SS	94.5	96.0	12-12-14	1.5		95		SP	Poorly graded sand, coarse grained, greyish red 5R 4/2, wet, med. dense, trace fine gravel		
									SW	Well graded sand, med. to coarse grained, dark yellowish brown 10YR 4/2, wet, med. dense, w/fine gravel		
65	SS	96.0	97.5	3-5-5	1.5				SP			
66	SS	97.5	99.0	5-5-6	1.4				SP			

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1606D** DATE **4/27/16** SHEET **5** OF **5**

PROJECT **ROCKPORT PLANT** BORING START **2/12/16** BORING FINISH **2/12/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										Poorly graded sand, coarse grained, greyish red 5R 4/2, wet, med. dense to loose, trace fine gravel		
67	SS	99.0	100.5	4-5-7	1.5					Poorly graded sand, fine grained, pale yellowish brown 10YR 6/2, wet, loose		
							100			@ 97.5' med. dense, fine grained		
68	SS	100.5	102.0	7-7-10	1.4				SP	Poorly graded sand, fine to fine grained, dusky red 5R 3/4, wet, med. dense		
69	SS	102.0	103.5	4-4-6	1.5					@ 102' loose, fine grained, moist @ 103.5' med. dense @ 105' fine grained		
70	SS	103.5	105.0	5-6-10	1.3					@ 106.5' dense @ 108' med. dense, trace fine gravel @ 109' no fine gravel @110.6' siltstone fragments to 2.5", moderate		
71	SS	105.0	106.5	4-6-9	1.5		105			brown 5YR 4/4, shiny, angular		
72	SS	106.5	108.0	7-11-20	1.4							
73	SS	108.0	109.5	8-13-15	1.5							
74	SS	109.5	111.0	10-18-11	1.3		110					
75	SS	111.0	112.5	14-50/3					ML	Silt, l. grey N7, moist, med. dense, non-durable shale @ 111' clayey silt, hard		
76	SS	112.5	114.0	50/4						Spoon refusal @ 111.7' Auger refusal @ 112.9 BT @ 112.9'		

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER	**42393125-01**				
COMPANY	**INDIANA MICHIGAN POWER COMPANY**	BORING NO.	**MW-1606I**	DATE **4/27/16**	SHEET **1** OF **4**
PROJECT	**ROCKPORT PLANT**	BORING START	**3/1/16**	BORING FINISH	**3/1/16**
COORDINATES	**N 151,500.4 E 512,885.5**	PIEZOMETER TYPE		WELL TYPE	**OW**
GROUND ELEVATION	**397.8** SYSTEM **State Plane using NAD27/29**	HGT. RISER ABOVE GROUND	**3.00**	DIA	**2.0**
		DEPTH TO TOP OF WELL SCREEN	**65.4**	BOTTOM	**75.05**
		WELL DEVELOPMENT	**YES**	BACKFILL	
		FIELD PARTY	**ZLR / REB**	RIG	**D-120**

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	3-5-9	1.5				CL	Crushed stone gravel (limestone) Lean clay, moderate yellowish brown 10YR 5/4, moist, trace fine grained sand, stiff		
2	SS	1.5	3.0	4-7-9	1.5					@ 1.5' as above, trace coarse grain sand and black decomposed organic staining @ 3' trace fine gravel		
3	SS	3.0	4.5	3-4-6	1.3							
4	SS	4.5	6.0	1-2-8	1.3		5					
5	SS	6.0	7.5	5-9-10	1.5				CL	Lean clay, pale yellow brown 10YR 6/2, moist, some light brown oxide staining @ 6.0' yellow brown and brown 10YR 5/4 @ 7.5' pale yellow brown 10YR 6/2, trace fine roots, trace fine grained sand		
6	SS	7.5	9.0	3-6-9	1.5				CL	Lean clay w/sand, dark yellow brown 10YR 4/2, moist, little fine grained sand		
7	SS	9.0	10.5	2-4-5	1.5		10		CL	Lean clay, light bluish gray 5B 7/1, moist, some brown oxide staining, trace coarse grained sand @ 12.5' as above, becomes moderate brown in color 5YR 4/4 @ 13.5' moderate yellow brown 10YR 5/4 and pale yellow brown 10YR 6/2) mottled @ 13.5' - 15' trace fine grained sand, trace fine gravel @ 19.5' mostly 10YR 6/2 in color		
8	SS	10.5	12.0	3-4-6	1.5							
9	SS	12.0	13.5	3-5-9	1.5							
10	SS	13.5	15.0	4-5-7	1.5		15					
11	SS	15.0	16.5	3-5-6	1.5							
12	SS	16.5	18.0	3-4-6	1.5							
13	SS	18.0	19.5	2-5-7	1.5							
14	SS	19.5	21.0	3-3-6	1.5							

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **AMEC FOSTER WHEELER**

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1606I** DATE **4/27/16** SHEET **2** OF **4**

PROJECT **ROCKPORT PLANT** BORING START **3/1/16** BORING FINISH **3/1/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	SAMPLE DEPTH IN FEET TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %
15	SS	21.0	22.5	3-4-5	1.5	
16	SS	22.5	24.0	2-4-6	1.5	
17	SS	24.0	25.5	1-2-5	1.2	
18	SS	25.5	27.0	2-4-6	1.5	
19	SS	27.0	28.5	1-5-9	1.3	
20	SS	28.5	30.0	4-4-5	1.3	
21	SS	30.0	31.5	5-7-8	1.5	
22	SS	31.5	33.0	3-3-4	1.1	
23	SS	33.0	34.5	1-2-5	0	
24	SS	34.5	36.0	3-4-8	.8	
25	SS	36.0	37.5	3-5-7	1.0	
26	SS	37.5	39.0	5-6-7	.9	
27	SS	39.0	40.5	4-7-20	1.2	
28	SS	40.5	42.0	7-7-8	1.1	
29	SS	42.0	43.5	4-6-10	1.0	
30	SS	43.5	45.0	4-5-7	1.0	
31	SS	45.0	46.5	4-6-10	1.2	

DEPTH IN FEET: 25, 30, 35, 40, 45

USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
CL ML	Silty clay, pale yellow brown 10YR 6/2, moist, trace to little fine grained sand		
SP SM	Poorly graded sand w/silt, pale yellow brown 10YR 6/2, moist, fine to medium grained sand @ 24.9' 3" silt layer		
CL	Lean clay, moderate yellowish brown 10YR 5/4, moist, few sandy layers <1" thick @ 28.3' SP-SM layer (~3" thick)		
SP SM	Poorly graded sand w/silt, dark yellowish orange 10YR 6/6, wet, fine to medium grained sand, little coarse grained sand @ 31.5' trace fine gravel @ 34.5' trace fine gravel		
SP	Poorly graded sand, dark yellowish orange 10YR 6/6, wet, fine to medium grained sand, trace to little coarse grained sand @ 37.5' trace gravel		
SP SM	Poorly graded sand w/silt, dark yellowish orange 10YR 6/6, wet, fine to medium grained sand, trace coarse grained sand		
SC	Clayey sand, moderate brown 5YR 3/4, wet, fine to medium grained sand		
SP	Poorly graded sand, dark yellowish orange 10YR 6/6, wet, fine to medium grained sand, trace coarse grained sand & fine gravel @ 42.0' - 43.5' increase in coarse grained sand @ 45.2' - 45.5' color change to moderate brown 5YR 4/4 @ 46.5' increase in coarse grained sand, trace wood fragments (tree bark) @ 48' color change to pale yellowish brown 10YR		

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1606I** DATE **4/27/16** SHEET **3** OF **4**

PROJECT **ROCKPORT PLANT** BORING START **3/1/16** BORING FINISH **3/1/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
32	SS	46.5	48.0	8-9-11	1.1					6/2, few black decomposed organic layers		
33	SS	48.0	49.5	6-10-13	1.1							
34	SS	49.5	51.0	18-13-13	.9		50		SW SM	Well graded sand w/silt & gravel, wet, pale yellowish brown 10YR 6/2, fine to coarse grained sand, little to some fine gravel, trace coarse gravel		
35	SS	51.0	52.5	7-14-16	1.1				SP SM	Poorly graded sand w/silt, moderate yellowish brown 10YR 5/4, wet, fine to medium grained sand, trace coarse grained sand, few layers of decomposed organics (from 51' - 52.5') @ 54' trace coarse gravel, fines between 5 - 10% @ 55.5' trace fine gravel		
36	SS	52.5	54.0	7-9-15	1.0							
37	SS	54.0	55.5	10-10-14	1.2		55					
38	SS	55.5	57.0	8-10-13	1.2							
39	SS	57.0	58.5	7-9-9	1.3				SW	Well graded sand, med. to coarse grained, dark yellowish brown 10YR 4/2), wet, med. dense, trace fine gravel @ 59' trace coarse gravel		
40	SS	58.5	60.0	4-5-9	1.2							
41	SS	60.0	61.5	6-6-9	1.5		60		SP	Poorly graded sand, fine grained, dusky yellowish brown 10YR 2/2, wet, med. dense, w/fine gravel @ 60.5' 2" shale fragment @ 61.5' dark yellowish brown 10YR 4/2, dense @ 61.8' 2" shale fragment @ 62' some lean clay, pale yellowish brown (prev. material) @ 62.5' no clay, trace fine gravel @ 63' no fine gravel @ 64.5' med. dense @ 65.8' 15" coarse sand seam (prev. material) @ 66' dense @ 67.2' 3" shale seam, med. l. grey N6 @ 67.7' med. grained		
42	SS	61.5	63.0	6-13-21	1.5							
43	SS	63.0	64.5	10-17-31	1.3							
44	SS	64.5	66.0	13-13-17	1.4		65					
45	SS	66.0	67.5	6-14-18	1.5							
46	SS	67.5	69.0	9-14-17	1.5				SP	Poorly graded sand, fine gravel, pale yellowish brown 10YR 6.2, wet, dense @ 69' moist to v. moist @ 72' med. dense, fine grained @ 75' dense, d. yellowish brown 10YR 4.2 @ 76.5' med. dense, trace black silt @ 80.6 3" shale plug (responsible for increase in N value (same material)) @ 81.3' 1.5" shale plug, dense		
47	SS	69.0	70.5	10-20-20	1.1		70					
48	SS	70.5	72.0	10-19-26	1.4							

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY | BORING NO. MW-1606I | DATE 4/27/16 | SHEET 4 OF 4

PROJECT ROCKPORT PLANT | BORING START 3/1/16 | BORING FINISH 3/1/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
49	SS	72.0	73.5	7-10-17	1.3					@ 81.5' no recovery, potential cobble blocking during sampling		
50	SS	73.5	75.0	8-9-13	1.2							
51	SS	75.0	76.5	10-16-25	1.4		75					
52	SS	76.5	78.0	9-10-14	1.4							

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY**

PROJECT **ROCKPORT PLANT**

COORDINATES **N 151,498.9 E 512,889.4**

GROUND ELEVATION **397.6** SYSTEM **State Plane using NAD27/29**

BORING NO. **MW-1606S** DATE **4/27/16** SHEET **1** OF **3**

BORING START **3/2/16** BORING FINISH **3/2/16**

PIEZOMETER TYPE WELL TYPE **OW**

HGT. RISER ABOVE GROUND **3.03** DIA **2.0**

DEPTH TO TOP OF WELL SCREEN **34.6** BOTTOM **44.22**

WELL DEVELOPMENT **YES** BACKFILL

FIELD PARTY **ZLR / REB** RIG **D-120**

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	3-5-9	1.5					Crushed stone gravel (limestone)		
									CL	Lean clay, moderate yellowish brown 10YR 5/4, moist, trace fine grained sand, stiff		
2	SS	1.5	3.0	4-7-9	1.5					@ 1.5' as above, trace coarse grain sand and black decomposed organic staining		
										@ 3' trace fine gravel		
3	SS	3.0	4.5	3-4-6	1.3							
4	SS	4.5	6.0	1-2-8	1.3		5					
									CL	Lean clay, pale yellow brown 10YR 6/2, moist, some light brown oxide staining		
5	SS	6.0	7.5	5-9-10	1.5					@ 6.0' yellow brown and brown 10YR 5/4		
										@ 7.5' pale yellow brown 10YR 6/2, trace fine roots, trace fine grained sand		
6	SS	7.5	9.0	3-6-9	1.5				CL	Lean clay w/sand, dark yellow brown 10YR 4/2, moist, little fine grained sand		
7	SS	9.0	10.5	2-4-5	1.5				CL	Lean clay, light bluish gray 5B 7/1, moist, some brown oxide staining, trace coarse grained sand		
							10			@ 12.5' as above, becomes moderate brown in color 5YR 4/4		
8	SS	10.5	12.0	3-4-6	1.5					@ 13.5' moderate yellow brown 10YR 5/4 and pale yellow brown 10YR 6/2) mottled		
9	SS	12.0	13.5	3-5-9	1.5					@ 13.5' - 15' trace fine grained sand, trace fine gravel		
										@ 19.5' mostly 10YR 6/2 in color		
10	SS	13.5	15.0	4-5-7	1.5							
11	SS	15.0	16.5	3-5-6	1.5		15					
12	SS	16.5	18.0	3-4-6	1.5							
13	SS	18.0	19.5	2-5-7	1.5							
14	SS	19.5	21.0	3-3-6	1.5							

Continued Next Page

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **AMEC FOSTER WHEELER**

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1606S** DATE **4/27/16** SHEET **2** OF **3**

PROJECT **ROCKPORT PLANT** BORING START **3/2/16** BORING FINISH **3/2/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
15	SS	21.0	22.5	3-4-5	1.5							
16	SS	22.5	24.0	2-4-6	1.5				CL ML	Silty clay, pale yellow brown 10YR 6/2, moist, trace to little fine grained sand		
17	SS	24.0	25.5	1-2-5	1.2		25		SP SM	Poorly graded sand w/silt, pale yellow brown 10YR 6/2, moist, fine to medium grained sand @ 24.9' 3" silt layer		
18	SS	25.5	27.0	2-4-6	1.5				CL	Lean clay, moderate yellowish brown 10YR 5/4, moist, few sandy layers <1" thick @ 28.3' SP-SM layer (~3" thick)		
19	SS	27.0	28.5	1-5-9	1.3							
20	SS	28.5	30.0	4-4-5	1.3		30		SP SM	Poorly graded sand w/silt, dark yellowish orange 10YR 6/6, wet, fine to medium grained sand, little coarse grained sand @ 31.5' trace fine gravel @ 34.5' trace fine gravel		
21	SS	30.0	31.5	5-7-8	1.5							
22	SS	31.5	33.0	3-3-4	1.1							
23	SS	33.0	34.5	1-2-5	0							
24	SS	34.5	36.0	3-4-8	.8		35					
25	SS	36.0	37.5	3-5-7	1.0							
26	SS	37.5	39.0	5-6-7	.9				SP	Poorly graded sand, dark yellowish orange 10YR 6/6, wet, fine to medium grained sand, trace to little coarse grained sand @ 37.5' trace gravel		
27	SS	39.0	40.5	4-7-20	1.2		40		SP SM	Poorly graded sand w/silt, dark yellowish orange 10YR 6/6, wet, fine to medium grained sand, trace coarse grained sand		
28	SS	40.5	42.0	7-7-8	1.1				SC	Clayey sand, moderate brown 5YR 3/4, wet, fine to medium grained sand		
29	SS	42.0	43.5	4-6-10	1.0				SP	Poorly graded sand, dark yellowish orange 10YR 6/6, wet, fine to medium grained sand, trace coarse grained sand & fine gravel @ 42.0' - 43.5' increase in coarse grained sand @ 45.2' - 45.5' color change to moderate brown 5YR 4/4 @ 46.5' increase in coarse grained sand, trace wood fragments (tree bark) @ 48' color change to pale yellowish brown 10YR		
30	SS	43.5	45.0	4-5-7	1.0		45					
31	SS	45.0	46.5	4-6-10	1.2							

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY BORING NO. MW-1606S DATE 4/27/16 SHEET 3 OF 3

PROJECT ROCKPORT PLANT BORING START 3/2/16 BORING FINISH 3/2/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										6/2, few black decomposed organic layers		

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
MONITORING WELL CONSTRUCTION

JOB NUMBER **42393125-01**

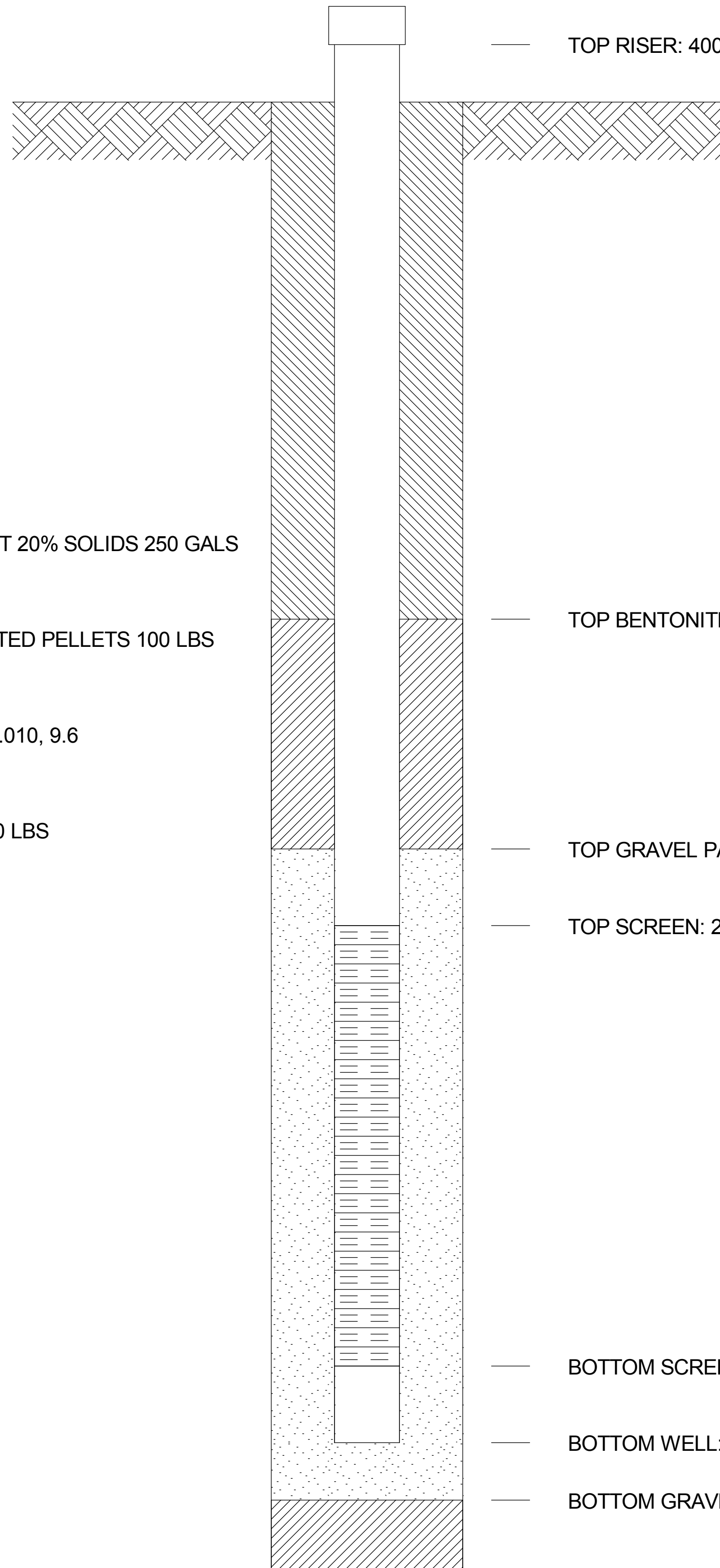
COMPANY **INDIANA MICHIGAN POWER COMPANY** WELL No. **MW-1606D** BORING No. **MW-1606D** INSTALLED **2/12/16**

PROJECT **ROCKPORT PLANT**

COORDINATES **N 151,502.1 E 512,881.5**

SYSTEM **State Plane using NAD27/29**

GROUND ELEVATION 397.82 FT.



TOP RISER: 400.73 FT.

TOP BENTONITE SEAL: 306.32 FT.

TOP GRAVEL PACK: 300.12 FT.

TOP SCREEN: 297.62 FT.

BOTTOM SCREEN: 288.00 FT.

BOTTOM WELL: 287.60 FT.

BOTTOM GRAVEL PACK: 284.92 FT.

BOTTOM BORING: 284.92 FT.

GROUT SEAL: QUICK GROUT 20% SOLIDS 250 GALS

BENTONITE SEAL: 3/8" COATED PELLETS 100 LBS

SCREEN: 2.0 dia., SLOTTED .010, 9.6

GRAVEL PACK: #5 SAND 350 LBS

RISER PIPE: 2.0, dia., PVC

SPACERS, DEPTH:

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER **42393125-01**

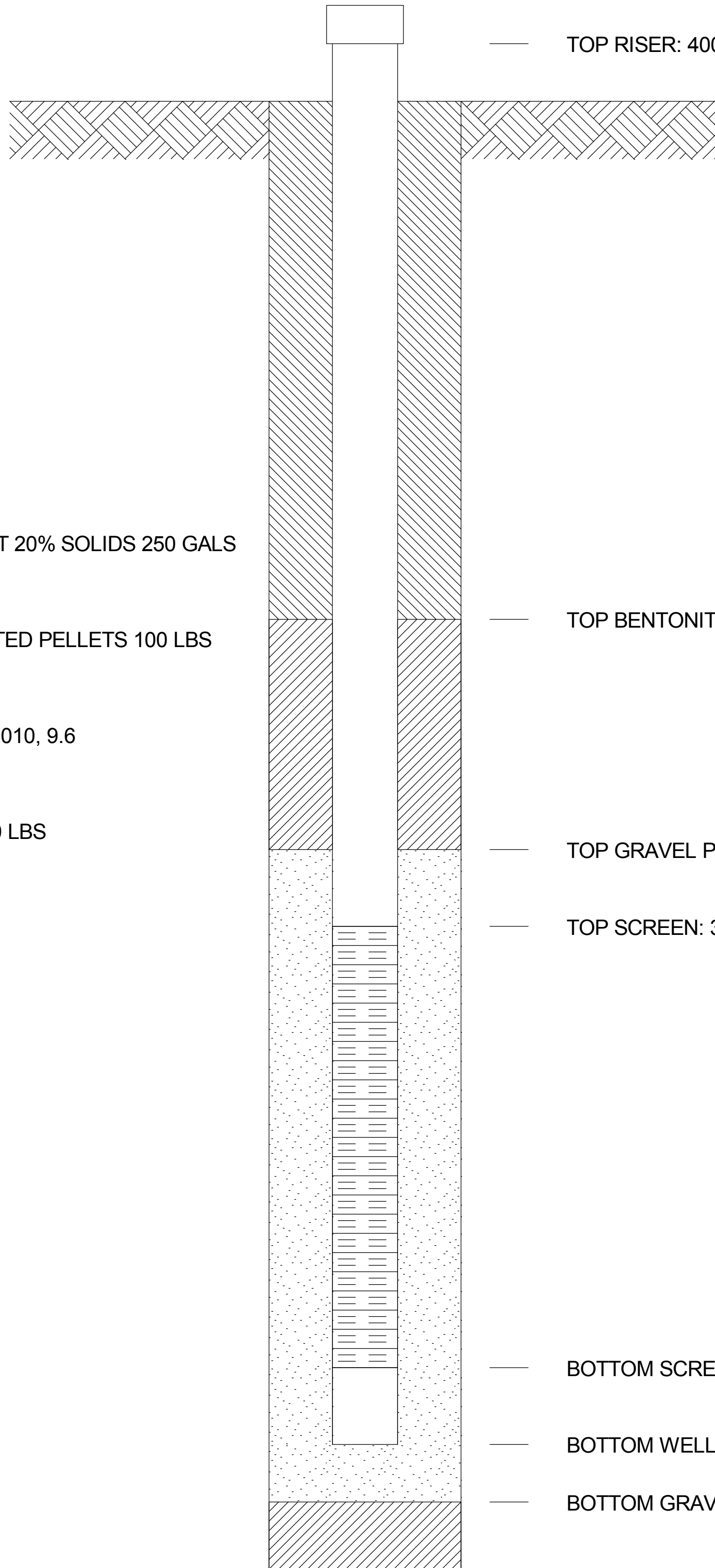
COMPANY **INDIANA MICHIGAN POWER COMPANY** WELL No. **MW-1606I** BORING No. **MW-1606I** INSTALLED **3/1/16**

PROJECT **ROCKPORT PLANT**

COORDINATES **N 151,500.4 E 512,885.5**

SYSTEM **State Plane using NAD27/29**

GROUND ELEVATION 397.75 FT.



GROUT SEAL: QUICK GROUT 20% SOLIDS 250 GALS

BENTONITE SEAL: 3/8" COATED PELLETS 100 LBS

SCREEN: 2.0 dia., SLOTTED .010, 9.6

GRAVEL PACK: #5 SAND 200 LBS

RISER PIPE: 2.0, dia., PVC

SPACERS, DEPTH:

GEOMCNST RK BAP CCR COMPLIANCE.GPJ AEP.GDT 4/27/16

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

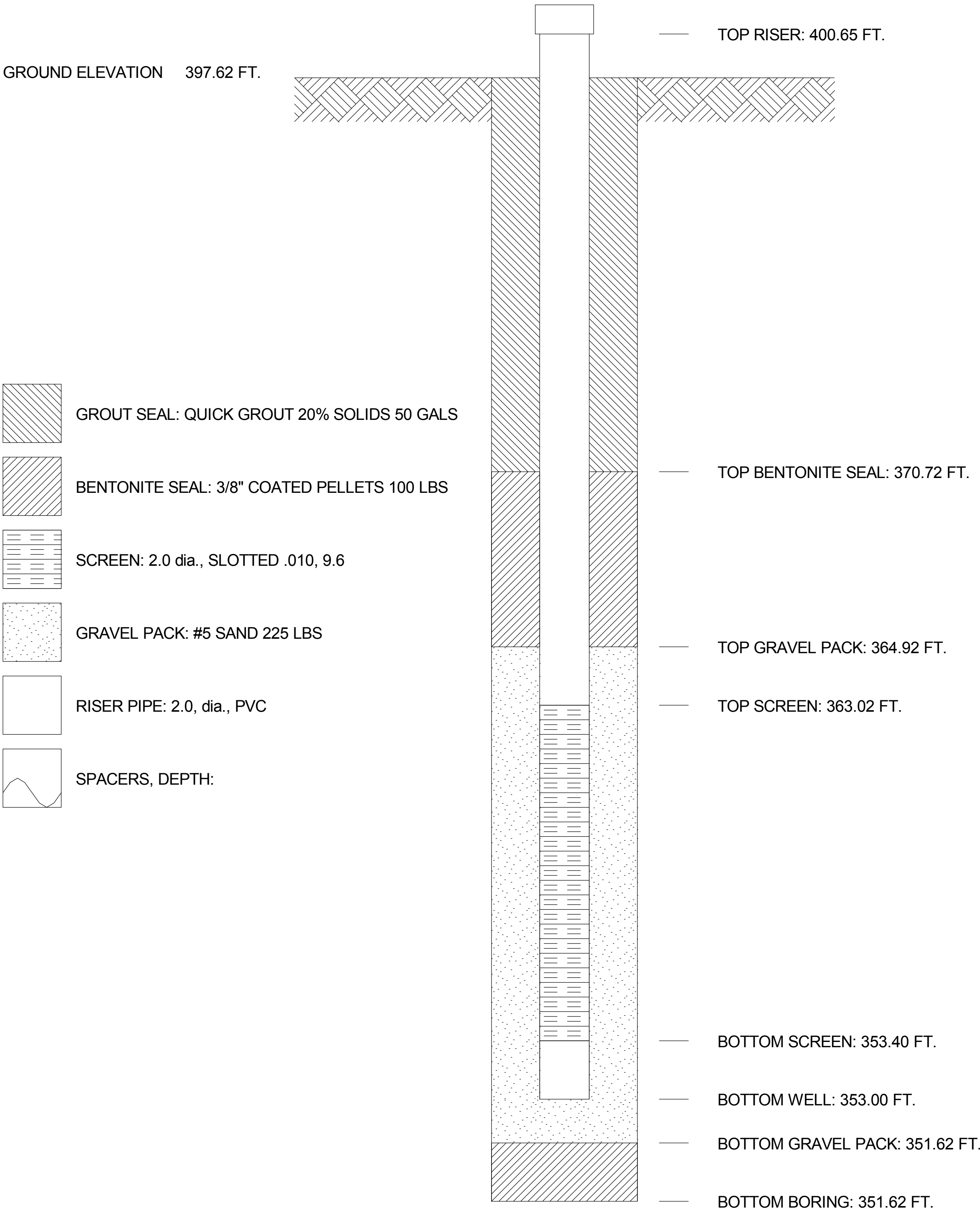
JOB NUMBER 42393125-01

COMPANY **INDIANA MICHIGAN POWER COMPANY** WELL No. **MW-1606S** BORING No. **MW-1606S** INSTALLED **3/2/16**

PROJECT **ROCKPORT PLANT**

COORDINATES **N 151,498.9 E 512,889.4**

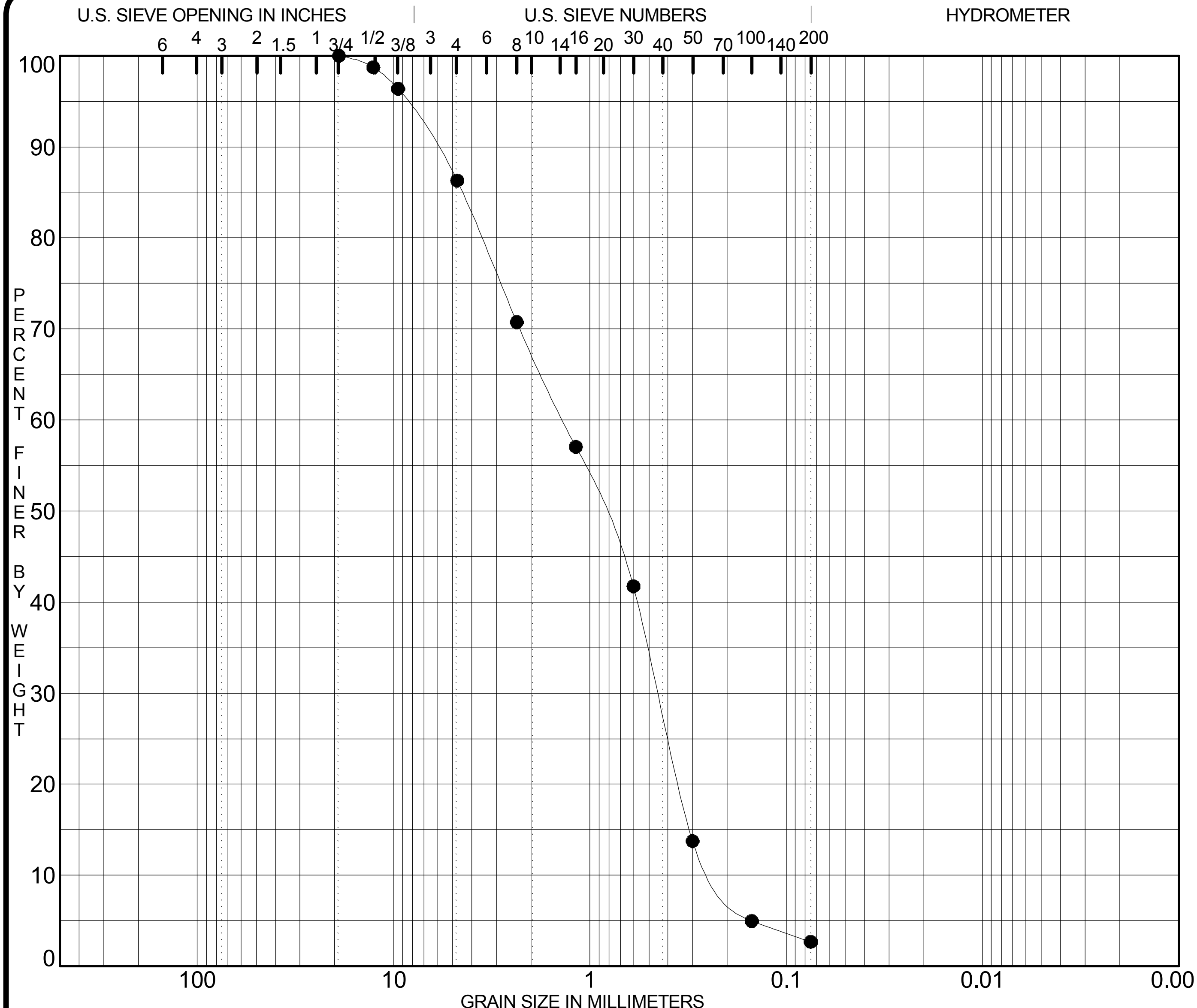
SYSTEM **State Plane using NAD27/29**



GEOMCNST RK BAP CCR COMPLIANCE.GPJ AEP.GDT 4/27/16

ATTACHMENT 2

GRADATION CURVES FOR SCREENED INTERVALS
2016 BA POND MONITORING WELLS



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.	
● MW-1600D 84.5-94.1ft		13.5					
	POORLY GRADED SAND SP						
	SS-57,58,59,60,61 (Composite)						
	N 154,306.3 E 512,449.0						
	ELEVATION 393.8						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● MW-1600D 84.5-94.1ft	19.000	1.370	0.449	0.223	13.7	83.6	2.7	

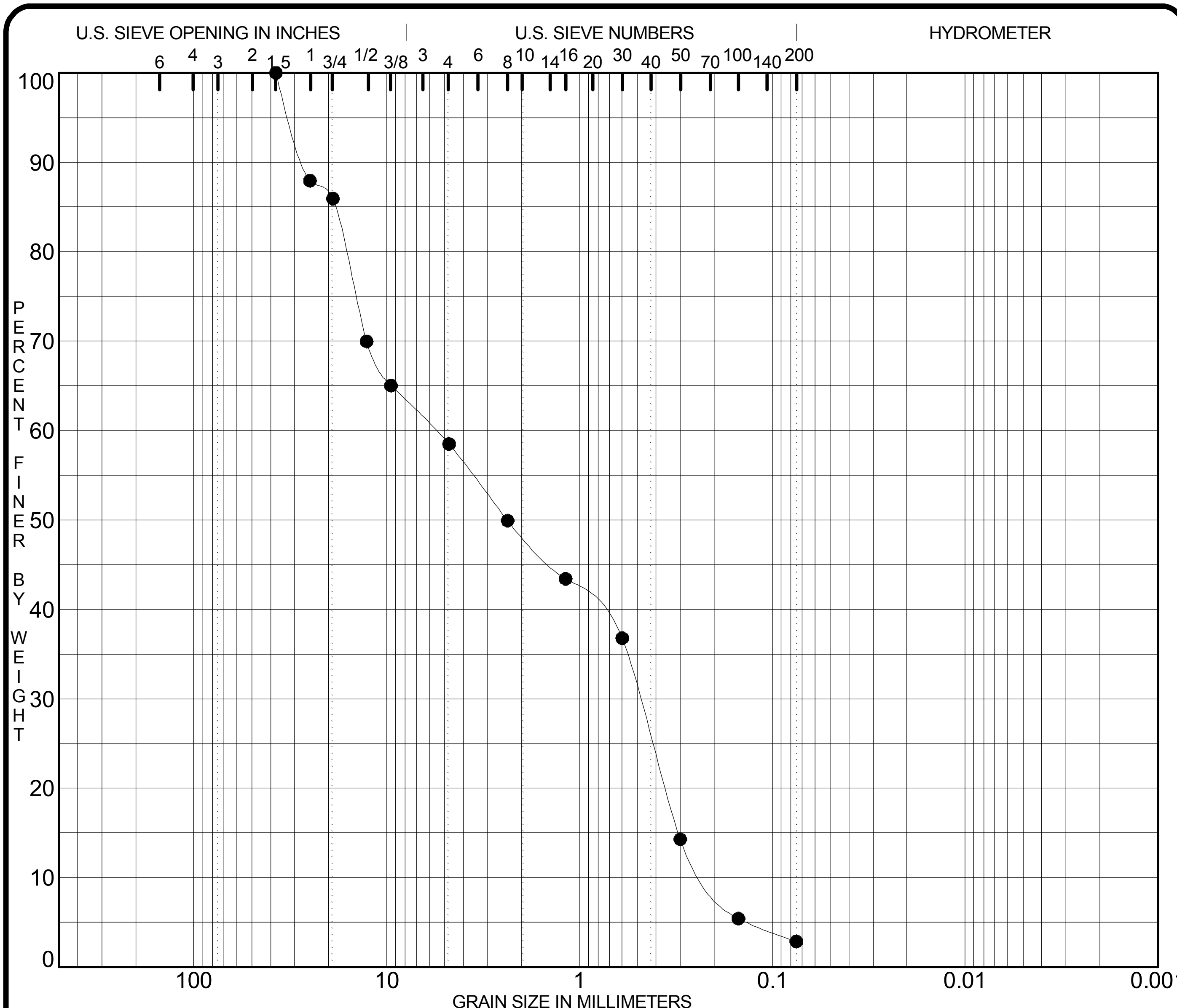
PROJECT **ROCKPORT PLANT -**

JOB NO. **42393125-01**
DATE **3/22/16**

GRADATION CURVES

American Electric Power Service Corp.

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.
● **MW-1600I 61.6-71.2ft**		**12.6**				
	POORLY GRADED SAND with GRAVEL SP					
	SS-42,43,44,45,46,47,48 (Composite)					
	N 154,306.0 E 512,454.0					
	ELEVATION 393.7					

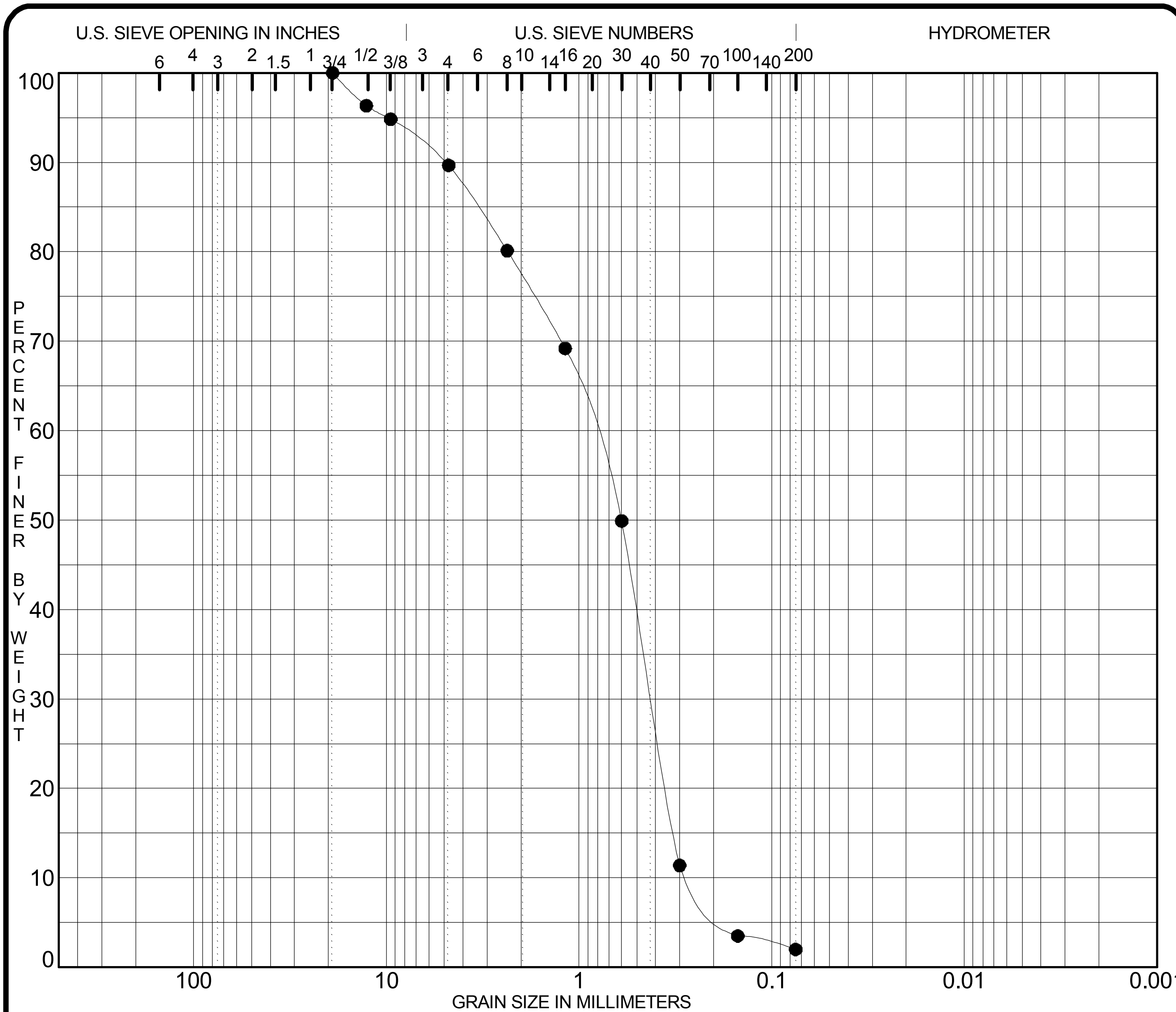
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● **MW-1600I 61.6-71.2ft**	**37.500**	**5.568**	**0.487**	**0.214**	**41.5**	**55.6**	**2.9**	

PROJECT **ROCKPORT PLANT -**

JOB NO. **42393125-01**
DATE **3/22/16**

GRADATION CURVES

American Electric Power Service Corp.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.
● MW-1600S 30.6-40.2ft		15.4				
	POORLY GRADED SAND SP					
	SS-21,22,23,24,25,26,27,28 (Composite)					
	N 154,305.9 E 512,458.0					
	ELEVATION 393.7					

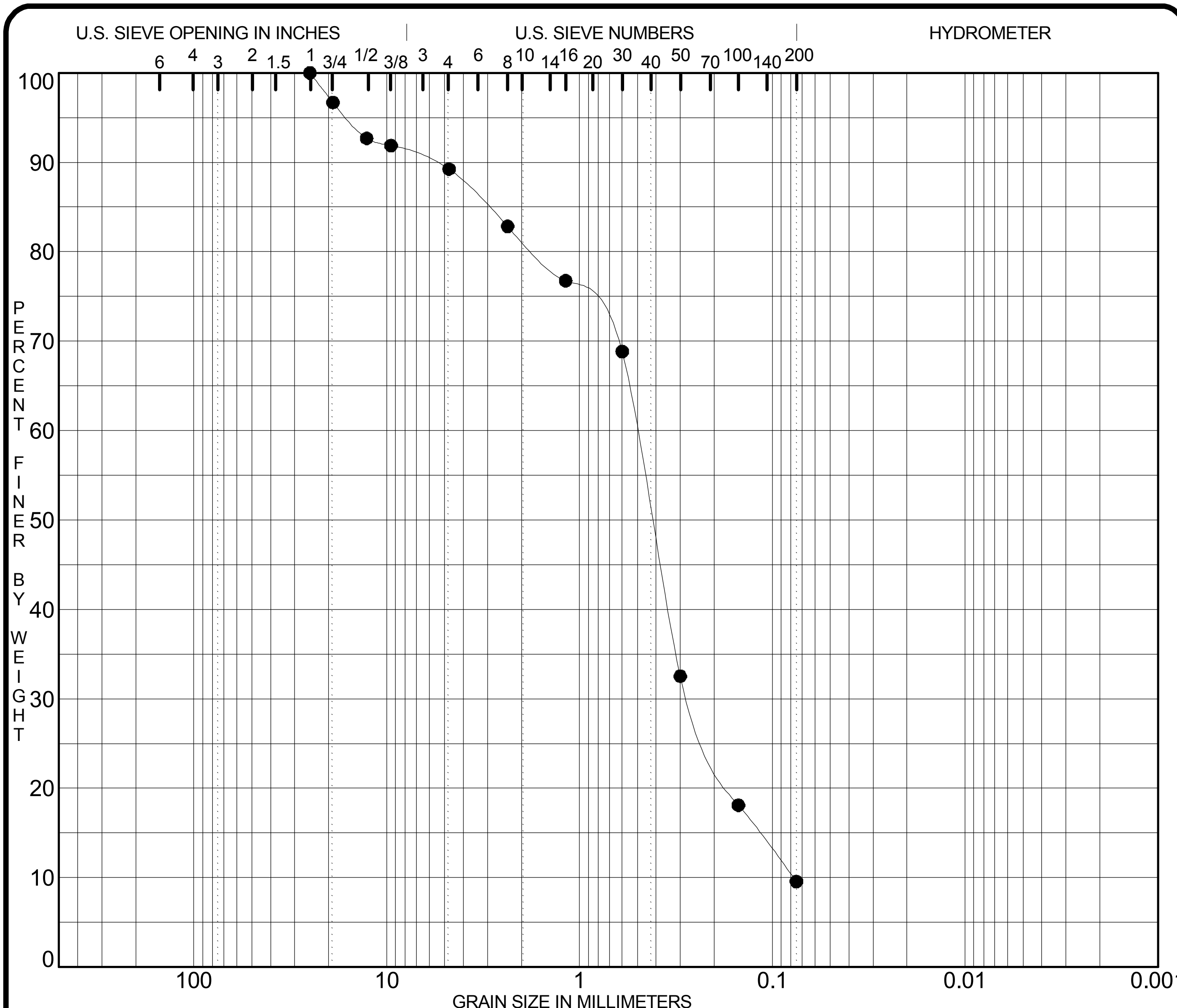
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● MW-1600S 30.6-40.2ft	19.000	0.855	0.419	0.266	10.3	87.7	2.0	

PROJECT **ROCKPORT PLANT -**

JOB NO. **42393125-01**
DATE **3/22/16**

GRADATION CURVES

American Electric Power Service Corp.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.	
●	MW-1601D 99.8-109.4ft		23.9					
		SS-68,69,70,71,72,73 (Composite)						
		N 154,323.2 E 513,487.5						
		ELEVATION 400.1						

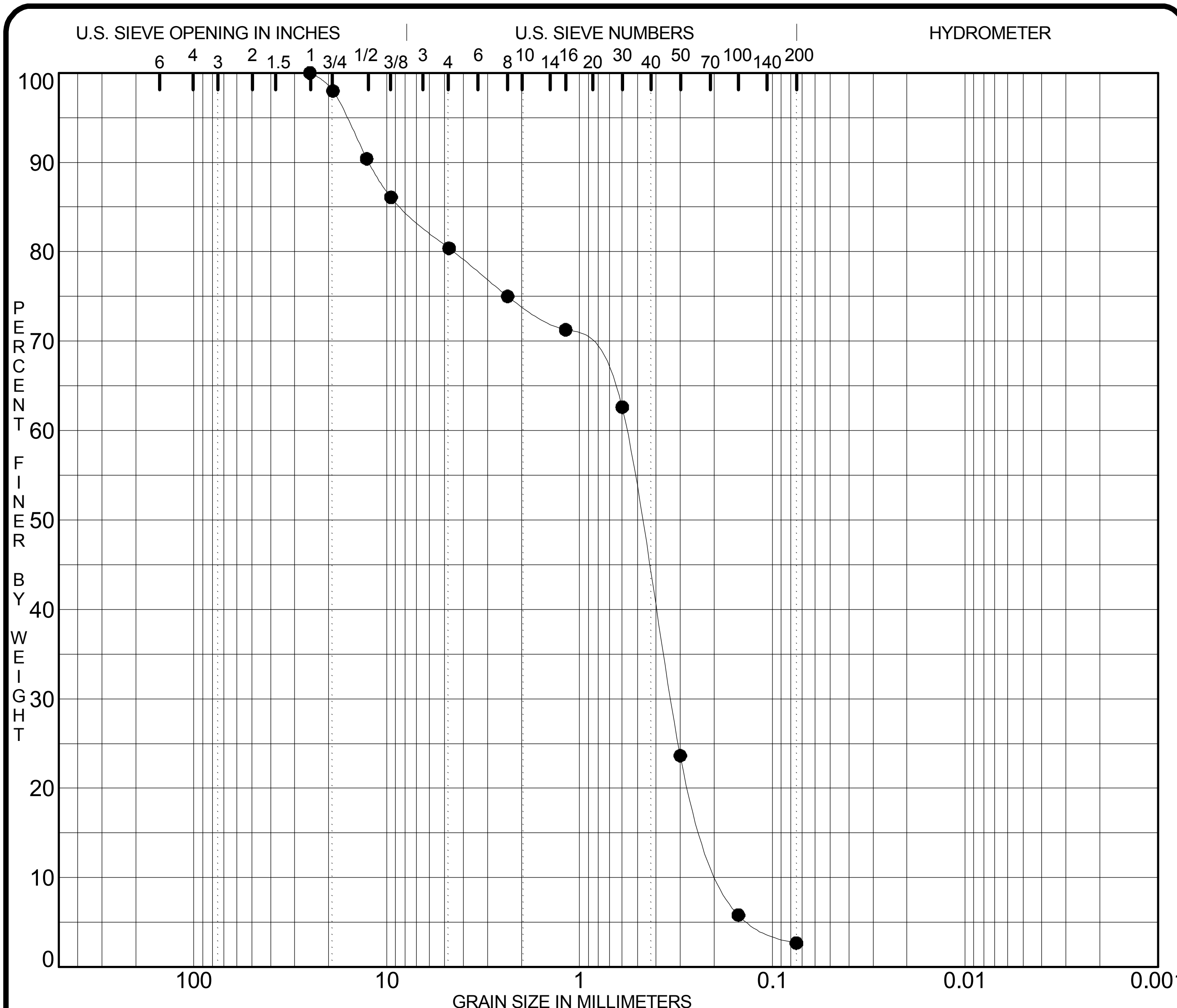
	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	MW-1601D 99.8-109.4ft	25.000	0.507	0.266	0.078	10.8	79.7	9.6	

PROJECT **ROCKPORT PLANT -**

JOB NO. **42393125-01**
DATE **3/22/16**

GRADATION CURVES
American Electric Power Service Corp.

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
●	MW-1601I 67.8-77.4ft		15.7					
		POORLY GRADED SAND with GRAVEL SP						
		SS-48,48,49,50,51 (Composite)						
		N 154,325.3 E 513,483.5						
		ELEVATION 400.0						

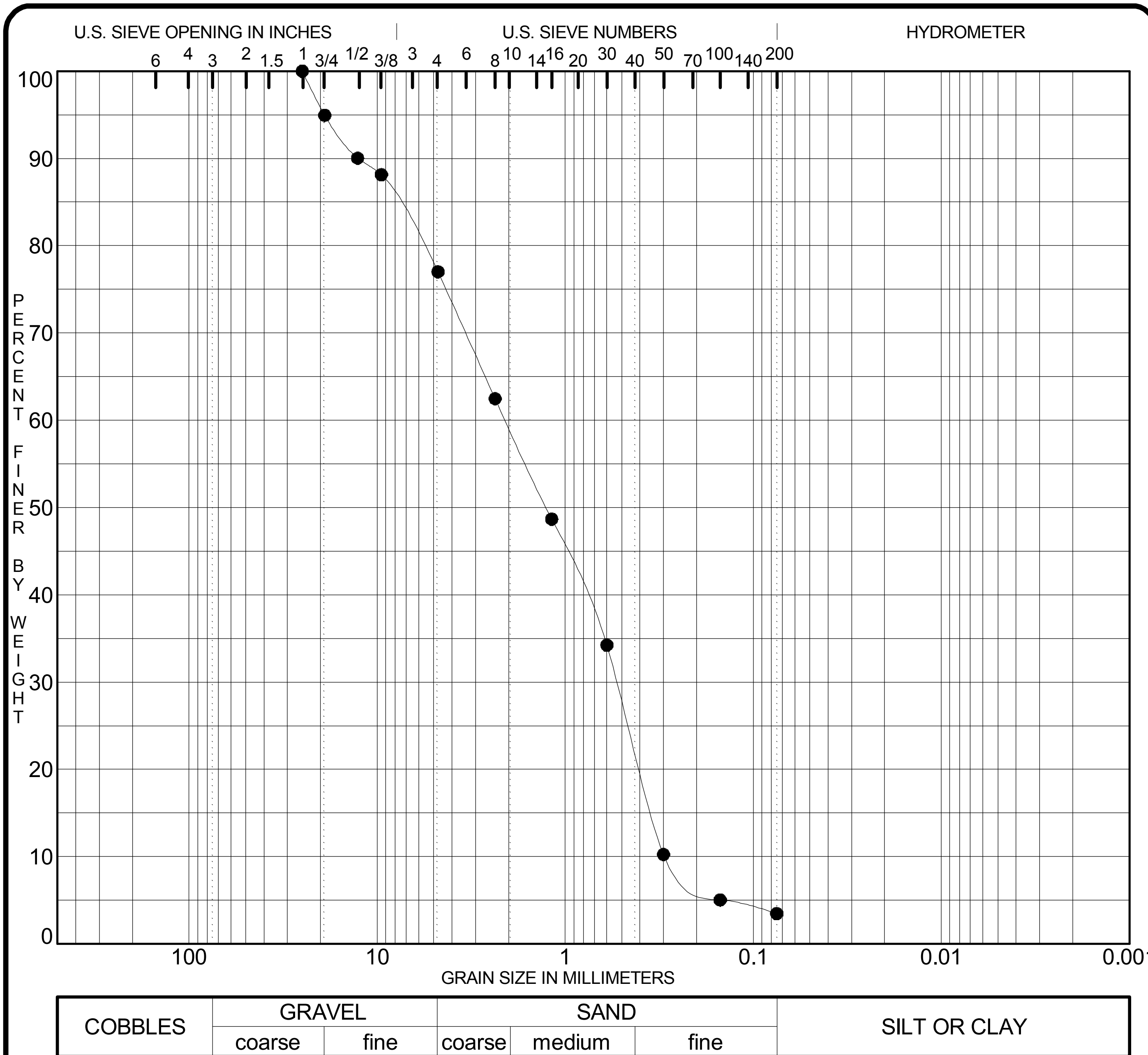
Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	MW-1601I 67.8-77.4ft	25.000	0.573	0.336	0.177	19.6	77.7	2.7	

PROJECT **ROCKPORT PLANT -**

JOB NO. **42393125-01**
DATE **3/22/16**

GRADATION CURVES

American Electric Power Service Corp.



Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.
● **MW-1601S 36.8-46.4ft**		**25.2**				
	POORLY GRADED SAND with GRAVEL SP					
	SS-26,27,28,29,30,31 (Composite)					
	N 154,327.6 E 513,479.7					
	ELEVATION 399.8					

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● **MW-1601S 36.8-46.4ft**	**25.000**	**2.084**	**0.531**	**0.290**	**23.0**	**73.5**	**3.5**	

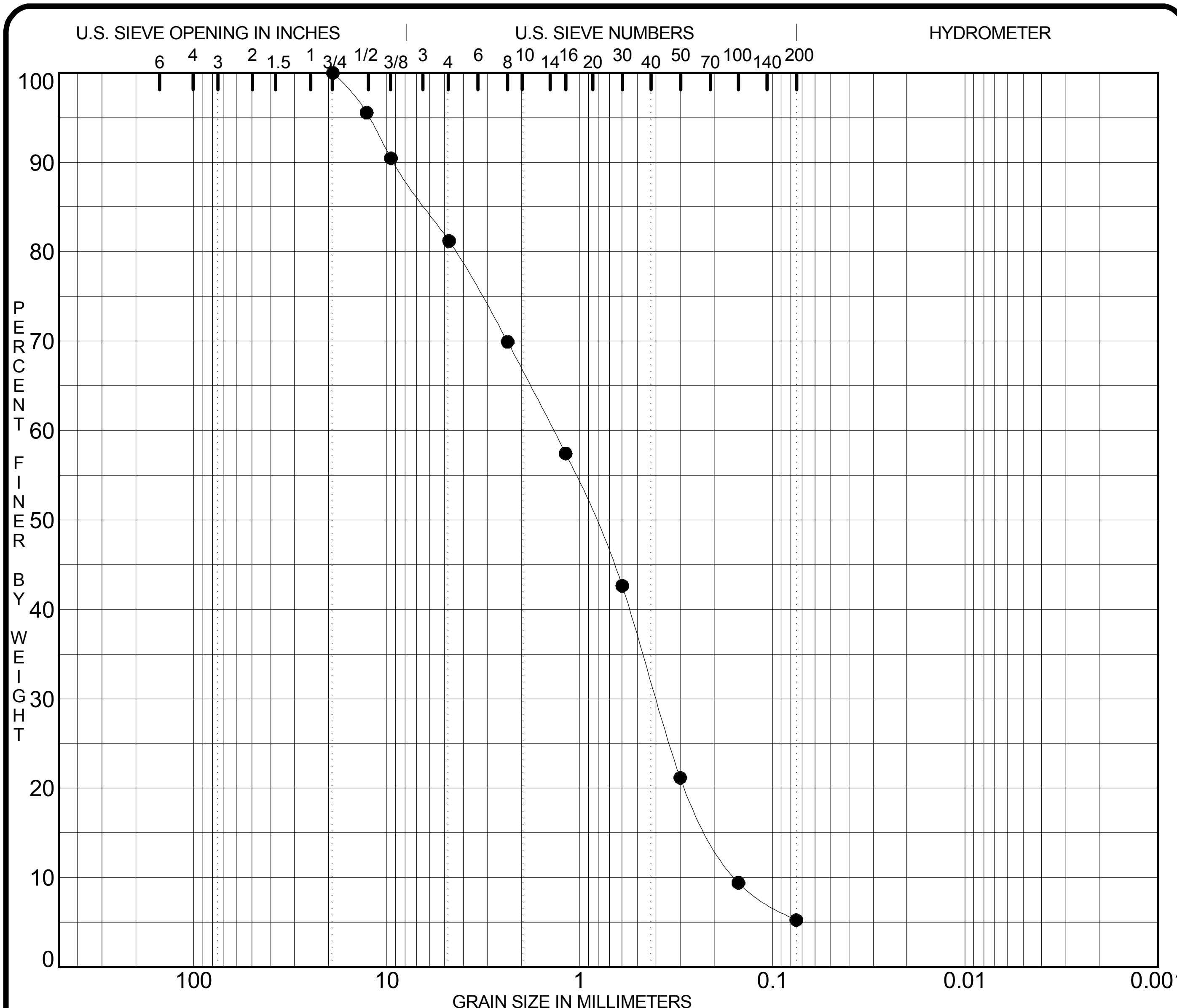
PROJECT **ROCKPORT PLANT -**

JOB NO. **42393125-01**
DATE **3/22/16**

GRADATION CURVES

American Electric Power Service Corp.

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.
● MW-1602D 114.0-123.6ft		14.1				
	N 152,300.2 E 514,229.4					
	ELEVATION 399.3					

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● MW-1602D 114.0-123.6ft	19.000	1.361	0.399	0.155	18.8	76.0	5.3	

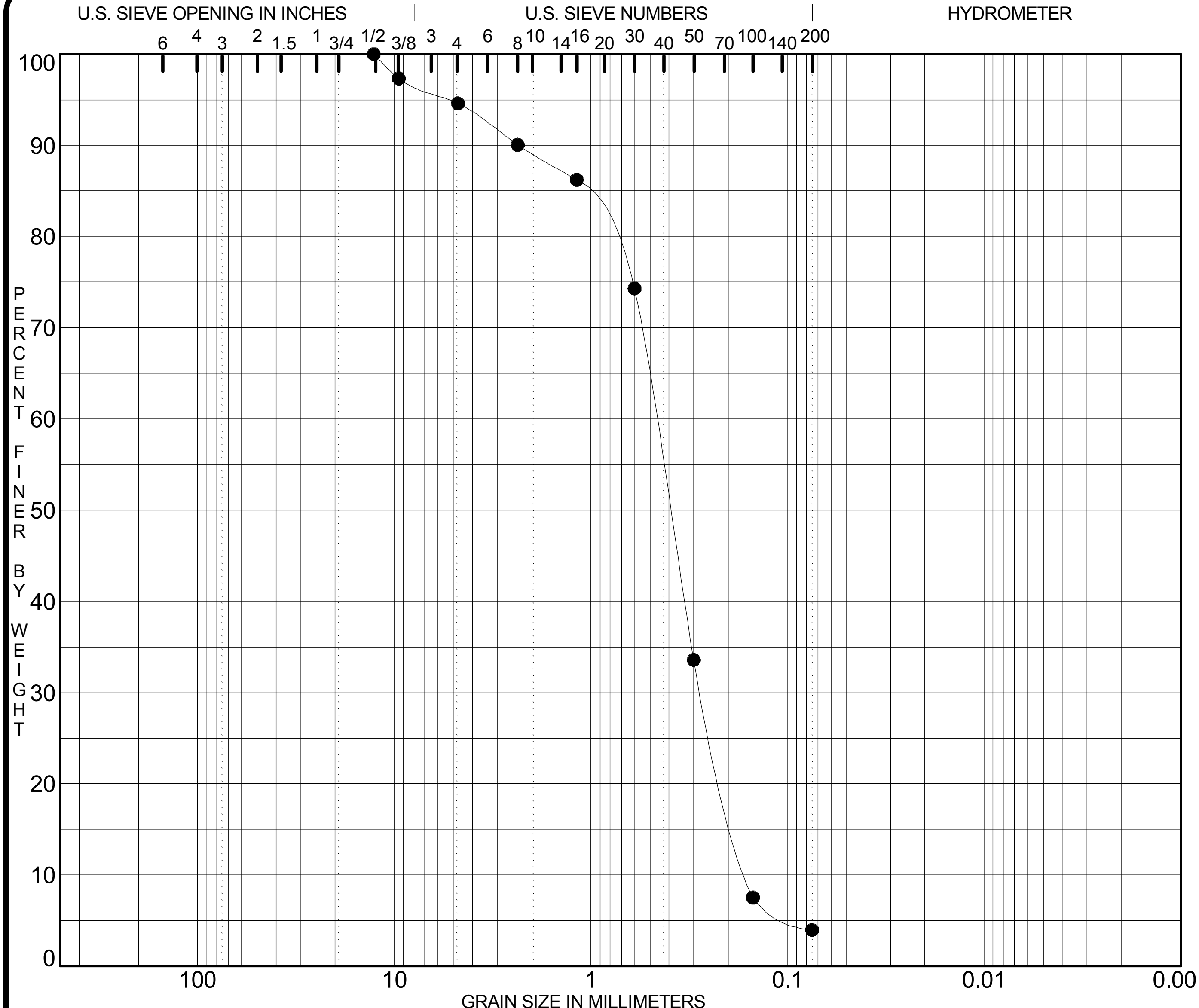
PROJECT **ROCKPORT PLANT -**

JOB NO. **42393125-01**
DATE **3/22/16**

GRADATION CURVES

American Electric Power Service Corp.

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.
● **MW-1602I 67.5-77.1ft**		**17.9**				
	POORLY GRADED SAND SP					
	N 152,295.0 E 514,229.2					
	ELEVATION 399.4					

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● **MW-1602I 67.5-77.1ft**	**12.700**	**0.470**	**0.273**	**0.160**	**5.4**	**90.6**	**4.0**	

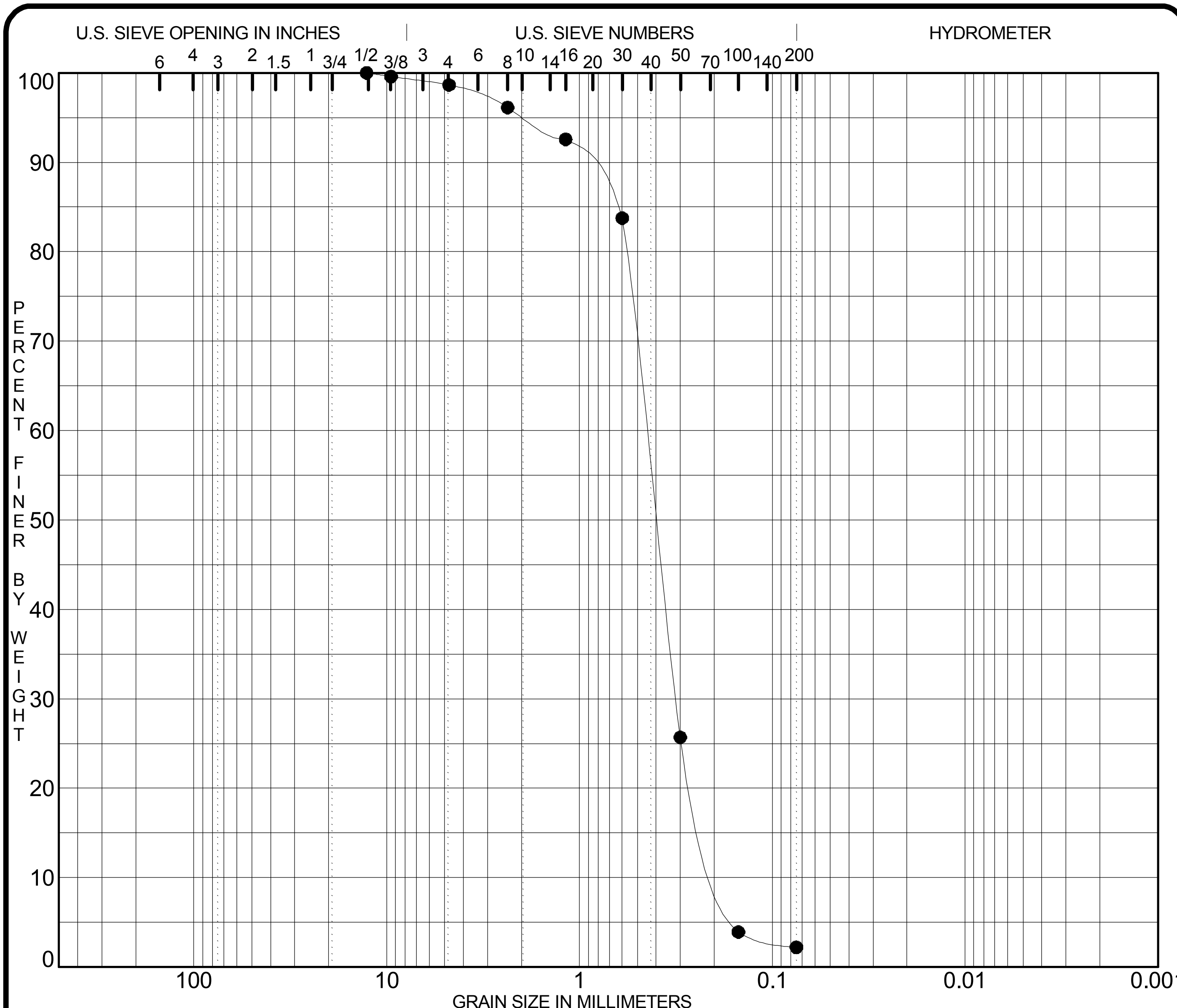
PROJECT **ROCKPORT PLANT -**

JOB NO. **42393125-01**
DATE **3/22/16**

GRADATION CURVES

American Electric Power Service Corp.

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.
● **MW-1602S 35.5-45.5ft**		**21.8**				
	POORLY GRADED SAND SP					
	SS-24,25,26,27,28 (Composite Sample)					
	ELEVATION					

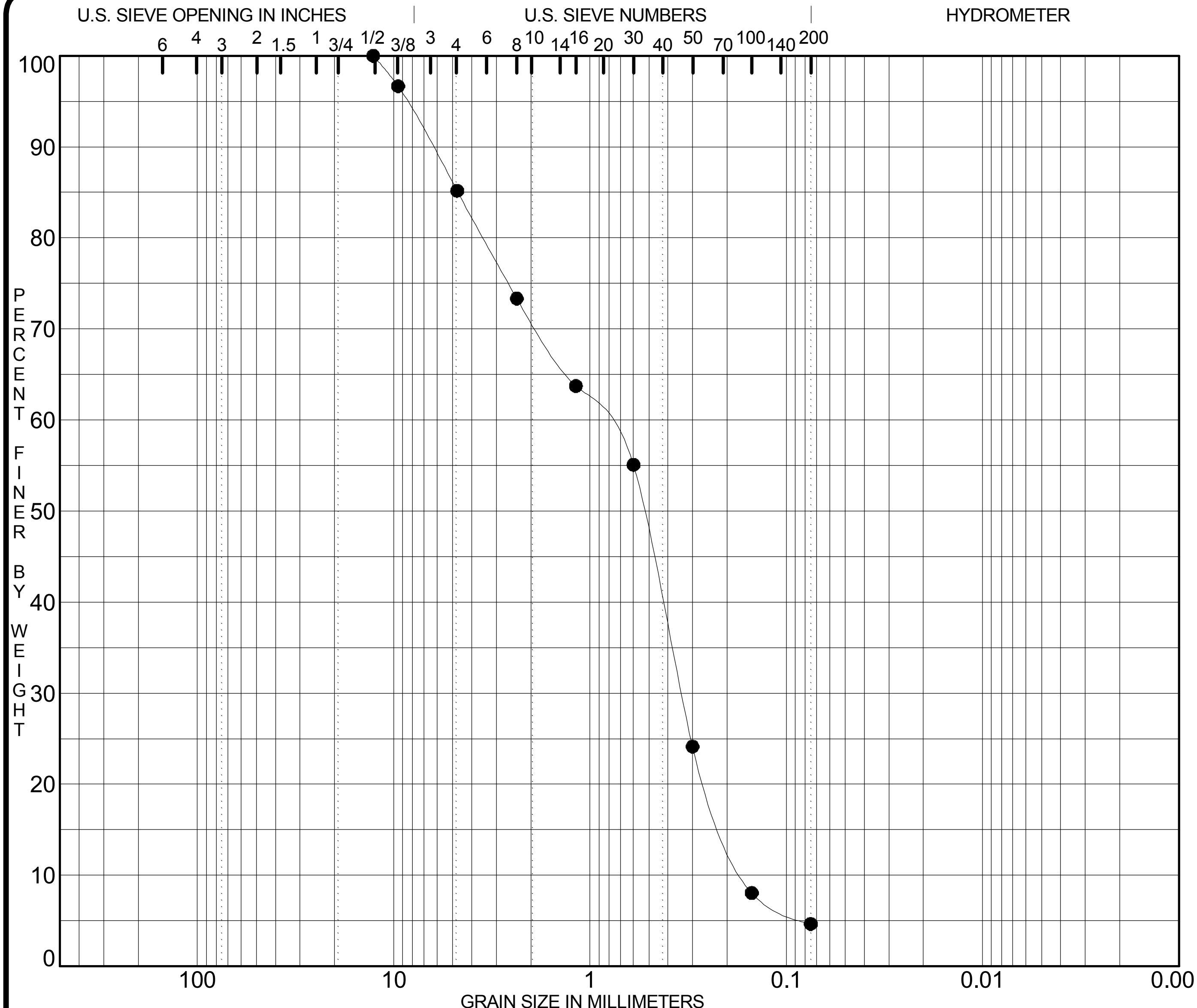
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● **MW-1602S 35.5-45.5ft**	**12.700**	**0.452**	**0.316**	**0.182**	**1.3**	**96.4**	**2.2**	

PROJECT **ROCKPORT PLANT -**

JOB NO. **42393125-01**
DATE **3/22/16**

GRADATION CURVES

American Electric Power Service Corp.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.
● **MW-1603D 110.0-119.6ft**		**10.7**				
	POORLY GRADED SAND SP					
	SS-75,76,77,78,79 (Composite Sample)					
	N 152,811.9 E 514,207.5					
	ELEVATION 401.6					

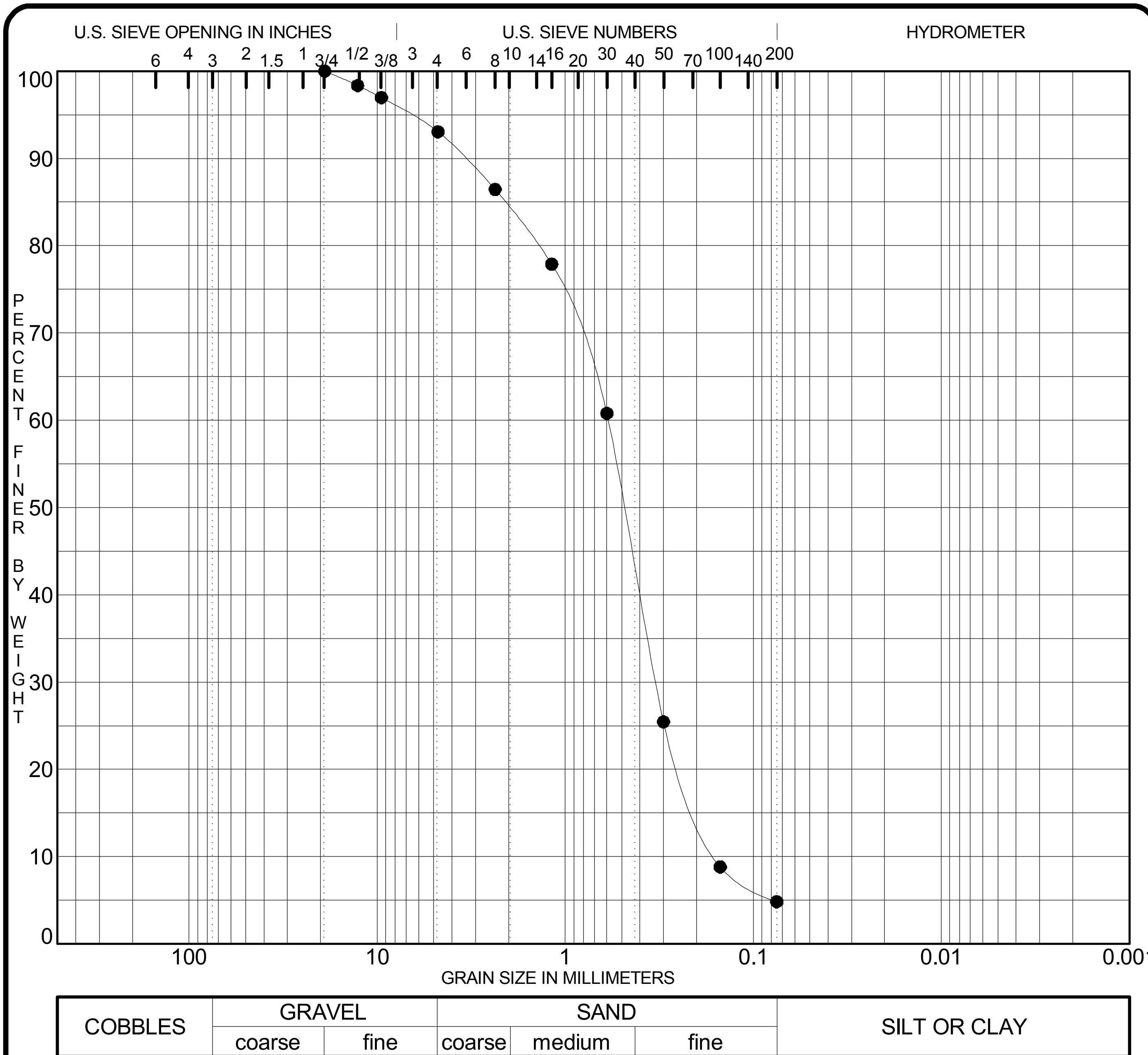
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● **MW-1603D 110.0-119.6ft**	**12.700**	**0.881**	**0.342**	**0.163**	**14.8**	**80.5**	**4.7**	

PROJECT **ROCKPORT PLANT -**

JOB NO. **42393125-01**
DATE **3/22/16**

GRADATION CURVES

American Electric Power Service Corp.



Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.
● MW-1603I	68.6-78.2ft		15.4				
		POORLY GRADED SAND SP					
		SS-47,48,49,50,51,52 (Composite Sample)					
		N 152,803.8 E 519,207.2					
		ELEVATION 401.4					

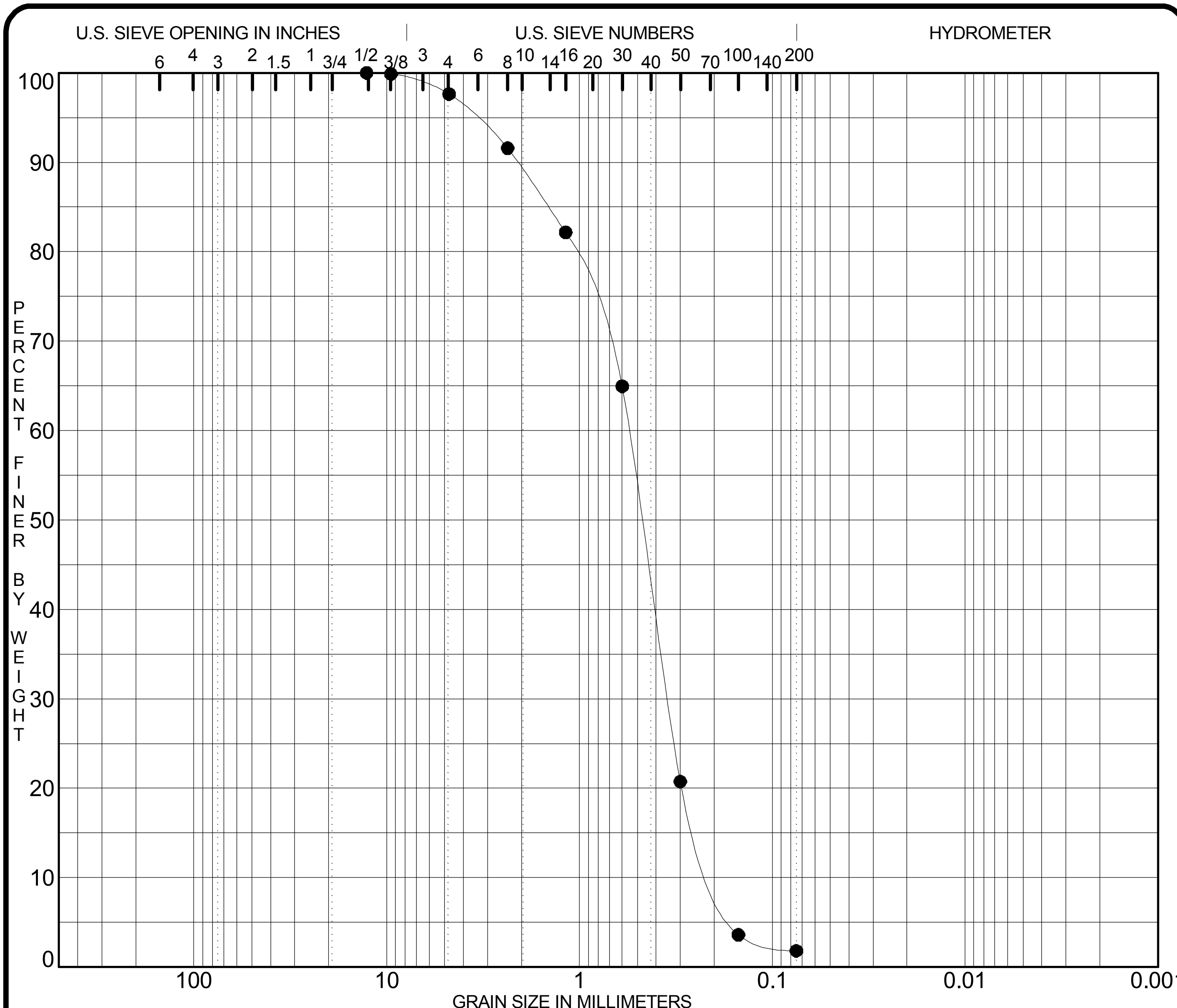
Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● MW-1603I	68.6-78.2ft	19.000	0.591	0.328	0.158	6.9	88.2	4.8	

PROJECT **ROCKPORT PLANT -**

JOB NO. **42393125-01**
DATE **3/22/16**

GRADATION CURVES

American Electric Power Service Corp.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.
● **MW-1603S 37.6-47.2ft**		**16.3**				
	POORLY GRADED SAND SP					
	SS-27,28,29,30 (Composite Sample)					
	N 152,802.7 E 514,206.9					
	ELEVATION 401.5					

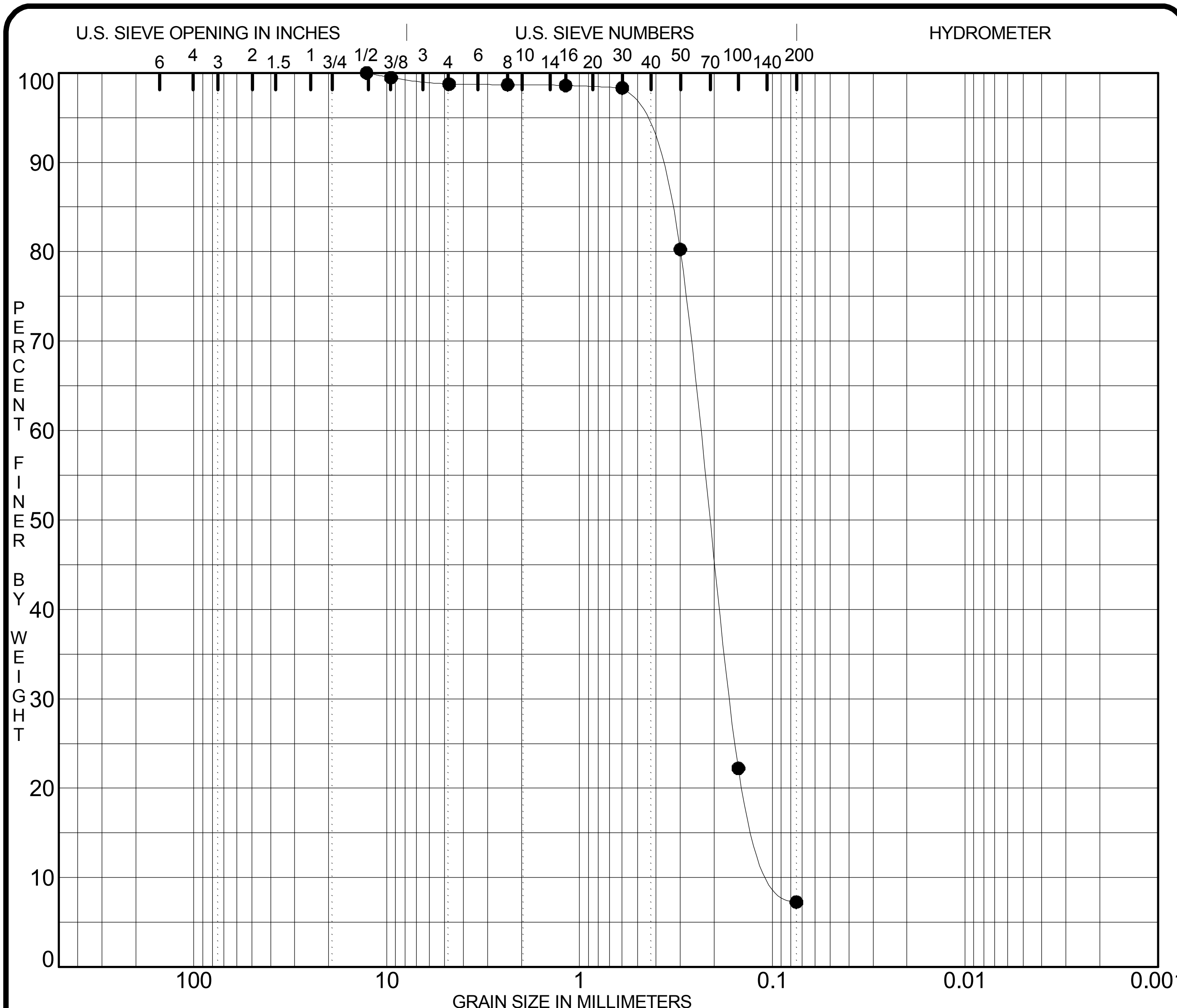
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● **MW-1603S 37.6-47.2ft**	**12.700**	**0.555**	**0.347**	**0.194**	**2.4**	**95.8**	**1.8**	

PROJECT **ROCKPORT PLANT -**

JOB NO. **42393125-01**
DATE **3/22/16**

GRADATION CURVES

American Electric Power Service Corp.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.	
● MW-1604D 115.0-124.6ft		24.9					
	SS-78,79,80,81,82,83 (Composite Sample)						
	N 151,518.2 E 514,204.9						
	ELEVATION 399.9						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● MW-1604D 115.0-124.6ft	12.700	0.236	0.165	0.085	1.3	91.5	7.3	

PROJECT **ROCKPORT PLANT -**

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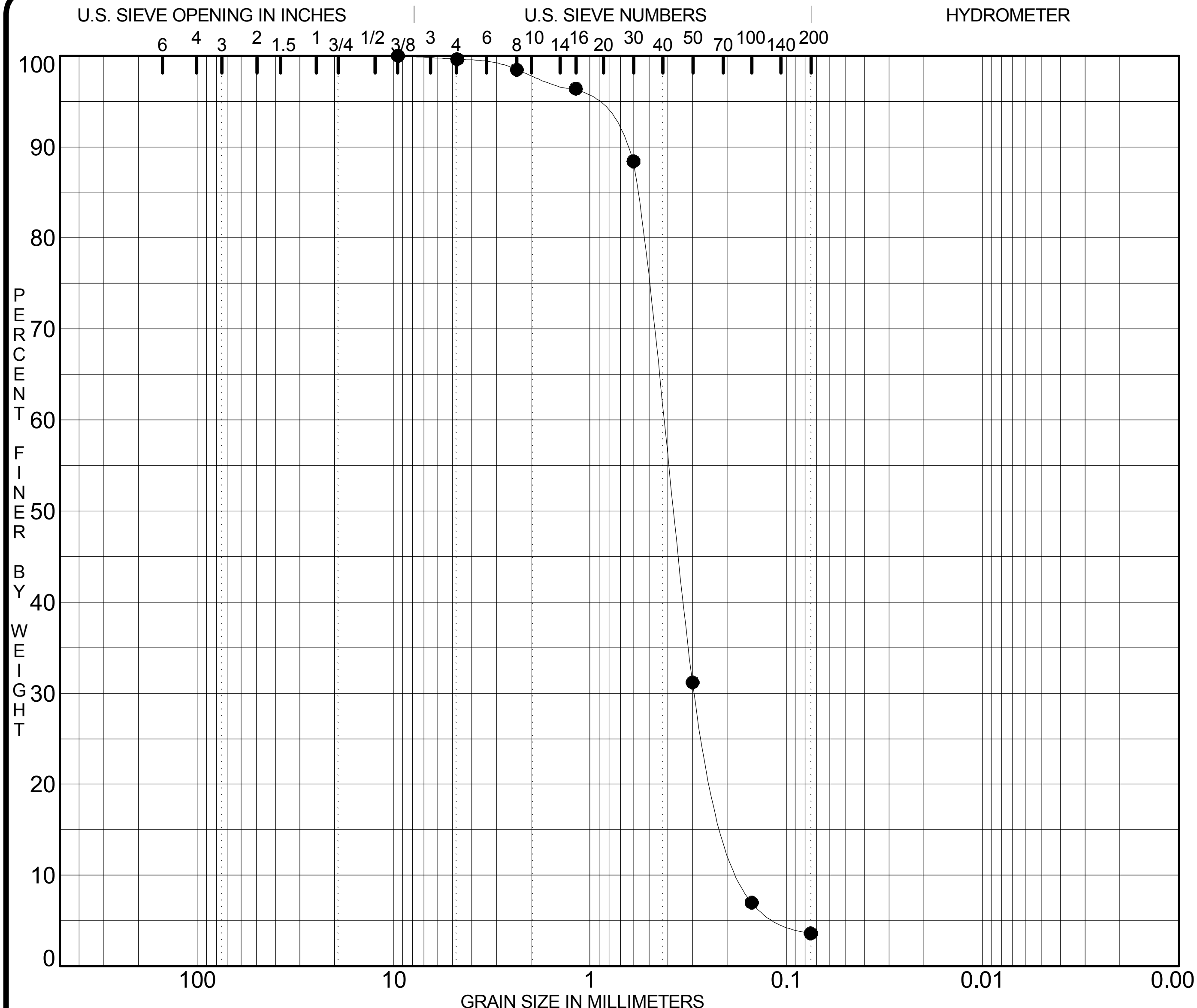
GRADATION CURVES

American Electric Power Service Corp.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.
● MW-1604I 68.0-77.6ft		**19.4**				
	POORLY GRADED SAND SP					
	SS-47,48,49,50,51 (Composite Sample)					
	N 151,506.5 E 514,201.0					
	ELEVATION 399.7					

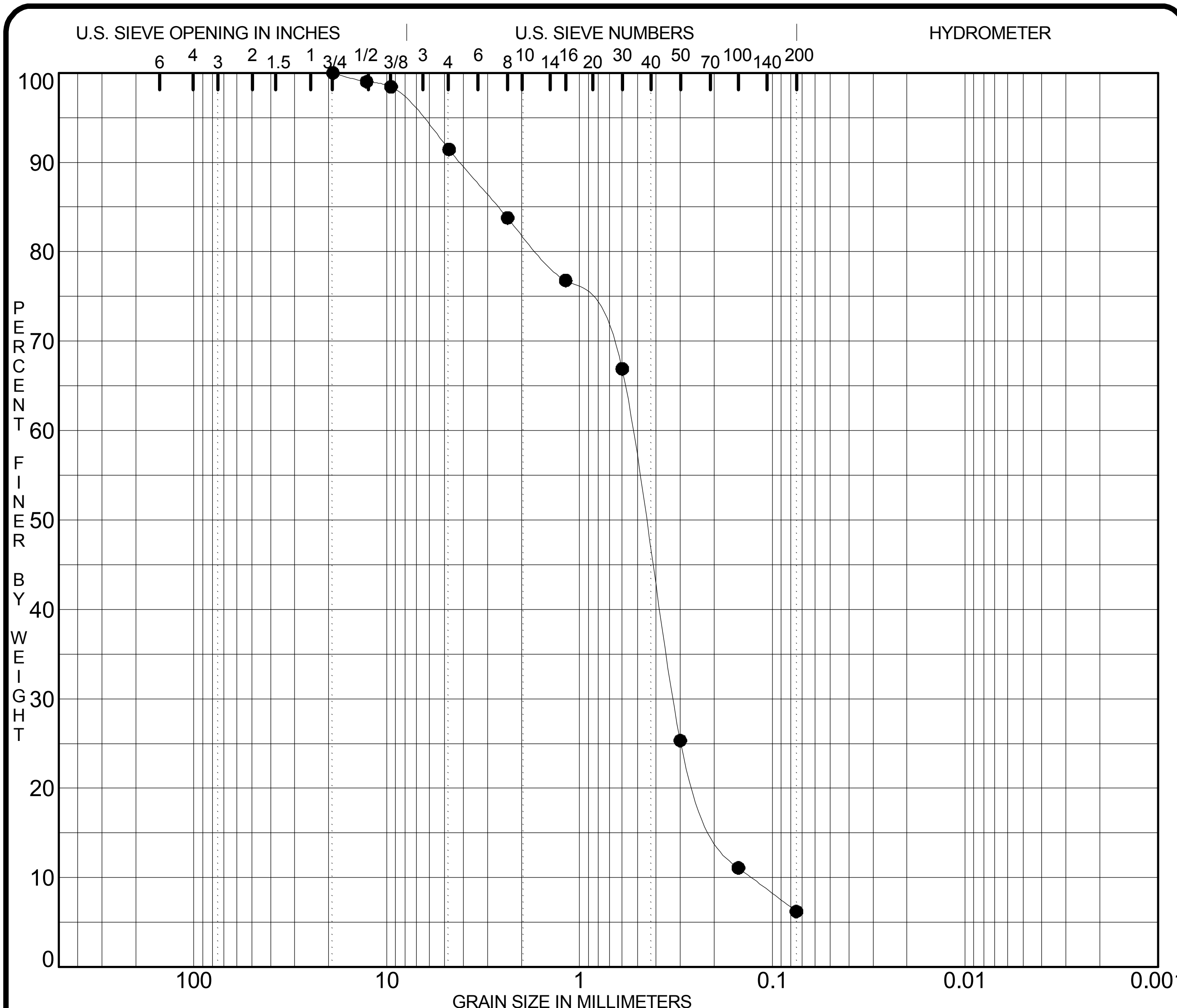
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● MW-1604I 68.0-77.6ft	**9.500**	**0.425**	**0.290**	**0.163**	**0.4**	**96.0**	**3.6**	

PROJECT **ROCKPORT PLANT -**

JOB NO. **42393125-01**
DATE **3/22/16**

GRADATION CURVES

American Electric Power Service Corp.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.	
● **MW-1604S 37.0-46.6ft**		**15.5**					
	SS-26,27,28,29,30,31 (Composite Samples)						
	N 151,503.4 E 514,197.3						
	ELEVATION 399.8						

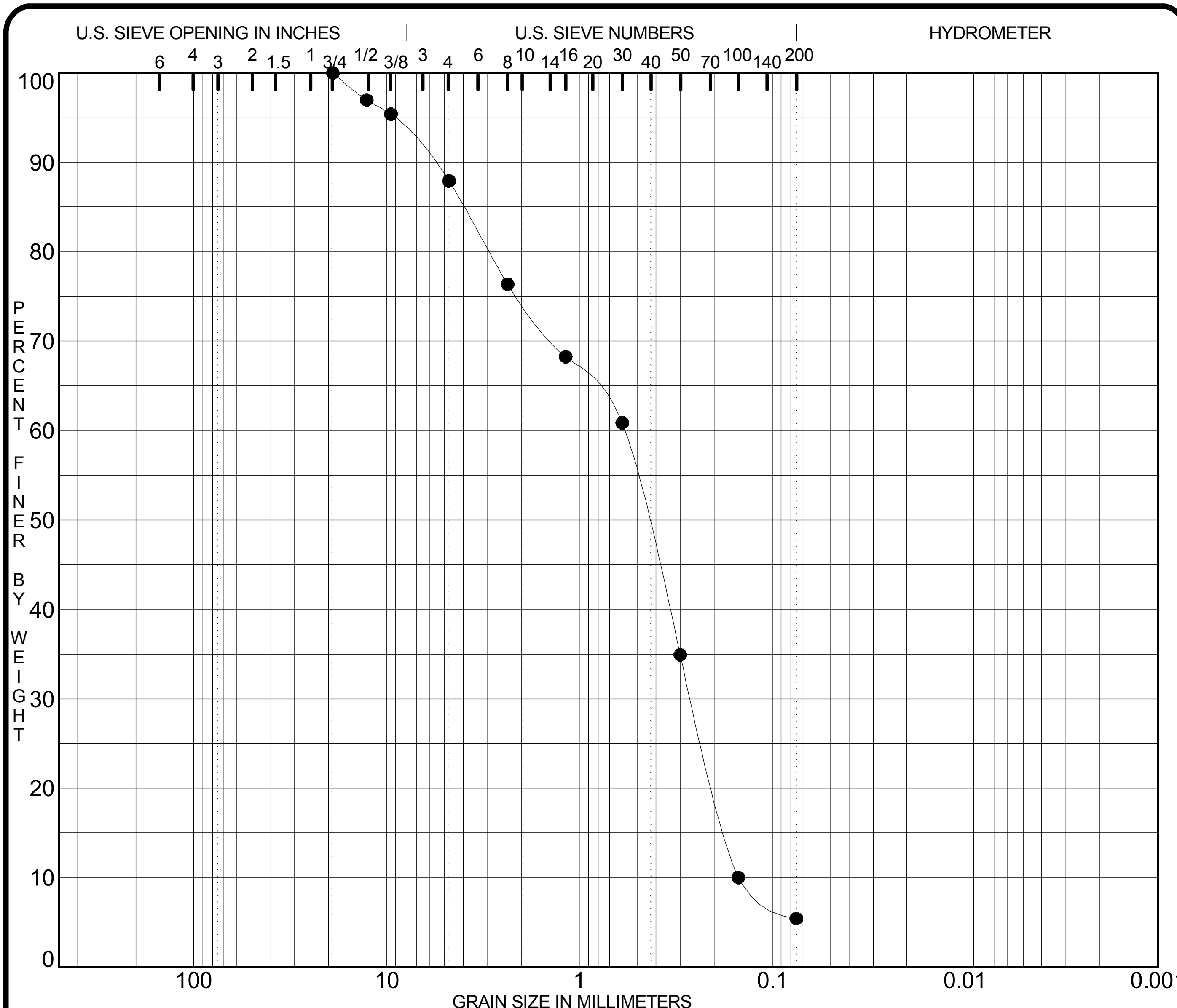
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● **MW-1604S 37.0-46.6ft**	**19.000**	**0.535**	**0.324**	**0.128**	**8.6**	**85.2**	**6.2**	

PROJECT **ROCKPORT PLANT -**

JOB NO. **42393125-01**
DATE **3/22/16**

GRADATION CURVES

American Electric Power Service Corp.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.
● MW-1605D 115.0-124.6ft		14.5				
	SS-78,79,80,81,82,83 (Composite Sample)					
	N 151,478.9 E 513,537.1					
	ELEVATION 400.4					

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● MW-1605D 115.0-124.6ft	19.000	0.586	0.262	0.150	12.1	82.5	5.4	

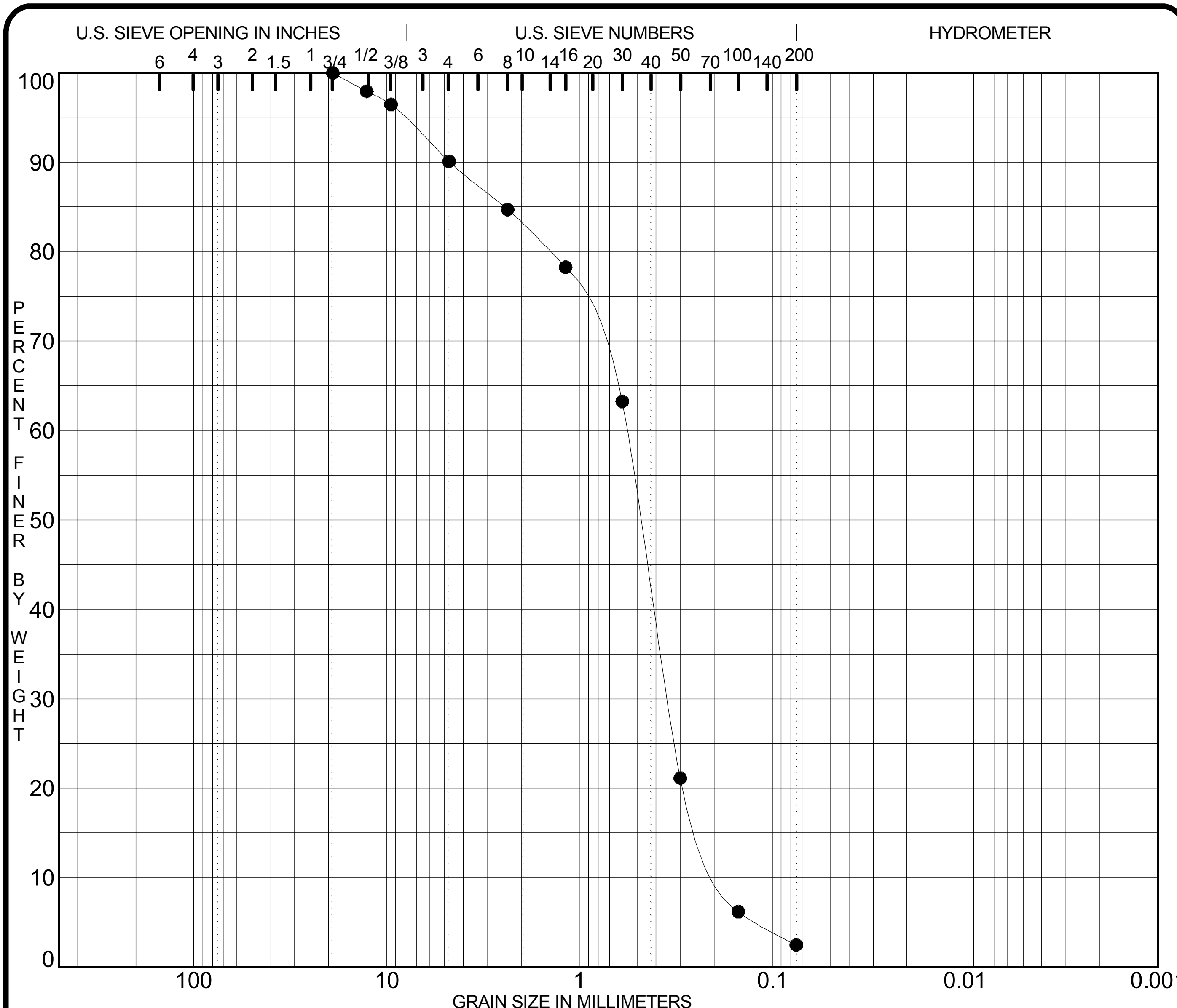
PROJECT **ROCKPORT PLANT -**

JOB NO. **42393125-01**
DATE **3/22/16**

GRADATION CURVES

American Electric Power Service Corp.

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification		Classification	MC%	LL	PL	PI	Sp.Gr.	
● MW-1605I	68.6-78.2ft		19.7					
		POORLY GRADED SAND SP						
		SS-48,49,50,51,52 (Composite Sample)						
		N 151,478.9 E 513,532.6						
		ELEVATION 400.6						

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● MW-1605I	68.6-78.2ft	19.000	0.569	0.347	0.179	9.9	87.6	2.5	

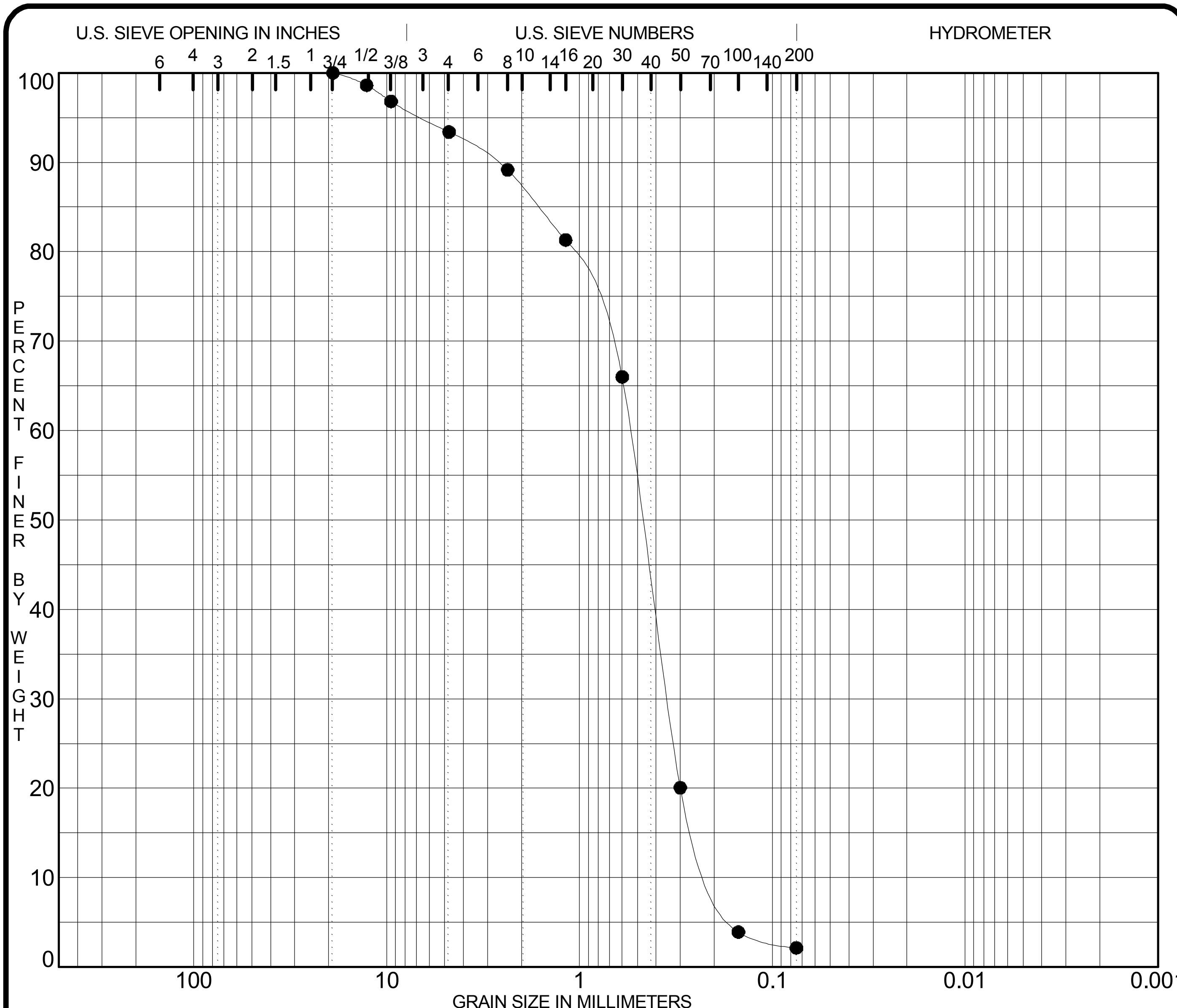
PROJECT **ROCKPORT PLANT -**

JOB NO. **42393125-01**
DATE **3/22/16**

GRADATION CURVES

American Electric Power Service Corp.

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.
● **MW-1605S 37.6-47.2ft**		**16.0**				
	POORLY GRADED SAND SP					
	SS-27,28,29,30,31 (Composite Sample)					
	N 151,478.8 E 513,528.4					
	ELEVATION 400.3					

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● **MW-1605S 37.6-47.2ft**	**19.000**	**0.548**	**0.349**	**0.195**	**6.6**	**91.3**	**2.1**	

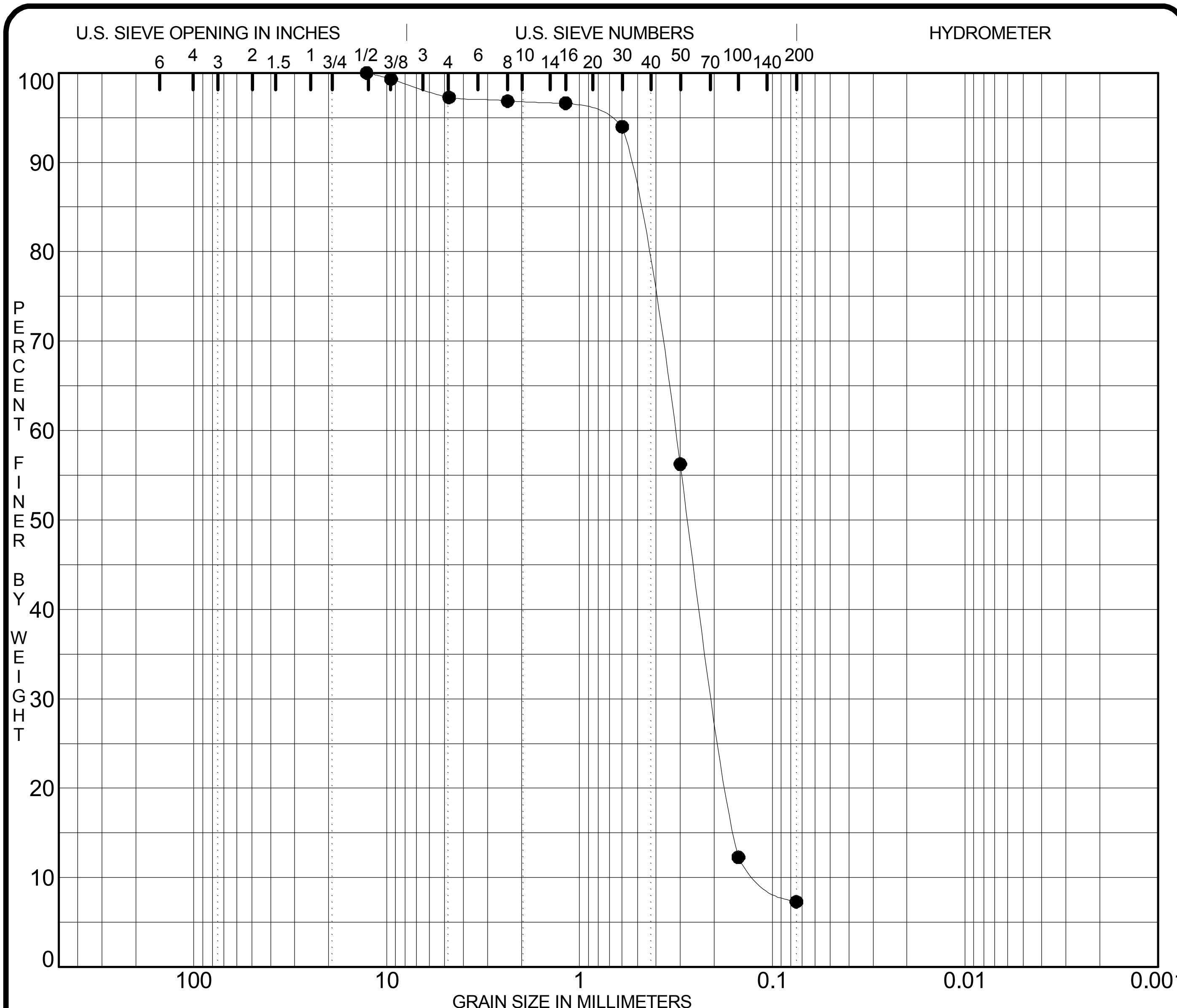
PROJECT **ROCKPORT PLANT -**

JOB NO. **42393125-01**
DATE **3/22/16**

GRADATION CURVES

American Electric Power Service Corp.

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.
● MW-1606D 100.0-109.6ft		28.6				
	SS-68,69,70,71,72,73 (Composite Sample)					
	N 151,502.1 E 512,881.5					
	ELEVATION 397.8					

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● MW-1606D 100.0-109.6ft	12.700	0.321	0.198	0.109	2.7	90.0	7.3	

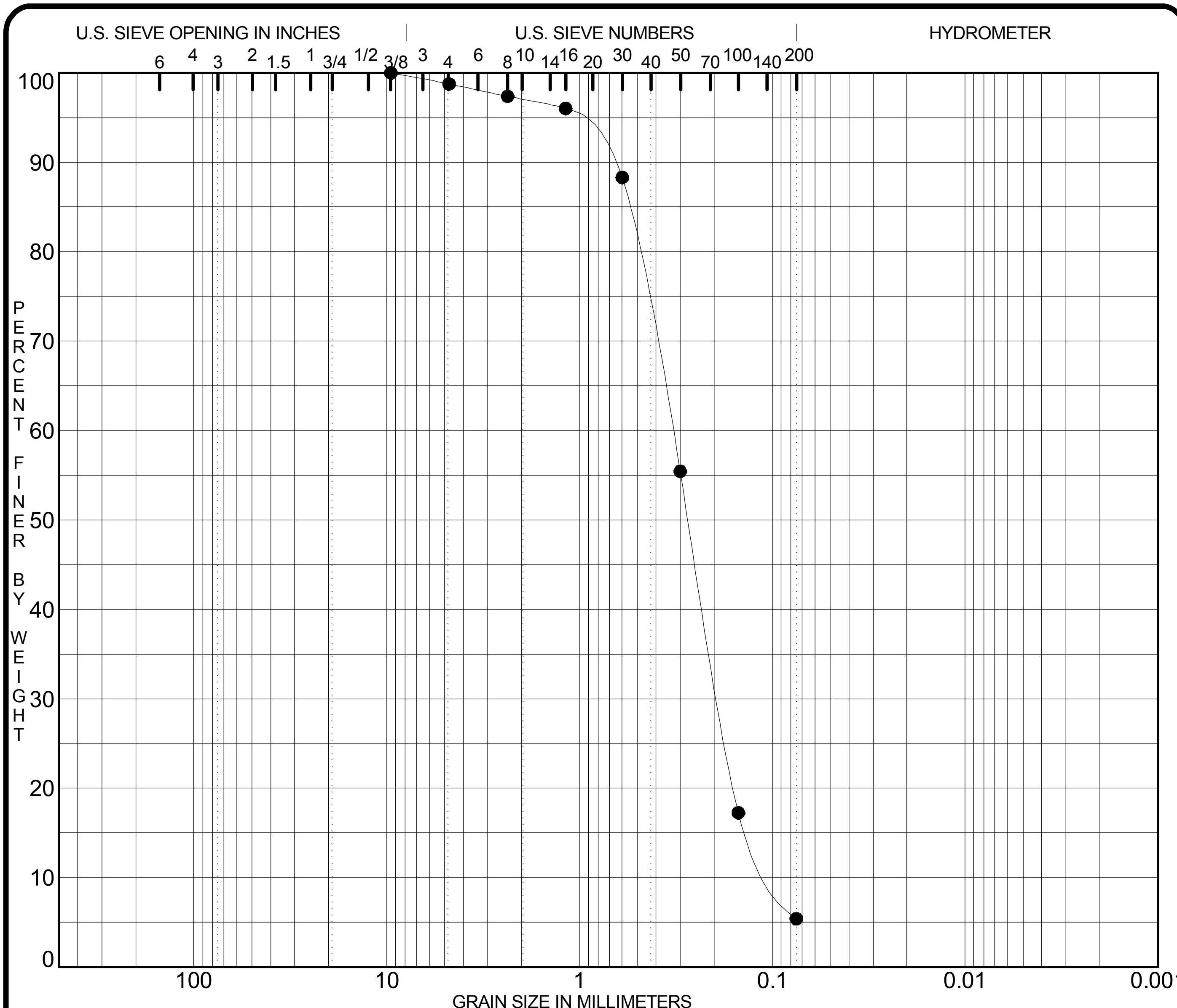
PROJECT **ROCKPORT PLANT -**

JOB NO. **42393125-01**
DATE **3/22/16**

GRADATION CURVES

American Electric Power Service Corp.

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.
● MW-1606I 65.7-75.3ft		18.9				
	SS-45,46,47,48,49,50 (Composite Sample)					
	N 151,508.4 E 512,885.5					
	ELEVATION 397.8					

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● MW-1606I 65.7-75.3ft	9.500	0.330	0.189	0.098	1.2	93.4	5.4	

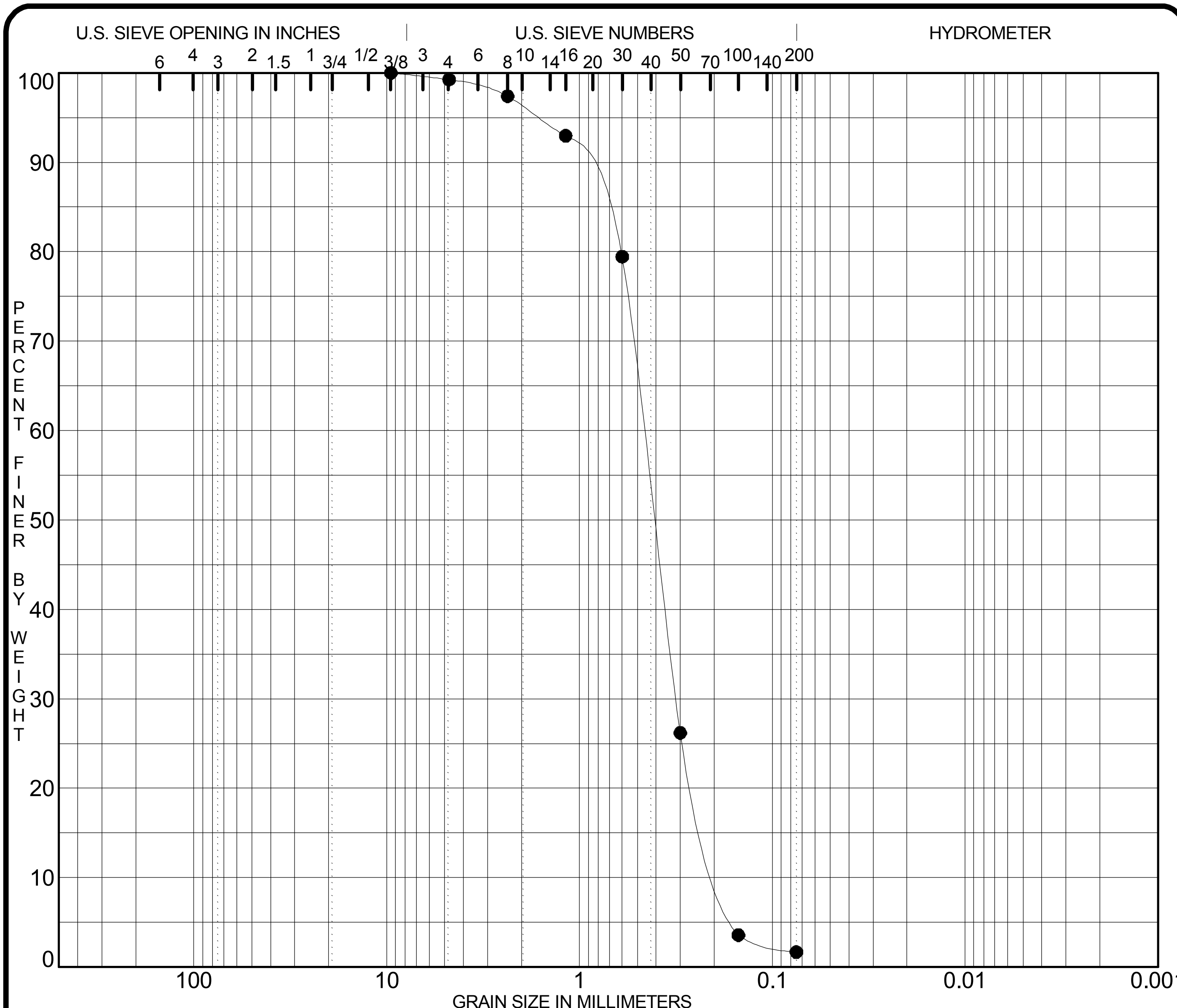
PROJECT **ROCKPORT PLANT -**

JOB NO. **42393125-01**
DATE **3/22/16**

GRADATION CURVES

American Electric Power Service Corp.

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.	
● **MW-1606S 34.7-44.3ft**		**20.9**					
	POORLY GRADED SAND SP						
	SS-25,26,27,28,29 (Composite Sample)						
	N 151,498.9 E 512,889.4						
	ELEVATION 397.6						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● **MW-1606S 34.7-44.3ft**	**9.500**	**0.466**	**0.315**	**0.183**	**0.8**	**97.6**	**1.7**	

PROJECT **ROCKPORT PLANT -**

JOB NO. **42393125-01**
DATE **3/22/16**

GRADATION CURVES

American Electric Power Service Corp.

ATTACHMENT 3

MONITORING WELL HYDROGRAPHS
2010 BA POND MONITORING WELLS

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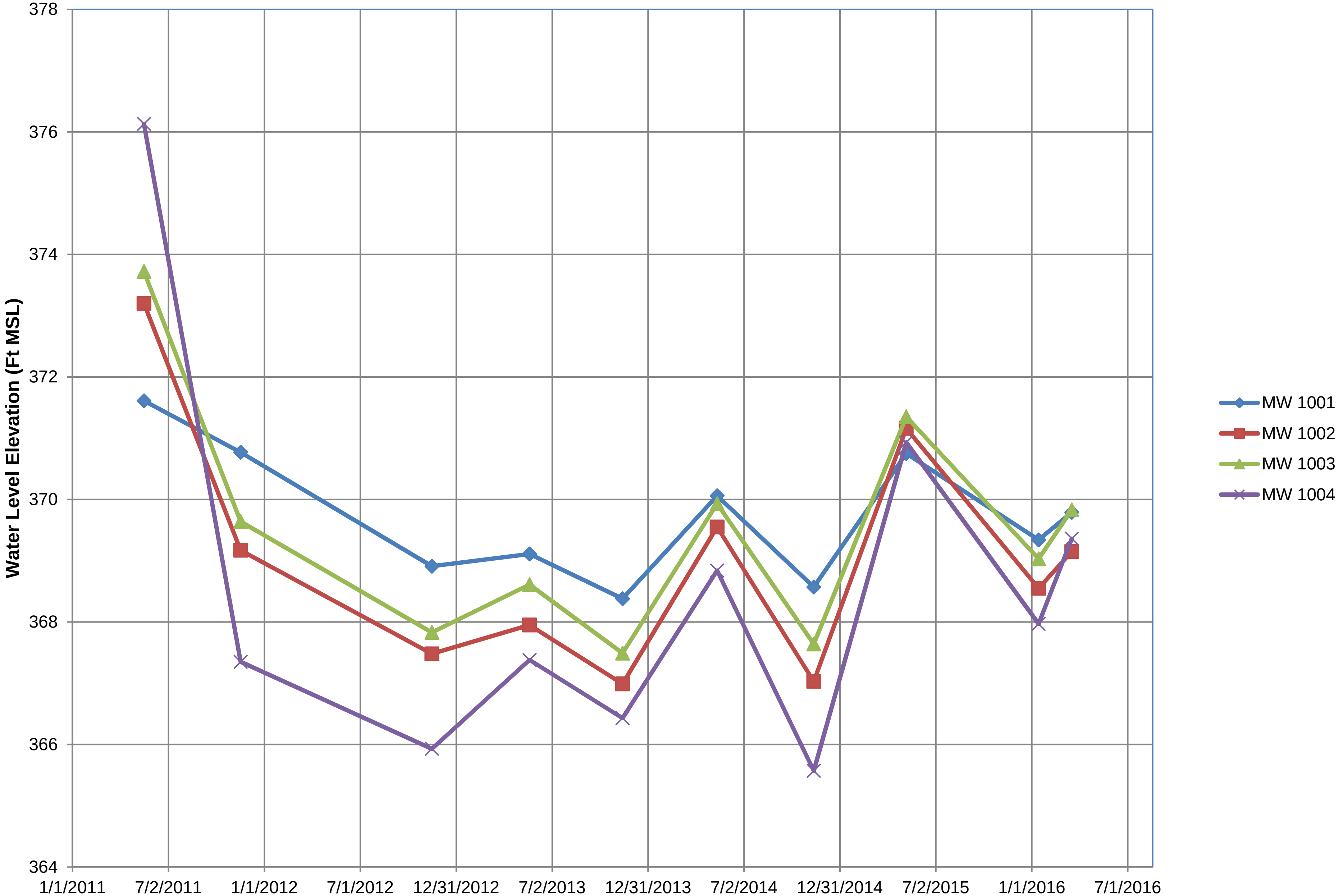
AEP Rockport Plant

Wastewater Pond Complex - Monitoring Well Hydrographs



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SEISMIC IMPACT ZONES DEMONSTRATION

CFR 257.63

Addendum for East Bottom Ash Pond

Rockport Plant
Town of Rockport, Spencer County, Indiana

October, 2023

Prepared for: INDIANA MICHIGAN POWER COMPANY - Rockport Plant
Town of Rockport, Spencer County, Indiana

Prepared by: Worley
One Meridian Boulevard
Suite 2C02, Wyomissing, PA, 19610

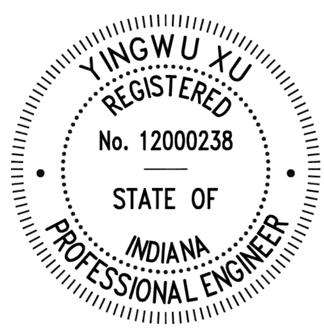
AMERICAN ELECTRIC POWER
BOUNDLESS ENERGY

SEISMIC IMPACT ZONE DEMONSTRATION
CFR 257.63
ADDENDUM FOR EAST BOTTOM ASH POND
ROCKPORT PLANT

PREPARED BY ______________________ DATE ______________
Erik Leiby

REVIEWED BY ______________________ DATE ______________
Greg Nadeau, P.E.

APPROVED BY ______________________ DATE ______________
Yingwu Xu, P.E.



I certify to the best of my knowledge, information, and belief that the information contained in this seismic impact zones demonstration meets the requirements of 40 CFR § 257.63

Table of Contents

List of Attachments:

1 OBJECTIVE

This addendum report was prepared by Worley to fulfill requirements of the CCR Rule CFR § 257.63. The report is an addendum to the existing AEP posted document from January, 2018 (attached) and describes the changes associated with the 2023 East Bottom Ash Pond retrofit construction, and thereby, any resulting seismic changes or requirements. Per the CCR Rule, New CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must not be located in seismic impact zones unless the owner or operator demonstrates by the dates specified in paragraph (c) of the referenced section that all structural components including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site.

2 DESCRIPTION OF THE PLANT AND THE CCR IMPOUNDMENT

The Rockport Power Plant is located at 791 N US Highway 231, Rockport, IN 47635-8883. The coordinates of the site are 37º55'32" N latitude and 87º02'02" W longitude. A Site Location Map is included as Figure1, in Attachment A. The plant operates two coal fired generating units rated at 1,300 megawatts (MW) each.

Unit 1 and Unit 2 were placed in service in 1984, and 1989, respectively. A Facility Layout Plan is included as Figure 2, in Attachment A. CCR material that is produced during power generation is managed on-site using the east bottom ash pond.

In 2022 and 2023, the east bottom ash pond was cleaned of all existing CCR material, plus a minimum of an additional 12-inches (min. el. 376). There were some limited areas where additional material was removed to ensure all remaining soils met background levels. Upon certification of clean closure, cohesive fill was placed to establish a liner system subgrade (min. el. 378.5) for the east bottom ash pond. The retrofitted east bottom ash pond is lined with a textured 40-mil LLDPE geomembrane overtop a geosynthetic clay liner (GCL) overtop a 10 oz/sy non-woven geotextile and discharges to the east waste water pond. A west bottom ash pond exists at the site and will commence closure when the retrofitted east bottom ash pond goes into service.

The facility utilizes six contiguous and hydraulically connected impoundments or cells (see Figure 2, in Attachment A) known as the BAP Complex for CCR management. The cells are separated by internal divider dikes. The individual cells of the BAP Complex are identified as follows:

- East Bottom Ash Pond
- West Bottom Ash Pond (To commence closure October, 2023)
- East Wastewater Pond
- West Wastewater Pond
- Reclaim Pond
- Clear Water Pond

The BAP Complex is a combination of incised and diked earthen embankment impoundment. It is incised below grade along most of its perimeter and is diked only on the west side of the West BA Pond, where the topography decreases in elevation toward a remnant drainage channel.

The embankments, including the west dike, have a crest elevation of 399 feet, and are approximately 30 feet wide. The west dike has a maximum height (from crest to outboard toe) of 13 feet. The inboard slope was constructed at a slope of 2 horizontal to 1 vertical (2H:1V), and the outboard slope at 2.5H:1V. The outer west dike, and the internal splitter dikes (constructed between the BA Ponds, and between each of the BA Ponds and the waste water ponds to the south) were constructed of natural clayey soils excavated from the interior of the ponds. The inboard slopes of all ponds in the complex are armored with rock riprap, except for the retrofitted east bottom ash pond slopes which are lined with either a 40-mil textured LLDPE geomembrane liner or 3” concrete revetment.

Based on the usage of the above-mentioned ponds, only the east bottom ash pond is considered an active CCR unit. However, both ponds were analyzed as part of the original 2018 Seismic Impact Zones Demonstration report in Attachment A.

3 SEISMIC IMPACT ZONE DETERMINATION 257.63(a)

Per the CCR Rules Definition, a seismic impact zone means an area having a two (2%) or greater probability that the maximum expected horizontal acceleration, expressed as a percentage of the earth’s gravitational pull (g), will exceed 0.10 g in 50 years.

The first step toward achieving compliance with this requirement is to identify whether the impoundment site lies within a seismic impact zone as defined above.

The determination of whether Rockport Plant area falls in a seismic impact zone and the level of the seismic acceleration is based on two approaches, the USGS web site as well as a site specific seismic analysis conducted for the plant area.

3.1 USGS MAP / WEB SITE DETERMINATION

See response in Attachment A, 2018 Seismic Impact Zones Demonstration report. There are no changes resulting from the 2023 east bottom ash pond construction.

3.2 SITE SPECIFIC SEISMIC ANALYSIS

See response in Attachment A, 2018 Seismic Impact Zones Demonstration report. There are no changes resulting from the 2023 east bottom ash pond construction.

4 DESCRIPTION OF THE FOUNDATION AND EMBANKEMENT MATERIALS 275.73(c)(1)(v)

[A description of the physical and engineering properties of the foundation and abutment materials on which the CCR unit is located.]

The description of the BAP Complex embankment and foundations soils was based on the 2016 site investigation and laboratory testing conducted by AEP Civil Engineering Laboratory. As part of the 2023 east bottom ash pond liner construction, cohesive soils were collected from an on-site borrow area and used to construct the pond bottom and side slopes and compacted to a minimum of 95% of the maximum density as determined by ASTM D698. Acceptable moisture range was +/- 3% of the optimum moisture content. Recent borings were also performed in 2015 through the embankment and indicate that the existing underlying material is stiff and representative of compacted earthen materials.

4.1 SITE INVESTIGATION

See response in Attachment A, 2018 Seismic Impact Zones Demonstration report. There are no changes resulting from the 2023 east bottom ash pond retrofit.

5 MODES OF FAILURE AND STABILITY DEMONSTRATION

Based on § 257.63 (a) part of the Rules, only the East Bottom Ash Pond is required to be covered under this demonstration. Seismic impact zones' Structural components including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site.

5.1 FAULTS

See response in Attachment A, 2018 Seismic Impact Zones Demonstration report. There are no changes resulting from the 2023 east bottom ash pond construction.

5.2 LIQUEFACTION POTENTIAL

See response in Attachment A, 2018 Seismic Impact Zones Demonstration report. There are no changes resulting from the 2023 east bottom ash pond construction.

5.3 SEISMIC INDUCED PERMANENT DISPLACEMENT

See response in Attachment A, 2018 Seismic Impact Zones Demonstration report. There are no changes resulting from the 2023 east bottom ash pond construction.

5.4 SEISMIC SLOPE STABILITY

See response in Attachment A, 2018 Seismic Impact Zones Demonstration report. There are no changes resulting from the 2023 east bottom ash pond retrofit construction. Also, seismic slope stability analyses have been run for the east bottom ash pond retrofit (see document, "Safety Factor Assessment – Initial Assessment – East Bottom Ash Pond).

5.5 OVER TOPPING OF CREST

The east bottom ash pond has been determined to be a Low Hazard potential CCR impoundment. Based on this hazard classification, the design flood as determined by section 257.82(a)(3) is to be the 100-year storm event that would incur 7.23 inches of precipitation in a 24-hour period. The site was modeled, however, using additional greater storms of 200-yr, 500-yr and 1,000-yr (1,000-year: 10.3 inches of precipitation in 24 hrs) to provide a more conservative analysis.

The catchment area for the east bottom ash pond is limited to the actual pond area itself. Pondpack analysis was performed for the various inflow design floods and shows that the pond has the capacity to manage the 100-yr inflow design flood, as well as larger flood events such as the 1000-yr flood.

The following table provides the maximum inflows and flood elevations for the east bottom ash pond.

East Bottom Ash Pond	24-hr, 100-yr	24-hr, 200-yr	24-hr, 500-yr	24-hr, 1,000-yr
Catchment Area = Pond Area	30 acres	30 acres	30 acres	30 acres
Initial WSEL (max operating pool)	396	396	396	396
Stormwater Volume (acre-ft)	18.06	20.21	23.28	25.73
Post Storm Peak Pool Elevation	396.45	396.50	396.57	396.63
Top of Pond Elevation	399	399	399	399
Freeboard (feet)	2.55	2.5	2.43	2.37

It can be concluded from the above results that the east bottom ash pond has adequate hydrologic and hydraulic capacity to collect and control the peak discharge resulting from the 1000-year inflow design flood and therefore the overtopping of the crest is not anticipated.

5.6 LINER

The retrofitted east bottom ash pond is lined with a textured 40-mil LLDPE geomembrane overtop a geosynthetic clay liner (GCL) overtop a 10 oz/sy non-woven geotextile. Prior to installing the liner the existing pond was cleaned of all CCR material to el. 377 (pond bottom), plus an additional 1-foot minimum to approximate el. 376. There were some limited areas where additional material was removed to ensure all remaining soils met background levels. Cohesive soils from an on-site borrow area were placed and compacted to a minimum of 95% of the maximum density to bring the east bottom ash pond bottom up to a minimum el. 378.5.

The overall size of the east bottom ash pond has not changed (approx. 30 acres) from the previous unlined condition and the pond side slopes remain 2:1, as previously. The bottom of the east bottom ash pond (liner subgrade) has been raised from previous el. 377 to 378.5, as described above. Since there is no load on the liner except for the weight of pond water and the load on the liner is fully controlled by the designed liner anchor trenches, the liner is not susceptible to seismic issues.

Typically, the concern during a seismic event is for the liner system or the cover on the liner system to slide (fail). The liner system is placed directly on the subgrade with no cover for most of the pond. Therefore, there is no cover material to slide off the liner system during a seismic event. In the forebay area the liner system is covered with a continuous 3” thick layer of concrete revetment. This revetment cannot slide off the liner as it is continuous from top to bottom and across the entire forebay. The liner system and concrete revetment (forebay area) is well anchored in a trench at the top of the slope all the way around the pond.

5.7 LEACHATE COLLECTION AND REMOVAL SYSTEMS

The east bottom ash pond is not equipped with a leachate collection and removal system; therefore, this demonstration is not applicable.

5.8 SURFACE WATER CONTROL SYSTEMS

See response in Attachment A, 2018 Seismic Impact Zones Demonstration report. The only changes resulting from the 2023 east bottom ash pond retrofit construction is that the sluice pipes entering the east bottom ash pond have been moved from the west side of the pond to the north side, the timber wood skimmers around the pond outlet structure has been removed, and the concrete pond inlet chute troughs have been eliminated. No new surface water controls systems were installed that would require analysis.

6 SUMMARY AND CONCLUSIONS

The east bottom ash pond is a surface impoundment within the bottom ash complex used for primary settling and storage of CCR material. The Bottom Ash Pond Complex is located in an area having a two (2%) or greater probability that the maximum expected horizontal acceleration, expressed as a percentage of the earth's gravitational pull (g) of 0.1487 g in 50 years, which is in excess of the 0.10 g maximum horizontal acceleration in lithified earth material. Therefore, a demonstration that all structural components including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site was conducted per the requirements of CFR§257.63 – Seismic Impact Zones.

Based on the analysis conducted, all structural components are designed to resist the maximum horizontal acceleration and the Bottom Ash Pond Complex meets the requirements of §257.63 – Seismic Impact Zones.

Attachment A - Seismic Impact Zones Demonstration (Bottom Ash Complex), January 2018

SEISMIC IMPACT ZONES DEMONSTRATION

CFR 257.63

Bottom Ash Complex

Rockport Plant
Town of Rockport, Spencer County, Indiana

January, 2018

Prepared for: INDIANA MICHIGAN POWER COMPANY - Rockport Plant
Town of Rockport, Spencer County, Indiana

Prepared by: Geotechnical Engineering Services
American Electric Power Service Corporation
1 Riverside Plaza
Columbus, OH 43215

GERS-18-004

SEISMIC IMPACT ZONE DEMONSTRATION

CFR 257.63

BOTTOM ASH COMPLEX

ROCKPORT PLANT

GERS-18-004

PREPARED BY Mohammad A. Ajlouni, Ph.D.,P.E. **DATE** 1/25/2018

REVIEWED BY Brett A. Dreger, P.E. **DATE** 1/29/2018

APPROVED BY Gary F. Zych, P.E. **DATE** 2/13/2018

Manager – AEP Geotechnical Engineering

MOHAMMAD A. AJLOUNI
REGISTERED
No. 10809354
STATE OF INDIANA
PROFESSIONAL ENGINEER

I certify to the best of my knowledge, information, and belief that the information contained in this seismic impact zones demonstration meets the requirements of 40 CFR § 257.63

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List of Appendices

1 OBJECTIVE

This report was prepared by AEP- Geotechnical Engineering Services (GES) section to fulfill requirements of the new Promulgated CCR Rule CFR § 257.63. Per the New Promulgated CCR Rule, New CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must not be located in seismic impact zones unless the owner or operator demonstrates by the dates specified in paragraph (c) of the referenced section that all structural components including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site.

This report will evaluate whether the Bottom Ash Ponds (BAP) Complex at Rockport Plant is located in seismic impact zones, and if so, the report will demonstrate that the all structural components including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site

2 DESCRIPTION OF THE PLANT AND THE CCR IMPOUNDMENT

The Rockport Power Plant is located at 791 N US Highway 231, Rockport, IN 47635-8883. The coordinates of the site are 37º55’32” N latitude and 87º02’02” W longitude. A Site Location Map is included as Figure 1. The plant operates two coal fired generating units rated at 1,300 megawatts (MW) each.

Unit 1 and Unit 2 were placed in service in 1984, and 1989, respectively. A Facility Layout Plan is included as Figure 2. Coal Combustion Waste (CCW) that is produced during power generation is managed on-site with a CCW impoundment.
The facility utilizes six contiguous and hydraulically connected impoundments or cells (see Figure 2) known as the BAP Complex for CCW management. The cells are separated by internal divider dikes. The individual cells of the BAC are identified as follows:

- East Bottom Ash Pond
- West Bottom Ash Pond
- East Wastewater Pond
- West Wastewater Pond
- Reclaim Pond
- Clear Water Pond

The wastewater pond complex is a combination incised and diked earthen embankment impoundment. It is incised below grade along most of its perimeter, and is diked only on the west side of the West BA Pond, where the topography decreases in elevation toward a remnant drainage channel.

The embankments, including the west dike, have a crest elevation of 399 feet, and are approximately 30 feet wide. The west dike has a maximum height (from crest to outboard toe) of 13 feet. The inboard slope was constructed at a slope of 2 horizontal to 1 vertical (2H:1V), and the outboard slope at 2.5H:1V. The outer west dike, and the internal splitter dikes (constructed between the BA Ponds, and between each of the BA Ponds and the wastewater ponds to the south) were constructed of natural clayey soils excavated from the interior of the ponds. The inboard slopes were armored with rock riprap. Reportedly, no engineered liner systems are present in the BA Ponds or the other ponds in the wastewater pond complex.

Based on the usage of the above mentioned ponds, only the East Bottom Ash Pond and the West Bottom Ash Pond are considered CCR units. These two ponds the subjects of this demonstration report.

3 SEISMIC IMPACT ZONE DETERMINATION 257.63(a)

Per the CCR Rules Definition, a seismic impact zone means an area having a two (2%) or greater probability that the maximum expected horizontal acceleration, expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10 g in 50 years.

The first step toward achieving compliance with this requirement is to identify whether the impoundment site lies within a seismic impact zone as defined above.

The determination of whether Rockport Plant area falls in a seismic impact zone and the level of the seismic acceleration is based on two approaches, the USGS web site as well as a site specific seismic analysis conducted for the plant area.

3.1 USGS MAP/WEB SITE DETERMINATION

The U.S. Geological Survey (USGS) National Seismic Hazard Mapping Program (NSHMP) Interactive Deaggregation website was used to provide the design ground acceleration relating to the design seismic event. For a 2,475-year return period (2% exceedance probability in 50 years), the website output indicates a PGA of 0.14957 g for the hard rock site (Based on URS Report recommendations, APPENDIX A). The corresponding earthquake magnitude (M) was 6.46.

3.2 SITE SPECIFIC SEISMIC ANALYSIS

URS Company (URS), Currently AECOM, performed a site-specific seismic hazard analysis for the Rockport power plant site in Indiana. The objective of the study was to compute the design earthquake response spectrum for the site per the requirements in Chapter 21 of the ASCE 7-05 standard, which is incorporated by reference in the 2006 International Building Code (IBC).
The study also meets the requirements of the Indiana State Building Code, which amends certain sections of the IBC.

The site-specific PGA computed in URS study for a 2,475-year return period is 0.13 g, very comparable to the USGS mapped value. Excerpts of the URS (AECOM) study are included in APPENDIX A.

Based on the results of the two approaches, the design seismic acceleration of the facility is to be taken as 0.14957 g. Therefore, the BAP complex falls in a seismic impact zone and the analysis of this report will attempt to demonstrate that the Structural components including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the 0.14957 g, maximum horizontal acceleration in lithified earth material.

4 DESCRIPTION OF THE FOUNDATION AND EMBANKEMENT MATERIALS 275.73(c)(1)(v)

[A description of the physical and engineering properties of the foundation and abutment materials on which the CCR unit is located.]

The description of the BAP Complex embankment and foundations soils were based on the 2016 site investigation and laboratory testing conducted by AEP Civil Engineering Laboratory.

4.1 SITE INVESTIGATION

AEP Civil Engineering Drilling crew conducted a soil site investigation of which two (2) soil test boring series (B-1605 and B-1606) that were drilled through the embankment and the foundation soils (See Figure 2), were selected for this demonstration. Representative but disturbed soil samples were collected in jars/bags and transferred to AEP Civil Engineering Laboratory for classification and testing. The Standard Penetration Resistances ($N1_{60}$-values) varied between a low of 2 to a high of 100 (refusal) blows per foot (bpf) with an average $N1_{60}$-values of 35 bpf.

The soils within the embankment were lean clay extending below the embankment with a total depth of 27-30 ft. The clay layer was underlain by fine to coarse sand deposits. Figure 4 present the soil profile interpreted from the two borings. Bedrock at the plant site is at approximate elevation of 290 ft-msl and comprised of predominantly shale.

Soil Samples from the borings at various depths were tested at AEP Civil Engineering Laboratory for the following tests:

- Moisture Content (ASTM 2216)
- Grain Size Analyses (ASTM D 422)
- Atterberg Limits (ASTM D 4318

Based on the lab soil tests results, the tested soils are non-plastic silty sand with fine content ranging from 14.5 to 28.6% with minor pockets of sandy lean clay. Laboratory test reports are included in APPENDIX B. Soil classification, index properties, and shear strength values obtained from subsurface soil investigation and laboratory tests are summarized in Table 1 below.

Table 1 Soil Properties Obtained in 2016 Investigation Laboratory Testing

Soil Boring ID	**Sample Depth (ft)**	**USCS Classification**	**Fine Content (%)**	**Moisture Content (%)**	**Atterberg Limits**		
					LL	**PL**	**PI**
MW-1605D	115.0-124.6ft	POORLY GRADED SAND SP	14.5	5.4	NP	NP	NP
MW-1605I	68.6-78.2ft	POORLY GRADED SAND SP	19.7	2.5	NP	NP	NP
MW-1605S	37.6-47.2ft	POORLY GRADED SAND SP	16	2.1	NP	NP	NP
MW-1606D	100.0-109.6ft	POORLY GRADED SAND SP	28.6	7.3	NP	NP	NP
MW-1606I	65.7-75.3ft	POORLY GRADED SAND SP	18.9	5.4	NP	NP	NP
MW-1606S	34.7-44.3ft	POORLY GRADED SAND SP	20.9	1.7	NP	NP	NP

APPENDIX B includes the boring logs for relevant boring 1605 and 1606 as well as the corresponding lab tests.

5 MODES OF FAILURE AND STABILITY DEMONSTRATION

Based on § 257.63 (a) part of the Rules, only East and West bottom Ash Ponds are required to be covered under this demonstration. Seismic impact zones' Structural components including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site.

5.1 FAULTS

Based on the geological survey of the Pond Complex area, there is no fault exists in the locality under the ponds dikes. This mode of failure is considered not applicable for the bottom ash pond complex.

Based on published data no active faults are known to traverse the site and no surficial evidence of faulting was observed during various field investigation conducted at the site. Figure 5 and Figure 6 present the nearest mapped fault trace considered to be active is one of a group of faults located approximately 5 miles west of the site.

5.2 Liquefaction Potential

Liquefaction is a condition where seismic ground motions cause excessive pore pressures in soils that result in a loss in shear strength. Liquefaction can cause slope instability and/or settlement. Liquefaction is most likely to occur for (1) loose sands/silts, (2) shallow groundwater conditions, and (3) strong ground motions.

Liquefaction potential analysis was performed using LiquefyPro program developed by CivilTech Software Company. The program evaluates liquefaction potential and calculates the settlement of soil deposits due to seismic loads.

LiquefyPro program is based on the most recent publications of the NCEER Workshop and SP117 Implementation. The user can choose between several different methods for liquefaction evaluation: one method for SPT and four methods for CPT data. Each method has different options that can be changed by the user. The options include Fines Correction, Hammer Type for SPT test, and Average Grain Size (D_{50}) for CPT.

The liquefaction analysis used the standard penetration (SPT) N-values recoded on the logs for the existing testing boring and monitoring wells MW-1605 and 1606. The liquefaction analysis has been performed for $N1_{60}$-values recorded in the upper 100 feet although the "RCRA Subtitle D (258) Seismic Design Guidance for Municipal Solid Waste Landfill Facilities" (U.S.EPA, 1995) states that liquefaction is generally not likely to occur more than 50 feet below the ground surface. At the BAP Complex, groundwater is at 27 to 30 feet below the ground surface.

The results of the liquefaction analysis are summarized in Table 2 and Figure 7 and Figure 8. The detail of the analysis is included in Appendix C. The analysis shows that liquefaction is unlikely for the embankment and the foundations soils during the assumed PGA.

Table 2 Summary of Supplemental Liquefaction Potential Results

Section	Minimum Factor of Safety	Required Minimum Factor of Safety	Notes
B-1605	>1.2	1.20	None
B-1606	>1.2	1.20	None

5.3 Seismic Induced Permanent Displacement

The computer program LiquefyPro developed by developed by CivilTech Software Company was used to predict the likely magnitude of seismically-induced permanent displacements. LiquefyPro performs numerical double integration of the HEA values that are in excess of the yield acceleration values.

LiquefyPro divides the soil deposit into very thin layers and calculates the settlement for each layer. The calculations are divided into two parts, dry soil settlement and saturated soil settlement. The soil above the groundwater table is referred to as dry soil and soil below the groundwater table is referred to as saturated soil. The total settlement at a certain depth is the sum of the settlements of the saturated and dry soil. The total settlement is presented in the graphical report as a cumulative settlement curve versus depth. LiquefyPro gives settlement in both liquefied and non-liquefied zones.

The results of the permanent displacement analyses using LiquefyPro are presented graphically in Figure 7 and Figure 8. The figures indicate that the seismic induced permanent displacement are very small and range from 0 to 0.01 feet (0 to 0.12 inches).

5.4 Seismic Slope Stability

As a part of the factor of Structural integrity criteria assessment part of the CCR Rule (CFR §257.7 e), Terracon Inc. conducted seismic slope stability analysis in 2016 for the worst section of the bottom ash pond which is the outer dike. Factor of safety of 1.21 and 2.14 were calculated for worst case section shown in Figure 9 Figure 10 for the upstream slopes and downstream slopes, respectively. The figures show the geometry of the worst case section along with their material properties for the various soil layers, the projected slip failure, and the resulting factor of safety.

5.5 Over Topping of Crest

The west bottom ash pond is comprised of diked embankment to the west and between its respective waste water pond and adjacent east bottom ash pond that directs storm water away from the impoundment and limits runoff to that which falls directly onto the water surface. The land area to the north is an open field area that is not graded toward the Bottom Ash Complex. The east bottom ash pond has a small 13 acre catchment area that will drain into the pond. Flow into the west bottom ash pond was modeled as the pumped influent from the plant (77 ac-ft) and from the storm event (48 ac-ft) and discharged through the pond complex to the Ohio River.

The Bottom Ash Pond Complex has been determined to be a Low Hazard potential CCR impoundment. Based on this hazard classification, the design flood as determined by section 257.82(a)(3) to be the 100 year storm event that would incur 7.23 inches of precipitation in a 24 hour period. Terracon, 2015 conducted hydraulic and hydrogeologic study in which the site was modeled, however, using a greater storm (1,000-year: 10.3 inches of precipitation in 24 hrs) event to provide a more conservative analysis.

The following table provides the maximum inflows, outflows and flood elevations for the west bottom ash pond.

West Bottom Ash Pond*	
Storm Event	1000 yr.
Peak Inflow	470 cfs
Peak Outflow	35 cfs
Maximum Pool Elevation	395 ft.
Crest Elevation	399 ft.

*Reference: Terracon 2015,"Hydrologic and Hydraulic Analysis Report, Rockport Plant Bottom Ash Pond Complex, Rockport Indiana", Terracon Project No. N4155126

It can be concluded from the above results that the Bottom Ash Pond Complex has adequate hydrologic and hydraulic capacity to collect and control the peak discharge resulting from the 1000-year inflow design flood and therefore the overtopping of the crest is not anticipated.

5.6 Liner

The Ponds are CCR surface impoundments that are not equipped with a liner; therefore, this demonstration is not applicable.

5.7 Leachate Collection and Removal Systems

The Ponds are CCR surface impoundments that are not equipped with a leachate collection and removal systems; therefore, this demonstration is not applicable.

5.8 Surface Water Control Systems

The surface water control structures were constructed in the late 70s and early 80s for the 2-unit operating plant with a total capacity of approximately 2,600 MW. The structures reviewed in this demonstration are all surface water control units facilitating water flow into and from the bottom ash ponds to the clear water ponds.

The components included in the demonstration can be classified into two groups:

• Group 1: components subjected to lateral loading due to the quakes used for transferring water from bottom ash ponds to waste water ponds including units used to dewater the BA ponds. The components are:

1. Energy Dissipater structure (EDS - 2 nos.) - approximately 8 plant pipes of 8 - 10 inch diameter pipes discharging into this structure and then transported into the BA pond through the Energy Dissipater troughs/Pond Discharge Inlet Chutes. EDSs are of concrete with steel dissipation flaps.
2. Energy Dissipater troughs/Pond Discharge Inlet Chutes (EDT)- These are concrete structures partially open at the top and partially covered by yellow steel boxes called Discharge Chute Covers.
3. Skimmers (SKM)- Timber structures surrounding the waste water discharge chute.
4. Waste water Discharge shaft (WWDS)- a steel and concrete prismoidal structure for routing waste water into the waste water discharge pipe.

• Group 2: Waste Water Discharge Pipe (WWDP)- Two buried 48 inch (one fiberglass and the other HDPE) pipes that transfer water under the dikes. Because they are buried they are affected by seismic waves and ground displacements.

Details of the analysis and are included in Appendix D. Appendix D contains the relevant calculations for the structures with the assumption that the dike stability against any seismic failure including liquefaction can be concluded. With this calculation results, the dike has been found stable. Therefore, the assumption is no more a restraint to use this calculation. The conclusion of the presented analysis indicated that

1. Based on a typical configuration, the seismic analyses of the structures are judged to meet local seismic requirements.

6 SUMMARY AND CONCLUSIONS

The Bottom Ash Pond Complex is a surface impoundment for storing CCR. The Bottom Ash Ponds within the complex are used for primary settling and storage of bottom ash. The Bottom Ash Pond Complex is located in an area having a two (2%) or greater probability that the maximum expected horizontal acceleration, expressed as a percentage of the earth's gravitational pull (g) of 0.1487 g in 50 years, which is in excess of the 0.10 g maximum horizontal acceleration in lithified earth material. Therefore, a demonstration that all structural components including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site was conducted per the requirements of CFR§257.63 – Seismic Impact Zones.

Based on the analysis conducted in this report, all structural components including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the maximum horizontal acceleration and the Bottom Ash Pond Complex meets the requirements of §257.63 – Seismic Impact Zones.

7 REFERENCES

USEPA, 2015. 40 CFR Parts 257 and 261, Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule. April 17, 2015. 201 pp.

Site-Specific Seismic hazard analysis for AEP power plant site, Rockport, Indiana URS corporation (currently AECOM) (2012).

Terracon 2015,"Hydrologic and Hydraulic Analysis Report, Rockport Plant Bottom Ash Pond Complex, Rockport Indiana", Terracon Project No. N4155126

Terracon, 2016. Geotechnical Engineering Report, AEP Rockport Bottom Ash Complex Professional Engineering Certification.

Figures

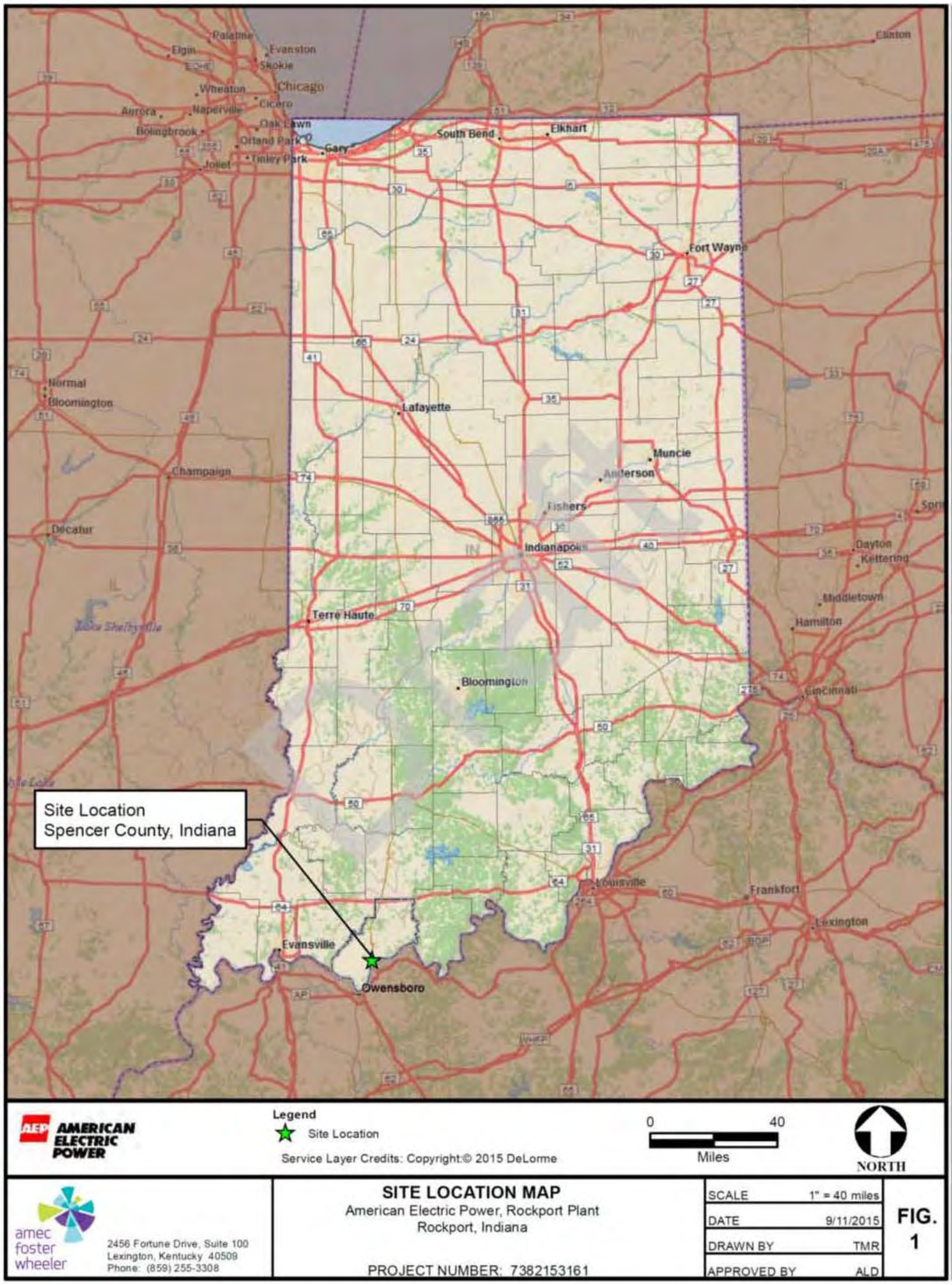

Figure 1 Rockport Power Station's Bottom Ash pond Complex Location Map

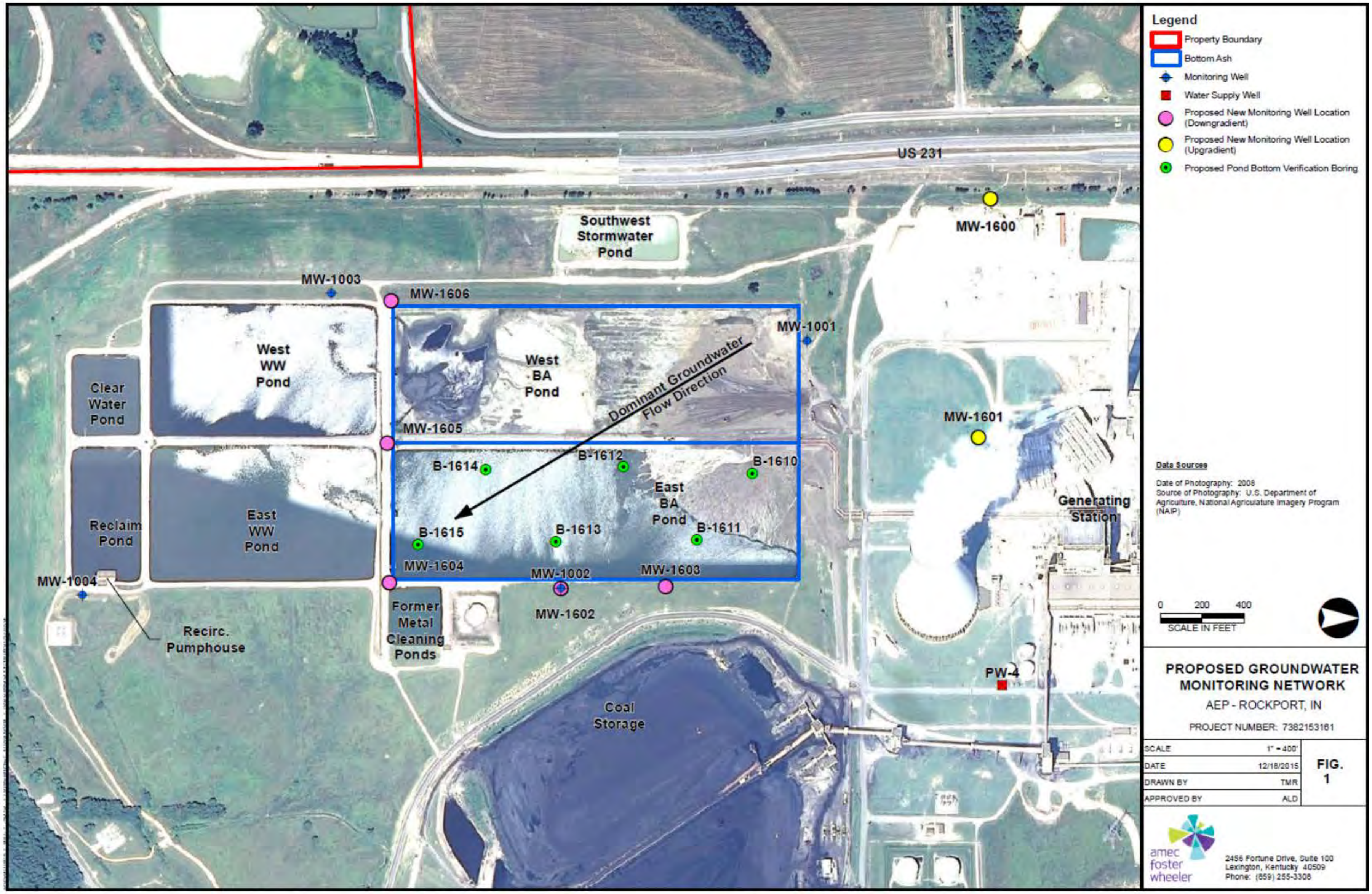

Figure 2 Rockport Power Station's BAP Plan View (Includes Borings location)

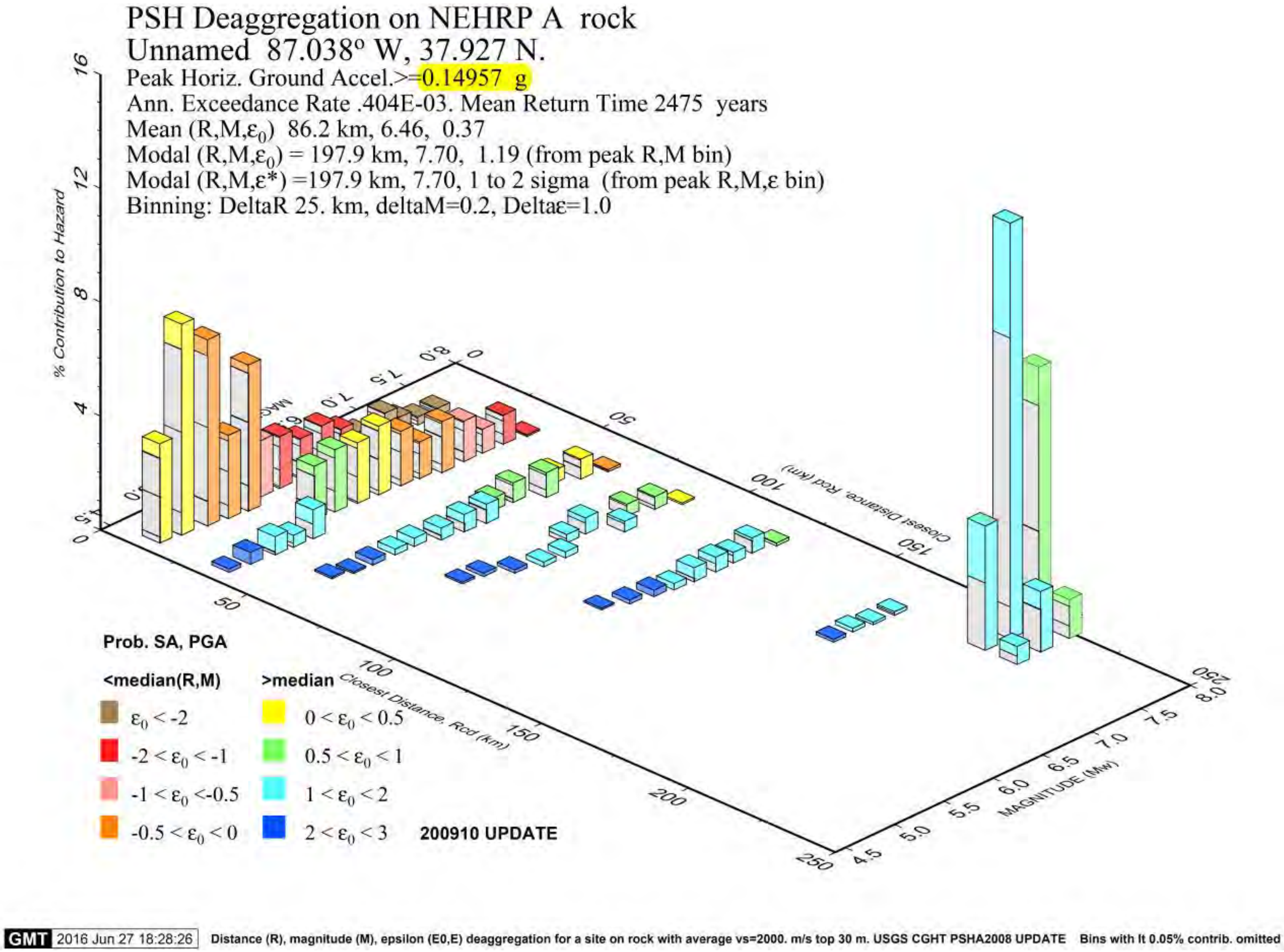

Figure 3 Maximum expected Earthquake Magnitude and horizontal acceleration based on U.S. Geological Survey Web Site

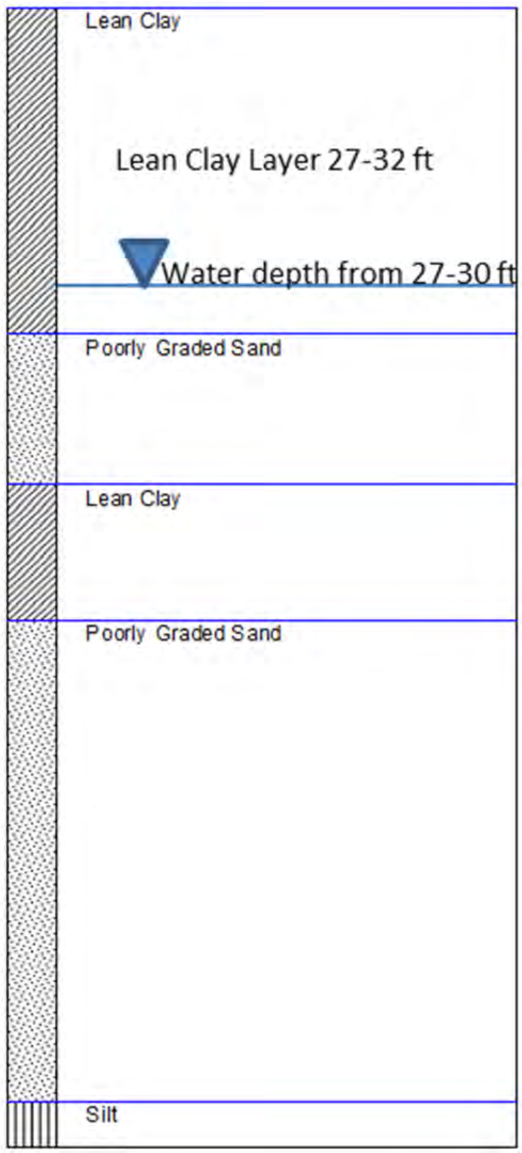

Figure 4 Soil Profile Interpreted from the Two Borings.

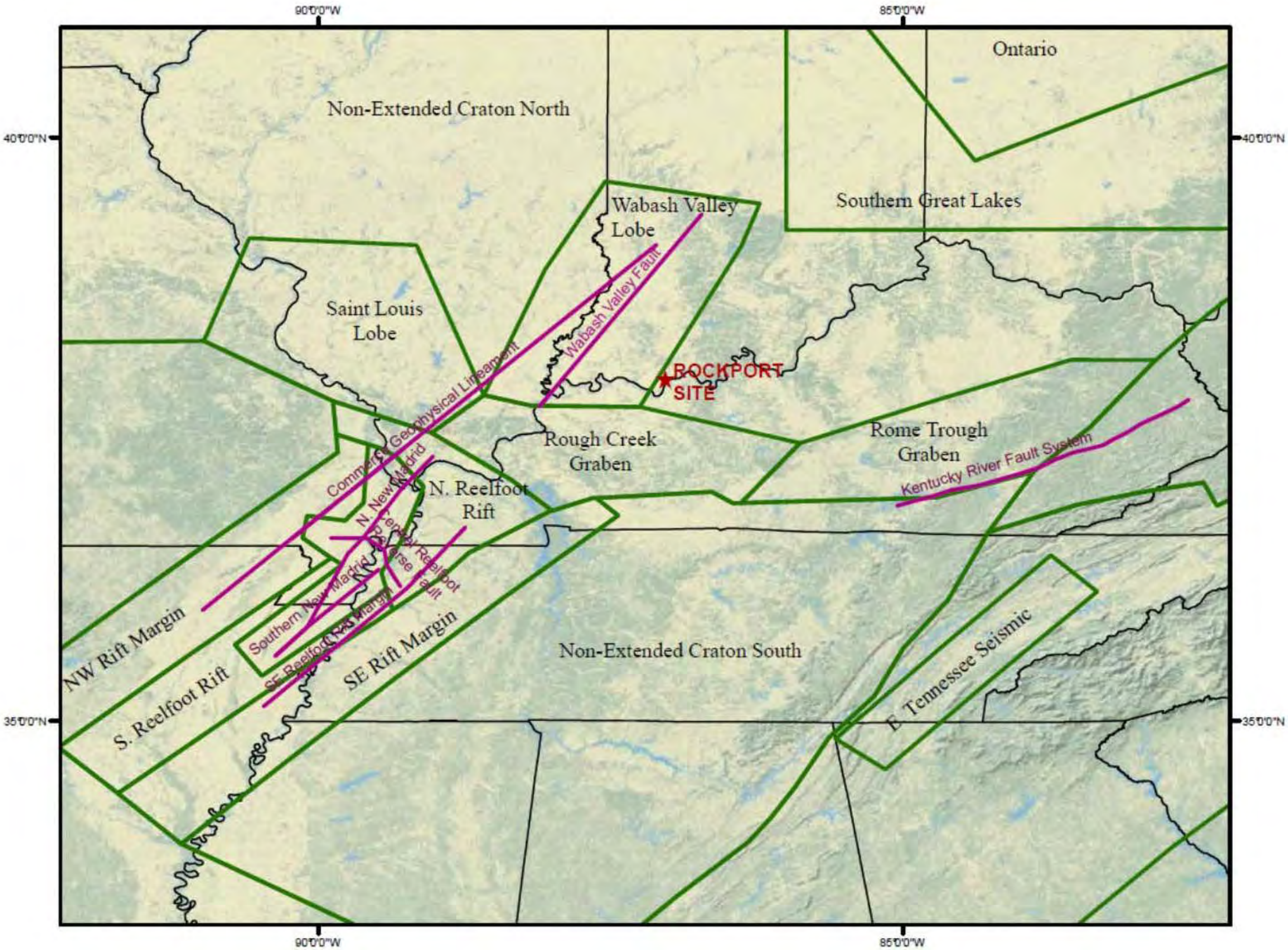

Figure 5 Regional Faults Location Map

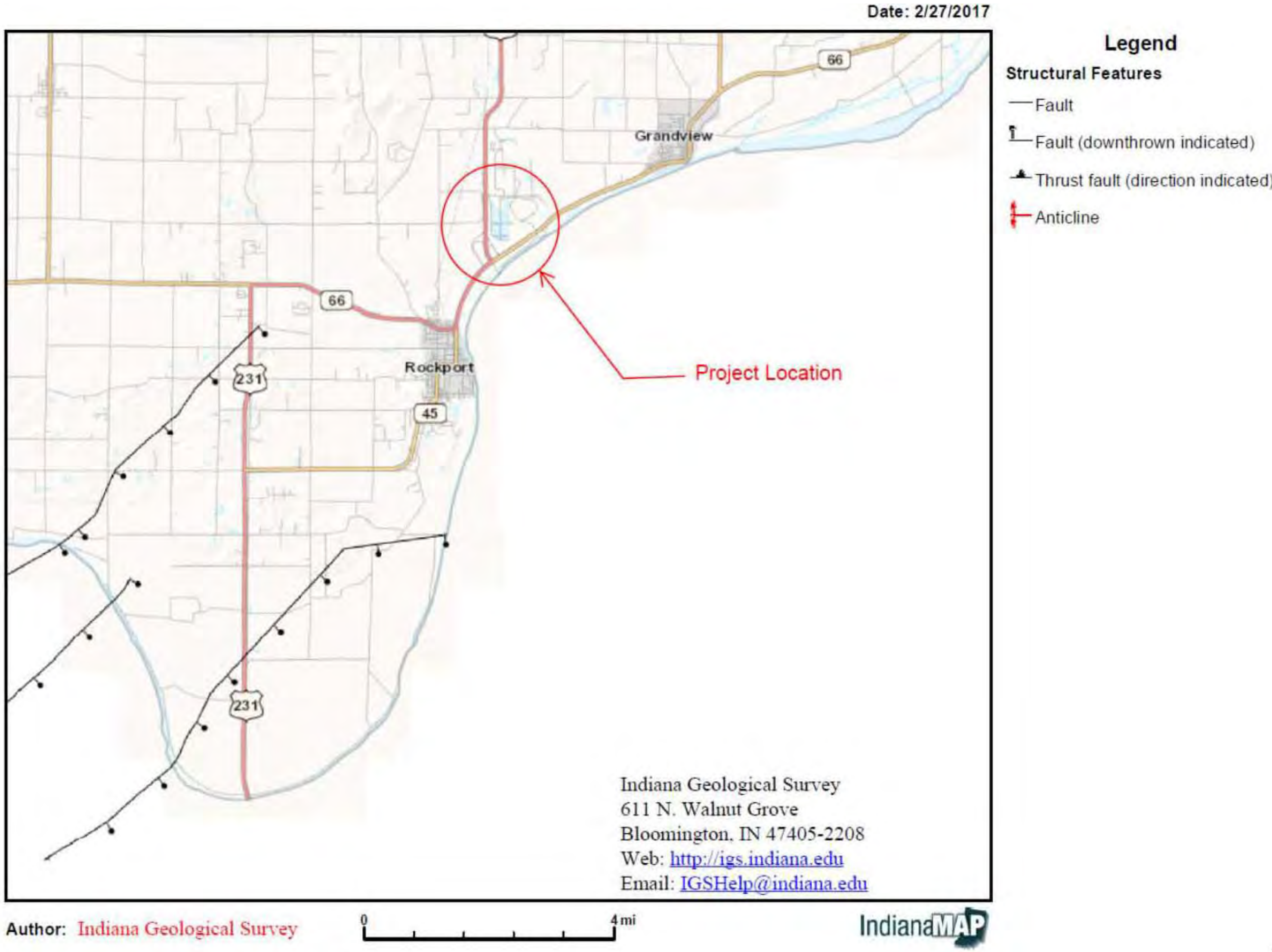

Figure 6 Local Faults Location Map

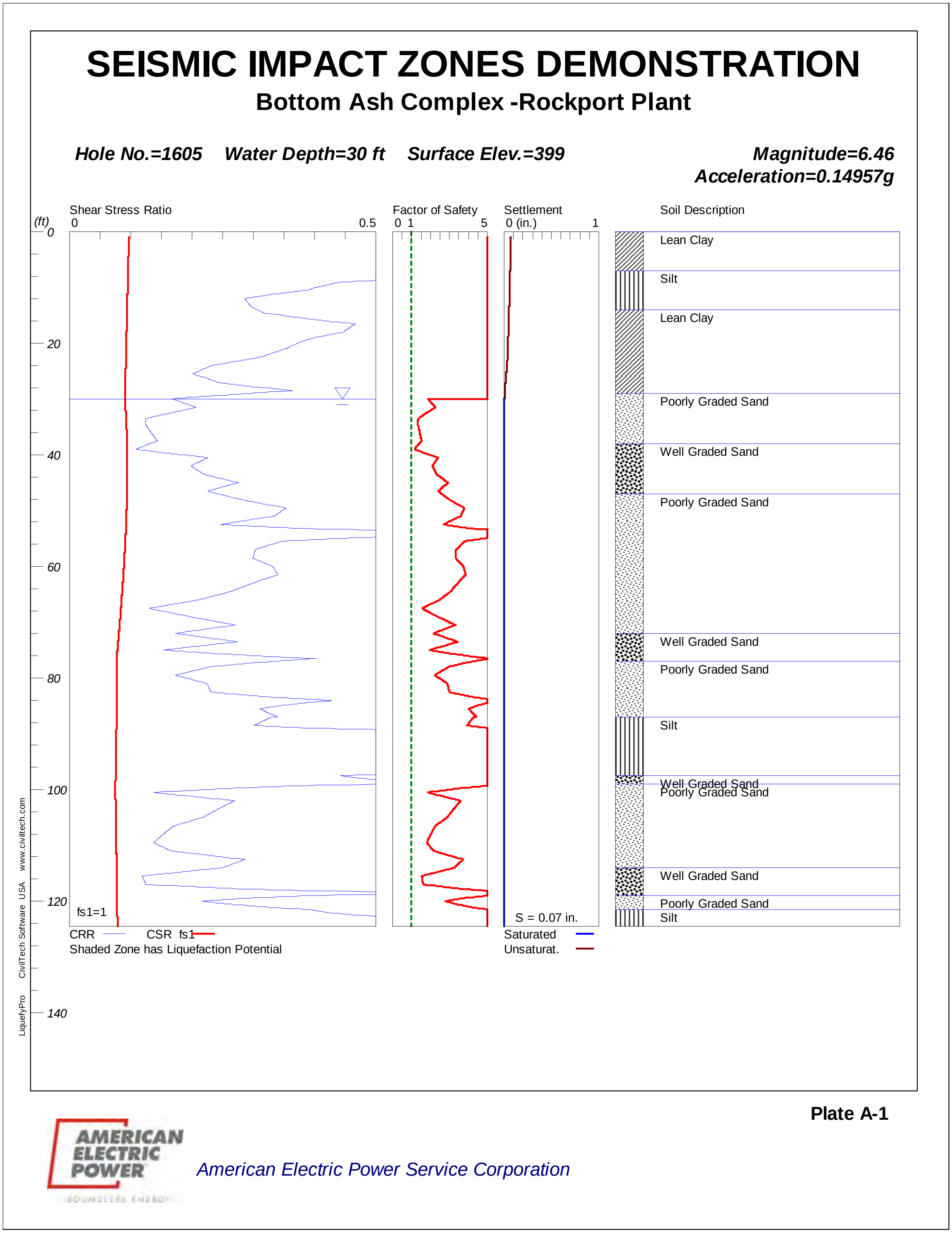

Figure 7 Liquefaction Analysis Results for B-1605Location

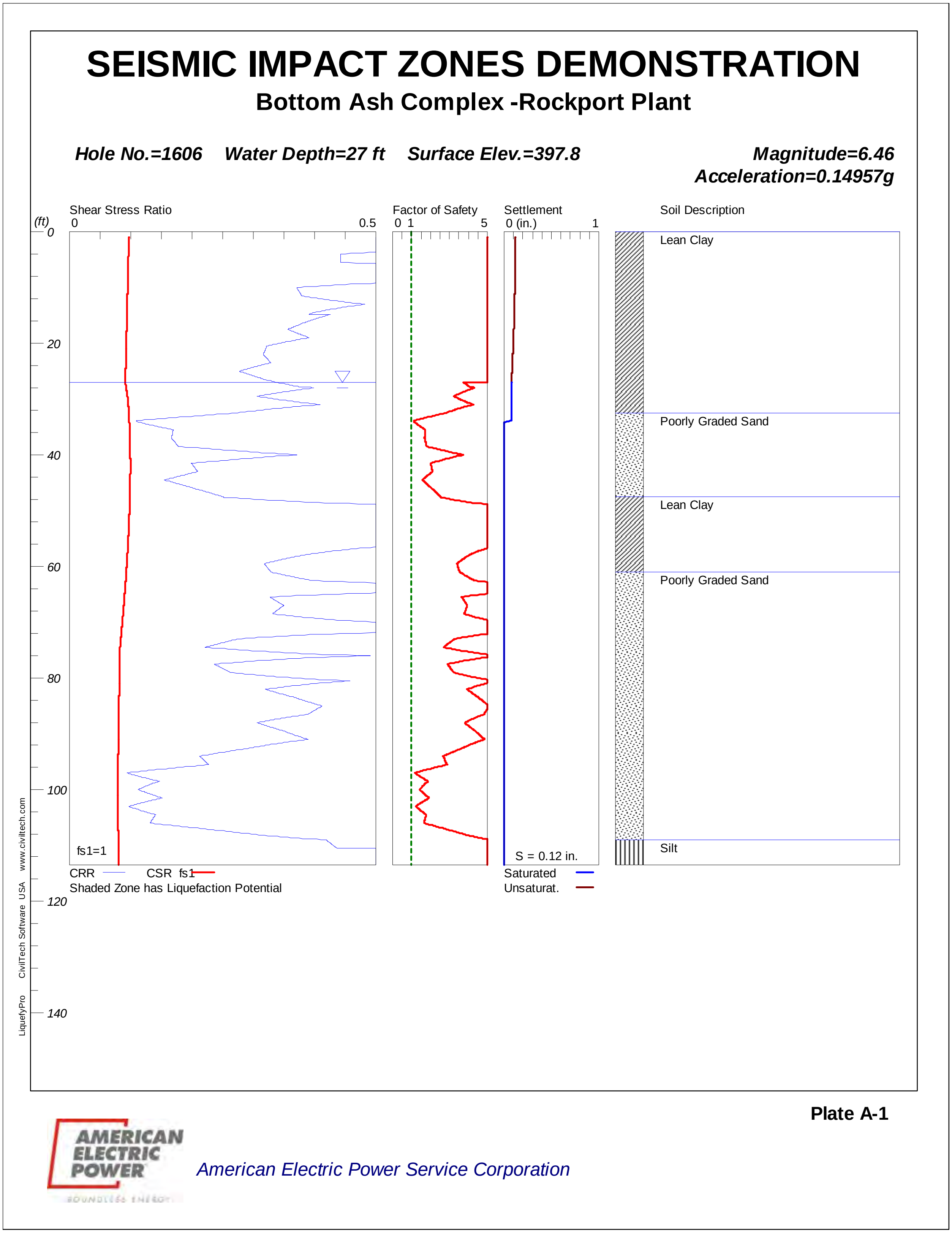

Figure 8 Liquefaction Analysis Results for B-1606Location

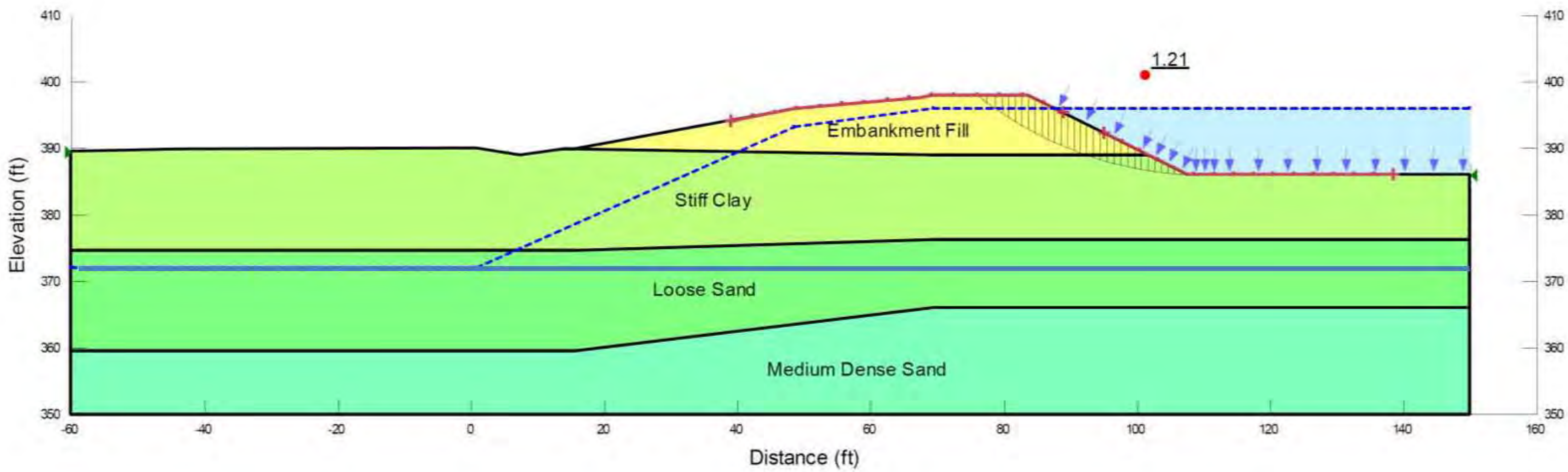

Figure 9 Results of Seismic Stability Analysis (Upstream)

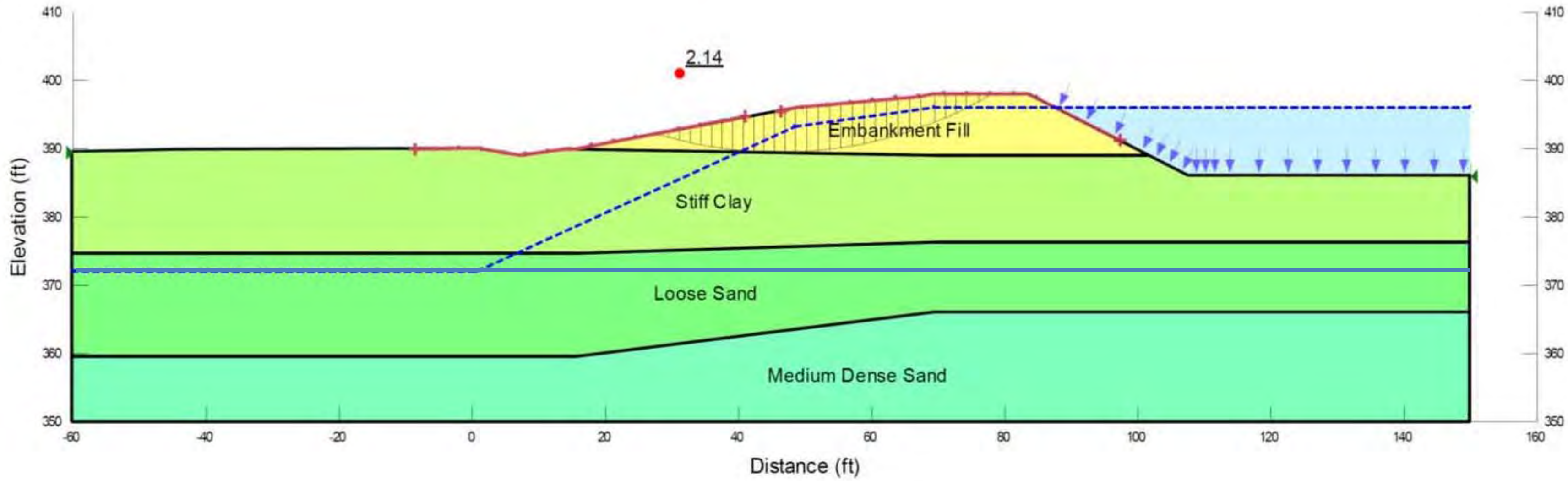

Figure 10 Results of Seismic Stability Analysis (Downstream)

APPENDICIES

APPENDIX A : Excerpts from the SITE-SPECIFIC SEISMIC HAZARD ANALYSIS

REPORT

SITE-SPECIFIC SEISMIC HAZARD ANALYSIS FOR AEP POWER PLANT SITE, ROCKPORT, INDIANA

Submitted to:

America Electric Power
1 Riverside Plaza
Columbus, Ohio 43215-2373

Prepared by:

URS Corporation
1501 4th Avenue, Suite 1400
Seattle, Washington 98101

URS Job No.: 13814835

March 12, 2012

URS performed a site-specific seismic hazard analysis for the American Electric Power (AEP) power plant site in Rockport, Indiana. The coordinates of the site are 37°55'32" N latitude and 87°02'02" W longitude. The objective of the study was to compute the design earthquake response spectrum for the site per the requirements in Chapter 21 of the ASCE 7-05 standard, which is incorporated by reference in the 2006 International Building Code (IBC). The study also meets the requirements of the Indiana State Building Code, which amends certain sections of the IBC.

To obtain the design earthquake response spectrum for the site, URS first conducted a probabilistic seismic hazard analysis (PSHA) to compute the 5% damped, horizontal component response spectrum corresponding to the Maximum Considered Earthquake (MCE). This spectrum pertained to a generic hard rock site condition (Site Class A, as defined in Chapter 20 of ASCE 7-05). The spectrum was then adjusted for the actual Site Class D site condition using the site coefficients in Section 11.4 of ASCE 7-05 and then converted to the design earthquake response spectrum according the provisions in Section 21.3 of the standard.

This report is organized as follows. Section 2.0 provides an overview of the PSHA methodology, while Section 3.0 summarizes the seismotectonic setting and historical seismicity of the site region. Sections 4.0 and 5.0 present, respectively, the inputs and results of the PSHA. Section 6.0 provides the determination of the site-specific design earthquake response spectrum. References are provided in Section 7.0 followed by the tables and figures.

5.1 COMPARISON WITH USGS NATIONAL HAZARD MAPS

In 1996, the USGS released a "landmark" set of National Hazard Maps for earthquake ground shaking, which was a significant improvement from previous maps they had developed (Frankel *et al.*, 1996). These maps were the result of the most comprehensive analyses of seismic sources and ground motion attenuation ever undertaken on a national scale. The maps are the basis for the NEHRP Maximum Considered Earthquake maps, which are used in the International Building Code. The maps are for NEHRP site class B/C (firm rock) and thus are not appropriate for the hard rock site conditions that are generally prevalent in the CEUS. The ground motions

on firm rock, however, can be adjusted to hard rock using adjustment factors developed by David Boore (Frankel *et al.*, 1996).

For a 2,475-year return period (2% exceedance probability in 50 years), the updated 2008 National Hazard Maps indicate a firm rock PGA of 0.21 g for the site (Petersen *et al.*, 2008). This value adjusted for hard rock is 0.14 g using an adjustment factor of 1.52 for PGA (Frankel *et al.*, 1996). The site-specific PGA computed in this study for a 2,475-year return period is 0.13 g, very comparable to the USGS mapped value.

APPENDIX B : Soil boring logs along with soil classification sheets

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY

PROJECT ROCKPORT PLANT

COORDINATES N 151,478.9 E 513,537.1

GROUND ELEVATION 400.4 SYSTEM State Plane using NAD27/29

BORING NO. MW-1605D DATE 4/27/16 SHEET 1 OF 6

BORING START 2/3/16 BORING FINISH 2/3/16

PIEZOMETER TYPE WELL TYPE OW

HGT. RISER ABOVE GROUND 3.36 DIA 2.0

DEPTH TO TOP OF WELL SCREEN 114.6 BOTTOM 124.22

WELL DEVELOPMENT YES BACKFILL

FIELD PARTY ZLR / REB RIG D-50

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	20-13-10	1.25					Gravel = 6 inches		
									CL	Silty clay, moderate yellowish brown 10R 5/4 and med l. grey N6 mottled, moist, v. stiff @ 1.5' hard @ 3' v. stiff		
2	SS	1.5	3.0	5-15-18	1.25							
3	SS	3.0	4.5	7-9-15	1.41							
4	SS	4.5	6.0	11-12-14	1.5		5					
5	SS	6.0	7.5	4-8-11	1.41							
									ML	Clayey silt, medium grey N5, moist, med. dense, w/mod. yellowish brown 10R 5/4 silty clay mottled		
6	SS	7.5	9.0	3-6-11	1.33							
7	SS	9.0	10.5	3-4-7	1.41				CL	Silty clay, mod. yellowish brown 10R 5/4, moist, stiff, w/med. grey N5 clayey silt mottled		
							10					
8	SS	10.5	12.0	3-4-6	1.5							
									CH	Fat to lean clay, med. l. grey N6, moist, firm		
9	SS	12.0	13.5	2-2-4	1.5							
10	SS	13.5	15.0	2-2-5	1.41							
									CL ML	Silty clay, mod. reddish brown 10R 4/6 w/med. l. grey N6 fat clay heavily mottled, moist, firm @ 15' stiff @ 15.5' l" shale fragment, angular @ 18' very silty @ 20' trace to some pale yellowish brown 10YR 6/2 silt		
11	SS	15.0	16.5	2-4-5	1.5		15					
12	SS	16.5	18.0	3-5-9	1.5							
13	SS	18.0	19.5	3-6-8	1.41							
14	SS	19.5	21.0	3-5-7	1.41							

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER AMEC FOSTER WHEELER

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1605D** DATE **4/27/16**

PROJECT **ROCKPORT PLANT** BORING START **2/3/16** BORING FINISH **2/3/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %
15	SS	21.0	22.5	3-4-7	1.5	
16	SS	22.5	24.0	4-4-5	1.5	
17	SS	24.0	25.5	1-1-3	1.5	
18	SS	25.5	27.0	1-1-1	1.5	
19	SS	27.0	28.5	2-1-4	1.5	
20	SS	28.5	30.0	5-6-7	1.33	
21	SS	30.0	31.5	3-5-7	1.25	
22	SS	31.5	33.0	5-7-8	1.5	
23	SS	33.0	34.5	3-3-6	1.41	
24	SS	34.5	36.0	2-4-5	1.5	
25	SS	36.0	37.5	2-4-6	1.33	
26	SS	37.5	39.0	4-3-8	1.5	
27	SS	39.0	40.5	3-3-5	1.5	
28	SS	40.5	42.0	11-8-10	1.25	
29	SS	42.0	43.5	4-5-11	1.5	
30	SS	43.5	45.0	8-9-9	1.16	
31	SS	45.0	46.5	6-9-14	1.5	

DEPTH IN FEET: 25, 30, 35, 40, 45

USCS	SOIL / ROCK IDENTIFICATION
ML	Clayey silt, pale yellowish brown 10YR 6/2, moist, med. dense, w/silty clay (prev. material), trace sand
SP	Poorly graded sand, v. fine to fine grained, l. brown 5YR 5/6, moist, loose @ 23.2' 2" clayey silt seam (prev. material)
ML	Clayey silt, pale yellowish brown 10YR 6/2, moist to wet, v. loose @ 25' 2" l. brown sand seam (prev. material) @ 26' 2" l. brown sand seam @ 26.4' 15" l. brown sand seam @ 26.8' l" l. brown sand seam @ 27' loose @ 28' 2" l. brown sand seam
SP	Poorly graded sand, fine grained, l. brown 5YR 5/6, moist, med. dense @ 30' d. yellowish orange 10YR 6/6 @ 31' 3" clayey silt seam (prev. material) @ 32.3' trace fine gravel and black silt @ 32.5' no fine gravel or silt @ 33' moist, loose @ 34.1' 2" clayey silt seam (prev. material) @ 34.5' moist to wet, water in spoon @ 34.9' 2.5' clayey silt seam (prev. material)
SW	Well graded sand, fine grained, l. brown 5YR 5/6, moist to wet, med. dense, w/fine gravel
SW	Well graded sand, coarse grained, grayish black N2, moist to wet, med. dense, trace fine gravel
SP	Poorly graded sand, v. fine grained, l. brown 5YR 5/6, moist to wet, med. dense
SW	Well graded sand, fine to med. grained, moderate yellowish brown 10YR 5/4, moist to wet, loose @ 40.5' med. dense @ 41' 1.5" shale seam w/clay
SP	Poorly graded sand, v. fine to fine grained, mod. yellowish brown 10YR 5/4, moist to wet, med. dense
SW	Well graded sand, med. grained, mod. reddish brown 10R 4/6, moist to wet, med. dense @ 44' med. to coarse grained
SP	Poorly graded sand, fine grained, mod. yellowish

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1605D** DATE **4/27/16**

PROJECT **ROCKPORT PLANT** BORING START **2/3/16** BORING FINISH **2/3/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	SAMPLE DEPTH IN FEET TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
32	SS	46.5	48.0	6-8-11	1.5				SW	brown 10YR 5/4, moist to wet, mod. dense, some fine gravel		
33	SS	48.0	49.5	6-10-14	1.5				SP	Well graded sand, med. to coarse grained, mod. reddish brown 10R 4/6, moist to wet, med. dense, trace fine gravel		
34	SS	49.5	51.0	8-12-18	1.33		50			Poorly graded sand, fine grained, mod. yellowish brown 10YR 5/4, moist to wet, med. dense, trace fine gravel @ 48' w/fine gravel, trace coarse gravel @ 49.5' no coarse gravel		
35	SS	51.0	52.5	8-11-18	1.41							
36	SS	52.5	54.0	8-9-13	.91				SW	Well graded sand, med. to coarse grained, mod. reddish brown 10R 4/6, moist to wet, mod. dense, trace fine gravel		
37	SS	54.0	55.5	11-20-26	1.25		55		SP	Poorly graded sand, fine grained, mod. yellowish brown 10YR 5/4, moist to wet, mod. dense, trace fine gravel @ 54' no fine gravel, dense @ 57' wet, mod. dense @ 60' dense @ 63' mod. dense		
38	SS	55.5	57.0	10-15-16	1.5							
39	SS	57.0	58.5	6-12-16	1.33							
40	SS	58.5	60.0	7-10-18	1.33							
41	SS	60.0	61.5	8-9-12	1.33		60					
42	SS	61.5	63.0	10-13-19	1.25							
43	SS	63.0	64.5	9-11-18	1.33							
44	SS	64.5	66.0	9-11-15	1.08		65		SW	Well graded sand, med. to coarse grained, mod. yellowish brown 10YR 5/4, moist to wet, mod. dense, trace black silt		
45	SS	66.0	67.5	7-8-13	1.41				SP	Poorly graded sand, fine grained, mod. yellowish brown 10YR 5/4, moist to wet, mod. dense @ 68.5' trace fine gravel, trace coal fragments @ 70' no fine gravel, no coal fragments @ 70.9' trace fine gravel @ 71.6' no fine gravel, wet		
46	SS	67.5	69.0	5-5-8	1.5							
47	SS	69.0	70.5	6-8-12	1.5		70					
48	SS	70.5	72.0	0-12-16	1.5							

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JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1605D** DATE **4/27/16**

PROJECT **ROCKPORT PLANT** BORING START **2/3/16** BORING FINISH **2/3/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %
49	SS	72.0	73.5	8-8-10	1.25	
50	SS	73.5	75.0	9-12-17	1.41	
51	SS	75.0	76.5	8-7-9	1.5	
52	SS	76.5	78.0	10-15-25	1.5	
53	SS	78.0	79.5	7-13-12	1.33	
54	SS	79.5	81.0	5-7-12	1.5	
55	SS	81.0	82.5	6-12-13	1.5	
56	SS	82.5	84.0	8-10-16	1.41	
57	SS	84.0	85.5	10-21-22	1.41	
58	SS	85.5	87.0	14-21-14	.5	
59	SS	87.0	88.5	6-13-25	1.41	
60	SS	88.5	90.0	8-9-9	1.16	
61	SS	90.0	91.5	15-24-7	1.41	
62	SS	91.5	93.0	7-21-28	1.5	
63	SS	93.0	94.5	14-18-21	1.5	
64	SS	94.5	96.0	12-17-25	1.5	
65	SS	96.0	97.5	20-21-19	1.33	
66	SS	97.5	99.0	13-11-18	1.41	

DEPTH IN FEET: 75, 80, 85, 90, 95

U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
SW	Well graded sand, fine grained d. yellowish brown 10YR 4/2, moist to wet, mod. dense, trace fine gravel @ 73.5' w/fine gravel, trace coarse gravel		
SW	Well graded sand, coarse grained, brownish grey 5YR 4/1, moist to wet, mod. dense, w/fine gravel, trace coarse gravel		
SP	Poorly graded sand, fine grained, pale yellowish brown 10YR 6/2, wet, dense, trace fine gravel @ 78' mod. dense @ 81' v. fine to fine grained @ 82.5' no fine gravel @ 84' dense @ 85' 2" shale fragment @ 85.2' v. fine grained @ 85.5' 3.5" shale fragment @ 87' fine grained, d. yellowish brown 10YR 4/2 @ 88.5' v. fine grained, mod. dense		
ML	Clayey silt, med. l. grey N6, moist to wet, mod. dense		
SP	Poorly graded sand, fine grained, d. yellowish brown 10YR 4/2, moist, dense		
ML	Clayey silt, med. l. grey N6, moist to wet, dense		
SW	Well graded sand, coarse grained, med. grey N5, w/fine gravel, some coarse gravel		
ML	Clayey silt, med. l. grey N6, moist to wet, dense		
SW	Well graded sand, fine grained, med. grey N5, moist to wet, dense, w/fine gravel		
ML	Clayey silt, med. l. grey N6, moist to wet, dense		
SW	Well graded sand, coarse grained, med. grey N5, moist to wet, dense, w/fine gravel @ 98.7' coal fragments		

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JOB NUMBER 42393125-01
COMPANY INDIANA MICHIGAN POWER COMPANY BORING NO. MW-1605D DATE 4/27/16 SHEET 5 OF 6
PROJECT ROCKPORT PLANT BORING START 2/3/16 BORING FINISH 2/3/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
67	SS	99.0	100.5	15-22-28	1.5		100		SP	Poorly graded sand, v. fine to fine grained, pale yellowish brown 10YR 6/2, moist to wet, dense, w/fine gravel @ 100.5' no fine gravel, mod. dense @ 102' v. fine, dense @ 105' mod. dense @ 106' trace coal fragments @ 106.3' no coal fragments @ 109.5' moist @ 111' v. moist to wet @ 112.5' moist to wet, dense @ 113' trace fine gravel, trace coarse gravel @ 113.5' no fine gravel, no coarse gravel		
68	SS	100.5	102.0	8-8-9	1.5							
69	SS	102.0	103.5	10-16-18	1.5							
70	SS	103.5	105.0	9-13-18	1.41							
71	SS	105.0	106.5	8-12-16	1.5		105					
72	SS	106.5	108.0	6-9-13	1.5							
73	SS	108.0	109.5	7-8-12	1.25							
74	SS	109.5	111.0	6-8-10	1.41		110					
75	SS	111.0	112.5	5-10-12	1.25							
76	SS	112.5	114.0	6-11-27	1.33							
77	SS	114.0	115.5	13-21-13	1.25		115		SW	Well graded sand, med. to coarse grained, med. grey N5, moist to wet, dense, w/fine gravel, some coarse gavel @ 115.5' coarse grained, mod. dense, trace coarse gravel @ 118.5' v. dense		
78	SS	115.5	117.0	7-7-9	1.33							
79	SS	117.0	118.5	9-9-8	1.16							
80	SS	118.5	120.0	12-36-22	1.5		120		SP	Poorly graded sand, v. fine grained, med. l. grey N6, moist to wet, v. dense @ 120' med. dense, sl. moist @ 122' fine grained, w/fine gravel, dense @ 124.5' trace coarse gravel		
81	SS	120.0	121.5	10-11-19	1.41							
82	SS	121.5	123.0	12-20-29	1.5							
83	SS	123.0	124.5	14-16-19	1.5							

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AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1605D** DATE **4/27/16** SHEET **6** OF **6**

PROJECT **ROCKPORT PLANT** BORING START **2/3/16** BORING FINISH **2/3/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
84	SS	124.5	126.0	18-12-25	1.5		125					
85	SS	126.0	127.5	17-28-50/5	1.5				ML	Clayey silt, l. grey N7, moist, hard, non-durable shale @ 126' flaky, dry to moist Spoon refusal @ 127.4' Auger refusal @127.5' (shale)		
86	SS	127.5	129.0	27-50/2	.66							

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY

PROJECT ROCKPORT PLANT

COORDINATES N 151,502.1 E 512,881.5

GROUND ELEVATION 397.8 SYSTEM State Plane using NAD27/29

BORING NO. MW-1606D DATE 4/27/16 SHEET 1 OF 5

BORING START 2/12/16 BORING FINISH 2/12/16

PIEZOMETER TYPE WELL TYPE OW

HGT. RISER ABOVE GROUND 2.91 DIA 2.0

DEPTH TO TOP OF WELL SCREEN 100.2 BOTTOM 109.82

WELL DEVELOPMENT YES BACKFILL

FIELD PARTY ZLR / REB RIG D-120

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	3-5-9	1.5				Crushed stone gravel (limestone)		
2	SS	1.5	3.0	4-7-9	1.5			CL	Lean clay, moderate yellowish brown 10YR 5/4, moist, trace fine grained sand, stiff @ 1.5' as above, trace coarse grain sand and black decomposed organic staining @ 3' trace fine gravel		
3	SS	3.0	4.5	3-4-6	1.3						
4	SS	4.5	6.0	1-2-8	1.3		5				
5	SS	6.0	7.5	5-9-10	1.5			CL	Lean clay, pale yellow brown 10YR 6/2, moist, some light brown oxide staining @ 6.0' yellow brown and brown 10YR 5/4 @ 7.5' pale yellow brown 10YR 6/2, trace fine roots, trace fine grained sand		
6	SS	7.5	9.0	3-6-9	1.5			CL	Lean clay w/sand, dark yellow brown 10YR 4/2, moist, little fine grained sand		
7	SS	9.0	10.5	2-4-5	1.5		10	CL	Lean clay, light bluish gray 5B 7/1, moist, some brown oxide staining, trace coarse grained sand @ 12.5' as above, becomes moderate brown in color 5YR 4/4 @ 13.5' moderate yellow brown 10YR 5/4 and pale yellow brown 10YR 6/2) mottled @ 13.5' - 15' trace fine grained sand, trace fine gravel @ 19.5' mostly 10YR 6/2 in color		
8	SS	10.5	12.0	3-4-6	1.5						
9	SS	12.0	13.5	3-5-9	1.5						
10	SS	13.5	15.0	4-5-7	1.5		15				
11	SS	15.0	16.5	3-5-6	1.5						
12	SS	16.5	18.0	3-4-6	1.5						
13	SS	18.0	19.5	2-5-7	1.5						
14	SS	19.5	21.0	3-3-6	1.5						

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER AMEC FOSTER WHEELER

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **42393125-01**

COMPANY **INDIANA MICHIGAN POWER COMPANY** BORING NO. **MW-1606D** DATE **4/27/16** SHEET **2** OF **5**

PROJECT **ROCKPORT PLANT** BORING START **2/12/16** BORING FINISH **2/12/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
15	SS	21.0	22.5	3-4-5	1.5							
									CL ML	Silty clay, pale yellow brown 10YR 6/2, moist, trace to little fine grained sand		
16	SS	22.5	24.0	2-4-6	1.5							
									SP SM	Poorly graded sand w/silt, pale yellow brown 10YR 6/2, moist, fine to medium grained sand @ 24.9' 3" silt layer		
17	SS	24.0	25.5	1-2-5	1.2		25					
18	SS	25.5	27.0	2-4-6	1.5				CL	Lean clay, moderate yellowish brown 10YR 5/4, moist, few sandy layers <1" thick @ 28.3' SP-SM layer (~3" thick)		
19	SS	27.0	28.5	1-5-9	1.3							
20	SS	28.5	30.0	4-4-5	1.3				SP SM	Poorly graded sand w/silt, dark yellowish orange 10YR 6/6, wet, fine to medium grained sand, little coarse grained sand @ 31.5' trace fine gravel @ 34.5' trace fine gravel		
21	SS	30.0	31.5	5-7-8	1.5		30					
22	SS	31.5	33.0	3-3-4	1.1							
23	SS	33.0	34.5	1-2-5	0							
24	SS	34.5	36.0	3-4-8	.8		35					
25	SS	36.0	37.5	3-5-7	1.0							
26	SS	37.5	39.0	5-6-7	.9				SP	Poorly graded sand, dark yellowish orange 10YR 6/6, wet, fine to medium grained sand, trace to little coarse grained sand @ 37.5' trace gravel		
27	SS	39.0	40.5	4-7-20	1.2				SP SM	Poorly graded sand w/silt, dark yellowish orange 10YR 6/6, wet, fine to medium grained sand, trace coarse grained sand		
							40					
28	SS	40.5	42.0	7-7-8	1.1				SC	Clayey sand, moderate brown 5YR 3/4, wet, fine to medium grained sand		
									SP	Poorly graded sand, dark yellowish orange 10YR 6/6, wet, fine to medium grained sand, trace coarse grained sand & fine gravel @ 42.0' - 43.5' increase in coarse grained sand @ 45.2' - 45.5' color change to moderate brown 5YR 4/4 @ 46.5' increase in coarse grained sand, trace wood fragments (tree bark) @ 48' color change to pale yellowish brown 10YR		
29	SS	42.0	43.5	4-6-10	1.0							
30	SS	43.5	45.0	4-5-7	1.0							
31	SS	45.0	46.5	4-6-10	1.2		45					

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY BORING NO. MW-1606D DATE 4/27/16 SHEET 3 OF 5

PROJECT ROCKPORT PLANT BORING START 2/12/16 BORING FINISH 2/12/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
32	SS	46.5	48.0	8-9-11	1.1					6/2, few black decomposed organic layers		
33	SS	48.0	49.5	6-10-13	1.1							
34	SS	49.5	51.0	18-13-13	.9		50		SW SM	Well graded sand w/silt & gravel, wet, pale yellowish brown 10YR 6/2, fine to coarse grained sand, little to some fine gravel, trace coarse gravel		
35	SS	51.0	52.5	7-14-16	1.1				SP SM	Poorly graded sand w/silt, moderate yellowish brown 10YR 5/4, wet, fine to medium grained sand, trace coarse grained sand, few layers of decomposed organics (from 51' - 52.5') @ 54' trace coarse gravel, fines between 5 - 10% @ 55.5' trace fine gravel		
36	SS	52.5	54.0	7-9-15	1.0							
37	SS	54.0	55.5	10-10-14	1.2		55					
38	SS	55.5	57.0	8-10-13	1.2							
39	SS	57.0	58.5	7-9-9	1.3				SW	Well graded sand, med. to coarse grained, dark yellowish brown 10YR 4/2), wet, med. dense, trace fine gravel @ 59' trace coarse gravel		
40	SS	58.5	60.0	4-5-9	1.2		60					
41	SS	60.0	61.5	6-6-9	1.5				SP	Poorly graded sand, fine grained, dusky yellowish brown 10YR 2/2, wet, med. dense, w/fine gravel @ 60.5' 2" shale fragment @ 61.5' dark yellowish brown 10YR 4/2, dense @ 61.8' 2" shale fragment @ 62' some lean clay, pale yellowish brown (prev. material) @ 62.5' no clay, trace fine gravel @ 63' no fine gravel @ 64.5' med. dense @ 65.8' 15" coarse sand seam (prev. material) @ 66' dense @ 67.2' 3" shale seam, med. l. grey N6 @ 67.7' med. grained		
42	SS	61.5	63.0	6-13-21	1.5							
43	SS	63.0	64.5	10-17-31	1.3							
44	SS	64.5	66.0	13-13-17	1.4		65					
45	SS	66.0	67.5	6-14-18	1.5							
46	SS	67.5	69.0	9-14-17	1.5				SP	Poorly graded sand, fine gravel, pale yellowish brown 10YR 6.2, wet, dense @ 69' moist to v. moist @ 72' med. dense, fine grained @ 75' dense, d. yellowish brown 10YR 4.2 @ 76.5' med. dense, trace black silt @ 80.6 3" shale plug (responsible for increase in N value (same material)) @ 81.3' 1.5" shale plug, dense		
47	SS	69.0	70.5	10-20-20	1.1		70					
48	SS	70.5	72.0	10-19-26	1.4							

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JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY BORING NO. MW-1606D DATE 4/27/16 SHEET 4 OF 5

PROJECT ROCKPORT PLANT BORING START 2/12/16 BORING FINISH 2/12/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
49	SS	72.0	73.5	7-10-17	1.3					@ 81.5' no recovery, potential cobble blocking during sampling		
50	SS	73.5	75.0	8-9-13	1.2							
51	SS	75.0	76.5	10-16-25	1.4		75					
52	SS	76.5	78.0	9-10-14	1.4							
53	SS	78.0	79.5	6-9-18	1.5							
54	SS	79.5	81.0	10-17-34	1.5		80					
55	SS	81.0	82.5	31-19-14	1.3							
56	SS	82.5	84.0	10-16-21	1.5				CH	Fat clay, med. l. grey N6, moist, firm		
									SW	Well graded sand, med. grained, dark yellowish brown 10YR 4/2, wet, dense, w/fine gravel @ 83' coal fragment (2" diam., 1" thick) @ 83.6' coal fragment (2" diam, 1" thick)		
57	SS	84.0	85.5	9-19-21	1.5		85					
58	SS	85.5	87.0	7-15-24	1.3				SP	Poorly graded sand, fine grained, pale yellowish brown 10YR 6/2, wet, dense @ 88.5' trace fine gravel @ 91.5' with fine gravel		
59	SS	87.0	88.5	10-13-20	1.2							
60	SS	88.5	90.0	8-14-23	1.4							
61	SS	90.0	91.5	8-13-27	1.3		90					
62	SS	91.5	93.0	8-7-16	1.5							
63	SS	93.0	94.5	7-9-15	1.5							
64	SS	94.5	96.0	12-12-14	1.5		95		SW	Well graded sand, med. to coarse grained, dark yellowish brown 10YR 4/2, wet, med. dense, w/fine gravel		
									SP	Poorly graded sand, coarse grained, greyish red 5R 4/2, wet, med. dense, trace fine gravel		
									SW	Well graded sand, med. to coarse grained, dark yellowish brown 10YR 4/2, wet, med. dense, w/fine gravel		
65	SS	96.0	97.5	3-5-5	1.5				SP			
66	SS	97.5	99.0	5-5-6	1.4				SP			

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

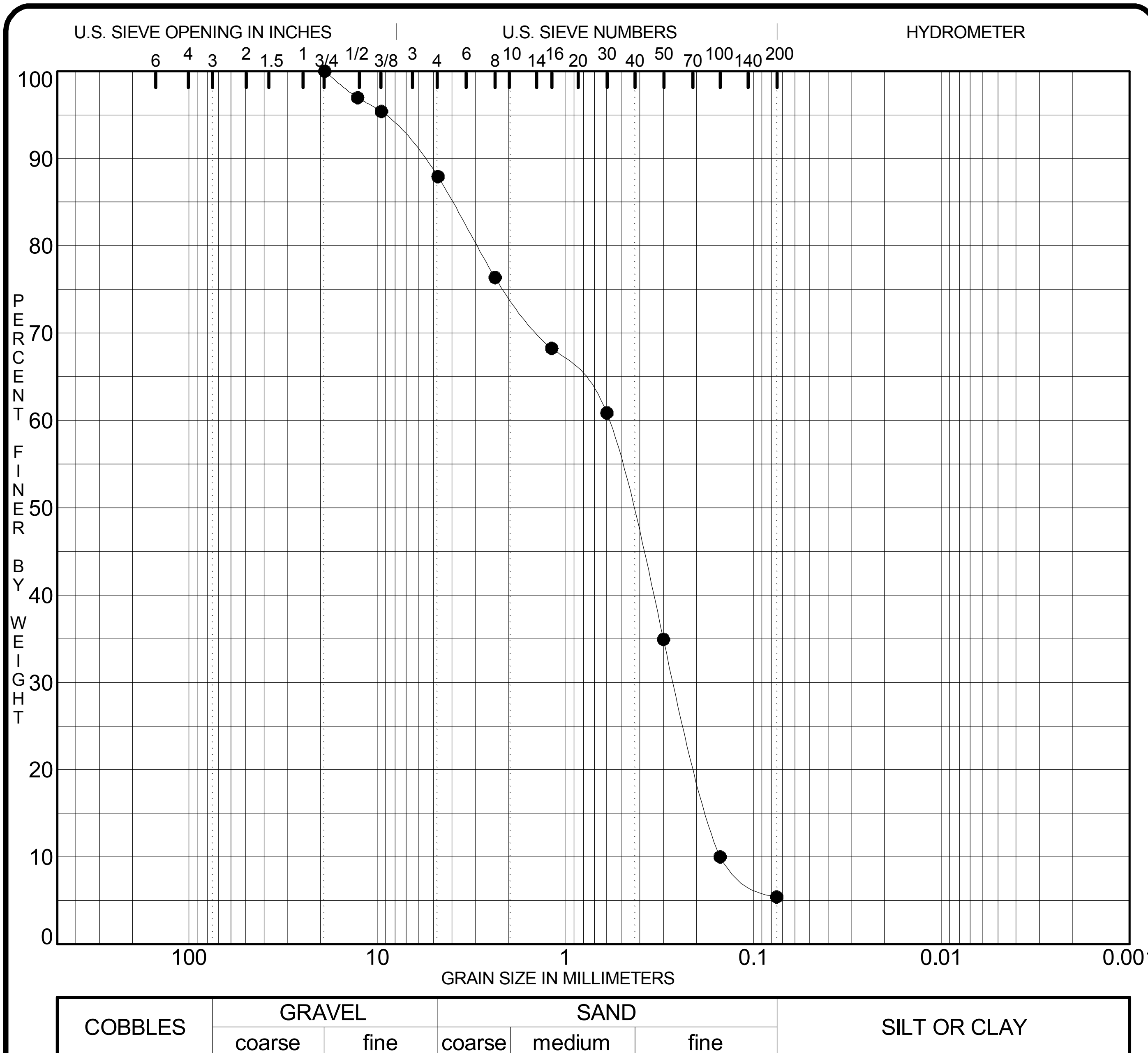
LOG OF BORING

JOB NUMBER 42393125-01

COMPANY INDIANA MICHIGAN POWER COMPANY | BORING NO. MW-1606D | DATE 4/27/16 | SHEET 5 OF 5

PROJECT ROCKPORT PLANT | BORING START 2/12/16 | BORING FINISH 2/12/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										Poorly graded sand, coarse grained, greyish red 5R 4/2, wet, med. dense to loose, trace fine gravel		
67	SS	99.0	100.5	4-5-7	1.5					Poorly graded sand, fine grained, pale yellowish brown 10YR 6/2, wet, loose @ 97.5' med. dense, fine grained		
68	SS	100.5	102.0	7-7-10	1.4		100					
69	SS	102.0	103.5	4-4-6	1.5				SP	Poorly graded sand, fine to fine grained, dusky red 5R 3/4, wet, med. dense @ 102' loose, fine grained, moist @ 103.5' med. dense @ 105' fine grained @ 106.5' dense @ 108' med. dense, trace fine gravel @ 109' no fine gravel @110.6' siltstone fragments to 2.5", moderate brown 5YR 4/4, shiny, angular		
70	SS	103.5	105.0	5-6-10	1.3							
71	SS	105.0	106.5	4-6-9	1.5		105					
72	SS	106.5	108.0	7-11-20	1.4							
73	SS	108.0	109.5	8-13-15	1.5							
74	SS	109.5	111.0	10-18-11	1.3		110					
75	SS	111.0	112.5	14-50/3					ML	Silt, l. grey N7, moist, med. dense, non-durable shale @ 111' clayey silt, hard Spoon refusal @ 111.7' Auger refusal @ 112.9 BT @ 112.9'		
76	SS	112.5	114.0	50/4								



Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.
● **MW-1605D 115.0-124.6ft**		**14.5**				
	SS-78,79,80,81,82,83 (Composite Sample)					
	N 151,478.9 E 513,537.1					
	ELEVATION 400.4					

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● **MW-1605D 115.0-124.6ft**	**19.000**	**0.586**	**0.262**	**0.150**	**12.1**	**82.5**	**5.4**	

PROJECT **ROCKPORT PLANT -**

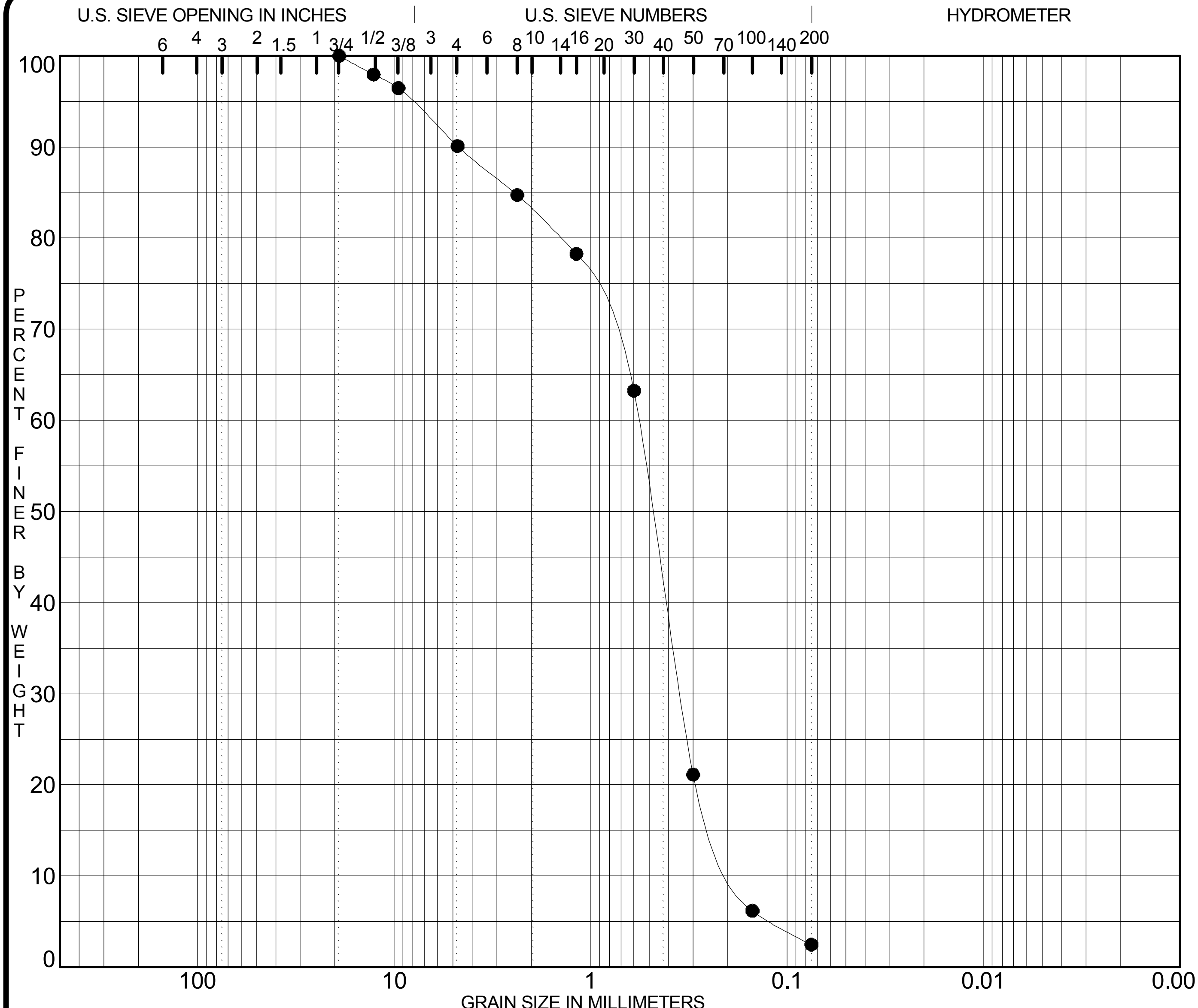
JOB NO. **42393125-01**

DATE **3/22/16**

GRADATION CURVES

American Electric Power Service Corp.

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.	
● MW-1605I 68.6-78.2ft		19.7					
	POORLY GRADED SAND SP						
	SS-48,49,50,51,52 (Composite Sample)						
	N 151,478.9 E 513,532.6						
	ELEVATION 400.6						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● MW-1605I 68.6-78.2ft	19.000	0.569	0.347	0.179	9.9	87.6	2.5	

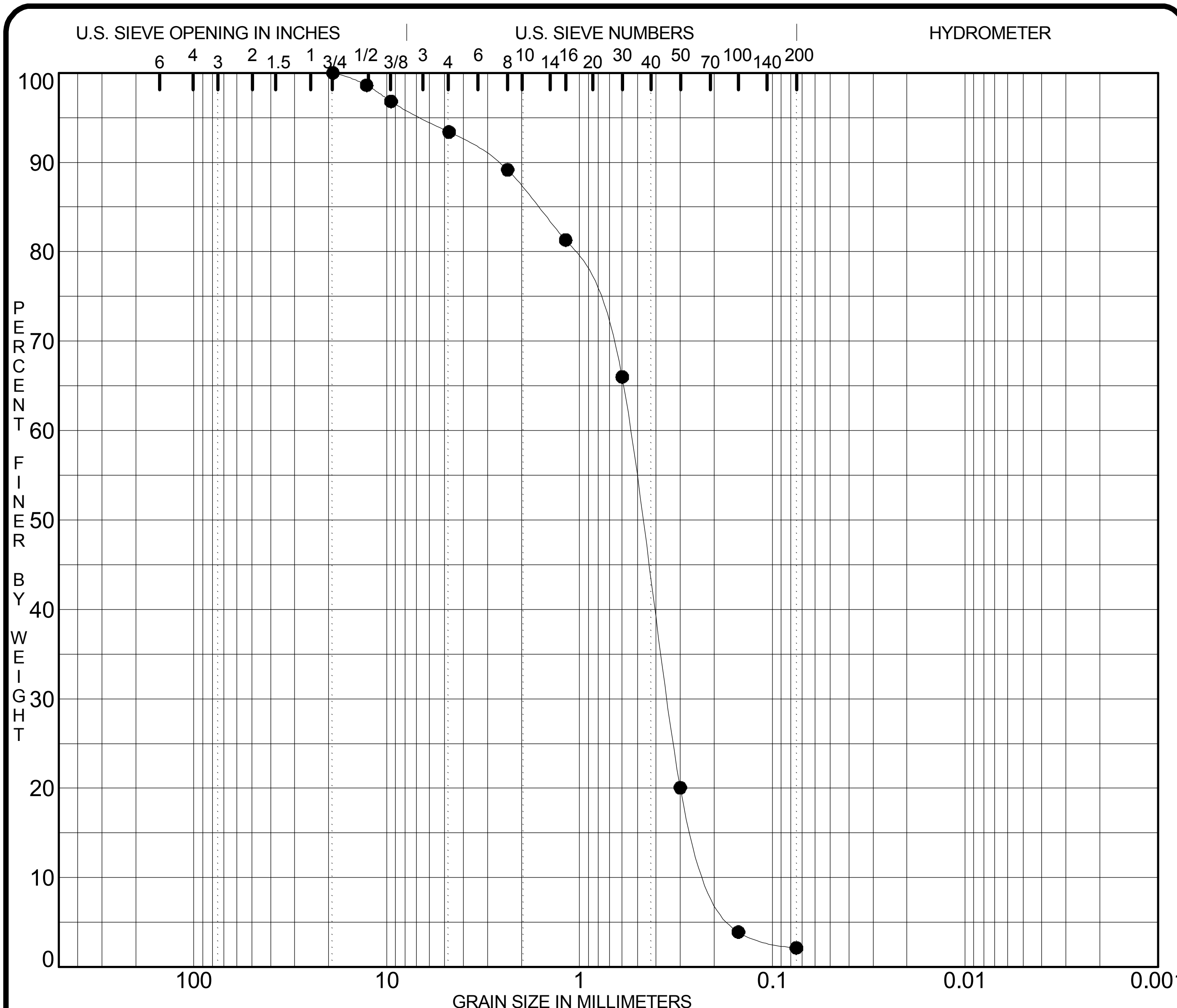
PROJECT **ROCKPORT PLANT -**

JOB NO. **42393125-01**
DATE **3/22/16**

GRADATION CURVES

American Electric Power Service Corp.

AEP



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.
● **MW-1605S 37.6-47.2ft**		**16.0**				
	POORLY GRADED SAND SP					
	SS-27,28,29,30,31 (Composite Sample)					
	N 151,478.8 E 513,528.4					
	ELEVATION 400.3					

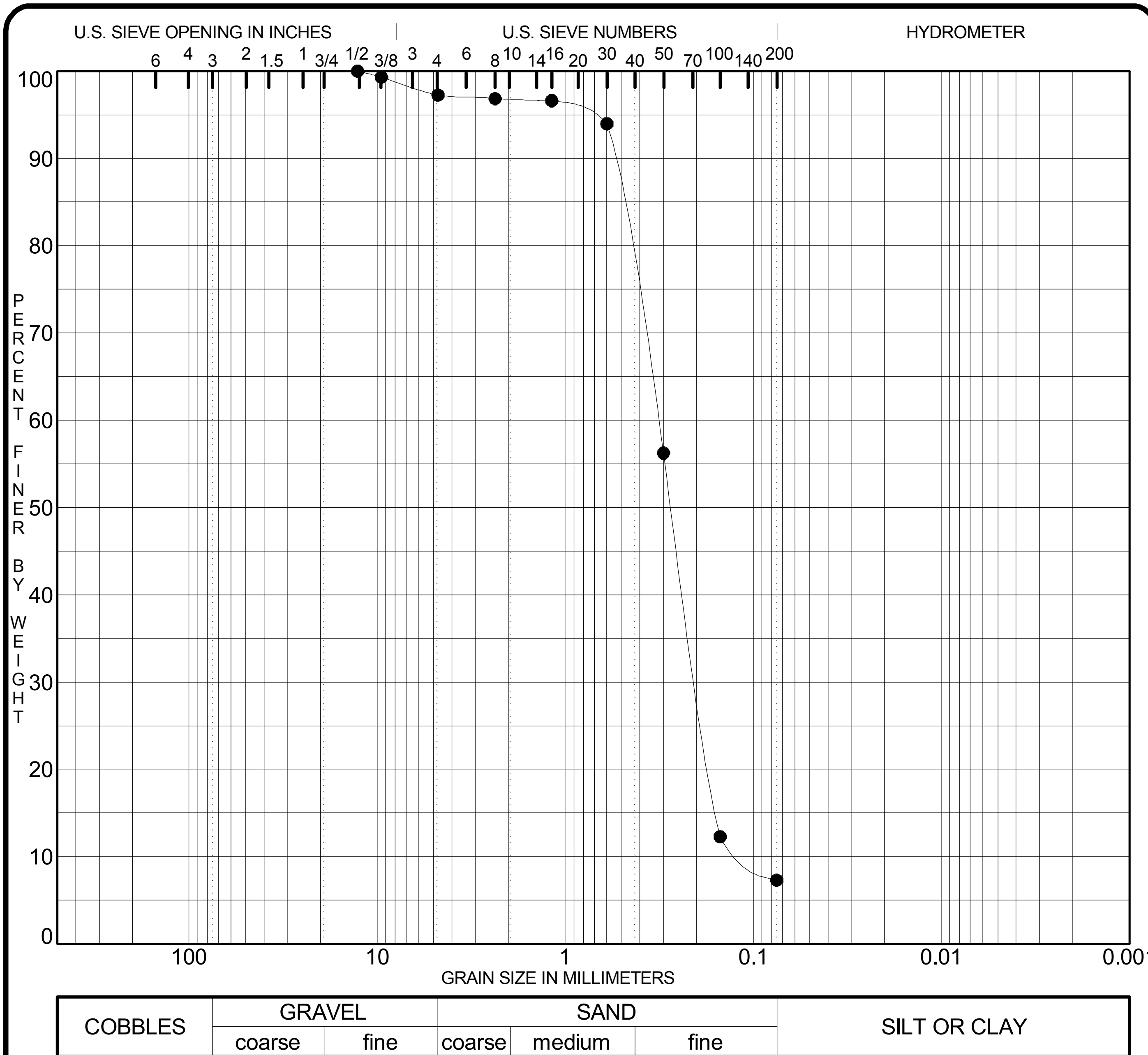
Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● **MW-1605S 37.6-47.2ft**	**19.000**	**0.548**	**0.349**	**0.195**	**6.6**	**91.3**	**2.1**	

PROJECT **ROCKPORT PLANT -**

JOB NO. **42393125-01**
DATE **3/22/16**

GRADATION CURVES

American Electric Power Service Corp.



Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.
● **MW-1606D 100.0-109.6ft**		**28.6**				
	SS-68,69,70,71,72,73 (Composite Sample)					
	N 151,502.1 E 512,881.5					
	ELEVATION 397.8					

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● **MW-1606D 100.0-109.6ft**	**12.700**	**0.321**	**0.198**	**0.109**	**2.7**	**90.0**	**7.3**	

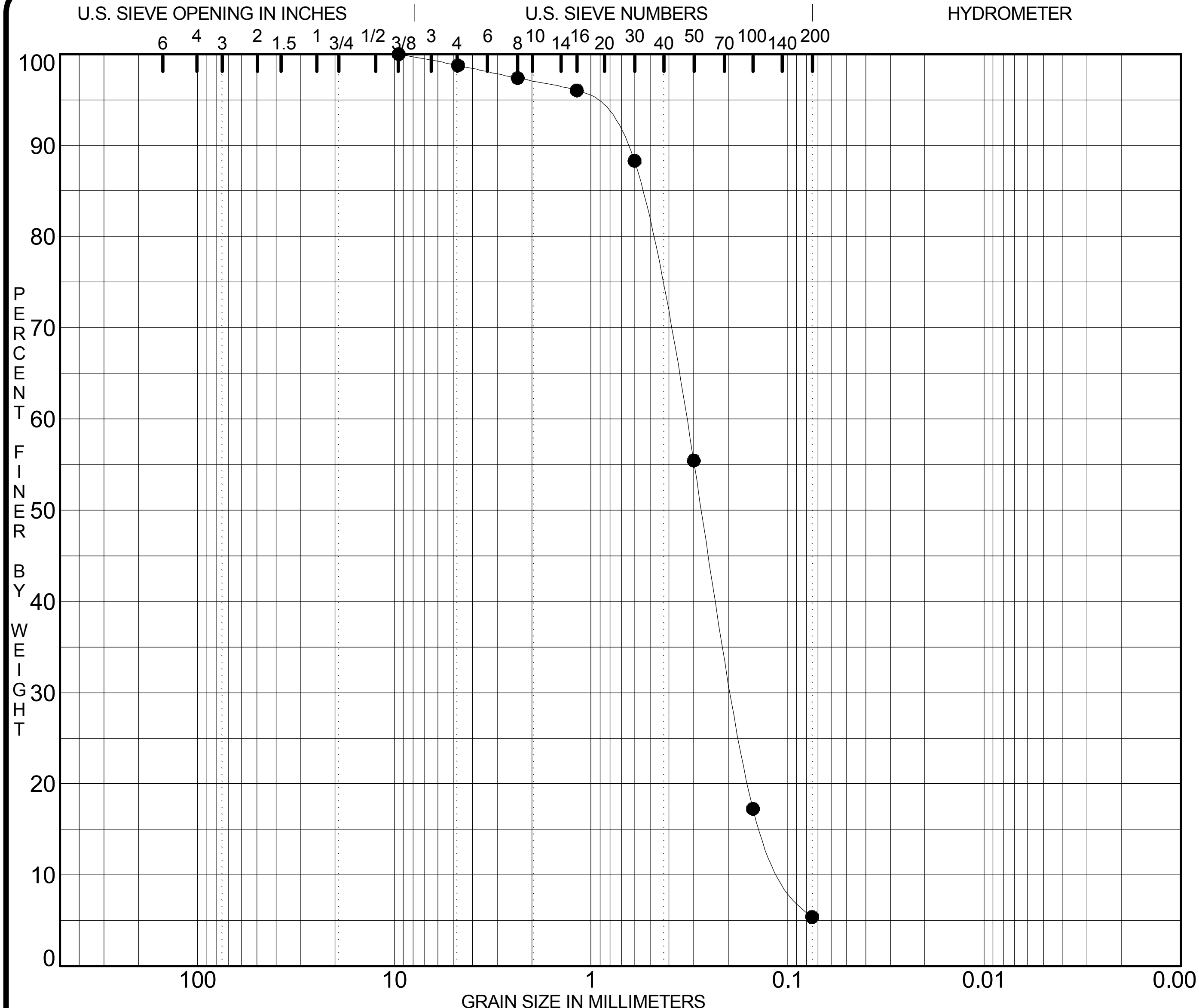
PROJECT **ROCKPORT PLANT -**

JOB NO. **42393125-01**

DATE **3/22/16**

GRADATION CURVES

American Electric Power Service Corp.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.	
●	MW-1606I 65.7-75.3ft		18.9					
		SS-45,46,47,48,49,50 (Composite						
		N 151,508.4 Sample) E 512,885.5						
		ELEVATION 397.8						

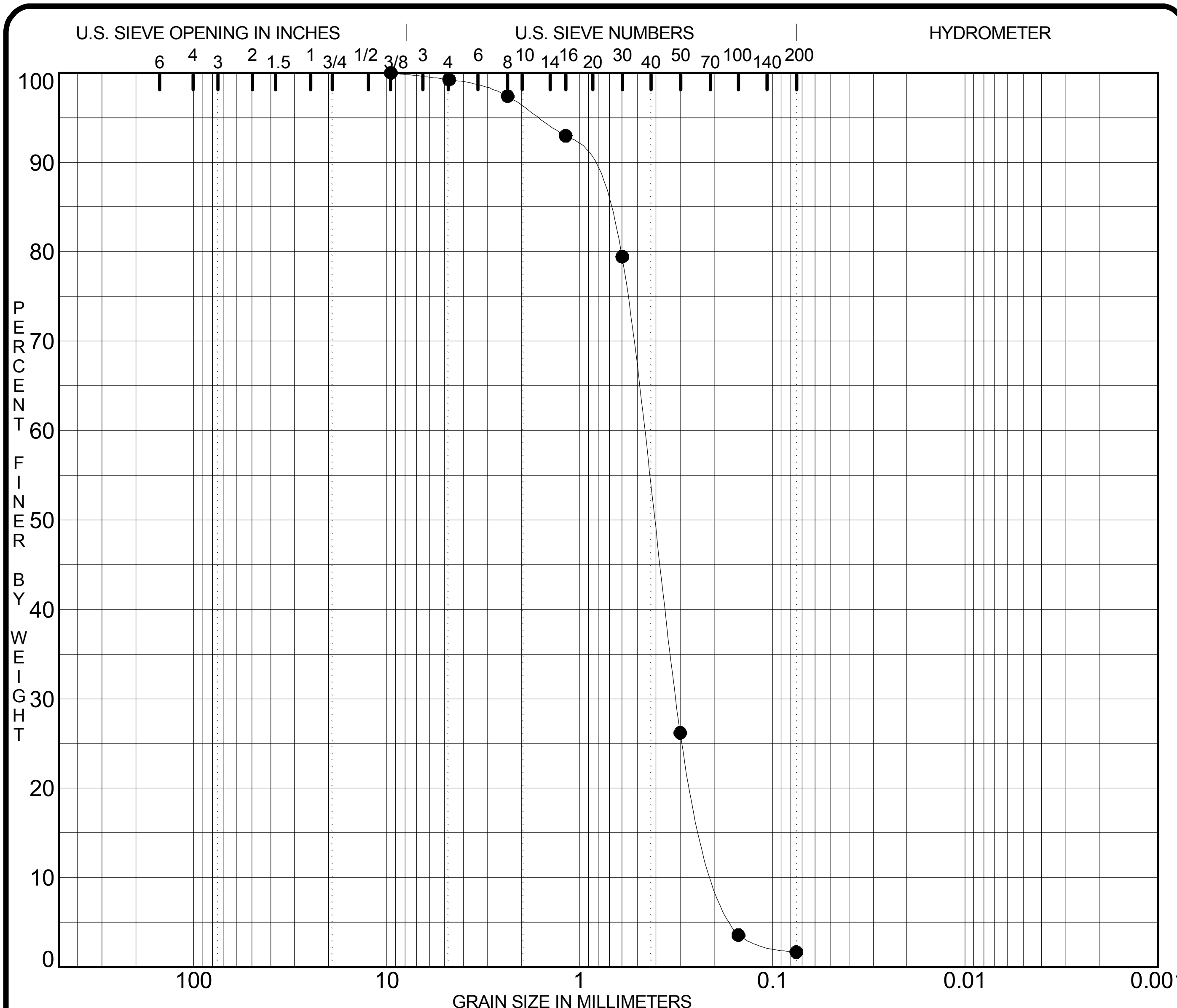
	Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
●	MW-1606I 65.7-75.3ft	9.500	0.330	0.189	0.098	1.2	93.4	5.4	

PROJECT **ROCKPORT PLANT -**

JOB NO. **42393125-01**
DATE **3/22/16**

GRADATION CURVES

American Electric Power Service Corp.



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.
● **MW-1606S 34.7-44.3ft**		**20.9**				
	POORLY GRADED SAND SP					
	SS-25,26,27,28,29 (Composite Sample)					
	N 151,498.9 E 512,889.4					
	ELEVATION 397.6					

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Fines	%<.002
● **MW-1606S 34.7-44.3ft**	**9.500**	**0.466**	**0.315**	**0.183**	**0.8**	**97.6**	**1.7**	

PROJECT **ROCKPORT PLANT -**

JOB NO. **42393125-01**
DATE **3/22/16**

GRADATION CURVES

American Electric Power Service Corp.

AEP

APPENDIX C : LiquefyPro Analysis Input and Output

SEISMIC IMPACT ZONES DEMONSTRATION

Bottom Ash Complex -Rockport Plant

Hole No.=1605 Water Depth=30 ft Surface Elev.=399 Magnitude=6.46
Acceleration=0.14957g

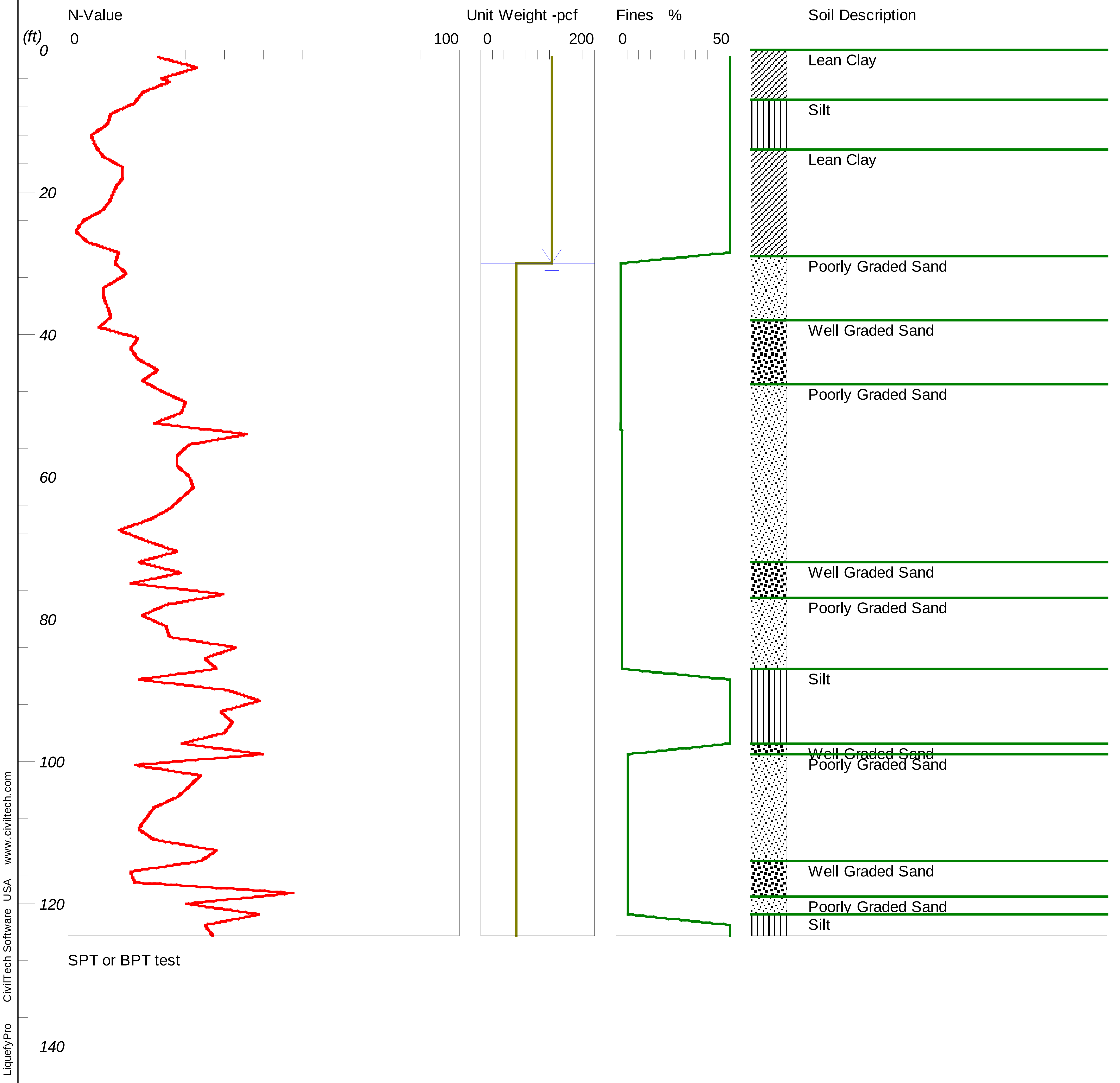


Plate A-1

American Electric Power Service Corporation

SEISMIC IMPACT ZONES DEMONSTRATION

Bottom Ash Complex -Rockport Plant

Hole No.=1605   Water Depth=30 ft   Surface Elev.=399

Magnitude=6.46
Acceleration=0.14957g

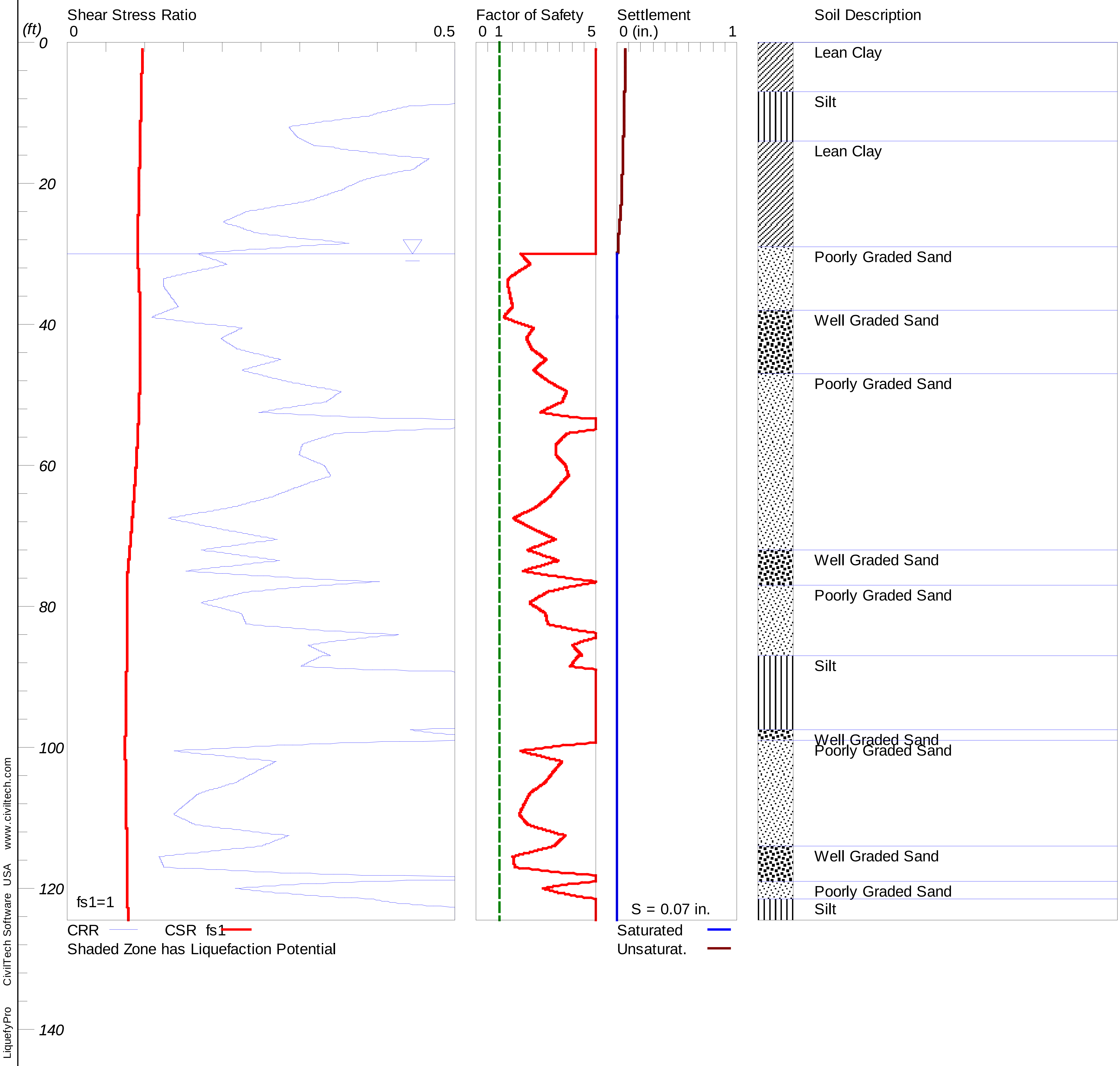


Plate A-1

American Electric Power Service Corporation

SEISMIC IMPACT ZONES DEMONSTRATION

Bottom Ash Complex -Rockport Plant

Hole No.=1606 Water Depth=27 ft Surface Elev.=397.8 Magnitude=6.46 Acceleration=0.14957g

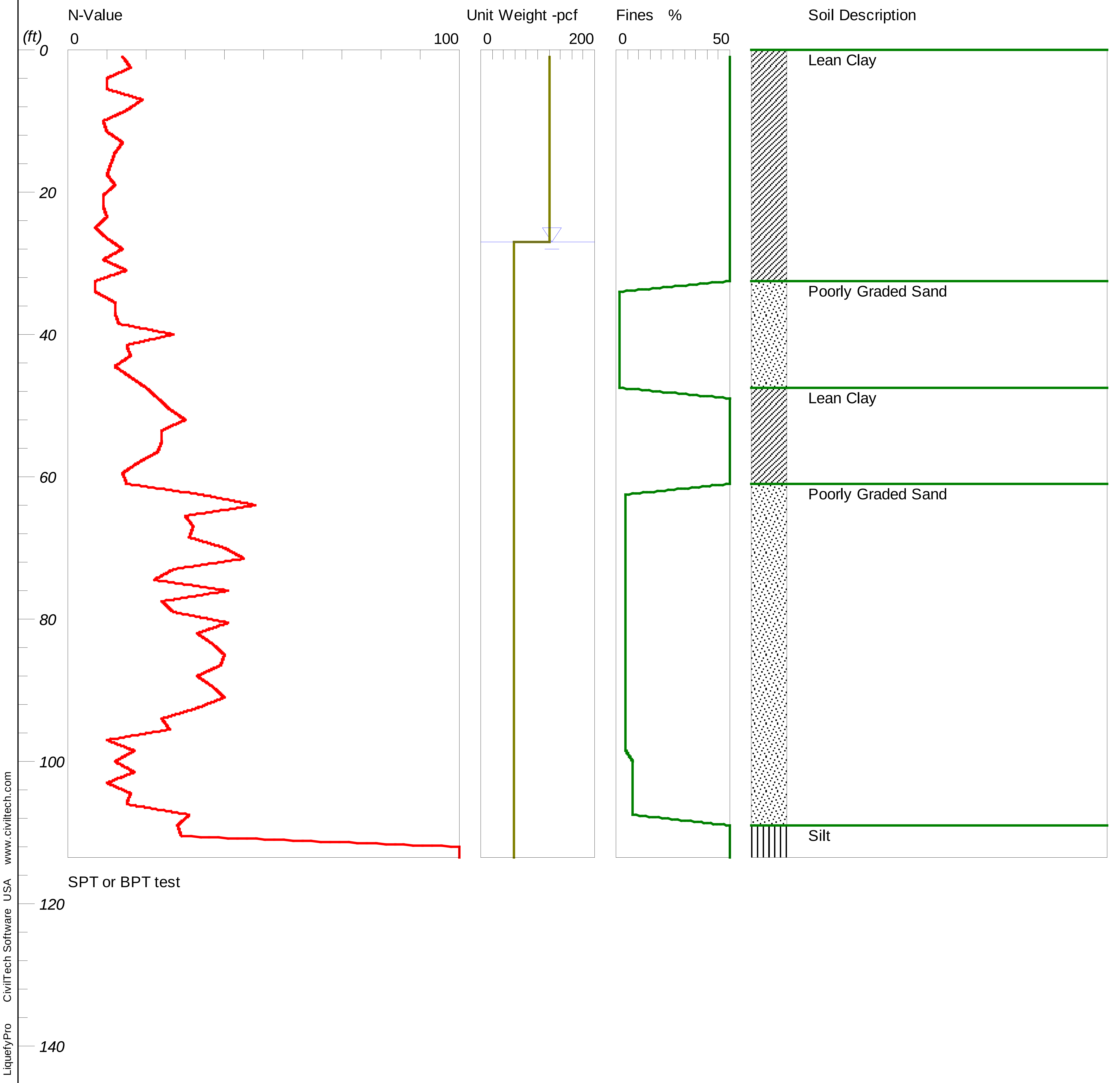


Plate A-1

American Electric Power Service Corporation

SEISMIC IMPACT ZONES DEMONSTRATION

Bottom Ash Complex -Rockport Plant

Hole No.=1606 Water Depth=27 ft Surface Elev.=397.8

Magnitude=6.46
Acceleration=0.14957g

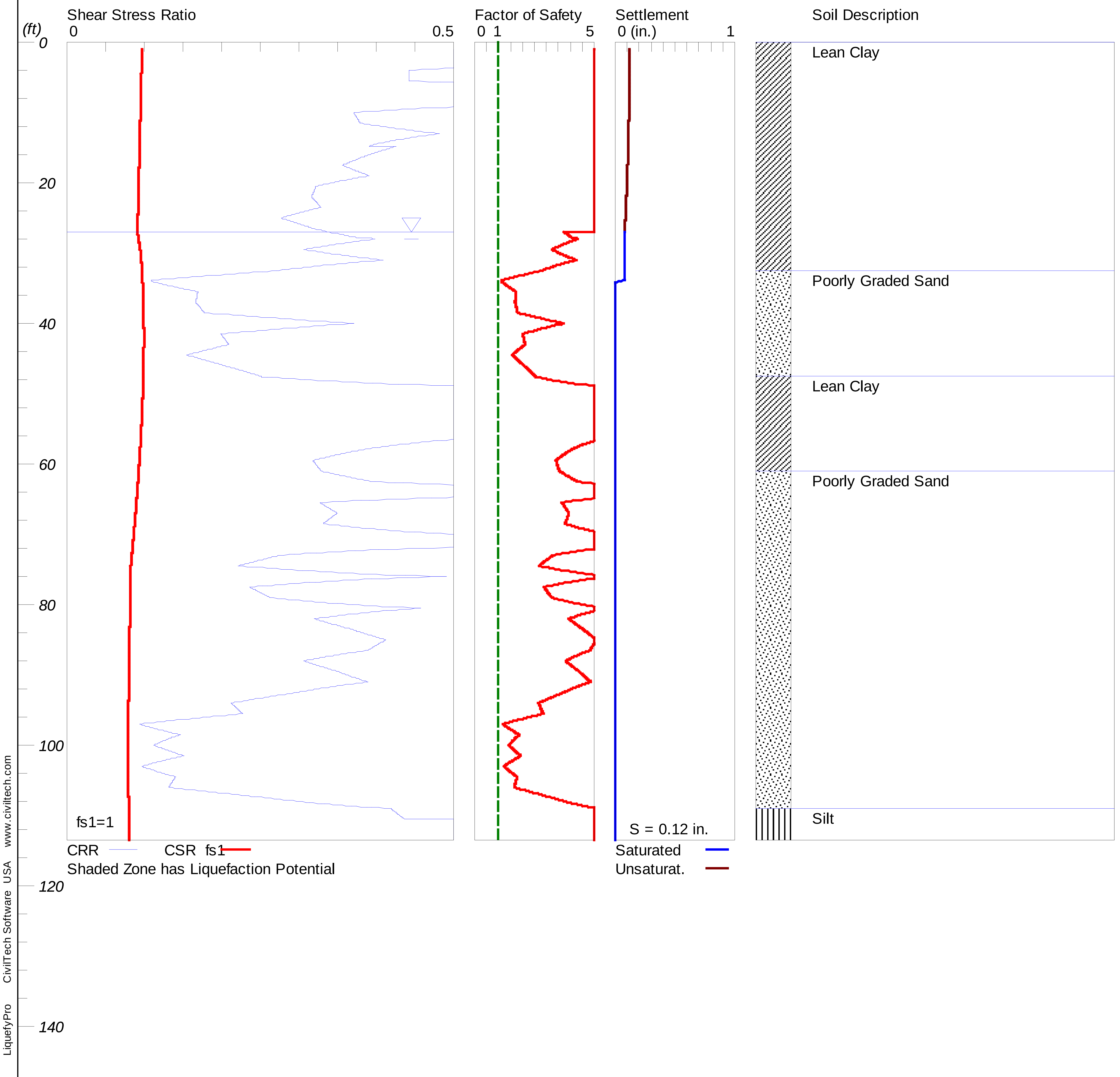


Plate A-1

AMERICAN ELECTRIC POWER
BOUNDLESS ENERGY

American Electric Power Service Corporation

APPENDIX D : Structural Calculation SES-CALC-02391

AEP AMERICAN ELECTRIC POWER

1/38

CALCULATION COVER SHEET

PLANT: Rockport **TITLE:** CCR Compliance of Seismic Impact Zone Review of Structures Located on Bottom Ash Ponds

UNIT: 0

CALCULATION NUMBER: SES-CALC- 02391 **REV. NUMBER:** 1

STRUCTURE/SYSTEM/COMPONENT: West and East Bottom ash Ponds

ASSOCIATED DRAWING NUMBERS: 12-30013

PURPOSE OF CALCULATION: to
Validate Compliance with CCR Rules
Rev. 1 provides clarification to corrective action. See page 37.

ALTERNATE CALCULATION PERFORMED TO VALIDATE THIS CALCULATION: (Y/N) _Y____
IF YES, THE ALTERNATE CALCULATION SHALL BE INCLUDED IN THIS PACKAGE.

PREPARER: Satyananda Chakrabarti **Date:** 9/22/2018

CHECKER: J. Reiniger **Date:** 9/26/2018

ENGINEERING SECTION MANAGER: [signature] **Date:** 10-5-18

Total No. of Pages Including Coversheet and Checklist: 38

38

Table of Contents Page No.

Calculation No. SES-CALC- 02391

THIS IS A SUPPORTING CALC FOR GEC-16-007

Units used in this calculation:

Mass: Length: Pressure/Stress: Angularity:

$kip \equiv 1000 \cdot lbf$ $lb \equiv \frac{kip}{1000}$ $ft \equiv 1 \cdot L$ $psi \equiv \frac{lbf}{in^2}$ $Rad \equiv 1$

$kips \equiv kip$ $lbs \equiv lb$ $ft \equiv 12 \cdot in$ $ksi \equiv \frac{kip}{in^2}$ $deg \equiv 2 \cdot \pi \cdot \frac{rad}{360}$

$pcf \equiv \frac{lbf}{ft^3}$ $acc := 32.2 \cdot \frac{ft}{sec^2}$ $psf \equiv \frac{lbf}{ft^2}$

$plinf := \frac{lbf}{ft}$

$ksf \equiv \frac{kip}{ft^2}$

SUMMARY OF CALCULATION

Objective of the calculation: Demonstrate that the structural components of the CCR units West and East Bottom Ash ponds are designed to meet the maximum horizontal acceleration in lithified earth material for the site. This calculation evaluates the seismic impact on the surface water control systems.

ASSUMPTION: This calculation assumes that the stability of the dikes which are currently being investigated for earthquakes will be found to be stable.

Background

1. The CCR rule requires:
§ 257.63 Seismic impact zones.
(a) New CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must not be located in seismic impact zones unless the owner or operator demonstrates by the dates specified in paragraph (c) of this section that all structural components including liners, leachate collection and removal systems, and surface water control systems, are designed to resist the maximum horizontal acceleration in lithified earth material for the site. (b) The owner or operator of the CCR unit must obtain a certification from a qualified professional engineer stating that the demonstration meets the requirements of paragraph (a) of this section.

2. The structures were constructed in the late 70s and early 80s for a 2-unit operating plant with

a total capacity of approximately 2,600 MW.

3. The structures reviewed in this evaluation are all surface water control units facilitating water flow from the Bottom Ash Ponds to the Waste water ponds.

4. The units included in the total population can be classified into two groups:

- Group 1: Units subjected to lateral loading due to the quakes used for transfering water from Bottom Ash ponds to waste water ponds including units used to dewater the BA ponds. The units are:

1. Energy Dissipator structure (EDS - 2 nos.) - approximately 8 plant pipes of 8 - 10 inch dia pipes discharging into this structure and then transported into the BA pond through the Energy Dissipator troughs/Pond Discharge Inlet Chutes. EDSs are of concrete with steel dissipation flaps.

2.Energy Dissipator troughs/Pond Discharge Inlet Chutes (EDT) - These are concrete structures partially open at the top and partially covered by yellow steel boxes called Discharge Chute Covers.

3. Skimmers (SKM)- Timber structures surrounding the waste water discharge chute

4. Waste water Discharge shaft (WWDS)- a steel and concrete prismoidal structure for routing waste water into the waste water discharge pipe.

- Group 2: Waste water discharge pipe (WWDP) - Two buried 48 inch (one fiberglass and the other HDPE) pipes that transfer water under the dikes. Because they are buried they are affected by seismic waves and ground displacements.

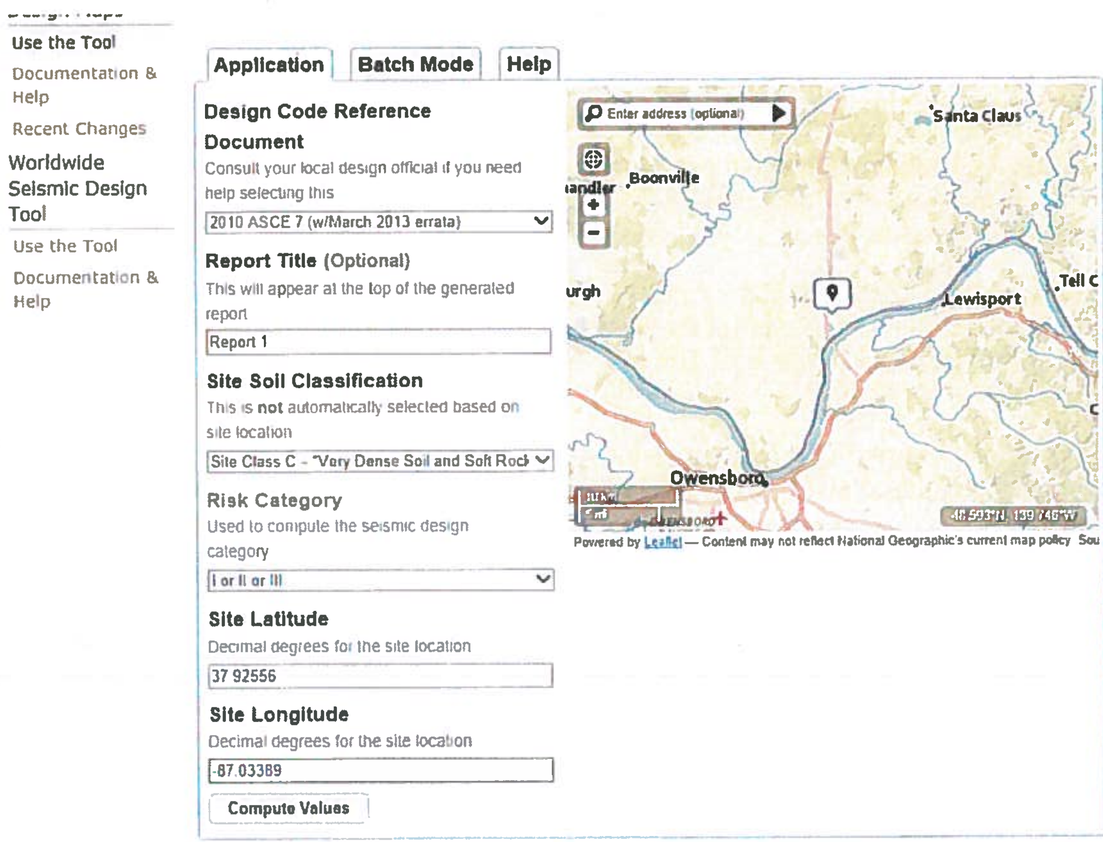
Two sets of analyses have been performed for the two groups.

5. Presentation of the Calculation

A. Part I - Relevant Cross-sections.
CCR Rule list

B. Part II - A - Maximum Considered Earthquake Spectral Acceleration
S_s = Mapped maximum considered earthquake spectral acceleration at 0.2 seconds
S_1 = Mapped maximum considered earthquake spectral acceleration at 1.0 seconds

Get the *"Latitude"* & *"Longitude"* for the site and input as shown below.



Part II - B. Apply site coefficients Fa and Fv - these are site amplification factors

Adjust MCE spectral response acceleration S_{MS} and S_{M1}

Derive S_{DS} and S_{D1} 5% damped design spectral response acceleration at 0.2 second period - ASCE 7-05

$S_{DS} = 2/3\ S_{MS}$ $S_{D1} = 2/3\ S_{M1}$

Plot Elastic Design Response Spectra

Part II - C Determine Seismic Design Category and Equivalent Lateral Load without SSI

Determine Risk and seismic category

Value of S_{DS}	Occupancy Category		
	I or II	III	. IV
$S_{DS} < 0.16g$	A	A	A
$0.16g \le S_{DS} < 0.33g$	B	B	C
$0.33g \le S_{DS} < 0.50g$	C	C	D
$S_{DS} \ge 0.50g$	D	D	D

Value of S_{D1}	Occupancy Category		
	I or II	III	IV
$S_{D1} < 0.067g$	A	A	A
$0.067g \le S_{D1} < 0.133g$	B	B	C
$0.133g \le S_{D1} < 0.20g$	C	C	D
$S_{D1} \ge 0.20g$	D	D	D
$S_{D1} \ge 0.75g$	E	E	F

This section calculates the initial lateral load without soil-structure interaction.

Part II-D Consider Soil-structure Interaction ASCE 7 Chapter 19

Soil Density = 120 pcf Vs = 1,200 ft/sec

Vertical and lateral spring calculated per Hall.

The reduction is minimal and neglected.

Finally vertical force due to vertical earthquake is calculated per ASCE 7 eqn. 12.4.2.2

Part II-E Apply hydrodynamic force

Because the skimmer is constructed of timber materials and its structural condition is deteriorated, it is assumed to fail during earthquake. The subject unit may then be subjected to hydrodynamic forces generated by waves,

The dynamic and static water pressure are then added to other forces for equilibrium.

Part II-F Final Check for equilibrium

Check safety against sliding and overturning

High safety factor obtained and no further check is performed.

This structure was analyzed as a typical structure subject to shear loading. Based on high safety margins, no other shear-susceptible structure was analyzed because by judgment they will be OK,

Part III - Analyses for underground piping

FEMA -ASCE, American Lifelines Alliance, Guidelines for the Design of Buried Steel Pipe, Jul 200

The pipelines (2 nos) one fiberglass and the other HDPE are not specifically addressed by the reference but the the treatment of strains and stresses can be transferred from steel properties to non-steel properties. If high safety factors are obtained, then specific analyses with the specific properties are not needed to evaluate.

11.1 Seismic Wave Propagation

Wave propagation provisions are presented in terms of longitudinal axial strain, that is, strain parallel to the pipe axis induced by ground strain. Flexural strains due to ground curvature are neglected since they are small for typical pipeline diameters.

The axial strain, ε_a, induced in a buried pipe by wave propagation can be approximated using the following equation:

$$\varepsilon_a = \frac{V_g}{\alpha C_s} \qquad (11\text{-}1)$$

where:

- V_g = peak ground velocity generated by ground shaking
- C_s = apparent propagation velocity for seismic waves (conservatively assumed to be 2 kilometers per second)
- α = 2.0 for C_s associated with shear waves, 1.0 otherwise

The axial strains produced by Equation (11-1) can be assumed to be transferred to the pipeline but need not be taken as larger than the axial strain induced by friction at the soil pipe interface:

$$\varepsilon_a \le \frac{T_u \lambda}{4AE} \qquad (11\text{-}2)$$

where:

- T_u = peak friction force per unit length at soil-pipe interface (see Appendix A)
- λ = apparent wavelength of seismic waves at ground surface, sometimes assumed to be 1.0 kilometers without further information
- A = pipe cross-sectional area
- E = steel modulus of elasticity

Tu is calculated by the eqn. below.

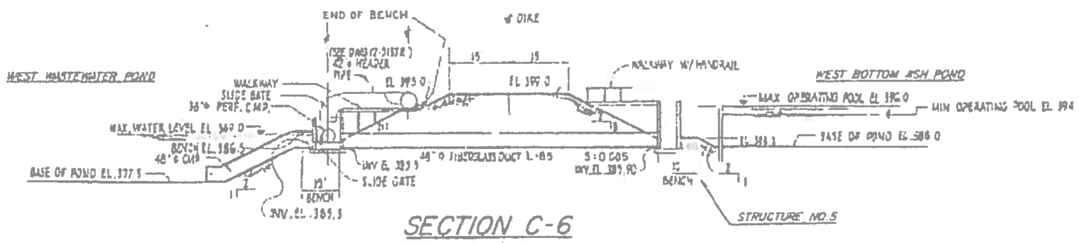
For our case, with cohesionless backfill, the peak force per unit length of the soil-pipe interface (from Appendix B) is:

$$T_u = \frac{\pi}{2} D H \overline{\gamma} \left(1 + K_o\right) \tan\delta$$

PART I

Relevant Cross Sections

Reference drawings:
12-30013, -27



SECTION C-6

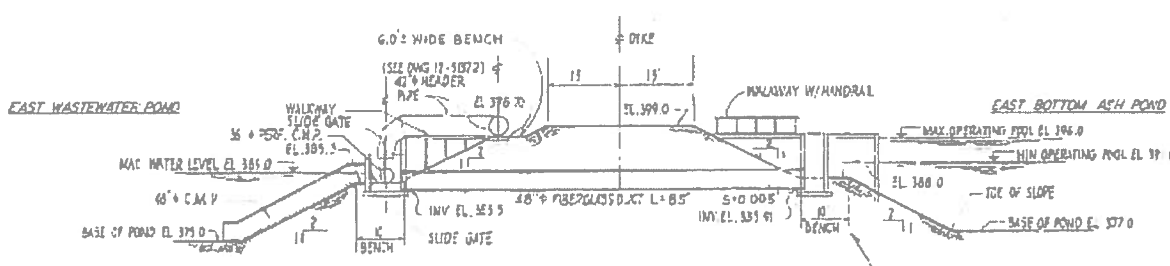
Structures/structural components at Section C-6:

West Bottom Ash Pond Side

C-6-1: 48" Fiberglass Duct
C-6-2: Concrete Inflow Box
C-6-3: Timber box for skimmer
C-6-4: Walkway with handrails

West Wastewater Pond Side

C-6-5: 48" CMP Discharge Line
C-6-6: 36" Perforated CMP
C-6-7: Concrete Inflow Box
C-6-8: Walkway with handrails



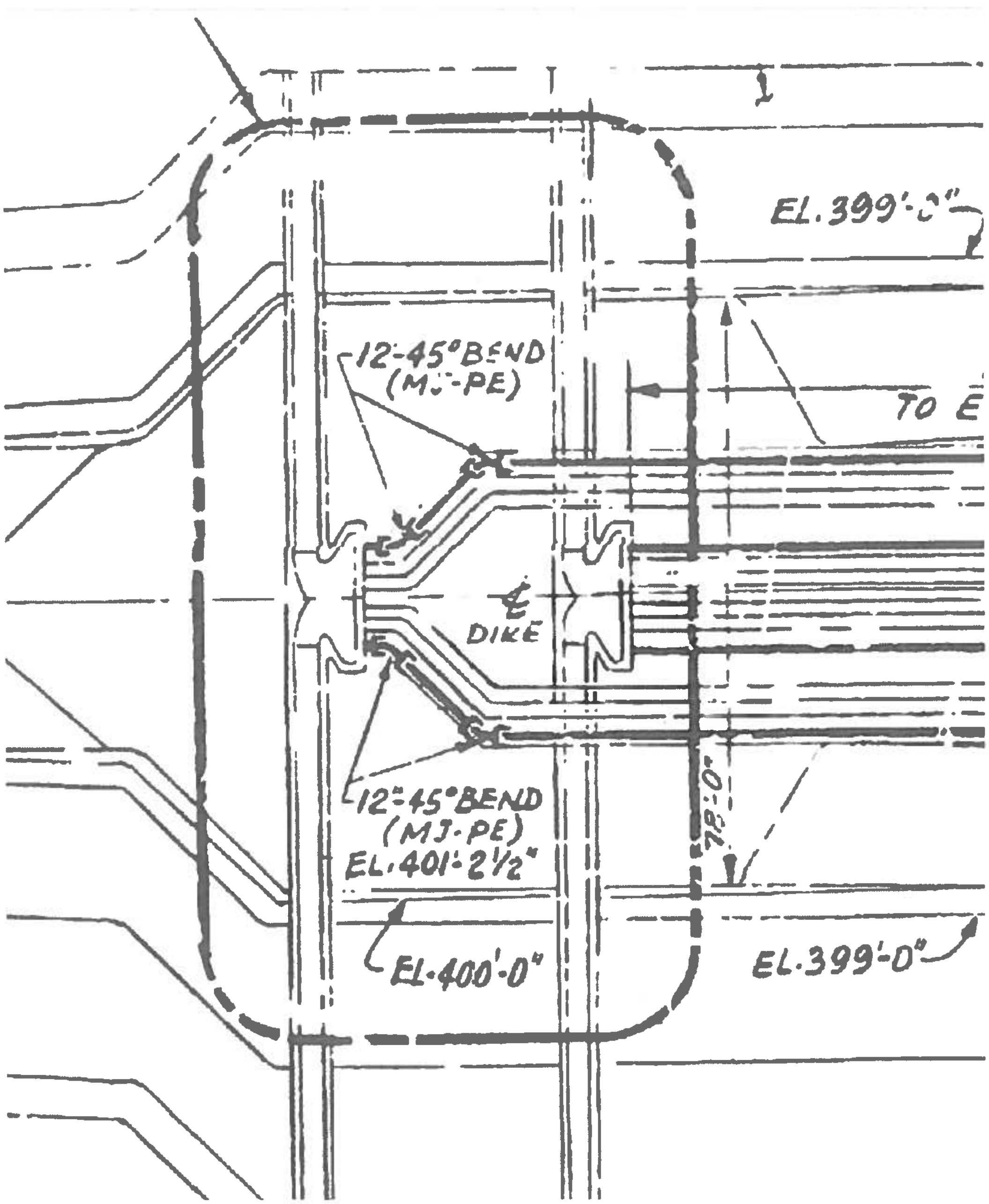
SECTION C-4

East Wastewater Pond Side

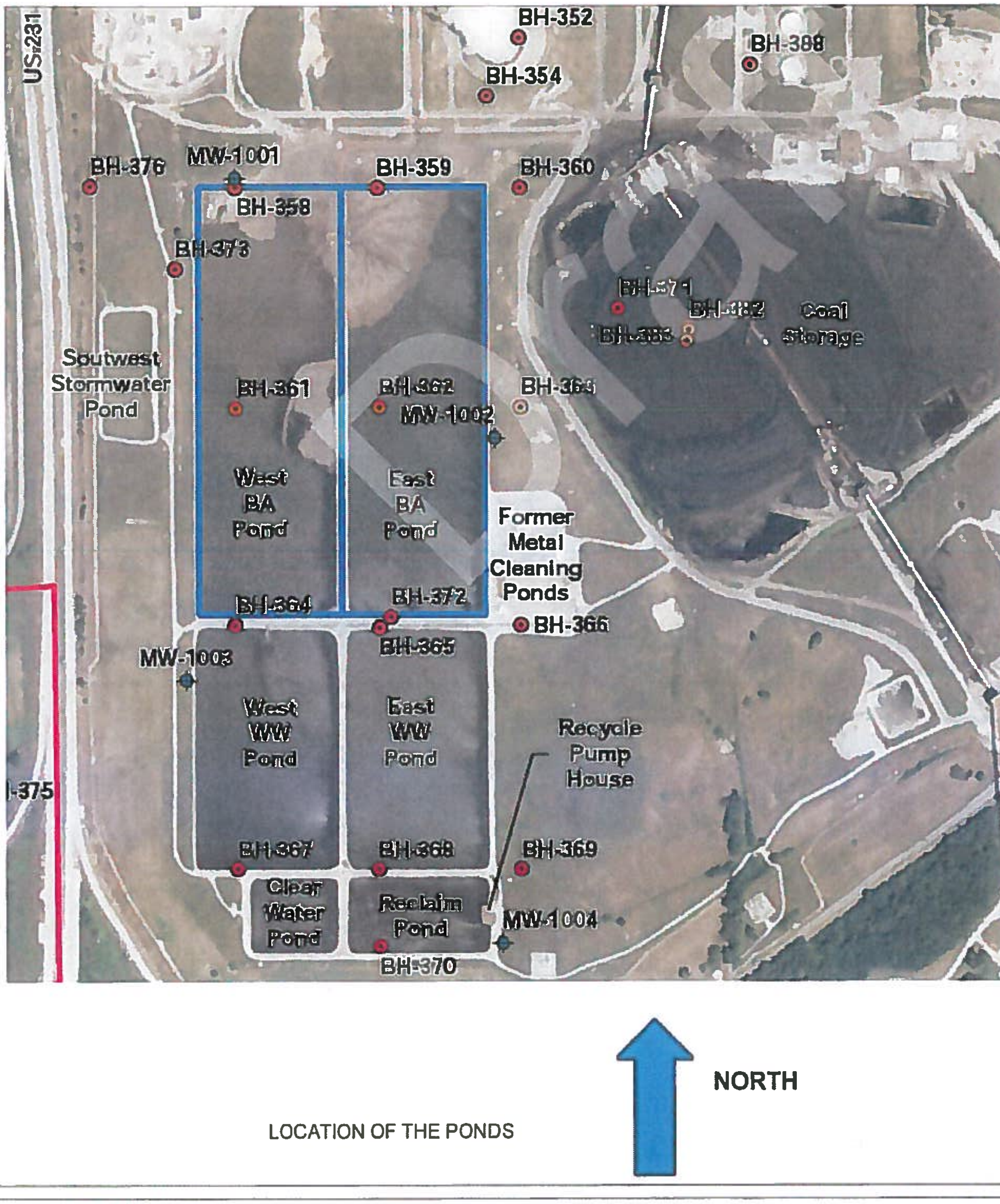
C-4-5: 48" CMP Discharge Line
C-4-6: 36" Perforated CMP
C-4-7: Concrete Inflow Box
C-4-8: Walkway with handrails

East Bottom Ash Pond Side

C-4-1: 48" Fiberglass Duct
C-4-2: Concrete Inflow Box
C-4-3: Timber box for skimmer
C-4-4: Walkway with handrails



Dike and Flow Diverters



LOCATION OF THE PONDS

PART II - A
Maximum Considered Earthquake Spectral Acceleration

CCR Rule

CCR Surface Impoundment Requirements								
Requirement	Existing Surface Impoundments				New Surface Impoundments and Lateral Expansions			
	Five feet high AND 20 acre-feet, or 20 feet high				Five feet high AND 20 acre-feet, or 20 feet high			
	Yes		No		Yes		No	
	Required?	Rule Section	Required?	Rule Section	Required?	Rule Section	Required?	Rule Section
Location Restrictions:	√	§257.60 - §257.64	√	§257.60 - §257.64	√	§257.60 - §257.64	√	§257.60 - §257.64
Placement Above the Uppermost Aquifer	√	§257.60	√	§257.60	√	§257.60	√	§257.60
Wetlands	√	§257.61	√	§257.61	√	§257.61	√	§257.61
Fault Areas	√	§257.62	√	§257.62	√	§257.62	√	§257.62
Seismic Impact Zones	√	§257.63	√	§257.63	√	§257.63	√	§257.63
Unstable Areas	√	§257.64	√	§257.64	√	§257.64	√	§257.64

With respect to seismic reviews two issues are relevant:

1. Fault Areas   2. Seismic Impact Zones

Reference : **EVALUATION OF LOCATION RESTRICTIONS, Bottom Ash Ponds, Rockport Plant, Draft Final, 25 sep 2015. p.15:**

"Based on available information, it is our opinion that the site meets the criterion of being located more than 200 feet from the outermost damage zone of a fault with displacement in Holocene time, as set forth in 40 CFR §257.62." End of Fault contributing to earthquake.

SEISMIC IMPACT ZONES **37.925560 Lat. -87.033890 Long.**

The same reference also states that: http://earthquake.usgs.gov/designmaps/us/application.php

"The 2014 USGS National Seismic Hazard Maps (NSHM) display earthquake ground motions for various probability levels across the United States. We have reviewed the USGS National Seismic Hazard Map showing a 2% probability that the maximum expected horizontal acceleration, expressed as a percentage of the earth''s gravitational pull (g), will be exceeded in years (2% exceedance in 50 years, Peak Ground Acceleration (PGA)). The USGS NSHM map is provided as **Figure 9**. Based on the NSHM map for a 2% exceedance in 50 years, we have determined the PGA for this site is 0.2 g."
(Figure 9 not attached).

From CCR Rules: " A Seismic impact zone means an area having a 2% or greater probability that the maximum expected horizontal acceleration, expressed as a percentage of the earth's gravitational pull (g), will exceed 0.10 g in 50 years. Seismic zones, which represent areas of the United States with the greatest seismic risk, are mapped by the U.S. Geological Survey and readily available for all the U.S. (http://earthquake.usgs.gov/hazards/apps/)".

References : The following references are used:

1. CCR Publication: Federal Register, April 17, 2015.

2. IBC Code, 2012/ASCE 7   3. FERC, Evaluation of Earthquake Ground Motions, Draft 06.5, FERC Feb 2007

USGS Design Maps Summary Report

User–Specified Input

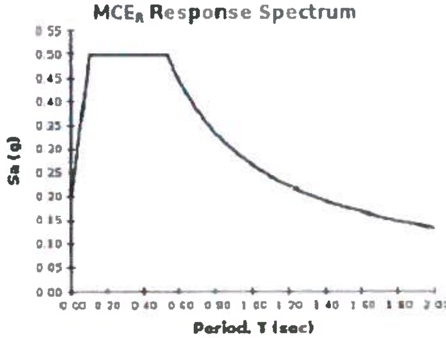
Report Title	USGS Data Sat August 27, 2016 14:53:43 UTC
Building Code Reference Document	ASCE 7-10 Standard (which utilizes USGS hazard data available in 2008)
Site Coordinates	37.92556°N, 87.03389°W
Site Soil Classification	Site Class C – "Very Dense Soil and Soft Rock"
Risk Category	I/II/III

USGS–Provided Output

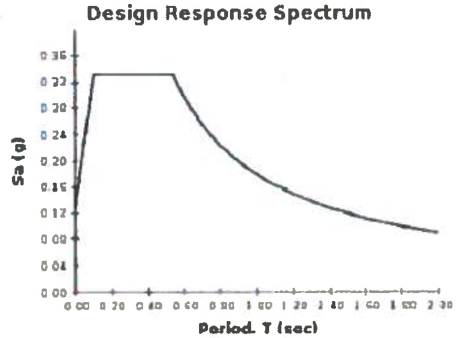
S_S = 0.415 g	S_{MS} = 0.498 g	S_{DS} = 0.332 g
S_1 = 0.163 g	S_{M1} = 0.267 g	S_{D1} = 0.178 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.

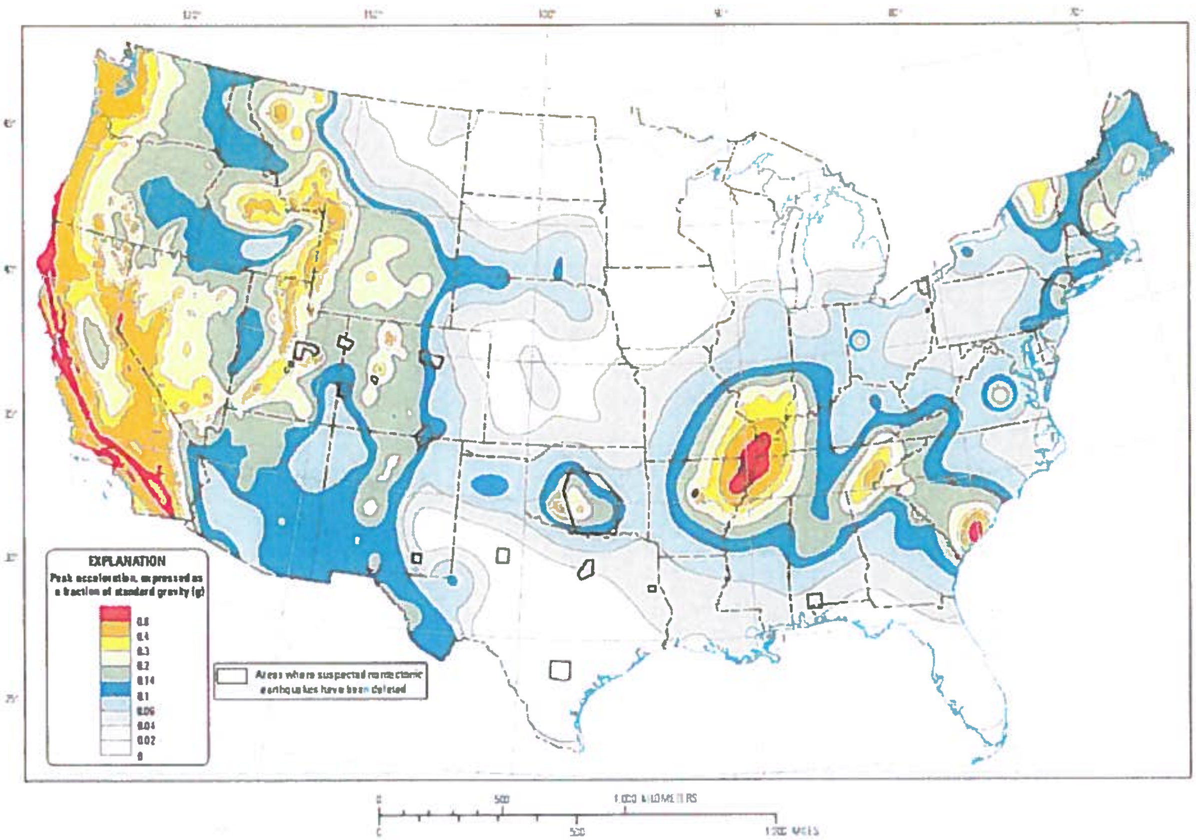
MCE_R Response Spectrum



Design Response Spectrum



For PGA_M, T_L, C_{RS}, and C_{R1} values, please view the detailed report.



Two-percent probability of exceedance in 50 years map of peak ground acceleration

The map indicates PGA = 0.2 g

Determine Building Occupancy: from IBC Section 312, Group U

Determine basic ground motion parameters

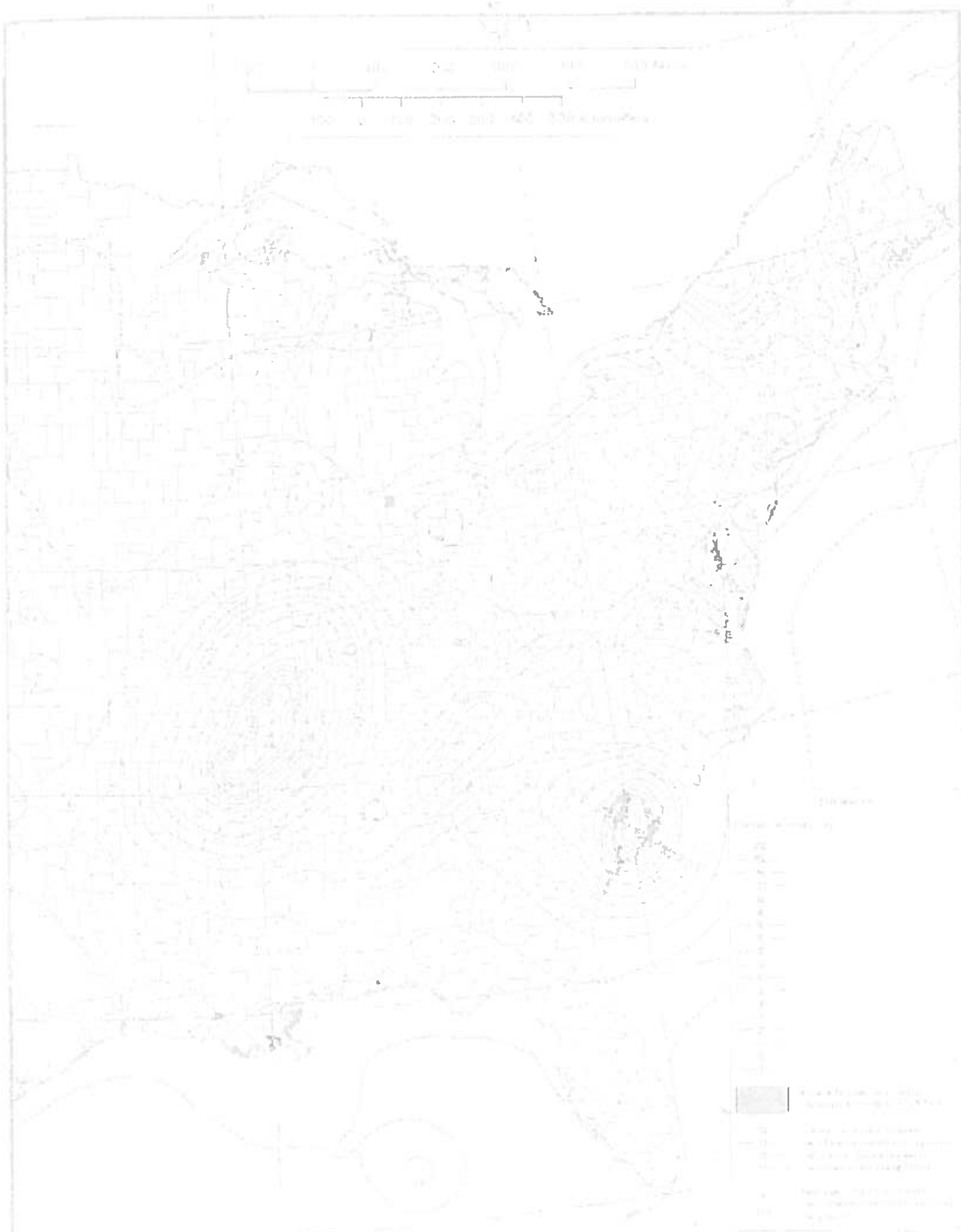


FIGURE 1613.3.1(1)—continued
RISK-TARGETED MAXIMUM CONSIDERED EARTHQUAKE (MCE_R) GROUND MOTION RESPONSE ACCELERATIONS FOR THE CONTERMINOUS UNITED STATES OF 0.2-SECOND SPECTRAL RESPONSE ACCELERATION (5% OF CRITICAL DAMPING), SITE CLASS B

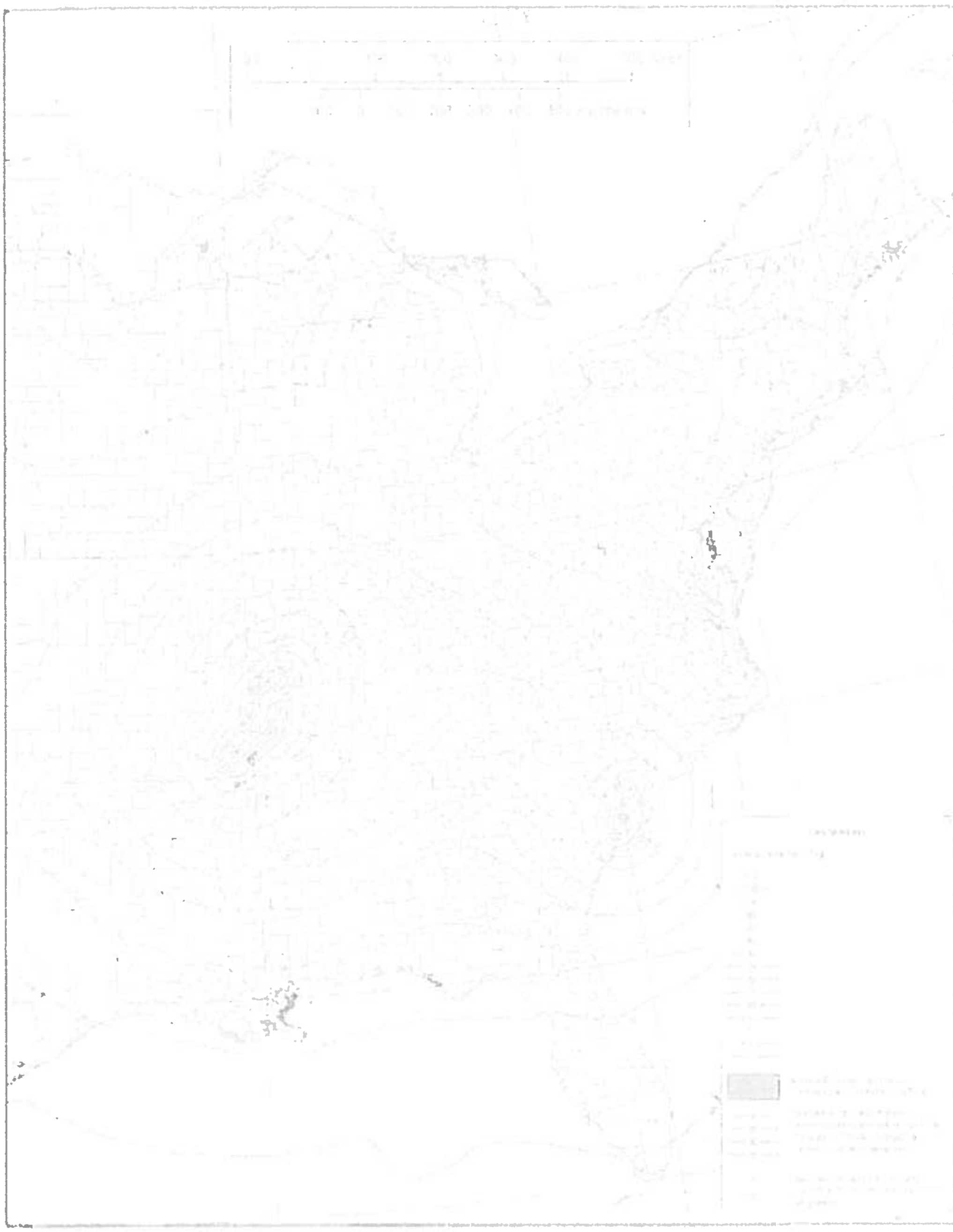


FIGURE 1613.3.1(2)—continued
RISK-TARGETED MAXIMUM CONSIDERED EARTHQUAKE (MCE_R) GROUND MOTION RESPONSE ACCELERATIONS FOR THE CONTERMINOUS UNITED STATES OF 1-SECOND SPECTRAL RESPONSE ACCELERATION (5% OF CRITICAL DAMPING), SITE CLASS B

S_s = Spectral acceleration for 0.2s

$S_s := 0.415 \cdot g$

S_1 = Spectral acceleration for 1s

$S_1 := 0.163 \cdot g$

Part II - B
Apply Site Amplification Factors

Calculate S_{DS} and S_{D1}

S_{DS} and S_{D1} = spectral values from Tables 1613.3.3(1) and 1613.3.3(2) respectively.

$S_{DS} = 2/3*F_a*S_s$ $S_{D1} = 2/3*F_v*S_1$

Fa and Fv are site coefficients.

TABLE 1613.3.3(1)
VALUES OF SITE COEFFICIENT F_a [a]

TE CLASS	MAPPED SPECTRAL RESPONSE ACCELERATION AT SHORT PERIOD				
	$S_s \le 0.25$	$S_s = 0.50$	$S_s = 0.75$	$S_s = 1.00$	$S_s \ge 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	Note b	Note b	Note b	Note b	Note b

aight-line interpolation for intermediate values of mapped spectral response acceleration at short period, S_s.
shall be determined in accordance with Section 11 4.7 of ASCE 7.

TABLE 1613.3.3(2)
VALUES OF SITE COEFFICIENT F_V [a]

TE CLASS	MAPPED SPECTRAL RESPONSE ACCELERATION AT 1-SECOND PERIOD				
	$S_1 \le 0.1$	$S_1 = 0.2$	$S_1 = 0.3$	$S_1 = 0.4$	$S_1 \ge 0.5$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	Note b	Note b	Note b	Note b	Note b

aight-line interpolation for intermediate values of mapped spectral response acceleration at 1-second period, S_1.
shall be determined in accordance with Section 11 4.7 of ASCE 7.

Table 20.3-1 of ASCE 7 provides definition of Site Class.

Table 20.3-1 Site Classification

Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard rock	>5,000 ft/s	NA	NA
B. Rock	2,500 to 5,000 ft/s	NA	NA
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the following characteristics: —Plasticity index $PI > 20$, —Moisture content $w \geq 40\%$, —Undrained shear strength $\bar{s}_u < 500$ psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1 ft/s = 0.3048 m/s; 1 lb/ft² = 0.0479 kN/m².

Reference: Engineering Report Minor Permit Modification, Mar 2012 provides a geotechnical evaluation of subsurface soi in the area. It estimates that the shear wave velocity is 1200 ft/sec. That makes it a site class C.

For S_s= 0.415g $\quad F_a := 1.2$

For S_1 =0.16 $\quad F_v := 1.7 - (1.7 - 1.6)\cdot\frac{.06}{0.1} = 1.64$

$$S_{DS} := \frac{2}{3}\cdot F_a\cdot S_s = 0.332\cdot g \qquad S_{D1} := \frac{2}{3}\cdot F_v\cdot S_1 = 0.178\cdot g$$

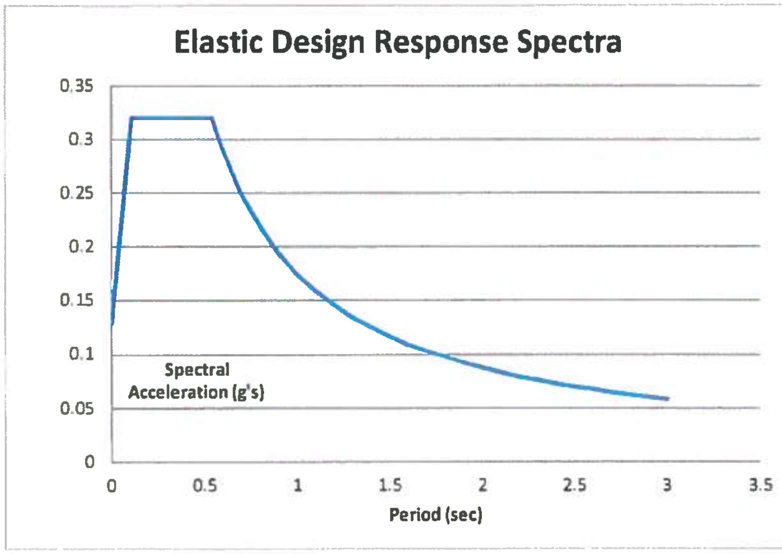
$$T_0 := 0.2\cdot\frac{S_{D1}}{S_{DS}}\cdot sec = 0.107 \quad T_s := \frac{S_{D1}}{S_{DS}}\cdot sec = 0.537\,s$$

For T< T_0 $\qquad$ Sa =(0.4+0.6*T/T_0)S_{DS}

For T< T_0 $\qquad$ $S_{a1}\left[S_{DS}\cdot\left(0.4 + 0.6\cdot\frac{1\cdot sec}{T_0}\right) = \blacksquare\right]$

T	S_{DS}	S_{D1}	T_0	T_S	S
	0.32	0.175	0.109	0.547	

T	Sa	
0	0.128	
0.109	0.32	9.17
0.547	0.32	1.83
0.6	0.29	1.67
0.7	0.25	1.43
0.8	0.22	1.25
0.9	0.19	1.11
1	0.18	1.00
1.1	0.16	0.91
1.2	0.15	0.83
1.3	0.13	0.77
1.4	0.13	0.71
1.5	0.12	0.67
1.6	0.11	0.63
1.7	0.10	0.59
1.8	0.10	0.56
1.9	0.09	0.53
2	0.09	0.50
2.1	0.08	0.48
2.2	0.08	0.45
2.3	0.08	0.43
2.4	0.07	0.42
2.5	0.07	0.40
2.6	0.07	0.38
2.7	0.06	0.37
2.8	0.06	0.36
2.9	0.06	0.34
3	0.06	0.33



Part II - C
Determine Seismic Design Category and Equivalent Lateral Load without SSI

RISK CATEGORY

Select Risk Category 1 per Table 1.5-1. below and Seismic Importance Factor =1.00

$Risk_{cat} := 1$

$I_e := 1$

Table 1.5-1 Risk Category of Buildings and Other Structures for Flood, Wind, Snow, Earthquake, and Ice Loads

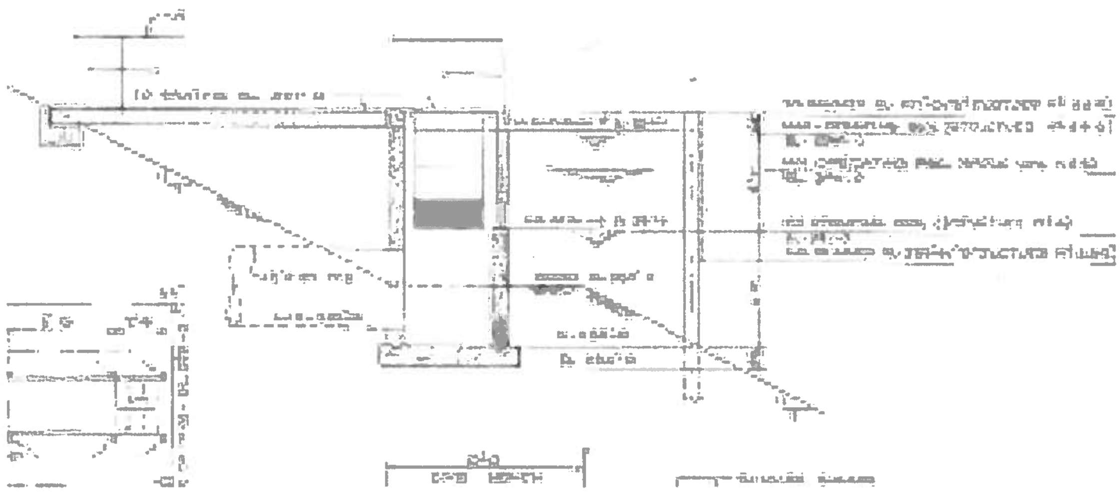
Use or Occupancy of Buildings and Structures	Risk Category
Buildings and other structures that represent a low risk to human life in the event of failure	I
All buildings and other structures except those listed in Risk Categories I, III, and IV	II
Buildings and other structures, the failure of which could pose a substantial risk to human life Buildings and other structures, not included in Risk Category IV, with potential to cause a substantial economic impact and/or mass disruption of day-to-day civilian life in the event of failure Buildings and other structures not included in Risk Category IV (including, but not limited to, facilities that manufacture, process, handle, store, use, or dispose of such substances as hazardous fuels, hazardous chemicals, hazardous waste, or explosives) containing toxic or explosive substances where their quantity exceeds a threshold quantity established by the authority having jurisdiction and is sufficient to pose a threat to the public if released.	III
Buildings and other structures designated as essential facilities. Buildings and other structures, the failure of which could pose a substantial hazard to the community. Buildings and other structures (including, but not limited to, facilities that manufacture, process, handle, store, use, or dispose of such substances as hazardous fuels, hazardous chemicals, or hazardous waste) containing sufficient quantities of highly toxic substances where the quantity exceeds a threshold quantity established by the authority having jurisdiction to be dangerous to the public if released and is sufficient to pose a threat to the public if released.[a] Buildings and other structures required to maintain the functionality of other Risk Category IV structures.	IV

[a]Buildings and other structures containing toxic, highly toxic, or explosive substances shall be eligible for classification to a lower Risk Category if it can be demonstrated to the satisfaction of the authority having jurisdiction by a hazard assessment as described in Section 1.5.2 that a release of the substances is commensurate with the risk associated with that Risk Category.

Table 1.5-2 Importance Factors by Risk Category of Buildings and Other Structures for Snow, Ice, and Earthquake Loads[a]

Risk Category from Table 1.5-1	Snow Importance Factor, I_s	Ice Importance Factor—Thickness, I_i	Ice Importance Factor—Wind, I_w	Seismic Importance Factor, I_e
I	0.80	0.80	1.00	1.00
II	1.00	1.00	1.00	1.00
III	1.10	1.25	1.00	1.25
IV	1.20	1.25	1.00	1.50

[a]The component importance factor, I_p, applicable to earthquake loads, is not included in this table because it is dependent on the importance of the individual component rather than that of the building as a whole, or its occupancy. Refer to Section 13.1.3.



Response Modification Factors, R_{xf}

ASCE 7-10, Table 12.2-1

Ordinary Reinforced Concrete Shear wall

$R_{cf} := 4$

$\Omega_{c0} := 2.5$ Overstrength Factor

$C_{cd} := 2.5$ Deflection Amplification Factor

Steel Ordinary Moment Frames

$R_{sf} := 3.5$

$\Omega_{s0} := 3$

$C_{sd} := 3$

Light -framed wood walls (by Judgment)

$R_{wf} := 3.5$

$\Omega_{w0} := 3$

$C_{wd} := 3$

Determine Seismic Response Coefficients - Concrete

Seismic Base shear

ASCE 7, Section 12.8.1.1 Concrete

$$C_{s\_conc1} := \frac{S_{DS}}{\left(\frac{R_{cf}}{I_e}\right)} = 0.083 \cdot g$$

ASCE 7, Eqn. 12.8-5, C_s shall not be less than

$$C_{s\_min} := \max\left(0.044 \cdot S_{DS} \cdot I_e, 0.01 \cdot g\right) = 0.015 \cdot g$$

Satisfy ASCE 7 eqn. 12.8-3 and 12.8-4 after calculating T_a

Calculate C_t $\quad C_{t\_conc} := 0.02$ ASCE 7 Table 12.8-2

$$x_{ct\_conc} := .75$$

ASCE 7 Page 225 Fig 22-12 $\quad T_{L\_conc} := 12 \cdot sec$

Calculate T_{a_conc}

Method 1: Use ASCE 7, eqn. 12.8-7 $\quad h_n := 13$ Dwg No. 12-3453

$$T_{a\_conc1} := C_{t\_conc} \cdot \left(h_n\right)^{x_{ct\_conc}} \cdot 1 \cdot sec = 0.137\, s$$

$$freq_{a\_conc1} := \frac{1}{T_{a\_conc1}} = 7.303 \cdot Hz$$

Method 2: Use ASCE 7 eqn. 12.8-7

$$N_{conc2} := 1$$

$$T_{a\_conc2} := 0.1 \cdot N_{conc2} \cdot 1 \cdot sec = 0.1\, s$$

$$freq_{a\_conc2} := \frac{1}{T_{a\_conc2}} = 10 \cdot Hz$$

Use average T.a

$$T_{a\_ave} := \frac{\left(T_{a\_conc1} + T_{a\_conc2}\right)}{2} = 0.118\,s$$

$S_{D1} = 0.178 \cdot g$

Determine C_s for $T_{a\_conc} < T_{L\_conc}$

$$C_{s\_conc2} := \frac{S_{D1}}{T_{a\_ave} \cdot \frac{1}{sec}\left(\frac{R_{cf}}{I_e}\right)} = 0.376 \cdot g$$

$$C_{s\_conc1} = 0.083 \cdot g$$

$$C_{s\_conc} := \max\left(\min\left(C_{s\_conc1}, C_{s\_conc2}\right), C_{s\_min}\right) = 0.083 \cdot g$$

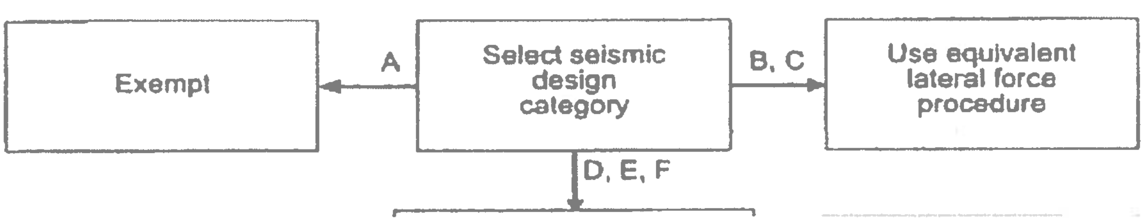
SUMMARY WITHOUT SOIL STRUCTURE INTERACTION

$T_{a\_wossi} := T_{a\_ave} = 0.118\,s$ Period

$C_{s\_conc\_wossi} := C_{s\_conc} = 0.083 \cdot g$

$S_{DS} = 0.332 \cdot g$

$S_{D1} = 0.178 \cdot g$



Part II-D
Consider Soil-structure Interaction ASCE 7 Chapter 19

Consider Soil-Structure Interaction per ASCE 7 Chapter 19

Size of found - 7'-8" by 7'-2"

$$A_{fdn} := 7.67 \cdot ft \cdot 7.17 \cdot ft = 54.994\,ft^2$$

Equivalent Radius $$r_{equiv} := \sqrt{\frac{A_{fdn}}{\pi}} = 4.184\,ft$$

Reference: Engineering Report Minor Permit Modification, Mar 2012 provides a geotechnical evaluation of subsurface soils in th area. It estimates that the shear wave velocity is 1200 ft/sec.

Because of the small size and the approximate nature of the shear wave velocity, no correction will be made due to G/G_{max} and D/D_{max} for being less than 1.

$$V_s := 1200 \cdot \frac{ft}{sec} = 1.2 \times 10^3\,\frac{ft}{s}$$

$$\rho := \frac{120 \cdot \frac{lb}{ft^3}}{32.2 \cdot \frac{ft}{sec^2}} = 3.727\,\frac{s^2}{ft} \cdot \frac{lb}{ft^3}$$

$$\nu := 0.3$$

$$G_{ssi} := \rho \cdot V_s^{\,2} = 5.366 \times 10^6 \cdot psf$$

Vibrations of Soils and Foundations, Richart, Hall and Woods, 1970

Sliding stiffness

$$K_{yssi} := 32 \cdot \frac{(1-\nu)}{(7 - 8 \cdot \nu)} \cdot G_{ssi} \cdot r_{equiv} = 1.093 \times 10^8 \cdot \frac{lb}{ft}$$

Rocking

$$K_{\theta ssi} := \frac{8 \cdot \left(\frac{1}{rad}\right) \cdot G_{ssi} \cdot r_{equiv}^{\,3}}{3 \cdot (1-\nu)} = 1.497 \times 10^6\,ft \cdot \frac{1}{rad} \cdot kip$$

Calculate W_{bar}

Weight of walls

$$W_{tot1} := \left[\left(5+\frac{4}{12}\right)\cdot\frac{10}{12}\cdot 2+\left(5+\frac{10}{12}\right)\cdot\frac{10}{12}\cdot 2\right]\cdot 13\cdot 150\cdot \mathbf{lbs} = 3.629\times 10^{4}\,\mathbf{lbf}$$

$$W_{tot2} := \left(7+\frac{8}{12}\right)\cdot\left(7+\frac{2}{12}\right)\cdot 1\cdot 150\cdot \mathbf{lbs} = 8.242\times 10^{3}\,\mathbf{lbf}$$ Slab weight

$$W_{tot} := W_{tot1}+W_{tot2} = 4.453\times 10^{4}\,\mathbf{lbf}$$ Weight of wall approximate due to stubby structure

$$T_{a\_ave} = 0.118\,\mathbf{s}$$

$$W_{bar} := .7\cdot W_{tot} = 3.117\times 10^{4}\,\mathbf{lbf}$$

$$k_{bar} := 4\cdot\pi^{2}\cdot\frac{W_{bar}}{32.2\cdot\frac{\mathbf{ft}}{\mathbf{sec}^{2}}\cdot T_{a\_ave}{}^{2}} = 2.723\times 10^{6}\,\frac{1}{\mathbf{ft}}\cdot\mathbf{lbf}$$

$$T_{bar} := T_{a\_ave}\cdot\sqrt{1+\frac{k_{bar}}{K_{yssi}}\cdot\left[1+\frac{K_{yssi}\cdot(.7\cdot 14\cdot \mathbf{ft})^{2}}{K_{\theta ssi}}\right]} = 0.13\,\mathbf{s}$$

$$freq_{bar} := \frac{1}{T_{bar}} = 7.707\cdot\mathbf{Hz}$$

Parametric Variation + or - 50% in G value or 123% or 70% respectively for V_s

Plugging the limiting shear wave velocities, the periods and freq values are:

$$T_{bar150} := .125\cdot\mathbf{sec} \qquad T_{bar50} := 0.136\cdot\mathbf{sec} \qquad T_{bar} = 0.13\,\mathbf{s}$$

$$freq_{bar150} := \frac{1}{T_{bar150}} = 8\cdot\mathbf{Hz} \qquad freq_{bar50} := \frac{1}{T_{bar50}} = 7.353\cdot\mathbf{Hz}$$

Calculate base shear reduction ASCE 7 Section 19.2

$r_{equiv} = 4.184\,ft$ $\qquad$ $h_{bar} := 0.7 \cdot 12.ft = 8.4\,ft$ $\qquad$ $L_0 := 7.67 \cdot ft$

$r_{radgyr} := .289 \cdot 7.167 \cdot ft = 2.071\,ft$

$b_0 := 7.167$ $\qquad$ $d_0 := 7.67$

$$I_0 := \frac{b_0 \cdot d_0^{\,3}}{12} = 269.49$$

$$r_m := 4 \cdot \sqrt{4 \cdot \frac{I_0}{\pi}} \cdot ft = 74.095\,ft \qquad \frac{h_{bar}}{r_m} = 0.113$$

Use h/r=0.5 curve

Calculate period lenghening

$$\frac{T_{bar}}{T_{a\_wossi}} = 1.095$$

$\beta_0 := 0.04$

ASCE 7 eqn 19.2-9

$$\beta_{bar} := \frac{(\beta_0 \cdot 0.05) \cdot 100}{\left(\frac{T_{bar}}{T_{a\_wossi}}\right)^3} = 0.152$$

No further SSI consideration
Conservative

$C_s := C_{s\_conc} = 0.083 \cdot g$

FINAL LATERAL LOAD FROM EARTHQUAKE

VERTICAL EARTHQUAKE

$E_{vert} := .2 \cdot S_{DS} = 0.066 \cdot g$

ASCE 7 Eqn. 12.4.2.2

Part II-E
Apply Hydrodynamic Force

Reference:Hydrodynamic Pressure on Culvert Gates during an Earthquake

Ali Rasekh *2012 SIMULIA Community Conference Attachment 2*

It is accepted in civil engineering to estimate the hydrodynamic pressure on the rigid reservoir dams by the Westergaard hydrodynamic pressure equation, which is

$$p_d = 0.875 \rho_w g k \sqrt{H.h}$$

where is the hydrodynamic pressure, g= acceleration due to gravity, and k is the design seismic coefficient. The value of is two third of the peak ground acceleration in terms of *g (i.e.k=(2/3))* PGA/g. H is the total depth of the water reservoir and is the depth from the reservoir water surface to the point of action of hydrodynamic pressure.

$H_{East} := (394 - 377) \cdot ft = 17 ft$ $\qquad$ $h_{EAST} := (394 - 388) \cdot ft = 6 ft$

$PGA := 0.213 \cdot g$ $\qquad$ $k_{East} := 2 \cdot \dfrac{PGA}{3.0 \cdot g} = 0.142$

$H_{East} := 17 ft$ $\qquad$ $h_{West} := 6.0 \cdot ft$ $\qquad$ $H_{West} := 6.ft$

$$p_d := .875 \cdot 62.4 \cdot pcf \cdot k_{East} \cdot \sqrt{H_{West} \cdot h_{West}} = 46.519 \cdot psf$$

Total Hydrodynamic force

$$P_d := \frac{2 \cdot h_{West} \cdot p_d}{3} = 186.077 \frac{1}{ft} \cdot lbf$$

Static water pressure

$$p_{static} := 62.4 pcf \cdot H_{West} = 2.6\, psi$$

$$P_{static} := .5 \cdot p_{static} \cdot H_{West} = 1.123 \times 10^3 \frac{1}{ft} \cdot lbf$$

Total water pressure

$$PW_{total} := P_{static} + P_d = 1.309 \times 10^3 \frac{1}{ft} \cdot lbf$$

$$W_{tot} = 4.453 \times 10^4\, lbf$$

Part II-F
Final Check for Equilibrium

CHECK AGAINST SLIDING

$$SEISMIC_{hor} := \frac{C_s \cdot W_{tot}}{1.g} = 3.696 \times 10^3 \cdot lbf$$

$$Seismic_{ver} := \frac{E_{vert} \cdot W_{tot}}{1.g} = 2.957 \times 10^3\, lbf$$

$$Hydro_{stdyn} := PW_{total} \cdot 6.67 \cdot ft = 8.733 \times 10^3\, lbf$$

Driving force $P_{dr} := SEISMIC_{hor} + Hydro_{stdyn} = 1.243 \times 10^4\, lbf$

active pressure coefficient

Assume $PHI := 30.deg$

$$PHI_{rad} := 30 \cdot \frac{\pi}{180} = 0.524 \cdot rad$$

$K_a := .333$ $K_p := 3$

$$C_c := \cos\left(PHI_{rad}\right) = 0.866$$

For seismic

$$C_{sin} := \sin(PHI_{rad}) = 0.5$$

$$K_{ae} := \frac{\left(1 + \frac{E_{vert}}{1 \cdot g}\right) \cdot C_c^{\ 2}}{\left(1 + C_{sin}\right)^2} = 0.355$$

$$K_{pe} := \frac{\left(1 + \frac{E_{vert}}{1 \cdot g}\right) \cdot C_c^{\ 2}}{\left(1 - C_{sin}\right)^2} = 3.199$$

Assume both active/passive pressure has the inverted pressure distribution. Conservative.
Net pressure coefficient

$$Net_{aepe} := K_{pe} - K_{ae} = 2.844$$

Net Resisting active/passive force

$$Net_{aepeforce} := .5 \cdot Net_{aepe} \cdot 67.6 \cdot pcf \cdot (3 \cdot ft)^2 \cdot 6.67 \cdot ft = 5.77 \times 10^3 \cdot lbf$$

$$Fric_{coef} := 0.5$$

Resisting force

$$Res_{force} := Fric_{coef} \cdot W_{tot} + Net_{aepeforce} = 2.804 \times 10^4 \, lbf$$

$$Res_{force1} := Fric_{coef} \cdot W_{tot} = 2.227 \times 10^4 \, lbf$$

$$\boxed{SF_{sliding} := \frac{Res_{force}}{P_{dr}} = 2.256} \qquad \boxed{SF_{sliding1} := \frac{Res_{force1}}{P_{dr}} = 1.791}$$

Minimum

CHECK OVERTURNING

$$SEISMIC_{hor} = 3.696 \times 10^{3}\,lbf \qquad Hydro_{stdyn} = 8.733 \times 10^{3}\,lbf$$

$$MOMARM_S := 7 \cdot ft \qquad MOMARM_H := H_{West} - h_{West} + 5 \cdot ft = 5\,ft$$

Driving Mpment

$$MOM_{DRsei} := SEISMIC_{hor} \cdot MOMARM_S + Hydro_{stdyn} \cdot MOMARM_H = 6.954 \times 10^{4}\,ft \cdot lbf$$

Restring Moment

$$RESTORING_M := W_{tot} \cdot \frac{7.167ft}{2} = 5.135 \times 10^{6}\,\frac{ft^2 \cdot lb}{s^2}$$

$$\boxed{SF_{Mom} := \frac{RESTORING_M}{MOM_{DRsei}} = 2.295}$$

CHECK BASE SHEAR

$P_{dr} = 1.243 \times 10^{4}\,lbf$ Horizontal Base shear

$$Area_{tot} := \left[\left(5 + \frac{4}{12}\right) \cdot ft \cdot \frac{10}{12} \cdot ft \cdot 2 + \left(5 + \frac{10}{12}\right) \cdot ft \cdot \frac{10}{12} \cdot ft \cdot 2\right] = 18.611\,ft^2$$

$$Base_{Shear} := \frac{P_{dr}}{Area_{tot}} = 4.638\,psi$$

$$f_{cprime} := 3000 \cdot psi$$

$$Shear_{allow} := 1.1 \cdot \frac{\sqrt{f_{cprime}}}{1 \cdot \sqrt{psi}} \cdot 1 \cdot psi = 60.249\,psi$$

$$\boxed{SF_{shear} := \frac{Shear_{allow}}{Base_{Shear}} = 12.991}$$

Because of the stubbiness of the structure, moment check is not necessary by judgment.

Part III - Analyses for Underground Piping

CHECK BURIED PIPING 48" DIAMETER

The thickness of pipe is not available. Unit wt is available. Derive thickness of pipe

$$R_{pipe} := \frac{48}{2} \cdot in = 2\,ft$$

The density of HDPE can range from 0.93 to 0.97 g/cm3 or 970 kg/m3.

$$HDPE_{den} := 0.95 \cdot \frac{gm}{cm^3} = 59.307 \frac{lb}{ft^3}$$

$$t := \frac{90 \cdot \frac{lbm}{ft}}{2 \cdot \pi \cdot R_{pipe} \cdot HDPE_{den}} = 0.121 \cdot ft \qquad t = 1.449 \cdot in$$

$$\varepsilon_c := 0.175 \cdot \frac{t}{R_{pipe}} = 0.011$$

This

Stiff Soil Table 11.1-1 ASCE

Assume Moment Magnitude =6.5

$$Ratio_{PGVPGA} := 109 \cdot \frac{\frac{cm}{sec}}{g}$$

$$PGA = 0.213 \cdot g$$

$$PGV := Ratio_{PGVPGA} \cdot PGA = 23.217 \cdot \frac{cm}{sec}$$

$$C_{sasce} := 2 \cdot \frac{km}{sec} = 6.562 \times 10^3 \frac{ft}{s}$$

Apparent wavelength of seismic waves at ground surface approx 2 km/sec

$$\alpha := 1$$

equal to 2 for shear waves and 1 otherwise assumed 1 for maximum

$$\varepsilon_{asce} := \frac{PGV}{\alpha \cdot C_{sasce}} = 0.00012$$

The axial strains produced by Equation (11-1) can be assumed to be transferred to the pipeline but need not be taken as larger than the axial strain induced by friction at the soil pipe interface:

$$\varepsilon_a = T_u \lambda/(4AE)$$

where

T_u = **peak friction force per unit length at soil-pipe interface**

λ = **apparent wavelength of seismic waves at ground surface, sometimes assumed to be 1.0 kilometers without further information**

A = Pipe cs area

E = Modulus elastic

For our case, with cohesionless backfill, the peak force per unit length of the soil-pipe interface (from Appendix B) is:

$$T_u = \frac{\pi}{2} D H \bar{\gamma} (1 + K_o) \tan\delta$$

$$D_{pipe} := 48 \cdot in$$

$$H_{BurDEP} := (399 - 385.5) \cdot ft + \frac{D_{pipe}}{2} = 15.5\,ft$$

$$\gamma_{soil} := 120 \cdot pcf \qquad K_0 := 1$$

$$\delta_{wall} := .8 \cdot 30 \cdot deg = 24 \cdot deg \qquad \tan(\delta_{wall}) = 0.445$$

$$\lambda := 1 \cdot km = 3.281 \times 10^3\,ft$$

$$T_u := \frac{\pi}{2} \cdot D_{pipe} \cdot H_{BurDEP} \cdot \gamma_{soil} \cdot (1 + K_0) \cdot \tan(\delta_{wall}) = 1.041 \times 10^4 \cdot \frac{lb}{ft}$$

$$E_{pipe} := 2 \cdot 10^6 \cdot psi \qquad Area_{pipe} := \left[D_{pipe}^{\ 2} - (D_{pipe} - 2 \cdot t)^2\right] \cdot \frac{\pi}{4} = 1.472\,ft^2$$

$$\varepsilon_a := \frac{T_u \cdot \lambda}{4 \cdot Area_{pipe} \cdot E_{pipe}} = 0.02 \qquad \varepsilon_a > \varepsilon_{asce} \qquad \text{OK}$$

Alternate evaluation using "Design Guideline for seismic Resistant Water pipeline Insrtallations", John Eidinger

The Guidelines provide three approaches can be used in the design of buried pipelines:

•Chart method. The simplest approach. Avoids all mathematical models, and allows the designed to pick a style of pipe installation based on parameters such as regional maps for PGV and PGD hazards, and the pipeline function class.

• Equivalent static method. Uses simple quantifiable models to predict the amount of stress, strain and displacement on a pipe for a particular level of earthquake loading.

• Finite element method. This method uses finite element models to examine the seismic loads (whether PGA, PGV or PGD) over the length of the pipeline, and then uses beam on inelastic foundation finite element models (or sometimes use two- or threedimensional mesh models) to examine the state of stress and strain and displacement within the pipeline and pipeline joints.

We select Chart method.

Conditions to meet:

"• Deliver water at serviceable pressure to 65% to 90% of all hydrants within the first hours after the earthquake, as long as there are adequate supply sources; and

• Deliver water via the pipe network to at least 90% of all customers within 3 days following an earthquake;"

These conditions can be met.

Define function classification:

Function	Seismic Importance	Description
I	Very Low to None	Pipelines that represent very low hazard to human life in the event of failure. Not needed for post earthquake system performance. response. or recovery. Widespread damage resulting in long restoration times (weeks or longer) will not materially harm the economic well being of the community.
II	Ordinary. Normal	Normal and ordinary pipeline use. common pipelines in most water systems. All pipes not identified as Function I. III. or IV.
III	Critical	Critical pipelines and appurtenances serving large numbers of customers and present significant economic impact to the community or a substantial hazard to human life and property in the event of failure.
IV	Essential	Essential pipelines required for post-earthquake response and recovery and intended to remain functional and operational during and following a design earthquake.

Table 1. Pipe Function Classifications

We select Class I because the probability of human impact is very low.

The seismic geotechnical analyses indicate there will not be any permanent displacement along the slope of the dike. There is also indication that the dike does not transverse a known fault and will not liquefy. The only load is ground shaking due to seismic waves. A single Design Category defines the earthquake loading.

Inch/sec	Function I	Function II	Function III, IV
$0 < PGV \le 10$	A	A	A
$10 < PGV \le 20$	A	A	A
$20 < PGV \le 30$	A	A	A (with additional valves)
$30 < PGV$	A	A (with additional valves)	B

Table 6. Distribution Pipelines – Ground Shaking

$$PGV = 9.141 \cdot \frac{in}{sec}$$

Design Category = A

Design Category	Cost Effective Design Approach	Notes
A	Standard	
B	Butt Fusion Joints	
C	Butt Fusion Joints	
D	Butt Fusion Joints	
E	Butt Fusion Joints	

Table 17. HDPE Pipe

A standard design approach is in sync with the earlier determination.

Part IV - Condition of the Units and Actions Needed

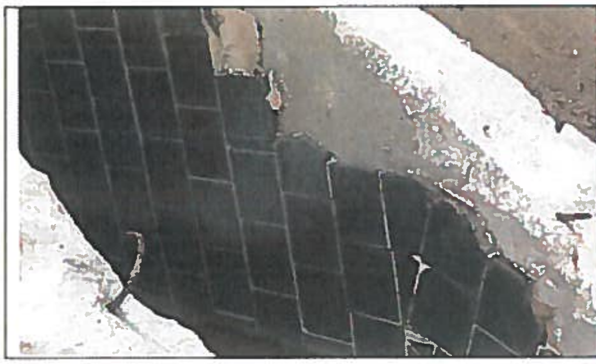
The study reported above is not a new construction. Therefore, a visual inspection of the site was also conducted to ascertain that the structure has not become visibly distressed. The results of that inspection are summarized below.

In general, most units were found to be in decent condition except the following:

- Energy Dissipator Troughs and Covers
- Wooden Skimmer

The actions for maintenance and immediate corrective measures are discussed below.

Institute an inspection program to monitor all structural units included in this list and any other items that, in the event of its failure, would crucially affect plant operation during and/or after an earthquak

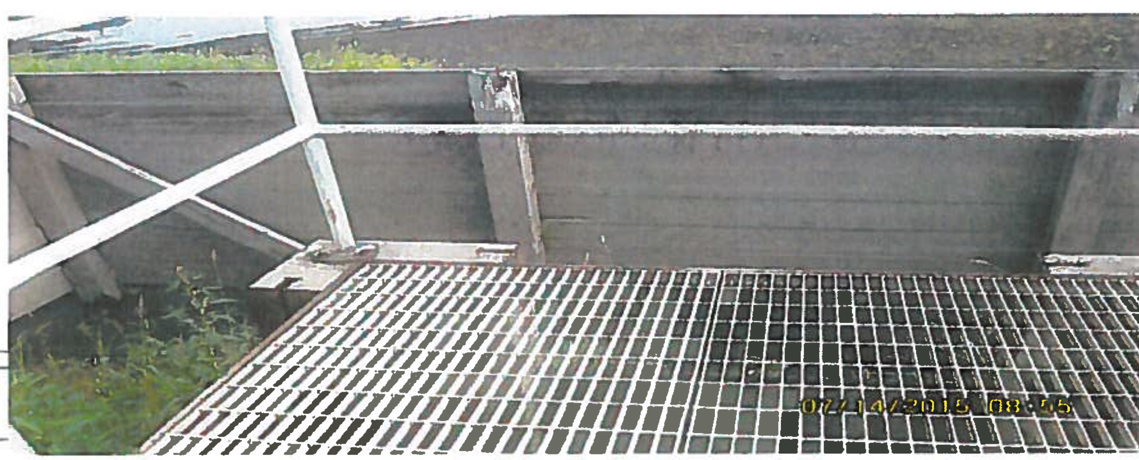


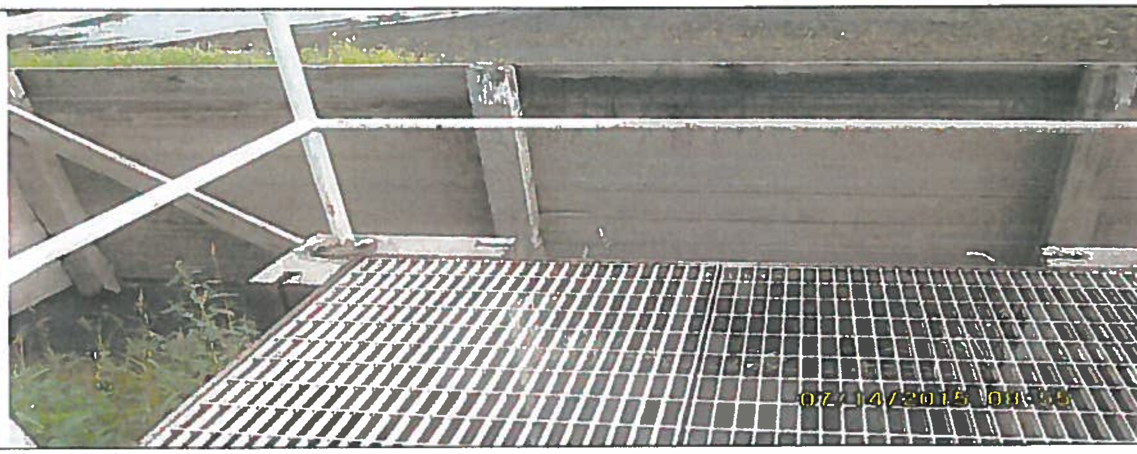
These actions may be implemented within the next 2-3 years from the date of this revision. SL 9/22/18
REV. 1

ACTION 1

The yellow boxes on top of the structure are not anchored and must be provided with anchors or replaced with a different anchored structure.

Also, the concrete inflow box is badly deteriorated and should be replaced with a like structure but with a better corrosion protection cladding.





ACTION 2
The skimmer is a wooden wall that presently is deemed non-effective. Either a more sturdy wall or a maintenance program needs to be initiated.

ACTION 3

Inspect the 48-inch diameter fiberglass/HDPE pipes to verify that the pipes are not distressed inside and out.

ACTION 4

Finally, institute a maintenance prigram that will periodically inspect the structural units against any degeneration.

CONCLUSION

1. Based on a typical configuration, the seismic analyses of the structures are judged to meet local seismic requirements with the following exception.

2. Some of the units are found to be deteriorated and should be remediated by either returning them to original configurations or replaced by new units.

ATTACHMENT 1

ATTACHMENT 1

USGS Design Maps Summary Report

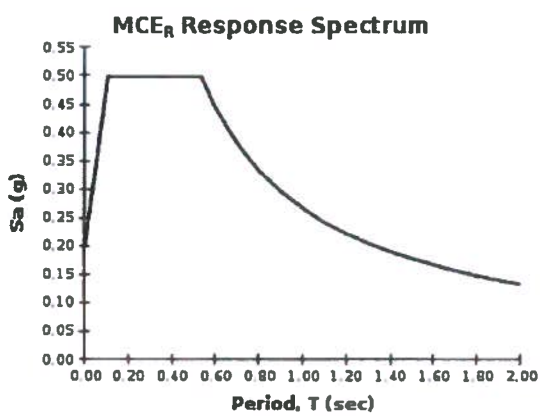
User-Specified Input

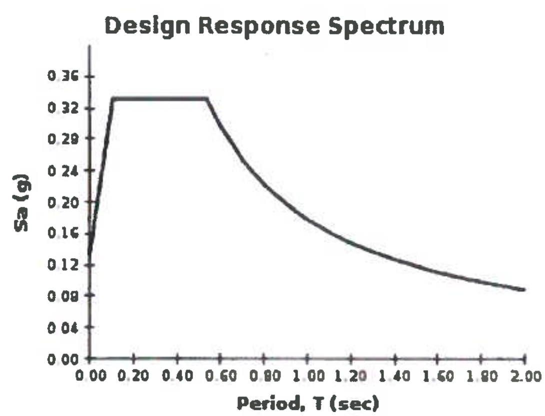
Report Title	USGS Data Sat August 27, 2016 14:53:43 UTC
Building Code Reference Document	ASCE 7-10 Standard (which utilizes USGS hazard data available in 2008)
Site Coordinates	37.92556°N, 87.03389°W
Site Soil Classification	Site Class C – "Very Dense Soil and Soft Rock"
Risk Category	I/II/III

USGS-Provided Output

S_S =	0.415 g	S_{MS} =	0.498 g	S_{DS} =	0.332 g
S_1 =	0.163 g	S_{M1} =	0.267 g	S_{D1} =	0.178 g

For information on how the SS and S1 values above have been calculated from probabilistic (risk-targeted) and deterministic ground motions in the direction of maximum horizontal response, please return to the application and select the "2009 NEHRP" building code reference document.





For PGA_M, T_L, C_{RS}, and C_{R1} values, please view the detailed report.

USGS Design Maps Detailed Report

ASCE 7-10 Standard (37.92556°N, 87.03389°W)

Site Class C – "Very Dense Soil and Soft Rock", Risk Category I/II/III

Section 11.4.1 — Mapped Acceleration Parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_s) and 1.3 (to obtain S_1). Maps in the 2010 ASCE-7 Standard are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 11.4.3.

From Figure 22-1 [1]	S_s = 0.415 g
From Figure 22-2 [2]	S_1 = 0.163 g

Section 11.4.2 — Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class C, based on the site soil properties in accordance with Chapter 20.

Table 20.3–1 Site Classification

Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index PI > 20, • Moisture content $w \geq 40\%$, and • Undrained shear strength $\bar{s}_u$ < 500 psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Section 11.4.3 — Site Coefficients and Risk–Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameters

Table 11.4–1: Site Coefficient F_a

Site Class	Mapped MCE $_R$ Spectral Response Acceleration Parameter at Short Period				
	$S_S \le 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \ge 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_S

For Site Class = C and S_S = 0.415 g, F_a = 1.200

Table 11.4–2: Site Coefficient F_v

Site Class	Mapped MCE $_R$ Spectral Response Acceleration Parameter at 1–s Period				
	$S_1 \le 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \ge 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of S_1

For Site Class = C and S_1 = 0.163 g, F_v = 1.637

Equation (11.4-1): $S_{MS} = F_aS_S = 1.200 \times 0.415 = 0.498$ g

Equation (11.4-2): $S_{M1} = F_vS_1 = 1.637 \times 0.163 = 0.267$ g

Section 11.4.4 — Design Spectral Acceleration Parameters

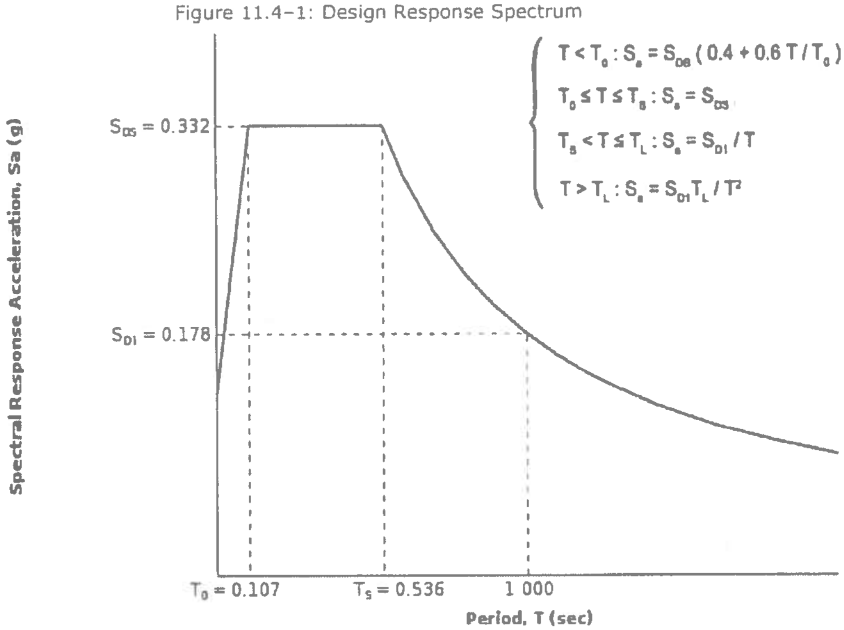
Equation (11.4-3): $S_{DS} = ⅔\, S_{MS} = ⅔ \times 0.498 = 0.332$ g

Equation (11.4-4): $S_{D1} = ⅔\, S_{M1} = ⅔ \times 0.267 = 0.178$ g

Section 11.4.5 — Design Response Spectrum

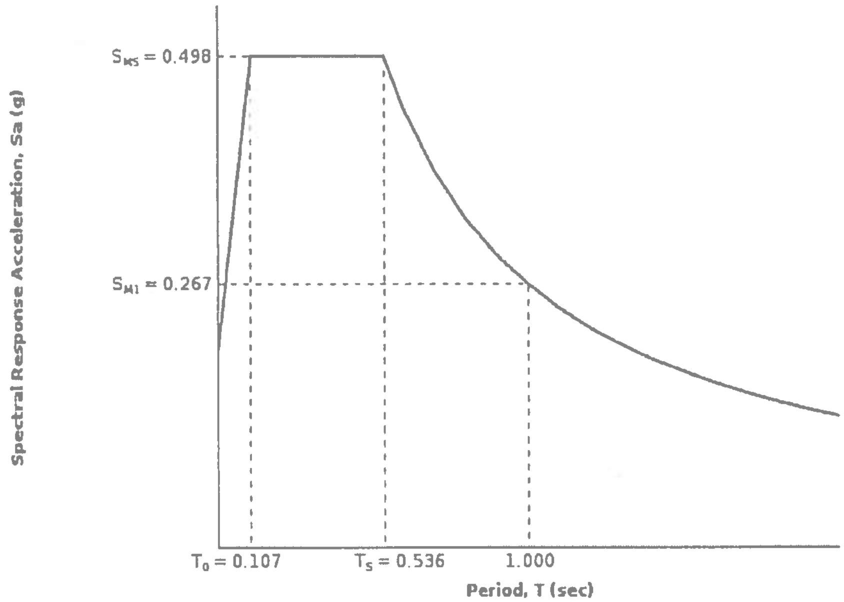
From Figure 22-12 [3] T_L = 12 seconds

Figure 11.4-1: Design Response Spectrum



Section 11.4.6 — Risk-Targeted Maximum Considered Earthquake (MCE_R) Response Spectrum

The MCE_R Response Spectrum is determined by multiplying the design response spectrum above by 1.5.



Section 11.8.3 — Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

From Figure 22-7 [4] PGA = 0.213

Equation (11.8–1): $PGA_M = F_{PGA}PGA = 1.187 \times 0.213 = 0.253$ g

Table 11.8–1: Site Coefficient F_{PGA}

Site Class	Mapped MCE Geometric Mean Peak Ground Acceleration, PGA				
	PGA ≤ 0.10	PGA = 0.20	PGA = 0.30	PGA = 0.40	PGA ≥ 0.50
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of PGA

For Site Class = C and PGA = 0.213 g, F_{PGA} = 1.187

Section 21.2.1.1 — Method 1 (from Chapter 21 – Site-Specific Ground Motion Procedures for Seismic Design)

From Figure 22-17 [5] C_{RS} = 0.876

From Figure 22-18 [6] C_{R1} = 0.842

Section 11.6 — Seismic Design Category

Table 11.6-1 Seismic Design Category Based on Short Period Response Acceleration Parameter

VALUE OF S_{DS}	RISK CATEGORY		
	I or II	III	IV
$S_{DS} < 0.167g$	A	A	A
$0.167g \le S_{DS} < 0.33g$	B	B	C
$0.33g \le S_{DS} < 0.50g$	C	C	D
$0.50g \le S_{DS}$	D	D	D

For Risk Category = I and S_{DS} = 0.332 g, Seismic Design Category = C

Table 11.6-2 Seismic Design Category Based on 1-S Period Response Acceleration Parameter

VALUE OF S_{D1}	RISK CATEGORY		
	I or II	III	IV
$S_{D1} < 0.067g$	A	A	A
$0.067g \le S_{D1} < 0.133g$	B	B	C
$0.133g \le S_{D1} < 0.20g$	C	C	D
$0.20g \le S_{D1}$	D	D	D

For Risk Category = I and S_{D1} = 0.178 g, Seismic Design Category = C

Note: When S_1 is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Risk Categories I, II, and III, and **F** for those in Risk Category IV, irrespective of the above.

Seismic Design Category ≡ "the more severe design category in accordance with Table 11.6-1 or 11.6-2" = C

Note: See Section 11.6 for alternative approaches to calculating Seismic Design Category.

References

1. *Figure 22-1*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-1.pdf
2. *Figure 22-2*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-2.pdf
3. *Figure 22-12*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-12.pdf
4. *Figure 22-7*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-7.pdf
5. *Figure 22-17*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-17.pdf
6. *Figure 22-18*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-18.pdf

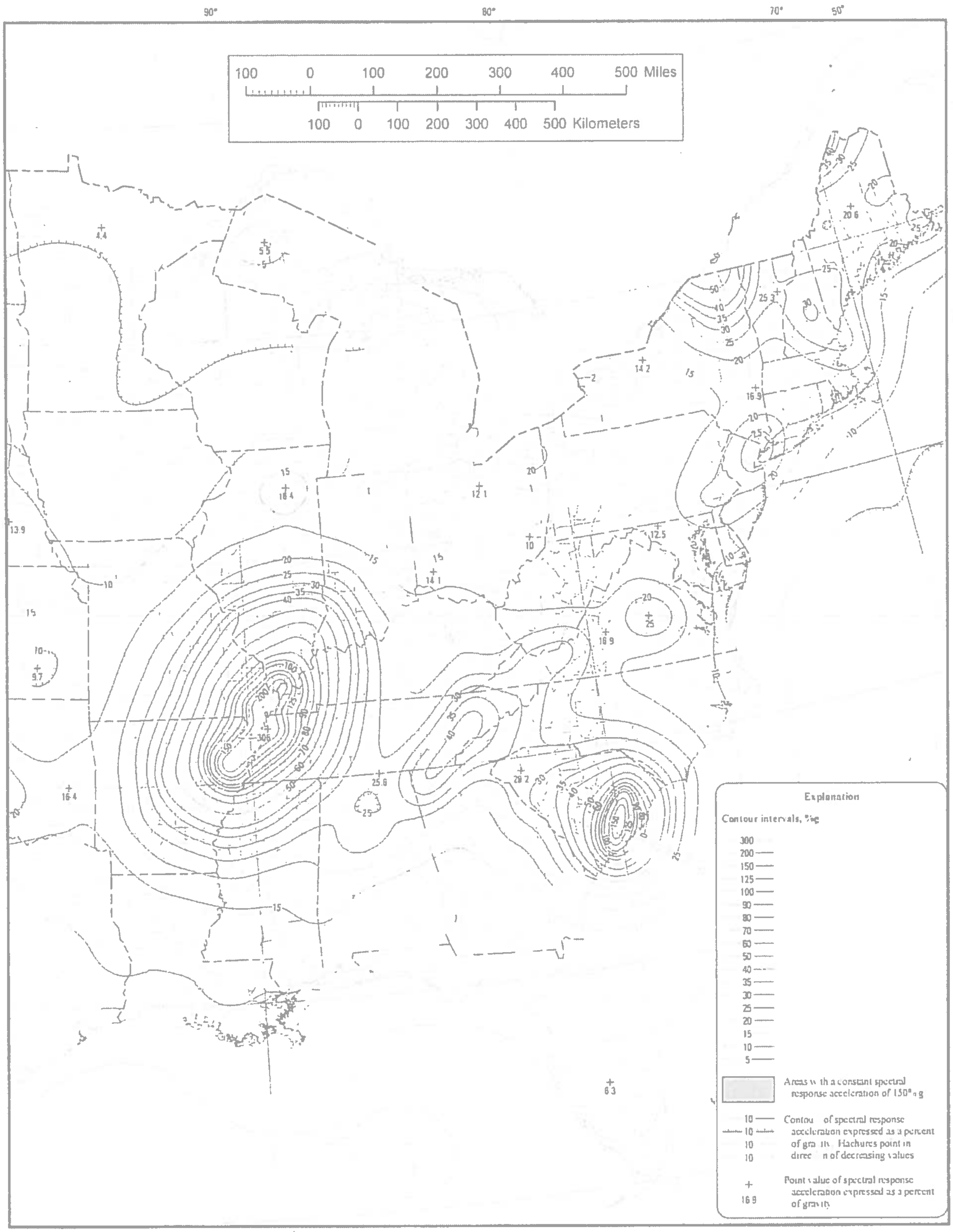


Figure 22-1 *(continued)* S_s Risk-Targeted Maximum Considered Earthquake (MCE_R) Ground Motion Parameter for the Conterminous United States for 0.2 s Spectral Response Acceleration (5% of Critical Damping), Site Class B.

Figure 22-12 (*continued*) Mapped Long-Period Transition Period, T_L (s), for the Conterminous United States.

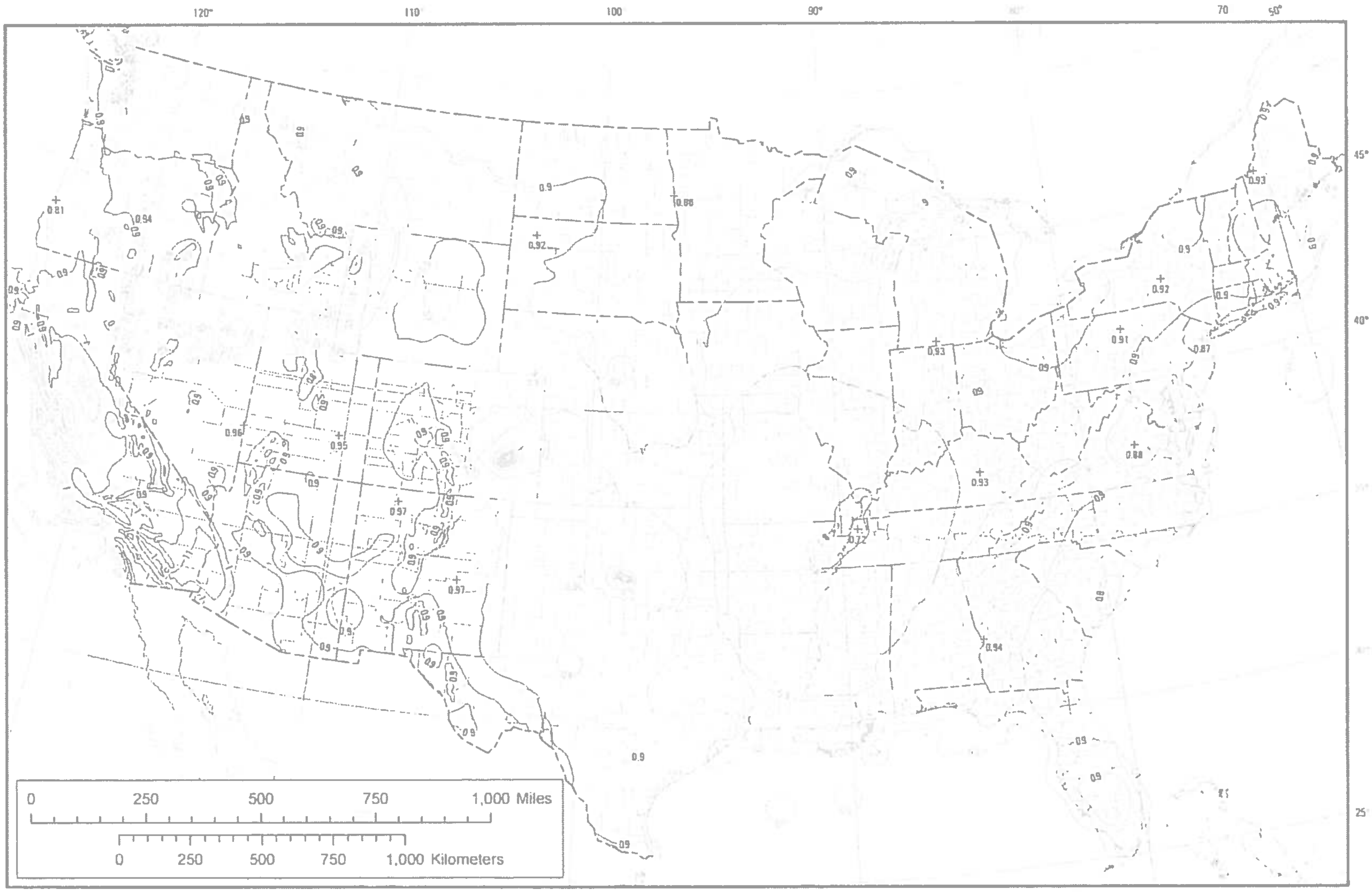
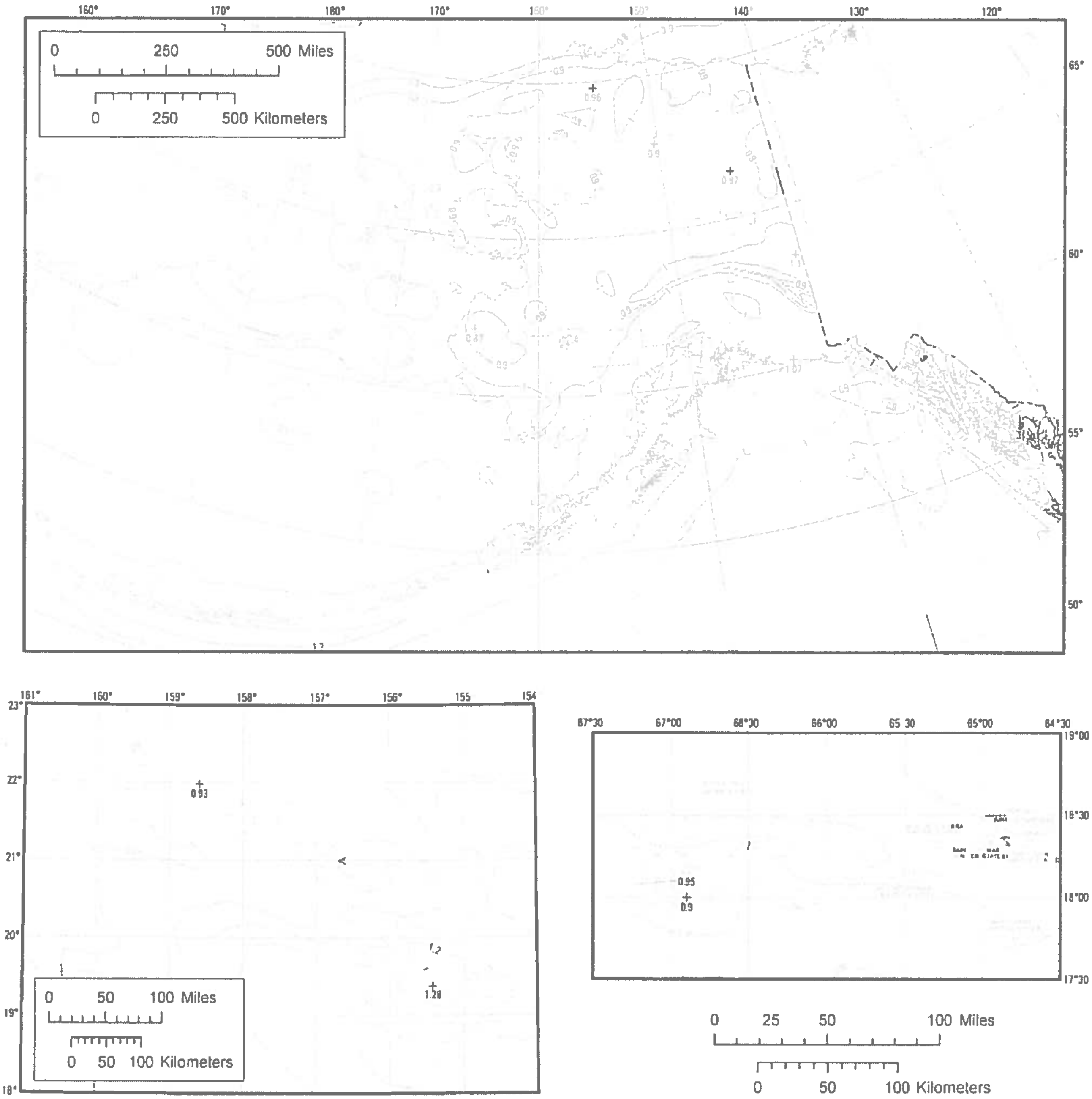


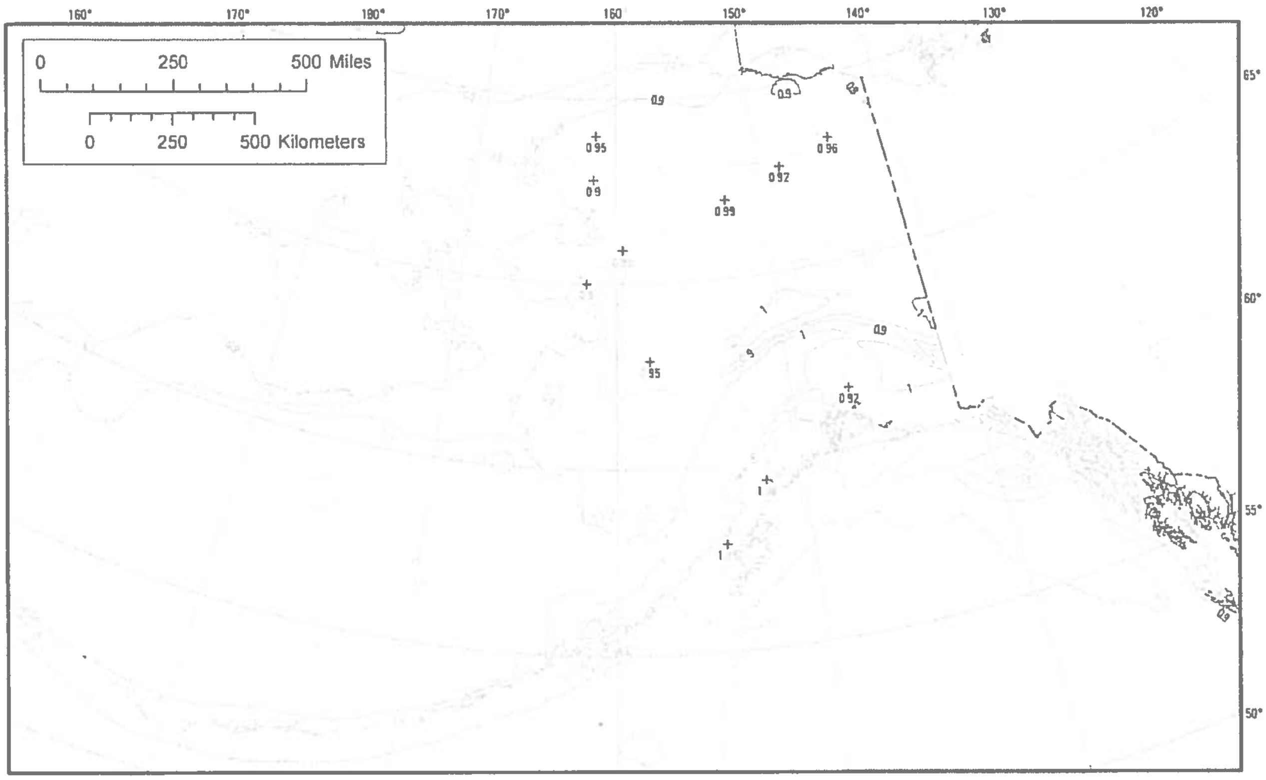
Figure 22-17 Mapped Risk Coefficient at 0.2 s Spectral Response Period, C_{RS}.

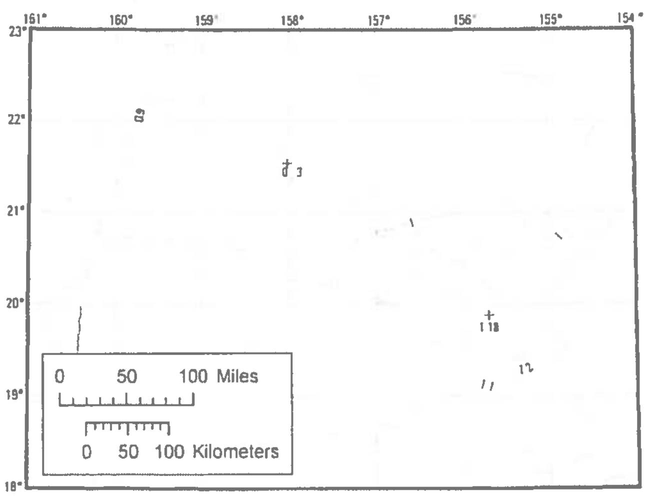


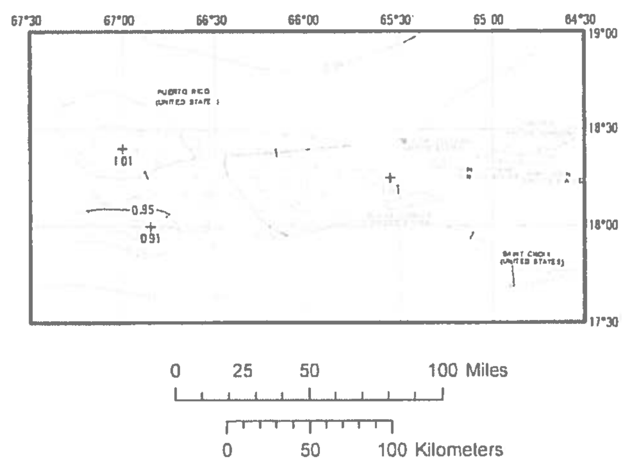
Notes:
- Maps prepared by United States Geological Survey (USGS).
- Larger, more detailed versions of these maps are not included because it is recommended that the corresponding USGS web tool (http://earthquake.usgs.gov/designmaps/) be used to determine the mapped value for a specified location.

Figure 22-17 ***(continued)*** **Mapped Risk Coefficient at 0.2 s Spectral Response Period,** C_{RS}.

Figure 22-18 Mapped Risk Coefficient at 1.0 s Spectral Response Period, C_{R1}.







Notes:

- Maps prepared by United States Geological Survey (USGS).
- Larger, more detailed versions of these maps are not included because it is recommended that the corresponding USGS web tool (http://earthquake.usgs.gov/designmaps/) be used to determine the mapped value for a specified location.

Figure 22-18 (*continued*) Risk Coefficient at 1.0 s Spectral Response Period, C_{R1}.

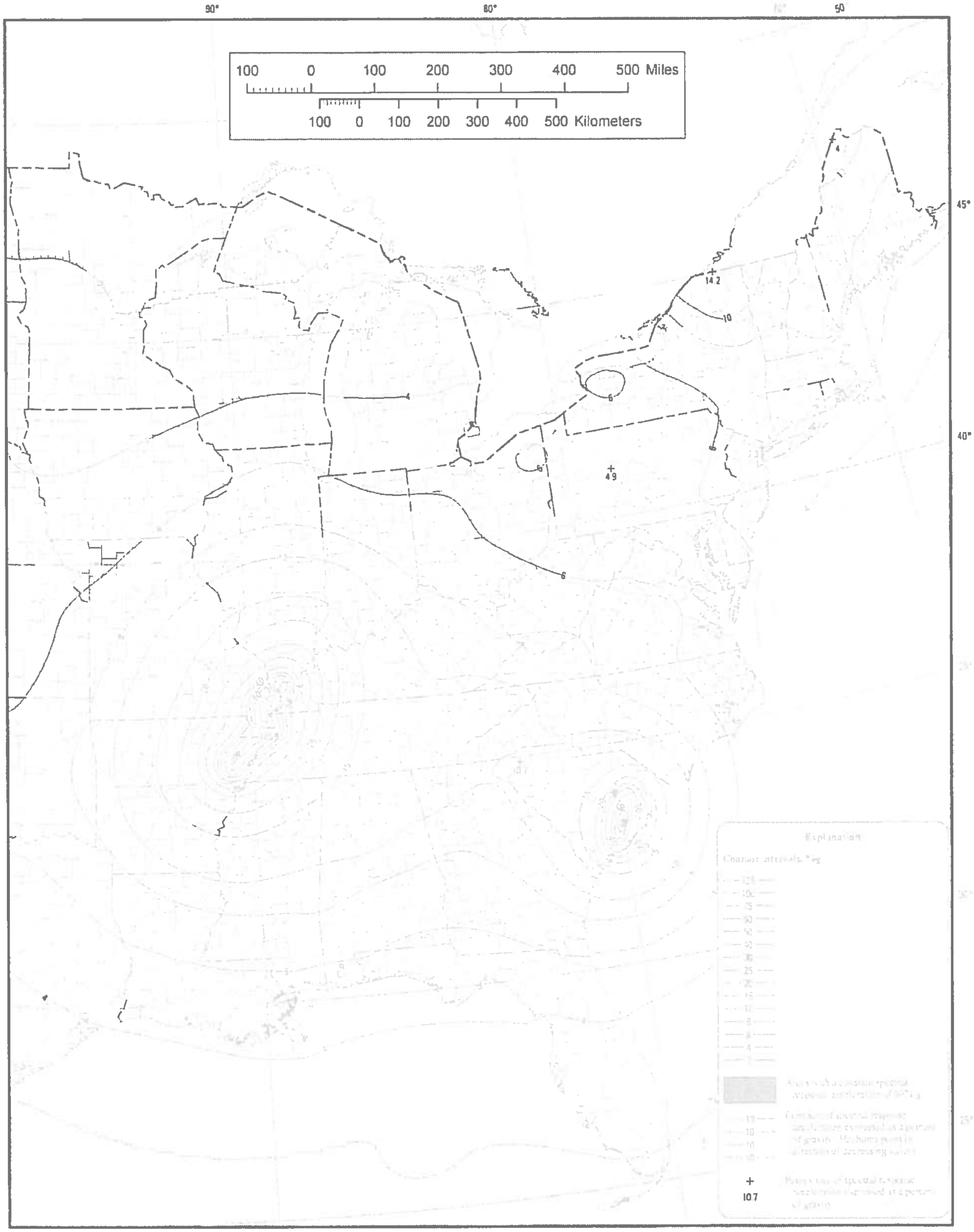


Figure 22-2 (*Continued*) S_1 Risk-Targeted Maximum Considered Earthquake (MCE_R) Ground Motion Parameter for the Conterminous United States for 1.0 s Spectral Response Acceleration (5% of Critical Damping), Site Class B.

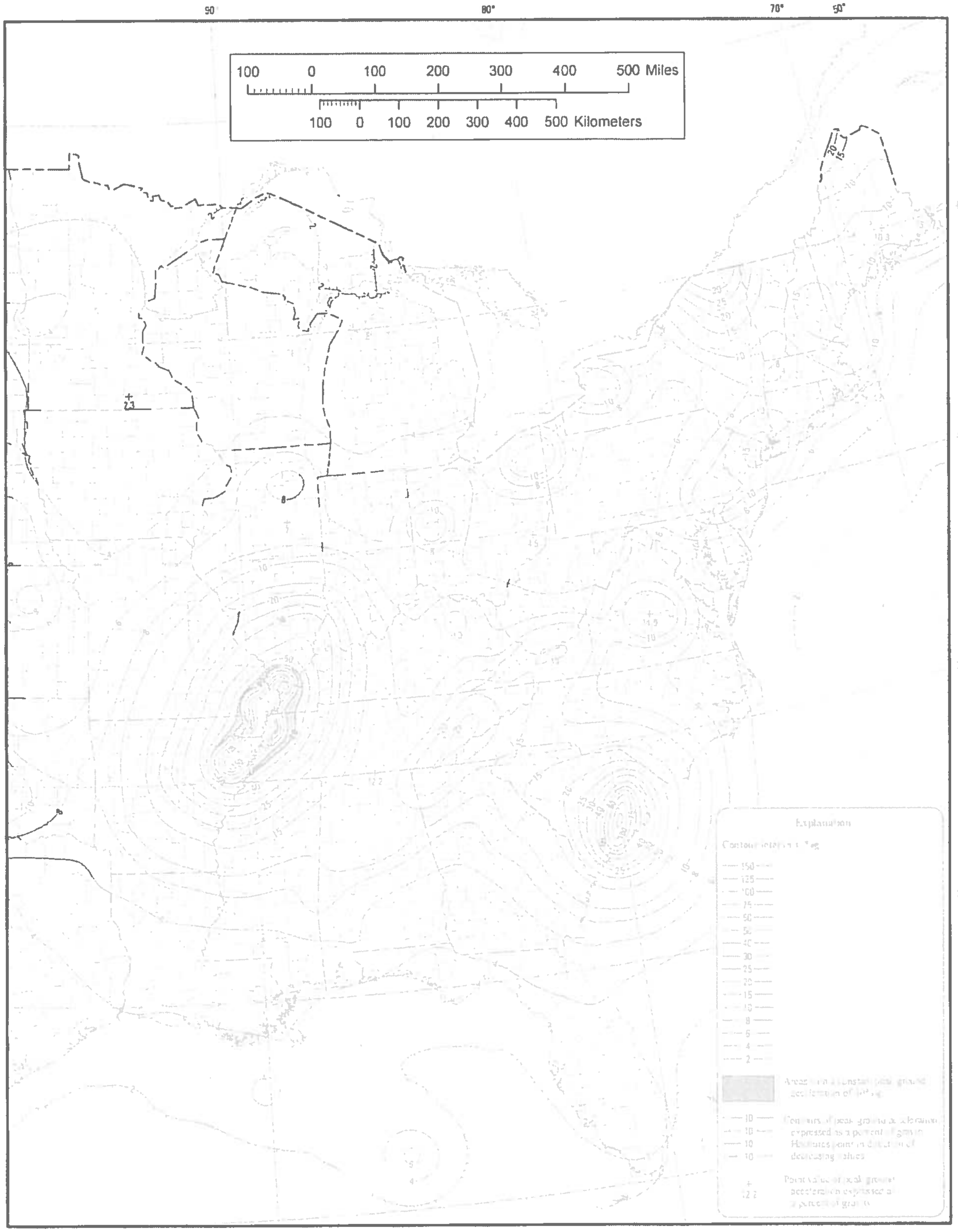


Figure 22-7 ***(continued)*** **Maximum Considered Earthquake Geometric Mean (MCE_G) PGA, %g, Site Class B for the Conterminous United States.**

ATTACHMENT 2

CALCULATE HYDRODYNAMIC FORCES & CHECK STABILITY OF DISCHARGE STRUCTURE

$H_{EAST} = 394 - 377 = 17'$ PGA = 0.213g PG 27

$h_{EAST} = 394 - 388 = 6'$ $K_{EAST} = \frac{2PGA}{3.0} = \frac{2}{3}(.213) = 0.142$

PG27 $P_d = 0.875 \rho_w g k \sqrt{Hh}$

$= 0.875 \times 62.4 \times .142 \sqrt{17 \times 6} = 78.3 psf$

$P_d = \frac{2 h_{EAST} p_d}{3} = \frac{2(6.0)}{3}(78.3) = 313\ lbf/ft$

DL WALLS $= \left[6.17 \times \frac{10}{12} \times 2 \times 12.0 + 5.0 \times 6.0 \times \frac{10}{12} + 2(.75) \times 6.0 \times \frac{10}{12} + (5.0 \times 12 - 2.0^2 \pi)\frac{10}{12}\right] 150$

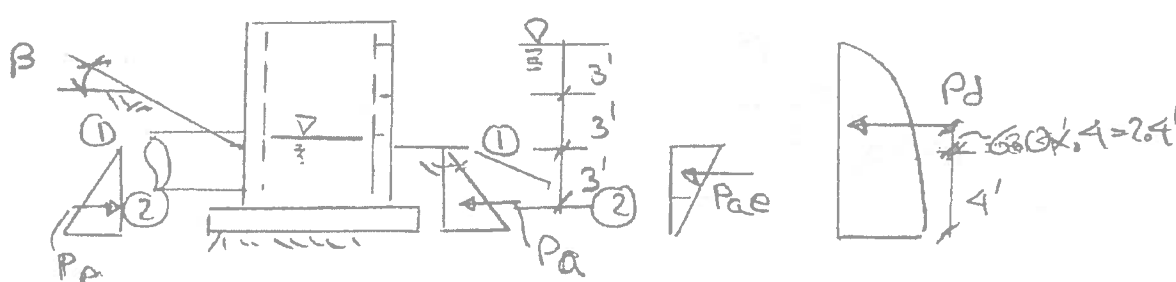
$= 29315$ #

DL SLAB $= 7.167 \times 7.067 \times 1.0 \times 150 = 8242$ #

$W_{TOT} = 29315 + 8242 = 37557^{lb}$

$SEISMIC_{HOR} = C_s W_{TOT} = .083(37557) = 3117$ #

SEISMIC VERT $= E_{VER} W_{TOT} = 0.066(37557) = 2479$ #



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COMPANY AEP G.O. ____
PLANT ROCKPORT

SUBJECT CCR COMPLIANCE CHECK

$\phi = 30^\circ$

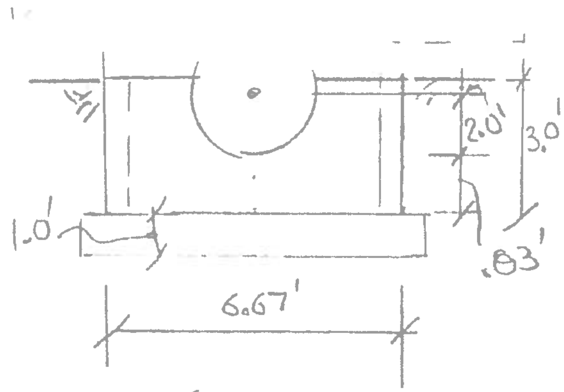
$\beta = 0^\circ$ CONSERVATIVE

$\delta = 0^\circ$

$\gamma = 120pcf$

$\gamma_w - 62.4pcf$

SEE PG 42 FOR
K_a, K_{ae}, K_p, K_{pe}



$A_g = 4.0(6.67) = 26.68SF$

$A_{OUT} = 12.56 - 5.62 = 6.94SF$

$P_{ae} = (.478 - 0.355)(4 \times .0676) \times 1/2 \times 4.0 \times 6.67 = 0.42^K$

$P_a = 0.355(4 \times .0676) \times 1/2 \times 4.0 \times 6.67 = 1.28$

$P_p = 2.526 \times 4^2 \times .0676/2 \times \frac{26.68 - 6.94}{26.68} \times 6.67 = 6.74^K$

TOTAL SLIDING FORCE $= 1.28 + 0.313(6.67) + 3.12 + 0.42$
$= 6.91^K$

$P_{BOUYANT} = [7.17 \times 7.67 \times 1.0 + 6.67 \times 6.17 \times 9.0] \frac{62.4}{1000} = 26.5^K$

WATER IN SUMP : $5.0 \times 4.5 \times 4.0 \times .0624 = 5.62^K$

$\mu = 0.5$

SLIDING RESISTANCE $= (37.56 + 5.62 - 26.5)(.9)(1 - .066).5 + 6.74(.9)$
$= 13.08^K$

SAFETY FACTOR $= \frac{13.08}{6.91} = 1.89$

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SUBJECT CCR COMPLIANCE CHECK

$$M_{OV} = .313(6.67)(6.4) + 1.28\left(\frac{4.0}{3}\right) + .42\left(\frac{2 \times 4.0}{3}\right) + 25.59$$

EQ ON STRUCTURE

$= 41.78'\text{-K}$

Pp

DL STRUCTURE

WATER IN STRUCTURE

$$M_R = (37.56 + 5.62 - 26.5).9(1 - .066)\left(\frac{7.17}{2}\right) + 6.74\left(\frac{4.0}{3}\right)$$

$= 59.25'\text{-K}$

$$\text{SAFETY FACTOR} = \frac{59.25}{41.78} = 1.42$$

EAST BOTTOM ASH POND IS WORST CASE, DEPTH OF POND & DEPTH OF WATER ABOVE DISCHARGE WEIR IS LARGEST. CONSERVATIVELY WATER LEVEL IN STRUCTURE IS ASSUMED TO MATCH WASTEWATER POND ELEVATION OF 389 ft.

V_U = SHEAR LOAD ON WALLS $= 6.91^K$

$$\phi V_C = \frac{0.75 \times 2\sqrt{3000}\,(74)(10) \times 2}{1000} = 121.6^K >> V_U \text{ OK.}$$

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SUBJECT CCR COMPLIANCE 9+24

LATERAL PRESSURE ON WALLS @ TOP OF FILL

1-1 $= \frac{78.3 + 6.0(62.4)}{1000} = 0.453\ KSF$

ASSUME WALLS HAVE MINIMUM REINFORCEMENT

$A_s = \frac{0.002(12)(10)}{2} = 0.12\ in^2/ft$

$M_u = 5.83^2(.453)/8 = 1.93^{k\text{-}ft}/ft \quad d = 10 - 2 - .625 - \frac{.625}{2} = 7.06''$

$\phi M_n = \frac{0.9(.12)(60)}{12}\left(7.06 - \frac{.59(.12)(60)}{3.0(12)}\right) = 3.75^{k\text{-}ft}/ft > M_u$ O.K.

2-2 $9.0 \times .0624 + .355(4.0 \times .0676) = 0.658\ KSF$

$M_u = 5.83^2(.658)/8 = 2.80^{k\text{-}ft} < 3.75^{k\text{-}ft}$ O.K.

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SHEET 42 OF ____
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COMPANY AEP G.O. ____
PLANT ROCKPORT

SUBJECT CCR COMPLIANCE CHECK

$$K_a = \frac{(1 + K_v)\cos^2\phi}{(1+\sin\phi)^2} = 0.355$$

$$\phi = 30^\circ$$

$$K_p = \frac{(1-K_v)\cos^2\phi}{(1-\sin\phi)^2} = 2.802$$

$$\theta' = \tan^{-1}\left(\frac{K_h}{1 \pm K_v} \cdot \frac{\gamma}{\gamma - \gamma_w}\right)$$

$K_h = 0.083$

$K_v = 0.066$

$\theta' = 9.214^\circ$

10.489°

$$K_{ae} = \frac{(1+K_v)\cos^2(\phi-\theta-\alpha)}{\cos\theta\cos^2\alpha\cos(\alpha+\delta+\theta)\left(1+\sqrt{\frac{\sin(\phi+\delta)\sin(\phi-\beta-\theta)}{\cos(\alpha+\delta+\theta)\cos(\alpha-\beta)}}\right)^2}$$

$$= \frac{(1+.066)\cos^2(30-9.214)}{\cos 9.214\cos^2 0\cos(0+0+9.214)\left(1+\sqrt{\frac{\sin(30)\sin(20.786)}{\cos(9.214)\cos 0}}\right)^2}$$

$$K_{ae} = \frac{0.932}{1.976} = 0.472$$

$$K_{pe} = \frac{(1-K_v)\cos^2(\phi+\alpha-\theta)}{\cos\theta\cos^2\alpha\cos(\delta-\alpha-\theta)\left(1+\sqrt{\frac{\sin(\phi+\delta)\sin(\phi+\beta-\theta)}{\cos(\delta-\alpha-\theta)\cos(\beta-\alpha)}}\right)^2}$$

$$= \frac{(1-.066)\cos^2(20.786)}{\cos 9.214\cos^2 0\cos(-9.214)\left(1-\sqrt{\frac{\sin 30\sin(20.786)}{\cos(-9.214)\cos 0}}\right)^2}$$

$$K_{pe} = \frac{0.816}{0.323} = 2.526$$

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SUBJECT CCR COMPLIANCE CHECK

CHECK UNDERGROUND PIPING

PIPE $\sigma_y = 3300$ psi

$L = 41.5'$

$$\sigma_{DESIGN} = \frac{T_u L}{2\pi D t} = \frac{10410 \times 465}{2\pi 48 \times 1.45} = 900 \text{ psi}$$

O.K.

$$\epsilon_a = \frac{T_u L}{\pi D t E}\left(1 + \underbrace{\frac{N}{(1+r)}\left(\frac{T_u L}{2\pi D t \sigma_y}\right)^r}_{1.0}\right)$$

N = 10
r = 100

$$\epsilon_a = \frac{10410 \times 41.5}{2\pi(48)(1.45)(2\times10^6)} = 4.94\times10^{-4} < 0.02 \text{ O.K.}$$

(PG 32)

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ATTACHMENT 3

DESIGN GUIDELINE FOR SEISMIC RESISTANT WATER PIPELINE INSTALLATIONS

John Eidinger[1]

ABSTRACT

Seismic design for water pipelines is not explicitly included in current AWWA standards. Compounding this problem, standard water pipeline materials and installation techniques are prone to high damage rates whenever there is significant permanent ground deformations or excessively high levels of ground shaking.

To help improve this situation, a new Design Guideline for Seismic Resistant Water Pipeline Installations (the Guidelines) has been developed. It is intended that the Guidelines be issued in March 2005. For the period from November 2004 through January 2005, the Guidelines are available in draft form for public comment. Comments from U.S., Japanese, Canadian and all other water utilities, pipeline manufacturers, AWWA, JWWA and other interested parties are welcomed.

The Guidelines provide direction for three situations:

- When the pipeline engineer has just rough estimates of the earthquake hazard, does not have the resources to do design by analysis, and wishes to rely on standardized pipeline components. The Guidelines provide the Chart Method. This is the preferred approach for common pipeline installations like 6-inch to 8-inch diameter pipes, fire hydrants and service laterals.

- When the pipeline engineer wishes to perform a limited design by analysis. The Guidelines provide the Equivalent Static Method. This is the preferred approach for medium important pipelines like 12-inch to 24-inch installations, or as a preliminary approach for major transmission pipelines.

- When the pipeline engineer has the resources to perform detailed subsurface investigations, geotechnical engineering and pipe stress analyses. The Guidelines provide the Finite Element Method. This is the preferred approach for essential non-redundant installations, like 36-inch to 120-inch pipelines.

INTRODUCTION

In most every severe earthquake, the largest negative impact to water utilities has been the damage to buried water pipelines. At the past three JWWA-AWWARF workshops (Oakland

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2000, Tokyo 2001, Los Angeles 2003), a great emphasis was placed by many participants on the rate of pipe damage, the causes of pipe damage, and the improved earthquake performance of new types of pipe.

After the Los Angeles workshop, many US participants got together and decided something ought to be done about this. Accordingly, in concert with FEMA, NIBS and the ALA, a team of engineers was assembled to put together the first ever US seismic design guideline for buried water pipelines. The American Lifelines Alliance (ALA) was formed by the Federal Emergency Management Agency (FEMA) in 1998 as a public-private partnership whose goal is to reduce risk to utility and transportation systems from natural hazards and manmade threats. In 2002, FEMA contracted with the National Institute of Building Sciences (NIBS) through its Multihazard Mitigation Council (MMC) to, among other things, assist FEMA in developing these Guidelines. The ALA sponsors this work through funding from NIBS and FEMA.

AmericanLifelinesAlliance

U.S. DEPARTMENT OF HOMELAND SECURITY   FEMA   National Institute of BUILDING SCIENCES

AUTHORS

The following people and their affiliations contributed to the Guidelines.

Person	Affiliation
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Mr. Luke Cheng	San Francisco Public Utilities Commission
Mr. Frank Collins	Parsons
Mr. Mike Conner	San Diego Water Department
Dr. Craig Davis	Los Angeles Department of Water & Power
Mr. Mike Matson	Raines, Melton and Carella, Inc.
Prof. Mike O'Rourke	Rennselaer Polytechnic Institute
Prof. Tom O'Rourke	Cornell University
Mr. Alex Tang	Nortel Networks, Retired
Mr. Doug Honegger	Consultant (Technical Oversight)
Mr. Joseph Steller	NIBS (Project Management)

The Guidelines would not have been possible without the contributions from numerous staff of the San Francisco Public Utilities Commission, East Bay Municipal Utilities District, City of San Diego Water Department, the Los Angeles Department of Water and Power, and many other participating agencies.

OUTLINE OF THE GUIDELINES

The Guidelines describe the various steps in seismic water pipeline design, with commentary. The main topics included are: Goals; Performance Objectives; Earthquake Hazards; Subsurface Investigations; General Pipeline Design; Analytical Models; Transmission Pipelines; Bypass Pipelines; Distribution Pipelines; Service and Hydrant Laterals; Distribution Pipelines; and Other Components. The Guidelines are meant to be a self-standing document that can be used by pipeline designers in water utilities; as such, it is geared to provide simple procedures to achieve the overall goal. The Guidelines always allow for more detailed procedures to be used by geologists, geotechnical engineers and pipeline engineers when suitable. A link to obtain the entire draft Guidelines is listed in the Conclusions.

For the 4th AWWARF-JWWA workshop, four papers cover the major topic areas of the Guidelines. This paper describes performance goals and the design-by-chart method. The paper by Dr. Craig Davis covers reliability goals and definition of geotechnical hazards. The paper by Mr. Luke Cheng covers design issues for transmission pipelines. The paper by Mr. Bruce Maison covers the two design-by-analysis models and design issues for service laterals.

GOAL OF SEISMIC DESIGN FOR WATER PIPELINES

The goal of the Guidelines is to improve the capability of water pipelines to function and operate during and following design earthquakes for life safety and economic reasons. This is accomplished using a performance based design methodology that provides cost-effective solutions and alternatives to problems resulting from seismic hazards. Improved water pipeline performance will help create a more resilient community for post-earthquake recovery; therefore portions of the Guidelines inherently consider the community impacts if pipeline damage were to occur. The Guidelines do not intend to prevent all pipelines from being damaged.

To achieve this goal, the fundamental intent of the Guidelines is to assure a reasonably low rate of water pipeline damage throughout a water utility system, such that about 90% of customers in a system can be restored with piped water service within about three days after a design basis earthquake.

To achieve this level of performance, an acceptable damage rate will be about 0.03 to 0.06 breaks per 1,000 feet (0.1 to 0.2 breaks per kilometer) of equivalent 6-inch diameter pipe. The commentary of the Guidelines provides a calculation to convert a network of pipes of different diameters that may suffer both breaks and leaks, in conjunction with network redundancy, into a single equivalent break rate per equivalent 6-inch diameter pipe. By minimizing pipeline damage after earthquakes to this level of damage, a typical water utility serving a population of 150,000 people could expect to:

- Deliver water at serviceable pressure to 65% to 90% of all hydrants within the first hours after the earthquake, as long as there are adequate supply sources; and

- Deliver water via the pipe network to at least 90% of all customers within 3 days following an earthquake;

as long as the utility can isolate most of the leaking and broken pipes within one day or so, and repair equivalent 6-inch diameter pipes at a rate of about 20 within the first three days after the earthquake, and 20 per day thereafter.

For water utilities with limited post-earthquake repair capability, or serving pipe networks with limited or no redundancy, it is important to limit the damage rate to the lower range. For water utilities with much greater post-earthquake repair capability, it might be acceptable to sustain damage to the higher range.

NEW INSTALLATIONS AND REPLACEMENT / RETROFIT

It is the intent of the Guidelines that they be used for all new pipeline installations. Over a period of many years, a sufficiently high percentage of pipelines in a network will eventually have been designed per these Guidelines. Thus, it may take decades for some utilities to ultimately achieve the goals, unless a pipeline replacement / retrofit program is also adopted.

The decision to replace older pipes is a complex one. In many networks, many existing pipelines (such as cast iron pipe with caulked joints) will not meet the seismic design capability recommended by the Guidelines. Still, the Guidelines do not recommend replacing older 4-inch to 10-inch diameter cast iron pipes solely on the basis of earthquake improvement, since this is not thought to be cost effective. However, as old pipeline are thought to need replacement because they no longer provide adequate fire flows, or have been observed to require repair at a rate of more than once every 5 years, then the added benefit of improved seismic performance may justify pipe replacement. When replaced, the new pipes should be designed per the Guidelines.

Replacement of larger diameter pipelines (12-inch diameter and upwards) may be cost effective just from a seismic point of view, in areas prone to PGDs.

PIPELINE FUNCTION CLASSES

A pipeline's function within the system identifies its importance in achieving the system performance goal. Table 1 provides the 4 function classes. A pipe function identifies a performance objective of an individual pipe, but not that of an entire system.

Function	Seismic Importance	Description
I	Very Low to None	Pipelines that represent very low hazard to human life in the event of failure. Not needed for post earthquake system performance, response, or recovery. Widespread damage resulting in long restoration times (weeks or longer) will not materially harm the economic well being of the community.
II	Ordinary, Normal	Normal and ordinary pipeline use, common pipelines in most water systems. All pipes not identified as Function I, III, or IV.
III	Critical	Critical pipelines and appurtenances serving large numbers of customers and present significant economic impact to the community or a substantial hazard to human life and property in the event of failure.
IV	Essential	Essential pipelines required for post-earthquake response and recovery and intended to remain functional and operational during and following a design earthquake.

Table 1. Pipe Function Classifications

THREE DESIGN APPROACHES

The Guidelines provide three approaches can be used in the design of buried pipelines.

- Chart method. The simplest approach. Avoids all mathematical models, and allows the designed to pick a style of pipe installation based on parameters such as regional maps for PGV and PGD hazards, and the pipeline function class.

- Equivalent static method. Uses simple quantifiable models to predict the amount of stress, strain and displacement on a pipe for a particular level of earthquake loading. The pipeline can then be designed to meet these quantified values, or pipe styles can be selected that presumably meet these quantified values without a formal capacity to demand check. Pipe selection is usually made by specification from available manufacturer's catalogs.

- Finite element method. This method uses finite element models to examine the seismic loads (whether PGA, PGV or PGD) over the length of the pipeline, and then uses beam on inelastic foundation finite element models (or sometimes use two- or three-dimensional mesh models) to examine the state of stress and strain and displacement within the pipeline and pipeline joints. Pipe design is often shown on contract drawings, covering material selection, joint preparation, trench design and other factors.

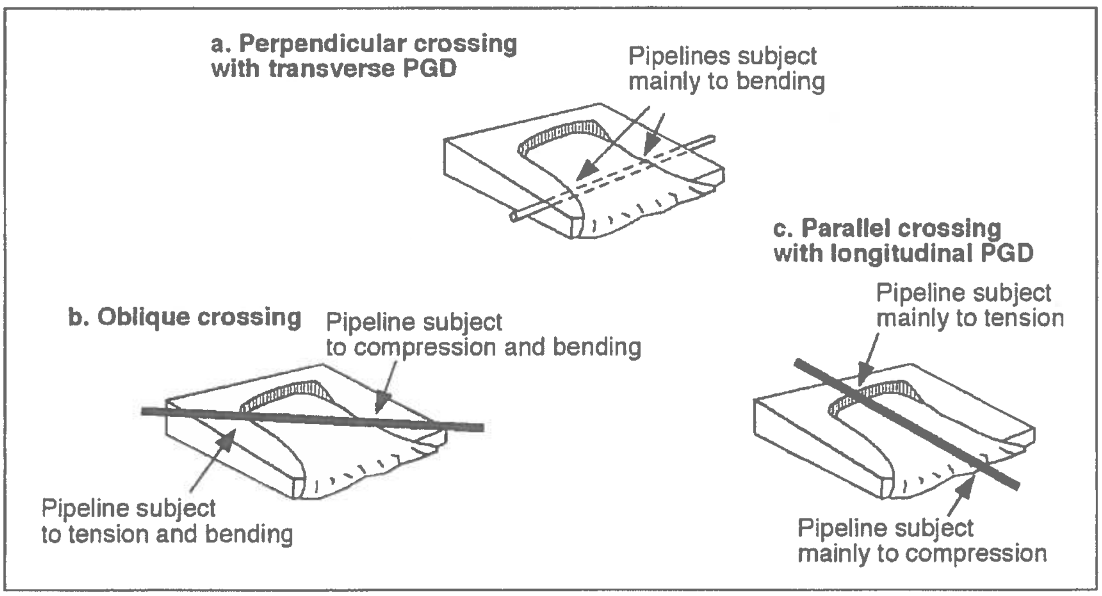


Figure 1. Direction of Permanent Ground Deformation (PGD)

CHART METHOD

Transmission Pipelines

Transmission pipelines may carry raw or treated water. Due to their importance to a great number of people, Function Class I is generally to be avoided except for those pipes whose failure would not impact any customer for 30 days or more.

Tables 2 to 5 set the pipeline design category (A, B, C, D or E). Figure 1 shows the meaning of perpendicular (transverse) and parallel (along the axis) orientations. If a portion of a pipeline has two or more categories for the various hazards (ground shaking, transverse PGDs, parallel PGDs, fault offset PGDs), then the highest category controls.

Inch/sec	Function I	Function II	Function III	Function IV
$0 < PGV \leq 10$	A	A	A	A
$10 < PGV \leq 20$	A	A	A	B
$20 < PGV \leq 30$	A	A	B	C
$30 < PGV$	A	B	C	D

Table 2. Transmission Pipelines – Ground Shaking

Inches	Function I	Function II	Function III	Function IV
$0 < PGD \leq 2$	A	A	A	A – welded steel B - segmented
$2 < PGD \leq 6$	A	A	A	B
$6 < PGD \leq 12$	A	A	B	C
$12 < PGD$	A	B	C	D

Table 3. Transmission Pipelines – Liquefaction and Landslide Transverse to Pipeline Alignment

Inches	Function I	Function II	Function III	Function IV
$0 < PGD \leq 2$	A	A	B	B
$2 < PGD \leq 6$	A	B	B	C
$6 < PGD \leq 12$	C	C	C	D
$12 < PGD$	D	D	D	E

Table 4. Transmission Pipelines -- Liquefaction (Lateral Spread) and Landslide Along Axis of Pipeline

Inches	Function I	Function II	Function III	Function IV
$0 < PGD \leq 2$	A	A	B	B
$2 < PGD \leq 6$	A	B	B	C
$6 < PGD \leq 12$	A	C	C	D
$12 < PGD \leq 24$	A	D	D	E
$24 < PGD$	A	D	E	E

Table 5. Transmission Pipelines – Fault Offset

Distribution Pipelines, Service Laterals and Fire Hydrant Laterals

In most cases, distribution pipelines are in networks. Failure of a single distribution pipeline will not fail the entire network (once the broken pipe is valved out), but the customers on the broken distribution pipeline will have no piped water service until the pipe is repaired. The engineer can assume that distribution pipelines are Function Class II, except in the following cases:

- The pipeline is the only pipe between lower elevation pump station and upper elevation pump station / reservoir in a pressure zone, and the failure of that pipeline will lead to complete loss of supply to the pump station serving a higher zone, or loss of the water in the reservoir for fire fighting purposes. For example, a 12-inch diameter pipe from lower elevation pump station that delivers water to a higher elevation tank within a pressure zone, and that also serves water to higher elevation pump stations.

- The pipeline is the only pipe delivering water to particularly important customers, such as critical care hospitals. For example, an 8-inch diameter pipe that has a service connection to a 200 bed hospital.

Past earthquakes have shown that there can be great quantity of damage to distribution pipelines, especially in areas prone to PGDs or high velocity pulses. While no single distribution pipeline is as important as a transmission pipeline, the large quantity of distribution pipe damage can lead to rapid system-wide depressurization, loss of fire fighting capability, and long outage times due to the great amount of repair work needed. Accordingly, we recommend that most distribution pipes be classified as Function Class II and very few as Function Class I (under ~5% of total pipeline inventory). A few distribution pipes serving essential facilities could be classified as Function III or IV; or they could be designated in suitable emergency response plans as prioritized for prioritized and rapid repair (generally under one day or two days at most). Once the Function Class is set, Tables 6 to 11 define the Design Category.

Inch/sec	Function I	Function II	Function III, IV
$0 < PGV \leq 10$	A	A	A
$10 < PGV \leq 20$	A	A	A
$20 < PGV \leq 30$	A	A	A (with additional valves)
$30 < PGV$	A	A (with additional valves)	B

Table 6. Distribution Pipelines – Ground Shaking

Inches	Function I	Function II	Function III, IV
$0 < PGD \leq 2$	A	A	A (with additional valves)
$2 < PGD \leq 6$	A	A (with additional valves)	B
$6 < PGD \leq 12$	A	B	C
$12 < PGD$	A	C	C

Table 7. Distribution Pipelines – Liquefaction and Landslide Transverse to Pipeline Alignment

Inches	Function I	Function II	Function III, IV
$0 < PGD \leq 2$	A	A	B (with additional valves)
$2 < PGD \leq 6$	A	B	C
$6 < PGD \leq 12$	A	C	D
$12 < PGD$	A	D	D

Table 8. Distribution Pipelines – Lateral Spread and Landslide Along Axis of Pipeline

Inches	Function I	Function II	Function III, IV
$0 < PGD \leq 2$	A	B	B
$2 < PGD \leq 6$	A	B	C
$6 < PGD \leq 12$	A	C	D
$12 < PGD \leq 24$	A	D	E
$24 < PGD$	A	E	E

Table 9. Distribution Pipelines – Fault Offset

Service Laterals and Hydrant Laterals

Inch/sec	Any Lateral
$0 < PGV \leq 10$	A
$10 < PGV \leq 30$	A
$30 < PGV$	B

Table 10. Laterals – Ground Shaking

Inches	Any Lateral
$0 < PGD \leq 2$	A
$2 < PGD \leq 12$	B
$12 < PGD$	C

Table 11. Laterals – Liquefaction, Landslide and Surface Faulting

Design Categories

There are five design categories. Category A denotes standard (non-seismic) design. The following summarizes the general design approach for Categories B, C, D and E:

- B = restrained with extra valves
- C = B + better pipe materials
- D = C + quantified seismic design; or provide bypass system.
- E = D + peer review (it is strongly recommended that FEM method be used for any pipe with Classification E)

Tables 12 to 19 provide guidance for seismic pipe design using the chart method based on the categories A through E. Note. This guidance is based on commonly available pipe and joinery as of 2004. As new pipe products become available, they can be used in the chart method as long as suitable justification (FEM, test, etc.) is provided to show that the pipe meets the intended reliability of the pipe and performance of the pipe network as a whole.

Design Category	Cost Effective Design Approach	Notes
A	Standard	
B	Extended Joints	
C	Restrained Joints	
D	Extended and Restrained Joints	Standard with bypass
E	Special Joints	Standard with bypass

Table 12. Ductile Iron Pipe

Design Category	Cost Effective Design Approach	Notes
A	Standard	
B	Standard with extra insertion	
C	Restrained Joints	
D	Extended and Restrained Joints	Standard with bypass
E	Not recommended	Standard with bypass

Table 13. PVC Pipe

Design Category	Cost Effective Design Approach	Notes
A	Single Lap Weld	
B	Single Lap Weld	Weld t = pipe t
C	Double Lap Weld	Weld t = pipe t
D	Double Lap Weld / Butt Weld	D/t max 110 in PGD zones
E	Butt Weld	D/t max 95 in PGD zones

Table 14. Welded Steel Pipe

Design Category	Cost Effective Design Approach	Notes
A	Standard	
B	Extended Joints	
C	Restrained Joints	
D	Extended and Restrained Joints	Standard with bypass
E	Not recommended	Standard with bypass

Table 15. Gasketed Steel Pipe

Design Category	Cost Effective Design Approach	Notes
A	Gasketed or Single Lap weld	
B	Single Lap Weld	Weld t = pipe t
C	Double Lap Weld	Weld t = pipe t
D	Not recommended	Standard with bypass
E	Not recommended	Standard with bypass

Table 16. CCP & RCCP Pipe

Design Category	Cost Effective Design Approach	Notes
A	Standard	
B	Butt Fusion Joints	
C	Butt Fusion Joints	
D	Butt Fusion Joints	
E	Butt Fusion Joints	

Table 17. HDPE Pipe

Design Category	Cost Effective Design Approach	Notes
A	Standard	
B	Soldered joints	
C	Soldered joints	Expansion loop / Christie box / Other box

Table 18. Copper Pipe

Design Category	Cost Effective Design Approach	Notes
A	Standard	
B	Dresser-type coupling	
C	Multiple dresser couplings	
D	EBAA flextend type couplings	
E	Not recommended	Relocate hydrant

Table 19. Segmented Pipelines Used as Hydrant Laterals

Design Category	Cost Effective Design Approach	Notes
A	Bolted, Single Lap Weld, Fusion Weld	
B	Bolted, Single Lap Weld, Fusion Weld	Weld t = pipe t
C	Bolted, Double Lap Weld, Single Lap Weld with fiber wrap, Fusion Weld	Weld t = pipe t
D	Bolted, Double Lap Weld, Single Lap Weld with fiber wrap, Butt Weld, Fusion Weld	Bolted, Double Lap Weld, Single Lap Weld with fiber wrap, Fusion Weld
E	Bolted, Double Lap Weld, Single Lap Weld with fiber wrap, Butt Weld, Fusion Weld	Bolted, Double Lap Weld, Single Lap Weld with fiber wrap, Fusion Weld

Table 20. Continuous Pipelines Used as Hydrant Laterals

In addition to the design categories in Tables 12 to 20, the following additional requirements are made. These recommendations are cumulative (For C, include B and C recommendations).

- B. Add isolation valves on all pipes within 50 feet of every intersection, for example, four valves on a four-way cross.
- C. Maximum pipe length between connections for segmented pipe is 16 feet, or as otherwise justified by ESM or FEM.
- D. Maximum pipe length between connections for segmented pipe is 12 feet, or as otherwise justified by ESM or FEM.

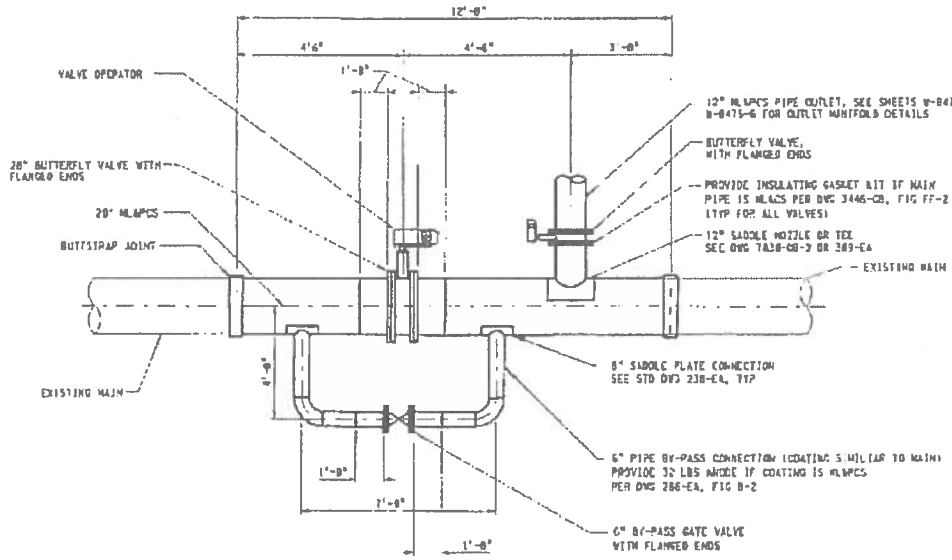
Bypass Pipelines

During design of a pipeline, it is typical to perform some preliminary seismic and hazard investigation. A geotechnical engineer can perform literature search of available publications and assess the seismic setting of the pipeline and identify potential hazards such as fault crossings, landslides, and zones of potential liquefaction.

With this information, the pipeline design engineer can often times route the pipeline to avoid well-defined hazards. This is the most cost-effective approach for minimizing seismic-related damage to a pipeline. However, sometimes there is no feasible way to avoid a hazard and the pipeline must be routed through the hazard.

Instead of using a higher Category Design (such as D or E), the owner can elect to provide a bypass capability, as long as the owner has the ability to install the bypass within about 1 day after the earthquake, and in consideration of the entire post-earthquake response. Bypass capability might be the most cost effective approach to mitigate many fault and landslide crossings for Function Class III pipelines. Bypasses can be used in retrofitting existing pipelines or for new construction where loss of service cannot be tolerated for more than one day.

A typical bypass is illustrated in Figure 2, consisting of a line isolation valve, if none previously existed, and a 12-inch diameter connection and manifold assembly on either side of the defined hazard. In order for the bypass to be used effectively, the hazard must be relatively well defined. Each of the manifolds is configured to accept one or multiple large diameter hose connections. In the event of a seismic event that results in a pipeline failure within the bounds of the hazard, the hazard isolation valves are closed, thereby stopping leakage at the point of failure. The hose is then deployed across the ground between the two manifold assemblies and serves as a temporary pipe bypass, allowing restoration of flows through the system. Figure 3 shows a deployed bypass system at a fault crossing where deployment of three flex hoses was possible.



Typical Isolation Valve with Bypass

Figure 2. Bypass Manifold Assembly

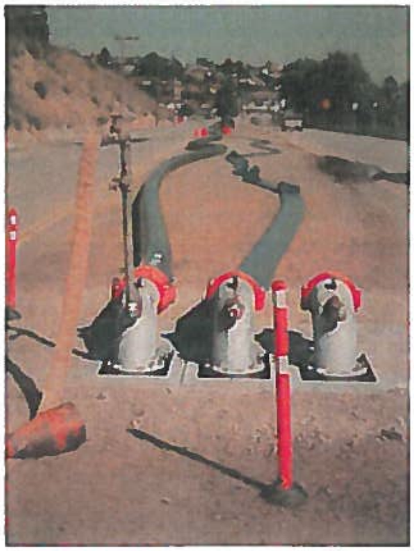


Figure 3. Flex Hose Attached to Manifold Outlets

The criteria for the bypass system components are included in Table 21. So called "large diameter flex hose" (diameter ~5-inches) will generally not provide sufficient flow rate at a reasonable pressure drop, for distances on the order of 1,000 feet between manifolds. So called "ultra large diameter flex hose" (diameter ~12-inches) can provide high flow rates at separation distances of 1,000 feet (or more). There are pros and cons with using either 5-inch or 12-inch hose, including: flow rate and pressure drop; cost; storage life; deployment effort and time; hose breakage and resultant pipe whip; etc.

Description	**Criteria**
Pipe Materials	Mortar-lined and mortar- or tape/epoxy-coated steel pipe Field joints shall be flanged, welded, or mechanically coupled with suitable restraint Design for anticipated internal, external, and transient loading conditions Provide cathodic protection as needed
Manifold Pit	Precast reinforced concrete with seismic design factors suitable for site Traffic rated steel plate cover Sized for easy hose deployment
12-inch Valves and Smaller	Butterfly or Gate
Flexible Hose	12 -inch flex hose, burst pressure ~ 400 psi, operating pressure ~150 psi. Distances up to 1,000 feet or more at flow rates of up to 5,000 gpm 5-inch fire hose from local Fire Department. Distances up to 1,000 feet at flow rates of up to 500 gpm Connections to be coordinated with manifold configuration

Table 21. Bypass System Components Criteria

CONCLUSIONS

It is the intent of these Guidelines to provide a unified, comprehensive and simple approach that can be readily adopted by water utilities for the design of new pipeline installations. The draft Guidelines are available for public comment through January 2005. They may be obtained via the Internet at: http://homepage.mac.com/eidinger/ (follow the link to downloads, and then download Seismic Guidelines.doc.) Comments should be sent to any of the authors.

The Guidelines may result in changes in pipeline installations in moderate and high seismic areas throughout the United States. Given the large economic consequences of widespread pipeline damage, the authors believe that the extra reliability afforded by these changes is worthwhile and cost effective. We hope that the Guidelines will spur water utilities to procure better pipelines in high hazard locations; in turn, the pipeline manufacturers will manufacture and supply better products. This is, in part, a "chicken and egg" process, since prior to the current moment (late 2004 – early 2005) we have not had the Guidelines for water utilities; nor have we always had suitable cost effective pipelines provided by manufacturers to meet the Guidelines.

ABBREVIATIONS AND UNITS

Customary US units (inches, pounds, gallons) are used in this paper. Conversions to SI units are provided below. All pipe sizes are in customary US units; conversion of a customary pipe size (such as 12-inch diameter) to SI units has no precision, as a 12-inch pipe may often have outside diameter anywhere from ~12-inches to ~13-inches.

ALA	American Lifelines Alliance
AWWA	American Water Works Association
AWWARF	American Water Works Association Research Foundation
ESM	Equivalent Static Method
FEM	Finite Element Method
FEMA	Federal Emergency Management Agency
JWWA	Japan Water Works Association
MMC	Multihazard Mitigation Council
NIBS	National Institute of Building Sciences
PGA	Peak Ground Acceleration (g)
PGD	Permanent Ground Deformation (1 inch = 2.54 cm)
PGV	Peak Ground Velocity (1 inch/sec = 2.54 cm/sec)
inch	inch (1 inch = 2.54 cm)
feet	feet (1 foot = 12 inches = 30.48 cm)
g	gravity constant (1g = 386.4 inch/sec^2 = 981 cm/sec^2)
gpm	gallons per minute (1 gpm = 3.785 liters per minute)
psi	pounds per square inch (1 psi = 6.895 kilopascals)
sec	second