STRUCTURAL STABILITY ASSESSMENT

# STRUCTURAL STABILITY ASSESSMENT

## Bremo Power Station CCR Surface Impoundment: North Ash Pond

Dominion

**Submitted To:** Bremo Power Station
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Bremo Bluff, VA 23022

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# Table of Contents

1.0 Certification ........ 1

2.0 Introduction ........ 2

3.0 Structural Stability ........ 2

3.1 Foundation and Abutments ........ 2

3.2 Slope Protection ........ 3

3.3 Compaction of Dikes ........ 3

3.4 Spillways ........ 4

3.5 Hydraulic Structures ........ 4

3.6 Inundation of Slopes ........ 5

4.0 Conclusions ........ 5

## Tables

Table 1 Summary of Geotechnical Strength Properties

Table 2 Summary of Primary Geotechnical Testing Data for the NAP Embankment Soil Fills

Table 3 Summary of Secondary Geotechnical Data for the NAP Embankment Soil Fills

## Appendices

Appendix A North Ash Pond Inundation Cross-Section

## 1.0 CERTIFICATION

This Structural Stability Assessment for the Bremo Power Station's North Ash Pond was prepared by Golder Associates Inc. (Golder). The document and Certification/Statement of Professional Opinion are based on and limited to information that Golder has relied on from Dominion and others, but not independently verified, as well as work products produced by Golder.

On the basis of and subject to the foregoing, it is my professional opinion as a Professional Engineer licensed in the Commonwealth of Virginia that this document has been prepared in accordance with good and accepted engineering practices as exercised by other engineers practicing in the same discipline(s), under similar circumstances, at the same time, and in the same locale. It is my professional opinion that the document was prepared consistent with the requirements in §257.73(d) of the United States Environmental Protection Agency's "Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments," published in the Federal Register on April 17, 2015, with an effective date of October 19, 2015 [40 CFR §257.73(d)].

The use of the word "certification" and/or "certify" in this document shall be interpreted and construed as a Statement of Professional Opinion, and is not and shall not be interpreted or construed as a guarantee, warranty, or legal opinion.

| | |
|---|---|
| James R. DiFrancesco, P.E. | Principal and Practice Leader |
| Print Name | Title |
| | 10/13/2016 |
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## 2.0 INTRODUCTION

This Structural Stability Assessment was prepared for the Bremo Power Station's (Station) existing Coal Combustion Residuals (CCR) surface impoundment known as the North Ash Pond (NAP). This Structural Stability Assessment was prepared in accordance with 40 CFR Part §257, Subpart D and is consistent with the requirements of 40 CFR §257.73(d).

The Station, owned and operated by Virginia Electric and Power Company d/b/a Dominion Virginia Power (Dominion), is located in Fluvanna County at 1038 Bremo Road, east of Route 15 (James Madison Highway) and north of the James River. The Station includes an existing CCR surface impoundment, the NAP, as defined by the Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule (40 CFR §257; the CCR rule).

## 3.0 STRUCTURAL STABILITY

### 3.1 Foundation and Abutments

The Station lies in a geologically stable area with no active (Holocene) faults, karst (limestone, dolomite, or marble) potential, or other geologic conditions of concern. The NAP is constructed on natural soils that consist of a typical Piedmont residual, saprolitic soil profile, formed from in-place weathering of rock. Piedmont soils consist of fine sandy silts (ML) and silty sands (SM), with occasional coarse materials that include coarser sands and angular gravel pieces derived from seams of resistant materials (mainly quartz), as well as the lower saprolites and upper disintegrated rock. Several areas within the NAP foundation were excavated, exposing disintegrated rock, and used to construct the dikes. Material properties within the NAP foundation and abutments were interpreted based on subsurface data and site reconnaissance taken from previous Golder investigations, analyses, and reports included in Golder's March 2016 Virginia Department of Conservation and Recreation (DCR) Impounding Structure Geotechnical Design Report Supporting Documents (Golder 2016), and are presented in Table 1 below.

**Table 1: Summary of Geotechnical Strength Properties**

| *Material* | *Total Unit Weight (pound per cubic foot, pcf)* | *Strength Properties* | | |
|---|---|---|---|---|
| | | **Peak ϕ' (°)** | **Cohesion (*pound per square foot, psf*)** | **Su (*ton per square foot, tsf*)** |
| *Dike Fill Soils- NAP* | 125 | 0 - 40 ft: 31<br>> 40 ft: 28 | 50 | 2.0 |
| *Residuum* | 125 | 28 | 50 | 1.5 |
| *Disintegrated Rock* | 140 | 31 | 1000 | 50 |

## 3.2 Slope Protection

The NAP dike was built at slopes of 2.5H:1V or flatter, with benches on the upstream and downstream sides. The dike is provided with seepage controls in the form of blanket drains that limit the risk of softening of the embankment surface that could make maintenance difficult and/or increase erosion and stability concerns. In addition, the vegetation on the dike is maintained to prevent brush, trees, clumping of weeds, etc. that would concentrate flow and lead to the development of erosion rills. The dikes are currently in good condition.

## 3.3 Compaction of Dikes

The following tables summarize the primary geotechnical laboratory results and basic cone penetrometer testing (CPT)-based interpretations (Table 2), and secondary laboratory data (Table 3) from the NAP dike laboratory soil tests and CPTs completed during the 2015 geotechnical exploration program.

**Table 2: Summary of Primary Geotechnical Testing Data for the NAP Embankment Soil Fills**

| Property | Number of Tests | Minimum | Maximum | Average | Median |
|---|---|---|---|---|---|
| Depth Range (feet) | - | 9.5 | 114.5 | 63.6 | 62.1 |
| Water Content (%) | 10 | 14 | 29 | 22 | 22 |
| Gravel (> 4.75 millimeters) (%) | 10 | 0 | 8 | 3 | 2 |
| Sand (%) | 10 | 39 | 67 | 57 | 61 |
| Fines (< 0.075 millimeters) (%) | 10 | 30 | 59 | 40 | 37 |
| Specific Gravity | 0 | - | - | - | - |
| Liquid Limit (LL) (%) | 5 | 32 | 46 | 40 | 42 |
| Plastic Limit (PL) (%) | 5 | 26 | 35 | 30 | 28 |
| Plasticity Index (PI) | 5 | 3 | 16 | 10 | 11 |
| Non-plastic Results | 5 | None of the 5 Atterberg tests completed (i.e., LL, PL, and PI) returned non-plastic results | | | |

**Table 3: Summary of Secondary Geotechnical Data for the NAP Embankment Soil Fills**

| Property | | Number of Points | Minimum | Maximum | Average | Median |
|---|---|---|---|---|---|---|
| Drilling | Standard Penetration Test (SPT) N (blows per foot, bpf) | 46 | 7 | 31 | 18.5 | 18 |
| CPT Based | *Peak φ' (°)* | 2538 | 20.7 | 47.5 | 34.0 | 34.1 |
| | Su (ton per square foot, tsf) | | 0.7 | 15.5 | 4.3 | 3.9 |
| | SPT $N_{60}$ (bpf) | | 5 | 100 | 29 | 27 |
| | Normalized CPT Tip Resistance (Qtn) | | 1.9 | 521.7 | 58.1 | 31.6 |

As seen in the above results tables, the NAP dikes generally consist of a mix of fine sandy silt (ML) and silty fine sand (SM) materials that show consistencies in line with a well compacted and competent fill material.

The NAP dike is homogeneous and well compacted, with preferential drainage paths occurring through the disintegrated rock and rock in the NAP bottom and dike abutments, as indicated by controlled drainage in the abutments and variation in water levels in wells screened through the dike.

## 3.4 Spillways

The NAP's primary spillway, an intake tower and 24-inch diameter pipe, has been plugged in order for water from the pond to be routed to the Centralized Water Treatment System for treatment prior to discharge. Surface water and pore water within the NAP are pumped to the on-site treatment plant for treatment and discharge. The emergency spillway, located on the west side of the NAP, is available for discharge should the water accumulate to the crest of the spillway. However, much of the surface water from this pond has been removed and treated in anticipation of closure. The existing emergency spillway is an approximately trapezoidal-shaped, broad-crested spillway that is built into the road surface along the top of the impoundment's western natural ridge line. Its original design crest width of 200 feet has been reduced to a width of approximately 153 feet due to operations and road maintenance over the years. The spillway has an effective depth of 2.6 feet and is surfaced with well-compacted crushed aggregate. The size and capacity of the emergency spillway are adequate to convey the runoff from the probable maximum flood (PMF) event without overtopping the embankment or eroding the spillway. The analysis of the spillway capacity is included in Appendix B of the Inflow Design Flood Control System Plan.

## 3.5 Hydraulic Structures

The primary spillway and toe drain collection system pass through the dike of the NAP. The primary spillway is a 24-inch diameter pipe connected to a concrete riser structure that is anchored within the main dike segment. The existing spillway structure will be removed and/or abandoned in place. The existing drainage controls for the NAP dike, which consist of 6-inch toe drains, are adequate and will be maintained during and after the closure activities. There is no record or knowledge of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, or debris associated with the primary spillway and toe drain collection system. In accordance with 40 CFR §257.83, the pipe systems will be monitored and inspected periodically for clogging, leaks, erosion around the pipes, movements, or other issues.

### 3.6 Inundation of Slopes

The NAP dam is located approximately 900 feet from the James River. The toe of the dam abuts the East Ash Pond (EAP) embankment at an approximate elevation of 234 feet above mean sea level (ft amsl). The 100-year and 500-year storm events were considered. The water surface elevations of the James River resulting from the 100-year and 500-year storm events are 227.91 ft amsl and 235.31 ft amsl, respectively. The resulting temporary inundation from the 500-year storm event (1.31 feet) is considered to have a negligible impact to the structural stability of the NAP embankment. A cross-section through the NAP dam and the James River is provided in Appendix A.

## 4.0 CONCLUSIONS

It is Golder's opinion, based upon a review of available information and the additional analyses performed for this and other assessments, that the NAP surface impoundment design, construction, operations, and maintenance procedures are consistent with good engineering practices for the volume of CCR and CCR wastewater that is impounded, and meets the requirements of 40 CFR 257.73(d).

Established in 1960, Golder Associates is a global, employee-owned organization that helps clients find sustainable solutions to the challenges of finite resources, energy and water supply and management, waste management, urbanization, and climate change. We provide a wide range of independent consulting, design, and construction services in our specialist areas of earth, environment, and energy. By building strong relationships and meeting the needs of clients, our people have created one of the most trusted professional services organizations in the world.


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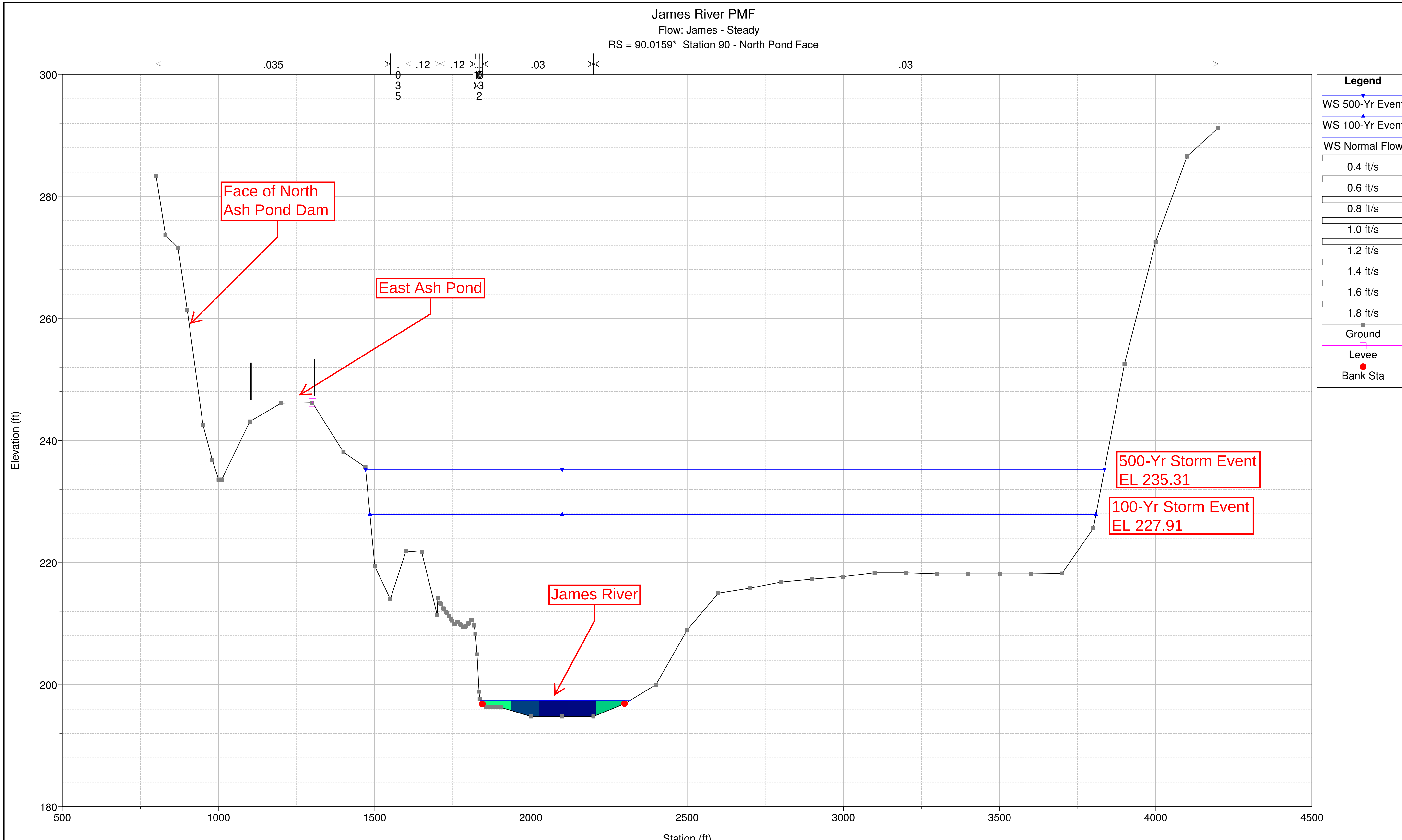
# Appendix A

## North Ash Pond Inundation Cross-Section


James River PMF
Flow: James - Steady
RS = 90.0159* Station 90 - North Pond Face
.035
.03
.12
.12
.03
.03
Legend
WS 500-Yr Event
WS 100-Yr Event
WS Normal Flow
0.4 ft/s
0.6 ft/s
0.8 ft/s
1.0 ft/s
1.2 ft/s
1.4 ft/s
1.6 ft/s
1.8 ft/s
Ground
Levee
Bank Sta
Face of North Ash Pond Dam
East Ash Pond
500-Yr Storm Event EL 235.31
100-Yr Storm Event EL 227.91
James River
Elevation (ft)
Station (ft)
300
280
260
240
220
200
180
500
1000
1500
2000
2500
3000
3500
4000
4500