DOMINION ENERGY

PERIODIC STRUCTURAL STABILITY ASSESSMENT

BREMO STATION INACTIVE CCR SURFACE IMPOUNDMENT: EAST POND

APRIL 2023

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APPENDICES

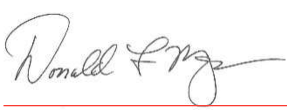
1 CERTIFICATION

This periodic Structural Stability Assessment for the Bremo Station's East Pond was prepared by WSP USA Inc. (WSP; formerly d/b/a Golder Associates USA Inc.). The document and Certification/Statement of Professional Opinion are based on and limited to information that WSP has relied on from Dominion Energy and others, but not independently verified, as well as work products previously produced by Golder.

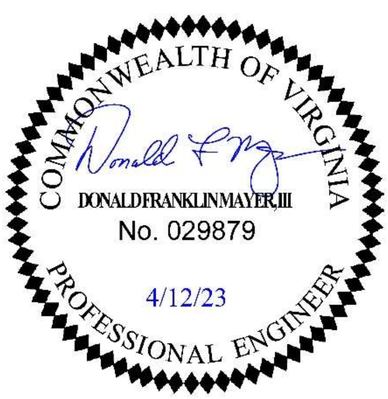
On the basis of and subject to the foregoing, it is my professional opinion as a Professional Engineer licensed in the Commonwealth of Virginia that this document has been prepared in accordance with good and accepted engineering practices as exercised by other engineers practicing in the same discipline(s), 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 40 CFR §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)], as well as with the requirements in 40 CFR §257.100 resulting from the EPA's "Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals from Electric Utilities: Extension of Compliance Deadlines for Certain Inactive Surface Impoundments; Response to Partial Vacatur" published in the Federal Register on August 5, 2016, with an effective date of October 4, 2016 (40 CFR §257.100).

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.

Donald Mayer, PE	Vice President
Print Name	Title



	04/12/2023
Signature	Date



2 INTRODUCTION

This periodic Structural Stability Assessment (Assessment) was prepared for the Bremo Station's (Station) existing Coal Combustion Residuals (CCR) inactive surface impoundment known as the East Pond. This periodic 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 Energy Virginia (Dominion Energy), 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, inactive CCR surface impoundment, the East Pond, as defined by the Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule and Direct Final Rule (40 CFR §257; the CCR Rule). The East Pond is also regulated as a dam by the Virginia Department of Conservation and Recreation (DCR) with Inventory Number 065019 (DCR Dam Permit). Discharge from the East Pond is currently regulated by Virginia Department of Environmental Quality (DEQ) Virginia Pollutant Discharge Elimination System Permit No. VA0004138 (VPDES Permit).

Dominion Energy performed closure by removal activities in the East Pond by removing the stored CCR and over-excavating soil pursuant to its solid waste permit closure plan (SWP 618). The Virginia Department of Environmental Quality (DEQ) verified removal activities in October 2019. The East Pond remains subject to the CCR Rule requirements due to observed groundwater impacts that prevent full closure of the unit under the rule even though the Pond no longer impounds CCR materials.

3 PURPOSE

This periodic Assessment is prepared pursuant to the requirements in the CCR Rule, 40 CFR §257.73(d)(1). The initial Structural Stability Assessment was completed in April 2018 and is required to be updated every five (5) years pursuant to 40 CFR §257.73(f)(3). The East Pond remains subject to the CCR Rule requirements, including this periodic structural stability assessment update, even though all CCR materials have been removed.

4 STRUCTURAL STABILITY ASSESSMENT REQUIREMENTS

In accordance with 40 CFR §257.73(d)(1), the owner or operator of a CCR surface impoundment must conduct periodic structural stability assessments and document whether the design, construction, operation, and maintenance of the CCR surface impoundment 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:

- Stable foundations and abutments;
- Adequate slope protection to protect against surface erosion, wave action, and adverse effects of sudden drawdown;
- Dikes mechanically compacted to a density sufficient to withstand the range of loading conditions in the CCR unit;
- Vegetated slopes of dikes and surrounding areas not to exceed a height of six inches above the slope of the dike, except for slopes which have an alternate form or forms of slope protection;
- A single spillway or a combination of spillways that is designed, constructed, operated, and maintained to adequately manage flow during and following the peak discharge from the 100-year flood;
- All spillways must be either of non-erodible construction and designed to carry sustained flows or earth- or grass-lined and designed to carry short-term, infrequent flows at non-erosive velocities where sustained flows are not expected;
- 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; and
- 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.

5 STRUCTURAL STABILITY ASSESSMENT

5.1 FOUNDATION AND ABUTMENTS

The Station lies on an alluvial terrace in a geologically stable area with no active (Holocene) faults, karst (limestone, dolomite, or marble) potential, or other geologic conditions of concern. The East Pond was constructed on the natural, alluvial soils generally consisting of clayey silts and locally-exposed underlying gravel channels or residual materials. The East Pond is roughly triangular in shape and is generally defined by the rising natural ground along the north and northeast side and by a western and southern earth dike that begins at a steep east abutment and extends about 1,900 feet to the west before turning north about 700 feet to meet the rising ground in the right or northwest abutment. The East Pond embankments were constructed of mostly alluvial soils excavated from within the footprint of the pond. Material properties within the East Pond foundation and abutments were interpreted based on subsurface data and site reconnaissance taken from previous investigations, analyses, and reports included in the March 2017 Virginia DCR Impoundment Structure Geotechnical Design Report Supporting Documents (Golder, 2017).

WSP's assessment of embankment stability in the Periodic Safety Factor Assessment (WSP, 2023b) show that the East Pond meets the minimum factor of safety requirements in the CCR Rule §257.73(e)(1).

Additionally, the East Pond has been routinely inspected and monitored by Station and Dominion Energy personnel in accordance with the requirements in the DCR Dam Permit. Areas of concern are evaluated by professional engineers with corrective actions implemented and documented.

5.2 SLOPE PROTECTION

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 interior and exterior slopes are maintained and protected against surface erosion by regular inspections and maintenance, as required, to prevent small erosion areas from developing into larger problem areas.

Dominion Energy performs annual inspections in accordance with the requirements of the DCR Dam Permit with the most recent inspections on June 17, 2021 (Virginia Electric and Power Company, 2021) and September 20, 2022 (Virginia Electric and Power Company, 2022). Dominion Energy evaluates the vegetation on the slopes of the impoundment embankment as part of the annual inspections. Current operations at the East Pond call for grass to be mowed 2-3 times per year to control vegetation height. Additionally, in accordance with 40 CFR Section §257.83, annual inspections are performed by a qualified professional engineer with the most recent inspection on June 16, 2022 (WSP, 2022).

5.3 COMPACTION OF DIKES

The following tables summarize the primary geotechnical laboratory results and basic cone penetrometer testing (CPT)-based interpretations (Table 1), and secondary laboratory data (Table 2) from the East Pond dike laboratory soil tests and CPTs completed during the 2015 geotechnical exploration program.

Table 1 Summary of Primary Geotechnical Testing Data for the East Pond Dike Soil Fills

PROPERTY	NUMBER OF TESTS	MINIMUM	MAXIMUM	AVERAGE	MEDIAN
Depth Range (feet)	-	9	49.6	22.3	17
Water Content (%)	8	12	30	24	24
Gravel (> 4.75 millimeters) (%)	5	0	6	1	0
Sand (%)	5	5	49	26	27
Fines (< 0.075 millimeters) (%)	6	51	95	74	75
Specific Gravity	2	2.71	2.76	2.74	2.74
Liquid Limit (LL) (%)	8	19	44	33	32
Plastic Limit (PL) (%)	8	15	33	22	22
Plasticity Index (PI)	8	4	18	11	11
Non-plastic Results	1	1 of 8			

Table 2 Summary of Secondary Geotechnical Data for the East Pond Dike Soil Fills

PROPERTY		NUMBER OF POINTS	MINIMUM	MAXIMUM	AVERAGE	MEDIAN
Drilling	Standard Penetration Test (SPT) N (blows per foot, bpf)	40	0	18	8	8

PROPERTY		NUMBER OF POINTS	MINIMUM	MAXIMUM	AVERAGE	MEDIAN
CPT Based	*Peak φ' (°)*	1539	23.1	47.1	33.8	33.5
	Su (ton per square foot, tsf)		0.4	8.3	2.4	2.1
	SPT N_{60} (bpf)		2	69	18	15
	Normalized CPT Tip Resistance (Qtn)		3.2	481.4	48.2	27.8

Embankment fills in the East Pond dikes generally consist of low-plasticity fines (CL and ML) with increasing amounts of sand with fines (SM and SC) encountered in the eastern portion of the embankment. Some trace ash was noted in the dike fills but is suggestive of incidental inclusion rather than deliberate construction. In contrast, the vertical expansion dikes used as internal and upper dike fills on the eastern half of the East Pond are generally comprised of compacted ash. The following table summarizes the geotechnical data for the compacted CCR fills:

Table 3 Summary of Secondary Geotechnical Data for the East Pond Dike CCR Fills

PROPERTY		NUMBER OF TESTS	MINIMUM	MAXIMUM	AVERAGE	MEDIAN
CPT Based	*Peak φ' (°)*	960	33.1	46.9	42.4	43.1
	Su (ton per square foot, tsf)		1.9	4.8	2.4	2.2
	SPT N_{60} (bpf)		9	67	35	36
	Normalized CPT Tip Resistance (Qtn)		26.7	460.8	209.1	207.7

Slope stability analyses presented in the Safety Factor Assessment (WSP, 2023b) present the embankment to be stable.

5.4 VEGETATED SLOPES

As required by §257.73(d)(1)(iv), vegetation on slopes and surrounding areas are not to exceed a height of six inches above the slope of the dike. Current operations at the East Pond call for grass to be mowed 2-3 times per year to control vegetation height. The vegetated slopes are operated and maintained to be stable and to provide for visual observation of any instability. The 2021 and 2022 annual DCR inspections (Virginia Electric and Power Company, 2021; Virginia Electric and Power Company, 2022) noted that the upstream and downstream slopes of the embankment have been mowed.

5.5 SPILLWAYS

The East Pond's primary spillway is through an existing outlet structure in the southeast corner of the pond. The outlet structure is a square concrete intake tower, 5-feet-6-inches in width with a weir opening at an elevation of approximately 214.0 feet above mean sea level (ft amsl). The outlet pipe is a 24-inch diameter reinforced concrete pipe with an inlet invert elevation of 206.9 ft amsl. An emergency spillway is located in the west side of the East Pond at an elevation of 230.0 ft amsl. The 24-inch diameter pipe extends from the structure under the East Pond dike to a drainage channel and ultimately through a permitted outfall.

As shown in the current Periodic Inflow Design Flood Control System Plan for the East Pond, the structure has adequate capacity to store the flow from the design storm event. Analysis of the spillway capacity is included in Appendix A of the Inflow Design Flood Control System Plan for the East Pond (WSP, 2023a).

5.6 HYDRAULIC STRUCTURES

The primary spillway passes through the dike of the East Pond. The primary spillway is a 24-inch diameter pipe connected to a concrete riser structure that is anchored within the footprint of the pond. There is no record or knowledge of significant deterioration, deformation, distortion, bedding deficiencies, sedimentation, or debris associated with the primary spillway. In accordance with 40 CFR §257.83, the pipe systems are monitored and inspected periodically for clogging, leaks, erosion around the pipes, movements, and other issues.

5.7 ADJACENT WATER BODIES

The East Pond dike is located approximately 325 feet north of the James River. The top of the embankment at the lowest point is elevation 230 feet above mean sea level. The mapped 100-year flood Zone AE elevation is approximately 228 ft amsl, so significant inundation of the exterior slopes of the East Pond can be expected during a 100-year flood event in the James River. Evaluation of the slope stability under rapid drawdown conditions after a 100-year flood event shows that the embankments exhibit satisfactory factors of safety. Analysis of the rapid drawdown conditions in included as Appendix A.

6 CORRECTIVE MEASURES

No structural stability deficiencies were identified, so no corrective measures are required.

7 CONCLUSIONS

The East Pond is subject to a periodic structural stability assessment update (due every 5 years from the original assessment performed in April 2018). The pond remains subject to the CCR rule requirements, even though it no longer impounds CCR materials, due to observed groundwater impacts that prevent full closure of the units under the rule.

Based on known site conditions, review of available information, and the current analyses performed for the East Pond embankment, the East Pond surface impoundment design, construction, operations, and maintenance procedures are consistent with good engineering practices for the volume of CCR wastewater that is impounded and meets the requirements of 40 CFR 257.73(d).

REFERENCES

- Golder Associates. Virginia Department of Conservation and Recreation Impounding Structure Geotechnical Design Report. March 2017.
- Virginia DCR Dam Permit, Inventory No. 065019.
- Virginia Electric and Power Company. Annual Inspection Report for Virginia Regulated Impounding Structures, Bremo Power Station East Ash Pond Dam. June 2021.
- Virginia Electric and Power Company. Annual Inspection Report for Virginia Regulated Impounding Structures, Bremo Power Station East Ash Pond Dam. September 2022.
- WSP USA Inc. Annual Inspection Report for Existing CCR Surface Impoundment, Bremo Power Station East Ash Pond Dam. July 2022.
- WSP USA Inc. Periodic Inflow Design Flood Control System Plan, Bremo Power Station Inactive CCR Surface Impoundment: East Pond. April 2023a.
- WSP USA Inc. Periodic Safety Factor Assessment, Bremo Power Station Inactive Surface Impoundment: East Pond. April 2023b.

APPENDIX

A

Rapid Drawdown Methodology Package

Date:	April 2023	**Made by:**	W. Foong
Project No.:	GL21466315	**Checked by:**	S. Secara
Subject:	Rapid Drawdown Methodology Package	**Reviewed by:**	G. Hebeler
Project Title:	**BREMO STATION – EAST POND**		

1.0 INTRODUCTION

This document describes the methodology WSP USA Inc. (WSP, formerly operating as Golder) used to evaluate the stability of East Pond dike slopes under rapid drawdown conditions at Dominion Energy's Bremo Station.

Rapid drawdown takes place when free water outside a slope draws down quickly such that the pore pressure in the slope does not have sufficient time to dissipate. The water level drop removes a stabilizing force outside the slope and reduces the stability factor of safety from steady-state conditions.

2.0 METHODOLOGY AND ASSUMPTIONS

WSP used the design procedures and criteria described in the Engineer Manual (EM) 1110-2-1902 from the United States Army Corps of Engineers (USACE, 2003) to evaluate stability under rapid drawdown conditions. For the conditions considered in this package, the USACE lists a minimum target factor of safety of 1.1. Thus, a minimum target factor of safety of 1.1 was adopted for this analysis.

Additionally, the following has been assumed for this analysis:

- The slope is subject to an elevated water level long enough to become saturated
- Drawdown from the elevated water level is rapid
- No drainage occurs out of the slope when the water level drops

USACE lists two methods for performing rapid drawdown analysis but identifies one as the recommended method. WSP used the recommended method for analysis which was developed by Lowe and Karafiath (1959) and later modified by Wright and Duncan (1987) and by Duncan, Wright, and Wong (1990). These procedures are described in whole in the book *Soil Strength and Slope Stability* (Duncan et al., 2014). WSP used the computer program SLIDE2's built-in rapid drawdown tool which includes the reference method (Rocscience, 2023).

Factors of safety were calculated using the general limit equilibrium (GLE) method developed by Morgenstern and Price (Abramson et al., 2002). The factor of safety is calculated by dividing the resisting forces by the driving forces along the critical slip surface.

The rapid drawdown method differs from steady-state stability analyses in the application of material strengths. The rapid drawdown method uses two strength envelopes.

The first strength envelope represents the isotropic consolidation condition where the stress ratio is one (Kc = 1) and is determined from isotropically consolidated-undrained triaxial shear tests by plotting the undrained shear strength (τ_{ff}) versus the effective stress on the failure plane at consolidation (σ'_{fc}). The slope and intercept of the shear strength envelope are $\psi_{Kc=1}$ and $d_{Kc=1}$ as shown below in Figure 1.

The second strength envelope used in rapid drawdown analysis represents the effective shear strength at on the maximum effective principal stress ratio (Kc = $K_{failure}$ = K_f). The slope and intercept of the strength envelope are defined by the effective friction angle (ϕ') and the effective cohesion (c') determined from isotropically consolidated-undrained triaxial shear tests as shown in Figure 2.

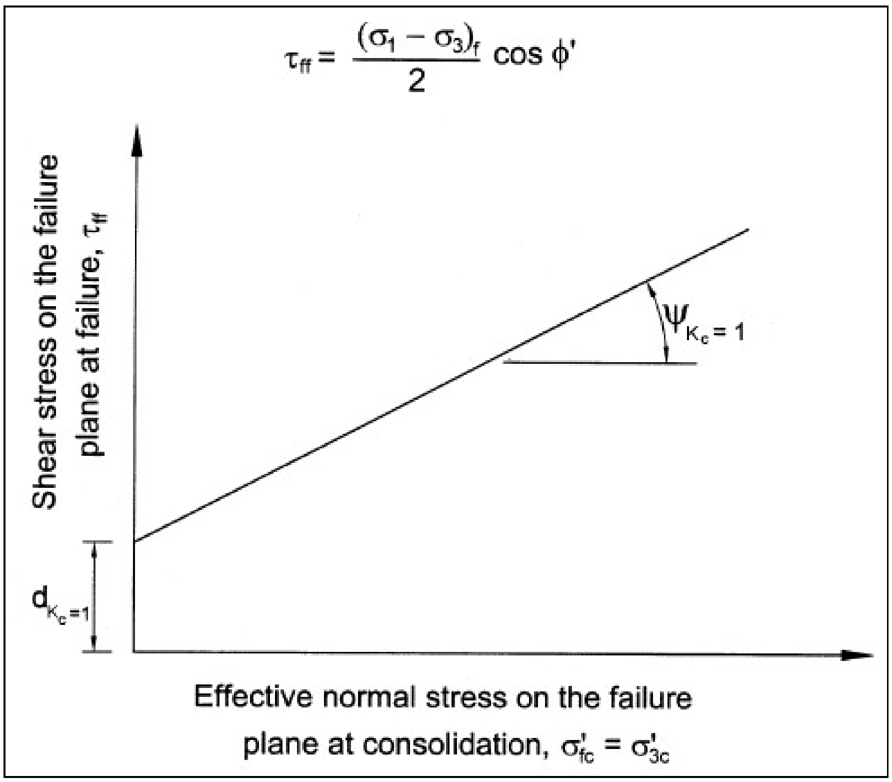


Figure 1. Estimation of Undrained Shear Strength Kc = 1

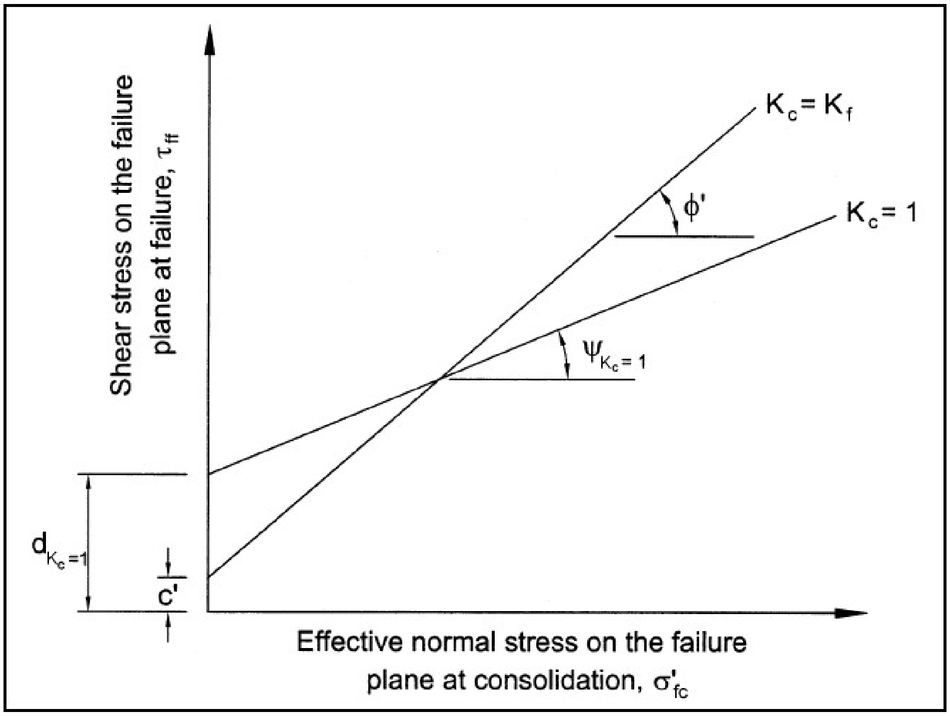


Figure 2. Shear Strength Envelopes for Rapid Drawdown Computations

3.0 SITE-SPECIFIC ANALYSIS

Based on the geotechnical exploration at the site, the East Pond and West Pond dikes at Bremo Power Station are composed of alluvial soils excavated from the interior portions of the ponds. These materials are primarily described as a mix of fine sandy silt and sandy clay (ML and CL) and silty fine sand (SM) (Golder, 2016).

3.1 Shear Strength of Embankment Fill

For the rapid drawdown analysis, results from isotropically consolidated undrained triaxial compression tests (CIU) are needed to develop the two strength envelopes described above. Two samples of East Pond dike fill material and one sample of West Pond dike fill material were subjected to such testing, as summarized in Table 1.

Table 1: Summary of Dike Sample Subject to CIU Testing

Sample ID	Sample Depth (ft)	Pond	USCS	Liquid Limit	Plasticity Index	Fines Content (%)
WB-01 UD-01	20.6 – 21.9	West	ML	36	11	90
GB-2 UD-01	8 – 10	East	CL	38	13	82
GB-3 UD-01	16 - 18	East	CL-ML	19	4	51

Data from the samples have been synthesized to estimate the shear strength envelopes of the dike under rapid drawdown conditions since the material for the dikes was obtained from the site and belongs to the same general soil unit. Table 2 lists the results of the triaxial tests and the calculated stresses.

Table 2: Summary of CIU Triaxial Results

Sample ID	σ'_{fc} (psi)	σ_{1f} (psi)	σ_{3f} (psi)	u_f (psi)	σ'_{1f} (psi)	σ'_{3f} (psi)	ϕ' (deg)	σ'_f (psi)	τ_{ff} (psi)
WB-1 UD-1	7.4	16.481	7.4	3.660	12.821	3.740	33.3	5.791	3.797
	14.8	31.806	14.8	6.592	25.214	8.208	30.6	12.384	7.320
	29.6	69.222	29.6	8.926	60.296	20.674	29.3	30.791	17.277
GB-2 UD-01	4.0	15.405	4.0	1.329	14.076	2.671	42.9	4.490	4.176
	8.0	19.835	8.0	3.840	15.995	4.160	36.0	6.603	4.790
	16.0	38.850	16.0	6.490	32.360	9.510	33.1	14.700	9.574
GB-3 UD-01	7.0	17.038	7.0	3.008	14.030	3.992	33.8	6.215	4.168
	15.0	28.801	15.0	5.984	22.817	9.016	25.7	12.925	6.218
	30.0	59.343	30.0	13.378	45.966	16.622	28.0	24.415	12.959

Strength envelopes were developed for the undrained (K_c = 1) condition and the effective strength condition (K_c = K_f) by fitting lines to the data as shown in Figure 3 and 4, respectively.

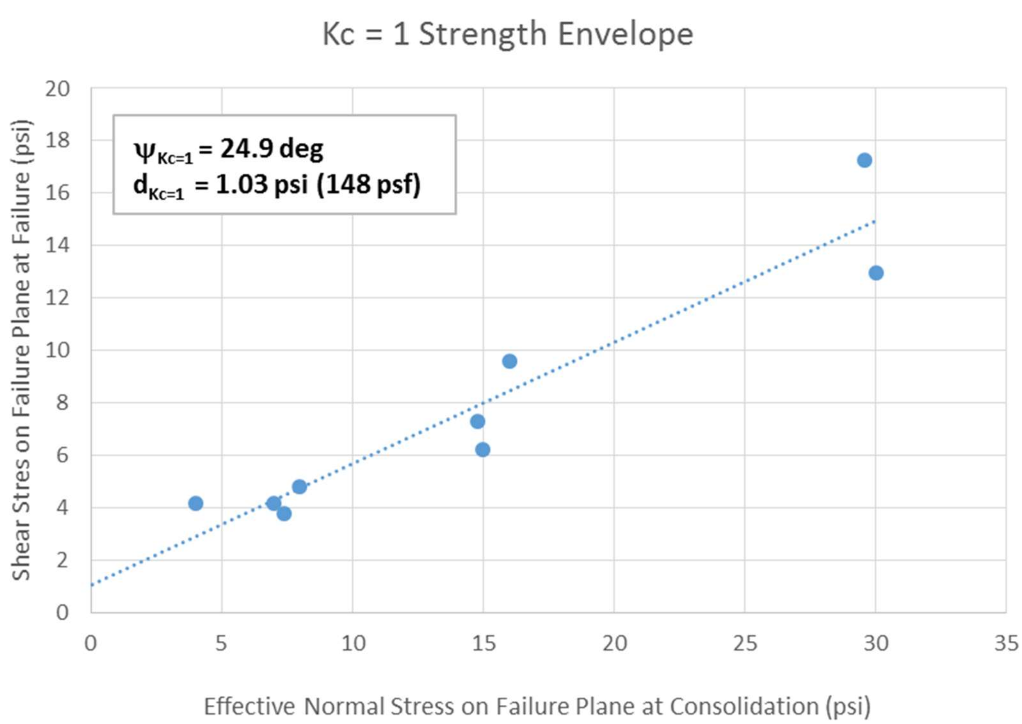


Figure 3. K_c = 1 Shear Strength Envelope for Rapid Drawdown Computations

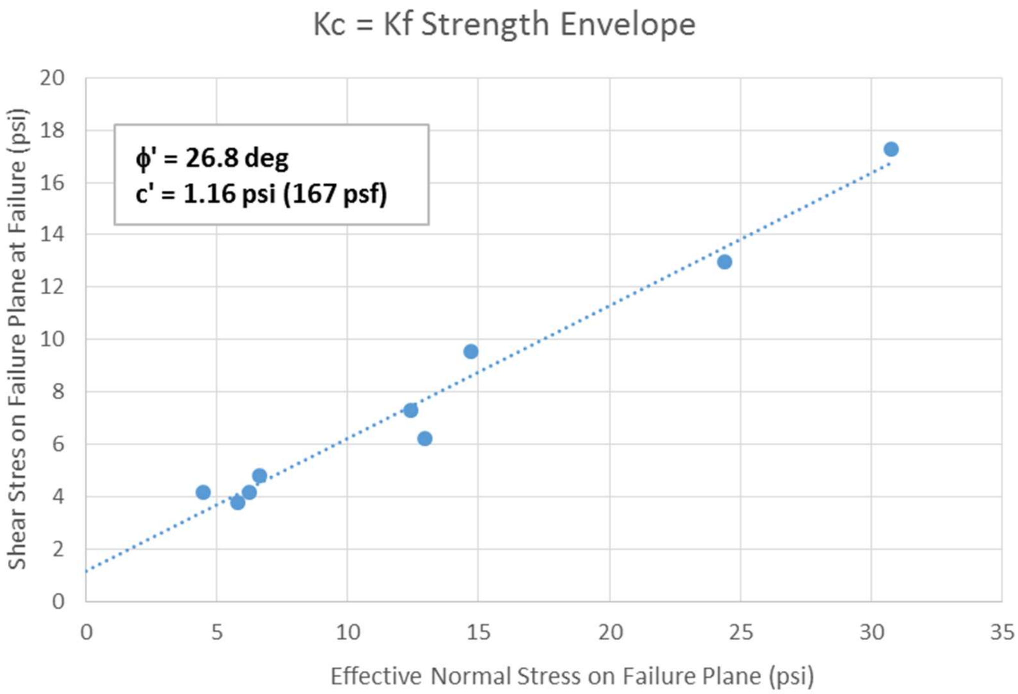


Figure 4. $K_c = K_f$ Shear Strength Envelope for Rapid Drawdown Computations

3.2 Water Levels

The initial (pre-drawdown) water level was set at 228.2 feet above mean sea level (ft-msl) which corresponds to the 100-year flood event. WSP assumed that the rapid drawdown condition would occur until the water level reached the toe of the dike.

4.0 CONCLUSIONS

Using the process described above, WSP evaluated the stability of the East Pond dikes under rapid drawdown conditions resulting from the site 100-year flood event. Table 3 presents the results of the analysis of the dikes surrounding the East Pond. For all sections analyzed, the calculated factors of safety are higher than those required. The detailed stability result figures are available in the pages following this text.

Table 3: Rapid Drawdown Analysis Results

Cross-Sections	Factor of Safety
A-A’	1.5
B-B’	1.7
C-C’	1.4
D-D’	1.5

5.0 REFERENCES

Abramson, L.W., Lee, T.S., Sharma, S., and Boyce, G.M. (2002) Slope Stability and Stabilization Methods, 2nd Edition, John Wiley & Sons, Inc.

Duncan, J.M., Wright, S.G., and Brandon, T. L. (2014) Soil Strength and Slope Stability 2nd Ed., John Wiley & Sons, Inc., Hoboken, NJ.

Duncan, J.M., Wright, S.G., and Wong, K.S. (1990) "Slope Stability During Rapid Drawdown," H. Bolton Seed Symposium, Vol. 2, University of California at Berkeley, pp. 253-272.

Lowe, J., and Karafiath, L. (1959). “Stability of earth dams upon drawdown,” Proceedings, First PanAmerican Conference on Soil Mechanics and Foundation Engineering, Mexico City, Vol. 2, pp. 537–552.

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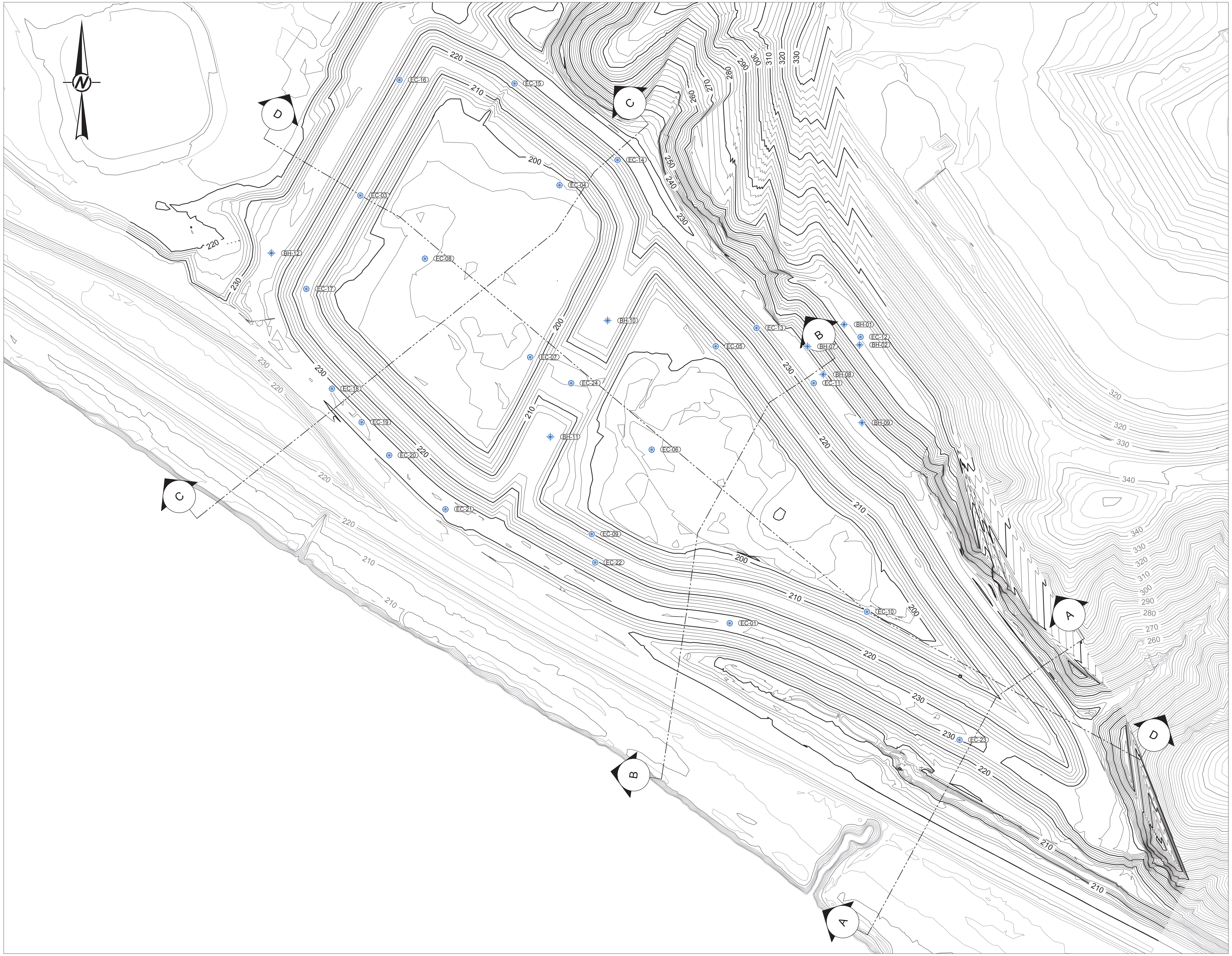
U.S. Army Corps of Engineers (2003) Engineering and Design - Slope Stability, Engineer Manual EM 1110-2-1902, Department of the U.S. Army, Office of the Chief Engineer, Washington, D.C.

Wright, S. G., and Duncan, J. M. (1987). An Examination of Slope Stability Computation Procedures for Sudden Drawdown, Miscellaneous Paper GL-87-25, Geotechnical Laboratory, U. S. Army Waterways Experiment Station, Vicksburg, MI, Sept.



LEGEND

EXISTING TOPOGRAPHIC CONTOURS (2' INTERVALS)

UPDATED SURVEY CONTOURS (2' INTERVALS)

GOLDER CONE PENETRATION TEST (CPT)

A — SLOPE STABILITY SECTIONS

REFERENCE(S)

1. SURROUNDING EXISTING TOPOGRAPHY DATED 2017, FROM DRAWING 1520347QA-N42.DWG.
2. UPDATED TOPOGRAPHY PER SURVEY FROM H&B SURVEYING & MAPPING, DATED FEBRUARY 3, 2020.

0 100 200

1" = 100' FEET

Path: C:\Users\KCernik\Downloads\ | File Name: Bremo Sections.dwg

wsp

DOMINION ENERGY- BREMO STATION

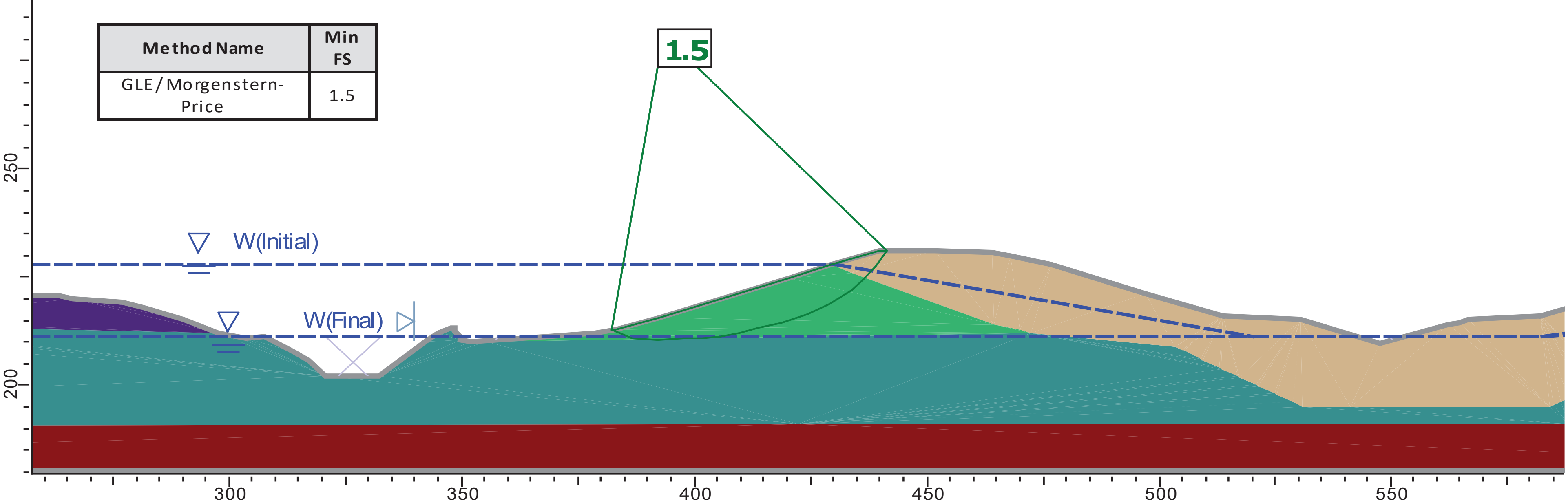
CCR IMPOUNDMENT CLOSURE, FLUVANNA COUNTY, VIRGINIA

SAFETY FACTOR ASSESSMENT - EAST POND PLAN VIEW

FIGURE 1

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Rapid Drawdown (RD) Undrained Strength	RD Envelope Type	RD d (psf)	RD Psi (deg)	Water Surface	Hu Type	Hu
Dike Fill Soils		125	Mohr-Coulomb	50	31	Yes	Kc = 1 linear	147.6	24.9	Water Surface	Custom	1
Alluvium		115	Mohr-Coulomb	50	28	No	Total stress R linear			Water Surface	Custom	1
Disintegrated Rock		140	Mohr-Coulomb	1000	31	No	Total stress R linear			Water Surface	Custom	1
RR Fill		120	Mohr-Coulomb	50	28	No	Total stress R linear			Water Surface	Custom	1
New Fill		120	Mohr-Coulomb	50	31	Yes	Kc = 1 linear	147.6	24.9	Water Surface	Custom	1

Method Name	Min FS
GLE/Morgenstern-Price	1.5



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DATE	April 2023	TITLE	Section A-A Rapid Drawdown
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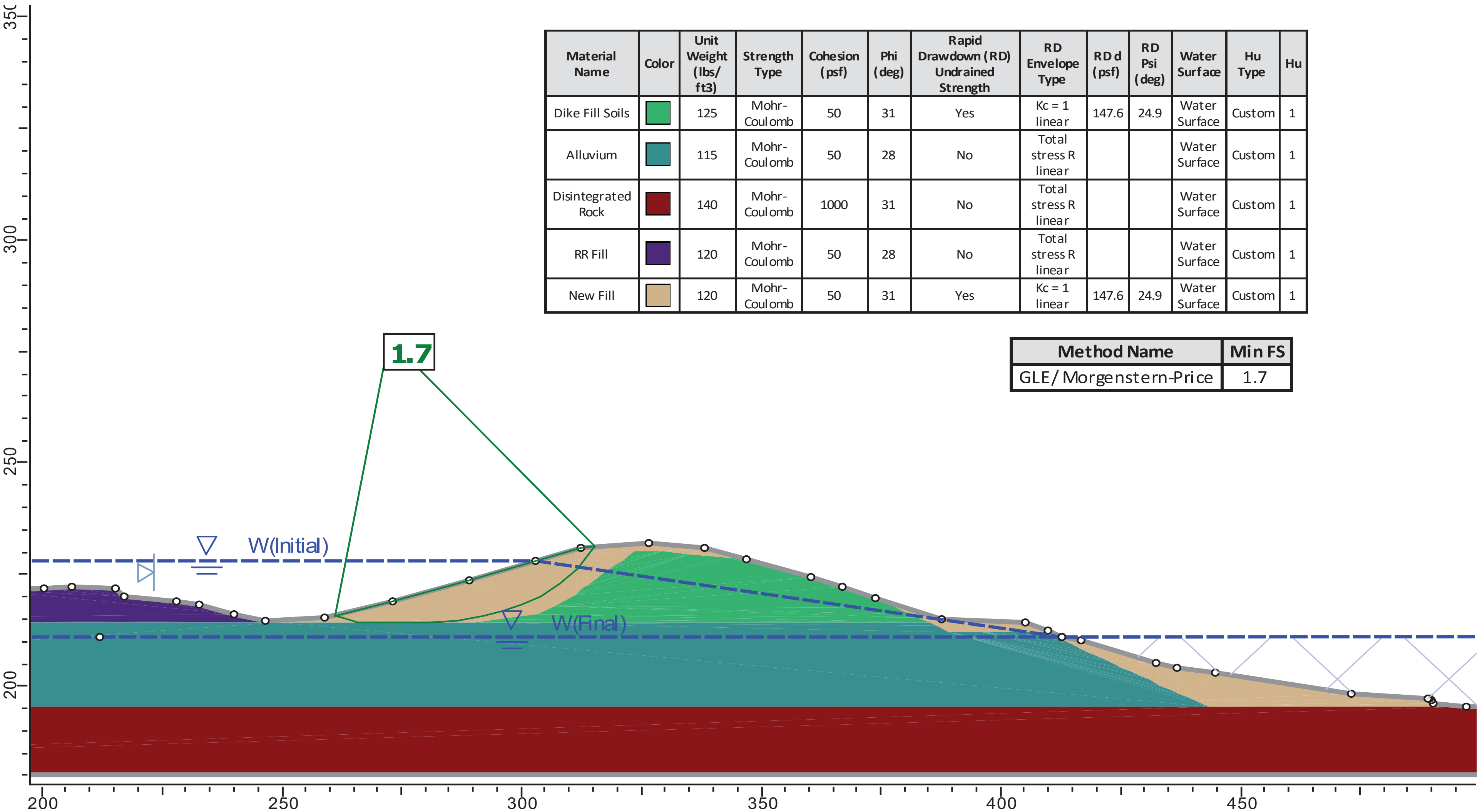
CAD	-		
CHECK	SSS	CLIENT	Dominion Energy
REVIEW	GLH	FIGURE	2(d)

FILE STABILITY

PROJECT No. GL21466315 REV. 0



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Rapid Drawdown (RD) Undrained Strength	RD Envelope Type	RD d (psf)	RD Psi (deg)	Water Surface	Hu Type	Hu
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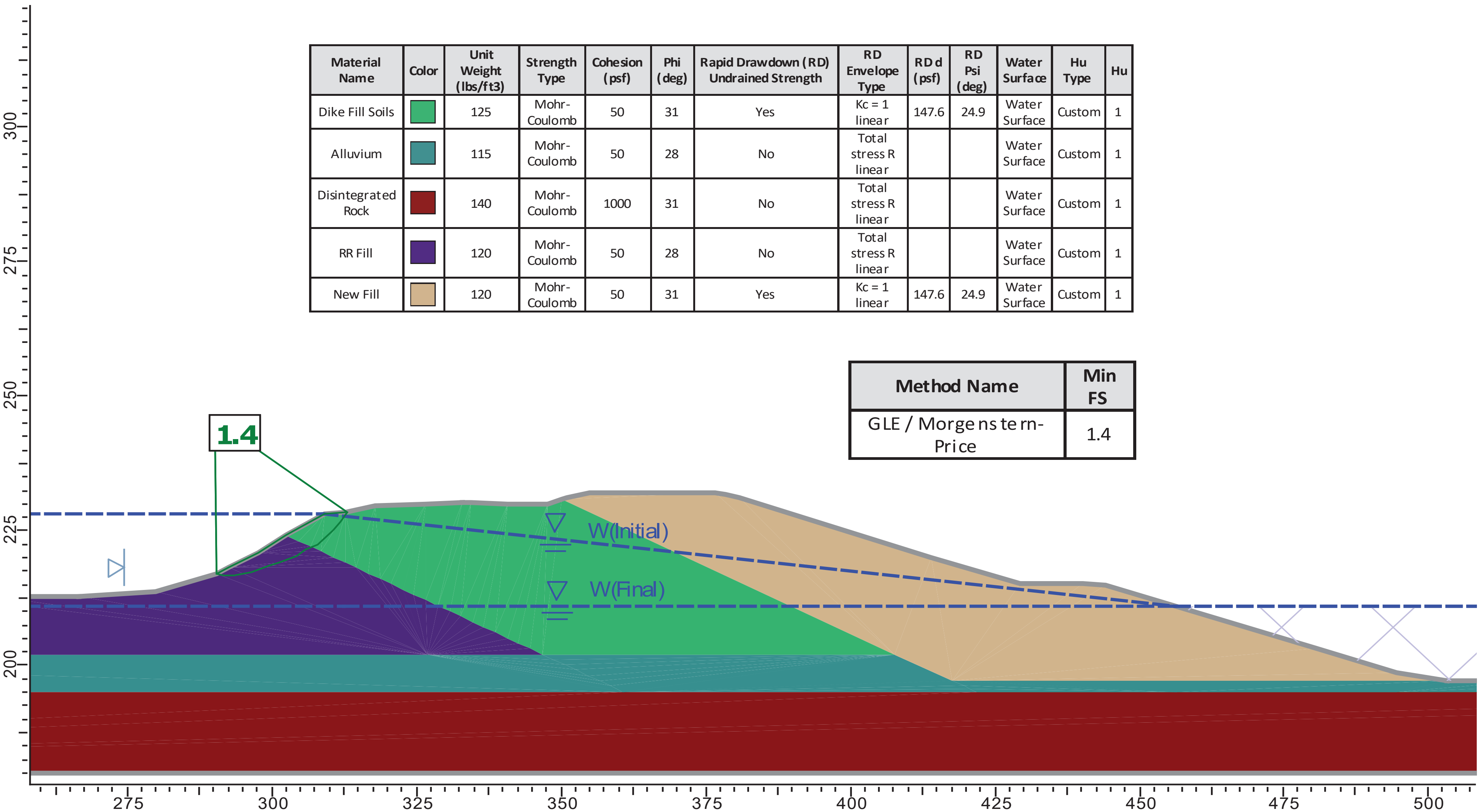
Disintegrated Rock		140	Mohr-Coulomb	1000	31	No	Total stress R linear			Water Surface	Custom	1
RR Fill		120	Mohr-Coulomb	50	28	No	Total stress R linear			Water Surface	Custom	1
New Fill		120	Mohr-Coulomb	50	31	Yes	Kc = 1 linear	147.6	24.9	Water Surface	Custom	1

Method Name	Min FS
GLE/Morgenstern-Price	1.7

SCALE	AS SHOWN	PROJECT	Bremo East Pond - 2023 Safety Factor Assessment
DATE	April 2023	TITLE	Section B-B Rapid Drawdown
MADE BY	WJF		
CAD	-		
CHECK	SSS	CLIENT	Dominion Energy
REVIEW	GLH	FIGURE	3(d)

FILE	STABILITY		
PROJECT No.	GL21466315	REV.	0



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Rapid Drawdown (RD) Undrained Strength	RD Envelope Type	RD d (psf)	RD Psi (deg)	Water Surface	Hu Type	Hu
Dike Fill Soils		125	Mohr-Coulomb	50	31	Yes	Kc = 1 linear	147.6	24.9	Water Surface	Custom	1
Alluvium		115	Mohr-Coulomb	50	28	No	Total stress R linear			Water Surface	Custom	1
Disintegrated Rock		140	Mohr-Coulomb	1000	31	No	Total stress R linear			Water Surface	Custom	1
RR Fill		120	Mohr-Coulomb	50	28	No	Total stress R linear			Water Surface	Custom	1
New Fill		120	Mohr-Coulomb	50	31	Yes	Kc = 1 linear	147.6	24.9	Water Surface	Custom	1

Method Name	Min FS
GLE / Morgenstern-Price	1.4

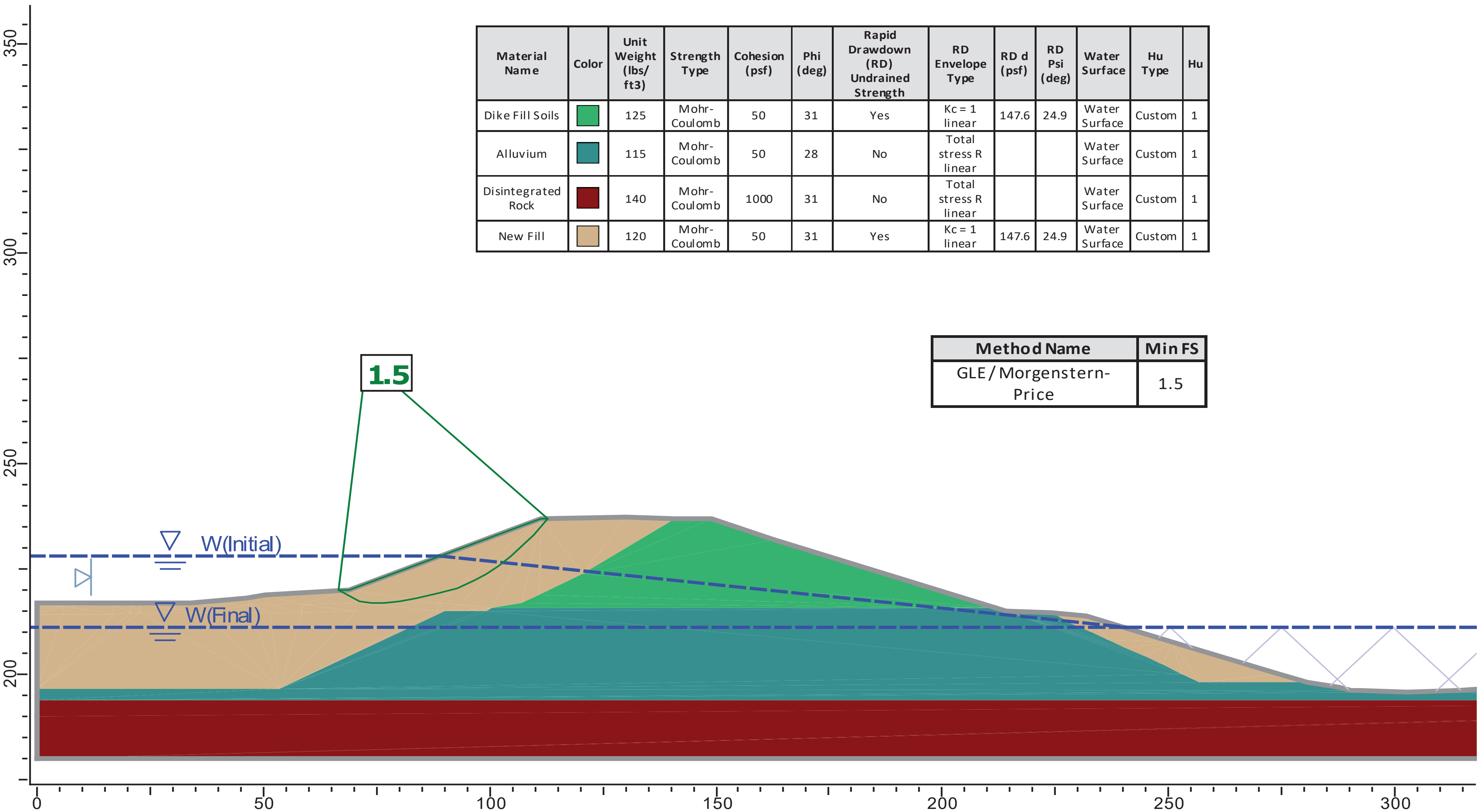
SCALE	AS SHOWN	PROJECT	Bremo East Pond - 2023 Safety Factor Assessment
DATE	April 2023	TITLE	Section C-C Rapid Drawdown
MADE BY	WJF		
CAD	-		
CHECK	SSS	CLIENT	Dominion Energy
REVIEW	GLH	FIGURE	4(d)

FILE: STABILITY

PROJECT No. GL21466315 REV. 0

Material Name	Color	Unit Weight (lbs/ ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Rapid Drawdown (RD) Undrained Strength	RD Envelope Type	RD d (psf)	RD Psi (deg)	Water Surface	Hu Type	Hu
Dike Fill Soils		125	Mohr-Coulomb	50	31	Yes	Kc = 1 linear	147.6	24.9	Water Surface	Custom	1
Alluvium		115	Mohr-Coulomb	50	28	No	Total stress R linear			Water Surface	Custom	1
Disintegrated Rock		140	Mohr-Coulomb	1000	31	No	Total stress R linear			Water Surface	Custom	1
New Fill		120	Mohr-Coulomb	50	31	Yes	Kc = 1 linear	147.6	24.9	Water Surface	Custom	1

Method Name	Min FS
GLE / Morgenstern-Price	1.5



wsp	SCALE	AS SHOWN	PROJECT	Bremo East Pond - 2023 Safety Factor Assessment	
	DATE	April 2023	TITLE	Section D-D Rapid Drawdown	
	MADE BY	WJF			
	CAD	-			
FILE STABILITY	CHECK	SSS	CLIENT	Dominion Energy	FIGURE 5(d)
PROJECT No. GL21466315 REV. 0	REVIEW	GLH			