



Structural Stability and Safety Factor Assessment Report

J.C. WEADOCK GENERATING FACILITY

BOTTOM ASH POND STRUCTURAL STABILITY AND SAFETY FACTOR ASSESSMENT REPORT

Essexville, Michigan

Pursuant to 40 CFR 257.73(d, e)

Submitted To: Consumers Energy Company
1945 W. Parnall Road
Jackson, Michigan 49201

Submitted By: Golder Associates Inc.
15851 South US 27, Suite 50
Lansing, Michigan 48906

October 2016

1655164





CERTIFICATION

Professional Engineer Certification Statement [40 CFR 257.73(d)(3) & 257.73(e)(2)]

I hereby certify that, having reviewed the attached documentation and being familiar with the provisions of Title 40 of the Code of Federal Regulations Section 257.73 (40 CFR Part 257.73), I attest that this Structural Stability and Safety Factor Assessment Report is accurate and has been prepared in accordance with good engineering practices, including the consideration of applicable industry standards, and with the requirements of 40 CFR Part 257.73(d) periodic structural stability assessments and 40 CFR Part 257.73(e) periodic safety factor assessments.

Golder Associates Inc.



Signature

October 14, 2016

Date of Report Certification

Matthew Wachholz, PE

Name

6201047513

Professional Engineer Certification Number





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1.0 INTRODUCTION

1.1 Purpose

On April 17, 2015, the United States Environmental Protection Agency (EPA) issued the Coal Combustion Residual (CCR) Resource Conservation and Recovery Act (RCRA) Rule (40 CFR 257 Subpart D) (“CCR RCRA Rule”) to regulate the beneficial use and disposal of CCR materials generated at coal-fired electrical power generating complexes. The CCR RCRA Rule requires that existing CCR surface impoundments meeting the requirements of Section 257.73(b) conduct initial and periodic structural stability assessments in accordance with Section 257.73(d) and safety factor assessments in accordance with Section 257.73(e). This report provides the initial structural stability assessment and the safety factor assessment for the Bottom Ash Pond surface impoundment (Bottom Ash Pond) at the J.C. Weadock Generating Facility (JC Weadock). A hazard potential classification was conducted for the Bottom Ash Pond pursuant to Section 257.73, which resulted in a low hazard potential classification. As a result of the low hazard potential classification, the 100-year flood elevation was used in the models to prepare this report.

1.2 Background

JC Weadock was a coal-fired power generation facility located near Essexville, Michigan near the southern shore of Saginaw Bay as shown on Figure 1 – Site Location Map. JC Weadock formerly operated multiple coal-burning baseload units but ceased electrical generation on April 15, 2016 and is currently being decommissioned. The Bottom Ash Pond is located in the west side of the JC Weadock ash disposal area, just east of JC Weadock. Prior to stopping electrical generation, bottom ash was sluiced from JC Weadock to the Bottom Ash Pond. As a result of the decommissioning, the Bottom Ash Pond is no longer receiving CCR from an active power generating plant although it is accepting negligible amounts of CCR contact wash water and other low-volume miscellaneous wastewaters. The JC Weadock Bottom Ash Pond is divided into two areas, Area 1 and Area 2 as shown on Figure 2 with dedicated outlet structures. The Bottom Ash Pond is divided into these two areas for ash storage, cleanout, and operational purposes. The Bottom Ash Pond discharged water via two steel outflow pipes. The pipes discharged to a series of ditches and then to the permitted National Pollutant Discharge Elimination System (NPDES) outfall.

1.3 Previous Evaluations

There are no certified records of previous slope stability analyses that have been performed for the Bottom Ash Pond embankments. A Probable Failure Mode Analysis (PFMA) was previously completed for JC Weadock (AECOM 2009a) to identify structural (geotechnical) and environmental risks. Additionally, previous site inspections have been conducted to observe and document the structural



conditions of the embankment dikes. A list of reviewed documents pertinent to the structural stability assessment is provided in Table 1.3.1.

Table 1.3.1 - Previous Reviewed Documents Related to Structural Stability Assessment

| Document | Date | Author |
|--------------------------------------------------------------------------------------------------------------------------------|---------------|--------------------------------|
| J.C. Weadock Bottom Ash Pond Annual RCRA CCR Surface Impoundment Inspection Report – January 2016 | January 2016 | Golder Associates Inc. |
| J.C. Weadock Generating Facility, Triennial Ash Dike Risk Assessment Report – Spring 2014 | December 2014 | Barr Engineering |
| J.C. Weadock Ash Disposal Area 2012 Ash Dike Risk Assessment FINAL Inspection Report | August 2012 | AECOM Technical Services, Inc. |
| Inspection Report J.C. Weadock Generating Facility Ash Dike Risk Assessment, Essexville, Michigan | November 2009 | AECOM Technical Services, Inc. |
| Potential Failure Mode Analysis (PFMA) Report, J.C. Weadock Generating Facility Ash Dike Risk Assessment, Essexville, Michigan | November 2009 | AECOM Technical Services, Inc. |



2.0 SUBSURFACE CONDITIONS

The site is located at the east side of the confluence of the Saginaw River with Saginaw Bay (part of Lake Huron). Quaternary native surficial deposits consist of a mixture of glacial, lacustrine, and alluvial deposits with varying thicknesses and extend to depths of approximately 85 to 95 feet below natural ground surface; where bedrock of the Saginaw formation consisting of gray and black shale is encountered. The glacial deposits generally consist of well sorted (poorly graded) outwash and glacial till. The till is relatively well graded (poorly sorted) and consists of a mixture of sand, silt, and clay. The lacustrine deposits consist of clay, silt, and sand with varying amounts of organics. Native soils are overlain by fill deposits consisting of CCR fill (both fly ash and bottom ash).

Cone penetrometer tests (CPT) were completed in 2016 around the Bottom Ash Pond to develop site specific stratigraphy and engineering material properties. Historic investigations from 2002, 2005, 2007, and 2015 were also utilized to supplement the 2016 investigation data. The subsurface investigations and testing identified that the near surface soils beneath the Bottom Ash Pond generally consist of CCR fill varying in thickness from approximately 10 to 30 feet. The fill is overlying native sand with interbedded seams of inorganic clay. The native sand has thicknesses varying approximately from 0 to 10 feet. Native hard to soft clay was observed below the native sands and fill and extended to the probable bedrock surface. The top of clay was typically observed between elevations 575 feet and 580 feet (NAVD88).



3.0 STRUCTURAL STABILITY ASSESSMENT [40 CFR 257.73(d)(1)(i)-(vii)]

The CCR RCRA Rule requires an initial and periodic structural stability assessment be conducted by a qualified professional engineer (QPE) to document whether design, construction, operation, and maintenance are consistent with recognized and generally accepted good engineering practices for the maximum volume of CCR and CCR wastewater that can be impounded therein. The following sections provide documentation on the initial structural stability assessment and rely mainly on the recent and historic annual inspections performed at the site as well as the weekly field inspections performed by Consumers Energy Company (CEC). The most recent inspection was completed by Golder Associates Inc. (Golder) in May 2016 for the initial structural stability assessment. The summary inspection checklist for the May 2016 site inspection is included in Appendix A.

In accordance with the CCR RCRA Rule, in any calendar year in which both the periodic inspection by a QPE and the quinquennial (occurring every five years) structural stability assessment by a QPE required by Sections 257.73(d) are required to be completed, the annual inspection is not required. If the annual inspection is not conducted in a year as provided by this paragraph, the deadline for completing the next annual inspection is one year from the date of completing the quinquennial structural stability assessment. As a result, a certified annual inspection report for Bottom Ash Pond will not be required until October 2017.

3.1 Foundations and Abutments [40 CFR 257.73(d)(1)(i)]

Certified issued for construction (IFC) drawings were not available on the original design of the Bottom Ash Pond embankments. As previously noted, the foundation soils consist primarily of CCR fill on native sand and clay. There has been no indication of foundational or abutment instability or movement in recent or historic site inspections and; therefore, the foundation soils and abutments are considered stable.

3.2 Slope Protection [40 CFR 257.73(d)(1)(ii)]

The downstream slopes of the embankments for the Bottom Ash Pond are protected from erosion and deterioration by the establishment of a vegetative cover. Existing slopes are inspected weekly for erosion, signs of seepage, animal burrows, sloughing, and plants that could negatively impact the embankment. The May 2016 inspection did not identify items relating to slope protection that required investigation or repair, and the downstream slopes of the Bottom Ash Pond are not subjected to wave or sudden drawdown effects. The discharge channel slopes are approximately 200 feet north of the Bottom Ash Pond northern slope and were not considered as part of the Bottom Ash Pond for this structural stability assessment. The existing slope protection measures are considered adequate to provide protection against surface erosion, wave action, and adverse effects of sudden drawdown.



3.3 Dikes (Embankment) [40 CFR 257.73(d)(1)(iii)]

As previously noted, certified IFC drawings were not available on the original design of the Bottom Ash Pond embankments. Based on subsurface investigation information, it is believed that the perimeter dike was constructed with standard earthwork equipment and is comprised of fill primarily consisting of bottom ash and fly ash. Results of the safety factor assessment are detailed in Section 4.0 and provide additional details on the stability of the external dike. Based on the relative density of the material encountered during the subsurface investigations, historic inspections, recent observations, and results of the stability analysis; the embankment dikes are considered sufficient to withstand the range of loading conditions in the Bottom Ash Pond.

3.4 Vegetated Slopes [40 CFR 257.73(d)(1)(iv)]

The EPA has vacated the requirement that vegetative cover on surface impoundment dikes be maintained at no more than six inches. A new rule establishing requirements relating to the use of vegetation as slope protection for CCR surface impoundments is still pending.

3.5 Spillways [40 CFR 257.73(d)(1)(v)]

There are no spillways on the Bottom Ash Pond. Flow is conveyed out of the Bottom Ash Pond via the outflow pipes as described in Section 3.6.

3.6 Hydraulic Structures [40 CFR 257.73(d)(1)(v)]

Area 1 and Area 2 of the Bottom Ash Pond have dedicated outlets (Figure 2). The Area 1 outlet is located on the east side and consists of a 24-inch diameter steel pipe with an upstream invert of 596.01 feet (NAVD88). The Area 2 outlet is located on the east side and consists of a 24-inch diameter steel pipe with an upstream invert of 590.36 feet (NAVD88). As a result, the normal operating level for the Bottom Ash Pond Area 1 has been determined to be at elevation 596.0 feet (NAVD88), and the normal operating level for the Bottom Ash Pond Area 2 has been determined to be at elevation 590.4 feet (NAVD88).

The outflow pipes were identified as the only hydraulic structures that are underlying the base or passing through the external dike of the CCR unit. Visual inspections of the pipes at their discharge locations indicate that the pipes appear to be in acceptable condition. Additionally, the structures are not anticipated to operate at design levels since the plant is no longer operational.

Based on visual inspection, the hydraulic structures are free of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, and debris which may negatively affect the operation of the hydraulic structure.



3.7 Downstream Slopes Adjacent to Water Body [40 CFR 257.73(d)(1)(vii)]

The downstream slopes of the Bottom Ash Pond are not adjacent to water bodies and; therefore, rapid-drawdown was not considered a potential mechanism for structural instability in the exterior slope. The discharge channel slopes are approximately 200 feet north of the Bottom Ash Pond northern slope and were not considered as part of the Bottom Ash Pond for this structural stability assessment.

3.8 Structural Stability Deficiencies [40 CFR 257.73(d)(2)]

Based on the 2016 site inspection and structural stability assessment contained herein, no structural stability deficiencies were identified.



4.0 SAFETY FACTOR ASSESSMENT [40 CFR 257.73(e)]

According to Section 257.73(e)(1) of the CCR RCRA Rule, periodic safety factor assessments must be conducted for each CCR unit. The safety factor assessment must document the calculated factor of safety for the dike slopes under the following scenarios:

- Maximum Pool Storage - Section 257.73(e)(1)(i) – Defined as the long-term, maximum storage pool (or operating) elevation and approximately equal to the outlet elevation (elevation = 590.4 feet NAVD88) for this facility; static factor of safety must equal or exceed 1.50
- Maximum Pool Surge - Section 257.73(e)(1)(ii) – Defined as the temporary raised pond level above the maximum pool storage elevation due to an inflow design flood (592.5 feet NAVD88); static factor of safety must equal or exceed 1.40
- Seismic Loading Conditions - Section 257.73(e)(1)(iii) – Seismic factor of safety must equal or exceed 1.00
- Liquefaction Potential - Section 257.73(e)(1)(iv) – Only necessary for dikes constructed of soils that have susceptibility to liquefaction; factor of safety must equal or exceed 1.20

The following sections provide details on the factor of safety assessment and methods used to calculate the slope factor of safety and results of the analysis.

4.1 Slope Stability Analysis

Slope stability analyses were performed to evaluate the factor of safety for each of the maximum pool storage, maximum pool surcharge, and seismic loading scenarios. In the Preamble to Sections 257 and 261 of the CCR RCRA Rule *General Safety Factor Assessment Considerations* [VI (E)(3)(b)(ii)(a)], limit equilibrium methods are identified as conventional analysis procedures for calculating the factor of safety and specific common methods are identified, including the Morgenstern and Price method of slices (Abramson et al. 2002), which was used for this stability analysis.

4.1.1 Cross Sections Analyzed

The critical section of the exterior dike were determined by using the existing topography (2016), an interpreted soil profile from the subsurface investigations, and an estimated phreatic surface. The critical cross section is anticipated to be the most susceptible of all cross sections to structural failure based on appropriate engineering considerations, including loading conditions.

The critical section used for the safety factor assessment was located along the Bottom Ash Pond's Area 2 northern dike as presented on Figure 2 – Section A-A'. Potential slope failures above the maximum pool surcharge elevation were not considered for the analysis.



4.1.2 Geotechnical Material Properties

Representative material properties based on the subsurface investigations and laboratory testing were selected for use in the safety factor assessment for the critical section as follows: 1) loose to medium dense embankment fill consisting of CCR; 2) loose to medium dense silty sand with clay seams (native foundation soil); and 3) hard silty clay till (native foundation soil).

4.1.3 Pond Elevation and Phreatic Surface/Groundwater

The phreatic surface was assumed to maintain equilibrium with the water elevation that is within the Bottom Ash Pond, as the pond is no longer accepting sluiced CCR from electrical generation. For the maximum pool storage scenario, ground water surface elevation was assumed equal to that of the normal operating elevation of the Bottom Ash Pond in Area 2 of 590.4 feet (NAVD88). The maximum pool surcharge scenario considers the temporary rise of the pond water elevation due to rainfall and collection of site stormwater runoff during the design event. Bottom Ash Pond water elevations were calculated for the 100-year storm event, resulting in an increase in pond elevations to an elevation of 592.5 feet (NAVD88) [rounded from 592.53 feet (NAVD88)] for Area 2, as provided in Golder's J.C. Weadock Generating Facility Bottom Ash Pond, Inflow Design Flood Control System Plan (Golder 2016b).

4.1.4 Vehicle Loading

The crest of the embankments are periodically used by maintenance vehicles as access roads around the ponds and; therefore, a vehicle load was applied to the critical cross section for the maximum pool storage and maximum pool surcharge cases to model the loading effects of vehicle traffic. The vehicle load was applied based on American Association of State Highway and Transportation Officials (AASHTO) recommended loading for truck loads acting perpendicular to traffic (AASHTO 2012).

4.1.5 Seismic Loading Conditions

Factors of safety for stability under seismic conditions were calculated using the pseudo-static method. The peak ground acceleration (PGA) based on the 2008 United States Geological Survey (USGS) seismic hazard maps (Peterson et al. 2008) with a two percent probability of exceedance in 50 years (2,475-year return period) is 0.028g; however, the Natural Resources Conservation Service (NRCS) recommends a minimum seismic coefficient of 0.05g for Michigan, so a seismic coefficient of 0.05g was used in seismic analyses.

4.2 Stability Analysis Results

Safety factor assessments were performed for long-term static conditions for the critical cross section considered under maximum pool storage and maximum pool surcharge scenarios as well as pseudo-static seismic conditions. The results of the safety factor assessments are presented in Table 4.2.1, and critical failure surface result outputs are contained in Appendix B. The results indicate that the calculated



factor of safety through the critical cross section in the Bottom Ash Pond surface impoundment meet or exceed the minimum values listed in Section 257.73(e)(1)(i-iv).

Table 4.2.1 - Slope Stability Analysis Results

| Scenarios | Maximum Pool Storage | Maximum Pool Surcharge | Seismic |
|------------------------|--------------------------|------------------------|---------|
| Required Safety Factor | 1.50 | 1.40 | 1.00 |
| Section | Calculated Safety Factor | | |
| Section A-A' | 1.70 | 1.70 | 1.64 |

4.3 Liquefaction Potential Assessment

Embankment and foundation soils were screened for seismically-induced liquefaction susceptibility using methods recommended by the National Center for Earthquake Research (NCEER), which uses CPT data (Youd et al. 2001; Robertson and Wride 1998). The calculated factor of safety against seismically-induced liquefaction is shown in Appendix C and was calculated to be greater than 1.20 throughout the depth of the embankments and underlying foundation in the evaluated CPT soundings for the considered earthquake loading. These screening-level results indicate that the embankments and foundation soils for the Bottom Ash Pond are not susceptible to seismically-induced liquefaction for the seismic loading considered.



5.0 SUMMARY

Based on our review of the information provided by CEC, onsite observations, and the results of the structural stability assessment; no structural stability deficiencies were identified in the Bottom Ash Pond surface impoundment during this assessment. Based on this same information and on our safety factor assessment, the calculated factor of safety through the critical cross section in the Bottom Ash Pond surface impoundment meets or exceeds the minimum values listed in Section 257.73(e)(1)(i-iv).



6.0 CLOSING

This report summarizes the results of the structural stability and factor of safety assessment to fulfill the provisions of Title 40 of the Code of Federal Regulations Section 257.73 (40 CFR Part 257.73) for the Bottom Ash Pond at JC Weadock.

GOLDER ASSOCIATES INC.

A handwritten signature in blue ink, appearing to read "Jeff Piaskowski".

Jeffrey Piaskowski, P.E.
Project Engineer

A handwritten signature in blue ink, appearing to read "Jeff Schneider".

Jeffrey Schneider, P.E.
Senior Project Engineer

A handwritten signature in black ink, appearing to read "Matt Wachholz".

Matt Wachholz, P.E.
Senior Engineer



7.0 REFERENCES

- AASHTO, 2012. American Association of State Highway and Transportation Officials, Load Resistant Factor Design (LFRD) Bridge Design Specifications, 2012.
- Abramson, L.W., T.S. Lee, S. Sharma, and G.M. Boyce (2002). Slope Stability and Stabilization Methods, 2nd edition, John Wiley & Sons, New York.
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- Golder 2016b. J.C. Weadock Generating Facility Bottom Ash Pond, Inflow Design Flood Control System Plan Golder Associates, Inc. report, October 2016.
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- Robertson, R. and Wride, C. 1998. Evaluating Cyclic Liquefaction Potential Using the Cone Penetration Test, Canadian Geotechnical Journal, vol. 35, pp. 442-459.
- “Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments,” Title 40 – Protection of the Environment Part 257 – Criteria for Classification of Solid Waste Disposal Facilities and Practices Subpart D – Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments.
- Youd, T., and Idriss, I., 2001. Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils, Journal of Geotechnical and Geoenvironmental Engineering, April 2001, pp. 297-313.

FIGURES



MICHIGAN COUNTIES
NOT TO SCALE

REFERENCE(S)

BASE MAP TAKEN FROM USGS 7.5 MINUTE QUADRANGLE
BAY CITY NE, MICHIGAN
DATED 2014



CLIENT
CONSUMERS ENERGY COMPANY
2742 NORTH WEADOCK HIGHWAY
ESSEXVILLE, MI. 48732

PROJECT
J.C. WEADOCK
BOTTOM ASH POND

CONSULTANT

YYYY-MM-DD 2016-08-22

DESIGNED MAL

PREPARED MAL

REVIEWED JRP

APPROVED MAB

TITLE

SITE LOCATION MAP

PROJECT NO.
1655164

REV.
0

FIGURE
1



NOT FOR CONSTRUCTION
DRAFT



| | | | |
|-----------------------------------------------|----------------------------------------------------------|---------------------------------------------|---------------------------------------------------|
| LEGEND | SBW-7 HISTORICAL CONVENTIONAL ROTARY BORINGS (BY STS) | JCW-BH-16002 BORING LOCATION (BY GOLDER) | MW-15007 MONITORING WELL LOCATION (BY ARCADIS) |
| B-14 HISTORICAL BOREHOLE LOCATION (BY STS) | JCW-CPT-16001 CPT LOCATION (BY GOLDER) | | |
| CPT-15 HISTORICAL CPT (BY STS) | OW-60 HISTORICAL POTENTIOMETRIC MONITORING WELL | | |

CLIENT
CONSUMERS ENERGY COMPANY
2742 NORTH WEADOCK HIGHWAY
ESSEXVILLE, MI. 48732

| | | |
|------------|------------|------------|
| CONSULTANT | YYYY-MM-DD | 2016-09-09 |
| | DESIGNED | MJ |
| | PREPARED | CMN |
| | REVIEWED | JS |
| | APPROVED | MW |



PROJECT
J.C. WEADOCK BOTTOM ASH POND
2016 RCRA COMPLIANCE STRUCTURAL STABILITY & FACTOR OF SAFETY ASSESMENT

| | | | |
|-----------------------------------------------------------|-------------|------|--------|
| TITLE | PROJECT NO. | REV. | FIGURE |
| BOREHOLE LOCATION & CROSS SECTION LOCATION MAP | 1655164 | --- | 2 |

Path: \\saramemo\cas\Sheets_Work for Other Offices\1655164_JC Weadock Bottom Ash Pond\CAD\3D_1 File Name: 1655164_2016-09-09 Survey.dwg

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM A3S D 11 in

APPENDIX A
SUMMARY INSPECTION CHECKLIST

CCR SURFACE IMPOUNDMENT VISUAL INSPECTION CHECKLIST

Facility Name: J.C. Weadock Bottom Ash Pond

Owner: Consumers Energy Company (CEC)

Purpose of Facility: Detention and settlement of sluiced bottom ash

County, State: Bay County, Michigan

Inspected By: Tiffany Johnson

Inspection Date: 05/18/2016

Weather: Sunny, 65-degrees F

| ITEM | | | | | REMARKS |
|-------------------------------------------------|------------|------------------|-------------|--------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| | Acceptable | Monitor/Maintain | Investigate | Repair | |
| 1. General Conditions | | | | | |
| a. Year Minimum Water Elevation | | | | | Elevation: 594.5 and 590.0 feet NAVD88 for Area 1 and Area 2 (respectively) |
| b. Year Average Water Elevation | | | | | Elevation: 595.3 and 590.2 feet NAVD88 for Area 1 and Area 2 (respectively) |
| c. Year Maximum Water Elevation | | | | | Elevation: 596.0 and 590.4 feet NAVD88 for Area 1 and Area 2 (respectively) |
| d. Current water level | | | | | Elevation: 594.5 and 590.0 feet NAVD88 for Area 1 and Area 2 (respectively) |
| e. Current storage capacity | | | | | Volume: 61,800 CY (see Note 1) |
| f. Current volume of impounded water and CCR | | | | | Volume: 27,700 CY (see Note 1) |
| g. Alterations | X | | | | |
| h. Development of downstream plain | X | | | | |
| i. Grass cover | | X | | | Crest of bottom ash pond generally bare of vegetation, See 5c below, maintain erosion and vegetation controls. See Note 2. |
| j. Settlement/misalignment/cracks | X | | | | |
| k. Sudden drops in water level? | | | | | NA – No drop in water level observed. |
| 2. Inflow Structure | | | | | |
| a. Settlement | X | | | | |
| b. Cracking | | X | | X | Observed cracked steel pipe at joint, water flowing out of the pipe was causing erosion, continue pipe maintenance procedures. See Note 3. |
| c. Corrosion | | X | | | Observed corrosion of steel trestles, continue pipe maintenance procedures. See Note 2. |
| d. Obstacles in inlet | X | | | | |
| e. Riprap/erosion control | | | | | NA – Bottom ash is discharged from vertical trestle. |
| 3. Outflow Structure | | | | | |
| a. Settlement | X | | | | |
| b. Cracking | X | | | | |
| c. Corrosion | X | | | | |
| d. Obstacles in outlet | X | | | | Water appeared to be flowing freely and was not submerged. |
| e. Riprap/erosion control | | X | | | Maintain erosion controls. See Note 2. |
| f. Seepage | X | | | | |
| 4. Upstream slope | | | | | South and west slopes considered as upstream slope. |
| a. Erosion | X | | | | |
| b. Rodent burrows | X | | | | |
| c. Vegetation | | X | | | Minor intermittent erosion noted along slope and sparse vegetation, maintain vegetation and erosion controls. See Note 2. |
| d. Cracks/settlement | X | | | | |
| e. Riprap/other erosion protection | X | | | | |
| f. Slide, Slough, Scarp | X | | | | |
| 5. Crest | | | | | |
| a. Soil condition | X | | | | |
| b. Comparable to width from previous inspection | X | | | | |
| c. Vegetation | X | | | | Crest was predominantly bottom ash, maintain erosion controls. |
| d. Rodent burrows | X | | | | |
| e. Exposed to heavy traffic | X | | | | |
| f. Damage from vehicles/machinery | X | | | | |
| 6. Downstream slope | | | | | North, west, and east slopes considered downstream. |
| a. Erosion | | X | | | Observed erosion around cracked pipe on west side near inlet trestle and near decomposing tree stumps, maintain erosion controls. See Note 2. |
| b. Vegetation | | X | | | Vegetation was longer than six inches in some places, maintain vegetation controls. See Note 2. |
| c. Rodent burrows | X | | | | |

| ITEM | Acceptable | Monitor/Maintain | Investigate | Repair | REMARKS |
|-------------------------|------------|------------------|-------------|--------|--------------------------------------------------------------------------------------------------------------------------------|
| d. Slide, Slough, Scarp | | X | | | Minor sloughing observed, maintain erosion and grading controls. Condition appears unchanged from 2014 inspection. See Note 2. |
| e. Drain conditions | X | | | | |
| f. Seepage | X | | | | |
| 7. Toe | | | | | |
| a. Vegetation | | X | | | Intermittent dense vegetation located along toe, maintain vegetation controls. See Note 2. |
| b. Rodent burrows | X | | | | |
| c. Settlement | X | | | | |
| d. Drainage conditions | X | | | | |
| e. Seepage | X | | | | Perimeter swale at toe on south side had water in it, no signs of seepage. |

Notes:

- 1) Current volume of impounded water and CCR for Area 1 and Area 2 is based on an approximate bottom elevation of 588.0 and 582.0 feet (NAVD88) and normal operating level of 594.5 and 590.0 feet (NAVD88), respectively. The unit's storage capacity for Area 1 and Area 2 is based on an approximate pond bottom elevation of 588.0 and 582.0 feet (NAVD88) and elevation 597.0 and 594.7 feet (NAVD88), respectively, which corresponds to 2 feet below the lowest elevation of the exterior berm for each area. Elevations used in this calculation are based off a May 2016 topographic and bathymetric survey completed by Engineering and Environmental Solutions, LLC (EES).
- 2) Features observed and documented in this checklist were not considered a deficiency or release as classified under 40 CFR 257.83(b)(5) and required no immediate action beyond periodic inspection in accordance with the SMP and typical maintenance.
- 3) Golder recommends that items identified with a repair designation exhibited conditions that should initiate measures be taken to rectify the area of concern. It should be noted that no items identified for repair were considered a deficiency or release as classified under 40 CFR 257.83(b)(5) requiring immediate action by CEC.

PROFESSIONAL ENGINEER SEAL

Name of Engineer: Tiffany Johnson, P.E.

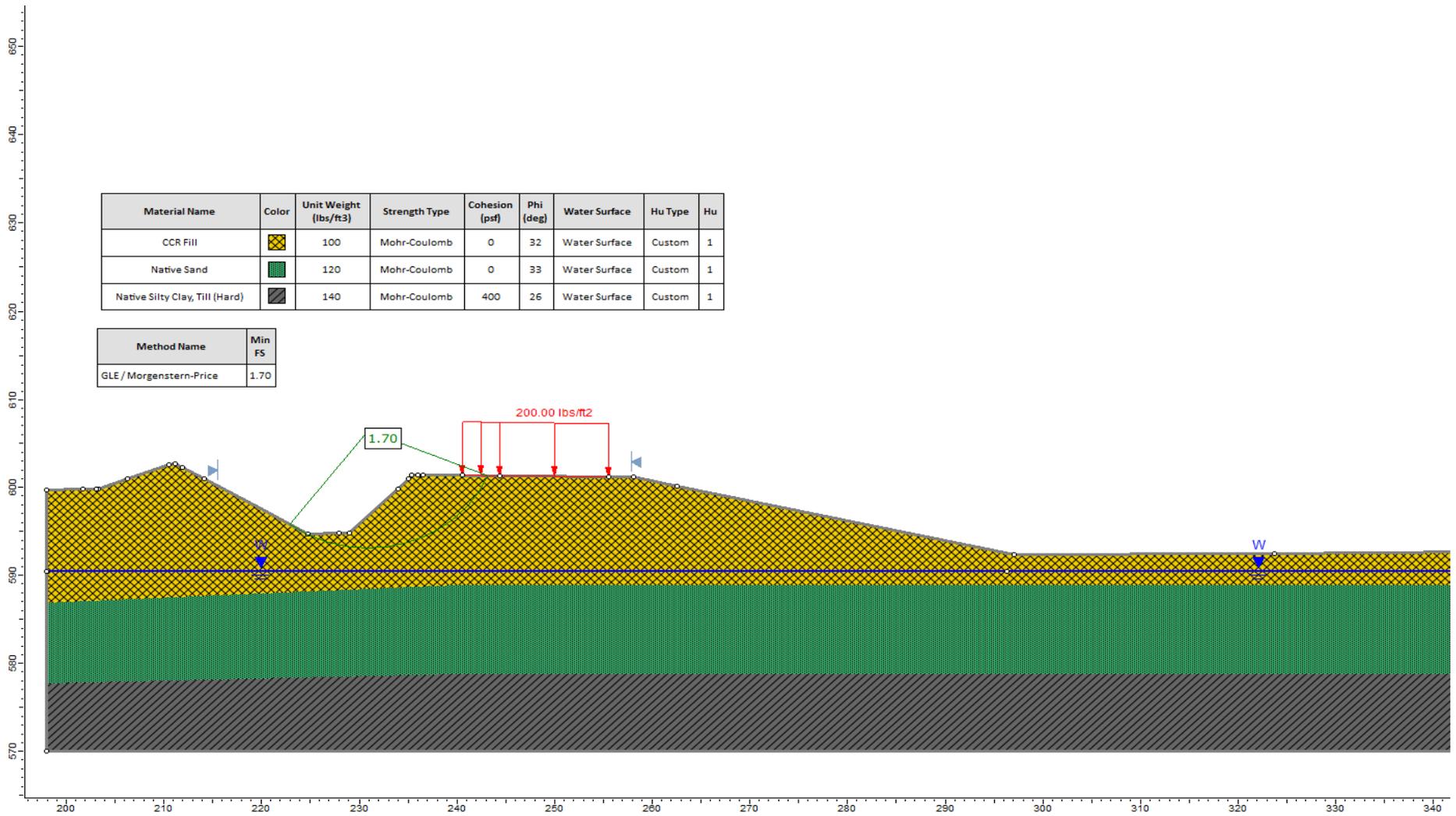
Date: 10/14/2016

Engineering Firm: Golder Associates Inc.

Signature:



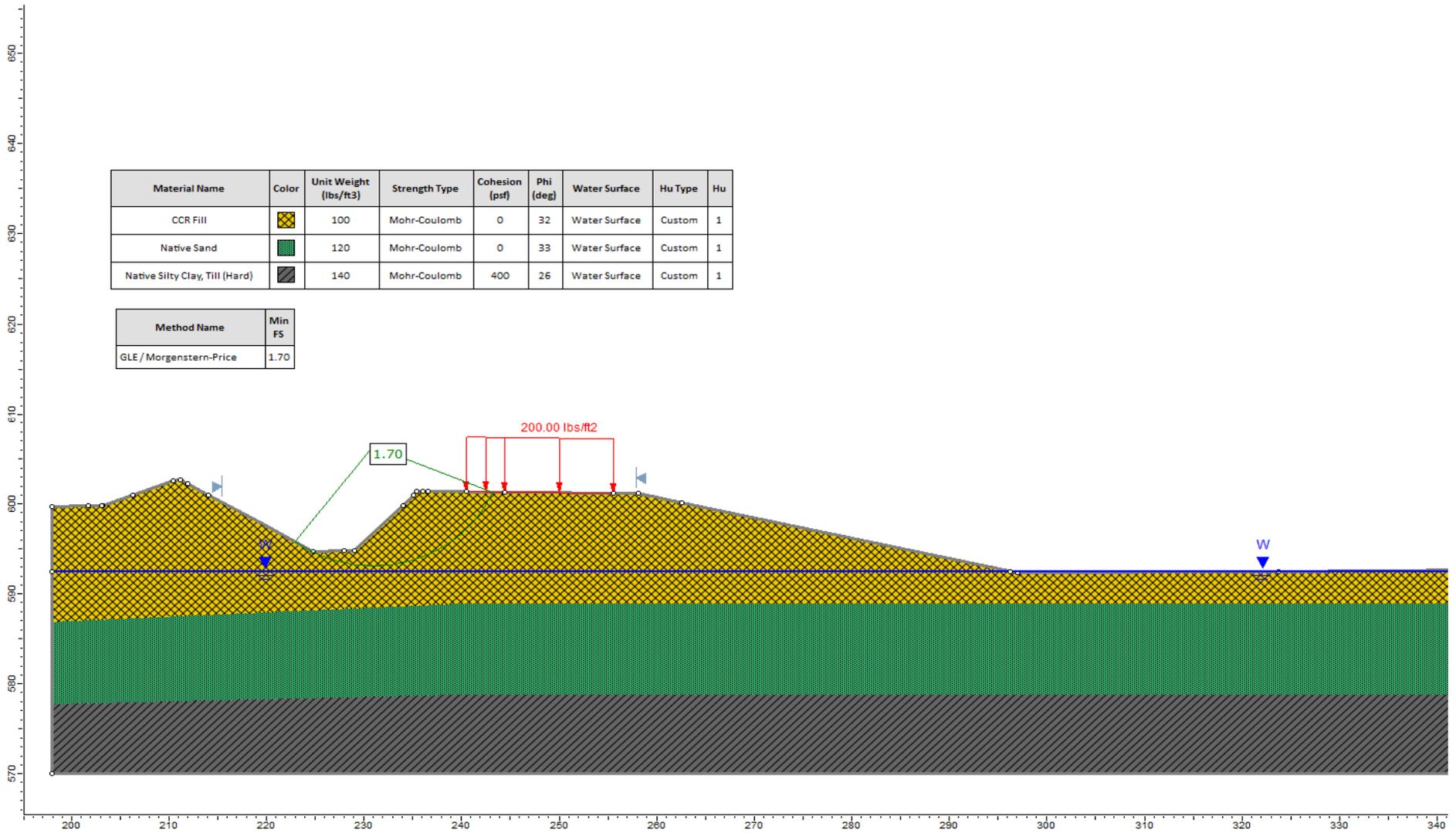
APPENDIX B
SLOPE STABILITY ANALYSIS RESULTS



| | |
|---------|----------|
| SCALE | AS SHOWN |
| DATE | Sep 2016 |
| MADE BY | BF |
| CAD | - |
| CHECK | JMS |
| REVIEW | MJW |

| | | |
|---------|------------------------------------------------------|--|
| PROJECT | J.C. Weadock Structural Stability Assessments | |
| TITLE | Bottom Ash Pond Section A-A' (North Slope) | |
| | Slope Factor of Safety | |
| | Max Pool Storage Scenario | |
| CLIENT | Consumers Energy Company | |
| FIGURE | B-A1 | |

| | | |
|-------------|-----------------------------------|--------|
| FILE | Weadock_Bottom_Ash_Pond_Stability | |
| PROJECT No. | 1655164 | REV. 0 |



| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface | Hu Type | Hu |
|--------------------------------|-------|-----------------------|---------------|----------------|-----------|---------------|---------|----|
| CCR Fill | | 100 | Mohr-Coulomb | 0 | 32 | Water Surface | Custom | 1 |
| Native Sand | | 120 | Mohr-Coulomb | 0 | 33 | Water Surface | Custom | 1 |
| Native Silty Clay, Till (Hard) | | 140 | Mohr-Coulomb | 400 | 26 | Water Surface | Custom | 1 |

| Method Name | Min FS |
|-------------------------|--------|
| GLE / Morgenstern-Price | 1.70 |



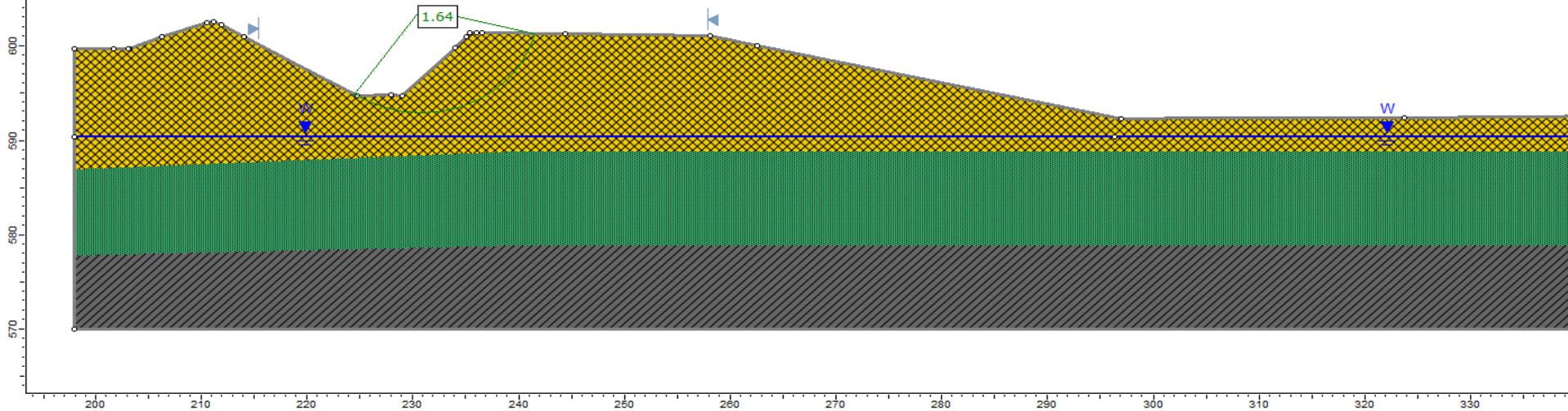
| | | |
|-------------------------------------------------------------------------------------------|-----------------------|------------------------------------------------------------------------------------------------------------------|
| FILE Weadock_Bottom_Ash_Pond_Stability PROJECT No. 1655164 REV. 0 | SCALE AS SHOWN | PROJECT J.C. Weadock Structural Stability Assessments |
| | DATE Sep 2016 | TITLE Bottom Ash Pond Section A-A' (North Slope) Slope Factor of Safety Max Pool Surcharge Scenario |
| | MADE BY BF | CLIENT Consumers Energy Company |
| | CAD - | |
| CHECK JMS REVIEW MJW | FIGURE B-A2 | |

650
640
630
620
610
600
590
580
570

0.05

| Material Name | Color | Unit Weight (lbs/ft3) | Strength Type | Cohesion (psf) | Phi (deg) | Water Surface | Hu Type | Hu |
|--------------------------------|-------|-----------------------|---------------|----------------|-----------|---------------|---------|----|
| CCR Fill | | 100 | Mohr-Coulomb | 0 | 32 | Water Surface | Custom | 1 |
| Native Sand | | 120 | Mohr-Coulomb | 0 | 33 | Water Surface | Custom | 1 |
| Native Silty Clay, Till (Hard) | | 140 | Mohr-Coulomb | 400 | 26 | Water Surface | Custom | 1 |

| Method Name | Min FS |
|-------------------------|--------|
| GLE / Morgenstern-Price | 1.64 |



| | |
|---------|----------|
| SCALE | AS SHOWN |
| DATE | Sep 2016 |
| MADE BY | BF |
| CAD | - |

| | | |
|---------|------------------------------------------------------|--|
| PROJECT | J.C. Weadock Structural Stability Assessments | |
| TITLE | Bottom Ash Pond Section A-A' (North Slope) | |
| | Slope Factor of Safety | |
| | Seismic Scenario | |

| | |
|--------|-----|
| CHECK | JMS |
| REVIEW | MJW |

| | |
|--------|---------------------------------|
| CLIENT | Consumers Energy Company |
|--------|---------------------------------|

| | | |
|-------------|-----------------------------------|--------|
| FILE | Weadock_Bottom_Ash_Pond_Stability | |
| PROJECT No. | 1655164 | REV. 0 |

FIGURE
B-A3

APPENDIX C
LIQUIFACTION POTENTIAL ANALYSIS RESULTS

Project: Weadock RCRA
Location: Essexville, MI
Client: CEC
Proj No.: 1655164
Termination: Target Depth

Test Type: CPTU
Device: 15 cm², Type 2 filter
Standard: ASTM D5778
Push Co.: ConeTec
Operator: Thomas Carpenter

Golder Eng: AK
Check: AF
Review: JS
Max Depth: 50.0 ft

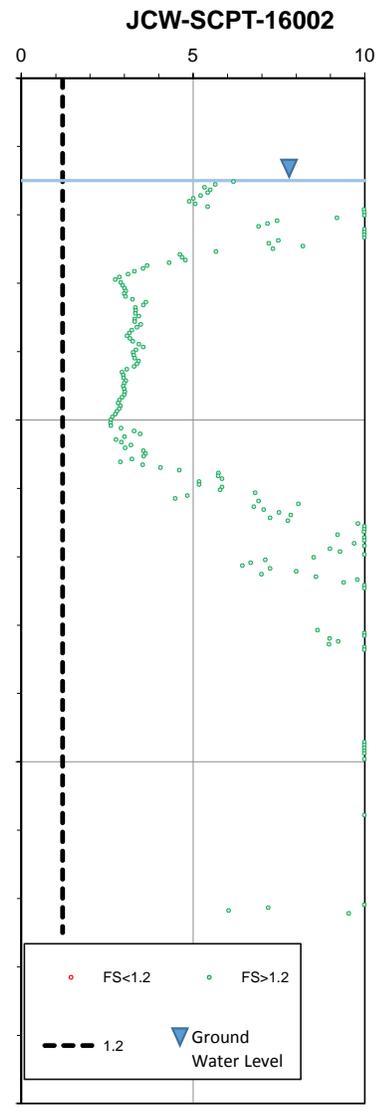
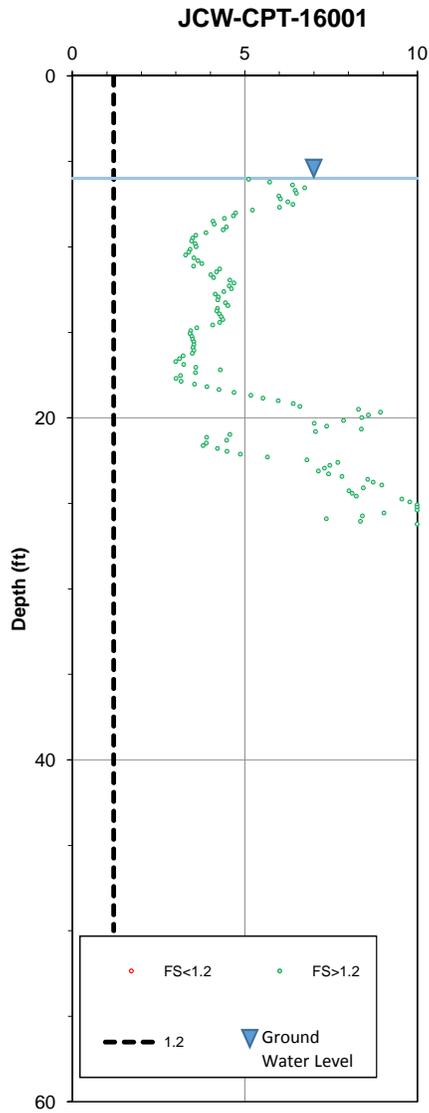
Design EQ 1
Magnitude: 6.8



CPT ID: JCW-CPT-16001
Test Date: 5/19/2016
Northing: 780275
Easting: 13263134
Elevation: 595 ft
a_{max}: 0.05 g
Water Table: 6.0 ft

CPT ID: JCW-SCPT-16002
Test Date: 5/19/2016
Northing: 780649
Easting: 13263582
Elevation: 600.0 ft
a_{max}: 0.05 g
Water Table: 6.0 ft

FACTOR OF SAFETY AGAINST LIQUEFACTION



Notes: Factors of safety (FS) greater than 10 are shown equal to 10.

NCEER (2001) method was used to calculate factors of safety against liquefaction.

The ground water levels shown here are the interpreted ground water levels at the time of CPT investigation.

No liquefaction assumed to be possible above the water table or if $qc1Ncs > 160$.

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