Submitted to
DTE Electric Company

Submitted by
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August 2019

CCR Certification:

Structural Stability Assessment

Inactive Bottom Ash Impoundment

DTE Monroe Power Plant

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Executive Summary

This Coal Combustion Residuals (CCR) Structural Stability Assessment (SSA) of the Inactive Bottom Ash Impoundment at the DTE Electric Company (DTE) Monroe Power Plant has been prepared in accordance with the requirements specified in the USEPA CCR Rule under 40 Code of Federal Regulations §257.73 (d)(1). All structural stability assessment requirements were evaluated, and the surface impoundment was found to meet all requirements as required within each individual structural stability assessment in §257.73 (d)(1); which is summarized in **Table ES-1**.

Table ES-1 – Certification Summary

Report Section	CCR Rule Reference	Requirement Summary	Requirement Met?	Comments
2.1	§257.73 (d)(1)(i)	*Foundations and Abutments*	Yes	The CCR Unit has stable foundations
2.2	§257.73 (d)(1)(ii)	*Slope Protections*	Yes	The CCR Unit has sufficient slope protection
2.3	§257.73 (d)(1)(iii)	*Dike Compaction*	Yes	The CCR Unit has appropriate dike Compaction
2.4	§257.73 (d)(1)(iv)	*Vegetated Slopes*	Yes	The CCR Unit has vegetated slopes or other forms of protection
2.5	§257.73 (d)(1)(v)	*Spillways*	Yes	The CCR Unit spillways are sufficient for the 1000-year event
2.6	§257.73 (d)(1)(vi)	*Stability and Structural Integrity of Hydraulic Structures*	Yes	Hydraulic structures passing through the base of the unit are free from defects which may negatively affect the operation of the unit
2.7	§257.73 (d)(1)(vii)	*Downstream Slope Inundation / Stability*	Yes	The CCR Unit maintains structural stability during low pool or sudden drawdown of adjacent water body

1 Introduction

1.1 Purpose of the Report

The purpose of the Initial Structural Stability Assessment (Structural Stability Assessment) presented in this report is to document that the requirements specified in 40 Code of Federal Regulations (CFR) §257.73 (d) have been met to support the certification required under each of the applicable regulatory provision for the Inactive Bottom Ash Impoundment. The Inactive Bottom Ash Impoundment is an inactive coal combustion residual (CCR) surface impoundments defined by 40 CFR §257.73.

The following table summarizes the documentation required within the CCR Rule and the sections that specifically respond to those requirements of this assessment.

Table 1-1 – CCR Rule Cross Reference Table		
Report Section	**Title**	**CCR Rule Reference**
2.1	Foundations and Abutments	§257.73 (d)(1)(i)
2.2	Slope Protection	§257.73 (d)(1)(ii)
2.3	Dike Compaction	§257.73 (d)(1)(iii)
2.4	Vegetated Slopes	§257.73 (d)(1)(iv)
2.5	Spillways	§257.73 (d)(1)(v)
2.6	Stability and Structural Integrity of Hydraulic Structures	§257.73 (d)(1)(vi)
2.7	Downstream Slope Inundation / Stability	§257.73 (d)(1)(vii)

This report presents the Initial Structural Stability Assessment as prepared by AECOM for the Inactive Bottom Ash Impoundment. This plan was prepared in response to the Environmental Protection Agency (EPA) adopting the Federal Register 40 CFR Part 257 to regulate the disposal of CCR as solid waste in April 2015. As required by 257.73(d), owners and operators of existing or new CCR surface impoundments must develop a structural stability assessment in accordance with the following:

Regulatory Citation: 40 CFR §257.73 (d); Periodic structural stability assessments.

- *(1) 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. The assessment must, at a minimum, document whether the CCR unit has been designed, constructed, operated, and maintained with:*
  - *(i) Stable foundations and abutments;*

- *(ii) Adequate slope protection to protect against surface erosion, wave action and adverse effects of sudden drawdown;*

- *(iii) Dikes mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit;*

- *(iv) Vegetated slopes of dikes and surrounding areas, except for slopes which have an alternate form or forms of slope protection;*

- *(v) A single spillway or a combination of spillways configured as specified in [paragraph (A) and (B)]:*
  (A) All spillways must be either:
  (1) of non-erodible construction and designed to carry sustained flows; or
  (2) earth- or grass-lined and designed to carry short-term, infrequent flows at non-erosive velocities where sustained flows are not expected.
  (B) The combined capacity of all spillways must adequately manage flow during and following the peak discharge from a:
  (1) Probable maximum flood (PMF) for a high hazard potential CCR surface impoundment; or
  (2) 1000-year flood for a significant hazard potential CCR surface impoundment; or
  (3) 100-year flood for a low hazard potential CCR surface impoundment.

- *(vi) Hydraulic structures underlying the base of the CCR unit or passing through the dike of the CCR unit that maintain structural integrity and are free of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, and debris which may negatively affect the operation of the hydraulic structure;*

- *(vii) For CCR units with downstream slopes which can be inundated by the pool of an adjacent water body, such as a river, stream or lake, downstream slopes that maintain structural stability during low pool of the adjacent water body or sudden drawdown of the adjacent water body.*

1.2 Brief Description of Impoundment

The DTE Monroe Plant is located in Monroe County, Michigan, approximately 2 miles east of the city of Monroe. The Monroe Plant was built in the early 1970s and occupies a parcel of land approximately 440 acres in size. The plant buildings, coal pile, and appurtenances associated with power generation reside on the northern (approximately 274 acres) portion of the 440-acre land parcel. The southern portion of the land parcel consists of the Inactive Bottom Ash Impoundment area plus the Process Waste and Stormwater Basin area which, together cover approximately 166 acres.

The Inactive Bottom Ash Impoundment is located to the south of the main Monroe Plant area and encompasses an area approximately 86.4 acres in size. The Inactive Bottom Ash Impoundment area was constructed in the late 1960s by building a perimeter dike to surround a low area of the adjacent Lake Erie. The area south of the plant was removed from the Waters of the United States by an Act of Congress prior to plant construction. CCR materials have been placed and allowed to drain into the impoundment from the north, and currently form a delta that extends about 1/3 of the way into the impoundment. Appendix A provides a Site Location Map showing the general location of the project site (**Figure 1)** and an Aerial Site Map of the Inactive Bottom Ash Impoundment **(Figure 2).**

1.2.1 Design and Construction

The Inactive Bottom Ash Impoundment consists of an embankment constructed primarily with rock fill and earth spoils generated during construction of the Monroe Power Plant. The basin was constructed on the existing natural ground surface, and the height of the embankment (from the lowest toe elevation to the top of embankment) is approximately 4 feet. A road along the top of the crest has a minimum width of approximately 12 feet and is 20 or more feet wide along the eastern side abutting Lake Erie, which was constructed with additional rock armament for shoreline protection. The northern boundary of the Inactive Bottom Ash Impoundment was formed by the natural ground surface and bottom ash is stored in this area. The southern boundary of the Inactive Bottom Ash Impoundment is a crushed rock embankment that separates the Inactive Bottom Ash Impoundment from the Process Waste and Stormwater basin to the South.

1.2.2 Outlet Structures

The Inactive Bottom Ash Impoundment has an overflow weir structure, approximately 240 feet in length. The weir allows water to overflow from the Inactive Bottom Ash Impoundment into the discharge canal at a maximum flood pool elevation of 577 feet. The overflow weir structure is located approximately 600 feet north of the intersection of the western perimeter dike and the divider berm.

2 Structural Stability Assessment Description

Regulatory Citation: 40 CFR §257.73 (d)(1);

- *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. The assessment must, at a minimum, document whether the CCR unit has been designed, constructed, operated, and maintained with [the standards in (d)(1)(i)-(vii)]:*

The Structural Stability Analysis for the Inactive Bottom Ash Impoundment is described in this section. Information about operational and maintenance procedures was provided by DTE Monroe Power Plant personnel. The DTE Monroe Power Plant follows an established maintenance program that quickly identifies and resolves issues of concern.

2.1 Foundation and Abutments

Regulatory Citation: 40 CFR §257.73 (d)(1);

- *(i) Stable foundations and abutments;*

Background and Assessment

The stability of the foundations was evaluated using soil data from field investigations and reviewing design drawings, operational and maintenance procedures, and conditions observed in the field by AECOM. Additionally, slope stability analyses were performed to evaluate the slip surfaces passing though the foundations.

At depth, the site is founded on very stiff to hard silty clay (CL-ML) and silt (ML) till. Moving up the profile, the foundation soils consist of interbedded soft to very soft cohesive silts and clays; and loose to medium dense sand and gravel soils. The slope stability analyses exceed the criteria listed in §257.73(e)(1)(iv) for slip surfaces passing through the foundation (including the post-liquefaction loading condition). Therefore, the foundation soils are considered to be stable under all loading conditions. The slope stability analyses are discussed in the CCR certification report: *Safety Factor Assessment Area 15 DTE Monroe Power Plant* (March 2018). A review of operational and maintenance procedures as well as current and past performance of the dikes has determined appropriate processes are in place for continued operational performance.

Conclusion and Recommendation

Based on the conditions observed by AECOM, the Inactive Bottom Ash Impoundment was designed and constructed with stable foundations. Operational and maintenance procedures are in place to address any issues related to the stability of foundations.

Therefore, the Inactive Bottom Ash Impoundment meets the requirements in §257.73 (d)(1)(i).

2.2 Slope Protection

Regulatory Citation: 40 CFR §257.73 (d)(1);

- (ii) Adequate slope protection to protect against surface erosion, wave action and adverse effects of sudden drawdown;

Background and Assessment

The adequacy of slope protection was evaluated by reviewing design drawings, operational and maintenance procedures, and conditions observed in the field by AECOM.

The perimeter dikes have natural slope protection in place. Both inner and outer slopes of the pond, are heavily vegetated with shrubs as well as smaller plants. Furthermore, various large trees are well established on the perimeter dikes. In addition to vegetation, the exterior slopes of the perimeter dikes are covered with rip-rap which has an approximate median diameter of 2-4 feet. Interior slopes of the impoundment have relatively calm water having little to no wave action. Therefore, reeds and thickets on the water's edge provide adequate slope protection.

Conclusion and Recommendation

Based on this evaluation, adequate slope protection was designed at the Inactive Bottom Ash Impoundment. In addition, the heavily vegetated dike slopes keep the dike material slope protected and in place. There is no evidence of significant areas of erosion or wave action depredation. Operational and maintenance procedures are in place to protect against surface erosion or wave action.

Sudden drawdown of the pool in the Inactive Bottom Ash Impoundment is not expected to occur.

See Section 2.7 of this report for further information on sudden drawdown.

Therefore, the Inactive Bottom Ash Impoundment meets the requirements in §257.73 (d)(1)(ii).

2.3 Dike Compaction

Regulatory Citation: 40 CFR §257.73 (d)(1)

- (iii) Dikes mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit;

Background and Assessment

The density of the dike materials was evaluated using soil data from field investigations and reviewing design drawings, operational and maintenance procedures, and conditions observed in the field by AECOM. Additionally, slope stability analyses were performed to evaluate slip surfaces passing through the dike over the range of expected loading conditions as defined within §257.73 (d)(1).

Historical construction drawings for the dam required that the embankment be compacted to 95% of the Standard Proctor maximum dry density (ASTM D 698). Based on the geotechnical field evaluations, the perimeter dikes were found to be constructed of fill material consisting of a variety of interlayered materials including sand (USCS type SP, SP-SM, SW), gravel (GP), silty sand (SM), lean clay (CL), silty clay (CL-ML), organic silt as topsoil (OL), asphalt and cobbles. Uncorrected Standard Penetration Test (SPT) resistance values (N-values) in the embankment ranged widely between 3 and 65 blows per foot (bpf) with an average of 17 bpf, indicating a generally medium dense apparent density which is indicative of well-compacted materials. Slope stability analyses exceed the criteria listed in §257.73(e)(1)(i) through (iv) for slip surfaces passing through the dike. The slope stability analyses are discussed in the CCR certification report: *Safety Factor Assessment Area 15 DTE Monroe Power Plant* (March 2018).

Conclusion and Recommendation

Based on the conditions observed by AECOM, the Inactive Bottom Ash Impoundment was designed and constructed with sufficient dike compaction.

Therefore, the Inactive Bottom Ash Impoundment meets the requirements in §257.73 (d)(1)(iii).

2.4 Vegetated Slopes

Regulatory Citation: 40 CFR §257.73 (d)(1)

– *(iv) Vegetated slopes of dikes and surrounding areas, except for slopes which have an alternate form or forms of slope protection;*[1]

Background and Assessment

The adequacy of slope vegetation was evaluated by reviewing design drawings, operational and maintenance procedures, and conditions observed in the field by AECOM.

As reported in Section 2.2, the perimeter dikes have natural slope protection in place. Both inner and outer slopes of the pond are heavily vegetated with shrubs, smaller plants, reeds and thickets. Furthermore, various large trees are well established on the perimeter dikes. In addition to vegetation, the exterior slopes of the perimeter dikes are covered with large rip-rap which has an approximate median diameter of 2 to 4 feet.

Conclusion and Recommendation

Based on this evaluation, the vegetation on the perimeter dikes slopes has adequate vegetated slopes. There are no substantial bare areas were observed, however, there are many areas that are overgrown and over vegetated. Though no immediate issue has been observed due to the overgrowth, continual operational and maintenance procedures should be updated to regularly manage vegetation growth.

Therefore, the Inactive Bottom Ash Impoundment meets the requirements in §257.73 (d)(1)(iv).

2.5 Spillways

Regulatory Citation: 40 CFR §257.73 (d)(1)

– *(v) single spillway or a combination of spillways configured as specified in [paragraph (A) and (B)]:*

(A) All spillways must be either:

(1) of non-erodible construction and designed to carry sustained flows; or
(2) earth- or grass-lined and designed to carry short-term, infrequent flows at non-erosive velocities where sustained flows are not expected.

(B) The combined capacity of all spillways must adequately manage flow during and following the peak discharge from a:

(1) Probable maximum flood (PMF) for a high hazard potential CCR surface impoundment; or
(2) 1000-year flood for a significant hazard potential CCR surface impoundment; or
(3) 100-year flood for a low hazard potential CCR surface impoundment.

[1] As modified by court order issued June 14, 2016, Utility Solid Waste Activities Group v. EPA, D.C. Cir. No. 15-1219 (order granting remand and vacatur of specific regulatory provisions).

Background and Assessment

Industrial process water and stormwater discharge from the Inactive Bottom Ash Impoundment into the cooling water discharge channel via an overflow weir spillway. The spillway consists of a 203-foot long multi-stage sharp-crested steel weir which discharges onto a riprap apron and then into the cooling water discharge canal. The normal water surface elevation of the Inactive Bottom Ash Impoundment is approximately 574.40 ft (Plant Datum) and the state ordinary high water elevation of Lake Erie/the cooling water discharge channel is 572.20 ft (Plant Datum).

Hydrologic and hydraulic analyses were completed to evaluate the capacity of the spillway relative to inflow estimated for the 1,000-year flood event for the significant hazard potential Inactive Bottom Ash Impoundment. The capacity of the spillway was evaluated using hydrologic and hydraulic analysis performed per §257.82(a). The hydrologic and hydraulic analyses are discussed in the *CCR Impoundment Inflow Design Flood Control System Plan: Inactive Bottom Ash Impoundment (Area 15), Monroe Power Plant, DTE Energy, Monroe, Michigan* (April 2018).

Conclusion and Recommendation

The spillway was designed to prevent erosion. The steel weir spillway is non-erodible material while the downstream outlet apron is lined with rip-rap.

The assessment found that the spillway can adequately manage flow during peak discharge resulting from the 1,000-year storm event without overtopping of the embankments. The peak water elevation is 575.23 feet during the inflow design flood, and the minimum crest elevation of the Inactive Bottom Ash Impoundment dike is 576.00 feet, resulting in 0.77 feet of freeboard. This also indicates that the design of the spillway is adequate to carry sustained flows. Operational and maintenance procedures are in place to remove debris or other obstructions from the spillway, if observed after normal inspections. As a result, these procedures are appropriate for maintaining the spillway.

Therefore, the Inactive Bottom Ash Impoundment meets the requirements in §257.73 (d)(1)(v).

2.6 Stability and Structural Integrity of Hydraulic Structures

Regulatory Citation: 40 CFR §257.73 (d)(1)

– *(vi) Hydraulic structures underlying the base of the CCR unit or passing through the dike of the CCR unit that maintain structural integrity and are free of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, and debris which may negatively affect the operation of the hydraulic structure*

Background and Assessment

The stability and structural integrity of hydraulic structures penetrating the dike of the Inactive Bottom Ash Impoundment was evaluated using design drawings, operational and maintenance procedures, and conditions observed in the field by AECOM in June of 2017 and during annual inspections performed in 2018 and 2019.

The only hydraulic structure that penetrates the embankment is the multistage weir that acts as the primary spillway. This structure is approximately 203 feet in width and appears to be in good condition, although there is some vegetative growth along the outlet channel. This vegetative growth does not appear to affect the operation or stability of the spillway.

Conclusion and Recommendation

Based on this evaluation, the primary spillway structure did not display any areas of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, or debris that may negatively affect the operation of the structure. Operational and maintenance procedures are in place to remove debris or other obstructions from the hydraulic structures, and address any deficiencies, as evidenced by conditions observed by AECOM. As a result, these procures are appropriate for maintaining the stability and structural integrity of the hydraulic structure.

DTE has indicated that a detailed subsurface and underwater inspection of the spillway is planned for the fall of 2019; AECOM recommends following through with this inspection.

The Inactive Bottom Ash Impoundment meets the requirements in §257.73 (d)(1)(vi).

2.7 Downstream Slope Inundation / Stability

Regulatory Citation: 40 CFR §257.73 (d)(1)

– *(vii) For CCR units with downstream slopes which can be inundated by the pool of an adjacent water body, such as a river, stream or lake, downstream slopes that maintain structural stability during low pool of the adjacent water body or sudden drawdown of the adjacent water body.*

Background and Assessment

The structural stability of the impoundment slopes of the Inactive Bottom Ash Impoundment was evaluated by comparing the location of the impoundment relative to adjacent water bodies using published United States Geological Survey (USGS) topographic maps, aerial imagery, and conditions observed in the field by AECOM.

Bodies of water are adjacent to the impoundment slopes of the Inactive Bottom Ash Impoundment. Adjacent waters bodies to the perimeter dikes are bordered by Lake Erie to the east and a channel that carries cooling water discharged from the power plant to the west, which is fed by Plum Creek.

Conclusion and Recommendation

The exterior lake level and the Inactive Bottom Ash Impoundment water level are relatively at the same elevation. The relatively stable water elevation of Lake Erie indicates that it is highly unlikely that there would be a rapid drawdown event that would negatively impact the Inactive Bottom Ash Impoundment.

Based on this evaluation, the requirements in §257.73 (d)(1)(vii) are not applicable to the Inactive Bottom Ash Impoundment, as inundation of the downstream slopes is not expected to occur.

3 Conclusions

The Structural Stability Assessment for the Inactive Bottom Ash Impoundment adequately addresses design criteria as required by the CCR Rule. It presents all supplemental information and verification of design as required. Therefore, the Structural Stability Assessment meets the requirements for certification.

The contents of this report, specifically **Section 2**, represent the Structural Stability Assessment for this CCR unit.

4 Certification

This Certification Statement documents that the Inactive Bottom Ash Impoundment at the DTE Monroe Power Plant meets the requirements specified in 40 CFR §257.73 (d). The Inactive Bottom Ash Impoundment is an inactive CCR surface impoundment as defined by 40 CFR §257.53. The CCR Rule requires that the initial structural stability assessment for an inactive CCR surface impoundment be completed by April 17, 2018.

CCR Unit: DTE Monroe Power Plant Inactive Bottom Ash Impoundment

I, Scott Hutsell, 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 this certification has been prepared in accordance with the accepted practice of engineering. I certify, for the above referenced CCR Unit, that the structural stability assessment meets the requirements of 40 CFR § 257.73 (d).

Scott G. Hutsell

Printed Name

08/30/19

Date

STATE OF MICHIGAN
SCOTT G. HUTSELL
ENGINEER
No. 43961
LICENSED PROFESSIONAL ENGINEER

5 Limitations

Background information, design basis, and other data have been furnished to AECOM by DTE, or collected by AECOM through various field investigations, which AECOM has used in preparing this report. AECOM has relied on this information as furnished and is not responsible for the accuracy of this information. Our recommendations are based on available information from previous and current investigations. These recommendations may be updated as future investigations are performed.

The conclusions presented in this report are intended only for the purpose, site location, and project indicated. The recommendations presented in this report should not be used for other projects or purposes. Conclusions or recommendations made from these data by others are their responsibility. The conclusions and recommendations are based on AECOM's understanding of current plant operations, maintenance, stormwater handling, and ash handling procedures at the station, as provided by DTE. Changes in any of these operations or procedures may invalidate the findings in this report until AECOM has had the opportunity to review the findings and revise the report if necessary.

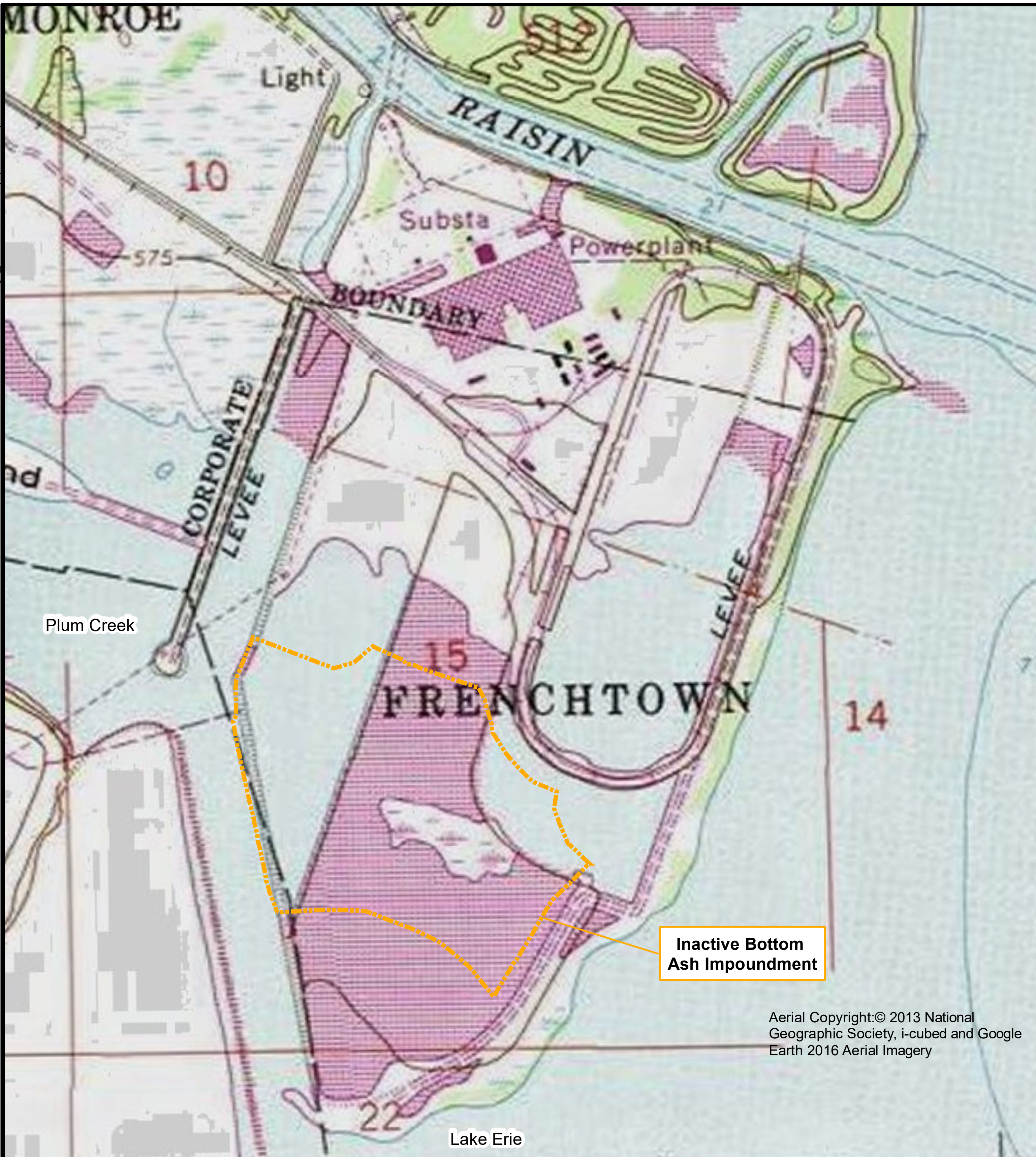
This development of the Structural Stability Assessment was performed in accordance with the standard of care commonly used as state-of-practice in our profession. Specifically, our services have been performed in accordance with accepted principles and practices of the engineering profession. The conclusions presented in this report are professional opinions based on the indicated project criteria and data available at the time this report was prepared. Our services were provided in a manner consistent with the level of care and skill ordinarily exercised by other professional consultants under similar circumstances. No other representation is intended.

Appendix A
Figures

Figure 1 – Site Location Map

Figure 2 – Aerial Site Map

Document Path: G:\Cincinnati\DCS\GIS\ArcMap_GeoDB_Projects\D\DTE\DTE-Monroe Plant\Data-Tech\GIS\Fig1_Site Location Map (8-2-2019).mxd



LEGEND:

Approximate Boundary of Inactive Bottom Ash Impoundment

N

0 750 1,500 Feet

DTE Energy

Monroe Power Plant

FIGURE 1
SITE LOCATION MAP

DATE: 8/13/2019	SCALE 1 inch = 907 feet
CREATED BY: KLP	
JOB NO. 60489524	

Document Path: G:\Cincinnati\DCS\GIS\ArcMap_GeoDB_Projects\D\DTE\DTE-Monroe Plant\Data-Tech\GIS\DTE_Monroe_Fig1_Site Vicinity Map.mxd

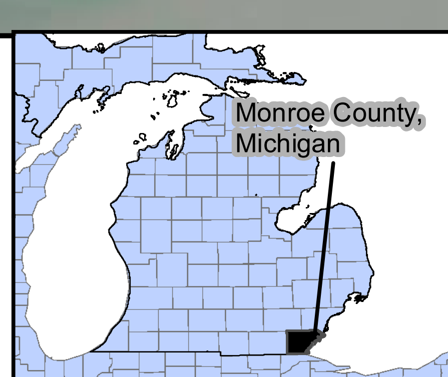
LEGEND:

Unit Separation Berm

Approximate Boundary of Inactive Bottom Ash Impoundment

N

0 700 1,400 Feet



DTE Energy

Monroe Power Plant

FIGURE 2
AERIAL SITE MAP

DATE: 8/13/2019	SCALE 1 inch = 700 feet
JOB NO. 60516675	

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