November 30, 2020

Sent via email

Mr. Andrew Wheeler, EPA Administrator
United States Environmental Protection Agency
1200 Pennsylvania Avenue, NW
Mail Code 50304-P
Washington DC, 20460

RE: Initial Application for Alternate Liner Demonstration
DTE Electric Company Monroe Power Plant
Fly Ash Basin Coal Combustion Residuals Unit
7955 East Dunbar Road, Monroe, Michigan

Dear Administrator Wheeler:

The DTE Electric Company (DTE Electric) is submitting this initial application to the US. Environmental Protection Agency (EPA) for approval to submit an Alternate Liner Demonstration pursuant to 40 C.F.R. §257.71(d) for the Fly Ash Basin (FAB) located at the Monroe Power Plant (MONPP) located in Monroe, Michigan. DTE Electric is requesting the opportunity to complete and submit an Alternate Liner Demonstration Package per 40 CFR §257.71(d)(1)(ii) which would enable the FAB to continue to receive CCR and non-CCR waste streams after April 11, 2021, until such time that EPA makes a decision on the adequacy of the MONPP FAB alternate liner system.

Enclosed is an Initial Application prepared by TRC that demonstrates how DTE Electric qualifies for and should be granted the opportunity to complete and submit an Alternate Liner Demonstration per 40 CFR §257.71(d)(1)(ii) for approval as continued operation of the MONPP FAB CCR unit would pose no reasonable probability of adverse effects to human health or the environment. As allowed by the agency, electronic files were submitted to Richard Huggins, Mary Jackson, Michelle Long, and Jason Mills via email. If you have any questions regarding this submittal, please contact me at 313.235.0153 or christopher.scieszka@dteenergy.com

Sincerely,

Christopher Scieszka
Project Manager, Environmental Management and Safety, DTE Energy

Enclosure

cc: Richard Huggins, Mary Jackson, Michelle Long, and Jason Mills

Initial Application for an Alternate Liner Demonstration

Monroe Power Plant
Fly Ash Basin Coal Combustion Residuals Unit

November 2020

Prepared For:

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TABLE OF CONTENTS

TRC

TABLES

FIGURES

APPENDICES

Executive Summary

TRC, on behalf of DTE Electric Company (DTE Electric), has prepared this Initial Application for an Alternate Liner Demonstration pursuant to the November 12, 2020 Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals From Electric Utilities; A Holistic Approach to Closure Part B: Alternate Demonstration for Unlined Surface Impoundments (40 CFR § 257.71(d)) (Part B Rule) for the Monroe Power Plant Fly Ash Basin (MONPP FAB) Coal Combustion Residuals (CCR) Unit.

This application and its attachments demonstrate how DTE Electric qualifies for and should be granted the opportunity to complete and submit an Alternate Liner Demonstration per 40 CFR § 257.71(d)(1)(i) for approval as continued operation of the MONPP FAB CCR Unit would pose no reasonable probability of adverse effects to human health or the environment in the future based on the following:

- Compliance with all provisions of the Final Rule: Disposal of CCR from Electric Utilities (CCR Rule); April 15, 2015, 40 CFR part 257 subpart D, including a sufficient groundwater monitoring network under § 257.91;
- The groundwater monitoring program meets the requirements of § 257.93 and § 257.94, and per the groundwater quality data collected as part of the program, remains in detection monitoring;
- The presence of a natural geologic barrier (more than 23 feet of native clay-rich soil) that provides the equivalent, or better level of protection from potential migration of contaminants than a composite liner defined in § 257.70(b);
- Soil boring data collected across the MONPP FAB CCR Unit, FAB construction documentation, structural stability and safety factor assessments and the data collected during the ongoing FAB slope maintenance and monitoring program demonstrate that there is no reasonable probability that a complete and direct transport pathway (*i.e.*, not mediated by groundwater) exists between the impoundment and any nearby water body; and
- Sufficient documentation that the unit meets all the location restrictions under § 257.60 through § 257.64 and documentation that the structural stability and safety factor requirements are met as documented in structural stability and safety factor assessments that were performed pursuant to 40 CFR § 257.73 (d) and (e).

1.0 Regulatory Framework and Site Background

TRC, on behalf of DTE Electric Company (DTE Electric), has prepared this Initial Application for an Alternate Liner Demonstration pursuant to the November 12, 2020 Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals From Electric Utilities; A Holistic Approach to Closure Part B: Alternate Demonstration for Unlined Surface Impoundments (40 CFR § 257.71(d)) (Part B Rule) for the Monroe Power Plant Fly Ash Basin (MONPP FAB) Coal Combustion Residuals (CCR) Unit.

1.1 Site Background

The MONPP is located in Section 16, Township 7 South, Range 9 East, at 7955 East Dunbar Road, Monroe, in Monroe County Michigan (**Figure 1**). The MONPP, including the FAB, was constructed in the 1970s.

The property has been used continuously as a coal fired power plant since the Detroit Edison Company (now DTE Electric) began power plant operations at MONPP in 1975. The FAB was completed in 1975 and accepts coal ash from the MONPP operations.

The MONPP FAB CCR Unit is approximately 410-acres with an original design storage capacity of 18,500 acre-feet at a maximum elevation of 615 feet relative to the National Geodetic Vertical Datum of 1929 (NGVD 29) (**Figure 2**). The FAB consists of an earthen clay-rich soil embankment (raised surface impoundment) with a crest perimeter length of approximately 18,200 feet and a general height (from the lowest toe elevation to the top of embankment) of approximately 40 feet, with a maximum height of 44 feet. A road along the top of the crest has a width of approximately 15 feet and an elevation of approximately 614 feet NGVD 29 with the typical water operational level being between 608 and 609 feet NGVD 29.

The FAB base is keyed into the existing natural clay-rich soil ground surface at an elevation of 563.4 feet. This natural low permeability clay-rich soil base serves as an underlying hydraulic barrier, forming a natural liner of at least 23 feet of natural clay-rich soil below the base of the FAB.

The Fly Ash Basin has a structural height of approximately 50.6 feet. The outer slope of the embankment has a slope generally ranging from approximately 2.0 horizontal to 1 vertical (2H:1V) to 3H:1V. The inner slope of the embankment where the coal ash slurry is stored has a slope of approximately 2H:1V. CCRs are placed into the FAB by use of a “wet” (sluiced) disposal method. In 2015, DTE Electric added a 79-acre “dry” disposal area vertical extension landfill (VEL) located on top of a portion of the FAB that had been filled to approximate final grade with CCR.

1.2 Regulatory Framework

On April 17, 2015, the U.S. EPA issued the Final Rule: Disposal of CCR from Electric Utilities (CCR Rule), 40 CFR 257, Subpart D, to regulate the disposal of CCR materials generated at coal-fired units. The rule is being administered under Subtitle D of the Resource Conservation and Recovery Act (RCRA, 42 U.S.C. § 6901 et seq.). On August 28, 2020 and November 12, 2020, the EPA Administrator issued revisions to the CCR Rule that required all unlined surface impoundments to initiate closure by April 11, 2021, unless an alternative deadline is requested and approved (40 CFR 257.103) or an initial application for an Alternate Liner Demonstration is prepared per 40 CFR § 257.71(d) and submitted by November 30, 2020. This applies to the MONPP FAB CCR Unit.

The April 11, 2021 deadline to cease receipt of waste and initiate closure will be tolled upon submission of a complete application and until such time that EPA makes a final decision on the application or subsequent demonstration. The initial application for an Alternate Liner Demonstration per § 257.71(d)(1)(i) must include the location of the facility and identify the specific CCR surface impoundment(s) for which the demonstration will be made. The application must also include all the following information:

- **§ 257.71(d)(1)(i)(A)** – A certification signed by the owner or operator that the CCR Unit is in full compliance with this subpart except for § 257.71(a)(1);
- **§ 257.71(d)(1)(i)(B)** – Documentation supporting the certification required under § 257.71(d)(1)(i)(A) which includes the following:
  1. Documentation that the groundwater monitoring network meets the requirements of § 257.91. This must include documentation that the existing network of groundwater monitoring wells is sufficient to ensure detection of any groundwater contamination resulting from the impoundment, based on direction of flow, well location, screening depth and other relevant factors;
  2. Documentation that the CCR surface impoundment remains in detection monitoring pursuant to § 257.94 as a precondition for submitting an application. This includes documentation that the groundwater monitoring program meets the requirements of § 257.93 and § 257.94;
  3. Documentation that the unit meets all the location restrictions under § 257.60 through § 257.64;
  4. Documentation of the most recent structural stability assessment required by § 257.73(d); and
  5. Documentation of the most recent safety factor assessment required by § 257.73(e).
- **§ 257.71(d)(1)(i)(C)** – Documentation of the design specifications for any engineered liner components, as well as all data and analyses the owner or operator of the CCR surface impoundment relied on when determining the materials are suitable for use and that the construction of the liner is of good quality and in-line with proven and accepted engineering practices;
- **§ 257.71(d)(1)(i)(D)** – Facilities with CCR surface impoundments located on properties adjacent to a water body must demonstrate that there is no reasonable probability that a complete and direct transport pathway (*i.e.*, not mediated by groundwater) can exist between the impoundment and any nearby water body; and
- **§ 257.71(d)(1)(i)(E)** – Upon submission of the application, and any supplemental materials submitted in support of the application to the Administrator or the Participating State Director, the owner or operator must place the complete application in the facility's operating record as required by § 257.105(f)(14).

The documentation that must be provided to the EPA per § 257.71(d)(1)(i) to demonstrate that the above criteria has been met for an initial Alternate Liner Demonstration for the MONPP FAB CCR Unit is provided within this report.

2.0 Site Geology and Hydrogeology

Pursuant to the Part B Rule, in order to meet the requirements of§ 257.71(d)(1), the owner or operator must demonstrate that, without a composite liner, the continued operation of the unit would pose no reasonable probability of adverse effects to human health or the environment. This is demonstrated when the surface impoundment has not and will not result in groundwater concentrations above the relevant groundwater protection standards (GWPS) at the unit boundary (health based or background, whichever is higher).

The geologic and hydrogeologic conditions at the site support a finding that there is no reasonable probability of adverse effects to human health or the environment due to the continued operation of the MONPP FAB CCR Unit. Over 23 feet of low permeability clay-rich deposits are present immediately beneath the CCR unit, vertically isolating the FAB from the underlying uppermost aquifer. Although regional groundwater present in the uppermost aquifer has the potential to be used for drinking water, the water at the MONPP FAB site is not used for drinking water nor is it likely to be used in the future and any potential off-site risk posed by the FAB is mitigated by the presence of the thick clay-rich deposits as described in **Sections 2.1 through 2.4** below. The following paragraphs document the existing site conditions, identification of potential receptors, and how potential risks have been mitigated.

2.1 Regional Geology and Hydrogeology

The geology of Monroe County consists of primarily unconsolidated alluvium and glacial deposits overlying bedrock. The unconsolidated material consists of shallow/surficial alluvium deposits (sand and gravel) on top of clay-rich glacial till with some sporadic glaciofluvial deposits that range from not present to more than 150 feet thick, with an average thickness of about 50 feet. These thick low permeability subsurface conditions are present on a regional basis due to continental glaciation and are discussed further in *The Natural Clay Liner Equivalency Evaluation Report,* DTE Electric and Consumers Energy Company Six Southeast Michigan Coal Combustion Residual Units (Natural Clay Equivalency Report), previously submitted to the EPA in December of 2018. This report contains additional information on the natural clay liner evaluation including hydraulic head data, cross-sections, site-specific clay hydraulic conductivity values and leakage rate calculations. This report has been attached as **Appendix A**. As part of this study, TRC evaluated multiple CCR impoundments in southeast Michigan, including the MONPP FAB. Using recognized and generally accepted good engineering practices, TRC concluded that the natural soils below these sites in southeast Michigan perform better than composite liners. In summary:

- TRC calculated leakage rates for six Southeast Michigan CCR units and compared these to the anticipated leakage rates for a single composite liner system. For all six units, the leakage rates were generally within an order of magnitude of the composite liner system. These data show that anticipated leakage rates between the natural soil barriers and the single composite liners are comparable. Data are summarized on Table 1 of the Natural Clay Liner Equivalency Report.
- Data also show that other site-specific factors contribute more significantly to the protectiveness of natural soil barriers when compared to single composite liner system, including thickness of the natural soil barrier, hydraulic conductivity of the soil barrier, and

the hydraulic gradient between the CCR unit and the underlying aquifer, which can result in significantly greater times of travel to the uppermost aquifer. The results of the time of travel calculations are summarized on Table 1 of the Natural Clay Liner Equivalency Report. As shown, all the six evaluated Southeast Michigan CCR units have natural clay liners that are more protective than single composite liner system.

- The travel time results from this study show times that exceed the USEPA's vulnerability criterion demonstrating that site-specific evaluation can demonstrate protectiveness. The sites presented in this study and the methods and criteria used to evaluate the competency of the liner systems meet the regulatory standard "does not pose a reasonable probability of adverse effects on health or the environment."

Bedrock in Monroe County is predominantly Devonian and Silurian-aged carbonates and includes the Antrim Shale, Traverse Group, Dundee Formation (limestone and some dolostone), Detroit River Group, Sylvania Sandstone, Bass Islands Group, and Salina Group. The bedrock surface is highest in the central and southwestern portion of the county and dips to the southeast and northwest due to erosion. Monroe County's eastern boundary is Lake Erie, and in general, regional groundwater flow is to the east towards Lake Erie. Much of the carbonate bedrock aquifer in Monroe County is confined and naturally artesian.

Saturated limestone bedrock of the Bass Islands Group is generally encountered from 37 to 53.5 feet below ground surface (feet-bgs). The Bass Island Group can be as thick as 350 feet in Monroe County. Two modes of groundwater movement through the carbonate bedrock are: (i) through pore spaces in the rock (primary porosity), and (ii) along an intersecting system of fractures, joints, and bedding planes, collectively referred to as secondary porosity. Groundwater flow in the carbonate bedrock aquifer in Monroe County is primarily through secondary porosity consisting of fractures often evident along bedding-plane partings.

2.2 Site Geology

The MONPP FAB Unit is located approximately 200 feet southwest of Plum Creek (a wide shallow creek) and north of Lake Erie. The MONPP FAB Unit uppermost aquifer consists of saturated limestone present beneath at least 37 feet and up to 53.5 feet of thick contiguous silty clay-rich soil that serves as a natural confining hydraulic barrier that isolates the underlying aquifer. The silty-clay unit has an extremely low permeability and potential vertical groundwater flow velocity and is laterally contiguous beneath the FAB as verified by numerous historical soil borings (refer to **Appendix K**), and also confirmed by TRC during completion of the seven soil borings installed as part of the CCR monitoring well installation program in 2016 from which several thin-walled tube soil samples were collected. The 2016 collected thin wall tube soil samples were tested for hydraulic conductivity with the hydraulic conductivity being measured to be in the 1.2 to 1.6 x 10^{-8} cm/s range as presented in **Appendix A**.

The uppermost aquifer encountered at the site is generally artesian except in the area of monitoring well MW-16-01. Monitoring well MW-16-01 is located within several hundred feet of several off-site domestic residential wells located to the north along Dunbar Road adjacent to Plum Creek that likely lower the hydraulic head in the area of MW-16-01.

Refer to the Groundwater Monitoring Systems Summary Report attached as **Appendix B** and **Figures 3 through 5.** Additional details on the site hydrogeology and vertical flow potential to the uppermost aquifer are presented in **Section 2.3 and Section 2.4** below.

2.3 Site Hydrogeology

Based on data collected by TRC, the general flow potential within the uppermost aquifer at the site is to the northeast towards Plum Creek. Wells located hydraulically upgradient of the CCR unit include MW-16-03, MW-16-04 and MW-16-05 on the southwestern and southern part of the FAB. These wells exhibit artesian conditions, in which potentiometric elevations are significantly above ground surface (generally 10 to 15 feet above ground surface). These conditions are similar to those encountered in historical borings (TB-11, TB-20 and TB-28) advanced in the 1970s in the same area prior to the FAB construction. Refer to **Appendix N** for details on the pre-construction artesian conditions encountered. Downgradient monitoring wells MW-16-01, MW-16-05 and MW 16-06 range from slightly artesian to not artesian, which is similar to the observations at the 1970s historical borings installed in this area (TB-2, TB-3, TB-4 and TB-5) prior to FAB construction. Given that the artesian conditions have remained consistent across the FAB CCR Unit from before the FAB construction to the present, there is no hydraulic connection between the FAB and the uppermost aquifer. Refer to **Figures 6 through 10** for 2017 through 2019 groundwater potentiometric surface maps.

The average hydraulic gradient to the northeast ranges from 0.002 to 0.0025 foot/foot along the eastern part of the FAB to 0.004 to 0.005 foot/foot in the center and northwestern part of the FAB, with an overall mean of 0.004 foot/foot.

The surface water elevation within the FAB raised surface impoundment is at least 5 to more than 30 feet above the potentiometric surface elevations in the uppermost aquifer limestone, and more than 60 feet above the base of the underlying clay-rich confining unit that isolates groundwater within the limestone aquifer. Therefore, flow potential from the CCR unit to the surrounding area would be radially outward from the FAB. However, there is no hydraulic communication between the uppermost aquifer and the FAB due to the continuous silty clay-rich confining unit beneath the MONPP FAB. Under pre-existing solid waste rules in Michigan, solid waste facilities with similar geology to the MONPP FAB CCR Unit including this site have been granted waivers from groundwater monitoring based on the environmental protectiveness of the native thick clay-rich geology.

A hydraulic conductivity of approximately 4.3 feet/day was measured at CCR monitoring well MW-16-01 using a single well hydraulic conductivity test (e.g., slug test) performed in 2016 (attached as **Appendix M**). Other monitoring wells at the FAB were not tested due to natural free flowing artesian conditions. This result is consistent with the 5 feet/day presented in other published sources for the hydraulic conductivity of the Bass Island Group (USGS, 2004).

Using the groundwater potentiometric surface elevations measured at the MONPP FAB unit in 2016 and 2017, the horizontal gradient has varied from approximately 0.002 to 0.005 with an average gradient of approximately 0.004 foot/foot to the northeast. Assuming an average porosity of 0.1 for the limestone in the uppermost aquifer, a mean hydraulic conductivity of 5 feet/day, and a hydraulic gradient of 0.004 for the limestone aquifer the potential horizontal groundwater flow rate to the northeast is approximately 0.2 feet/day or 73 feet/year.

Based on the artesian conditions, the low permeability of the underlying natural soils, and the calculated time of travel for groundwater to flow vertically from the FAB to the uppermost aquifer, it is not possible for the uppermost aquifer to be affected by CCR from FAB operations that began in the mid to late 1970s (see vertical time of travel discussion below). This is further supported by groundwater quality data collected at the site which is comparable to regional background quality (USGS, 1996).

Refer to **Appendix C** for the 2019 Annual Groundwater Monitoring Report, **Appendix D** for the 2018 Annual Groundwater Monitoring Report and **Appendix E** for the 2017 Annual Groundwater Monitoring Report for more information on the groundwater flow. Refer to **Figures 6 through 10** potentiometric surface maps for 2017 through 2019.

2.4 Vertical Flow Potential to Uppermost Aquifer

The MONPP FAB CCR Unit was constructed in an area that consists of a naturally occurring silty-clay rich soil. This naturally deposited soil barrier has been verified by numerous historical soil borings (refer to **Appendix K**), and also confirmed by TRC during completion of the seven soil borings installed as part of the CCR monitoring well installation program. Consequently, the geology and hydrogeology of the site provides a very high level of environmental protection of the uppermost aquifer. Based on the site geology and hydrogeology, there is extremely low potential for the FAB Unit to affect the uppermost aquifer groundwater in the future. Groundwater present in the deep confined uppermost limestone aquifer is protected from CCR constituents by the thick clay-rich aquitard with low hydraulic conductivity.

Using the hydrogeologic information for the site, the time of travel for water from the base-grade elevation of the MONPP FAB down to the uppermost aquifer has previously been calculated to be 308 years assuming a maximum silty-clay hydraulic conductivity of 6.5×10^{-8} cm/s and 23 feet of silty-clay present between the bottom of the MONPP FAB CCR unit and the limestone bedrock surface (**Appendix K**). The calculated travel time presented in the Natural Clay Liner Equivalency Report was performed using the actual vertical hydraulic head gradient of 0.97 ft/ft vs. the slightly more conservative hydraulic head gradient of 1 ft/ft used in the conservative seepage velocity calculation above resulted in a travel time of 441 years as detailed in **Appendix A.** Therefore, given that the MONPP FAB operations began in the 1970s, there is no reasonable potential for the uppermost aquifer to have been affected by the MONPP CCR FAB Unit within the past 50 years. In addition, given the fact that DTE Electric has detailed in the FAB Closure Plan that it plans to cease placing CCR and initiate closure of the FAB beginning with dewatering in 2024, there is no reasonable potential for the uppermost aquifer to be affected by the FAB in the future. Refer to the October 2016 Closure Plan attached as **Appendix F**. These data show that the natural clay-rich soil liner underlying the FAB CCR Unit consists of thick, low hydraulic conductivity clay, that provides the same, or better level of protection from potential migration of contaminants than the composite liner defined in § 257.70(b).

2.5 Groundwater Use

Groundwater use in the vicinity of the site is very limited. Water supply wells are present within the limestone aquifer unit off-site within several hundred feet north of the MONPP FAB site at residences located adjacent to Plum Creek. There is no on-site use of groundwater at the MONPP FAB site. Based on the information presented in **Sections 2.2 to 2.4**, the MONPP FAB CCR Unit is separated from the uppermost aquifer by an extensive clay unit that protects the uppermost aquifer. In addition, as described in **Section 3.3** there have been no confirmed statistically significant increases (SSIs) during the MONPP FAB CCR Unit detection monitoring from 2017 to the present and the FAB Unit remains in detection monitoring. Therefore, there is no reasonable potential for a release to the uppermost aquifer on-site or off-site that could affect these residences wells.

2.6 Surface Water

Surface water bodies present in the area of the MONPP FAB include the Plum Creek a wide shallow creek (as close as 200 feet north and northeast of the MONPP FAB), Lake Erie (adjacent to a portion of the MONPP FAB to the south) and the LaPlaisance Creek (approximately 2,000 feet south of the MONPP FAB). Based on historic soil borings data collected across the MONPP FAB CCR Unit (presented in **Appendix K**); the FAB construction documentation (presented in **Appendix L**); the FAB Structural Stability and Safety Factor Assessments (presented in **Appendix H**); and related data collected during the ongoing FAB slope maintenance and monitoring program described in **Section 3.5**; the FAB CCR Unit is separated from the water bodies by an extensive underlying low permeability clay unit and an extensive 40 or more-foot-high perimeter compacted stable clay berm. Therefore, there is no reasonable probability that a complete and direct transport pathway (*i.e.*, not mediated by groundwater) exists between the impoundment and any nearby surface water body.

3.0 Facility Compliance

DTE Electric has a public repository of documents in accordance with 40 CFR § 257.107 which can be found here: DTE CCR Compliance Data and Information. This repository demonstrates that the MONPP facility is in compliance with all record keeping, notification and internet posting requirements as required by 40 CFR 257 Subpart D. DTE Electric retained TRC to audit their records to identify any gaps in compliance and none were noted. As required by § 257.71(d)(1)(i)(A), a certification signed by the owner or operator that the MONPP FAB CCR Unit is in full compliance with this subpart, except for § 257.71(a)(1), has been included as **Appendix G**. A summary of the key compliance metrics for the MONPP FAB is discussed below.

3.1 Groundwater Monitoring System § 257.71(d)(1)(i)(B)(1)

In accordance with 40 CFR § 257.91, a P.E. certified groundwater monitoring system is established for the MONPP FAB CCR Unit **(Appendix B)**. The established groundwater monitoring network has also been approved in a Michigan Department of the Environment, Great Lakes, and Energy (EGLE)-approved Hydrogeologic Monitoring Plan (HMP) through the state-run solid waste compliance program which was recently updated in December 2018 to align with the Federal CCR Rule. The monitoring well network for the FAB CCR Unit currently consists of seven monitoring wells around the perimeter of the MONPP FAB that are screened in the uppermost aquifer and are sufficient to ensure detection of groundwater contamination resulting from the CCR unit, Four of these wells are located hydraulically upgradient/side gradient and three of these wells are located hydraulically downgradient of the FAB. Given the presence of the thick natural clay-rich liner hydraulic barrier as discussed in **Section 2.0**, the perimeter groundwater monitoring well network is appropriate to monitor the MONPP FAB CCR Unit as discussed further below. The monitoring well locations are shown on **Figure 2.**

These monitoring wells are adequately placed for detection monitoring at the FAB. The surface water level within the FAB is at least 5 to more than 30 feet above the potentiometric surface elevations measured in the perimeter monitoring wells installed in the uppermost aquifer limestone. The base of the FAB is more than 23 feet above the first encountered groundwater at the base of the underlying clay-rich confining unit that isolates groundwater within the limestone aquifer, as shown in the cross-sections on **Figures 3 through 5**. Therefore, with consideration of the vertical hydraulic isolation between the FAB and the underlying uppermost aquifer (and lack of hydraulic communication between them) in conjunction with the diffusive properties of the clay, the flow potential for surface water or CCRs from the CCR unit to the surrounding area would be radially outward from the FAB toward the underlying aquifer. As such, given that groundwater quality has not been previously affected by the CCR unit, the seven monitoring wells located around the perimeter of the MONPP FAB have been selected to serve as both background and downgradient monitoring wells using intrawell statistical methods and provide increased protection by having downgradient monitoring wells distributed around the perimeter of the FAB. The intrawell statistical approach is discussed in more detail below in **Section 3.2**.

In February 2016 through April 2016, soil borings were advanced to evaluate the subsurface geology and to allow monitoring well installation using sonic drilling techniques with 4-inch and

6-inch tooling along the perimeter of the FAB Unit area. Soil samples were collected continuously in ten-foot sections from the ground surface to the termination of the soil boring. A TRC geologist was present to log each boring and describe the soil samples in accordance with the Unified Soil Classification System (USCS). The soil borings were advanced to depths ranging from approximately 40 to 60 feet-bgs to within the top of the underlying limestone bedrock beneath the MONPP. In most cases (at every location except for MW-16-01), artesian conditions were encountered at the terminus of the soil borings. The variability in boring depth is related to the variable thickness of the overlying silty clay-rich soil (ranging from 37 to 53.5 feet) that overlies and confines the uppermost portion of the limestone uppermost aquifer and the distance to top of bedrock at each location.

In February 2016, four soil boring locations along the perimeter of the FAB (now logged as monitoring wells MW-16-01, MW-16-02, MW-16-03 and MW-16-04) were advanced to the limestone bedrock. At each of those locations a contiguous silty-clay till unit was present to depths ranging from 37 to 53.5 feet-bgs (**Figures 4 and 5**).

After the geology and groundwater potentiometric surface and flow were evaluated in the newly installed monitoring wells MW-16-01, MW-16-02, MW-16-03 and MW-16-04, TRC mobilized to complete a second round of investigation performed in the same manner as described above to further document subsurface conditions and enhance the monitoring network by installing additional monitoring wells MW-16-05, MW-16-06 and MW-16-07 in April 2016.

Groundwater elevation data collected indicate a northeasterly flow direction within the uppermost aquifer. Groundwater potentiometric surface maps for 2017 through 2019 are shown on **Figures 6 through 10**. However, as discussed above, this was not the only factor used to determine the monitoring network layout.

The perimeter groundwater monitoring well network is appropriate to monitor the MONPP FAB CCR Unit given the wells provide coverage of the perimeter of the FAB where if water were to escape from the CCR unit and travel vertically through the clay aquitard carrying CCR constituents, it could be detected at multiple locations around the perimeter unit, including in the northeasterly groundwater flow direction. The monitoring well system is considered a conservative approach to demonstrating compliance given the hydraulic isolation of the CCR unit provided by the presence of the thick natural clay-rich liner hydraulic barrier (as discussed in **Section 2.0** with the consistency of the natural clay liner across the site documented in historical borings across the CCR Unit **(Appendix K**) and documented during the CQA performed during the construction of the FAB (**Appendix L**). The monitoring well locations are shown on **Figure 2**. Well Construction and Soil Boring Logs for the monitoring network are attached in **Appendix B**.

3.2 Groundwater Statistical Evaluation Plan § 257.71(d)(1)(i)(B)(2)

The CCR Rule allows a variety of methods for conducting statistical evaluations. The P.E. certified Groundwater Statistical Evaluation Plan for the MONPP FAB CCR Unit is attached as **Appendix I**. This plan was developed using USEPA's *Unified Guidance* and other available guidance (e.g., ASTM) and the methods presented in the plan have been approved for use at the site by the EGLE as part of their approval of the HMP for the site. In addition to using applicable guidance documents, commercially available statistical evaluation tools were utilized to establish statistically derived limits so that detection monitoring data could be evaluated. Statistical methods were also selected considering site specific geologic and hydrogeologic conditions.

TRC considered interwell and intrawell methods as part of the selection criteria. These methods are fundamentally different, but both have their advantages and disadvantages. While the interwell analysis compares downgradient compliance wells against a background composed of upgradient well data, it typically relies on uniform hydrogeologic conditions and the presence of consistently upgradient and downgradient hydraulic flow conditions. By contrast, the intrawell analysis compares each compliance well against a background composed of its own historical data such that individual wells serve as both the background and downgradient compliance wells and assumes that that aquifer is unaffected by the CCR unit. Intrawell statistical methods for the MONPP FAB CCR Unit were selected based on the following hydrogeologic conditions described in detail in **Section 2.0** and in the aforementioned monitoring system discussion in **Section 3.1**:

- Interwell statistical methods assume groundwater within the aquifer is uniform across the site. Significant spatial variability of Appendix III constituents are present naturally within the aquifer, observed in up and downgradient groundwater, and do not allow for the underlying assumption of uniformity in the interwell analysis to be met. Where hydrogeologic conditions result in statistically significant variation naturally present in the aquifer, an intrawell analysis is the preferred approach;
- The extremely low vertical groundwater flow velocity, the diffusive properties of clay, and the radial flow potential outward from the CCR unit if it were to leak; and,
- The saturated unit being monitored is hydraulically isolated by a 23-ft-thick (or more) laterally contiguous silty-clay unit native clay liner, which significantly impedes vertical groundwater flow thus preventing the monitored saturated zone from potentially being affected by CCR from the FAB.

When an intrawell analysis is used, the base assumption is that the data used as background have not been impacted by the CCR unit. Given the significant clay isolation thickness between the FAB and the uppermost aquifer, and the low permeability and diffusive properties of the underlying soil, the potential for water quality to be impacted from the FAB CCR Unit is extremely unlikely as described in detail in **Section 2.0** of this report. This is further supported by groundwater quality at the site being consistent with regional background quality based on publicly available resources (USGS, 1996). On this basis, the intrawell methods are appropriate for detection monitoring at the FAB CCR Unit.

3.3 Detection Monitoring § 257.71(d)(1)(i)(B)(2)

Detection monitoring has been completed since 2017 in accordance with § 257.93 and § 257.94 with compliance as required in § 257.71(d)(1)(i)(B)(2) being documented in the 2017, 2018 and 2019 Annual Reports prepared in accordance with § 257.90 (**Appendix C, D and E**). Subsequent to each groundwater sampling event, statistical evaluation of groundwater data is completed in accordance with the Groundwater Statistical Evaluation Plan attached as

Appendix I. The groundwater sampling results have been confirmed to be below background limits for Appendix III indicator parameters since semiannual monitoring events began in 2017 and/or were successfully addressed with an alternative source demonstration (ASD). Therefore, no confirmed SSIs have been reported for the MONPP FAB CCR unit. See **Appendix C, D and E** for the Annual Groundwater Monitoring Reports that include ASDs (when performed) and **Table 1.1 through 1.5** for a summary of the detection monitoring analytical data and statistical analysis completed for the site from 2017 through 2019.

3.4 Location Standards § 257.71(d)(1)(i)(B)(3)

The MONPP FAB CCR Unit is compliant with the location restrictions of § 257.60-64 as described below.

§ 257.60 – Placement Above the Uppermost Aquifer

The federal CCR rule requires that CCR units such as the MONPP FAB must be constructed with a base that is located no less than 1.52 meters (five feet) above the upper limit of the uppermost aquifer, or must demonstrate that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in the groundwater elevations (including the seasonal high water table). The FAB is keyed into the natural clay-rich soil ground surface at an elevation of 563.4 feet. The FAB is underlain by at least 23 feet of the natural low permeability clay-rich soil. The uppermost aquifer, based on saturated soil observations during soil borings is located at the silty clay-weathered limestone interface, at an approximate elevation of 527 to 540 ft MSL. Cross-sections showing the installation top and bottom elevation of the approximate basin bottom and depth to the uppermost aquifer are attached as **Figures 3 through 5.**

Based on this demonstration, the base of the MONPP FAB is located greater than 5 feet above the upper limit of the uppermost aquifer and there is not a hydraulic connection between the FAB and the underlying groundwater caused by normal fluctuations in groundwater level. Therefore, the FAB is in compliance with the requirements of § 257.60.

§ 257.61 – Wetlands

The CCR location standards restrict existing and new CCR surface impoundments from being located in wetlands, as defined at § 232.2 (§ 257.61(a). Wetlands are defined in § 232.2 *Waters of the United States (3)(iv)* as, "…those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." TRC reviewed National Wetland Inventory (NWI) maps and Michigan Resource Information System (MIRIS) Land Cover Maps archived and available through Michigan Department of Natural Resources (MDNR), Michigan Resource Inventory Program (MRIP) to ascertain whether or not the MONPP FAB located in wetlands.

Soils at and in the vicinity of the site are designated as wetland soils, most likely due to the proximity of the site to Plum Creek and Lake Erie. NWI (2005) recognizes areas to the southeast and northeast of the FAB as wetlands, and an area identified as wetlands on NWI and MIRIS maps that has wetland soils is located within the site. However, wetland delineations performed at the MONPP FAB by DTE Electric showed that all wetlands were located outside of the FAB berms (outside the CCR unit) in perimeter drainage channels. Mitigation and restoration plans have been developed for these delineated wetland areas by DTE Electric if they are impacted by ongoing facility operations. Additionally, these delineated wetland areas are fully protected by DTE Electric and are not to be encroached upon without permit.

Based on TRC's review of wetland inventory resources and current site conditions, the MONPP FAB is not located in an area exhibiting wetland characteristics, and that MONPP has established operations plans to minimize any potential impact to wetlands near the CCR unit. TRC also concludes that due to its use as an NPDES treatment unit, this basin is not wetlands as defined in § 232.2.

§ 257.62 – Fault Areas

The federal CCR rule requires that CCR units not be located within 60 meters (200 feet) of the outermost damage zone of a fault that has had displacement in Holocene time (within the most recent 11,700 years) unless the owner or operator demonstrates that an alternative setback distance of less than 60 meters (200 feet) will not cause damage to the structural integrity of the CCR unit. As shown on the U.S. Quaternary Folds and Faults Database Map (USGS, accessed 9/7/2018), no faults have been mapped near the MONPP FAB.

The lower peninsula of Michigan is covered by a mantle of glacial deposits obscuring any surficial evidence of faulting (Bricker, 1977). In these areas of glacial deposition, fault zones are considered to be stable, and any recent recorded earth movement in Michigan has been noted to originate from source depths of 95 to 110 kilometers into the subsurface (Brinker, 1977). Historical records indicate that nearly all seismic events that have occurred in Michigan have been relatively minor in intensity (I to VI on the Modified Mercalli Intensity Scale).

Evidence of active faulting during the Holocene in the MONPP FAB area is not supported by this determination; therefore, the FAB is in compliance with the requirements of §257.62.

§ 257.63 – Seismic Impact Zones

The federal CCR rule requires that CCR units not be located in seismic impact zones unless the owner or operator demonstrates 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. The federal CCR rule defines a seismic impact zone as "an area having a 2% or greater probability that the maximum expected horizontal acceleration, expressed as a percentage of the earth's gravitation pull (g), will exceed 0.10 g in 50 years."

To determine whether the MONPP FAB is located in a seismic impact zone, the USGS Earthquake Hazards Program was consulted to determine the earthquake hazard for the FAB.

The Earthquake Hazards Program uses the 2015 NEHRP Provisions as a reference document; the following factors were used to calculate the peak ground acceleration:

- The site class is Class C: firm to very stiff surficial clay soils underlain by very stiff to hard clay beginning at approximately 20 ft bgs. The clay is underlain by weathered and competent limestone bedrock beginning approximately 30 to 50 ft bgs. This determination was made based on the first 100 ft of soil and rock encountered. The first 50 feet are comprised of very stiff to hard clay, and the remainder is limestone bedrock.
- The site falls under the Risk Category III, due to its primary function as a power-generating station.

The 2015 National Earthquake Hazards Reduction Program U.S. seismic design maps website (USGS 2015; Appendix E) indicates a mapped peak ground acceleration of 0.063 g for the FAB area. Using the Class C site determination results in a design peak ground acceleration of 0.082 g. This calculated design peak ground acceleration value is less than 0.10 g in 50 years.

Evidence of a seismic impact zone is not supported by this determination; therefore, TRC concludes that the MONPP FAB is not located in a seismic impact zone. The FAB is in compliance with the requirements of § 257.63.

§ 257.64 – Unstable Areas

The federal CCR rule requires that CCR units not be located in an unstable area unless the owner or operator demonstrates that recognized and generally accepted good engineering practices have 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. Factors associated with soil conditions resulting in significant differential settlement, geologic or geomorphologic features, and human-made features or events must be evaluated to determine compliance.

This demonstration was performed by evaluating the results of geotechnical explorations at the MONPP (Geosyntec Consultants, 2010), the Round 7 Dam Assessment-Final Report (GZA GeoEnvironmental, Inc., 2011), reviewing local geology and topography, and evaluating human-made features or events at the MONPP area.

The geotechnical exploration performed at the MONPP identified silty clay, with traces of sand and gravel. The clay exhibits a very stiff to hard consistency and high shear strengths, with harder and stronger soils noted with depth. The unconsolidated soils occur above weathered and competent limestone bedrock. Based on these geotechnical records, there is no evidence of unstable soil or underlying bedrock conditions proximal to the FAB.

Based on information maintained by the Michigan Natural Features Inventory and Michigan State University Extension, Monroe County topography, due to the presence of underlying limestone bedrock, is subject to the potential but infrequent occurrence of sinkholes and caves. However, no evidence of sinkholes or caves have been discovered or noted at the MONPP property and therefore are not expected to contribute to the development of unstable site soil conditions.

Based on DTE Electric records, the perimeter berm for the FAB was constructed in the 1970s. In 2016, Geosystec Consultants performed a slope stability safety factor assessment for the FAB berms (Geosyntec, 2016). The assessment concluded that the Ash Basin meets the safety factor requirements with the maximum water level maintained at 609 ft MSL or less.

Evidence of unstable areas due to soil conditions resulting in significant differential settling, geologic or geomorphologic features, or human-made features or events is not supported by this determination; therefore, the MONPP FAB is not located in an unstable geological area and that the FAB berm meets safety factor requirements at current FAB operating conditions and berm structural conditions. The FAB, therefore, is in compliance with the requirements of § 257.64.

3.5 Structural Stability and Safety Factor Assessments § 257.71(d)(1)(i)(B)(4 and 5)

Structural stability assessment and safety factor assessments, as required per§ 257.73 (d) and (e), are required for the MONPP FAB surface impoundment.

The MONPP FAB Surface Impoundment has been compressively analyzed and is in compliance with periodic structural stability assessments pursuant to § 257.73(d) and periodic safety factor assessments pursuant to § 257.73(e). These assessments have been completed by a qualified professional engineer, are attached as **Appendix H** and are summarized below:

<u>Demonstration of Compliance with § 257.73(d)</u>

The first Periodic Structural Stability Assessment report, dated October 17, 2016, concluded:

> "Based on the safety factor assessment and the annual inspection results, Geosyntec concludes that the Monroe Ash Basin facility was designed, constructed, operated and maintained with generally accepted good engineering standards."

To reach this conclusion, the following specific requirements of § 257.73(d) were found to be in compliance (abbreviated text provided):

(1) Initial structural stability assessment
  - (i) Stable foundations and abutments;
  - (ii) Adequate slope protection;
  - (iii) Dikes mechanically compacted to sufficient density;
  - (iv) Vegetated slopes of dikes to resist erosion, wave action and sudden drawdown; and
  - (v) A single spillway with an emergency spillway that meet the CCR Rule;

(2) Identification of any structural stability deficiencies and recommended corrective measures.

Since 2016, periodic annual inspections have been performed and documented by a qualified professional engineer in accordance with § 257.83. Based on the results obtained from annual inspections, FAB Surface Impoundment has continued to meet the requirements of § 257.73(d).

Demonstration of Compliance with § 257.73(e)

The first Safety Factor Assessment report, dated October 17, 2016, concluded:

> "Based on the results of slope stability analyses, the Ash Basin meets the safety factor assessment required per § 257.73(e)."

To reach this conclusion, the following were considered in the analysis:

- The embankment is uniformly, mechanically compacted with low plasticity clay to a minimum dry density established based on a Modified Proctor Test (ASTM D-1557);
- Four potentially critical cross-sections were analyzed increasing the confidence in the analysis by examining the slope to identify the lowest factor of safety; Soil shear strengths of the FAB Surface Impoundment and foundation soils were established using 23 laboratory tests that confirmed consistent results with little variability providing confidence in the shear strength values;
- Piezometric pressures that were measured from the embankment with the vibrating wire piezometers were used for more accurate slope stability analyses; and
- The FAB Surface Impoundment water levels are being maintained at elevation 609 ft since 2016, which is several feet lower than historic water levels. As a result, the factor of safety is expected to increase over time.

Since 2016, periodic annual inspections have been performed and documented by a qualified professional engineer in accordance with § 257.83. Based on the results obtained from annual inspections, the FAB Surface Impoundment has continued to meet the requirements of § 257.73(e).

3.6 Documentation of Design Specifications § 257.71(d)(1)(i)(C)

The liner is comprised of two components: natural clay deposits and the compacted clay embankment for the side liner. Geotechnical investigations completed in 1970, 1973, 1974 and 1994 and for monitoring well installations in 2016 demonstrate extensive clay deposits that act as an effective natural clay liner across the MONPP FAB CCR Unit. This is documented in the *Effectiveness of the Underlying Clay Soil as a Natural Barrier On-Site, Ash Disposal Basin, Monroe Power Plant* technical report, prepared in 1995 by the Detroit Edison Design Engineering Power Generation Organization. According to the 1995 Report, "The underlying clay soil has been analyzed and found to serve as an effective natural barrier against the steady-state seepage of leachate from the facility to the hydrogeologic environment. No migration of leachate from the facility is predicted to occur during its active life and the ensuing 30-year post closure period". This report is attached as **Appendix K**.

Prior to construction, a formal embankment design for the FAB was performed. A review of the FAB construction quality was completed by Geosyntec Consultants (Geosyntec). The results of the review are provided in an Alternate Liner Demonstration Application Support for DTE Monroe Power Plant Fly Ash Basin in Monroe, MI Documentation of Source Material and Construction Quality memorandum dated November 24, 2020. This memorandum is attached as **Appendix L.** The memorandum documents that the FAB clay embankment was constructed using state of the practice specifications and construction methods. This has been confirmed and documented by many investigations in the embankment after construction. Further, the majority of the embankment has been made wider through a slope flattening program where the embankment was constructed under state of the practice specifications and a well-documented construction quality assurance (CQA) program. The embankment (liner) construction is of good quality and in line with proven and accepted engineering practices.

3.7 Facilities with CCR surface impoundments Located on Properties Adjacent to a Water Body § 257.71(d)(1)(i)(D)

The MONPP FAB CCR Unit is located adjacent to surface water bodies, however, based on historic soil boring data (presented in **Appendix K**) and construction documentation (presented in **Appendix L**), the FAB Unit is separated from the water bodies by an extensive low permeability clay unit and an extensive 40 or more-foot-high perimeter compacted stable clay berm. Specifically, based on the soil boring data collected across the MONPP FAB CCR Unit, the FAB construction documentation, the FAB Structural Stability and Safety Factor Assessments (presented in **Appendix H**); and related data collected during the ongoing FAB slope maintenance and monitoring program described in **Section 3.5**; the FAB CCR Unit is separated from the water bodies by an extensive underlying low permeability clay unit and an extensive 40 or more-foot-high perimeter compacted stable clay berm. Therefore, there is no reasonable probability that a complete and direct transport pathway (*i.e.*, not mediated by groundwater) exists between the impoundment and any nearby surface water body.

3.8 Alternate Liner Application Placed in the Operating Record - § 257.71(d)(1)(i)(E)

This alternate liner demonstration application and supplemental materials submitted in this application have been placed in the facility's operating record as required by § 257.105(f)(14).

4.0 Conclusions

This document demonstrates how the MONPP FAB CCR Unit meets the provisions of the initial application for an alternate liner demonstration by:

- Demonstrating continued compliance with the CCR Rule for all record keeping, notification and internet posting requirements. In addition, detection monitoring is completed at the established groundwater monitoring network as required by 40 CFR § 257.93 and § 257.94 and annual reporting as required by 40 CFR § 257.90 documents compliance with the detection monitoring program;
- Demonstrating the presence of a natural geologic barrier underlying the MONPP FAB CCR Unit, that consists of a thick (> 23 feet), low hydraulic conductivity clay, that provides the same, or better level of protection from potential migration of contaminants than the composite liner defined in 40 CFR § 257.70(b);
- Demonstrating that the MONPP FAB CCR Unit is compliant with the location restrictions of 40 CFR § 257.60-64 and the structural stability and safety factor assessments as required per 40 CFR § 257.103 (f)(2)(v)(C)(7) and (8);
- Soil boring data collected across the MONPP FAB CCR Unit, FAB construction documentation, FAB structural stability and safety factor assessments and the data collected during the ongoing FAB slope maintenance and monitoring program demonstrate that there is no reasonable probability that a complete and direct transport pathway (*i.e.*, not mediated by groundwater) exists between the impoundment and any nearby water body and;
- Placing this alternate liner demonstration application and supplemental materials submitted in this application in the facility's operating record as required by § 257.105(f)(14).

Therefore, it is requested that the EPA approve DTE Electric's initial application to complete an alternate liner demonstration for the MONPP FAB CCR Unit prepared per§ 257.71(d)(i).

5.0 References

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Tables

Table 1.1
Comparison of Appendix III Parameter Results to Background Limits – September 2017
Monroe Power Plant Fly Ash Basin – RCRA CCR Monitoring Program
Monroe, Michigan

Sample Location:		MW-16-01		MW-16-02		MW-16-03		MW-16-04		MW-16-05		MW-16-06			MW-16-07		
Sample Date:		9/18/2017		9/18/2017		9/19/2017		9/19/2017		9/19/2017		9/18/2017	1/8/2018 (1)		9/19/2017	1/8/2018 (1)	
Constituent	Unit	Data	PL	Data	PL	Data	PL	Data	PL	Data	PL	Data		PL	Data		PL
Appendix III																	
Boron	ug/L	270	310	420	470	460	510	170	210	250	280	340	--	400	200	--	280
Calcium	ug/L	380,000	450,000	390,000	430,000	400,000	490,000	530,000	610,000	390,000	440,000	380,000	--	420,000	370,000	--	440,000
Chloride	mg/L	11	14	13	15	18	20	34	39	11	12	11	--	12	7.8	--	13
Fluoride	mg/L	1.8	2.1	1.6	1.8	1.5	1.8	1.0	1.1	1.5	1.7	1.6	--	1.8	1.5	--	1.8
pH, Field	SU	6.9	6.3 - 9.0	7.0	6.9 - 7.3	6.9	6.7 - 7.3	7.0	7.0 - 7.5	6.9	6.6 - 7.7	**6.9**	7.0	7.0 - 7.3	**6.8**	7.0	6.9 - 7.4
Sulfate	mg/L	1,500	1,500	1,500	1,700	1,500	1,700	1,300	1,500	1,400	1,600	1,500	--	1,600	1,400	--	1,600
Total Dissolved Solids	mg/L	2,200	2,200	2,300	2,300	2,300	2,300	2,100	2,200	2,100	2,200	2,300	--	2,300	2,100	--	2,200

Notes:

ug/L - micrograms per liter.

mg/L - milligrams per liter.

SU - standard units; pH is a field parameter.

-- = not analyzed

All metals were analyzed as total unless otherwise specified.

Bold font indicates an exceedance of the Prediction Limit (PL).

(1) Results shown for verification sampling performed on 1/8/18.

Table 1.2
Comparison of Appendix III Parameter Results to Background Limits – April 2018
Monroe Power Plant Fly Ash Basin – RCRA CCR Monitoring Program
Monroe, Michigan

Sample Location:		MW-16-01		MW-16-02		MW-16-03		MW-16-04		MW-16-05		MW-16-06			MW-16-07		
Sample Date:		4/2/2018	PL	4/3/2018	PL	4/3/2018	PL	4/3/2018	PL	4/3/2018	PL	4/2/2018	5/23/18(1)	PL	4/2/2018	5/23/18(1)	PL
Constituent	Unit	Data		Data		Data		Data		Data		Data			Data		
Appendix III																	
Boron	ug/L	280	310	400	470	460	510	180	210	240	280	340	--	400	220	--	280
Calcium	ug/L	420,000	450,000	410,000	430,000	280,000	490,000	300,000	610,000	440,000	440,000	**430,000**	380,000	420,000	**450,000**	410,000	440,000
Chloride	mg/L	11	14	14	15	19	20	35	39	11	12	12	--	12	8.1	--	13
Fluoride	mg/L	1.8	2.1	1.6	1.8	1.5	1.8	1.0	1.1	1.5	1.7	1.6	--	1.8	1.5	--	1.8
pH, Field	SU	7.1	6.3 - 9.0	7.0	6.9 - 7.3	7.0	6.7 - 7.3	7.0	7.0 - 7.5	7.0	6.6 - 7.7	7.1	--	7.0 - 7.3	7.0	--	6.9 - 7.4
Sulfate	mg/L	1,500	1,500	1,500	1,700	1,600	1,700	1,400	1,500	1,400	1,600	1,500	--	1,600	1,400	--	1,600
Total Dissolved Solids	mg/L	2,200	2,200	2,100	2,300	2,200	2,300	2,000	2,200	2,000	2,200	**2,500**	2,200	2,300	2,000	--	2,200

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
-- = not analyzed
All metals were analyzed as total unless otherwise specified.
Bold font indicates an exceedance of the Prediction Limit (PL).
RESULT Shading and bold font indicates a comfirmed exceedance of the Prediction Limit (PL).
(1) Results shown for verification sampling performed on 5/23/18.

Table 1.3
Comparison of Appendix III Parameter Results to Background Limits – October 2018
Monroe Power Plant Fly Ash Basin – RCRA CCR Monitoring Program
Monroe, Michigan

Sample Location:		MW-16-01		MW-16-02		MW-16-03		MW-16-04		MW-16-05		MW-16-06		MW-16-07	
Sample Date:		10/8/2018	PL	10/8/2018	PL	10/8/2018	PL	10/8/2018	PL	10/8/2018	PL	10/8/2018	PL	10/8/2018	PL
Constituent	Unit	Data		Data		Data		Data		Data		Data		Data	
Appendix III															
Boron	ug/L	280	310	410	470	480	510	200	210	240	280	360	400	220	280
Calcium	ug/L	350,000	450,000	340,000	430,000	400,000	490,000	500,000	610,000	350,000	440,000	360,000	420,000	360,000	440,000
Chloride	mg/L	11	14	14	15	19	20	35	39	11	12	12	12	8.1	13
Fluoride	mg/L	1.7	2.1	1.5	1.8	1.5	1.8	0.99	1.1	1.4	1.7	1.5	1.8	1.5	1.8
pH, Field	SU	7.1	6.3 - 9.0	7.1	6.9 - 7.3	7.1	6.7 - 7.3	7.1	7.0 - 7.5	7.1	6.6 - 7.7	7.0	7.0 - 7.3	7.0	6.9 - 7.4
Sulfate	mg/L	1,500	1,500	1,600	1,700	1,600	1,700	1,500	1,500	1,600	1,600	1,600	1,600	1,600	1,600
Total Dissolved Solids	mg/L	2,100	2,200	2,200	2,300	2,200	2,300	2,000	2,200	2,000	2,200	2,100	2,300	2,100	2,200

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
-- = not analyzed
All metals were analyzed as total unless otherwise specified.
Bold font indicates an exceedance of the Prediction Limit (PL).
RESULT Shading and bold font indicates a comfirmed exceedance of the Prediction Limit (PL).

Table 1.4
Comparison of Appendix III Parameter Results to Background Limits – March 2019
Monroe Power Plant FAB and VEL – RCRA CCR Monitoring Program
Monroe, Michigan

Sample Location:		MW-16-01		MW-16-02		MW-16-03		MW-16-04		MW-16-05		MW-16-06		MW-16-07	
Sample Date:		3/26/2019	PL	3/25/2019	PL	3/25/2019	PL	3/25/2019	PL	3/25/2019	PL	3/25/2019	PL	3/26/2019	PL
Constituent	Unit	Data		Data		Data		Data		Data		Data		Data	
Appendix III															
Boron	ug/L	270	310	420	470	460	510	170	210	230	280	350	400	210	280
Calcium	ug/L	390,000	450,000	400,000	430,000	400,000	490,000	510,000	610,000	400,000	440,000	400,000	420,000	400,000	440,000
Chloride	mg/L	10	14	13	15	18	20	33	39	11	12	12	12	7.8	13
Fluoride	mg/L	1.7	2.1	1.5	1.8	1.5	1.8	0.95	1.1	1.5	1.7	1.5	1.8	1.5	1.8
pH, Field	SU	7.1	6.3 - 9.0	7.1	6.9 - 7.3	6.7	6.7 - 7.3	7.0	7.0 - 7.5	6.9	6.6 - 7.7	7.0	7.0 - 7.3	7.1	6.9 - 7.4
Sulfate	mg/L	1,400	1,500	1,500	1,700	1,600	1,700	1,400	1,500	1,500	1,600	1,500	1,600	1,400	1,600
Total Dissolved Solids	mg/L	2,200	2,200	2,200	2,300	2,200	2,300	2,100	2,200	2,200	2,200	2,100	2,300	2,100	2,200

Notes:

ug/L - micrograms per liter.

mg/L - milligrams per liter.

SU - standard units; pH is a field parameter.

All metals were analyzed as total unless otherwise specified.

Bold font indicates an exceedance of the Prediction Limit (PL).

FAB - Fly Ash Basin.

VEL - Vertical Extension Landfill.

Table 1.5

Comparison of Appendix III Parameter Results to Background Limits – March 2019
Monroe Power Plant FAB and VEL – RCRA CCR Monitoring Program
Monroe, Michigan

Sample Location:		MW-16-01		MW-16-02		MW-16-03			MW-16-04			MW-16-05		MW-16-06		MW-16-07	
Sample Date:		9/23/2019	PL	9/23/2019	PL	9/23/2019	11/6/2019	PL	9/23/2019	11/6/2019[1]	PL	9/25/2019	PL	9/23/2019	PL	9/23/2019	PL
Constituent	Unit	Data		Data		Data			Data			Data		Data		Data	
Appendix III																	
Boron	ug/L	250	310	380	470	440	--	510	160	--	210	220	280	310	400	190	280
Calcium	ug/L	400,000	450,000	380,000	430,000	410,000	--	490,000	520,000	--	610,000	370,000	440,000	380,000	420,000	390,000	440,000
Chloride	mg/L	9.9	14	13	15	18	--	20	32	--	39	11	12	11	12	7.5	13
Fluoride	mg/L	1.7	2.1	1.5	1.8	1.5	--	1.8	0.95	--	1.1	1.4	1.7	1.5	1.8	1.4	1.8
pH, Field	SU	7.2	6.3 - 9.0	7.2	6.9 - 7.3	7.1	7.2	6.7 - 7.3	7.2	7.2	7.0 - 7.5	7.0	6.6 - 7.7	7.1	7.0 - 7.3	7.2	6.9 - 7.4
Sulfate	mg/L	1,500	1,500	1,600	1,700	1,600	--	1,700	1,400	--	1,500	1,400	1,600	1,500	1,600	1,500	1,600
Total Dissolved Solids	mg/L	2,200	2,200	2,200	2,300	**2,500**	2,300	2,300	**2,300**	**2,300**[2]	2,200	2,100	2,200	2,300	2,300	2,100	2,200

Notes:

ug/L - micrograms per liter.

mg/L - milligrams per liter.

SU - standard units; pH is a field parameter.

-- - not analyzed.

FAB - Fly Ash Basin.

VEL - Vertical Extension Landfill.

All metals were analyzed as total unless otherwise specified.

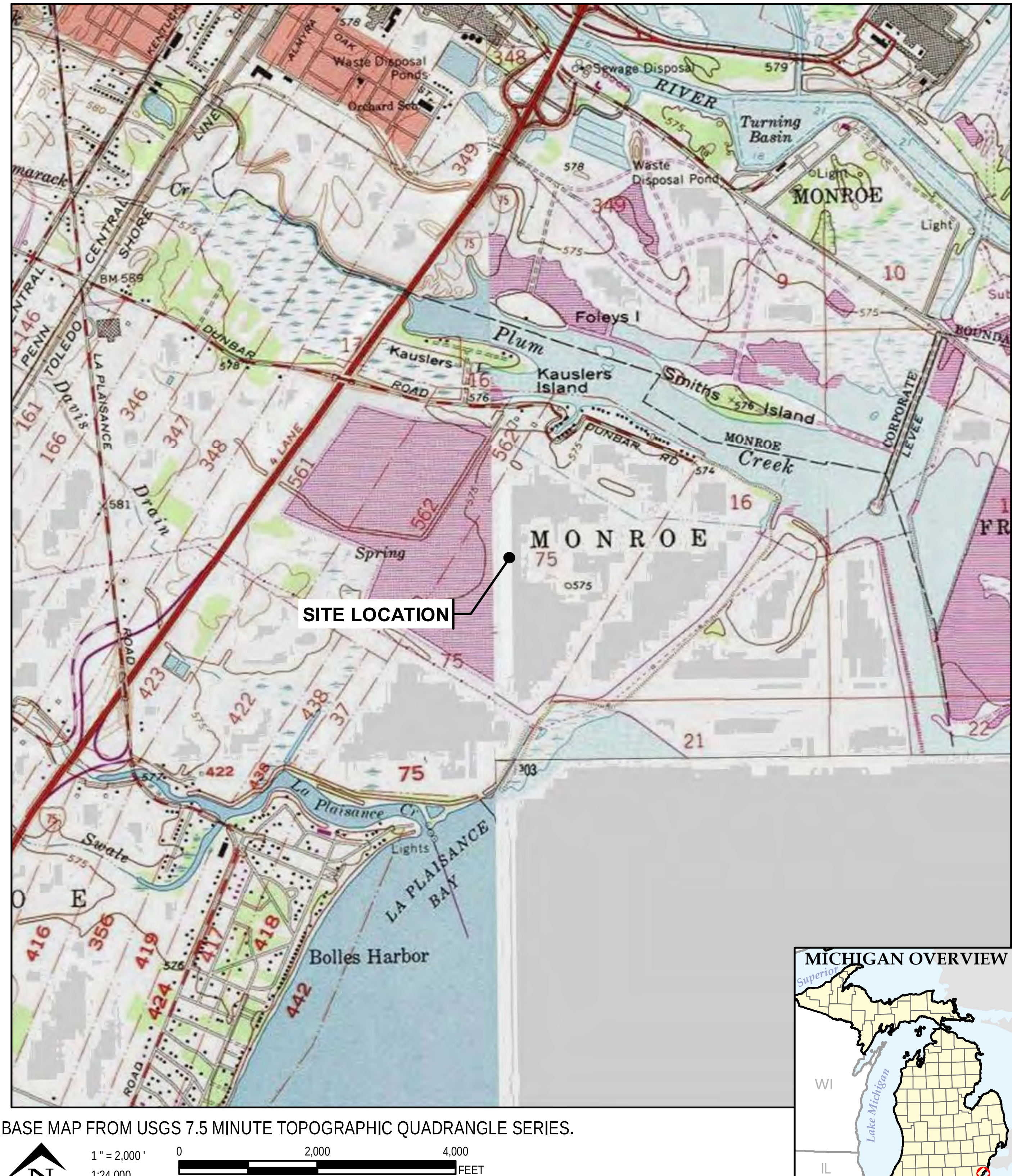
Bold font indicates an exceedance of the Prediction Limit (PL).

RESULT Shading and bold font indicates a confirmed exceedance of the Prediction Limit (PL).

(1) - Results shown for verification sampling performed on 11/6/2019.

(2) - New successful alternative source demonstration was completed following confirmation of the intial statistically significant exceedance.

Figures



BASE MAP FROM USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE SERIES.

N

1 " = 2,000 '

1:24,000

0 2,000 4,000 FEET

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PROJECT:

DTE ELECTRIC COMPANY
MONROE POWER PLANT
FLY ASH BASIN AND VERTICAL EXTENSION LANDFILL
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:

SITE LOCATION MAP

DRAWN BY:	S.MAJOR
CHECKED BY:	B. YELEN
APPROVED BY:	V. BUENING
DATE:	JANUARY 2020
PROJ. NO.:	320511.0001
FILE:	320511-0001-008SLM-MPP-Fig01.mxd

FIGURE 1

E:\DTE\CCR_Sites\2017_265996\320511-0001-008SLM-MPP-Fig01.mxd -- Saved By: MVAPHIADIS on 1/28/2020, 11:58:35 AM

LEGEND

- MONITORING WELLS
- APPROXIMATE BOUNDARY OF FLY ASH BASIN
- APPROXIMATE BOUNDARY OF VERTICAL EXTENSION LANDFILL

NOTES

1. BASE MAP IMAGERY FROM GOOGLE EARTH PRO, 2018.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.

PROJECT:
DTE ELECTRIC COMPANY
MONROE POWER PLANT
FLY ASH BASIN AND VERTICAL EXTENSION LANDFILL
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:
MONITORING NETWORK AND SITE PLAN

DRAWN BY:	M. VAPHIADIS	PROJ NO.:	320511.0001
CHECKED BY:	J. KRENZ	FIGURE 2	
APPROVED BY:	V. BUENING		
DATE:	JANUARY 2020		

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FILE NO.: 320511-0001-017-MPP-Fig02.mxd

TRC - GIS

Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

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Path: E:\DTE\CCR_Sites\2017_265996\320511-0001-017-MPP-Fig02.mxd

LEGEND

- MONITORING
- APPROXIMATE SURFACE WATER SAMPLE MP-001F LOCATION
- APPROXIMATE BOUNDARY OF FLY ASH
- APPROXIMATE BOUNDARY OF VERTICAL EXTENSION LANDFILL
- CROSS

NOTES

1. BASE MAP IMAGERY FROM GOOGLE EARTH PRO, 2018.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.

N

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:

DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN AND VERTICAL EXTENSION LANDFILL
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:

CROSS SECTION LOCATOR MAP

DRAWN BY:	J. PAPEZ	PROJ NO.:	265996.0001
CHECKED BY:	S. HOLMSTROM	**FIGURE 3**	
APPROVED BY:	V. BUENING		
DATE:	OCTOBER 2019		

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FILE NO.: 320511-0001-003.mxd

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Coordinate System: NAD 1983 UTM Zone 17N (Meter)
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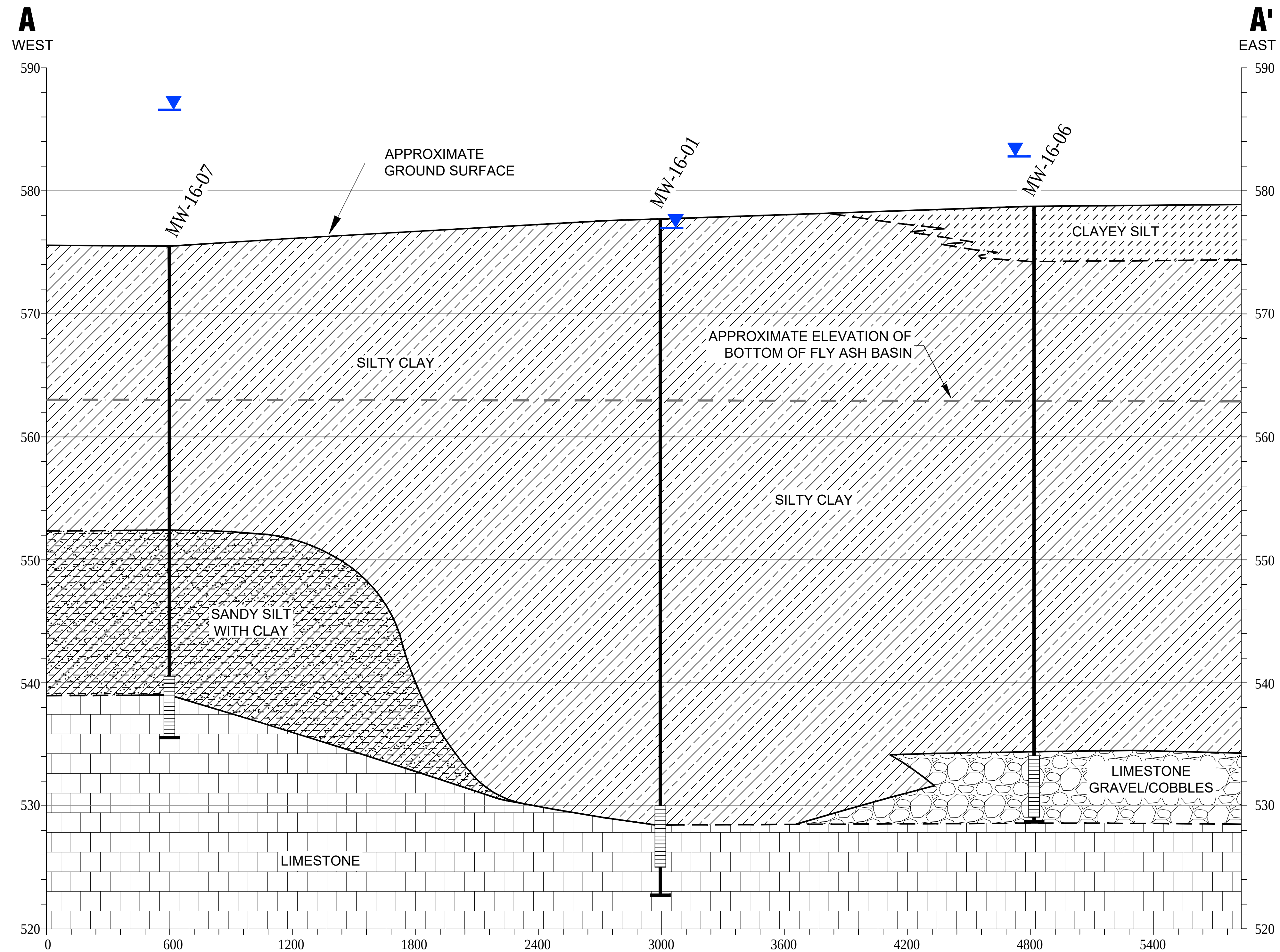
Path: E:\DTE\CCR_Sites\2017_265996\320511-0001-003.mxd

GENERALIZED GEOLOGIC CROSS-SECTION A-A'



LEGEND

STRATEGRAPHIC BOUNDARY
(DASHED WHERE INFERRED)

GROUNDWATER ELEVATION
(COLLECTED ON 03/06/2017)

SOIL BORING

WELL SCREEN INTERVAL

END OF BORING

Lithology Key

CLAYEY SILT

SILTY CLAY

SANDY SILT WITH CLAY

LIMESTONE
GRAVEL / COBBLES

LIMESTONE BEDROCK

SCALE
IN
FEET

VERTICAL 0 10

HORIZONTAL 0 600

PROJECT: **DTE ELECTRIC COMPANY**
MONROE POWER PLANT
FLY ASH BASIN AND VERTICAL EXTENSION LANDFILL
MONROE, MICHIGAN

TITLE: **GENERALIZED**
GEOLOGIC CROSS-SECTION A-A'

DRAWN BY:	D.STEHLE	PROJ NO.:	265996.0001.01
CHECKED BY:	S.HOLMSTROM		**FIGURE 4**
APPROVED BY:	V.BUENING		
DATE:	SEPTEMBER 2017		

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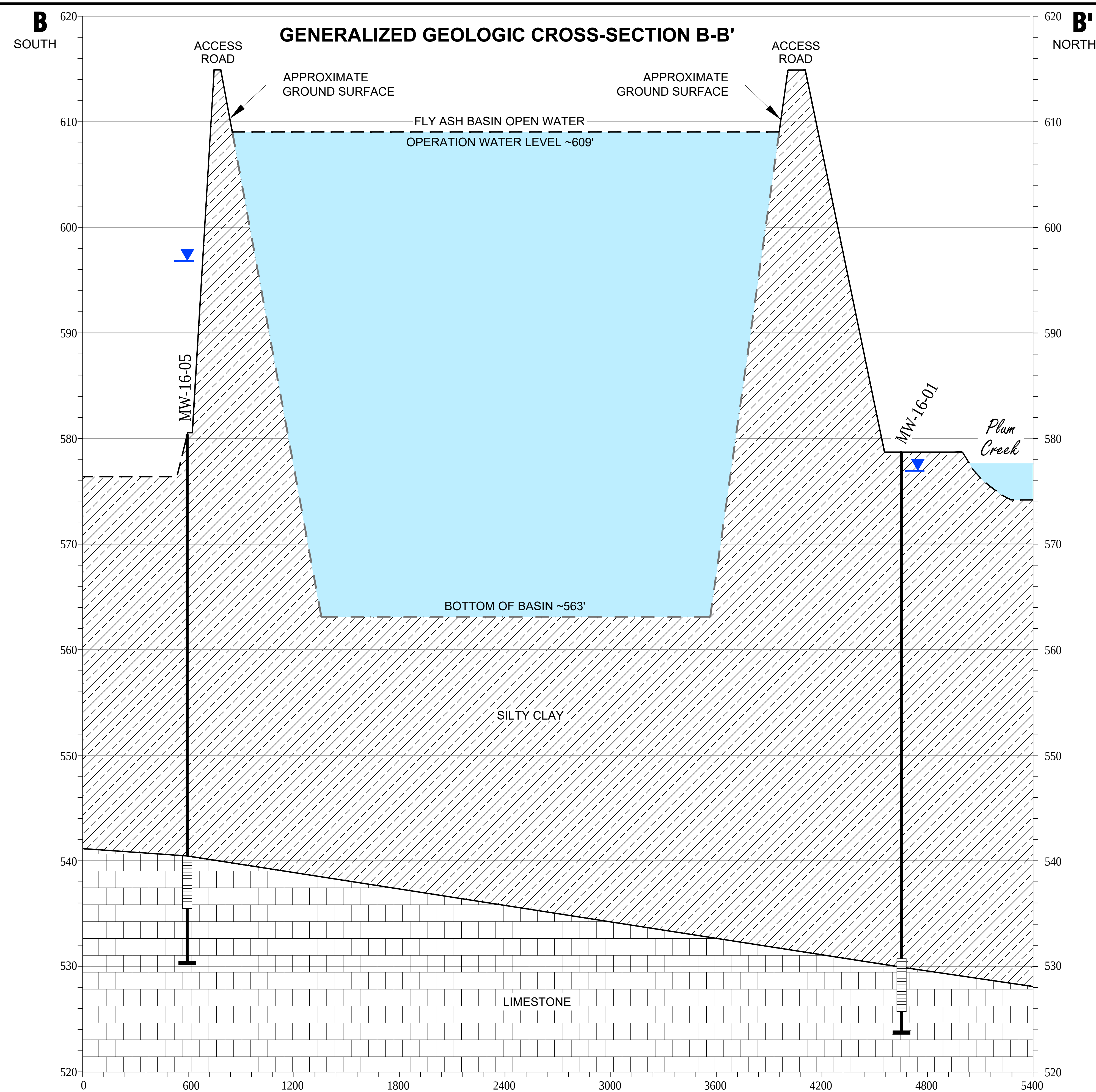
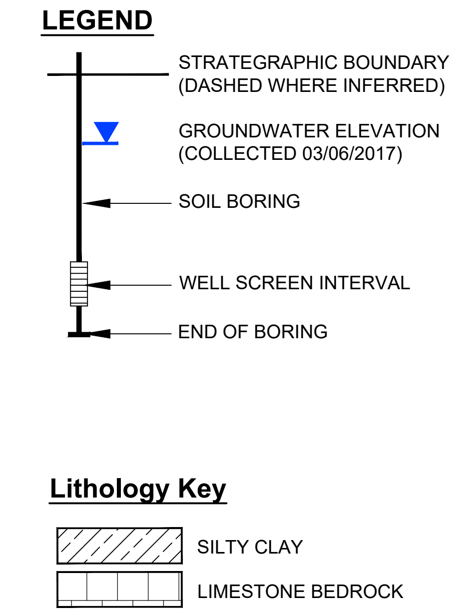
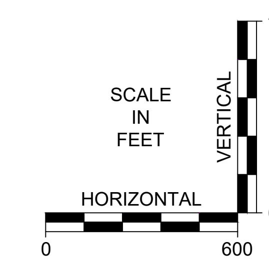
FILE NO.: 265996.0001.01.01.04-05.dwg

11x17 --- ATTACHED XREFS: --- ATTACHED IMAGES:
DRAWING NAME: J:_TRC\DTE\Monroe PP\265996\0001\01\ 265996.0001.01.01.04-05.dwg --- PLOT DATE: November 11, 2020 - 8:31AM --- LAYOUT: FIG04 XS AA







PROJECT: DTE ELECTRIC COMPANY
MONROE POWER PLANT
FLY ASH BASIN AND VERTICAL EXTENSION LANDFILL
MONROE, MICHIGAN

TITLE: GENERALIZED GEOLOGIC CROSS-SECTION B-B'

DRAWN BY:	D.Stehle	PROJ NO.:	265996.0001.01.01
CHECKED BY:	S.HOLMSTROM	FIGURE 5	
APPROVED BY:	V.BUENING		
DATE:	MAY 2017		

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FILE NO.: 265996.0001.01.01.04-05.dwg

11x17 --- ATTACHED XREF'S: --- ATTACHED IMAGES:
DRAWING NAME: J:_TRC\DTE\Monroe PP\265996\0001\01\ 265996.0001.01.01.04-05.dwg --- PLOT DATE: November 11, 2020 - 8:32AM --- LAYOUT: FIG05 XS BB

LEGEND

- MONITORING WELL
- APPROXIMATE BOUNDARY OF FLY ASH BASIN
- INFERRED GROUNDWATER FLOW DIRECTION
- POTENTIOMETRIC SURFACE CONTOUR LINE (5-FT INTERVAL,DASHED WHERE INFERRED)
- (582.69) STATIC WATER ELEVATION IN FEET (NAVD, 1988)

NOTES

1. BASE MAP IMAGERY FROM ESRI/MICROSOFT, "WORLD IMAGERY", WEB BASEMAP SERVICE LAYER.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.
3. GROUNDWATER ELEVATIONS DISPLAYED IN FEET RELATIVE TO NORTH AMERICAN VERTICAL DATUM OF 1988

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:

DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:

POTENTIOMETRIC SURFACE MAP
SEPTEMBER 2017

DRAWN BY:	S MAJOR	PROJ NO.:	265996.0001
CHECKED BY:	C. SCIESZKA		**FIGURE 6**
APPROVED BY:	V. BUENING		
DATE:	JANUARY 2018		

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FILE NO.: 265996-0001-011a.mxd

TRC - GIS

Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

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Path: E:\DTE\CCR_Sites\2017_265996\265996-0001-011a.mxd

LEGEND

- MONITORING WELL
- APPROXIMATE BOUNDARY OF FLY ASH BASIN
- INFERRED GROUNDWATER FLOW DIRECTION
- POTENTIOMETRIC SURFACE CONTOUR LINE (5-FT INTERVAL,DASHED WHERE INFERRED)
- (582.69) STATIC WATER ELEVATION IN FEET (NAVD, 1988)

NOTES

1. BASE MAP IMAGERY FROM ESRI/MICROSOFT, "WORLD IMAGERY", WEB BASEMAP SERVICE LAYER.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.
3. GROUNDWATER ELEVATIONS DISPLAYED IN FEET RELATIVE TO NORTH AMERICAN VERTICAL DATUM OF 1988

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:
DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:
POTENTIOMETRIC SURFACE MAP
APRIL 2018

DRAWN BY:	S MAJOR	PROJ NO.:	265996.0001
CHECKED BY:	C. SCIESZKA		
APPROVED BY:	V. BUENING		**FIGURE 7**
DATE:	JANUARY 2019		

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FILE NO.: 265996-0001-013.mxd

Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

Plot Date: 1/2/2019, 09:48:54 AM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\DTE\CCR_Sites\2017_265996\265996-0001-013.mxd

LEGEND

- MONITORING WELL
- APPROXIMATE BOUNDARY OF FLY ASH BASIN
- INFERRED GROUNDWATER FLOW DIRECTION
- POTENTIOMETRIC SURFACE CONTOUR LINE (5-FT INTERVAL,DASHED WHERE INFERRED)
- *(582.69)* STATIC WATER ELEVATION IN FEET (NAVD, 1988)

NOTES

1. BASE MAP IMAGERY FROM ESRI/MICROSOFT, "WORLD IMAGERY", WEB BASEMAP SERVICE LAYER.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.
3. GROUNDWATER ELEVATIONS DISPLAYED IN FEET RELATIVE TO NORTH AMERICAN VERTICAL DATUM OF 1988

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:
DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:
POTENTIOMETRIC SURFACE MAP
OCTOBER 2018

DRAWN BY:	S MAJOR	PROJ NO.:	265996.0001
CHECKED BY:	C. SCIESZKA		
APPROVED BY:	V. BUENING	**FIGURE 8**	
DATE:	JANUARY 2019		

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Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

Plot Date: 1/2/2019, 12:36:34 PM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\DTE\CCR_Sites\2017_265996\265996-0001-015.mxd

LEGEND

- MONITORING WELL
- APPROXIMATE BOUNDARY OF FLY ASH BASIN
- APPROXIMATE BOUNDARY OF VERTICAL EXTENSION LANDFILL
- POTENTIOMETRIC SURFACE CONTOUR LINE (5-FT INTERVAL,DASHED WHERE INFERRED)
- *(582.84)* STATIC WATER ELEVATION IN FEET (NAVD, 1988)

NOTES

1. BASE MAP IMAGERY FROM GOOGLE & PARTNERS GOOGLE EARTH PRO, 04/2018.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.
3. GROUNDWATER ELEVATIONS DISPLAYED IN FEET RELATIVE TO NORTH AMERICAN VERTICAL DATUM OF 1988

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:
DTE ELECTRIC COMPANY
MONROE POWER PLANT
FLY ASH BASIN AND VERTICAL EXTENSION LANDFILL
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:
POTENTIOMETRIC SURFACE MAP
MARCH 2019

DRAWN BY:	M. VAPHIADIS	PROJ NO.:	320511.0001
CHECKED BY:	J. KRENZ		**FIGURE 9**
APPROVED BY:	V. BUENING		
DATE:	JANUARY 2020		

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FILE NO.: 320511-0001-018-MPP-Fig03.mxd

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Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

Plot Date: 1/28/2020, 11:49:05 AM by MVAPHIADIS -- LAYOUT: ANSI B(11"x17")
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TRC - GIS

Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

Plot Date: 10/29/2020, 14:00:20 PM by AHORRIE -- LAYOUT: ANSI B(11"x17")
Path: E:\DTE\CCR_Sites\2017_265996\386089-0001-019-MPP-Fig07.mxd

LEGEND

- MONITORING WELL
- APPROXIMATE BOUNDARY OF FLY ASH BASIN
- APPROXIMATE BOUNDARY OF VERTICAL EXTENSION LANDFILL
- POTENTIOMETRIC SURFACE CONTOUR LINE (5-FT INTERVAL,DASHED WHERE INFERRED)
- *(582.69)* STATIC WATER ELEVATION IN FEET (NAVD, 1988)

NOTES

1. BASE MAP IMAGERY FROM GOOGLE EARTH PRO, 2018.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.
3. GROUNDWATER ELEVATIONS DISPLAYED IN FEET RELATIVE TO NORTH AMERICAN VERTICAL DATUM OF 1988.
4. NM = NOT MEASURED; MW-16-05 WAS DAMAGED AT THE TIME OF SAMPLING.

0 600 1,200 Feet

1 " = 600 '
1:7,200

PROJECT:
DTE ELECTRIC COMPANY
MONROE POWER PLANT
FLY ASH BASIN AND VERTICAL EXTENSION LANDFILL
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:
POTENTIOMETRIC SURFACE MAP
SEPTEMBER 2019

DRAWN BY:	M. VAPHIADIS	PROJ NO.:	386089.0002
CHECKED BY:	J. KRENZ		
APPROVED BY:	V. BUENING		**FIGURE 10**
DATE:	OCTOBER 2020		

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FILE NO.: 386089-0001-019-MPP-Fig07.mxd

Appendix A
Natural Clay Liner Equivalency Evaluation Report, DTE Electric and Consumers Energy Company Six Southeast Michigan Coal Combustion Residual Units, December 2018

Natural Clay Liner Equivalency Evaluation Report

DTE Electric Company and
Consumers Energy Company
Six Southeast Michigan Coal Combustion Residual Units

December 2018

Natural Clay Liner Equivalency Evaluation Report

DTE Electric Company and Consumers Energy Company Six Southeast Michigan Coal Combustion Residual Units

December 2018

Prepared For
DTE Electric Company and
Consumers Energy Company

Graham Crockford, CPG
CCR Program Manager

Vincent E. Buening, CPG
Senior Project Manager

Steve Sellwood, PhD
Senior Hydrogeologist

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Table of Contents

List of Tables

List of Appendices

Section 1
Introduction

1.1 Background and Objective

The minimum composite liner specified by federal regulations promulgated on April 17, 2015 (CCR Rule) for coal combustion residual (CCR) disposal units includes a geomembrane directly overlying two feet of compacted clay having a hydraulic conductivity no greater than 1 x 10^{-7} cm/s. For new and existing CCR disposal units, Michigan regulations define a natural soil barrier having a hydraulic conductivity no greater than 1 x 10^{-7} cm/s that may be permitted as a protective liner system in lieu of a constructed composite liner if it can be demonstrated that the natural soil liner meets the performance standards outlined in Rule 299.4307 of PA 451 of the Natural Resources and Environmental Protection Act (NREPA), Part 115 (Solid Waste Management). Michigan's Solid Waste Management Program codified in Part 115 is the state's equivalent Subtitle D permitting program for solid waste management, and is a United States Environmental Protection Agency (EPA) authorized program and consequently there is an inherent acknowledgement that natural soil liners can provide equivalent protection as composite liner systems by Michigan and the EPA.

On August 21, 2018 the United States Court of Appeals District of Columbia Circuit Court (DC Court) ruled on a number of CCR issues, some that have been pending since promulgation of the CCR Rule in 2015. The primary response from the DC Court was to rule on whether EPA's request to stay litigation pending anticipated court-mandated rulemaking from a settlement agreement entered on April 18, 2016 where EPA committed to addressing issues in a Remand Rule by June 2019. The court requested oral argument on all remaining issues of litigation at the time of the request for stay in order to weigh merits of the motion. The DC Court decision ultimately denies the motion and issues an opinion on all of the remaining issues of litigation which included vacatur and remand of:

- 257.101(a), which governed the conditions that would force an unlined surface impoundment to cease receiving CCR and non-CCR if a groundwater protection standard was exceeded unless strict conditions and timelines for alternative closure could be certified by the owner or operator pursuant to 257.103.
- 257.71(a)(1)(i), which defined 2 feet of compacted soil (K value of no more than 1x10^{-7} cm/s) for existing impoundments as meeting the liner standard (i.e., "clay lined" pond considered a lined pond).

By vacating 257.101(a) and 257.71(a)(1)(i), electric power generators who intended to continue using their existing ponds for CCR or non-CCR (assuming they met all of the remaining provisions/standards of 257.101), would potentially have to close or retrofit/reline these ponds.

Multiple CCR impoundments in southeast Michigan are documented to be constructed within thick (> 20 feet thick, in some cases more than 100 feet thick) laterally contiguous glacially compacted natural clay-rich soils with a hydraulic conductivity no greater than 1 x 10^{-7} cm/s prior to implementation of the CCR Rule requiring composite liners (§257.70) or demonstration of equivalent performance to alternative composite liners. As the natural soil underlying these CCR impoundment units consists of thick, low-hydraulic conductivity clay, it is likely that the natural soil is providing the same, or better level of protection from potential migration of contaminants than the composite liner defined in 257.70(b). The purpose of our study is to present existing site data to assess whether the natural soils below six CCR impoundment units at four sites in southeast Michigan are performing equivalently to a composite liner using recognized and generally accepted good engineering practices.

1.2 Description of CCR Units

Natural clay liners were evaluated for six CCR units at four power generation facilities in southeast Michigan:

- Bell River Power Plant (BRPP) Bottom Ash Basins (BAB) CCR Unit
- BRPP Diversion Basin (DB) CCR Unit
- St. Clair Power Plant (SCPP) BAB CCR Unit
- Monroe Power Plant (MONPP) Fly Ash Basin (FAB) CCR Unit
- J.R. Whiting Power Plant (JRWPP) Ponds 1 and 2 CCR Unit
- JRWPP Pond 6 Inactive CCR Unit

Data used for the natural clay liner evaluations were obtained from existing reports and Conceptual Site Models (CSMs) previously developed for each site. A summary of the CSM for each site is provided in the following sections.

1.2.1 BRPP Bottom Ash Basins CCR Unit

The BABs are two adjacent physical sedimentation basins that are slightly raised CCR surface impoundments referred to as the North and South BABs, located north of the BRPP. These are considered one CCR unit. The BABs receive sluiced bottom ash and other process flow water from the power plant. Discharge water from each BAB flows over an outlet weir that gravity flows to a site storm water conveyance network of ditches and pipes, then flows into the DB CCR unit. The North and South BABs run roughly east to west approximately 420 feet long by 120 feet wide with bottom elevations of approximately 580 feet and outflow weir elevations of approximately 590.25 feet (TRC 2017a).

1.2.2 BRPP Diversion Basin CCR Unit

The DB is an incised CCR surface impoundment located west of the BRPP. Water flows into the DB from the North and South BABs through a network of pipes and ditches. The DB discharges to the St. Clair River with other site wastewater in accordance with a National Pollution Discharge Elimination System (NPDES) permit. The DB has an approximately 300 foot long entrance channel that connects to the main portion of the basin that runs approximately north-south. The main portion of the DB is approximately 400 feet long by approximately 120 feet wide with a bottom elevation of approximately 576 feet with the water level being maintained at approximately 580 feet (TRC 2017a).

1.2.3 SCPP Bottom Ash Basins CCR Unit

The SCPP BABs are two adjacent sedimentation basins that are incised CCR surface impoundments. The impoundments are sheet piled around the perimeters to approximately 13 feet below ground surface (bgs) into the native clay-rich soil. The BABs are located south of the SCPP and adjacent to the St. Clair River and are used for receiving bottom ash and other process flow water from the power plant, which is first sent to the East BAB then to the West BAB through a connecting concrete canal. Discharge water from the basins flows with other site wastewater into the Overflow Canal in accordance with a NPDES permit (TRC 2017b).

The West and East BABs run roughly north to south with the following approximate dimensions (TRC 2017b):

- The West BAB is approximately 300 feet long by 90 feet wide with a bottom elevation of approximately 572 feet (when fully cleaned out) with an outflow weir elevation of approximately 579.3 feet; and
- The East BAB is approximately 400 feet long by 70 feet wide with a bottom elevation of approximately 572 feet (when fully cleaned out) with an outflow weir elevation of approximately 579.4 feet.

1.2.4 MONPP Fly Ash Basin CCR Unit

The MONPP FAB CCR unit is approximately 410-acres with an original design storage capacity of 18,500 acre-feet at a maximum elevation of 614 feet. The FAB consists of an earthfill clay-rich soil embankment (raised surface impoundment) with a crest perimeter length of approximately 18,200 feet and a general height (from the lowest toe elevation to the top of embankment) of approximately 40 feet, with a maximum height of 44 feet. A road along the top of the crest has an elevation of approximately 614 feet with the typical water operational level being 609 feet. The FAB base is keyed into the existing natural clay-rich soil ground surface at an elevation of 563.4 feet. CCRs are placed into the FAB by use of a "wet" (sluiced) disposal method (TRC 2017c).

1.2.5 JRWPP Ponds 1 and 2 CCR Unit

The JRWPP Ponds 1 and 2 CCR unit is located east of the JRWPP adjacent to Lake Erie. The JRWPP is no longer an active power generating facility and Ponds 1 and 2 are no longer active. The ponds were constructed in the native clay soil and received ash by sluicing. Sluice water was discharged to Pond 2 and then flowed into Pond 1 via a connecting pipe. Discharge water from the basins flowed into the adjacent Forebay in accordance with a NPDES permit (Golder Associates 2017). The Pond 1 outlet had an elevation of 586.3 feet and a perimeter crest of approximately 590 feet (AECOM 2009).

1.2.6 JRWPP Pond 6 CCR Unit

The JRWPP Pond 6 CCR unit is located north of the JRWPP. Pond 6 is no longer in operation and has received a final cap. Pond 6 was constructed in the native clay soil and received ash by sluicing. Discharge water from Pond 6 flowed into the adjacent LaPointe Drain in accordance with a NPDES permit. When in operation, the pool elevation in Pond 6 was maintained between elevations of 592.6 feet and 596.5 feet with a perimeter crest elevation of approximately 600 feet (AECOM 2009).

Section 2
Composite Liner Leakage Literature

2.1 Literature Review

A single composite liner specified by state and federal regulations for new CCR disposal units includes a geomembrane directly overlying two feet (0.61 meters) of compacted clay having a hydraulic conductivity no greater than 1 x 10^{-7} cm/s. These composite liners are intended to prevent advective flow of leachate through the liner. However, studies of installed composite liner systems have identified that composite liners leak through holes in the geomembrane that result from manufacturing defects, damage during installation, or degradation of the membrane over time (Rowe 2012). Holes in the geomembrane allow migration of leachate from the liner cell into the compacted clay portion of the liner. Once in the clay, leachate can migrate through the clay via porous media flow, eventually exiting the clay liner as leakage.

The amount of leakage through a composite liner is controlled in part by the number of holes in the geomembrane, the size of the holes, and the quality of contact between the geomembrane and the underlying clay. Based on a review of available literature, Rowe (2012) reports that the median radius of geomembrane holes is greater than 5 mm (meaning geomembrane holes at a scale of millimeters to centimeters are not uncommon) and the number of holes ranges from 2.5 to 12 holes per hectare of liner. Gaps between the geomembrane and the underlying clay also influence leakage rates by increasing the surface area through which leachate can penetrate the underlying clay (Rowe 2012).

Liner performance can be quantified in terms of the rate of leakage of leachate through the liner into the underlying soils. Researchers have quantified leakage rates for composite liners through the use of leak detection systems (e.g., Bonaparte et al. 2002) and calculations (e.g., Giroud et al. 1998; Rowe 2012). Leakage rates are measured in terms of the volume of liquid (liters or gallons) leaking through the liner each day over the surface area of the liner (hectares or acres) e.g. liters per hectare per day (lphd).

Leakage through the compacted clay portion of a composite liner or through a natural clay liner is controlled by several factors, including the hydraulic conductivity of the clay, the hydraulic head gradient across the liner, and the thickness of the clay. Flow through clay liners can be calculated using physical parameters of the system in question and applying Darcy's Law. The performance of natural clay liners can be assessed by comparing calculated leakage rates for natural clay liners with calculated leakage rates for composite liners.

Section 3
Site Conceptual Models

3.1 Belle River Power Plant

The BRPP CCR units are underlain by more than 130 feet of unconsolidated sediments, consisting mostly of silty clay-rich till. The silty clay-rich till is present from the surface to depths of 86 to 130 feet bgs at the BRPP CCR units. Falling head permeameter tests were completed on four samples of the site clay, producing hydraulic conductivity values ranging from 2.1 x 10^{-8} cm/s to 2.9 x 10^{-8} cm/s. Saturated silts and sands underlie the clay and form the shallowest aquifer below the CCR units. The unconsolidated sand and silt aquifer is underlain by the uppermost bedrock consisting of the Bedford Shale, which is generally encountered from 135 to 145 feet bgs (TRC 2017a).

3.1.1 Bottom Ash Basins CCR Unit

As described above, the uppermost aquifer units beneath the BABs CCR unit are hydraulically isolated by at least 80 feet of silty clay-rich till. The first observed sand-rich units that meet the 40 CFR §257.53 definition of uppermost aquifer is encountered at depths ranging from 90 to 136 feet bgs. The sand-rich unit rapidly thins to the south and east of the BABs and pinches out in the southeastern portion of the BABs CCR unit area (TRC 2017a).

The water level in the BABs is maintained at an elevation of approximately 590 feet. The hydraulic head in the aquifer below the BAB is approximately 574 feet (TRC 2018a). The bottom of the BABs is at an elevation of approximately 580 feet and the bottom of the clay underlying the BABs is at an elevation of approximately 500 feet, thus 80 feet of clay separate the bottom of the BABs CCR unit from the underlying aquifer.

3.1.2 Diversion Basin CCR Unit

The potential uppermost aquifer under the DB CCR unit is located at depths ranging from 131 to 145 feet bgs at the silt/shale bedrock interface. The DB CCR unit is isolated from the underlying potential uppermost aquifer by approximately 130 feet of silty clay-rich till. Although the encountered zone of saturation along the interface did not yield significant groundwater, it was conservatively interpreted as the first underlying saturated zone that would presumably become affected with CCR constituents since it was saturated, and although the hydraulic conductivity was low, exhibited a much higher hydraulic conductivity than the clay-rich soils between the bottom of the basin and the monitored zone (TRC 2017a).

The water level in the DB is maintained at an elevation of 580 feet or less. The hydraulic head in the aquifer below the DB is approximately 575 feet (TRC 2018b). The bottom of the DB is at an elevation of approximately 576 feet and the bottom of the clay underlying the DB is at an elevation of approximately 459 feet, thus 117 feet of clay separate the bottom of the DB CCR unit from the underlying aquifer.

3.2 St. Clair Power Plant BABs

The SCPP CCR unit is underlain by glacial silty-clay till, with few isolated sand lenses, and a silt and clay-rich hardpan base directly overlying the shale bedrock (likely the Bedford Shale). The shale bedrock is generally encountered below 130 feet bgs. No significant soil or gravel intervals were encountered at any of the groundwater monitoring system well locations. However, during soil boring advancement for the groundwater monitoring system well locations, some signs of saturation were observed throughout a 5-foot interval along the interface between the overlying till/hardpan and the underlying shale bedrock. The underlying shale does not yield groundwater, rather it is an aquiclude that prevents groundwater flow (i.e., is not an aquifer). Although the encountered zone of saturation along the interface did not yield significant groundwater, it was conservatively interpreted as the uppermost aquifer, because it is saturated and exhibits higher hydraulic conductivity than the clay-rich soils between the bottom of the basin and the monitored zone (TRC 2017b).

The potential uppermost aquifer as defined in 40 CFR §257.53 is encountered at an elevation of approximately 462 feet. The bottom of the BABs is at an elevation of approximately 572 feet, thus 110 feet of vertically contiguous silty clay-rich till separates the BABs CCR unit from the underlying aquifer and serves as a natural confining hydraulic barrier that isolates the underlying uppermost potential aquifer. The overlying silty clay-rich low-permeability soil has a hydraulic conductivity on the order of 2.3 to 3.1 x 10^{-8} centimeters per second (cm/s) as found in soil testing performed during the CCR monitoring well installation in the area of the BABs (TRC 2017b).

The water level in the BABs is maintained at an elevation between 579 feet and 580 feet. The hydraulic head in the aquifer below the BABs is approximately 580 feet (TRC 2018c), thus the little hydraulic head gradient between the BABs CCR unit and the underlying aquifer is very small.

3.3 Monroe Power Plant FAB

The MONPP FAB overlies unconsolidated clay-rich glacial till and/or lacustrine deposits with saturated limestone of the Bass Islands Group bedrock generally encountered from 37 to 53.5 feet below ground surface. The limestone aquifer encountered at the site is generally artesian except in the area of monitoring well MW-16-01. Monitoring well MW-16-01 is located within several hundred feet of several off-site domestic residential water supply wells located to the north along Dunbar Road adjacent to Plum Creek that likely lower the hydraulic head in the area of MW-16-01 (TRC 2017c).

The MONPP FAB CCR unit uppermost aquifer as defined in 40 CFR §257.53 consists of saturated limestone present beneath at least 37 feet and up to 53.5 feet of thick contiguous silty clay-rich soil that serves as a natural confining hydraulic barrier that isolates the underlying uppermost aquifer. At its deepest incised area the MONPP FAB has approximately 23 feet of clay-rich soil separating the bottom of the FAB from the uppermost aquifer. Near the north end of the FAB where the hydraulic gradient is steeper, the clay is at least 30 feet thick. The overlying low permeability silty clay-rich soil has a hydraulic conductivity of 2.7×10^{-8} cm/s calculated as the geometric mean of 33 hydraulic conductivity values obtained from testing of the clay. The water level in the FAB is maintained at an elevation of approximately 609 feet. The hydraulic head in the aquifer below the FAB is ranges from approximately 580 feet to 597 feet (TRC 2018d).

3.4 J.R. Whiting Power Plant

The JRWPP overlies more than 50 feet of unconsolidated clay-rich glacial till and/or lacustrine deposits overlying limestone bedrock. Bedrock is generally encountered from 52 to 64 feet below ground surface (elevations of 524 to 516 feet) (STS Consultants 1993). Permeameter tests completed on eight samples of the site clay produced hydraulic conductivity values ranging from 5.5×10^{-9} cm/s to 2.23×10^{-8} cm/s. The limestone bedrock aquifer underlying clay deposits forms the shallowest aquifer below the CCR units.

3.4.1 JRWPP Ponds 1 and 2 CCR Unit

As described above, the uppermost aquifer unit beneath the Ponds 1 and 2 CCR unit is limestone bedrock that is hydraulically isolated by the overlying clay-rich till. The shallowest bedrock is encountered at an elevation of approximately 520 feet (TRC 2016) and the bottom of the pond is at an elevation of approximately 555 feet (Golder Associates 2016), thus 35 feet of clay separate the bottom of the Ponds 1 and 2 CCR Unit from the underlying aquifer. The water level in Ponds 1 and 2 was maintained at an elevation of approximately 586 feet. The hydraulic head in the aquifer below Ponds 1 and 2 is approximately 575 feet (TRC 2018e).

3.4.2 JRWPP Pond 6 CCR Unit

As with Ponds 1 and 2, the shallowest bedrock is encountered at an elevation of approximately 520 feet below the Pond 6 CCR unit (TRC 2016). The bottom of Pond 6 is at an elevation of approximately 560 feet, thus 40 feet of clay separate the bottom of the Pond 6 CCR unit from the underlying aquifer. During its operational years, the water level in Pond 6 was maintained at elevations between approximately 592 feet to 597 feet. The hydraulic head in the aquifer below Pond 6 is approximately 575 feet.

Section 4
Leakage Rate Calculations

To assess the performance of the natural clay liners underlying the six CCR units at the sites discussed above, leakage rates were calculated for each of the units using site-specific parameters and Darcy's Law:

$$Q = -KA\frac{dh}{dl}$$

where Q is the leakage rate, K is the hydraulic conductivity of the clay, A is the cross-sectional area of flow, dh is the difference between the hydraulic head in the CCR unit and the hydraulic head in the aquifer below the natural clay, and dl is the thickness of the clay. This analysis assumes that flow through the liner is vertical and one-dimensional. Input parameters for K, dh, and dl for each CCR unit are summarized in Table 1. By assuming the cross-sectional area of flow to be one hectare, leakage rates are determined on a per hectare basis, consistent with the liner leakage literature. Calculated leakage rates (in lphd) are also summarized in Table 1. Calculation documentation is provided in Appendix B. Calculated leakage rates for the natural clay liners ranged from 2 lphd (SCPP BABs) to 227 lphd (MONPP FAB).

The calculated leakage rates represent the expected leakage through the natural clays below the CCR units under currently operating conditions, except for the JRWPP CCR units, which are no longer operating. For the JRWPP CCR units, the calculated leakage rates are conservatively based on conditions experienced while they were operating. Now that Pond 6 is capped, it is expected that the hydraulic head within the CCR unit is less than it was during operation, and therefore, the leakage rate under capped conditions is expected to be less than the calculated leakage rate. Ponds 1 and 2 are planned to be capped in the near future, which will also likely reduce the leakage rate associated with that CCR unit.

To compare the performance of the natural clay liners with the expected performance of a single composite liner, potential leakage rates were also calculated for a hypothetical composite liner meeting state and federal regulations. Giroud et al. (1998) provide an equation for calculating the expected leakage through a composite clay liner resulting from a geomembrane defect:

$$Q = 0.976C_{qo}\left[1 + 0.1\left(\frac{h}{T}\right)^{0.95}\right]d^{0.2}h^{0.9}K^{0.74}$$

where Q is the leakage rate (m^3/s), C_{qo} is a dimensionless coefficient that characterizes the quality of contact between the geomembrane and the clay, h is the hydraulic head of the leachate on the liner (m), T is the thickness of the compacted clay (m), d is the diameter of the defect (m), and K is the hydraulic conductivity of the compacted clay (m/s).

The composite liner leakage calculations assume that liner construction consists of two feet (0.61 m) of compacted clay having hydraulic conductivity of 1 x 10^{-7} cm/s (1 x 10^{-9} m/s) underlying a geomembrane. A leachate head of one foot (0.3 m) over the liner and head of zero below the liner is also assumed. As previously discussed, the composite liner leakage calculation also requires assumptions regarding the number of defects, the size of the defects, and the quality of contact between the geomembrane and the clay. To assess the effects of these assumed parameters on the calculated leakage rate, calculations were made using two different values for defect diameter (0.001 m and 0.00564 m), contact coefficient (per Giroud et al. 1998, C_{qo} = 0.21 for good contact, C_{qo} = 1.15 for poor contact), and defect frequency (2.5 defects per hectare and 5 defects per hectare). Using multiple inputs results in a range of potential leakage rates for the hypothetical composite liner in question.

Calculated leakage rates for a composite liner are shown in Table 2. Calculation documentation is provided in Appendix B. The calculated rates range from a low of 0.9 lphd (for 2.5 small defects per hectare and assuming good contact between the geomembrane and underlying clay) to 14 lphd (for 5 large defects per hectare and assuming poor geomembrane-clay contact). Thus a composite liner built in accordance with current regulations could be expected to leak up to 14 lphd.

Rowe (2012) suggests that calculated leakage rates actually underestimate actual leakage. As a result, actual leakage rates from composite liners may be higher than 14 lphd. Nevertheless, two of the investigated CCR units (BRPP DB and SCPP BABs) have leakage rates less than 14 lphd, indicating they are performing at least as well as a single composite liner. Three of the other four CCR units have leakage rates within one order of magnitude of 14 lphd indicating that these natural liners provide a fairly comparable, if not equal, level of protection as a composite liner.

In addition to leakage rate, leachate travel time can also be used to assess liner performance. To determine the amount of time required for leachate to travel through a clay liner the average linear velocity of the leachate must be calculated. Average linear velocity is calculated using a version of Darcy's Law:

$$v = -\frac{K}{n_e}\frac{dh}{dl}$$

where v is the average linear velocity of leachate advection, n_e is the effective porosity of the clay, and K, dh, and dl are as previously defined. Using the values for K, dh, and dl from

Table 1 and assuming an effective porosity for clay of 0.4, average linear velocity was calculated for each of the CCR units. Leachate travel time (t) was then calculated using:

$$t = \frac{dl}{v}$$

Travel times for the six natural clay liners are shown in Table 1. Calculation documentation is provided in Appendix B. Calculations for the MONPP FAB CCR Unit used average hydraulic conductivity due to the amount of historical hydraulic conductivity values. For all other units, calculations used the highest hydraulic conductivity value obtained at the site to produce conservative results. Travel times range from 441 years (MONPP FAB) to 150,800 years (SCPP BABs). All of the computed travel times suggest that the natural clay liners below the six CCR units will be protective of the underlying aquifers well into the future.

For comparison, the calculated time for leachate to travel through 2 feet of compacted clay in a composite liner (assuming leachate head of 1 foot (0.3 meters) above the liner and head of zero below the liner) after having penetrated through a geomembrane defect is only 5 years. Thus even for the natural liners that have higher leakage rates than a composite liner, the thickness of the natural clay results in protection over a much longer timeframe than can be provided by a composite liner.

An additional point of comparison relates to US EPA Statutory Interpretive Guidance – Criteria for Identifying Areas of Vulnerable Hydrogeology Under the Resource Conservation and Recovery Act (July 1986). This document develops criteria and a method for determining groundwater vulnerability at hazardous waste facilities. The method requires calculation of the travel time along a 100-foot flow line originating at the base of the hazardous waste unit. The intent is for the 100-foot flow line to represent a sample of the geologic material at the site representing an area of likelihood of investigation for release. The criterion established by this method relates a travel time along 100-ft of flow line on the order of 100 years is the threshold for vulnerability (US EPA, p. ES-3).

This analog is a very important concept for responding to the DC Court Opinion that found that the record evidence showed that the vast majority of existing impoundments are unlined and that unlined impoundments have a 36.2 to 57 percent chance of leaking at a harmfully contaminating level during their foreseeable use (DC Court, pg. 18). Based on this record, the DC Court found that it isn't reasonable to rely on leak detection followed by closure in order to address reasonable protectiveness of human health and the environment.

The travel time results from this study show travel times that far exceed the vulnerability criterion, demonstrating that site-specific evaluation can demonstrate protectiveness.

Interestingly, the DC Court also found that the self-implementing one-size-fits-all may have been necessary as a national minimum standard, but also acknowledged that more precise risk-based standards are both feasible and enforceable under the individualized permitting programs and direct monitoring provisions authorized by WIIN Act (DC Court, pg. 38). The sites presented in this study and the methods and criterion used to evaluate the competency of the liner systems meet the regulatory standard "does not pose a reasonable probability of adverse effects on health or the environment."

Section 5
Conclusions

Multiple CCR impoundments in southeast Michigan are documented to be constructed within thick (> 20 feet thick, in some cases more than 100 feet thick) laterally contiguous glacially compacted natural clay-rich soils with a hydraulic conductivity no greater than 1 x 10^{-7} cm/s prior to implementation of the CCR Rule requiring composite liners (§257.70) or demonstration of equivalent performance to alternative composite liners. The natural soil underlying these CCR impoundment units consists of thick, low-hydraulic conductivity clay, that provides the same, or better level of protection from potential migration of contaminants than the composite liner defined in 257.70(b). Using recognized and generally accepted good engineering practices, TRC concludes that the natural soils below six CCR impoundment units at four sites in southeast Michigan perform better than composite liners. In summary:

- TRC calculated leakage rates for six Southeast Michigan CCR units and compared these to the anticipated leakage rates for a single composite liner system. For all six units, the leakage rates were generally within an order of magnitude of the composite liner system. These data show that anticipated leakage rates between the natural soil barriers and the single composite liners are comparable. Data are summarized on Table 1. Data also show that other site specific factors contribute more significantly to the protectiveness of natural soil barriers when compared to single composite liner system, including thickness of the natural soil barrier, hydraulic conductivity of the soil barrier, and the hydraulic gradient between the CCR unit and the underlying aquifer, which can result in significantly greater times of travel to the uppermost aquifer. The results of the time of travel calculations are summarized on Table 1. As shown, all the six evaluated Southeast Michigan CCR units have natural clay liners that are more protective than single composite liner system.

- The travel time results from this study show times that exceed the USEPA's vulnerability criterion demonstrating that site-specific evaluation can demonstrate protectiveness. The sites presented in this study and the methods and criteria used to evaluate the competency of the liner systems meet the regulatory standard "does not pose a reasonable probability of adverse effects on health or the environment."

- Additionally, all of the studied CCR units have been in operation for decades. Although not the focus of this study, groundwater monitoring is currently being performed at all six of the CCR units that are the subject of this study. Based on review of this data, CCR-affected groundwater is not present at these facilities, which further supports the conclusions of this study. Groundwater data supporting this statement are available at:

Consumers Energy

https://www.consumersenergy.com/community/sustainability/environment/waste-management/coal-combustion-residuals

DTE Energy

https://newlook.dteenergy.com/wps/wcm/connect/dte-web/home/community-and-news/common/environment/coal-combustion-residual

Section 6
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TRC. 2017b. Groundwater Monitoring System Summary Report, DTE Electric Company, St. Claire Power Plant Bottom Ash Basins Coal Combustion Residual Unit. October 2017.

TRC. 2017c. Groundwater Monitoring System Summary Report, DTE Electric Company, Monroe Power Plant Fly Ash Basin Coal Combustion Residual Unit. October 2017.

TRC. 2018a. Annual Groundwater Monitoring Report, DTE Electric Company, Belle River Power Plant Bottom Ash Basins. January 2018.

TRC. 2018b. Annual Groundwater Monitoring Report, DTE Electric Company, Belle River Power Plant Diversion Basin. January 2018.

TRC. 2018c. Annual Groundwater Monitoring Report, DTE Electric Company, St. Clair Power Plant Bottom Ash Basins. January 2018.

TRC. 2018d. Annual Groundwater Monitoring Report, DTE Electric Company, Monroe Power Plant Fly Ash Basin Coal Combustion Residual Unit. January 2018.

TRC. 2018e. Annual Groundwater Monitoring Report, Former JR Whiting Power Plant Ponds 1 and 2 CCR Unit. January 2018.

Tables

Table 1
Summary of Velocity and Travel Time Calculations
Natural Clay Liner Equivalency Evaluation

CCR Units	Basin head (ft amsl)	Aquifer head (ft amsl)	dh	Basin Bottom (ft amsl)	Bottom of Clay (ft amsl)	Clay Thickness (dl, ft)	Vertical Hydraulic Gradient	Max K (cm/s)*	Q (lphd)	Velocity (ft/d)**	Travel time (yrs)
Two feet of clay***	--	--	3	--	--	2	1.5	1.0E-07	--	1.1E-03	5
Belle River PP BABs	590	574	16	580	500	80	0.20	2.9E-08	50	4.1E-05	5,329
Belle River PP DB	580	575	5	576	459	117	0.043	2.9E-08	11	8.8E-06	36,474
St. Clair PP BABs	580	579	1	572	462	110	0.009	3.1E-08	2	2.0E-06	150,800
Monroe PP FAB	609	580	29	563	533	30	0.97	2.7E-08	227	1.9E-04	441
Whiting Ponds 1&2	586	575	11	555	520	35	0.31	2.2E-08	61	5.0E-05	1,929
Whiting Pond 6	597	575	22	560	520	40	0.55	2.2E-08	106	8.7E-05	1,260

Created by: S. Sellwood 11/27/2018
Checked by: C. Olson 12/3/2018

Notes:
ft = feet
ft/d = feet per day
cm/s = centimeters per second
yrs = years
lphd = liters per hectare per day
amsl = above mean sea level
dh = difference between basin head and aquifer head
K = vertical hydraulic conductivity
Q = leakage rate
*The geometric mean of 33 available K values used for Monroe PP FAB, maximum K used for all other CCR units
**Velocity assumes effective porosity of 0.4
***Represents migration of leachate through a composite liner after passing through holes in the geomembrane, assumes 1 foot of head above the liner and head of zero below the liner

Table 2
Calculated Composite Liner Leakage Rates
Natural Clay Liner Equivalency Evaluation

			Size of Liner Defects		Quality of Contact				Q (lphd)		
h (m)	T (m)	K (m/s)	d_{sml} (m)	d_{lrg} (m)	$C_{qo(good)}$	$C_{qo(poor)}$	Q (m^3/s)	Q (L/day)	2.5 defects/hc	5 defects/hc	Assumptions
0.305	0.61	1.00E-09	0.001		0.21		4.07E-09	0.35	0.9	1.8	small defects, liner in good contact with clay
0.305	0.61	1.00E-09		0.00564	0.21		5.75E-09	0.50	1.2	2.5	large defects, liner in good contact with clay
0.305	0.61	1.00E-09	0.001			1.15	2.23E-08	1.92	4.8	9.6	small defects, liner in poor contact with clay
0.305	0.61	1.00E-09		0.00564		1.15	3.15E-08	2.72	6.8	14	large defects, liner in poor contact with clay

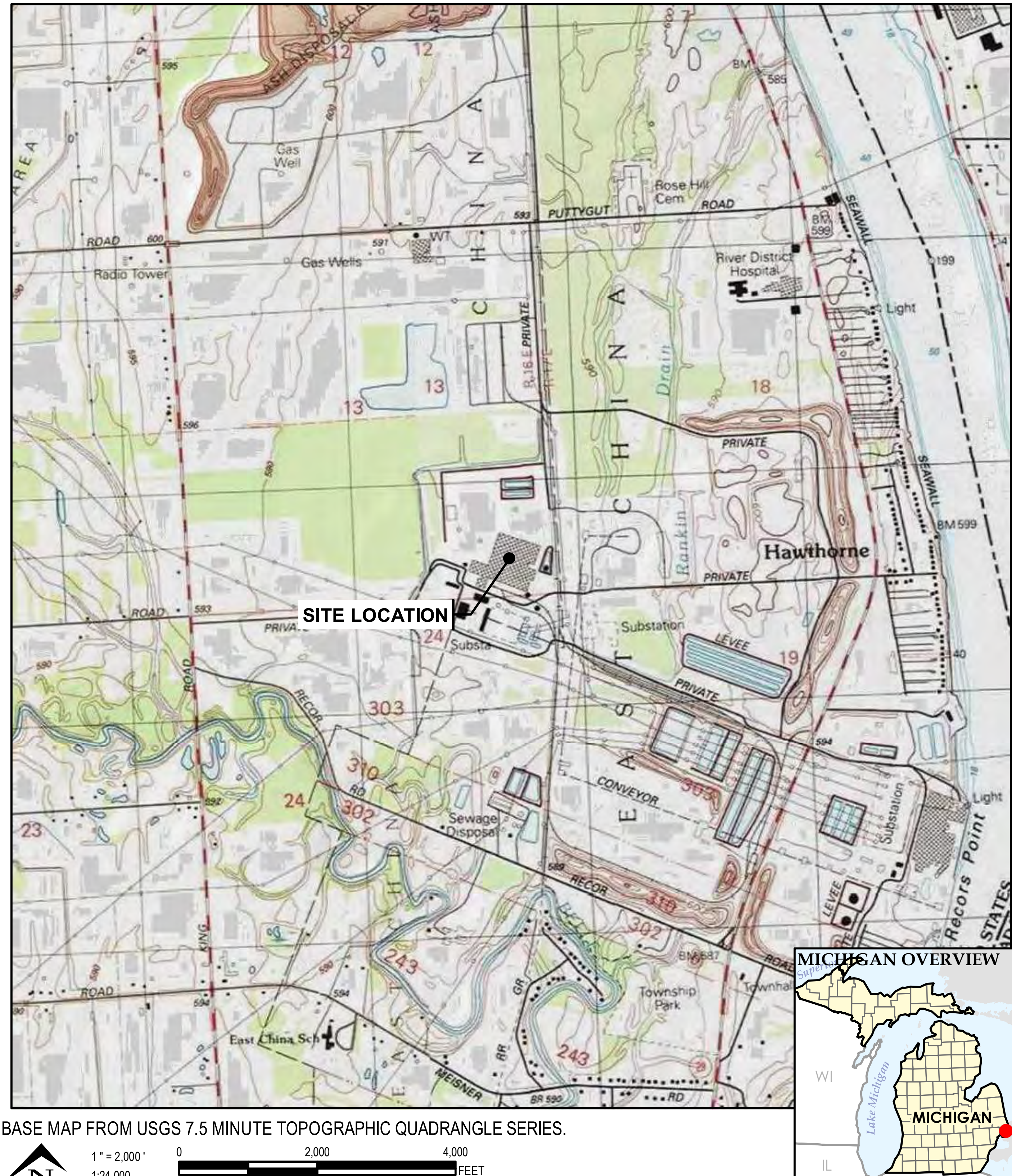
Notes:
h = height of water above the geomembrane
T = thickness of the compacted clay liner
K = hydraulic conductivity of the compacted clay liner
d = diameter of geomembrane defects
C_{qo} = dimensionless coefficient characterizing the quality of the contact between the geomembrane and the underlying compacted clay liner (Giroud et al. 1998)
Q = leakage rate, calculated in accordance with Giroud et al. 1998
m = meter
s = second
L = liter
lphd = liter per hectare per day
hc = hectare

Created by: S. Sellwood 11/27/2018
Checked by: C. Olson 12/3/2018

Appendix A
Site Data (Four Southeast MI CCR Unit Sites)

Table of Contents

BRPP BABs and DB CCR Units Site



BASE MAP FROM USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE SERIES.

N

1 " = 2,000 '
1:24,000

0 2,000 4,000 FEET

TRC

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TRC - GIS

PROJECT:

DTE ELECTRIC COMPANY
BELLE RIVER POWER PLANT
4505 KING ROAD
CHINA TOWNSHIP, MICHIGAN

TITLE:

SITE LOCATION MAP

DRAWN BY:	J. PAPEZ
CHECKED BY:	S HOLMSTROM
APPROVED BY:	V. BUENING
DATE:	OCTOBER 2017
PROJ. NO.:	265996.0003
FILE:	265996-SLMMB.mxd

FIGURE 1

LEGEND

- SOIL BORING
- MONITORING WELL
- DECOMMISSIONED MONITORING WELL

NOTES

1. BASE MAP IMAGERY FROM ST. CLAIR COUNTY INFORMATION TECHNOLOGY DEPARTMENT WEBMAP, 2015.
2. WELL LOCATIONS SURVEYED IN MARCH, APRIL, JUNE 2016, AND JUNE 2017 BY BMJ ENGINEERS & SURVEYORS, INC.

N

0 200 400 Feet

1 " = 200 '

1:2,400

PROJECT: DTE ELECTRIC COMPANY BELLE RIVER POWER PLANT 4505 KING ROAD CHINA TOWNSHIP, MICHIGAN			
TITLE: SITE PLAN			
DRAWN BY:	R SUEMNICHT	PROJ NO.:	265996.0003
CHECKED BY:	S HOLMSTROM	FIGURE 2	
APPROVED BY:	V BUENING		
DATE:	OCTOBER 2017		

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FILE NO.: 265996-0003-002.mxd

TRC - GIS

Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0

Plot Date: 10/9/2017, 15:18:14 PM by BDEEGAN -- LAYOUT: ANSI B(11"x17")
Path: E:\DTE\CCR_Sites\2017_265996\265996-0003-002.mxd

Table 1

Groundwater Elevation Summary

Belle River Power Plant Bottom Ash Basins – RCRA CCR Monitoring Program

China Township, Michigan

Well ID	MW-16-01		MW-16-02		MW-16-03		MW-16-04		MW-16-09	
Date Installed	3/17/2016		3/15/2016		6/1/2016		3/8/2016		6/2/2016	
TOC Elevation	590.06		588.94		590.66		590.51		590.80	
Geologic Unit of Screened Interval	Sand		Sand		Silty Sand		Sand		Sand	
Screened Interval Elevation	496.3 to 491.3		494.3 to 489.3		456.0 to 451.0		468.5 to 463.5		452.3 to 447.3	
Unit	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft
Measurement Date	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation
8/1/2016	16.21	573.85	15.30	573.64	16.53	574.13	16.89	573.62	16.70	574.10
9/19/2016	16.25	573.81	23.33	565.61	16.54	574.12	16.90	573.61	16.70	574.10
11/7/2016	16.58	573.48	19.91	569.03	16.82	573.84	17.15	573.36	16.95	573.85
1/9/2017	16.39	573.67	17.90	571.04	16.66	574.00	17.02	573.49	16.90	573.90
2/27/2017	16.11	573.95	16.65	572.29	16.43	574.23	16.75	573.76	16.56	574.24
4/17/2017	16.05	574.01	15.71	573.23	16.31	574.35	16.63	573.88	16.45	574.35
5/18/2017	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
6/5/2017	15.67	574.39	14.80	574.14	15.98	574.68	16.31	574.20	16.18	574.62
6/30/2017	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
7/24/2017	15.82	574.24	14.45	574.49	16.12	574.54	16.44	574.07	16.29	574.51

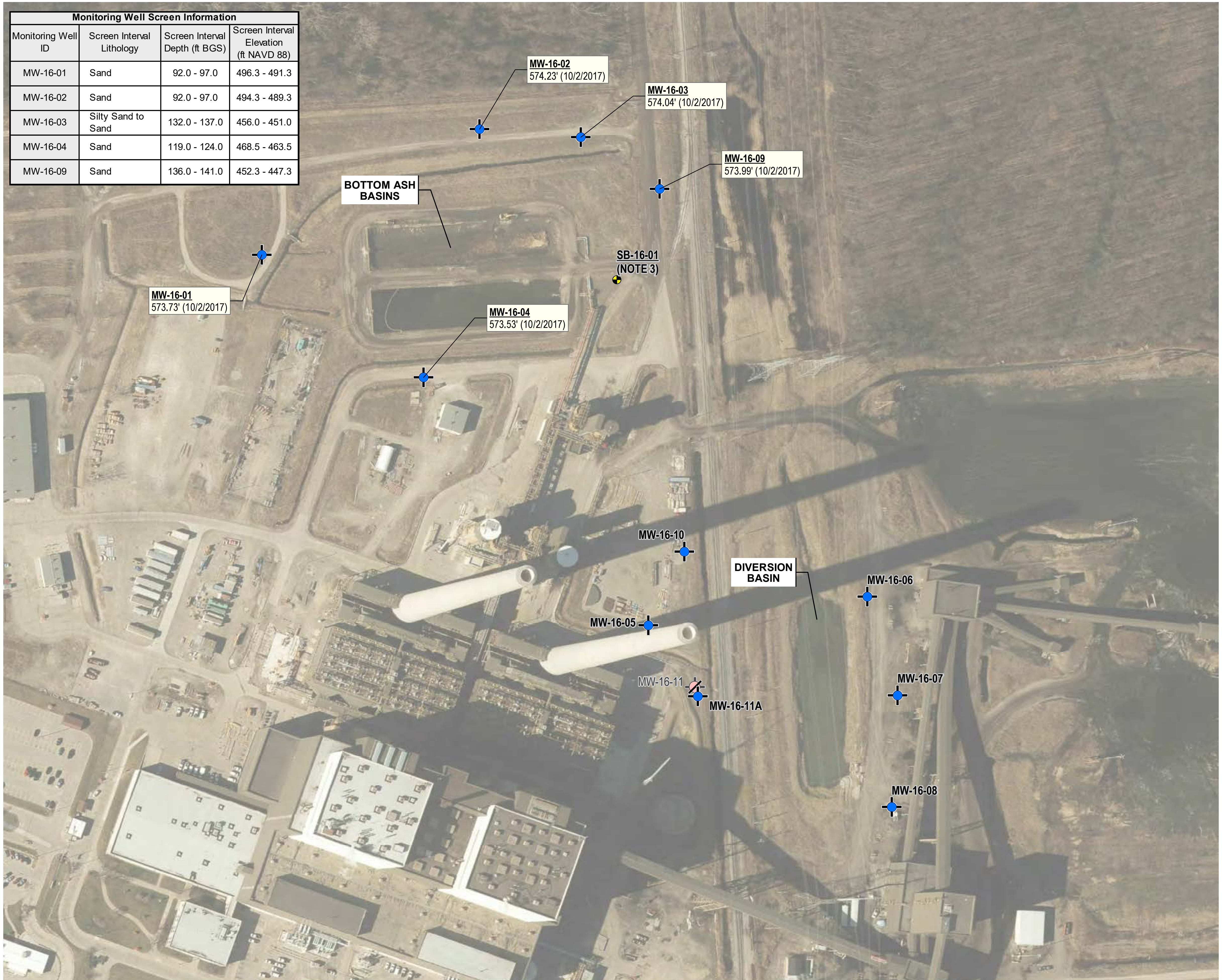
Notes:

Elevations are reported in feet relative to the North American Vertical Datum of 1988.

ft BTOC - feet Below top of casing

NM - Not Measured

Monitoring Well Screen Information			
Monitoring Well ID	Screen Interval Lithology	Screen Interval Depth (ft BGS)	Screen Interval Elevation (ft NAVD 88)
MW-16-01	Sand	92.0 - 97.0	496.3 - 491.3
MW-16-02	Sand	92.0 - 97.0	494.3 - 489.3
MW-16-03	Silty Sand to Sand	132.0 - 137.0	456.0 - 451.0
MW-16-04	Sand	119.0 - 124.0	468.5 - 463.5
MW-16-09	Sand	136.0 - 141.0	452.3 - 447.3



LEGEND

- SOIL BORING
- MONITORING WELL
- DECOMMISSIONED MONITORING WELL

MW ID
GROUNDWATER ELEVATION (DATE)
GROUNDWATER ELEVATION (DATE)
etc...

FT BGS
FEET BELOW GROUND SURFACE
FT NAVD 88
ELEVATION RELATIVE TO THE NORTH AMERICAN VERTICAL DATUM OF 1988

NOTES

1. BASE MAP IMAGERY FROM ESRI/MICROSOFT, "WORLD IMAGERY", WEB BASEMAP SERVICE LAYER.
2. WELL LOCATIONS SURVEYED IN MARCH, APRIL AND JUNE 2016 AND JUNE 2017 BY BMJ ENGINEERS & SURVEYORS, INC.
3. NO SAND OR GRAVEL UNIT PRESENT ABOVE BEDROCK IN THIS LOCATION.

N

0 200 400
Feet

1 " = 200 '
1:2,400

PROJECT:
DTE ELECTRIC COMPANY
BELLE RIVER POWER PLANT
4505 KING ROAD
CHINA TOWNSHIP, MICHIGAN

TITLE:
BOTTOM ASH BASINS
GROUNDWATER POTENTIOMETRIC
ELEVATION SUMMARY OCTOBER 2017

DRAWN BY:	S. MAJOR	PROJ NO.:	265996.0003
CHECKED BY:	C. SCIESZKA	**FIGURE 3**	
APPROVED BY:	V. BUENING		
DATE:	JANUARY 2018		

TRC
1540 Eisenhower Place
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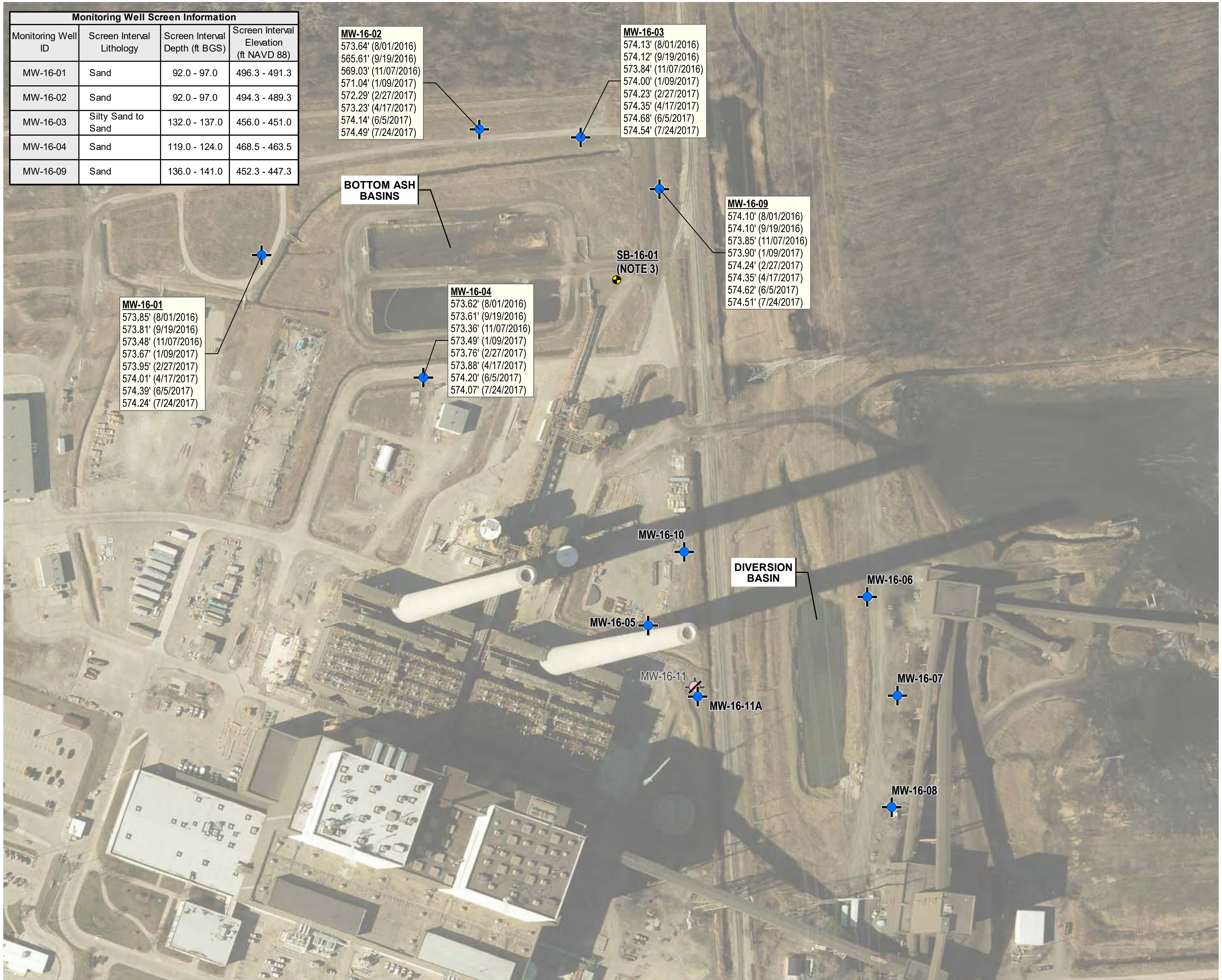
FILE NO.: 265996-0003-014.mxd

TRC - GIS

Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0

Plot Date: 1/12/2018, 09:54:28 AM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\DTE\CCR_Sites\2017_265996\265996-0003-014.mxd

Monitoring Well Screen Information			
Monitoring Well ID	Screen Interval Lithology	Screen Interval Depth (ft BGS)	Screen Interval Elevation (ft NAVD 88)
MW-16-01	Sand	92.0 - 97.0	496.3 - 491.3
MW-16-02	Sand	92.0 - 97.0	494.3 - 489.3
MW-16-03	Silty Sand to Sand	132.0 - 137.0	456.0 - 451.0
MW-16-04	Sand	119.0 - 124.0	468.5 - 463.5
MW-16-09	Sand	136.0 - 141.0	452.3 - 447.3



LEGEND

- SOIL BORING
- MONITORING WELL
- DECOMMISSIONED MONITORING WELL

MW ID
GROUNDWATER ELEVATION (DATE)
GROUNDWATER ELEVATION (DATE)
etc...

FT BGS
FEET BELOW GROUND SURFACE
FT NAVD 88
ELEVATION RELATIVE TO THE NORTH AMERICAN VERTICAL DATUM OF 1988

NOTES

1. BASE MAP IMAGERY FROM ESRI/MICROSOFT, "WORLD IMAGERY", WEB BASEMAP SERVICE LAYER.
2. WELL LOCATIONS SURVEYED IN MARCH, APRIL AND JUNE 2016 AND JUNE 2017 BY BMJ ENGINEERS & SURVEYORS, INC.
3. NO SAND OR GRAVEL UNIT PRESENT ABOVE BEDROCK IN THIS LOCATION.

N

0 200 400 Feet
1 " = 200 '
1:2,400

PROJECT: DTE ELECTRIC COMPANY
BELLE RIVER POWER PLANT
4505 KING ROAD
CHINA TOWNSHIP, MICHIGAN

TITLE: BOTTOM ASH BASINS
GROUNDWATER POTENTIOMETRIC
ELEVATION SUMMARY

DRAWN BY:	J. PAPEZ	PROJ NO.:	265996.0003
CHECKED BY:	C. SCIESZKA	FIGURE 1	
APPROVED BY:	V. BUENING		
DATE:	JANUARY 2018		

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FILE NO.: 265996-0003-003A.mxd

TRC - GIS
Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
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Table 1

Groundwater Elevation Summary

Belle River Power Plant Diversion Basin – RCRA CCR Monitoring Program

China Township, Michigan

Well ID	MW-16-05		MW-16-06		MW-16-07		MW-16-08		MW-16-10		MW-16-11 [1]		MW-16-11A	
Date Installed	3/4/2016		3/11/2016		3/9/2016		3/10/2016		6/6/2016		6/7/2016		5/12/2017	
TOC Elevation	590.82		593.21		592.58		591.88		592.26		591.54		591.66	
Geologic Unit of Screened Interval	Clayey Silt/Shale Interface		Silt/Shale Interface		Silt/Shale Interface		Silt/Shale Interface		Gravelly Silt and Silty Clay		Sandy Clay		Silt and Silty Clay	
Screened Interval Elevation	449.3 to 444.3		455.0 to 450.0		456.9 to 451.9		456.3 to 451.3		444.3 to 439.3		452.0 to 447.0		452.5 to 447.5	
Unit	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft
Measurement Date	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation
8/1/2016	16.95	573.87	17.74	575.47	16.84	575.74	15.74	576.14	17.88	574.38	16.86	574.68	Not Installed	
9/19/2016	17.00	573.82	17.85	575.36	17.00	575.58	15.90	575.98	17.98	574.28	16.96	574.58		
11/7/2016	17.13	573.69	17.59	575.62	16.70	575.88	15.70	576.18	18.06	574.20	16.99	574.55		
1/9/2017	17.11	573.71	17.51	575.70	16.60	575.98	15.58	576.30	17.94	574.32	16.87	574.67		
2/27/2017	16.74	574.08	17.36	575.85	16.56	576.02	15.50	576.38	17.72	574.54	NU	NU		
4/17/2017	16.77	574.05	17.71	575.50	16.84	575.74	15.70	576.18	17.81	574.45	NU	NU		
5/18/2017	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	Decommissioned		16.69	574.97
6/5/2017	16.61	574.21	17.66	575.55	16.83	575.75	15.72	576.16	17.73	574.53			16.71	574.95
6/30/2017	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM			16.83	574.83
7/24/2017	16.74	574.08	18.01	575.20	17.13	575.45	15.99	575.89	17.93	574.33			16.91	574.75

Notes:

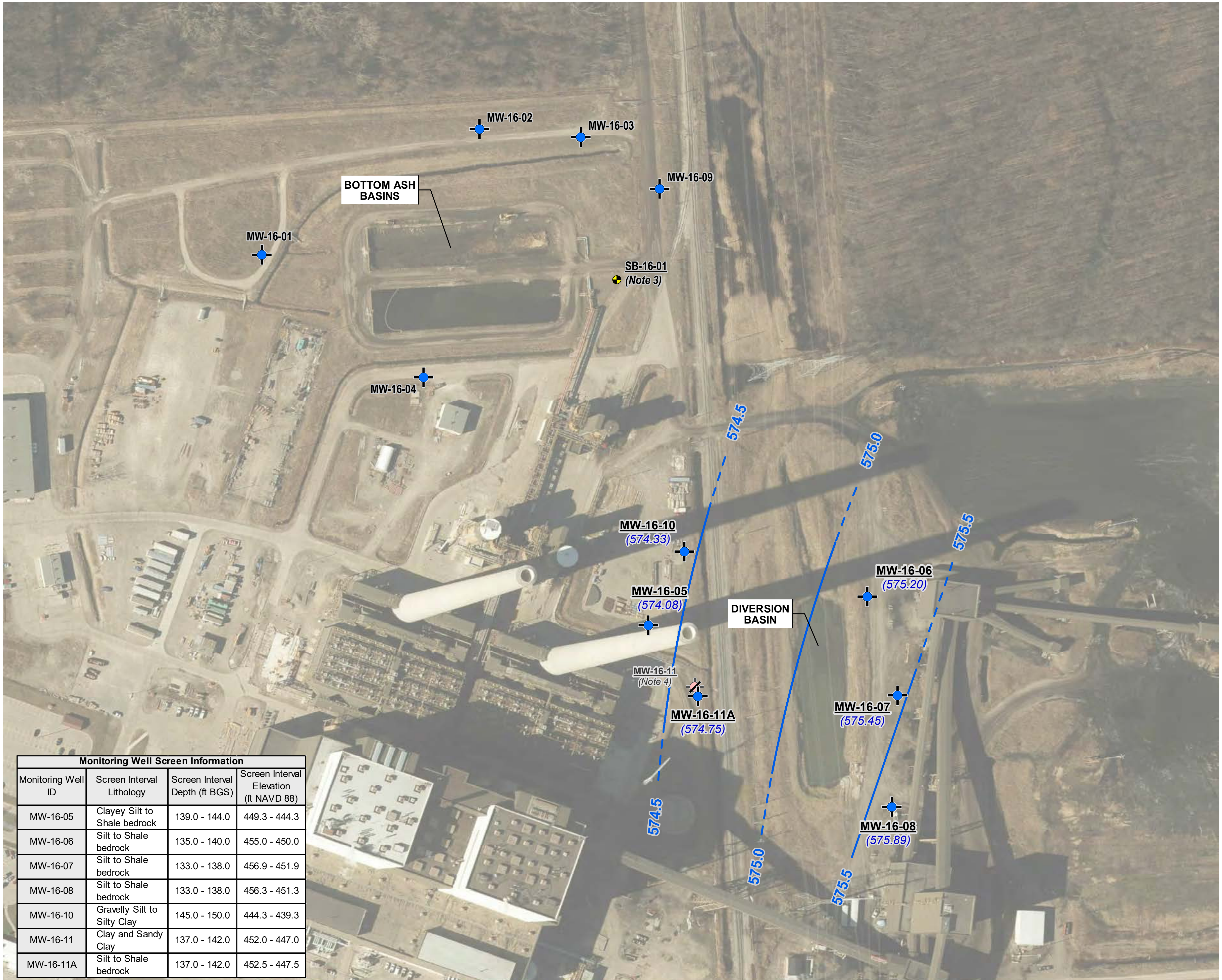
Elevations are reported in feet relative to the North American Vertical Datum of 1988.

ft BTOC - feet Below top of casing

NU - Not Used; monitoring well was damaged at the time of data collection.

NM - Not Measured

(1) MW-16-11 decomissioned on 5/11/2017 and replaced with MW-16-11A.



Monitoring Well Screen Information

Monitoring Well ID	Screen Interval Lithology	Screen Interval Depth (ft BGS)	Screen Interval Elevation (ft NAVD 88)
MW-16-05	Clayey Silt to Shale bedrock	139.0 - 144.0	449.3 - 444.3
MW-16-06	Silt to Shale bedrock	135.0 - 140.0	455.0 - 450.0
MW-16-07	Silt to Shale bedrock	133.0 - 138.0	456.9 - 451.9
MW-16-08	Silt to Shale bedrock	133.0 - 138.0	456.3 - 451.3
MW-16-10	Gravelly Silt to Silty Clay	145.0 - 150.0	444.3 - 439.3
MW-16-11	Clay and Sandy Clay	137.0 - 142.0	452.0 - 447.0
MW-16-11A	Silt to Shale bedrock	137.0 - 142.0	452.5 - 447.5

LEGEND

- SOIL BORING
- MONITORING WELL
- DECOMMISSIONED MONITORING
- *(575.47)* GROUNDWATER ELEVATION (FT NAVD 88)
- GROUNDWATER ELEVATION CONTOUR (0.5-FT INTERVAL, DASHED WHERE INFERRED)

NOTES

1. BASE MAP IMAGERY FROM ESRI/MICROSOFT, "WORLD IMAGERY", WEB BASEMAP SERVICE LAYER.
2. WELL LOCATIONS SURVEYED IN MARCH, APRIL, AND JUNE 2016 BY BMJ ENGINEERS AND SURVEYORS. INC.
3. NO SAND OR GRAVEL UNIT PRESENT ABOVE BEDROCK IN THIS LOCATION.
4. MONITORING WELL MW-16-11 WAS DECOMMISSIONED AND REPLACED BY MW-16-11A IN MAY 2017.
5. GROUNDWATER ELEVATIONS DISPLAYED IN FEET RELATIVE TO NORTH AMERICAN VERTICAL DATUM OF 1988.

0 200 400 Feet

1 " = 200 '

1:2,400

PROJECT:
DTE ELECTRIC COMPANY
BELLE RIVER POWER PLANT
4505 KING ROAD
CHINA TOWNSHIP, MICHIGAN

TITLE:
DIVERSION BASIN GROUNDWATER POTENTIOMETRIC SURFACE MAP
JULY 2017

DRAWN BY:	J. PAPEZ	PROJ NO.:	265996.0003
CHECKED BY:	C. SCIESZKA		
APPROVED BY:	V. BUENING	**FIGURE 8**	
DATE:	JANUARY 2018		

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FILE NO.: 265996-0003-012.mxd

TRC - GIS

Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0

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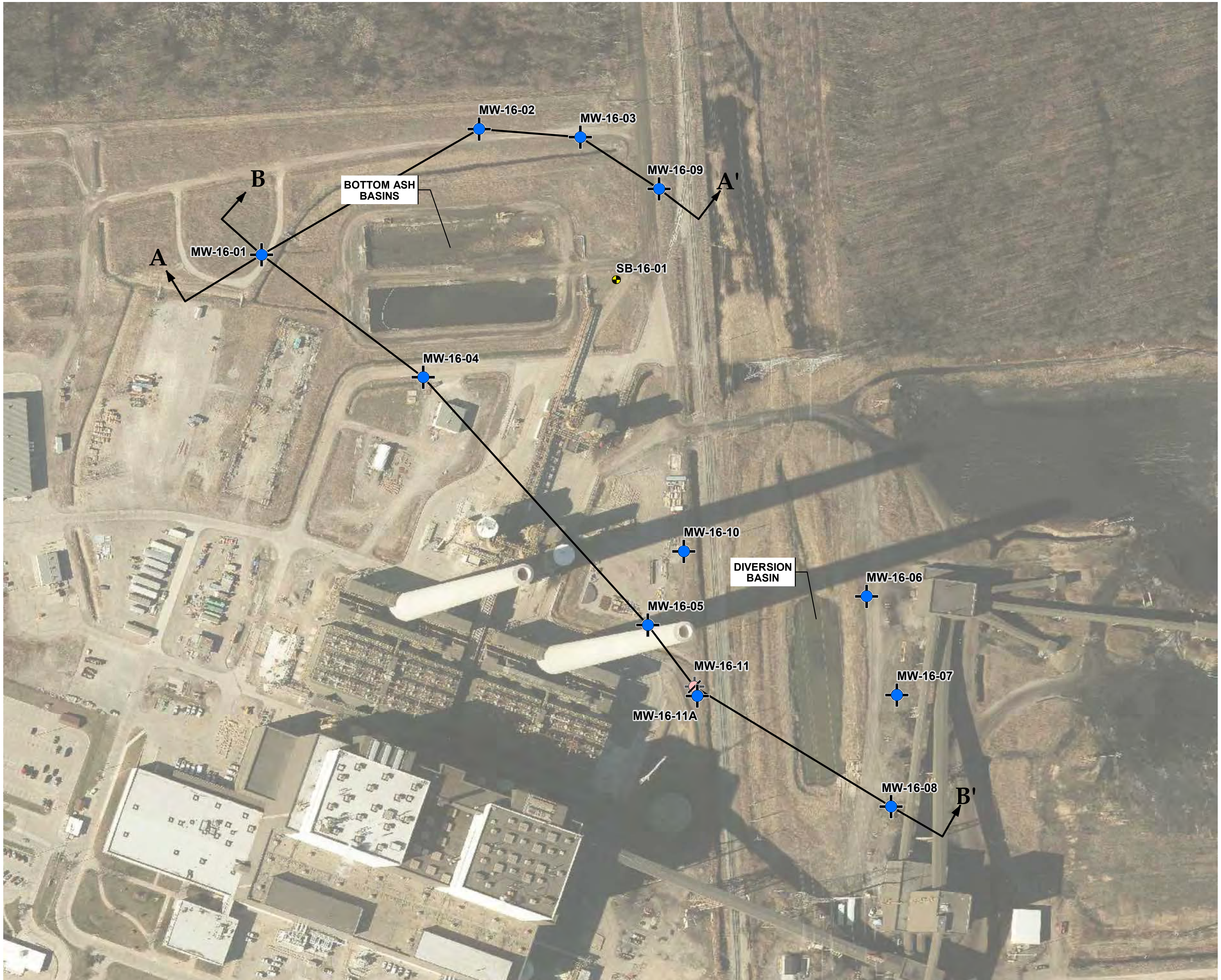

LEGEND

- SOIL BORING
- MONITORING WELL
- DECOMMISSIONED MONITORING WELL
- CROSS SECTIONS

NOTES

1. BASE MAP IMAGERY FROM ST. CLAIR COUNTY INFORMATION TECHNOLOGY DEPARTMENT WEBMAP, 2015.
2. WELL LOCATIONS SURVEYED IN MARCH, APRIL, JUNE 2016, AND JUNE 2017.

0 200 400 Feet

1 " = 200 '

1:2,400

PROJECT: DTE ELECTRIC COMPANY
BELLE RIVER POWER PLANT
4505 KING ROAD
CHINA TOWNSHIP, MICHIGAN

TITLE: CROSS SECTION LOCATOR MAP

DRAWN BY:	J. PAPEZ	PROJ NO.:	265996.0003
CHECKED BY:	S. HOLMSTROM		FIGURE 3
APPROVED BY:	V. BUENING		
DATE:	OCTOBER 2017		

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FILE NO.: 265996-0003-011.mxd

TRC - GIS

Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0

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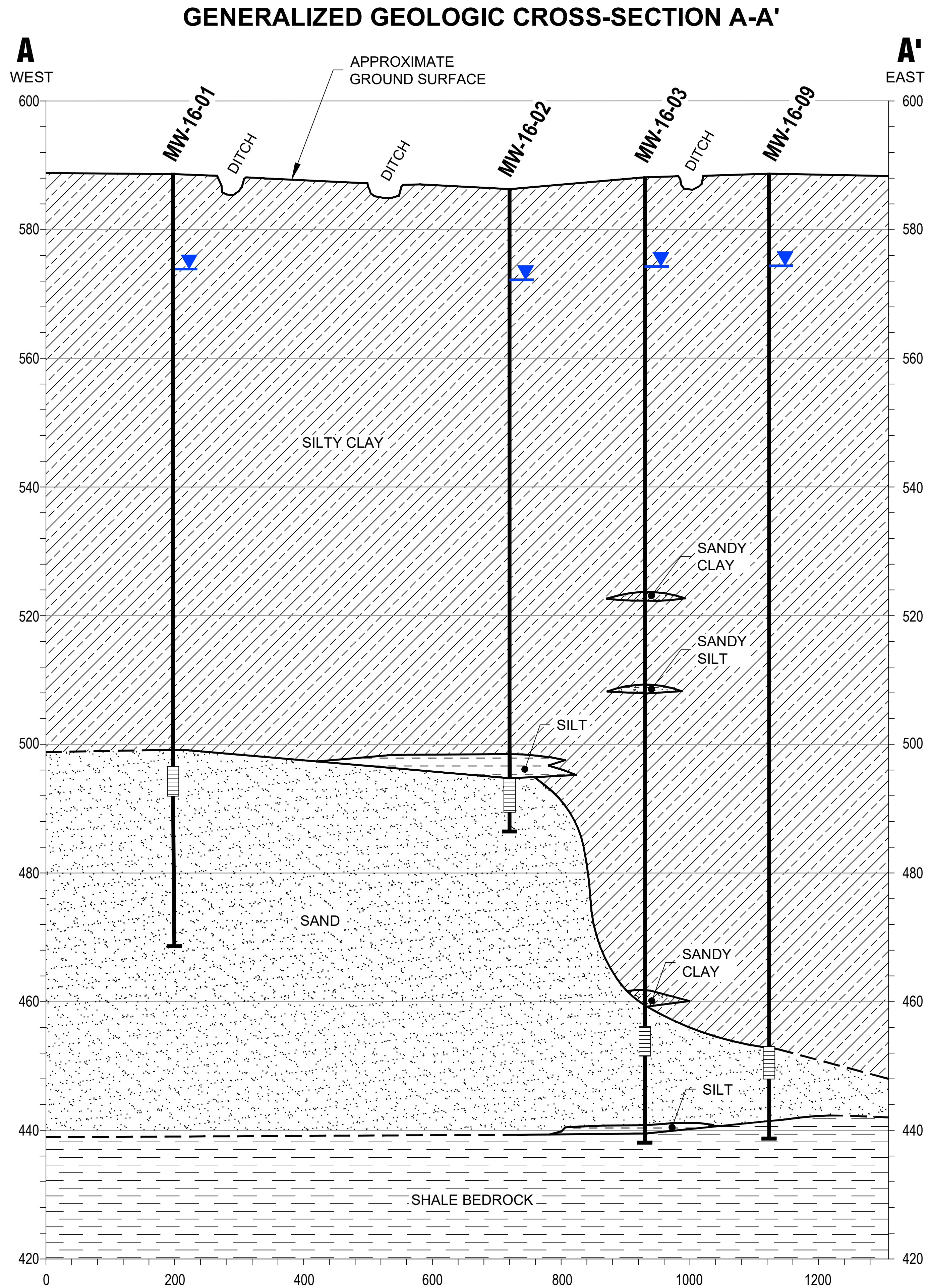
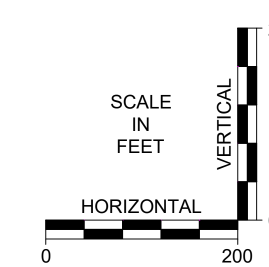


LEGEND

- STRATEGRAPHIC BOUNDARY (DASHED WHERE INFERRED)
- GROUNDWATER ELEVATION (COLLECTED 02/27/2017)
- SOIL BORING
- WELL SCREEN INTERVAL
- END OF BORING

Lithology Key

- SILTY CLAY
- SAND
- SILT
- SANDY CLAY
- SANDY SILT
- SHALE BEDROCK



PROJECT:	DTE ELECTRIC COMPANY BELLE RIVER POWER PLANT CHINA TOWNSHIP, MICHIGAN
TITLE:	GENERALIZED GEOLOGIC CROSS-SECTION A-A'
DRAWN BY: D.STEHLE	PROJ NO.: 265996.0003.01
CHECKED BY: S.HOLMSTROM	FIGURE 4
APPROVED BY: V.BUENING	
DATE: SEPTEMBER 2017	

TRC

1540 Eisenhower Place
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Phone: 734.971.7080
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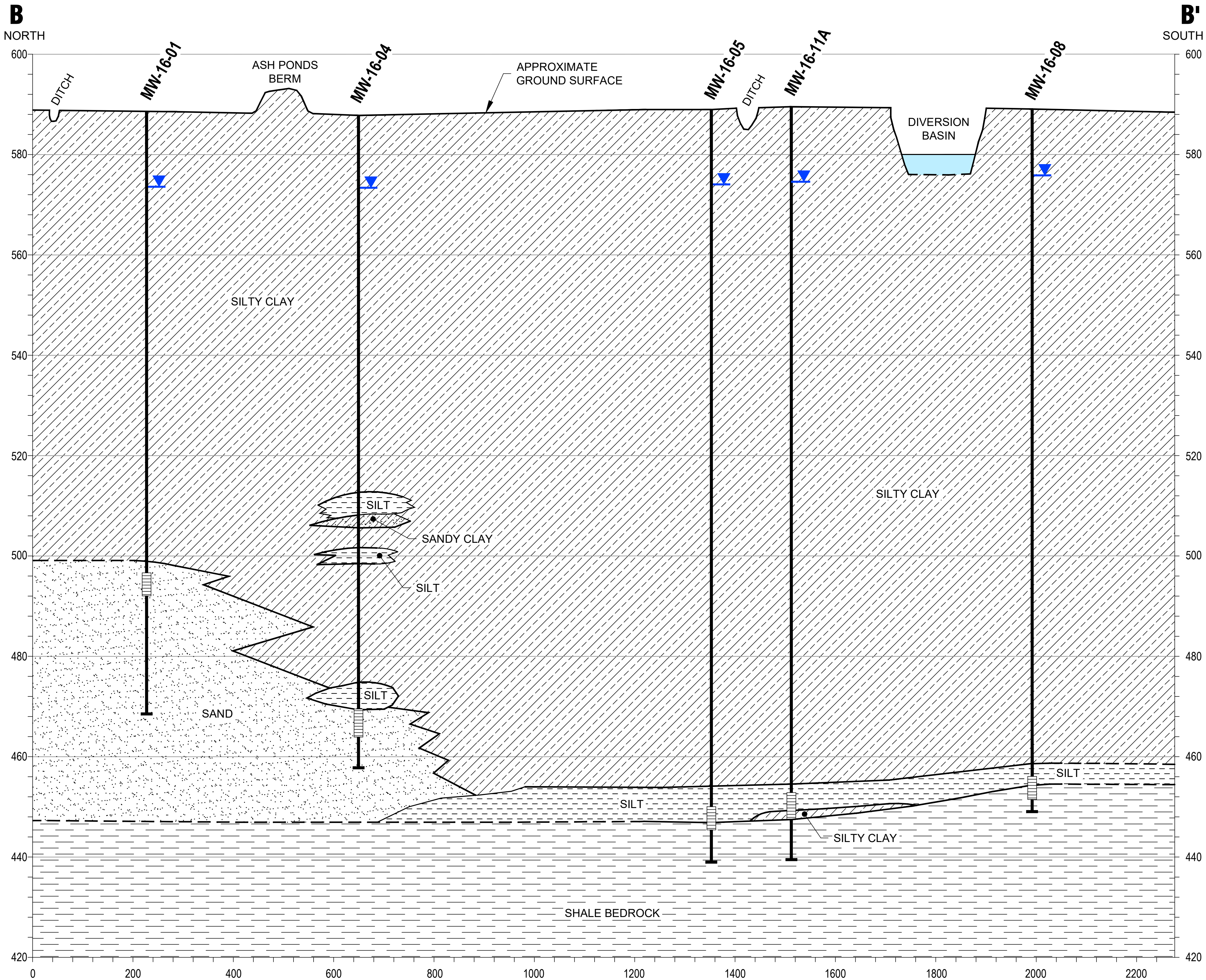
FILE NO.: 265996.0003.01.04-05.dwg

11x17 --- ATTACHED XREFS: --- ATTACHED IMAGES: DTE BRPP XSs XXXXXXXXXXX-02172017092213_Page_1; DTE BRPP XSs XXXXXXXXXXX-02172017092213_Page_2; XS aa wells; XS cc wells; XS DD wells;
DRAWING NAME: J:_TRC\DTE\Belle River PP\265996\0003\265996.0003.01.04-05.dwg --- PLOT DATE: October 10, 2017 - 6:47AM --- LAYOUT: FIG04 XS AA

GENERALIZED GEOLOGIC CROSS-SECTION B-B'

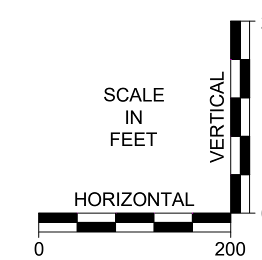


LEGEND

- STRATEGRAPHIC BOUNDARY (DASHED WHERE INFERRED)
- GROUNDWATER ELEVATION (COLLECTED 02/27/2017)
- SOIL BORING
- WELL SCREEN INTERVAL
- END OF BORING

Lithology Key

- SILTY CLAY
- SAND
- SILT
- SANDY CLAY
- SHALE BEDROCK



PROJECT:	DTE ELECTRIC COMPANY BELLE RIVER POWER PLANT CHINA TOWNSHIP, MICHIGAN
TITLE:	GENERALIZED GEOLOGIC CROSS-SECTION B-B'
DRAWN BY:	D.STEHLE
CHECKED BY:	S.HOLMSTROM
APPROVED BY:	V.BUENING
DATE:	SEPTEMBER 2017
PROJ NO.:	265996.0003
	FIGURE 5
FILE NO.:	265996.0003.01.04-05.dwg

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11x17 --- ATTACHED XREFS: --- ATTACHED IMAGES: DTE BRPP XSs XXXXXXXXXX-02172017092213_Page_1; DTE BRPP XSs XXXXXXXXXX-02172017092213_Page_2; XS aa wells; XS cc wells; XS DD wells;
DRAWING NAME: J:_TRC\DTE\Belle River PP\265996\0003\265996.0003.01.04-05.dwg --- PLOT DATE: October 10, 2017 - 6:47AM --- LAYOUT: FIG05 XS BB

TRC Environmental Corporation	QC: JPH
Falling Head, Rising Tailwater Permeability Test (ASTM D5084, Method C)	QA: JPH

Project Name:	DTE - BRPP BAB and DB	Cell #:	8
Project #:	231828.0003.0000	USCS Description:	N/A
Sample Name:	MW-16-01, 50-52'	USCS Classification:	N/A
Visual Descript:	Gray lean clay	Average Kv =	2.9E-08 cm/s

Sample Type: Undisturbed	Initial Values	Final Values			
Sample Dia. (in)	2.87	2.87	Permeant:	Water	
Sample Ht. (in)	3.02	3.02	Permeant Specific Gravity:	1.00	
Tare & Wet (g)	775.10	649.20	Sample Specific Gravity:	2.70	Est.
Tare & Dry (g)	562.60	471.50	Confining Pressure (psi):	100.0	
Tare (g)	88.86	88.64	Burette Diameter (in):	0.250	
Sample Wt. (g)	563.65	560.56	Burette Zero (cm):	100.0	

	Initial	Final		
Moisture (%)	44.9	46.4	Maximum Gradient:	7.0
Wet Density (pcf)	109.9	109.5	Average Gradient:	6.5
Dry Density (pcf)	75.9	74.8	Max. Effect. Stress (psi):	5.7
Saturation (%)	99.2	100.0	Min. Effect. Stress (psi):	4.3
			Ave. Effect. Stress (psi):	4.8

	Date			Time		Run	Temp	Pressure (psi)		Cham	Cham.	Bot	Bot.	Top	Top	Flow	Kv ***	Ave.*
	Yr.	Mo.	Day	Hr.	Min.	Time (s)	C°**	Bot	Top	(cm)	Dif.(cm)	(cm)	Dif.(cm)	(cm)	Dif.(cm)	Dif.(%)	cm/s	0,1
1	2016	3	15	8	10.00		0.0	95	95	55.40		3.45		102.60				
2	2016	3	15	11	15.00	11100	23.0	95	95	56.10	0.70	4.05	0.60	101.30	1.30	-36.8	4.7E-08	
3	2016	3	15	14	16.00	10860	23.0	95	95	57.00	0.90	4.75	0.70	100.60	0.70	0.0	3.6E-08	
4	2016	3	15	18	15.00	14340	23.0	95	95	57.75	0.75	5.55	0.80	99.75	0.85	-3.0	3.3E-08	
5	2016	3	16	4	55.00	38400	22.0	95	95	59.30	1.55	7.65	2.10	97.50	2.25	-3.4	3.4E-08	
6	2016	3	16	8	38.00	13380	23.0	95	95	59.80	0.50	8.35	0.70	96.80	0.70	0.0	3.2E-08	
7	2016	3	16	11	56.00	11880	23.0	95	95	60.35	0.55	9.05	0.70	96.30	0.50	16.7	3.1E-08	
8	2016	3	16	15	1.00	11100	23.0	95	95	60.40	0.05	9.60	0.55	95.70	0.60	-4.3	3.2E-08	
9	2016	3	17	5	14.00	51180	22.0	95	95	61.30	0.90	12.10	2.50	93.20	2.50	0.0	3.2E-08	
10	2016	3	17	8	17.00	10980	24.0	95	95	62.05	0.75	12.65	0.55	92.75	0.45	10.0	3.0E-08	
11	2016	3	17	12	19.00	14520	23.0	95	95	62.15	0.10	13.25	0.60	92.05	0.70	-7.7	3.0E-08	
12	2016	3	17	17	49.00	19800	23.0	95	95	62.60	0.45	14.15	0.90	91.30	0.75	9.1	2.9E-08	
13	2016	3	18	5	23.00	41640	22.0	95	95	63.15	0.55	16.00	1.85	89.40	1.90	-1.3	3.3E-08	
14	2016	3	18	8	58.00	12900	24.0	95	95	63.60	0.45	16.55	0.55	88.90	0.50	4.8	3.0E-08	
15	2016	3	18	12	55.00	14220	23.0	95	95	63.80	0.20	17.10	0.55	88.30	0.60	-4.3	3.0E-08	
16	2016	3	18	16	30.00	12900	23.0	95	95	64.10	0.30	17.65	0.55	87.90	0.40	15.8	2.8E-08	
17	2016	3	21	4	58.00	217680	22.0	95	95	67.20	3.10	25.35	7.70	80.20	7.70	0.0	3.1E-08	
18	2016	3	21	8	1.00	10980	24.0	95	95	67.60	0.40	25.70	0.35	79.85	0.35	0.0	3.1E-08	
19	2016	3	21	12	10.00	14940	23.0	95	95	67.60	0.00	26.15	0.45	79.40	0.45	0.0	3.0E-08	
20	2016	3	21	15	12.00	10920	23.0	95	95	67.70	0.10	26.40	0.25	79.15	0.25	0.0	2.3E-08	1
21	2016	3	21	19	36.00	15840	23.0	95	95	68.30	0.60	26.90	0.50	78.70	0.45	5.3	3.1E-08	1
22	2016	3	21	21	31.00	6900	23.0	95	95	68.10	-0.20	27.10	0.20	78.50	0.20	0.0	3.0E-08	1
23	2016	3	22	5	52.00	30060	25.0	95	95	68.90	0.80	28.05	0.95	77.65	0.85	5.6	3.1E-08	1
24	2016	3	22	10	31.00	16740	23.0	95	95	68.85	-0.05	28.45	0.40	77.20	0.45	-5.9	2.8E-08	1
25	2016	3	22	15	59.00	19680	24.0	95	95	69.40	0.55	29.00	0.55	76.70	0.50	4.8	2.9E-08	1
26	2016	3	22	22	32.00	23580	24.0	95	95	69.80	0.40	29.55	0.55	76.10	0.60	-4.3	2.7E-08	1

**A zero in this column starts a series of measurements. *Average Kv for those rows with a 1 in the Ave. column. 2.9E-08 cm/s

(Termination determined by stable Kv and low flow differential.) ***Kv adjusted for temperature.

TRC Environmental Corporation

Falling Head, Rising Tailwater Permeability Test (ASTM D5084, Method C)

QC: JPH
QA: JPH

Project Name:	DTE - BRPP BAB and DB	Cell #:	9
Project #:	231828.0003.0000	USCS Description:	N/A
Sample Name:	MW-16-05, 50-52'	USCS Classification:	N/A
Visual Descript:	Gray lean clay	Average Kv =	2.7E-08 cm/s

	Initial Values	Final Values			
Sample Type: Undisturbed					
Sample Dia. (in)	2.87	2.84	Permeant:	Water	
Sample Ht. (in)	3.25	3.20	Permeant Specific Gravity:	1.00	
Tare & Wet (g)	536.11	691.40	Sample Specific Gravity:	2.70	Est.
Tare & Dry (g)	403.90	517.10	Confining Pressure (psi):	100.0	
Tare (g)	93.83	91.24	Burette Diameter (in):	0.250	
Sample Wt. (g)	610.40	600.16	Burette Zero (cm):	100.0	

Moisture (%)	42.6	40.9	Maximum Gradient:	7.3
Wet Density (pcf)	110.6	112.8	Average Gradient:	6.9
Dry Density (pcf)	77.5	80.0	Max. Effect. Stress (psi):	6.1
Saturation (%)	98.2	100.0	Min. Effect. Stress (psi):	4.6
			Ave. Effect. Stress (psi):	5.1

	Date Yr.	Mo.	Day	Time Hr.	Min.	Run Time (s)	Temp C°**	Pressure (psi) Bot	Top	Cham (cm)	Cham. Dif.(cm)	Bot (cm)	Bot. Dif.(cm)	Top (cm)	Top Dif.(cm)	Flow Dif.(%)	Kv *** cm/s	Ave.* 0,1
1	2016	3	15	8	11.00		0.0	95	95	25.20		1.95		101.75				
2	2016	3	15	11	15.00		0.0	95	95	27.70		1.80		99.60				
3	2016	3	15	14	17.00	10920	23.0	95	95	29.40	1.70	2.00	0.20	98.65	0.95	-65.2	3.2E-08	
4	2016	3	15	18	16.00	14340	23.0	95	95	30.65	1.25	2.40	0.40	97.60	1.05	-44.8	3.1E-08	
5	2016	3	16	4	56.00	38400	22.0	95	95	32.20	1.55	3.85	1.45	95.40	2.20	-20.5	3.1E-08	
6	2016	3	16	8	39.00	13380	23.0	95	95	32.40	0.20	4.40	0.55	94.85	0.55	0.0	2.6E-08	
7	2016	3	16	11	57.00	11880	23.0	95	95	33.85	1.45	4.95	0.55	94.40	0.45	10.0	2.7E-08	
8	2016	3	16	15	2.00	11100	23.0	95	95	34.00	0.15	5.35	0.40	93.90	0.50	-11.1	2.7E-08	
9	2016	3	17	5	15.00	51180	22.0	95	95	35.20	1.20	7.35	2.00	91.80	2.10	-2.4	2.8E-08	
10	2016	3	17	8	17.00	10920	24.0	95	95	35.80	0.60	7.80	0.45	91.45	0.35	12.5	2.5E-08	
11	2016	3	17	12	20.00	14580	23.0	95	95	35.90	0.10	8.30	0.50	89.85	1.60	-52.4	5.1E-08	
12	2016	3	17	17	50.00	19800	23.0	95	95	36.40	0.50	9.10	0.80	89.25	0.60	14.3	2.6E-08	
13	2016	3	18	5	23.00	41580	22.0	95	95	37.00	0.60	10.65	1.55	88.60	0.65	40.9	2.0E-08	
14	2016	3	18	8	58.00	12900	24.0	95	95	37.50	0.50	11.15	0.50	88.15	0.45	5.3	2.7E-08	
15	2016	3	18	12	55.00	14220	23.0	95	95	37.70	0.20	11.65	0.50	87.60	0.55	-4.8	2.8E-08	
16	2016	3	18	16	31.00	12960	23.0	95	95	38.00	0.30	12.10	0.45	87.20	0.40	5.9	2.5E-08	
17	2016	3	21	4	59.00	217680	22.0	95	95	41.00	3.00	19.25	7.15	79.85	7.35	-1.4	3.0E-08	
18	2016	3	21	8	2.00	10980	24.0	95	95	41.40	0.40	19.55	0.30	79.60	0.25	9.1	2.4E-08	
19	2016	3	21	12	10.00	14880	23.0	95	95	41.40	0.00	19.95	0.40	79.15	0.45	-5.9	2.8E-08	
20	2016	3	21	15	13.00	10980	23.0	95	95	41.60	0.20	20.25	0.30	78.85	0.30	0.0	2.7E-08	1
21	2016	3	21	19	37.00	15840	23.0	95	95	42.00	0.40	20.80	0.55	78.55	0.30	29.4	2.7E-08	1
22	2016	3	21	21	32.00	6900	23.0	95	95	41.80	-0.20	20.90	0.10	78.30	0.25	-42.9	2.6E-08	1
23	2016	3	22	5	53.00	30060	25.0	95	95	42.75	0.95	21.75	0.85	77.55	0.75	6.3	2.6E-08	1
24	2016	3	22	10	32.00	16740	23.0	95	95	42.75	0.00	22.20	0.45	77.10	0.45	0.0	2.8E-08	1
25	2016	3	22	16	0.00	19680	24.0	95	95	43.25	0.50	22.75	0.55	76.65	0.45	10.0	2.7E-08	1
26	2016	3	22	22	33.00	23580	24.0	95	95	43.60	0.35	23.35	0.60	76.10	0.55	4.3	2.6E-08	1

**A zero in this column starts a series of measurements. *Average Kv for those rows with a 1 in the Ave. column. 2.7E-08 cm/s

(Termination determined by stable Kv and low flow differential.) ***Kv adjusted for temperature.

TRC Environmental Corporation

Falling Head, Rising Tailwater Permeability Test (ASTM D5084, Method C)

QC: JPH
QA: JPH

Project Name:	DTE - BRPP BAB and DB	Cell #:	9
Project #:	231828.0003.0000	USCS Description:	N/A
Sample Name:	MW-16-07, 50-52'	USCS Classification:	N/A
Visual Descript:	Gray sandy lean clay, with gravel	Average Kv =	2.9E-08 cm/s

Sample Type: Undisturbed	Initial Values	Final Values			
Sample Dia. (in)	2.86	2.83	Permeant:	Water	
Sample Ht. (in)	3.50	3.48	Permeant Specific Gravity:	1.00	
Tare & Wet (g)	512.00	737.80	Sample Specific Gravity:	2.68	Est.
Tare & Dry (g)	387.40	552.10	Confining Pressure (psi):	100.0	
Tare (g)	92.18	89.22	Burette Diameter (in):	0.250	
Sample Wt. (g)	666.40	648.58	Burette Zero (cm):	100.0	

	Initial	Final		
Moisture (%)	42.2	40.1		
Wet Density (pcf)	112.9	112.9		
Dry Density (pcf)	79.4	80.6	Max. Effect. Stress (psi):	6.2
Saturation (%)	102.4	100.0	Min. Effect. Stress (psi):	4.5
			Ave. Effect. Stress (psi):	5.0

	Date Yr.	Mo.	Day	Time Hr.	Min.	Run Time (s)	Temp C°**	Pressure (psi) Bot	Top	Cham (cm)	Cham. Dif.(cm)	Bot (cm)	Bot. Dif.(cm)	Top (cm)	Top Dif.(cm)	Flow Dif.(%)	Kv *** cm/s	Ave.* 0,1
1	2016	4	21	11	16.00		0.0	95	95	16.80		2.50		102.25				
2	2016	4	21	20	32.00	33360	27.0	95	95	27.60	10.80	1.25	-1.25	96.40	5.85	-154.3	4.1E-08	
3	2016	4	22	9	22.00	46200	24.0	95	95	32.50	4.90	2.40	1.15	93.40	3.00	-44.6	3.0E-08	
4	2016	4	22	12	18.00	10560	24.0	95	95	33.50	1.00	2.85	0.45	92.90	0.50	-5.3	3.1E-08	
5	2016	4	22	18	33.00	22500	25.0	95	95	35.05	1.55	3.80	0.95	91.95	0.95	0.0	2.9E-08	
6	2016	4	25	11	30.00	233820	23.0	95	95	44.30	9.25	12.75	8.95	83.10	8.85	0.6	3.1E-08	
7	2016	4	25	17	41.00	22260	24.0	95	95	45.35	1.05	13.50	0.75	82.40	0.70	3.4	2.9E-08	
8	2016	4	25	20	39.00	10680	24.0	95	95	45.30	-0.05	13.80	0.30	82.00	0.40	-14.3	3.0E-08	
9	2016	4	25	23	15.00	9360	24.0	95	95	45.35	0.05	14.10	0.30	81.70	0.30	0.0	3.0E-08	
10	2016	4	26	4	59.00	20640	25.0	95	95	46.00	0.65	14.75	0.65	81.00	0.70	-3.7	3.0E-08	
11	2016	4	26	8	19.00	12000	24.0	95	95	45.95	-0.05	15.10	0.35	80.60	0.40	-6.7	3.0E-08	
12	2016	4	26	13	18.00	17940	24.0	95	95	46.40	0.45	15.70	0.60	80.10	0.50	9.1	3.0E-08	
13	2016	4	27	4	57.00	56340	23.0	95	95	47.60	1.20	17.40	1.70	78.60	1.50	6.2	2.9E-08	
14	2016	4	27	12	47.00	28200	23.0	95	95	47.95	0.35	18.20	0.80	77.90	0.70	6.7	2.8E-08	
15	2016	4	27	15	8.00	8460	23.0	95	95	47.90	-0.05	18.45	0.25	77.65	0.25	0.0	3.2E-08	
16	2016	4	28	5	1.00	49980	22.0	95	95	48.80	0.90	19.80	1.35	76.35	1.30	1.9	3.0E-08	
17	2016	4	28	8	5.00	11040	24.0	95	95	49.40	0.60	20.15	0.35	76.15	0.20	27.3	2.8E-08	
18	2016	4	28	14	56.00	24660	23.0	95	95	49.60	0.20	20.75	0.60	75.55	0.60	0.0	2.8E-08	
19	2016	4	28	20	48.00	21120	23.0	95	95	49.90	0.30	21.30	0.55	75.10	0.45	10.0	2.8E-08	
20	2016	4	29	5	31.00	31380	26.0	95	95	51.05	1.15	22.10	0.80	74.35	0.75	3.2	2.8E-08	
21	2016	4	29	10	27.00	17760	23.0	95	95	50.90	-0.15	22.50	0.40	73.90	0.45	-5.9	3.0E-08	
22	2016	4	29	14	41.00	15240	23.0	95	95	51.25	0.35	22.90	0.40	73.60	0.30	14.3	2.9E-08	
23	2016	4	29	18	0.00	11940	23.0	95	95	51.55	0.30	23.20	0.30	73.40	0.20	20.0	2.7E-08	
24	2016	5	1	16	23.00	166980	22.0	95	95	54.25	2.70	26.95	3.75	70.05	3.35	5.6	3.0E-08	
25	2016	5	2	4	58.00	45300	23.0	95	95	55.05	0.80	27.85	0.90	69.25	0.80	5.9	2.9E-08	
26	2016	5	2	8	4.00	11160	23.0	95	95	55.30	0.25	28.10	0.25	69.05	0.20	11.1	3.1E-08	

**A zero in this column starts a series of measurements. *Average Kv for those rows with a 1 in the Ave. column.

(Termination determined by stable Kv and low flow differential.) ***Kv adjusted for temperature.

TRC Environmental Corporation

Falling Head, Rising Tailwater Permeability Test (ASTM D5084, Method C)

QC: JPH
QA: JPH

Project Name:	DTE - BRPP BAB and DB	Cell #:	9
Project #:	231828.0003.0000	USCS Description:	N/A
Sample Name:	MW-16-07, 50-52'	USCS Classification:	N/A
Visual Descript:	Gray sandy lean clay, with gravel		

Sample Type: Undisturbed	Initial Values	Final Values			
Sample Dia. (in)	2.86	2.83	Permeant:	Water	
Sample Ht. (in)	3.50	3.48	Permeant Specific Gravity:	1.00	
Tare & Wet (g)	512.00	737.80	Sample Specific Gravity:	2.68	Est.
Tare & Dry (g)	387.40	552.10	Confining Pressure (psi):	100.0	
Tare (g)	92.18	89.22	Burette Diameter (in):	0.250	
Sample Wt. (g)	666.40	648.58	Burette Zero (cm):	100.0	

Moisture (%)	42.2	40.1	Maximum Gradient:	3.8
Wet Density (pcf)	112.9	112.9	Average Gradient:	3.6
Dry Density (pcf)	79.4	80.6	Max. Effect. Stress (psi):	5.2
Saturation (%)	102.4	100.0	Min. Effect. Stress (psi):	4.6
			Ave. Effect. Stress (psi):	4.9

	Date			Time		Run	Temp	Pressure (psi)		Cham	Cham.	Bot	Bot.	Top	Top	Flow	Kv ***	Ave.*
	Yr.	Mo.	Day	Hr.	Min.	Time (s)	C°**	Bot	Top	(cm)	Dif.(cm)	(cm)	Dif.(cm)	(cm)	Dif.(cm)	Dif.(%)	cm/s	0,1
1	2016	5	2	8	4.00		0.0	95	95	55.30		28.10		69.05				
2	2016	5	2	13	15.00	18660	23.0	95	95	55.65	0.35	28.50	0.40	68.80	0.25	23.1	2.8E-08	
3	2016	5	2	20	45.00	27000	26.0	95	95	56.30	0.65	29.00	0.50	68.35	0.45	5.3	2.6E-08	
4	2016	5	3	4	50.00	29100	23.0	95	95	56.00	-0.30	29.50	0.50	67.75	0.60	-9.1	3.1E-08	
5	2016	5	3	8	0.00	11400	25.0	95	95	56.35	0.35	29.70	0.20	67.60	0.15	14.3	2.5E-08	
6	2016	5	3	11	10.00	11400	23.0	95	95	56.30	-0.05	29.90	0.20	67.35	0.25	-11.1	3.4E-08	
7	2016	5	3	14	12.00	10920	23.0	95	95	56.40	0.10	30.15	0.25	67.25	0.10	42.9	2.8E-08	
8	2016	5	3	19	36.00	19440	24.0	95	95	57.20	0.80	30.55	0.40	67.05	0.20	33.3	2.6E-08	
9	2016	5	4	5	24.00	35280	23.0	95	95	57.60	0.40	31.15	0.60	66.50	0.55	4.3	2.9E-08	
10	2016	5	4	9	48.00	15840	23.0	95	95	57.60	0.00	31.40	0.25	66.25	0.25	0.0	2.9E-08	
11	2016	5	4	14	50.00	18120	23.0	95	95	57.70	0.10	31.70	0.30	66.00	0.25	9.1	2.8E-08	
12	2016	5	4	20	0.00	18600	25.0	95	95	58.25	0.55	32.10	0.40	65.80	0.20	33.3	2.9E-08	
13	2016	5	5	5	24.00	33840	24.0	95	95	58.35	0.10	32.60	0.50	65.30	0.50	0.0	2.8E-08	1
14	2016	5	5	10	25.00	18060	24.0	95	95	58.60	0.25	32.90	0.30	65.10	0.20	20.0	2.7E-08	1
15	2016	5	5	14	42.00	15420	24.0	95	95	58.90	0.30	33.20	0.30	64.85	0.25	9.1	3.5E-08	1
16	2016	5	6	4	52.00	51000	23.0	95	95	59.50	0.60	34.00	0.80	64.25	0.60	14.3	2.8E-08	1
17	2016	5	6	9	32.00	16800	23.0	95	95	59.70	0.20	34.25	0.25	64.05	0.20	11.1	2.9E-08	1
18																		
19																		
20																		
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22																		
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24																		
25																		
26																		

**A zero in this column starts a series of measurements. *Average Kv for those rows with a 1 in the Ave. column. 2.9E-08 cm/s

(Termination determined by stable Kv and low flow differential.) ***Kv adjusted for temperature.

TRC Environmental Corporation

Falling Head, Rising Tailwater Permeability Test (ASTM D5084, Method C)

QC: JPH
QA: JPH

Project Name:	DTE - BRPP BAB and DB	Cell #:	10
Project #:	231828.0003.0000	USCS Description:	N/A
Sample Name:	SB-16-01, 50-52'	USCS Classification:	N/A
Visual Descript:	Gray lean clay	Average Kv =	2.1E-08 cm/s

Sample Type: Undisturbed	Initial Values	Final Values			
Sample Dia. (in)	2.87	2.82	Permeant:	Water	
Sample Ht. (in)	2.88	2.86	Permeant Specific Gravity:	1.00	
Tare & Wet (g)	534.46	607.60	Sample Specific Gravity:	2.70	Est.
Tare & Dry (g)	400.40	448.80	Confining Pressure (psi):	100.0	
Tare (g)	98.45	86.36	Burette Diameter (in):	0.250	
Sample Wt. (g)	532.36	521.24	Burette Zero (cm):	100.0	

	Initial	Final		
Moisture (%)	44.4	43.8	Maximum Gradient:	8.9
Wet Density (pcf)	109.0	111.0	Average Gradient:	8.4
Dry Density (pcf)	75.5	77.2	Max. Effect. Stress (psi):	6.1
Saturation (%)	97.4	100.0	Min. Effect. Stress (psi):	4.5
			Ave. Effect. Stress (psi):	5.1

	Date			Time		Run	Temp	Pressure (psi)		Cham	Cham.	Bot	Bot.	Top	Top	Flow	Kv ***	Ave.*
	Yr.	Mo.	Day	Hr.	Min.	Time (s)	C°**	Bot	Top	(cm)	Dif.(cm)	(cm)	Dif.(cm)	(cm)	Dif.(cm)	Dif.(%)	cm/s	0,1
1	2016	3	15	8	11.00		0.0	95	95	24.00		1.65		102.30				
2	2016	3	15	11	16.00		0.0	95	95	27.35		1.15		99.70				
3	2016	3	15	14	17.00		0.0	95	95	29.50		1.15		98.60				
4	2016	3	15	18	17.00	14400	23.0	95	95	30.90	1.40	1.35	0.20	97.50	1.10	-69.2	2.5E-08	
5	2016	3	16	4	56.00	38340	22.0	95	95	34.75	3.85	2.00	0.65	95.00	2.50	-58.7	2.4E-08	
6	2016	3	16	8	39.00	13380	23.0	95	95	35.00	0.25	2.50	0.50	94.55	0.45	5.3	2.0E-08	
7	2016	3	16	11	58.00	11940	23.0	95	95	35.45	0.45	3.00	0.50	94.10	0.45	5.3	2.3E-08	
8	2016	3	16	15	3.00	11100	23.0	95	95	35.80	0.35	3.35	0.35	93.60	0.50	-17.6	2.2E-08	
9	2016	3	17	5	15.00	51120	22.0	95	95	38.75	2.95	4.55	1.20	91.10	2.50	-35.1	2.2E-08	
10	2016	3	17	8	18.00	10980	24.0	95	95	38.25	-0.50	5.25	0.70	90.95	0.15	64.7	2.3E-08	
11	2016	3	17	12	21.00	14580	23.0	95	95	38.60	0.35	5.65	0.40	90.35	0.60	-20.0	2.1E-08	
12	2016	3	17	17	51.00	19800	23.0	95	95	38.50	-0.10	6.45	0.80	89.85	0.50	23.1	2.1E-08	
13	2016	3	18	5	24.00	41580	22.0	95	95	40.80	2.30	7.40	0.95	87.95	1.90	-33.3	2.3E-08	
14	2016	3	18	8	59.00	12900	24.0	95	95	40.40	-0.40	8.05	0.65	87.70	0.25	44.4	2.3E-08	
15	2016	3	18	12	56.00	14220	23.0	95	95	40.70	0.30	8.40	0.35	87.25	0.45	-12.5	1.9E-08	
16	2016	3	18	16	32.00	12960	23.0	95	95	40.70	0.00	8.95	0.55	86.90	0.35	22.2	2.4E-08	
17	2016	3	21	4	59.00	217620	22.0	95	95	45.25	4.55	15.10	6.15	80.30	6.60	-3.5	2.2E-08	
18	2016	3	21	8	2.00	10980	24.0	95	95	45.25	0.00	15.50	0.40	80.10	0.20	33.3	2.2E-08	
19	2016	3	21	12	11.00	14940	23.0	95	95	45.40	0.15	15.90	0.40	79.65	0.45	-5.9	2.4E-08	1
20	2016	3	21	15	13.00	10920	23.0	95	95	45.70	0.30	16.10	0.20	79.35	0.30	-20.0	1.9E-08	1
21	2016	3	21	19	38.00	15900	23.0	95	95	45.70	0.00	16.65	0.55	79.10	0.25	37.5	2.1E-08	1
22	2016	3	21	21	33.00	6900	23.0	95	95	46.10	0.40	16.70	0.05	78.80	0.30	-71.4	2.2E-08	1
23	2016	3	22	5	53.00	30000	25.0	95	95	47.20	1.10	17.35	0.65	78.00	0.80	-10.3	2.0E-08	1
24	2016	3	22	10	32.00	16740	23.0	95	95	47.10	-0.10	17.80	0.45	77.60	0.40	5.9	2.2E-08	1
25	2016	3	22	16	0.00	19680	24.0	95	95	47.40	0.30	18.35	0.55	77.15	0.45	10.0	2.2E-08	1
26	2016	3	22	22	34.00	23640	24.0	95	95	47.10	-0.30	19.10	0.75	76.80	0.35	36.4	2.1E-08	1

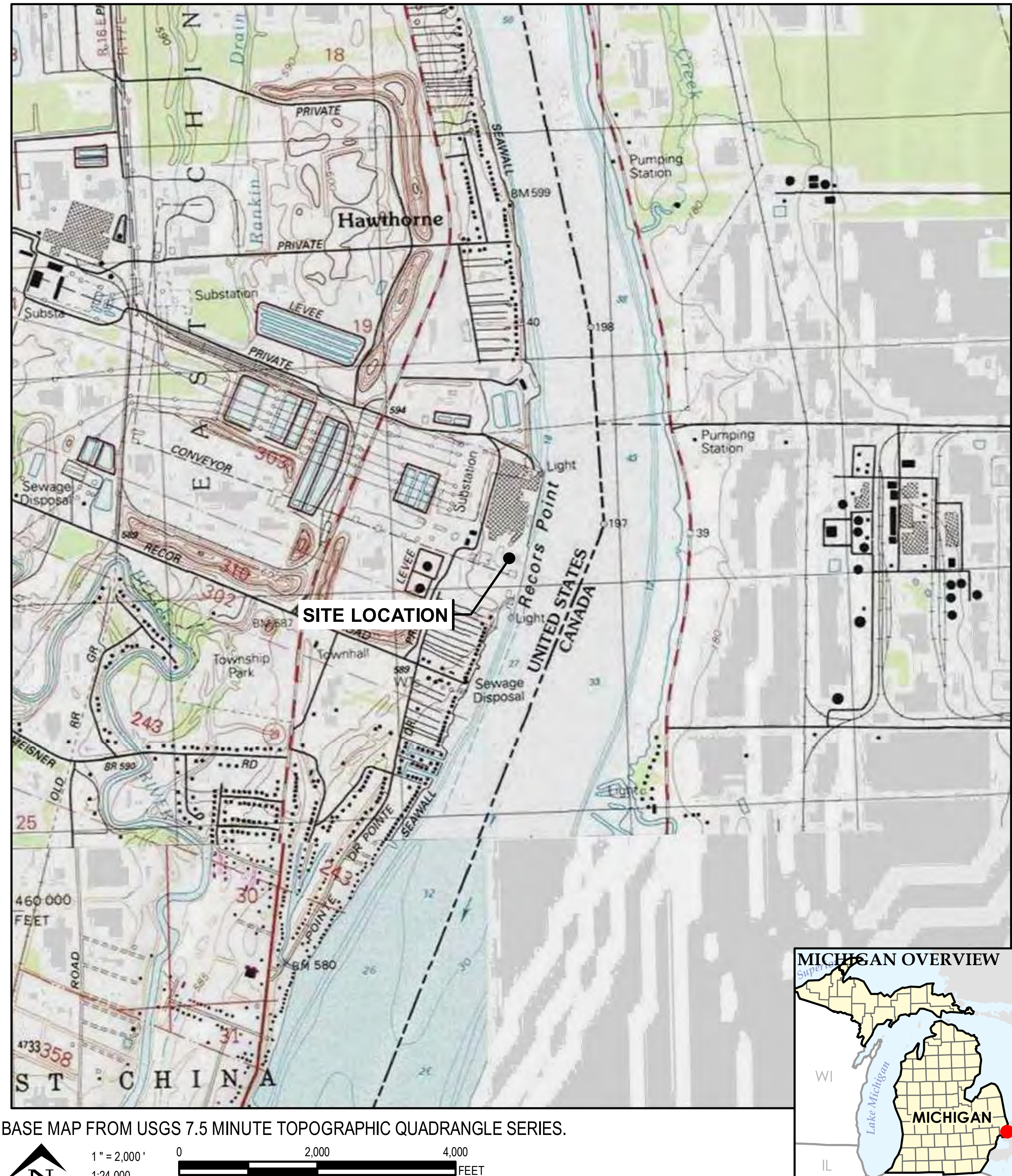
**A zero in this column starts a series of measurements.

*Average Kv for those rows with a 1 in the Ave. column. 2.1E-08 cm/s

(Termination determined by stable Kv and low flow differential.)

***Kv adjusted for temperature.

MONPP FAB CCR Unit Site



BASE MAP FROM USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE SERIES.

N

1 " = 2,000 '
1:24,000

0 2,000 4,000 FEET

TRC 1540 Eisenhower Place Ann Arbor, MI 48108-3284 Phone: 734.971.7080 *TRC - GIS*	PROJECT: **DTE ELECTRIC COMPANY ST. CLAIR POWER PLANT 4901 POINTE DRIVE EAST CHINA TOWNSHIP, MICHIGAN**	DRAWN BY: J. PAPEZ CHECKED BY: S HOLMSTROM APPROVED BY: V. BUENING
	TITLE: **SITE LOCATION MAP**	DATE: OCTOBER 2017 PROJ. NO.: 265996.0004 FILE: 265996-SLMMB.mxd **FIGURE 1**

E:\DTE\CCR_Sites\2017_265996\265996-SLMMB.mxd -- Saved By: BDEEGAN on 10/9/2017, 14:51:49 PM

LEGEND

- MONITORING WELLS
- SURFACE WATER MEASURING POINT
- *(579.85)* GROUNDWATER ELEVATION (FT NAVD88)
- GROUNDWATER ELEVATION CONTOUR (0.5-FT INTERVAL, DASHED WHERE INFERRED)

NOTES

1. BASE MAP IMAGERY FROM ST. CLAIR COUNTY INFORMATION TECHNOLOGY DEPARTMENT WEBMAP, 2015.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN APRIL 2016.
3. GROUNDWATER ELEVATIONS DISPLAYED IN FEET RELATIVE TO NORTH AMERICAN VERTICAL DATUM OF 1988.
4. GROUNDWATER ELEVATION DATA FOR MW-16-02 WAS NOT USED. GROUNDWATER LEVEL WAS NOT FULLY RECOVERED AT THE TIME OF DATA COLLECTION.

PROJECT:	DTE ELECTRIC COMPANY ST. CLAIR POWER PLANT 4901 POINTE DRIVE CHINA TOWNSHIP, MICHIGAN
TITLE:	GROUNDWATER POTENTIOMETRIC SURFACE MAP OCTOBER 2017
DRAWN BY:	S. MAJOR
PROJ NO.:	265996.0004
CHECKED BY:	S. SCIESZKA
APPROVED BY:	V. BUENING
DATE:	JANUARY 2018
	FIGURE 3
FILE NO.:	265996-0004-012.mxd

TRC
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Ann Arbor, MI 48108-3284
Phone: 734.971.7080
www.trcsolutions.com

TRC - GIS

Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0

Plot Date: 1/12/2018, 10:19:44 AM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\DTE\CCR_Sites\2017_265996\265996-0004-012.mxd

Table 1
Groundwater Elevation Summary
St. Clair Power Plant Bottom Ash Basins – RCRA CCR Monitoring Program
East China Township, Michigan

Well ID	MP-01		MW-16-01		MW-16-02		MW-16-03		MW-16-04	
Date Installed	3/23/2016		3/31/2016		3/29/2016		3/25/2016		3/23/2016	
TOC Elevation	580.84(1)		584.74		581.43		581.39		580.95	
Geologic Unit of Screened Interval	NA		Silty Clay Shale Interface		Silty Clay Shale Interface		Silty Clay/Hardpan Shale Interface		Silty Clay/Hardpan Shale Interface	
Screened Interval Elevation	NA		458.1 to 453.1		456.2 to 451.2		455.1 to 450.1		455.0 to 450.0	
Unit	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft
Measurement Date	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation
8/1/2016	NM	NM	3.16	581.58	1.32	580.11	1.39	580.00	1.10	579.85
10/3/2016	4.25	576.58	3.63	581.09	5.25	579.49	1.70	579.69	3.22	578.98
11/11/2016	4.72	576.11	3.25	581.49	1.85	579.58	2.00	579.39	1.43	579.52
1/13/2017	4.95	575.88	3.38	581.36	1.82	579.61	1.85	579.54	1.84	579.11
2/28/2017	5.00	575.83	3.42	581.32	2.10	579.33	3.08	578.31	1.60	579.35
4/21/2017	4.21	576.62	3.44	581.30	2.42	579.01	2.06	579.33	1.24	579.71
6/9/2017	4.12	576.71	3.16	581.58	1.30	580.13	1.40	579.99	1.01	579.94
7/27/2017	4.68	576.15	2.31	582.43	1.41	580.02	1.39	580.00	1.28	579.67

Notes:

Elevations are reported in feet relative to the North American Vertical Datum of 1988.

ft BTOC - feet below top of casing

NA - not applicable

NM - not measured

1) Elevation represents the point of reference used to collect surface water level measurements.

LEGEND

- MONITORING WELLS
- SURFACE WATER MEASURING POINT

NOTES

1. BASE MAP IMAGERY FROM GOOGLE EARTH PRO & PARTNERS, APRIL 2015.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN APRIL 2016.

PROJECT:
DTE ELECTRIC COMPANY
ST. CLAIR POWER PLANT
4901 POINTE DRIVE
CHINA TOWNSHIP, MICHIGAN

TITLE:
CROSS SECTION LOCATOR MAP

DRAWN BY:	J. PAPEZ	PROJ NO.:	265996.0004
CHECKED BY:	S. HOLMSTROM	FIGURE 3	
APPROVED BY:	V. BUENING		
DATE:	OCTOBER 2017		

TRC
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Ann Arbor, MI 48108-3284
Phone: 734.971.7080
www.trcsolutions.com

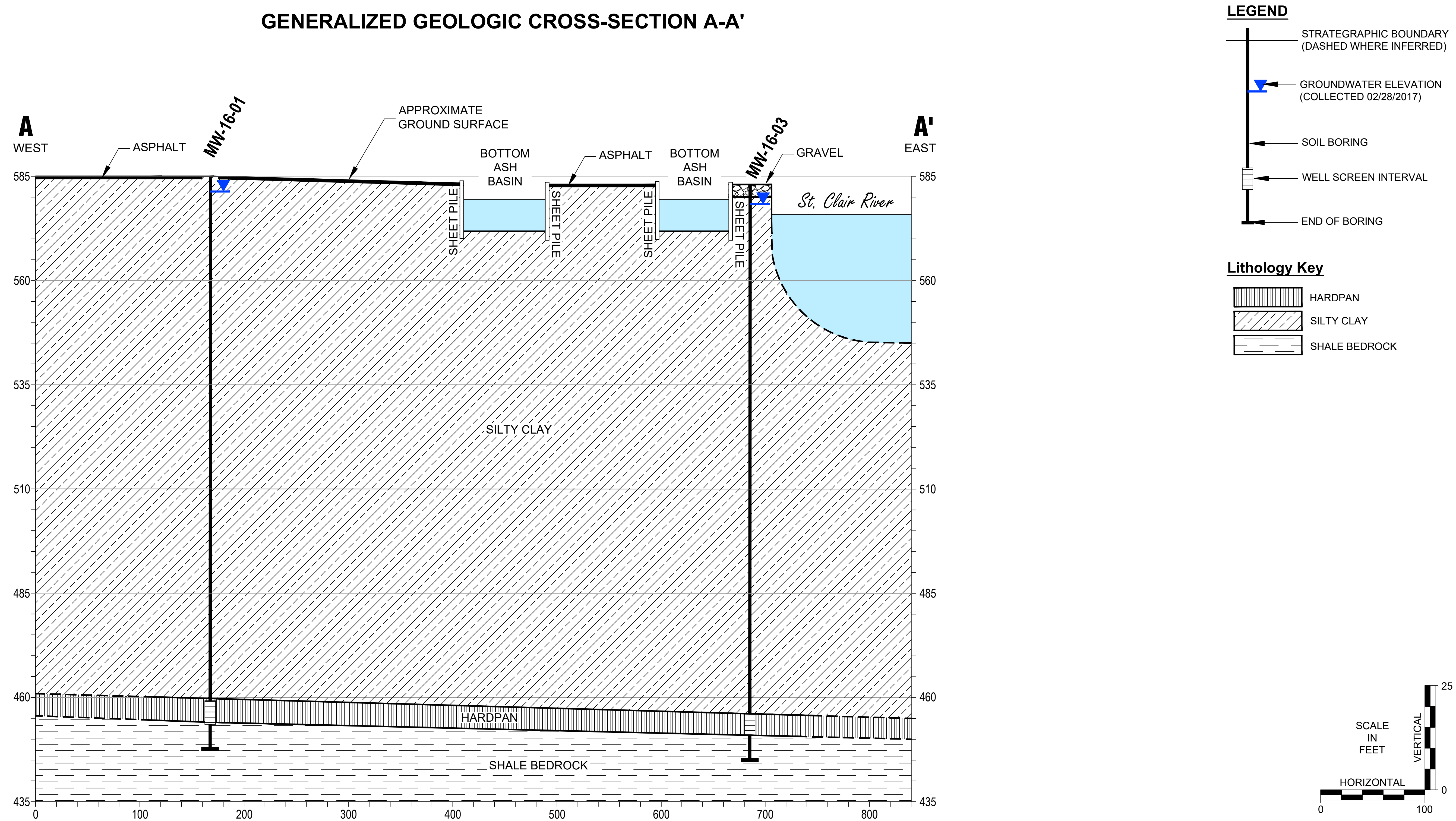
FILE NO.: 265996-0004-010.mxd

TRC - GIS

Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0

Plot Date: 10/9/2017, 15:36:52 PM by BDEEGAN -- LAYOUT: ANSI B(11"x17")
Path: E:\DTE\CCR_Sites\2017_265996\265996-0004-010.mxd

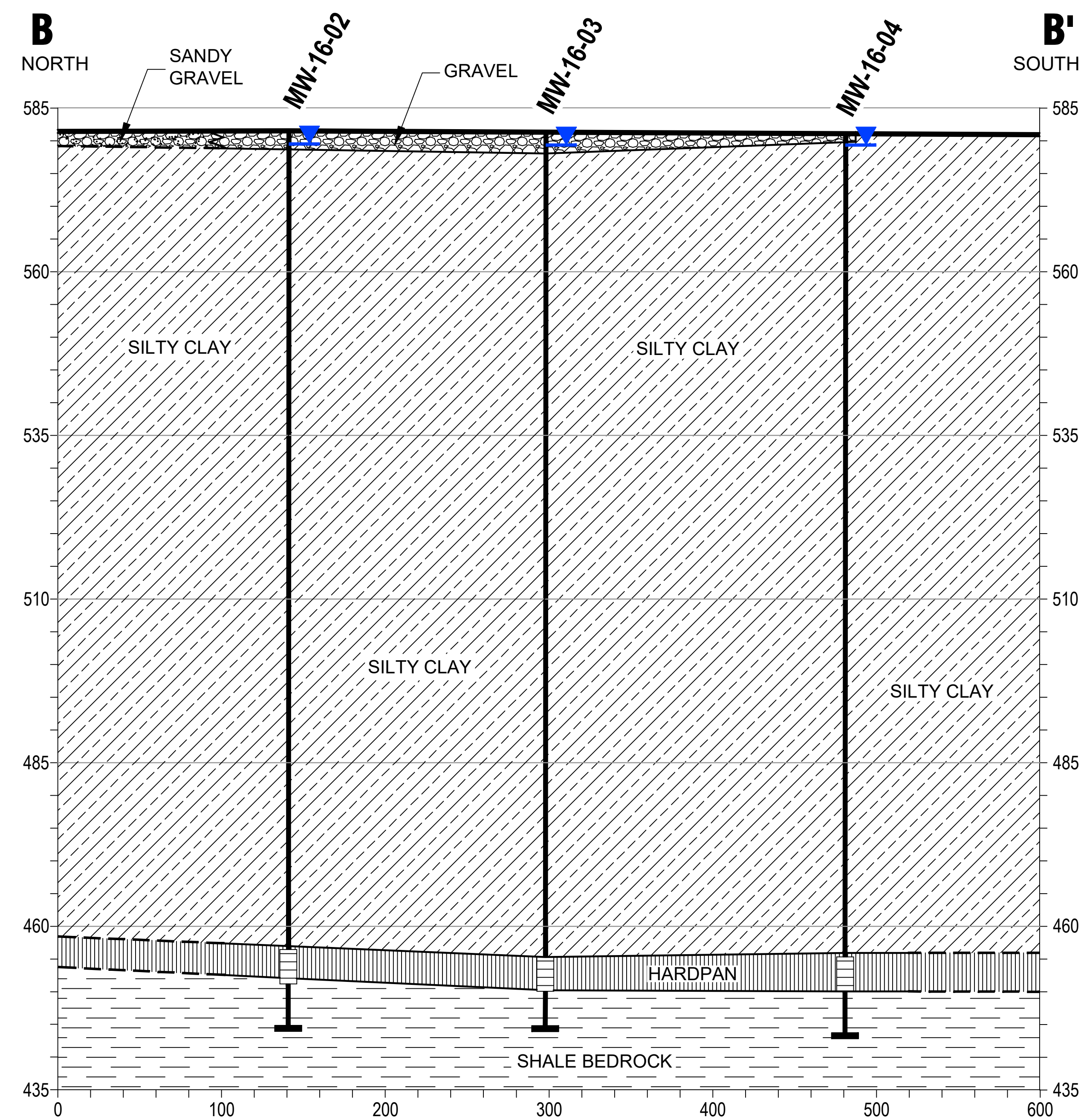
GENERALIZED GEOLOGIC CROSS-SECTION A-A'



PROJECT:	DTE ELECTRIC COMPANY ST. CLAIR POWER PLANT EAST CHINA TOWNSHIP, MICHIGAN
TITLE:	GENERALIZED GEOLOGIC CROSS-SECTION A-A'
DRAWN BY: D.STEHLE	PROJ NO.: 265996.0004.01.01
CHECKED BY: S.HOLMSTROM	FIGURE 4
APPROVED BY: V.BUENING	
DATE: SEPTEMBER 2017	
TRC	1540 Eisenhower Place Ann Arbor, MI 48108 Phone: 734.971.7080 www.trcsolutions.com
FILE NO.:	265996.0004.01.01.04-05.dwg

11x17 --- ATTACHED XREFS: --- ATTACHED IMAGES:
DRAWING NAME: J:_TRC\DTE\St Clair PP\265996\0004\01\ 265996.0004.01.01.04-05.dwg --- PLOT DATE: October 12, 2017 - 12:02PM --- LAYOUT: FIG04 XS AA

GENERALIZED GEOLOGIC CROSS-SECTION B-B'



LEGEND

STRATEGRAPHIC BOUNDARY (DASHED WHERE INFERRED)

GROUNDWATER ELEVATION (COLLECTED 02/28/2017)

SOIL BORING

WELL SCREEN INTERVAL

END OF BORING

Lithology Key

HARDPAN

SILTY CLAY

SHALE BEDROCK

GRAVEL

SANDY GRAVEL

SCALE IN FEET

VERTICAL 0 – 25

HORIZONTAL 0 – 100

PROJECT:

DTE ELECTRIC COMPANY
ST. CLAIR POWER PLANT
EAST CHINA TOWNSHIP, MICHIGAN

TITLE:

GENERALIZED GEOLOGIC CROSS-SECTION B-B'

DRAWN BY:	D.STEHLE	PROJ NO.:	265996.0004.01.01
CHECKED BY:	S.HOLMSTROM	FIGURE 5	
APPROVED BY:	V.BUENING		
DATE:	SEPTEMBER 2017		

TRC

1540 Eisenhower Place
Ann Arbor, MI 48108
Phone: 734.971.7080
www.trcsolutions.com

FILE NO.: 265996.0004.01.01.04-05.dwg

11x17 --- ATTACHED XREF'S: --- ATTACHED IMAGES:
DRAWING NAME: J:_TRC\DTE\St Clair PP\265996\0004\01\ 265996.0004.01.01.04-05.dwg --- PLOT DATE: October 12, 2017 - 12:03PM --- LAYOUT: FIG05 XS BB

TRC Environmental Corporation

Falling Head, Rising Tailwater Permeability Test (ASTM D5084, Method C)

QC: JPH
QA: JPH

Project Name: DTE - SCPP BAB | Cell #: 10
Project #: 231828.0004.0000 | USCS Description: N/A
Sample Name: MW-16-01, 40-42' | USCS Classification: N/A
Visual Descript: Gray sandy lean clay, with gravel | Average Kv = 2.3E-08 cm/s

Sample Type: Undisturbed

	Initial Values	Final Values
Sample Dia. (in)	2.86	2.83
Sample Ht. (in)	3.62	3.47
Tare & Wet (g)	470.27	763.70
Tare & Dry (g)	373.66	604.00
Tare (g)	88.45	89.44
Sample Wt. (g)	703.30	674.26

Permeant: Water
Permeant Specific Gravity: 1.00
Sample Specific Gravity: 2.60 Est.
Confining Pressure (psi): 100.0
Burette Diameter (in): 0.250
Burette Zero (cm): 100.0

	Initial	Final
Moisture (%)	33.9	31.0
Wet Density (pcf)	115.2	117.7
Dry Density (pcf)	86.1	89.8
Saturation (%)	99.4	100.0

Max. Effect. Stress (psi): 6.2
Min. Effect. Stress (psi): 4.1
Ave. Effect. Stress (psi): 4.6

	Date Yr.	Mo.	Day	Time Hr.	Min.	Run Time (s)	Temp C°**	Pressure (psi) Bot	Top	Cham (cm)	Cham. Dif.(cm)	Bot (cm)	Bot. Dif.(cm)	Top (cm)	Top Dif.(cm)	Flow Dif.(%)	Kv *** cm/s	Ave.* 0,1
1	2016	4	22	9	23.00		0.0	95	95	13.65		2.80		101.50				
2	2016	4	22	18	33.00	33000	25.0	95	95	31.40	17.75	1.00	-1.80	91.35	10.15	-143.1	8.2E-08	
3	2016	4	25	11	31.00	233880	23.0	95	95	54.55	23.15	2.00	1.00	79.25	12.10	-84.7	2.1E-08	
4	2016	4	25	17	43.00	22320	24.0	95	95	55.40	0.85	2.75	0.75	78.55	0.70	3.4	2.7E-08	
5	2016	4	25	20	40.00	10620	24.0	95	95	55.85	0.45	2.95	0.20	78.15	0.40	-33.3	2.3E-08	
6	2016	4	25	23	16.00	9360	24.0	95	95	56.35	0.50	3.20	0.25	77.80	0.35	-16.7	2.7E-08	
7	2016	4	26	5	0.00	20640	25.0	95	95	56.65	0.30	3.85	0.65	77.25	0.55	8.3	2.4E-08	
8	2016	4	26	8	19.00	11940	24.0	95	95	57.55	0.90	4.00	0.15	76.70	0.55	-57.1	2.5E-08	
9	2016	4	26	13	18.00	17940	24.0	95	95	58.40	0.85	4.45	0.45	76.10	0.60	-14.3	2.5E-08	
10	2016	4	27	4	58.00	56400	23.0	95	95	61.65	3.25	5.45	1.00	74.05	2.05	-34.4	2.5E-08	
11	2016	4	27	12	48.00	28200	23.0	95	95	62.00	0.35	6.10	0.65	73.35	0.70	-3.7	2.3E-08	
12	2016	4	27	15	9.00	8460	23.0	95	95	62.00	0.00	6.30	0.20	73.05	0.30	-20.0	2.8E-08	
13	2016	4	28	5	2.00	49980	22.0	95	95	65.10	3.10	6.95	0.65	71.35	1.70	-44.7	2.4E-08	
14	2016	4	28	8	6.00	11040	24.0	95	95	64.75	-0.35	7.40	0.45	71.25	0.10	63.6	2.4E-08	
15	2016	4	28	14	57.00	24660	23.0	95	95	65.30	0.55	7.85	0.45	70.60	0.65	-18.2	2.3E-08	
16	2016	4	28	20	48.00	21060	23.0	95	95	66.25	0.95	8.30	0.45	70.00	0.60	-14.3	2.6E-08	
17	2016	4	29	5	31.00	31380	26.0	95	95	68.05	1.80	8.70	0.40	69.05	0.95	-40.7	2.1E-08	
18	2016	4	29	10	27.00	17760	23.0	95	95	67.10	-0.95	9.25	0.55	68.80	0.25	37.5	2.4E-08	
19	2016	4	29	14	42.00	15300	23.0	95	95	67.70	0.60	9.55	0.30	68.50	0.30	0.0	2.1E-08	
20	2016	4	29	18	0.00	11880	23.0	95	95	67.50	-0.20	9.90	0.35	68.35	0.15	40.0	2.3E-08	
21	2016	5	1	16	24.00	167040	22.0	95	95	72.80	5.30	12.75	2.85	64.50	3.85	-14.9	2.4E-08	
22	2016	5	2	4	59.00	45300	23.0	95	95	74.50	1.70	13.35	0.60	63.50	1.00	-25.0	2.2E-08	
23	2016	5	2	8	5.00	11160	23.0	95	95	74.15	-0.35	13.65	0.30	63.35	0.15	33.3	2.6E-08	
24	2016	5	2	13	16.00	18660	23.0	95	95	74.45	0.30	14.00	0.35	63.10	0.25	16.7	2.1E-08	
25	2016	5	2	20	46.00	27000	26.0	95	95	73.50	-0.95	14.75	0.75	62.90	0.20	57.9	2.2E-08	
26	2016	5	3	4	50.00	29040	23.0	95	95	74.70	1.20	15.05	0.30	62.10	0.80	-45.5	2.5E-08	

**A zero in this column starts a series of measurements. *Average Kv for those rows with a 1 in the Ave. column.

(Termination determined by stable Kv and low flow differential.) ***Kv adjusted for temperature.

TRC Environmental Corporation	QC: JPH
Falling Head, Rising Tailwater Permeability Test (ASTM D5084, Method C)	QA: JPH

Project Name:	DTE - SCPP BAB	Cell #:	10
Project #:	231828.0004.0000	USCS Description:	N/A
Sample Name:	MW-16-01, 40-42'	USCS Classification:	N/A
Visual Descript:	Gray sandy lean clay, with gravel		

Sample Type: Undisturbed	Initial Values	Final Values			
Sample Dia. (in)	2.86	2.83	Permeant:	Water	
Sample Ht. (in)	3.62	3.47	Permeant Specific Gravity:	1.00	
Tare & Wet (g)	470.27	763.70	Sample Specific Gravity:	2.60	Est.
Tare & Dry (g)	373.66	604.00	Confining Pressure (psi):	100.0	
Tare (g)	88.45	89.44	Burette Diameter (in):	0.250	
Sample Wt. (g)	703.30	674.26	Burette Zero (cm):	100.0	

Moisture (%)	33.9	31.0	Maximum Gradient:	4.7
Wet Density (pcf)	115.2	117.7	Average Gradient:	4.5
Dry Density (pcf)	86.1	89.8	Max. Effect. Stress (psi):	4.8
Saturation (%)	99.4	100.0	Min. Effect. Stress (psi):	4.1
			Ave. Effect. Stress (psi):	4.4

	Date			Time		Run	Temp	Pressure (psi)		Cham	Cham.	Bot	Bot.	Top	Top	Flow	Kv ***	Ave.*
	Yr.	Mo.	Day	Hr.	Min.	Time (s)	C°**	Bot	Top	(cm)	Dif.(cm)	(cm)	Dif.(cm)	(cm)	Dif.(cm)	Dif.(%)	cm/s	0,1
1	2016	5	3	4	50.00		0.0	95	95	74.70		15.05		62.10				
2	2016	5	3	8	1.00	11460	25.0	95	95	75.05	0.35	15.25	0.20	61.90	0.20	0.0	2.3E-08	
3	2016	5	3	11	11.00	11400	23.0	95	95	75.60	0.55	15.30	0.05	61.65	0.25	-66.7	1.8E-08	
4	2016	5	3	14	13.00	10920	23.0	95	95	76.00	0.40	15.50	0.20	61.45	0.20	0.0	2.5E-08	
5	2016	5	3	19	37.00	19440	24.0	95	95	76.30	0.30	15.95	0.45	61.25	0.20	38.5	2.3E-08	
6	2016	5	4	5	24.00	35220	23.0	95	95	76.70	0.40	16.45	0.50	60.65	0.60	-9.1	2.2E-08	
7	2016	5	4	9	49.00	15900	23.0	95	95	76.85	0.15	16.75	0.30	60.35	0.30	0.0	2.8E-08	
8	2016	5	4	14	51.00	18120	23.0	95	95	77.40	0.55	16.90	0.15	60.00	0.35	-40.0	2.0E-08	
9	2016	5	4	20	1.00	18600	25.0	95	95	76.85	-0.55	17.40	0.50	59.90	0.10	66.7	2.3E-08	
10	2016	5	5	5	25.00	33840	24.0	95	95	78.30	1.45	17.75	0.35	59.15	0.75	-36.4	2.4E-08	
11	2016	5	5	10	26.00	18060	24.0	95	95	78.30	0.00	18.10	0.35	58.90	0.25	16.7	2.5E-08	1
12	2016	5	5	14	42.00	15360	24.0	95	95	78.60	0.30	18.30	0.20	58.70	0.20	0.0	2.0E-08	1
13	2016	5	6	4	53.00	51060	23.0	95	95	79.30	0.70	19.10	0.80	58.00	0.70	6.7	2.4E-08	1
14	2016	5	6	9	33.00	16800	23.0	95	95	79.90	0.60	19.25	0.15	57.70	0.30	-33.3	2.2E-08	1
15																		
16																		
17																		
18																		
19																		
20																		
21																		
22																		
23																		
24																		
25																		
26																		

**A zero in this column starts a series of measurements. *Average Kv for those rows with a 1 in the Ave. column. 2.3E-08 cm/s

(Termination determined by stable Kv and low flow differential.) ***Kv adjusted for temperature.

TRC Environmental Corporation

Falling Head, Rising Tailwater Permeability Test (ASTM D5084, Method C)

QC: JPH

QA: JPH

Project Name:	DTE - SCPP BAB	Cell #:	11
Project #:	231828.0004.0000	USCS Description:	N/A
Sample Name:	MW-16-02, 40-42'	USCS Classification:	N/A
Visual Descript:	Gray sandy lean clay, with gravel	Average Kv =	2.7E-08 cm/s

Sample Type: Undisturbed	Initial Values	Final Values			
Sample Dia. (in)	2.85	2.84	Permeant:	Water	
Sample Ht. (in)	2.69	2.68	Permeant Specific Gravity:	1.00	
Tare & Wet (g)	482.10	587.40	Sample Specific Gravity:	2.68	Est.
Tare & Dry (g)	371.38	440.90	Confining Pressure (psi):	100.0	
Tare (g)	87.03	88.43	Burette Diameter (in):	0.250	
Sample Wt. (g)	507.56	498.97	Burette Zero (cm):	100.0	

	Initial	Final		
Moisture (%)	38.9	41.6	Maximum Gradient:	9.0
Wet Density (pcf)	112.8	112.0	Average Gradient:	8.3
Dry Density (pcf)	81.2	79.1	Max. Effect. Stress (psi):	5.5
Saturation (%)	98.4	100.0	Min. Effect. Stress (psi):	4.0
			Ave. Effect. Stress (psi):	4.6

	Date Yr.	Mo.	Day	Time Hr.	Min.	Run Time (s)	Temp C°**	Pressure (psi) Bot	Top	Cham (cm)	Cham. Dif.(cm)	Bot (cm)	Bot. Dif.(cm)	Top (cm)	Top Dif.(cm)	Flow Dif.(%)	Kv *** cm/s	Ave.* 0,1
1	2016	4	29	5	36.00		0.0	95	95	65.15		2.65		103.70				
2	2016	4	29	10	28.00	17520	23.0	95	95	67.50	2.35	3.50	0.85	102.35	1.35	-22.7	3.1E-08	
3	2016	4	29	14	45.00	15420	23.0	95	95	69.50	2.00	4.40	0.90	102.40	-0.05	111.8	1.4E-08	
4	2016	4	29	17	58.00	11580	23.0	95	95	70.70	1.20	5.05	0.65	102.00	0.40	23.8	2.3E-08	
5	2016	5	1	16	20.00	166920	22.0	95	95	80.70	10.00	13.65	8.60	96.80	5.20	24.6	2.3E-08	
6	2016	5	2	5	0.00	45600	23.0	95	95	82.70	2.00	15.70	2.05	94.70	2.10	-1.2	2.8E-08	
7	2016	5	2	8	7.00	11220	23.0	95	95	83.25	0.55	16.20	0.50	94.25	0.45	5.3	2.6E-08	
8	2016	5	2	13	7.00	18000	23.0	95	95	84.00	0.75	17.05	0.85	93.55	0.70	9.7	2.7E-08	
9	2016	5	2	20	40.00	27180	26.0	95	95	85.60	1.60	18.20	1.15	92.50	1.05	4.5	2.5E-08	
10	2016	5	3	4	51.00	29460	23.0	95	95	85.85	0.25	19.35	1.15	91.10	1.40	-9.8	2.9E-08	
11	2016	5	3	8	3.00	11520	25.0	95	95	86.60	0.75	19.85	0.50	90.65	0.45	5.3	2.7E-08	
12	2016	5	3	11	8.00	11100	23.0	95	95	86.60	0.00	20.30	0.45	90.15	0.50	-5.3	3.0E-08	
13	2016	5	3	14	13.00	11100	23.0	95	95	87.30	0.70	20.75	0.45	89.70	0.45	0.0	2.9E-08	
14	2016	5	3	19	34.00	19260	24.0	95	95	88.25	0.95	21.55	0.80	89.15	0.55	18.5	2.5E-08	
15	2016	5	4	5	25.00	35460	23.0	95	95	89.35	1.10	22.85	1.30	87.75	1.40	-3.7	2.8E-08	
16	2016	5	4	9	50.00	15900	23.0	95	95	89.70	0.35	23.45	0.60	87.20	0.55	4.3	2.8E-08	
17	2016	5	4	14	52.00	18120	23.0	95	95	90.20	0.50	24.10	0.65	86.55	0.65	0.0	2.8E-08	
18	2016	5	4	19	58.00	18360	25.0	95	95	91.10	0.90	24.80	0.70	86.00	0.55	12.0	2.6E-08	
19	2016	5	5	5	26.00	34080	24.0	95	95	91.75	0.65	25.95	1.15	84.75	1.25	-4.2	2.8E-08	1
20	2016	5	5	10	27.00	18060	24.0	95	95	92.40	0.65	26.50	0.55	84.20	0.55	0.0	2.5E-08	1
21	2016	5	5	14	43.00	15360	24.0	95	95	92.80	0.40	27.05	0.55	83.70	0.50	4.8	2.9E-08	1
22	2016	5	6	4	53.00	51000	23.0	95	95	84.30	-8.50	28.70	1.65	82.15	1.55	3.1	2.8E-08	1
23	2016	5	6	9	34.00	16860	23.0	95	95	94.70	10.40	29.20	0.50	81.65	0.50	0.0	2.8E-08	1
24																		
25																		
26																		

**A zero in this column starts a series of measurements. *Average Kv for those rows with a 1 in the Ave. column. 2.7E-08 cm/s

(Termination determined by stable Kv and low flow differential.) ***Kv adjusted for temperature.

TRC Environmental Corporation	QC: JPH
Falling Head, Rising Tailwater Permeability Test (ASTM D5084, Method C)	QA: JPH

Project Name:	DTE - SCPP BAB	Cell #:	2
Project #:	231828.0004.0000	USCS Description:	N/A
Sample Name:	MW-16-03, 40-42'	USCS Classification:	N/A
Visual Descript:	Gray sandy lean clay, with gravel	Average Kv =	2.9E-08 cm/s

Sample Type: Undisturbed	Initial Values	Final Values			
Sample Dia. (in)	2.86	2.83	Permeant:	Water	
Sample Ht. (in)	2.90	2.85	Permeant Specific Gravity:	1.00	
Tare & Wet (g)	474.40	611.40	Sample Specific Gravity:	2.70	Est.
Tare & Dry (g)	351.87	453.40	Confining Pressure (psi):	100.0	
Tare (g)	86.27	88.02	Burette Diameter (in):	0.250	
Sample Wt. (g)	535.23	523.38	Burette Zero (cm):	100.0	

	Initial	Final		
Moisture (%)	46.1	43.2	Maximum Gradient:	7.7
Wet Density (pcf)	109.4	111.2	Average Gradient:	7.3
Dry Density (pcf)	74.9	77.6	Max. Effect. Stress (psi):	5.5
Saturation (%)	99.8	100.0	Min. Effect. Stress (psi):	3.8
			Ave. Effect. Stress (psi):	4.3

	Date Yr.	Mo.	Day	Time Hr.	Min.	Run Time (s)	Temp C°**	Pressure (psi) Bot	Top	Cham (cm)	Cham. Dif.(cm)	Bot (cm)	Bot. Dif.(cm)	Top (cm)	Top Dif.(cm)	Flow Dif.(%)	Kv *** cm/s	Ave.* 0,1
1	2016	4	29	5	39.00		0.0	95	95	71.90		3.05		103.70				
2	2016	4	29	10	29.00	17400	23.0	95	95	74.80	2.90	3.25	0.20	100.00	3.70	-89.7	6.0E-08	
3	2016	4	29	14	46.00	15420	23.0	95	95	77.30	2.50	3.70	0.45	98.60	1.40	-51.4	3.3E-08	
4	2016	4	29	17	59.00	11580	23.0	95	95	78.70	1.40	4.15	0.45	97.75	0.85	-30.8	3.1E-08	
5	2016	5	1	16	21.00	166920	22.0	95	95	90.30	11.60	11.25	7.10	89.20	8.55	-9.3	3.0E-08	
6	2016	5	2	5	1.00	45600	23.0	95	95	92.75	2.45	13.05	1.80	87.30	1.90	-2.7	2.8E-08	
7	2016	5	2	8	7.00	11160	23.0	95	95	93.70	0.95	13.40	0.35	86.80	0.50	-17.6	2.7E-08	
8	2016	5	2	13	8.00	18060	23.0	95	95	94.25	0.55	14.20	0.80	86.20	0.60	14.3	2.8E-08	
9	2016	5	2	20	42.00	27240	26.0	95	95	96.15	1.90	15.25	1.05	85.20	1.00	2.6	2.6E-08	
10	2016	5	3	4	52.00	29400	23.0	95	95	95.60	-0.55	16.20	0.95	83.85	1.35	-17.5	3.0E-08	
11	2016	5	3	8	3.00	11460	25.0	95	95	96.60	1.00	16.60	0.40	83.45	0.40	0.0	2.6E-08	
12	2016	5	3	11	9.00	11160	23.0	95	95	96.20	-0.40	17.10	0.50	82.95	0.50	0.0	3.6E-08	
13	2016	5	3	14	14.00	11100	23.0	95	95	97.05	0.85	17.35	0.25	82.55	0.40	-23.1	2.4E-08	
14	2016	5	3	19	34.00	19200	24.0	95	95	98.70	1.65	18.10	0.75	82.00	0.55	15.4	2.7E-08	
15	2016	5	4	5	26.00	35520	23.0	95	95	99.75	1.05	19.25	1.15	80.70	1.30	-6.0	2.9E-08	
16	2016	5	4	9	50.00	15840	23.0	95	95	100.30	0.55	19.80	0.55	80.20	0.50	4.5	2.9E-08	
17	2016	5	4	14	52.00	18120	23.0	95	95	100.60	0.30	20.30	0.50	79.55	0.65	-13.0	2.8E-08	
18	2016	5	4	19	59.00	18420	25.0	95	95	101.75	1.15	21.00	0.70	79.10	0.45	21.7	2.7E-08	
19	2016	5	5	5	26.00	34020	24.0	95	95	102.60	0.85	21.90	0.90	77.85	1.25	-16.3	2.8E-08	
20	2016	5	5	10	27.00	18060	24.0	95	95	103.20	0.60	22.50	0.60	77.35	0.50	9.1	2.8E-08	1
21	2016	5	5	14	43.00	15360	24.0	95	95	103.50	0.30	22.95	0.45	76.85	0.50	-5.3	2.9E-08	1
22	2016	5	6	4	54.00	51060	23.0	95	95	104.00	0.50	24.35	1.40	75.40	1.45	-1.8	2.8E-08	1
23	2016	5	6	9	35.00	16860	23.0	95	95	105.00	1.00	24.80	0.45	74.90	0.50	-5.3	2.9E-08	1
24																		
25																		
26																		

**A zero in this column starts a series of measurements. *Average Kv for those rows with a 1 in the Ave. column. 2.9E-08 cm/s

(Termination determined by stable Kv and low flow differential.) ***Kv adjusted for temperature.

TRC Environmental Corporation Falling Head, Rising Tailwater Permeability Test (ASTM D5084, Method C)	QC: JPH QA: JPH

Project Name:	DTE - SCPP BAB	Cell #:	3
Project #:	231828.0004.0000	USCS Description:	N/A
Sample Name:	MW-16-04, 40-42'	USCS Classification:	N/A
Visual Descript:	Gray sandy lean clay, with gravel	Average Kv =	3.1E-08 cm/s

Sample Type: Undisturbed	Initial Values	Final Values			
Sample Dia. (in)	2.85	2.82	Permeant:	Water	
Sample Ht. (in)	2.88	2.84	Permeant Specific Gravity:	1.00	
Tare & Wet (g)	561.80	656.70	Sample Specific Gravity:	2.63	Est.
Tare & Dry (g)	460.60	537.10	Confining Pressure (psi):	100.0	
Tare (g)	95.90	87.80	Burette Diameter (in):	0.250	
Sample Wt. (g)	580.00	568.90	Burette Zero (cm):	100.0	

Moisture (%)	27.7	26.6	Maximum Gradient:	7.7
Wet Density (pcf)	120.5	122.2	Average Gradient:	7.3
Dry Density (pcf)	94.3	96.5	Max. Effect. Stress (psi):	5.5
Saturation (%)	98.7	100.0	Min. Effect. Stress (psi):	4.0
			Ave. Effect. Stress (psi):	4.6

	Date			Time		Run	Temp	Pressure (psi)		Cham	Cham.	Bot	Bot.	Top	Top	Flow	Kv ***	Ave.*
	Yr.	Mo.	Day	Hr.	Min.	Time (s)	C°**	Bot	Top	(cm)	Dif.(cm)	(cm)	Dif.(cm)	(cm)	Dif.(cm)	Dif.(%)	cm/s	0,1
1	2016	4	29	5	41.00		0.0	95	95	66.60		1.60		104.80				
2	2016	4	29	10	30.00	17340	23.0	95	95	68.30	1.70	2.15	0.55	101.80	3.00	-69.0	5.3E-08	
3	2016	4	29	14	47.00	15420	23.0	95	95	69.60	1.30	2.90	0.75	100.80	1.00	-14.3	3.0E-08	
4	2016	4	29	17	59.00	11520	23.0	95	95	70.60	1.00	3.50	0.60	100.15	0.65	-4.0	2.9E-08	
5	2016	5	1	16	21.00	166920	22.0	95	95	77.85	7.25	11.95	8.45	91.30	8.85	-2.3	3.2E-08	
6	2016	5	2	5	2.00	45660	23.0	95	95	79.40	1.55	13.95	2.00	89.10	2.20	-4.8	3.1E-08	
7	2016	5	2	8	8.00	11160	23.0	95	95	80.15	0.75	14.40	0.45	88.65	0.45	0.0	2.8E-08	
8	2016	5	2	13	9.00	18060	23.0	95	95	80.40	0.25	15.25	0.85	88.00	0.65	13.3	3.0E-08	
9	2016	5	2	20	43.00	27240	26.0	95	95	81.60	1.20	16.40	1.15	86.95	1.05	4.5	2.8E-08	
10	2016	5	3	4	52.00	29340	23.0	95	95	80.60	-1.00	17.50	1.10	85.50	1.45	-13.7	3.3E-08	
11	2016	5	3	8	2.00	11400	25.0	95	95	81.25	0.65	18.00	0.50	85.10	0.40	11.1	2.9E-08	
12	2016	5	3	11	9.00	11220	23.0	95	95	80.75	-0.50	18.40	0.40	84.60	0.50	-11.1	3.2E-08	
13	2016	5	3	14	15.00	11160	23.0	95	95	81.55	0.80	18.85	0.45	84.15	0.45	0.0	3.2E-08	
14	2016	5	3	19	35.00	19200	24.0	95	95	82.95	1.40	19.60	0.75	83.60	0.55	15.4	2.7E-08	
15	2016	5	4	5	26.00	35460	23.0	95	95	83.40	0.45	20.90	1.30	82.20	1.40	-3.7	3.2E-08	
16	2016	5	4	9	50.00	15840	23.0	95	95	83.70	0.30	21.40	0.50	81.60	0.60	-9.1	3.0E-08	
17	2016	5	4	14	53.00	18180	23.0	95	95	83.80	0.10	22.05	0.65	80.95	0.65	0.0	3.2E-08	
18	2016	5	4	19	59.00	18360	25.0	95	95	84.80	1.00	22.80	0.75	80.50	0.45	25.0	2.8E-08	
19	2016	5	5	5	27.00	34080	24.0	95	95	85.10	0.30	23.85	1.05	79.20	1.30	-10.6	3.1E-08	
20	2016	5	5	10	28.00	18060	24.0	95	95	85.60	0.50	24.45	0.60	78.65	0.55	4.3	3.0E-08	1
21	2016	5	5	14	44.00	15360	24.0	95	95	85.80	0.20	25.00	0.55	78.25	0.40	15.8	3.0E-08	1
22	2016	5	6	4	55.00	51060	23.0	95	95	86.70	0.90	26.50	1.50	76.75	1.50	0.0	3.0E-08	1
23	2016	5	6	9	35.00	16800	23.0	95	95	87.20	0.50	27.00	0.50	76.15	0.60	-9.1	3.5E-08	1
24																		
25																		
26																		

**A zero in this column starts a series of measurements. *Average Kv for those rows with a 1 in the Ave. column. 3.1E-08 cm/s

(Termination determined by stable Kv and low flow differential.) ***Kv adjusted for temperature.

SCPP BABs CCR Unit Site

BASE MAP FROM USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE SERIES.

N

1 " = 2,000 '
1:24,000

0 2,000 4,000 FEET

TRC

1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080

TRC - GIS

PROJECT:	DTE ELECTRIC COMPANY MONROE POWER PLANT 7955 EAST DUNBAR ROAD MONROE, MICHIGAN
TITLE:	SITE LOCATION MAP

DRAWN BY:	J. PAPEZ
CHECKED BY:	S HOLMSTROM
APPROVED BY:	V. BUENING
DATE:	OCTOBER 2017
PROJ. NO.:	265996.0001
FILE:	265996-SLMMB.mxd

FIGURE 1

E:\DTE\CCR_Sites\2017_265996\265996-SLMMB.mxd -- Saved By: BDEEGAN on 10/9/2017, 14:49:39 PM

LEGEND

- MONITORING WELLS
- APPROXIMATE BOUNDARY OF FLY ASH BASIN

NOTES

1. BASE MAP IMAGERY FROM ESRI/MICROSOFT, "WORLD IMAGERY", WEB BASEMAP SERVICE LAYER.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.

N

0 600 1,200 Feet

1 " = 600 '
1:7,200

PROJECT:
DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:
MONITORING NETWORK AND SITE PLAN

DRAWN BY:	J. PAPEZ	PROJ NO.:	265996.0001
CHECKED BY:	S. HOLMSTROM	**FIGURE 2**	
APPROVED BY:	V. BUENING		
DATE:	JANUARY 2018		

TRC
1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080
www.trcsolutions.com

FILE NO.: 265996-0001-000.mxd

Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

Plot Date: 1/29/2018, 09:45:57 AM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\DTE\CCR_Sites\2017_265996\265996-0001-000.mxd

LEGEND

- MONITORING WELL
- APPROXIMATE BOUNDARY OF FLY ASH BASIN
- INFERRED GROUNDWATER FLOW DIRECTION
- POTENTIOMETRIC SURFACE CONTOUR LINE (5-FT INTERVAL,DASHED WHERE INFERRED)
- (582.69) STATIC WATER ELEVATION IN FEET (NAVD, 1988)

NOTES

1. BASE MAP IMAGERY FROM ESRI/MICROSOFT, "WORLD IMAGERY", WEB BASEMAP SERVICE LAYER.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.
3. GROUNDWATER ELEVATIONS DISPLAYED IN FEET RELATIVE TO NORTH AMERICAN VERTICAL DATUM OF 1988

N

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:
DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:
POTENTIOMETRIC SURFACE MAP
SEPTEMBER 2017

DRAWN BY:	S MAJOR	PROJ NO.:	265996.0001
CHECKED BY:	C. SCIESZKA	**FIGURE 3**	
APPROVED BY:	V. BUENING		
DATE:	JANUARY 2018		

TRC

1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080
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FILE NO.: 265996-0001-011a.mxd

TRC - GIS

Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

Plot Date: 1/12/2018, 08:54:41 AM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\DTE\CCR_Sites\2017_265996\265996-0001-011a.mxd

Table 1
Groundwater Elevation Summary
Range Road Landfill – RCRA CCR Monitoring Program
China Township, Michigan

Well ID	MW-16-01		MW-16-02		MW-16-03		MW-16-04		MW-16-05		MW-16-06		MW-16-07	
Date Installed	1/13/2016		1/27/2016		2/1/2016		5/24/2016		5/13/2016		5/10/2016		5/13/2016	
TOC Elevation	595.35		598.44		597.69		596.87		601.97		600.68		589.34	
Geologic Unit of Screened interval	Sand with Silt		Silty Sand with Gravel		Silty Gravel with Sand		Silty Sand		Gravel with Sand		Sand		Sand	
Screened Interval Elevation	390.7 to 385.7		393.8 to 388.8		432.1 to 427.1		414.1 to 409.1		476.6 to 471.6		508.0 to 503.0		494.4 to 489.4	
Unit	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft
Measurement Date	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation
8/11/2016	22.77	572.58	21.10	577.34	20.24	577.45	19.54	577.33	27.73	574.24	23.89	576.79	16.13	573.21
9/22/2016	21.41	573.94	21.04	577.40	20.23	577.46	20.92	575.95	27.74	574.23	23.90	576.78	16.40	572.94
11/10/2016	21.07	574.28	20.96	577.48	20.17	577.52	19.55	577.32	27.72	574.25	23.80	576.88	16.20	573.14
1/11/2017	19.63	575.72	20.87	577.57	20.10	577.59	19.38	577.49	27.53	574.44	23.71	576.97	15.80	573.54
1/3/2017	19.05	576.30	20.30	578.14	19.49	578.20	18.85	578.02	26.91	575.06	23.08	577.60	15.74	573.60
4/19/2017	19.11	576.24	20.75	577.69	19.94	577.75	19.32	577.55	27.41	574.56	23.56	577.12	16.19	573.15
6/7/2017	19.00	576.35	20.79	577.65	20.03	577.66	19.32	577.55	27.50	574.47	23.65	577.03	15.82	573.52
7/26/2017	18.90	576.45	20.45	577.99	20.05	577.64	19.45	577.42	27.60	574.37	23.75	576.93	16.30	573.04

Notes:
Elevations are reported in feet relative to the North American Vertical Datum of 1988.
ft BTOC - feet below top of casing.

LEGEND

- MONITORING WELLS
- APPROXIMATE BOUNDARY OF FLY ASH
- CROSS SECTIONS

NOTES

1. BASE MAP IMAGERY FROM ESRI/MICROSOFT, "WORLD IMAGERY", WEB BASEMAP SERVICE LAYER.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.

N

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:

DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:

CROSS SECTION LOCATOR MAP

DRAWN BY:	J. PAPEZ	PROJ NO.:	265996.0001
CHECKED BY:	S. HOLMSTROM	**FIGURE 3**	
APPROVED BY:	V. BUENING		
DATE:	OCTOBER 2017		

TRC

1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080
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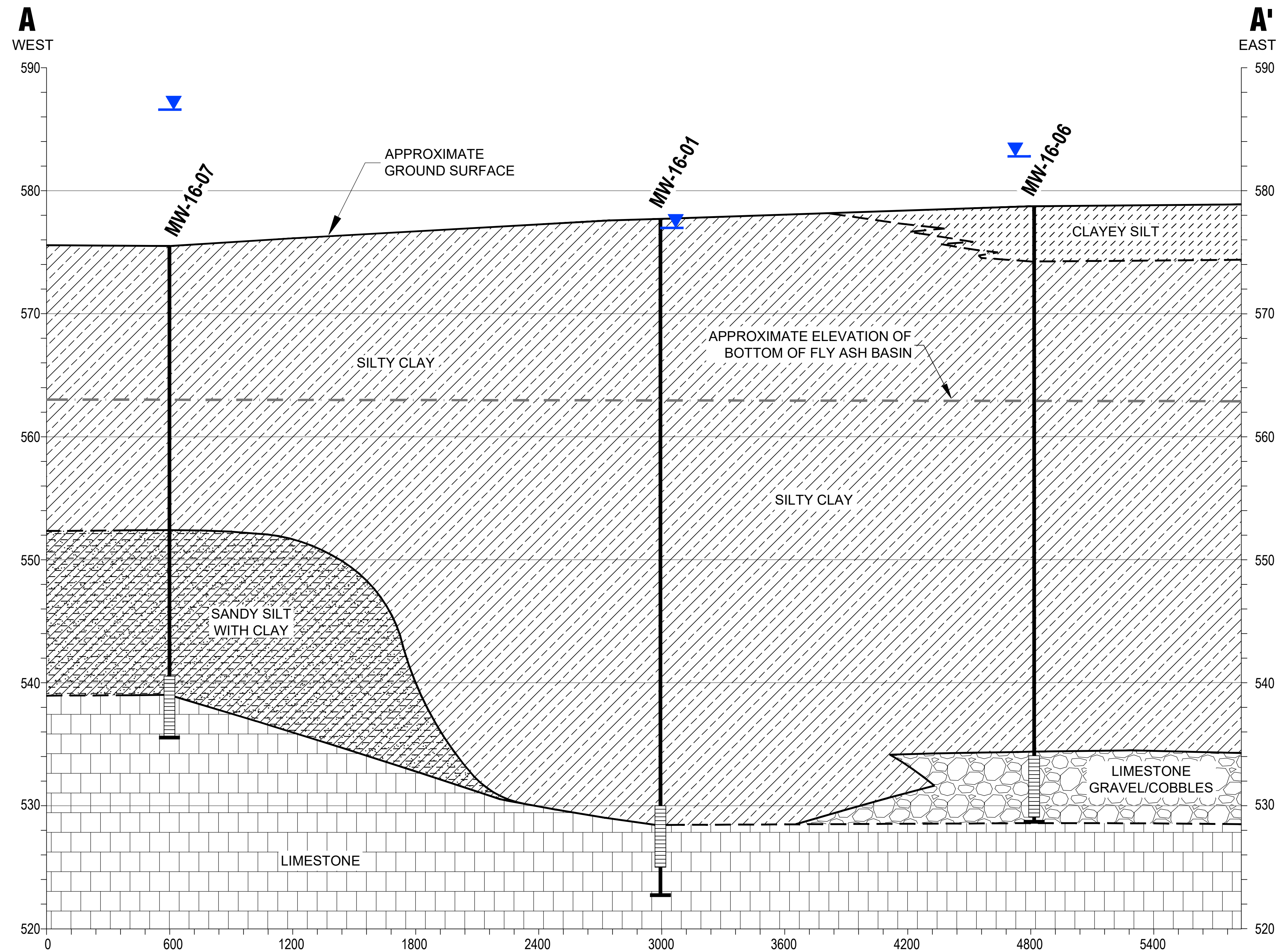
FILE NO.: 265996-0001-008.mxd

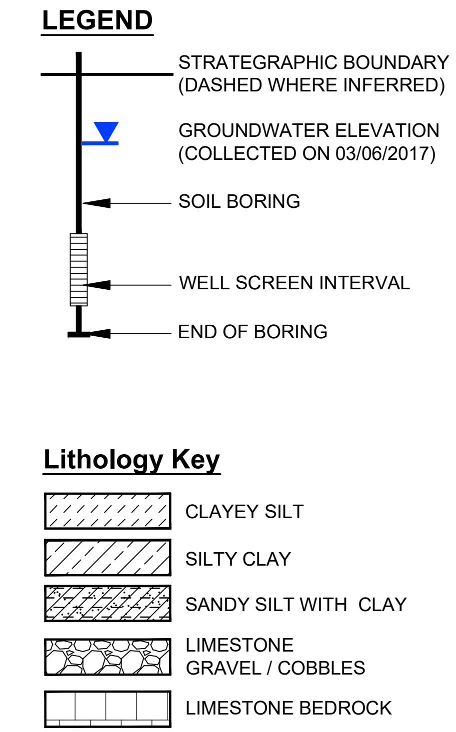
TRC - GIS

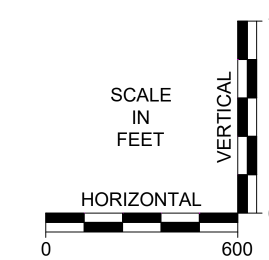
Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

Plot Date: 10/9/2017, 14:56:26 PM by BDEEGAN -- LAYOUT: ANSI B(11"x17")
Path: E:\DTE\CCR_Sites\2017_265996\265996-0001-008.mxd

GENERALIZED GEOLOGIC CROSS-SECTION A-A'







PROJECT:
DTE ELECTRIC COMPANY
MONROE POWER PLANT - FLY ASH BASIN
MONROE, MICHIGAN

TITLE:
GENERALIZED
GEOLOGIC CROSS-SECTION A-A'

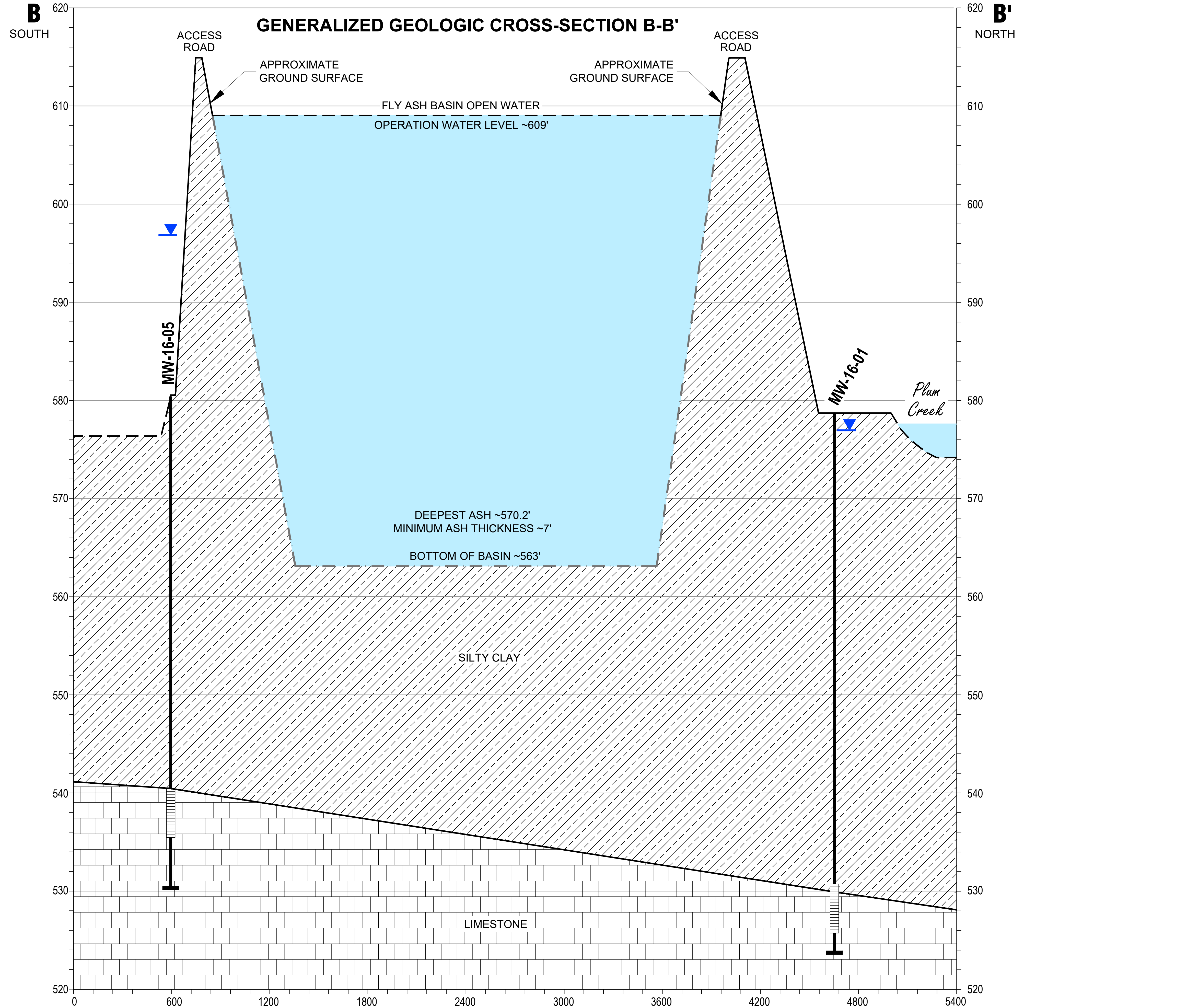
DRAWN BY:	D.STEHLE	PROJ NO.:	265996.0001.01
CHECKED BY:	S.HOLMSTROM	FIGURE 4	
APPROVED BY:	V.BUENING		
DATE:	SEPTEMBER 2017		

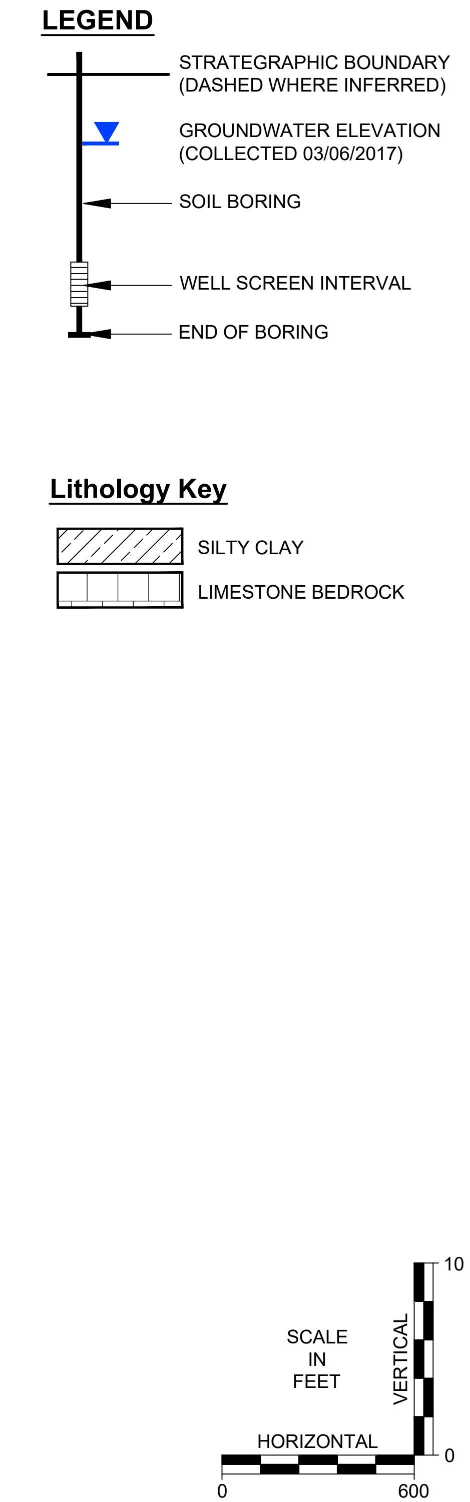
TRC

1540 Eisenhower Place
Ann Arbor, MI 48108
Phone: 734.971.7080
www.trcsolutions.com

FILE NO.: 265996.0001.01.01.04-05.dwg

11x17 --- ATTACHED XREFS: --- ATTACHED IMAGES:
DRAWING NAME: J:_TRC\DTE\Monroe PP\265996\0001\01\ 265996.0001.01.01.04-05.dwg --- PLOT DATE: October 12, 2017 - 11:17AM --- LAYOUT: FIG04 XS AA





PROJECT:
DTE ELECTRIC COMPANY
MONROE POWER PLANT - FLY ASH BASIN
MONROE, MICHIGAN

TITLE:
GENERALIZED GEOLOGIC CROSS-SECTION B-B'

DRAWN BY:	D.Stehle	PROJ NO.:	265996.0001.01.01
CHECKED BY:	S.HOLMSTROM	**FIGURE 5**	
APPROVED BY:	V.BUENING		
DATE:	MAY 2017		

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FILE NO.: 265996.0001.01.01.04-05.dwg

11x17 --- ATTACHED XREFS: --- ATTACHED IMAGES:
DRAWING NAME: J:_TRC\DTE\Monroe PP\265996\0001\01\01\265996.0001.01.01.04-05.dwg --- PLOT DATE: October 12, 2017 - 11:17AM --- LAYOUT: FIG05 XS BB

TRC Environmental Corporation

Falling Head, Rising Tailwater Permeability Test (ASTM D5084, Method C)

QC: JPH
QA: JPH

Project Name:	DTE - Monroe FAB	Cell #:	8
Project #:	231828.0001.0000	USCS Description:	N/A
Sample Name:	MW-16-01, 20-22'	USCS Classification:	N/A
Visual Descript:	Gray sandy lean clay, with gravel	Average Kv =	1.6E-08 cm/s

Sample Type: Undisturbed	Initial Values	Final Values		
Sample Dia. (in)	2.87	2.87	Permeant:	Water
Sample Ht. (in)	3.31	3.31	Permeant Specific Gravity:	1.00
Tare & Wet (g)	542.53	912.90	Sample Specific Gravity:	2.81 Est.
Tare & Dry (g)	495.80	821.70	Confining Pressure (psi):	100.0
Tare (g)	90.23	91.36	Burette Diameter (in):	0.250
Sample Wt. (g)	816.00	821.54	Burette Zero (cm):	100.0

Moisture (%)	11.5	12.5	Maximum Gradient:	6.7
Wet Density (pcf)	145.1	146.0	Average Gradient:	6.5
Dry Density (pcf)	130.1	129.8	Max. Effect. Stress (psi):	5.8
Saturation (%)	92.9	100.0	Min. Effect. Stress (psi):	4.4
			Ave. Effect. Stress (psi):	4.9

	Date			Time		Run	Temp	Pressure (psi)		Cham	Cham.	Bot	Bot.	Top	Top	Flow	Kv ***	Ave.*
	Yr.	Mo.	Day	Hr.	Min.	Time (s)	C°**	Bot	Top	(cm)	Dif.(cm)	(cm)	Dif.(cm)	(cm)	Dif.(cm)	Dif.(%)	cm/s	0,1
1	2016	3	2	5	6.00		0.0	95	95	45.70		2.90		102.20				
2	2016	3	2	9	13.00	14820	24.0	95	95	46.50	0.80	4.15	1.25	100.65	1.55	-10.7	5.6E-08	
3	2016	3	2	12	8.00	10500	22.0	95	95	46.70	0.20	4.95	0.80	99.85	0.80	0.0	4.8E-08	
4	2016	3	2	20	42.00	30840	22.0	95	95	48.30	1.60	7.20	2.25	97.85	2.00	5.9	4.5E-08	
5	2016	3	3	14	8.00	62760	23.0	95	95	50.95	2.65	10.90	3.70	94.55	3.30	5.7	3.8E-08	
6	2016	3	3	18	52.00	17040	24.0	95	95	51.50	0.55	11.80	0.90	93.80	0.75	9.1	3.4E-08	
7	2016	3	4	13	27.00	66900	22.0	95	95	53.20	1.70	14.70	2.90	91.15	2.65	4.5	3.2E-08	
8	2016	3	4	18	53.00	19560	22.0	95	95	53.80	0.60	15.45	0.75	90.45	0.70	3.4	3.0E-08	
9	2016	3	7	5	14.00	210060	22.0	95	95	58.95	5.15	21.05	5.60	85.35	5.10	4.7	2.2E-08	
10	2016	3	7	8	14.00	10800	23.0	95	95	59.30	0.35	21.30	0.25	85.15	0.20	11.1	1.9E-08	
11	2016	3	7	13	26.00	18720	22.0	95	95	59.75	0.45	21.65	0.35	84.80	0.35	0.0	1.8E-08	
12	2016	3	7	18	47.00	19260	21.0	95	95	60.50	0.75	22.05	0.40	84.55	0.25	23.1	1.7E-08	
13	2016	3	8	5	5.00	37080	25.0	95	95	61.50	1.00	22.75	0.70	83.85	0.70	0.0	1.7E-08	
14	2016	3	8	13	23.00	29880	22.0	95	95	62.20	0.70	23.30	0.55	83.30	0.55	0.0	1.8E-08	
15	2016	3	8	19	23.00	21600	22.0	95	95	63.10	0.90	23.70	0.40	83.10	0.20	33.3	1.4E-08	
16	2016	3	9	5	30.00	36420	24.0	95	95	63.80	0.70	24.30	0.60	82.40	0.70	-7.7	1.8E-08	
17	2016	3	9	11	14.00	20640	24.0	95	95	64.30	0.50	24.65	0.35	82.15	0.25	16.7	1.5E-08	
18	2016	3	9	20	22.00	32880	22.0	95	95	64.70	0.40	25.25	0.60	81.70	0.45	14.3	1.7E-08	
19	2016	3	10	4	59.00	31020	23.0	95	95	65.20	0.50	25.70	0.45	81.20	0.50	-5.3	1.6E-08	1
20	2016	3	10	8	24.00	12300	23.0	95	95	65.40	0.20	25.90	0.20	81.00	0.20	0.0	1.7E-08	1
21	2016	3	10	11	23.00	10740	23.0	95	95	65.40	0.00	26.05	0.15	80.85	0.15	0.0	1.5E-08	1
22	2016	3	10	20	45.00	33720	23.0	95	95	66.20	0.80	26.65	0.60	80.45	0.40	20.0	1.6E-08	1
23	2016	3	11	4	53.00	29280	22.0	95	95	66.20	0.00	27.05	0.40	79.95	0.50	-11.1	1.8E-08	1
24	2016	3	11	7	57.00	11040	24.0	95	95	66.60	0.40	27.20	0.15	79.80	0.15	0.0	1.5E-08	1
25																		
26																		

**A zero in this column starts a series of measurements. *Average Kv for those rows with a 1 in the Ave. column. 1.6E-08 cm/s

(Termination determined by stable Kv and low flow differential.) ***Kv adjusted for temperature.

TRC Environmental Corporation

Falling Head, Rising Tailwater Permeability Test (ASTM D5084, Method C)

QC: JPH
QA: JPH

Project Name:	DTE - Monroe FAB	Cell #:	9
Project #:	231828.0001.0000	USCS Description:	N/A
Sample Name:	MW-16-02, 30-32'	USCS Classification:	N/A
Visual Descript:	Gray sandy lean clay, with gravel	Average Kv =	1.3E-08 cm/s

Sample Type: Undisturbed

	Initial Values	Final Values			
Sample Dia. (in)	2.87	2.86	Permeant:	Water	
Sample Ht. (in)	3.06	3.03	Permeant Specific Gravity:	1.00	
Tare & Wet (g)	392.27	822.40	Sample Specific Gravity:	2.80	Est.
Tare & Dry (g)	353.20	733.00	Confining Pressure (psi):	100.0	
Tare (g)	89.98	90.41	Burette Diameter (in):	0.250	
Sample Wt. (g)	733.20	731.99	Burette Zero (cm):	100.0	

Moisture (%)	14.8	13.9	Maximum Gradient:	9.2
Wet Density (pcf)	141.0	143.2	Average Gradient:	9.0
Dry Density (pcf)	122.8	125.7	Max. Effect. Stress (psi):	5.7
Saturation (%)	98.2	100.0	Min. Effect. Stress (psi):	4.2
			Ave. Effect. Stress (psi):	4.8

	Date Yr.	Mo.	Day	Time Hr.	Min.	Run Time (s)	Temp C°**	Pressure (psi) Bot	Top	Cham (cm)	Cham. Dif.(cm)	Bot (cm)	Bot. Dif.(cm)	Top (cm)	Top Dif.(cm)	Flow Dif.(%)	Kv *** cm/s	Ave.* 0,1
1	2016	3	2	5	7.00		0.0	95	95	55.10		2.10		101.90				
2	2016	3	2	9	14.00	14820	24.0	95	95	55.90	0.80	2.65	0.55	101.15	0.75	-15.4	2.4E-08	
3	2016	3	2	12	9.00	10500	22.0	95	95	56.20	0.30	2.95	0.30	100.75	0.40	-14.3	1.9E-08	
4	2016	3	2	20	43.00	30840	22.0	95	95	57.75	1.55	4.05	1.10	99.90	0.85	12.8	1.8E-08	
5	2016	3	3	14	9.00	62760	23.0	95	95	60.30	2.55	5.95	1.90	98.50	1.40	15.2	1.5E-08	
6	2016	3	3	18	53.00	17040	24.0	95	95	60.85	0.55	6.50	0.55	98.00	0.50	4.8	1.8E-08	
7	2016	3	4	13	28.00	66900	22.0	95	95	62.50	1.65	8.30	1.80	96.55	1.45	10.8	1.5E-08	
8	2016	3	4	18	54.00	19560	22.0	95	95	63.10	0.60	8.80	0.50	96.15	0.40	11.1	1.5E-08	
9	2016	3	7	5	15.00	210060	22.0	95	95	67.80	4.70	13.70	4.90	92.40	3.75	13.3	1.4E-08	
10	2016	3	7	8	14.00	10740	23.0	95	95	68.30	0.50	13.95	0.25	92.20	0.20	11.1	1.5E-08	
11	2016	3	7	13	26.00	18720	21.0	95	95	68.60	0.30	14.35	0.40	92.00	0.20	33.3	1.2E-08	
12	2016	3	7	18	48.00	19320	21.0	95	95	69.35	0.75	14.80	0.45	91.75	0.25	28.6	1.3E-08	
13	2016	3	8	5	5.00	37020	25.0	95	95	70.40	1.05	15.60	0.80	91.15	0.60	14.3	1.3E-08	
14	2016	3	8	13	48.00	31380	22.0	95	95	70.40	0.00	16.15	0.55	90.70	0.45	10.0	1.2E-08	
15	2016	3	8	19	24.00	20160	22.0	95	95	71.75	1.35	16.60	0.45	90.55	0.15	50.0	1.1E-08	
16	2016	3	9	5	31.00	36420	24.0	95	95	72.40	0.65	17.25	0.65	90.15	0.40	23.8	1.1E-08	
17	2016	3	9	11	15.00	20640	24.0	95	95	72.80	0.40	17.65	0.40	89.85	0.30	14.3	1.3E-08	
18	2016	3	9	20	23.00	32880	22.0	95	95	73.20	0.40	18.35	0.70	89.55	0.30	40.0	1.2E-08	
19	2016	3	10	4	59.00	30960	23.0	95	95	73.60	0.40	18.85	0.50	89.10	0.45	5.3	1.2E-08	1
20	2016	3	10	8	23.00	12240	23.0	95	95	73.80	0.20	19.10	0.25	88.90	0.20	11.1	1.4E-08	1
21	2016	3	10	11	23.00	10800	23.0	95	95	73.80	0.00	19.30	0.20	88.70	0.20	0.0	1.5E-08	1
22	2016	3	10	20	46.00	33780	23.0	95	95	74.50	0.70	20.00	0.70	88.45	0.25	47.4	1.1E-08	1
23	2016	3	11	4	54.00	29280	22.0	95	95	74.40	-0.10	20.45	0.45	87.85	0.60	-14.3	1.5E-08	1
24	2016	3	11	7	58.00	11040	24.0	95	95	74.80	0.40	20.70	0.25	87.75	0.10	42.9	1.3E-08	1
25																		
26																		

**A zero in this column starts a series of measurements.

*Average Kv for those rows with a 1 in the Ave. column. 1.3E-08 cm/s

(Termination determined by stable Kv and low flow differential.)

***Kv adjusted for temperature.

TRC Environmental Corporation	QC: JPH
Falling Head, Rising Tailwater Permeability Test (ASTM D5084, Method C)	QA: JPH

Project Name:	DTE - Monroe FAB	Cell #:	10
Project #:	231828.0001.0000	USCS Description:	N/A
Sample Name:	MW-16-03, 20-22'	USCS Classification:	N/A
Visual Descript:	Gray sandy lean clay, with gravel	Average Kv =	1.2E-08 cm/s

Sample Type: Undisturbed	Initial Values	Final Values			
Sample Dia. (in)	2.87	2.87	Permeant:	Water	
Sample Ht. (in)	3.00	3.01	Permeant Specific Gravity:	1.00	
Tare & Wet (g)	563.98	834.70	Sample Specific Gravity:	2.82	Est.
Tare & Dry (g)	512.90	750.80	Confining Pressure (psi):	100.0	
Tare (g)	88.99	90.55	Burette Diameter (in):	0.250	
Sample Wt. (g)	740.10	744.15	Burette Zero (cm):	100.0	

Moisture (%)	12.0	12.7	Maximum Gradient:	9.8
Wet Density (pcf)	145.3	145.8	Average Gradient:	9.4
Dry Density (pcf)	129.7	129.4	Max. Effect. Stress (psi):	5.7
Saturation (%)	95.6	100.0	Min. Effect. Stress (psi):	4.2
			Ave. Effect. Stress (psi):	4.8

	Date			Time		Run	Temp	Pressure (psi)		Cham	Cham.	Bot	Bot.	Top	Top	Flow	Kv ***	Ave.*
	Yr.	Mo.	Day	Hr.	Min.	Time (s)	C°**	Bot	Top	(cm)	Dif.(cm)	(cm)	Dif.(cm)	(cm)	Dif.(cm)	Dif.(%)	cm/s	0,1
1	2016	3	2	5	8.00		0.0	95	95	50.70		2.00		101.60				
2	2016	3	2	9	14.00	14760	24.0	95	95	50.40	-0.30	2.65	0.65	100.90	0.70	-3.7	2.4E-08	
3	2016	3	2	12	9.00	10500	22.0	95	95	51.00	0.60	2.95	0.30	100.50	0.40	-14.3	1.9E-08	
4	2016	3	2	20	44.00	30900	22.0	95	95	52.65	1.65	3.85	0.90	99.75	0.75	9.1	1.5E-08	
5	2016	3	3	14	10.00	62760	23.0	95	95	55.10	2.45	5.50	1.65	98.30	1.45	6.5	1.4E-08	
6	2016	3	3	18	54.00	17040	24.0	95	95	55.30	0.20	6.00	0.50	97.90	0.40	11.1	1.5E-08	
7	2016	3	4	13	29.00	66900	22.0	95	95	57.20	1.90	7.55	1.55	96.50	1.40	5.1	1.3E-08	
8	2016	3	4	18	55.00	19560	22.0	95	95	57.70	0.50	8.00	0.45	96.00	0.50	-5.3	1.5E-08	
9	2016	3	7	5	15.00	210000	22.0	95	95	63.25	5.55	12.30	4.30	92.10	3.90	4.9	1.3E-08	
10	2016	3	7	8	15.00	10800	23.0	95	95	63.40	0.15	12.60	0.30	91.90	0.20	20.0	1.6E-08	
11	2016	3	7	13	27.00	18720	21.0	95	95	63.80	0.40	12.85	0.25	91.60	0.30	-9.1	1.1E-08	
12	2016	3	7	18	49.00	19320	21.0	95	95	64.65	0.85	13.35	0.50	91.35	0.25	33.3	1.4E-08	
13	2016	3	8	5	6.00	37020	25.0	95	95	65.15	0.50	14.00	0.65	90.75	0.60	4.0	1.1E-08	
14	2016	3	8	13	48.00	31320	22.0	95	95	66.90	1.75	14.40	0.40	90.15	0.60	-20.0	1.2E-08	
15	2016	3	8	19	25.00	20220	22.0	95	95	67.60	0.70	14.80	0.40	89.95	0.20	33.3	1.1E-08	
16	2016	3	9	5	31.00	36360	24.0	95	95	67.70	0.10	15.50	0.70	89.35	0.60	7.7	1.3E-08	1
17	2016	3	9	11	15.00	20640	24.0	95	95	68.40	0.70	15.85	0.35	89.00	0.35	0.0	1.2E-08	1
18	2016	3	9	20	24.00	32940	22.0	95	95	69.10	0.70	16.40	0.55	88.60	0.40	15.8	1.1E-08	1
19	2016	3	10	5	0.00	30960	23.0	95	95	70.20	1.10	16.75	0.35	88.05	0.55	-22.2	1.1E-08	1
20	2016	3	10	8	24.00	12240	23.0	95	95	69.90	-0.30	17.00	0.25	87.80	0.25	0.0	1.6E-08	1
21	2016	3	10	11	24.00	10800	23.0	95	95	70.20	0.30	17.20	0.20	87.70	0.10	33.3	1.1E-08	1
22	2016	3	10	20	47.00	33780	23.0	95	95	70.40	0.20	17.80	0.60	87.40	0.30	33.3	1.0E-08	1
23	2016	3	11	4	54.00	29220	22.0	95	95	71.40	1.00	18.15	0.35	86.75	0.65	-30.0	1.4E-08	1
24	2016	3	11	7	58.00	11040	24.0	95	95	71.25	-0.15	18.35	0.20	86.65	0.10	33.3	1.0E-08	1
25																		
26																		

**A zero in this column starts a series of measurements. *Average Kv for those rows with a 1 in the Ave. column. 1.2E-08 cm/s

(Termination determined by stable Kv and low flow differential.) ***Kv adjusted for temperature.

TRC Environmental Corporation

Falling Head, Rising Tailwater Permeability Test (ASTM D5084, Method C)

QC: JPH
QA: JPH

Project Name:	DTE - Monroe FAB	Cell #:	11
Project #:	231828.0001.0000	USCS Description:	N/A
Sample Name:	MW-16-04, 20-22'	USCS Classification:	N/A
Visual Descript:	Gray sandy lean clay, with gravel	Average Kv =	1.2E-08 cm/s

Sample Type: Undisturbed	Initial Values	Final Values			
Sample Dia. (in)	2.87	2.85	Permeant:	Water	
Sample Ht. (in)	3.55	3.51	Permeant Specific Gravity:	1.00	
Tare & Wet (g)	869.30	961.20	Sample Specific Gravity:	2.80	Est.
Tare & Dry (g)	785.95	875.10	Confining Pressure (psi):	100.0	
Tare (g)	0.00	89.15	Burette Diameter (in):	0.250	
Sample Wt. (g)	869.30	872.05	Burette Zero (cm):	100.0	

Moisture (%)	10.6	11.0	Maximum Gradient:	8.4
Wet Density (pcf)	144.2	148.4	Average Gradient:	8.1
Dry Density (pcf)	130.4	133.7	Max. Effect. Stress (psi):	5.7
Saturation (%)	87.3	100.0	Min. Effect. Stress (psi):	4.1
			Ave. Effect. Stress (psi):	4.7

	Date			Time		Run	Temp	Pressure (psi)		Cham	Cham.	Bot	Bot.	Top	Top	Flow	Kv ***	Ave.*
	Yr.	Mo.	Day	Hr.	Min.	Time (s)	C°**	Bot	Top	(cm)	Dif.(cm)	(cm)	Dif.(cm)	(cm)	Dif.(cm)	Dif.(%)	cm/s	0,1
1	2016	3	2	5	8.00		0.0	95	95	52.10		2.10		102.60				
2	2016	3	2	9	15.00	14820	24.0	95	95	53.45	1.35	2.75	0.65	101.85	0.75	-7.1	3.0E-08	
3	2016	3	2	12	10.00	10500	22.0	95	95	54.20	0.75	3.15	0.40	101.45	0.40	0.0	2.5E-08	
4	2016	3	2	20	40.00	30600	22.0	95	95	56.60	2.40	4.40	1.25	100.50	0.95	13.6	2.4E-08	
5	2016	3	3	14	6.00	62760	23.0	95	95	60.60	4.00	6.50	2.10	98.80	1.70	10.5	2.1E-08	
6	2016	3	3	18	50.00	17040	24.0	95	95	61.60	1.00	7.05	0.55	98.40	0.40	15.8	1.9E-08	
7	2016	3	4	13	25.00	66900	22.0	95	95	64.60	3.00	8.85	1.80	96.75	1.65	4.3	1.9E-08	
8	2016	3	4	18	51.00	19560	22.0	95	95	65.60	1.00	9.35	0.50	96.30	0.45	5.3	1.8E-08	
9	2016	3	7	5	16.00	210300	22.0	95	95	73.80	8.20	13.55	4.20	92.50	3.80	5.0	1.5E-08	
10	2016	3	7	8	15.00	10740	23.0	95	95	74.30	0.50	13.80	0.25	92.30	0.20	11.1	1.7E-08	
11	2016	3	7	13	27.00	18720	21.0	95	95	74.95	0.65	14.10	0.30	92.00	0.30	0.0	1.4E-08	
12	2016	3	7	18	46.00	19140	21.0	95	95	75.95	1.00	14.45	0.35	91.85	0.15	40.0	1.1E-08	
13	2016	3	8	5	6.00	37200	25.0	95	95	77.60	1.65	15.00	0.55	91.35	0.50	4.8	1.1E-08	
14	2016	3	8	13	50.00	31440	22.0	95	95	78.60	1.00	15.45	0.45	90.80	0.55	-10.0	1.4E-08	
15	2016	3	8	19	21.00	19860	22.0	95	95	79.60	1.00	15.80	0.35	90.70	0.10	55.6	9.9E-09	
16	2016	3	9	5	32.00	36660	24.0	95	95	80.80	1.20	16.30	0.50	90.20	0.50	0.0	1.1E-08	1
17	2016	3	9	11	16.00	20640	24.0	95	95	81.60	0.80	16.60	0.30	89.90	0.30	0.0	1.2E-08	1
18	2016	3	9	20	20.00	32640	22.0	95	95	82.25	0.65	17.10	0.50	89.60	0.30	25.0	1.1E-08	1
19	2016	3	10	5	0.00	31200	23.0	95	95	82.90	0.65	17.55	0.45	89.10	0.50	-5.3	1.4E-08	1
20	2016	3	10	8	24.00	12240	23.0	95	95	83.30	0.40	17.70	0.15	89.00	0.10	20.0	9.1E-09	1
21	2016	3	10	11	24.00	10800	23.0	95	95	83.50	0.20	17.85	0.15	88.85	0.15	0.0	1.2E-08	1
22	2016	3	10	20	43.00	33540	23.0	95	95	84.50	1.00	18.35	0.50	88.60	0.25	33.3	1.0E-08	1
23	2016	3	11	4	55.00	29520	22.0	95	95	84.70	0.20	18.65	0.30	88.05	0.55	-29.4	1.3E-08	1
24	2016	3	11	7	59.00	11040	24.0	95	95	85.30	0.60	18.85	0.20	88.00	0.05	60.0	1.0E-08	1
25																		
26																		

**A zero in this column starts a series of measurements. *Average Kv for those rows with a 1 in the Ave. column. 1.2E-08 cm/s

(Termination determined by stable Kv and low flow differential.) ***Kv adjusted for temperature.

LABORATORY TEST RESULTS
VERIFICATION OF NATURAL SOIL BARRIER - MONROE ASH BASIN
SME PROJECT NO. PG-22087

BORING NO.	SAMPLE NO.	DEPTH (feet)	CLASSIFICATION SYMBOL	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	SPECIFIC GRAVITY	VOID RATIO (calculated)	ATTERBERG LIMITS			PARTICLE SIZE DISTRIBUTION (%)						COEFFICIENT OF PERMEABILITY (cm/sec)
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY	
B2	CS2	6.5	CL	21	108	2.73	0.58	42	17	25	0	0	2	5	36	57	3.3E-08
B2	CS4	11.5	CL	12	126	2.68	0.33	23	15	8	0	0	8	18	39	35	5.8E-08
B2	CS6	16.5	CL	12	126	2.72	0.35	23	14	9	0	0	8	16	40	36	1.3E-08
B2	CS8	21.5	CL	12	127	2.72	0.34	24	13	11	0	0	8	17	38	37	1.5E-08
B2	CS10	26.5	CL	10	131	2.75	0.31	20	11	9	0	0	9	24	34	33	2.0E-08
B2	CS12	31.5	CL	12	122	2.73	0.40	32	15	17	0	0	5	9	39	47	2.0E-08
B4	CS2	6.5	CL	18	111	2.73	0.53	45	19	26	0	0	2	8	37	53	6.6E-08
B4	CS4	11.5	CL	21	109	2.73	0.56	43	17	26	0	0	3	11	36	50	2.1E-08
B4	CS6	16.5	CL	12	126	2.71	0.34	24	13	11	0	0	8	17	41	34	4.7E-08
B4	CS8	21.5	CL	11	136	2.70	0.24	23	13	10	0	0	8	18	37	37	2.1E-08
B4	CS10	26.5	CL	11	130	2.73	0.31	23	14	9	0	0	8	17	38	37	3.0E-08
B4	CS12	31.5	CL	10	128	2.71	0.32	25	14	11	0	0	4	11	44	41	1.8E-08
B4	CS14	36.5	CL	8	118	2.73	0.44	24	13	11	0	0	13	23	44	20	*
B6	CS2	6.5	CL	12	123	2.70	0.37	27	15	12	0	0	8	17	39	36	7.4E-08
B6	CS4	11.5	CL	11	132	2.72	0.29	23	13	10	0	0	8	17	39	36	1.8E-08
B6	CS6	16.5	CL	8	134	2.72	0.27	21	12	9	0	0	7	22	38	33	4.0E-08
B6	CS8	21.5	CL	11	133	2.75	0.29	21	12	9	0	0	7	21	37	35	6.5E-08
B6	CS10	26.5	CL	9	125	2.71	0.35	26	14	12	0	0	5	13	39	43	*
B6	CS12	31.5	CL	10	128	2.74	0.34	26	15	11	0	0	11	17	33	39	*
B8	CS2	6.5	CL	13	118	2.73	0.44	41	15	26	0	0	3	12	35	50	1.5E-08
B8	CS4	11.5	CL	17	112	2.73	0.52	34	17	17	0	0	7	17	38	38	2.2E-08
B8	CS6	16.5	CL	13	127	2.73	0.34	26	15	11	0	0	9	19	38	34	4.8E-08
B8	CS8	21.5	CL	12	129	2.74	0.33	24	14	10	0	0	8	17	40	35	1.6E-08
B8	CS10	26.5	CL	13	130	2.76	0.32	25	14	11	0	0	7	18	36	39	1.7E-08
B8	CS12	31.5	CL	10	134	2.73	0.27	20	11	9	0	0	10	24	41	25	4.7E-08
B8	CS14	36.5	CL	11	135	2.75	0.27	23	12	11	0	0	11	24	31	34	3.8E-08
B8	CS16	41.5	CL	10	127	2.78	0.37	23	13	10	0	0	15	19	46	20	1.9E-07

LABORATORY TEST RESULTS
VERIFICATION OF NATURAL SOIL BARRIER - MONROE ASH BASIN
SME PROJECT NO. PG-22087

BORING NO.	SAMPLE NO.	DEPTH (feet)	CLASSIFICATION SYMBOL	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	SPECIFIC GRAVITY	VOID RATIO (calculated)	ATTERBERG LIMITS			PARTICLE SIZE DISTRIBUTION (%)						COEFFICIENT OF PERMEABILITY (cm/sec)
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY	
B10	CS2	6.5	CL	20	114	2.72	0.49	40	15	25	0	0	3	13	35	49	3.6E-08
B10	CS4	11.5	CL	18	112	2.75	0.53	35	15	20	0	0	2	9	39	50	1.2E-08
B10	CS6	16.5	CL	22	102	2.74	0.68	36	17	19	0	0	1	2	37	60	5.3E-08
B10	CS8	21.5	CL	13	127	2.71	0.33	25	14	11	0	0	8	17	37	38	3.7E-08
B10	CS10	26.5	CL	10	133	2.74	0.29	23	14	9	0	0	7	17	39	37	1.5E-08

NOTE:
* Sample too small or disturbed to run test.

JRW Ponds 1 & 2 CCR Unit and Pond 6 Inactive CCR Unit Site

BASE MAP FROM USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE SERIES.

1 " = 3,000 '
1:36,000

0 3,000 6,000 FEET

TRC

1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080

TRC - GIS

PROJECT:	CONSUMERS ENERGY COMPANY JR WHITING POWER PLANT ERIE, MICHIGAN
TITLE:	SITE LOCATION MAP
DRAWN BY:	J. PAPEZ
CHECKED BY:	S. HOLMSTROM
APPROVED BY:	V. BUENING
DATE:	OCTOBER 2017
PROJ. NO.:	269767-004
FILE:	269767-004-000SLM.mxd

FIGURE 1

E:\ConsumersEnergy\CCR_GW\2017_269767\269767-004-000SLM.mxd -- Saved By: JPAPEZ on 10/17/2017, 09:07:39 AM

LEGEND

MONITORING WELL (STATIC WATER LEVEL ONLY)

CCR UNIT MONITORING WELL

LABEL FORMAT

MONITORING WELL ID
GROUNDWATER ELEVATION FT MSL (MEASUREMENT DATE)
GROUNDWATER ELEVATION FT MSL (MEASUREMENT DATE)
etc...

NOTES

1. BASE MAP IMAGERY FROM NEARMAP, 4/12/2017.
2. WELL LOCATIONS SURVEYED BY SHERIDAN SURVEYING CO. ON 11/19/2015 AND 11/30/2016.

N

0 500 1,000 Feet

1 " = 500 '

1:6,000

PROJECT:

CONSUMERS ENERGY COMPANY
JR WHITING POWER PLANT
ERIE, MICHIGAN

TITLE:

GROUNDWATER POTENTIOMETRIC ELEVATION SUMMARY

WORKING COPY

DRAWN BY:	J. PAPEZ	PROJ NO.:	297944-001
CHECKED BY:	J. LI		
APPROVED BY:		**FIGURE 3**	
DATE:	JULY 2018		

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FILE NO.: 297944-001-001.mxd

TRC - GIS

Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0

Plot Date: 7/25/2018, 10:23:57 AM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\ConsumersEnergy\CCR_GW\2017_269767\297944-001-001.mxd

Table 1
Summary of Groundwater Elevation Data
JR Whiting – RCRA CCR Monitoring Program
Erie, Michigan

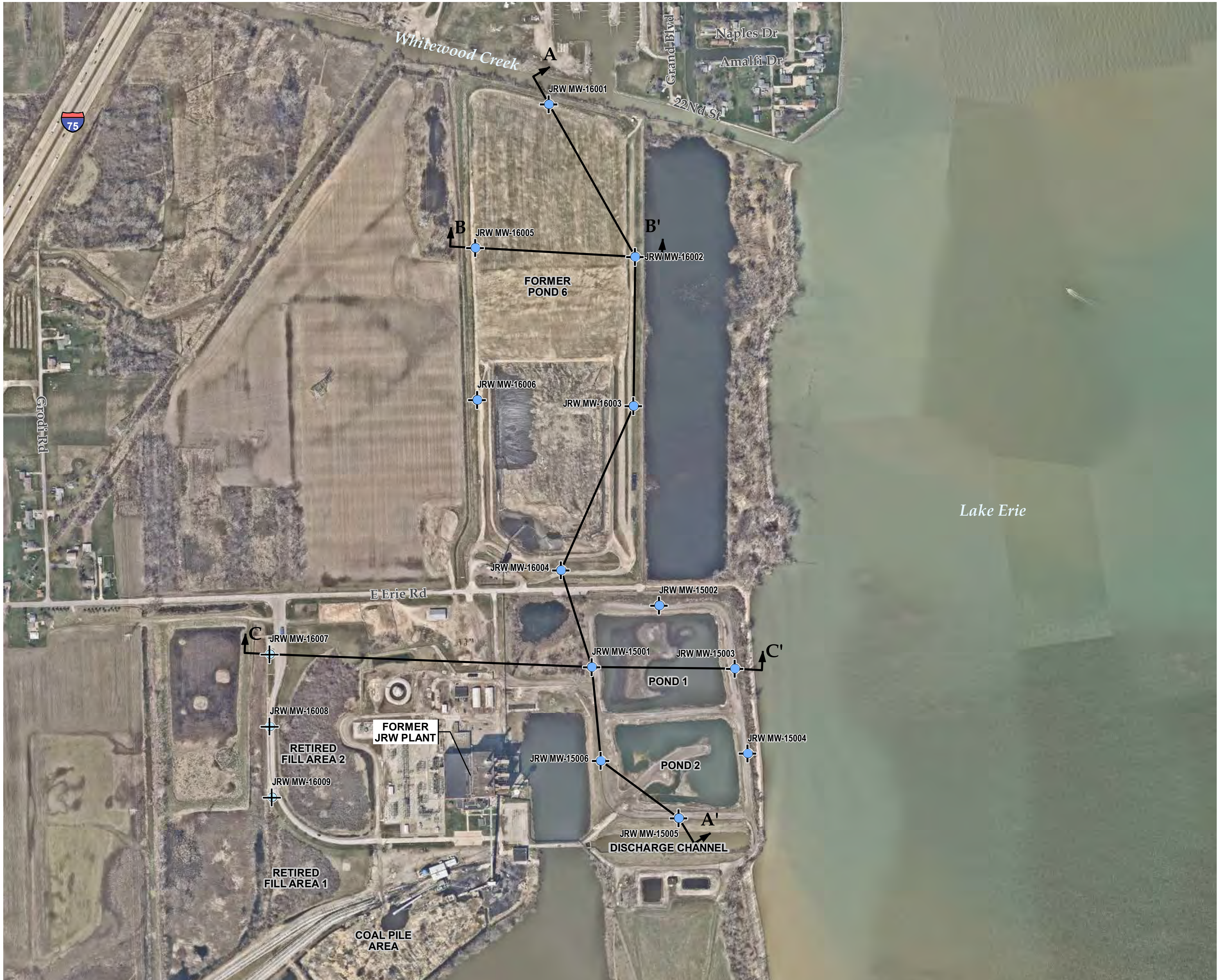
Well Location	Ground Surface Elevation (ft)	TOC Elevation (ft)	Geologic Unit of Screen Interval	Screen Interval Depth (ft BGS)			Screen Interval Elevation (ft)			Round 1 November 21, 2016 Depth to Water (ft BTOC)	Round 1 November 21, 2016 Groundwater Elevation (ft)	Round 1 December 19, 2016 Depth to Water (ft BTOC)	Round 1 December 19, 2016 Groundwater Elevation (ft)	Round 2 January 24, 2017 Depth to Water (ft BTOC)	Round 2 January 24, 2017 Groundwater Elevation (ft)	Round 3 March 8, 2017 Depth to Water (ft BTOC)	Round 3 March 8, 2017 Groundwater Elevation (ft)	Round 4 April 12, 2017 Depth to Water (ft BTOC)	Round 4 April 12, 2017 Groundwater Elevation (ft)
Background																			
JRW-MW-16007	579.47	582.32	Limestone	68.0	to	78.0	511.5	to	501.5	7.58	574.74	8.28	574.04	7.14	575.18	6.78	575.54	6.18	576.14
JRW-MW-16008	579.95	582.84	Limestone	68.0	to	73.0	512.0	to	507.0	7.93	574.91	8.77	574.07	7.70	575.14	7.34	575.50	6.82	576.02
JRW-MW-16009	579.90	582.59	Limestone	69.0	to	79.0	510.9	to	500.9	7.70	574.89	8.53	574.06	7.43	575.16	7.09	575.50	6.54	576.05
Ponds 1 & 2																			
JRW-MW-15001	589.6	590.71	Limestone	78.0	to	88.0	511.6	to	501.6	--	--	16.55	574.16	15.57	575.14	15.22	575.49	14.68	576.03
JRW-MW-15002	590.6	592.31	Limestone	81.0	to	91.0	509.6	to	499.6	--	--	18.13	574.18	17.11	575.20	16.77	575.54	16.25	576.06
JRW-MW-15003	589.6	591.36	Limestone	81.0	to	91.0	508.6	to	498.6	--	--	17.11	574.25	16.18	575.18	16.24	575.12	15.32	576.04
JRW-MW-15004	590.8	592.52	Limestone	86.0	to	96.0	504.8	to	494.8	--	--	18.24	574.28	17.36	575.16	17.07	575.45	16.51	576.01
JRW-MW-15005	592.7	594.25	Limestone	86.0	to	96.0	506.7	to	496.7	--	--	19.96	574.29	19.12	575.13	18.79	575.46	18.22	576.03
JRW-MW-15006	590.3	592.01	Limestone	81.0	to	91.0	509.3	to	499.3	--	--	17.80	574.21	16.91	575.10	16.56	575.45	15.98	576.03

Notes:
Survey conducted by Sheridan Surveying Co., November 2015 (2015 wells), and November 2016 (2016 wells)
Elevation in feet relative to North American Vertical Datum 1988 (NAVD 88).
TOC: Top of well casing.
ft BTOC: Feet below top of well casing.
ft BGS: Feet below ground surface.

Table 1
Summary of Groundwater Elevation Data
JR Whiting – RCRA CCR Monitoring Program
Erie, Michigan

Well Location	Ground Surface Elevation (ft)	TOC Elevation (ft)	Geologic Unit of Screen Interval	Screen Interval Depth (ft BGS)			Screen Interval Elevation (ft)			Round 5 May 23, 2017 Depth to Water (ft BTOC)	Round 5 May 23, 2017 Groundwater Elevation (ft)	Round 6 June 27, 2017 Depth to Water (ft BTOC)	Round 6 June 27, 2017 Groundwater Elevation (ft)	Round 7 July 31, 2017 Depth to Water (ft BTOC)	Round 7 July 31, 2017 Groundwater Elevation (ft)	Round 8 September 5, 2017 Depth to Water (ft BTOC)	Round 8 September 5, 2017 Groundwater Elevation (ft)	Round 9 October 9, 2017 Depth to Water (ft BTOC)	Round 9 October 9, 2017 Groundwater Elevation (ft)
Background																			
JRW-MW-16007	579.47	582.32	Limestone	68.0	to	78.0	511.5	to	501.5	6.14	576.18	7.33	574.99	6.87	575.45	7.14	575.18	7.93	574.39
JRW-MW-16008	579.95	582.84	Limestone	68.0	to	73.0	512.0	to	507.0	6.66	576.18	7.84	575.00	7.41	575.43	7.63	575.21	8.41	574.43
JRW-MW-16009	579.90	582.59	Limestone	69.0	to	79.0	510.9	to	500.9	6.40	576.19	7.59	575.00	7.15	575.44	7.35	575.24	8.18	574.41
Ponds 1 & 2																			
JRW-MW-15001	589.6	590.71	Limestone	78.0	to	88.0	511.6	to	501.6	14.45	576.26	15.65	575.06	15.27	575.44	15.38	575.33	16.18	574.53
JRW-MW-15002	590.6	592.31	Limestone	81.0	to	91.0	509.6	to	499.6	16.00	576.31	17.18	575.13	16.83	575.48	17.00	575.31	17.80	574.51
JRW-MW-15003	589.6	591.36	Limestone	81.0	to	91.0	508.6	to	498.6	15.02	576.34	16.14	575.22	15.89	575.47	16.00	575.36	16.80	574.56
JRW-MW-15004	590.8	592.52	Limestone	86.0	to	96.0	504.8	to	494.8	16.20	576.32	17.33	575.19	17.05	575.47	17.10	575.42	18.00	574.52
JRW-MW-15005	592.7	594.25	Limestone	86.0	to	96.0	506.7	to	496.7	17.89	576.36	19.04	575.21	18.79	575.46	18.84	575.41	19.70	574.55
JRW-MW-15006	590.3	592.01	Limestone	81.0	to	91.0	509.3	to	499.3	15.71	576.30	16.77	575.24	16.55	575.46	16.68	575.33	17.50	574.51

Notes:
Survey conducted by Sheridan Surveying Co., November 2015 (2015 wells), and November 2016 (2016 wells)
Elevation in feet relative to North American Vertical Datum 1988 (NAVD 88).
TOC: Top of well casing.
ft BTOC: Feet below top of well casing.
ft BGS: Feet below ground surface.



TRC - GIS

Coordinate System: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl (Foot)
Map Rotation: 0

Plot Date: 10/17/2017, 09:08:10 AM by JPAPEZ -- LAYOUT: ANSI B(11"x17")
Path: E:\ConsumersEnergy\CCR_GW\2017_269767\269767-004-004.mxd

LEGEND

- BACKGROUND MONITORING WELL
- CCR UNIT MONITORING WELL
- CROSS SECTION LOCATION

NOTES

1. BASE MAP IMAGERY FROM NEARMAP, 4/12/2017.
2. WELL LOCATIONS SURVEYED BY SHERIDAN SURVEYING CO. ON 11/19/2015 AND 11/30/2016.

1 " = 500 '
1:6,000

PROJECT:
CONSUMERS ENERGY COMPANY
JR WHITING POWER PLANT
ERIE, MICHIGAN

TITLE:
SITE PLAN WITH MONITORING WELL LOCATIONS

DRAWN BY:	J. PAPEZ	PROJ NO.:	269767-001
CHECKED BY:	S. HOLMSTROM	**FIGURE 1**	
APPROVED BY:	V. BUENING		
DATE:	OCTOBER 2017		

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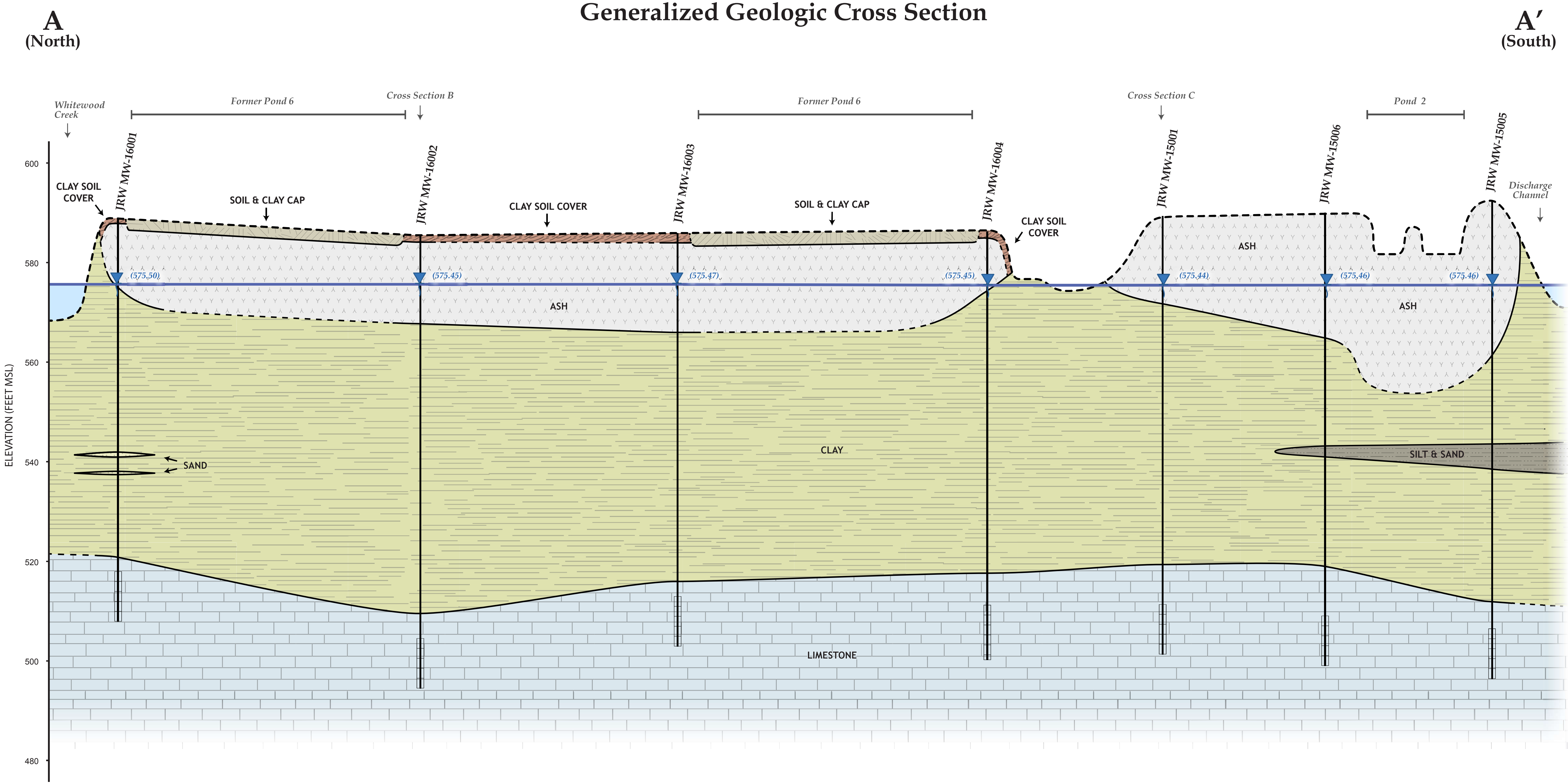
Phone: 734.971.7080
www.trcsolutions.com

FILE NO.: 269767-004-004.mxd

Generalized Geologic Cross Section



LEGEND

- GROUND SURFACE PROFILE, DASHED WHERE INFERRED
- STRATIGRAPHIC BOUNDARY, DASHED WHERE INFERRED
- APPROXIMATE CONFINED GROUNDWATER POTENTIOMETRIC ELEVATION (JULY 31, 2017)

SOIL UNIT LITHOLOGY

- SOIL & CLAY CAP
- CLAY SOIL COVER
- ASH
- CLAY
- LIMESTONE
- SILT & SAND
- SAND

- WELL BOREHOLE
- WELL SCREEN

20 / 10 / 0 — 0 / 150 / 300

Horizontal Scale: 1" = 300'
Vertical Scale: 1" = 20'
15x Vertical Exaggeration
(Scale is Approximate)

NOTES

1. FEATURE LOCATIONS AND SCALE ARE APPROXIMATE.
2. CROSS SECTION BASED UPON INFORMATION FROM ASH POND MATERIAL CHARACTERIZATION (GOLDER, 2016), SUMMARY OF MONITORING WELL DESIGN, INSTALLATION, AND DEVELOPMENT (ARCADIS, 2016), AND 2016 MONITORING WELL DESIGN, INSTALLATION, DEVELOPMENT, AND DECOMISSIONING (TRC, 2016).

PROJECT:
CONSUMERS ENERGY COMPANY
JR WHITING POWER PLANT
ERIE, MICHIGAN

TITLE:
GENERALIZED GEOLOGIC CROSS SECTION A-A'

DRAWN BY:	L. AUNER
CHECKED BY:	S. HOLMSTROM
APPROVED BY:	V. BUENING
DATE:	OCTOBER 2017
PROJ NO.:	269767

FIGURE 2

TRC
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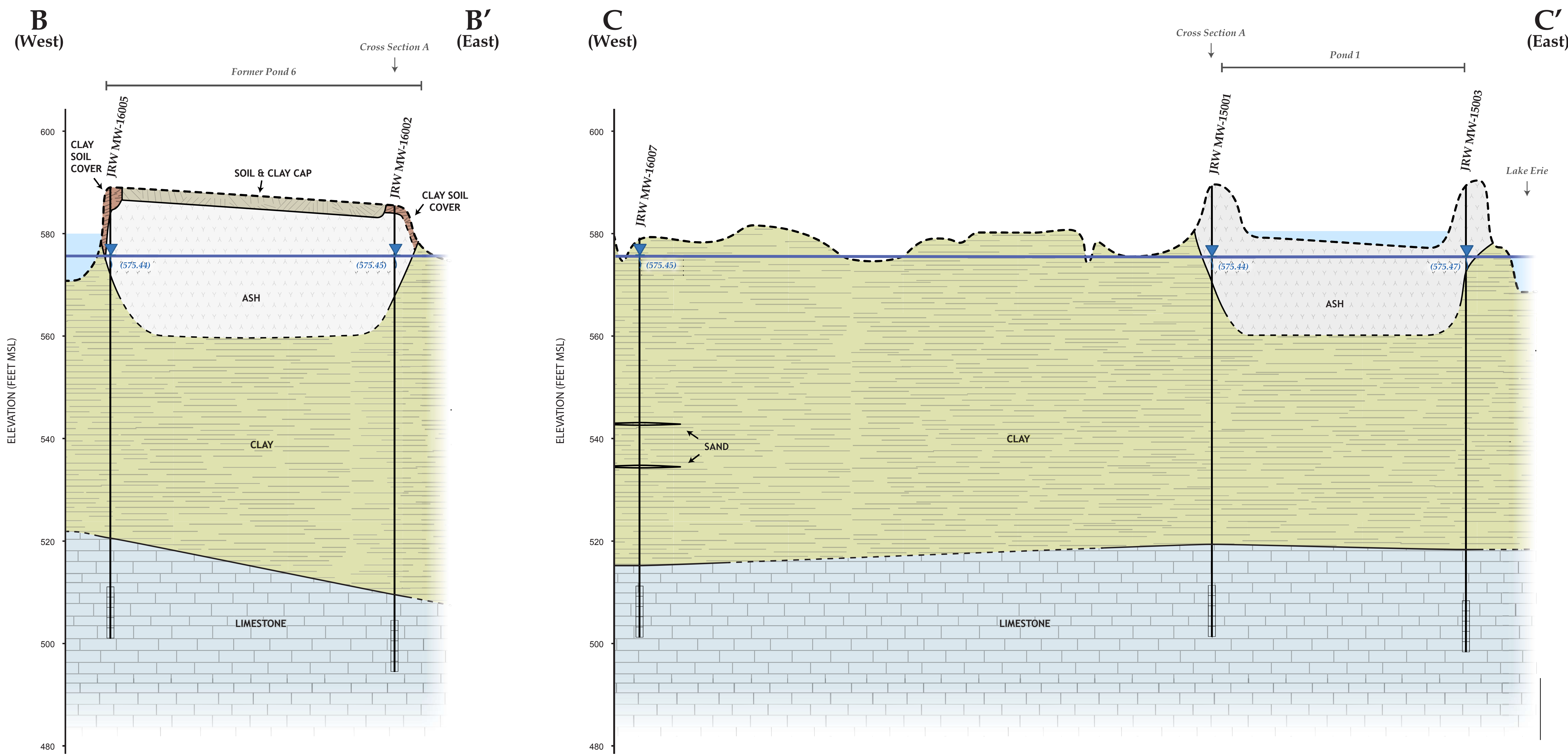
Ann Arbor, MI 48108
Phone: 734.971.7080

FILE NO.: 269767-004-ai01.ai

File Path: E:\WI_DOT\2015_229576\AI\269767-004-ai01.ai

Generalized Geologic Cross Sections



LEGEND

GROUND SURFACE PROFILE, DASHED WHERE INFERRED

STRATIGRAPHIC BOUNDARY, DASHED WHERE INFERRED

APPROXIMATE CONFINED GROUNDWATER POTENTIOMETRIC ELEVATION (JULY 31, 2017)

SOIL UNIT LITHOLOGY

SOIL & CLAY CAP

CLAY SOIL COVER

ASH

CLAY

LIMESTONE

SAND

WELL BOREHOLE

WELL SCREEN

NOTES

1. FEATURE LOCATIONS AND SCALE ARE APPROXIMATE.
2. CROSS SECTION BASED UPON INFORMATION FROM ASH POND MATERIAL CHARACTERIZATION (GOLDER, 2016), SUMMARY OF MONITORING WELL DESIGN, INSTALLATION, AND DEVELOPMENT (ARCADIS, 2016), AND 2016 MONITORING WELL DESIGN, INSTALLATION, DEVELOPMENT, AND DECOMISSIONING (TRC, 2016).

20
10
0
0 150 300

Horizontal Scale: 1" = 300'
Vertical Scale: 1" = 20'
15x Vertical Exaggeration
(Scale is Approximate)

PROJECT:
CONSUMERS ENERGY COMPANY
JR WHITING POWER PLANT
ERIE, MICHIGAN

TITLE:
GENERALIZED GEOLOGIC CROSS SECTIONS B-B' AND C-C'

DRAWN BY:	L. AUNER	PROJ NO.:	269767
CHECKED BY:	S. HOLMSTROM	FIGURE 3	
APPROVED BY:	V. BUENING		
DATE:	OCTOBER 2017		

TRC
1540 Eisenhower Place
Ann Arbor, MI 48108
Phone: 734.971.7080

FILE NO.: 269767-004-ai02.ai

File Path: E:\WI_DOT\2015_229576\AI\269767-004-ai02.ai

December 23, 2016

PROJECT: Laboratory Services
Geotill PROJECT NO.: 111610601
Geotill WORK ORDER NO.: 8601
SAMPLE RECEIVED: December 15, 2016
TOTAL PAGES: 9

Mr. Zachary Carr, P.E.
FK Engineering Associates
30425 Stephenson Hwy.
Madison Heights, MI 48071

Enclosed are the laboratory test results for the project shown above.

NUMBER	TEST
8	Permeability

We appreciate the opportunity to be of service to you on this project. If you have any questions, please feel free to contact our office.

Respectfully Submitted,

Malek Smadi, Ph.D., PE
Principal Engineer
GEOTILL, Inc.
Ph: (317) 449-0033 - Ext 101
e-mail: msmadi@geotill.com

GEOTILL
ENGINEERING, INC.

December 23, 2016

PROJECT: Laboratory Services
Geotill PROJECT NO.: 111610601
Geotill WORK ORDER NO.: 8601
SAMPLE RECEIVED: December 15, 2016
TOTAL PAGES: 9

Mr. Zachary Carr, P.E.
FK Engineering Associates
30425 Stephenson Hwy.
Madison Heights, MI 48071

LABORATORY HYDRAULIC CONDUCTIVITY TEST SUMMARY TRIAXIAL CELL WITH BACK PRESSURE /ASTM D-5084				
TEST CHARACTERISTICS				
Boring No.:	MW-16007	Confining Pressure (psi):		75
Sample No.:	BS-5	Target Back Pressure Differential (psi):		NA
Depth (ft):	34.0'-35.0'	Target Bottom Burette Pressure (psi):		70
		Target Top Burette Pressure (psi):		70

SAMPLE CHARACTERISTICS		
CHARACTERISTICS	INITIAL	FINAL
Length (in)	4.14	4.22
Diameter (in)	4.21	4.14
Dry Unit Weight (pcf)	**130.1**	131.0
Moisture Content (%)	**10.5**	10.1
B Value	96	

SUMMARY OF FINAL FOUR MEASUREMENTS				
MEASUREMENT	1	2	3	4
Elapsed Time (sec)	947	1027	1124	1740
True Back Pressure Differential (psi)	NA*	NA*	NA*	NA*
Flow Into Sample (cm^3)	NA*	NA*	NA*	NA*
Flow Out of Sample (cm^3)	NA*	NA*	NA*	NA*
Hydraulic Conductivity (cm/sec)	1.21×10^{-8}	1.07×10^{-8}	9.14×10^{-9}	8.03×10^{-9}
Average Hydraulic Conductivity (cm/sec)	**1.00×10^{-8}**	**(Temperature Corrected)**		

COMMENTS: * Constant volume panel was used for the flow measurement   Permeant: tap water

Deviations from the test method: None

December 23, 2016

PROJECT: Laboratory Services
Geotill PROJECT NO.: 111610601
Geotill WORK ORDER NO.: 8601
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TOTAL PAGES: 9

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LABORATORY HYDRAULIC CONDUCTIVITY TEST SUMMARY TRIAXIAL CELL WITH BACK PRESSURE /ASTM D-5084			
TEST CHARACTERISTICS			
Boring No.:	MW-16006	Confining Pressure (psi):	75
Sample No.:	BS-5	Target Back Pressure Differential (psi):	NA
Depth (ft):	34.5'-35.5	Target Bottom Burette Pressure (psi):	70
		Target Top Burette Pressure (psi):	70

SAMPLE CHARACTERISTICS		
CHARACTERISTICS	INITIAL	FINAL
Length (in)	4.13	4.20
Diameter (in)	3.99	3.91
Dry Unit Weight (pcf)	**120.2**	123.0
Moisture Content (%)	**15.1**	12.8
B Value	98	

SUMMARY OF FINAL FOUR MEASUREMENTS				
MEASUREMENT	1	2	3	4
Elapsed Time (sec)	1015	1040	1106	1136
True Back Pressure Differential (psi)	NA*	NA*	NA*	NA*
Flow Into Sample (cm^3)	NA*	NA*	NA*	NA*
Flow Out of Sample (cm^3)	NA*	NA*	NA*	NA*
Hydraulic Conductivity (cm/sec)	2.13×10^{-8}	1.90×10^{-8}	1.85×10^{-8}	1.62×10^{-8}
Average Hydraulic Conductivity (cm/sec)	**1.88×10^{-8}**	**(Temperature Corrected)**		

COMMENTS: * Constant volume panel was used for the flow measurement Permeant: tap water

Deviations from the test method: None

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LABORATORY HYDRAULIC CONDUCTIVITY TEST SUMMARY TRIAXIAL CELL WITH BACK PRESSURE /ASTM D-5084			
TEST CHARACTERISTICS			
Boring No.:	MW-16005	Confining Pressure (psi):	75
Sample No.:	BS-7	Target Back Pressure Differential (psi):	NA
Depth (ft):	38.0'-39.0'	Target Bottom Burette Pressure (psi):	70
		Target Top Burette Pressure (psi):	70

SAMPLE CHARACTERISTICS		
CHARACTERISTICS	INITIAL	FINAL
Length (in)	4.18	4.20
Diameter (in)	4.11	4.08
Dry Unit Weight (pcf)	**128.2**	130.4
Moisture Content (%)	**11.9**	9.9
B Value	100	

SUMMARY OF FINAL FOUR MEASUREMENTS				
MEASUREMENT	1	2	3	4
Elapsed Time (sec)	1027	1105	1151	1242
True Back Pressure Differential (psi)	NA*	NA*	NA*	NA*
Flow Into Sample (cm^3)	NA*	NA*	NA*	NA*
Flow Out of Sample (cm^3)	NA*	NA*	NA*	NA*
Hydraulic Conductivity (cm/sec)	1.55×10^{-8}	1.25×10^{-8}	1.13×10^{-8}	1.15×10^{-8}
Average Hydraulic Conductivity (cm/sec)	**1.27×10^{-8}**	**(Temperature Corrected)**		

COMMENTS: * Constant volume panel was used for the flow measurement   Permeant: tap water

Deviations from the test method: None

December 23, 2016

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LABORATORY HYDRAULIC CONDUCTIVITY TEST SUMMARY
TRIAXIAL CELL WITH BACK PRESSURE /ASTM D-5084

TEST CHARACTERISTICS

Boring No.:	MW-16001	Confining Pressure (psi):	80
Sample No.:	BS-7	Target Back Pressure Differential (psi):	NA
Depth (ft):	44.0'-45.0'	Target Bottom Burette Pressure (psi):	75
		Target Top Burette Pressure (psi):	75

SAMPLE CHARACTERISTICS

CHARACTERISTICS	INITIAL	FINAL
Length (in)	4.10	4.10
Diameter (in)	3.67	3.65
Dry Unit Weight (pcf)	**136.4**	137.0
Moisture Content (%)	**9.0**	8.5
B Value	96	

SUMMARY OF FINAL FOUR MEASUREMENTS

MEASUREMENT	1	2	3	4
Elapsed Time (sec)	1357	1418	1442	1511
True Back Pressure Differential (psi)	NA*	NA*	NA*	NA*
Flow Into Sample (cm^3)	NA*	NA*	NA*	NA*
Flow Out of Sample (cm^3)	NA*	NA*	NA*	NA*
Hydraulic Conductivity (cm/sec)	$1.64x10^{-8}$	$1.28x10^{-8}$	$1.20x10^{-8}$	$1.17x10^{-8}$

Average Hydraulic Conductivity (cm/sec) **$1.32x10^{-8}$** **(Temperature Corrected)**

COMMENTS: * Constant volume panel was used for the flow measurement Permeant: tap water

Deviations from the test method: None

December 23, 2016

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LABORATORY HYDRAULIC CONDUCTIVITY TEST SUMMARY TRIAXIAL CELL WITH BACK PRESSURE /ASTM D-5084			
TEST CHARACTERISTICS			
Boring No.:	MW-16002	Confining Pressure (psi):	80
Sample No.:	BS-5	Target Back Pressure Differential (psi):	NA
Depth (ft):	33.0'-34.0'	Target Bottom Burette Pressure (psi):	75
		Target Top Burette Pressure (psi):	75

SAMPLE CHARACTERISTICS		
CHARACTERISTICS	INITIAL	FINAL
Length (in)	3.88	3.89
Diameter (in)	3.37	3.35
Dry Unit Weight (pcf)	**123.4**	123.7
Moisture Content (%)	**13.7**	13.1
B Value	96	

SUMMARY OF FINAL FOUR MEASUREMENTS				
MEASUREMENT	1	2	3	4
Elapsed Time (sec)	1346	1417	1445	1521
True Back Pressure Differential (psi)	NA*	NA*	NA*	NA*
Flow Into Sample (cm^3)	NA*	NA*	NA*	NA*
Flow Out of Sample (cm^3)	NA*	NA*	NA*	NA*
Hydraulic Conductivity (cm/sec)	1.79×10^{-8}	1.38×10^{-8}	1.46×10^{-8}	1.31×10^{-8}
Average Hydraulic Conductivity (cm/sec)	**1.50×10^{-8}**	**(Temperature Corrected)**		

COMMENTS: * Constant volume panel was used for the flow measurement   Permeant: tap water

Deviations from the test method: None

December 23, 2016

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LABORATORY HYDRAULIC CONDUCTIVITY TEST SUMMARY
TRIAXIAL CELL WITH BACK PRESSURE /ASTM D-5084

TEST CHARACTERISTICS			
Boring No.:	MW-16003	Confining Pressure (psi):	80
Sample No.:	BS-4C	Target Back Pressure Differential (psi):	NA
Depth (ft):	33.0'-34.0'	Target Bottom Burette Pressure (psi):	75
		Target Top Burette Pressure (psi):	75

SAMPLE CHARACTERISTICS		
CHARACTERISTICS	INITIAL	FINAL
Length (in)	4.11	4.11
Diameter (in)	3.88	3.90
Dry Unit Weight (pcf)	**124.3**	123.3
Moisture Content (%)	**10.5**	10.8
B Value	96	

SUMMARY OF FINAL FOUR MEASUREMENTS				
MEASUREMENT	1	2	3	4
Elapsed Time (sec)	1430	1534	1643	1614
True Back Pressure Differential (psi)	NA*	NA*	NA*	NA*
Flow Into Sample (cm^3)	NA*	NA*	NA*	NA*
Flow Out of Sample (cm^3)	NA*	NA*	NA*	NA*
Hydraulic Conductivity (cm/sec)	$6.65x10^{-9}$	$6.05x10^{-9}$	$5.07x10^{-9}$	$4.24x10^{-9}$
Average Hydraulic Conductivity (cm/sec)	**$5.50x10^{-9}$**	**(Temperature Corrected)**		

COMMENTS: * Constant volume panel was used for the flow measurement   Permeant: tap water

Deviations from the test method: None

December 23, 2016

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LABORATORY HYDRAULIC CONDUCTIVITY TEST SUMMARY
TRIAXIAL CELL WITH BACK PRESSURE /ASTM D-5084

TEST CHARACTERISTICS

Boring No.:	MW-16007	Confining Pressure (psi):	75
Sample No.:	BS-10	Target Back Pressure Differential (psi):	NA
Depth (ft):	52.0'-53.0'	Target Bottom Burette Pressure (psi):	70
		Target Top Burette Pressure (psi):	70

SAMPLE CHARACTERISTICS

CHARACTERISTICS	INITIAL	FINAL
Length (in)	4.17	4.17
Diameter (in)	4.14	4.11
Dry Unit Weight (pcf)	**115.3**	116.1
Moisture Content (%)	**15.6**	15.3
B Value	96	

SUMMARY OF FINAL FOUR MEASUREMENTS

MEASUREMENT	1	2	3	4
Elapsed Time (sec)	933	947	1009	1032
True Back Pressure Differential (psi)	NA*	NA*	NA*	NA*
Flow Into Sample (cm^3)	NA*	NA*	NA*	NA*
Flow Out of Sample (cm^3)	NA*	NA*	NA*	NA*
Hydraulic Conductivity (cm/sec)	3.69×10^{-8}	3.15×10^{-8}	2.87×10^{-8}	2.14×10^{-8}

Average Hydraulic Conductivity (cm/sec) **2.23×10^{-8}** **(Temperature Corrected)**

COMMENTS: * Constant volume panel was used for the flow measurement Permeant: tap water

Deviations from the test method: None

GEOTILL
ENGINEERING, INC.

December 23, 2016

PROJECT: Laboratory Services
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LABORATORY HYDRAULIC CONDUCTIVITY TEST SUMMARY TRIAXIAL CELL WITH BACK PRESSURE /ASTM D-5084			
TEST CHARACTERISTICS			
Boring No.:	MW-16004	Confining Pressure (psi):	75
Sample No.:	BS-4	Target Back Pressure Differential (psi):	NA
Depth (ft):	31.5'-32.3'	Target Bottom Burette Pressure (psi):	70
		Target Top Burette Pressure (psi):	70

SAMPLE CHARACTERISTICS		
CHARACTERISTICS	INITIAL	FINAL
Length (in)	3.92	3.92
Diameter (in)	3.91	3.84
Dry Unit Weight (pcf)	**121.0**	123.5
Moisture Content (%)	**14.4**	13.3
B Value	104	

SUMMARY OF FINAL FOUR MEASUREMENTS				
MEASUREMENT	1	2	3	4
Elapsed Time (sec)	951	1010	1030	1058
True Back Pressure Differential (psi)	NA*	NA*	NA*	NA*
Flow Into Sample (cm^3)	NA*	NA*	NA*	NA*
Flow Out of Sample (cm^3)	NA*	NA*	NA*	NA*
Hydraulic Conductivity (cm/sec)	$2.222.8\text{x}10^{-8}$	$1.78\text{x}10^{-8}$	$1.72\text{x}10^{-8}$	$1.58\text{x}10^{-8}$
Average Hydraulic Conductivity (cm/sec)	**$1.83\text{x}10^{-8}$**	**(Temperature Corrected)**		

COMMENTS: * Constant volume panel was used for the flow measurement Permeant: tap water

Deviations from the test method: None

Appendix B
Calculation Documentation

TRC
Results you can rely on

SUBJECT Composite Liner Leakage

Per Giroud et al. 1998, rate of leakage through a composite liner can be calculated by:

$$Q = 0.976\, C_{q0}\left[1 + 0.1\, (h/T)^{0.95}\right] d^{0.2}\, h^{0.9}\, K^{0.74}$$

where Q = leakage rate, m^3/s
C_{q0} = coefficient characterizing contact between geomembrane and underlying clay, dimensionless
C_{q0} - good = 0.21
C_{q0} - poor = 1.15
h = leachate head on top of liner, m
T = thickness of clay liner below geomembrane, m
d = defect diameter, m
K = hydraulic conductivity of clay liner, m/s

Assume:
h = 0.3 m   T = 0.61 m   K = 1×10^{-9} m/s

1. Assume:
d = 0.001 m $C_{q0} = 0.21$

$$Q = 0.976(0.21)\left[1 + 0.1\left(\frac{0.3}{0.61}\right)^{0.95}\right](0.001)^{0.2}(0.3)^{0.9}(1\times10^{-9})^{0.74}$$

$$Q = 0.976(0.21)(1.05)(0.251)(0.338)(2.19\times10^{-7}) = 4\times10^{-9}\ m^3/s$$

$$4\times10^{-9}\ m^3/s \cdot 86400\ s/day \cdot 1000\ L/m^3 = 0.35\ L/day \text{ per defect}$$

0.35 L/day/defect $\cdot$ 2.5 defects/hc = **0.9 lphd**

0.35 L/day/defect $\cdot$ 5 defects/hc = **1.8 lphd**

lphd = liters per hectare per day

hc = hectare

2. Assume:
d = 0.00564 m $C_{q0} = 0.21$

$$Q = 0.976(0.21)\left[1 + 0.1\left(\frac{0.3}{0.61}\right)^{0.95}\right](0.00564)^{0.2}(0.3)^{0.9}(1\times10^{-9})^{0.74}$$

$$Q = 0.976(0.21)(1.05)(0.355)(0.338)(2.19\times10^{-7}) = 5.7\times10^{-9}\ m^3/s$$

$$5.7\times10^{-9}\ m^3/s \cdot 86400\ s/d \cdot 1000\ L/m^3 = 0.5\ L/day \text{ per defect}$$

0.5 L/day·defect (2.5 defects/hc) = **1.2 lphd**

0.5 L/day·defect (5 defects/hc) = **2.5 lphd**

A

3. Assume

$d = 0.001 \text{ m} \qquad C_{90} = 1.15$

$Q = 0.976(1.15)[1.05](0.001)^{0.2}(0.338)(2.19 \times 10^{-7}) = 2.2 \times 10^{-8} \text{ m}^3/\text{s}$

$2.2 \times 10^{-8} \text{ m}^3/\text{s} \cdot 86400 \frac{\text{s}}{\text{day}} \cdot \frac{1000 \text{ L}}{\text{m}^3} = 1.9 \frac{\text{L}}{\text{day}}$ per defect

$1.9 \frac{\text{L}}{\text{day-defect}} \cdot \frac{2.5 \text{ defects}}{\text{hc}} = \boxed{4.8 \text{ lphd}}$

$1.9 \frac{\text{L}}{\text{day} \cdot \text{defect}} \cdot 5 \frac{\text{defects}}{\text{hc}} = \boxed{9.6 \text{ lphd}}$

4. Assume

$d = 0.00564 \text{ m} \qquad C_{90} = 1.15$

$Q = 0.976(1.15)[1.05](0.00564)^{0.2}(0.338)(2.19 \times 10^{-7}) = 3.1 \times 10^{-8} \text{ m}^3/\text{s}$

$3.1 \times 10^{-8} \text{ m}^3/\text{s} \cdot 86400 \frac{\text{s}}{\text{day}} \cdot \frac{1000 \text{ L}}{\text{m}^3} = 2.7 \frac{\text{L}}{\text{day}}$ per defect

$2.7 \frac{\text{L}}{\text{day}} \cdot \frac{2.5 \text{ defects}}{\text{hc}} = \boxed{6.7 \text{ lphd}}$

$2.7 \frac{\text{L}}{\text{day}} \cdot \frac{5 \text{ defects}}{\text{hc}} = \boxed{14 \text{ lphd}}$

SHEET NO. 2 OF 2
PROJECT NO. 319742
DATE 11-27-2018
BY S. Sellwood
CHK'D A. Sellwood

TRC — Results you can rely on

SUBJECT Natural Clay Leakage

Leakage through a clay-only liner can be calculated using Darcy's Law assuming one-dimensional vertical flow:

$$Q = -KA\frac{dh}{dl}$$

where Q = leakage rate (units depend on inputs)
K = hydraulic conductivity of the clay
A = cross-sectional area of flow
dh = difference in head between the head above the clay and the head in the aquifer underlying the clay
dl = thickness of clay separating hydrogeologic units

CCR Unit	K	dh	dl	A
a. BRPP BABs	2.9×10^{-8} cm/s	16 ft	80 ft	assume 1 hectare (hc)
b. BRPP DB	2.9×10^{-8} cm/s	5 ft	117 ft	"
c. SCPP BABs	3.1×10^{-8} cm/s	1 ft	110 ft	"
d. Monroe PP FAB	6.5×10^{-8} cm/s	12 ft	23 ft	"
e. Whiting Ponds 1+2	2.23×10^{-8} cm/s	11 ft	35 ft	"
f. Whiting Pond 6	2.23×10^{-8} cm/s	22 ft	40 ft	"

a. $Q = -2.9\times10^{-8}\text{ cm/s}\left(-\frac{16\text{ ft}}{80\text{ ft}}\right)(1\text{ hc})(107{,}639\text{ ft}^2/\text{hc})(28.317\text{ L/ft}^3)(2834.6\text{ ft/d/cm/s}) = 50$ lph
b. $Q = -2.9\times10^{-8}\text{ cm/s}\left(\frac{-5\text{ ft}}{117\text{ ft}}\right)(1\text{ hc})(107{,}639\text{ ft}^2/\text{hc})(28.317\text{ L/ft}^3)(2834.6\text{ ft/d/cm/s}) = 11$ lphd
c. $Q = -3.1\times10^{-8}\text{ cm/s}(-1\text{ ft}/110\text{ ft})(1\text{ hc})(107{,}639\text{ ft}^2/\text{hc})(28.317\text{ L/ft}^3)(2834.6\text{ ft/d/cm/s}) = 2$ lphd
d. $Q = -6.5\times10^{-8}\text{ cm/s}(-12\text{ ft}/23\text{ ft})(1\text{ hc})(107{,}639\text{ ft}^2/\text{hc})(28.317\text{ L/ft}^3)(2834.6\text{ ft/d/cm/s}) = 293$ lp
e. $Q = -2.23\times10^{-8}\text{ cm/s}(-11\text{ ft}/35\text{ ft})(1\text{ hc})(107{,}639\text{ ft}^2/\text{hc})(28.317\text{ L/ft}^3)(2834.6\text{ ft/d/cm/s}) = 61$ lphd
f. $Q = -2.23\times10^{-8}\text{ cm/s}(-22\text{ ft}/40\text{ ft})(1\text{ hc})(107{,}639\text{ ft}^2/\text{hc})(28.317\text{ L/ft}^3)(2834.6\text{ ft/d/cm/s}) = 106$ lphd

Velocity: $V = \frac{-K}{n_e}\frac{dh}{dl}$ where n_e = effective clay porosity, assume 0.40 (dimensionless)
a. $V = -2.9\times10^{-8}\text{ cm/s}\left(\frac{1}{0.4}\right)(-16\text{ ft}/80\text{ ft})(2834.6\text{ ft/d/cm/s}) = 4.1\times10^{-5}$ ft/d
b. $V = -2.9\times10^{-8}\text{ cm/s}\left(\frac{1}{0.4}\right)(-5\text{ ft}/117\text{ ft})(2834.6\text{ ft/d/cm/s}) = 8.8\times10^{-6}$ ft/d
c. $V = -3.1\times10^{-8}\text{ cm/s}\left(\frac{1}{0.4}\right)(-1\text{ ft}/110\text{ ft})(2834.6\text{ ft/d/cm/s}) = 2\times10^{-6}$ ft/d
d. $V = -6.5\times10^{-8}\text{ cm/s}\left(\frac{1}{0.4}\right)(-12\text{ ft}/23\text{ ft})(2834.6\text{ ft/d/cm/s}) = 2.4\times10^{-4}$ ft/d
e. $V = -2.23\times10^{-8}\text{ cm/s}\left(\frac{1}{0.4}\right)(-11\text{ ft}/35\text{ ft})(2834.6\text{ ft/d/cm/s}) = 5\times10^{-5}$ ft/d
f. $V = -2.23\times10^{-8}\text{ cm/s}\left(\frac{1}{0.4}\right)(-22\text{ ft}/40\text{ ft})(2834.6\text{ ft/d/cm/s}) = 8.7\times10^{-5}$ ft/d

* lphd = liters per hectare per day

A

travel time: $t = \frac{dl}{v}$

a. $t = \frac{80 \text{ ft}}{4.1 \times 10^{-5} \text{ ft/d}} = 1.95 \times 10^{6}$ days

$\frac{1.95 \times 10^{6} \text{ days}}{365.25 \text{ days/yr}} = 5{,}300$ yrs

b. $t = \frac{117 \text{ ft}}{8.8 \times 10^{-6} \text{ ft/d}} = 1.33 \times 10^{7}$ days

$\frac{1.33 \times 10^{7} \text{ days}}{365.25 \text{ days/yr}} = 36{,}400$ yrs

c. $t = \frac{110 \text{ ft}}{2 \times 10^{-6} \text{ ft/d} \, (365.25 \text{ d/yr})} = 151{,}000$ yrs

d. $t = \frac{23 \text{ ft}}{2.4 \times 10^{-4} \text{ ft/d} \, (365.25 \text{ d/yr})} = 260$ yrs

e. $t = \frac{35 \text{ ft}}{5 \times 10^{-5} \text{ ft/d} \, (365.25 \text{ d/yr})} = 1{,}900$ yrs

f. $t = \frac{40 \text{ ft}}{8.7 \times 10^{-5} \text{ ft/d} \, (365.25 \text{ d/yr})} = 1{,}260$ yrs

Monroe PP FAB assuming average K, steeper gradient, and clay thickness associated with the steeper gradient.

$K = 2.7 \times 10^{-8}$ cm/s $dh = 29$ ft $dl = 30$ ft

$Q = -2.7 \times 10^{-8} \text{ cm/s} \left(\frac{-29 \text{ ft}}{30 \text{ ft}}\right)(1 \text{ ha})(107{,}639 \text{ ft}^2/\text{ha})(28.317 \text{ L/ft}^3)(2834.6 \text{ ft/d/cm/s}) = 226$ lphd

$V = -2.7 \times 10^{-8} \text{ cm/s} \left(\frac{1}{0.4}\right)\left(\frac{-29 \text{ ft}}{30 \text{ ft}}\right)(2834.6 \text{ ft/d/cm/s}) = 1.85 \times 10^{-4}$ ft/d

$t = \frac{30 \text{ ft}}{1.85 \times 10^{-4} \text{ ft/d} \, (365.25 \text{ d/yr})} = 440$ yrs

Appendix B
Groundwater Monitoring Systems Summary Report, October 2017

Groundwater Monitoring System Summary Report

DTE Electric Company
Monroe Power Plant Fly Ash Basin
Coal Combustion Residual Unit

7955 East Dunbar Road
Monroe, Michigan

October 2017

Groundwater Monitoring System Summary Report

DTE Electric Company
Monroe Power Plant Fly Ash Basin
Coal Combustion Residual Unit

7955 East Dunbar Road
Monroe, Michigan

October 2017

Prepared For
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Final
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Table of Contents

List of Tables

List of Figures

List of Appendices

Section 1
Introduction

1.1 Background and Objective

The United States Environmental Protection Agency (U.S. EPA) established a comprehensive set of requirements for management and disposal of coal combustion residuals (CCR) in landfills and surface impoundments in the Final Rule: Disposal of CCR from Electric Utilities (CCR Rule) on April 17, 2015. The DTE Electric Company (DTE Electric) Monroe Power Plant (MONPP) Fly Ash Basin (FAB) CCR unit is subject to the CCR Rule.

The objective of this report is to document and certify that the CCR Groundwater Monitoring System for the MONPP FAB CCR unit has been designed and constructed to meet the requirements of Title 40 Code of Federal Regulations (CFR) §257.91 (a)(1) and (2) of the CCR Rule. TRC Engineers Michigan, Inc. (TRC) was retained by DTE Electric to provide this report documenting the construction of the CCR groundwater monitoring system for the MONPP BAB.

1.2 Site Location

The MONPP is located in Section 16, Township 7 South, Range 9 East, at 7955 East Dunbar Road, Monroe in Monroe County, Michigan (**Figure 1**). The MONPP FAB is located about one mile southwest of the MONPP at latitude 41° 53' 03" North and longitude 83° 22' 31" West. The MONPP FAB is bounded by Dunbar Road and Plum Creek to the north and northeast, Interstate 75 to the northwest, a 200-acre peninsula into Lake Erie to the east and southeast, Lake Erie to the south and a large open field to the southwest (**Figure 2**).

1.3 Description of CCR Unit

The property has been used continuously for the operation of the MONPP FAB since approximately 1975 and is constructed over a natural clay-rich soil base. The MONPP FAB and landfill is a Type III solid waste disposal facility owned by DTE Electric, which currently accepts coal ash from DTE Electric's MONPP. The MONPP FAB is operated in accordance with Michigan Part 115 rules and the current operating license number 9393.

The MONPP FAB CCR unit is approximately 410-acres with an original design storage capacity of 18,500 acre-feet at a maximum elevation of 614 feet relative to the National Geodetic Vertical Datum of 1929 (NGVD 29)[1] (**Figure 2**). The FAB consists of an earthfill clay-rich soil

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[1] GZA Geo Environmental, Inc., 2011, Round 7 Dam Assessment, DTE Energy Monroe Power Plant, Fly Ash Basin and Bottom Ash Stormwater Pond

embankment (raised surface impoundment) with a crest perimeter length of approximately 18,200 feet and a general height (from the lowest toe elevation to the top of embankment) of approximately 40 feet, with a maximum height of 44 feet. A road along the top of the crest has a width of approximately 15 feet and an elevation of approximately 614 feet NGVD 29 with the typical water operational level being 610 feet NGVD 29[1].

The FAB base is keyed into the existing natural clay-rich soil ground surface at an elevation of 563.4 feet. This natural low permeability clay-rich soil base serves as an underlying hydraulic barrier, forming a natural liner of at least 23 feet of natural clay-rich soil below the base of the FAB. Under Michigan Part 115 rules, the MONPP FAB CCR unit is not required to monitor units beneath the clay-rich soil base confining unit due to its thickness, continuity and low hydraulic conductivity.

The Fly Ash Basin has a structural height of approximately 50.6 feet. The outer slope of the embankment has a slope generally ranging from approximately 1.8 horizontal to 1 vertical (1.8H:1V) to 2.5H:1. The inner slope of the embankment where the coal ash slurry is stored has a slope of approximately 2H:1V. CCRs are placed into the FAB by use of a "wet" (sluiced) disposal method. In 2015, DTE Electric added a 79-acre "dry" disposal area vertical extension landfill located on top of a portion of the FAB that had been filled to approximate final grade with CCR[2].

[2] Geosyntec Consultants, 2015, 2015 Annual Inspection Report, Vertical Extension Landfill, Monroe Power Plant, Monroe, Michigan

Section 2
Hydrogeology

2.1 Regional Hydrogeologic Setting

The geology of Monroe County consists of primarily unconsolidated alluvium and glacial deposits overlying bedrock. The unconsolidated material consists of shallow/surficial alluvium deposits (sand and gravel) on top of clay-rich glacial till with some sporadic glaciofluvial deposits that range from not present to more than 150 feet thick, with an average thickness of about 50 feet[3]. Bedrock in Monroe County is predominantly Devonian and Silurian-aged carbonates and includes the Antrim Shale, Traverse Group, Dundee Formation (limestone and some dolostone), Detroit River Group, Sylvania Sandstone, Bass Islands Group, and Salina Group. There is a potential for uppermost aquifers to be within the overlying alluvium (4%); however, the majority of drinking water wells in the county (91%) are installed in bedrock[3]. The bedrock surface is highest in the central and southwestern portion of the county and dips to the southeast and northwest due to erosion. Monroe County's eastern boundary is Lake Erie, and in general, regional groundwater flow is to the east towards Lake Erie[3]. Much of the carbonate bedrock aquifer in Monroe County is generally confined and naturally artesian.

2.2 MONPP FAB Hydrogeology

The subsurface site geology presented in this report is primarily based on historical MONPP design borings advanced in the 1970s, in addition to the recent soil data collected from around the FAB during the groundwater monitoring system installation detailed in Section 3. Soil borings from the groundwater monitoring system installation are included in Appendix A and generalized geologic cross sections are provided in **Figures 3 through 5**.

Historical borings advanced when designing the MONPP FAB in the 1970s and recent work performed to install monitoring wells MW-16-01 through MW-16-07 documented that the MONPP FAB overlies more than 35 feet of unconsolidated clay-rich glacial till and/or lacustrine deposits with saturated limestone of the Bass Islands Group bedrock generally encountered from 37 to 53.5 feet below ground surface (feet-bgs) (**Figures 3 through 5**). The Bass Island Group can be as thick as 350 feet in Monroe County[4]. Two modes of groundwater movement through the carbonate bedrock are recognized: (i) through pore spaces in the rock (primary porosity),

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[3] Beth A. Apple and Howard W. Reeves, 2007, Summary of Hydrogeologic Conditions by County for the State of Michigan. U.S. Geological Survey Open-File Report 2007-1236, 78 p.
[4] Reeves, H.W., Wright, KV and Nicholas, J.R., 2004, Hydrogeology and Simulation of Regional Ground-Water-Level Declines in Monroe County, Michigan, Water-Resources Investigations Report 03-4312, U.S. Department of the Interior, U.S. Geological Survey, Lansing, Michigan, 69 p.

and (ii) along an intersecting system of fractures, joints, and bedding planes, collectively referred to as secondary porosity[4]. Groundwater flow in the carbonate bedrock aquifer in Monroe County is primarily through secondary porosity consisting of fractures often evident along bedding-plane partings.

The limestone aquifer encountered at the site is generally artesian except in the area of monitoring well MW-16-01. Monitoring well MW-16-01 is located within several hundred feet of several off-site domestic residential water supply wells located to the north along Dunbar Road adjacent to Plum Creek that likely lower the hydraulic head in the area of MW-16-01.

Surface water bodies present in the area of the MONPP FAB include the Plum Creek a wide shallow creek (as close as 200 feet north and northeast of the MONPP FAB), Lake Erie (immediately adjacent to a portion of the MONPP FAB to the south) and the LaPlaisance Creek (approximately 2,000 feet south of the MONPP FAB).

2.2.1 Uppermost Aquifer

Definition

The 40 CFR §257.53 definitions of an aquifer and uppermost aquifer are as follows:

- *Aquifer* means a geologic formation, group of formations, or portion of a formation capable of yielding useable quantities of groundwater to wells or springs.
- *Uppermost aquifer* means the geologic formation nearest the natural ground surface that is an aquifer, as well as the 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.

Site Uppermost Aquifer

As described above, the MONPP FAB CCR unit uppermost aquifer as defined in 40 CFR §257.53 consists of saturated limestone present beneath at least 37 feet and up to 53.5 feet of thick contiguous silty clay-rich soil that serves as a natural confining hydraulic barrier that isolates the underlying uppermost aquifer (**Figures 3 through 5**). The overlying low permeability silty clay-rich soil consistently has a hydraulic conductivity on the order of 1 to 2 x 10^{-8} cm/s as found in soil testing performed during the CCR monitoring well installation and no higher than 6.5 x 10^{-8} cm/s in historical site clay-rich soil testing[5].

[5] Detroit Edison, 1995, MONPP – Effectiveness of the Underlying Clay Soil as a Natural Barrier On-Site Ash Disposal Basin, Technical Report 242

The limestone bedrock aquifer is artesian in every location except MW-16-01, where static water level was approximately 1 to 2 feet-bgs. As mentioned above, it is likely that the hydraulic head in the area of monitoring well MW-16-01 is lower due to groundwater pumping from several water supply wells in the area. Soil boring and well logs for the CCR monitoring wells are included in Appendix A.

2.2.2 Groundwater Flow

Groundwater Flow Direction

TRC installed the groundwater monitoring wells included in the CCR monitoring well system which were completed in April 2016. TRC was also retained to collect water samples and to measure groundwater level data from these wells. Based on data collected by TRC, the general flow potential within the uppermost aquifer at the site is to the northeast towards Plum Creek. **Figure 6** provides a representative groundwater potentiometric surface map from January 2017. Wells located hydraulically upgradient of the CCR unit include MW-16-03, MW-16-04 and MW-16-05 on the southwestern and southern part of the FAB CCR. These wells exhibit potentiometric elevations (generally 10 to 15 feet above ground surface) resulting in flowing conditions. Downgradient monitoring wells MW-16-01, MW-16-05 and MW-16-06 are slightly artesian to not artesian.

The potentiometric groundwater elevations collected in 2016 and 2017 suggest that there is horizontal groundwater flow potential within the upper aquifer unit generally to the northeast towards Plum Creek. The average hydraulic gradient to the northeast ranges from 0.002 to 0.0025 foot/foot along the eastern part of the FAB to 0.004 to 0.005 foot/foot in the center and northwestern part of the FAB, with an overall mean of 0.004 foot/foot.

The surface water elevation within the FAB raised surface impoundment is at least 5 to more than 30 feet above the potentiometric surface elevations in the uppermost aquifer limestone, and more than 60 feet above the base of the underlying clay-rich confining unit that isolates groundwater within the limestone aquifer. Therefore, flow potential from the CCR unit to the surrounding area would be radially outward from the FAB. However, there is no hydraulic communication between the uppermost aquifer and the FAB due to the continuous silty clay-rich confining unit beneath the MONPP FAB. Based on the artesian conditions, the low permeability of the underlying natural soils, and the calculated time of travel for groundwater to flow vertically from the FAB to the uppermost aquifer, it is not possible for the uppermost aquifer to have been affected by CCR from FAB operations that began in 1975.

Uppermost Aquifer Hydraulic Conductivity

A mean hydraulic conductivity of approximately 4.3 feet/day was measured from one of the CCR monitoring wells using single well hydraulic conductivity tests (e.g., slug tests) performed in 2016. This result is consistent with other sources (5 feet/day) for the hydraulic conductivity of the Bass Island Group[4].

Horizontal Time of Travel

Using the groundwater potentiometric surface elevations measured at the MONPP FAB unit in 2016 and 2017, the horizontal gradient has varied from approximately 0.002 to 0.005 with an average gradient approximately 0.004 foot/foot to the northeast. Assuming an average porosity of 0.1 for the limestone in the uppermost aquifer, a mean hydraulic conductivity of 5 feet/day, and a hydraulic gradient of 0.004 for the limestone aquifer the potential horizontal groundwater flow rate to the northeast is approximately 0.2 feet/day or 73 feet/year.

Vertical Time of Travel

The MONPP FAB CCR unit was constructed in an area that consists of a naturally occurring silty-clay rich soil. This naturally deposited soil barrier has been verified by numerous historical soil borings[5], and also confirmed by TRC during completion of the seven soil borings installed as part of the CCR monitoring well installation program. Consequently, the geology and hydrogeology of the site provides a very high level of environmental protection of the uppermost aquifer. Based on the site geology and hydrogeology, there is extremely low potential for the landfill to affect the off-site uppermost aquifer groundwater in the future. Groundwater occurring in the deep confined uppermost limestone aquifer is protected from CCR constituents by the thick clay-rich aquitard with low hydraulic conductivity. In addition, under Michigan Part 115 rules, the MONPP FAB CCR unit is not required to monitor units beneath the clay-rich confining unit due to its thickness, continuity and low hydraulic conductivity.

Using the hydrogeologic information for the site, the time of travel for water from the base-grade elevation of the MONPP FAB down to the uppermost aquifer has previously been calculated to be 308 years assuming a maximum silty-clay hydraulic conductivity of 6.5×10^{-8} cm/s and 23 feet of silty-clay present between the bottom of the MONPP FAB CCR unit and the limestone bedrock surface[5]. Therefore, given that the MONPP FAB operations began in 1975, approximately 42-years ago, there is no potential for the uppermost aquifer CCR groundwater monitoring system wells to be affected from the MONPP FAB CCR unit.

Section 3
Groundwater Monitoring System

3.1 Groundwater Monitoring System Installation

During February to April 2016, TRC, on behalf of DTE oversaw the installation and development of the groundwater monitoring system in accordance with the 40 CFR §257.91. Seven monitoring wells (MW-16-01 through MW-16-07) were installed by a Michigan-licensed well driller at the MONPP FAB in order to establish the groundwater monitoring system as described below:

3.1.1 Soil Boring Advancement

In February through April 2016, seven soil borings were advanced to evaluate the subsurface geology and to allow monitoring well installation using sonic drilling techniques with 4-inch and 6-inch tooling along the perimeter of the MONPP FAB CCR unit. Soil samples were collected continuously in ten-foot sections from the ground surface to the termination of the soil boring. A TRC geologist was present to log each boring and describe the soil samples in accordance with the Unified Soil Classification System (USCS).

The soil borings were advanced to depths ranging from approximately 40 to 60 ft-bgs to within the top of the limestone bedrock. In most cases (at every location except MW-16-01), artesian conditions were encountered at the terminus of the soil borings. The variability in boring depth is related to the variable thickness of the overlying silty clay-rich soil (ranging from 37 to 53.5 feet) that overlies and confines the uppermost portion of the limestone uppermost aquifer and the distance to top of bedrock at each location.

3.1.2 Monitoring Well Installation

Based on the depths to the uppermost aquifer in each soil boring location, CCR monitoring wells MW-16-01 through MW-16-07 were screened within the uppermost portion of the limestone uppermost aquifer (along the clay/bedrock interface). Screened intervals in these monitoring wells range from 35 to 40 feet-bgs to 53 to 58 feet-bgs in the seven locations around the MONPP FAB perimeter (Figure 2). Given the presence of the natural clay-rich hydraulic barrier and the observed artesian conditions within the uppermost aquifer, the horizontal spacing of the wells is adequate to detect constituents from the CCR unit.

Monitoring wells were constructed within each borehole using 2-inch-diameter, Schedule 40 PVC casing and 5-foot long screens with 0.010-inch factory cut slots. Monitoring well construction diagrams from the installed monitoring wells accompany the soil boring logs in Appendix A. Following well installation, the cement grout and bentonite seal materials were allowed to stabilize for more than 24-hours before monitoring well development began.

3.1.3 Monitoring Well Development and Surveying

Following installation, each CCR monitoring well was developed by air lifting methods or by allowing it to develop naturally through artesian flow. In addition, a Michigan-licensed surveyor horizontally located each monitoring well utilizing the Michigan State Plane South Zone-2113, North American Datum 1983 (NAD 83), International feet. Vertical elevations of the ground surface at each soil boring and monitoring well location and the top of casing for each monitoring well were also surveyed in feet relative to the North American Vertical Datum of 1988 (NAVD 88). Monitoring well coordinates, elevations, screened intervals, and other monitoring well details are included in Table 1.

3.1.4 Detection Monitoring

The MONPP FAB CCR unit groundwater monitoring system, as shown on Figure 2, will serve as the detection monitoring locations pursuant to Title 40 CFR §257.93 and §257.94 of the CCR Rule. The MONPP FAB CCR unit will use intra-well statistical methods because the saturated unit being monitored is isolated by a laterally contiguous silty-clay unit which significantly impedes vertical groundwater flow thus preventing the monitored saturated zone from potentially being affected by CCR. In addition, the flow potential of liquid within the FAB is radially outward relative to the uppermost aquifer due to the elevation water is maintained within the FAB CCR unit. Based on these hydrogeologic conditions, intra-well statistical approaches are likely a more appropriate method to evaluate groundwater data statistically. Consequently, intra-well statistical tests will be evaluated for use during detection monitoring. Using the data collected from the monitoring well system, a statistical evaluation plan is being developed to evaluate compliance with the CCR Rule.

Section 4
Groundwater Monitoring System Certification

Groundwater Monitoring System Certification per 40 CFR §257.91(f)
Monroe Power Plant Fly Ash Basin
Monroe, Michigan

The U.S. EPA's Disposal of Coal Combustion Residuals from Electric Utilities Final Rule Title 40 CFR Part 257, §257.91, requires that the owner or operator of an existing CCR unit install a groundwater monitoring system. The owner or operator must obtain a certification from a qualified professional engineer stating that the groundwater monitoring system has been designed and constructed to meet the requirements of Title 40 CFR §257.91.

CERTIFICATION

I hereby certify that the groundwater monitoring system presented within this document for the MONPP FAB CCR unit has been designed and constructed to meet the requirements of Title 40 CFR §257.91 of the Federal CCR Rule. This document is accurate and has been prepared in accordance with good engineering practices, including the consideration of applicable industry standards, and with the requirements of Title 40 CFR §257.91.

Name	Expiration Date	
David B. McKenzie, P.E.	October 31, 2017	
Company	Date	
TRC Engineers Michigan, Inc.	October 13, 2017	Stamp

Tables

Table 1
Monitoring Well Information Summary
DTE Electric Company – Monroe Power Plant Fly Ash Basin
Monroe, Michigan

Well Location	Date Installed	Northing	Easting	Ground Surface Elevation (ft AMSL)	TOC Elevation (ft AMSL)	Geologic Unit of Screen Interval	Well Construction	Screen Interval Depth (ft BGS)	Screen Interval Elevation (ft AMSL)	Borehole Terminus Depth (ft BGS)	Borehole Terminus Elevation (ft AMSL)
Monroe Fly Ash Basin											
MW-16-01	2/17/2016	143121.86	13394675.84	578.91	581.74	Silty Clay at 48-50 ft bgs, Limestone bedrock at 50-53 ft bgs	2" PVC	48.0 to 53.0	530.9 to 525.9	55.0	523.9
MW-16-02	2/18/2016	140938.78	13396986.03	579.44	581.81	Silty Clay at 53-53.5 ft bgs, Limestone bedrock at 53.5-58 ft bgs	2" PVC	53.0 to 58.0	526.4 to 521.4	60.0	519.4
MW-16-03	2/16/2016	139040.68	13395136.56	577.29	579.95	Sand at 37.5-39 ft bgs, Silty Clay at 39-40 ft bgs, Limestone bedrock 40-42 ft bgs	2" PVC	37.0 to 42.0	540.3 to 535.3	50.0	527.3
MW-16-04	2/15/2016	140704.67	13390758.97	582.64	585.54	Silty Gravel at 41-42.5, Silty Sand at 42.5-44, Silt at 44-46 ft bgs, Limestone bedrock at 46 ft bgs	2" PVC	41.0 to 46.0	541.6 to 536.6	50.0	532.6
MW-16-05	4/13/2016	139537.00	13392809.68	580.51	583.25	Limestone bedrock	2" PVC	40.0 to 45.0	540.5 to 535.5	50.0	530.5
MW-16-06	4/13/2016	142566.72	13396398.37	579.20	581.94	Gravel and Cobbles	2" PVC	45.0 to 50.0	534.2 to 529.2	50.0	529.2
MW-16-07	4/14/2016	143408.82	13392311.01	575.41	578.40	Sandy Silt with Clay at 35-37 ft bgs, Limestone bedrock at 37-40 ft bgs.	2" PVC	35.0 to 40.0	540.4 to 535.4	40.0	535.4

Notes:
Coordinates are Michigan State Plane South Zone-2113, International Feet.
Elevation in feet above NAVD88.
TOC: Top of well casing.
ft AMSL: Feet above mean sea level.
ft BGS: Feet below ground surface.

Figures

BASE MAP FROM USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE SERIES.

N

1 " = 2,000 '
1:24,000

0 2,000 4,000 FEET

TRC

1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080

TRC - GIS

PROJECT:	DTE ELECTRIC COMPANY MONROE POWER PLANT 7955 EAST DUNBAR ROAD MONROE, MICHIGAN
TITLE:	SITE LOCATION MAP

DRAWN BY:	J. PAPEZ
CHECKED BY:	S HOLMSTROM
APPROVED BY:	V. BUENING
DATE:	OCTOBER 2017
PROJ. NO.:	265996.0001
FILE:	265996-SLMMB.mxd

FIGURE 1

LEGEND

- MONITORING WELLS
- APPROXIMATE BOUNDARY OF FLY ASH

NOTES

1. BASE MAP IMAGERY FROM ESRI/MICROSOFT, "WORLD IMAGERY", WEB BASEMAP SERVICE LAYER.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.

N

0 600 1,200 Feet

1 " = 600 '
1:7,200

PROJECT:
DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:
MONITORING NETWORK AND SITE PLAN

DRAWN BY:	J. PAPEZ	PROJ NO.:	265996.0001
CHECKED BY:	S. HOLMSTROM		**FIGURE 1**
APPROVED BY:	V. BUENING		
DATE:	OCTOBER 2017		

TRC

1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080
www.trcsolutions.com

FILE NO.: 265996-0001-000.mxd

TRC - GIS

Coordinate System: NAD 1983 UTM Zone 17N (Meter)
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LEGEND

- MONITORING WELLS
- APPROXIMATE BOUNDARY OF FLY ASH
- CROSS SECTIONS

NOTES

1. BASE MAP IMAGERY FROM ESRI/MICROSOFT, "WORLD IMAGERY", WEB BASEMAP SERVICE LAYER.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.

N

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:

DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:

CROSS SECTION LOCATOR MAP

DRAWN BY:	J. PAPEZ	PROJ NO.:	265996.0001
CHECKED BY:	S. HOLMSTROM		**FIGURE 3**
APPROVED BY:	V. BUENING		
DATE:	OCTOBER 2017		

TRC
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Ann Arbor, MI 48108-3284
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FILE NO.: 265996-0001-008.mxd

TRC - GIS

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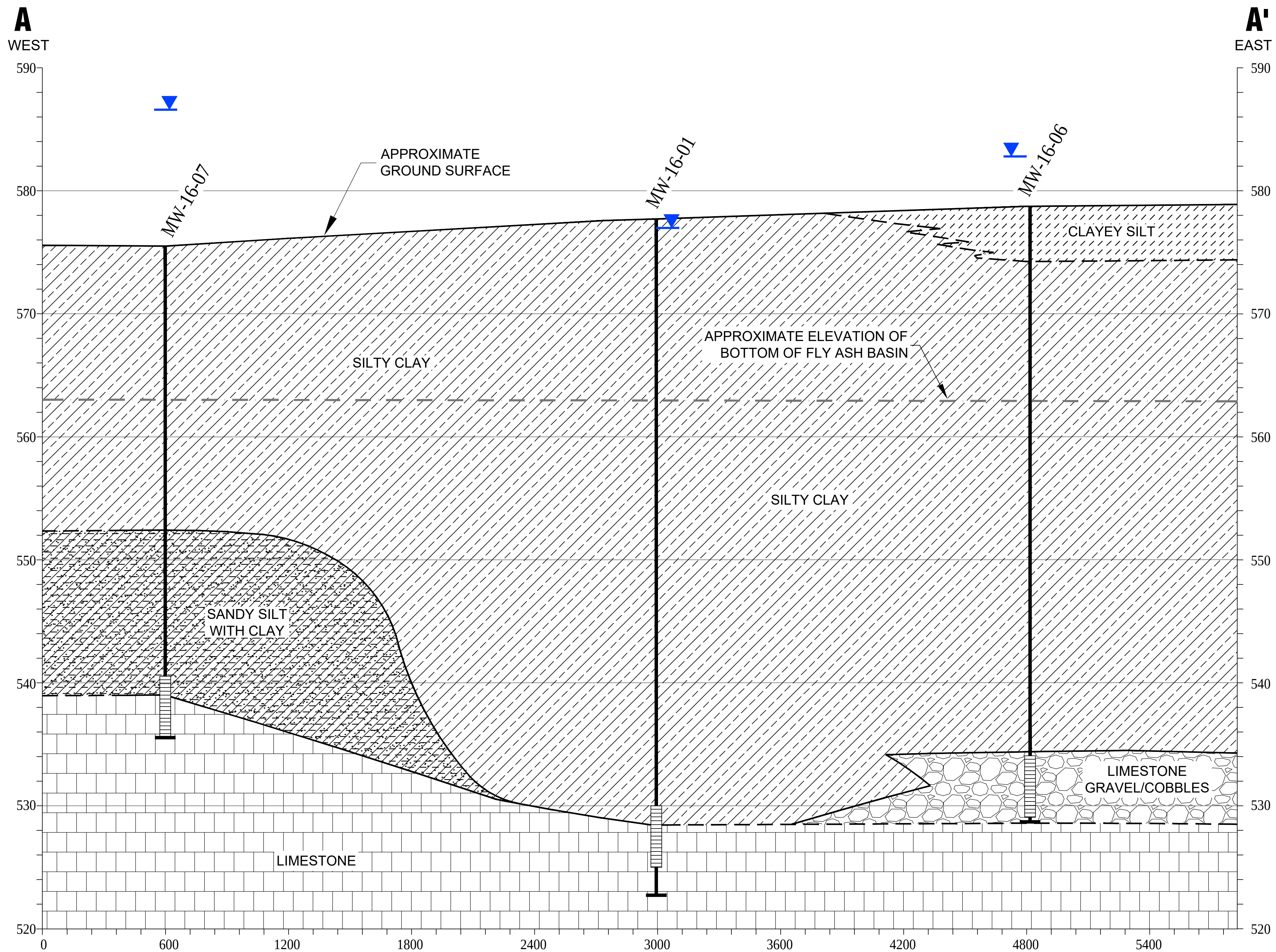
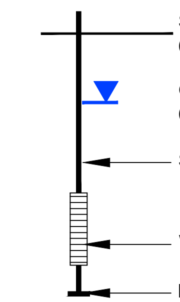
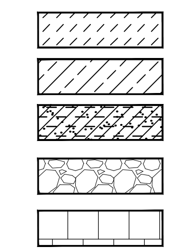
GENERALIZED GEOLOGIC CROSS-SECTION A-A'

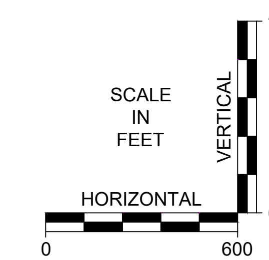


LEGEND



Lithology Key





PROJECT:
DTE ELECTRIC COMPANY
MONROE POWER PLANT - FLY ASH BASIN
MONROE, MICHIGAN

TITLE:
GENERALIZED GEOLOGIC CROSS-SECTION A-A'

DRAWN BY:	D.STEHLE	PROJ NO.:	265996.0001.01
CHECKED BY:	S.HOLMSTROM		FIGURE 4
APPROVED BY:	V.BUENING		
DATE:	SEPTEMBER 2017		

TRC
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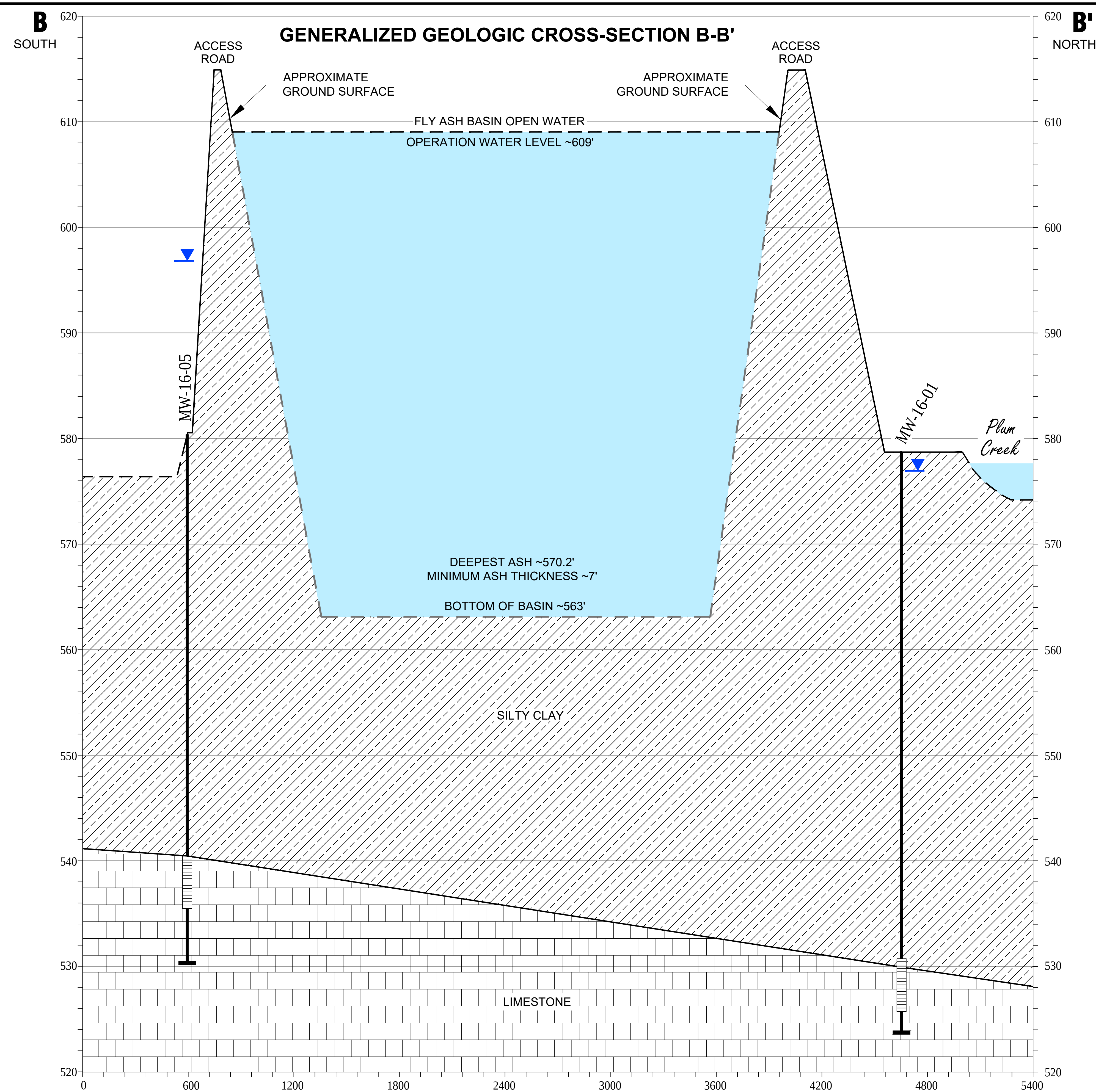
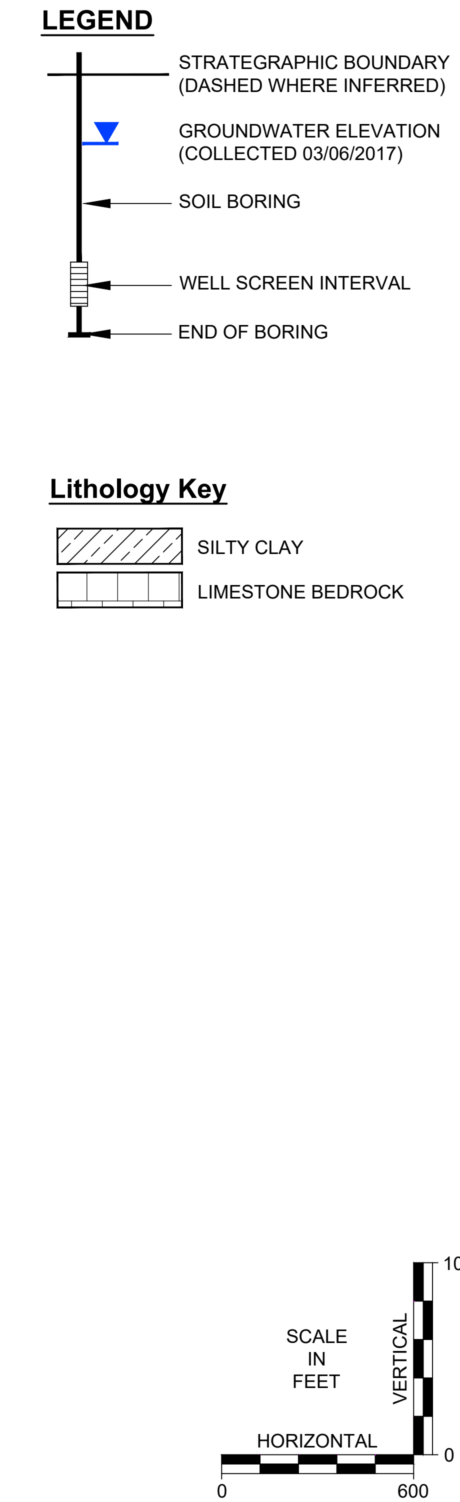
FILE NO.: 265996.0001.01.01.04-05.dwg

11x17 --- ATTACHED XREFS: --- ATTACHED IMAGES:
DRAWING NAME: J:_TRC\DTE\Monroe PP\265996\0001\01\ 265996.0001.01.01.04-05.dwg --- PLOT DATE: October 12, 2017 - 11:17AM --- LAYOUT: FIG04 XS AA





PROJECT:

DTE ELECTRIC COMPANY
MONROE POWER PLANT - FLY ASH BASIN
MONROE, MICHIGAN

TITLE:

GENERALIZED
GEOLOGIC CROSS-SECTION B-B'

DRAWN BY:	D.Stehle	PROJ NO.:	265996.0001.01.01
CHECKED BY:	S.HOLMSTROM		**FIGURE 5**
APPROVED BY:	V.BUENING		
DATE:	MAY 2017		

TRC
1540 Eisenhower Place
Ann Arbor, MI 48108
Phone: 734.971.7080
www.trcsolutions.com

FILE NO.: 265996.0001.01.01.04-05.dwg

11x17 --- ATTACHED XREFS: --- ATTACHED IMAGES:
DRAWING NAME: J:_TRC\DTE\Monroe PP\265996\0001\01\ 265996.0001.01.01.04-05.dwg --- PLOT DATE: October 12, 2017 - 11:17AM --- LAYOUT: FIG05 XS BB

LEGEND

- MONITORING WELL
- APPROXIMATE BOUNDARY OF FLY ASH BASIN
- GROUNDWATER FLOW DIRECTION
- POTENTIOMETRIC SURFACE CONTOUR LINE (DASHED WHERE INFERRED)
- *582.69* STATIC WATER ELEVATION IN FEET (NGVD, 1988)

NOTES

1. BASE MAP IMAGERY FROM ESRI/MICROSOFT, "WORLD IMAGERY", WEB BASEMAP SERVICE LAYER.
2. GROUNDWATER MEASUREMENTS FROM 5/5/2016.
3. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:

DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:

GROUNDWATER POTENTIOMETRIC SURFACE MAP JANUARY 2017

DRAWN BY:	B. DEEGAN	PROJ NO.:	265996.0001
CHECKED BY:	S. HOLMSTROM	**FIGURE 6**	
APPROVED BY:	V. BUENING		
DATE:	OCTOBER 2017		

TRC

1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080
www.trcsolutions.com

FILE NO.: 265996-0001-009.mxd

TRC - GIS

Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

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Path: E:\DTE\CCR_Sites\2017_265996\265996-0001-009.mxd

Appendix A
Soil Boring and Monitoring Well Installation Logs

TRC

WELL CONSTRUCTION LOG

WELL NO. MW-16-01

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
DTE EC: Monroe FAB	2/17/16	2/17/16	231828.0001.0000

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Stock Drilling	Sonic	578.91	581.74	60.0	6

Boring Location:	Personnel	Drilling Equipment:
SW of fly ash basin. N: 143121.86 E: 13394675.84	Logged By - Jennifer Reed Driller - Austin Goldsmith	TerraSonic

Civil Town/City/or Village:	County:	State:	Water Level Observations:
Monroe, MI	Monroe	Michigan	While Drilling: Date/Time Depth (ft bgs) After Drilling: Date/Time 3/17/16 08:45 ▼ Depth (ft bgs) 2.00

SAMPLE Number and Type	SAMPLE Recovery (%)	Blow Counts	Depth in Feet	Lithologic Description	USCS	Comments
1 CS	65		0–10	▼ **SILTY CLAY** mostly clay, some silt, low plasticity, very dark gray (7.5YR 3/1), no odor, moist, medium stiff, high organic content, roots and grass. Change to no roots at 3.5 feet. Change to hard at 5.0 feet. Change to medium stiff at 5.5 feet. Change to trace to few gravel at 6.0 feet.	CL-ML	
2 CS	95		10–20	Change to medium plasticity, dark gray (10YR 4/1) mottled with yellowish brown (10YR 5/6), at 12.5 feet. Change to dark gray (10YR 4/1), very stiff at 17.5 feet.		
3 ST	60		20–22			
4 CS	100		22–30			
5 CS	100		30–40	Change to weathered limestone appearance, light gray (10YR 7/1), slight odor, stiff at 32.5 feet.		
6 CS	95		40–50	Change to not cohesive at 42.5 feet. Change to little silt, few coarse sand at 43.5 feet. Change to some silt, trace coarse sand at 45.0 feet. Grades to wet from 40 to 48 feet. Change to bedrock fragments encountered, wet at 48.0 feet.		
7 CS	100		50–55	**LIMESTONE** very weathered, light gray (10YR 7/1), moist, medium dense, similar to silt.		
				End of boring at 55.0 feet below ground surface.		

Signature: [signature]

Firm: TRC Environmental Corporation 734-971-7080
1540 Eisenhower Place Ann Arbor, Michigan Fax 734-971-9022

WELL CONSTRUCTION LOG

TRC

WELL NO. MW-16-02

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
DTE EC: Monroe FAB	2/18/16	2/18/16	231828.0001.0000

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Stock Drilling	Sonic	579.44	581.81	55.0	6

Boring Location: S of fly ash basin. N: 140938.78 E: 13396986.03	Personnel: Logged By - Jennifer Reed; Driller - Austin Goldsmith	Drilling Equipment: TerraSonic

Civil Town/City/or Village:	County:	State:	Water Level Observations:
Monroe, MI	Monroe	Michigan	While Drilling: Date/Time Depth (ft bgs); After Drilling: Date/Time 3/17/16 09:30 Depth (ft bgs) -4.82

Sample Number and Type	Recovery (%)	Blow Counts	Depth in Feet	Lithologic Description	USCS	Comments
1 CS	90		0–10	**SILTY CLAY** mostly clay, some silt, trace to few sand, trace to few gravel, low plasticity, dark brown (10YR 3/3), no odor, moist, hard. Change to dry at 3.25 feet. Change to dark gray (10YR 4/1) at 5.0 feet.	CL-ML	Artesian well conditions present.
2 CS	95		10–20	Change to moist at 9.5 feet. Change to very stiff at 10.5 feet. Change to dark gray (10YR 4/1), mottled with light reddish brown (5YR 6/3) at 12.0 feet.		
3 ST	65		20			
4 CS	100			Change to no mottling at 25.0 feet.		
5 ST	95		30			
6 CS	100					
7 CS	100		40	**SILTY CLAY WITH SAND** mostly clay, some silt, little fine to coarse sand, low plasticity, dark gray (10YR 4/1), no odor, moist, very stiff. Change to light gray (10YR 7/1), slight odor at 42.5 feet.	CL-ML	
			50	**SILTY CLAY** mostly clay, some silt, few gravel, very low plasticity, light gray (10YR 7/1), slight odor, moist, hard. Change to dry, not cohesive at 51.5 feet.	CL-ML	
8 CS	100			**LIMESTONE** weathered, slight odor, saturated.		
			60	End of boring at 60.0 feet below ground surface.		

Signature: [signature]

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WELL CONSTRUCTION LOG

TRC

WELL NO. MW-16-03

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
DTE EC: Monroe FAB	2/16/16	2/16/16	231828.0001.0000

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Stock Drilling	Sonic	577.29	579.95	50.0	6

Boring Location:	Personnel	Drilling Equipment:
E of fly ash basin. N: 139040.68 E: 13395136.56	Logged By - Chris Scieszka Driller - Austin Goldsmith	TerraSonic

Civil Town/City/or Village:	County:	State:	Water Level Observations:
Monroe, MI	Monroe	Michigan	While Drilling: Date/Time Depth (ft bgs) After Drilling: Date/Time 3/17/16 09:25 Depth (ft bgs) -13.95

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	WELL DIAGRAM	COMMENTS
1 CS	70			**SILTY CLAY** mostly clay, some silt, low plasticity, very dark brown (10YR 2/2), no odor, moist, medium stiff (2.0 tsf), high organics, roots. Change to no roots, trace fine gravel at 2.5 feet. Change to wood fragments present at 8.0 feet.				Artesian well conditions present.
2 CS	60		10	Change to medium to high plasticity, dark gray (10YR 4/1), mottled with yellowish brown (10YR 5/6) and light reddish brown (5YR 6/3), no organics at 10.0 feet. Change to trace to few fine to coarse sand, trace to few fine gravel low plasticity, yellowish brown (10YR 5/4), at 12.0 feet. Change to dark gray (10YR 4/1), very stiff (3.0 tsf) at 17.0 feet.	CL-ML			
3 ST	100		20					
4 CS	100							
5 CS	100		30	Change to hard (>4.0 tsf) at 30.0 feet.				
				SAND mostly fine to coarse sand, trace to few silt, very dark gray (10YR 3/1), no odor, moist, loose.	SP			
6 CS	100		40	**SILTY CLAY** mostly clay, some silt, low plasticity, dark gray (10YR 4/1), no odor, moist, very stiff (3.0 tsf).	CL-ML			
				LIMESTONE light gray (10YR 7/1), slight odor, weathered, saturated. Change to very weathered, moist at 41.0 feet. Change to competent, dry.				
			50	End of boring at 50.0 feet below ground surface.				

SOIL BORING WELL CONSTRUCTION LOG 231828.0001.GPJ TRC_CORP.GDT 231828.0001.0000 5/16/16

Signature: [signature]

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WELL CONSTRUCTION LOG

TRC

WELL NO. MW-16-04

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
DTE EC: Monroe FAB	2/15/16	2/15/16	231828.0001.0000

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Stock Drilling	Sonic	582.64	585.54	50.0	6

Boring Location: N of fly ash basin.	Personnel	Drilling Equipment:
N: 140704.67 E: 13390758.97	Logged By - Chris Scieszka Driller - Austin Goldsmith	TerraSonic

Civil Town/City/or Village:	County:	State:	Water Level Observations:
Monroe, MI	Monroe	Michigan	While Drilling: Date/Time Depth (ft bgs) After Drilling: Date/Time 3/17/16 10:15 Depth (ft bgs) -19.40

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	WELL DIAGRAM	COMMENTS
1 CS	20			**SILTY CLAY** mostly clay, little to some silt, trace to few fine to coarse sand, trace to few fine to coarse gravel, low plasticity, dark brown (10YR 3/3), no odor, dry, hard (>4.0 tsf).	CL-ML			Artesian well conditions present.
2 CS	100		10	Change to soft (0.5 tsf) at 10.0 feet. Change to very stiff (3 to 4 tsf) at 15.0 feet.				
3 ST	80		20	Change to dark gray (10YR 4/1) at 19.0 feet.				
4 CS	100			Change to very stiff to hard (3 to >4 tsf) at 22.0 feet.				
5 CS	100		30	Change to cobble present at 29.5 feet. Change to hard (>4.0 tsf) at 31.0 feet.				
6 CS	80		40	**SILTY GRAVEL** mostly fine to coarse gravel, little to some silt, few fine to coarse sand, gray (10YR 5/1), no odor, saturated, medium dense to dense.	GM			
				SILTY SAND mostly fine to medium sand, little to some silt, gray (10YR 5/1), no odor, moist to saturated, dense to very dense.	SM			
				SILT mostly silt, trace to few fine sand, no plasticity, dark grayish brown (10YR 4/2), no odor, dry, very dense.	ML			
			50	**LIMESTONE** gray (10YR 5/1) to dark gray (10 R 4/1), dry, competent but fractured.				
				End of boring at 50.0 feet below ground surface.				

Signature: [signature]

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WELL CONSTRUCTION LOG

TRC

WELL NO. MW-16-05

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
DTE EC: Monroe FAB	4/12/16	4/13/16	231828.0001.0000

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Stock Drilling	Sonic	580.51	583.25	50.0	6

Boring Location: S edge of fly ash basin, along farm field edge.

N: 139537.14 E: 13392810.51

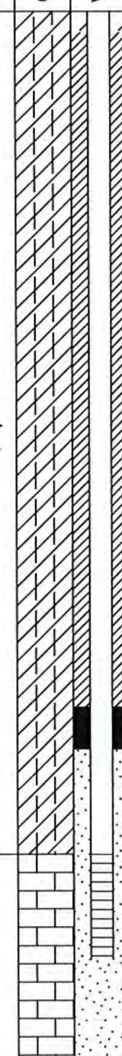
Personnel
Logged By - Jennifer Reed
Driller - Austin Goldsmith

Drilling Equipment: TerraSonic

Civil Town/City/or Village:	County:	State:
Monroe, MI	Monroe	Michigan

Water Level Observations:
While Drilling: Date/Time Depth (ft bgs)
After Drilling: Date/Time 5/5/16 12:47 Depth (ft bgs) -16.70

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	COMMENTS
1 CS	75		0–10	**SILTY CLAY** mostly clay, little to some silt, low plasticity, very dark brown (10YR 2/2), no odor, moist, medium stiff, organic material present, roots and grass. Change to few to little fine to coarse sand at 2.5 feet. Change to brown (10YR 5/3), very stiff, no organic material at 5.0 feet. Change to trace to few gravel, gray (10YR 5/1) at 7.5 feet.	CL-ML	Artesian well conditions present.
2 CS	100		10–20			
3 CS	100		20–30			
4 CS	100		30–40	Change to no to trace fine to medium sand, no gravel, dark gray (10YR 4/1), hard at 30 feet.		
5 CS	100		40–50	**LIMESTONE** weathered, light gray (10YR 7/1), slight odor, moist to dry. Change to competent at 46.5 feet.		
			50	End of boring at 50.0 feet below ground surface.		



Signature: [signature]

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WELL CONSTRUCTION LOG

TRC

WELL NO. MW-16-06

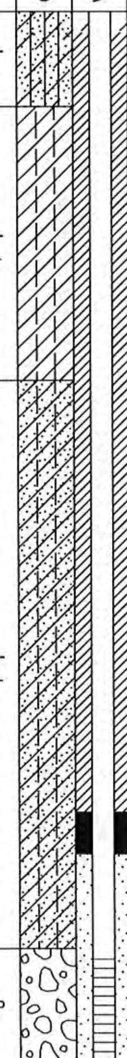
Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
DTE EC: Monroe FAB	4/13/16	4/13/16	231828.0001.0000

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Stock Drilling	Sonic	579.20	581.94	50.0	6

Boring Location:	Personnel	Drilling Equipment:
NE of fly ash basin, along the river's edge. N: 142566.72 E: 13396398.37	Logged By - Jennifer Reed Driller - Austin Goldsmith	TerraSonic

Civil Town/City/or Village:	County:	State:	Water Level Observations:
Monroe, MI	Monroe	Michigan	While Drilling: Date/Time Depth (ft bgs) After Drilling: Date/Time 5/5/16 09:30 Depth (ft bgs) -3.45

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	COMMENTS
1 CS	98		0–3	**CLAYEY SILT WITH SAND** mostly silt, few to little fine to coarse sand, few to little clay, black (10YR 2/1), no odor, moist, medium stiff, high organic content, roots and grass. Change to very dark gray (10YR 3/1) at 2.5 feet.	ML-CL	Artesian well conditions present.
			3–17	**SILTY CLAY** mostly clay, some silt, few to little fine to coarse sand, light yellowish brown (10YR 6/4), moist, medium stiff. Change to brown (10YR 5/3), very stiff to hard at 7.0 feet.	CL-ML	
2 CS	100		10	Change to dark gray (10YR 4/1), hard at 11.5 feet.		
				Change to no to trace sand at 15.0 feet.		
			17–44.5	**SILTY CLAY WITH SAND** mostly clay, some silt, little fine to coarse sand, dark gray (10YR 4/1), moist, hard.	CL-ML	
3 CS	100		20			
4 CS	100		30			
5 CS	100		40			
			44.5–50	**GRAVEL AND COBBLES** large broken limestone boulders, and cobbles, saturated.	GP	
			50	End of boring at 50.0 feet below ground surface.		



Signature: [signature]

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WELL CONSTRUCTION LOG

TRC

WELL NO. MW-16-07

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
DTE EC: Monroe FAB	4/14/16	4/14/16	231828.0001.0000

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Stock Drilling	Sonic	575.41	578.40	40.0	6

Boring Location: N of fly ash basin, S of E Dunbar Road, W of main gate.
N: 143408.82 E: 13392311.01

Personnel
Logged By - Jennifer Reed
Driller - Austin Goldsmith

Drilling Equipment: TerraSonic

Civil Town/City/or Village:	County:	State:
Monroe, MI	Monroe	Michigan

Water Level Observations:
While Drilling: Date/Time Depth (ft bgs)
After Drilling: Date/Time 5/5/16 10:44 Depth (ft bgs)

SAMPLE Number and Type	Recovery (%)	Blow Counts	Depth in Feet	Lithologic Description	USCS	Comments
				TOPSOIL		
1 CS	95			**SILTY CLAY** mostly clay, some silt, few to little sand, brown (10YR 5/3) to gray (10YR 5/1), no odor, moist, medium stiff.	CL-ML	Artesian well conditions present.
2 CS	100		10	Change to dark gray (10YR 4/1) at 9.5 feet.		
			20			
3 CS	100			**SANDY SILT WITH CLAY** mostly silt, little sand, little clay, dark gray (10YR 4/1), moist, medium to very stiff. Change to little to some sand at 25.0 feet.	ML-CL	
			30	Change to gray (GLEY1 5/N), crumbly at 28.5 feet.		
4 CS	100			Change to wet at 35.0 feet.		
				LIMESTONE weathered, light gray (10YR 7/1), slight odor, wet.		
			40	Change to saturated at 39.5 feet.		
				End of boring at 40.0 feet below ground surface.		
			50			

Signature: [signature] for J Reed

Firm: TRC Environmental Corporation
1540 Eisenhower Place Ann Arbor, Michigan
734-971-7080
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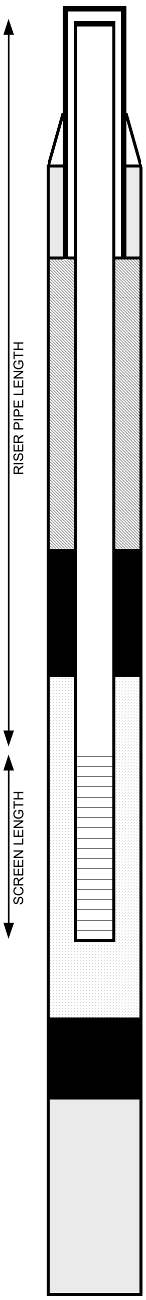
WELL CONSTRUCTION DIAGRAM

PROJ. NAME: DTE EC: MFAB CCR MW Installation		WELL ID:	**MW-16-01**
PROJ. NO: 231828.0001	DATE INSTALLED: 2/17/2016 INSTALLED BY: J. REED		CHECKED BY: C. Scieszka

ELEVATION (BENCHMARK: USGS)	DEPTH BELOW OR ABOVE GROUND SURFACE (FEET)
581.74	2.8 TOP OF CASING
578.91	0.0 GROUND SURFACE
	1.0 CEMENT SURFACE PLUG
	GROUT/BACKFILL MATERIAL: GROUT SLURRY
50.8 (RISER PIPE LENGTH)	GROUT/BACKFILL METHOD: TREMIE
	39.5 GROUT
	BENTONITE SEAL MATERIAL: PELLETS
	44.0 BENTONITE SEAL
530.9	48.0 TOP OF SCREEN
5.0 (SCREEN LENGTH)	FILTER PACK MATERIAL: MEDIUM, WASHED SAND
525.9	53.0 BOTTOM OF SCREEN
	53.0 BOTTOM OF FILTER PACK
	NA BENTONITE PLUG
	BACKFILL MATERIAL: WASHED SAND
523.91	55.0 HOLE BOTTOM



NOTES:

CASING AND SCREEN DETAILS

TYPE OF RISER: 2-INCH PVC

PIPE SCHEDULE: 40

PIPE JOINTS: THREADED O-RINGS

SCREEN TYPE: 2-INCH PVC

SCR. SLOT SIZE: 0.01-INCH

BOREHOLE DIAMETER: 6 IN. FROM 0 TO 55 FT.
____ IN. FROM ____ TO ____ FT.

SURF. CASING DIAMETER: ____ IN. FROM ____ TO ____ FT.
____ IN. FROM ____ TO ____ FT.

WELL DEVELOPMENT

DEVELOPMENT METHOD: SURGE AND PUMP

TIME DEVELOPING: 50 MINUTES

WATER REMOVED: 100 GALLONS

WATER ADDED: 0 GALLONS

WATER CLARITY BEFORE / AFTER DEVELOPMENT

CLARITY BEFORE: VERY TURBID

COLOR BEFORE: DARK GRAY

CLARITY AFTER: CLEAR

COLOR AFTER: NONE

ODOR (IF PRESENT): NONE

WATER LEVEL SUMMARY

MEASUREMENT (FEET)			DATE	TIME
DTB BEFORE DEVELOPING:	--	T/PVC	--	--
DTB AFTER DEVELOPING:	57.30	T/PVC	2/19/2016	11:00
SWL BEFORE DEVELOPING:	4.69	T/PVC	2/19/2016	10:00
SWL AFTER DEVELOPING:	4.80	T/PVC	3/17/2016	8:45
OTHER SWL:		T/PVC		
OTHER SWL:		T/PVC		

PROTECTIVE CASING DETAILS

PERMANENT, LEGIBLE WELL LABEL ADDED? ☑ YES ☐ NO

PROTECTIVE COVER AND LOCK INSTALLED? ☑ YES ☐ NO

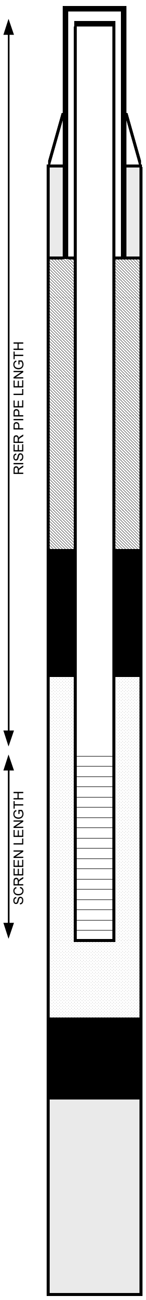
LOCK KEY NUMBER: 3120

REVISED 11/2013

WELL CONSTRUCTION DIAGRAM

PROJ. NAME: DTE EC: MFAB CCR MW Installation		WELL ID:	MW-16-02
PROJ. NO: 231828.0001	DATE INSTALLED: 2/18/2016 INSTALLED BY: J. REED		CHECKED BY: C. Scieszka

ELEVATION (BENCHMARK: USGS)	DEPTH BELOW OR ABOVE GROUND SURFACE (FEET)
581.81	2.4 TOP OF CASING
579.44	0.0 GROUND SURFACE
	1.0 CEMENT SURFACE PLUG
	GROUT/BACKFILL MATERIAL: CEMENT/GROUT SLURRY
	GROUT/BACKFILL METHOD: TREMIE
55.4 (RISER PIPE LENGTH)	
	40.0 GROUT
	BENTONITE SEAL MATERIAL: PELLETS
	44.0 BENTONITE SEAL
526.4	53.0 TOP OF SCREEN
	FILTER PACK MATERIAL: MEDIUM, WASHED SAND
5.0 (SCREEN LENGTH)	
521.4	58.0 BOTTOM OF SCREEN
	60.0 BOTTOM OF FILTER PACK
	NA BENTONITE PLUG
	BACKFILL MATERIAL: WASHED SAND
519.44	60.0 HOLE BOTTOM



NOTES:
ARTESIAN MONITORING WELL

CASING AND SCREEN DETAILS

TYPE OF RISER: 2-INCH PVC

PIPE SCHEDULE: 40

PIPE JOINTS: THREADED O-RINGS

SCREEN TYPE: 2-INCH PVC

SCR. SLOT SIZE: 0.01-INCH

BOREHOLE DIAMETER: 6 IN. FROM 0 TO 60 FT.
___ IN. FROM ___ TO ___ FT.

SURF. CASING DIAMETER: ___ IN. FROM ___ TO ___ FT.
___ IN. FROM ___ TO ___ FT.

WELL DEVELOPMENT

DEVELOPMENT METHOD: ARTESIAN WELL

TIME DEVELOPING: 24 HOURS

WATER REMOVED: 2,880 GALLONS

WATER ADDED: 0 GALLONS

WATER CLARITY BEFORE / AFTER DEVELOPMENT

CLARITY BEFORE: SLIGHTLY CLOUDY TO CLOUDY

COLOR BEFORE: LIGHT GRAY

CLARITY AFTER: CLEAR

COLOR AFTER: NONE

ODOR (IF PRESENT): NONE

WATER LEVEL SUMMARY

MEASUREMENT (FEET)			DATE	TIME
DTB BEFORE DEVELOPING:	--	T/PVC	--	--
DTB AFTER DEVELOPING:	61.03	T/PVC	3/17/2016	9:30
SWL BEFORE DEVELOPING:	--	T/PVC	--	--
SWL AFTER DEVELOPING:	2.42	ATOC	3/17/2016	9:30
OTHER SWL:		T/PVC		
OTHER SWL:		T/PVC		

PROTECTIVE CASING DETAILS

PERMANENT, LEGIBLE WELL LABEL ADDED? ☑ YES ☐ NO

PROTECTIVE COVER AND LOCK INSTALLED? ☑ YES ☐ NO

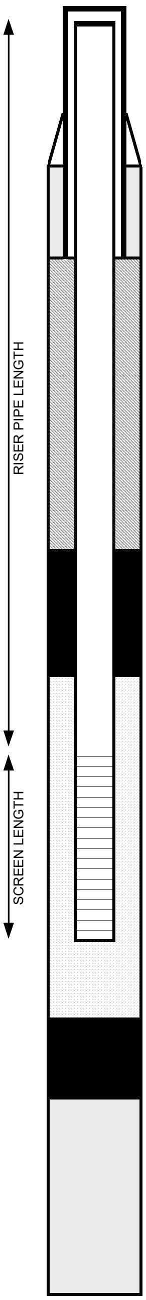
LOCK KEY NUMBER: 3120

REVISED 11/2013

WELL CONSTRUCTION DIAGRAM

PROJ. NAME:	DTE EC: MFAB CCR MW Installation		WELL ID:	MW-16-03
PROJ. NO:	231828.0001	DATE INSTALLED: 2/16/2016	INSTALLED BY: J. REED	CHECKED BY: C. Scieszka

ELEVATION (BENCHMARK: USGS)	DEPTH BELOW OR ABOVE GROUND SURFACE (FEET)
579.95	2.7 TOP OF CASING
577.29	0.0 GROUND SURFACE
	1.0 CEMENT SURFACE PLUG
	GROUT/BACKFILL MATERIAL: CEMENT/GROUT SLURRY
39.7	GROUT/BACKFILL METHOD: TREMIE
	28.0 GROUT
	BENTONITE SEAL MATERIAL: PELLETS
	32.0 BENTONITE SEAL
540.3	37.0 TOP OF SCREEN
5.0	FILTER PACK MATERIAL: PEA STONE
535.3	42.0 BOTTOM OF SCREEN
	50.0 BOTTOM OF FILTER PACK
	NA BENTONITE PLUG
	BACKFILL MATERIAL: WASHED SAND
527.29	50.0 HOLE BOTTOM



NOTES:
ARTESIAN MONITORING WELL

CASING AND SCREEN DETAILS

TYPE OF RISER: 2-INCH PVC

PIPE SCHEDULE: 40

PIPE JOINTS: THREADED O-RINGS

SCREEN TYPE: 2-INCH PVC

SCR. SLOT SIZE: 0.01-INCH

BOREHOLE DIAMETER: 6 IN. FROM 0 TO 50 FT.
IN. FROM ___ TO ___ FT.

SURF. CASING DIAMETER: ___ IN. FROM ___ TO ___ FT.
___ IN. FROM ___ TO ___ FT.

WELL DEVELOPMENT

DEVELOPMENT METHOD: ARTESIAN WELL

TIME DEVELOPING: 16 HOURS

WATER REMOVED: 7,200 GALLONS

WATER ADDED: 0 GALLONS

WATER CLARITY BEFORE / AFTER DEVELOPMENT

CLARITY BEFORE: VERY TURBID

COLOR BEFORE: DARK GRAY

CLARITY AFTER: CLEAR

COLOR AFTER: NONE

ODOR (IF PRESENT): SULFUR

WATER LEVEL SUMMARY

MEASUREMENT (FEET)			DATE	TIME
DTB BEFORE DEVELOPING:	--	T/PVC	--	--
DTB AFTER DEVELOPING:	44.65	T/PVC	3/17/2016	9:25
SWL BEFORE DEVELOPING:	--	T/PVC	--	--
SWL AFTER DEVELOPING:	11.20	ATOC	3/17/2016	9:25
OTHER SWL:		T/PVC		
OTHER SWL:		T/PVC		

PROTECTIVE CASING DETAILS

PERMANENT, LEGIBLE WELL LABEL ADDED? ☑ YES ☐ NO

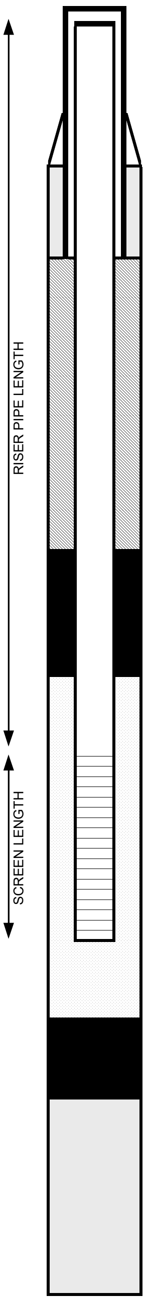
PROTECTIVE COVER AND LOCK INSTALLED? ☑ YES ☐ NO

LOCK KEY NUMBER: 3120

WELL CONSTRUCTION DIAGRAM

PROJ. NAME:	DTE EC: MFAB CCR MW Installation		WELL ID:	MW-16-04
PROJ. NO:	231828.0001	DATE INSTALLED: 2/15/2016	INSTALLED BY: C. Scieszka	CHECKED BY: C. Scieszka

ELEVATION (BENCHMARK: USGS)	DEPTH BELOW OR ABOVE GROUND SURFACE (FEET)	
585.54	2.9	TOP OF CASING
582.64	0.0	GROUND SURFACE
	1.0	CEMENT SURFACE PLUG
		GROUT/BACKFILL MATERIAL: CEMENT/GROUT SLURRY
		GROUT/BACKFILL METHOD: TREMIE
43.9 (RISER PIPE LENGTH)		
	32.0	GROUT
		BENTONITE SEAL MATERIAL: PELLETS
	36.0	BENTONITE SEAL
541.6	41.0	TOP OF SCREEN
5.0 (SCREEN LENGTH)		FILTER PACK MATERIAL: PEA STONE
536.6	46.0	BOTTOM OF SCREEN
	50.0	BOTTOM OF FILTER PACK
	NA	BENTONITE PLUG
		BACKFILL MATERIAL: WASHED SAND
532.64	50.0	HOLE BOTTOM



NOTES:
ARTESIAN MONITORING WELL

CASING AND SCREEN DETAILS

TYPE OF RISER: 2-INCH PVC

PIPE SCHEDULE: 40

PIPE JOINTS: THREADED O-RINGS

SCREEN TYPE: 2-INCH PVC

SCR. SLOT SIZE: 0.01-INCH

BOREHOLE DIAMETER: 6 IN. FROM 0 TO 50 FT.
____ IN. FROM ____ TO ____ FT.

SURF. CASING DIAMETER: ____ IN. FROM ____ TO ____ FT.
____ IN. FROM ____ TO ____ FT.

WELL DEVELOPMENT

DEVELOPMENT METHOD: ARTESIAN WELL

TIME DEVELOPING: 16 HOURS

WATER REMOVED: 28,900 GALLONS

WATER ADDED: 0 GALLONS

WATER CLARITY BEFORE / AFTER DEVELOPMENT

CLARITY BEFORE: VERY TURBID

COLOR BEFORE: DARK GRAY

CLARITY AFTER: CLEAR

COLOR AFTER: NONE

ODOR (IF PRESENT): SULFUR

WATER LEVEL SUMMARY

MEASUREMENT (FEET)			DATE	TIME
DTB BEFORE DEVELOPING:	--	T/PVC	--	--
DTB AFTER DEVELOPING:	49.45	T/PVC	3/17/2016	10:15
SWL BEFORE DEVELOPING:	--	T/PVC	--	--
SWL AFTER DEVELOPING:	16.50	ATOC	3/17/2016	10:15
OTHER SWL:		T/PVC		
OTHER SWL:		T/PVC		

PROTECTIVE CASING DETAILS

PERMANENT, LEGIBLE WELL LABEL ADDED? ☑ YES ☐ NO

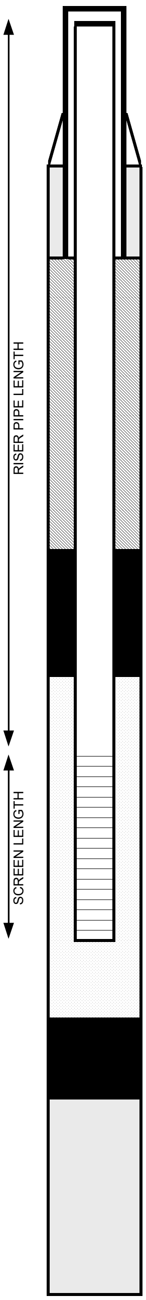
PROTECTIVE COVER AND LOCK INSTALLED? ☑ YES ☐ NO

LOCK KEY NUMBER: 3120

REVISED 11/2013

WELL CONSTRUCTION DIAGRAM

PROJ. NAME:	DTE EC: MFAB CCR MW Installation		WELL ID:	MW-16-05
PROJ. NO:	231828.0001	DATE INSTALLED: 4/13/2016 INSTALLED BY: J. REED		CHECKED BY: C. Scieszka



ELEVATION (BENCHMARK: USGS)	DEPTH BELOW OR ABOVE GROUND SURFACE (FEET)	
583.25	2.7	TOP OF CASING
580.51	0.0	GROUND SURFACE
	1.0	CEMENT SURFACE PLUG
		GROUT/BACKFILL MATERIAL: CEMENT/GROUT SLURRY
		GROUT/BACKFILL METHOD: TREMIE
42.7 (RISER PIPE LENGTH)		
	33.0	GROUT
		BENTONITE SEAL MATERIAL: PELLETS
	35.0	BENTONITE SEAL
540.5	40.0	TOP OF SCREEN
5.0 (SCREEN LENGTH)		FILTER PACK MATERIAL: PEA STONE
535.5	45.0	BOTTOM OF SCREEN
	45.0	BOTTOM OF FILTER PACK
	NA	BENTONITE PLUG
		BACKFILL MATERIAL: PEA STONE
530.51	50.0	HOLE BOTTOM

NOTES:

CASING AND SCREEN DETAILS

TYPE OF RISER: 2-INCH PVC

PIPE SCHEDULE: 40

PIPE JOINTS: THREADED O-RINGS

SCREEN TYPE: 2-INCH PVC

SCR. SLOT SIZE: 0.01-INCH

BOREHOLE DIAMETER: 6 IN. FROM 0 TO 50 FT.
___ IN. FROM ___ TO ___ FT.

SURF. CASING DIAMETER: ___ IN. FROM ___ TO ___ FT.
___ IN. FROM ___ TO ___ FT.

WELL DEVELOPMENT

DEVELOPMENT METHOD: ARTESIAN WELL

TIME DEVELOPING: 12 HOURS

WATER REMOVED: 120 GALLONS

WATER ADDED: 0 GALLONS

WATER CLARITY BEFORE / AFTER DEVELOPMENT

CLARITY BEFORE: SLIGHTLY CLOUDY

COLOR BEFORE: VERY LIGHT GRAY

CLARITY AFTER: CLEAR

COLOR AFTER: NONE

ODOR (IF PRESENT): VERY SLIGHT TO NONE SULFUR

WATER LEVEL SUMMARY

MEASUREMENT (FEET)			DATE	TIME
DTB BEFORE DEVELOPING:	--	T/PVC	--	--
DTB AFTER DEVELOPING:	--	T/PVC	--	--
SWL BEFORE DEVELOPING:	--	T/PVC	--	--
SWL AFTER DEVELOPING:	14.00	ATOC	5/5/2016	12:47
OTHER SWL:		T/PVC		
OTHER SWL:		T/PVC		

PROTECTIVE CASING DETAILS

PERMANENT, LEGIBLE WELL LABEL ADDED? ☑ YES ☐ NO

PROTECTIVE COVER AND LOCK INSTALLED? ☑ YES ☐ NO

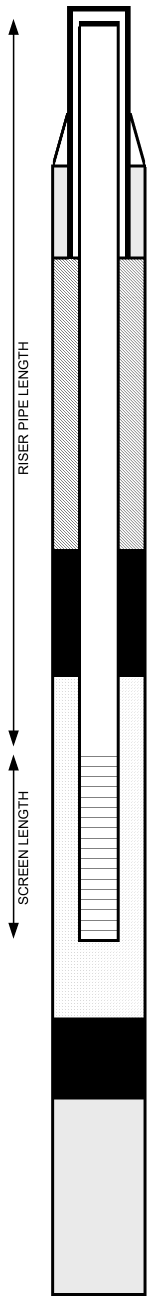
LOCK KEY NUMBER: 3120

REVISED 11/2013

WELL CONSTRUCTION DIAGRAM

PROJ. NAME: DTE EC: MFAB CCR MW Installation		WELL ID:	MW-16-06
PROJ. NO: 231828.0001	DATE INSTALLED: 4/13/2016 INSTALLED BY: J. REED	CHECKED BY: C. Scieszka	

ELEVATION (BENCHMARK: USGS)	DEPTH BELOW OR ABOVE GROUND SURFACE (FEET)	
581.94	2.7	TOP OF CASING
579.20	0.0	GROUND SURFACE
	1.0	CEMENT SURFACE PLUG
		GROUT/BACKFILL MATERIAL: CEMENT/GROUT SLURRY
47.7 (RISER PIPE LENGTH)		GROUT/BACKFILL METHOD: TREMIE
	38.0	GROUT
		BENTONITE SEAL MATERIAL: PELLETS
	40.0	BENTONITE SEAL
534.20	45.0	TOP OF SCREEN
5.0 (SCREEN LENGTH)		FILTER PACK MATERIAL: PEA STONE
529.20	50.0	BOTTOM OF SCREEN
	50.0	BOTTOM OF FILTER PACK
	NA	BENTONITE PLUG
		BACKFILL MATERIAL: NA
529.20	50.0	HOLE BOTTOM



NOTES:

CASING AND SCREEN DETAILS

TYPE OF RISER: 2-INCH PVC

PIPE SCHEDULE: 40

PIPE JOINTS: THREADED O-RINGS

SCREEN TYPE: 2-INCH PVC

SCR. SLOT SIZE: 0.01-INCH

BOREHOLE DIAMETER: 6 IN. FROM 0 TO 50 FT.
IN. FROM ___ TO ___ FT.

SURF. CASING DIAMETER: ___ IN. FROM ___ TO ___ FT.
___ IN. FROM ___ TO ___ FT.

WELL DEVELOPMENT

DEVELOPMENT METHOD: ARTESIAN WELL

TIME DEVELOPING: 24 HOURS

WATER REMOVED: 240-250 GALLONS

WATER ADDED: 0 GALLONS

WATER CLARITY BEFORE / AFTER DEVELOPMENT

CLARITY BEFORE: SLIGHTLY CLOUDY

COLOR BEFORE: SLIGHTLY LIGHT GRAY

CLARITY AFTER: CLEAR

COLOR AFTER: NONE

ODOR (IF PRESENT): NONE

WATER LEVEL SUMMARY

MEASUREMENT (FEET)			DATE	TIME
DTB BEFORE DEVELOPING:	--	T/PVC	--	--
DTB AFTER DEVELOPING:	--	T/PVC	--	--
SWL BEFORE DEVELOPING:	--	T/PVC	--	--
SWL AFTER DEVELOPING:	0.75	ATOC	5/5/2016	9:30
OTHER SWL:		T/PVC		
OTHER SWL:		T/PVC		

PROTECTIVE CASING DETAILS

PERMANENT, LEGIBLE WELL LABEL ADDED? ☑ YES ☐ NO

PROTECTIVE COVER AND LOCK INSTALLED? ☑ YES ☐ NO

LOCK KEY NUMBER: 3120

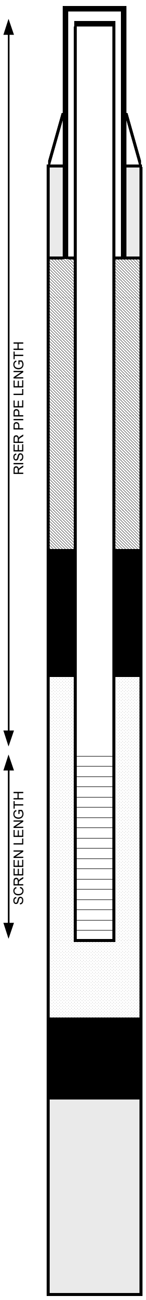
REVISED 11/2013

WELL CONSTRUCTION DIAGRAM

TRC

PROJ. NAME:	DTE EC: MFAB CCR MW Installation	WELL ID:	**MW-16-07**
PROJ. NO: 231828.0001	DATE INSTALLED: 4/14/2016	INSTALLED BY: J. REED	CHECKED BY: C. Scieszka

ELEVATION (BENCHMARK: USGS)	DEPTH BELOW OR ABOVE GROUND SURFACE (FEET)
578.40	3.0 TOP OF CASING
575.41	0.0 GROUND SURFACE
	1.0 CEMENT SURFACE PLUG
	GROUT/BACKFILL MATERIAL: CEMENT/GROUT SLURRY
38.0 (RISER PIPE LENGTH)	GROUT/BACKFILL METHOD: TREMIE
	27.0 GROUT
	BENTONITE SEAL MATERIAL: PELLETS
	30.0 BENTONITE SEAL
540.4	35.0 TOP OF SCREEN
5.0 (SCREEN LENGTH)	FILTER PACK MATERIAL: PEA STONE
535.4	40.0 BOTTOM OF SCREEN
	40.0 BOTTOM OF FILTER PACK
	NA BENTONITE PLUG
	BACKFILL MATERIAL: NA
535.41	40.0 HOLE BOTTOM



NOTES:

CASING AND SCREEN DETAILS

TYPE OF RISER: 2-INCH PVC

PIPE SCHEDULE: 40

PIPE JOINTS: THREADED O-RINGS

SCREEN TYPE: 2-INCH PVC

SCR. SLOT SIZE: 0.01-INCH

BOREHOLE DIAMETER: 6 IN. FROM 0 TO 40 FT.
___ IN. FROM ___ TO ___ FT.

SURF. CASING DIAMETER: ___ IN. FROM ___ TO ___ FT.
___ IN. FROM ___ TO ___ FT.

WELL DEVELOPMENT

DEVELOPMENT METHOD: ARTESIAN WELL

TIME DEVELOPING: 24 HOURS

WATER REMOVED: 240 GALLONS

WATER ADDED: 0 GALLONS

WATER CLARITY BEFORE / AFTER DEVELOPMENT

CLARITY BEFORE: SLIGHTLY CLOUDY

COLOR BEFORE: SLIGHTLY LIGHT GRAY

CLARITY AFTER: CLEAR

COLOR AFTER: NONE

ODOR (IF PRESENT): NONE

WATER LEVEL SUMMARY

MEASUREMENT (FEET)			DATE	TIME
DTB BEFORE DEVELOPING:	--	T/PVC	--	--
DTB AFTER DEVELOPING:	--	T/PVC	--	--
SWL BEFORE DEVELOPING:	--	T/PVC	--	--
SWL AFTER DEVELOPING:	8.80	ATOC	5/5/2016	10:44
OTHER SWL:	.	T/PVC		
OTHER SWL:		T/PVC		

PROTECTIVE CASING DETAILS

PERMANENT, LEGIBLE WELL LABEL ADDED? ☑ YES ☐ NO

PROTECTIVE COVER AND LOCK INSTALLED? ☑ YES ☐ NO

LOCK KEY NUMBER: 3120

REVISED 11/2013

Appendix C
2019 Annual Groundwater Monitoring Report

2019 Annual Groundwater Monitoring Report

DTE Electric Company
Monroe Power Plant Fly Ash Basin and Vertical Extension Landfill
Coal Combustion Residual Unit

January 2020

2019 Annual Groundwater Monitoring Report

DTE Electric Company
Monroe Power Plant Fly Ash Basin and Vertical Extension Landfill
Coal Combustion Residual Unit

7955 East Dunbar Road
Monroe, Michigan

January 2020

Prepared For
DTE Electric Company

Graham Crockford, C.P.G.
Senior Project Geologist

David B. McKenzie, P.E.
Senior Project Engineer

TRC | DTE Electric Company
Final
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Table of Contents

List of Tables

List of Figures

List of Appendices

Executive Summary

On April 17, 2015, the United States Environmental Protection Agency (USEPA) published the final rule for the regulation and management of Coal Combustion Residuals (CCR) under the Resource Conservation and Recovery Act (RCRA) (the CCR Rule), as amended July 30, 2018. The CCR Rule, which became effective on October 19, 2015 (amendment effective August 29, 2018), applies to the DTE Electric Company (DTE Electric) Monroe Power Plant (MONPP) Coal Combustion Residual Fly Ash Basin and Vertical Extension Landfill (FAB & VEL) CCR unit. Pursuant to the CCR Rule, no later than January 31, 2018, and annually thereafter, the owner or operator of a CCR unit must prepare an annual groundwater monitoring and corrective action report for the CCR unit documenting the status of groundwater monitoring and corrective action for the preceding year in accordance with §257.90(e). On behalf of DTE Electric, TRC Engineers Michigan, Inc., the engineering entity of TRC Environmental Corporation (TRC), has prepared this Annual Groundwater Monitoring Report for calendar year 2019 activities at the MONPP FAB & VEL CCR unit.

The semiannual detection monitoring events for 2019 were completed in March and September 2019 and included sampling and analyzing groundwater within the groundwater monitoring system for the indicator parameters listed in Appendix III to the CCR Rule. As part of the statistical evaluation, the data collected during detection monitoring events are evaluated to identify statistically significant increases (SSIs) in detection monitoring parameters to determine if concentrations in detection monitoring well samples exceed background levels. Detection monitoring data that has been collected and evaluated in 2019 are presented in this report.

SSIs for Appendix III constituents were confirmed for total dissolved solids (TDS) in September 2019 in one or more downgradient wells during the September 2019 monitoring event. TRC performed an alternate source demonstration (ASD) and determined the observation of TDS above background was a result of natural variability in groundwater quality and not attributable to the MONPP FAB & VEL CCR unit. Therefore, no SSIs were recorded that were not addressed by an ASD for the 2019 monitoring period and detection monitoring will be continued at the MONPP FAB & VEL CCR unit in accordance with §257.94. In addition, based on the artesian conditions, the low permeability of the underlying natural soils, and the calculated time of travel for groundwater to flow vertically from the MONPP FAB & VEL to the uppermost aquifer, it is not possible for the uppermost aquifer to have been affected by CCR from FAB & VEL operations that began in 1975. Also, due to limitations on CCR Rule implementation timelines, the background data sets are of relatively short duration for capturing the occurrence of natural temporal changes in the aquifer.

Section 1
Introduction

1.1 Program Summary

On April 17, 2015, the United States Environmental Protection Agency (USEPA) published the final rule for the regulation and management of Coal Combustion Residuals (CCR) under the Resource Conservation and Recovery Act (RCRA) (the CCR Rule), as amended July 30, 2018. The CCR Rule, which became effective on October 19, 2015 (amendment effective August 29, 2018), applies to the DTE Electric Company (DTE Electric) Monroe Power Plant (MONPP) Coal Combustion Residual Fly Ash Basin and Vertical Extension Landfill (FAB & VEL) CCR unit. Pursuant to the CCR Rule, no later than January 31, 2018, and annually thereafter, the owner or operator of a CCR unit must prepare an annual groundwater monitoring and corrective action report for the CCR unit documenting the status of groundwater monitoring and corrective action for the preceding year in accordance with §257.90(e). On behalf of DTE Electric, TRC Engineers Michigan, Inc., the engineering entity of TRC Environmental Corporation (TRC), has prepared this Annual Groundwater Monitoring Report for calendar year 2019 activities at the MONPP FAB & VEL CCR unit (2019 Annual Report).

In the January 31, 2018 *Annual Groundwater Monitoring Report for the Monroe Power Plant Fly Ash Basin CCR* Unit, covering calendar year 2017 activities (2017 Annual Report), DTE Electric reported that the pH observed within groundwater at one or more downgradient wells was outside background limits. Based on the results of the resampling, the pH was within the prediction limits and no statistically significant increase (SSI) or decrease exists for pH in accordance with the Stats. Therefore, DTE Electric continued detection monitoring at the MONPP FAB & VEL CCR unit pursuant to §257.94 of the CCR Rule. No potential SSIs were noted in the 2018 semiannual detection monitoring events (TRC, January 2019).

This 2019 Annual Report presents the monitoring results and the statistical evaluation of the detection monitoring parameters (Appendix III to Part 257 of the CCR Rule) for the March and September 2019 semiannual groundwater monitoring events for the MONPP FAB & VEL CCR unit. Detection monitoring for these events continued to be performed in accordance with the *CCR Groundwater Monitoring and Quality Assurance Project Plan – DTE Electric Company Monroe Power Plant Coal Combustion Residual Fly Ash Basin* (QAPP) (TRC, August 2016; revised March 2017) and statistically evaluated per the Stats Plan. As part of the statistical evaluation, the data collected during detection monitoring events are evaluated to identify SSIs of detection monitoring parameters compared to background levels.

1.2 Site Overview

The MONPP FAB & VEL is located about one mile southwest of the MONPP in Section 16, Township 7 South, Range 9 East at 7955 East Dunbar Road, Monroe, Monroe County, Michigan (Figure 1). The MONPP FAB & VEL is bounded by Dunbar Road and Plum Creek to the north and northeast, Interstate 75 to the northwest, a 200-acre peninsula into Lake Erie to the east and southeast, Lake Erie to the south, and a large open field to the southwest (Figure 2).

The property has been used continuously for the operation of the MONPP FAB & VEL since approximately 1975 and is constructed over a natural clay-rich soil base. The MONPP FAB & VEL and landfill is a Type III solid waste disposal facility owned by DTE Electric, which currently accepts coal ash from DTE Electric's MONPP. The MONPP FAB & VEL is operated in accordance with Michigan Part 115 of the Natural Resources and Environmental Protection Act (NREPA), PA 451 of 1994, as amended, and the current operating license number 9579.

1.3 Geology/Hydrogeology

The MONPP FAB & VEL CCR unit is located within 200 feet southwest of Plum Creek and immediately north of Lake Erie. The MONPP FAB & VEL CCR unit uppermost aquifer consists of saturated limestone present beneath at least 37 feet and up to 53.5 feet of thick contiguous silty clay-rich soil that serves as a natural confining hydraulic barrier that isolates the underlying uppermost aquifer. The limestone bedrock aquifer is artesian in every location except MW-16-01, where the static water level was approximately 1 to 2 feet below ground surface (ft bgs).

Potentiometric groundwater elevation data from 2016 through 2019 suggest that there is horizontal groundwater flow potential within the upper aquifer unit generally to the northeast towards Plum Creek. The average hydraulic gradient to the northeast is on the order of 0.002 foot/foot along the eastern part of the MONPP FAB & VEL to 0.004 to 0.005 foot/foot in the center and northwestern part of the FAB & VEL, with an overall mean of 0.004 foot/foot.

The surface water elevation within the FAB & VEL raised surface impoundment is at least 5 to more than 30 feet above the potentiometric surface elevations in the uppermost aquifer limestone, and more than 60 feet above the base of the underlying clay-rich confining unit that isolates groundwater within the limestone aquifer. Therefore, flow potential from the CCR unit to the surrounding area would be radially outward from the FAB & VEL. However, there is no hydraulic communication between the uppermost aquifer and the FAB & VEL due to the continuous silty clay-rich confining unit beneath the MONPP FAB & VEL. Based on the artesian conditions, the low permeability of the underlying natural soils, and the calculated time of travel for groundwater to flow vertically from the FAB & VEL to the uppermost aquifer, it is not possible for the uppermost aquifer to have been affected by CCR from FAB & VEL operations that began in 1975.

The MONPP FAB & VEL CCR unit uses intrawell statistical methods because the saturated unit being monitored is isolated by a laterally contiguous silty clay unit which significantly impedes vertical groundwater flow thus preventing the monitored saturated zone from potentially being affected by CCR. In addition, the flow potential of liquid within the FAB & VEL is radially outward relative to the uppermost aquifer due to the elevation water is maintained within the FAB & VEL CCR unit. Based on these hydrogeologic conditions, intrawell statistical approaches are likely a more appropriate method to evaluate groundwater data statistically. Consequently, intrawell statistical tests are being used during detection monitoring as outlined in the Stats Plan.

Section 2
Groundwater Monitoring

2.1 Monitoring Well Network

A groundwater monitoring system has been established for the MONPP FAB & VEL CCR unit as detailed in the *Groundwater Monitoring System Summary Report – Monroe Power Plant Coal Combustion Residual Fly Ash Basin* (GWMS Report) (TRC, October 2017). The detection monitoring well network for the MONPP FAB & VEL CCR unit currently consists of seven monitoring wells that are screened in the uppermost aquifer. The monitoring well locations are shown on Figure 2.

As discussed in the Stats Plan, intrawell statistical methods for MONPP FAB & VEL were selected based on the geology and hydrogeology at the Site (primarily the presence of clay/hydraulic barrier and the hydraulic separation between the CCR unit and underlying uppermost aquifer), in addition to other supporting lines of evidence that the aquifer is unaffected by the CCR unit (such as the consistency in concentrations of water quality data). An intrawell statistical approach requires that each of the downgradient wells doubles as a background and compliance well, where data from each individual well during a detection monitoring event is compared to a statistical limit developed using the background dataset from that same well. Monitoring wells MW-16-01 through MW-16-07 are located around the perimeter of the MONPP FAB & VEL and provide data on both background and downgradient groundwater quality that has not been affected by the CCR unit (total of seven background/downgradient monitoring wells).

Site construction activities damaged the top of the MW-16-05 casing prior to the September 2019 semiannual monitoring event, therefore no static water level was collected during the 2019 second semiannual detection monitoring event. However, a representative groundwater sample was able to be collected in the September 2019 semiannual detection monitoring event from the artesian monitoring well MW-16-05. The well casing was subsequently repaired in late 2019 and the top of casing elevation was resurveyed.

2.2 Semiannual Groundwater Monitoring

The semiannual monitoring parameters for the detection groundwater monitoring program were selected per the CCR Rule's Appendix III to Part 257 – Constituents for Detection Monitoring. The Appendix III indicator parameters consist of boron, calcium, chloride, fluoride, pH (field reading), sulfate, and total dissolved solids (TDS) and were analyzed in accordance with the sampling and analysis plan included within the QAPP. In addition to pH, the collected field parameters included dissolved oxygen, oxidation reduction potential, specific conductivity, temperature, and turbidity.

2.2.1 Data Summary

The first semiannual groundwater detection monitoring event for 2019 was performed during March 25 to March 26, 2019 by TRC personnel and samples were analyzed by Eurofins TestAmerica in accordance with the QAPP. Static water elevation data were collected at all seven monitoring well locations. Groundwater samples were collected from the seven detection monitoring wells for the Appendix III indicator parameters and field parameters. A summary of the groundwater data collected during the March 2019 event is provided on Table 1 (static groundwater elevation data), Table 2 (field data), and Table 3 (analytical results).

The second semiannual groundwater detection monitoring event for 2019 was performed on September 23 and September 25, 2019 by TRC personnel and samples were analyzed by Eurofins TestAmerica in accordance with the QAPP. Static water elevation data were collected at all seven monitoring well locations. Groundwater samples were collected from the seven detection monitoring wells for the Appendix III indicator parameters and field parameters. A summary of the groundwater data collected during the September 2019 event is provided on Table 1 (static groundwater elevation data), Table 2 (field data), and Table 4 (analytical results).

2.2.2 Data Quality Review

Data from each round were evaluated for completeness, overall quality and usability, method-specified sample holding times, precision and accuracy, and potential sample contamination. The data were found to be complete and usable for the purposes of the CCR monitoring program. Data quality reviews are summarized in Appendix B.

2.2.3 Groundwater Flow Rate and Direction

Groundwater elevation data collected during the March and September 2019 sampling events continue to show that groundwater within the uppermost aquifer generally flows to the northeast across the Site. Groundwater potentiometric surface elevations measured across the Site during the March and September 2019 sampling events are provided on Table 1 and were used to construct the groundwater potentiometric surface maps shown on Figure 3 and Figure 4, respectively.

The groundwater flow rate and direction is consistent with previous monitoring events. The average groundwater hydraulic gradient throughout the Site during both 2019 monitoring events is approximately 0.004 ft/ft with an average seepage velocity of 0.2

ft/day (70 ft/year), using the average hydraulic conductivity of 5 ft/day (TRC, 2017) and an assumed effective porosity of 0.1.

The general flow rate and direction from both events are similar to that identified in previous monitoring rounds and continues to demonstrate that the downgradient wells are appropriately positioned to detect the presence of Appendix III parameters that could potentially migrate from the MONPP FAB & VEL CCR unit.

Section 3
Statistical Evaluation

3.1 Establishing Background Limits

Per the Stats Plan, background limits were established for the Appendix III indicator parameters following the collection of at least eight background monitoring events using data collected from each of the seven established detection monitoring wells (MW-16-01 through MW-16-07). The statistical evaluation of the background data is presented in the 2017 Annual Report. The Appendix III background limits for each monitoring well will be used throughout the detection monitoring period to determine whether groundwater has been impacted from the MONPP FAB & VEL CCR unit by comparing concentrations in the detection monitoring wells to their respective background limits for each Appendix III indicator parameter.

3.2 Data Comparison to Background Limits – First 2019 Semiannual Event (March 2019)

The concentrations of the indicator parameters in each of the detection monitoring wells (MW-16-01 through MW-16-07) were compared to their respective statistical background limits calculated from the background data collected from each individual well (i.e., monitoring data from MW-16-01 is compared to the background limit developed using the background dataset from MW-16-01, and so forth).

The comparisons for the March 2019 detection monitoring event are presented on Table 3. The statistical evaluation of the March 2019 Appendix III indicator parameters shows all of the results are below their respective background limits and, therefore, there are no SSIs over background.

3.3 Data Comparison to Background Limits – Second 2019 Semiannual Event (September 2019)

The data comparisons for the September 2019 groundwater monitoring event are presented on Table 4. Based on the statistical evaluation of the September 2019 Appendix III indicator parameters a resample of the following was collected in accordance with the Stats Plan:

- Total Dissolved Solids at MW-16-03 and MW-16-04.

3.4 Verification Resampling for the Second 2019 Semiannual Event

Verification resampling is performed per the Stats Plan and the *USEPA's Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (Unified Guidance, USEPA, 2009) to achieve performance standards as specified by §257.93(g) in the CCR rules. Per the

Stats Plan, if there is an exceedance of a prediction limit for one or more of the parameters, the well(s) of concern will be resampled within 30 days of the completion of the initial statistical analysis. Constituents that have been addressed through an alternative source demonstration (ASD) will not be analyzed for verification purposes.

Verification resampling was conducted on November 6, 2019, by TRC personnel. Groundwater samples were collected for TDS at monitoring wells MW-16-03 and MW-16-04 in accordance with the QAPP. A summary of the groundwater data collected during the verification resampling event is provided on Table 4. The associated data quality review is included in Appendix A.

The November 2019 verification sampling confirmed the SSI for TDS at monitoring well MW-16-04. TRC reviewed the data and determined that TDS is a result of natural variability in groundwater quality and not attributable to the MONPP FAB & VEL CCR unit as presented in the *Alternate Source Demonstration: 2019 Second Semiannual Detection Monitoring Sampling Event for the Monroe Power Plant Coal Combustion Residual Fly Ash Basin and Vertical Extent Landfill, Monroe, Michigan*, dated January 30, 2020 (January 2020 ASD) (Appendix B).

The MW-16-03 TDS verification results were within the prediction limits and no SSI exists from the September 2019 event for this parameter in accordance with the Stats Plan and the Unified Guidance. As no SSIs were found that were not addressed within an ASD, detection monitoring will be continued at the MONPP FAB & VEL CCR unit in accordance with §257.94 of the CCR Rule.

Section 4
Conclusions and Recommendations

Potential SSIs over background limits were noted for one Appendix III constituent in two downgradient wells during the September 2019 monitoring event. These potential SSIs were either not statistically significant (i.e. verification resampling did not confirm the exceedance) or were addressed through an ASD that demonstrated the observed concentrations were a result of natural variability in groundwater quality and not attributable to the MONPP FAB & VEL CCR unit. Therefore, no SSIs were recorded that were not addressed by an ASD for the 2019 monitoring period and detection monitoring will be continued at the MONPP FAB & VEL in accordance with §257.94.

In addition, as discussed above, and in the GWMS Report, based on the artesian conditions, the low permeability of the underlying natural soils, and the calculated time of travel for groundwater to flow vertically from the MONPP FAB & VEL to the uppermost aquifer, it is not possible for the uppermost aquifer to have been affected by CCR from FAB & VEL operations that began in 1975. Also, due to limitations on CCR Rule implementation timelines, the background data sets are of relatively short duration for capturing the occurrence of natural temporal changes in the aquifer.

No corrective actions were performed in 2019. The next semiannual monitoring event at the MONPP FAB & VEL CCR unit is scheduled for the second calendar quarter of 2020.

Section 5
Groundwater Monitoring Report Certification

The U.S. EPA's Disposal of Coal Combustion Residuals from Electric Utilities Final Rule Title 40 CFR Part 257 §257.90(e) requires that the owner or operator of an existing CCR unit prepare an annual groundwater monitoring and corrective action report.

Annual Groundwater Monitoring Report Certification
Monroe Power Plant Fly Ash Basin and Vertical Extension Landfill
Monroe, Michigan

CERTIFICATION

I hereby certify that the annual groundwater and corrective action report presented within this document for the MONPP FAB & VEL CCR unit has been prepared to meet the requirements of Title 40 CFR §257.90(e) of the Federal CCR Rule. This document is accurate and has been prepared in accordance with good engineering practices, including the consideration of applicable industry standards, and with the requirements of Title 40 CFR §257.90(e).

Name: David B. McKenzie, P.E.	Expiration Date: October 31, 2021	State of Michigan David B. McKenzie Engineer No. 42332 Licensed Professional Engineer Stamp
Company: TRC Engineers Michigan, Inc.	Date: January 30, 2020	

Section 6
References

TRC Environmental Corporation. August 2016; Revised March 2017. CCR Groundwater Monitoring and Quality Assurance Project Plan – DTE Electric Company Monroe Power Plant Coal Combustion Residual Fly Ash Basin, 7955 East Dunbar Road, Monroe, Michigan. Prepared for DTE Electric Company.

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USEPA. April 2015. 40 CFR Parts 257 and 261. Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule. 80 Federal Register 74 (April 17, 2015), pp. 21301-21501 (80 FR 21301).

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USEPA. April 2018. Barnes Johnson (Office of Resource Conservation and Recovery) to James Roewer (c/o Edison Electric Institute) and Douglas Green, Margaret Fawal (Venable LLP). Re: Coal Combustion Residuals Rule Groundwater Monitoring Requirements. April 30, 2018. United States Environmental Protection Agency, Washington, D.C. 20460. Office of Solid Waste and Emergency Response, now the Office of Land and Emergency Management.

Tables

Table 1
Summary of Groundwater Elevation Data – March and September 2019
Monroe Power Plant FAB and VEL – RCRA CCR Monitoring Program
Monroe, Michigan

Well ID	MW-16-01		MW-16-02		MW-16-03		MW-16-04		MW-16-05		MW-16-06		MW-16-07	
Date Installed	2/17/2016		2/18/2016		2/16/2016		2/15/2016		4/13/2016		4/13/2016		4/14/2016	
TOC Elevation	581.74		581.81		579.95		585.54		583.25		581.94		578.40	
Geologic Unit of Screened Interval	Silt/Limestone Interface		Silt/Limestone Interface		Sand & Silty Clay Limestone Interface		Silty Sand and Gravel		Limestone		Gravel and Cobbles		Silt/Limestone Interface	
Screened Interval Elevation	530.9 to 525.9		526.4 to 521.4		540.3 to 535.3		541.6 to 536.6		540.5 to 535.5		534.2 to 529.2		540.4 to 535.4	
Unit	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft
Measurement Date	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation
3/25/2019	4.45	577.29	-3.20	585.01	-10.00	589.95	-15.30	600.84	-12.70	595.95	-0.90	582.84	-7.30	585.70
9/23/2019	4.74	577.00	-2.05	583.86	-10.50	590.45	-15.00	600.54	NM	--	-0.10	582.04	-6.10	584.50

Notes:

Negative depth to water measurement indicates artesian conditions, actual measured water level is above the top of casing.

Elevations are reported in feet relative to the North American Vertical Datum of 1988.

ft BTOC - feet below top of casing

NM = Not measured. The top of casing of monitoring well MW-16-05 was damaged at the time of sampling.

FAB - Fly Ash Basin.

VEL - Vertical Extension Landfill.

Table 2
Summary of Field Parameters – March and September 2019
Monroe Power Plant FAB and VEL – RCRA CCR Monitoring Program
Monroe, Michigan

Sample Location	Sample Date	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	pH (SU)	Specific Conductivity (umhos/cm)	Temperature (deg C)	Turbidity (NTU)
MW-16-01	3/26/2019	0.52	89.7	7.1	1,637	9.21	5.07
	9/23/2019	0.39	69.0	7.2	1,891	15.10	2.90
MW-16-02	3/25/2019	0.07	60.8	7.1	1,698	10.61	37.9
	9/23/2019	0.20	63.3	7.2	1,850	12.89	3.12
MW-16-03	3/25/2019	0.46	179.8	6.7	190	11.08	9.61
	9/23/2019	0.17	58.5	7.1	1,913	13.49	4.26
MW-16-04	3/25/2019	0.08	71.2	7.0	1,683	11.11	4.11
	9/23/2019	0.17	23.0	7.2	1,781	12.73	2.90
MW-16-05	3/25/2019	0.07	51.8	6.9	1,682	11.69	6.40
	9/25/2019	0.09	34.2	7.0	1,729	12.34	22.2
MW-16-06	3/25/2019	0.46	45.2	7.0	1,692	11.08	16.9
	9/23/2019	0.16	76.6	7.1	1,884	14.39	4.02
MW-16-07	3/26/2019	1.36	9.3	7.1	1,713	11.73	4.90
	9/23/2019	0.11	73.3	7.2	1,789	13.40	2.08

Notes:
mg/L - milligrams per liter.
mV - milliVolt.
SU - standard unit.
umhos/cm - micro-mhos per centimeter.
deg C - degrees celcius.
NTU - nephelometric turbidity units.
FAB - Fly Ash Basin
VEL - Vertical Extension Landfill.

Table 3
Comparison of Appendix III Parameter Results to Background Limits – March 2019
Monroe Power Plant FAB and VEL – RCRA CCR Monitoring Program
Monroe, Michigan

Sample Location:		MW-16-01		MW-16-02		MW-16-03		MW-16-04		MW-16-05		MW-16-06		MW-16-07	
Sample Date:		3/26/2019	PL	3/25/2019	PL	3/25/2019	PL	3/25/2019	PL	3/25/2019	PL	3/25/2019	PL	3/26/2019	PL
Constituent	Unit	Data		Data		Data		Data		Data		Data		Data	
Appendix III															
Boron	ug/L	270	310	420	470	460	510	170	210	230	280	350	400	210	280
Calcium	ug/L	390,000	450,000	400,000	430,000	400,000	490,000	510,000	610,000	400,000	440,000	400,000	420,000	400,000	440,000
Chloride	mg/L	10	14	13	15	18	20	33	39	11	12	12	12	7.8	13
Fluoride	mg/L	1.7	2.1	1.5	1.8	1.5	1.8	0.95	1.1	1.5	1.7	1.5	1.8	1.5	1.8
pH, Field	SU	7.1	6.3 - 9.0	7.1	6.9 - 7.3	6.7	6.7 - 7.3	7.0	7.0 - 7.5	6.9	6.6 - 7.7	7.0	7.0 - 7.3	7.1	6.9 - 7.4
Sulfate	mg/L	1,400	1,500	1,500	1,700	1,600	1,700	1,400	1,500	1,500	1,600	1,500	1,600	1,400	1,600
Total Dissolved Solids	mg/L	2,200	2,200	2,200	2,300	2,200	2,300	2,100	2,200	2,200	2,200	2,100	2,300	2,100	2,200

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
All metals were analyzed as total unless otherwise specified.
Bold font indicates an exceedance of the Prediction Limit (PL).
FAB - Fly Ash Basin.
VEL - Vertical Extension Landfill.

Table 4
Comparison of Appendix III Parameter Results to Background Limits – September 2019 and November 2019
Monroe Power Plant FAB and VEL – RCRA CCR Monitoring Program
Monroe, Michigan

Sample Location:		MW-16-01		MW-16-02		MW-16-03			MW-16-04			MW-16-05		MW-16-06		MW-16-07	
Sample Date:		9/23/2019	PL	9/23/2019	PL	9/23/2019	11/6/2019	PL	9/23/2019	11/6/2019[1]	PL	9/25/2019	PL	9/23/2019	PL	9/23/2019	PL
Constituent	Unit	Data		Data		Data			Data			Data		Data		Data	
Appendix III																	
Boron	ug/L	250	310	380	470	440	--	510	160	--	210	220	280	310	400	190	280
Calcium	ug/L	400,000	450,000	380,000	430,000	410,000	--	490,000	520,000	--	610,000	370,000	440,000	380,000	420,000	390,000	440,000
Chloride	mg/L	9.9	14	13	15	18	--	20	32	--	39	11	12	11	12	7.5	13
Fluoride	mg/L	1.7	2.1	1.5	1.8	1.5	--	1.8	0.95	--	1.1	1.4	1.7	1.5	1.8	1.4	1.8
pH, Field	SU	7.2	6.3 - 9.0	7.2	6.9 - 7.3	7.1	7.2	6.7 - 7.3	7.2	7.2	7.0 - 7.5	7.0	6.6 - 7.7	7.1	7.0 - 7.3	7.2	6.9 - 7.4
Sulfate	mg/L	1,500	1,500	1,600	1,700	1,600	--	1,700	1,400	--	1,500	1,400	1,600	1,500	1,600	1,500	1,600
Total Dissolved Solids	mg/L	2,200	2,200	2,200	2,300	**2,500**	2,300	2,300	**2,300**	**2,300[2]**	2,200	2,100	2,200	2,300	2,300	2,100	2,200

Notes:

ug/L - micrograms per liter.

mg/L - milligrams per liter.

SU - standard units; pH is a field parameter.

-- - not analyzed.

FAB - Fly Ash Basin.

VEL - Vertical Extension Landfill.

All metals were analyzed as total unless otherwise specified.

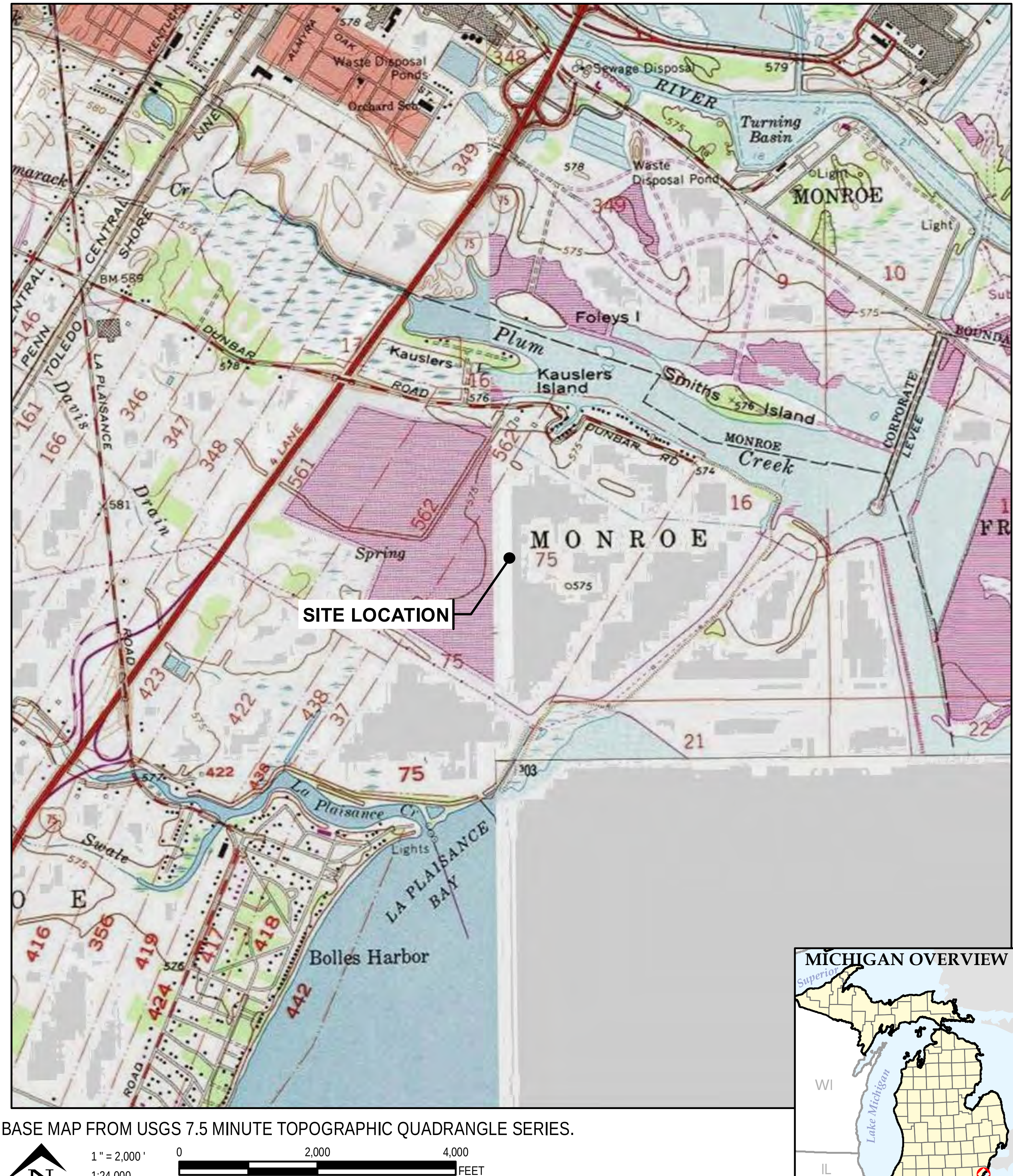
Bold font indicates an exceedance of the Prediction Limit (PL).

RESULT Shading and bold font indicates a confirmed exceedance of the Prediction Limit (PL).

(1) - Results shown for verification sampling performed on 11/6/2019.

(2) - New successful alternative source demonstration was completed following confirmation of the intial statistically significant exceedance.

Figures



BASE MAP FROM USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE SERIES.

N

1 " = 2,000 '
1:24,000

0 2,000 4,000 FEET

TRC 1540 Eisenhower Place Ann Arbor, MI 48108-3284 Phone: 734.971.7080 www.trccompanies.com TRC - GIS	PROJECT: DTE ELECTRIC COMPANY MONROE POWER PLANT FLY ASH BASIN AND VERTICAL EXTENSION LANDFILL 7955 EAST DUNBAR ROAD MONROE, MICHIGAN	DRAWN BY: S.MAJOR CHECKED BY: B. YELEN APPROVED BY: V. BUENING DATE: JANUARY 2020 PROJ. NO.: 320511.0001 FILE: 320511-0001-008SLM-MPP-Fig01.mxd
	TITLE: SITE LOCATION MAP	FIGURE 1

E:\DTE\CCR_Sites\2017_265996\320511-0001-008SLM-MPP-Fig01.mxd -- Saved By: MVAPHIADIS on 1/28/2020, 11:58:35 AM

LEGEND

- MONITORING WELLS
- APPROXIMATE BOUNDARY OF FLY ASH
- APPROXIMATE BOUNDARY OF VERTICAL EXTENSION LANDFILL

NOTES

1. BASE MAP IMAGERY FROM GOOGLE EARTH PRO, 2018.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT: **DTE ELECTRIC COMPANY**
MONROE POWER PLANT
FLY ASH BASIN AND VERTICAL EXTENSION LANDFILL
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE: **MONITORING NETWORK AND SITE PLAN**

DRAWN BY:	M. VAPHIADIS	PROJ NO.:	320511.0001
CHECKED BY:	J. KRENZ		**FIGURE 2**
APPROVED BY:	V. BUENING		
DATE:	JANUARY 2020		

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FILE NO.: 320511-0001-017-MPP-Fig02.mxd

TRC - GIS

Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

Plot Date: 1/28/2020, 11:41:53 AM by MVAPHIADIS -- LAYOUT: ANSI B(11"x17")
Path: E:\DTE\CCR_Sites\2017_265996\320511-0001-017-MPP-Fig02.mxd

LEGEND

MONITORING WELL

APPROXIMATE BOUNDARY OF FLY ASH BASIN

APPROXIMATE BOUNDARY OF VERTICAL EXTENSION LANDFILL

POTENTIOMETRIC SURFACE CONTOUR LINE (5-FT INTERVAL,DASHED WHERE INFERRED)

(582.84) STATIC WATER ELEVATION IN FEET (NAVD, 1988)

NOTES

1. BASE MAP IMAGERY FROM GOOGLE & PARTNERS GOOGLE EARTH PRO, 04/2018.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.
3. GROUNDWATER ELEVATIONS DISPLAYED IN FEET RELATIVE TO NORTH AMERICAN VERTICAL DATUM OF 1988

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:

DTE ELECTRIC COMPANY
MONROE POWER PLANT
FLY ASH BASIN AND VERTICAL EXTENSION LANDFILL
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:

POTENTIOMETRIC SURFACE MAP
MARCH 2019

DRAWN BY:	M. VAPHIADIS	PROJ NO.:	320511.0001
CHECKED BY:	J. KRENZ	**FIGURE 3**	
APPROVED BY:	V. BUENING		
DATE:	JANUARY 2020		

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FILE NO.: 320511-0001-018-MPP-Fig03.mxd

TRC - GIS

Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

Plot Date: 1/28/2020, 11:49:05 AM by MVAPHIADIS -- LAYOUT: ANSI B(11"x17")
Path: E:\DTE\CCR_Sites\2017_265996\320511-0001-018-MPP-Fig03.mxd

LEGEND

- MONITORING WELL
- APPROXIMATE BOUNDARY OF FLY ASH BASIN
- APPROXIMATE BOUNDARY OF VERTICAL EXTENSION LANDFILL
- POTENTIOMETRIC SURFACE CONTOUR LINE (5-FT INTERVAL,DASHED WHERE INFERRED)
- *(582.69)* STATIC WATER ELEVATION IN FEET (NAVD, 1988)

NOTES

1. BASE MAP IMAGERY FROM GOOGLE EARTH PRO, 2018.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.
3. GROUNDWATER ELEVATIONS DISPLAYED IN FEET RELATIVE TO NORTH AMERICAN VERTICAL DATUM OF 1988.
4. NM = NOT MEASURED; MW-16-05 WAS DAMAGED AT THE TIME OF SAMPLING.

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:

DTE ELECTRIC COMPANY
MONROE POWER PLANT
FLY ASH BASIN AND VERTICAL EXTENSION LANDFILL
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:

POTENTIOMETRIC SURFACE MAP
SEPTEMBER 2019

DRAWN BY:	M. VAPHIADIS	PROJ NO.:	320511.0001
CHECKED BY:	J. KRENZ		
APPROVED BY:	V. BUENING		**FIGURE 4**
DATE:	JANUARY 2020		

TRC

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FILE NO.: 320511-0001-019-MPP-Fig04.mxd

TRC - GIS

Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

Plot Date: 1/28/2020, 11:54:08 AM by MVAPHIADIS -- LAYOUT: ANSI B(11"x17")
Path: E:\DTE\CCR_Sites\2017_265996\320511-0001-019-MPP-Fig04.mxd

Appendix A
Alternate Source Demonstration

1540 Eisenhower Pl.
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TRCcompanies.com

Technical Memorandum

Date: January 30, 2020

To: Christopher P. Scieszka
DTE Electric Company

From: Graham Crockford, TRC
David McKenzie, TRC

Project No.: 320511.0001.0000 Phase 001, Task 001

Subject: Alternate Source Demonstration: 2019 Second Semiannual Detection Monitoring Sampling Event Monroe Power Plant Coal Combustion Residual Fly Ash Basin and Vertical Extension Landfill, Monroe, Michigan

---

Introduction

On April 17, 2015, the United States Environmental Protection Agency (USEPA) published the final rule for the regulation and management of Coal Combustion Residuals (CCR) under the Resource Conservation and Recovery Act (RCRA) (the CCR Rule). The CCR Rule, which became effective on October 19, 2015, applies to the DTE Electric Company (DTE Electric) Monroe Power Plant (MONPP) Coal Combustion Residual Fly Ash Basin and Vertical Extent Landfill (FAB & VEL) CCR unit.

TRC Engineers Michigan, Inc. (TRC) conducted the second semiannual 2019 detection groundwater monitoring event for the MONPP FAB & VEL CCR unit on behalf of DTE Electric on September 23 and 25, 2019 in accordance with the *CCR Groundwater Monitoring and Quality Assurance Project Plan – DTE Electric Company Monroe Power Plant Fly Ash Basin* (QAPP) (TRC, August 2016; revised March 2017). . The semiannual groundwater monitoring event included the statistical evaluation of the detection monitoring parameters (Appendix III to Part 257 of the CCR Rule) for the MONPP FAB & VEL CCR unit. This event was the fifth detection monitoring event performed to comply with §257.94. As part of the statistical evaluation, the data collected during detection monitoring events are evaluated to identify statistically significant increases (SSIs) in detection monitoring parameters to determine if concentrations in detection monitoring well samples exceed background levels. The statistical analysis was performed pursuant to §257.93(f) and (g), and in accordance with the Groundwater Statistical Evaluation Plan (Stats Plan) (TRC, 2017).

The statistical evaluation of the September 2019 Appendix III indicator parameters showed potential SSIs over background for:

- Total Dissolved Solids (TDS) at MW-16-03 and MW-16-04

Verification sampling conducted in November 2019 only confirmed the SSI for TDS at MW-16-04. All other Appendix III constituents were within the statistical background limits. In accordance with §257.94(e)(2), DTE Electric may demonstrate that a source other than the CCR unit caused the SSI or that the SSI resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. This Alternate Source Demonstration (ASD) has been prepared to address the potential SSIs identified in the September 2019 detection monitoring event.

Background

The MONPP is located in Monroe in Monroe County, Michigan. The MONPP FAB & VEL is bounded by Dunbar Road and Plum Creek to the north and northeast, Interstate 75 to the northwest, a 200-acre peninsula into Lake Erie to the east and southeast, Lake Erie to the south and a large open field to the southwest. The property has been used continuously for the operation of the MONPP FAB & VEL since approximately 1975 and is constructed over a natural clay-rich soil base. The MONPP FAB & VEL is a Type III solid waste disposal facility owned by DTE Electric, which currently accepts coal ash from DTE Electric's MONPP. The MONPP FAB & VEL is operated in accordance with Michigan Part 115 of the Natural Resources and Environmental Protection Act (NREPA), PA 451 of 1994, as amended, and the current operating license number 9579.

The MONPP FAB & VEL CCR unit uppermost aquifer consists of saturated limestone present beneath at least 37 feet and up to 53.5 feet of thick contiguous silty clay-rich soil that serves as a natural confining hydraulic barrier that isolates the underlying uppermost aquifer. The limestone bedrock aquifer is artesian in every location except MW-16-01, where the static water level was approximately 1 to 2 feet below ground surface (bgs).

The detection monitoring well network for the MONPP FAB & VEL CCR unit currently consists of seven monitoring wells that are screened in the uppermost aquifer. The MONPP FAB & VEL CCR unit uses intrawell statistical methods because the saturated unit being monitored is isolated by a laterally contiguous silty clay unit which significantly impedes vertical groundwater flow thus preventing the monitored saturated zone from potentially being affected by CCR. In addition, the flow potential of liquid within the FAB is radially outward relative to the uppermost aquifer due to the elevation that water is maintained within the FAB CCR unit. Based on these hydrogeologic conditions, intrawell statistical tests are used during detection monitoring as outlined in the Stats Plan.

Alternate Source Demonstration

Verification resampling was performed as recommended per the Stats Plan and the USEPA's Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance (Unified

Guidance, USEPA, 2009) to achieve performance standards as specified by §257.93(g) in the CCR rules. Per the Stats Plan, if there is an exceedance of a prediction limit for one or more of the parameters, the well(s) of concern will be resampled within 30 days of the completion of the initial statistical analysis. Only those constituents that initially exceed their statistical limit (i.e., have no previously recorded SSIs) will be analyzed for verification purposes. As such, verification resampling was conducted on November 6, 2019, by TRC personnel. Groundwater samples were collected for TDS at monitoring wells MW-16-03 and MW-16-04 in accordance with the Quality Assurance Project Plan (TRC, August 2016; Revised March 2017). A summary of the groundwater data collected during the verification resampling event is provided on Table 1. The associated data quality review is included in Attachment A.

The TDS verification result for MW-16-03 are within the prediction limits; consequently, the initial SSI from the September 2019 event is not confirmed. Therefore, in accordance with the Stats Plan and the Unified Guidance, the initial exceedance at MW-16-03 is not statistically significant and no SSI will be recorded for this well during the September 2019 monitoring event. However, the verification resampling confirmed the TDS exceedance at MW-16-04 during the November 2019 verification sampling event. The following discussion presents the ASD for the confirmed prediction limit exceedance at MW-16-04.

TDS at MW-16-04: The SSI of TDS at MW-16-04, shown graphically as data points greater than the prediction limit in Figure 3, are likely the result of natural spatial variability in groundwater quality at the site and not the result of a release from the MONPP FAB & VEL CCR unit. Multiple lines of evidence are provided in support of this conclusion and are as follows:

- **Insufficient background sampling timeline to account for long-term trends** – Variability in TDS concentrations observed in the groundwater at MONPP FAB during the background sampling events provides evidence of the heterogeneity of this constituent in groundwater. The short duration of the background sampling events limits the ability of the statistical analysis to capture the natural temporal trends in the groundwater quality at the MONPP FAB & VEL. This is a limitation of the CCR Rule implementation timeline.
- **Lack of similar increase in other indicator parameters** – The lack of SSIs for any other parameters within the same monitoring well, and across the other wells within the monitoring well network, also suggests a source other than CCR leachate for the observed TDS SSI at this location.
- **Time of travel analysis** – The clay formation immediately beneath the MONPP FAB & VEL CCR unit provides a natural geologic barrier to migration of CCR constituents to the underlying aquifer. The vertical extent of the clay layer beneath the CCR unit is shown in Figures 5 and 6 as cross-sections. Figure 4 shows the cross-section locations in plan view. Conservatively calculating a time of travel for liquid from the base of the MONPP FAB & VEL CCR unit through a minimum of 23 feet of silty clay, to the underlying upper aquifer, yields approximately 308 years of travel time (TRC, October 2017). The MONPP FAB & VEL CCR unit began accepting coal ash in

approximately 1975, so, based on this analysis, there is no potential for indicator parameters to have migrated to the upper aquifer.

Conclusions and Recommendations

The information provided in this report serves as the ASD for the DTE Electric MONPP FAB & VEL CCR unit. This report was prepared in accordance with 40 CFR 257.94(e)(2) of the CCR Rule, and demonstrates that the TDS SSI detected at MW-16-04 during the second semiannual detection monitoring event performed in 2019 is not due to a release of CCR leachate into the groundwater. In addition, based on the results of the verification resampling, the initial exceedance for TDS at monitoring well MW-16-03is not statistically significant. Therefore, no SSIs are recorded for this fifth detection monitoring event.

In addition, as discussed in the Annual Report, based on the artesian conditions, the low permeability of the underlying natural soils, and the calculated time of travel for groundwater to flow vertically from the MONPP FAB to the uppermost aquifer, it is not possible for the uppermost aquifer to have been affected by CCR from FAB operations that began in 1975. Due to limitations on CCR Rule implementation timelines, the background data sets are of relatively short duration for capturing the occurrence of natural temporal changes in the aquifer.

Since no confirmed SSIs over background limits that were not addressed with an ASD were identified for any of the Appendix III parameters during the September 2019 monitoring event, DTE Electric will continue with the detection monitoring program at MONPP FAB & VEL CCR unit. The next semiannual monitoring event is scheduled for the second calendar quarter of 2020.

Certification Statement

I hereby certify that the alternative source demonstration presented within this document for the MONPP FAB & VEL CCR unit has been prepared to meet the requirements of Title 40 CFR §257.94(e) 2 of the Federal CCR Rule. This document is accurate and has been prepared in accordance with good engineering practices, including the consideration of applicable industry standards, and with the requirements of Title 40 CFR §257.94(e) 2.

Name: David B. McKenzie, P.E.	Expiration Date: October 31, 2021	State of Michigan David B. McKenzie Engineer No. 42332 Licensed Professional Engineer
Company: TRC Engineers Michigan, Inc.	Date: January 30, 2020	

References

TRC Environmental Corporation. August 2016; Revised March 2017. CCR Groundwater Monitoring and Quality Assurance Project Plan – DTE Electric Company Monroe Power Plant Coal Combustion Residual Fly Ash Basin, 7955 East Dunbar Road, Monroe, Michigan. Prepared for DTE Electric Company.

TRC Environmental Corporation. October 2017. Groundwater Monitoring System Summary Report –Monroe Power Plant Coal Combustion Residual Fly Ash Basin, 7955 East Dunbar Road, Monroe, Michigan. Prepared for DTE Electric Company.

TRC Environmental Corporation. October 2017. Groundwater Statistical Evaluation Plan – Monroe Power Plant Coal Combustion Residual Fly Ash Basin, 7955 East Dunbar Road, Monroe, Michigan. Prepared for DTE Electric Company.

TRC Environmental Corporation. January 2018. Annual Groundwater Monitoring Report – Monroe Power Plant Coal Combustion Residual Fly Ash Basin, 7955 East Dunbar Road, Monroe, Michigan. Prepared for DTE Electric Company.

TRC Environmental Corporation. January 2019. 2018 Annual Groundwater Monitoring Report – Monroe Power Plant Coal Combustion Residual Fly Ash Basin, 7955 East Dunbar Road, Monroe, Michigan. Prepared for DTE Electric Company.

USEPA. 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA facilities, Unified Guidance. Office of Conservation and Recovery. EPA 530/R-09-007.

Attachments

Table 1

Table 1
Comparison of Verification Sampling Results to Background Limits
Monroe Power Plant Fly Ash Basin and Vertical Extension Landfill – RCRA CCR Monitoring Program
Monroe, Michigan

	Sample Location:	MW-16-03		MW-16-04	
	Sample Date:	11/6/2019		11/6/2019	
Constituent	Unit	Data	PL	Data	PL
Appendix III					
Total Dissolved Solids	mg/L	2,300	2,300	**2,300**	2,200

Notes:

mg/L - milligrams per liter

RESULT Shading and bold font indicates a confirmed exceedance of the Prediction Limits (PL).

Figures

BASE MAP FROM USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE SERIES.

N

1 " = 2,000 '
1:24,000

0 2,000 4,000 FEET

TRC

1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080

TRC - GIS

PROJECT:

DTE ELECTRIC COMPANY
MONROE POWER PLANT
FLY ASH BASIN AND VERTICAL EXTENSION LANDFILL
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:

SITE LOCATION MAP

DRAWN BY:	S.MAJOR
CHECKED BY:	
APPROVED BY:	
DATE:	OCTOBER 2019
PROJ. NO.:	320511.0001
FILE:	320511-0001-007SLM.mxd

FIGURE 1

E:\DTE\CCR_Sites\2017_265996\320511-0001-007SLM.mxd -- Saved By: SMAJOR on 10/29/2019, 16:23:20 PM

LEGEND

- MONITORING WELLS
- APPROXIMATE BOUNDARY OF FLY ASH
- APPROXIMATE BOUNDARY OF VERTICAL EXTENSION LANDFILL

NOTES

1. BASE MAP IMAGERY FROM GOOGLE EARTH PRO, 2018.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:	DTE ELECTRIC COMPANY MONROE POWER PLANT FLY ASH BASIN AND VERTICAL EXTENSION LANDFILL 7955 EAST DUNBAR ROAD MONROE, MICHIGAN		
TITLE:	MONITORING NETWORK AND SITE PLAN		
DRAWN BY:	M. VAPHIADIS	PROJ NO.:	320511.0001
CHECKED BY:	J. KRENZ		FIGURE 2
APPROVED BY:	V. BUENING		
DATE:	JANUARY 2020		

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FILE NO.: 320511-0001-017-MPP-Fig02.mxd

TRC - GIS

Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

Plot Date: 1/28/2020, 11:41:53 AM by MVAPHIADIS -- LAYOUT: ANSI B(11"x17")
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FIGURE 3

MW-16-04 TOTAL DISSOLVED SOLIDS TIME SERIES PLOT

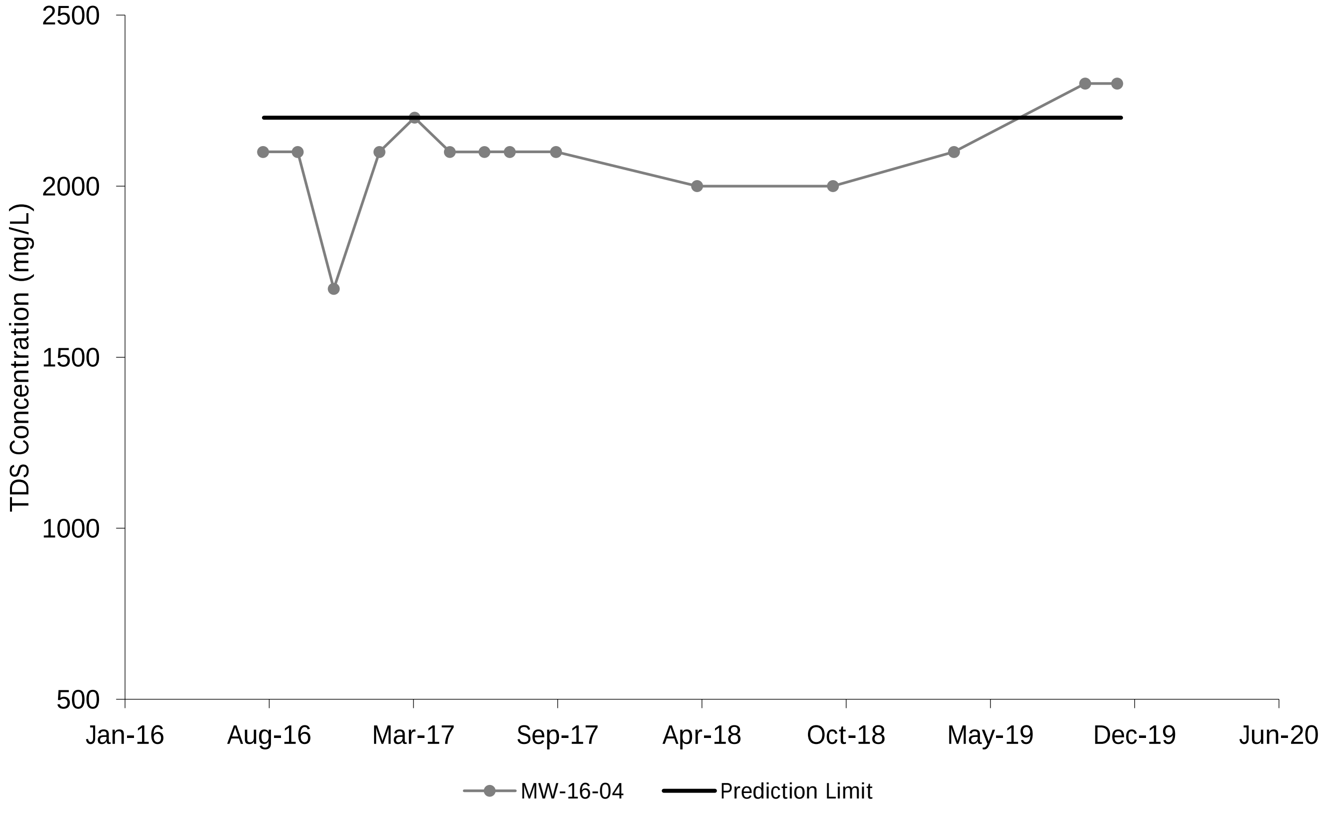
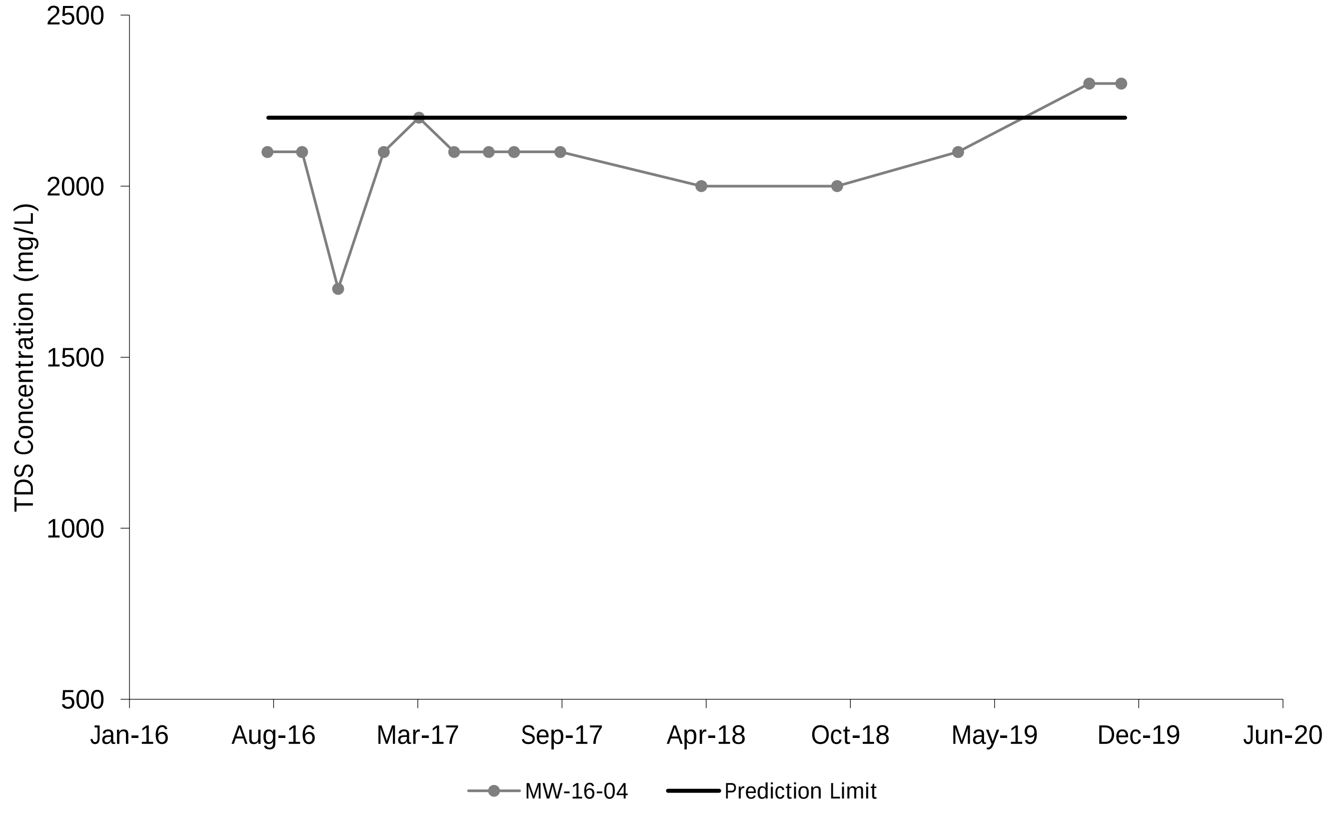


FIGURE 3

MW-16-04 TOTAL DISSOLVED SOLIDS TIME SERIES PLOT



LEGEND

- MONITORING WELLS
- APPROXIMATE BOUNDARY OF FLY ASH BASIN
- CROSS SECTIONS

NOTES

1. BASE MAP IMAGERY FROM GOOGLE & PARTNERS GOOGLE EARTH PRO, 2018.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.

PROJECT:
DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:
CROSS SECTION LOCATOR MAP

DRAWN BY:	M. VAPHIADIS	PROJ NO.:	320511.0001
CHECKED BY:	B. YELEN	**FIGURE 4**	
APPROVED BY:	V. BUENING		
DATE:	JANUARY 2020		

TRC
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FILE NO.: 320511-0001-013.mxd

TRC - GIS

Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

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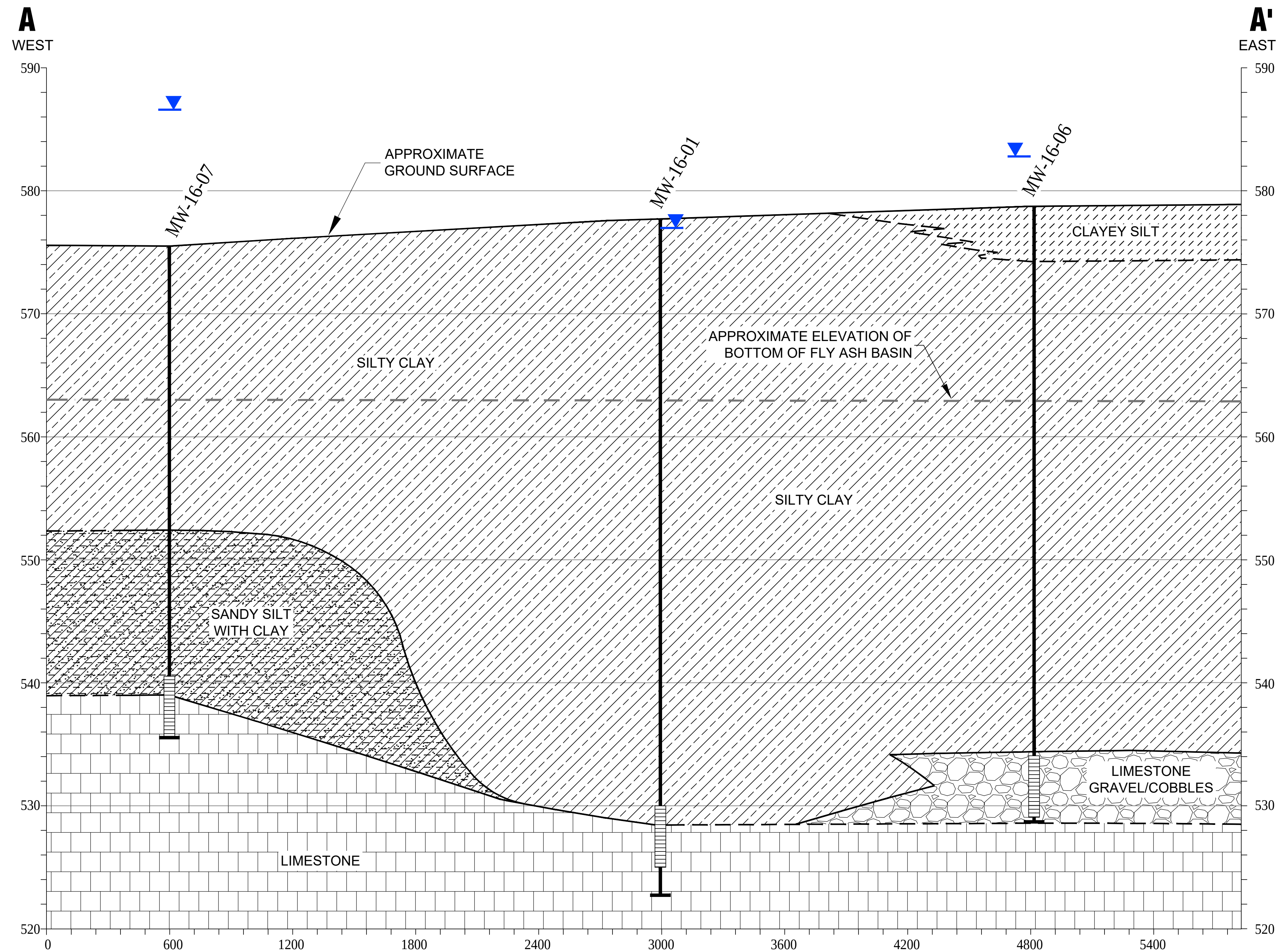
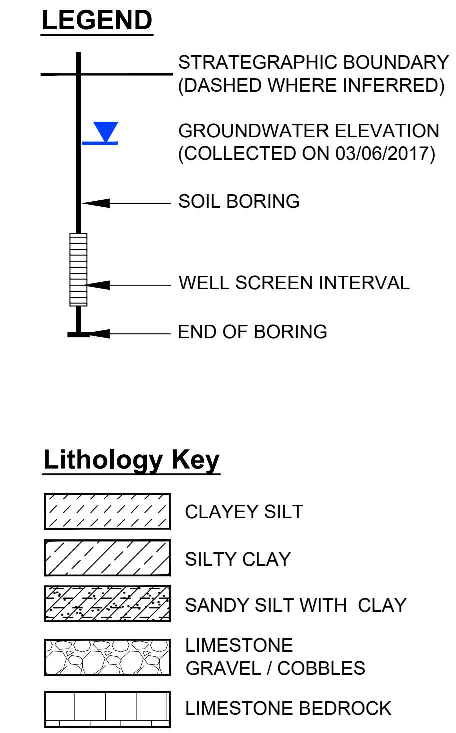
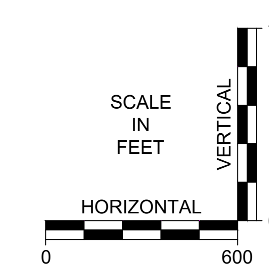
Path: E:\DTE\CCR_Sites\2017_265996\320511-0001-013.mxd

GENERALIZED GEOLOGIC CROSS-SECTION A-A'







PROJECT:	DTE ELECTRIC COMPANY MONROE POWER PLANT FLY ASH BASIN AND VERTICAL EXTENSION LANDFILL MONROE, MICHIGAN
TITLE:	GENERALIZED GEOLOGIC CROSS-SECTION A-A'
DRAWN BY: D.STEHLE	PROJ NO.: 320511.0001.01.01
CHECKED BY: S.HOLMSTROM	FIGURE 5
APPROVED BY: V.BUENING	
DATE: JANUARY 2020	

TRC

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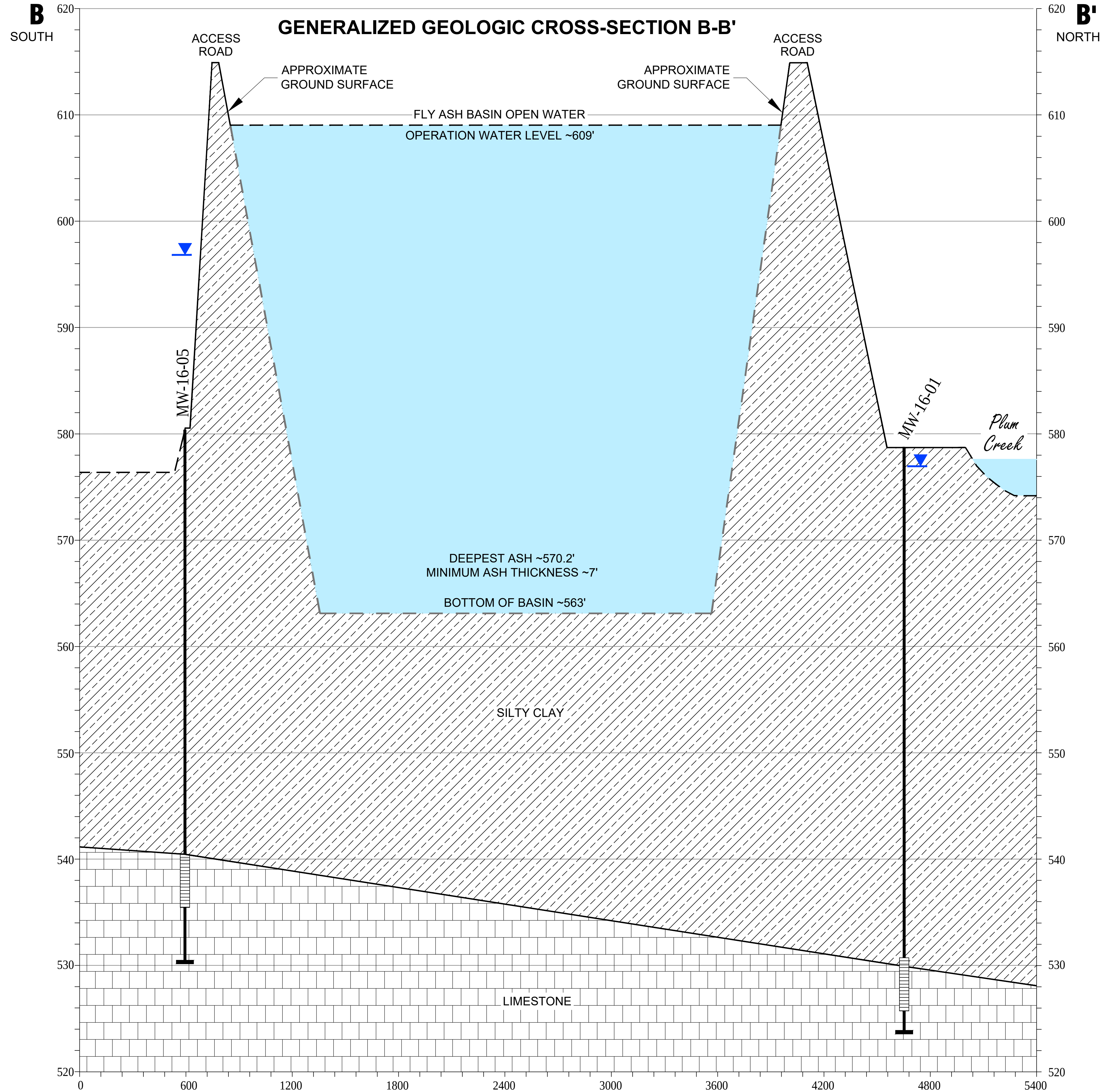
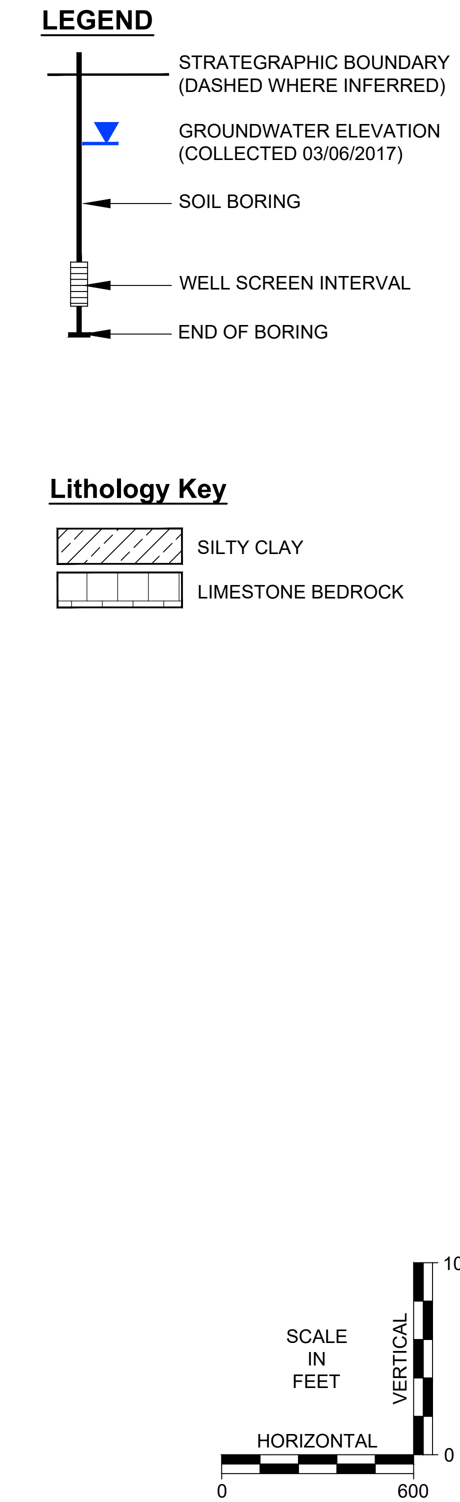
Ann Arbor, MI 48108
Phone: 734.971.7080
www.trccompanies.com

FILE NO.: 320511.0001.01.01.05-06 ASD.dwg





PROJECT: DTE ELECTRIC COMPANY
MONROE POWER PLANT
FLY ASH BASIN AND VERTICAL EXTENSION LANDFILL
MONROE, MICHIGAN

TITLE: GENERALIZED GEOLOGIC CROSS-SECTION B-B'

DRAWN BY:	D.STEHLE	PROJ NO.:	320511.0001.01.01
CHECKED BY:	S.HOLMSTROM	FIGURE 6	
APPROVED BY:	V.BUENING		
DATE:	JANUARY 2020		

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FILE NO.: 320511.0001.01.01.05-06 ASD.dwg

11x17 --- ATTACHED XREFS: --- ATTACHED IMAGES:
DRAWING NAME: J:_TRC\DTE\Monroe PP\320511\0001\01\01_ASD Rpt\320511.0001.01.01.05-06 ASD.dwg --- PLOT DATE: January 10, 2020 - 9:30AM --- LAYOUT: FIG06 XS BB

Attachment A

Laboratory Data Quality Review
Groundwater Monitoring Event November 2019 (Verification Sampling)
DTE Electric Company Monroe Power Plant Fly Ash Basin and Vertical Extension Landfill (DTE MONPP FAB & VEL)

Groundwater samples were collected by TRC for the November 2019 verification sampling event. Samples were analyzed for anions, total metals, and total dissolved solids by Test America Laboratories, Inc. (Test America), located in North Canton, Ohio. The laboratory analytical results are reported in laboratory report 240-121974-1.

During the November 2019 verification sampling event, a groundwater sample was collected from each of the following wells on November 6, 2019:

- MW-16-03
- MW-16-04

Each sample was analyzed for the following constituents:

Analyte Group	Method
Total Dissolved Solids	SM 2540C

TRC reviewed the laboratory data to assess data usability. The following sections summarize the data review procedure and the results of the review.

Data Quality Review Procedure

The analytical data were reviewed using the USEPA National Functional Guidelines for Inorganic Superfund Data Review (USEPA, 2017). The following items were included in the evaluation of the data:

- Sample receipt, as noted in the cover page or case narrative;
- Technical holding times for analyses;
- Reporting limits (RLs) compared to project-required RLs;
- Data for method blanks and equipment blanks. Method blanks are used to assess potential contamination arising from laboratory sample preparation and/or analytical procedures. Equipment blanks are used to assess potential contamination arising from field procedures;
- Data for laboratory control samples (LCSs). The LCSs are used to assess the accuracy of the analytical method using a clean matrix;

- Data for matrix spike and matrix spike duplicate samples (MS.MSDs). The MS/MSDs are used to assess the accuracy and precision of the analytical method using a sample from the dataset;
- Data for laboratory duplicates. The laboratory duplicates are used to assess the precision of the analytical method using a sample from the dataset;
- Data for blind field duplicates. Field duplicate samples are used to assess variability introduced by the sampling and analytical processes; and
- Overall usability of the data.

This data usability report addresses the following items:

- Usability of the data if quality control (QC) results suggest potential problems with all or some of the data;
- Actions regarding specific QC criteria exceedances.

Review Summary

The data quality objectives and laboratory completeness goals for the project were met, and the data are usable for their intended purpose. A summary of the data quality review, including non-conformances and issues identified in this evaluation are noted below.

- Appendix III constituents will be utilized for the purposes of a detection monitoring program.
- Data are usable for the purposes of the detection monitoring program.

QA/QC Sample Summary:

- Target analytes were not detected in the method blanks.
- LCS recoveries for all target analytes were within laboratory control limits.
- MS/MSD analyses were not performed on a sample from the data set.
- DUP-01 corresponds with MW-16-04; RPDs between the parent and duplicate sample were within the QC limits.

Appendix B
Data Quality Reviews

Laboratory Data Quality Review
Groundwater Monitoring Event March 2019 (Detection Monitoring)
DTE Electric Company Monroe Power Plant Fly Ash Basin and Vertical Extension Landfill (DTE MONPP FAB & VEL)

Groundwater samples were collected by TRC for the March 2019 sampling event. Samples were analyzed for anions, total metals, and total dissolved solids by Test America Laboratories, Inc. (Test America), located in North Canton, Ohio. The laboratory analytical results are reported in laboratory report 240-110058-1.

During the March 2019 sampling event, a groundwater sample was collected from each of the following wells:

- MW-16-01
- MW-16-02
- MW-16-03
- MW-16-04
- MW-16-05
- MW-16-06
- MW-16-07

Each sample was analyzed for the following constituents:

Analyte Group	Method
Anions (Chloride, Fluoride, Sulfate)	SW846 9056A
Total Boron	SW846 3005A/6010B
Total Calcium	SW846 3005A/6020
Total Dissolved Solids	SM 2540C

TRC reviewed the laboratory data to assess data usability. The following sections summarize the data review procedure and the results of the review.

Data Quality Review Procedure

The analytical data were reviewed using the USEPA National Functional Guidelines for Inorganic Superfund Data Review (USEPA, 2017). The following items were included in the evaluation of the data:

- Sample receipt, as noted in the cover page or case narrative;
- Technical holding times for analyses;
- Reporting limits (RLs) compared to project-required RLs;
- Data for method blanks and equipment blanks. Method blanks are used to assess potential contamination arising from laboratory sample preparation and/or analytical procedures. Equipment blanks are used to assess potential contamination arising from field procedures;

- Data for laboratory control samples (LCSs). The LCSs are used to assess the accuracy of the analytical method using a clean matrix;
- Data for matrix spike and matrix spike duplicate samples (MS.MSDs), if applicable. The MS/MSDs are used to assess the accuracy and precision of the analytical method using a sample from the dataset;
- Data for laboratory duplicates, if applicable. The laboratory duplicates are used to assess the precision of the analytical method using a sample from the dataset;
- Data for blind field duplicates. Field duplicate samples are used to assess variability introduced by the sampling and analytical processes; and
- Overall usability of the data.

This data usability report addresses the following items:

- Usability of the data if quality control (QC) results suggest potential problems with all or some of the data;
- Actions regarding specific QC criteria exceedances.

Review Summary

The data quality objectives and laboratory completeness goals for the project were met, and the data are usable for their intended purpose. A summary of the data quality review, including non-conformances and issues identified in this evaluation are noted below.

- Appendix III constituents will be utilized for the purposes of a detection monitoring program.
- Data are usable for the purposes of the detection monitoring program.

QA/QC Sample Summary:

- The holding time for TDS for sample MW-16-01 exceeded the 7-day holding time criteria by approximately 3 hours. This result is estimated and may be biased low.
- An equipment blank was not included with this data set per the project QAPP.
- Target analytes were not detected in the method blanks.
- LCS recoveries for all target analytes were within laboratory control limits.
- Sample Dup-01 corresponds with sample MW-16-03; relative percent differences (RPDs) between the parent and duplicate sample were within the QC limits.
- MS/MSD analyses were not performed for boron, calcium, and anions in this SDG, however MS/MSD alaysis were performed on other client samples in the batch in accordance with the labs QA/QC program at a rate of 1 per 20 samples

- Laboratory duplicate analyses were performed on sample MW-16-06 for TDS; the RPDs were within the acceptance limits.

Laboratory Data Quality Review
Groundwater Monitoring Event September 2019 (Detection Monitoring)
DTE Electric Company Monroe Power Plant Fly Ash Basin and Vertical Extension Landfill (DTE MONPP FAB & VEL)

Groundwater samples were collected by TRC for the September 2019 sampling event. Samples were analyzed for anions, total boron, total calcium, and total dissolved solids by Eurofins-Test America Laboratories, Inc. (Eurofins-TA), located in North Canton, Ohio. The laboratory analytical results are reported in laboratory reports 240-119636-1 and 240-119702-1.

During the September 2019 sampling event, a groundwater sample was collected from each of the following wells:

- MW-16-01
- MW-16-02
- MW-16-03
- MW-16-04
- MW-16-05
- MW-16-06
- MW-16-07

Each sample was analyzed for the following constituents:

Analyte Group	Method
Anions (Chloride, Fluoride, Sulfate)	SW846 9056A
Total Boron	SW846 3005A/6010B
Total Calcium	SW846 3005A/6020
Total Dissolved Solids	SM 2540C

TRC reviewed the laboratory data to assess data usability. The following sections summarize the data review procedure and the results of the review.

Data Quality Review Procedure

The analytical data were reviewed using the USEPA National Functional Guidelines for Inorganic Superfund Data Review (USEPA, 2017). The following items were included in the evaluation of the data:

- Sample receipt, as noted in the cover page or case narrative;
- Technical holding times for analyses;
- Reporting limits (RLs) compared to project-required RLs;
- Data for method blanks and equipment blanks, where applicable. Method blanks are used to assess potential contamination arising from laboratory sample preparation and/or

analytical procedures. Equipment blanks are used to assess potential contamination arising from field procedures;

- Data for laboratory control samples (LCSs). The LCSs are used to assess the accuracy of the analytical method using a clean matrix;
- Data for matrix spike and matrix spike duplicate samples (MS/MSDs), where applicable. The MS/MSDs are used to assess the accuracy and precision of the analytical method using a sample from the dataset;
- Data for laboratory duplicates, where applicable. The laboratory duplicates are used to assess the precision of the analytical method using a sample from the dataset;
- Data for blind field duplicates. Field duplicate samples are used to assess variability introduced by the sampling and analytical processes; and
- Overall usability of the data.

This data usability report addresses the following items:

- Usability of the data if quality control (QC) results suggest potential problems with all or some of the data;
- Actions regarding specific QC criteria exceedances.

Review Summary

The data quality objectives and laboratory completeness goals for the project were met, and the data are usable for their intended purpose. A summary of the data quality review, including non-conformances and issues identified in this evaluation are noted below.

- Appendix III constituents will be utilized for the purposes of a detection monitoring program.
- Data are usable for the purposes of the detection monitoring program.

QA/QC Sample Summary:

- The holding time for TDS for samples MW-16-02, MW-16-03, and MW-16-04 exceeded the 7-day holding time criteria by approximately 20 minutes, one hour, and one hour and 30 minutes, respectively. These results should be considered estimated and may be biased low as noted in the attached table.
- Target analytes were not detected in the method blanks.
- LCS recoveries for all target analytes were within laboratory control limits.
- MS/MSD analyses were not performed for anions, boron, and calcium. Per the project QAPP, MS/MSD analyses are required for these analyses at a frequency of 1 per 20 samples.

- Laboratory duplicate analysis was not performed for TDS. Per the project QAPP, laboratory duplicate analyses are required for TDS at a frequency of 1 per 20 samples.
- Dup-01 corresponds with MW-16-02; relative percent differences (RPDs) between the parent and duplicate sample were within the QC limits.

Laboratory Data Quality Review
Groundwater Monitoring Event November 2019 (Verification Sampling)
DTE Electric Company Monroe Power Plant Fly Ash Basin and Vertical Extension Landfill (DTE MONPP FAB & VEL)

Groundwater samples were collected by TRC for the November 2019 verification sampling event. Samples were analyzed for anions, total metals, and total dissolved solids by Test America Laboratories, Inc. (Test America), located in North Canton, Ohio. The laboratory analytical results are reported in laboratory report 240-121974-1.

During the November 2019 verification sampling event, a groundwater sample was collected from each of the following wells on November 6, 2019:

- MW-16-03
- MW-16-04

Each sample was analyzed for the following constituents:

Analyte Group	Method
Total Dissolved Solids	SM 2540C

TRC reviewed the laboratory data to assess data usability. The following sections summarize the data review procedure and the results of the review.

Data Quality Review Procedure

The analytical data were reviewed using the USEPA National Functional Guidelines for Inorganic Superfund Data Review (USEPA, 2017). The following items were included in the evaluation of the data:

- Sample receipt, as noted in the cover page or case narrative;
- Technical holding times for analyses;
- Reporting limits (RLs) compared to project-required RLs;
- Data for method blanks and equipment blanks. Method blanks are used to assess potential contamination arising from laboratory sample preparation and/or analytical procedures. Equipment blanks are used to assess potential contamination arising from field procedures;
- Data for laboratory control samples (LCSs). The LCSs are used to assess the accuracy of the analytical method using a clean matrix;

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- Data for laboratory duplicates. The laboratory duplicates are used to assess the precision of the analytical method using a sample from the dataset;
- Data for blind field duplicates. Field duplicate samples are used to assess variability introduced by the sampling and analytical processes; and
- Overall usability of the data.

This data usability report addresses the following items:

- Usability of the data if quality control (QC) results suggest potential problems with all or some of the data;
- Actions regarding specific QC criteria exceedances.

Review Summary

The data quality objectives and laboratory completeness goals for the project were met, and the data are usable for their intended purpose. A summary of the data quality review, including non-conformances and issues identified in this evaluation are noted below.

- Appendix III constituents will be utilized for the purposes of a detection monitoring program.
- Data are usable for the purposes of the detection monitoring program.

QA/QC Sample Summary:

- Target analytes were not detected in the method blanks.
- LCS recoveries for all target analytes were within laboratory control limits.
- MS/MSD analyses were not performed on a sample from the data set.
- DUP-01 corresponds with MW-16-04; RPDs between the parent and duplicate sample were within the QC limits.

Appendix D
2018 Annual Groundwater Monitoring Report

2018 Annual Groundwater Monitoring Report

DTE Electric Company
Monroe Power Plant Fly Ash Basin
Coal Combustion Residual Unit

7955 East Dunbar Road
Monroe, Michigan

January 2019

2018 Annual Groundwater Monitoring Report

DTE Electric Company
Monroe Power Plant Fly Ash Basin
Coal Combustion Residual Unit

7955 East Dunbar Road
Monroe, Michigan

January 2019

Prepared For
DTE Electric Company

Graham Crockford, C.P.G
Senior Project Geologist

David B. McKenzie, P.E.
Senior Project Engineer

TRC | DTE Electric Company
Final
X:\WPAAM\PJT2\265996\01 MPP\CCR\2018\R265996-MONPP FINAL.DOCX

1540 Eisenhower Place, Ann Arbor, MI 48108 ● 734.971.7080 Phone ● 734.971.9022 Fax
www.TRCsolutions.com

Table of Contents

List of Tables

List of Figures

List of Appendices

Executive Summary

On April 17, 2015, the United States Environmental Protection Agency (USEPA) published the final rule for the regulation and management of Coal Combustion Residuals (CCR) under the Resource Conservation and Recovery Act (RCRA) (the CCR Rule), as amended July 30, 2018. The CCR Rule, which became effective on October 19, 2015 (amendment effective August 29, 2018), applies to the DTE Electric Company (DTE Electric) Monroe Power Plant (MONPP) Coal Combustion Residual Fly Ash Basin (FAB) CCR unit. Pursuant to the CCR Rule, no later than January 31, 2018, and annually thereafter, the owner or operator of a CCR unit must prepare an annual groundwater monitoring and corrective action report for the CCR unit documenting the status of groundwater monitoring and corrective action for the preceding year in accordance with §257.90(e). On behalf of DTE Electric, TRC Engineers Michigan, Inc., the engineering entity of TRC Environmental Corporation (TRC), has prepared this Annual Groundwater Monitoring Report for calendar year 2018 activities at the MONPP FAB CCR unit.

In the January 31, 2018 *Annual Groundwater Monitoring Report for the Monroe Power Plant Fly Ash Basin CCR* Unit, covering calendar year 2017 activities, DTE Electric reported that the pH observed within groundwater at one or more downgradient wells was outside background limits. Resampling was performed in January 2018 in accordance with the TRC October 2017 *Groundwater Statistical Evaluation Plan – Monroe Power Plant Coal Combustion Residual Fly Ash Basin* (Stats Plan). Based on the results of the resampling, the pH was within the prediction limits and no statistically significant increase (SSI) or decrease exists for pH in accordance with the Stats Plan. Therefore, DTE Electric continued detection monitoring at the MONPP FAB CCR unit pursuant to §257.94 of the CCR Rule. The verification sampling and results are summarized in the *Alternate Source Demonstration: 2017 Initial Detection Monitoring Sampling Event Monroe Power Plant Coal Combustion Residual Fly Ash Basin, Monroe, Michigan*, dated April 12, 2018.

The semiannual detection monitoring events for 2018 were completed in April and October 2018 and included sampling and analyzing groundwater within the groundwater monitoring system for the indicator parameters listed in Appendix III to the CCR Rule. As part of the statistical evaluation, the data collected during detection monitoring events are evaluated to identify SSIs in detection monitoring parameters to determine if concentrations in detection monitoring well samples exceed background levels. Detection monitoring data that has been collected and evaluated in 2018 are presented in this report.

No SSIs were recorded for the 2018 monitoring period and detection monitoring will be continued at the MONPP FAB CCR unit in accordance with §257.94. In addition, based on the artesian conditions, the low permeability of the underlying natural soils, and the calculated time of travel for groundwater to flow vertically from the MONPP FAB to the uppermost aquifer, it is not possible for the uppermost aquifer to have been affected by CCR from FAB operations that began in 1975. Also, due to limitations on CCR Rule implementation timelines, the background data sets are of relatively short duration for capturing the occurrence of natural temporal changes in the aquifer.

Section 1
Introduction

1.1 Program Summary

On April 17, 2015, the United States Environmental Protection Agency (USEPA) published the final rule for the regulation and management of Coal Combustion Residuals (CCR) under the Resource Conservation and Recovery Act (RCRA) (the CCR Rule), as amended July 30, 2018. The CCR Rule, which became effective on October 19, 2015 (amendment effective August 29, 2018), applies to the DTE Electric Company (DTE Electric) Monroe Power Plant (MONPP) Coal Combustion Residual Fly Ash Basin (FAB) CCR unit. Pursuant to the CCR Rule, no later than January 31, 2018, and annually thereafter, the owner or operator of a CCR unit must prepare an annual groundwater monitoring and corrective action report for the CCR unit documenting the status of groundwater monitoring and corrective action for the preceding year in accordance with §257.90(e). On behalf of DTE Electric, TRC Engineers Michigan, Inc., the engineering entity of TRC Environmental Corporation (TRC), has prepared this Annual Groundwater Monitoring Report for calendar year 2018 activities at the MONPP FAB CCR unit (2018 Annual Report).

In the January 31, 2018 *Annual Groundwater Monitoring Report for the Monroe Power Plant Fly Ash Basin CCR* Unit, covering calendar year 2017 activities (2017 Annual Report), DTE Electric reported that the pH observed within groundwater at one or more downgradient wells was outside background limits. Resampling was performed in January 2018 in accordance with the *Groundwater Statistical Evaluation Plan – Monroe Power Plant Coal Combustion Residual Fly Ash Basin* (Stats Plan) (TRC, October 2017). Based on the results of the resampling, the pH was within the prediction limits and no statistically significant increase (SSI) or decrease exists for pH in accordance with the Stats. Therefore, DTE Electric continued detection monitoring at the MONPP FAB CCR unit pursuant to §257.94 of the CCR Rule. The verification sampling and results are summarized in the *Alternate Source Demonstration: 2017 Initial Detection Monitoring Sampling Event Monroe Power Plant Coal Combustion Residual Fly Ash Basin, Monroe, Michigan*, dated April 12, 2018, (April 2018 ASD) included in Appendix A.

This 2018 Annual Report presents the monitoring results and the statistical evaluation of the detection monitoring parameters (Appendix III to Part 257 of the CCR Rule) for the April and October 2018 semiannual groundwater monitoring events for the MONPP FAB CCR unit. Detection monitoring for these events continued to be performed in accordance with the *CCR Groundwater Monitoring and Quality Assurance Project Plan – DTE Electric Company Monroe Power Plant Coal Combustion Residual Fly Ash Basin* (QAPP) (TRC, August 2016; revised March 2017) and statistically evaluated per the Stats Plan. As part of the statistical evaluation, the data collected during detection monitoring events are evaluated to identify SSIs of detection monitoring parameters compared to background levels.

1.2 Site Overview

The MONPP is located in Section 16, Township 7 South, Range 9 East, at 7955 East Dunbar Road, Monroe in Monroe County, Michigan (Figure 1). The MONPP FAB is located about one mile southwest of the MONPP at latitude 41° 53' 03" North and longitude 83° 22' 31" West. The MONPP FAB is bounded by Dunbar Road and Plum Creek to the north and northeast, Interstate 75 to the northwest, a 200-acre peninsula into Lake Erie to the east and southeast, Lake Erie to the south and a large open field to the southwest (Figure 2).

The property has been used continuously for the operation of the MONPP FAB since approximately 1975 and is constructed over a natural clay-rich soil base. The MONPP FAB and landfill is a Type III solid waste disposal facility owned by DTE Electric, which currently accepts coal ash from DTE Electric's MONPP. The MONPP FAB is operated in accordance with Michigan Part 115 of the Natural Resources and Environmental Protection Act (NREPA), PA 451 of 1994, as amended, and the current operating license number 9393.

1.3 Geology/Hydrogeology

The MONPP FAB CCR unit is located within 200 feet southwest of Plum Creek and immediately north of Lake Erie. The MONPP FAB CCR unit uppermost aquifer consists of saturated limestone present beneath at least 37 feet and up to 53.5 feet of thick contiguous silty clay-rich soil that serves as a natural confining hydraulic barrier that isolates the underlying uppermost aquifer. The limestone bedrock aquifer is artesian in every location except MW-16-01, where the static water level was approximately 1 to 2 feet below ground surface (ft bgs).

Potentiometric groundwater elevation data from 2016 through 2018 suggest that there is horizontal groundwater flow potential within the upper aquifer unit generally to the northeast towards Plum Creek. The average hydraulic gradient to the northeast is on the order of 0.002 foot/foot along the eastern part of the MONPP FAB to 0.004 to 0.005 foot/foot in the center and northwestern part of the FAB, with an overall mean of 0.004 foot/foot.

The surface water elevation within the FAB raised surface impoundment is at least 5 to more than 30 feet above the potentiometric surface elevations in the uppermost aquifer limestone, and more than 60 feet above the base of the underlying clay-rich confining unit that isolates groundwater within the limestone aquifer. Therefore, flow potential from the CCR unit to the surrounding area would be radially outward from the FAB. However, there is no hydraulic communication between the uppermost aquifer and the FAB due to the continuous silty clay-rich confining unit beneath the MONPP FAB. Based on the artesian conditions, the low permeability of the underlying natural soils, and the calculated time of travel for groundwater to flow vertically from the FAB to the uppermost aquifer, it is not possible for the uppermost aquifer to have been affected by CCR from FAB operations that began in 1975.

The MONPP FAB CCR unit uses intrawell statistical methods because the saturated unit being monitored is isolated by a laterally contiguous silty clay unit which significantly impedes vertical groundwater flow thus preventing the monitored saturated zone from potentially being affected by CCR. In addition, the flow potential of liquid within the FAB is radially outward relative to the uppermost aquifer due to the elevation water is maintained within the FAB CCR unit. Based on these hydrogeologic conditions, intrawell statistical approaches are likely a more appropriate method to evaluate groundwater data statistically. Consequently, intrawell statistical tests are being used during detection monitoring as outlined in the Stats Plan.

Section 2
Groundwater Monitoring

2.1 Monitoring Well Network

A groundwater monitoring system has been established for the MONPP FAB CCR unit as detailed in the *Groundwater Monitoring System Summary Report – Monroe Power Plant Coal Combustion Residual Fly Ash Basin* (GWMS Report) (TRC, October 2017). The detection monitoring well network for the MONPP FAB CCR unit currently consists of seven monitoring wells that are screened in the uppermost aquifer. The monitoring well locations are shown on Figure 2.

As discussed in the Stats Plan, intrawell statistical methods for MONPP FAB were selected based on the geology and hydrogeology at the Site (primarily the presence of clay/hydraulic barrier and the hydraulic separation between the CCR unit and underlying uppermost aquifer), in addition to other supporting lines of evidence that the aquifer is unaffected by the CCR unit (such as the consistency in concentrations of water quality data). An intrawell statistical approach requires that each of the downgradient wells doubles as a background and compliance well, where data from each individual well during a detection monitoring event is compared to a statistical limit developed using the background dataset from that same well. Monitoring wells MW-16-01 through MW-16-07 are located around the perimeter of the MONPP FAB and provide data on both background and downgradient groundwater quality that has not been affected by the CCR unit (total of seven background/downgradient monitoring wells).

2.2 Semiannual Groundwater Monitoring

The semiannual monitoring parameters for the detection groundwater monitoring program were selected per the CCR Rule's Appendix III to Part 257 – Constituents for Detection Monitoring. The Appendix III indicator parameters consist of boron, calcium, chloride, fluoride, pH (field reading), sulfate, and total dissolved solids (TDS) and were analyzed in accordance with the sampling and analysis plan included within the QAPP. In addition to pH, the collected field parameters included dissolved oxygen, oxidation reduction potential, specific conductivity, temperature, and turbidity.

2.2.1 Data Summary

The first semiannual groundwater detection monitoring event for 2018 was performed during April 2 to April 3, 2018 by TRC personnel and samples were analyzed by TestAmerica in accordance with the QAPP. Static water elevation data were collected at all seven monitoring well locations. Groundwater samples were collected from the seven detection monitoring wells for the Appendix III indicator parameters and field parameters. A summary of the groundwater data collected during the April 2018 event is provided on Table 1 (static groundwater elevation data), Table 2 (field data), and Table 3 (analytical results).

The second semiannual groundwater detection monitoring event for 2018 was performed on October 8, 2018 by TRC personnel and samples were analyzed by TestAmerica in accordance with the QAPP. Static water elevation data were collected at all seven monitoring well locations. Groundwater samples were collected from the seven detection monitoring wells for the Appendix III indicator parameters and field parameters. A summary of the groundwater data collected during the October 2018 event is provided on Table 1 (static groundwater elevation data), Table 2 (field data), and Table 4 (analytical results).

2.2.2 Data Quality Review

Data from each round were evaluated for completeness, overall quality and usability, method-specified sample holding times, precision and accuracy, and potential sample contamination. The data were found to be complete and usable for the purposes of the CCR monitoring program. Data quality reviews are summarized in Appendix B.

2.2.3 Groundwater Flow Rate and Direction

Groundwater elevation data collected during the April 2018 sampling event show that groundwater within the uppermost aquifer generally flows to the northeast across the Site (Figure 2). Groundwater potentiometric surface elevations measured across the Site during the April and October 2018 sampling events are provided on Table 1 and were used to construct the groundwater potentiometric surface maps shown on Figure 3 and Figure 4, respectively. The groundwater flow rate and direction is consistent with previous monitoring events. The average groundwater hydraulic gradient throughout the Site during both 2018 monitoring events is approximately 0.004 ft/ft with an average seepage velocity of 0.2 ft/day (73 ft/year), using the average hydraulic conductivity of 5 ft/day (TRC, 2017) and an assumed effective porosity of 0.1.

The general flow rate and direction from both events are similar to that identified in previous monitoring rounds and continues to demonstrate that the downgradient wells are appropriately positioned to detect the presence of Appendix III parameters that could potentially migrate from the MONPP FAB CCR unit.

Section 3
Statistical Evaluation

3.1 Establishing Background Limits

Per the Stats Plan, background limits were established for the Appendix III indicator parameters following the collection of at least eight background monitoring events using data collected from each of the seven established detection monitoring wells (MW-16-01 through MW-16-07). The statistical evaluation of the background data is presented in the 2017 Annual Report. The Appendix III background limits for each monitoring well will be used throughout the detection monitoring period to determine whether groundwater has been impacted from the MONPP FAB CCR unit by comparing concentrations in the detection monitoring wells to their respective background limits for each Appendix III indicator parameter.

3.2 Data Comparison to Background Limits – First Semiannual Event (April 2018)

The concentrations of the indicator parameters in each of the detection monitoring wells (MW-16-01 through MW-16-07) were compared to their respective statistical background limits calculated from the background data collected from each individual well (i.e., monitoring data from MW-16-01 is compared to the background limit developed using the background dataset from MW-16-01, and so forth). The comparisons for the April 2018 detection monitoring event are presented on Table 3.

Based on the statistical evaluation of the April 2018 Appendix III indicator parameters the following resamples were collected in accordance with the Stats Plan:

- Calcium at MW-16-06 and MW-16-07; and
- TDS at MW-16-06.

Verification resampling is performed per the Stats Plan and the *USEPA's Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (USEPA, 2009) (Unified Guidance) to achieve performance standards as specified by §257.93(g) in the CCR Rule. Per the Stats Plan, if there is an exceedance of a prediction limit for one or more of the parameters, the well(s) of concern will be resampled within 30 days of the completion of the initial statistical analysis. Only constituents that initially exceed their statistical limit (i.e., have no previously recorded SSIs) will be analyzed for verification purposes.

3.3 Verification Resampling for the First Semiannual Event

Verification resampling was conducted on May 23, 2018, by TRC personnel. Groundwater samples were collected for calcium at monitoring wells MW-16-06 and MW-16-07, and TDS at MW-16-06, in accordance with the QAPP. A summary of the groundwater data collected during the verification resampling event is provided on Table 3. The associated data quality review is included in Appendix B.

All of the verification results were within the prediction limits and no SSI exists from the April 2018 event for these parameters in accordance with the Stats Plan and the Unified Guidance. As such, detection monitoring was continued in accordance with §257.94 of the CCR Rule.

3.4 Data Comparison to Background Limits – Second Semiannual Event (October 2018)

The data comparisons for the October 2018 groundwater monitoring event are presented on Table 4. The statistical evaluation of the October 2018 Appendix III indicator parameters shows all of the results are below their respective background limits and, therefore, there are no SSIs over background.

Section 4
Conclusions and Recommendations

No SSIs were recorded for the 2018 monitoring period and detection monitoring will be continued at the MONPP FAB CCR unit in accordance with §257.94. In addition, as discussed above, and in the GWMS Report, based on the artesian conditions, the low permeability of the underlying natural soils, and the calculated time of travel for groundwater to flow vertically from the MONPP FAB to the uppermost aquifer, it is not possible for the uppermost aquifer to have been affected by CCR from FAB operations that began in 1975. Also, due to limitations on CCR Rule implementation timelines, the background data sets are of relatively short duration for capturing the occurrence of natural temporal changes in the aquifer.

No corrective actions were performed in 2018. The next semiannual monitoring event at the MONPP FAB CCR unit is scheduled for the second calendar quarter of 2019.

Section 5
Groundwater Monitoring Report Certification

The U.S. EPA's Disposal of Coal Combustion Residuals from Electric Utilities Final Rule Title 40 CFR Part 257 §257.90(e) requires that the owner or operator of an existing CCR unit prepare an annual groundwater monitoring and corrective action report.

Annual Groundwater Monitoring Report Certification
Monroe Power Plant Fly Ash Basin
Monroe, Michigan

CERTIFICATION

I hereby certify that the annual groundwater and corrective action report presented within this document for the MONPP FAB CCR unit has been prepared to meet the requirements of Title 40 CFR §257.90(e) of the Federal CCR Rule. This document is accurate and has been prepared in accordance with good engineering practices, including the consideration of applicable industry standards, and with the requirements of Title 40 CFR §257.90(e).

Name: David B. McKenzie, P.E.	Expiration Date: October 31, 2019	State of Michigan David B. McKenzie Engineer No. 42332 Licensed Professional Engineer
Company: TRC Engineers Michigan, Inc.	Date: January 31, 2019	Stamp

Section 6
References

TRC Environmental Corporation. August 2016; Revised March 2017. CCR Groundwater Monitoring and Quality Assurance Project Plan – DTE Electric Company Monroe Power Plant Coal Combustion Residual Fly Ash Basin, 7955 East Dunbar Road, Monroe, Michigan. Prepared for DTE Electric Company.

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USEPA. April 2018. Barnes Johnson (Office of Resource Conservation and Recovery) to James Roewer (c/o Edison Electric Institute) and Douglas Green, Margaret Fawal (Venable LLP). Re: Coal Combustion Residuals Rule Groundwater Monitoring Requirements. April 30, 2018. United States Environmental Protection Agency, Washington, D.C. 20460. Office of Solid Waste and Emergency Response, now the Office of Land and Emergency Management.

Tables

Table 1
Summary of Groundwater Elevation Data – April and October 2018
Monroe Power Plant Fly Ash Basin – RCRA CCR Monitoring Program
Monroe, Michigan

Well ID	MW-16-01		MW-16-02		MW-16-03		MW-16-04		MW-16-05		MW-16-06		MW-16-07	
Date Installed	2/17/2016		2/18/2016		2/16/2016		2/15/2016		4/13/2016		4/13/2016		4/14/2016	
TOC Elevation	581.74		581.81		579.95		585.54		583.25		581.94		578.40	
Geologic Unit of Screened Interval	Silt/Limestone Interface		Silt/Limestone Interface		Sand & Silty Clay Limestone Interface		Silty Sand and Gravel		Limestone		Gravel and Cobbles		Silt/Limestone Interface	
Screened Interval Elevation	530.9 to 525.9		526.4 to 521.4		540.3 to 535.3		541.6 to 536.6		540.5 to 535.5		534.2 to 529.2		540.4 to 535.4	
Unit	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft
Measurement Date	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation
4/2/2018	4.90	576.84	-2.90	584.71	-11.20	591.15	-15.80	601.34	-12.80	596.05	-0.50	582.44	-7.10	585.50
10/8/2018	4.90	576.84	-2.00	583.81	-8.30	588.25	-13.30	598.84	-10.75	594.00	0.27	581.67	-6.50	584.90

Notes:

Negative depth to water measurement indicates artesian conditions, actual measured water level is above the top of casing.

Elevations are reported in feet relative to the North American Vertical Datum of 1988.

ft BTOC - feet below top of casing

Table 2
Summary of Field Parameters – April and October 2018
Monroe Power Plant Fly Ash Basin – RCRA CCR Monitoring Program
Monroe, Michigan

Sample Location	Sample Date	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	pH (SU)	Specific Conductivity (umhos/cm)	Temperature (deg C)	Turbidity (NTU)
MW-16-01	4/2/2018	0.37	17.9	7.1	2,371	10.47	3.81
	10/8/2018	1.64	59.0	7.1	1,578	14.17	2.86
MW-16-02	4/3/2018	0.11	13.8	7.0	2,350	10.35	2.84
	10/8/2018	0.08	5.8	7.1	2,095	12.11	4.53
MW-16-03	4/3/2018	0.09	-3.8	7.0	2,374	11.28	14.8
	10/8/2018	0.11	-12.7	7.1	2,104	14.35	11.2
MW-16-04	4/3/2018	0.13	-105.2	7.0	2,176	11.00	2.59
	10/8/2018	0.11	-56.2	7.1	2,042	11.81	2.03
MW-16-05	4/3/2018	0.07	-41.3	7.0	2,234	11.53	9.95
	10/8/2018	0.05	-21.6	7.1	2,013	12.02	5.96
MW-16-06	4/2/2018	0.10	14.6	7.1	2,276	11.84	4.58
	10/8/2018	1.28	27.1	7.0	1,658	15.75	38.2
MW-16-07	4/2/2018	0.08	-10.8	7.0	2,177	11.74	3.15
	10/8/2018	0.06	-13.4	7.0	2,008	12.59	2.69

Notes:
mg/L - milligrams per liter.
mV - milliVolt.
SU - standard unit.
umhos/cm - micro-mhos per centimeter.
deg C - degrees celcius.
NTU - nephelometric turbidity units.

Table 3
Comparison of Appendix III Parameter Results to Background Limits – April 2018
Monroe Power Plant Fly Ash Basin – RCRA CCR Monitoring Program
Monroe, Michigan

Sample Location:		MW-16-01		MW-16-02		MW-16-03		MW-16-04		MW-16-05		MW-16-06			MW-16-07		
Sample Date:		4/2/2018	PL	4/3/2018	PL	4/3/2018	PL	4/3/2018	PL	4/3/2018	PL	4/2/2018	5/23/18 (1)	PL	4/2/2018	5/23/18 (1)	PL
Constituent	Unit	Data		Data		Data		Data		Data		Data			Data		
Appendix III																	
Boron	ug/L	280	310	400	470	460	510	180	210	240	280	340	--	400	220	--	280
Calcium	ug/L	420,000	450,000	410,000	430,000	280,000	490,000	300,000	610,000	440,000	440,000	**430,000**	380,000	420,000	**450,000**	410,000	440,000
Chloride	mg/L	11	14	14	15	19	20	35	39	11	12	12	--	12	8.1	--	13
Fluoride	mg/L	1.8	2.1	1.6	1.8	1.5	1.8	1.0	1.1	1.5	1.7	1.6	--	1.8	1.5	--	1.8
pH, Field	SU	7.1	6.3 - 9.0	7.0	6.9 - 7.3	7.0	6.7 - 7.3	7.0	7.0 - 7.5	7.0	6.6 - 7.7	7.1	--	7.0 - 7.3	7.0	--	6.9 - 7.4
Sulfate	mg/L	1,500	1,500	1,500	1,700	1,600	1,700	1,400	1,500	1,400	1,600	1,500	--	1,600	1,400	--	1,600
Total Dissolved Solids	mg/L	2,200	2,200	2,100	2,300	2,200	2,300	2,000	2,200	2,000	2,200	**2,500**	2,200	2,300	2,000	--	2,200

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
-- = not analyzed
All metals were analyzed as total unless otherwise specified.
Bold font indicates an exceedance of the Prediction Limit (PL).
RESULT Shading and bold font indicates a comfirmed exceedance of the Prediction Limit (PL).
(1) Results shown for verification sampling performed on 5/23/18.

Table 4
Comparison of Appendix III Parameter Results to Background Limits – October 2018
Monroe Power Plant Fly Ash Basin – RCRA CCR Monitoring Program
Monroe, Michigan

Sample Location:		MW-16-01		MW-16-02		MW-16-03		MW-16-04		MW-16-05		MW-16-06		MW-16-07	
Sample Date:		10/8/2018	PL	10/8/2018	PL	10/8/2018	PL	10/8/2018	PL	10/8/2018	PL	10/8/2018	PL	10/8/2018	PL
Constituent	Unit	Data		Data		Data		Data		Data		Data		Data	
Appendix III															
Boron	ug/L	280	310	410	470	480	510	200	210	240	280	360	400	220	280
Calcium	ug/L	350,000	450,000	340,000	430,000	400,000	490,000	500,000	610,000	350,000	440,000	360,000	420,000	360,000	440,000
Chloride	mg/L	11	14	14	15	19	20	35	39	11	12	12	12	8.1	13
Fluoride	mg/L	1.7	2.1	1.5	1.8	1.5	1.8	0.99	1.1	1.4	1.7	1.5	1.8	1.5	1.8
pH, Field	SU	7.1	6.3 - 9.0	7.1	6.9 - 7.3	7.1	6.7 - 7.3	7.1	7.0 - 7.5	7.1	6.6 - 7.7	7.0	7.0 - 7.3	7.0	6.9 - 7.4
Sulfate	mg/L	1,500	1,500	1,600	1,700	1,600	1,700	1,500	1,500	1,600	1,600	1,600	1,600	1,600	1,600
Total Dissolved Solids	mg/L	2,100	2,200	2,200	2,300	2,200	2,300	2,000	2,200	2,000	2,200	2,100	2,300	2,100	2,200

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
-- = not analyzed
All metals were analyzed as total unless otherwise specified.
Bold font indicates an exceedance of the Prediction Limit (PL).
RESULT Shading and bold font indicates a comfirmed exceedance of the Prediction Limit (PL).

Figures

BASE MAP FROM USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE SERIES.

N

1 " = 2,000 '
1:24,000

0 2,000 4,000 FEET

TRC

1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080

TRC - GIS

PROJECT:	**DTE ELECTRIC COMPANY** **MONROE POWER PLANT** **7955 EAST DUNBAR ROAD** **MONROE, MICHIGAN**
TITLE:	**SITE LOCATION MAP**

DRAWN BY:	J. PAPEZ
CHECKED BY:	S HOLMSTROM
APPROVED BY:	V. BUENING
DATE:	OCTOBER 2017
PROJ. NO.:	265996.0001
FILE:	265996-SLMMB.mxd

FIGURE 1

LEGEND

- MONITORING WELLS
- APPROXIMATE BOUNDARY OF FLY ASH BASIN

NOTES

1. BASE MAP IMAGERY FROM ESRI/MICROSOFT, "WORLD IMAGERY", WEB BASEMAP SERVICE LAYER.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:

DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:

MONITORING NETWORK AND SITE PLAN

DRAWN BY:	J. PAPEZ	PROJ NO.:	265996.0001
CHECKED BY:	S. HOLMSTROM	**FIGURE 2**	
APPROVED BY:	V. BUENING		
DATE:	JANUARY 2018		

TRC

1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080
www.trcsolutions.com

FILE NO.: 265996-0001-000.mxd

TRC - GIS

Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

Plot Date: 1/29/2018, 09:45:57 AM by SMAJOR -- LAYOUT: ANSI B(11"x17")
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LEGEND

- MONITORING WELL
- APPROXIMATE BOUNDARY OF FLY ASH BASIN
- INFERRED GROUNDWATER FLOW DIRECTION
- POTENTIOMETRIC SURFACE CONTOUR LINE (5-FT INTERVAL,DASHED WHERE INFERRED)
- (582.69) STATIC WATER ELEVATION IN FEET (NAVD, 1988)

NOTES

1. BASE MAP IMAGERY FROM ESRI/MICROSOFT, "WORLD IMAGERY", WEB BASEMAP SERVICE LAYER.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.
3. GROUNDWATER ELEVATIONS DISPLAYED IN FEET RELATIVE TO NORTH AMERICAN VERTICAL DATUM OF 1988

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:
DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:
POTENTIOMETRIC SURFACE MAP
APRIL 2018

DRAWN BY:	S MAJOR	PROJ NO.:	265996.0001
CHECKED BY:	C. SCIESZKA	**FIGURE 3**	
APPROVED BY:	V. BUENING		
DATE:	JANUARY 2019		

TRC

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Phone: 734.971.7080
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FILE NO.: 265996-0001-013.mxd

TRC - GIS

Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

Plot Date: 1/2/2019, 09:48:54 AM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\DTE\CCR_Sites\2017_265996\265996-0001-013.mxd

LEGEND

MONITORING WELL

APPROXIMATE BOUNDARY OF FLY ASH BASIN

INFERRED GROUNDWATER FLOW DIRECTION

POTENTIOMETRIC SURFACE CONTOUR LINE (5-FT INTERVAL,DASHED WHERE INFERRED)

(582.69) STATIC WATER ELEVATION IN FEET (NAVD, 1988)

NOTES

1. BASE MAP IMAGERY FROM ESRI/MICROSOFT, "WORLD IMAGERY", WEB BASEMAP SERVICE LAYER.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.
3. GROUNDWATER ELEVATIONS DISPLAYED IN FEET RELATIVE TO NORTH AMERICAN VERTICAL DATUM OF 1988

N

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:

DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:

POTENTIOMETRIC SURFACE MAP
OCTOBER 2018

DRAWN BY:	S MAJOR	PROJ NO.:	265996.0001
CHECKED BY:	C. SCIESZKA	**FIGURE 4**	
APPROVED BY:	V. BUENING		
DATE:	JANUARY 2019		

TRC
1540 Eisenhower Place
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FILE NO.: 265996-0001-015.mxd

TRC - GIS

Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

Plot Date: 1/2/2019, 12:36:34 PM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\DTE\CCR_Sites\2017_265996\265996-0001-015.mxd

Appendix A
Alternate Source Demonstration

Technical Memorandum

Date: April 12, 2018

To: Robert J. Lee, DTE Electric Company

From: Sarah Holmstrom, TRC
Graham Crockford, TRC

Project No.: 265996.0001.0000 Phase 002, Task 001

Subject: Alternate Source Demonstration: 2017 Initial Detection Monitoring Sampling Event
Monroe Power Plant Coal Combustion Residual Fly Ash Basin, Monroe, Michigan

Introduction

On April 17, 2015, the United States Environmental Protection Agency (USEPA) published the final rule for the regulation and management of Coal Combustion Residuals (CCR) under the Resource Conservation and Recovery Act (RCRA) (the CCR Rule). The CCR Rule, which became effective on October 19, 2015, applies to the DTE Electric Company (DTE Electric) Monroe Power Plant (MONPP) Coal Combustion Residual Fly Ash Basin (FAB) CCR unit.

TRC Engineers Michigan, Inc. (TRC) prepared the 2017 Annual Groundwater Monitoring Report (Annual Report) for the MONPP FAB CCR unit on behalf of DTE Electric in accordance with the requirements of §257.90(e) (TRC, 2018). The Annual Report included the results of the September 2017 semiannual groundwater monitoring event for the MONPP FAB CCR unit and the statistical evaluation of the detection monitoring parameters (Appendix III to Part 257 of the CCR Rule) for the MONPP FAB CCR unit. This event was the initial detection monitoring event performed to comply with §257.94. As part of the statistical evaluation, the data collected during detection monitoring events are evaluated to identify statistically significant increases (SSIs) in detection monitoring parameters to determine if concentrations in detection monitoring well samples exceed background levels. The statistical analysis was performed pursuant to §257.93(f) and (g), and in accordance with the Groundwater Statistical Evaluation Plan (Stats Plan) (TRC, 2017).

The statistical evaluation of the September 2017 Appendix III indicator parameters showed potential SSIs over background for:

- pH at MW-16-06 and MW-16-07

All other Appendix III constituents were within the statistical background limits.

Technical Memorandum

In accordance with §257.94(3)(2), DTE Electric may demonstrate that a source other than the CCR unit caused the SSI or that the SSI resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. This Alternate Source Demonstration (ASD) has been prepared to address the potential SSIs identified in the September 2017 detection monitoring event.

Background

The MONPP is located in Monroe in Monroe County, Michigan. The MONPP FAB is bounded by Dunbar Road and Plum Creek to the north and northeast, Interstate 75 to the northwest, a 200-acre peninsula into Lake Erie to the east and southeast, Lake Erie to the south and a large open field to the southwest. The property has been used continuously for the operation of the MONPP FAB since approximately 1975 and is constructed over a natural clay-rich soil base. The MONPP FAB and landfill is a Type III solid waste disposal facility owned by DTE Electric, which currently accepts coal ash from DTE Electric's MONPP. The MONPP FAB is operated in accordance with Michigan Part 115 of the Natural Resources and Environmental Protection Act (NREPA), PA 451 of 1994, as amended, and the current operating license number 9393.

The MONPP FAB CCR unit uppermost aquifer consists of saturated limestone present beneath at least 37 feet and up to 53.5 feet of thick contiguous silty clay-rich soil that serves as a natural confining hydraulic barrier that isolates the underlying uppermost aquifer. The limestone bedrock aquifer is artesian in every location except MW-16-01, where the static water level was approximately 1 to 2 feet below ground surface (bgs).

The detection monitoring well network for the MONPP FAB CCR unit currently consists of seven monitoring wells that are screened in the uppermost aquifer. The MONPP FAB CCR unit uses intrawell statistical methods because the saturated unit being monitored is isolated by a laterally contiguous silty clay unit which significantly impedes vertical groundwater flow thus preventing the monitored saturated zone from potentially being affected by CCR. In addition, the flow potential of liquid within the FAB is radially outward relative to the uppermost aquifer due to the elevation water is maintained within the FAB CCR unit. Based on these hydrogeologic conditions, intrawell statistical tests are used during detection monitoring as outlined in the Stats Plan.

Alternate Source Demonstration

Verification resampling was performed as recommended per the Stats Plan and the USEPA's Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance (Unified Guidance, USEPA, 2009) to achieve performance standards as specified by §257.93(g) in the CCR rules. Per the Stats Plan, if there is an exceedance of a prediction limit for one or more of the parameters, the well(s) of concern will be resampled within 30 days of the completion of the initial statistical analysis. Only constituents that initially exceed their statistical limit (i.e., have no previously recorded SSIs) will be analyzed for verification purposes. As such, verification resampling was conducted on January 8, 2018, by TRC personnel. Groundwater samples were collected for pH (field reading) at monitoring wells MW-16-06 and MW-16-07 in accordance with the Quality Assurance Project Plan (TRC, August 2016; Revised March 2017). A summary of the groundwater data collected during the verification resampling event is provided on Table 1. The associated data quality review is included in Attachment A.

All of the pH verification results are within the prediction limits; consequently, the initial SSIs from the September 2017 event are not confirmed. Therefore, in accordance with the Stats Plan and the Unified Guidance, the initial exceedances are not statistically significant and no SSIs will be recorded for the September 2017 monitoring event.

Conclusions and Recommendations

Based on the results of the verification resampling, the initial exceedances for pH at monitoring wells MW-16-06 and MW-16-07 are not statistically significant; therefore, no SSIs are recorded for the initial detection monitoring event.

In addition, as discussed in the Annual Report, based on the artesian conditions, the low permeability of the underlying natural soils, and the calculated time of travel for groundwater to flow vertically from the MONPP FAB to the uppermost aquifer, it is not possible for the uppermost aquifer to have been affected by CCR from FAB operations that began in 1975. Due to limitations on CCR Rule implementation timelines, the background data sets are of relatively short duration for capturing the occurrence of natural temporal changes in the aquifer.

Since no confirmed SSIs over background limits were identified for any of the Appendix III parameters during the September 2017 monitoring event, DTE Electric will continue with the detection monitoring program at MONPP FAB. The next semiannual monitoring event is scheduled for the second calendar quarter of 2018.

Technical Memorandum

Certification Statement

I hereby certify that the alternative source demonstration presented within this document for the MONPP FAB CCR unit has been prepared to meet the requirements of Title 40 CFR §257.94(e) 2 of the Federal CCR Rule. This document is accurate and has been prepared in accordance with good engineering practices, including the consideration of applicable industry standards, and with the requirements of Title 40 CFR §257.94(e) 2.

Name: David B. McKenzie, P.E.	Expiration Date: October 31, 2019	State of Michigan David B. McKenzie Engineer No. 42332 Licensed Professional Engineer Stamp
Company: TRC Engineers Michigan, Inc.	Date: April 12, 2018	

References

TRC Environmental Corporation. August 2016; Revised March 2017. CCR Groundwater Monitoring and Quality Assurance Project Plan – DTE Electric Company Monroe Power Plant Coal Combustion Residual Fly Ash Basin, 7955 East Dunbar Road, Monroe, Michigan. Prepared for DTE Electric Company.

TRC Environmental Corporation. October 2017. Groundwater Statistical Evaluation Plan – Monroe Power Plant Coal Combustion Residual Fly Ash Basin, 7955 East Dunbar Road, Monroe, Michigan. Prepared for DTE Electric Company.

TRC Environmental Corporation. January 2018. Annual Groundwater Monitoring Report – Monroe Power Plant Coal Combustion Residual Fly Ash Basin, 7955 East Dunbar Road, Monroe, Michigan. Prepared for DTE Electric Company.

USEPA. 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA facilities, Unified Guidance. Office of Conservation and Recovery. EPA 530/R-09-007.

Attachments

Table 1. Comparison of Verification Sampling Results to Background Limits

Attachment A. Data Quality Review

Table 1

Table 1
Comparison of Verification Sampling Results to Background Limits
Monroe Power Plant Fly Ash Basin – RCRA CCR Monitoring Program
Monroe, Michigan

	Sample Location:	**MW-16-06**		**MW-16-07**	
	Sample Date:	1/8/2018		1/8/2018	
Constituent	Unit	Data	PL	Data	PL
Appendix III					
pH, Field	SU	7.0	7.0 - 7.3	7.0	6.9 - 7.4

Notes:

SU - standard units; pH is a field parameter.

RESULT Shading and bold font indicates a confirmed exceedance of the Prediction Limit (PL).

Attachment A

Field Parameter Data Quality Review
Groundwater Monitoring Event January 2018 (Verification Resampling)
DTE Electric Company Monroe Fly Ash Basin (DTE MFAB)

On January 8, 2018, TRC Environmental Corporation (TRC) collected groundwater samples at monitoring wells MW-16-06 and MW-16-07 to verify initial pH (field measured) results that were outside of the prediction limits during the September 2017 detection monitoring event. Prior to sample collection, groundwater was purged and stabilized using the low flow sampling methods followed during the September 2017 monitoring event in accordance with the *CCR Groundwater Monitoring and Quality Assurance Project Plan* (TRC, March 2017).

TRC reviewed the laboratory data to assess data usability. The following sections summarize the data review procedure and the results of the review.

Data Quality Review Procedure

The following items were included in the evaluation of the data:

- Review of sonde calibration data;
- Confirm field parameter stabilization criteria were met;
- Compare field parameters to historical data; and
- Overall usability of the data based on these items.

Review Summary

The data quality objectives and completeness goals for the project were met, and the data are usable for their intended purpose. A summary of the data quality review, including non-conformances and issues identified in this evaluation are noted below.

QA/QC Sample Summary:

- Sonde calibration readings were within calibration range for all field parameters.
- Field parameters met stabilization criteria for 3 successive readings.
- Field parameters readings were comparable to historical data.
- Data are usable for purposes of verification resampling.

Appendix B
Data Quality Reviews

Laboratory Data Quality Review
Groundwater Monitoring Event April 2018 (Detection Monitoring)
DTE Electric Company Monroe Fly Ash Basin (DTE MFAB)

Groundwater samples were collected by TRC for the April 2018 sampling event. Samples were analyzed for anions, total metals, and total dissolved solids by Test America Laboratories, Inc. (Test America), located in Canton, Ohio. The laboratory analytical results are reported in laboratory report J93633-1.

During the April 2018 sampling event, a groundwater sample was collected from each of the following wells:

- MW-16-01
- MW-16-02
- MW-16-03
- MW-16-04
- MW-16-05
- MW-16-06
- MW-16-07

Each sample was analyzed for the following constituents:

Analyte Group	Method
Anions (Chloride, Fluoride, Sulfate)	EPA 300.0
Total Metals	EPA 6010B
Total Dissolved Solids	SM 2540C

TRC reviewed the laboratory data to assess data usability. The following sections summarize the data review procedure and the results of the review.

Data Quality Review Procedure

The analytical data were reviewed using the USEPA National Functional Guidelines for Inorganic Superfund Data Review (USEPA, 2017). The following items were included in the evaluation of the data:

- Sample receipt, as noted in the cover page or case narrative;
- Technical holding times for analyses;
- Data for method blanks. Method blanks are used to assess potential contamination arising from laboratory sample preparation and/or analytical procedures;
- Percent recoveries for matrix spike (MS) and matrix spike duplicates (MSD). Percent recoveries are calculated for each analyte spiked and used to assess bias due to sample matrix effects;
- Reporting limits (RLs) compared to project-required RLs;

- Data for blind field duplicates. Field duplicate samples are used to assess variability introduced by the sampling and analytical processes;
- Data for laboratory control samples (LCSs). The LCSs are used to assess the accuracy of the analytical method using a clean matrix;
- Overall usability of the data.

This data usability report addresses the following items:

  - Usability of the data if quality control (QC) results suggest potential problems with all or some of the data;
  - Actions regarding specific QC criteria exceedances.

Review Summary

The data quality objectives and laboratory completeness goals for the project were met, and the data are usable for their intended purpose. A summary of the data quality review, including non-conformances and issues identified in this evaluation are noted below.

- Appendix III constituents will be utilized for the purposes of a detection monitoring program.
- Data are usable for the purposes of the detection monitoring program.

QA/QC Sample Summary:

- Target analytes were not detected in the method blank.
- LCS recoveries were within laboratory control limits.
- Dup-01 corresponds with MW-16-05; relative percent differences (RPDs) between the parent and duplicate sample were within the QC limits.
- MS/MSD analyses were performed on sample MW-16-07 for anions (chloride and fluoride). Percent recoveries and RPDs were within the QC limits.

Laboratory Data Quality Review
Groundwater Monitoring Event May 2018 (Verification Resampling)
DTE Electric Company Monroe Fly Ash Basin (DTE MFAB)

Groundwater samples were collected by TRC for the May 2018 verification resampling event. Samples were analyzed for total metals (calcium) and total dissolved solids by Test America Laboratories, Inc. (Test America), located in Canton, Ohio. The laboratory analytical results are reported in laboratory report J96216-1.

During the May 2018 sampling event, a groundwater sample was collected from each of the following wells:

- MW-16-01
- MW-16-02
- MW-16-03
- MW-16-04
- MW-16-05
- MW-16-06
- MW-16-07

Each sample was analyzed for the following constituents:

Analyte Group	Method
Total Metals (Calcium)	EPA 6020
Total Dissolved Solids	SM 2540C

TRC reviewed the laboratory data to assess data usability. The following sections summarize the data review procedure and the results of the review.

Data Quality Review Procedure

The analytical data were reviewed using the USEPA National Functional Guidelines for Inorganic Superfund Data Review (USEPA, 2017). The following items were included in the evaluation of the data:

- Sample receipt, as noted in the cover page or case narrative;
- Technical holding times for analyses;
- Reporting limits (RLs) compared to project-required RLs;
- Data for method blanks. Method blanks are used to assess potential contamination arising from laboratory sample preparation and/or analytical procedures;
- Data for laboratory control samples (LCSs). The LCSs are used to assess the accuracy of the analytical method using a clean matrix;
- Data for blind field duplicates. Field duplicate samples are used to assess variability introduced by the sampling and analytical processes;

- Overall usability of the data.

This data usability report addresses the following items:

  - Usability of the data if quality control (QC) results suggest potential problems with all or some of the data;
  - Actions regarding specific QC criteria exceedances.

Review Summary

The data quality objectives and laboratory completeness goals for the project were met, and the data are usable for their intended purpose. A summary of the data quality review, including non-conformances and issues identified in this evaluation are noted below.

- Appendix III constituents will be utilized for the purposes of a detection monitoring program.
- Data are usable for the purposes of the detection monitoring program.

QA/QC Sample Summary:

- Target analytes were not detected in the associated method blanks.
- LCS recoveries were within laboratory control limits.
- The field duplicate pair was sample Dup-01 with MW-16-06; relative percent differences (RPDs) between the parent and duplicate sample were within the QC limits.

Laboratory Data Quality Review
Groundwater Monitoring Event October 2018 (Detection Monitoring)
DTE Electric Company Monroe Fly Ash Basin (DTE MFAB)

Groundwater samples were collected by TRC for the October 2018 sampling event. Samples were analyzed for anions, total metals, and total dissolved solids by Test America Laboratories, Inc. (Test America), located in North Canton, Ohio. The laboratory analytical results are reported in laboratory report 240-102555-1.

During the October 2018 sampling event, a groundwater sample was collected from each of the following wells:

- MW-16-01
- MW-16-02
- MW-16-03
- MW-16-04
- MW-16-05
- MW-16-06
- MW-16-07

Each sample was analyzed for the following constituents:

Analyte Group	Method
Anions (Chloride, Fluoride, Sulfate)	SW846 9056A
Total Boron	SW846 3005A/6010B
Total Calcium	SW846 3005A/6020
Total Dissolved Solids	SM 2540C

TRC reviewed the laboratory data to assess data usability. The following sections summarize the data review procedure and the results of the review.

Data Quality Review Procedure

The analytical data were reviewed using the USEPA National Functional Guidelines for Inorganic Superfund Data Review (USEPA, 2017). The following items were included in the evaluation of the data:

- Sample receipt, as noted in the cover page or case narrative;
- Technical holding times for analyses;
- Reporting limits (RLs) compared to project-required RLs;
- Data for method blanks and equipment blanks. Method blanks are used to assess potential contamination arising from laboratory sample preparation and/or analytical procedures. Equipment blanks are used to assess potential contamination arising from field procedures;
- Data for laboratory control samples (LCSs). The LCSs are used to assess the accuracy of the analytical method using a clean matrix;

- Data for matrix spike and matrix spike duplicate samples (MS.MSDs). The MS/MSDs are used to assess the accuracy and precision of the analytical method using a sample from the dataset;
- Data for laboratory duplicates. The laboratory duplicates are used to assess the precision of the analytical method using a sample from the dataset;
- Data for blind field duplicates. Field duplicate samples are used to assess variability introduced by the sampling and analytical processes; and
- Overall usability of the data.

This data usability report addresses the following items:

- Usability of the data if quality control (QC) results suggest potential problems with all or some of the data;
- Actions regarding specific QC criteria exceedances.

Review Summary

The data quality objectives and laboratory completeness goals for the project were met, and the data are usable for their intended purpose. A summary of the data quality review, including non-conformances and issues identified in this evaluation are noted below.

- Appendix III constituents will be utilized for the purposes of a detection monitoring program.
- Data are usable for the purposes of the detection monitoring program.

QA/QC Sample Summary:

- Target analytes were not detected in the method blank.

- LCS recoveries for all target analytes were within laboratory control limits.

- Dup-01 corresponds with MW-16-01; relative percent differences (RPDs) between the parent and duplicate sample were within the QC limits.

Appendix E
2017 Annual Groundwater Monitoring Report

Annual Groundwater Monitoring Report

DTE Electric Company
Monroe Power Plant Fly Ash Basin
Coal Combustion Residual Unit

7955 East Dunbar Road
Monroe, Michigan

January 2018

Annual Groundwater Monitoring Report

DTE Electric Company
Monroe Power Plant Fly Ash Basin
Coal Combustion Residual Unit

7955 East Dunbar Road
Monroe, Michigan

January 2018

Prepared For
DTE Electric Company

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Senior Project Engineer

TRC | DTE Electric Company
Final
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Table of Contents

List of Tables

List of Figures

List of Appendices

Executive Summary

On April 17, 2015, the United States Environmental Protection Agency (USEPA) published the final rule for the regulation and management of Coal Combustion Residuals (CCR) under the Resource Conservation and Recovery Act (RCRA) (the CCR Rule). The CCR Rule, which became effective on October 19, 2015, applies to the DTE Electric Company (DTE Electric) Monroe Power Plant (MONPP) Coal Combustion Residual Fly Ash Basin (FAB) CCR unit. Pursuant to the CCR Rule, no later than January 31, 2018, and annually thereafter, the owner or operator of a CCR unit must prepare an annual groundwater monitoring and corrective action report for the CCR unit documenting the status of groundwater monitoring and corrective action for the preceding year in accordance with §257.90(e).

TRC Engineers Michigan, Inc., the engineering entity of TRC Environmental Corporation (TRC), prepared this Annual Groundwater Monitoring Report (Annual Report) for the MONPP FAB CCR unit on behalf of DTE Electric. This Annual Report was prepared in accordance with the requirements of §257.90(e) and presents the monitoring results and the statistical evaluation of the detection monitoring parameters (Appendix III to Part 257 of the CCR Rule) for the September 2017 semiannual groundwater monitoring event for the MONPP FAB CCR unit. This event is the initial detection monitoring event performed to comply with §257.94. As part of the statistical evaluation, the data collected during detection monitoring events are evaluated to identify statistically significant increases (SSIs) in detection monitoring parameters to determine if concentrations in detection monitoring well samples exceed background levels.

Potential SSIs over background limits were noted for pH in one or more downgradient wells for the September 2017 monitoring event. This is the initial detection monitoring event; therefore, it is the initial identification of a SSI over background levels. Based on the hydrogeology at the Site, with the presence of the clay-rich confining till beneath the MONPP FAB CCR unit, it is not possible for the uppermost aquifer to have been affected by CCR from operations. Due to limitations on CCR Rule implementation timelines, the background data sets are of relatively short duration for capturing the occurrence of natural temporal changes in the aquifer.

According to §257.94(e), if the facility determines, pursuant to §257.93(h), that there is a SSI over background levels for one or more of the Appendix III constituents, the facility will, within 90 days of detecting a SSI, establish an assessment monitoring program **<or>** demonstrate that:

- A source other than the CCR unit caused the SSI, or
- The SSI resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality.

In response to the potential pH SSIs over background limits noted during the September 2017 monitoring event, DTE Electric plans to collect a resample for each of the potential SSIs and prepare an Alternative Source Demonstration (ASD) to evaluate the SSIs. The SSI is likely the result of temporal variability that was not captured in the background data set, given the short duration of time that the background data set was collected, but this will be further evaluated during the ASD process.

Section 1
Introduction

1.1 Program Summary

On April 17, 2015, the United States Environmental Protection Agency (USEPA) published the final rule for the regulation and management of Coal Combustion Residuals (CCR) under the Resource Conservation and Recovery Act (RCRA) (the CCR Rule). The CCR Rule, which became effective on October 19, 2015, applies to the DTE Electric Company (DTE Electric) Monroe Power Plant (MONPP) Coal Combustion Residual Fly Ash Basin (FAB) CCR unit. Pursuant to the CCR Rule, no later than January 31, 2018, and annually thereafter, the owner or operator of a CCR unit must prepare an annual groundwater monitoring and corrective action report for the CCR unit documenting the status of groundwater monitoring and corrective action for the preceding year in accordance with §257.90(e).

TRC Engineers Michigan, Inc., the engineering entity of TRC Environmental Corporation (TRC), prepared this Annual Groundwater Monitoring Report (Annual Report) for the MONPP FAB CCR unit on behalf of DTE Electric. This Annual Report was prepared in accordance with the requirements of §257.90(e) and presents the monitoring results and the statistical evaluation of the detection monitoring parameters (Appendix III to Part 257 of the CCR Rule) for the September 2017 semiannual groundwater monitoring event for the MONPP FAB CCR unit. This event is the initial detection monitoring event performed to comply with §257.94. The monitoring was performed in accordance with the *CCR Groundwater Monitoring and Quality Assurance Project Plan – DTE Electric Company Monroe Power Plant Coal Combustion Residual Fly Ash Basin* (QAPP) (TRC, August 2016; revised March 2017) and statistically evaluated per the *Groundwater Statistical Evaluation Plan – Monroe Power Plant Coal Combustion Residual Fly Ash Basin* (Stats Plan) (TRC, October 2017). As part of the statistical evaluation, the data collected during detection monitoring events are evaluated to identify statistically significant increases (SSIs) of detection monitoring parameters compared to background levels.

1.2 Site Overview

The MONPP is located in Section 16, Township 7 South, Range 9 East, at 7955 East Dunbar Road, Monroe in Monroe County, Michigan (Figure 1). The MONPP FAB is located about one mile southwest of the MONPP at latitude 41° 53' 03" North and longitude 83° 22' 31" West. The MONPP FAB is bounded by Dunbar Road and Plum Creek to the north and northeast, Interstate 75 to the northwest, a 200-acre peninsula into Lake Erie to the east and southeast, Lake Erie to the south and a large open field to the southwest (Figure 2).

The property has been used continuously for the operation of the MONPP FAB since approximately 1975 and is constructed over a natural clay-rich soil base. The MONPP FAB and landfill is a Type III solid waste disposal facility owned by DTE Electric, which currently accepts coal ash from DTE Electric's MONPP. The MONPP FAB is operated in accordance with Michigan Part 115 of the Natural Resources and Environmental Protection Act (NREPA), PA 451 of 1994, as amended, and the current operating license number 9393.

1.3 Geology/Hydrogeology

The MONPP FAB CCR unit is located within 200 feet southwest of Plum Creek and immediately north of Lake Erie. The MONPP FAB CCR unit uppermost aquifer consists of saturated limestone present beneath at least 37 feet and up to 53.5 feet of thick contiguous silty clay-rich soil that serves as a natural confining hydraulic barrier that isolates the underlying uppermost aquifer. The limestone bedrock aquifer is artesian in every location except MW-16-01, where the static water level was approximately 1 to 2 feet below ground surface (ft bgs).

Potentiometric groundwater elevation data collected in 2016 and 2017 suggest that there is horizontal groundwater flow potential within the upper aquifer unit generally to the northeast towards Plum Creek. The average hydraulic gradient to the northeast is on the order of 0.002 foot/foot along the eastern part of the MONPP FAB to 0.004 to 0.005 foot/foot in the center and northwestern part of the FAB, with an overall mean of 0.004 foot/foot.

The surface water elevation within the FAB raised surface impoundment is at least 5 to more than 30 feet above the potentiometric surface elevations in the uppermost aquifer limestone, and more than 60 feet above the base of the underlying clay-rich confining unit that isolates groundwater within the limestone aquifer. Therefore, flow potential from the CCR unit to the surrounding area would be radially outward from the FAB. However, there is no hydraulic communication between the uppermost aquifer and the FAB due to the continuous silty clay-rich confining unit beneath the MONPP FAB. Based on the artesian conditions, the low permeability of the underlying natural soils, and the calculated time of travel for groundwater to flow vertically from the FAB to the uppermost aquifer, it is not possible for the uppermost aquifer to have been affected by CCR from FAB operations that began in 1975.

The MONPP FAB CCR unit will use intrawell statistical methods because the saturated unit being monitored is isolated by a laterally contiguous silty clay unit which significantly impedes vertical groundwater flow thus preventing the monitored saturated zone from potentially being affected by CCR. In addition, the flow potential of liquid within the FAB is radially outward relative to the uppermost aquifer due to the elevation water is maintained within the FAB CCR unit. Based on these hydrogeologic conditions, intrawell statistical approaches are likely a more appropriate method to evaluate groundwater data statistically. Consequently, intrawell statistical tests will be used during detection monitoring as outlined in the Stats Plan.

Section 2
Groundwater Monitoring

2.1 Monitoring Well Network

A groundwater monitoring system has been established for the MONPP FAB CCR unit as detailed in the *Groundwater Monitoring System Summary Report – Monroe Power Plant Coal Combustion Residual Fly Ash Basin* (GWMS Report) (TRC, October 2017). The detection monitoring well network for the MONPP FAB CCR unit currently consists of seven monitoring wells that are screened in the uppermost aquifer. The monitoring well locations are shown on Figure 2.

As discussed in the Stats Plan, intrawell statistical methods for MONPP FAB were selected based on the geology and hydrogeology at the Site (primarily the presence of clay/hydraulic barrier and the hydraulic separation between the CCR unit and underlying uppermost aquifer), in addition to other supporting lines of evidence that the aquifer is unaffected by the CCR unit (such as the consistency in concentrations of water quality data). An intrawell statistical approach requires that each of the downgradient wells doubles as the background and compliance well, where data from each individual well during a detection monitoring event is compared to a statistical limit developed using the background dataset from that same well. Monitoring wells MW-16-01 through MW-16-07 are located around the perimeter of the MONPP FAB and provide data on both background and downgradient groundwater quality that has not been affected by the CCR unit (total of seven background/downgradient monitoring wells).

2.2 Background Sampling

Background groundwater monitoring was conducted at the MONPP FAB CCR unit from August 2016 through July 2017 in accordance with the QAPP. Data collection included eight background data collection events of static water elevation measurements, analysis for parameters required in the CCR Rule's Appendix III and Appendix IV to Part 257, and field parameters (dissolved oxygen, oxidation reduction potential, pH, specific conductivity, temperature, and turbidity) from all seven monitoring wells installed for the MONPP FAB CCR unit. The groundwater samples were analyzed by TestAmerica Laboratories, Inc. (TestAmerica).

Background data are included in Appendix A Tables 1 through 3, where: Table 1 is a summary of static water elevation data; Table 2 is a summary of groundwater analytical data compared to potentially relevant criteria; and Table 3 is a summary of field data. In addition to the data tables, groundwater potentiometric elevation data are summarized for each background monitoring event in Appendix A Figures 1 through 8.

2.3 Semiannual Groundwater Monitoring

The semiannual monitoring parameters for the detection groundwater monitoring program were selected per the CCR Rule's Appendix III to Part 257 – Constituents for Detection Monitoring. The Appendix III indicator parameters consist of boron, calcium, chloride, fluoride, pH (field reading), sulfate, and total dissolved solids (TDS) and were analyzed in accordance with the sampling and analysis plan included within the QAPP. In addition to pH, the collected field parameters included dissolved oxygen, oxidation reduction potential, specific conductivity, temperature, and turbidity.

2.3.1 Data Summary

The initial semiannual groundwater detection monitoring event for 2017 was performed during September 18 and 19, 2017, by TRC personnel and samples were analyzed by TestAmerica in accordance with the QAPP. Static water elevation data were collected at all seven monitoring well locations. Groundwater samples were collected from the seven detection monitoring wells for the Appendix III indicator parameters and field parameters. A summary of the groundwater data collected during the September 2017 event is provided on Table 1 (static groundwater elevation data), Table 2 (analytical results), and Table 3 (field data).

2.3.2 Data Quality Review

Data from each round were evaluated for completeness, overall quality and usability, method-specified sample holding times, precision and accuracy, and potential sample contamination. The data were found to be complete and usable for the purposes of the CCR monitoring program. Particular data non-conformances are summarized in Appendix B.

2.3.3 Groundwater Flow Rate and Direction

Groundwater elevation data collected during the most recent background sampling events showed that groundwater within the uppermost aquifer generally flows to the northeast across the Site. Groundwater potentiometric surface elevations measured across the Site during the September 2017 sampling event are provided on Table 1 and were used to construct a groundwater potentiometric surface map (Figure 3).

The map indicates that current groundwater flow is consistent with previous monitoring events. The average hydraulic gradient throughout the Site during this event is estimated at 0.004 ft/ft. Resulting in an estimated average seepage velocity of approximately 0.18 ft/day or 66 ft/year for this event, using the average hydraulic conductivity of 5 ft/day (TRC, 2017) and an assumed effective porosity of 0.1.

The general flow direction is similar to that identified in previous monitoring rounds and continues to demonstrate that the downgradient wells are appropriately positioned to detect the presence of Appendix III parameters that could potentially migrate from the MONPP FAB CCR unit.

Section 3
Statistical Evaluation

3.1 Establishing Background Limits

Per the Stats Plan, background limits were established for the Appendix III indicator parameters following the collection of at least eight background monitoring events using data collected from each of the seven established detection monitoring wells (MW-16-01 through MW-16-07). The statistical evaluation of the background data is presented in detail in Appendix C. The Appendix III background limits for each monitoring well will be used throughout the detection monitoring period to determine whether groundwater has been impacted from the MONPP FAB CCR unit by comparing concentrations in the detection monitoring wells to their respective background limits for each Appendix III indicator parameter.

3.2 Data Comparison to Background Limits

The concentrations of the indicator parameters in each of the detection monitoring wells (MW-16-01 through MW-16-07) were compared to their respective statistical background limits calculated from the background data collected from each individual well (i.e., monitoring data from MW-16-01 is compared to the background limit developed using the background dataset from MW-16-01, and so forth). The comparisons are presented on Table 4.

The statistical evaluation of the September 2017 Appendix III indicator parameters shows potential SSIs over background for:

- pH at MW-16-06 and MW-16-07.

There were no SSIs compared to background for boron, calcium, chloride, fluoride, sulfate or TDS.

Section 4
Conclusions and Recommendations

Potential SSIs over background limits were noted for pH in one or more downgradient wells during the September 2017 monitoring event. This is the initial detection monitoring event; therefore, it is the initial identification of a potential SSI over background levels. As discussed above, and in the GWMS Report, based on the artesian conditions, the low permeability of the underlying natural soils, and the calculated time of travel for groundwater to flow vertically from the MONPP FAB to the uppermost aquifer, it is not possible for the uppermost aquifer to have been affected by CCR from FAB operations that began in 1975. Due to limitations on CCR Rule implementation timelines, the background data sets are of relatively short duration for capturing the occurrence of natural temporal changes in the aquifer. In addition, although the statistical limits based on the initial eight-round background dataset were exceeded for pH, the calculated prediction limits and results respective to each of these potential SSIs are within the USEPA's maximum contaminant level (MCL) pH range of 6.5 to 8.5 standard units (SU) for drinking water (USEPA, 2012).

According to §257.94(e), in the event that the facility determines, pursuant to §257.93(h), that there is a SSI over background levels for one or more of the Appendix III constituents, the facility will, within 90 days of detecting a SSI, establish an assessment monitoring program **<or>** demonstrate that:

- A source other than the CCR unit caused the SSI, or
- The SSI resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality.

The owner or operator must complete a written demonstration (i.e., Alternative Source Demonstration, ASD), of the above within 90 days of confirming the SSI. Based on the outcome of the ASD the following steps will be taken:

- If a successful ASD is completed, a certification from a qualified professional engineer is required, and the CCR unit may continue with detection monitoring.
- If a successful ASD is not completed within the 90-day period, the owner or operator of the CCR unit must initiate an assessment monitoring program as required under §257.95. The facility must also include the ASD in the annual groundwater monitoring and corrective action report required by §257.90(e), in addition to the certification by a qualified professional engineer.

In response to the potential SSIs over background limits noted for the September 2017 monitoring event, DTE Electric plans to collect a resample for each of the potential SSIs and prepare an ASD within 90-days to evaluate the SSIs. The SSI is likely the result of temporal variability that was not captured in the background data set, given the short duration of time that the background data set was collected, but this will be further evaluated during the ASD process.

No corrective actions were performed in 2017. The next semiannual monitoring event at the MONPP FAB is scheduled for the second calendar quarter of 2018.

Section 5
Groundwater Monitoring Report Certification

The U.S. EPA's Disposal of Coal Combustion Residuals from Electric Utilities Final Rule Title 40 CFR Part 257 §257.90(e) requires that the owner or operator of an existing CCR unit prepare an annual groundwater monitoring and corrective action report.

Annual Groundwater Monitoring Report Certification
Monroe Power Plant Fly Ash Basin
Monroe, Michigan

CERTIFICATION

I hereby certify that the annual groundwater and corrective action report presented within this document for the MONPP FAB CCR unit has been prepared to meet the requirements of Title 40 CFR §257.90(e) of the Federal CCR Rule. This document is accurate and has been prepared in accordance with good engineering practices, including the consideration of applicable industry standards, and with the requirements of Title 40 CFR §257.90(e).

Name: David B. McKenzie, P.E.	Expiration Date: October 31, 2019	State of Michigan David B. McKenzie Engineer No. 42332 Licensed Professional Engineer Stamp
Company: TRC Engineers Michigan, Inc.	Date: 1/30/18	

Section 6
References

TRC Environmental Corporation. August 2016; Revised March 2017. CCR Groundwater Monitoring and Quality Assurance Project Plan – DTE Electric Company Monroe Power Plant Coal Combustion Residual Fly Ash Basin, 7955 East Dunbar Road, Monroe, Michigan. Prepared for DTE Electric Company.

TRC Environmental Corporation. October 2017. Groundwater Monitoring System Summary Report – Monroe Power Plant Coal Combustion Residual Fly Ash Basin, 7955 East Dunbar Road, Monroe, Michigan. Prepared for DTE Electric Company.

TRC Environmental Corporation. October 2017. Groundwater Statistical Evaluation Plan – Monroe Power Plant Coal Combustion Residual Fly Ash Basin, 7955 East Dunbar Road, Monroe, Michigan. Prepared for DTE Electric Company.

U.S. Environmental Protection Agency. April 2012. 2012 Edition of the Drinking Water Standards and Health Advisories. EPA 822-S-12-001. Office of Water, U.S. Environmental Protection Agency, Washington, DC. Spring 2012; Date of update: April, 2012.

Tables

Table 1
Groundwater Elevation Summary – September 2017
Monroe Fly Ash Basin – RCRA CCR Monitoring Program
Monroe, Michigan

Well ID	MW-16-01		MW-16-02		MW-16-03		MW-16-04		MW-16-05		MW-16-06		MW-16-07	
Date Installed	2/17/2016		2/18/2016		2/16/2016		2/15/2016		4/13/2016		4/13/2016		4/14/2016	
TOC Elevation	581.74		581.81		579.95		585.54		583.25		581.94		578.40	
Geologic Unit of Screened Interval	Silt/Limestone Interface		Silt/Limestone Interface		Sand & Silty Clay Limestone Interface		Silty Sand and Gravel		Limestone		Gravel and Cobbles		Silt/Limestone Interface	
Screened Interval Elevation	530.9 to 525.9		526.4 to 521.4		540.3 to 535.3		541.6 to 536.6		540.5 to 535.5		534.2 to 529.2		540.4 to 535.4	
Unit	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft
Measurement Date	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation
9/19/2017	5.07	576.67	-1.35	583.16	-8.93	588.88	-11.40	596.94	-10.60	593.85	0.83	581.11	-5.45	583.85

Notes:

Negative depth to water measurement indicates artesian conditions, actual measured water level is above the top of casing.

Elevations are reported in feet relative to the North American Vertical Datum of 1988.

ft BTOC - feet below top of casing

Table 2
Summary of Groundwater Analytical Data – September 2017
Monroe Power Plant Fly Ash Basin – RCRA CCR Monitoring Program
Monroe, Michigan

Sample Location:		MW-16-01	MW-16-02	MW-16-03	MW-16-04	MW-16-05	MW-16-06	MW-16-07
Sample Date:		9/18/2017	9/18/2017	9/19/2017	9/19/2017	9/19/2017	9/18/2017	9/19/2017
Constituent	Unit							
Appendix III								
Boron	ug/L	270	420	460	170	250	340	200
Calcium	ug/L	380,000	390,000	400,000	530,000	390,000	380,000	370,000
Chloride	mg/L	11	13	18	34	11	11	7.8
Fluoride	mg/L	1.8	1.6	1.5	1.0	1.5	1.6	1.5
pH	SU	6.9	7.0	6.9	7.0	6.9	6.9	6.8
Sulfate	mg/L	1,500	1,500	1,500	1,300	1,400	1,500	1,400
Total Dissolved Solids	mg/L	2,200	2,300	2,300	2,100	2,100	2,300	2,100

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units; pH is a field parameter.
All metals were analyzed as total
unless otherwise specified.

Table 3
Summary of Field Parameters – September 2017
Monroe Power Plant Fly Ash Basin – RCRA CCR Monitoring Program
Monroe, Michigan

Sample Location	Sample Date	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	pH (SU)	Specific Conductivity (umhos/cm)	Temperature (deg C)	Turbidity (NTU)
MW-16-01	9/18/2017	0.41	-4.6	6.9	2,343	13.76	2.27
MW-16-02	9/18/2017	0.06	6.4	7.0	2,410	12.36	3.69
MW-16-03	9/19/2017	0.07	-11.9	6.9	2,476	12.74	11.1
MW-16-04	9/19/2017	0.15	-109.6	7.0	2,361	11.79	1.04
MW-16-05	9/19/2017	0.09	-20.0	6.9	2,319	12.16	4.01
MW-16-06	9/18/2017	0.46	-11.0	6.9	2,367	14.08	11.5
MW-16-07	9/19/2017	0.06	-21.0	6.8	2,317	12.71	1.79

Notes:

mg/L - milligrams per liter.

mV - milliVolt.

SU - standard unit.

umhos/cm - micro-mhos per centimeter.

deg C - degrees celcius.

NTU - nephelometric turbidity units.

Table 4
Comparison of Appendix III Parameter Results to Background Limits – September 2017
Monroe Power Plant Fly Ash Basin – RCRA CCR Monitoring Program
Monroe, Michigan

	Sample Location:	MW-16-01		MW-16-02		MW-16-03		MW-16-04		MW-16-05		MW-16-06		MW-16-07	
	Sample Date:	9/18/2017		9/18/2017		9/19/2017		9/19/2017		9/19/2017		9/18/2017		9/19/2017	
Constituent	Unit	Data	PL	Data	PL	Data	PL	Data	PL	Data	PL	Data	PL	Data	PL
Appendix III															
Boron	ug/L	270	310	420	470	460	510	170	210	250	280	340	400	200	280
Calcium	ug/L	380,000	450,000	390,000	430,000	400,000	490,000	530,000	610,000	390,000	440,000	380,000	420,000	370,000	440,000
Chloride	mg/L	11	14	13	15	18	20	34	39	11	12	11	12	7.8	13
Fluoride	mg/L	1.8	2.1	1.6	1.8	1.5	1.8	1.0	1.1	1.5	1.7	1.6	1.8	1.5	1.8
pH, Field	SU	6.9	6.3 - 9.0	7.0	6.9 - 7.3	6.9	6.7 - 7.3	7.0	7.0 - 7.5	6.9	6.6 - 7.7	**6.9**	7.0 - 7.3	**6.8**	6.9 - 7.4
Sulfate	mg/L	1,500	1,500	1,500	1,700	1,500	1,700	1,300	1,500	1,400	1,600	1,500	1,600	1,400	1,600
Total Dissolved Solids	mg/L	2,200	2,200	2,300	2,300	2,300	2,300	2,100	2,200	2,100	2,200	2,300	2,300	2,100	2,200

Notes:

ug/L - micrograms per liter.

mg/L - milligrams per liter.

SU - standard units; pH is a field parameter.

All metals were analyzed as total unless otherwise specified.

RESULT Shading and bold font indicates an exceedance of the Prediction Limit (PL).

Figures

BASE MAP FROM USGS 7.5 MINUTE TOPOGRAPHIC QUADRANGLE SERIES.

N

1 " = 2,000 '
1:24,000

0 2,000 4,000 FEET

TRC
1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080
TRC - GIS

PROJECT:

DTE ELECTRIC COMPANY
MONROE POWER PLANT
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:

SITE LOCATION MAP

DRAWN BY:	J. PAPEZ
CHECKED BY:	S HOLMSTROM
APPROVED BY:	V. BUENING
DATE:	OCTOBER 2017
PROJ. NO.:	265996.0001
FILE:	265996-SLMMB.mxd

FIGURE 1

LEGEND

MONITORING WELLS

APPROXIMATE BOUNDARY OF FLY ASH BASIN

NOTES

1. BASE MAP IMAGERY FROM ESRI/MICROSOFT, "WORLD IMAGERY", WEB BASEMAP SERVICE LAYER.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.

N

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:

DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:

MONITORING NETWORK AND SITE PLAN

DRAWN BY:	J. PAPEZ	PROJ NO.:	265996.0001
CHECKED BY:	S. HOLMSTROM		**FIGURE 2**
APPROVED BY:	V. BUENING		
DATE:	JANUARY 2018		

TRC

1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080
www.trcsolutions.com

FILE NO.: 265996-0001-000.mxd

TRC - GIS

Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

Plot Date: 1/29/2018, 09:45:57 AM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\DTE\CCR_Sites\2017_265996\265996-0001-000.mxd

LEGEND

- MONITORING WELL
- APPROXIMATE BOUNDARY OF FLY ASH BASIN
- INFERRED GROUNDWATER FLOW DIRECTION
- POTENTIOMETRIC SURFACE CONTOUR LINE (5-FT INTERVAL,DASHED WHERE INFERRED)
- (582.69) STATIC WATER ELEVATION IN FEET (NAVD, 1988)

NOTES

1. BASE MAP IMAGERY FROM ESRI/MICROSOFT, "WORLD IMAGERY", WEB BASEMAP SERVICE LAYER.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.
3. GROUNDWATER ELEVATIONS DISPLAYED IN FEET RELATIVE TO NORTH AMERICAN VERTICAL DATUM OF 1988

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:
DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:
POTENTIOMETRIC SURFACE MAP
SEPTEMBER 2017

DRAWN BY:	S MAJOR	PROJ NO.:	265996.0001
CHECKED BY:	C. SCIESZKA	FIGURE 3	
APPROVED BY:	V. BUENING		
DATE:	JANUARY 2018		

TRC

1540 Eisenhower Place
Ann Arbor, MI 48108-3284
Phone: 734.971.7080
www.trcsolutions.com

FILE NO.: 265996-0001-011a.mxd

TRC - GIS

Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

Plot Date: 1/12/2018, 08:54:41 AM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\DTE\CCR_Sites\2017_265996\265996-0001-011a.mxd

Appendix A
Background Data

Table 1
Groundwater Elevation Summary
Monroe Fly Ash Basin – RCRA CCR Monitoring Program
Monroe, Michigan

Well ID	MW-16-01		MW-16-02		MW-16-03		MW-16-04		MW-16-05		MW-16-06		MW-16-07	
Date Installed	2/17/2016		2/18/2016		2/16/2016		2/15/2016		4/13/2016		4/13/2016		4/14/2016	
TOC Elevation	581.74		581.81		579.95		585.54		583.25		581.94		578.40	
Geologic Unit of Screened Interval	Silt/Limestone Interface		Silt/Limestone Interface		Sand & Silty Clay Limestone Interface		Silty Sand and Gravel		Limestone		Gravel and Cobbles		Silt/Limestone Interface	
Screened Interval Elevation	530.9 to 525.9		526.4 to 521.4		540.3 to 535.3		541.6 to 536.6		540.5 to 535.5		534.2 to 529.2		540.4 to 535.4	
Unit	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft	ft BTOC	ft
Measurement Date	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation	Depth to Water	GW Elevation
8/8/2016	5.62	576.12	-0.68	582.49	-7.40	587.35	-10.50	596.04	-8.18	591.43	1.50	580.44	-4.90	583.30
9/26/2016	5.45	576.29	-1.26	583.07	-7.97	587.92	-11.50	597.04	-9.90	593.15	1.13	580.81	-5.85	584.25
11/14/2016	4.92	576.82	-2.00	583.81	-10.60	590.55	-15.00	600.54	-11.80	595.05	0.17	581.77	-6.80	585.20
1/17/2017	4.74	577.00	-3.10	584.91	-11.30	591.25	-16.20	601.74	-13.15	596.40	-0.60	582.54	-7.40	585.80
3/6/2017	4.76	576.98	-3.35	585.16	-11.10	591.05	-16.85	602.39	-13.60	596.85	-0.85	582.79	-8.20	586.60
4/25/2017	4.63	577.11	-3.72	585.53	-11.90	591.85	-17.72	603.26	-13.95	597.20	-1.05	582.99	-8.10	586.50
6/12/2017	4.90	576.84	-2.70	584.51	-10.80	590.75	-15.50	601.04	-12.50	595.75	-0.35	582.29	-13.00	591.40
7/17/2017	4.94	576.80	-2.30	584.11	-10.40	590.35	-15.10	600.64	-12.40	595.65	0.00	581.94	-8.10	586.50

Notes:

Negative depth to water measurement indicates artesian conditions, actual measured water level is above the top of casing.

Elevations are reported in feet relative to the North American Vertical Datum of 1988.

ft BTOC - feet below top of casing

Table 2
Summary of Groundwater Analytical Data
Monroe Power Plant Fly Ash Basin – RCRA CCR Monitoring Program
Monroe, Michigan

	Sample Location:	MW-16-01										
	Sample Date:	8/8/2016	8/8/2016	9/27/2016	11/14/2016	1/17/2017	3/6/2017	3/6/2017	4/26/2017	6/13/2017	6/13/2017	7/17/2017
Constituent	Unit		Field Dup					Field Dup			Field Dup	
Appendix III												
Boron	ug/L	240	250	240	280	240	300	250	270	260	260	290
Calcium	ug/L	320,000	330,000	340,000	410,000	350,000	360,000	370,000	390,000	410,000	400,000	410,000
Chloride	mg/L	9.9	12	8.8	< 10	10	10	10	11	12	11	11
Fluoride	mg/L	1.1	0.86	1.4	1.4	1.2	1.7	1.7	1.8	1.8	1.7	1.7
pH	SU	8.3	8.2	7.8	7.7	7.5	7.8	7.5	7.3	7.3	7.3	7.3
Sulfate	mg/L	1,400	1,500	1,500	1,500	1,400	1,300	1,300	1,400	1,400	1,400	1,400
Total Dissolved Solids	mg/L	2,100	2,100	2,000	2,000	2,200	2,100	2,100	2,100	2,100	2,100	2,100
Appendix IV												
Antimony	ug/L	< 2.0	< 2.0	< 2.0	2.1	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Arsenic	ug/L	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Barium	ug/L	20	23	19	16	16	15	15	15	14	15	15
Beryllium	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chromium	ug/L	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Cobalt	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Fluoride	mg/L	1.1	0.86	1.4	1.4	1.2	1.7	1.7	1.8	1.8	1.7	1.7
Lead	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	76	77	77	77	65	63	66	78	67	65	64
Mercury	ug/L	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Radium-226	pCi/L	0.359	0.236	0.251	< 0.365	0.430	0.334	0.328	0.325	0.328	0.268	0.372
Radium-226/228	pCi/L	< 0.391	0.465	0.497	0.852	0.668	0.649	0.634	< 0.367	0.722	0.511	0.852
Radium-228	pCi/L	< 0.391	< 0.371	< 0.478	< 0.569	< 0.392	< 0.406	< 0.368	< 0.367	0.395	< 0.295	0.480
Selenium	ug/L	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Thallium	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units.
pCi/L - picocuries per liter.
All metals were analyzed as total
unless otherwise specified.

Table 2
Summary of Groundwater Analytical Data
Monroe Power Plant Fly Ash Basin – RCRA CCR Monitoring Program
Monroe, Michigan

Sample Location:		MW-16-02									
Sample Date:		8/9/2016	9/27/2016	11/15/2016	11/15/2016	1/17/2017	3/7/2017	4/25/2017	4/25/2017	6/12/2017	7/18/2017
Constituent	Unit				Field Dup				Field Dup		
Appendix III											
Boron	ug/L	360	370	460	450	400	410	410	400	410	420
Calcium	ug/L	400,000	410,000	410,000	400,000	390,000	390,000	420,000	410,000	430,000	400,000
Chloride	mg/L	13	11	12	12	13	13	14	14	14	13
Fluoride	mg/L	1.5	1.5	1.4	1.4	1.4	1.7	1.7	1.7	1.6	1.6
pH	SU	7.2	7.1	7.2	7.5	7.1	7.4	7.2	7.1	7.2	7.1
Sulfate	mg/L	1,600	1,600	1,600	1,600	1,500	1,400	1,600	1,500	1,500	1,500
Total Dissolved Solids	mg/L	2,200	2,200	2,200	2,200	2,300	2,200	2,200	2,200	2,200	2,300
Appendix IV											
Antimony	ug/L	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Arsenic	ug/L	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Barium	ug/L	6.7	7.7	8.4	8.7	9.0	7.3	6.9	6.9	7.4	8.4
Beryllium	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chromium	ug/L	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Cobalt	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Fluoride	mg/L	1.5	1.5	1.4	1.4	1.4	1.7	1.7	1.7	1.6	1.6
Lead	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	93	110	93	100	85	89	110	100	100	87
Mercury	ug/L	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Radium-226	pCi/L	2.45	2.58	2.35	2.45	2.16	2.75	2.28	2.15	2.16	1.98
Radium-226/228	pCi/L	2.88	3.30	2.82	2.92	2.54	3.16	2.47	2.28	2.24	2.41
Radium-228	pCi/L	< 0.432	0.727	0.464	0.475	< 0.383	0.415	< 0.395	< 0.306	< 0.351	0.431
Selenium	ug/L	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Thallium	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units.
pCi/L - picocuries per liter.
All metals were analyzed as total
unless otherwise specified.

Table 2
Summary of Groundwater Analytical Data
Monroe Power Plant Fly Ash Basin – RCRA CCR Monitoring Program
Monroe, Michigan

Sample Location:		MW-16-03							
Sample Date:		8/8/2016	9/27/2016	11/15/2016	1/17/2017	3/7/2017	4/25/2017	6/12/2017	7/18/2017
Constituent	Unit								
Appendix III									
Boron	ug/L	390	400	500	460	430	450	460	450
Calcium	ug/L	480,000	430,000	470,000	420,000	450,000	430,000	440,000	410,000
Chloride	mg/L	18	15	18	19	19	19	19	20
Fluoride	mg/L	1.4	1.5	1.4	1.4	1.6	1.7	1.6	1.6
pH	SU	7.2	7.2	7.1	7.2	7.3	7.1	7.1	7.1
Sulfate	mg/L	1,600	1,600	1,600	1,600	1,500	1,500	1,500	1,500
Total Dissolved Solids	mg/L	2,300	2,200	2,300	2,300	2,200	2,300	2,300	2,300
Appendix IV									
Antimony	ug/L	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Arsenic	ug/L	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Barium	ug/L	21	8.5	11	8.6	13	9.1	7.8	9.1
Beryllium	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chromium	ug/L	3.1	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Cobalt	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Fluoride	mg/L	1.4	1.5	1.4	1.4	1.6	1.7	1.6	1.6
Lead	ug/L	2.5	< 1.0	< 1.0	< 1.0	1.3	< 1.0	< 1.0	< 1.0
Lithium	ug/L	100	110	110	97	98	120	110	92
Mercury	ug/L	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Radium-226	pCi/L	2.44	1.90	2.25	1.86	1.88	1.75	1.70	1.73
Radium-226/228	pCi/L	2.51	2.36	2.51	2.45	2.51	2.13	1.93	2.27
Radium-228	pCi/L	< 0.803	0.462	< 0.420	0.583	0.638	0.385	< 0.416	0.533
Selenium	ug/L	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Thallium	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units.
pCi/L - picocuries per liter.
All metals were analyzed as total
unless otherwise specified.

Table 2
Summary of Groundwater Analytical Data
Monroe Power Plant Fly Ash Basin – RCRA CCR Monitoring Program
Monroe, Michigan

Sample Location:		MW-16-04								
	Sample Date:	8/9/2016	9/26/2016	9/26/2016	11/15/2016	1/17/2017	3/7/2017	4/25/2017	6/12/2017	7/17/2017
Constituent	Unit			Field Dup						
Appendix III										
Boron	ug/L	130	130	120	210	170	160	170	170	190
Calcium	ug/L	570,000	510,000	500,000	570,000	570,000	550,000	550,000	580,000	590,000
Chloride	mg/L	29	28	28	33	35	35	33	36	35
Fluoride	mg/L	0.88	0.88	0.89	0.87	0.86	1.1	1.0	1.0	1.0
pH	SU	7.2	7.1	7.2	7.1	7.2	7.3	7.2	7.2	7.2
Sulfate	mg/L	1,400	1,400	1,400	1,500	1,400	1,300	1,300	1,400	1,400
Total Dissolved Solids	mg/L	2,100	2,100	2,000	1,700	2,100	2,200	2,100	2,100	2,100
Appendix IV										
Antimony	ug/L	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Arsenic	ug/L	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Barium	ug/L	8.9	9.5	9.0	10	9.6	11	10	11	11
Beryllium	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chromium	ug/L	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Cobalt	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Fluoride	mg/L	0.88	0.88	0.89	0.87	0.86	1.1	1.0	1.0	1.0
Lead	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	18	20	19	20	17	17	21	18	17
Mercury	ug/L	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Radium-226	pCi/L	0.354	0.503	0.714	0.453	0.424	0.530	0.358	0.411	0.517
Radium-226/228	pCi/L	0.775	0.869	0.947	0.574	0.974	0.723	0.650	0.578	0.639
Radium-228	pCi/L	0.421	< 0.439	< 0.469	< 0.363	0.550	< 0.352	< 0.343	< 0.373	< 0.329
Selenium	ug/L	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Thallium	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units.
pCi/L - picocuries per liter.
All metals were analyzed as total
unless otherwise specified.

Table 2
Summary of Groundwater Analytical Data
Monroe Power Plant Fly Ash Basin – RCRA CCR Monitoring Program
Monroe, Michigan

Sample Location:		MW-16-05							
Sample Date:		8/8/2016	9/26/2016	11/15/2016	1/17/2017	3/7/2017	4/25/2017	6/12/2017	7/17/2017
Constituent	Unit								
Appendix III									
Boron	ug/L	200	190	270	220	220	230	230	250
Calcium	ug/L	410,000	390,000	420,000	400,000	410,000	420,000	430,000	400,000
Chloride	mg/L	12	9.0	< 10	11	11	11	12	12
Fluoride	mg/L	1.3	1.4	1.3	1.4	1.6	1.6	1.5	1.6
pH	SU	7.1	7.1	7.1	7.2	7.2	7.1	7.1	7.1
Sulfate	mg/L	1,500	1,500	1,500	1,400	1,400	1,400	1,500	1,500
Total Dissolved Solids	mg/L	2,100	2,000	2,100	2,100	2,200	2,100	2,200	2,100
Appendix IV									
Antimony	ug/L	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Arsenic	ug/L	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Barium	ug/L	8.7	7.2	11	12	12	14	9.7	8.7
Beryllium	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chromium	ug/L	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Cobalt	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Fluoride	mg/L	1.3	1.4	1.3	1.4	1.6	1.6	1.5	1.6
Lead	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	40	43	41	39	40	47	42	39
Mercury	ug/L	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Radium-226	pCi/L	1.61	1.63	1.52	1.41	1.77	1.37	1.38	1.41
Radium-226/228	pCi/L	2.11	2.26	1.56	1.46	1.78	1.41	1.44	1.68
Radium-228	pCi/L	0.496	0.632	< 0.446	< 0.452	< 0.344	< 0.348	< 0.386	< 0.303
Selenium	ug/L	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Thallium	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units.
pCi/L - picocuries per liter.
All metals were analyzed as total
unless otherwise specified.

Table 2
Summary of Groundwater Analytical Data
Monroe Power Plant Fly Ash Basin – RCRA CCR Monitoring Program
Monroe, Michigan

Sample Location:		MW-16-06							
Sample Date:		8/9/2016	9/27/2016	11/15/2016	1/17/2017	3/6/2017	4/25/2017	6/13/2017	7/17/2017
Constituent	Unit								
Appendix III									
Boron	ug/L	270	270	380	330	340	330	320	350
Calcium	ug/L	370,000	380,000	400,000	390,000	400,000	410,000	410,000	390,000
Chloride	mg/L	12	9.8	11	11	12	12	12	12
Fluoride	mg/L	1.5	1.5	1.4	1.5	1.7	1.7	1.6	1.7
pH	SU	7.1	7.2	7.2	7.2	7.2	7.1	7.1	7.2
Sulfate	mg/L	1,500	1,500	1,600	1,500	1,400	1,400	1,400	1,500
Total Dissolved Solids	mg/L	2,200	2,100	2,200	2,200	2,100	2,100	2,200	2,200
Appendix IV									
Antimony	ug/L	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Arsenic	ug/L	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Barium	ug/L	34	14	13	12	15	9.9	14	13
Beryllium	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chromium	ug/L	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Cobalt	ug/L	1.6	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Fluoride	mg/L	1.5	1.5	1.4	1.5	1.7	1.7	1.6	1.7
Lead	ug/L	1.1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	68	85	76	75	80	94	79	74
Mercury	ug/L	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Radium-226	pCi/L	0.346	0.633	0.638	0.492	0.536	0.491	0.525	0.477
Radium-226/228	pCi/L	0.575	0.751	0.918	0.732	0.700	0.648	0.623	0.650
Radium-228	pCi/L	< 0.346	< 0.376	< 0.881	< 0.397	< 0.377	< 0.322	< 0.330	< 0.333
Selenium	ug/L	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Thallium	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units.
pCi/L - picocuries per liter.
All metals were analyzed as total
unless otherwise specified.

Table 2
Summary of Groundwater Analytical Data
Monroe Power Plant Fly Ash Basin – RCRA CCR Monitoring Program
Monroe, Michigan

Sample Location:		MW-16-07									
Sample Date:		8/8/2016	9/26/2016	11/15/2016	1/17/2017	1/17/2017	3/6/2017	4/25/2017	6/12/2017	7/17/2017	7/17/2017
Constituent	Unit					Field Dup					Field Dup
Appendix III											
Boron	ug/L	160	160	240	200	200	190	210	210	230	230
Calcium	ug/L	390,000	390,000	410,000	390,000	390,000	390,000	420,000	430,000	420,000	410,000
Chloride	mg/L	7.7	6.8	< 10	7.3	7.4	< 10	8.0	< 10	10	< 10
Fluoride	mg/L	1.4	1.4	1.3	1.4	1.4	1.6	1.6	1.6	1.7	1.7
pH	SU	7.1	7.1	7.1	7.2	7.1	7.2	7.1	7.1	7.2	7.1
Sulfate	mg/L	1,500	1,500	1,500	1,400	1,500	1,400	1,400	1,400	1,500	1,500
Total Dissolved Solids	mg/L	2,100	2,000	2,100	2,100	2,100	2,100	2,100	2,200	2,100	2,100
Appendix IV											
Antimony	ug/L	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Arsenic	ug/L	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Barium	ug/L	9.0	8.2	9.4	9.2	8.3	8.3	8.3	8.2	7.7	7.9
Beryllium	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chromium	ug/L	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Cobalt	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Fluoride	mg/L	1.4	1.4	1.3	1.4	1.4	1.6	1.6	1.6	1.7	1.7
Lead	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lithium	ug/L	32	36	34	34	33	33	39	38	32	33
Mercury	ug/L	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Molybdenum	ug/L	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Radium-226	pCi/L	0.512	0.609	0.548	0.567	0.565	0.566	0.384	0.481	0.465	0.526
Radium-226/228	pCi/L	0.595	1.11	0.654	0.763	0.717	0.751	0.558	0.585	0.759	0.699
Radium-228	pCi/L	< 0.450	0.505	< 0.464	< 0.418	< 0.379	< 0.364	< 0.321	< 0.343	< 0.301	< 0.325
Selenium	ug/L	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Thallium	ug/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Notes:
ug/L - micrograms per liter.
mg/L - milligrams per liter.
SU - standard units.
pCi/L - picocuries per liter.
All metals were analyzed as total
unless otherwise specified.

Table 3
Summary of Field Parameters
Monroe Fly Ash Basin – RCRA CCR Monitoring Program
Monroe, Michigan

Sample Location	Sample Date	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	pH (SU)	Specific Conductivity (umhos/cm)	Temperature (deg C)	Turbidity (NTU)
MW-16-01	8/8/2016	0.25	7.5	8.63	1,808	13.59	3.08
	9/27/2016	0.58	3.2	8.29	1,945	13.72	7.09
	11/14/2016	3.47	115.4	7.74	1,732	13.68	5.65
	1/17/2017	1.09	46.3	7.46	1,712	11.25	3.10
	3/6/2017	0.47	41.6	7.34	1,706	11.56	2.50
	4/26/2017	0.40	8.8	7.23	2,211	12.21	2.23
	6/13/2017	0.58	19.0	7.20	2,271	15.92	2.53
	7/17/2017	0.77	36.5	7.23	2,197	16.36	2.18
MW-16-02	8/9/2016	0.49	35.9	7.07	2,014	11.77	0.00
	9/27/2016	0.61	33.4	7.30	2,045	13.01	2.66
	11/15/2016	0.92	29.9	7.06	1,672	11.13	4.74
	1/17/2017	0.21	-39.0	7.09	2,620	10.64	102
	3/7/2017	0.13	49.2	7.15	1,800	10.80	2.58
	4/25/2017	0.06	13.0	6.99	2,289	11.14	1.71
	6/12/2017	0.07	21.9	7.04	2,235	11.96	5.80
	7/18/2017	0.08	37.0	7.02	2,308	11.75	2.22
MW-16-03	8/8/2016	0.21	19.6	6.93	1,905	12.48	129
	9/27/2016	0.36	32.1	7.17	2,047	12.22	55.2
	11/15/2016	0.73	-3.2	7.04	1,733	11.74	31.6
	1/17/2017	0.47	-3.0	6.72	2,650	11.65	55.3
	3/7/2017	0.13	37.9	7.13	1,872	11.51	54.5
	4/25/2017	0.07	2.7	6.98	2,342	12.04	38.1
	6/12/2017	0.06	-7.4	7.02	2,282	12.89	14.9
	7/18/2017	0.05	10.7	6.97	2,351	13.03	25.6
MW-16-04	8/9/2016	0.50	-1.8	7.02	1,978	11.86	1.29
	9/26/2016	0.98	13.8	7.53	1,945	11.09	2.54
	11/15/2016	0.41	-77.4	7.11	1,625	10.98	3.98
	1/17/2017	0.47	2.6	7.02	1,756	10.83	3.07
	3/7/2017	0.13	-48.1	7.19	1,703	11.19	2.88
	4/25/2017	0.23	-133.1	7.04	2,239	11.42	3.88
	6/12/2017	0.17	-73.6	7.10	2,172	12.20	4.15
	7/17/2017	0.15	-42.2	7.22	1,653	12.03	2.45
MW-16-05	8/8/2016	0.35	10.3	7.30	1,834	12.51	8.28
	9/26/2016	1.12	12.3	7.67	1,927	11.44	16.7
	11/15/2016	1.36	-9.7	7.12	1,618	11.47	21.4
	1/17/2017	1.20	0.20	6.95	1,747	11.32	24.3
	3/7/2017	0.08	21.6	7.15	1,752	11.61	31.7
	4/25/2017	0.07	-20.1	7.00	2,194	12.00	29.2
	6/12/2017	0.09	-29.8	7.05	2,139	12.44	17.4
	7/17/2017	0.05	8.9	7.12	1,629	12.02	12.2

Notes:

mg/L - milligrams per liter.

mV - milliVolt.

SU - standard unit.

umhos/cm - micro-mhos per centimeter.

deg C - degrees celcius.

NTU - nephelometric Turbidity Units.

Table 3
Summary of Field Parameters
Monroe Fly Ash Basin – RCRA CCR Monitoring Program
Monroe, Michigan

Sample Location	Sample Date	Dissolved Oxygen (mg/L)	Oxidation Reduction Potential (mV)	pH (SU)	Specific Conductivity (umhos/cm)	Temperature (deg C)	Turbidity (NTU)
MW-16-06	8/9/2016	0.46	25.4	7.06	2,171	15.44	72.5
	9/27/2016	1.37	-3.6	7.33	2,029	13.56	19.9
	11/15/2016	2.47	41.6	7.07	1,725	12.95	3.70
	1/17/2017	2.19	-15.0	7.01	2,580	10.95	14.8
	3/6/2017	0.05	38.8	7.05	1,273	11.12	9.89
	4/25/2017	0.07	3.5	7.01	2,242	12.11	8.04
	6/13/2017	0.14	-14.1	7.05	2,300	15.96	17.8
	7/17/2017	0.18	14.6	7.11	2,197	15.79	8.83
MW-16-07	8/8/2016	0.80	18.4	6.96	1,796	12.71	5.55
	9/26/2016	0.54	26.8	7.40	1,978	12.64	5.53
	11/15/2016	0.77	-4.6	7.05	1,639	12.25	7.15
	1/17/2017	1.28	31.7	6.92	1,760	11.94	4.23
	3/6/2017	0.08	20.7	6.96	1,290	11.89	3.88
	4/25/2017	0.06	-27.3	6.97	2,189	12.07	2.53
	6/12/2017	0.09	-25.5	6.95	2,111	13.57	3.68
	7/17/2017	0.06	7.7	6.96	1,658	12.91	2.71

Notes:
mg/L - milligrams per liter.
mV - milliVolt.
SU - standard unit.
umhos/cm - micro-mhos per centimeter.
deg C - degrees celcius.
NTU - nephelometric Turbidity Units.

LEGEND

- MONITORING WELL
- APPROXIMATE BOUNDARY OF FLY ASH BASIN
- INFERRED GROUNDWATER FLOW DIRECTION
- POTENTIOMETRIC SURFACE CONTOUR LINE (DASHED WHERE INFERRED)
- (582.69) STATIC WATER ELEVATION IN FEET (NAVD, 1988)

NOTES

1. BASE MAP IMAGERY FROM ESRI/MICROSOFT, "WORLD IMAGERY", WEB BASEMAP SERVICE LAYER.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.
3. GROUNDWATER ELEVATIONS DISPLAYED IN FEET RELATIVE TO NORTH AMERICAN VERTICAL DATUM OF 1988.

N

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:

DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:

POTENTIOMETRIC SURFACE MAP
AUGUST 2016

DRAWN BY:	B DEEGAN	PROJ NO.:	265996.0001
CHECKED BY:	C. SCIESZKA		**FIGURE 1**
APPROVED BY:	V. BUENING		
DATE:	JANUARY 2018		

TRC

1540 Eisenhower Place
Ann Arbor, MI 48108-3284
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FILE NO.: 265996-0001-001.mxd

TRC - GIS

Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

Plot Date: 1/12/2018, 09:15:35 AM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\DTE\CCR_Sites\2017_265996\265996-0001-001.mxd

LEGEND

- MONITORING WELL
- APPROXIMATE BOUNDARY OF FLY ASH BASIN
- INFERRED GROUNDWATER FLOW DIRECTION
- POTENTIOMETRIC SURFACE CONTOUR LINE (DASHED WHERE INFERRED)
- (582.69) STATIC WATER ELEVATION IN FEET (NAVD, 1988)

NOTES

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3. GROUNDWATER ELEVATIONS DISPLAYED IN FEET RELATIVE TO NORTH AMERICAN VERTICAL DATUM OF 1988.

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1:7,200

PROJECT:
DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:
POTENTIOMETRIC SURFACE MAP
SEPTEMBER 2016

DRAWN BY:	B DEEGAN	PROJ NO.:	265996.0001
CHECKED BY:	C. SCIESZKA		
APPROVED BY:	V. BUENING	**FIGURE 2**	
DATE:	JANUARY 2018		

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FILE NO.: 265996-0001-002.mxd

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Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

Plot Date: 1/12/2018, 09:18:03 AM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\DTE\CCR_Sites\2017_265996\265996-0001-002.mxd

LEGEND

- MONITORING WELL
- APPROXIMATE BOUNDARY OF FLY ASH BASIN
- INFERRED GROUNDWATER FLOW DIRECTION
- POTENTIOMETRIC SURFACE CONTOUR LINE (DASHED WHERE INFERRED)
- (582.69) STATIC WATER ELEVATION IN FEET (NAVD, 1988)

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3. GROUNDWATER ELEVATIONS DISPLAYED IN FEET RELATIVE TO NORTH AMERICAN VERTICAL DATUM OF 1988.

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1:7,200

PROJECT:
DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:
POTENTIOMETRIC SURFACE MAP
NOVEMBER 2016

DRAWN BY:	B DEEGAN	PROJ NO.:	265996.0001
CHECKED BY:	C. SCIESZKA		
APPROVED BY:	V. BUENING	**FIGURE 3**	
DATE:	JANUARY 2018		

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FILE NO.: 265996-0001-003.mxd

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Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0
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Path: E:\DTE\CCR_Sites\2017_265996\265996-0001-003.mxd

LEGEND

- MONITORING WELL
- APPROXIMATE BOUNDARY OF FLY ASH BASIN
- INFERRED GROUNDWATER FLOW DIRECTION
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- (582.69) STATIC WATER ELEVATION IN FEET (NAVD, 1988)

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0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:
DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:
POTENTIOMETRIC SURFACE MAP
JANUARY 2017

DRAWN BY:	B DEEGAN	PROJ NO.:	265996.0001
CHECKED BY:	C. SCIESZKA		**FIGURE 4**
APPROVED BY:	V. BUENING		
DATE:	JANUARY 2018		

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Coordinate System: NAD 1983 UTM Zone 17N (Meter)
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LEGEND

MONITORING WELL

APPROXIMATE BOUNDARY OF FLY ASH BASIN

INFERRED GROUNDWATER FLOW DIRECTION

POTENTIOMETRIC SURFACE CONTOUR LINE (DASHED WHERE INFERRED)

(582.69) STATIC WATER ELEVATION IN FEET (NAVD, 1988)

NOTES

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3. GROUNDWATER ELEVATIONS DISPLAYED IN FEET RELATIVE TO THE NORTH AMERICAN VERTICAL DATUM OF 1988.

N

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT: **DTE ELECTRIC COMPANY MONROE POWER PLANT FLY ASH BASIN 7955 EAST DUNBAR ROAD MONROE, MICHIGAN**

TITLE: **POTENTIOMETRIC SURFACE MAP MARCH 2017**

DRAWN BY:	B DEEGAN	PROJ NO.:	265996.0001
CHECKED BY:	C. SCIESZKA		**FIGURE 5**
APPROVED BY:	V. BUENING		
DATE:	JANUARY 2018		

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Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

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Path: E:\DTE\CCR_Sites\2017_265996\265996-0001-005.mxd

LEGEND

- MONITORING WELL
- APPROXIMATE BOUNDARY OF FLY ASH BASIN
- INFERRED GROUNDWATER FLOW DIRECTION
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0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:
DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:
POTENTIOMETRIC SURFACE MAP
APRIL 2017

DRAWN BY:	B DEEGAN	PROJ NO.:	265996.0001
CHECKED BY:	C. SCIESZKA		
APPROVED BY:	V. BUENING	**FIGURE 6**	
DATE:	JANUARY 2018		

TRC

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FILE NO.: 265996-0001-006.mxd

TRC - GIS

Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

Plot Date: 1/12/2018, 09:28:14 AM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\DTE\CCR_Sites\2017_265996\265996-0001-006.mxd

LEGEND

- MONITORING WELL
- APPROXIMATE BOUNDARY OF FLY ASH BASIN
- INFERRED GROUNDWATER FLOW DIRECTION
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- *(582.69)* STATIC WATER ELEVATION IN FEET (NAVD, 1988)

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0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:

DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:

POTENTIOMETRIC SURFACE MAP
JUNE 2017

DRAWN BY:	B DEEGAN	PROJ NO.:	265996.0001
CHECKED BY:	C. SCIESZKA		
APPROVED BY:	V. BUENING	**FIGURE 7**	
DATE:	JANUARY 2018		

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FILE NO.: 265996-0001-007.mxd

TRC - GIS

Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

Plot Date: 1/12/2018, 10:43:22 AM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\DTE\CCR_Sites\2017_265996\265996-0001-007.mxd

LEGEND

- MONITORING WELL
- APPROXIMATE BOUNDARY OF FLY ASH BASIN
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0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:
DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:
POTENTIOMETRIC SURFACE MAP
JULY 2017

DRAWN BY:	S MAJOR	PROJ NO.:	265996.0001
CHECKED BY:	C. SCIESZKA		
APPROVED BY:	V. BUENING		**FIGURE 8**
DATE:	JANUARY 2018		

TRC
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FILE NO.: 265996-0001-010.mxd

TRC - GIS

Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

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Path: E:\DTE\CCR_Sites\2017_265996\265996-0001-010.mxd

Appendix B
Data Quality Review

Laboratory Data Quality Review
Groundwater Monitoring Event September 2017
DTE Electric Company Monroe Fly Ash Basin (DTE MFAB)

Groundwater samples were collected by TRC for the September 2017 sampling event. Samples were analyzed for anions, pH, total metals, and total dissolved solids by Test America Laboratories, Inc. (Test America), located in Canton, Ohio. The laboratory analytical results are reported in laboratory report J85237-1.

During the September 2017 sampling event, a groundwater sample was collected from each of the following wells:

- MW-16-01
- MW-16-02
- MW-16-03
- MW-16-04
- MW-16-05
- MW-16-06
- MW-16-07

Each sample was analyzed for the following constituents:

Analyte Group	Method
Anions (Chloride, Fluoride, Sulfate)	EPA 300.0
pH	EPA 9040C
Total Metals	EPA 6010B
Total Dissolved Solids	SM 2540C
Alkalinity	SM 2320B

TRC reviewed the laboratory data to assess data usability. The following sections summarize the data review procedure and the results of the review.

Data Quality Review Procedure

The analytical data were reviewed using the USEPA National Functional Guidelines for Inorganic Superfund Data Review (USEPA, 2017). The following items were included in the evaluation of the data:

- Sample receipt, as noted in the cover page or case narrative;
- Technical holding times for analyses;
- Data for method blanks. Method blanks are used to assess potential contamination arising from laboratory sample preparation and/or analytical procedures;
- Percent recoveries for matrix spike (MS) and matrix spike duplicates (MSD). Percent recoveries are calculated for each analyte spiked and used to assess bias due to sample matrix effects;

- Reporting limits (RLs) compared to project-required RLs;
- Data for blind field duplicates. Field duplicate samples are used to assess variability introduced by the sampling and analytical processes;
- Data for laboratory control samples (LCSs). The LCSs are used to assess the accuracy of the analytical method using a clean matrix;
- Data for laboratory duplicates. The laboratory duplicates are replicate analyses of one sample and are used to assess the precision of the analytical method; and
- Overall usability of the data.

This data usability report addresses the following items:

  - Usability of the data if quality control (QC) results suggest potential problems with all or some of the data;
  - Actions regarding specific QC criteria exceedances.

Review Summary

The data quality objectives and laboratory completeness goals for the project were met, and the data are usable for their intended purpose. A summary of the data quality review, including non-conformances and issues identified in this evaluation are noted below.

- Appendix III constituents will be utilized for the purposes of a detection monitoring program.
- Data are usable for the purposes of the detection monitoring program.
- When the data are evaluated through a detection monitoring statistical program, findings below may be used to support the removal of outliers.

QA/QC Sample Summary:

- Target analytes were not detected in the method blank.
- Dup-01 corresponds with MW-16-07; relative percent differences (RPDs) between the parent and duplicate sample were within the QC limits.
- Laboratory duplicates were performed on sample MW-16-01 for alkalinity and on sample MW-16-02 for pH; RPDs between the parent and duplicate sample were within the QC limits.
- MS/MSD analyses were performed on sample MW-16-01 and MW-16-02 for anions (chloride and fluoride). Percent recoveries and RPDs were within the QC limits.

Appendix C
Statistical Background Limits

Technical Memorandum

Date: January 15, 2018

To: DTE Electric Company

From: Darby Litz, TRC
Sarah Holmstrom, TRC
Jane Li, TRC

Project No.: 265996.0001.0000 Phase 001, Task 001

Subject: Background Statistical Evaluation – DTE Electric Company, Monroe Power Plant Fly Ash Basin, Monroe, Michigan

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Pursuant to the United States Environmental Protection Agency's (U.S. EPA's) Resource Conservation and Recovery Act (RCRA) Federal Final Rule for Hazardous and Solid Waste Management System Disposal of Coal Combustion Residuals from Electric Utilities (herein after "the CCR Rule") promulgated on April 17, 2015, the owner or operator of a CCR Unit must collect a minimum of eight rounds of background groundwater data to initiate a detection monitoring program and evaluate statistically significant increases above background (40 CFR §257.94). This memorandum presents the background statistical limits derived for the DTE Electric Company (DTE Electric) Monroe Power Plant (MONPP) Fly Ash Basin (FAB) CCR unit (the Site).

DTE Electric operates the MONPP FAB in Monroe, Michigan. The property has been used continuously for the operation of the MONPP FAB since approximately 1975 and is constructed over a natural clay-rich soil base. The MONPP FAB and landfill is a licensed Type III solid waste disposal facility in accordance with Michigan's regulations, and currently accepts coal ash from DTE Electric's MONPP. The landfill qualifies as a CCR storage unit. Therefore, it is required to be monitored under the CCR Rule.

A groundwater monitoring system has been established for MONPP FAB CCR unit (TRC, October 2017), which established the following locations for detection monitoring.

MW-16-01	MW-16-02	MW-16-03
MW-16-04	MW-16-05	MW-16-06
MW-16-07		

Following the baseline data collection period (August 2016 through July 2017), the background data for the Site were evaluated in accordance with the *Groundwater Statistical Evaluation Plan* (Stats Plan) (TRC, October 2017). Background data were evaluated in ChemStat™ statistical software. ChemStat™ is a software tool that is commercially available for performing statistical evaluation consistent with procedures outlined in U.S. EPA's Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities (Unified Guidance; UG). Within the ChemStat™ statistical program (and the UG), prediction limits (PLs) were selected to perform the statistical calculation for background limits. Use of PLs is recommended by the UG to provide high statistical power and is an acceptable approach for intrawell detection monitoring under the CCR rule. PLs were calculated for each of the CCR Appendix III parameters. The following narrative describes the methods employed and the results obtained and the ChemStat™ output files are included as an attachment.

The set of background wells utilized for MONPP FAB CCR Unit includes MW-16-01 through MW-16-07. The background evaluation included the following steps:

- Review of data quality checklists for the baseline/background data sets for CCR Appendix III constituents;
- Graphical representation of the baseline data as time versus concentration (T v. C) by well/constituent pair;
- Outlier testing of individual data points that appear from the graphical representations as potential outliers;
- Evaluation of percentage of nondetects for each baseline/background well-constituent (w/c) pair;
- Distribution of the data; and
- Calculation of the upper PLs for each cumulative baseline/background data set (upper and lower PLs were calculated for field pH).

The results of these evaluations are presented and discussed below.

Data Quality

Data from each sampling round were evaluated for completeness, overall quality and usability, method-specified sample holding times, precision and accuracy, and potential sample contamination. The review was completed using the following quality control (QC) information which at a minimum included chain-of-custody forms, investigative sample results including blind field duplicates, and, as provided by the laboratory, method blanks, laboratory control spikes, laboratory duplicates. The data were found to be complete and usable for the purposes of the CCR monitoring program.

Time versus Concentration Graphs

The time versus concentration (T v. C) graphs (Attachment A) did not show potential or suspect outliers for any of the Appendix III parameters.

While variations in results are present, the graphs show consistent baseline data and do not suggest that data sets, as a whole, likely have overall trending or seasonality. However, due to limitations on CCR Rule implementation timelines, the data sets are of relatively short duration for making such observations regarding overall trending or seasonality.

Outlier Testing

No outliers were identified in the T v. C graphs. Therefore, outlier testing was not applicable.

Distribution of the Data Sets

ChemStat™ was utilized to evaluate each data set for normality. If the skewness coefficient was calculated to be between negative one and one, then the data were assumed to be approximately normally distributed. If the skewness coefficient was calculated as greater than one (or less than negative one) then the calculation was performed on the natural log (Ln) of the data. If the Ln of the data still determined that the data appeared to be skewed, then the Shapiro-Wilk test of normality (Shapiro-Wilk) was performed. The Shapiro-Wilk statistic was calculated on both non-transformed data, and the Ln-transformed data. If the Shapiro-Wilk statistic indicated that normal distributional assumptions were not valid, then the parameter was considered a candidate for non-parametric statistical evaluation. The data distributions are summarized in Table 1.

Prediction Limits

Table 1 presents the calculated PLs for the background/baseline data sets. For normal and lognormal distributions, PLs are calculated for 95 percent confidence using parametric methods. For nonnormal background datasets, a nonparametric PL is utilized, resulting in the highest value from the background dataset as the PL. The achieved confidence levels for nonparametric prediction limits depend entirely on the number of background data points, which are shown in the ChemStat™ outputs. Verification resampling (1 of 2) is recommended per the Stats Plan and UG to achieve performance standards specified in the CCR rules.

Attachments

Table 1 – Summary of Descriptive Statistics and Prediction Limit Calculations
Attachment A – Background Concentration Time-Series Charts
Attachment B – ChemStat™ Prediction Limit Outputs

Tables

Table 1
Summary of Descriptive Statistics and Prediction Limit Calculations
Background Statistical Evaluation
DTE Electric Company – Monroe Fly Ash Basin

Monitoring Well	Skewness Test		Shapiro-Wilks Test (5% Critical Value)		Outliers Removed	Prediction Limit Test	Prediction Limit
	Un-Transformed Data	Natural Log Transformed Data	Un-Transformed Data	Natural Log Transformed Data			
Appendix III							
Boron (ug/L)							
MW-16-01	-1 < 0.167705 < 1	--	--	--	N	Parametric	310
MW-16-02	-1 < 0.189903 < 1	--	--	--	N	Parametric	470
MW-16-03	-1 < -0.0751609 < 1	--	--	--	N	Parametric	510
MW-16-04	>50% Non-Detect	--	--	--	N	Non-Parametric	210
MW-16-05	-1 < 0.282475 < 1	--	--	--	N	Parametric	280
MW-16-06	-1 < -0.311091 < 1	--	--	--	N	Parametric	400
MW-16-07	-1 < -0.878206 < 1	--	--	--	N	Parametric	280
Calcium (ug/L)							
MW-16-01	-1 < -0.207579 < 1	--	--	--	N	Parametric	450,000
MW-16-02	-1 < 0.384794 < 1	--	--	--	N	Parametric	430,000
MW-16-03	-1 < 0.42921 < 1	--	--	--	N	Parametric	490,000
MW-16-04	-1 > -1.0588	-1 > -1.13701	0.818 < 0.879119	--	N	Parametric	610,000
MW-16-05	-1 < 0 < 1	--	--	--	N	Parametric	440,000
MW-16-06	-1 < -0.384794 < 1	--	--	--	N	Parametric	420,000
MW-16-07	-1 < 0.284605 < 1	--	--	--	N	Parametric	440,000
Chloride (mg/L)							
MW-16-01	-1 > -1.40642	-1 > -1.77056	0.818 < 0.826001	--	N	Parametric	14
MW-16-02	-1 < -0.691361 < 1	--	--	--	N	Parametric	15
MW-16-03	-1 > -1.48824	-1 > -1.61823	0.818 > 0.779035	0.818 > 0.750893	N	Non-Parametric	20
MW-16-04	-1 < -0.799533 < 1	--	--	--	N	Parametric	39
MW-16-05	-1 < -1.6207	-1 > -1.86936	0.818 > 0.720465	0.818 > 0.654166	N	Non-Parametric	12
MW-16-06	-1 < -1.18771	-1 > -1.26234	0.818 > 0.716331	0.818 > 0.710616	N	Non-Parametric	12
MW-16-07	-1 < -0.469884 < 1	--	--	--	N	Parametric	13
Fluoride (mg/L)							
MW-16-01	-1 < -0.315179 < 1	--	--	--	N	Parametric	2.1
MW-16-02	-1 < -2.67648e-015 < 1	--	--	--	N	Parametric	1.8
MW-16-03	-1 < 0.0724471 < 1	--	--	--	N	Parametric	1.8
MW-16-04	-1 < 0.453171 < 1	--	--	--	N	Parametric	1.1
MW-16-05	-1 < -0.0842382 < 1	--	--	--	N	Parametric	1.7
MW-16-06	-1 < -0.0724471 < 1	--	--	--	N	Parametric	1.8
MW-16-07	-1 < 5.15164e-015 < 1	--	--	--	N	Parametric	1.8

Notes:

2.14275 > 1 -1 < 0.537721 < 1 0.818 > 0.781314

Skewness Coefficient

Shapiro-Wilks 5% Critical Value

Shapiro-Wilks 'W' Statistic

ug/L = micrograms per liter
mg/L = milligrams per liter
SU = standard units

Table 1
Summary of Descriptive Statistics and Prediction Limit Calculations
Background Statistical Evaluation
DTE Electric Company – Monroe Fly Ash Basin

Monitoring Well	Skewness Test		Shapiro-Wilks Test (5% Critical Value)		Outliers Removed	Prediction Limit Test	Prediction Limit
	Un-Transformed Data	Natural Log Transformed Data	Un-Transformed Data	Natural Log Transformed Data			
pH (SU)							
MW-16-01	-1 < 0.943826 < 1	--	--	--	N	Parametric	6.3 - 9.0
MW-16-02	1.31816	1.2979 > 1	0.818 < 0.853216	--	N	Parametric	6.9 - 7.3
MW-16-03	-1 < -0.774615 < 1	--	--	--	N	Parametric	6.7 - 7.3
MW-16-04	1.48086 > 1	1.44944 > 1	0.818 > 0.791445	0.818 > 0.798258	N	Non-Parametric	7.0 - 7.5
MW-16-05	1.41222 > 1	1.36764 > 1	0.818 < 0.825294	--	N	Parametric	6.6 - 7.7
MW-16-06	1.85089 > 1	1.83706 > 1	0.818 > 0.699609	0.818 > 0.704141	N	Non-Parametric	7.0 - 7.3
MW-16-07	2.04057 > 1	2.02941 > 1	0.818 > 0.604641	0.818 > 0.609456	N	Non-Parametric	6.9 - 7.4
Sulfate (mg/L)							
MW-16-01	-1 < -0.0543951 < 1	--	--	--	N	Parametric	1,500
MW-16-02	-1 < -0.660484 < 1	--	--	--	N	Parametric	1,700
MW-16-03	-1 < 0 < 1	--	--	--	N	Parametric	1,700
MW-16-04	-1 < 0.0543951 < 1	--	--	--	N	Parametric	1,500
MW-16-05	-1 < -0.516398 < 1	--	--	--	N	Parametric	1,600
MW-16-06	-1 < 0.32397 < 1	--	--	--	N	Parametric	1,600
MW-16-07	-1 < 0 < 1	--	--	--	N	Parametric	1,600
Total Dissolved Solids (mg/L)							
MW-16-01	-1 < 0.0543951 < 1	--	--	--	N	Parametric	2,200
MW-16-02	1.1547 > 1	1.1547 > 1	0.818 > 0.566231	0.818 > 0.566231	N	Non-Parametric	2,300
MW-16-03	-1 > -1.1547	-1 > -1.1547	0.818 > 0.566231	0.818 > 0.566231	N	Non-Parametric	2,300
MW-16-04	-1 > -1.9997	-1 > -2.05737	0.818 > 0.576798	0.818 > 0.560738	N	Non-Parametric	2,200
MW-16-05	-1 < -0.0543951 < 1	--	--	--	N	Parametric	2,200
MW-16-06	-1 < -0.516398 < 1	--	--	--	N	Parametric	2,300
MW-16-07	-1 < 0 < 1	--	--	--	N	Parametric	2,200

Notes:

2.14275 > 1 -1 < 0.537721 < 1 0.818 > 0.781314

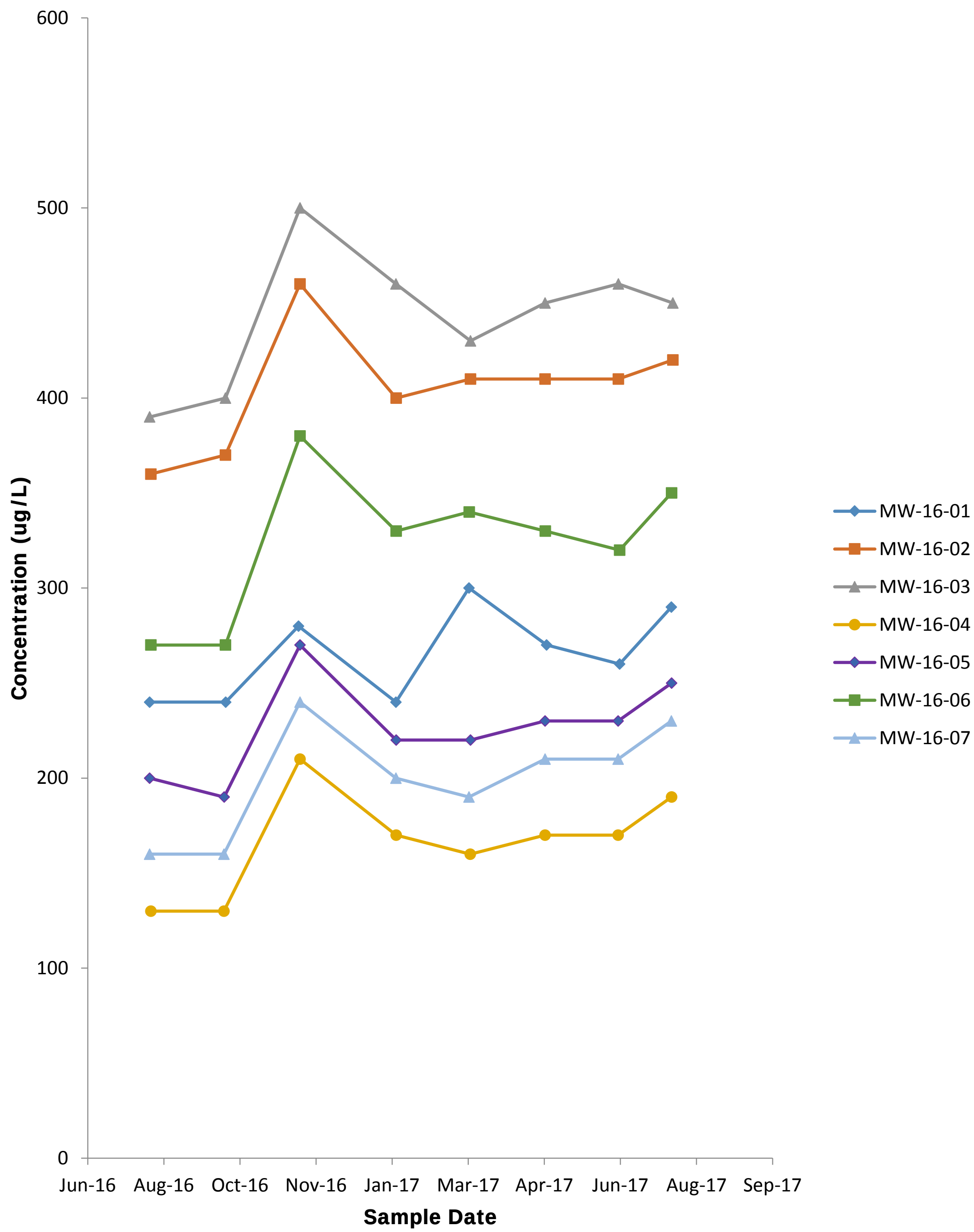
Skewness Coefficient
Shapiro-Wilks 5% Critical Value
Shapiro-Wilks 'W' Statistic

ug/L = micrograms per liter
mg/L = milligrams per liter
SU = standard units

Attachment A

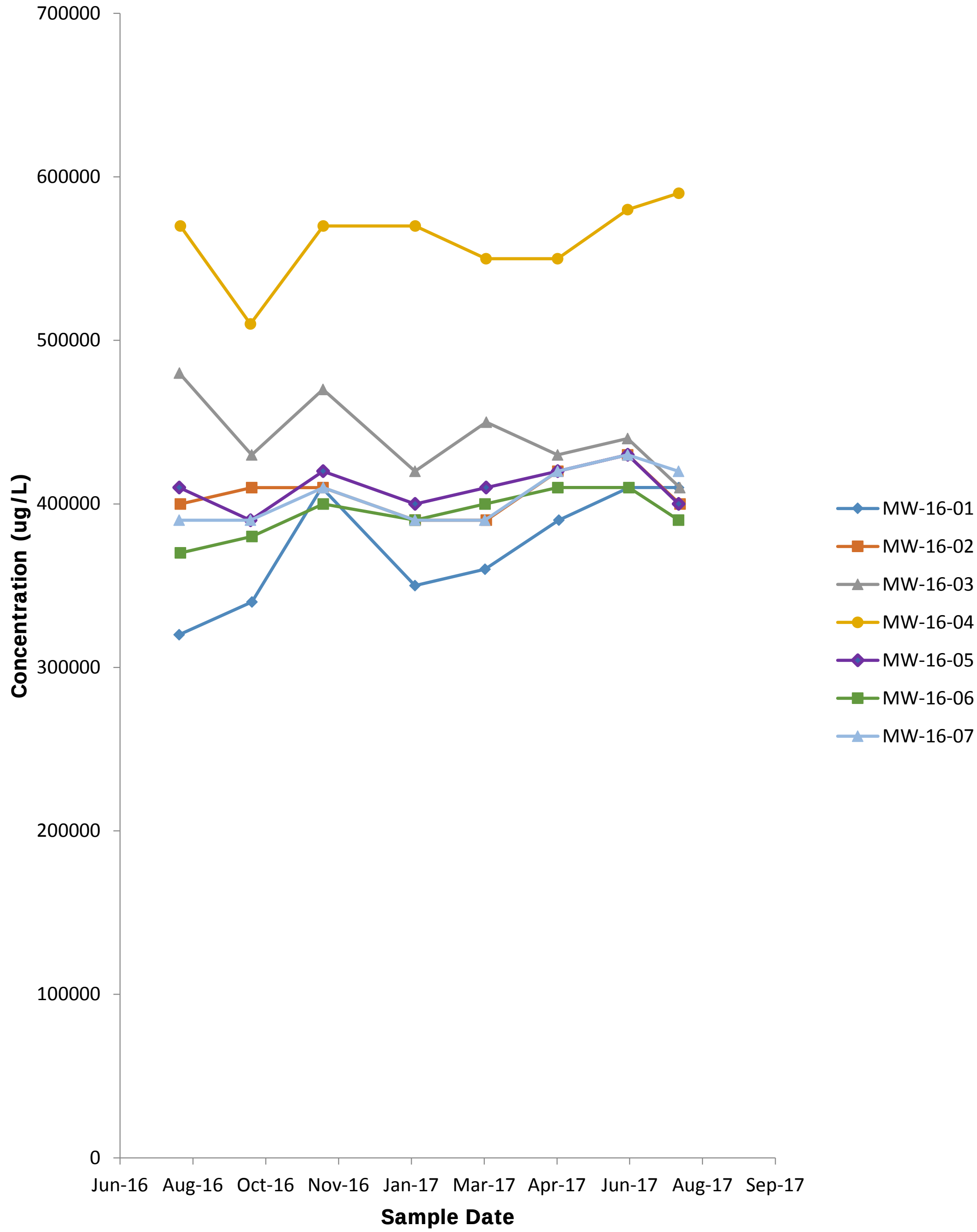
Background Concentration Time-Series Charts

Time-Series Plots
DTE Electric Company - Monroe Fly Ash Basin
Monroe, Michigan
Boron



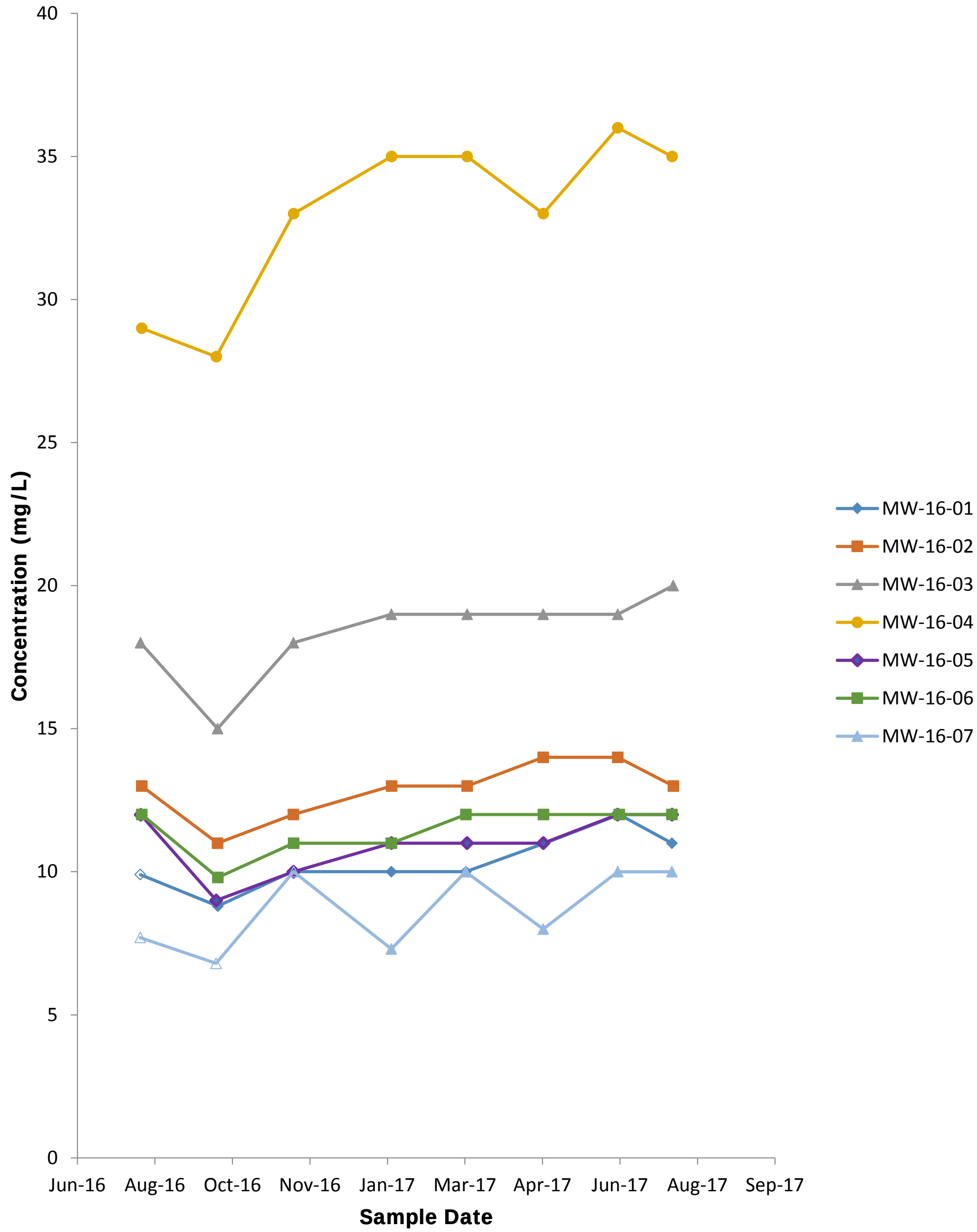
Open symbols denote non-detect concentrations.

Time-Series Plots
DTE Electric Company - Monroe Fly Ash Basin
Monroe, Michigan
Calcium



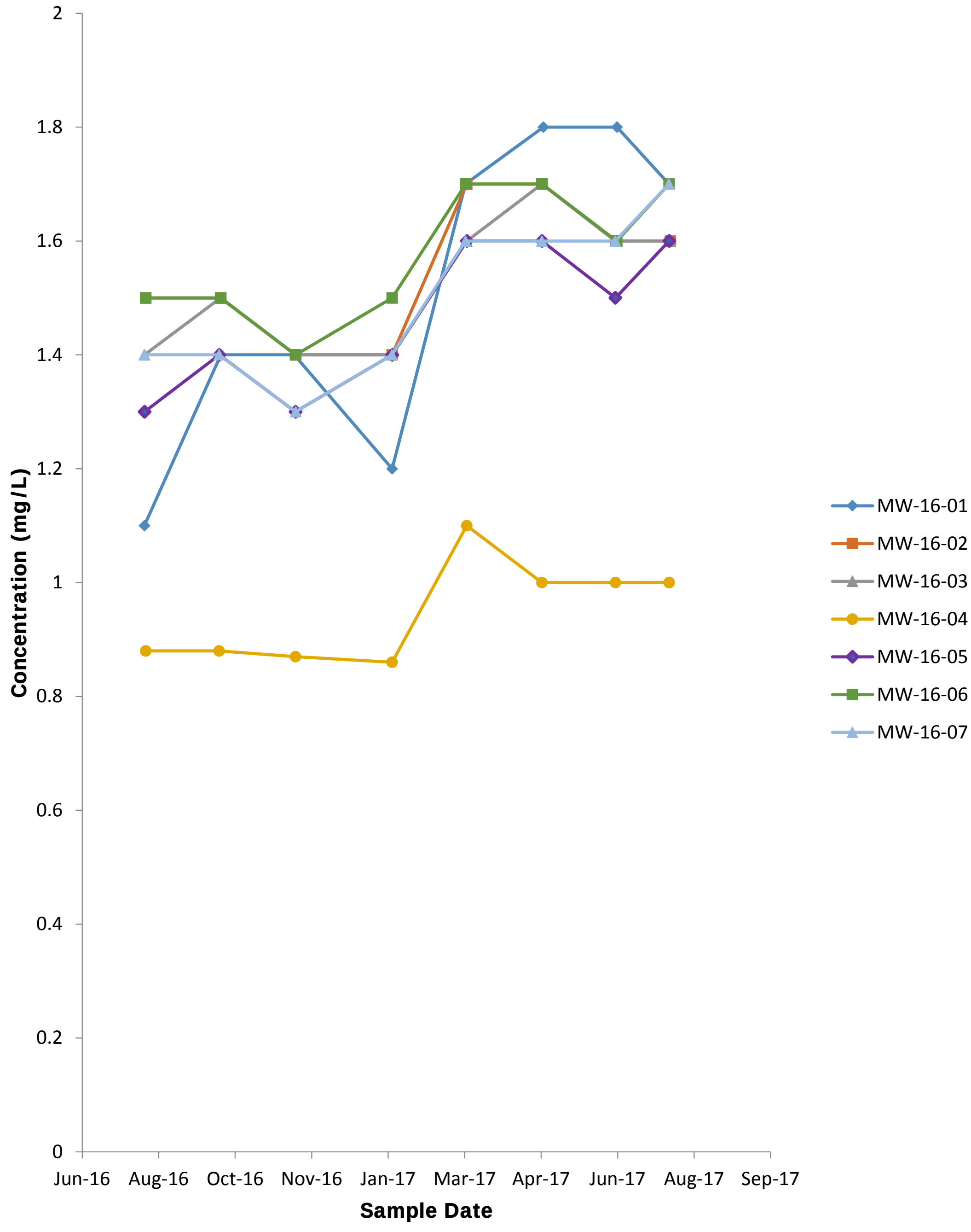
Open symbols denote non-detect concentrations.

Time-Series Plots
DTE Electric Company - Monroe Fly Ash Basin
Monroe, Michigan
Chloride



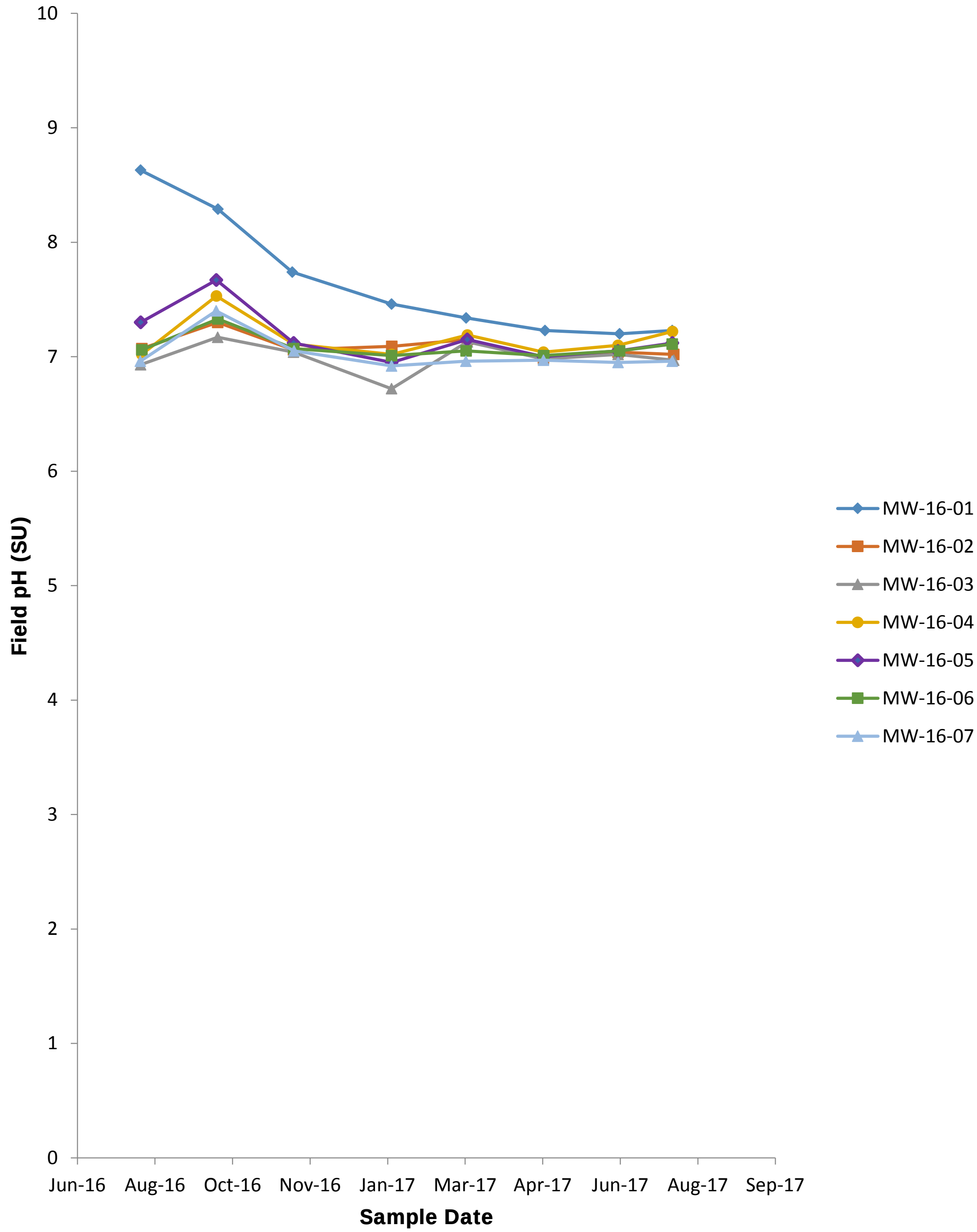
Open symbols denote non-detect concentrations.

Time-Series Plots
DTE Electric Company - Monroe Fly Ash Basin
Monroe, Michigan
Fluoride

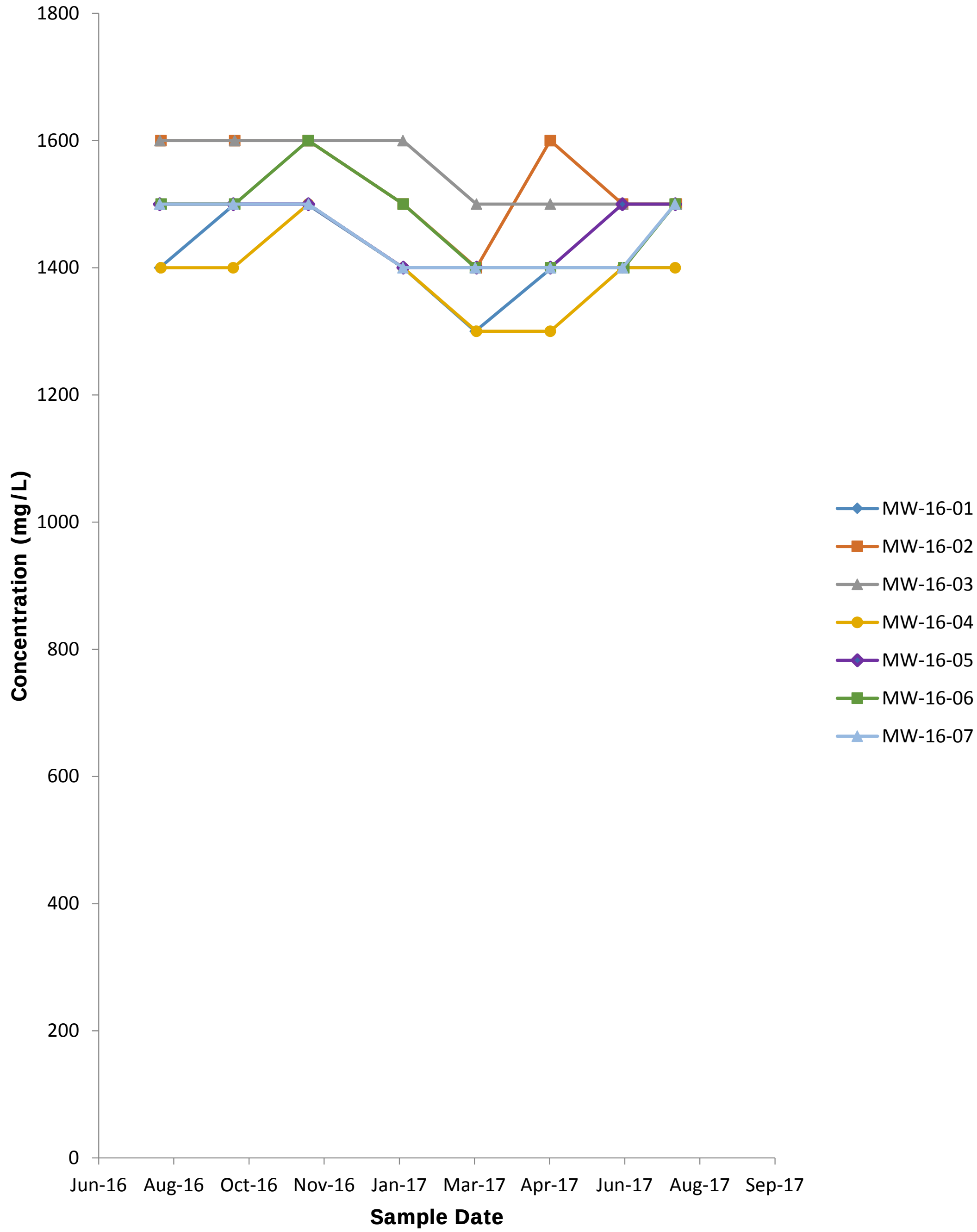


Open symbols denote non-detect concentrations.

Time-Series Plots
DTE Electric Company - Monroe Fly Ash Basin
Monroe, Michigan
pH, Field

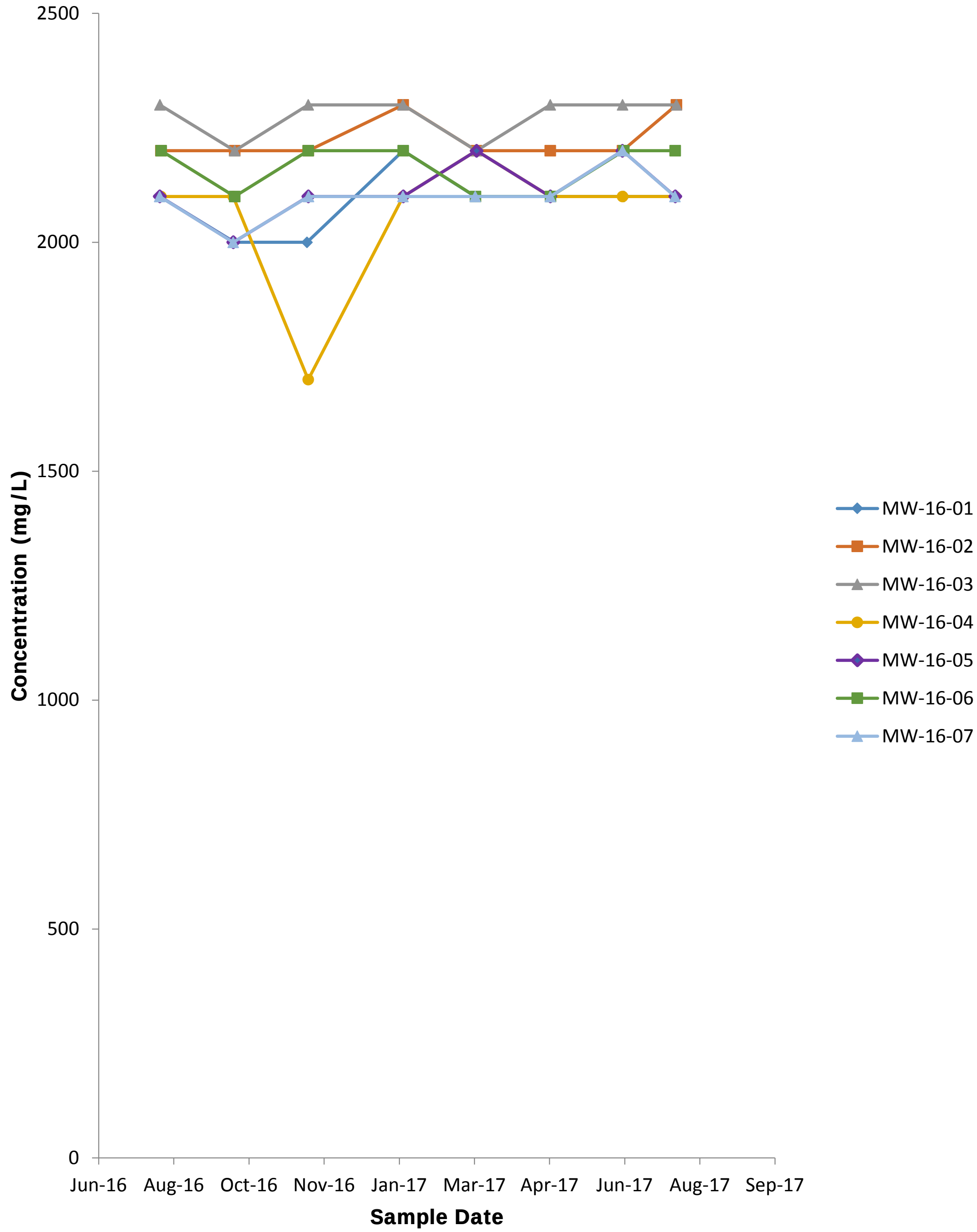


Time-Series Plots
DTE Electric Company - Monroe Fly Ash Basin
Monroe, Michigan
Sulfate



Open symbols denote non-detect concentrations.

Time-Series Plots
DTE Electric Company - Monroe Fly Ash Basin
Monroe, Michigan
Total Dissolved Solids



Open symbols denote non-detect concentrations.

Attachment B

ChemStat™ Prediction Limit Outputs

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-01
Parameter: Boron
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/8/2016	240
	9/27/2016	240
	11/14/2016	280
	1/17/2017	240
	3/6/2017	300
	4/26/2017	270 B
	6/13/2017	260
	7/17/2017	290

From 8 baseline samples
Baseline mean = 265
Baseline std Dev = 23.9046

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/18/2017	1	270	[0, 313.036]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-02
Parameter: Boron
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/9/2016	360
	9/27/2016	370
	11/15/2016	460
	1/17/2017	400
	3/7/2017	410
	4/25/2017	410 B
	6/12/2017	410
	7/18/2017	420

From 8 baseline samples
Baseline mean = 405
Baseline std Dev = 30.706

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/18/2017	1	420	[0, 466.704]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-03
Parameter: Boron
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/8/2016	390
	9/27/2016	400
	11/15/2016	500
	1/17/2017	460
	3/7/2017	430
	4/25/2017	450 B
	6/12/2017	460
	7/18/2017	450

From 8 baseline samples
Baseline mean = 442.5
Baseline std Dev = 35.3553

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/19/2017	1	460	[0, 513.547]	FALSE

Non-Parametric Prediction Interval

Intra-Well Comparison for MW-16-04
Parameter: Boron
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total Percent Non-Detects = 62.5%
Future Samples (k) = 1
Recent Dates = 1
Baseline Measurements (n) = 8
Maximum Baseline Concentration = 210
Confidence Level = 88.9%
False Positive Rate = 11.1%

Baseline Measurements	Date	Value
	8/9/2016	130
	9/26/2016	130
	11/15/2016	210
	1/17/2017	ND<170 J
	3/7/2017	ND<160 J
	4/25/2017	ND<170 JB
	6/12/2017	ND<170 J
	7/17/2017	ND<190 J

Date	Count	Mean	Significant
9/19/2017	1	170	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-05
Parameter: Boron
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/8/2016	200
	9/26/2016	190
	11/15/2016	270
	1/17/2017	220
	3/7/2017	220
	4/25/2017	230 B
	6/12/2017	230
	7/17/2017	250

From 8 baseline samples
Baseline mean = 226.25
Baseline std Dev = 25.5999

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/19/2017	1	250	[0, 277.693]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-06
Parameter: Boron
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/9/2016	270
	9/27/2016	270
	11/15/2016	380
	1/17/2017	330
	3/6/2017	340
	4/25/2017	330 B
	6/13/2017	320
	7/17/2017	350

From 8 baseline samples
Baseline mean = 323.75
Baseline std Dev = 37.7728

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/18/2017	1	340	[0, 399.655]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-07
Parameter: Boron
Original Data (Not Transformed)
Non-Detects Replaced with 1/2 DL

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/8/2016	160
	9/26/2016	160
	11/15/2016	240
	1/17/2017	200
	3/6/2017	ND<95 J
	4/25/2017	210 B
	6/12/2017	210
	7/17/2017	230

From 8 baseline samples
Baseline mean = 188.125
Baseline std Dev = 47.5047

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/19/2017	1	200	[0, 283.586]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-01
Parameter: Calcium
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/8/2016	320000
	9/27/2016	340000
	11/14/2016	410000
	1/17/2017	350000
	3/6/2017	360000
	4/26/2017	390000
	6/13/2017	410000
	7/17/2017	410000

From 8 baseline samples
Baseline mean = 373750
Baseline std Dev = 35831.9

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/18/2017	1	380000	[0, 445754]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-02
Parameter: Calcium
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/9/2016	400000
	9/27/2016	410000
	11/15/2016	410000
	1/17/2017	390000
	3/7/2017	390000
	4/25/2017	420000
	6/12/2017	430000
	7/18/2017	400000

From 8 baseline samples
Baseline mean = 406250
Baseline std Dev = 14078.9

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/18/2017	1	390000	[0, 434542]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-03
Parameter: Calcium
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/8/2016	480000
	9/27/2016	430000
	11/15/2016	470000
	1/17/2017	420000
	3/7/2017	450000
	4/25/2017	430000
	6/12/2017	440000
	7/18/2017	410000

From 8 baseline samples
Baseline mean = 441250
Baseline std Dev = 24164.6

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/19/2017	1	400000	[0, 489809]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-04
Parameter: Calcium
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/9/2016	570000
	9/26/2016	510000
	11/15/2016	570000
	1/17/2017	570000
	3/7/2017	550000
	4/25/2017	550000
	6/12/2017	580000
	7/17/2017	590000

From 8 baseline samples
Baseline mean = 561250
Baseline std Dev = 24748.7

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/19/2017	1	530000	[0, 610983]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-05
Parameter: Calcium
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/8/2016	410000
	9/26/2016	390000
	11/15/2016	420000
	1/17/2017	400000
	3/7/2017	410000
	4/25/2017	420000
	6/12/2017	430000
	7/17/2017	400000

From 8 baseline samples
Baseline mean = 410000
Baseline std Dev = 13093.1

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/19/2017	1	390000	[0, 436311]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-06
Parameter: Calcium
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/9/2016	370000
	9/27/2016	380000
	11/15/2016	400000
	1/17/2017	390000
	3/6/2017	400000
	4/25/2017	410000
	6/13/2017	410000
	7/17/2017	390000

From 8 baseline samples
Baseline mean = 393750
Baseline std Dev = 14078.9

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/18/2017	1	380000	[0, 422042]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-07
Parameter: Calcium
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/8/2016	390000
	9/26/2016	390000
	11/15/2016	410000
	1/17/2017	390000
	3/6/2017	390000
	4/25/2017	420000
	6/12/2017	430000
	7/17/2017	420000

From 8 baseline samples
Baseline mean = 405000
Baseline std Dev = 16903.1

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/19/2017	1	370000	[0, 438967]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-01
Parameter: Chloride
Original Data (Not Transformed)
Non-Detects Replaced with 1/2 DL

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/8/2016	9.9
	9/27/2016	8.8
	11/14/2016	ND<5 U
	1/17/2017	10
	3/6/2017	10
	4/26/2017	11
	6/13/2017	12
	7/17/2017	11

From 8 baseline samples
Baseline mean = 9.7125
Baseline std Dev = 2.13102

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/18/2017	1	11	[0, 13.9948]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-02
Parameter: Chloride
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/9/2016	13
	9/27/2016	11
	11/15/2016	12
	1/17/2017	13
	3/7/2017	13
	4/25/2017	14
	6/12/2017	14
	7/18/2017	13

From 8 baseline samples
Baseline mean = 12.875
Baseline std Dev = 0.991031

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/18/2017	1	13	[0, 14.8665]	FALSE

Non-Parametric Prediction Interval

Intra-Well Comparison for MW-16-03
Parameter: Chloride
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total Percent Non-Detects = 0%
Future Samples (k) = 1
Recent Dates = 1
Baseline Measurements (n) = 8
Maximum Baseline Concentration = 20
Confidence Level = 88.9%
False Positive Rate = 11.1%

Baseline Measurements	Date	Value
	8/8/2016	18
	9/27/2016	15
	11/15/2016	18
	1/17/2017	19
	3/7/2017	19
	4/25/2017	19
	6/12/2017	19
	7/18/2017	20

Date	Count	Mean	Significant
9/19/2017	1	18	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-04
Parameter: Chloride
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/9/2016	29
	9/26/2016	28
	11/15/2016	33
	1/17/2017	35
	3/7/2017	35
	4/25/2017	33
	6/12/2017	36
	7/17/2017	35

From 8 baseline samples
Baseline mean = 33
Baseline std Dev = 2.9761

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/19/2017	1	34	[0, 38.9805]	FALSE

Non-Parametric Prediction Interval

Intra-Well Comparison for MW-16-05
Parameter: Chloride
Original Data (Not Transformed)
Non-Detects Replaced with 1/2 DL

Total Percent Non-Detects = 12.5%
Future Samples (k) = 1
Recent Dates = 1
Baseline Measurements (n) = 8
Maximum Baseline Concentration = 12
Confidence Level = 88.9%
False Positive Rate = 11.1%

Baseline Measurements	Date	Value
	8/8/2016	12
	9/26/2016	9
	11/15/2016	ND<5 U
	1/17/2017	11
	3/7/2017	11
	4/25/2017	11
	6/12/2017	12
	7/17/2017	12

Date	Count	Mean	Significant
9/19/2017	1	11	FALSE

Non-Parametric Prediction Interval

Intra-Well Comparison for MW-16-06
Parameter: Chloride
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total Percent Non-Detects = 0%
Future Samples (k) = 1
Recent Dates = 1
Baseline Measurements (n) = 8
Maximum Baseline Concentration = 12
Confidence Level = 88.9%
False Positive Rate = 11.1%

Baseline Measurements	Date	Value
	8/9/2016	12
	9/27/2016	9.8
	11/15/2016	11
	1/17/2017	11
	3/6/2017	12
	4/25/2017	12
	6/13/2017	12
	7/17/2017	12

Date	Count	Mean	Significant
9/18/2017	1	11	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-07
Parameter: Chloride
Original Data (Not Transformed)
Cohen's Adjustment

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/8/2016	7.7
	9/26/2016	6.8
	11/15/2016	ND<10 U
	1/17/2017	7.3
	3/6/2017	ND<10 U
	4/25/2017	8
	6/12/2017	ND<10 U
	7/17/2017	10

From 8 baseline samples
Baseline mean = 9.24155
Baseline std Dev = 2.02913

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/19/2017	1	7.8	[0, 13.3191]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-01
Parameter: Fluoride
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/8/2016	1.1
	9/27/2016	1.4
	11/14/2016	1.4
	1/17/2017	1.2
	3/6/2017	1.7
	4/26/2017	1.8
	6/13/2017	1.8
	7/17/2017	1.7

From 8 baseline samples
Baseline mean = 1.5125
Baseline std Dev = 0.274838

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/18/2017	1	1.8	[0, 2.06479]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-02
Parameter: Fluoride
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/9/2016	1.5
	9/27/2016	1.5
	11/15/2016	1.4
	1/17/2017	1.4
	3/7/2017	1.7
	4/25/2017	1.7
	6/12/2017	1.6
	7/18/2017	1.6

From 8 baseline samples
Baseline mean = 1.55
Baseline std Dev = 0.119523

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/18/2017	1	1.6	[0, 1.79018]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-03
Parameter: Fluoride
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/8/2016	1.4
	9/27/2016	1.5
	11/15/2016	1.4
	1/17/2017	1.4
	3/7/2017	1.6
	4/25/2017	1.7
	6/12/2017	1.6
	7/18/2017	1.6

From 8 baseline samples
Baseline mean = 1.525
Baseline std Dev = 0.116496

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/19/2017	1	1.5	[0, 1.7591]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-04
Parameter: Fluoride
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/9/2016	0.88
	9/26/2016	0.88
	11/15/2016	0.87
	1/17/2017	0.86
	3/7/2017	1.1
	4/25/2017	1
	6/12/2017	1
	7/17/2017	1

From 8 baseline samples
Baseline mean = 0.94875
Baseline std Dev = 0.0880645

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/19/2017	1	1	[0, 1.12572]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-05
Parameter: Fluoride
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/8/2016	1.3
	9/26/2016	1.4
	11/15/2016	1.3
	1/17/2017	1.4
	3/7/2017	1.6
	4/25/2017	1.6
	6/12/2017	1.5
	7/17/2017	1.6

From 8 baseline samples
Baseline mean = 1.4625
Baseline std Dev = 0.130247

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/19/2017	1	1.5	[0, 1.72423]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-06
Parameter: Fluoride
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/9/2016	1.5
	9/27/2016	1.5
	11/15/2016	1.4
	1/17/2017	1.5
	3/6/2017	1.7
	4/25/2017	1.7
	6/13/2017	1.6
	7/17/2017	1.7

From 8 baseline samples
Baseline mean = 1.575
Baseline std Dev = 0.116496

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/18/2017	1	1.6	[0, 1.8091]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-07
Parameter: Fluoride
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/8/2016	1.4
	9/26/2016	1.4
	11/15/2016	1.3
	1/17/2017	1.4
	3/6/2017	1.6
	4/25/2017	1.6
	6/12/2017	1.6
	7/17/2017	1.7

From 8 baseline samples
Baseline mean = 1.5
Baseline std Dev = 0.141421

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/19/2017	1	1.5	[0, 1.78419]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-01
Parameter: pH, Field
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% Two-Sided Comparison

Baseline Samples	Date	Result
	8/8/2016	8.63
	9/27/2016	8.29
	11/14/2016	7.74
	1/17/2017	7.46
	3/6/2017	7.34
	4/26/2017	7.23
	6/13/2017	7.2
	7/17/2017	7.23

From 8 baseline samples
Baseline mean = 7.64
Baseline std Dev = 0.543113

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1)/2 = 97.5 %
t is Percentile of Student's T-Test (0.95/1/2) = 0.975
Degrees of Freedom = 8 (background observations) - 1
t(0.975, 8) = 2.36462

Date	Samples	Mean	Interval	Significant
9/18/2017	1	6.92	[6.28, 9]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-02
Parameter: pH, Field
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% Two-Sided Comparison

Baseline Samples	Date	Result
	8/9/2016	7.07
	9/27/2016	7.3
	11/15/2016	7.06
	1/17/2017	7.09
	3/7/2017	7.15
	4/25/2017	6.99
	6/12/2017	7.04
	7/18/2017	7.02

From 8 baseline samples
Baseline mean = 7.09
Baseline std Dev = 0.0973946

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1)/2 = 97.5 %
t is Percentile of Student's T-Test (0.95/1/2) = 0.975
Degrees of Freedom = 8 (background observations) - 1
t(0.975, 8) = 2.36462

Date	Samples	Mean	Interval	Significant
9/18/2017	1	7.01	[6.85, 7.33]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-03
Parameter: pH, Field
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% Two-Sided Comparison

Baseline Samples	Date	Result
	8/8/2016	6.93
	9/27/2016	7.17
	11/15/2016	7.04
	1/17/2017	6.72
	3/7/2017	7.13
	4/25/2017	6.98
	6/12/2017	7.02
	7/18/2017	6.97

From 8 baseline samples
Baseline mean = 6.995
Baseline std Dev = 0.137425

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1)/2 = 97.5 %
t is Percentile of Student's T-Test (0.95/1/2) = 0.975
Degrees of Freedom = 8 (background observations) - 1
t(0.975, 8) = 2.36462

Date	Samples	Mean	Interval	Significant
9/19/2017	1	6.89	[6.65, 7.34]	FALSE

Non-Parametric Prediction Interval

Intra-Well Comparison for MW-16-04
Parameter: pH, Field
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total Percent Non-Detects = 0%
Future Samples (k) = 1
Recent Dates = 1
Baseline Measurements (n) = 8
Maximum Baseline Concentration = 7.53
Confidence Level = 88.9%
False Positive Rate = 11.1%

Baseline Measurements	Date	Value
	8/9/2016	7.02
	9/26/2016	7.53
	11/15/2016	7.11
	1/17/2017	7.02
	3/7/2017	7.19
	4/25/2017	7.04
	6/12/2017	7.1
	7/17/2017	7.22

Date	Count	Mean	Significant
9/19/2017	1	7.02	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-05
Parameter: pH, Field
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% Two-Sided Comparison

Baseline Samples	Date	Result
	8/8/2016	7.3
	9/26/2016	7.67
	11/15/2016	7.12
	1/17/2017	6.95
	3/7/2017	7.15
	4/25/2017	7
	6/12/2017	7.05
	7/17/2017	7.12

From 8 baseline samples
Baseline mean = 7.17
Baseline std Dev = 0.228035

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1)/2 = 97.5 %
t is Percentile of Student's T-Test (0.95/1/2) = 0.975
Degrees of Freedom = 8 (background observations) - 1
t(0.975, 8) = 2.36462

Date	Samples	Mean	Interval	Significant
9/19/2017	1	6.89	[6.6, 7.74]	FALSE

Non-Parametric Prediction Interval

Intra-Well Comparison for MW-16-06
Parameter: pH, Field
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total Percent Non-Detects = 0%
Future Samples (k) = 1
Recent Dates = 1
Baseline Measurements (n) = 8
Maximum Baseline Concentration = 7.33
Confidence Level = 88.9%
False Positive Rate = 11.1%

Baseline Measurements	Date	Value
	8/9/2016	7.06
	9/27/2016	7.33
	11/15/2016	7.07
	1/17/2017	7.01
	3/6/2017	7.05
	4/25/2017	7.01
	6/13/2017	7.05
	7/17/2017	7.11

Date	Count	Mean	Significant
9/18/2017	1	6.93	FALSE

Non-Parametric Prediction Interval

Intra-Well Comparison for MW-16-07
Parameter: pH, Field
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total Percent Non-Detects = 0%
Future Samples (k) = 1
Recent Dates = 1
Baseline Measurements (n) = 8
Maximum Baseline Concentration = 7.4
Confidence Level = 88.9%
False Positive Rate = 11.1%

Baseline Measurements	Date	Value
	8/8/2016	6.96
	9/26/2016	7.4
	11/15/2016	7.05
	1/17/2017	6.92
	3/6/2017	6.96
	4/25/2017	6.97
	6/12/2017	6.95
	7/17/2017	6.96

Date	Count	Mean	Significant
9/19/2017	1	6.78	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-01
Parameter: Sulfate
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/8/2016	1400
	9/27/2016	1500
	11/14/2016	1500
	1/17/2017	1400
	3/6/2017	1300
	4/26/2017	1400
	6/13/2017	1400
	7/17/2017	1400

From 8 baseline samples
Baseline mean = 1412.5
Baseline std Dev = 64.087

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/18/2017	1	1500	[0, 1541.28]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-02
Parameter: Sulfate
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/9/2016	1600
	9/27/2016	1600
	11/15/2016	1600
	1/17/2017	1500
	3/7/2017	1400
	4/25/2017	1600
	6/12/2017	1500
	7/18/2017	1500

From 8 baseline samples
Baseline mean = 1537.5
Baseline std Dev = 74.4024

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/18/2017	1	1500	[0, 1687.01]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-03
Parameter: Sulfate
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/8/2016	1600
	9/27/2016	1600
	11/15/2016	1600
	1/17/2017	1600
	3/7/2017	1500
	4/25/2017	1500
	6/12/2017	1500
	7/18/2017	1500

From 8 baseline samples
Baseline mean = 1550
Baseline std Dev = 53.4522

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/19/2017	1	1500	[0, 1657.41]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-04
Parameter: Sulfate
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/9/2016	1400
	9/26/2016	1400
	11/15/2016	1500
	1/17/2017	1400
	3/7/2017	1300
	4/25/2017	1300
	6/12/2017	1400
	7/17/2017	1400

From 8 baseline samples
Baseline mean = 1387.5
Baseline std Dev = 64.087

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/19/2017	1	1300	[0, 1516.28]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-05
Parameter: Sulfate
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/8/2016	1500
	9/26/2016	1500
	11/15/2016	1500
	1/17/2017	1400
	3/7/2017	1400
	4/25/2017	1400
	6/12/2017	1500
	7/17/2017	1500

From 8 baseline samples
Baseline mean = 1462.5
Baseline std Dev = 51.7549

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/19/2017	1	1400	[0, 1566.5]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-06
Parameter: Sulfate
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/9/2016	1500
	9/27/2016	1500
	11/15/2016	1600
	1/17/2017	1500
	3/6/2017	1400
	4/25/2017	1400
	6/13/2017	1400
	7/17/2017	1500

From 8 baseline samples
Baseline mean = 1475
Baseline std Dev = 70.7107

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/18/2017	1	1500	[0, 1617.09]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-07
Parameter: Sulfate
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/8/2016	1500
	9/26/2016	1500
	11/15/2016	1500
	1/17/2017	1400
	3/6/2017	1400
	4/25/2017	1400
	6/12/2017	1400
	7/17/2017	1500

From 8 baseline samples
Baseline mean = 1450
Baseline std Dev = 53.4522

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/19/2017	1	1400	[0, 1557.41]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-01
Parameter: Total Dissolved Solids
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/8/2016	2100
	9/27/2016	2000
	11/14/2016	2000
	1/17/2017	2200
	3/6/2017	2100
	4/26/2017	2100
	6/13/2017	2100
	7/17/2017	2100

From 8 baseline samples
Baseline mean = 2087.5
Baseline std Dev = 64.087

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/18/2017	1	2200	[0, 2216.28]	FALSE

Non-Parametric Prediction Interval

Intra-Well Comparison for MW-16-02
Parameter: Total Dissolved Solids
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total Percent Non-Detects = 0%
Future Samples (k) = 1
Recent Dates = 1
Baseline Measurements (n) = 8
Maximum Baseline Concentration = 2300
Confidence Level = 88.9%
False Positive Rate = 11.1%

Baseline Measurements	Date	Value
	8/9/2016	2200
	9/27/2016	2200
	11/15/2016	2200
	1/17/2017	2300
	3/7/2017	2200
	4/25/2017	2200
	6/12/2017	2200
	7/18/2017	2300

Date	Count	Mean	Significant
9/18/2017	1	2300	FALSE

Non-Parametric Prediction Interval

Intra-Well Comparison for MW-16-03
Parameter: Total Dissolved Solids
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total Percent Non-Detects = 0%
Future Samples (k) = 1
Recent Dates = 1
Baseline Measurements (n) = 8
Maximum Baseline Concentration = 2300
Confidence Level = 88.9%
False Positive Rate = 11.1%

Baseline Measurements	Date	Value
	8/8/2016	2300
	9/27/2016	2200
	11/15/2016	2300
	1/17/2017	2300
	3/7/2017	2200
	4/25/2017	2300
	6/12/2017	2300
	7/18/2017	2300

Date	Count	Mean	Significant
9/19/2017	1	2300	FALSE

Non-Parametric Prediction Interval

Intra-Well Comparison for MW-16-04
Parameter: Total Dissolved Solids
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Total Percent Non-Detects = 0%
Future Samples (k) = 1
Recent Dates = 1
Baseline Measurements (n) = 8
Maximum Baseline Concentration = 2200
Confidence Level = 88.9%
False Positive Rate = 11.1%

Baseline Measurements	Date	Value
	8/9/2016	2100
	9/26/2016	2100
	11/15/2016	1700
	1/17/2017	2100
	3/7/2017	2200
	4/25/2017	2100
	6/12/2017	2100
	7/17/2017	2100

Date	Count	Mean	Significant
9/19/2017	1	2100	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-05
Parameter: Total Dissolved Solids
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/8/2016	2100
	9/26/2016	2000
	11/15/2016	2100
	1/17/2017	2100
	3/7/2017	2200
	4/25/2017	2100
	6/12/2017	2200
	7/17/2017	2100

From 8 baseline samples
Baseline mean = 2112.5
Baseline std Dev = 64.087

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/19/2017	1	2100	[0, 2241.28]	FALSE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-06
Parameter: Total Dissolved Solids
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/9/2016	2200
	9/27/2016	2100
	11/15/2016	2200
	1/17/2017	2200
	3/6/2017	2100
	4/25/2017	2100
	6/13/2017	2200
	7/17/2017	2200

From 8 baseline samples
Baseline mean = 2162.5
Baseline std Dev = 51.7549

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/18/2017	1	2300	[0, 2266.5]	TRUE

Parametric Prediction Interval Analysis

Intra-Well Comparison for MW-16-07
Parameter: Total Dissolved Solids
Original Data (Not Transformed)
Non-Detects Replaced with Detection Limit

Intra-Well Unified Guid. Formula 95% One-Sided Comparison

Baseline Samples	Date	Result
	8/8/2016	2100
	9/26/2016	2000
	11/15/2016	2100
	1/17/2017	2100
	3/6/2017	2100
	4/25/2017	2100
	6/12/2017	2200
	7/17/2017	2100

From 8 baseline samples
Baseline mean = 2100
Baseline std Dev = 53.4522

For 1 recent sampling event(s)
Actual confidence level is 1.0 - (0.05/1) = 95 %
t is Percentile of Student's T-Test (0.95/1) = 0.95
Degrees of Freedom = 8 (background observations) - 1
t(0.95, 8) = 1.89458

Date	Samples	Mean	Interval	Significant
9/19/2017	1	2100	[0, 2207.41]	FALSE

Appendix F
Closure Plan

Prepared for

DTE Energy
2000 2nd Street
Detroit, Michigan 48226

MONROE ASH BASIN CLOSURE PLAN

For the

MONROE POWER PLANT

Monroe, Michigan

Prepared by

Geosyntec consultants

engineers | scientists | innovators

134 North La Salle Street, Suite 300
Chicago, Illinois 60602

Project Number CHE8242R

October 2016

Table of Contents

LIST OF TABLES

LIST OF ATTACHMENTS

1. INTRODUCTION

This Closure Plan was prepared by Geosyntec Consultants (Geosyntec) for DTE Electric Company (DTE) to document the closure process for the Monroe Fly Ash Basin located at the DTE, Monroe Power Plant facility in Monroe, Michigan. The permitted Monroe Disposal Facility includes a 79-acre vertical extension (Vertical Extension) and 331-acre fly ash basin (Ash Basin), as shown on Attachment 1. The Closure Plan was developed for the Ash Basin in accordance with the United States Environmental Protection Agency (EPA) coal combustion residuals (CCR) rule ("CCR Rule") (40 CFR Part 257). The Ash Basin is considered to be a "surface impoundment" under the CCR Rule.

The purpose of this closure plan is to meet the requirements of rule [40 CFR § 257.102 (b)].

2. CLOSURE NARRATIVE [40 CFR § 257.102(b)(1)(i)]

This section is a narrative of how the Ash Basin will be closed by leaving most of the CCR in place and potentially closing by removal a small, mostly unfilled portion of the Ash Basin near the existing discharge weir, shown on Figure 1. This narrative meets the requirements of [40 CFR § 257.102(b)(1)(iii)], [40 CFR § 257.102(c)] and the final cover requirements of [40 CFR § 257.102(d)].

2.1. Site Description

The Ash Basin is a licensed Michigan Type III industrial waste landfill (Facility ID number 397800) located in Monroe, Michigan, and along Lake Erie. It is also operated to meet the requirements of NPDES permit No. MI001848. The Ash Basin is a manmade impoundment contained by an engineered compacted clay embankment, up to 46 feet tall, that was constructed by excavating 5 to 10 feet of clay from the center of the Ash Basin for use in building the perimeter embankment to contain ash. Ash has been deposited as shown on a site plan drawing (Attachment 1). The center of the Ash Basin and the discharge weir area remain largely unfilled, and the approximate limits of which are shown on Attachment 1. The Ash Basin is projected to receive sluiced ash until 2023.

2.2. Narrative [40 CFR § 257.102(b)(1)(iii)]

The Ash Basin will be closed by leaving CCR in place and potentially closing by removal a limited portion of the Ash Basin near the discharge weir which has only received a minimal depth of CCR. Key features of the closure include:

i) removing 45 feet of water from the Ash Basin;
ii) obtaining necessary construction and water discharge permits;

iii) establishing sedimentation/treatment ponds near future storm water runoff discharge points (note that the number of discharge points has not been finalized);

iv) allowing the ash to dewater until the ash will be dewatered sufficiently to allow regrading to final cover grades;

v) breaching the 40-foot-high, 200-foot-wide clay dike, likely in the vicinity of the present discharge weir, to accommodate gravity drainage of the entire site;

vi) regrading the existing ash as necessary to facilitate capping of most areas and closure by removal/relocation of an area to establish either one or two main discharge channels designed to promote stormwater drainage and discharge at NPDES permitted discharge points; and

vii) installing a cap designed to limit infiltration and erosion. The cap will tie in to the perimeter embankment of the Ash Basin.

Detailed discussion of each component of the closure to meet the requirements of 40 CFR § 257.102(c) and 257.102(d) are discussed in subsequent sections.

2.2.1. **Closure by Removal of CCR** [40 CFR § 257.102(c)]

A limited area of the Ash Basin near the weir may be closed by removal of CCR. Ash will be removed and relocated within the Ash Basin. Closure by removal requires that all CCR material and a demonstration that groundwater has not been impacted. Within the proposed limits of the closure by removal, existing ash and some of the foundation material below it would be moved to other areas of the Ash Basin.

The closure by removal area may include a sedimentation/treatment pond with a clay perimeter berm that would tie into the Ash Basin cover system. This pond would manage contact storm during construction of the cover system. This pond would be able to manage storm water runoff after closure. The groundwater monitoring program would reflect the monitoring necessary to demonstrate closure by removal in accordance with 257.95(h).

2.2.2. **Closure Infiltration Mitigation** [40 CFR § 257.102(d)(1)(i)]

The closure of the Ash Basin will be designed to control and minimize the potential for post closure infiltration of liquids in to the ash and releases of CCR, leachate, or contact run-off[1] to the ground or surface waters, or to the atmosphere. This will be accomplished by constructing a cover system with a low permeability infiltration layer, grading the site gravity drain, and managing all discharge water through sedimentation/treatment ponds.

[11] "Contact run-off" is surface water that has contacted CCR and will be managed in accordance with regulatory requirements.

2.2.3. **Water Impoundment Mitigation** [40 CFR § 257.102(d)(1)(ii)]

The design of the cover system will preclude the probability of future impoundment of water, slurry, or sediment. This will be accomplished by breaching the impoundment embankment to discharge all impounded water, and constructing a cover system with discharge channels and side slopes that maintain gravity drainage designed to preclude surface water ponding.

The Ash Basin will be regraded to develop a topography where surface water drains towards feeder channels that then drain to central discharge channel that discharges to a breach in the embankment. At least one breach to the impoundment embankment will be implemented. Water would pass through sedimentation/treatment ponds before being discharged to surface water.

Storm water diversion berms may be necessary to divert runoff water and channel it towards the feeder channels to prevent sheet flow. These grades would allow the cover system to accommodate subsidence and settlement, thus preventing low spots and ponding.

2.2.4. **Cap Stability** [40 CFR § 257.102(d)(1)(iii)]

The cover system will include measures to provide slope stability to prevent the sloughing or movement of the final cover system during the closure and post-closure care period. This will be accomplished by: (i) dewatering the ash and improving the subgrade strength; and (ii) installing a drainage layer below the low permeability infiltration control layer at specified collection areas to reduce pore pressure buildup under the cover and increase the stability of the cover system.

2.2.5. **Maintenance** [40 CFR § 257.102(d)(1)(iv)]

The cover system and closure will include measures to limit future maintenance. This will be accomplished with a cover system designed with: (i) an erosion protection layer; (ii) gravity draining channels; and (iii) storm water berms.

The erosion protection layer will include vegetative layer vegetated with local vegetation as further discussed in Section 2.2.9.

2.2.6. **Constructability** [40 CFR § 257.102(d)(1)(v)]

The design and construction of the cover system will be completed in the shortest time consistent with recognized and generally accepted good engineering practices. Closure activities are estimated to begin in 2023.

2.2.7. Management of Free Liquids [40 CFR § 257.102(d)(2)(i)]

Free liquids will be managed by removing the liquids that separate from the remaining waste. The Ash Basin will be dewatered by gravity draining or pumping/siphoning water to create a stable base for the cover system.

2.2.8. Ash Stabilization [40 CFR § 257.102(d)(2)(ii)]

The remaining ash will be stabilized to support the cover system. The ash will be dewatered thereby improving the internal strength of the material allowing it to support the cover system and will be graded to stable slopes.

2.2.9. Cover System Components [40 CFR § 257.102(d)(3)]

The final cover system will be designed to minimize infiltration and erosion and meet the CCR Rule. To meet these requirements, the cover system will include three distinct components, including, from top to bottom: (i) an erosion protection layer, (ii) an infiltration layer; and (iii) cover system drainage features.

Infiltration Layer [40 CFR § 257.102(d)(3)(i)(A)], [40 CFR § 257.102(d)(3)(i)(B)], [40 CFR § 257.102(d)(3)(ii)]

The CCR Rule requires that the permeability of the final cover system to be less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1 x 10^{-5} cm/sec., whichever is less.

The final cover will include a minimum of 18 inches of compacted earthen material or comparable alternative system with a permeability equal to or less than the permeability of the foundation native clay subsoils present and no greater than 1 x 10^{-5} cm/sec.

Erosion Protection Layer [40 CFR § 257.102(d)(3)(i)(C)]

The CCR Rule requires that the erosion protection layer consist of six inches of soil capable of sustaining native plant growth. To meet these requirements, the erosion protection layer will be either:

- (i) a minimum 6-inch thick earthen material capable of supporting native plant growth; or
- (ii) an approved alternative material, such as artificial turf designed to provide equivalent erosion protection [40 CFR § 257.102(d)(3)(ii)].

Cover System Drainage Features [40 CFR § 257.102(d)(3)(i)(D)]

The cover system will be designed with features that avoid disruption to its integrity and can accommodate settling and subsidence. This will be accomplished by design of drainage features within and below the cover system. An ash pore pressure relief system will be constructed below the cover system over select regions of the ash to maintain slope stability and manage free liquids. Along steep sections of the cover system, a drainage layer may be placed below the erosion protection or protective soil layer to prevent softening and destabilization of the cover system. The requirements of the drainage layer will be defined after selection of the type of infiltration layer and the final cover grades.

The final grading of the cover system will limit the potential for differential settlement and subsidence of the cover system to avoid deformation of the cover system and protect its integrity.

2.3. CCR Inventory [40 CFR § 257.102(b)(1)(iv)]

An estimate of the maximum expected volume of CCR to be impounded within the Ash Basin is estimated to be 19,900,000 cubic yards.

2.4. CCR Area [40 CFR § 257.102(b)(1)(v)]

An estimate of the largest area of the CCR unit to require final cover is approximately 320 acres.

2.5. Permitting

General construction associated with the closure will require permits such as MDEQ Part 31 construction permit, and Part 91 soil erosion and sediment control (SESC) permit. To construct the sedimentation ponds and channels outside of the limits of the Ash Basin may require excavation and fill placement below the Lake Erie Ordinary High Water Mark (OHWM) and therefore require permits such as MDEQ Park 325 for Great Lakes Submerged Lands, US Army Corp. of Engineering (USACE) Section 10 permit, and USACE Clean Water Act Section 404 Permit. Discharging water towards wetlands to the south of the site will require a MDEQ Part 303 permit for Wetlands Protection. The closure will require modifications to the National Pollutant Discharge Elimination System (NPDES) Industrial Permit.

2.6. Closure Schedule [40 CFR § 257.102(b)(1)(vi)]

An initial estimated schedule for engineering, permitting, and construction of the closure is presented in Table 1. Some of the activities associated with milestones that are dependent on site characteristics and timeframes will be revised as more information becomes available.

Table 1: Estimated Closure Schedule

Activity	Approximate Period
Post Closure Plan to Public Website	Oct 17, 2016
Continue Sluicing	Present -2023
Detailed Design	2023
Permitting	2023
Dewatering	2024
Ash Stabilization/Breaching of Dike	2025
Ash Grading	2026
Final Cover /Clean Closure	2027
Completion	2028

3. CERTIFICATION STATEMENT

3.1. Initial Written Closure Plan [40 CFR § 257.102(b)(4)]

I, John Seymour, being a Licensed Professional Engineer in good standing in the State of Michigan, do hereby certify, to the best of my knowledge, information, and belief that the information contained in the certification has been prepared in accordance with the accepted practice of engineering. I certify, for the DTE Monroe Basin CCR unit, that the information contained in this closure plan, dated October 14, 2016, meets the requirements of 40 CFR § 257.102.

[signature]
Signature

John Seymour
Printed Name

10/14/2016
Date

3.2. Design of the Final Cover System [40 CFR § 257.102(d)(3)(iii)]

I, John Seymour, being a Registered Professional Engineer in good standing in the State of Michigan, do hereby certify, to the best of my knowledge, information, and belief that the information contained in the certification has been prepared in accordance with the accepted practice of engineering. I certify, for the DTE Monroe Basin CCR unit, that the design of the final cover system as included in the initial written closure plan, dated October 14, 2016, meets the requirements of 40 CFR § 257.102.

Signature

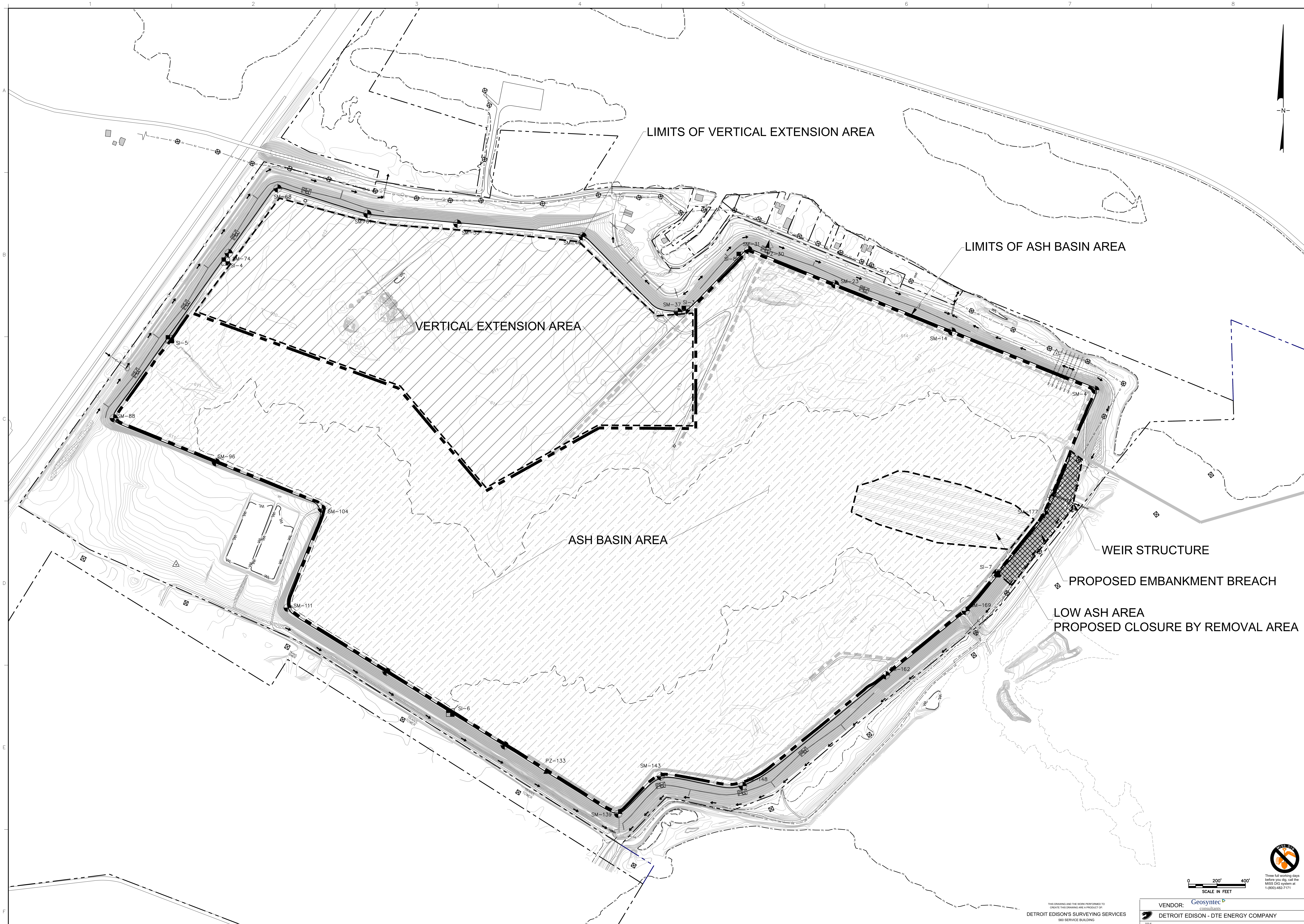
JOHN SEYMOUR
Printed Name

10/14/2016
Date

STATE OF MICHIGAN
JOHN P. SEYMOUR
ENGINEER
No. 33056
LICENSED PROFESSIONAL ENGINEER

ATTACHMENT 1

Monroe Disposal Facility Site Plan



THIS DRAWING AND THE WORK PERFORMED TO CREATE THIS DRAWING ARE A PRODUCT OF:
DETROIT EDISON'S SURVEYING SERVICES
560 SERVICE BUILDING

VENDOR: Geosyntec consultants

DETROIT EDISON - DTE ENERGY COMPANY

TITLE

MONROE DISPOSAL FACILITY SITE PLAN

LOCATION NAME: MONROE COUNTY, MICHIGAN

MONROE POWER PLANT

UNIT NUMBER

ORIGINATING SOURCE: ENGINEERING SUPPORT ORGANIZATION

SCALE: USE DIMENSIONS ONLY DO NOT SCALE

DRAWING NUMBER: 1 OF 1

JOB NUMBER: CHE8242R

Appendix G
Owner Certification of Compliance

Owner Certification of Site Compliance per 40 CFR 257 Subpart D
Monroe Power Plant Fly Ash Basin
Monroe, Michigan

The United States Environmental Protection Agency (EPA) Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals From Electric Utilities; A Holistic Approach to Closure Part B: Alternate Demonstration for Unlined Surface Impoundments (40 CFR §257.71(d)), requires that the owner of an existing CCR unit certify the facility is in compliance with the requirements of the CCR Rules (40 CFR 257 Subpart D) except for §257.71(a)(1).

CERTIFICATION

Based on our review of the CCR Rules, I hereby certify that the subject facility is in compliance with the requirements of 40 CFR 257 Subpart D except for §257.71(a)(1).

[signature] 11/30/2020

SIGNATURE DATE

Michael Twomley Plant Manager

PRINT NAME TITLE

DTE Electric Company

COMPANY NAME

Appendix H
Structural Stability and Safety Factor Assessments

Geosyntec consultants

134 N. La Salle Street, Suite 300
Chicago, Illinois 60602
PH 312.658.0500
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www.geosyntec.com

17 October 2016

Via Email

Mr. William Neal, P.E.
Technological Specialist
DTE Energy
One Energy Plaza
Detroit, MI 48226

Subject: Safety Factor Assessment
Monroe Power Plant Ash Basin Facility
Monroe, MI

Dear Mr. Neal:

This letter report presents Geosyntec Consultants' (Geosyntec's) safety factor assessment for DTE Electric Company's (DTE's) Monroe Power Plant Ash Basin (Ash Basin). The safety factor assessment is required under the United States Environmental Protection Agency (USEPA) Coal Combustion Residual (CCR) Rule (CCR Rule) published on 17 April 2015 (40 CFR Parts 257 and 261). Under the CCR Rule, the Ash Basin is an "existing surface impoundment" and must meet safety factor requirements per §257.73(e)[1] of the CCR Rule.

This letter report presents an executive summary followed by details of the analysis.

EXECUTIVE SUMMARY

A slope stability safety factor assessment was completed in accordance with §257.73(e) of the CCR Rule. The CCR Rule requires that surface impoundments have minimum safety factors for various loading conditions.

The results of the analyses indicate the Ash Basin meets the safety factor requirements per §257.73(e) with the maximum water level operated at a maximum elevation[2] of approximately 609 ft.

[1] §257.73(e) – Periodic Safety Factor Assessments.
[2] Elevations are in NGVD29 datum.

SAFETY FACTOR ASSESSMENT

Requirements of the CCR Rules

Slope stability analyses were conducted to assess whether the Ash Basin meets the safety factor (also referred to as "factor of safety") requirements of §257.73(e)(1) of the CCR Rule. §257.73(e)(1) requires that:

(i) *"The calculated static factor of safety under the long-term, maximum storage pool loading condition must equal or exceed 1.50.*
(ii) *The calculated static factor of safety under the maximum surcharge pool loading condition must equal or exceed 1.40.*
(iii) *The calculated seismic factor of safety must equal or exceed 1.00*
(iv) *For embankments constructed of soils that have susceptibility to liquefaction, the calculated liquefaction factor of safety must equal or exceed 1.20."*

Summary of Method and Analyses

Analyses were conducted to calculate factors of safety (FS) for loading conditions described in §257.73(e)(1)(i) through §257.73(e)(1)(iii) of the CCR Rule. Analysis for liquefaction FS was not conducted per §257.73(e)(1)(iv) of the CCR Rule because the embankment is not considered to be susceptible to liquefaction because of its stiff clayey nature. More information on the liquefaction potential of the Monroe Ash Basin embankment is provided in a subsequent section of this report.

The FS values were calculated with limit equilibrium methods using the computer software program SLIDE 6.0© (by Rocscience), a two-dimensional (2D) slope stability computer program. The FS for potential slip surfaces were evaluated using Spencer's Method (Spencer, 1967).

Monroe Ash Basin Embankment and Subsurface Conditions

The embankment was constructed using on-site soils that were excavated within the footprint of the Ash Basin. The embankment material is characterized as stiff to very stiff, consisting of lean clay with some sand and a trace of gravel. The embankment was constructed using standard engineering and construction methods including compaction of each lift to a specified minimum compaction level based on maximum dry density and optimum moisture content of the soil material. The embankment material is considered to be relatively uniform based on the results of a number of field investigations and laboratory testing programs conducted since construction was completed. The embankment has a maximum height of approximately 46 ft and side slopes ranging from 2 horizontal to 1 vertical (2H:1V) to 2.5H:1V.

The subsurface soil conditions at the site (below the embankment) consist of an approximately 30- to 50-ft thick stiff to hard silty clay layer with trace to some sand and gravel that generally gets progressively stiffer with depth. For the analysis, this soil is called "natural soil". The bedrock below this soil unit is characterized primarily as dolomite with occasional interbedded shale.

There are two phreatic surfaces at the site below the embankment: (i) the upper phreatic surface was observed in soil units at depths ranging from 10 to 40 ft below natural ground, and (ii) the bedrock phreatic surface which is at or above the ground surface (artesian condition).

Cross Sections Selected for Analyses

Analyses were conducted on four cross sections that were deemed potentially "critical" based on embankment height and steepness of the outer slopes. The cross section at Station 58+75 was analyzed for the northern part of the embankment, the cross section at Station 75+50 was analyzed for the western part of the embankment, the cross section at Station 133+00 was analyzed for the southern part of the embankment, and the cross section at Station 164+00 was analyzed for the eastern part of the embankment. Cross section locations are provided on Figure 1.

Engineering Parameters

Shear strength parameters of the embankment and the native soil were evaluated using consolidated-undrained triaxial compression (CU) test (ASTM D 4767) results. Twenty-three CU tests were performed on soil samples obtained from the embankment. Twenty were sampled utilizing thin-walled (Shelby) tubes (ASTM D 1587) and the remaining three were reconstituted using compaction methods in ASTM D 1557 (modified Proctor). Eight CU tests were performed on native soil samples obtained from Shelby tube samples. Sample locations are provided on Figure 1.

Geosyntec developed effective shear strength parameters (i.e., soil friction angle ϕ' and soil cohesion intercept c') using the CU test results. Geosyntec used the maximum obliquity approach to define soil failure. With this approach, shear strength parameters are evaluated for the stress condition corresponding to the maximum ratio of major principal effective stress (σ'_1) to minor principal effective stress (σ'_3).

The shear strength versus the mean effective stress (q vs. p') from the maximum obliquity approach was plotted for the embankment and the native soil on Figures 2 and 3, respectively. Geosyntec selected the effective friction angle and effective cohesion intercept as computed from the slope and intercept of the best fit linear relationship of the data. The selected effective friction angles are 34^o and 37^o for the embankment and native soil, respectively. The selected effective cohesion intercept values are 165 psf and 90 psf for the embankment and native soil, respectively.[3]

Unit weights used in the analyses are based on the samples collected as part of various field investigation studies that were conducted since 2009.

Water Level in the Ash Basin and Phreatic Surfaces Used for Analyses

The water level in the Ash Basin has been between approximately 607 ft and 611 ft since the Ash Basin started operating. Based on the operation records, the water level has been mostly 610.5 ft and 611 ft since the beginning of 2011. In 2015, DTE lowered the water level to a maximum elevation of 609 ft and will maintain that maximum elevation for the remainder of the operating life of the Ash Basin, which is estimated to be in 2023.

Five vibrating wire piezometers were installed in the embankment at Station 133+00 in August 2011 to obtain pore pressure information to be used to estimate the existing phreatic surface for a global stability assessment of the Ash Basin (Geosyntec, 2012a). The piezometers were installed at five different locations within a transverse section of the embankment (see Figure 4). The pore pressures obtained from the piezometer readings along with the Ash Basin water level are presented as piezometric elevations on Figure 5.

Considering that the Ash Basin has been holding sluice water for the last approximately 40 years and the measured piezometric elevations have been near constant for the last approximately two and a half years of measurement history, it is reasonable to assume that the phreatic surface in the embankment has reached a steady state condition. Therefore, it is reasonable to assume that piezometric levels will remain approximately at current values or decrease during the remaining operating life of the Ash Basin as a result of the decrease in

[3] For the seismic loading condition, drained strength parameters were selected for the analysis because undrained shear strengths yielded higher FS values.

Ash Basin operating water level. Consequently, the existing phreatic surface as measured in piezometers is representative for the safety factor assessment of the long-term condition.

The Ash Basin has received a "Significant Hazard Potential" classification per §257.73(a)(2)[4]. Based on this classification, the water level for the "maximum surcharge pool loading condition" must be estimated based on the 1,000-yr flood event. However, the analysis was conducted based on the more conservative probable maximum flood (PMF).

For the analysis considering the maximum storage pool loading condition (per §257.73(e)(1)(i)) and seismic condition (per §257.73(e)(1)(iii)), the phreatic surface was established by linearly connecting the piezometric elevations between piezometers, and upstream and downstream boundary conditions. The phreatic surface was first established for Station 133+00 where piezometers are located, and then applied to other cross sections. Because the embankment geometry is similar and the embankment material is relatively homogenous over the entire embankment, it is reasonable (for this type of evaluation) to assume hydraulic characteristics and phreatic surfaces are similar along the length of the embankment.

For the analysis considering the maximum surcharge pool loading condition (per §257.73(e)(1)(ii)), the same phreatic surface as for the maximum storage pool loading condition was used, except that the water level in the Ash Basin was raised to elevation 612.3 ft as a result of the Probable Maximum Flood[5]. It is assumed that the increase in water level from 609 ft to 612.3 ft will not create a considerable change in the phreatic surface within the embankment because the water level will return to elevation 609 ft in approximately six days[6]. Because of the low hydraulic conductivity of the embankment materials, pore pressure changes that could affect the calculated stability of the embankment would not be expected to occur in six days.

Artesian conditions in the bedrock exhibits approximately 35 ft of pressure head (Geosyntec, 2012b). The effect of pressure head was assessed by analyzing potential slip surfaces that extend 30 to 50 ft below ground level. The analysis results indicated that these potential slip surfaces exhibit higher FS values than for those reported subsequently. Therefore, artesian pressures were not considered in the analyses.

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[4] A separate letter is provided for the hazard potential classification for the Monroe Ash Basin, which is considered to be "Significant Hazard".
[5] Provided as part of a separate letter for the Hydraulic Capacity Assessment.
[6] Provided as part of a separate letter for the Hydraulic Capacity Assessment.

Seismic Coefficient for Analysis

The peak horizontal acceleration was selected based on the maps published by USGS (2010). A peak horizontal acceleration at the hard rock (with a 2% probability of exceedance in 50 years) of 0.04g was selected from the map. For analysis, a seismic coefficient of 0.04 was used. The use of a seismic coefficient for slope stability analysis based on the peak horizontal acceleration (without any reduction) is conservative.

Liquefaction Potential of the Monroe Ash Basin Embankment

The Ash Basin embankment was constructed using the onsite clayey native soil. These soils may be susceptible to strength loss during a seismic event. A method proposed by Bray and Sancio (2006) uses the results of laboratory investigations on silts and clays to define a range of soil index parameters for which a silt or clay may be susceptible to strength loss. The results provided on Figure 6 indicate that the Monroe Ash Basin embankment is not susceptible to strength loss, and therefore not susceptible to liquefaction. Results provided on Figure 6 are from index soil data (see Geosyntec, 2012b).

Analysis Results and Conclusion

The analysis results are summarized in Table 1 and provided on Figures 8 through 20.

Table 1. Analysis Summary.

Station #	Maximum Storage Pool Loading Condition Per §257.73(e)(1)(i) SF ≥ 1.50		Maximum Surcharge Pool Loading Condition Per §257.73(e)(1)(ii) SF ≥ 1.40		Seismic Loading Condition Per §257.73(e)(1)(iii) SF ≥ 1.00	
	SF	Figure #	SF	Figure #	SF	Figure #
58+75	1.68	7	1.68	8	1.53	9
75+50*	1.98, 1.91	10, 11	1.98	12	1.76	13
133+00	1.57	14	1.57	15	1.41	16
164+00	1.62	17	1.62	18	1.47	19

* Maximum storage pool loading condition for Station 75+50 was analyzed considering Navarre Drain was flowing both full and dry.

Based on the results of slope stability analyses, the Ash Basin meets the safety factor assessment required per §257.73(e) of the CCR Rule.

CONCLUSIONS AND RECOMMENDATIONS

The results indicate that the Ash Basin embankment meet the FS criteria of §257.73(e).

The maximum storage pool operating level is to be maintained at or below elevation 609 ft as this is a key factor in the analysis. If this water level cannot be maintained, or there are structural/geometrical changes to the embankment, analyses need to be conducted to assess compliance with the CCR Rule. However, no structural changes to the embankment and discharge structure are required at this time to meet FS criteria.

QUALIFICATIONS OF LICENSED PROFESSIONAL ENGINEER

John Seymour is a qualified licensed professional engineer with over 30 years of experience in civil and geotechnical engineering associated with earthen structures and dams.

CERTIFICATION

I, John Seymour, am a qualified licensed professional engineer in Michigan have evaluated the Ash Basin and hereby certify that the results of the safety factor assessment meet the requirements of 40 CFR 257.73(e).

Certified by:

STATE OF MICHIGAN
JOHN P. SEYMOUR
ENGINEER
No. 33056
LICENSED PROFESSIONAL ENGINEER

______________________ Date 10/17/2016

John Seymour, P.E.
Michigan License Number 620103356
Senior Principal

Attachments: Figures 1 through 19

Copies to: Mark Green (DTE)

REFERENCES

Bray, J.D. and Sancio, R.B. (2006) "Assessment of the Liquefaction Susceptibility of Fine-Grained Soils" Journal of Geotechnical and Geoenvironmental Engineering, 132 (9), 1165-1177

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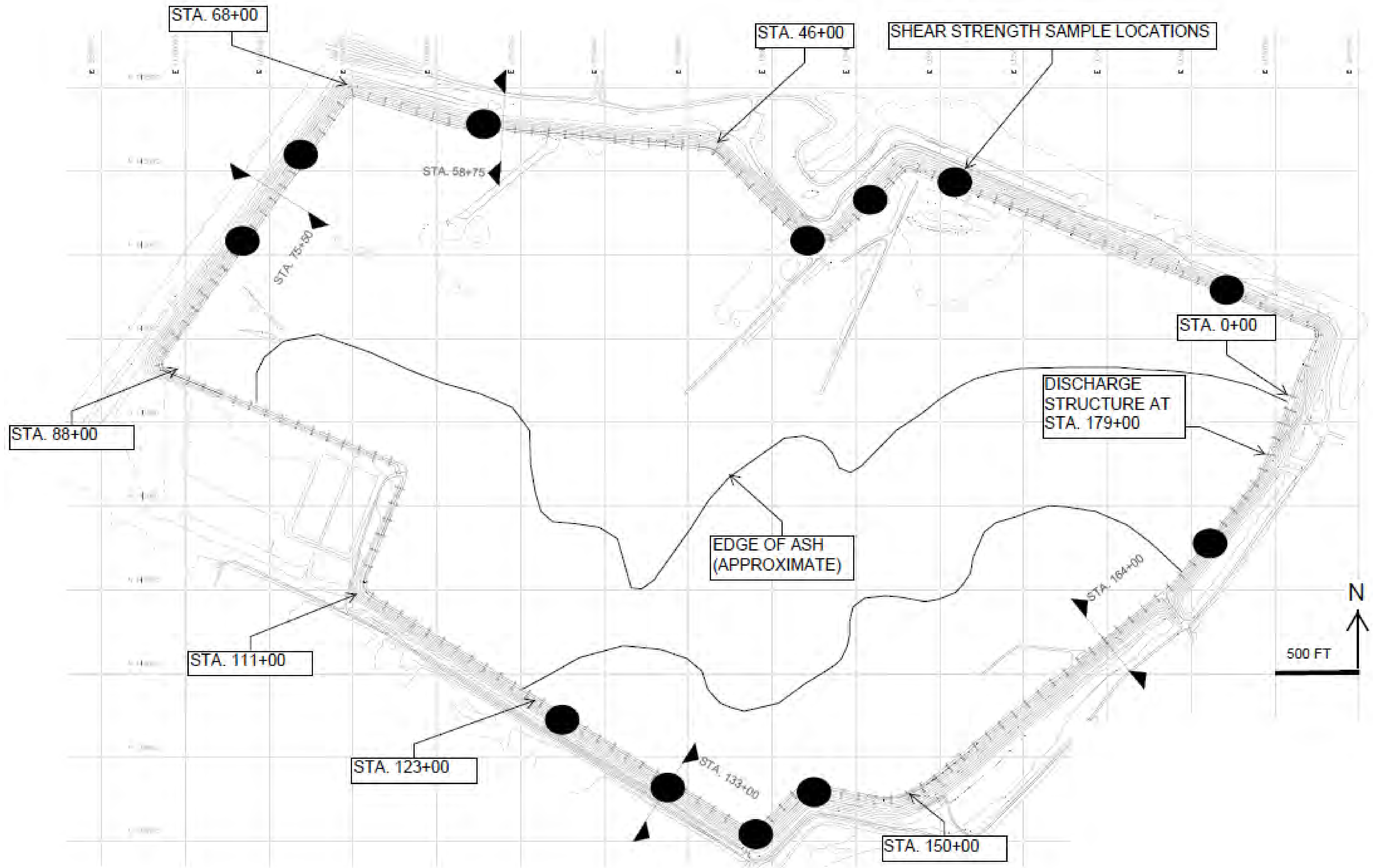
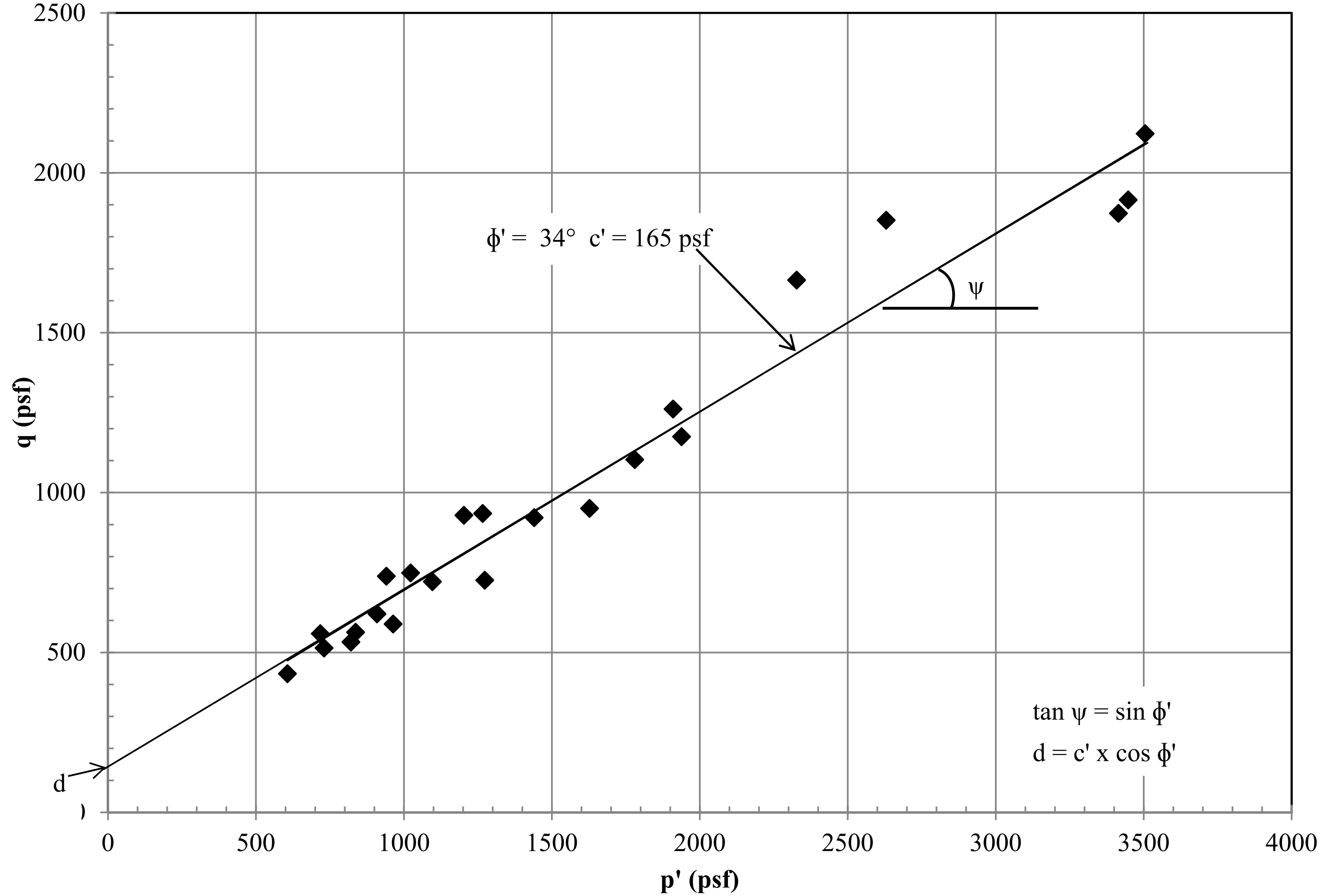
FIGURES



Monroe Ash Basin Layout, Cross Sections and Shear Strength Sample Locations

Monroe Ash Basin Safety Factor Assessment September, 2016	Geosyntec consultants / DTE Energy	Figure 1

G:\CWP\CHE8242-Detroit Edison\500 - Technical\502 Ash Pond Stability\502-13 Structural Stability & Hydraulics Assessment\Report\Figures



where:

$p' = (\sigma'_1 + \sigma'_3) / 2$ σ'_1 : Major principal effective stress

$q = (\sigma'_1 - \sigma'_3) / 2$ σ'_3 : Minor principal effective stress

Shear Strength Envelope and Parameters for Ash Basin Embankment

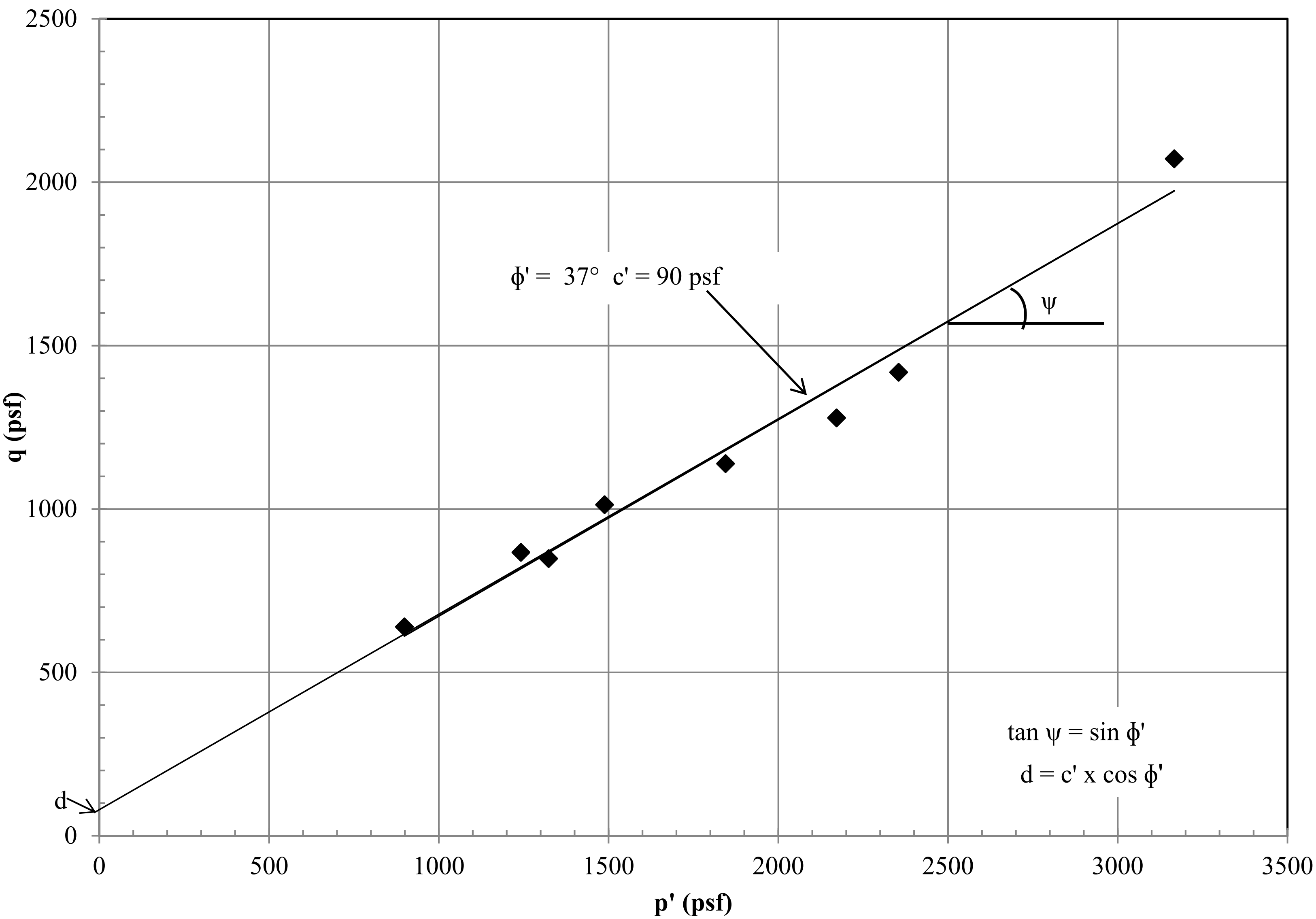
Monroe Ash Basin Safety Factor Assessment
September, 2016

Geosyntec consultants

DTE Energy

Figure 2

G:\CWP\CHE8242-Detroit Edison\500 - Technical\502 Ash Pond Stability\502-13 Structural Stability & Hydraulics Assessment\Report\Figures



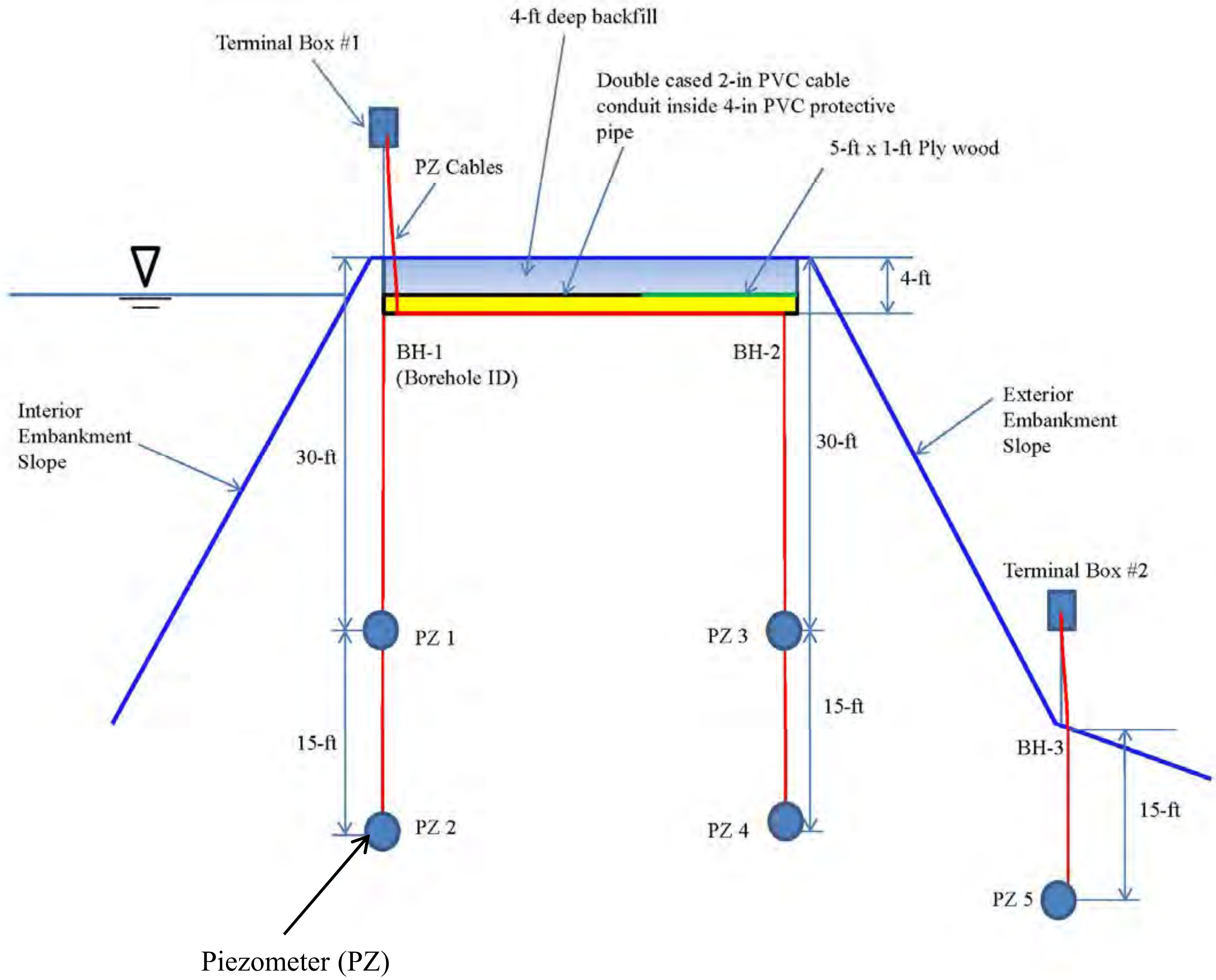
where:

$p' = (\sigma'_1 + \sigma'_3) / 2$ σ'_1 : Major principal effective stress

$q = (\sigma'_1 - \sigma'_3) / 2$ σ'_3 : Minor principal effective stress

Shear Strength Envelope and Parameters for Native Soil		
Monroe Ash Basin Safety Factor Assessment September, 2016	Geosyntec consultants / DTE Energy	Figure 3

G:\CWP\CHE8242-Detroit Edison\500 - Technical\502 Ash Pond Stability\502-13 Structural Stability & Hydraulics Assessment\Report\Figures



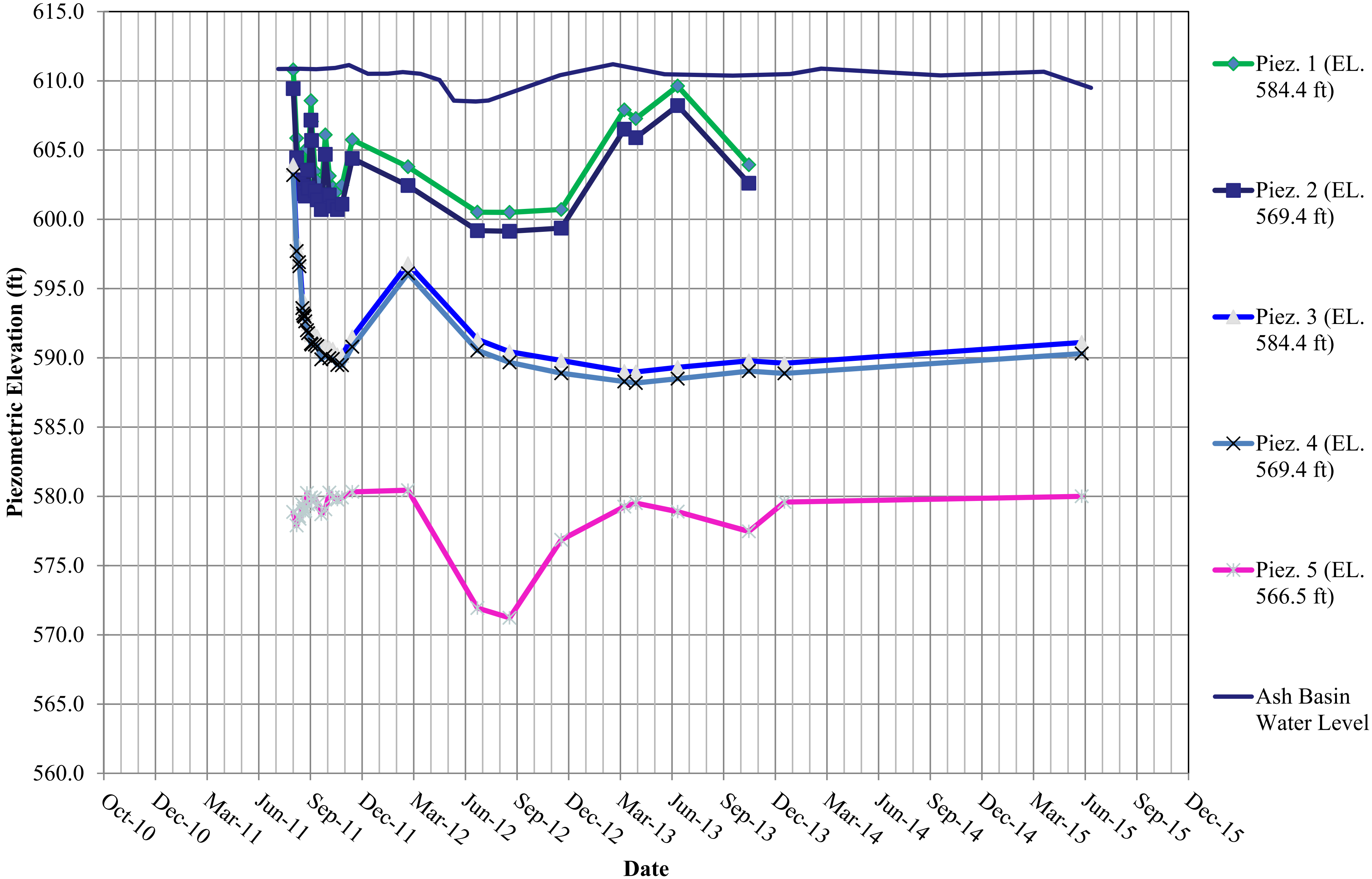
Piezometer Locations at Station 133+00

Monroe Ash Basin Safety Factor Assessment
September, 2016

Geosyntec consultants | DTE Energy

Figure 4

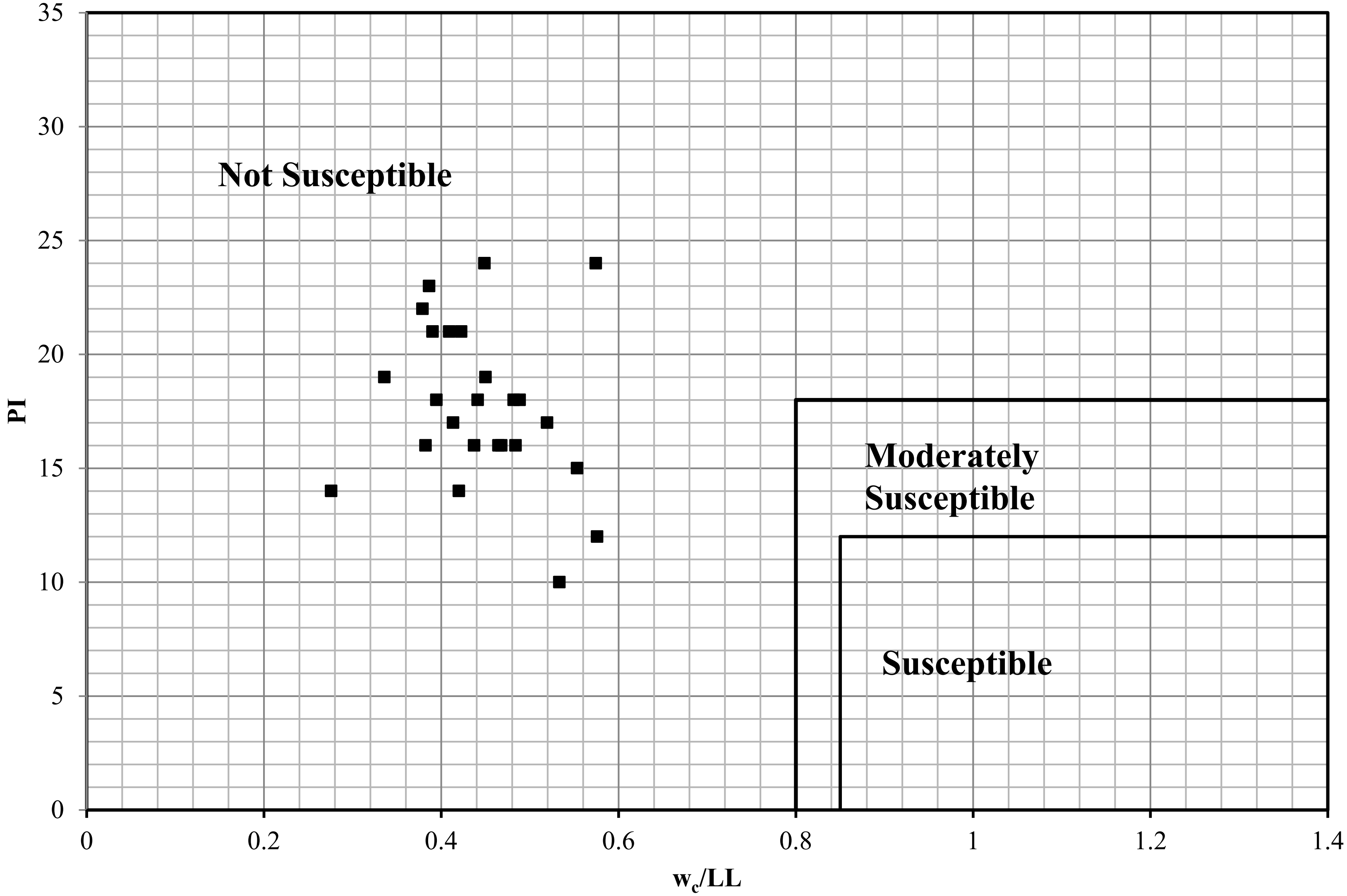
G:\CWP\CHE8242-Detroit Edison\500 - Technical\502 Ash Pond Stability\502-13 Structural Stability & Hydraulics Assessment\Report\Figures



Notes:

- Piezometric elevations at Piezometer (Piez.) 1 & 2 locations are not reported beyond October 29, 2013 due to likely piezometer malfunctions.

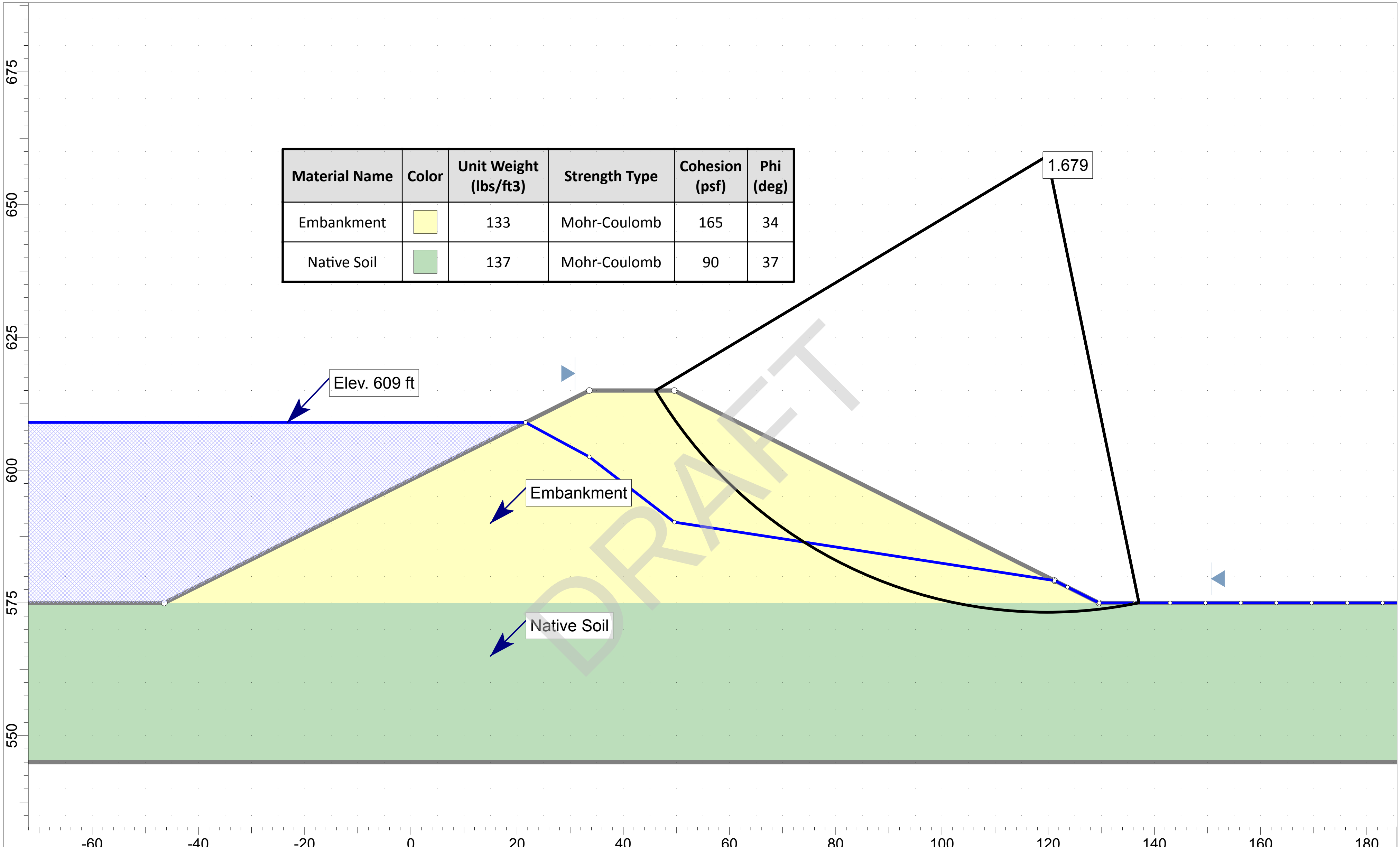
Piezometric Elevation at Piezometer Locations at Station 133+00		
Monroe Ash Basin Safety Factor Assessment September, 2016	Geosyntec consultants / DTE Energy	Figure 5



PI = Plasticity Index
LL = Liquid Limit
w_c = water content

Evaluation of Liquefaction Potential of Embankment

Monroe Ash Basin Safety Factor Assessment September, 2016	Geosyntec consultants / DTE Energy	Figure **6**



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment		133	Mohr-Coulomb	165	34
Native Soil		137	Mohr-Coulomb	90	37

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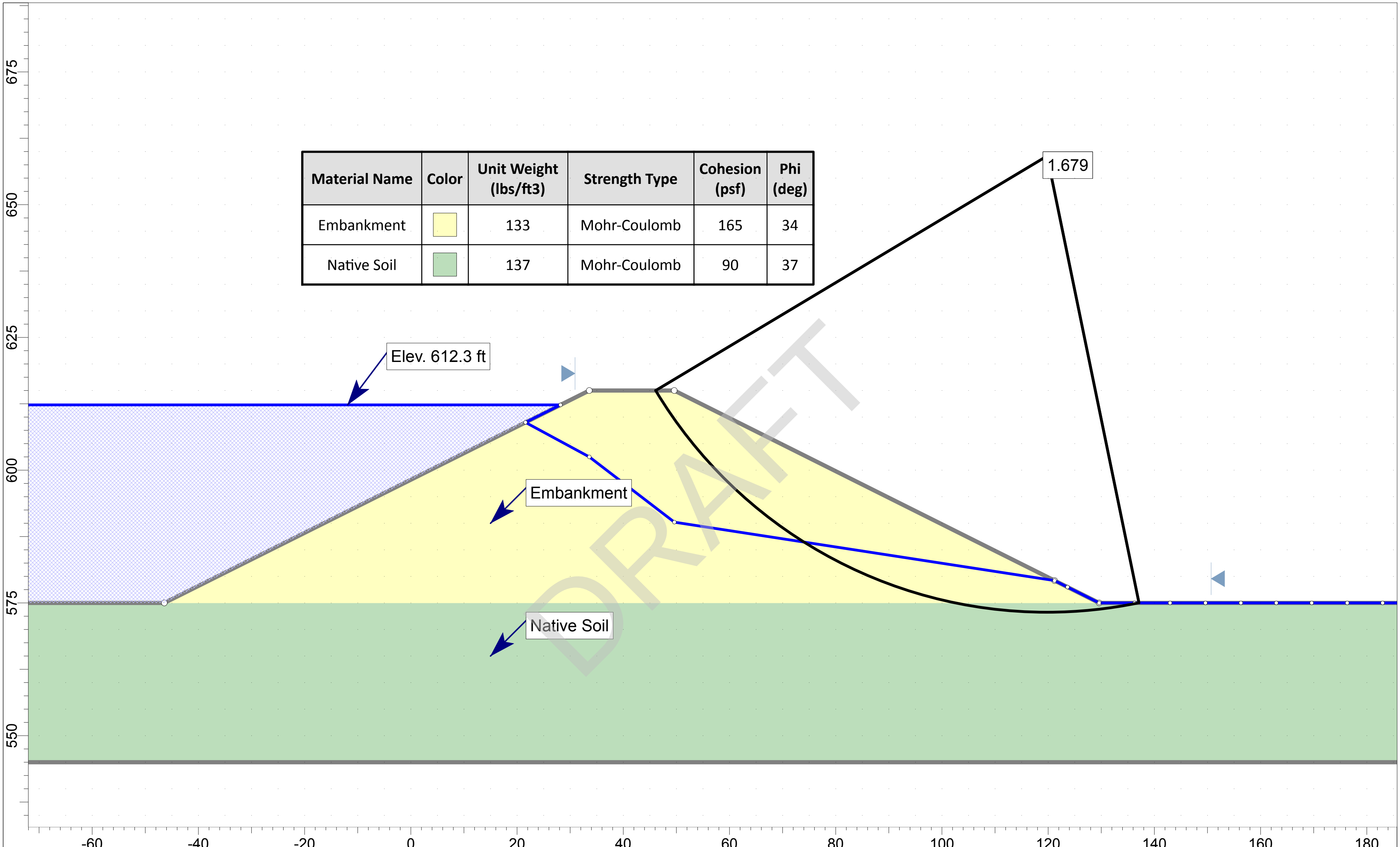
SLIDEINTERPRET 6.035

Project	Monroe Ash Basin Safety Factor Assessment
Analysis Description	Long Term Stability
Analysis By	YK
Client	Geosyntec Consultants
Date	6/15/2015, 1:34:40 PM
Scale	1:300
File Name	station58_75_static.slim

FIGURE 7



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment		133	Mohr-Coulomb	165	34
Native Soil		137	Mohr-Coulomb	90	37

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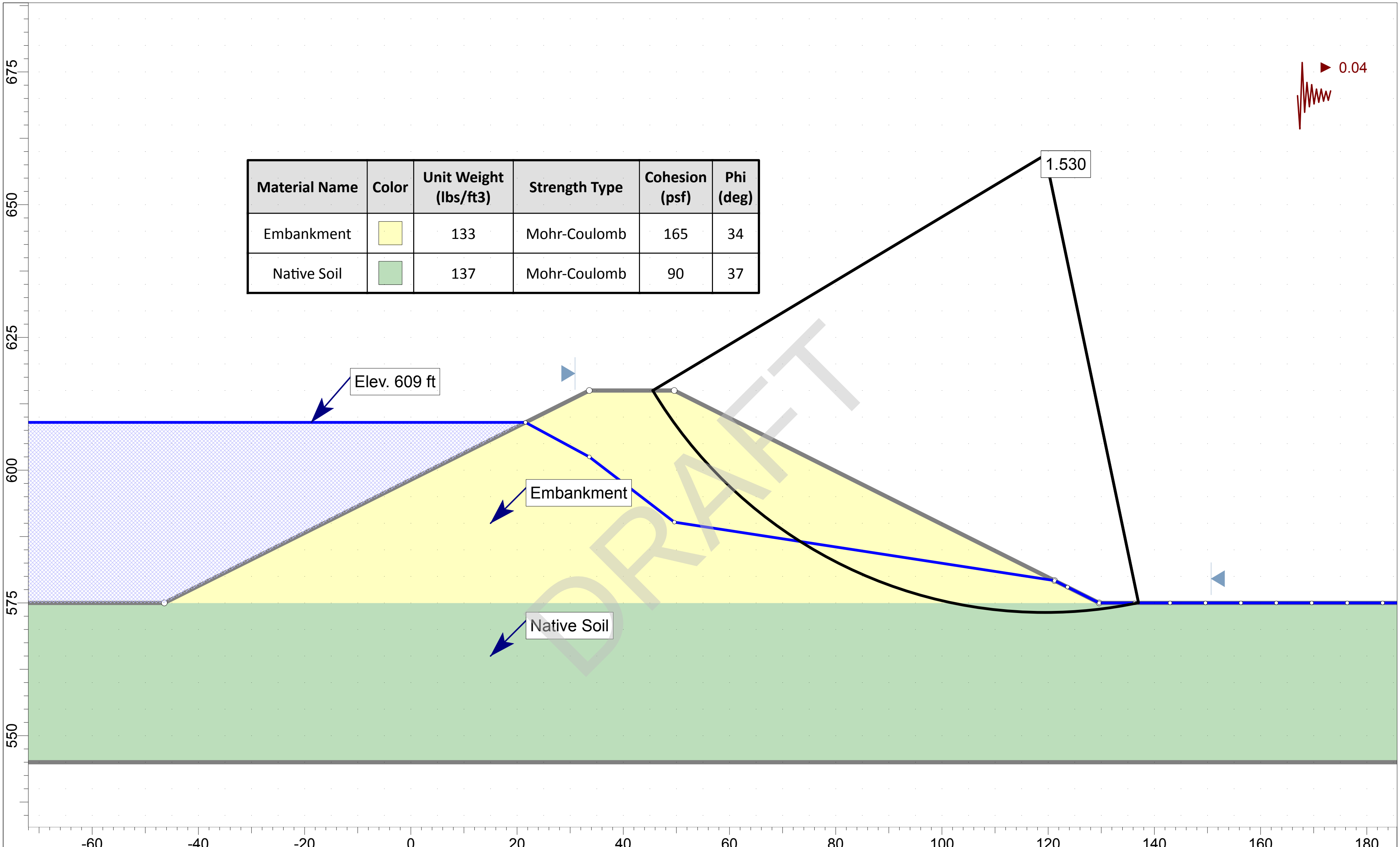
SLIDEINTERPRET 6.035

Project	Monroe Ash Basin Safety Factor Assessment
Analysis Description	Maximum Surcharge Pool Loading
Analysis By	YK
Client	Geosyntec Consultants
Date	6/15/2015, 1:34:40 PM
Scale	1:300
File Name	station58_75_static_MSPL.slim

FIGURE 8



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment		133	Mohr-Coulomb	165	34
Native Soil		137	Mohr-Coulomb	90	37

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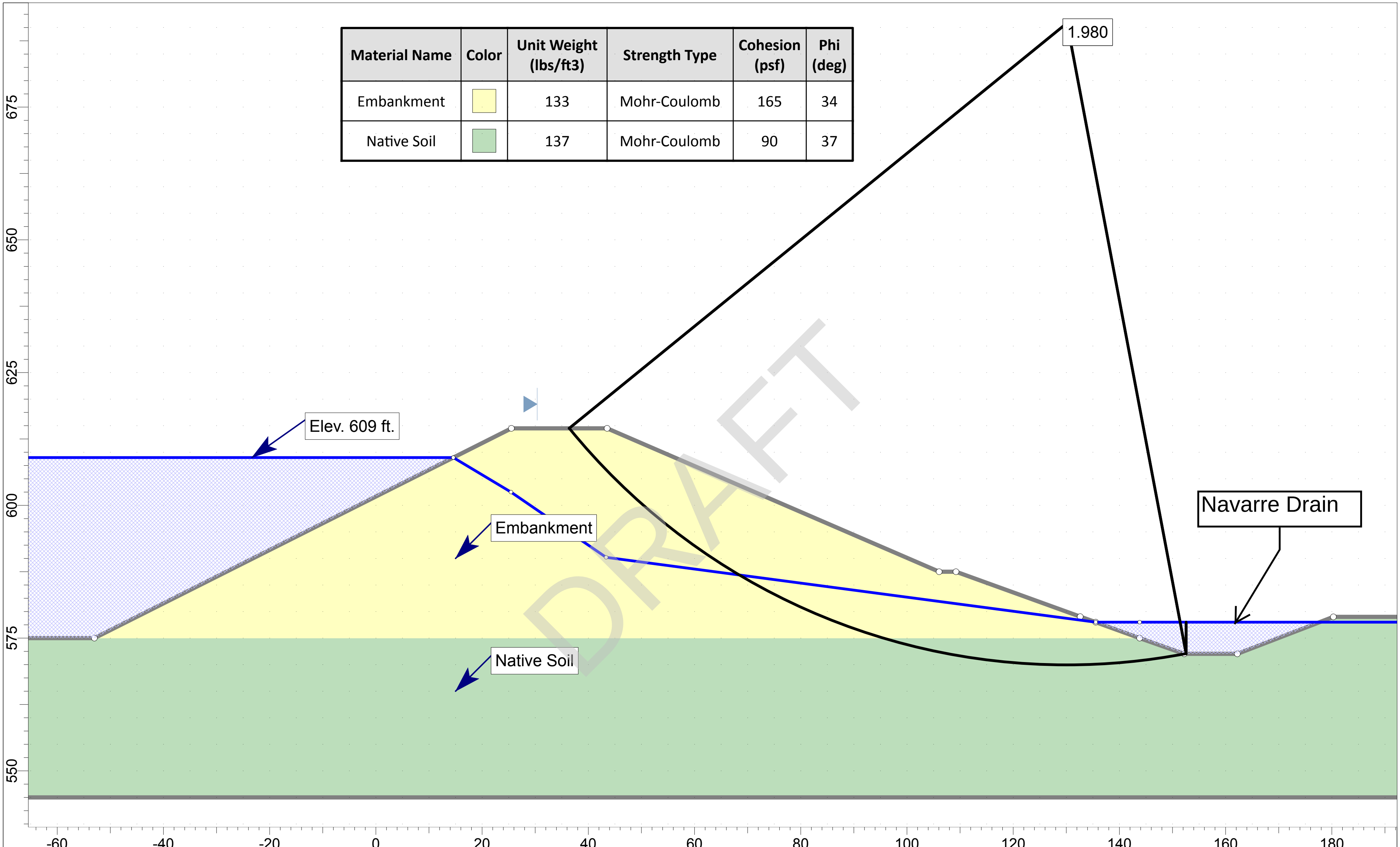
Project	Monroe Ash Basin Safety Factor Assessment
Analysis Description	Seismic Loading
Analysis By	YK
Client	Geosyntec Consultants
Date	6/15/2015, 1:34:40 PM
Scale	1:300
File Name	station58_75_static_seismic.slim

FIGURE 9



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment		133	Mohr-Coulomb	165	34
Native Soil		137	Mohr-Coulomb	90	37

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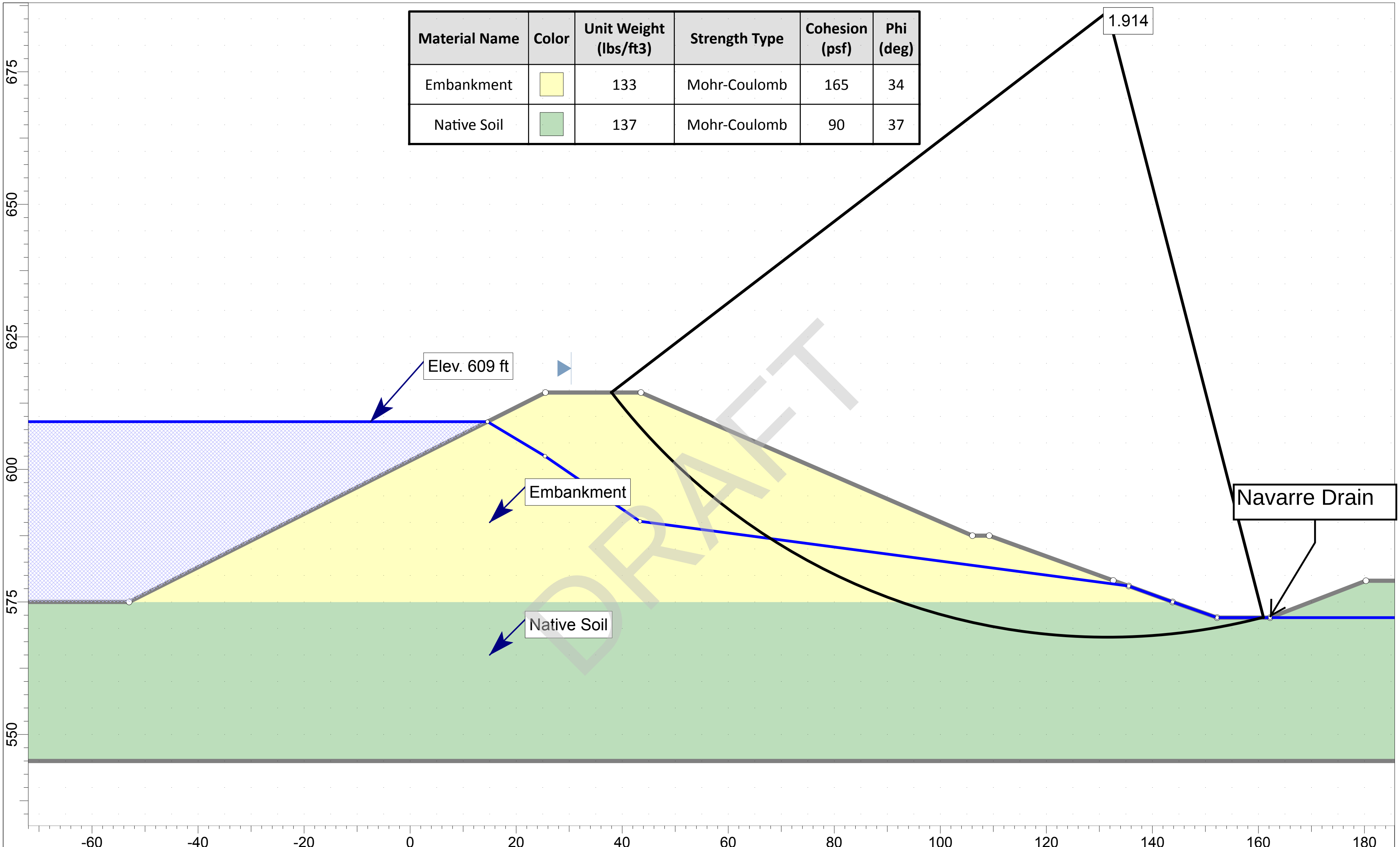
SLIDEINTERPRET 6.035

Project	Monroe Ash Basin Safety Factor Assessment
Analysis Description	Long Term Stability
Analysis By	YK
Client	Geosyntec Consultants
Date	6/17/2015, 11:38:55 AM
Scale	1:300
File Name	station75_50_static.slim

FIGURE 10



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment		133	Mohr-Coulomb	165	34
Native Soil		137	Mohr-Coulomb	90	37

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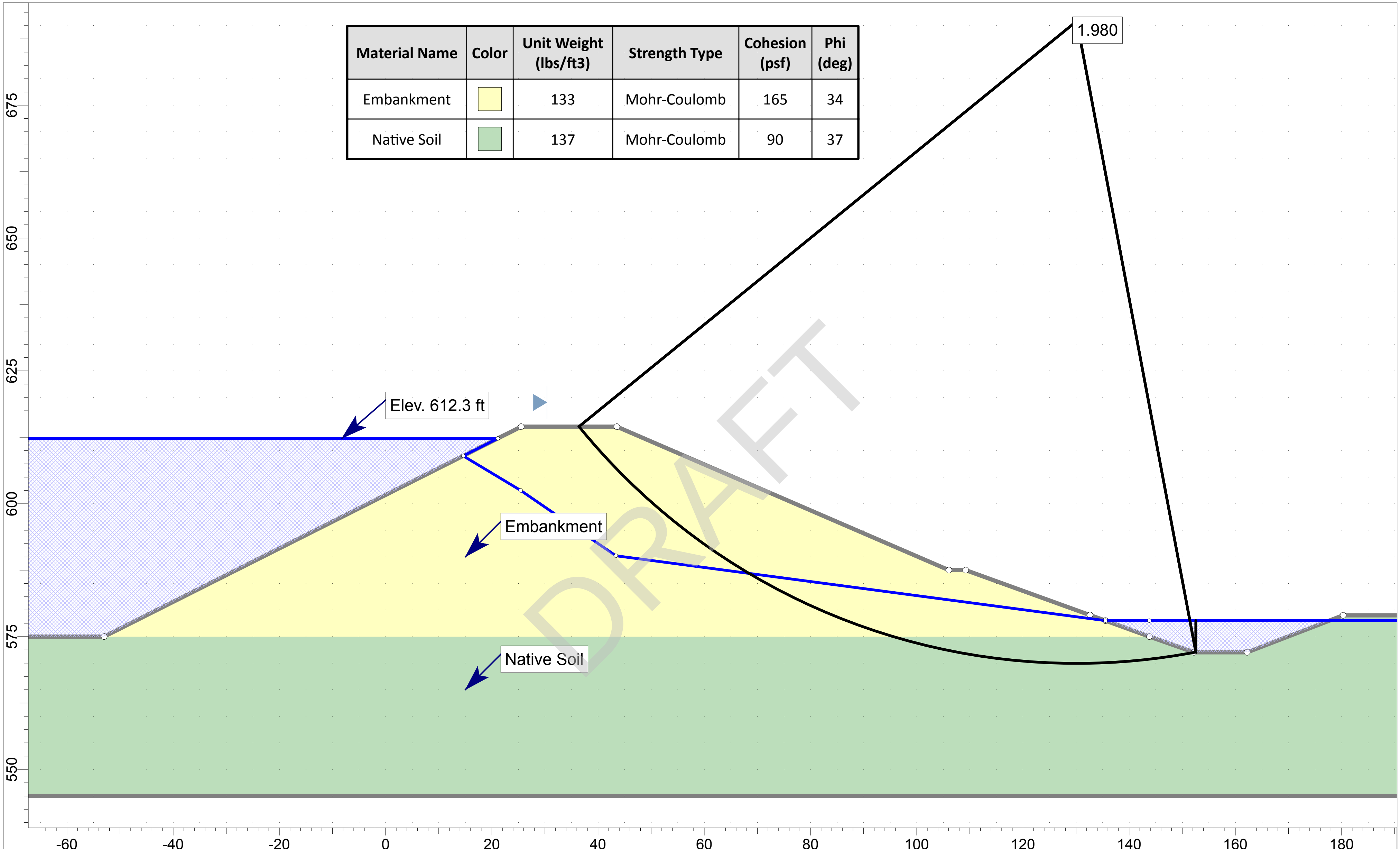
SLIDEINTERPRET 6.035

Project	Monroe Ash Basin Safety Factor Assessment
Analysis Description	Dry Drain
Analysis By	YK
Client	Geosyntec Consultants
Date	6/17/2015, 11:38:55 AM
Scale	1:300
File Name	station75_50_static_drydrain.slim

FIGURE 11



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment		133	Mohr-Coulomb	165	34
Native Soil		137	Mohr-Coulomb	90	37

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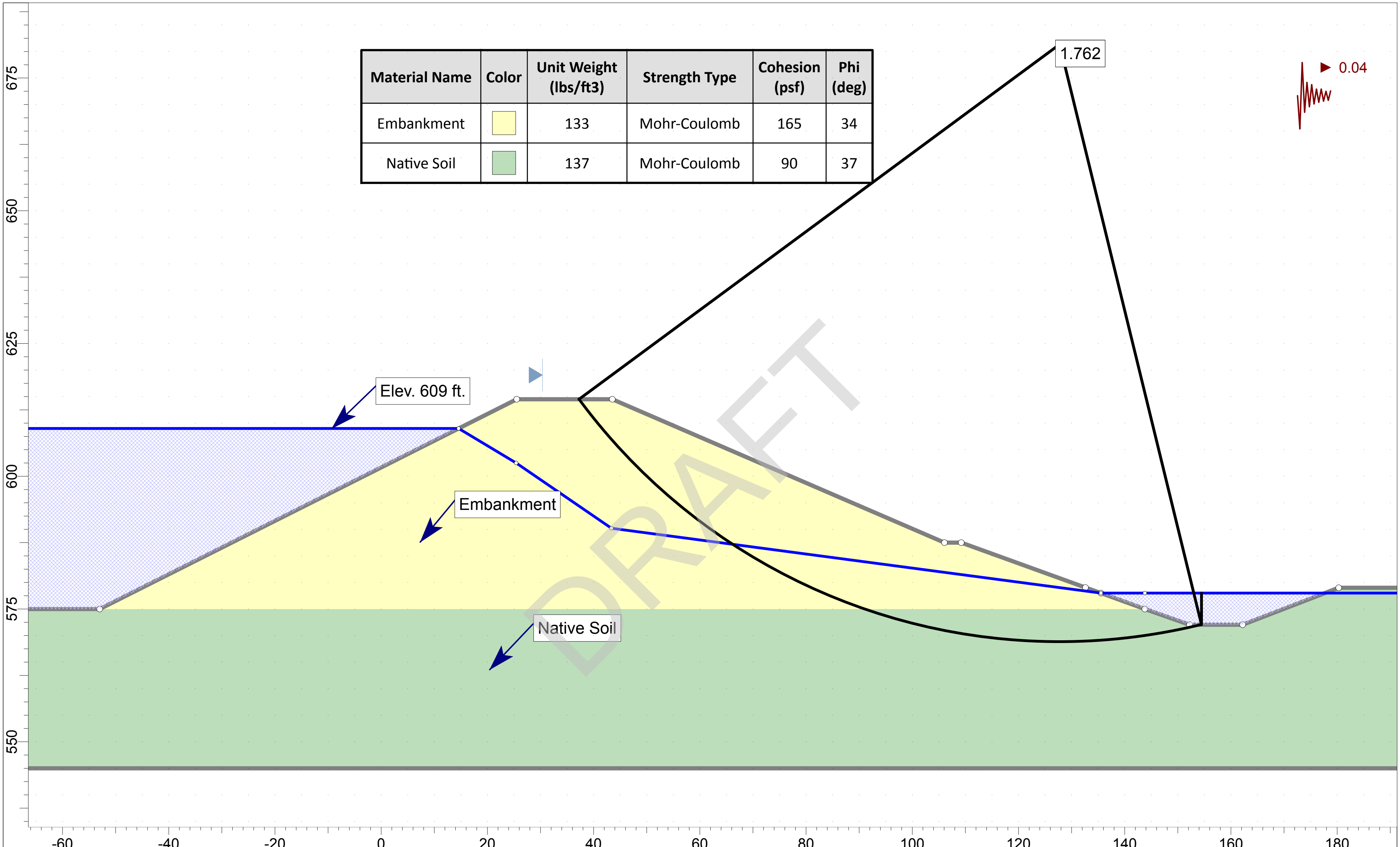
SLIDEINTERPRET 6.035

Project	Monroe Ash Basin Safety Factor Assessment
Analysis Description	Maximum Surcharge Pool Loading
Analysis By	YK
Client	Geosyntec Consultants
Date	6/17/2015, 11:38:55 AM
Scale	1:300
File Name	station75_50_static_MSPL.slim

FIGURE 12



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment		133	Mohr-Coulomb	165	34
Native Soil		137	Mohr-Coulomb	90	37

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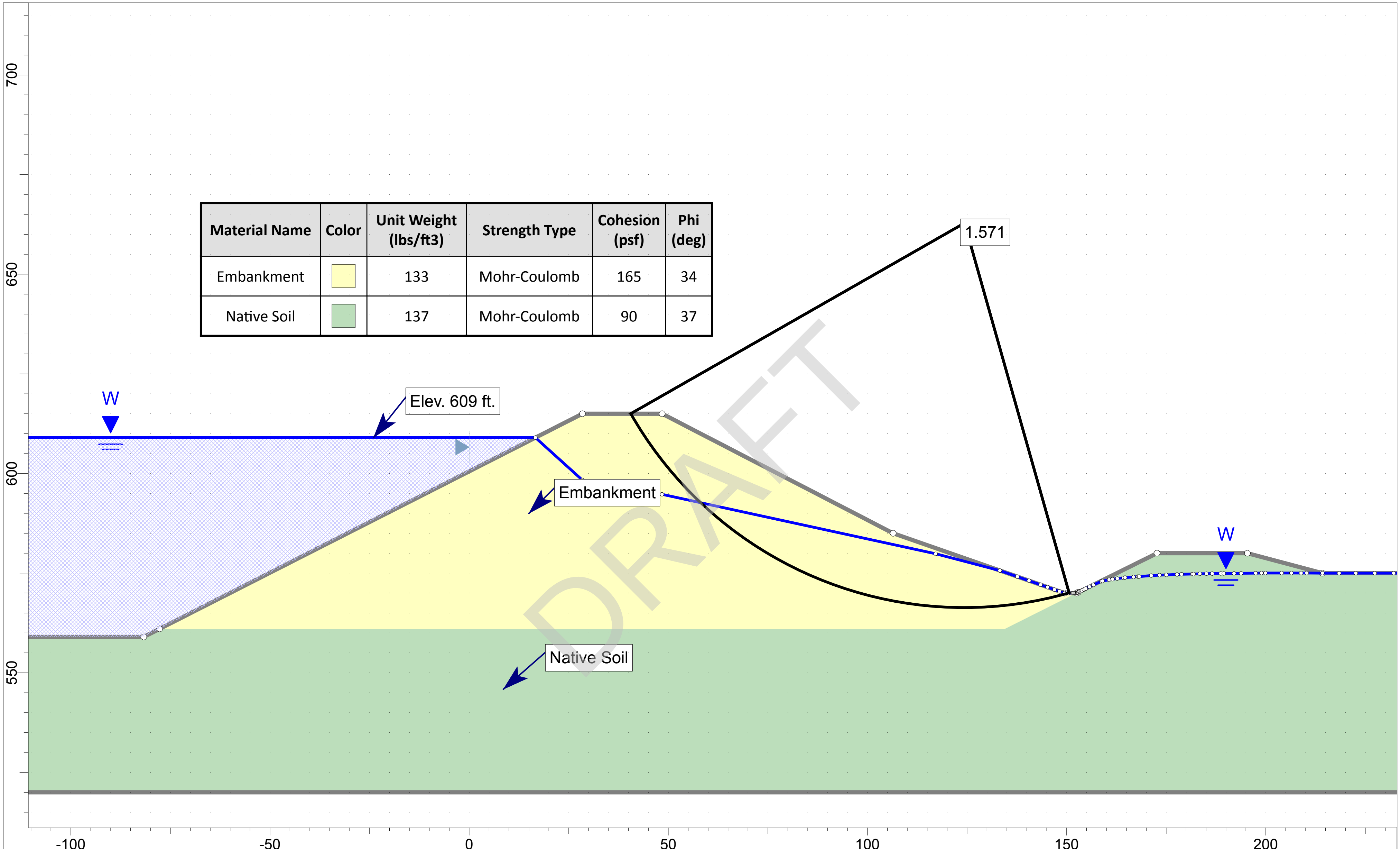
SLIDEINTERPRET 6.035

Project	Monroe Ash Basin Safety Factor Assessment
Analysis Description	Seismic Loading
Analysis By	YK
Client	Geosyntec Consultants
Date	6/17/2015, 11:38:55 AM
Scale	1:300
File Name	station75_50_static_seismic.slim

FIGURE 13



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment		133	Mohr-Coulomb	165	34
Native Soil		137	Mohr-Coulomb	90	37

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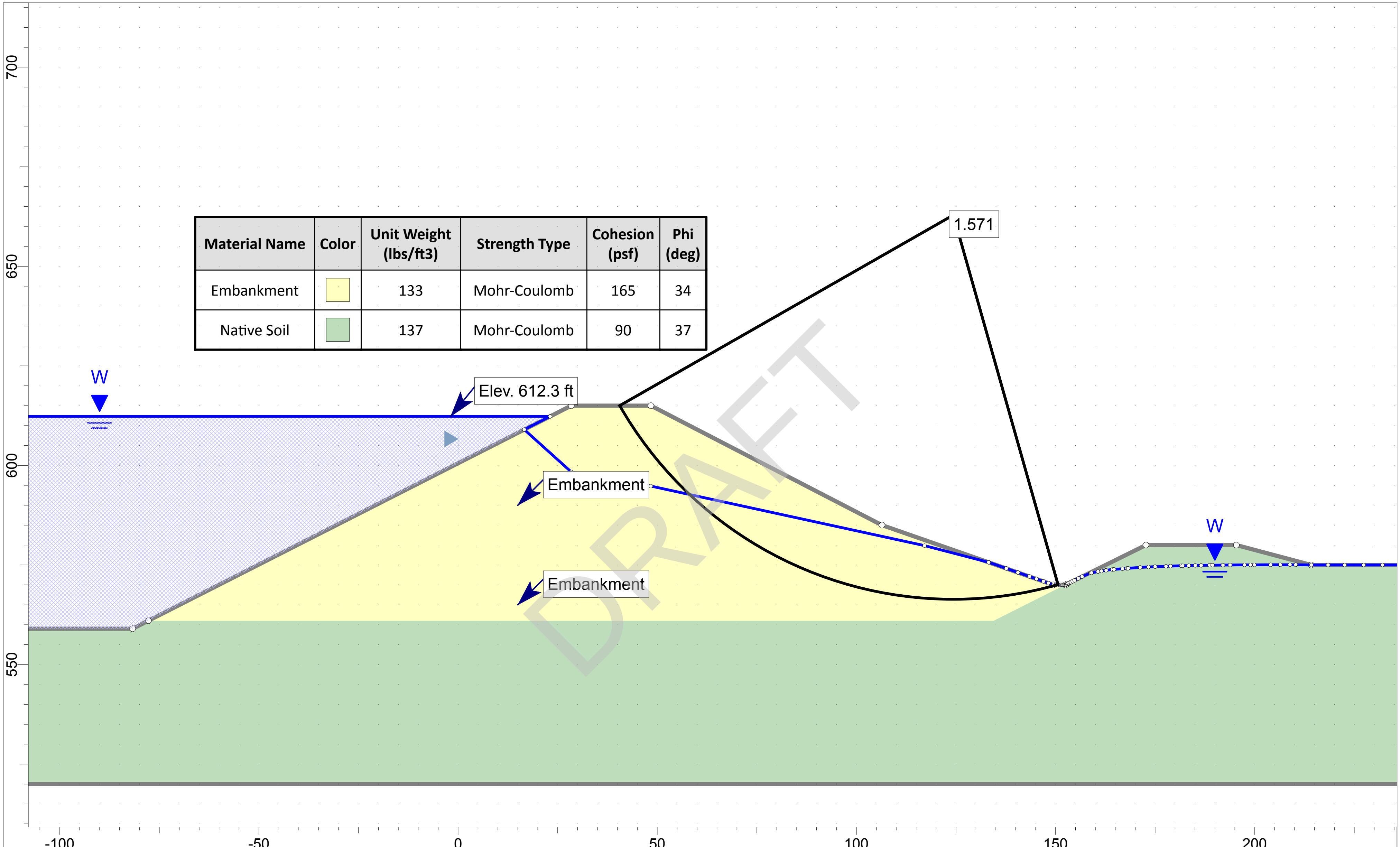
Project	Monroe Ash Basin Safety Factor Assessment		
Analysis Description	Long-term Stability		
Analysis By	YK	*Client*	Geosyntec Consultants
Date	6/12/2015, 1:25:17 PM	*Scale* 1:400	*File Name* Station133_static.slim

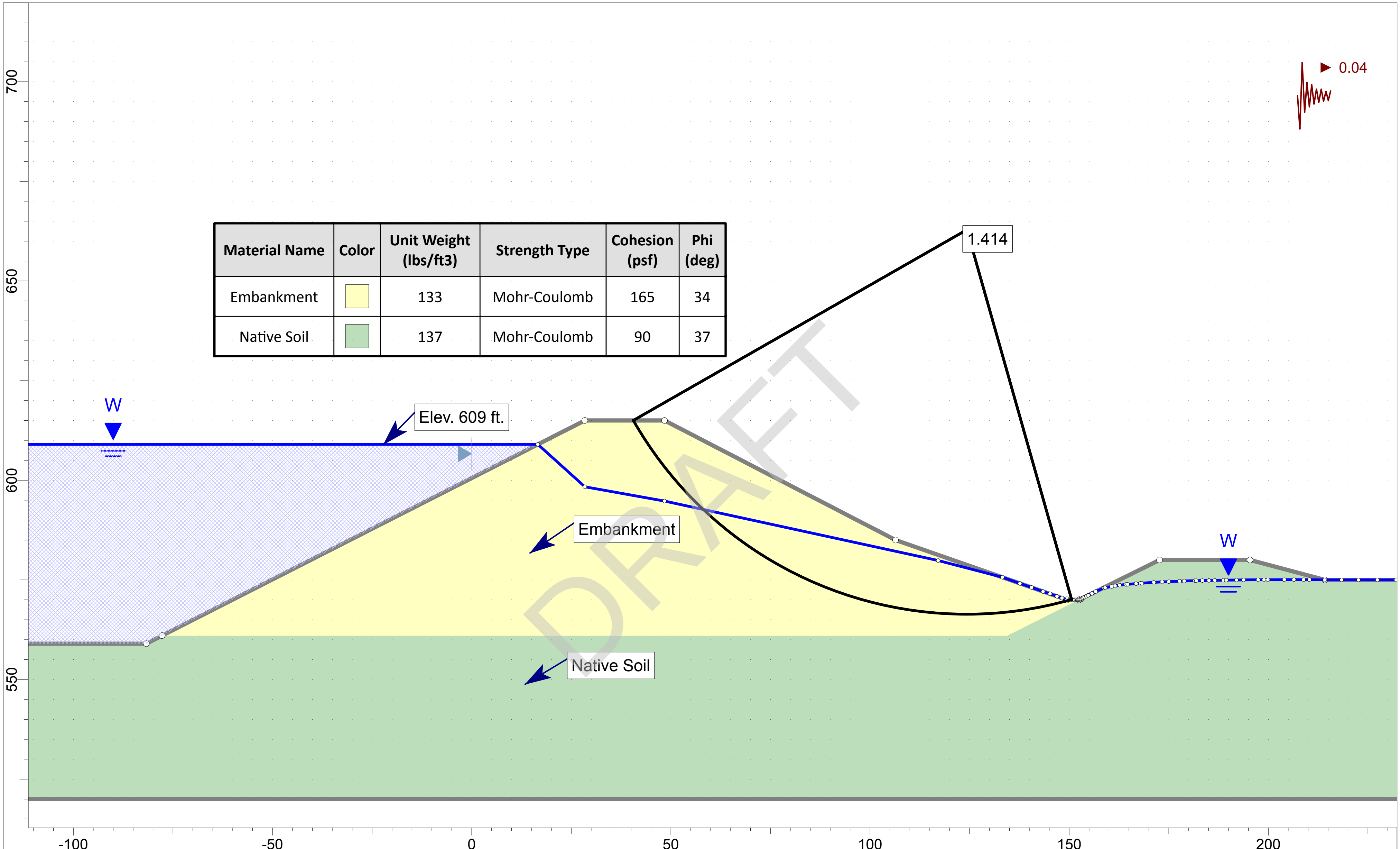
FIGURE 14

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment		133	Mohr-Coulomb	165	34
Native Soil		137	Mohr-Coulomb	90	37



Geosyntec consultants engineers | scientists | innovators	*Project* Monroe Ash Basin Safety Factor Assessment		
	Analysis Description Maximum Surcharge Pool Loading		
	Analysis By YK		*Client* Geosyntec Consultants
SLIDEINTERPRET 6.035	*Date* 6/12/2015, 1:25:17 PM	*Scale* 1:400	*File Name* Station133_static_MSPL.slim

FIGURE 15



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment		133	Mohr-Coulomb	165	34
Native Soil		137	Mohr-Coulomb	90	37

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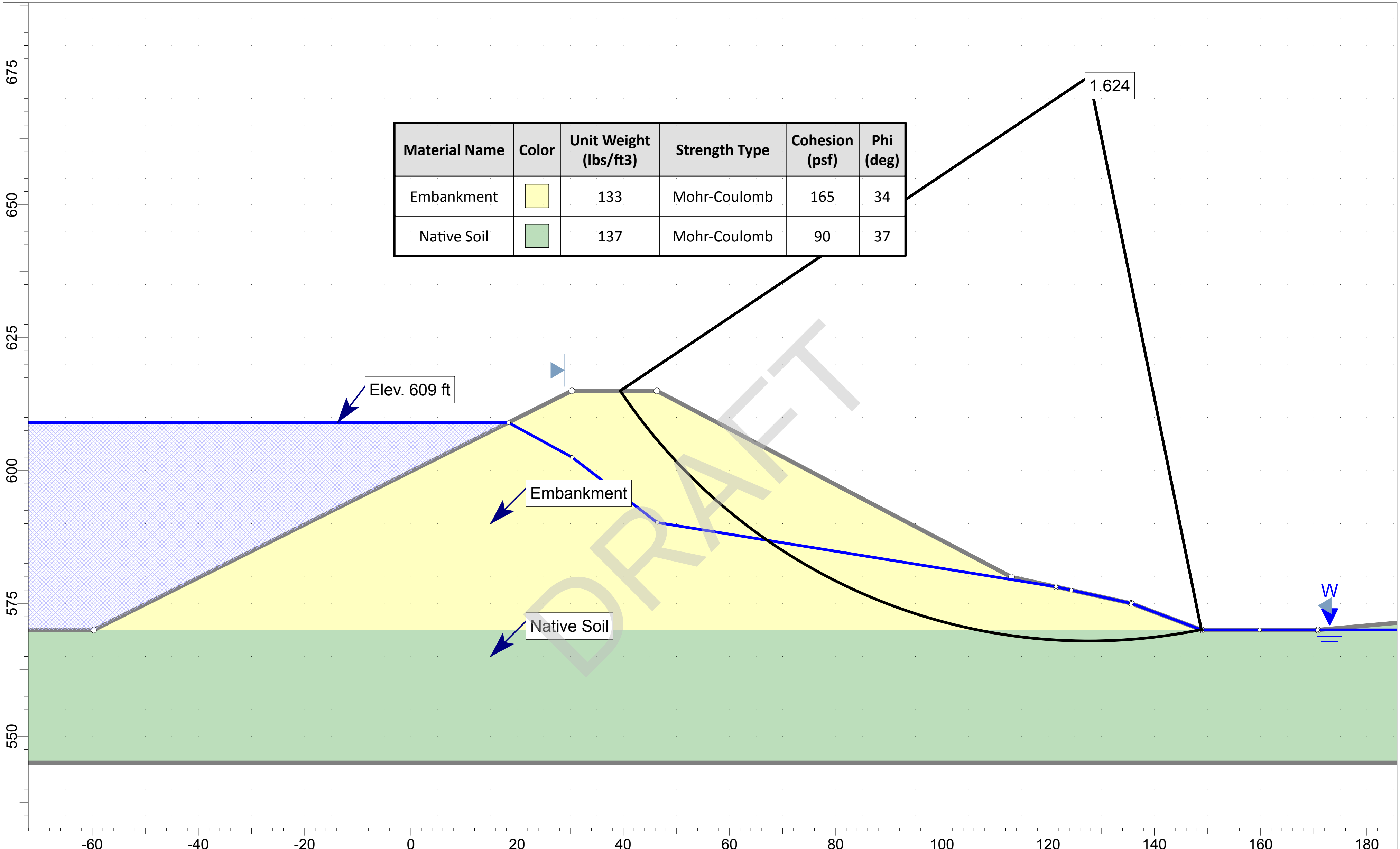
SLIDEINTERPRET 6.035

Project	Monroe Ash Basin Safety Factor Assessment
Analysis Description	Seismic Loading
Analysis By	YK
Client	Geosyntec Consultants
Date	6/12/2015, 1:25:17 PM
Scale	1:400
File Name	Station133_static_seismic.slim

FIGURE 16



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment		133	Mohr-Coulomb	165	34
Native Soil		137	Mohr-Coulomb	90	37

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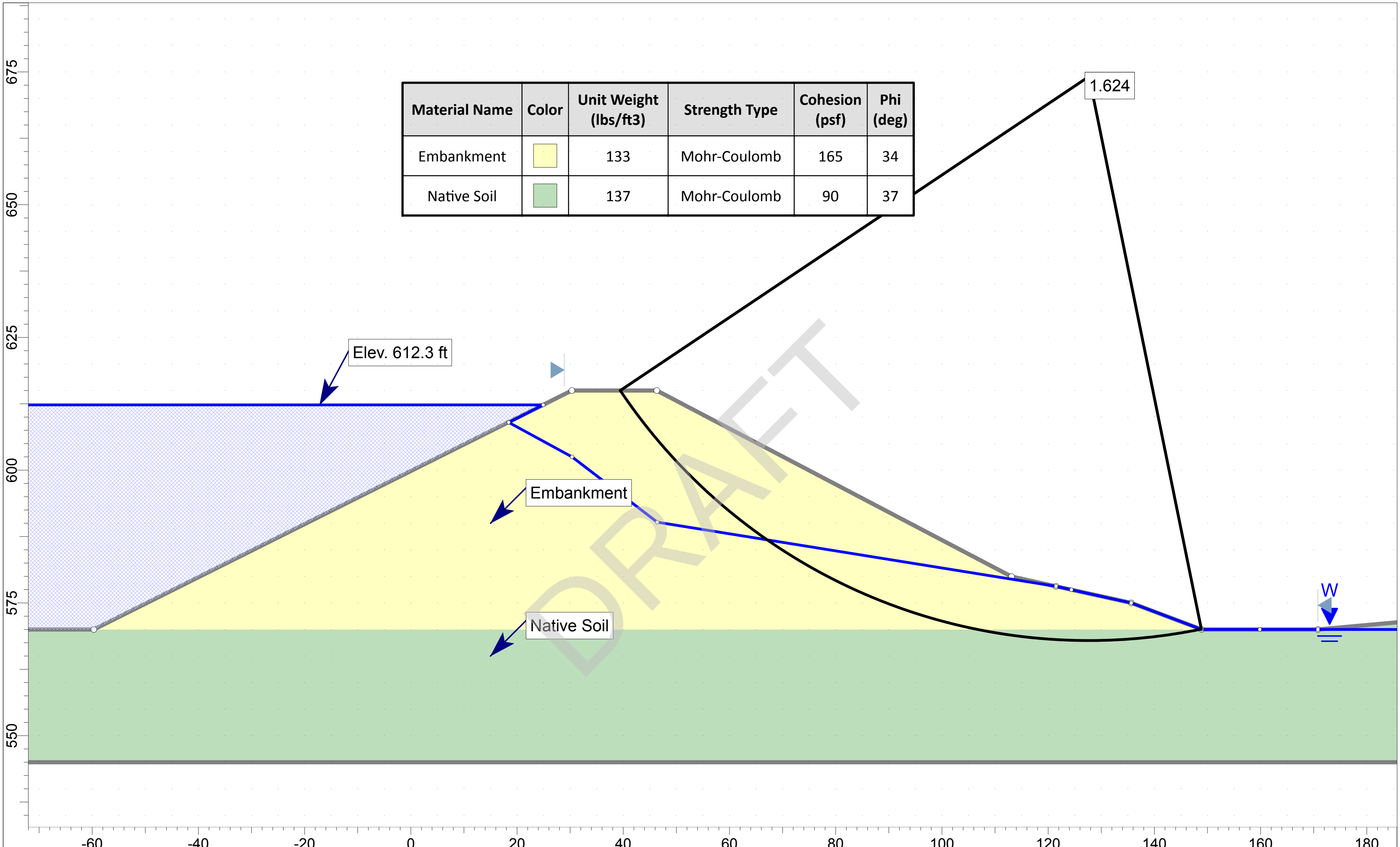
SLIDEINTERPRET 6.035

Project	Monroe Ash Basin Safety Factor Assessment		
Analysis Description	Long-term Stability - STA. 164+00		
Analysis By	YK	*Client*	Geosyntec Consultants
Date	6/17/2015, 3:20:58 PM	*Scale* 1:300	*File Name* station 164_static.slim

FIGURE 17



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment		133	Mohr-Coulomb	165	34
Native Soil		137	Mohr-Coulomb	90	37

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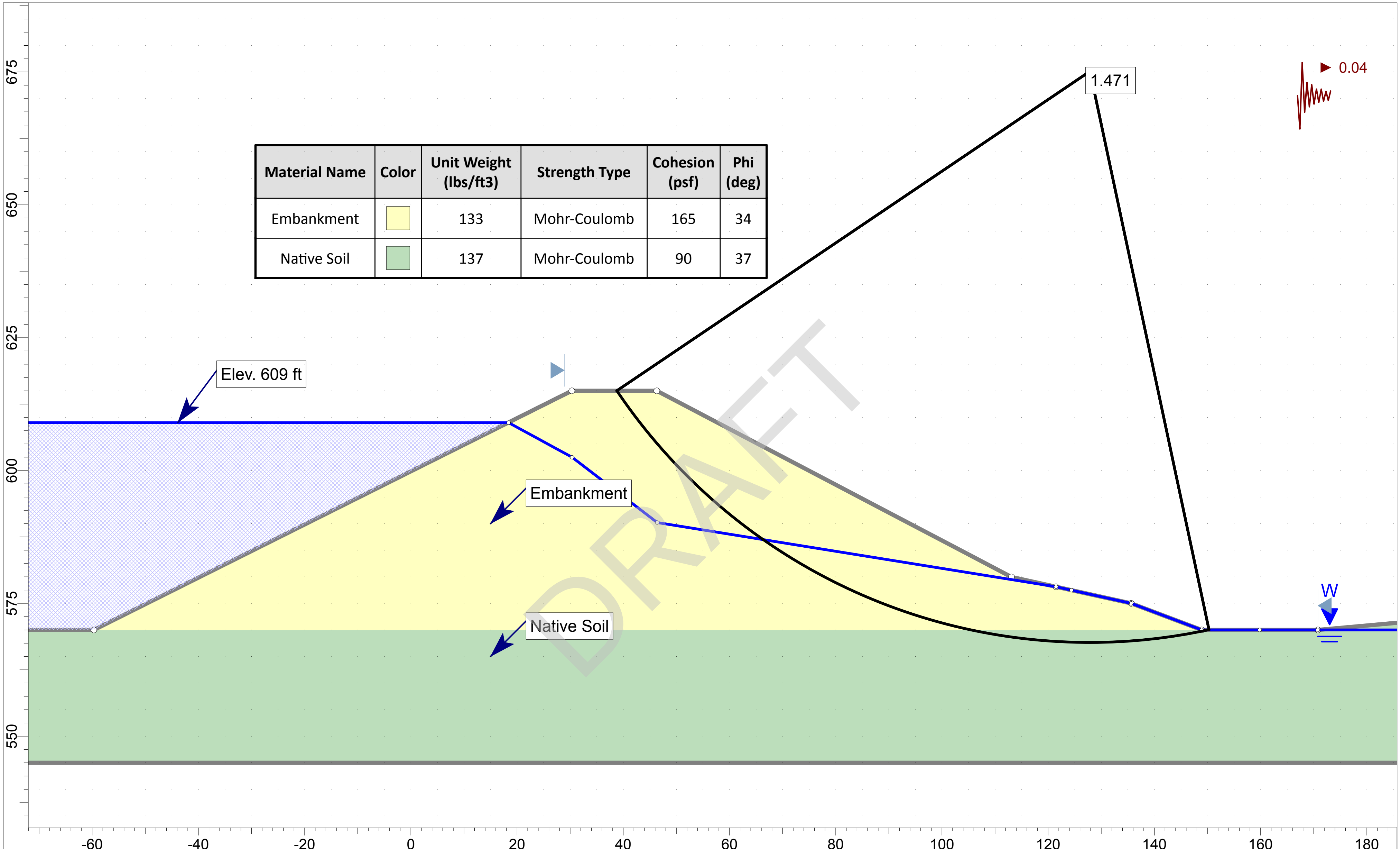
SLIDEINTERPRET 6.035

Project	Monroe Ash Basin Safety Factor Assessment
Analysis Description	Maximum Surcharge Pool Loading
Analysis By	YK
Client	Geosyntec Consultants
Date	6/17/2015, 3:20:58 PM
Scale	1:300
File Name	station 164_static_MSPL.slim

FIGURE 18



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
Embankment		133	Mohr-Coulomb	165	34
Native Soil		137	Mohr-Coulomb	90	37

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SLIDEINTERPRET 6.035

Project	Monroe Ash Basin Safety Factor Assessment		
Analysis Description	Seismic Loading		
Analysis By	YK	*Client*	Geosyntec Consultants
Date 6/17/2015, 3:20:58 PM	*Scale* 1:300	*File Name*	station 164_seismic.slim

FIGURE 19

Geosyntec consultants

134 N. La Salle Street, Suite 300
Chicago, Illinois 60602
PH 312.658.0500
FAX 312.658.0576
www.geosyntec.com

17 October 2016

Via Email

Mr. William Neal, P.E.
Technological Specialist
DTE Electric Company
One Energy Plaza
Detroit, MI 48226

Subject: Periodic Structural Stability Assessments
Monroe Power Plant Ash Basin Facility
Monroe, MI

Dear Mr. Neal:

This letter presents Geosyntec Consultants' (Geosyntec's) initial structural stability assessment for DTE Electric Company's (DTE's) Monroe Power Plant Ash Basin (Ash Basin). Initial and periodic structural stability assessments of the Ash Basin is required under the United States Environmental Protection Agency (USEPA) Coal Combustion Residual (CCR) Rule (CCR Rule) published on 17 April 2015 (40 CFR 257.73(d)(1)). Under the CCR Rule:

"The owner or operator of the CCR unit must conduct initial and periodic structural stability assessments and document whether the design, construction, operation, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater which can be impounded therein."

Geosyntec performed a series of slope stability analyses as part of §257.73(e) – Periodic Safety Factor Assessments; and performed an inspection of the Ash Basin in 2015 as part of §257.83 – "Inspection Requirements for CCR Surface Impoundments of the CCR Rule". Results of safety factor analyses indicate that the Ash Basin embankment meet the minimum safety factor criteria per §257.73(e). As part of 2015 annual inspection, Geosyntec reviewed construction documents, operating records, operational procedures, and instrumentation results at the Ash Basin. Based on the safety factor assessment and the annual inspection results, Geosyntec concludes that the Monroe Ash Basin facility was designed, constructed, operated and maintained with generally accepted good engineering standards."

QUALIFICATIONS OF LICENSED PROFESSIONAL ENGINEER

John Seymour is a qualified licensed professional engineer with over 30 years of experience in civil and geotechnical engineering associated with dams.

CERTIFICATION

I, John Seymour, am a qualified licensed professional engineer in Michigan have evaluated the Ash Basin and hereby certify that the structural stability assessment has been conducted in accordance with the requirements of §257.73(d).

Certified by:

STATE OF MICHIGAN
JOHN P. SEYMOUR
ENGINEER
No. 33056
LICENSED PROFESSIONAL ENGINEER

Date 10/17/2016

John Seymour, P.E.
Michigan License Number 620103356
Senior Principal

Appendix I
Groundwater Statistical Evaluation Plan - October 2017

Groundwater Statistical Evaluation Plan

Monroe Power Plant Coal Combustion Residual Fly Ash Basin

7955 East Dunbar Road
Monroe, Michigan

October 2017

Groundwater Statistical Evaluation Plan

Monroe Power Plant Coal Combustion Residual Fly Ash Basin

7955 East Dunbar Road
Monroe, Michigan

October 2017

Prepared For
DTE Electric Company

Graham Crockford, C.P.G.
Senior Project Geologist

David B. McKenzie, P.E.
Senior Project Engineer

TRC Engineers Michigan, Inc. | DTE Electric Company
Final
X:\WPAAM\PJT2\265996\STATS CERTS\01 MFAB\R265996-MONPP.DOCX

1540 Eisenhower Place, Ann Arbor, MI 48108 ● 734.971.7080 Phone ● 734.971.9022 Fax
www.TRCsolutions.com

Table of Contents

List of Figures

Section 1
Introduction

1.1 Regulatory Framework

The United States Environmental Protection Agency (U.S. EPA) published the final rule for the regulation and management of Coal Combustion Residuals (CCR) under the Resource Conservation and Recovery Act (RCRA) (the CCR Rule) on April 17, 2015. The CCR Rule, which became effective on October 19, 2015, applies to the Monroe Power Plant (MONPP) CCR Fly Ash Basin (FAB). Pursuant to the CCR Rule, no later than October 17, 2017, the owner or operator of a CCR unit must develop the groundwater sampling and analysis program to include selection and certification of the statistical procedures to be used for evaluating groundwater in accordance with Title 40 Code of Federal Regulations (CFR) §257.93. This certification must include a narrative description of the statistical method that will be used for evaluating groundwater monitoring data.

TRC Engineers Michigan, Inc., the engineering entity of TRC Environmental Corporation (TRC), prepared this Groundwater Statistical Evaluation Plan (Statistical Plan) for the MONPP FAB CCR unit on behalf of DTE Electric Company (DTE Electric). This Statistical Plan was prepared in accordance with the requirements of §257.93 and describes how data collected from the groundwater monitoring system will be evaluated. As part of the evaluation, the data collected during detection monitoring events (post October 17, 2017), are evaluated to identify statistically significant increases (SSIs) in detection monitoring parameters (Appendix III of the CCR Rule) to determine if concentrations in detection monitoring well samples exceed background levels.

The CCR Rule is not prescriptive with regards to the actual means and methods to be used for statistically evaluating groundwater data, and there is flexibility in the method selection, as long as specific performance metrics are met. A description of statistical methods that meet the performance objectives of the CCR Rule are described in U.S. EPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (*Unified Guidance,* USEPA, 2009).

1.2 Site Hydrogeology

The MONPP FAB CCR unit is located within 200 feet southwest of Plum Creek and immediately north of Lake Erie. The MONPP FAB CCR unit uppermost aquifer consists of saturated limestone present beneath at least 37 feet and up to 53.5 feet of thick contiguous silty clay-rich soil that serves as a natural confining hydraulic barrier that isolates the underlying uppermost aquifer. The limestone bedrock aquifer is artesian in every location except MW-16-01, where the static water level was approximately 1 to 2 feet below ground surface (feet-bgs).

Potentiometric groundwater elevation data collected in 2016 and 2017 suggest that there is horizontal groundwater flow potential within the upper aquifer unit generally to the northeast towards Plum Creek. The average hydraulic gradient to the northeast ranges from 0.002 to 0.0025 foot/foot along the eastern part of the FAB to 0.004 to 0.005 foot/foot in the center and northwestern part of the FAB, with an overall mean of 0.004 foot/foot.

The surface water elevation within the FAB raised surface impoundment is at least 5 to more than 30 feet above the potentiometric surface elevations in the uppermost aquifer limestone, and more than 60 feet above the base of the underlying clay-rich confining unit that isolates groundwater within the limestone aquifer. Therefore, flow potential from the CCR unit to the surrounding area would be radially outward from the FAB. However, there is no hydraulic communication between the uppermost aquifer and the FAB due to the continuous silty clay-rich confining unit beneath the MONPP FAB. Based on the artesian conditions, the low permeability of the underlying natural soils, and the calculated time of travel for groundwater to flow vertically from the FAB to the uppermost aquifer, it is not possible for the uppermost aquifer to have been affected by CCR from FAB operations that began in 1975.

The MONPP FAB CCR unit will use intra-well statistical methods because the saturated unit being monitored is isolated by a laterally contiguous silty-clay unit which significantly impedes vertical groundwater flow thus preventing the monitored saturated zone from potentially being affected by CCR. In addition, the flow potential of liquid within the FAB is radially outward relative to the uppermost aquifer due to the elevation water is maintained within the FAB CCR unit. Based on these hydrogeologic conditions, intra-well statistical approaches are likely a more appropriate method to evaluate groundwater data statistically. Consequently, intra-well statistical tests will be used during detection monitoring.

Section 2
Groundwater Monitoring System

2.1 Groundwater Monitoring System

A groundwater monitoring system has been established for MONPP FAB CCR unit (TRC, October 2017), which established the following locations for detection monitoring. The locations are shown on Figure 1.

MW-16-01	MW-16-02	MW-16-03
MW-16-04	MW-16-05	MW-16-06
MW-16-07		

2.2 Constituents for Detection Monitoring

Subsection 257.94 describes the requirement for detection monitoring for Appendix III parameters. Detection monitoring will be performed semiannually unless an alternative frequency is made on a site-specific basis. The detection monitoring parameters are identified in Appendix III of §257.94 and consist of the following:

Boron	Calcium	Chloride
Fluoride	pH	Sulfate
Total Dissolved Solids (TDS)		

2.3 Constituents for Assessment Monitoring

Assessment monitoring per §257.95 is required when a SSI over background has been detected for one or more of the constituents identified in Appendix III to Part 257 – Constituents for Detection Monitoring. In the event that assessment monitoring is triggered through the statistical evaluation of detection monitoring parameters, the following assessment monitoring parameters will be sampled:

Antimony	Arsenic	Barium
Beryllium	Cadmium	Chromium
Cobalt	Fluoride	Lead
Lithium	Mercury	Molybdenum
Selenium	Thallium	Radium 226 and 228 (combined)

Section 3
Statistical Analysis

Groundwater sampling and analytical requirements are described in §257.93. The owner or operator of the CCR unit must select a statistical method specified in §257.93(f) to be used in evaluating groundwater monitoring data. The test shall meet the performance standards outlined in §257.93(g). The goal of the statistical evaluation plan is to provide a means to formulate an opinion or judgement as to whether the CCR unit has released contaminants into groundwater. This plan describes the statistical procedures to be used to determine if a statistical significant increase (SSI) or in the case of pH, a statistically significant difference (SSD), indicating that data is from a different population than background. This plan was developed using applicable guidance, including the *Unified Guidance*. In addition to using applicable guidance documents, commercially available statistical evaluation tools will be utilized by MONPP FAB CCR unit to develop statistically derived limits so that detection monitoring results can be compared to background.

The CCR Rule allows a variety of methods for conducting statistical evaluations. The specific procedure for a given data set depends on several factors including the proportion of the data set with detected values and the distribution of the data. These will not be known until the data are collected. It is generally anticipated, however, that the tolerance or prediction interval procedure will be the preferred method of conducting detection monitoring data evaluation to the extent that the data support the use of that method. This statistical procedure is described below in this section of the plan and in detail in the *Unified Guidance*.

3.1 Establishing Background

Background groundwater quality shall be established prior to October 17, 2017. Per §257.93(d), the owner or operator of the CCR unit must establish background groundwater quality in hydraulically upgradient or background well(s). The development of a groundwater statistical evaluation program for detection monitoring involves the proper collection of background samples, regardless of whether an inter-well or intra-well monitoring strategy is implemented. Background may be established at wells that are not located hydraulically upgradient from the unit if it meets the requirement of §257.91(a)(1). A determination of background quality may include sampling of wells that are not hydraulically upgradient of the CCR management area where:

1. Hydrogeologic conditions do not allow the owner or operator of the CCR unit to determine what wells are hydraulically upgradient; or
2. Sampling at other wells will provide an indication of background groundwater quality that is as representative as or more representative than that provided by the upgradient wells.

The purpose of obtaining adequate background groundwater data is to approximate, as accurately as possible, the true range of ambient concentrations of targeted constituents. Background groundwater data should eliminate, to the extent possible, statistically significant concentration increases not attributable to the CCR unit. Specifically, the owner or operator of a CCR unit must install a groundwater monitoring system that consists of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer that accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit. The sampling frequency should be selected so that the samples are physically independent. These background groundwater parameters can be adequately qualified by doing the following:

- Collecting the minimum number of samples that satisfy the requirements of the statistical methods that are used (i.e., that result in adequate statistical power);
- Incorporating seasonal and/or temporal variability into the background data set; and

Incorporating the spatial component of variability into the background data set (i.e., the variability that comes with obtaining samples from different locations within the same groundwater zone).

The initial background/baseline sampling period is a minimum of eight events for Existing CCR units that were in operation on October 19, 2015. This provides a minimal background data set to initiate statistical comparisons. Over time, the short baseline period may result in a high risk of false positive statistical results. The facility may periodically update background data to account for variability in background conditions. The *Unified Guidance* recommends that background data be updated every 4 to 8 measurements (i.e., every two to four years if samples are collected semi-annually, or one to two years if samples are collected quarterly). The background data will be reviewed for trends or changes that may necessitate discontinuation of earlier portions of the background data set.

3.2 Data Evaluation and Data Distributions

DTE Electric will evaluate the groundwater data for each constituent included in the groundwater monitoring program using intra-well tolerance or prediction limits. The tolerance or prediction interval statistical procedure establishes an interval that bounds the ranges of expected concentrations representative of unaffected groundwater using the distribution of background data. The upper tolerance or prediction limit of that interval is then used for comparison to the concentration level of each constituent in each compliance well. Development of the tolerance or prediction limits used for comparison during detection monitoring will be conducted in accordance with the *Unified Guidance.* The following is a summary of descriptive statistics and tolerance or prediction limit choices.

3.2.1 Background Determination

Statistical limits will be calculated after the collection of a minimum of eight independent samples. The analytical results from the eight "background" samples will be used to determine the statistical limits for each individual parameter. For inter-well comparisons, background data should be "pooled" creating a single, combined background dataset from the background monitoring wells. For intra-well, the background data set is comprised of the historical data set established at each individual monitoring well.

The background dataset (and hence the prediction limits) will be updated as appropriate (as discussed above in Section 3.1) to maintain necessary statistical sensitivity. New data will be compared to the existing background data set to determine if there are outlier values, and whether the data are statistically similar. If there are no outliers and the data are statistically similar, the new data will be added to the existing background data set.

3.2.2 Outlier Evaluation

Outliers and anomalies are inconsistently large or small values that can occur as a result of sampling, analytical, or transcription errors; laboratory or field contamination; or shelf-life exceedance; or extreme, but accurately detected environmental conditions (e.g., spills). Data will be reviewed graphically using tools such as time concentration trend plots, box and whisker plots and/or probability plots to illustrate and identify outliers, trends, or otherwise unusual observations at each monitoring location. This will be accomplished prior to further in-depth review of the data sets to identify any obvious field or laboratory anomalies. Data points that are determined to be non-representative will be 'flagged' for further detailed evaluation prior to removing from the background data or designating as an outlier.

3.2.3 Testing for Normality

Statistical tests often assume that data are normally distributed or that data can be normalized by various standard methods. The assumption of normality can be tested in various ways. Formal normality testing such as utilizing the Shapiro-Wilk test (for $n<50$) or the Shapiro-Francia Test (for $n>50$) or calculation of a coefficient of skewness may be utilized in accordance with the *Unified Guidance*. Alternatively, graphing data on a probability plot can also be used to test for normality. If the data appear to be non-normal, mathematical transformations of the data may be utilized such that the transformed data follow a normal distribution (e.g., lognormal distributions). Alternatively, non-parametric tests may be utilized when data cannot be normalized.

The following are guidelines for decision making during normality testing:

1. If the original data show that the data are not normally distributed, then apply a natural log-transformation to the data and test for normality using the above methods.
2. If the original or the natural log-transformed data confirm that the data are normally distributed, then apply a normal distribution test.
3. If neither the original nor the natural log-transformed data fit a normal distribution, then apply a distribution-free test.

3.2.4 Evaluation of Non-Detects

Background concentrations that are reported as less than the practical quantitation limit (PQL) (herein referred to as non-detects) will be evaluated differently, depending upon the percentage of non-detects to the reported concentrations for a given parameter at a given monitoring well. The evaluation of non-detects was as follows:

Less Than 15% Non-detects

For data that was normally or lognormally distributed and less than 15% non-detects, one-half the value of the method detection limit will be used to calculate the prediction limit. If normally or lognormally cannot be met using one-half of the method detection limit, and if the method detection limits were equal, alternating zero with the value of the method detection limit will be considered in order to determine the normality of the data set.

15% to 50% Non-detects

If more than 15% but less than 50% of the overall data are less than the detection limit, either Aitchison's adjustment, or Cohen's adjustment, or the Kaplan Meijer adjustment will be used to determine the statistical limits in accordance with the *Unified Guidance*.

51% to 100% Non-detects

For data sets that contain greater than 50% non-detects, the non-parametric statistical limits will be utilized as described below.

3.3 Parametric Tolerance or Prediction Limits

Tolerance and prediction intervals are similar approaches to establish statistical ranges constructed from background or baseline data. However, tolerance limits define the range of data that fall within a specified percentage with a specified level of confidence (where a proportion of the population is expected to lie), whereas prediction limits involve predicting the upper limit of possible future values based on a background or baseline data set and comparing that predicted limit to compliance well data.

Intra-well tolerance or prediction limits are calculated using baseline period or background data from each well. The tolerance or prediction limit will be calculated in accordance with the *Unified Guidance*. If the data set is log-normally distributed the tolerance or prediction limits will be calculated using the log-normally transformed data, and subsequently un-transformed to normal units.

In §257.93(g)(2) it states that for multiple comparisons, each testing period should have a Type I error rate no less than 0.05 while maintaining an individual well Type I error rate of no less than 0.01. Per §257.93(g)(4), these Type I limits do not apply directly to tolerance intervals or prediction intervals; however, the levels of confidence for the tolerance or prediction limit approach must be at least as effective as any other approach based on consideration of the number of samples, distribution, and range of concentration values in the background data set for each constituent.

3.4 Non-Parametric Tolerance or Prediction Limits

Parameters that consist of mainly non-detect data usually violate the assumptions needed for normal based tolerance or parametric prediction intervals. Therefore, as recommended in the *Unified Guidance*, the non-parametric tolerance or prediction limit method will be chosen.

A non-parametric upper tolerance or prediction limit is constructed by setting the limit as a large order statistic selected from background (e.g., the maximum background value). This method has lower statistical power than parametric methods; therefore, it is important to control outliers within the dataset to maintain adequate statistical power that this method can provide. Due to the lack of statistical power of this method, it will only be used when other methods are not available.

3.5 Double Quantification Rule

The double quantification rule is discussed in Section 6.2.2 of the *Unified Guidance*. In the cases where the background dataset for a given well is 100% non-detect, a confirmed exceedance is registered if any well-constituent pair exhibits quantified measurements (i.e., at or above the reporting limit) in two consecutive sample and resample events. This method will be used for non-detect data sets.

3.6 Verification Resampling

In order to achieve the site wide false positive rates (SWFPR) recommended in the *Unified Guidance*, a verification resampling program is necessary. Without verification resampling, the

SWFPR cannot be reasonably met, and much larger statistical limits would be required to achieve a SWFPR of 5% or less. Furthermore, the resulting false negative rate would be greatly increased. Under these circumstances, if there is an exceedance of a tolerance limit or prediction limit for one or more of the parameters, the well(s) of concern will be resampled within 30 days of the completion of the initial statistical analysis. Only constituents that initially exceed their statistical limit (i.e., have no previously recorded SSIs) will be analyzed for verification purposes. This verification sampling must be performed within the same compliance period as the event being verified. If the verification sample remains statistically significant, then statistical significance will be considered. If the verification sample is not statistically significant, then no SSI will be recorded for the monitoring event.

Section 4
Evaluation of Detection Monitoring Data

4.1 Statistical Evaluation during Detection Monitoring

According to §257.94(e), if the facility determines, pursuant to §257.93(h), that there is a SSI over background levels for one or more of the Appendix III constituents, the facility will, within 90 days of detecting a SSI, establish an assessment monitoring program **<or>** demonstrate that:

- A source other than the CCR unit caused the SSI, or
- The SSI resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality.

The owner or operator must complete a written demonstration (i.e., Alternative Source Demonstration, ASD), of the above within 90 days of confirming the SSI. If a successful ASD is completed, a certification from a qualified professional engineer is required, and the CCR unit may continue with detection monitoring.

If a successful ASD is not completed within the 90-day period, the owner or operator of the CCR unit must initiate an assessment monitoring program as required under §257.95, described further in Section 5. The facility must also include the ASD in the annual groundwater monitoring and corrective action report required by §257.90(e), in addition to the certification by a qualified professional engineer.

Section 5
Assessment Monitoring

As discussed in Section 4, the facility must begin assessment monitoring for the CCR unit if a SSI is identified, and the SSI cannot be attributed to an ASD. Per the CCR Rule, assessment monitoring must begin within 90 days of identification of a SSI that is not attributed to an alternative source. During the 90-day period, wells included in the groundwater monitoring system will be sampled for Appendix IV constituents pursuant to §257.95(b). Within 90 days of obtaining the results from the first assessment monitoring event, all of the wells will be sampled for Appendix III and the detected Appendix IV parameters in the initial assessment monitoring event.

If assessment monitoring is triggered pursuant to §257.94(e)(1), data are compared to Groundwater Protection Standards (GPSs) or background groundwater quality. The CCR Rule [§257.95(h)] requires GPSs to be established for Appendix IV constituents that have been detected during baseline sampling. The GPS is set at the EPA maximum contaminant level (MCL) or a value based on background data. The MCLs will be the GPSs for those constituents that have MCLs unless the background concentration is greater than the MCL, which in that case, the statistically-determined background values becomes the GPS. For all other parameters that do not have MCLs, the GPS defaults to a statistically-based limit developed using background data. For GPSs that are established using background, tolerance limits are anticipated to be used to calculate the GPS. The background will be updated every two years, along with the resulting GPS, consistent with the *Unified Guidance*. If additional assessment monitoring parameters become detected during the assessment monitoring, GPSs will be developed for those parameters in the same manner as the initial parameters.

Consistent with the *Unified Guidance*, the preferred method for comparisons to a fixed standard will be confidence limits. An exceedance of the standard occurs when the 95 percent lower confidence level of the downgradient data exceeds the GPS. Confidence intervals will be established in a manner appropriate to the data set being evaluated (proportion of non-detect data, distribution, etc.). If the statistical tests conclude that an exceedance of the GPS or background has occurred, verification resampling may be conducted by the facility. Once the resampling data are available, the comparison to the GPS or background will be evaluated.

Section 6
Certification

Statistical Methods Certification per 40 CFR §257.93(f)
Monroe Power Plant Fly Ash Basin
Monroe, Michigan

The U.S. EPA's Disposal of Coal Combustion Residuals from Electric Utilities Final Rule Title 40 CFR Part 257 §257.93 requires that the owner or operator of an existing CCR unit develop the groundwater sampling and analysis program to include the selection of the statistical procedures to be used for evaluating groundwater monitoring data. The owner or operator must obtain a certification from a qualified professional engineer stating that the selected statistical method is appropriate for evaluating the groundwater monitoring data for the CCR management area. The certification must include a narrative description of the statistical method selected to evaluate the groundwater monitoring data to meet the requirements of Title 40 CFR §257.93.

CERTIFICATION

By means of this certification, I certify that I am a qualified professional engineer as defined by Title 40 CFR §257.53, that I have reviewed this Statistical Evaluation Plan, and that the statistical methods described herein are appropriate and meet the requirements of Title 40 CFR §257.93. This document is accurate and has been prepared in accordance with good engineering practices, including the consideration of applicable industry standards, and with the requirements of Title 40 CFR §257.93.

Name: David B. McKenzie, P.E.	Date: October 31, 2017	STATE OF MICHIGAN DAVID B. McKENZIE ENGINEER No. 42332 LICENSED PROFESSIONAL ENGINEER [signature] Stamp
Company: TRC Engineers Michigan, Inc.	Expiration Date: October 13, 2017	

Section 7
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Figure

LEGEND

- MONITORING WELLS
- APPROXIMATE BOUNDARY OF FLY ASH BASIN

NOTES

1. BASE MAP IMAGERY FROM ESRI/MICROSOFT, "WORLD IMAGERY", WEB BASEMAP SERVICE LAYER.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.

N

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:

DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:

MONITORING NETWORK AND SITE PLAN

DRAWN BY:	J. PAPEZ	PROJ NO.:	265996.0001
CHECKED BY:	C. SCIESZKA		**FIGURE 1**
APPROVED BY:	V. BUENING		
DATE:	OCTOBER 2017		

TRC

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www.trcsolutions.com

FILE NO.: 265996-0001-000_Stat.mxd

TRC - GIS
Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0
Plot Date: 10/4/2017, 13:56:35 PM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\DTE\CCR_Sites\2017_265996\265996-0001-000_Stat.mxd

Appendix J
Location Restriction Certification Report

Location Restrictions Demonstrations

DTE Electric Company
Monroe Power Plant Fly Ash Basin
Coal Combustion Residual Unit

7955 East Dunbar Road
Monroe, Michigan

October 2018

Location Restrictions Demonstrations

DTE Electric Company
Monroe Power Plant Fly Ash Basin
Coal Combustion Residual Unit

7955 East Dunbar Road
Monroe, Michigan

October 2018

Prepared For
DTE Electric Company

Graham Crockford, C.P.G.
Senior Project Geologist

David B. McKenzie, P.E.
Senior Project Engineer

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Table of Contents

List of Appendices

Certification

I, the undersigned Michigan Professional Engineer, hereby certify that I am familiar with the technical requirements of Title 40 Code of Federal Regulations Part 257 Subpart D (§257). I also certify that it is my professional opinion that, to the best of my knowledge, information, and belief, that the information in this demonstration is in accordance with current good and accepted engineering practice(s) and standard(s) and meets the requirements of §257.60 through §257.64.

For the purpose of this document, "certify" and "certification" shall be interpreted and construed to be a "statement of professional opinion." The certification is understood and intended to be an expression of my professional opinion as a Michigan Licensed Professional Engineer, based upon knowledge, information, and belief. The statement(s) of professional opinion are not and shall not be interpreted or construed to be a guarantee or a warranty of the analysis herein.

State of Michigan
David B. McKenzie
Engineer
No. 42332
Licensed Professional Engineer

Seal/Date 10/15/18

David B. McKenzie, P.E.

License No: 6201042332

Section 1
Background

The purpose of this document is to determine whether the Coal Combustion Residual (CCR) Fly Ash Basin (FAB) at the Monroe Power Plant (MONPP) is in compliance with the location restrictions outlined in the Environmental Protection Agency's (EPA) final CCR rule [Title 40 Code of Federal Regulations Parts 257 and 261] Subpart D – "Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments" (§257.60 through §257.64, federal rule). The FAB is considered a CCR impoundment and landfill.

This document includes information from a desktop study and well installation activities, and also engineering calculations to demonstrate that the FAB is in compliance with placement above the uppermost aquifer criteria (§257.60), and location criteria with respect to wetlands (§257.61), fault areas (§257.62), seismic impact zones (§257.63), and unstable areas (§257.64).

Supporting documents are provided as appendices to this demonstration.

1.1 Facility and CCR Unit Information

The MONPP is located in Section 16, Township 7 South, Range 9 East, at 7955 East Dunbar Road, Monroe in Monroe County, Michigan. The MONPP FAB is located about one mile southwest of the MONPP at latitude 41° 53' 03" North and longitude 83° 22' 31" West. The MONPP FAB is bounded by Dunbar Road and Plum Creek to the north and northeast, Interstate 75 to the northwest, a 200-acre peninsula into Lake Erie to the east and southeast, Lake Erie to the south, and a large open field to the southwest.

The property has been used continuously for the operation of the MONPP FAB since approximately 1975 and is constructed over a natural clay-rich soil base. The MONPP FAB and landfill is a Type III solid waste disposal facility owned by DTE Electric Company (DTE Electric), which currently accepts coal ash from DTE Electric's MONPP. The MONPP FAB is operated in accordance with Michigan Part 115 of the Natural Resources and Environmental Protection Act (NREPA), PA 451 of 1994, as amended, and the current operating license number is 9393.

The FAB base is keyed into the existing natural clay-rich soil ground surface at an elevation of 563.4 feet. This natural low permeability clay-rich soil base serves as an underlying hydraulic barrier, forming a natural liner of at least 23 feet of natural clay-rich soil below the base of the FAB. The constructed berm that follows the perimeter of the FAB reaches an elevation of 614 ft., approximately 5 ft above the operational water level of the FAB.

1.2 Site Setting

The MONPP FAB CCR unit is located approximately 200 feet southwest of Plum Creek and immediately north of Lake Erie. The uppermost aquifer at the MONPP FAB CCR consists of saturated limestone present beneath at least 37 feet and up to 53.5 feet of thick contiguous silty clay-rich soil that serves as a natural confining hydraulic barrier that isolates the underlying uppermost aquifer. The limestone bedrock aquifer is artesian in every location except MW-16-01, where the static water level was approximately 1 to 2 feet below ground surface (ft bgs).

A groundwater monitoring system has been established for the MONPP FAB CCR unit as detailed in the *Groundwater Monitoring System Summary Report – Monroe Power Plant Coal Combustion Residual Fly Ash Basin* (GWMS Report) (TRC, October 2017). The detection monitoring well network for the MONPP FAB CCR unit currently consists of seven monitoring wells that are screened in the uppermost aquifer. The monitoring well boring logs are included in Appendix A.

A mean hydraulic conductivity of approximately 4.3 feet/day was measured from one of the CCR monitoring wells using single well hydraulic conductivity tests (e.g., slug tests) performed in 2016. This result is consistent with other sources (5 feet/day) for the hydraulic conductivity of the Bass Island Group.

Potentiometric groundwater elevation data collected in 2016 and 2017 suggest that there is horizontal groundwater flow potential within the upper aquifer unit generally to the northeast towards Plum Creek. The average hydraulic gradient to the northeast is on the order of 0.002 foot/foot along the eastern part of the MONPP FAB to 0.004 to 0.005 foot/foot in the center and northwestern part of the FAB, with an overall mean gradient of 0.004 foot/foot.

The surface water elevation within the FAB raised surface impoundment is at least 5 to more than 30 feet above the potentiometric surface elevations in the uppermost aquifer limestone, and more than 60 feet above the base of the underlying clay-rich confining unit that isolates groundwater within the limestone aquifer. Therefore, flow potential from the CCR unit to the surrounding area would be radially outward from the FAB. However, there is no hydraulic communication between the uppermost aquifer and the FAB due to the continuous silty clay-rich confining unit beneath the MONPP FAB. Based on the artesian conditions, the low permeability of the underlying natural soils, and the calculated time of travel for groundwater to flow vertically from the FAB to the uppermost aquifer, it is not possible for the uppermost aquifer to have been affected by CCR from FAB operations that began in 1975.

Section 2
Location Restrictions

The location restrictions designated in the federal CCR rule are presented below with a corresponding demonstration to show compliance with each restriction. The location restrictions include placement above the uppermost aquifer, within wetlands, near fault areas, within seismic impact zones, and unstable areas based on available geologic and geomorphological information. Supporting information for the demonstrations is included in the appendices to this report.

2.1 §257.60 – Placement Above the Uppermost Aquifer

The federal CCR rule requires that CCR units such as the MONPP FAB must be constructed with a base that is located no less than 1.52 meters (five feet) above the upper limit of the uppermost aquifer, or must demonstrate that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in the groundwater elevations (including the seasonal high water table). As discussed in Section 1.1 (above), the FAB is keyed into the natural clay-rich soil ground surface at an elevation of 563.4 feet. The FAB is underlain by at least 23 feet of the natural low permeability clay-rich soil. The uppermost aquifer, based on saturated soil observations during soil borings is located at the silty clay-weathered limestone interface, at an approximate elevation of 527 to 540 ft MSL. Cross-sections showing the installation top and bottom elevation of the approximate basin bottom and depth to the uppermost aquifer are included in Appendix B.

Based on this demonstration, the base of the MONPP FAB is located greater than 5 feet above the upper limit of the uppermost aquifer and there is not a hydraulic connection between the FAB and the underlying groundwater caused by normal fluctuations in groundwater level. Therefore, the FAB is in compliance with the requirements of §257.60.

2.2 §257.61 – Wetlands

The CCR location standards restrict existing and new CCR surface impoundments from being located in wetlands, as defined at 40 CFR 232.2 (40 CFR 257.61(a)). Wetlands are defined in 40 CFR 232.2 *Waters of the United States (3)(iv)* as, "…those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas." TRC reviewed National Wetland Inventory (NWI) maps and Michigan Resource Information

System (MIRIS) Land Cover Maps archived and available through Michigan Department of Natural Resources (MDNR), Michigan Resource Inventory Program (MRIP) to ascertain whether or not the MONPP FAB located in wetlands.

As shown on the map in Appendix C, soils at and in the vicinity of the site are designated as wetland soils, most likely due to the proximity of the site to Plum Creek and Lake Erie. NWI (2005) recognizes areas to the southeast and northeast of the FAB as wetlands, and an area identified as wetlands on NWI and MIRIS maps that has wetland soils is located within the site. However, wetland delineations performed at the MONPP FAB by DTE Electric showed that all wetlands were located outside of the FAB berms (outside the CCR unit) in perimeter drainage channels. Mitigation and restoration plans have been developed for these delineated wetland areas by DTE if they are impacted by ongoing facility operations. Additionally, these delineated wetland areas are fully protected by DTE and are not to be encroached upon without permit.

Based on TRC's review of wetland inventory resources and current site conditions, TRC is of the opinion that the MONPP FAB is not located in an area exhibiting wetland characteristics, and that MONPP has established operations plans to minimize any potential impact to wetlands near the CCR unit. TRC also concludes that due to its use as an NPDES treatment unit, this basin is not wetlands as defined in 40 CFR 232.2.

2.3 §257.62 – Fault areas

The federal CCR rule requires that CCR units not be located within 60 meters (200 feet) of the outermost damage zone of a fault that has had displacement in Holocene time (within the most recent 11,700 years) unless the owner or operator demonstrates that an alternative setback distance of less than 60 meters (200 feet) will not cause damage to the structural integrity of the CCR unit. USGS-recognized Quaternary faults in the U.S. are shown on the map in Appendix D.

The lower peninsula of Michigan is covered by a mantle of glacial deposits obscuring any surficial evidence of faulting (Bricker, 1977). In these areas of glacial deposition, fault zones are considered to be stable, and any recent recorded earth movement in Michigan has been noted to originate from source depths of 95 to 110 kilometers into the subsurface (Brinker, 1977). Historical records indicate that nearly all seismic events that have occurred in Michigan have been relatively minor in intensity (I to VI on the Modified Mercalli Intensity Scale).

Evidence of active faulting during the Holocene in the MONPP FAB area is not supported by this determination; therefore, the FAB is in compliance with the requirements of §257.62.

2.4 §257.63 – Seismic Impact Zones

The federal CCR rule requires that CCR units not be located in seismic impact zones unless the owner or operator demonstrates 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. The federal CCR rule defines a seismic impact zone as "an area having a 2% or greater probability that the maximum expected horizontal acceleration, expressed as a percentage of the earth's gravitation pull (g), will exceed 0.10 g in 50 years."

To determine whether the MONPP FAB is located in a seismic impact zone, the USGS Earthquake Hazards Program was consulted to determine the earthquake hazard for the FAB. The Earthquake Hazards Program uses the 2015 NEHRP Provisions as a reference document; the following factors were used to calculate the peak ground acceleration:

- The site class is Class C: firm to very stiff surficial clay soils underlain by very stiff to hard clay beginning at approximately 20 ft bgs. The clay is underlain by weathered and competent limestone bedrock beginning approximately 30 to 50 ft bgs. This determination was made based on the first 100 ft of soil and rock encountered. The first 50 feet are comprised of very stiff to hard clay, and the remainder is limestone bedrock.
- The site falls under the Risk Category III, due to its primary function as a power-generating station.

The 2015 National Earthquake Hazards Reduction Program U.S. seismic design maps website (USGS 2015; Appendix E) indicates a mapped peak ground acceleration of 0.063 g for the FAB area. Using the Class C site determination results in a design peak ground acceleration of 0.082 g. This calculated design peak ground acceleration value is less than 0.10 g in 50 years.

Evidence of a seismic impact zone is not supported by this determination; therefore, TRC concludes that the MONPP FAB is not located in a seismic impact zone. The FAB is in compliance with the requirements of §257.63.

2.5 §257.64 – Unstable Areas

The federal CCR rule requires that CCR units not be located in an unstable area unless the owner or operator demonstrates that recognized and generally accepted good engineering practices have 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. Factors associated with soil conditions resulting in significant differential settlement, geologic or geomorphologic features, and human-made features or events must be evaluated to determine compliance.

This demonstration was performed by evaluating the results of geotechnical explorations at the MONPP (Geosyntec Consultants, 2010), the Round 7 Dam Assessment-Final Report (GZA GeoEnvironmental, Inc., 2011), reviewing local geology and topography, and evaluating human-made features or events at the MONPP area.

The geotechnical exploration performed at the MONPP identified silty clay, with traces of sand and gravel. The clay exhibits a very stiff to hard consistency and high shear strengths, with harder and stronger soils noted with depth. The unconsolidated soils occur above weathered and competent limestone bedrock. Based on these geotechnical records, there is no evidence of unstable soil or underlying bedrock conditions proximal to the FAB.

Based on information maintained by the Michigan Natural Features Inventory and Michigan State University Extension, Monroe County topography, due to the presence of underlying limestone bedrock, is subject to the potential but infrequent occurrence of sinkholes and caves. However, no evidence of sinkholes or caves have been discovered or noted at the MONPP property and therefore are not expected to contribute to the development of unstable site soil conditions.

Based on DTE Electric records, the perimeter berm for the FAB was constructed in the 1970s. In 2016, Geosystec Consultants performed a slope stability safety factor assessment for the FAB berms (Geosyntec, 2016). The assessment concluded that the Ash Basin meets the safety factor requirements with the maximum water level maintained at 609 ft MSL or less.

Evidence of unstable areas due to soil conditions resulting in significant differential settling, geologic or geomorphologic features, or human-made features or events is not supported by this determination; therefore, it is TRC's opinion that MONPP FAB is not located in an unstable geological area and that the FAB berm meets safety factor requirements at current FAB operating conditions and berm structural conditions. The FAB, therefore, is in compliance with the requirements of §257.64.

Section 3
Conclusions

Based on the evaluation provided in this demonstration, the MONPP FAB is in compliance with the location restrictions provided in §257.60 through §257.64 of the CCR rule. No additional action, justification, or demonstration is required to document compliance with the location restrictions provided in the CCR rule after this demonstration has been placed into the operating record, posted to the publicly-accessible website, and government notifications provided.

Section 4
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Appendix A
Monitoring Well Boring Logs

TRC

WELL CONSTRUCTION LOG

WELL NO. MW-16-01

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
DTE EC: Monroe FAB	2/17/16	2/17/16	231828.0001.0000

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Stock Drilling	Sonic	578.91	581.74	60.0	6

Boring Location: SW of fly ash basin.	Personnel	Drilling Equipment:
N: 143121.86 E: 13394675.84	Logged By - Jennifer Reed Driller - Austin Goldsmith	TerraSonic

Civil Town/City/or Village:	County:	State:	Water Level Observations:
Monroe, MI	Monroe	Michigan	While Drilling: Date/Time Depth (ft bgs) After Drilling: Date/Time 3/17/16 08:45 ▼ Depth (ft bgs) 2.00

SAMPLE NUMBER AND TYPE	SAMPLE RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	WELL DIAGRAM	COMMENTS
1 CS	65			**SILTY CLAY** mostly clay, some silt, low plasticity, very dark ▼ gray (7.5YR 3/1), no odor, moist, medium stiff, high organic content, roots and grass. Change to no roots at 3.5 feet. Change to hard at 5.0 feet. Change to medium stiff at 5.5 feet. Change to trace to few gravel at 6.0 feet.				
2 CS	95		10	Change to medium plasticity, dark gray (10YR 4/1) mottled with yellowish brown (10YR 5/6), at 12.5 feet. Change to dark gray (10YR 4/1), very stiff at 17.5 feet.				
3 ST	60		20					
4 CS	100				CL-ML			
5 CS	100		30	Change to weathered limestone appearance, light gray (10YR 7/1), slight odor, stiff at 32.5 feet.				
6 CS	95		40	Change to not cohesive at 42.5 feet. Change to little silt, few coarse sand at 43.5 feet. Change to some silt, trace coarse sand at 45.0 feet. Grades to wet from 40 to 48 feet. Change to bedrock fragments encountered, wet at 48.0 feet.				
7 CS	100		50	**LIMESTONE** very weathered, light gray (10YR 7/1), moist, medium dense, similar to silt.				
				End of boring at 55.0 feet below ground surface.				

Signature: Reed

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WELL CONSTRUCTION LOG

TRC

WELL NO. MW-16-02

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
DTE EC: Monroe FAB	2/18/16	2/18/16	231828.0001.0000

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Stock Drilling	Sonic	579.44	581.81	55.0	6

Boring Location:	Personnel	Drilling Equipment:
S of fly ash basin. N: 140938.78 E: 13396986.03	Logged By - Jennifer Reed Driller - Austin Goldsmith	TerraSonic

Civil Town/City/or Village:	County:	State:	Water Level Observations:
Monroe, MI	Monroe	Michigan	While Drilling: Date/Time Depth (ft bgs) After Drilling: Date/Time 3/17/16 09:30 Depth (ft bgs) -4.82

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	WELL DIAGRAM	COMMENTS
1 CS	90		0–10	**SILTY CLAY** mostly clay, some silt, trace to few sand, trace to few gravel, low plasticity, dark brown (10YR 3/3), no odor, moist, hard. Change to dry at 3.25 feet. Change to dark gray (10YR 4/1) at 5.0 feet.				Artesian well conditions present.
2 CS	95		10	Change to moist at 9.5 feet Change to very stiff at 10.5 feet. Change to dark gray (10YR 4/1), mottled with light reddish brown (5YR 6/3) at 12.0 feet.				
3 ST	65		20		CL-ML			
4 CS	100			Change to no mottling at 25.0 feet.				
5 ST	95		30					
6 CS	100							
7 CS	100		40	**SILTY CLAY WITH SAND** mostly clay, some silt, little fine to coarse sand, low plasticity, dark gray (10YR 4/1), no odor, moist, very stiff. Change to light gray (10YR 7/1), slight odor at 42.5 feet.	CL-ML			
8 CS	100		50	**SILTY CLAY** mostly clay, some silt, few gravel, very low plasticity, light gray (10YR 7/1), slight odor, moist, hard. Change to dry, not cohesive at 51.5 feet.	CL-ML			
				LIMESTONE weathered, slight odor, saturated.				
			60	End of boring at 60.0 feet below ground surface.				

SOIL BORING WELL CONSTRUCTION LOG 231828.0001.GPJ TRC CORP.GDT 231828.0001.0000 5/16/16

Signature: [signature]

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Fax 734-971-9022

WELL CONSTRUCTION LOG

TRC

WELL NO. MW-16-03

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
DTE EC: Monroe FAB	2/16/16	2/16/16	231828.0001.0000

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Stock Drilling	Sonic	577.29	579.95	50.0	6

Boring Location: E of fly ash basin. N: 139040.68 E: 13395136.56	Personnel: Logged By - Chris Scieszka; Driller - Austin Goldsmith	Drilling Equipment: TerraSonic

Civil Town/City/or Village:	County:	State:	Water Level Observations:
Monroe, MI	Monroe	Michigan	While Drilling: Date/Time ___ Depth (ft bgs) ___; After Drilling: Date/Time 3/17/16 09:25 Depth (ft bgs) -13.95

Sample Number and Type	Recovery (%)	Blow Counts	Depth in Feet	Lithologic Description	USCS	Comments
1 CS	70		0–10	**SILTY CLAY** mostly clay, some silt, low plasticity, very dark brown (10YR 2/2), no odor, moist, medium stiff (2.0 tsf), high organics, roots. Change to no roots, trace fine gravel at 2.5 feet. Change to wood fragments present at 8.0 feet.	CL-ML	Artesian well conditions present.
2 CS	60		10–20	Change to medium to high plasticity, dark gray (10YR 4/1), mottled with yellowish brown (10YR 5/6) and light reddish brown (5YR 6/3), no organics at 10.0 feet. Change to trace to few fine to coarse sand, trace to few fine gravel low plasticity, yellowish brown (10YR 5/4), at 12.0 feet. Change to dark gray (10YR 4/1), very stiff (3.0 tsf) at 17.0 feet.	CL-ML	
3 ST	100		20			
4 CS	100		20–30			
5 CS	100		30–40	Change to hard (>4.0 tsf) at 30.0 feet.		
				SAND mostly fine to coarse sand, trace to few silt, very dark gray (10YR 3/1), no odor, moist, loose.	SP	
			40	**SILTY CLAY** mostly clay, some silt, low plasticity, dark gray (10YR 4/1), no odor, moist, very stiff (3.0 tsf).	CL-ML	
6 CS	100		40–50	**LIMESTONE** light gray (10YR 7/1), slight odor, weathered, saturated. Change to very weathered, moist at 41.0 feet. Change to competent, dry.		
			50	End of boring at 50.0 feet below ground surface.		

Signature: [signature]

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WELL CONSTRUCTION LOG

TRC

WELL NO. MW-16-04

Facility/Project Name: DTE EC: Monroe FAB			Date Drilling Started: 2/15/16	Date Drilling Completed: 2/15/16		Project Number: 231828.0001.0000
Drilling Firm: Stock Drilling	Drilling Method: Sonic		Surface Elev. (ft) 582.64	TOC Elevation (ft) 585.54	Total Depth (ft bgs) 50.0	Borehole Dia. (in) 6
Boring Location: N of fly ash basin. N: 140704.67 E: 13390758.97			Personnel Logged By - Chris Scieszka Driller - Austin Goldsmith		Drilling Equipment: TerraSonic	
Civil Town/City/or Village: Monroe, MI	County: Monroe	State: Michigan	Water Level Observations: While Drilling: Date/Time Depth (ft bgs) After Drilling: Date/Time 3/17/16 10:15 Depth (ft bgs) -19.40			

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	WELL DIAGRAM	COMMENTS
				SILTY CLAY mostly clay, little to some silt, trace to few fine to coarse sand, trace to few fine to coarse gravel, low plasticity, dark brown (10YR 3/3), no odor, dry, hard (>4.0 tsf).				Artesian well conditions present.
1 CS	20							
			10	Change to soft (0.5 tsf) at 10.0 feet.				
2 CS	100			Change to very stiff (3 to 4 tsf) at 15.0 feet.				
3 ST	80		20	Change to dark gray (10YR 4/1) at 19.0 feet.	CL-ML			
				Change to very stiff to hard (3 to >4 tsf) at 22.0 feet.				
4 CS	100							
			30	Change to cobble present at 29.5 feet.				
				Change to hard (>4.0 tsf) at 31.0 feet.				
5 CS	100							
			40	**SILTY GRAVEL** mostly fine to coarse gravel, little to some silt, few fine to coarse sand, gray (10YR 5/1), no odor, saturated, medium dense to dense.	GM			
6 CS	80			**SILTY SAND** mostly fine to medium sand, little to some silt, gray (10YR 5/1), no odor, moist to saturated, dense to very dense.	SM			
				SILT mostly silt, trace to few fine sand, no plasticity, dark grayish brown (10YR 4/2), no odor, dry, very dense.	ML			
			50	**LIMESTONE** gray (10YR 5/1) to dark gray (10 R 4/1), dry, competent but fractured.				
				End of boring at 50.0 feet below ground surface.				

Signature: [signature]

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WELL CONSTRUCTION LOG

TRC

WELL NO. MW-16-05

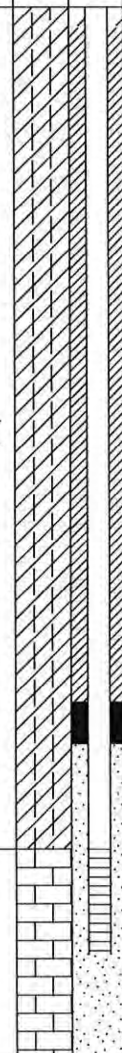
Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
DTE EC: Monroe FAB	4/12/16	4/13/16	231828.0001.0000

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Stock Drilling	Sonic	580.51	583.25	50.0	6

Boring Location:	Personnel	Drilling Equipment:
S edge of fly ash basin, along farm field edge. N: 139537.14 E: 13392810.51	Logged By - Jennifer Reed Driller - Austin Goldsmith	TerraSonic

Civil Town/City/or Village:	County:	State:	Water Level Observations:
Monroe, MI	Monroe	Michigan	While Drilling: Date/Time Depth (ft bgs) After Drilling: Date/Time 5/5/16 12:47 Depth (ft bgs) -16.70

SAMPLE Number and Type	Recovery (%)	Blow Counts	Depth in Feet	Lithologic Description	USCS	Comments
1 CS	75		0–10	**SILTY CLAY** mostly clay, little to some silt, low plasticity, very dark brown (10YR 2/2), no odor, moist, medium stiff, organic material present, roots and grass. Change to few to little fine to coarse sand at 2.5 feet. Change to brown (10YR 5/3), very stiff, no organic material at 5.0 feet. Change to trace to few gravel, gray (10YR 5/1) at 7.5 feet.	CL-ML	Artesian well conditions present.
2 CS	100		10–20			
3 CS	100		20–30			
4 CS	100		30–40	Change to no to trace fine to medium sand, no gravel, dark gray (10YR 4/1), hard at 30 feet.		
5 CS	100		40–50	**LIMESTONE** weathered, light gray (10YR 7/1), slight odor, moist to dry. Change to competent at 46.5 feet.		
			50	End of boring at 50.0 feet below ground surface.		



Signature: [signature]

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WELL CONSTRUCTION LOG

TRC

WELL NO. MW-16-06

Facility/Project Name:	Date Drilling Started:	Date Drilling Completed:	Project Number:
DTE EC: Monroe FAB	4/13/16	4/13/16	231828.0001.0000

Drilling Firm:	Drilling Method:	Surface Elev. (ft)	TOC Elevation (ft)	Total Depth (ft bgs)	Borehole Dia. (in)
Stock Drilling	Sonic	579.20	581.94	50.0	6

Boring Location: NE of fly ash basin, along the river's edge. N: 142566.72 E: 13396398.37	Personnel: Logged By - Jennifer Reed; Driller - Austin Goldsmith	Drilling Equipment: TerraSonic

Civil Town/City/or Village:	County:	State:	Water Level Observations:
Monroe, MI	Monroe	Michigan	While Drilling: Date/Time Depth (ft bgs) After Drilling: Date/Time 5/5/16 09:30 Depth (ft bgs) -3.45

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	WELL DIAGRAM	COMMENTS
			0–4	**CLAYEY SILT WITH SAND** mostly silt, few to little fine to coarse sand, few to little clay, black (10YR 2/1), no odor, moist, medium stiff, high organic content, roots and grass. Change to very dark gray (10YR 3/1) at 2.5 feet.	ML-CL			Artesian well conditions present.
1 CS	98		4–17	**SILTY CLAY** mostly clay, some silt, few to little fine to coarse sand, light yellowish brown (10YR 6/4), moist, medium stiff. Change to brown (10YR 5/3), very stiff to hard at 7.0 feet.	CL-ML			
			10	Change to dark gray (10YR 4/1), hard at 11.5 feet.				
2 CS	100			Change to no to trace sand at 15.0 feet.				
			17–45	**SILTY CLAY WITH SAND** mostly clay, some silt, little fine to coarse sand, dark gray (10YR 4/1), moist, hard.	CL-ML			
			20					
3 CS	100							
			30					
4 CS	100							
			40					
5 CS	100		45–50	**GRAVEL AND COBBLES** large broken limestone boulders, and cobbles, saturated.	GP			
			50	End of boring at 50.0 feet below ground surface.				

Signature: [signature]

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WELL CONSTRUCTION LOG

TRC

WELL NO. MW-16-07

Facility/Project Name: DTE EC: Monroe FAB			Date Drilling Started: 4/14/16	Date Drilling Completed: 4/14/16		Project Number: 231828.0001.0000
Drilling Firm: Stock Drilling	Drilling Method: Sonic		Surface Elev. (ft) 575.41	TOC Elevation (ft) 578.40	Total Depth (ft bgs) 40.0	Borehole Dia. (in) 6
Boring Location: N of fly ash basin, S of E Dunbar Road, W of main gate. N: 143408.82 E: 13392311.01			Personnel Logged By - Jennifer Reed Driller - Austin Goldsmith		Drilling Equipment: TerraSonic	
Civil Town/City/or Village: Monroe, MI	County: Monroe	State: Michigan	Water Level Observations: While Drilling: Date/Time Depth (ft bgs) After Drilling: Date/Time 5/5/16 10:44 Depth (ft bgs)			

SAMPLE NUMBER AND TYPE	RECOVERY (%)	BLOW COUNTS	DEPTH IN FEET	LITHOLOGIC DESCRIPTION	USCS	GRAPHIC LOG	WELL DIAGRAM	COMMENTS
				TOPSOIL				Artesian well conditions present.
1 CS	95			**SILTY CLAY** mostly clay, some silt, few to little sand, brown (10YR 5/3) to gray (10YR 5/1), no odor, moist, medium stiff.	CL-ML			
2 CS	100		10	Change to dark gray (10YR 4/1) at 9.5 feet.				
3 CS	100		20	**SANDY SILT WITH CLAY** mostly silt, little sand, little clay, dark gray (10YR 4/1), moist, medium to very stiff. Change to little to some sand at 25.0 feet.	ML-CL			
4 CS	100		30	Change to gray (GLEY1 5/N), crumbly at 28.5 feet. Change to wet at 35.0 feet.				
				LIMESTONE weathered, light gray (10YR 7/1), slight odor, wet.				
			40	Change to saturated at 39.5 feet.				
				End of boring at 40.0 feet below ground surface.				
			50					

Signature: [signature] for J Reed

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Appendix B
Cross Sections

LEGEND

- MONITORING WELLS
- APPROXIMATE BOUNDARY OF FLY ASH
- CROSS SECTIONS

NOTES

1. BASE MAP IMAGERY FROM ESRI/MICROSOFT, "WORLD IMAGERY", WEB BASEMAP SERVICE LAYER.
2. WELL LOCATIONS SURVEYED BY BMJ ENGINEERS AND SURVEYORS INC. IN MARCH AND MAY 2016.

0 600 1,200 Feet

1 " = 600 '

1:7,200

PROJECT:

DTE ELECTRIC COMPANY
MONROE POWER PLANT FLY ASH BASIN
7955 EAST DUNBAR ROAD
MONROE, MICHIGAN

TITLE:

CROSS SECTION LOCATOR MAP

DRAWN BY:	J. PAPEZ	PROJ NO.:	265996.0001
CHECKED BY:	C. SCIESZKA	**FIGURE B -1**	
APPROVED BY:	V. BUENING		
DATE:	OCTOBER 2018		

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Ann Arbor, MI 48108-3284
Phone: 734.971.7080
www.trcsolutions.com

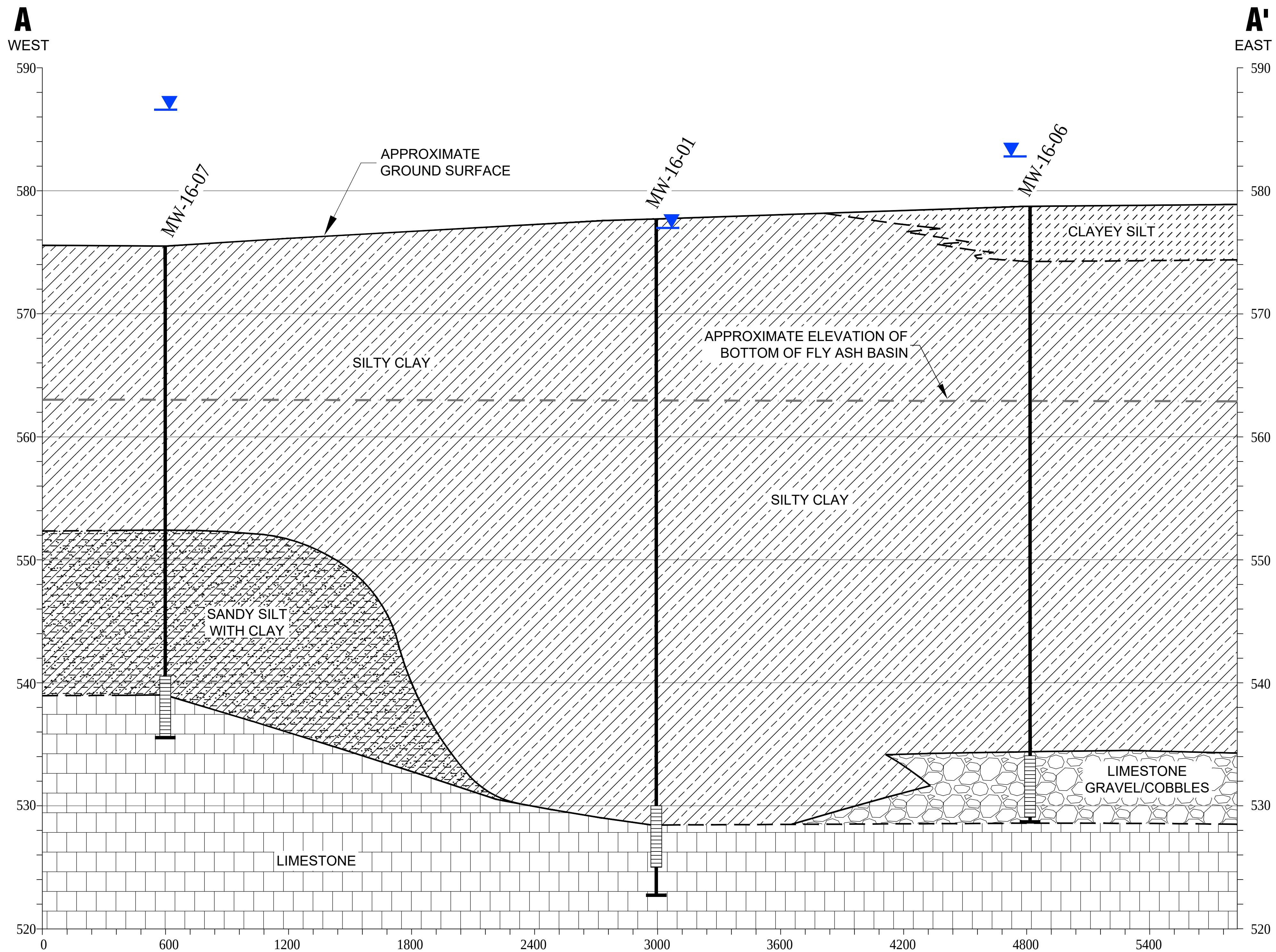
FILE NO.: 265996-0001-014.mxd

TRC - GIS

Coordinate System: NAD 1983 UTM Zone 17N (Meter)
Map Rotation: 0

Plot Date: 10/15/2018, 08:59:53 AM by SMAJOR -- LAYOUT: ANSI B(11"x17")
Path: E:\DTE\CCR_Sites\2017_265996\265996-0001-014.mxd

GENERALIZED GEOLOGIC CROSS-SECTION A-A'



LEGEND

- STRATEGRAPHIC BOUNDARY (DASHED WHERE INFERRED)
- GROUNDWATER ELEVATION (COLLECTED ON 03/06/2017)
- SOIL BORING
- WELL SCREEN INTERVAL
- END OF BORING

Lithology Key

- CLAYEY SILT
- SILTY CLAY
- SANDY SILT WITH CLAY
- LIMESTONE GRAVEL / COBBLES
- LIMESTONE BEDROCK

SCALE IN FEET

VERTICAL: 0 – 10

HORIZONTAL: 0 – 600

PROJECT:
DTE ELECTRIC COMPANY
MONROE POWER PLANT - FLY ASH BASIN
MONROE, MICHIGAN

TITLE:
GENERALIZED GEOLOGIC CROSS-SECTION A-A'

DRAWN BY:	D.STEHLE	PROJ NO.:	265996.0001.01
CHECKED BY:	S.HOLMSTROM	**FIGURE B-2**	
APPROVED BY:	V.BUENING		
DATE:	SEPTEMBER 2017		

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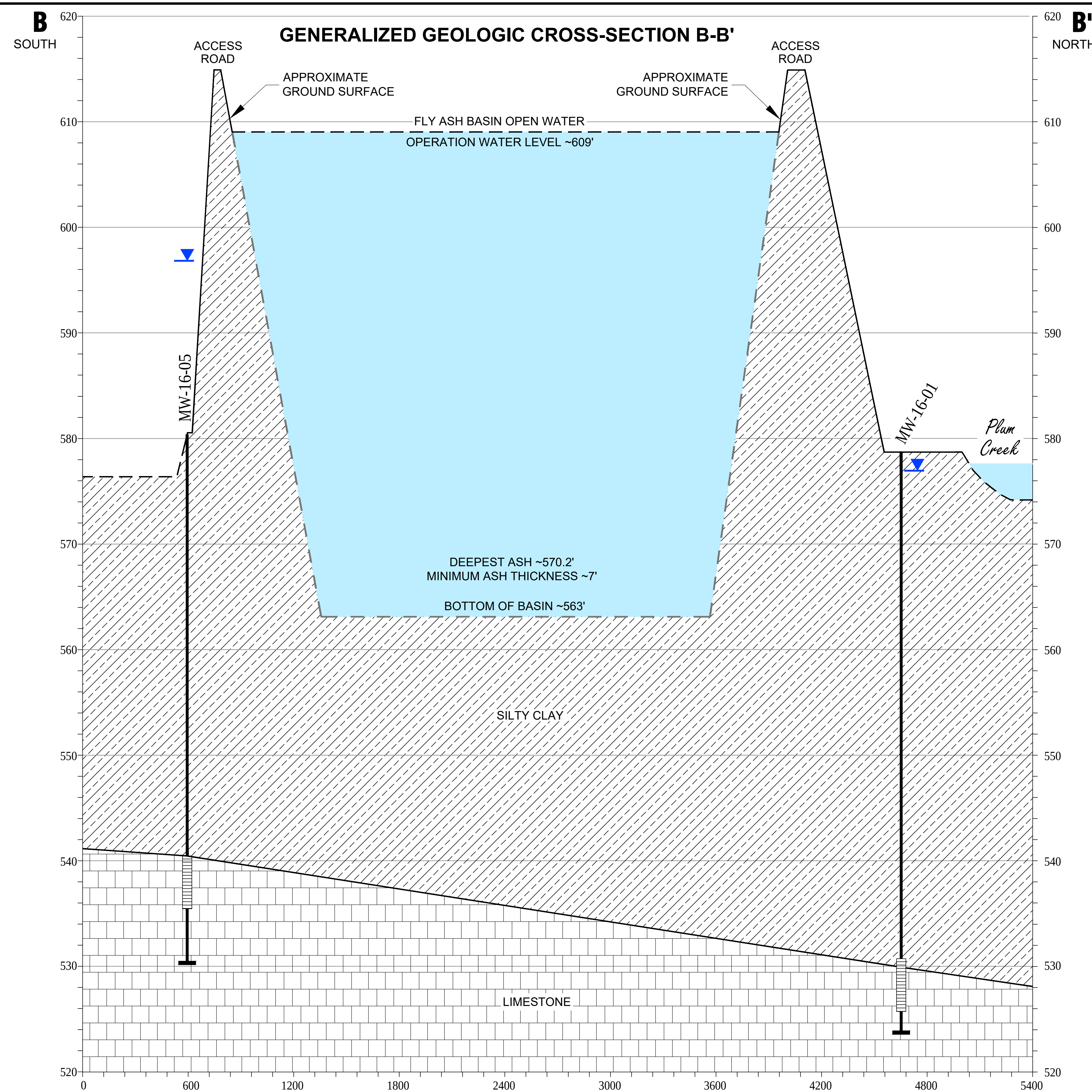
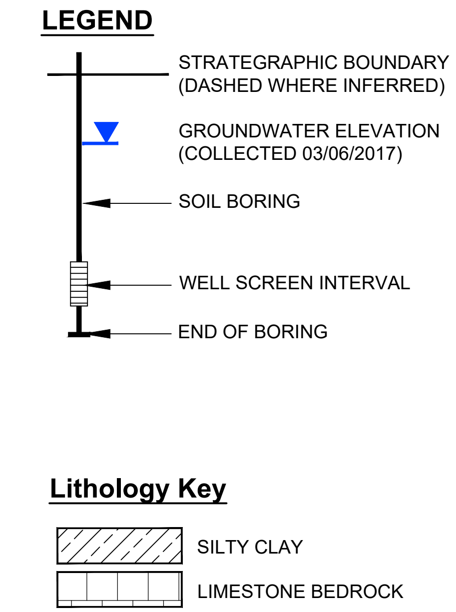
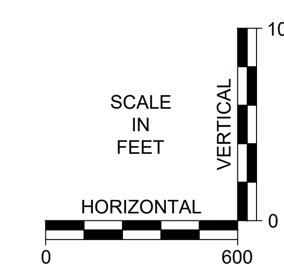
FILE NO.: 265996.0001.01.01.04-05.dwg

11x17 --- ATTACHED XREFS: --- ATTACHED IMAGES:
DRAWING NAME: J:_TRC\DTE\Monroe PP\265996\0001\01\ 265996.0001.01.01.04-05.dwg --- PLOT DATE: October 12, 2017 - 11:17AM --- LAYOUT: FIG04 XS AA







PROJECT:
DTE ELECTRIC COMPANY
MONROE POWER PLANT - FLY ASH BASIN
MONROE, MICHIGAN

TITLE:
GENERALIZED GEOLOGIC CROSS-SECTION B-B'

DRAWN BY:	D.Stehle	PROJ NO.:	265996.0001.01.01
CHECKED BY:	S.HOLMSTROM	**FIGURE B-3**	
APPROVED BY:	V.BUENING		
DATE:	MAY 2017		

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Ann Arbor, MI 48108
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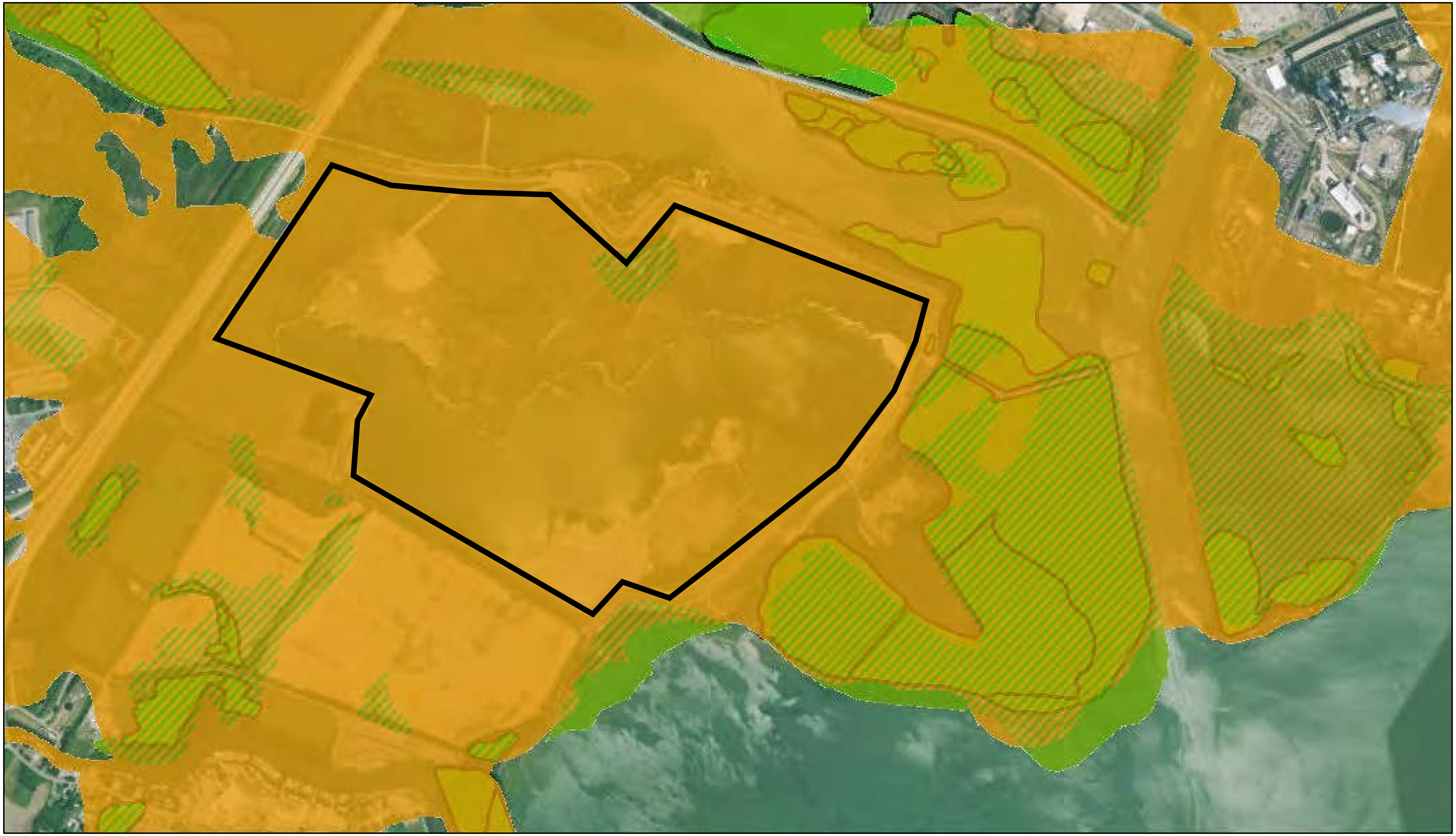
FILE NO.: 265996.0001.01.01.04-05.dwg

11x17 --- ATTACHED XREF'S: --- ATTACHED IMAGES:
DRAWING NAME: J:_TRC\DTE\Monroe PP\265996\0001\01\ 265996.0001.01.01.04-05.dwg --- PLOT DATE: October 12, 2017 - 11:17AM --- LAYOUT: FIG05 XS BB

Appendix C
National Wetland Inventory Map

Wetlands Map Viewer



August 17, 2018

Part 303 Final Wetlands Inventory

- Wetlands as identified on NWI and MIRIS maps
- Soil areas which include wetland soils
- Wetlands as identified on NWI and MIRIS maps and soil areas which include wetland soils
- Gage Stations
- National Wetlands Inventory 2005

1:15,382

0 0.125 0.25 0.5 mi

0 0.2 0.4 0.8 km

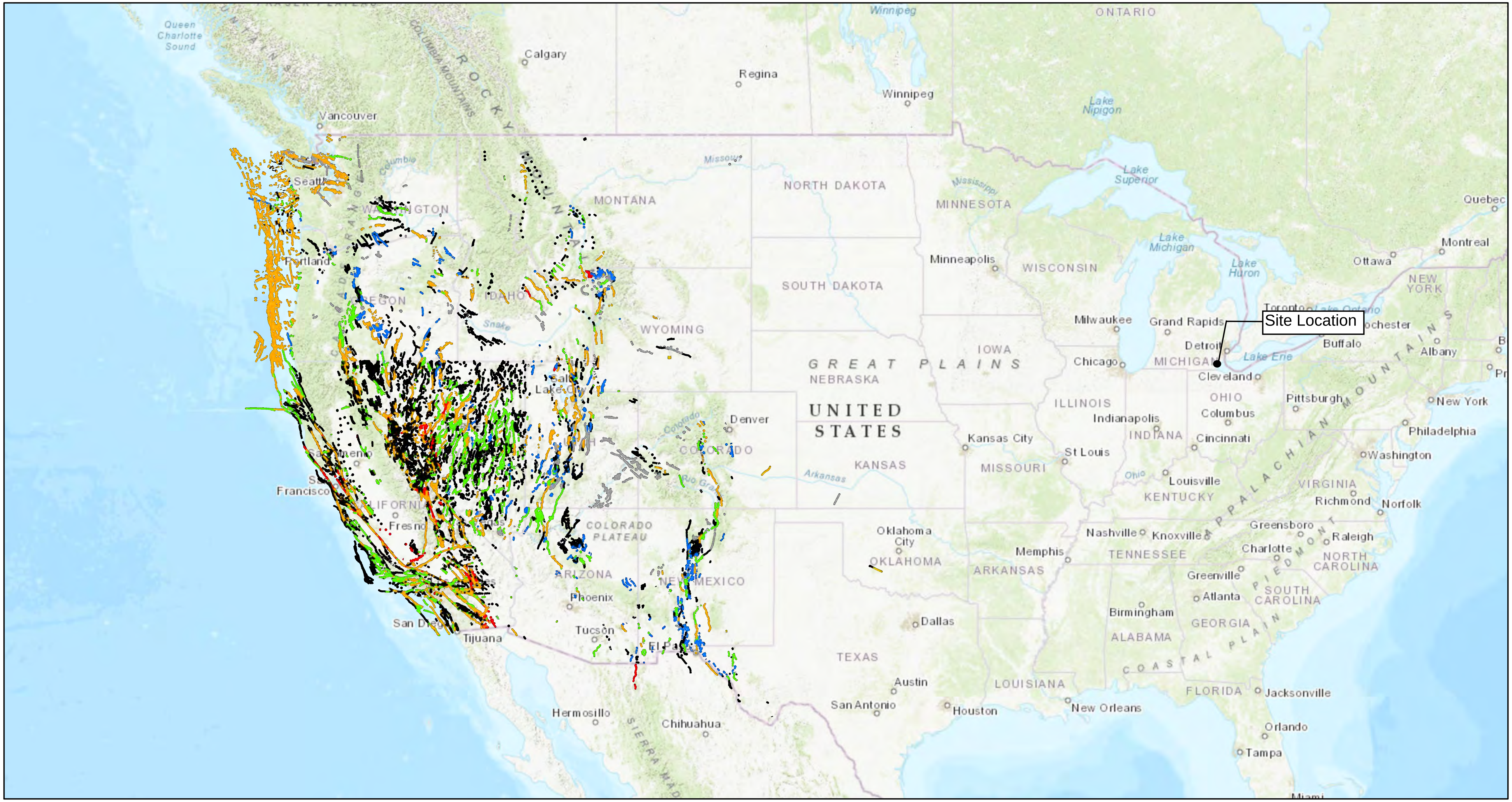
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, © OpenStreetMap contributors, and the GIS User Community

Disclaimer: This map is not intended to be used to determine the specific locations and jurisdictional boundaries of wetland areas subject to regulation. More information regarding this map, including how to obtain a copy can be accessed at www.michigan.gov/wetlands.

Map by: State of Michigan - CSS

Appendix D
U.S. Quaternary Faults and Folds Map

US Quaternary Faults and Folds



9/7/2018, 3:20:39 PM

1:18,489,298

0	175	350	700 mi
0	275	550	1,100 km

Quaternary faults

- unspecified age, well constrained location
- unspecified age, moderately constrained location
- unspecified age, inferred location
- undifferentiated Quaternary (< 130,000 years), well constrained location
- undifferentiated Quaternary (< 130,000 years), moderately constrained location
- undifferentiated Quaternary (< 130,000 years), inferred location
- middle and late Quaternary (< 1.6 million years), well constrained location
- middle and late Quaternary (< 1.6 million years), moderately constrained location
- middle and late Quaternary (< 1.6 million years), inferred location
- latest Quaternary (<15,000 years), well constrained location
- latest Quaternary (<15,000 years), moderately constrained location
- latest Quaternary (<15,000 years), inferred location
- late Quaternary (< 130,000 years), well constrained location

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community, USGS

Web AppBuilder for ArcGIS
USGS | Esri, FAO, NOAA |

Appendix E
U.S. Seismic Design Maps

U.S. Geological Survey - Earthquake Hazards Program

Due to insufficient resources and the recent development of similar web tools by third parties, this spring the USGS will be streamlining the two U.S. Seismic Design Maps web applications, including the one below. Whereas the current applications each interact with users through a graphical user interface (GUI), the new web services will receive the inputs (e.g. latitude and longitude) in the form of a web address and return the outputs (e.g. S_{DS} and S_{D1}) in text form, without supplementary graphics. Though designed primarily to be read by the aforementioned third-party web GUIs, the text outputs are also human-readable. To preview the new web services, please click here. Step-by-step instructions for using one of these web services, namely that for the recently published 2016 ASCE 7 Standard, are posted here.

MONPP FAB - Seismic Impact Zone

Latitude = 41.884°N, Longitude = 83.375°W

Location

Reference Document

2015 NEHRP Provisions

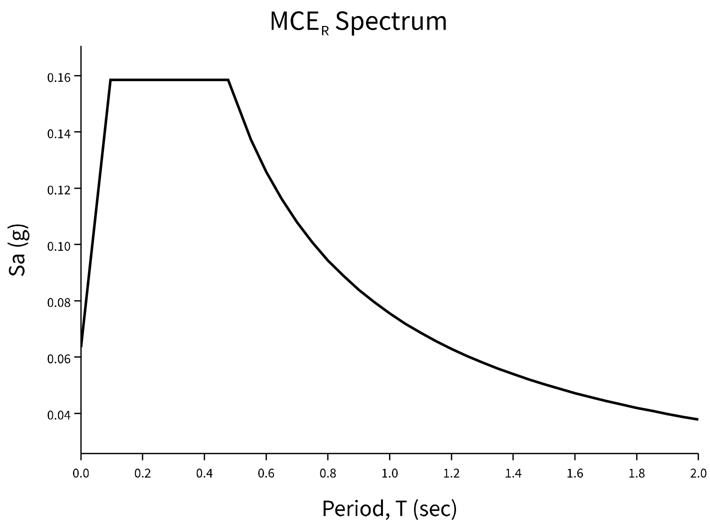
Site Class

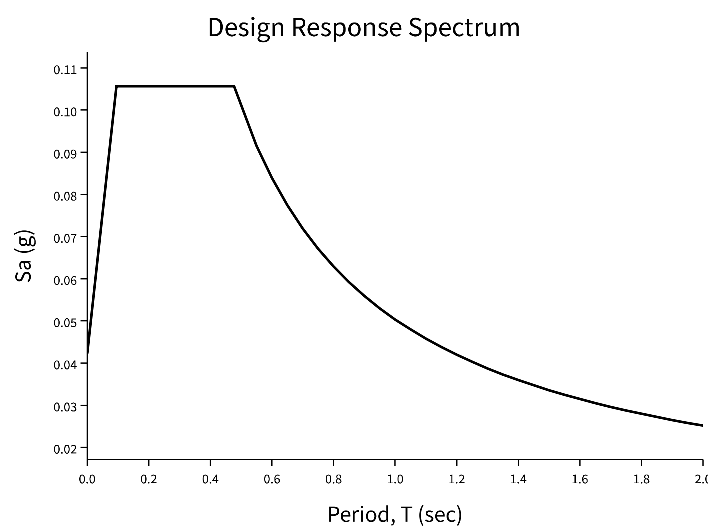
C: Very Dense Soil and Soft Rock

Risk Category

I or II or III

S_S =	0.122 g	S_{MS} =	0.158 g	S_{DS} =	0.106 g
S_1 =	0.050 g	S_{M1} =	0.076 g	S_{D1} =	0.050 g


MCE$_R$ Spectrum
Sa (g)
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
Period, T (sec)


Design Response Spectrum
Sa (g)
0.11
0.10
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
Period, T (sec)

Mapped Acceleration Parameters, Long-Period Transition Periods, and Risk Coefficients

Note: The S_S and S_1 ground motion maps provided below are for the direction of maximmum 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) 1.3 (to obtain S_1).

- FIGURE 22-1 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 22-2 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 22-9 Maximum Considered Earthquake Geometric Mean (MCE_G) PGA, %g, Site Class B for the Conterminous United States
- FIGURE 22-14 Mapped Long-Period Transition Period, T_L (s), for the Conterminous United States
- FIGURE 22-18 Mapped Risk Coefficient at 0.2 s Spectral Response Period, C_{RS}
- FIGURE 22-19 Mapped Risk Coefficient at 1.0 s Spectral Response Period, C_{R1}

Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site class as Site Class , based on the site soil properties in accordance with Chapter 20.

Table 20.3-1 Site Classification

Site Class	$\overline{v}_S$	$\overline{N}$ or $\overline{N}_{ch}$	$\overline{s}_u$
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 ≥ 40%, and • Undrained shear strength $\overline{s}_u$ < 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/ft^2 = 0.0479 kN/m^2			

Site Coefficients and Risk-Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameters

Risk-targeted Ground Motion (0.2 s)

$C_{RS}S_{SUH} = 0.950 \times 0.128 = 0.122$ g

Deterministic Ground Motion (0.2 s)

$S_{SD} = 1.500$ g

$S_S \equiv$ "Lesser of $C_{RS}S_{SUH}$ and S_{SD}" = 0.122 g

Risk-targeted Ground Motion (1.0 s)

$C_{R1}S_{1UH} = 0.903 \times 0.056 = 0.050$ g

Deterministic Ground Motion (1.0 s)

$S_{1D} = 0.600$ g

$S_1 \equiv$ "Lesser of $C_{R1}S_{1UH}$ and S_{1D}" = 0.050 g

Table 11.4-1: Site Coefficient F_a

Site Class	Spectral Reponse Acceleration Parameter at Short Period					
	$S_S \le 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S = 1.25$	$S_S \ge 1.50$
A	0.8	0.8	0.8	0.8	0.8	0.8
B (measured)	0.9	0.9	0.9	0.9	0.9	0.9
B (unmeasured)	1.0	1.0	1.0	1.0	1.0	1.0
C	1.3	1.3	1.2	1.2	1.2	1.2
D (determined)	1.6	1.4	1.2	1.1	1.0	1.0
D (default)	1.6	1.4	1.2	1.2	1.2	1.2
E	2.4	1.7	1.3	1.2 *	1.2 *	1.2 *
F	See Section 11.4.7					

* For Site Class E and $S_S \ge 1.0$ g, see the requirements for site-specific ground motions in Section 11.4.7 of the 2015 NEHRP Provisions. Here the exception to those requirements allowing F_a to be taken as equal to that of Site Class C has been invoked.

Note: Use straight-line interpolation for intermediate values of S_S.

Note: Where Site Class B is selected, but site-specific velocity measurements are not made, the value of F_a shall be taken as 1.0 per Section 11.4.2.

Note: Where Site Class D is selected as the default site class per Section 11.4.2, the value of F_a shall not be less than 1.2 per Section 11.4.3.

For Site Class = C and S_S = 0.122 g, F_a = 1.300

Table 11.4-2: Site Coefficient F_V

Site Class	Spectral Response Acceleration Parameter at 1-Second Period					
	$S_1 \le 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 = 0.50$	$S_1 \ge 0.60$
A	0.8	0.8	0.8	0.8	0.8	0.8
B (measured)	0.8	0.8	0.8	0.8	0.8	0.8
B (unmeasured)	1.0	1.0	1.0	1.0	1.0	1.0
C	1.5	1.5	1.5	1.5	1.5	1.4
D (determined)	2.4	2.2 [1]	2.0 [1]	1.9 [1]	1.8 [1]	1.7 [1]
D (default)	2.4	2.2 [1]	2.0 [1]	1.9 [1]	1.8 [1]	1.7 [1]
E	4.2	3.3 [1]	2.8 [1]	2.4 [1]	2.2 [1]	2.0 [1]
F	See Section 11.4.7					

[1] For Site Class D or E and $S_1 \ge 0.2$ g, site-specific ground motions might be required. See Section 11.4.7 of the 2015 NEHRP Provisions.

Note: Use straight-line interpolation for intermediate values of S_1.

Note: Where Site Class B is selected, but site-specific velocity measurements are not made, the value of F_V shall be taken as 1.0 per Section 11.4.2.

For Site Class = C and S_1 = 0.050 g, F_v = 1.500

Site-adjusted MCE_R (0.2 s)

$$S_{MS} = F_a S_S = 1.300 \times 0.122 = 0.158 \text{ g}$$

Site-adjusted MCE_R (1.0 s)

$$S_{M1} = F_v S_1 = 1.500 \times 0.050 = 0.076 \text{ g}$$

Design Spectral Acceleration Parameters

Design Ground Motion (0.2 s)

$S_{DS} = ⅔\, S_{MS} = ⅔ \times 0.158 = 0.106$ g

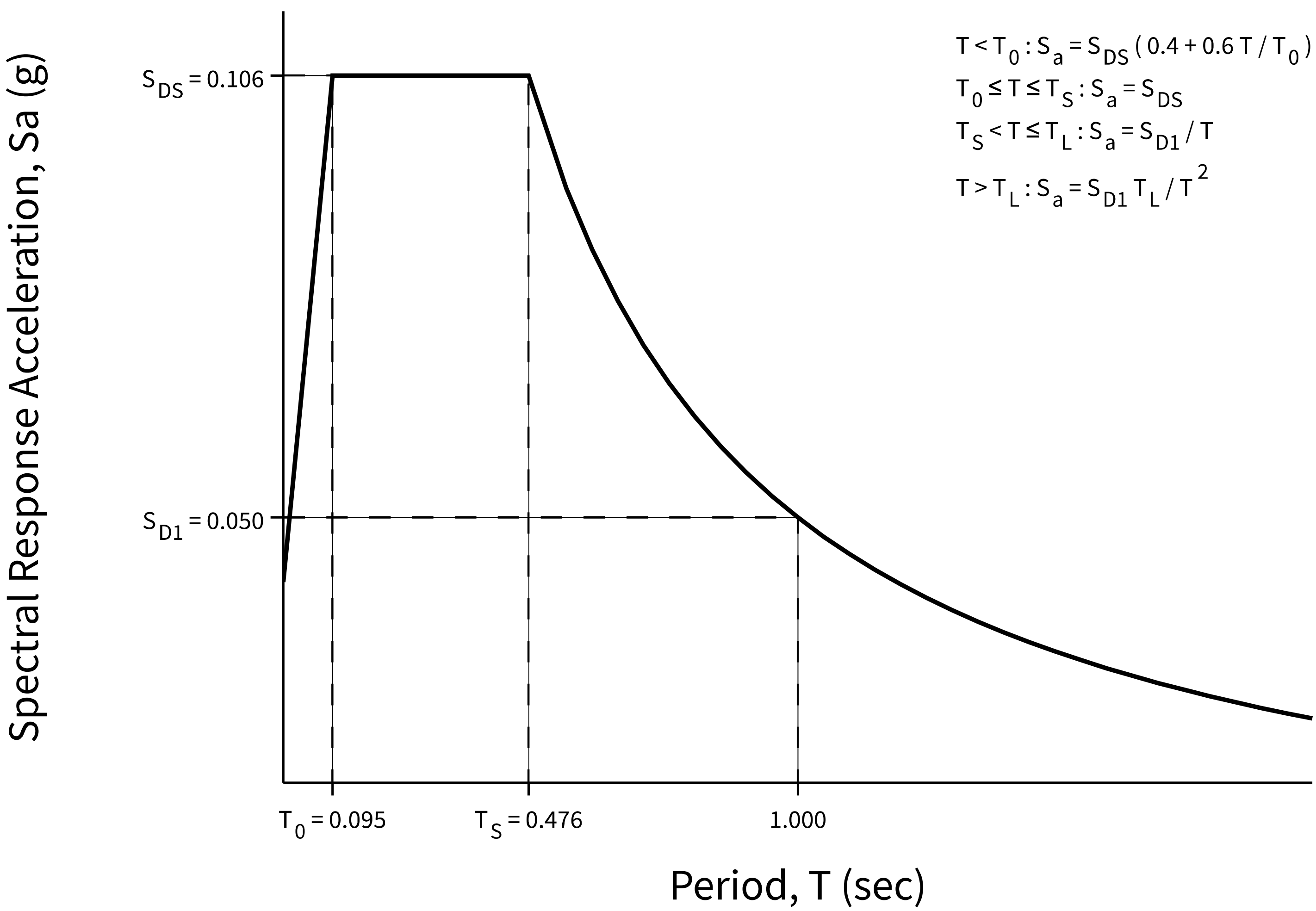
Design Ground Motion (1.0 s)

$S_{D1} = ⅔\, S_{M1} = ⅔ \times 0.076 = 0.050$ g

Design Response Spectrum

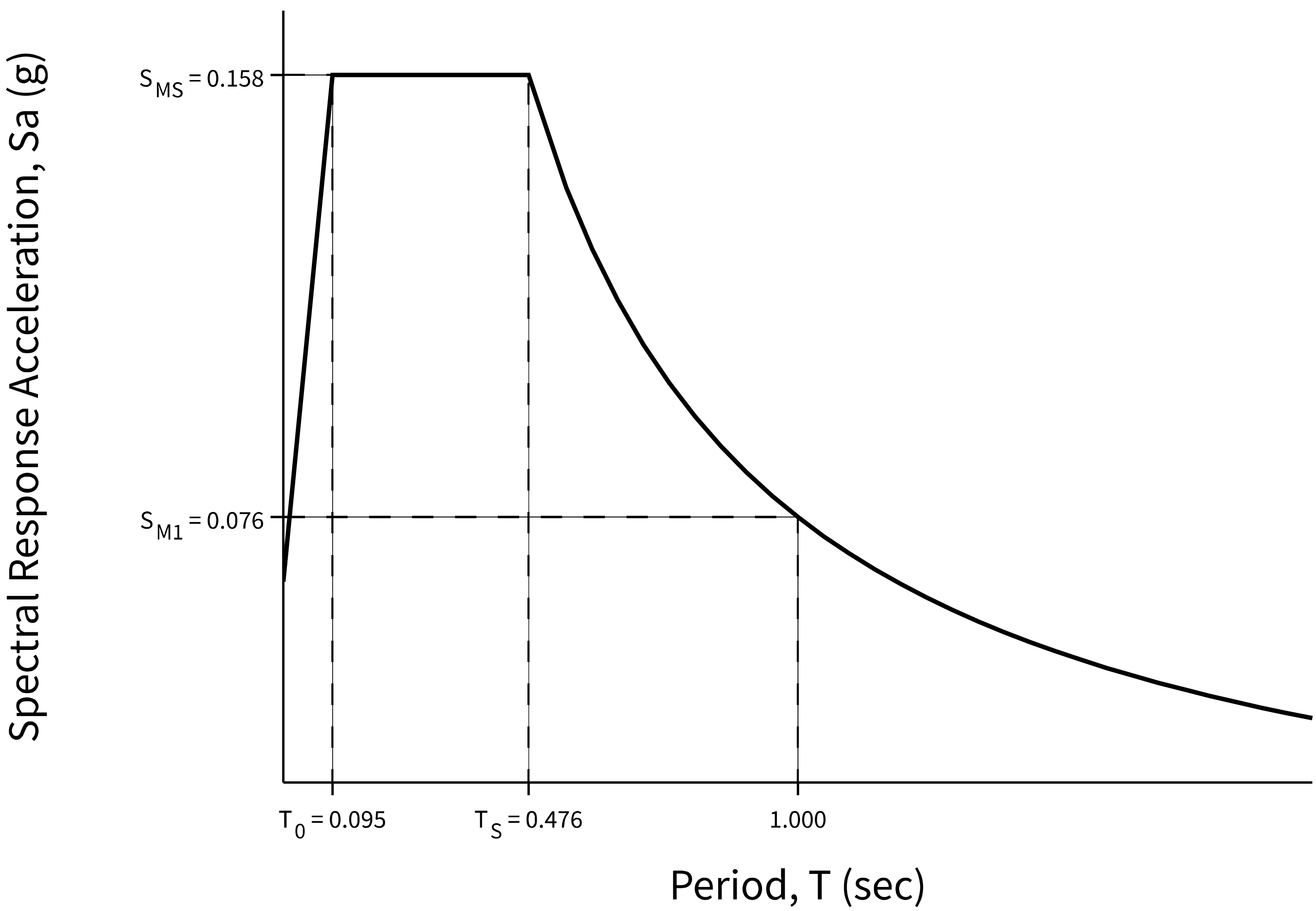
Long-Period Transition Period = T_L = 12 s

Figure 11.4-1: Design Response Spectrum



MCE_R Response Spectrum

The MCE_R response spectrum is determined by multiplying the design response spectrum above by 1.5.



Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

Table 11.8-1: Site Coefficient for F_{PGA}

Site Class	Mapped MCE Geometric Mean (MCE_G) Peak Ground Acceleration					
	PGA ≤ 0.10	PGA = 0.20	PGA = 0.30	PGA = 0.40	PGA = 0.50	PGA ≥ 0.60
A	0.8	0.8	0.8	0.8	0.8	0.8
B (measured)	0.9	0.9	0.9	0.9	0.9	0.9
B (unmeasured)	1.0	1.0	1.0	1.0	1.0	1.0
C	1.3	1.2	1.2	1.2	1.2	1.2
D (determined)	1.6	1.4	1.3	1.2	1.1	1.1
D (default)	1.6	1.4	1.3	1.2	1.2	1.2
E	2.4	1.9	1.6	1.4	1.2	1.1
F	See Section 11.4.7					

Note: Use straight-line interpolation for intermediate values of PGA

Note: Where Site Class D is selected as the default site class per Section 11.4.2, the value of F_{pga} shall not be less than 1.2.

For Site Class = C and PGA = 0.063 g, F_{PGA} = 1.300

Mapped MCE_G

PGA = 0.063 g

Site-adjusted MCE_G

$PGA_M = F_{PGA}PGA = 1.300 \times 0.063 = 0.082$ g

Appendix K
Effectiveness of the Underlying Clay Soil as a Natural Barrier On-Site, Ash Disposal Basin, Monroe Power Plant Technical Report, Detroit Edison Design Engineering, 1995

Technical Report No. 242

Title MONPP - Effectivenes of the Underlying Clay Soil as a Natural Barrier On-Site Ash Disposal Basin

Author(s) J R Decator, Jr P E

Date March 1995

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EFFECTIVENESS OF THE UNDERLYING CLAY SOIL AS A NATURAL BARRIER

ON-SITE ASH DISPOSAL BASIN

MONROE POWER PLANT

TECHNICAL REPORT No 0695-242

APPROVALS

	Date
W.M. Street	3/15/95
W M Street Supervising Engineer Architectural-Civil Engineering	
S H Noetzel	3-16-95
S H Noetzel Director, Design Engineering Power Generation	

EXECUTIVE SUMMARY

Monroe Power Plant's On-Site Fly Ash Disposal Basin has an expected 45-year active life as a waste management facility, through the Year 2020 The underlying clay soil has been analyzed and found to serve as an effective natural barrier against the steady-state seepage of leachate from the facility to the hydrogeologic environment No migration of leachate from the facility is predicted to occur during its active life and the ensuing 30-year post closure period Therefore, application will be made to secure a waiver with respect to the groundwater monitoring well requirements of the Michigan Solid Waste Management Act for the facility

EFFECTIVENESS OF THE UNDERLYING CLAY SOIL AS A NATURAL BARRIER

ON-SITE ASH DISPOSAL BASIN

MONROE POWER PLANT

TECHNICAL REPORT No 0695-242

TABLE OF CONTENTS

INTRODUCTION

Monroe Power Plant's On-Site Fly Ash Disposal Basin was constructed during 1973 - 1974 for the disposal of slurried fly ash produced as a waste product from the plant Deposition of slurried fly ash into the facility began in January, 1975 Approximately 12 6 million cubic yards of fly ash have been deposited into the facility during the past 20 years, about 47% of the total basin capacity Based on current projections of the rate of deposition of slurried fly ash into the facility, the basin is expected to have an active life of 45 years, and to be closed in the Year 2020

The On-Site Fly Ash Disposal Basin is classified as a Type III Landfill and is subject to the Michigan Solid Waste Management Act with respect to construction, operation, maintenance and closure This Act requires the installation of groundwater monitoring wells around the perimeter of a licensed waste management facility unless, under Rule 299 4318, data can be presented demonstrating that no migration of leachate from the waste management facility will occur during its active life plus the ensuing 30-year post closure period

A Work Plan was developed to assess the effectiveness of the clay soil underlying the basin as a natural barrier between the impounded waste material and the hydrogeologic environment, by limiting the steady-state seepage from the facility The plan consisted of new soil borings and laboratory testing of soil specimens to develop additional data to supplement earlier geotechnical information obtained for the site The Work Plan was approved by the Michigan Department of Natural Resources in July, 1994

The purpose of this Technical Report is to review the geotechnical data obtained and established for Monroe Power Plant's On-Site Fly Ash Disposal Basin, and to present both a transit time prediction of the rate of seepage with time, and the time for leachate to seep through the underlying natural clay barrier to the hydrogeologic environment

SUMMARY AND CONCLUSIONS

The On-Site Fly Ash Disposal Basin was constructed during 1973 - 1974 for the disposal of slurried fly ash from Monroe Power Plant Deposition of slurried ash into the facility began in January, 1975. The On-Site Ash Disposal Basin is expected to have an active life of 45 years, and to be closed in the Year 2020

Engineering properties of the underlying clay soils determined in 1994 correlate well with earlier investigations made in 1970 and 1973 - 74 Both the brown silty clay and the gray silty clay soils prevalent at the site exhibit hard to very hard consistencies and suitable levels of moisture contents and porosity Hydraulic conductivity values for "undisturbed" samples were all found to be less than 10^{-7} cm/sec

A method of transit time analysis for steady-state conditions was used to predict both the rate of seepage with time and the time it would take for contaminants to migrate through the natural clay barrier underlying the basin The Darcian flux was determined to be 1 0 x 10^{-7} cm^3/cm^2-sec The predicted time for contaminants to migrate from the basin to the hydrogeologic environment is a minimum of 308 years

The minimum thickness of a natural clay barrier to inhibit the migration of leachate from the basin for a period of 75 years, equal to the expected active life plus a 30-year post closure period, is 10 feet This minimum thickness is significantly less than the range of thicknesses determined in the field, which are between 22 feet and 37 feet

It is concluded that the underlying natural clay soil is an effective barrier against the steady-state seepage of leachate from Monroe Power Plant's On-Site Ash Disposal Basin to the hydrogeologic environment, and that no migration of leachate will occur during the expected 45-year active life and the ensuing 30-year post closure period of the facility

DISCUSSION

Site Description

Planning of Monroe Power Plant's On-Site Fly Ash Disposal Basin began about 1969 when a nearby site of about 400 acres was identified and acquired The site is bounded by I-75 on the west, LaPlaisance Creek on the south, and Plum Creek on the north and east Monroe Power Plant is immediately east of the site, on the other side of Plum Creek

A topographic map was prepared, and became the basis for subsequent exploration and design development work Original site characteristics and topography are summarized by the following

1 The ground site was relatively flat, but not level The ground surface sloped eastward away from I-75, falling from about Elevation 577 feet on the west to about Elevation 565 feet on the east

2 Portions of the site were below the level of Lake Erie, which under conditions of high water can rise above Elevation 569 feet Previous owners had constructed a dike along the east side to keep the lake water out and permit the land to be farmed

Lacustrine clay soils, or glacial till, are those soil deposits laid down by the advances and retreats of the North American continental ice sheets The soil deposits came directly from the glacial ice with little or no sorting by moving water The glacial till is generally a matrix of fine silt and clay, often with embedded rock fragments and boulders Discontinuous lenses and seams of sand and gravel are frequently encountered within the matrix The result is a dense soil of low permeability and considerable shear strength

The eastern half of Monroe County, Michigan, is noted for the occurrence and consistency of its impermeable lacustrine clay soil The clay soil is encountered immediately below the topsoil, and extends down to the underlying bedrock surface Groundwater is usually encountered in the upper portion of the fragmented bedrock

Generalized Site Geology

Fifty-two (52) soil borings were made at the site in 1970 Of these, ten (10) extended fully down through the overburden to the underlying bedrock and included rock core samples Locations of seventeen (17) of these soil borings, including all of those made to bedrock, are plotted on the map included as Exhibit A, and copies of the boring logs are included as Exhibit B An additional sixty-four (64) soil borings of 15 to 20 foot depth were made in 1973 and 1974 to fill in data gaps and discontinuities Copies of all soil boring logs and data are preserved in Design Engineering's files

For all borings made in the 1970's, a "spoon" sampler was driven into the soil using a "drop" hammer to collect representative samples at 5-foot intervals Samples of the clay soil were collected using a 1 75-inch liner, and 2 0-inch heavy wall samplers were used to obtain rock core samples Results of these earlier investigations are summarized by the following

1 The overburden was found to consist of

   a Topsoil, consisting of fertile organic and mineral material
   b Weathered brown silty clay, with traces of sand and gravel, below the topsoil
   c Unweathered gray silty clay, with traces of sand and gravel, between the brown silty clay and bedrock

2 Within the gray silty clay stratum, rock fragments and boulders were encountered between about Elevation 551 feet and the surface of bedrock, about 15 to 20 feet below It was sometimes necessary to 'drill" through the rock fragments and boulders to enable the soil borings to be advanced down to the bedrock surface

3 The high shear strengths of the brown and gray silty clays confirmed their suitability for use for construction of an impoundment to hold slurried fly ash

4 The bedrock surface is variable across the site A "ridge" at about elevation 539 feet bisects the site from approximately the midpoint of the north side, to the southeast corner Elevations in the northeast corner and the southwest corner of the basin are 10 to 15 feet lower

5 Rock core samples indicated that bedrock consisted of 5 to 10 feet of fragmented limestone overlying gray weathered shale All of the bedrock to the depths cored was interlaced with water

6 Artesian water was found at a number of the borings made to bedrock. The differing heads of water recorded varied from 5 to 20 feet above grade

Construction of the ash disposal basin proceeded throughout 1973 and 1974 Topsoil material was stripped and stockpiled at the site for future use The interior of the basin was excavated uniformly to Elevation 562 feet, and the brown and gray silty clay soil material was used to construct the perimeter embankments The earthen embankments are keyed into the underlying gray clay stratum, and have a top elevation of 613 feet

Ten (10) additional soil borings were made around the perimeter of the On-Site Ash Basin in the Fall of 1994 using the Central Mine Equipment "Continuous Sample Tube System " This sampling method employed a 3-inch diameter removable liner within a sampler barrel, which is mounted within the lead section of a hollow stem auger column The soil boring is advanced by augering into the soil, and filling the liner After advancing 30 inches, the length of the sample tube, the entire assembly is withdrawn and the "filled" liner removed After a new liner is installed in the sampler barrel, the procedure is repeated for the full depth of the boring By sampling continuously, a picture of the soil is provided for the full depth of the test hole, and seams and lenses of sand and gravel are detected which might be missed if samples were obtained at some prescribed interval In addition, the specimens of soil collected in the liner are "undisturbed," and the resulting laboratory analyses better depict the "in situ" condition of the soil

Locations of the ten (10) soil borings made in 1994 are plotted on the map included as Exhibit A, and copies of the boring logs are included as Exhibit C Soil specimens collected from five of the soil borings underwent a rigorous testing and analysis program in the laboratory, including determination of hydraulic conductivity The specimens from the other five borings were retained for testing in the event that anomalies were detected The report prepared by Soil and Material Engineers, dated January 30, 1995, will be retained in Design Engineering's files

It was anticipated that the continuous soil coring procedure used to make the 1994 soil borings would have difficulty achieving full depth penetration of the stiff to very stiff gray clay stratum because of the presence of many rock fragments and boulders Consequently, many of the 1994 soil borings were strategically located in close proximity to the earlier 1970 borings to permit correlation of results Very little variation in the descriptions and engineering properties of the clay soil native to the site is noted

Site-Specific Engineering Properties of the Clay Soils

The engineering properties of soils are as varied as their chemical compositions, modes of formation, and past and present environmental settings A wide assortment of test procedures have been developed and are used to predict the engineering performance of a soil (index tests) or to measure the soil performance directly with respect to parameters of concern (e g , permeability and shear strength)

The various engineering properties of the clay soils as determined by the laboratory tests performed in 1994 are included as Exhibit D Brief descriptions of the each of the engineering properties, and the range of values measured, follow

Moisture Content A fundamental property of any soil, it is expressed as a percentage of the weight of water in a given soil mass to the weight of solid particles

Brown Silty Clay	12 % to 25 %
Gray Silty Clay	7 % to 16 %

Dry Unit Weight· The mass per unit volume, in pounds per cubic foot (pcf)

Brown Silty Clay	102 to 126 pcf
Gray Silty Clay	118 to 136 pcf

Specific Gravity The ratio of the density of the solid particles to the density of distilled water

Brown Silty Clay	2 71 to 2 75
Gray Silty Clay	2 68 to 2 78

Void Ratio· The ratio of the volume of voids to the volume of solids in a given mass of soil

Brown Silty Clay	0 34 to 0 68
Gray Silty Clay	0 24 to 0 40

Porosity The ratio of the total volume of the voids of a given mass of soil to the total volume of the soil mass, expressed as a percentage

Brown Silty Clay	25 % to 40 %
Gray Silty Clay	19 % to 28 5 %

Atterberg Limits The consistency of a cohesive soil may range from that of a viscous liquid to that of a hard solid This range of consistency is arbitrarily divided into four stages, referred to as "limits " The "Liquid Limit" is the point at which, when the moisture content is reduced below it, the clay soil ceases to behave as a liquid and begins to acquire the properties of a deformable "plastic" solid As the moisture content is reduced further, the "Plastic Limit" is the point at which the plastic clay soil ceases being deformable and enters a semi-solid state The Plasticity Index is the numerical difference between the Liquid Limit and the Plastic Limit, and represents the range of moisture within which the soil remains plastic

Brown Silty Clay	Classification "CL"
Liquid Limit	23 to 36
Plasticity Index	8 to 19

Gray Silty Clay	Classification "CL"
Liquid Limit	20 to 32
Plasticity Index	9 to 17

Grain Size Distribution Well-graded soils have a good representation of all particle sizes over a fairly broad size range Poorly-graded soil have an excess or deficiency of particles within a certain size range (gap-graded or skip-graded), or all the particles occur within a fairly narrow range The Brown Silty Clay and the Gray Silty Clay specimens tested at the site were found to be well-graded

Shear Strength A soil mass is a compressible matrix of solid particles and voids, partially or fully filled with moisture Both the upper stratum of brown silty clay and the lower stratum of gray silty clay exhibited very stiff to hard consistencies

Brown Silty Clay	3 0 to 4 5 kips/square foot
Gray Silty Clay	2 5 to 4 5 kips/square foot

Hydraulic Conductivity: A measure of how rapidly a permeant fluid can move through a porous soil matrix under a hydraulic gradient, also referred to as permeability Flow through clay soils has been found to obey Darcy's Law

Although the numerical value for hydraulic conductivity is often expressed in the dimensions of a velocity (cm/sec), the true dimensions are cm^3/cm^2-sec (i e volume per unit area per unit time) Darcy's Law assumes a direct proportionality between the hydraulic gradient and the flow rate

Brown Silty Clay	2.2×10^{-8} to 7.4×10^{-8} cm^3/cm^2-sec
Gray Silty Clay	1.3×10^{-8} to 6.5×10^{-8} cm^3/cm^2-sec

Transit Time Analysis

Although clay soils have low hydraulic conductivity, they are nonetheless a complex matrix of permeable porous media The purpose of transit time prediction is to determine both the rate of seepage with time, and the time it will take for leachate to seep through a clay barrier, under steady-state conditions

A key assumption in making the transit time prediction is that a vertical flow regime is sufficient to describe the leachate flow This assumption is appropriate because the ratio of the width of the clay barrier to its thickness is very large

The general form of the equation which is used to describe the vertical flow of fluid through a flow domain also includes parameters to account for retardation and axial dispersion The retardation factor is dependent on the attenuation capacity of the soil medium, and must be determined experimentally The axial dispersion coefficient consists of both hydrodynamic dispersion and molecular dispersion, and is very difficult to determine Conservatively, for the transit time analysis for the natural clay barrier underlying the ash basin, a retardation factor of unity (i e no attenuation) is assumed and the effect of diffusion or dispersion is neglected (i e. solute transport is by advection only)

The steady-state Darcian velocity and flux, assuming linear potential gradient, is given by

$$v = K * [(H/D) + 1]$$

where
- v = Darcian flux (cm^3/cm^2-sec)
- K = Saturated Hydraulic Conductivity
- H = Hydrostatic Head
- D = Thickness of Clay Barrier

A migratory downward flow from the On-Site Ash Basin must overcome the "head" of the artesian water in order to reach the underlying aquifer For this analysis, "H" is taken as the difference between the water level in the basin, Elevation 610 feet, and the level of Lake Erie, Elevation 568 feet, or 42 feet This is a conservative assumption because the soil borings drilled down to bedrock prior to the construction of the ash basin recorded levels of artesian water of 5 to 20 feet above grade, and therefore higher than the level of Lake Erie

Although the basin was uniformly excavated to Elevation 562 feet, the thickness "D" of the natural clay barrier underlying the basin varies because of the variability of the bedrock surface Elevations of the bedrock surface as determined by soil test borings are presented in Exhibit E An elevation of 539 feet is selected as representative of the higher elevations of the bedrock surface underlying the site Therefore, "D", is taken as the difference between Elevation 562 feet and Elevation 539 feet, or 23 feet

Borings made within the limits of the ash basin indicated that the gray silty clay stratum typically began at about Elevation 562 feet, the same level as the bottom of the basin Therefore, the hydraulic conductivity parameter "K" is assumed as the upper value recorded during the testing of the samples of the gray silty clay, or $6\ 5 \times 10^{-8}$ cm/sec

Inserting the above parameters and solving the equation, the Darcian flux "v" is

$$v = (6\ 5 \times 10^{-8}) * [(23/42) + 1]$$

$$= \underline{1\ 0 \times 10^{-7}\ cm^3/cm^2\text{-sec}}$$

Because the clay barrier is assumed to be saturated for its full depth, the seepage flux is assumed to be established in the basin as soon as the impoundment head was established Therefore, the time taken by the leachate to migrate downward through the natural clay barrier under steady-state conditions is given by

$$t = [(1 - \phi) * D] / v$$

where t = Transit Time
ϕ = Porosity of Clay Barrier

The porosity of the gray silty clay varied between 19% and 28 5 % An average value of 24 % is assumed for this analysis

Therefore, the transit time for leachate to migrate downward through the natural clay barrier under steady-state conditions is

$$t = [(1 - 0\ 24) * (42 * 12 * 2\ 54)] / (1\ 0 \times 10^{-7})$$

$$= 9\ 7 \times 10^{9}\ sec$$

$$= \underline{308\ years}$$

The above-described formula can be re-arranged and solved to determine the minimum thickness of a clay liner needed to inhibit the migratory flow of leachate for a certain time period For a period of 75 years, and using the above-listed values of "K", "v", "H", and "ϕ" , the following minimum thickness is determined

$$D_{min} = [75 * (365 * 24 * 60 * 60)] * 1\ 0 \times 10^{-7} / 0\ 76$$

$$= 311\ cm$$

$$= \underline{10\ 2\ feet}$$

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EXHIBIT A

SITE MAP

AND

SOIL BORING LOCATION PLAN

ON-SITE ASH DISPOSAL BASIN

MONROE POWER PLANT

Reports\TR242 ACE
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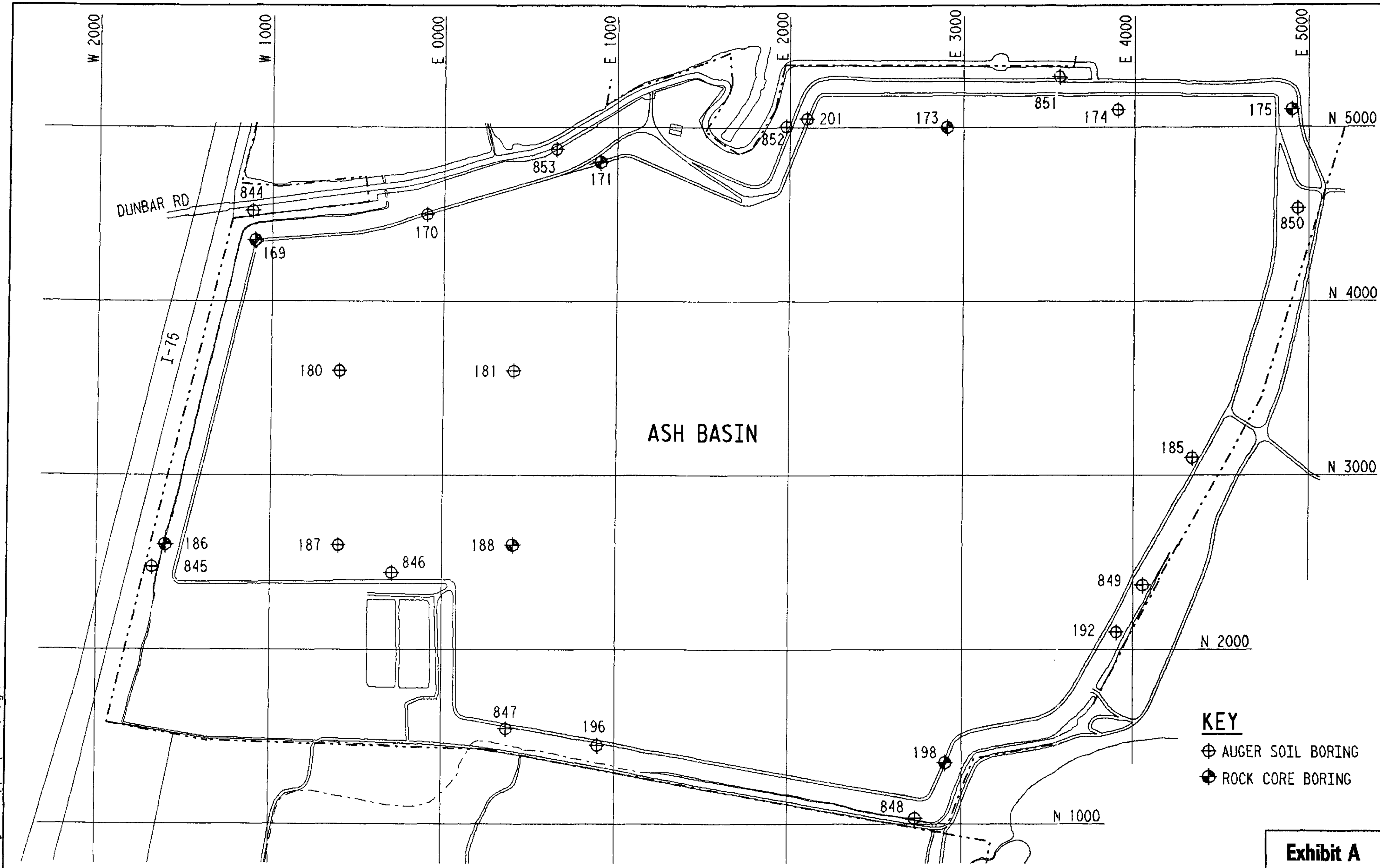

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Exhibit A

EXHIBIT C

1995 SOIL BORING LOGS

PREPARED BY

SOIL AND MATERIAL ENGINEERS INC

ON-SITE ASH DISPOSAL BASIN

MONROE POWER PLANT

Reports\TR242 ACE
031595 1007

soil and materials engineers, inc.

MON 844

JOB NAME.	VERIFICATION OF SOIL BARRIER	A/E:	
JOB LOCATION	MONROE, MICHIGAN	BY SDN DATE 9/12/94	BORING TB1
OWNER:	DETROIT EDISON	JOB NUMBER: PG22087	SHEET 1

DRILLER: JH RIG: 26

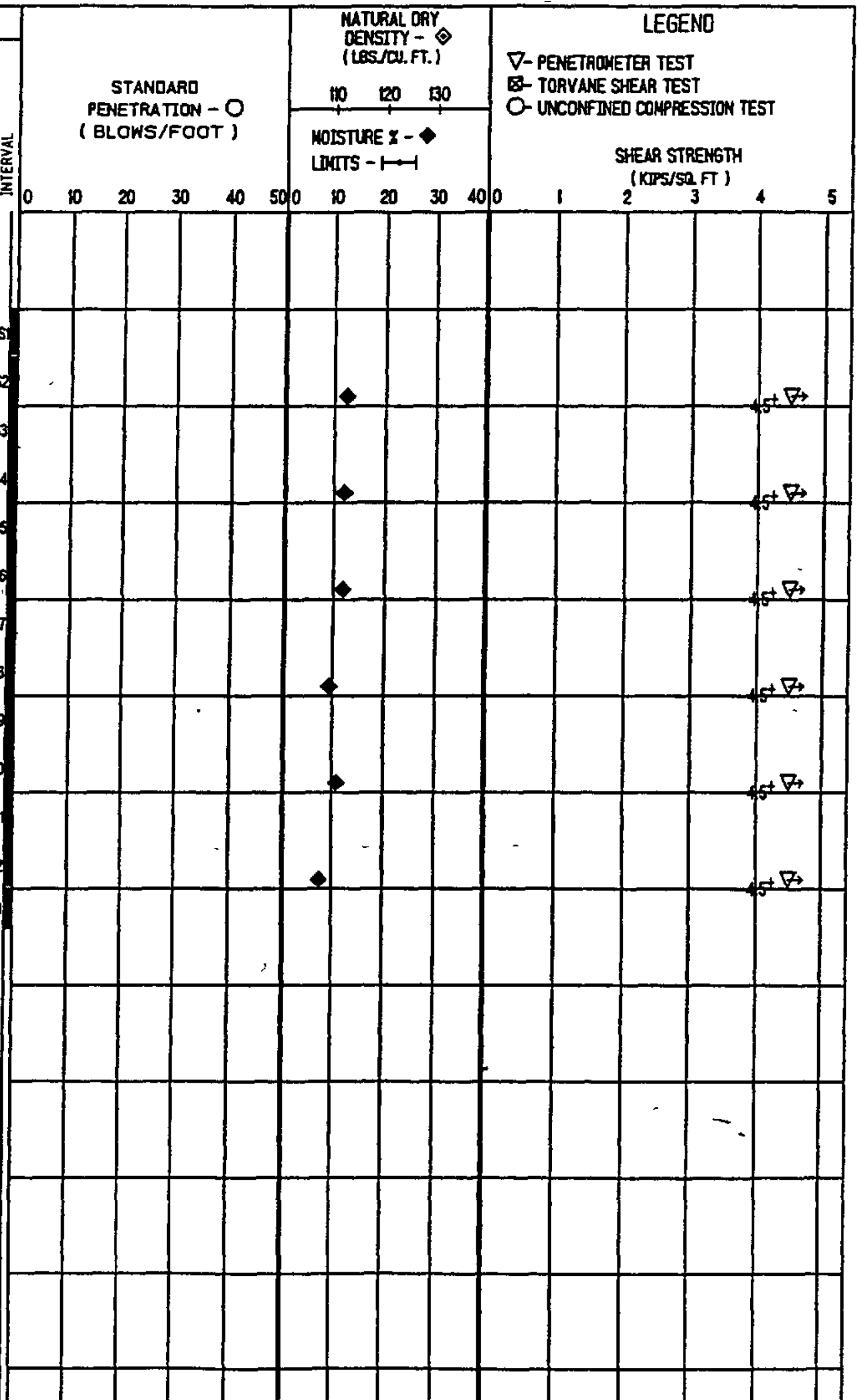
ELEVATION (FEET) | SYMBOLIC PROFILE | PROFILE DESCRIPTION | SAMPLE TYPE, NUMBER & INTERVAL

GROUND SURFACE ELEVATION = 577

Elevation (ft)	Profile Description	Samples
577–572	Silty Clay Fill-Trace Sand, Gravel and Topsoil-Brown-Hard (CL-Fill)	CS1, CS2
572–561	Silty Clay-Some Sand-Trace Gravel-with Occasional Silt & Sand Seams & Layers-Mottled Brown-Hard (CL)	CS3, CS4, CS5, CS6
561–556	Silty Clay-Some Sand-Trace Gravel-Gray-Hard (CL)	CS7, CS8
556–544.5	Silty Clay-Trace Sand & Gravel-with Fine Sand Layer from 24 to 25 feet-Gray-Hard (CL)	CS9, CS10, CS11, CS12
544.5–543	Driller reported 1.5 feet of layered Shale & Limestone	CS13

Notes:

1. Soil boring location 4519.60 North and -1114.24 East.
2. End of boring at 24 feet (elevation 543 feet).
3. Groundwater was not observed after completion of the drilling operations.



WATER LEVEL OBSERVATIONS

▼ GROUNDWATER ENCOUNTERED DURING DRILLING

NOTES

1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. BORING BACKFILLED WITH NATURAL SOILS UNLESS OTHERWISE NOTED.

soil and materials engineers, inc.

MON 845

JOB NAME: VERIFICATION OF SOIL BARRIER
JOB LOCATION: MONROE, MICHIGAN
OWNER: DETROIT EDISON

A/E.
BY. SDN DATE 9/20/94
JOB NUMBER: PG22087

BORING TB2
SHEET 1

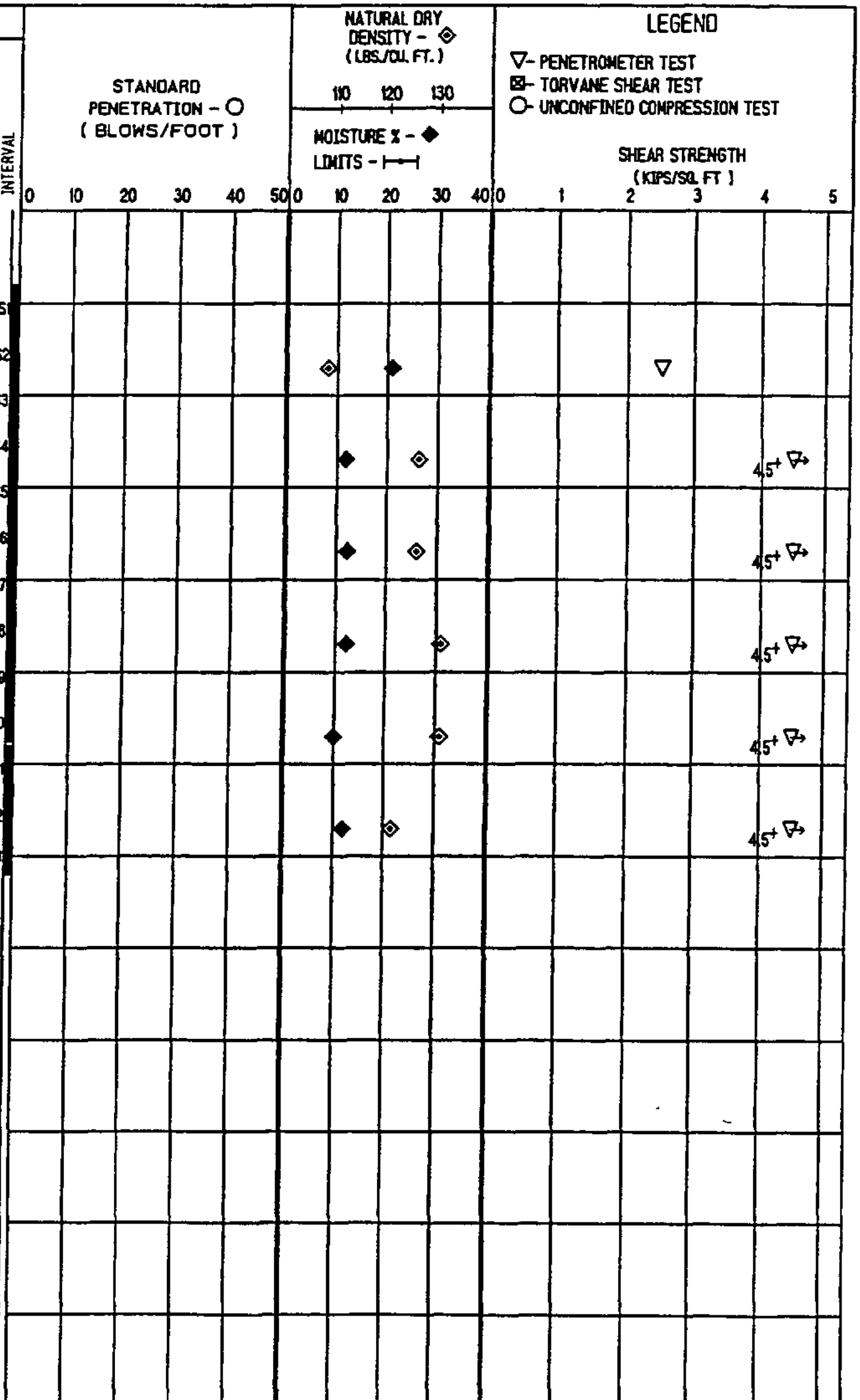
DRILLER: JH | RIG 26

ELEVATION (FEET) | SYMBOLIC PROFILE | PROFILE DESCRIPTION | SAMPLE TYPE, NUMBER & INTERVAL

GROUND SURFACE ELEVATION = 578

Elevation	Profile Description	Samples
578–570	Silty Clay Fill-Trace Sand, Gravel, Topsoil and Brick Pieces- Brown-Hard to Very Stiff (CL-Fill)	CS1, CS2
570–567	Silty Clay-Some Sand-Trace Gravel-Brown-Hard (CL)	CS3, CS4
567–546	Silty Clay-Some Sand-Trace Gravel-Gray-Hard (CL)	CS5, CS6, CS7, CS8, CS9, CS10, CS11, CS12
546–545	Limestone	CS13

Elevation scale: 575, 570, 585, 580, 555, 550, 545, 540, 535, 530, 525, 520, 515



Notes:

1. Artesian water encountered at 32 feet (elevation 546 feet) Groundwater observed 1 foot above ground surface immediately after completion of drilling.
2. Soil boring location 2473.92 North and -1878 08 East.
3. End of boring at 33 feet (elevation 545 feet)

WATER LEVEL OBSERVATIONS

▼ GROUNDWATER ENCOUNTERED DURING DRILLING
▽ GROUNDWATER 0 HOURS AFTER DRILLING

NOTES.
1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. BORING BACKFILLED WITH NATURAL SOILS UNLESS OTHERWISE NOTED.

soil and materials engineers, inc.

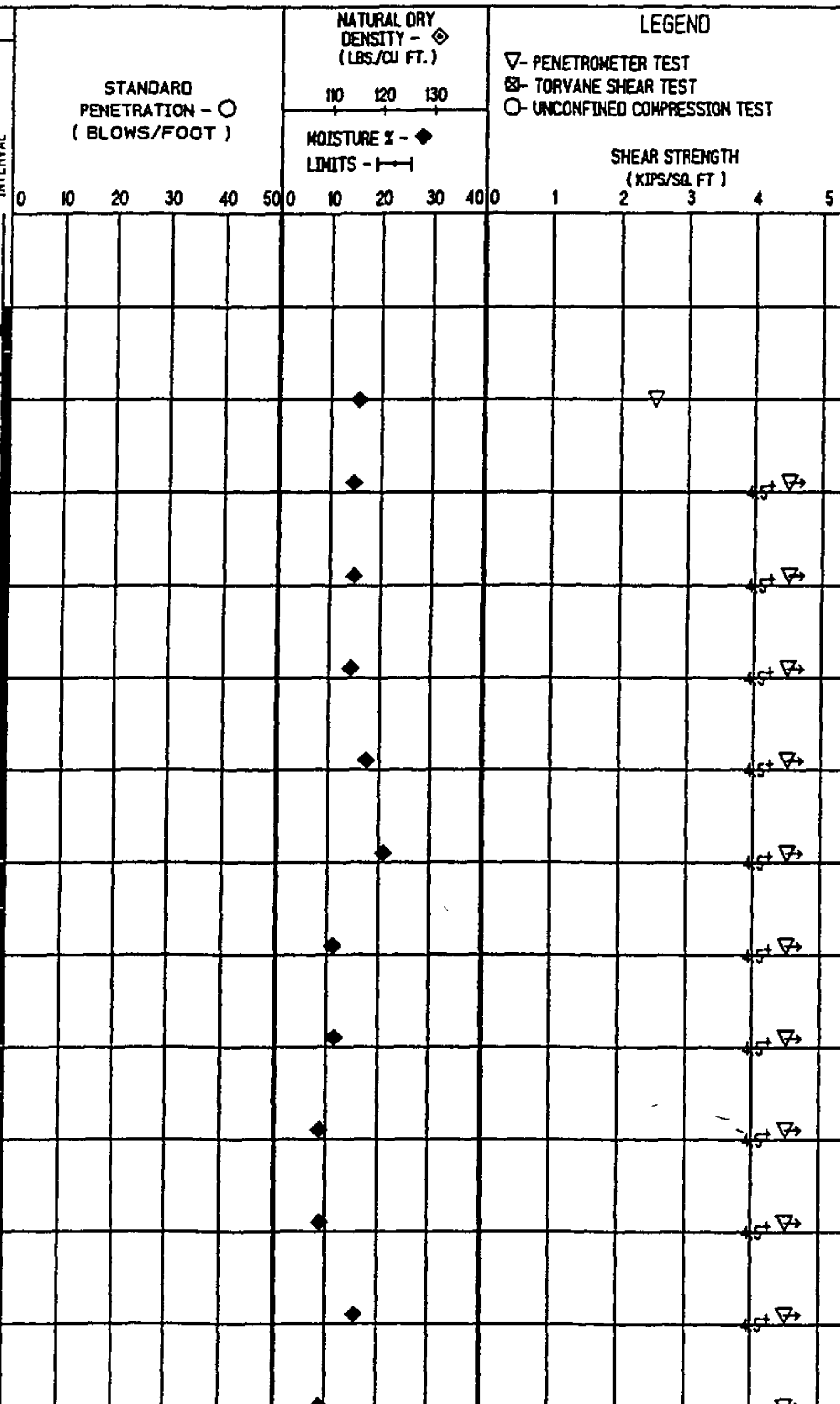
MON 846

JOB NAME. VERIFICATION OF SOIL BARRIER
JOB LOCATION: MONROE, MICHIGAN
OWNER: DETROIT EDISON

A/E.
BY. SDN DATE 9/19/94 BORING TB3
JOB NUMBER: PG22087 SHEET 1

DRILLER: JH RIG 26

ELEVATION (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE, NUMBER & INTERVAL
	GROUND SURFACE ELEVATION = 602	
602–597	Silty Clay Fill-Trace Sand and Gravel-Brown and Gray-Very Stiff (CL-Fill)	CS1, CS2
597–567	Silty Clay-Some Sand-Trace Gravel-Brown-Hard (CL)	CS3, CS4, CS5, CS6, CS7, CS8, CS9, CS10, CS11, CS12, CS13
567–540	Silty Clay-Some Sand-Trace Gravel-Gray-with Hardpan Layer from 48 to 50 feet-Gray-Hard (CL)	CS14, CS15, CS16, CS17, CS18, CS19, CS20, CS21, CS22, CS23, CS24



WATER LEVEL OBSERVATIONS

▼ GROUNDWATER ENCOUNTERED DURING DRILLING
▽ GROUNDWATER 0 HOURS AFTER DRILLING

NOTES. 1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. BORING BACKFILLED WITH NATURAL SOILS ...

soil and materials engineers, inc.

JOB NAME. VERIFICATION OF SOIL BARRIER
JOB LOCATION: MONROE, MICHIGAN
OWNER: DETROIT EDISON

A/E.
BY: SDN DATE 9/19/94
JOB NUMBER: PG22087

BORING TB3
SHEET 2

DRILLER. JH — RIG 28

ELEVATION (FEET) | SYMBOLIC PROFILE | PROFILE DESCRIPTION | SAMPLE TYPE, NUMBER & INTERVAL | STANDARD PENETRATION – O (BLOWS/FOOT) 0 10 20 30 40 50 | NATURAL DRY DENSITY – ◇ (LBS./CU FT) 110 120 130; MOISTURE % – ◆; LIMITS – ├─•─┤ 0 10 20 30 40 | SHEAR STRENGTH (KIPS/SQ. FT) 0 1 2 3 4 5

LEGEND
▽– PENETROMETER TEST
⊠– TORVANE SHEAR TEST
O– UNCONFINED COMPRESSION TEST

GROUND SURFACE
ELEVATION = 602

Weathered Limestone — CS25

Notes

1. Soil boring location 244L20 North and -29L12 East.

2. End of boring at 63 feet (elevation 539 feet)

Elevation scale: 535, 530, 525, 520, 515, 510, 505, 500, 495, 490, 485, 480, 475

WATER LEVEL OBSERVATIONS

▼ GROUNDWATER ENCOUNTERED DURING DRILLING

NOTES 1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.

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MON 847

JOB NAME: VERIFICATION OF SOIL BARRIER
JOB LOCATION: MONROE, MICHIGAN
OWNER: DETROIT EDISON

A/E.
BY. SDN DATE 9/16/94
JOB NUMBER: PG22087

BORING TB4
SHEET 1

DRILLER: JH RIG 26

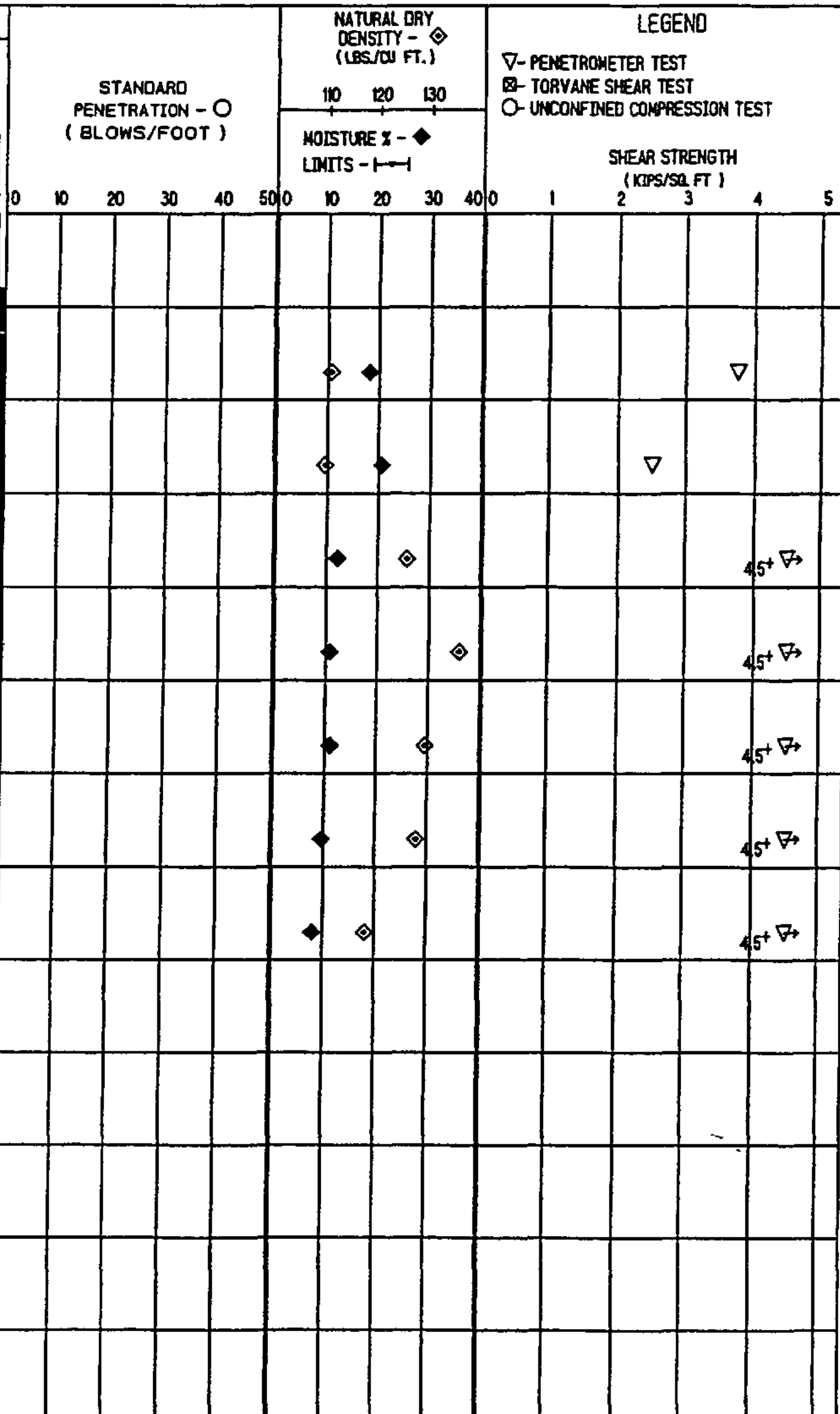
ELEVATION (FEET) | SYMBOLIC PROFILE | PROFILE DESCRIPTION | SAMPLE TYPE, NUMBER & INTERVAL

GROUND SURFACE ELEVATION = 578

Elevation (feet)	Profile Description	Samples
578–566	Silty Clay Fill-Trace to Some Sand, Trace of Gravel, Topsoil and Roots -Brown-Hard to Very Stiff (CL-Fill)	CS1, CS2, CS3, CS4
566–561	Silty Clay-Some Sand-Trace Gravel-Mottled Brown-Hard (CL)	CS5, CS6
561–548	Silty Clay-Some Sand-Trace Gravel-Gray-Hard (CL)	CS7, CS8, CS9, CS10, CS11
548–541	Silty Clay-Trace to Some Sand-Trace Gravel-Gray-Hard (CL)	CS12, CS13, CS14
541–540	Driller reported 1 foot of Limestone	

Notes:

1. Soil boring location 1544.94 North and 368.61 East.
2. Artesian water encountered at 37 feet (elevation 541 feet).
3. End of boring at 38 feet (elevation 540 feet)



WATER LEVEL OBSERVATIONS

GROUNDWATER ENCOUNTERED DURING DRILLING

NOTES
1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. BORING BACKFILLED WITH NATURAL SOILS UNLESS OTHERWISE NOTED.

soil and materials engineers, inc.

MON 848

JOB NAME.	VERIFICATION OF SOIL BARRIER	A/E.	
JOB LOCATION:	MONROE, MICHIGAN	BY: SDN DATE 9/15/94	BORING TB5
OWNER:	DETROIT EDISON	JOB NUMBER: PG22087	SHEET 1

DRILLER JH — RIG 28

ELEVATION (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE, NUMBER & INTERVAL
	GROUND SURFACE ELEVATION = 575	
575–568	Silty Clay Fill–Trace Gravel, Silt, Topsoil, Roots and Slag– Dark Gray–Very Stiff (CL–Fill)	CS1, CS2
568–561	Silty Clay–Some Sand–Trace Gravel–Mottled Brown–Very Stiff (CL)	CS3, CS4, CS5
561–535	Silty Clay–Some Sand–Trace Gravel–Gray–Very Stiff to Hard (CL)	CS6, CS7, CS8, CS9, CS10, CS11, CS12, CS13, CS14, CS15
535–528	Silty Clay–Some Sand–Trace of Gravel–Gray–Hard (CL)	CS16, CS17, CS18
528–525.5	Driller reported 2.5 feet of Limestone	CS19

Notes

1. Soil boring location 1032.95 North & 2728.92 East.

2. End of boring at 49.5 feet (elevation 525.5 feet)

STANDARD PENETRATION – ○ (BLOWS/FOOT) 0 10 20 30 40 50

NATURAL DRY DENSITY – ◇ (LBS./CU FT.) 110 120 130

MOISTURE % – ◆

LIMITS – ├─┤ 0 10 20 30 40

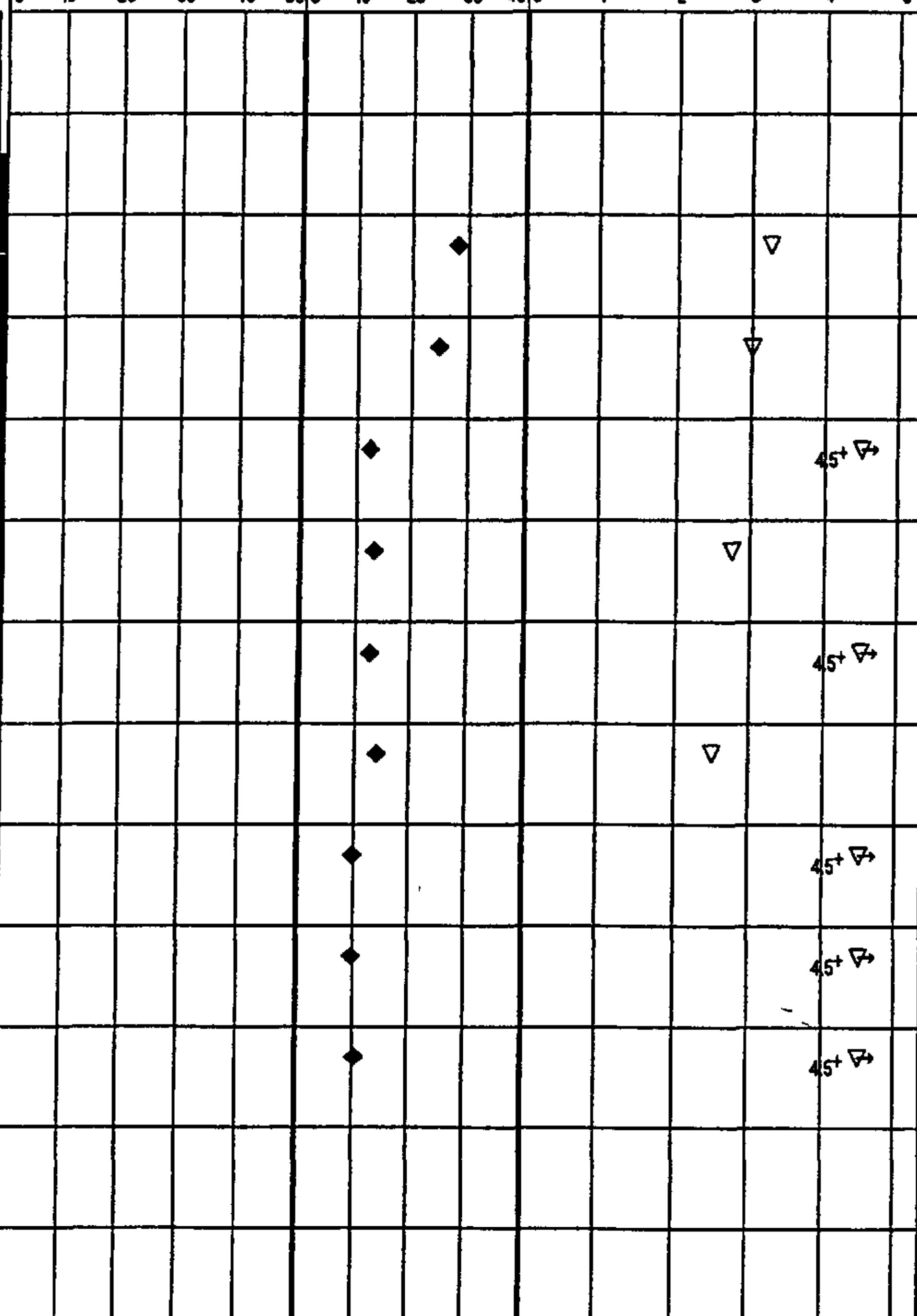
LEGEND

▽– PENETROMETER TEST

⊠– TORVANE SHEAR TEST

○– UNCONFINED COMPRESSION TEST

SHEAR STRENGTH (KIPS/SQ. FT.) 0 1 2 3 4 5



WATER LEVEL OBSERVATIONS

▼ GROUNDWATER ENCOUNTERED DURING DRILLING

▽ GROUNDWATER 0 HOURS AFTER DRILLING

NOTES

1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.

2. BORING BACKFILLED WITH NATURAL SOILS UNLESS OTHERWISE NOTED

soil and materials engineers, inc.

MON 849

JOB NAME: VERIFICATION OF SOIL BARRIER
JOB LOCATION: MONROE, MICHIGAN
OWNER: DETROIT EDISON

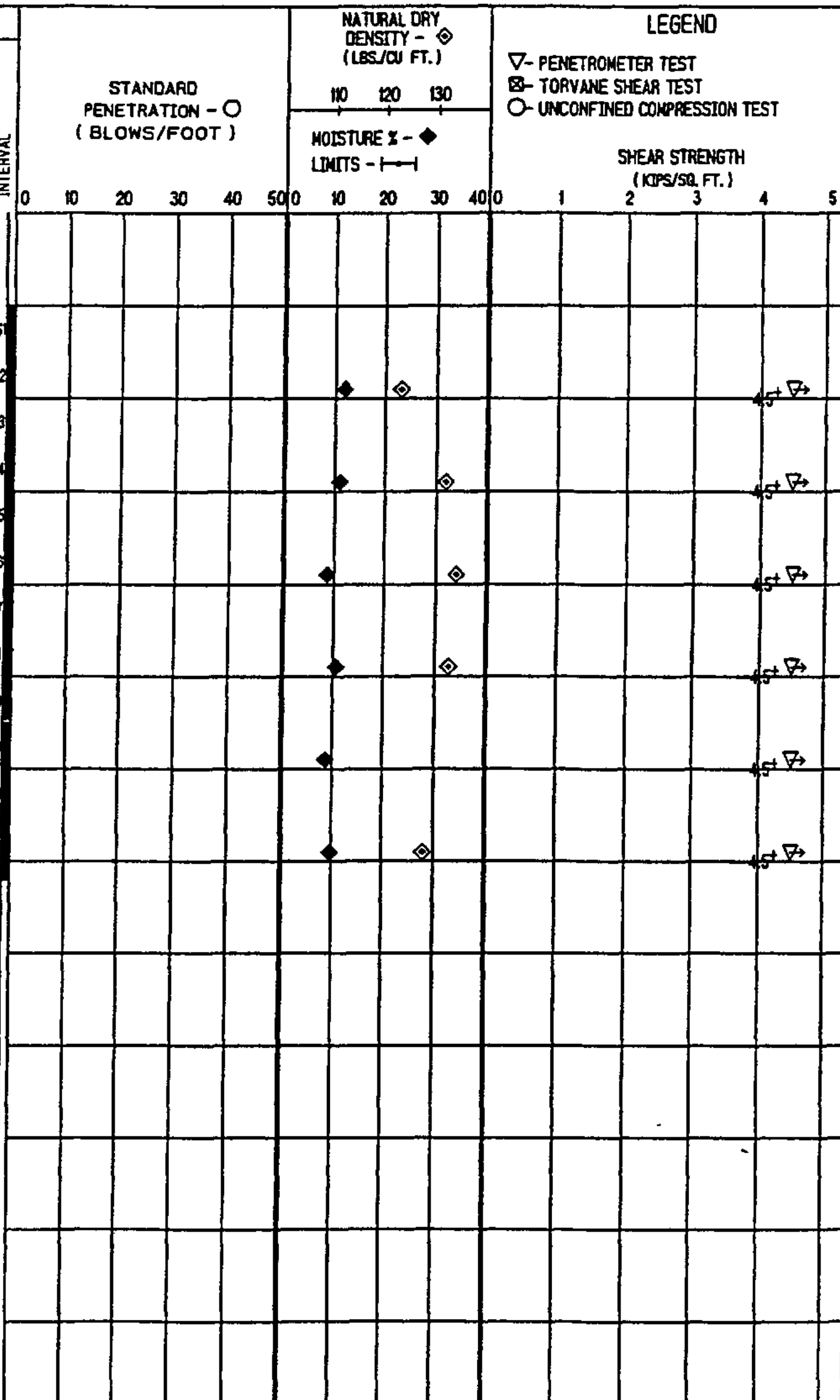
A/E
BY SDN DATE 9/14/94
JOB NUMBER: PG22087

BORING TB6
SHEET 1

DRILLER: JH RIG 28

GROUND SURFACE ELEVATION = 567

Elevation (feet)	Profile Description	Sample
567–566	Driller reported 1.0 feet of Bottom Ash (Fill)	CS1
566–559	Silty Clay-Some Sand-Trace Gravel-Brown-Hard (CL)	CS2, CS3
559–542	Silty Clay-Some Sand-Trace of Gravel-with Occasional Fine Sand Seams & Sand Layer from 22 to 23 feet-Gray-Hard (CL)	CS4, CS5, CS6, CS7, CS8, CS9
542–536	Silty Clay-Trace to Some Sand-Trace of Gravel-Gray-Hard (CL)	CS10, CS11, CS12
536–534	Driller reported 2 feet of Limestone	CS13



Notes.

1. Soil boring location 2389.89 North and 4053.28 East.
2. End of boring at 33 feet (elevation 534 feet).

WATER LEVEL OBSERVATIONS

▼ GROUNDWATER ENCOUNTERED DURING DRILLING
▽ GROUNDWATER 0 HOURS AFTER DRILLING

NOTES:
1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. BORING BACKFILLED WITH NATURAL SOILS UNLESS OTHERWISE NOTED.

soil and materials engineers, inc.

MON 850

JOB NAME: VERIFICATION OF SOIL BARRIER
JOB LOCATION: MONROE, MICHIGAN
OWNER: DETROIT EDISON

A/E.
BY. SDN DATE 9/13/94 BORING TB7
JOB NUMBER: PG22087 SHEET. 1

DRILLER: JH RIG: 26

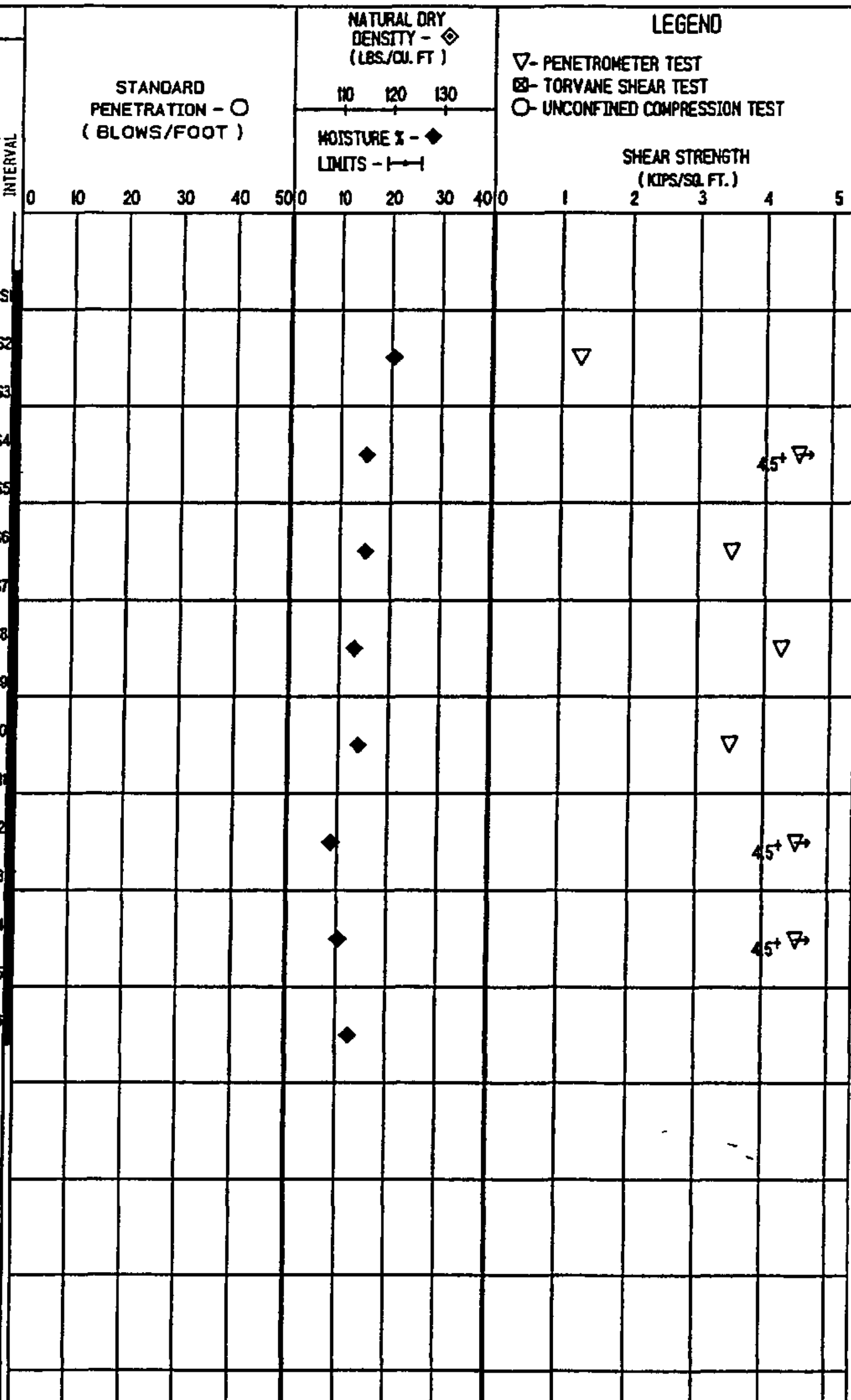
PROFILE DESCRIPTION

GROUND SURFACE ELEVATION = 574

Elevation (feet)	Profile Description	Sample Type, Number & Interval
	Driller reported 1.5 feet of Bottom Ash (Fill)	CS1
570	Silty Clay Fill-Trace Sand, Gravel, Topsoil & Roots-Brown-Stiff (CL-Fill)	CS2
565	Silty Clay-Some Sand-Trace Gravel-with Occasional Seams & Layers of Sand-Mottled Brown-Hard to Very Stiff (CL)	CS3, CS4, CS5, CS6
555–535	Silty Clay-Some Sand-Trace Gravel-with Occasional Layers of Hardpan-Gray-Very Stiff to Hard (CL)	CS7, CS8, CS9, CS10, CS11, CS12, CS13, CS14, CS15, CS16
	Driller reported 1 foot of fractured Shale	

Notes

1. Soil boring location 4532.59 North and 4935.74 East.
2. End of boring at 42 feet (elevation 532 feet)



WATER LEVEL OBSERVATIONS

▼ GROUNDWATER ENCOUNTERED DURING DRILLING
▽ GROUNDWATER 24 HOURS AFTER DRILLING

NOTES.
1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. BORING BACKFILLED WITH NATURAL SOILS UNLESS OTHERWISE NOTED.

soil and materials engineers, inc.

MON 851

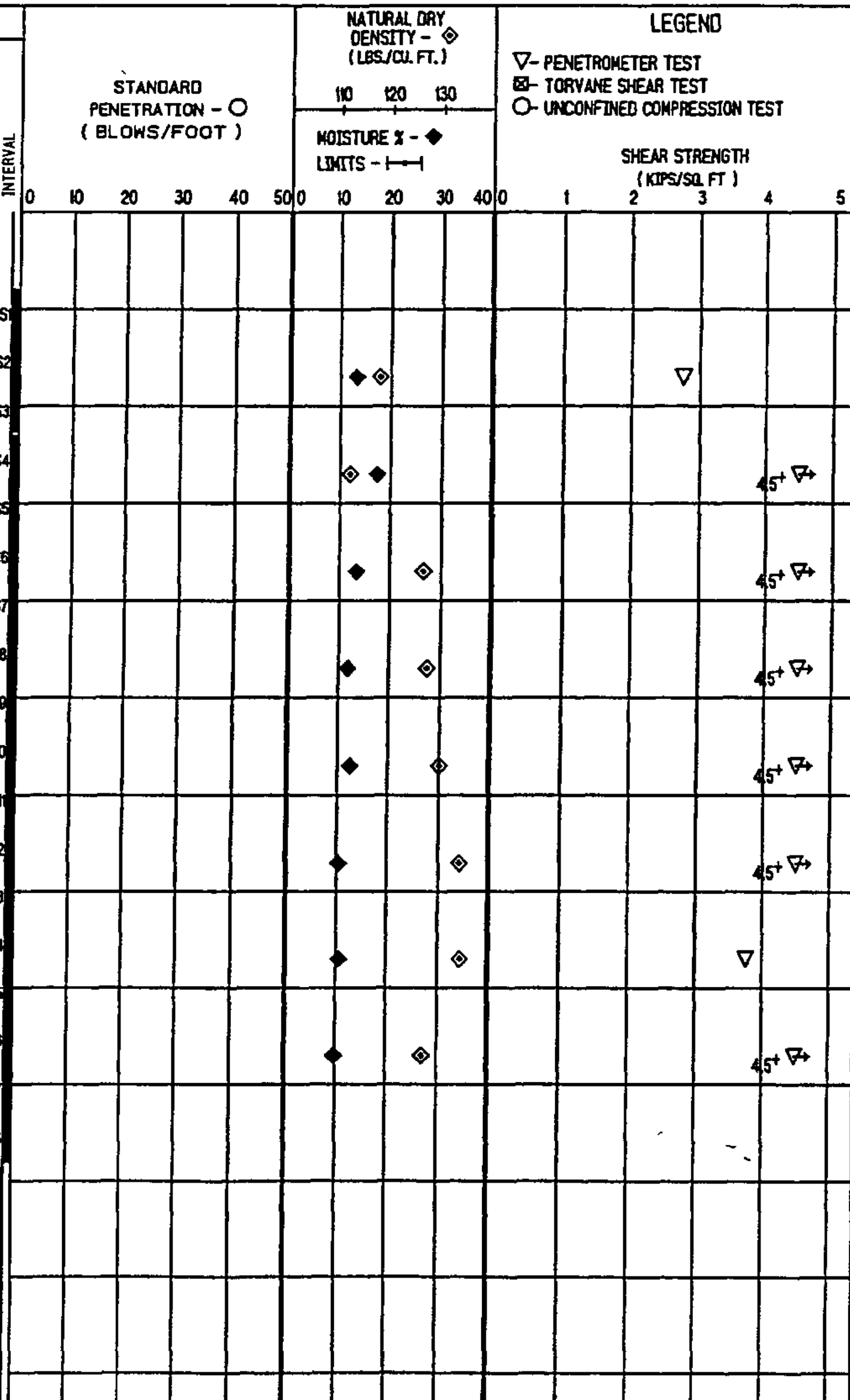
JOB NAME: VERIFICATION OF SOIL BARRIER
A/E:
JOB LOCATION: MONROE, MICHIGAN
BY: LMJ/SDN DATE: 9/13/94 BORING TB8
OWNER: DETROIT EDISON
JOB NUMBER: PG22087 SHEET: 1

DRILLER: JH RIG: 28

ELEVATION (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE, NUMBER & INTERVAL
	GROUND SURFACE ELEVATION = 578	
575 – 571	Silty Clay Fill–Trace Sand, Gravel and Brick–Brown–Very Stiff to Stiff (CL-Fill)	CS1, CS2
571 – 561	Silty Clay–Trace Sand and Gravel–with Occasional Sand Seams–Mottled Brown–Hard (CL)	CS3, CS4, CS5, CS6
561 – 548	Silty Clay–Some Sand–Trace of Gravel–with Occasional Sand Seams–Gray–Hard (CL)	CS7, CS8, CS9, CS10, CS11
548 – 537	Silty Clay–Some Sand–Trace of Gravel–with Occasional Silt Layers–Gray–Hard (CL)	CS12, CS13, CS14, CS15, CS16
537 – 532	Weathered Shale–with Occasional Silt & Sand Layers	CS17, CS18

Notes:

1. Soil boring location 5291.48 North and 3558.45 East.
2. End of boring at 46 feet (elevation 532 feet)



WATER LEVEL OBSERVATIONS

- ↧ GROUNDWATER ENCOUNTERED DURING DRILLING
- ↧ GROUNDWATER 0 HOURS AFTER DRILLING

NOTES:
1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. BORING BACKFILLED WITH NATURAL SOILS UNLESS OTHERWISE NOTED.

soil and materials engineers, inc.

MON 852

JOB NAME: VERIFICATION OF SOIL BARRIER
JOB LOCATION: MONROE, MICHIGAN
OWNER: DETROIT EDISON

A/E:
BY SDN DATE 9/12/94
JOB NUMBER: PG22087

BORING TB9
SHEET 1

DRILLER: JH | RIG 26

PROFILE DESCRIPTION

GROUND SURFACE ELEVATION = 579

ELEVATION (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE, NUMBER & INTERVAL	SHEAR STRENGTH (KIPS/SQ. FT)
579–574	Silty Clay Fill-Trace Sand, Gravel, Topsoil, Roots and Brick Pieces-Brown-Very Stiff (CL-Fill)	CS1, CS2	4.5+
574–563	Silty Clay-Some Sand-Trace Gravel-Brown-Hard (CL)	CS3, CS4, CS5, CS6	4.5+, 4.5+
563–557	Silty Clay-Some Sand-Trace Gravel-Gray-Hard (CL)	CS7, CS8	4.5+
557–551	Fine Sand-Trace to Some Silt-Trace Gravel-with Occasional Clay Layers-Gray-Wet-Medium Dense (SP)	CS9, CS10	
551–545	Driller reported 8 feet of Sandy Clay (Hardpan)-Trace to Some Gravel (CL)	CS11, CS12, CS13	
545–543.5	Driller reported 1.5 feet of Shale and Limestone		

STANDARD PENETRATION - ○ (BLOWS/FOOT): 0 10 20 30 40 50

NATURAL DRY DENSITY - ◇ (LBS/CU FT.): 110 120 130

MOISTURE % - ◆; LIMITS - ├─•─┤: 0 10 20 30 40

LEGEND
- ▽- PENETROMETER TEST
- ⊠- TORVANE SHEAR TEST
- ○- UNCONFINED COMPRESSION TEST

SHEAR STRENGTH (KIPS/SQ. FT): 0 1 2 3 4 5

Elevation scale: 575, 570, 565, 560, 555, 550, 545, 540, 535, 530, 525, 520, 515

Notes

1. Soil boring location 5004.06 North and 1977.59 East.
2. Installed PVC well at depth of 27 ft., (elevation 552 feet), backfilled with sand to 20 ft, placed 1 foot of bentonite & grouted to surface.
3. End of boring at 35.5 feet (elevation 543.5 feet)

WATER LEVEL OBSERVATIONS

- ▼ GROUNDWATER ENCOUNTERED DURING DRILLING
- ▽ GROUNDWATER 0 HOURS AFTER DRILLING

NOTES.
1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. BORING BACKFILLED WITH NATURAL SOILS UNLESS OTHERWISE NOTED.

soil and materials engineers, inc.

MON 853

JOB NAME: VERIFICATION OF SOIL BARRIER — A/E:
JOB LOCATION: MONROE, MICHIGAN — BY. SDN — DATE 9/9/94 — BORING TB10
OWNER: DETROIT EDISON — JOB NUMBER PG22087 — SHEET 1

DRILLER: JH — RIG: 28

ELEVATION (FEET)	PROFILE DESCRIPTION	SAMPLE TYPE, NUMBER & INTERVAL
	GROUND SURFACE ELEVATION = 578	
575	Driller reported 12 inches of Organic Topsoil-Black (Topsoil)	CS1
570	Silty Clay Fill-Trace to Some Sand, Trace of Gravel, Roots and Brick Pieces-Brown-Very Stiff to Stiff (CL-Fill)	CS2, CS3, CS4
565	Silty Clay-Trace Sand & Gravel-Mottled Brown-Hard (CL)	CS5, CS6
560	Silty Clay-Some Sand-Trace Gravel-Gray-Hard (CL)	CS7, CS8, CS9, CS10
550	Weathered Shale	CS11

Notes:

1. Soil boring location 4875.58 North & 840.68 East.
2. End of boring at 29 feet (elevation 549 feet)

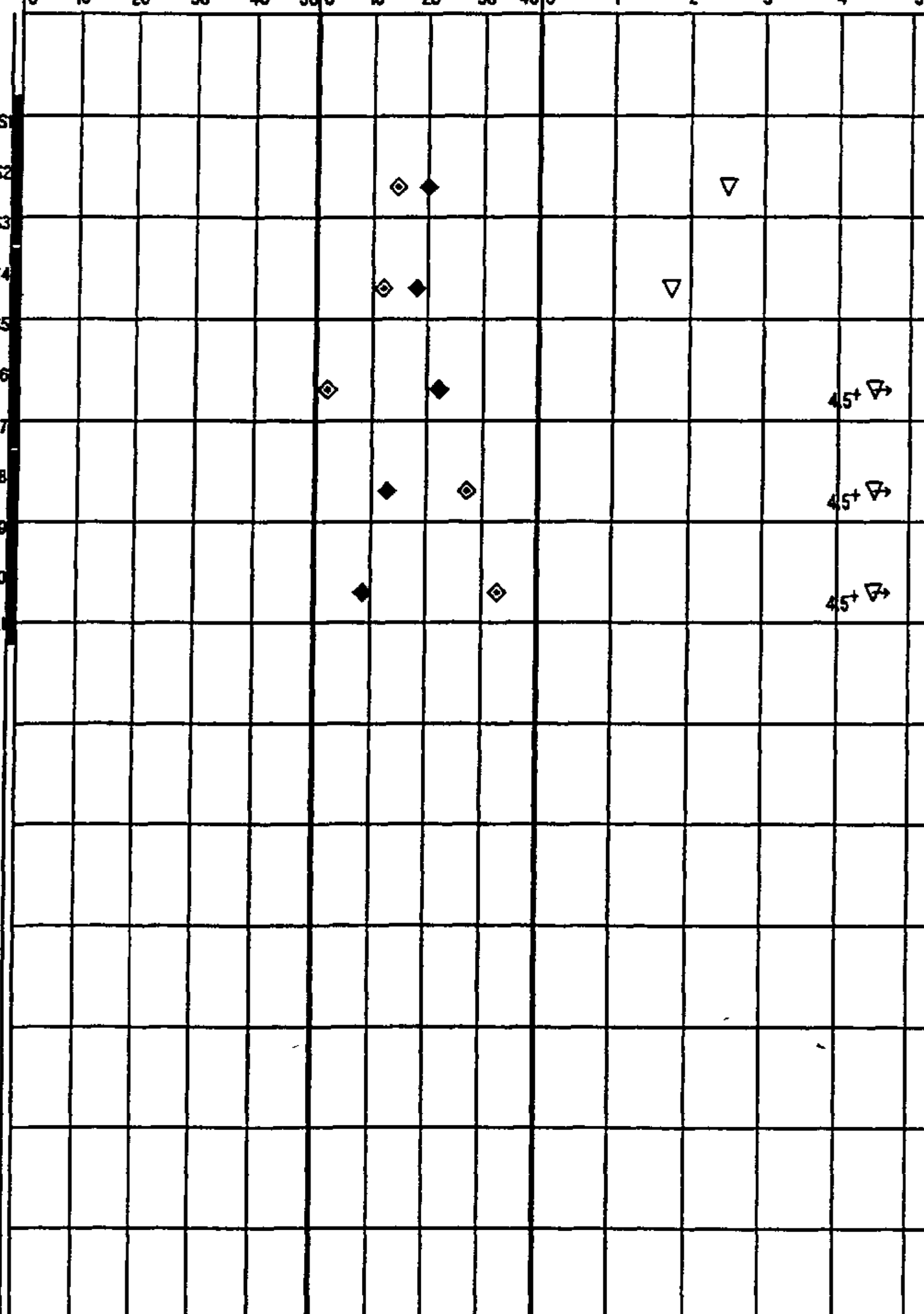
Elevation scale: 575, 570, 565, 560, 555, 550, 545, 540, 535, 530, 525, 520, 515

STANDARD PENETRATION – ○ (BLOWS/FOOT): 0 10 20 30 40 50

NATURAL DRY DENSITY – ◇ (LBS./CU FT.): 110 120 130
MOISTURE % – ◆
LIMITS – ├─┤
0 10 20 30 40

LEGEND
▽– PENETROMETER TEST
⊠– TORVANE SHEAR TEST
○– UNCONFINED COMPRESSION TEST

SHEAR STRENGTH (KIPS/SQ. FT.): 0 1 2 3 4 5



WATER LEVEL OBSERVATIONS

▼ GROUNDWATER ENCOUNTERED DURING DRILLING

NOTES. 1. THE INDICATED STRATIFICATION LINES ARE APPROXIMATE IN SITU, THE TRANSITION BETWEEN MATERIALS MAY BE GRADUAL.
2. BORING BACKFILLED WITH NATURAL SOILS UNLESS OTHERWISE NOTED.

EXHIBIT D

ENGINEERING PROPERTIES OF CLAY SOILS

UNDERLYING THE

ON-SITE ASH DISPOSAL BASIN

MONROE POWER PLANT

Reports\TR242 ACE
031595 1007

LABORATORY TEST RESULTS
VERIFICATION OF NATURAL SOIL BARRIER - MONROE ASH BASIN
SME PROJECT NO. PG-22087

BORING NO.	SAMPLE NO.	DEPTH (feet)	CLASSIFICATION SYMBOL	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	SPECIFIC GRAVITY	VOID RATIO (calculated)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	PARTICLE SIZE DISTRIBUTION (%): GRAVEL	PARTICLE SIZE DISTRIBUTION (%): COARSE SAND	PARTICLE SIZE DISTRIBUTION (%): MEDIUM SAND	PARTICLE SIZE DISTRIBUTION (%): FINE SAND	PARTICLE SIZE DISTRIBUTION (%): SILT	PARTICLE SIZE DISTRIBUTION (%): CLAY	COEFFICIENT OF PERMEABILITY (cm/sec)
B2	CS2	6.5	CL	21	108	2.73	0.58	42	17	25	0	0	2	5	36	57	3.3E-08
B2	CS4	11.5	CL	12	126	2.68	0.33	23	15	8	0	0	8	18	39	35	5.8E-08
B2	CS6	16.5	CL	12	126	2.72	0.35	23	14	9	0	0	8	16	40	36	1.3E-08
B2	CS8	21.5	CL	12	127	2.72	0.34	24	13	11	0	0	8	17	38	37	1.5E-08
B2	CS10	26.5	CL	10	131	2.75	0.31	20	11	9	0	0	9	24	34	33	2.0E-08
B2	CS12	31.5	CL	12	122	2.73	0.40	32	15	17	0	0	5	9	39	47	2.0E-08
B4	CS2	6.5	CL	18	111	2.73	0.53	45	19	26	0	0	2	8	37	53	6.6E-08
B4	CS4	11.5	CL	21	109	2.73	0.56	43	17	26	0	0	3	11	36	50	2.1E-08
B4	CS6	16.5	CL	12	126	2.71	0.34	24	13	11	0	0	8	17	41	34	4.7E-08
B4	CS8	21.5	CL	11	136	2.70	0.24	23	13	10	0	0	8	18	37	37	2.1E-08
B4	CS10	26.5	CL	11	130	2.73	0.31	23	14	9	0	0	8	17	38	37	3.0E-08
B4	CS12	31.5	CL	10	128	2.71	0.32	25	14	11	0	0	4	11	44	41	1.8E-08
B4	CS14	36.5	CL	8	118	2.73	0.44	24	13	11	0	0	13	23	44	20	*
B6	CS2	6.5	CL	12	123	2.70	0.37	27	15	12	0	0	8	17	39	36	7.4E-08
B6	CS4	11.5	CL	11	132	2.72	0.29	23	13	10	0	0	8	17	39	36	1.8E-08
B6	CS6	16.5	CL	8	134	2.72	0.27	21	12	9	0	0	7	22	38	33	4.0E-08
B6	CS8	21.5	CL	11	133	2.75	0.29	21	12	9	0	0	7	21	37	35	6.5E-08
B6	CS10	26.5	CL	9	125	2.71	0.35	26	14	12	0	0	5	13	39	43	*
B6	CS12	31.5	CL	10	128	2.74	0.34	26	15	11	0	0	11	17	33	39	*
B8	CS2	6.5	CL	13	118	2.73	0.44	41	15	26	0	0	3	12	35	50	1.5E-08
B8	CS4	11.5	CL	17	112	2.73	0.52	34	17	17	0	0	7	17	38	38	2.2E-08
B8	CS6	16.5	CL	13	127	2.73	0.34	26	15	11	0	0	9	19	38	34	4.8E-08
B8	CS8	21.5	CL	12	129	2.74	0.33	24	14	10	0	0	8	17	40	35	1.6E-08
B8	CS10	26.5	CL	13	130	2.76	0.32	25	14	11	0	0	7	18	36	39	1.7E-08
B8	CS12	31.5	CL	10	134	2.73	0.27	20	11	9	0	0	10	24	41	25	4.7E-08
B8	CS14	36.5	CL	11	135	2.75	0.27	23	12	11	0	0	11	24	31	34	3.8E-08
B8	CS16	41.5	CL	10	127	2.78	0.37	23	13	10	0	0	15	19	46	20	1.9E-07

LABORATORY TEST RESULTS
VERIFICATION OF NATURAL SOIL BARRIER - MONROE ASH BASIN
SME PROJECT NO. PG-22087

BORING NO.	SAMPLE NO.	DEPTH (feet)	CLASSIFICATION SYMBOL	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	SPECIFIC GRAVITY	VOID RATIO (calculated)	ATTERBERG LIMITS			PARTICLE SIZE DISTRIBUTION (%)						COEFFICIENT OF PERMEABILITY (cm/sec)
								LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	SILT	CLAY	
B10	CS2	6.5	CL	20	114	2.72	0.49	40	15	25	0	0	3	13	35	49	3.6E-08
B10	CS4	11.5	CL	18	112	2.75	0.53	35	15	20	0	0	2	9	39	50	1.2E-08
B10	CS6	16.5	CL	22	102	2.74	0.68	36	17	19	0	0	1	2	37	60	3.3E-08
B10	CS8	21.5	CL	13	127	2.71	0.33	25	14	11	0	0	8	17	37	38	3.7E-08
B10	CS10	26.5	CL	10	133	2.74	0.29	23	14	9	0	0	7	17	39	37	1.5E-08

NOTE:
* Sample too small or disturbed to run test.

EXHIBIT E

ELEVATIONS OF TOP OF BEDROCK

ON-SITE ASH DISPOSAL BASIN

MONROE POWER PLANT

Boring Number Elevation Recorded

MON-169	Elevation 531 0 feet
MON-171	Elevation 539 0 feet
MON-173	Elevation 529 4 feet
MON-175	Elevation 526 6 feet
MON-183	Elevation 531 2 feet
MON-185	Elevation 528 3 feet
MON-186	Elevation 524 7 feet
MON-188	Elevation 532 4 feet
MON-196	Elevation 524 9 feet
MON-198	Elevation 539 5 feet

NOTE Refer to Exhibit A for the location of the above-listed soil borings

Appendix L
Documentation of Design Specifications
Documentation of Source Material and Construction Quality, Geosyntec, November 2020

Geosyntec consultants

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Memorandum

Date:	November 24, 2020
To:	Chris Scieszka, DTE Electric Company (DTE)
Copies to:	Robert Lee, DTE
From:	Omer Bozok, P.E. and Rachel Thompson, P.E., Geosyntec Consultants of Michigan (Geosyntec)
Subject:	Alternate Liner Demonstration Application Support for DTE Monroe Power Plant Fly Ash Basin in Monroe, MI Documentation of Source Material and Construction Quality

INTRODUCTION

This memorandum was prepared by Geosyntec Consultants of Michigan, Inc. (Geosyntec) for the DTE Electric Company (DTE) in support of the Alternate Liner Demonstration (ALD) application for the Monroe Power Plant (MONPP) Fly Ash Basin (FAB) embankment in Monroe, MI. Specifically, it provides the documentation of source material and construction quality for the engineered FAB embankment in accordance with 40 Code of Federal Regulations (CFR) §257.71(d)(1)(i)(C). Per the Rule, "…*facilities are required to provide documentation of the design specifications for any engineered liner components (e.g., manufactured geomembrane, mechanically compacted soil), as well as all data and analyses the facility relied on when determining that the materials are suitable for use and that the construction of the liner is of good quality and in line with proven and accepted engineering practices.*"

Purpose

The purpose of this memorandum is to document the original construction and restoration activities for the FAB embankment to fulfill the requirements of 40 CFR §257.71(d)(1)(i)(C) for the FAB ALD application. This memorandum demonstrates the following:

- The source material is suitable for use as a compacted low permeability liner; and

- The construction quality is good and in-line with proven and accepted engineering practices.

Site Location

The FAB is located about one mile southwest of the MONPP near Monroe, Michigan and covers an area of approximately 410 acres. The FAB perimeter is comprised of a clay fill embankment, approximately 3.5-miles long. Fly ash (ash) is sluiced from MONPP to the FAB using four, above grade, steel pipelines from the Plant to the FAB that feed into polyethylene pipes to distribute sluiced ash.

The FAB is bounded on the east by Lake Erie and the MONPP discharge canal, on the west by Interstate Highway 75 (I-75), on the south by an agricultural field, and on the north by residential property and Plum Creek. The FAB overview is provided in **Figure 1**.

Construction History

The embankment was constructed between 1973 and 1974 using existing onsite low plasticity clay excavated from within the FAB footprint. The embankment clay was excavated from the upper 10 ft below ground surface (bgs) such that sufficient soil material remained in-place to resist uplift pressures from existing artesian groundwater conditions (DTE, 1977). The bottom of the FAB is at approximately El. 563 ft[1].

The original embankment crest elevation is at approximately El. 615 ft and was constructed with 2 horizontal to 1 vertical (2H:1V) interior and exterior side slopes. Compacted clay was specified for the embankment as discussed in the following sections.

During the service life of the ash basin surface sloughs were observed at several locations caused by reduction of shear strength of the near surface soils (upper 2 to 3 ft bgs) from infiltration of surface water and seasonal freeze-thaw cycles. To address surficial sloughs, and to increase global factor of safety for slope stabilization, 88 percent of the perimeter embankment was restored; of which 94 percent of the slopes were flattened from approximately 2H:1V to between 2.3H:1V to 3H:1V. The extent of restored slopes are provided in **Figure 1**. Geosyntec designed and provided construction quality assurance (CQA) services for construction activities at the embankment between 2009 and 2019. **Figure 2** provides a cross section schematic across the FAB.

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[1] Elevations in this report are referenced to the National Geodetic Vertical Datum of 1929 (NGVD29), unless otherwise noted. NGVD29 is 1.5 ft higher than the local MONPP datum.

Regulatory Background

The FAB is regulated as an existing coal combustion residual (CCR) surface impoundment in accordance with 40 CFR § 257 published on April 17, 2015, and as amended on July 30, 2018 and October 15, 2020 (CCR Rule) and is a licensed coal ash landfill in accordance with Michigan Part 115 solid waste regulations. The embankment is an engineered structure and considered to be an engineered bottom (side portion) liner per the CCR Rule.

ORIGINAL EMBANKMENT CONSTRUCTION

Documentation of Source Material

Pre-Construction Investigation

A pre-design geotechnical investigation was performed by Soil and Foundations Associates (SAFA) of Southfield, MI between 1970 and 1971. The boring logs and laboratory test results from this investigation were reviewed by Geosyntec. In general, the overburden was measured to be 40 to 50-ft thick and generally consists of three stratigraphic units:

- Topsoil material in the upper 1 to 2 ft;
- Soft to medium stiff lean clay (approximately 10 ft thick);
- Stiff to very stiff lean clay (approximately 15-ft thick)
- Hard silty clay down to bedrock (approximately 20-ft thick).

The following laboratory tests were performed for disturbed samples collected from the pre-construction investigation:

- Moisture content;
- Determination of maximum dry unit weight and optimum moisture content using modified Proctor (ASTM D1557);
- Atterberg limits; and
- Particle size distribution.

Laboratory results from this investigation are summarized in **Table 1**.

In general, the soils in the upper 10 ft bgs that were used to construct the embankment were classified as silty clay (CL-ML) to lean clay (CL) in accordance with the Unified Soil Classification System (USCS). The fines content (by dry weight) of the samples ranged from about 70 to 90 percent (%) with clay content (i.e., particle diameter less than 0.005 mm) of between 34% and 55%. The measured liquid limits of the samples ranged from 22 to 38 with a mean value of 29. The plasticity indices ranged from 8 to 20 with a mean value of 12.

The measured maximum dry unit weight from the modified Proctor tests ranged from about 120 to 133 pounds per cubic foot (pcf) with a mean value of 126 pcf. The optimum moisture content ranged from 9% to 13% with a mean value of 10.9%. The mean natural moisture content of the samples was 13.2%.

Construction Materials

Laboratory testing of embankment material was performed by SAFA during construction in 1973 and 1974, as conformance testing. The same suite of laboratory testing was performed as for the pre-construction investigation except that Atterberg limits and particle size were not measured for all samples. The test results are summarized in **Table 2**.

Review of Original Construction Specifications

The construction specifications for the original FAB embankment construction are included in DTE, (1977). The following requirements from the specifications indicate that the design of the embankment was prepared in accordance with generally accepted engineering principles and practice for clay embankments.

Inspection

All work for the embankment construction was specified to be performed under the inspection and to the satisfaction of DTE and/or it's designated Engineer.

Embankment Material

The material specifications for the FAB embankment clay fill were as follows:

- Maximum dry unit weight of at least 112 pcf per ASTM D1557;
- Liquid limit of 25% or greater per ASTM D4318; and
- Soil fraction finer than 0.005 mm, by dry weight, of 35% or greater.

Materials that were unsuitable as embankment fill were specified to be removed from the excavation and embankment areas and disposed of in designated onsite areas. Unsuitable materials included marl, sand and gravel, construction debris, rubble, rubbish, organic material, vegetation, and surplus topsoil.

Subgrade Preparation

The exposed horizontal surface to be used as the embankment subgrade was specified to meet the compaction requirements for the embankment material to a depth of two (2) ft bgs. In areas where unsuitable embankment material was encountered at the proposed embankment base, the material was required to be undercut along the full width of the embankment. The areas to be undercut were delineated in the field by the Engineer as excavation proceeded.

In areas where an undercut was not performed, a foundation key was specified with a width of 16 ft and a depth as established in the field by the Engineer as excavation proceeded.

Material Placement and Compaction

The material used for embankment construction was specified to be placed in horizontal lifts with loose thicknesses between 12 and 18 inches. The Contractor was required to demonstrate that the compaction specifications would be consistently met using the selected lift thickness.

Embankment material was specified to be compacted to at least 95% of the maximum dry unit weight at a moisture content within +1% to -2% of the optimum moisture content as determined by ASTM D1557. The material was specified to be moisture conditioned, as required to meet the specification, prior to compaction. Each lift was required to be uniformly compacted prior to the placement of subsequent lifts.

The specified compaction equipment was sheepsfoot rollers, either static or vibratory, providing foot pressures of at least 700 pounds per square inch (psi). Smooth-surface compaction equipment was only allowed to seal off the fill surface from moisture.

Vegetation

Topsoil from onsite was stockpiled during excavation and reused for stabilization at the embankment crest and exterior side slopes (except in areas that received gravel roadbed). Topsoil thickness was specified to be three inches. Seed, mulch, and fertilizer were also specified in areas that received topsoil.

Documentation of Construction Quality

Construction Observations

During construction, compaction requirements were reported to have been achieved by compacting material in 10-inch thick loose lifts using 8 passes of a "Hyster tamping foot compactor, moving 10 miles per hour," (DTE, 1977).

Marl material was encountered in some areas and was deemed unsuitable for subgrade or embankment material. Generally, where it was in juxtaposition with the embankment foundation, the marl was removed and disposed. However, thicker marl was encountered at the proposed southwest corner of the FAB embankment, and rather than excavate and replace the marl, the embankment was detoured inward and around the critical area (DTE, 1977).

Embankment Material

Investigation locations on the embankment are provided in **Figure 3**.

Measurements of in-situ moisture content and unit weight of the embankment material were collected in 1975 during an investigation by U.W. Stoll & Associates. Three soils borings were advanced through the embankment crest in the northwest corner of the FAB. Laboratory test results for each sample were not available for this investigation. However, a summary of the results from 10 samples was presented by DTE (1977) and indicated: (i) in-situ moisture content of the clay fill was generally between 9% and 12% with a maximum value of 14%; and (ii) dry unit weight generally ranged from 121 to 127 pcf with a minimum value of 119 pcf.

Thin-walled tube samples were collected during a 1994 investigation of the embankment performed by Soil and Materials Engineers, Inc. of Plymouth, MI (SME, 1995). A summary of these results is provided in **Table 3**. The soils were classified as lean clay (CL). The fines content (by dry weight) of the samples ranged from about 64% to 97% with clay content (i.e., particle diameter less than 0.005 mm) of between 20% and 60%. The measured liquid limits of the samples ranged from about 20 to 45 with a mean value of 28. The plasticity indices ranged from about 8 to 26 with a mean value of 14. The measured in-situ dry unit weight ranged from about 102 to 136 pcf with a mean value of 124 pcf. The in-situ moisture content ranged from 8% to 22% with a mean value of 13%.

Geosyntec performed laboratory testing of embankment materials between 2009 and 2012 (Geosyntec, 2012a). A summary of these results is provided in **Table 4**. The soils were classified as lean clay (CL). The fines content (by dry weight) of the samples ranged from about 67% to 92%

with clay content (i.e., particle diameter less than 0.005 mm) of between 38% and 57%. The measured liquid limits of the samples ranged from about 24 to 44 with a mean value of 36. The plasticity indices ranged from about 10 to 30 with a mean value of 18. The measured in-situ dry unit weight ranged from about 103 to 123 pcf with a mean value of 117 pcf. The in-situ moisture content ranged from 8% to 25% with a mean value of 16%. In general, the lower dry unit weight and higher water content values corresponded to the sections of the embankment closer to the ground surface and is consistent with the results from SME (1995).

Geosyntec performed flexible wall permeameter testing (ASTM D5084) on an undisturbed sample collected from the embankment. Four tests were performed at effective consolidation pressures of 5 psi, 10 psi, 15 psi, and 20 psi. Measured hydraulic conductivity values ranged from approximately $2x10^{-8}$ cm/s to $6x10^{-9}$ cm/s. This is an indication that the embankment was adequately compacted.

Essentially all results indicate that the embankment meets the requirements of the construction specifications.

EMBANKMENT RESTORATION ACTIVITIES

Geosyntec designed and provided construction quality assurance (CQA) services for restoration construction activities at the exterior embankment slopes between 2009 and 2019 as described in the following sections and documented in construction completion reports for each construction season (Geosyntec, 2010-2020).

Restoration of sloughed surface soils on the slope was performed by stripping the topsoil, excavating sloughed materials, and placing new fill to flatten the slopes from about 2H:1V to between 2.3H:1V to 3H:1V. A limited slope restoration was conducted at the northeastern corner of the ash basin, which included removal and replacement of topsoil and vegetation.

Design Studies

Geosyntec conducted slope stability assessments to support the slope restoration design work. During the 2011 construction season, Geosyntec conducted an additional investigation to assess the source of: (i) standing water that was generally observed intermittently along the toe of the northern embankment between Stations 14 and 37; and (ii) water observed within the slope inclinometer (SI) casings of SI-2 and SI-3 located in the crest of the embankment and subsoils.

Water samples were collected from SI casings, ash basin pore water from a piezometer, and the temporary piezometers installed along the embankment toe. Samples were analyzed for major chemistry and tritium to help assess the source of water within the SI casings and the toe of embankment. Based on the study, it was concluded that: (i) the source of standing water along the embankment toe was mainly due to surface water infiltration and lack of drainage along the embankment toe; and (ii) the chemistry of water within the SI casings were similar to the chemistry of ash basin water.

Visual documentation of the embankment face was recommended for the 2011 construction season to assess if there was active seepage. CQA personnel documented the embankment conditions after topsoil stripping and reported no evidence of active seepage or sandy lenses.

Documentation of Source Material

Clay fill for slope flattening was sourced from the Stoneco Denniston and Newport Quarries, Aggregate Industries Dundee Quarry, and Great Lakes Aggregates, LLC (a.k.a., Sylvania Materials, LLC) South Rockwood Quarry. Samples of the materials were collected and tested for pre-qualification and specified to meet the following material requirements:

- Natural soils that are relatively homogenous and free of debris, foreign objects, rock fragments, roots, and organic material.
- Maximum particle size/diameter of 3 inches and no less than 40 percent, by weight, passing through the standard U.S. No. 200 sieve per ASTM D6913 and ASTM D7928;
- Plasticity index between 8 and 30 per ASTM D4318; and
- Classification of SC or CL material in accordance with the USCS.

Conformance sampling and laboratory testing was also performed for clay fill sources at a frequency of at least one test per 5,000 cubic yards. The results of the CQA laboratory testing indicated that the clay fill from offsite sources met the requirements of the material specifications.

Documentation of Construction Quality

CQA testing and observations from the restoration construction at the FAB embankment indicates that the clay fill materials used for slough mitigation and slope flattening met the requirements of the construction specifications. In addition, the material was reported to have been placed and compacted in substantial accordance with the construction specifications.

Clay fill was specified to be placed and compacted for slope flattening as follows:

- Place in horizontal lifts in bench fashion with a loose thickness of not more than 9 inches or compacted thickness not more than 6 inches, using approved equipment in accordance with the Contractor's work plan.

- Scarify the surface of each lift prior to the placement of subsequent clay fill lifts.

- In-place moisture content shall be -2% to +3% of optimum moisture content (-2% to +2% in 2010) as determined by ASTM D1557. The lift shall be moisture-conditioned such that uniform moisture conditions are achieved.

- Clay fill shall meet a minimum of 90% of the maximum dry unit weight (95% in 2009 through 2013) as determined from ASTM D1557.

CQA testing was performed during construction for in-situ moisture content and unit weight using nuclear methods in accordance with ASTM D6938. The testing frequency was the greater of every 200 cubic yards of material placed or at least one test per lift for each 200 lineal feet of constructed clay bench. The CQA in-situ testing indicated the clay fill met the specifications for placement and compaction on the exterior embankment slopes.

Construction Observations

Geosyntec CQA personnel did not observe wet spots or indications of seeps below the excavated surface soils during the restoration activities that exposed approximately 88% of the surface of the embankment. This indicates that the embankment is homogenous, well compacted and without permeable features such as sand seams or higher permeability clay soils extending through the entire embankment section.

Construction completion reports were documented by Geosyntec (Geosyntec, 2010-2020).

SUMMARY AND CONCLUSIONS

The FAB is regulated as an existing CCR surface impoundment in accordance with the CCR Rule and the embankment is characterized as an engineered liner. Documentation of the source material and construction quality is required for submittal of an application to perform an ALD for the FAB, in accordance with 40 Code of Federal Regulations (CFR) §257.71(d)(i)(C).

The embankment materials are suitable for their intended use and the construction quality of the embankment is of good quality and in-line with proven and accepted engineering practices based upon a review of the documentation throughout the construction history and service duration of the FAB. The FAB embankment engineered liner meets the requirements of 40 CFR §257.71(d)(i)(C).

REFERENCES

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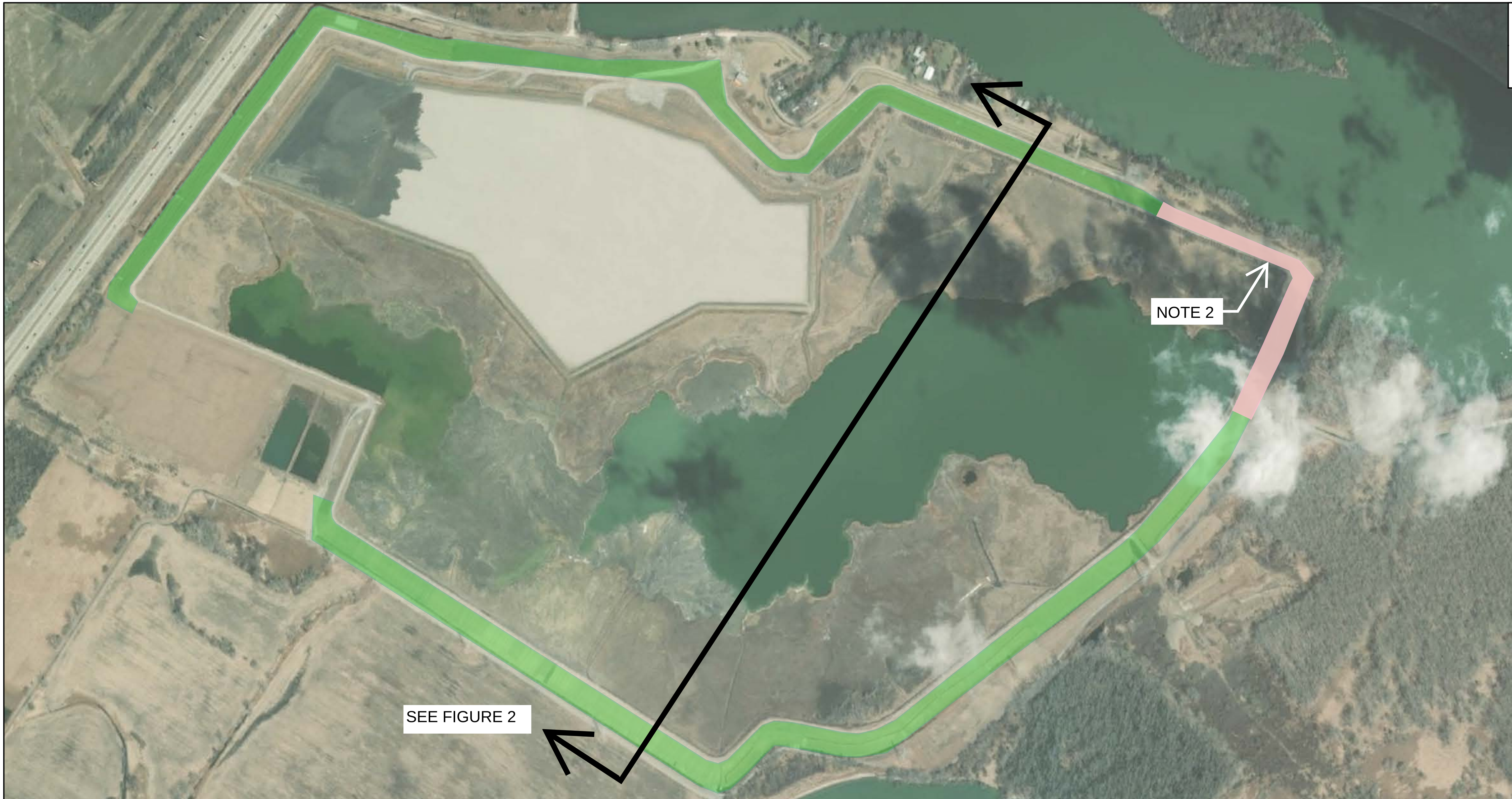


Flattened slopes

Limited slope restoration

Notes:
1) Slope flattening included topsoil removal, slough removal, embankment construction with compacted clay fill, topsoil replacement and vegetation.
2) Limited slope restoration included removal and replacement of topsoil and vegetation.
3) Construction completion certification reports are on file.

1,000 500 0 1,000 Feet

Monroe Ash Basin Overview and the Extent of Slope Restoration

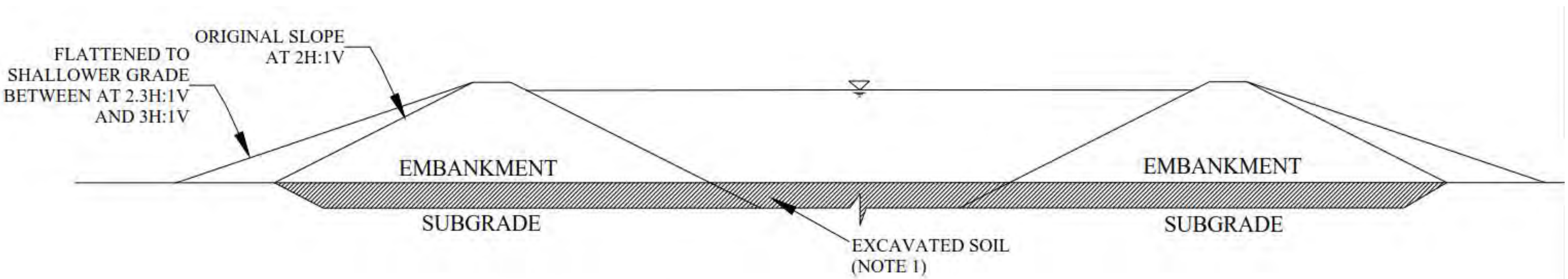
DTE Monroe Power Plant
Monroe, MI

Geosyntec consultants

Ann Arbor, Michigan | 2020/11/05

Figure 1

\\Chicago-01\prj1$\NCPs\NCP2020\DTE Monroe FAB Investigation\RFP\Work Plan Figures\MXDs\20200922 Monroe Ash Basin Cut and Fill Areas.mxd. SKaroly. 9/23/2020. Project/Phase/Task.



NOTES: 1) APPROXIMATELY 10 FT OF SOIL WAS EXCAVATED FROM THE SUBGRADE AND WAS UTILIZED FOR CONSTRUCTION OF THE EMBANKMENT.

Monroe Ash Basin Cross Section Schematic DTE Monroe Power Plant Monroe, MI		
Geosyntec consultants		**Figure** **2**
Ann Arbor, MI	2020/11/02	

Geosyntec consultants

134 NORTH LASALLE STREET., SUITE 300
CHICAGO, ILLINIOS 60602 USA
PHONE: 312.658.0500

TITLE: INVESTIGATION LOCATIONS FOR EMBANKMENT

PROJECT: ALTERNATE LINER DEMONSTRATION SUPPORT

SITE: DTE MONROE ASH POND
MONROE, MICHIGAN

DESIGN BY:		DATE:	DECEMBER 2009
DRAWN BY:		PROJECT NO.:	CHE8242
CHECKED BY:		FILE:	8242-001
REVIEWED BY:		FIGURE NO.:	3
APPROVED BY:			

Table 1. Pre-Construction Investigation Laboratory Test Results Summary
MONPP FAB ALD Application Support

Boring ID	Elevation, NGVD29 (ft)	Sample No.	Modified Proctor (ASTM D1557)		Natural Moisture Content, NMC (%)	Atterberg Limits			USCS Classification	Particle Size Distribution, by dry weight				
			Max. Dry Unit Weight, γ_d (pcf)	Opt. Moisture Content (%)		Liquid Limit, LL (%)	Plastic Limit, PL (%)	Plasticity Index, PI (%)		% Gravel (>4.75 mm)	% Sand (<4.75 mm; >0.075 mm)	% Silt (<0.075 mm; >0.005 mm)	% Clay (<0.005 mm)	% Fines (<0.075 mm)
TB-27	569-567	70665	122.2	12.0	12.0	30.3	18.4	11.9	CL	0	17	36	47	83
	567-563	70666	130.5	9.6	12.2	22.7	15.7	7.0	CL-ML	0	26	36	38	74
TB-46	575-569	70717	120.0	13.4	13.8	38.0	19.1	18.9	CL	0	15	30	55	85
SJ	574-570	70871	127.8	10.3	11.9	25.5	17.0	8.5	CL	1	23	38	38	76
	570-566	70872	129.4	9.8	11.3	24.8	16.1	8.7	CL	1	28	35	36	71
	563-558	70873	133.0	9.2	9.8	21.8	13.9	7.9	CL	3	28	35	34	69
SK	573-569	70874	119.8	12.4	20.2	38.2	18.1	20.1	CL	0	8	43	49	92
SL	569-566	70878	128.0	10.5	14.1	29.0	17.0	12.0	CL	1	24	37	38	75

Table 2. Construction Material Laboratory Test Results Summary
MONPP FAB ALD Application Support

Boring ID	Depth (ft bgs)	Sample No.	Modified Proctor (ASTM D1557)		Natural Moisture Content, NMC (%)	Atterberg Limits			Particle Size Distribution, by dry weight				
			Max. Dry Unit Weight, Υ_d (pcf)	Opt. Moisture Content (%)		Liquid Limit, LL (%)	Plastic Limit, PL (%)	Plasticity Index, PI (%)	% Gravel (>4.75 mm)	% Sand (<4.75 mm; >0.075 mm)	% Silt (<0.075 mm; >0.005 mm)	% Clay (<0.005 mm)	% Fines (<0.075 mm)
TB C-1	1.5-4.5	73106	119.0	13.6	22.3	44.2	19.5	24.7	0	10	43	47	90
	5.5-8.5	73193	128.1	9.6	16.2	N/A			N/A				
TB C-2	5.5-8.0	73112	126.7	11.6	N/A	32.0	18.1	13.9	N/A				
TB C-3	1.3-2.5	73512	118.4	11.7	25.3	45.1	21.7	23.4	0	11	44	45	89
	3.0-4.5	73513	119.6	11.8	24.5	N/A			N/A				
TB C-4	3.0-4.5	73437	122.8	11.4	23.9	N/A			N/A				
	8.5-10.0	73439	130.9	9.1	16.6	N/A			N/A				
TB C-5	1.0-7.5	73195	120.9	13.2	20.8	N/A			N/A				
TB C-6	10.0-12.0	73119	127.4	10.5	16.8	N/A			N/A				
TB C-7	0-5.0	73134	119.6	13.1	22.0	N/A			N/A				
	6.0-10.1	73135	129.3	9.8	14.5	N/A			N/A				
TB C-26	0-2.0	73362	120.9	13.2	25.5	N/A			N/A				
	2.0-4.0	73363	119.7	12.0	26.5	N/A			N/A				
	5.0-7.0	73364	117.2	12.8	26.1	N/A			N/A				
	7.0-9.0	73365	124.8	10.8	22.1	N/A			N/A				
TB C-27	0.5-3.0	73369	119.6	12.6	25.1	N/A			N/A				
	6.0-7.0	73370	125.8	10.4	17.5	N/A			N/A				
TB C-29	5.0-6.0	73124	123.4	11.1	28.4	N/A			N/A				
TB C-30	1.5-5.5	73137	120.8	12.0	19.8	N/A			N/A				
	5.5-9.0	71378	127.0	9.3	N/A	N/A			N/A				
TB C-31	1.0-4.5	73130	122.5	10.6	20.8	N/A			N/A				
	6.5-9.0	73131	129.9	9.1	14.9	N/A			N/A				
TB C-32	6.5-9.5	73142	125.1	10.9	21.8	N/A			N/A				
TB C-33	4.0-7.0	73201	121.6	11.2	23.9	N/A			N/A				
TB C-34	1.5-4.0	73198	117.2	13.1	26.3	N/A			N/A				
	8.0-10.0	73202	128.8	9.7	18.5	N/A			N/A				
TB C-35	1.0-5.5	73827	120.3	12.0	24.5	N/A			N/A				
	6.0-8.5	73828	127.8	9.6	N/A	N/A			N/A				
TB C-36	1.5-5.0	73373	121.6	12.0	18.5	N/A			N/A				
	5.0-8.5	73374	129.4	9.6	14.0	N/A			N/A				
TB C-37	1.0-4.5	73161	119.8	12.5	16.3	N/A			N/A				
	5.0-8.0	73162	127.9	9.9	18.7	N/A			N/A				
TB C-38	5.0-10.0	73166	120.0	12.0	23.1	N/A			N/A				

DTE Energy

Geosyntec consultants

Table 2. Construction Material Laboratory Test Results Summary
MONPP FAB ALD Application Support

Boring ID	Depth (ft bgs)	Sample No.	Modified Proctor (ASTM D1557) Max. Dry Unit Weight, γ_d (pcf)	Modified Proctor (ASTM D1557) Opt. Moisture Content (%)	Natural Moisture Content, NMC (%)	Atterberg Limits Liquid Limit, LL (%)	Atterberg Limits Plastic Limit, PL (%)	Atterberg Limits Plasticity Index, PI (%)	Particle Size Distribution, by dry weight % Gravel (>4.75 mm)	% Sand (<4.75 mm; >0.075 mm)	% Silt (<0.075 mm; >0.005 mm)	% Clay (<0.005 mm)	% Fines (<0.075 mm)
TB C-39	1.5-5.0	73168	120.0	12.8	15.3	44.5	19.1	25.4	0	12	44	44	88
	5.0-8.0	73169	124.9	10.3	16.9	N/A			N/A				
TB C-40	1.5-4.0	73174	122.9	10.6	25.1	N/A			N/A				
	8.0-15.0	73176	131.2	9.2	12.5	N/A			N/A				
TB C-41	3.0-8.0	73183	119.7	12.8	24.2	N/A			N/A				
	9.0-13.0	73184	131.0	9.2	13.3	N/A			N/A				

Table 3. In-Situ Embankment Material Laboratory Test Results (SME, 1995)
MONPP FAB ALD Application Support

Boring ID	Sample ID	Depth (ft bgs)	USCS Classification	Natural Moisture Content, NMC (%)	Dry Density, γ_d (pcf)	Specific Gravity, Gs	Atterberg Limits			Particle Size Distribution, by dry weight				
							Liquid Limit, LL (%)	Plastic Limit, PL (%)	Plasticity Index, PI (%)	% Gravel (>4.75 mm)	% Sand (<4.75 mm; >0.075 mm)	% Silt (<0.075 mm; >0.005 mm)	% Clay (<0.005 mm)	% Fines (<0.075 mm)
B2	CS2	6.5	CL	21	108	2.73	42	17	25	0	7	36	57	93
	CS4	11.5	CL	12	126	2.68	23	15	8	0	26	39	35	74
	CS6	16.5	CL	12	126	2.72	23	14	9	0	24	40	36	76
	CS8	21.5	CL	12	127	2.72	24	13	11	0	25	38	37	75
	CS10	26.5	CL	10	131	2.75	20	11	9	0	33	34	33	67
	CS12	31.5	CL	12	122	2.73	32	15	17	0	14	39	47	86
B4	CS2	6.5	CL	18	111	2.73	45	19	26	0	10	37	53	90
	CS4	11.5	CL	21	109	2.73	43	17	26	0	14	36	50	86
	CS6	16.5	CL	12	126	2.71	24	13	11	0	25	41	34	75
	CS8	21.5	CL	11	136	2.70	23	13	10	0	26	37	37	74
	CS10	26.5	CL	11	130	2.73	23	14	9	0	25	38	37	75
	CS12	31.5	CL	10	128	2.71	25	14	11	0	15	44	41	85
	CS14	36.5	CL	8	118	2.73	24	13	11	0	36	44	20	64
B6	CS2	6.5	CL	12	123	2.70	27	15	12	0	25	39	36	75
	CS4	11.5	CL	11	132	2.72	23	10	13	0	25	39	36	75
	CS6	16.5	CL	8	134	2.72	21	12	9	0	29	38	33	71
	CS8	21.5	CL	11	133	2.75	21	12	9	0	28	37	35	72
	CS10	26.5	CL	9	125	2.71	26	14	12	0	18	39	43	82
	CS12	31.5	CL	10	128	2.74	26	15	11	0	28	33	39	72
B8	CS2	6.5	CL	13	118	2.73	41	15	26	0	15	35	50	85
	CS4	11.5	CL	17	112	2.73	34	17	17	0	24	38	38	76
	CS6	16.5	CL	13	127	2.73	26	15	11	0	28	38	34	72
	CS8	21.5	CL	12	129	2.74	24	14	10	0	28	38	34	72
	CS10	26.5	CL	13	130	2.76	25	14	11	0	25	40	35	75
	CS12	31.5	CL	10	134	2.73	20	11	9	0	34	41	25	66
	CS14	36.5	CL	11	135	2.75	23	12	11	0	35	31	34	65
	CS16	41.5	CL	10	127	2.78	23	13	10	0	34	46	20	66
B10	CS2	6.5	CL	20	114	2.72	40	15	25	0	16	35	49	84
	CS4	11.5	CL	18	112	2.75	35	15	20	0	11	39	50	89
	CS6	16.5	CL	22	102	2.74	36	17	19	0	3	37	60	97
	CS8	21.5	CL	13	127	2.71	25	14	11	0	25	37	38	75
	CS10	26.5	CL	10	133	2.74	23	14	9	0	24	39	37	76

	Sample ID	Location	Depth (ft bgs)	ASTM D2487 USCS Classification	ASTM D2216 Moisture Content (%)	ASTM D7263 (from triaxial testing) In-situ Dry Unit Weight (pcf)			ASTM D422 or ASM D1140 % Gravel (>4.75 mm)	% Sand (<4.75 mm; >0.075 mm)	% Silt (<0.075 mm; >0.005 mm)	% Clay (<0.005 mm)	% Fines (<0.075 mm)	Atterberg Limits (ASTM D4318) Liquid Limit, LL (%)	Plastic Limit, PL (%)	Plasticity Index, PI (%)	Liquidity Index, LI (%)
2009 Field Investigation	09-A-1	62+20	0-1		19.6	98.0											
	09-A-4	62+20	2-3	CL	19.3				3.1	16	29.9	51.0	80.9	43	19	24	0.01
	09-A-6	62+20	2-3		17.2	105.0											
	09-A-T1 & T2	62+20	0-3	CL	18.7	114.7	113.6	110.3	3.2	18			78.8	36	19	17	-0.02
	09-A-T3 & T4	62+20	3.5-6	CL	16.9	111.3	115.8	115.4	6	23.7			70.3	40	19	21	-0.10
	09-B-1	80+88	1-2		21.4	101.3											
	09-B-5	80+88	0-3	CL	16.6				3.2	25.4	33.1	38.3	71.4	30	15	15	0.11
	09-C-T2	143+66	2-4		14.9	122.5											
	09-C-3	143+66	3-4		18.6	104.7											
	09-C-5	143+66	2-3	CL	17.1				2.2	19.1	33.8	44.9	78.7	35	17	18	0.01
	09-D-6	136+5	4		19.9	101.5											
	09-E-6	176+80	2-3		18.2	107.7											
	09-F-6	17+90	2-3		17.8	104.0											
	09-G-1	126+60	0-1		15.2	106.1											
	09-G-5	126+60	0-4		14.8				7.7	23.4			68.9				
	09-H-1	37+90	1-2		22.6	97.8											
	09-H-4	37+90	0-4	CL	24.7				0.2	13			86.8	43	19	24	0.24
	09-H-5	37+90	0-4	CL	24.7				0.3	13	29.5	57.3	86.8	43	19	24	0.24
	09-H-T1	37+90	0-3	CL	14.7-22.8	120.4	103.2		4.5	26			69.5	44	21	23	
	Mix-01			CL	14.5	119.0	119.3	119.8	2.7	17.2			80.1	34	16	18	-0.08
	SB-1	10+00	13.5-17.5	CL	15.8	119.7	113.6	114.2	2.5	25			72.5	34	18	16	-0.14
2009 Slope Inclinometer Installation	SI-6	125+00	15-19	CL	15.9	118.8	116.8		1.5	20.2			78.3	33	15	18	0.05
	SI-7	172+00	15-19	CL	14.5	121.6	122.5	121.3	5.9	19.4			74.7	31	15	16	-0.03
2010 Field Investigation Study	B-03-2010 (5-6)	69+75	5-6		20.5									41	21	30	-0.03
	B-04-2010 (8-10)	138+50	8-10		13.8-14.3	124.1	121.5	121.2						30	17	13	
2010 Slope Inclinometer Installation	B-08-SS-02 & 03	31+06	8.5-10/12.5-13.5	CL	12.9-16.8				0.6	32.5	27.4	39.5	66.9	34	16	18	
	B-08-SS-08 & 09	31+06	38.5-40/43.5-45	CL	17.8-19.2				0.2	15.2	31.8	52.8	84.6	44	23	21	
	B-08-SS-10 & 11	31+06	48.5-50/53.5-55	CL	12.0-12.2				1.2	20.3	35.6	43.0	78.6	28	15	13	
2010 Piezometer Installation	B10-P1-SS-04	30+00	18.5-20	CL	15.3				1	23.5	33.7	41.8	75.5	35	19	16	-0.23
	B10-P1-SS-07	30+00	33.5-35	CL	15.3				1.6	13.5	37.4	47.5	84.9	37	20	17	-0.28
	B10-P2-SS-01	30+00	3.5-5		8.0									29	15	14	-0.50
	B10-P3-SS-01	30+00	3.5-5		19.9									41	22	19	-0.11
	B10-P3-SS-02	30+00	8.5-10	CL	20.5				0.1	9.1	41.1	49.7	90.8	40	18	22	0.11
2011 Piezometer Installation	BH-1-SS-6	133+00	23.5-25	CL	15.0				1.5	8.4	40.2	49.9	90.1	31	15	16	0.00
	BH-2-SS-5	133+00	18.5-20		12.6									30	16	14	-0.24
	BH-3-SS-15	133+00	22-23.5		12.8									24	14	10	-0.12
	BH-1-ST-2	133+00	29-31		18.4	112.1											
	BH-2-ST-2	133+00	29-31		16.3 & 20.7	114.0	110.8										
	BH-3-ST-1	133+00	23.5-25.5		11.9-16.3	126.6	118.1	113.9									
2011 Field Investigation Study	I-T1	0+00	0.5		13.1	115.6							80.2	39	20	19	-0.36
	I-T1	0+00	1.5		13.7	112.8											
	I-T1	0+00	2.5		11.4	118.5											
	I-T2	0+00	0.5		14.4	113.2											
	I-T2	0+00	1.5		15.7&15.3	115.3	115.0										
	I-T2	0+00	2.5		10.9	125.8											
	J-T1	6+00	0.5		16.7	109.6							73.7	29	17	12	-0.03
	J-T1	6+00	1.5		15.5	113.0											
	J-T1	6+00	2.5		15.5	113.3											
	J-T2	6+00	0.5		13.9	114.6											
	J-T2	6+00	1.5		14.7	111.2											

Table 4. In-Situ Embankment Material Laboratory Test Results (Geosyntec, 2012a)
MONPP FAB ALD Application Support

				ASTM D2487	ASTM D2216	ASTM D7263 (from triaxial testing)			ASTM D422 or ASM D1140					Atterberg Limits (ASTM D4318)			
	Sample ID	Location	Depth (ft bgs)	USCS Classification	Moisture Content (%)	In-situ Dry Unit Weight (pcf)			% Gravel (>4.75 mm)	% Sand (<4.75 mm; >0.075 mm)	% Silt (<0.075 mm; >0.005 mm)	% Clay (<0.005 mm)	% Fines (<0.075 mm)	Liquid Limit, LL (%)	Plastic Limit, PL (%)	Plasticity Index, PI (%)	Liquidity Index, LI (%)
2011 Field Investigation Study	J-T2	6+00	2.5		14.2	107.7							84.7	34	17	17	
	K-T1	11+00	0.5		13.5	115.2											
	K-T1	11+00	1.5		13.9	117.1											
	K-T1	11+00	2.5		16.4	109.9											
	K-T2	11+00	0.5		18.0	104.7											
	K-T2	11+00	1.5		16.5 & 13.1	113.7	111.4										
	K-T2	11+00	2.5		15.5	115.8											
	L-T1	53+00	0.5		14.4	111.4							77.1	38	16	22	-0.07
	L-T1	53+00	1.5		15.0 & 15.5	108.4	106.6										
	L-T1	53+00	2.5		15.3	105.7											
	L-T2	53+00	0.5		12.8	114.0											
	L-T2	53+00	1.5		14.9 & 16.0	107.8	104.3										
	L-T2	53+00	2.5		13.5	114.4											
	M-T1	56+00	0.5		13.0	112.0							73.6	34	18	16	-0.31
	M-T1	56+00	1.5		13.4 & 14.9	115.7	114.8										
	M-T1	56+00	2.5		18.2	108.1											
	M-T2	56+00	0.5		14.2	116.5											
	M-T2	56+00	1.5		18.4 & 17.5	107.9	108.7										
	M-T2	56+00	2.5		12.6	112.6											
	N-T1	161+75	1		16.3 & 16.0	110.1	104.9						81.3	41	20	21	-0.19
	N-T1	161+75	2		11.7	107.4											
	N-T1	161+75	3		9.4	119.5											
	N-T2	161+75	1		17.2	104.8											
	N-T2	161+75	1.5		16.9 & 16.5	106.7	107.6										
	N-T2	161+75	2		15.3	107.5											
2011 Field Investigation Study	N-T2	161+75	3		14.5	111.5											
	O-T1	165+50	1		15.3	106.4							76.5	34	15	19	0.02
	O-T1	165+50	1.5		16.5 & 17.3	105.0	103.8										
	O-T1	165+50	2		13.0	119.6											
	O-T1	165+50	3		14.4	114.1											
	O-T2	165+50	0.5		16.7	105.1											
	O-T2	165+50	1.5		18.8 & 18.6	104.0	103.5										
	O-T2	165+50	2.5		15.2	109.1											
	P-T1	167+50	1		14.6	105.9							81.2	37	19	18	-0.24
	P-T1	167+50	1.5		11.3 & 11.9	114.5	112.2										
	P-T1	167+50	2		12.4	111.5											
	P-T1	167+50	3		11.2	117.4											
	P-T2	167+50	0.5		18.8	104.7											
	P-T2	167+50	1.5		19.1 & 18.6	105.2	103.5										
	P-T2	167+50	2.5		15.8	109.5											

Appendix M
Single Well Hydraulic Conductivity Test Result

Hydraulic Conductivity Results

DTE Electric Company Monroe Power Plant Fly Ash Basin

Monroe, Michigan

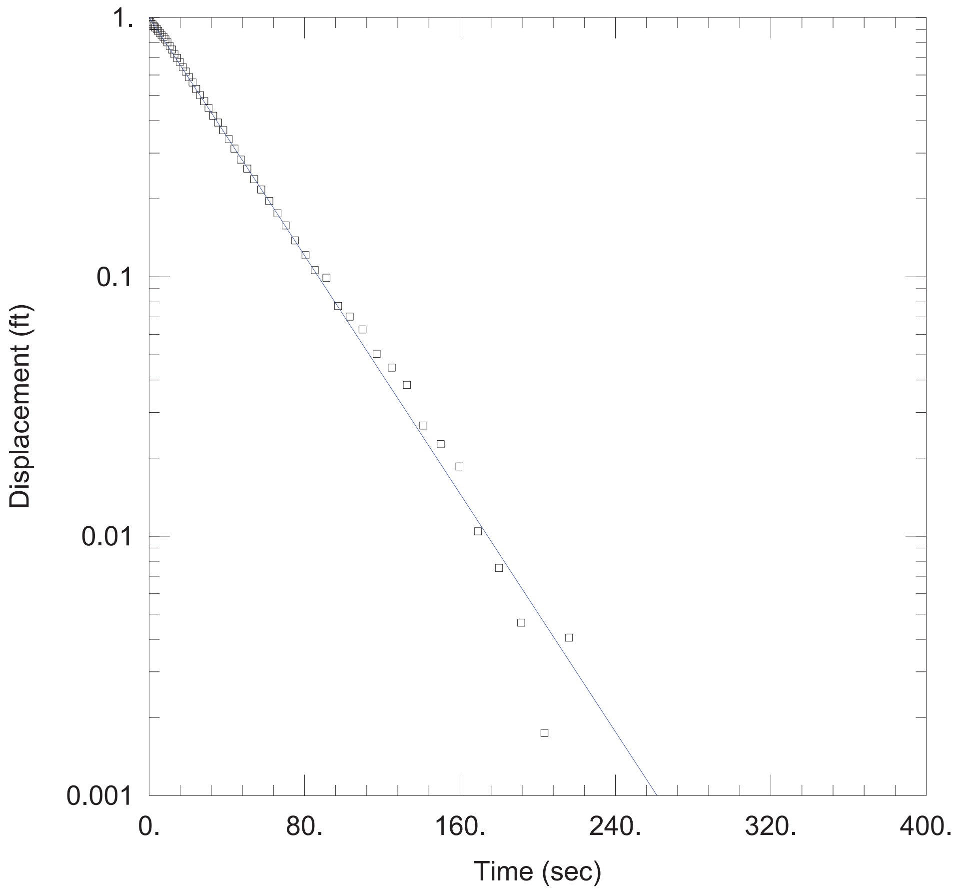
Test Location ID	Date Performed	Test Type	Hydraulic Conductivity (K)	
			cm/sec	ft/day
MW-16-01	3/1/2016	Falling Head	1.91E-03	5.403
		Rising Head	1.08E-03	3.053
		Average	**1.49E-03**	**4.228**

Conversion:

$$\frac{1\ \text{cm}}{1\ \text{sec}} \times \frac{86{,}400\ \text{sec}}{1\ \text{day}} \times \frac{1\ \text{ft}}{30.48\ \text{cm}} = 2.83\text{E+03}\ \frac{\text{ft}}{}$$

Notes:

Slug test results calculated using the Bower-Rice (1976) Solution.



FALLING HEAD SLUG TEST

Data Set: P:\...\MW-16-01 IN.aqt
Date: 11/27/17 Time: 14:21:09

PROJECT INFORMATION

Company: TRC Environmental Corporation
Client: DTE MFAB CCR
Project: 231828.0001.0000
Location: Monroe, MI
Test Well: MW-16-01
Test Date: 3/2/16

AQUIFER DATA

Saturated Thickness: 7. ft
Anisotropy Ratio (Kz/Kr): 1.

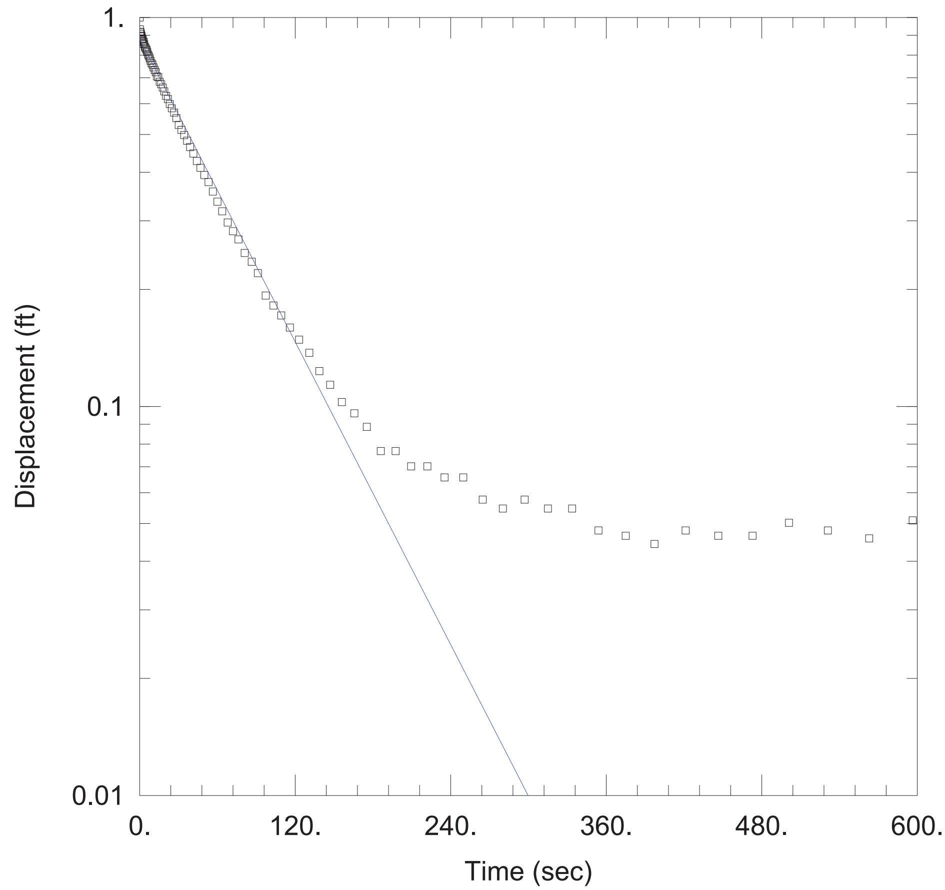
WELL DATA (MW-16-01)

Initial Displacement: 1.724 ft
Static Water Column Height: 48.77 ft
Total Well Penetration Depth: 53.21 ft
Screen Length: 5. ft
Casing Radius: 0.08333 ft
Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Confined
Solution Method: Bouwer-Rice

K = 0.001906 cm/sec
y0 = 1.725 ft



RISING HEAD SLUG TEST

Data Set: P:\...\MW-16-01 OUT.aqt
Date: 11/27/17 Time: 14:23:00

PROJECT INFORMATION

Company: TRC Environmental Corporation
Client: DTE MFAB CCR
Project: 231828.0001.0000
Location: Monroe, MI
Test Well: MW-16-01
Test Date: 3/2/16

AQUIFER DATA

Saturated Thickness: 7. ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-16-01)

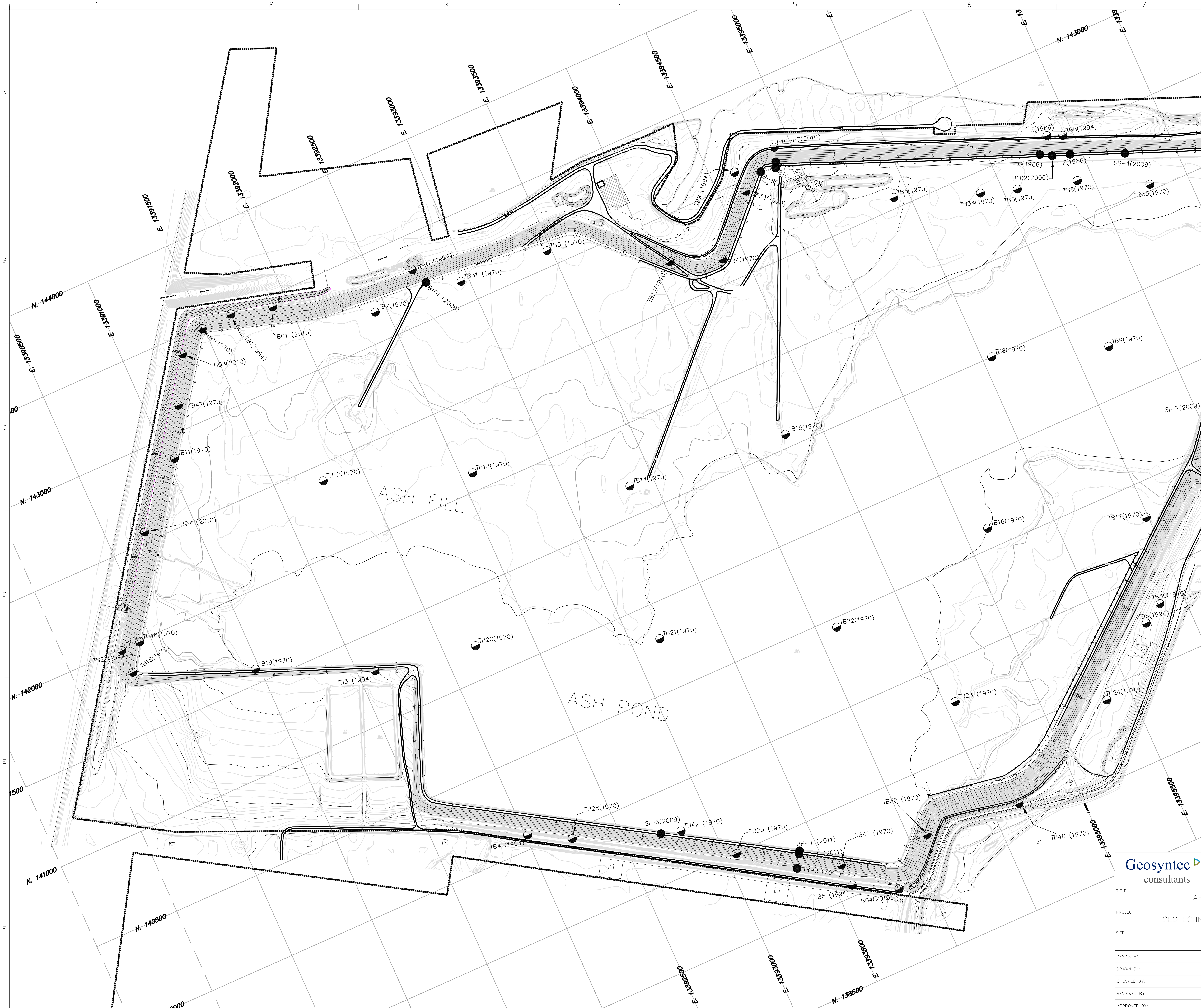
Initial Displacement: 1.354 ft Static Water Column Height: 48.77 ft
Total Well Penetration Depth: 53.21 ft Screen Length: 5. ft
Casing Radius: 0.08333 ft Well Radius: 0.08333 ft

SOLUTION

Aquifer Model: Confined Solution Method: Bouwer-Rice

K = 0.001077 cm/sec y0 = 1.191 ft

Appendix N
Historic Groundwater Artesian Conditions Documentation



NOTES:

1. NUMBERS IN PARANTHESIS NEXT TO BORING ID INDICATE THE YEAR IT WAS DRILLED.
2. BORINGS FROM 1970 WERE DRILLED BY SAFA BEFORE THE CONSTRUCTION OF THE EMBANKMENT.
3. BORINGS FROM 1986 WERE DRILLED BY DTE.
4. BORINGS FROM 1994 AND 2006 WERE DRILLED BY SME.
5. BORINGS FROM 2009, 2010 and 2011 WERE DRILLED BY GEOSYNTEC.

LEGEND

78+00	STATION MARKS
— 585 —	EXISTING GROUND SURFACE ELEVATION
	PROPERTY BOUNDARY
● B03(2010)	BORINGS THROUGH THE EMBANKMENT
◒ TB22(1970)	BORINGS THROUGH THE SUBGRADE

0 200 400
SCALE:

Geosyntec consultants

134 NORTH LASALLE STREET., SUITE 300
CHICAGO, ILLINIOS 60602 USA
PHONE: 312.658.0500

TITLE: APPROXIMATE BORING LOCATIONS	
PROJECT: GEOTECHNICAL SITE CHARACTERIZATION REPORT	
SITE: DTE MONROE ASH POND MONROE, MICHIGAN	
DESIGN BY:	DATE:
DRAWN BY:	PROJECT NO.: CHE8242
CHECKED BY:	FILE: 8242-001
REVIEWED BY:	FIGURE NO.: 6
APPROVED BY:	

TABLE 5

LOWER GROUNDWATER CONDITIONS
GEOTECHNICAL SITE CHARACTERIZATION REPORT
MONROE ASH BASIN, DETROIT, MICHIGAN

Boring No	Existing Ground Surface (ft)	Elevation at Which Groundwater Was Observed (ft)	Water Level Reported During or After Drilling (ft)	Rise in Water (ft)	Rise Above Existing Ground (ft)
TB 1	578.4	539.9	584.4	44.5	6.0
TB 2	575.5	545.5	576.7	31.2	1.2
TB 3	577.3	541.3	569.0	27.7	-
TB 4	574.6	546.4	564.3	17.9	-
TB 7	571.3	518.0	575.5	57.5	4.2
TB 11	578.7	545.2	591.8	46.6	13.1
TB 12	576.7	545.2	564.1	18.9	-
TB 13	575.6	544.3	566.8	22.5	-
TB 15	573.1	529.1	578.6	49.5	5.5
TB 17	571.2	537.9	573.0	35.1	1.8
TB 18	577.0	544.7	578.8	34.1	1.8
TB 19	575.6	546.4	584.9	38.5	9.3
TB 20	575.3	552.0	588.4	36.4	13.1
TB 28	574.7	526.3	593.0	66.7	18.3
TB 30	571.9	527.4	579.4	52.0	7.5
TB 2*	579.4	547.4	580.4	33.0	1.0
TB 5*	576.4	530.4	536.4	6.0	-
TB 7*	575.4	563.4	573.4	10.0	-
MW-1R[1]	579.0	553.0	586.5	33.5	7.5

[1] MW-1R is a monitoring well.

* indicates borings that were drilled by SME in 1994. Remaining borings were drilled by SAFA before the construction of the embankment in 1970.