REPORT

Safety Factor Assessment 5-Year Update

Oak Grove Steam Electric Station
FGD Ponds
Robertson County, Texas

Submitted to:

Oak Grove Management Company LLC

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Irving, Texas 75039

Submitted by:

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October 2021

PROFESSIONAL CERTIFICATION

This document and all attachments were prepared by Golder Associates Inc. under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I hereby certify that the Factor of Safety Assessment Update has been prepared in accordance with the requirements of 40 C.F.R. § 257.73(e) and 30 T.A.C. § 353.731.

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Associate
Golder Associates Inc.
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1.0 INTRODUCTION

Oak Grove Management Company LLC (Oak Grove) owns and operates the Oak Grove Steam Electric Station (OGSES) located approximately ten miles north of Franklin in Robertson County, Texas. The power plant and related support areas are located along the south side of Twin Oak Reservoir (Figure 1). The OGSES consists of two lignite-fired units with a combined operating capacity of approximately 1,796 megawatts. Coal Combustion Residuals (CCR) including fly ash, bottom ash, and gypsum are generated as part of OGSES unit operation. The CCRs are transported off-site for beneficial use by third-parties or are disposed at the OGSES Ash Landfill 1.

The U.S. Environmental Protection Agency promulgated 40 C.F.R. Part 257, Subpart D (the CCR Rule) and the Texas Commission on Environmental Quality (TCEQ) promulgated 30 T.A.C. Chapter 352 (which largely adopts the federal CCR Rule by reference) to establish technical requirements for new and existing CCR landfills and surface impoundments. On June 28, 2021, USEPA approved the majority of TCEQ's CCR program, which will now operate in lieu of the federal regulations. FGD-A, FGD-B, and FGD-C (collectively the "FGD Ponds") at the OGSES have been identified as Existing CCR Surface Impoundments regulated under the CCR Rule.

Section 257.73(e) of the CCR Rule specifies that periodic safety factor assessments must be conducted for each CCR surface impoundment and 30 T.A.C. 352.731 adopts this requirement by reference. In accordance with § 257.73(g), the initial Safety Factor Assessments for the FGD Ponds was completed and placed in the facility operating record in November 2016 (Golder, 2016). As specified in § 257.73(f)(3), the Safety Factor Assessment must be updated every five years from the completion date of the initial plan. Golder Associates Inc., member of WSP (Golder), was retained by Luminant to prepare this updated Safety Factor Assessment for the FGD Ponds.

1.1 Description of FGD Ponds

The FGD Ponds are located approximately 2,500 feet northwest of the OGSES power generation units (Figure 1) and are constructed above grade and surrounded by engineered earthen dikes that extend up to approximately 25 feet above surrounding grade.

The FGD Ponds receive wastewater from the FGD wet scrubber system blowdown, low volume wastewater, bottom ash contact water, and storm water runoff from approximately 41 acres of the power plant. All fluids are pumped into the FGD Ponds and there are no uncontrolled or gravity inflows into the ponds, with the exception of a gravity overflow from FGD-A to FGD-B. Process wastewater can be transferred between the FGD Ponds and is used as makeup water to the FGD scrubber system and related purposes. The are no spillways or other uncontrolled gravity flow releases from the ponds. Solids that accumulate in the FGD ponds are periodically removed and transported to OGSES Ash Landfill 1.

FGD-A covers an area of approximately 9.5 acres and was constructed in 2008. FGD-A is currently lined with a 3-foot thick compacted clay liner; however, FGD-A ceased receipt of waste by April 11, 2021, and Oak Grove has initiated the retrofit of FGD-A with a composite liner system meeting the requirements of § 257.71(a)(1)(ii).

FGD-B covers an area of approximately 12 acres and was constructed in 2011. FGD-B is constructed with a composite liner consisting of a minimum 2-foot thick compacted clay liner, overlain be a 60-mil HDPE geomembrane liner, overlain by a 1-foot thick layer of protective soil. The composite liner system in FGD-B complies with the requirements of § 257.71(a)(1)(ii).

FGD-C is approximately 25 acres and was constructed in 2016. FGD-C is constructed with a composite liner consisting of a minimum 2-foot thick compacted clay liner, overlain by a 60-mil HDPE geomembrane liner, overlain by a 2-foot thick soil/ash protective layer. The composite liner system in FGD-C complies with the requirements of § 257.71(a)(1)(ii).

1.2 Previous Slope Stability Evaluations

As required under § 257.73(e)(1), the Initial Factor of Safety Assessment for the FGD Ponds was completed and placed in the OGSES operating record in October 2016 (Golder, 2016). The calculated factors of safety met the minimum criteria presented in § 257.73(e)(i) through (iv).

In addition, Golder performed previous evaluations on the FGD-A, and FGD-B ponds as part of the below reports submitted to Luminant:

- FGD-B Slope Stability Investigation Report (Revised), Luminant Oak Grove SES, Robertson County, Texas, dated June 2010
- FGD-A Slope Stability Evaluation Report, Luminant Oak Grove SES, Robertson County, Texas, dated March 2011
- Addendum to Slope Stability Investigation Reports Luminant Oak Grove SES, Robertson County, Texas, March 2014

These studies found the pond slopes to be adequately stable.

Construction of FGD-C Pond was completed in 2016. During the design of FGD-C Pond, Golder evaluated the stability of the embankments.

2.0 SUBSURFACE CONDITIONS

2.1 Regional Geology

The OGSES site is located in the Sandy Hills physiographic province of Texas. Ground elevations range from 400 to 425 feet MSL (mean sea level), and the topography is characterized by low rolling hills and shallow stream valleys (Espey, Huston & Associates, 1987). The regional terrain consists of a thick series of unconsolidated sediments consisting of sand, silt, clay, and lignite. The major geologic units are the tertiary age ‘bedrock’ strata and the quaternary age fluviatile deposits. Eroded bedrock is overlain by alluvium and terraces along the valleys of larger streams. The approximate thickness of alluvium in the area of the site varies from 0 to 50 ft. The alluvium typically consists of sand, silt, silty clay and sandy clay and is not easily differentiated from the underlying bedrock strata in many instances.

2.2 Site Geology

2.2.1 Subsurface Investigations and Laboratory Testing

Information from previous subsurface investigations was used to characterize the subsurface site conditions. Golder conducted a subsurface investigation for the FGD-A pond in July 2008, prior to construction of the clay liner within the pond. Golder completed nine borings within the pond footprint with boring depths ranging from 16 to 28 feet below ground surface (bgs) (Golder, 2008). Golder also conducted a subsurface investigation for FGD-B pond in March 2010 (Golder, 2010). In December 2014, Golder completed another subsurface investigation including ten geotechnical boreholes and installation of 3 groundwater monitoring wells, to facilitate design and construction of the FGD-C pond. Appendix A of the initial Factor of Safety Assessment (Golder, 2016) includes the boring location maps and select, representative boring logs.

For each investigation, laboratory testing was performed on selected samples, in accordance with commonly accepted methods and practices. Undisturbed and disturbed soil samples were tested to determine water content, Atterberg limits, grain size distribution, and shear strength. Water content determination was performed in accordance with ASTM D2216; Atterberg limits were determined in accordance with ASTM D4318; and grain size distribution was performed in accordance with ASTM D422. Shear strength testing consisted of unconsolidated-undrained (UU) and consolidated-undrained (CU) triaxial compression tests in general accordance with ASTM D2850 and D4767, respectively. Laboratory test results are presented in Appendix B of the initial Factor of Safety Assessment (Golder, 2016).

The findings from the above subsurface investigations were reviewed for their applicability to this study and are summarized in the following sections.

2.2.2 Subsurface Site Conditions

2.2.2.1 FGD-A Pond

The soils encountered under the FGD-A Pond consist of lean clays, sandy clays, silty clays, sands, silty sands, clayey sands, and sandy silts. The near surface soils under the pond generally consist of fine- grained soils extending to depths ranging from approximately 6 feet to more than 19 feet below the pond bottom. Coarse-grained soils (i.e., sands) were generally encountered at depths greater than 6 feet below the pond bottom. Sands were encountered at shallower depths in the northwest portion of the pond than in the southeast portion of the pond.

Historical monitoring well measurements near the FGD-A Pond indicate that the groundwater level is between approximately 406 and 411 ft-msl.

2.2.2.2 FGD-B Pond

The soils encountered in the borings generally consisted of very stiff to hard clays and compact to very dense sands. The surficial soils were generally classified as very stiff to hard sandy (lean and fat) clay and ranged in thickness from 8 to 27 ft. The surficial clay stratum was underlain by layers of compact to very dense sand, clayey sand, silty sand, and/or very stiff to hard silty clay or clay.

Based on monitoring well measurements near FGD-B, the groundwater level ranges from approximately 405 to 411 ft-msl.

2.2.2.3 FGD-C Pond

Based on the results of the geotechnical investigations at this facility, soils in the footprint of the FGD-C Pond in general comprise the following:

- Laminated clays, silty clays and sandy clays having low horizontal and vertical hydraulic conductivity;
- Thinly bedded clays, clayey silts, and silty sands characterized by low to moderate horizontal permeability and low net vertical permeability; and
- Bedded sands, silty sands, clayey sands, and silts of moderate to relatively high horizontal and moderate vertical permeability.

Based on monitoring well measurements near FGD-C, the groundwater level ranges from approximately 410 ft-msl to 413 ft-msl.

3.0 UPDATED STABILITY ANALYSIS - § 257.73(e)

3.1 Safety Factor Assessment

According to the CCR rules, structural stability factors of safety need to be evaluated for the critical cross- section of each CCR facility under static and seismic loading for “Maximum Storage Pool” (2 feet of freeboard for this facility) and “Maximum Surcharge Pool” conditions. Liquefaction potential analysis is only necessary when soil sampling, construction documentation or anecdotal evidence from personnel with knowledge about the facility, indicates that soils of the embankment are susceptible to liquefaction.

None of the FGD Ponds have downstream slopes that could be inundated by the pool of an adjacent water body; therefore, rapid-drawdown loading conditions were not evaluated.

Slope stability analyses were performed using a limit-equilibrium-based commercial computer program, Slide v7.0 by Rocscience. The analyses used a searching routine to identify the potential failure surface with minimum factor of safety for a given set of geometry, ground and groundwater conditions. The Spencer method of analysis was used in the analyses, while the Morgenstern-Price method was used for verification. The factors of safety of numerous potential failure surfaces were computed to establish minimum factors of safety. Circular failure surfaces were considered for all cases except for section B1-B1’ (discussed later) that has a thin layer of silt, and hence, a block failure produces a lower factor of safety. Stability analyses were performed for “Maximum Storage Pool” (freeboard of 2 feet) and “Maximum Surcharge Pool” (no freeboard) conditions for both the interior and exterior slopes of the ponds. In addition, the interior slopes were analyzed while the pond is empty. For each case, respective slopes were analyzed for both static and seismic loading conditions.

3.2 Cross-Sections Analyzed

After considering multiple cross-sections a critical cross-section was identified for each pond and used for the stability analysis. The critical cross-section was determined considering the geometry of the slopes, soil profile, phreatic surface and loading conditions. More than one cross-section was used when required. For example, the critical section for the interior slopes of FGD-B is located to the east bordering pond FGD-A. However, since FGD-A adjoins FGD-B here, the critical section for exterior slopes of FGD-B is not located on this section. Hence, another section is analyzed on the west side of FGD-B to evaluate the exterior slopes. The critical cross-sections analyzed – A-A’, B-B’, B1-B1’, C-C’ – for each pond are shown in Figure 1.

3.3 Material Properties

Based on the previous subsurface investigations, appropriate material properties were selected for use in the stability analysis. Table 1, Table 2, Table 3, and Table 4 summarize the material properties used in the stability analysis.

Espey, Huston & Associates, 1987 present boreholes drilled on the embankment of FGD-A composed of structural fill. The borings on the embankment crest and the slopes show high pocket penetrometer values of 4.5 tons/ft^2 or above, indicating considerably hard clays. Also, we reviewed the Atterberg limits on samples collected from fill at the FGD-C pond. Based on these values, a conservative shear strength was assumed for the structural fill as shown in the below tables.

Table 1: Soil Properties for Section A-A'

Soil Material	Description	Moist Unit Weigh (lb./ft^3)	Saturated Unit Weigh (lb./ft^3)	Drained Soil Properties	
				Cohesion, c'(lb./ft^2)	Friction Angle, ϕ'(°)
I	Sandy Clay	127	132	270	26
II	Silty Clay/ Clay	127	132	0	26
III	Clayey Sand	127	132	0	32

Table 2: Soil Properties for Section B-B'

Soil Material	Description	Moist Unit Weigh (lb./ft^3)	Saturated Unit Weigh (lb./ft^3)	Drained Soil Properties	
				Cohesion, c'(lb./ft^2)	Friction Angle, ϕ'(°)
I	Clay/ Silty Clay/ Sandy Clay	127	132	270	26
II	Sandy Silt	127	132	0	26
III	Sand/ Silty Sand	127	132	0	36
	Structural Fill	127	132	270	26

Table 3: Soil Properties for Section B1-B1'

Soil Material	Description	Moist Unit Weigh (lb./ft^3)	Saturated Unit Weigh (lb./ft^3)	Drained Soil Properties	
				Cohesion, c'(lb./ft^2)	Friction Angle, ϕ'(°)
I	Clay/ Silty Clay/ Sandy Clay	127	132	270	26
II	Sand/ Silty Sand	127	132	0	36
	Structural Fill	127	132	270	26

Table 4: Soil Properties for Section C-C'

Soil Material	Description	Moist Unit Weigh (lb./ft^3)	Saturated Unit Weigh (lb./ft^3)	Drained Soil Properties	
				Cohesion, c'(lb./ft^2)	Friction Angle, ϕ'(°)
I	New Fill - compacted onsitelow to moderate plasticity clay soils	125	n/a	200	26
II	Existing Fill - stiffto very stiff clays	125	n/a	150	24
III	Very stiff Silty Clay	127	132	270	26
IV	Very dense Silty Sand	120	130	n/a	34

3.4 Phreatic Surface

For the stability analysis, the location of the phreatic surface within the FGD-A Pond embankment was conservatively assumed to correspond to the water level in the pond and to the ground surface of the exterior slope of the embankment. The only exception to this is Case 5a and 5b for FGD-B, where the phreatic surface from the adjoining FGD-A embankment was assumed to slope at approximately 3H:1V. As noted previously, the retrofit of FGD-A Pond with a composite liner system is underway. This liner system will prevent seepage into the embankment; therefore, the stability analysis for FGD-A is conservative.

FGD-B and FGD-C Ponds are both lined with a composite geomembrane/clay liner; therefore, no phreatic surface is expected to develop within the embankments. The groundwater level below the FGD-B Pond was assumed to be at 410 ft-msl. The groundwater level near the cross-section analyzed for FGD-C Pond was assumed to be at 410 ft-msl, which is representative of the eastern portion of the pond.

3.5 Seismic Loading

Based on the "US Seismic Hazard 2014 Map" prepared by the United States Geologic Survey (USGS) and the "2008 Interactive Deaggregations" (USGS), the peak ground acceleration (PGA) for a 2% probability of exceedance in 50 years (return period of 2,475 years) is 0.06g for the site location (including amplification factors for site soil conditions). A horizontal seismic load coefficient equal to the PGA was conservatively used in the pseudostatic analysis.

3.6 Liquefaction Potential

Soil liquefaction describes a phenomenon whereby a saturated or partially saturated soil substantially loses strength and stiffness in response to an applied stress, usually earthquake shaking or other sudden change in stress condition, causing it to behave like a liquid. The phenomenon is most often observed in saturated, loose (low density or uncompacted), sandy soils.

The embankment soils of ponds FGD-A, FGD-B, and FGD-C are all composed of clayey materials with significant fines content. The immediate foundation materials are also composed of soils containing a significant portion of fines and are as well considerable dense. The subsurface investigations performed at each of the ponds do not indicate any soils in the embankment or its foundation, which are susceptible to liquefaction. Hence, failure of the pond slopes due to liquefaction is considered unlikely for the CCR surface impoundments at the OGSES.

3.7 Stability Analysis Results

Slope stability analyses were performed for long-term conditions for each of the critical cross-sections considered under static and seismic loading conditions. Both interior and exterior slopes were analyzed for “Maximum Storage Pool” (2 feet of freeboard) and “Maximum Surcharge Pool” (no freeboard) conditions. The interior slopes were analyzed for the condition where the pond is empty.

The results of the slope stability analysis cases are presented in Table 5, Table 6, and Table 7 for ponds FGD-A, FGD-B, and FGD- C, respectively. The corresponding analysis outputs can be found in Appendix A. The results indicate that the pond slopes are sufficiently stable under all considered loading scenarios.

Table 5: Slope Stability Analysis Results – FGD-A

<table>
<tr><th>Cross-Section</th><th>Case #</th><th>Slope Location</th><th>Pond Pool Level</th><th>Loading Condition</th><th>Required Safety Factor (1)</th><th>Calculated Safety Factor</th></tr>
<tr><td rowspan="10">A-A'</td><td>1a</td><td rowspan="4">Exterior</td><td rowspan="2">Storage</td><td>Static</td><td>1.50</td><td>1.89</td></tr>
<tr><td>1b</td><td>Pseudostatic</td><td>1.00</td><td>1.61</td></tr>
<tr><td>2a</td><td rowspan="2">Surcharge</td><td>Static</td><td>1.40</td><td>1.84</td></tr>
<tr><td>2b</td><td>Pseudostatic</td><td>1.00</td><td>1.56</td></tr>
<tr><td>3a</td><td rowspan="6">Interior</td><td rowspan="2">Storage</td><td>Static</td><td>1.50</td><td>4.72</td></tr>
<tr><td>3b</td><td>Pseudostatic</td><td>1.00</td><td>3.58</td></tr>
<tr><td>4a</td><td rowspan="2">Surcharge</td><td>Static</td><td>1.40</td><td>5.20</td></tr>
<tr><td>4b</td><td>Pseudostatic</td><td>1.00</td><td>3.90</td></tr>
<tr><td>5a</td><td rowspan="2">Empty</td><td>Static</td><td>1.50</td><td>2.15</td></tr>
<tr><td>5b</td><td>Pseudostatic</td><td>1.00</td><td>1.77</td></tr>
</table>

Note: (1) Required safety factors per §257.73(e)(i)-(iii)

Table 6: Slope Stability Analysis Results – FGD-B

<table>
<tr><th>Cross-Section</th><th>Case #</th><th>Slope Location</th><th>Pond Pool Level</th><th>Loading Condition</th><th>Required Safety Factor (1)</th><th>Calculated Safety Factor</th></tr>
<tr><td rowspan="4">B-B'</td><td>1a</td><td rowspan="4">Exterior</td><td rowspan="2">Storage</td><td>Static</td><td>1.50</td><td>2.43</td></tr>
<tr><td>1b</td><td>Pseudostatic</td><td>1.00</td><td>2.07</td></tr>
<tr><td>2a</td><td rowspan="2">Surcharge</td><td>Static</td><td>1.40</td><td>2.43</td></tr>
<tr><td>2b</td><td>Pseudostatic</td><td>1.00</td><td>2.07</td></tr>
</table>

Cross-Section	Case #	Slope Location	Pond Pool Level	Loading Condition	Required Safety Factor (1)	Calculated Safety Factor
B1-B1'	3a	Interior	Storage	Static	1.50	1.51
	3b			Pseudostatic	1.00	1.20
	4a		Surcharge	Static	1.40	1.55
	4b			Pseudostatic	1.00	1.25
	5a		Empty	Static	1.50	2.20
	5b			Pseudostatic	1.00	1.79

Note: (1) Required safety factors per §257.73(e)(i)-(iii)

Table 7: Slope Stability Analysis Results - FCD-C

Cross-Section	Case #	Slope Location	Pond Pool Level	Loading Condition	Required Safety Factor (1)	Calculated Safety Factor
C-C'	1a	Exterior	Storage	Static	1.50	2.06
	1b			Pseudostatic	1.00	1.72
	2a		Surcharge	Static	1.40	2.06
	2b			Pseudostatic	1.00	1.72
	3a	Interior	Storage	Static	1.50	5.53
	3b			Pseudostatic	1.00	4.04
	4a		Surcharge	Static	1.40	6.19
	4b			Pseudostatic	1.00	4.44
	5a		Empty	Static	1.50	2.16
	5b			Pseudostatic	1.00	1.80

Note: (1) Required safety factors per §257.73(e)(i)-(iii)

4.0 CONCLUSIONS

Based on our review of the information provided by Oak Grove, on information prepared by Golder, and on our analyses, the calculated factors of safety through the critical cross sections in the surface exceed the values listed in § 257.73(e)(1)(i)-(iv).

5.0 REFERENCES

Espey, Huston & Associates, Inc., 1987, Hydrogeologic Assessment of Proposed Surface Impoundment Areas, Twin Oak SES, Robertson County, Texas.

Golder Associates Inc. 2008, Data Report - Oak Grove SES, FGD Pond Subsurface Investigation, Robertson County, Texas.

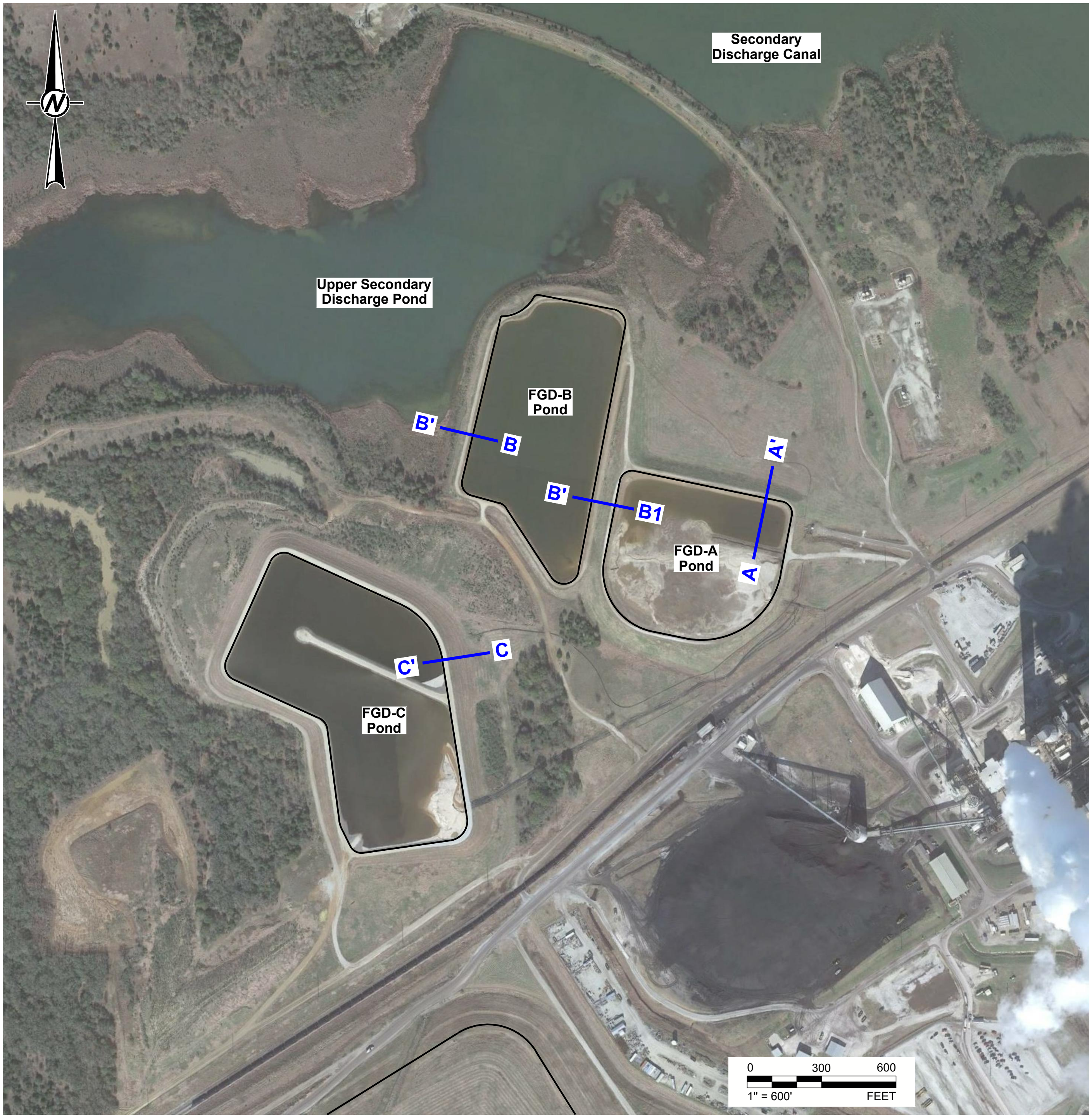
Golder Associates Inc. 2010, FGD-B Slope Stability Investigation Report (Revised), Luminant Oak Grove SES, Robertson County, Texas.

Golder Associates Inc. 2011, FGD-A Slope Stability Evaluation Report, Luminant Oak Grove SES, Robertson County, Texas.

Golder Associates Inc. 2014, Addendum to Slope Stability Investigation Reports, Luminant Oak Grove SES, Robertson County, Texas.

Golder Associates Inc. 2016. Factor of Safety Assessment Report, Luminant Oak Grove Steam Electric Station.

Figures



LEGEND

A ——— A' CRITICAL CROSS-SECTION

REFERENCE(S)

BASE MAP TAKEN FROM GOOGLE EARTH, IMAGERY DATED 12/9/18.

CLIENT

OAK GROVE MANAGEMENT COMPANY LLC

PROJECT

OAK GROVE STEAM ELECTRIC STATION
FGD PONDS
FACTOR OF SAFETY ASSESSMENT UPDATE

TITLE

SITE PLAN

CONSULTANT

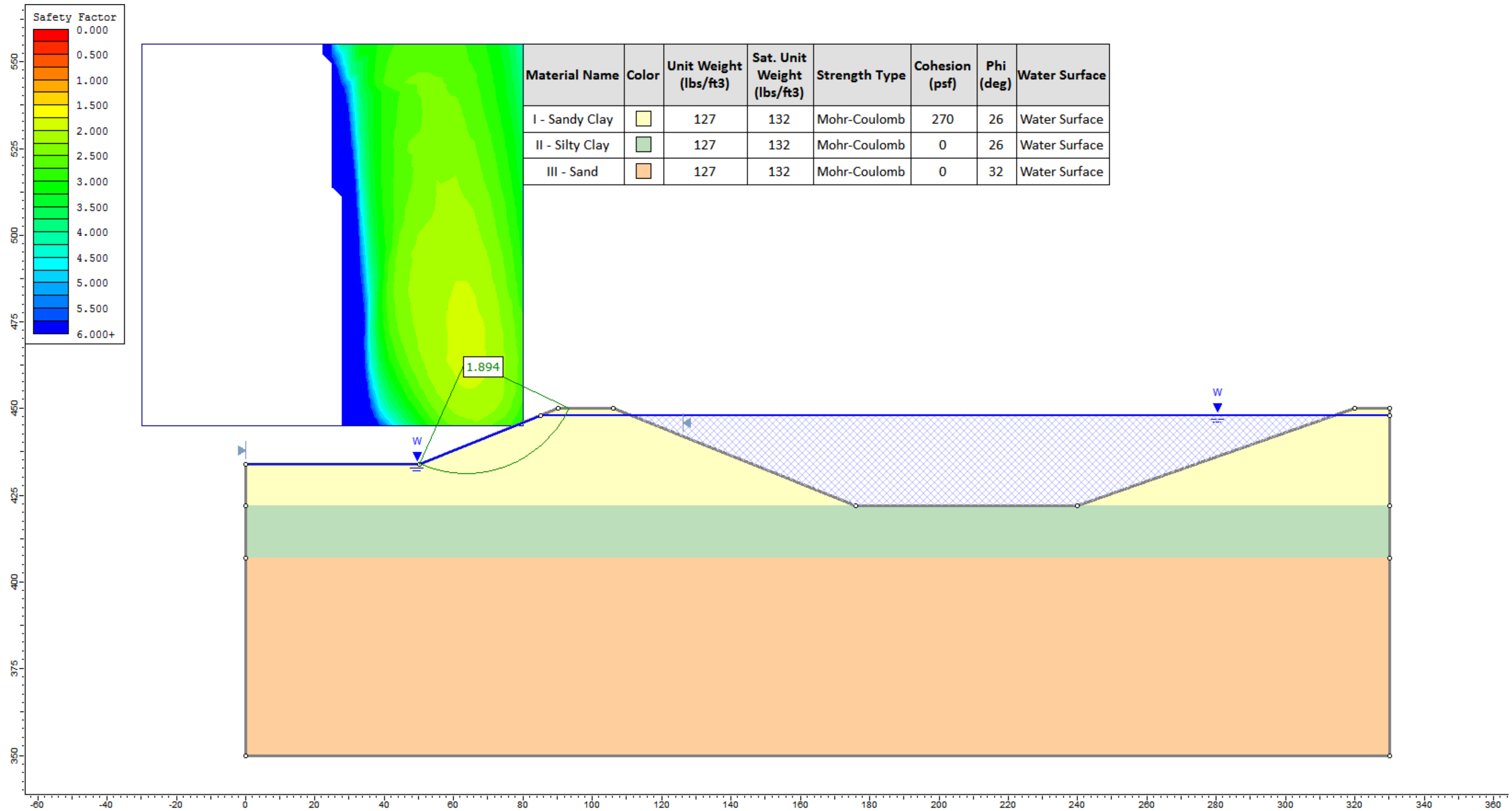
GOLDER
MEMBER OF WSP

YYYY-MM-DD	2021-10-04
DESIGNED	AJD
PREPARED	AJD
REVIEWED	JBF
APPROVED	JBF

PROJECT NO.	CONTROL	REV.	FIGURE
21465177		0	1

APPENDIX A

Slope Stability Analysis Results

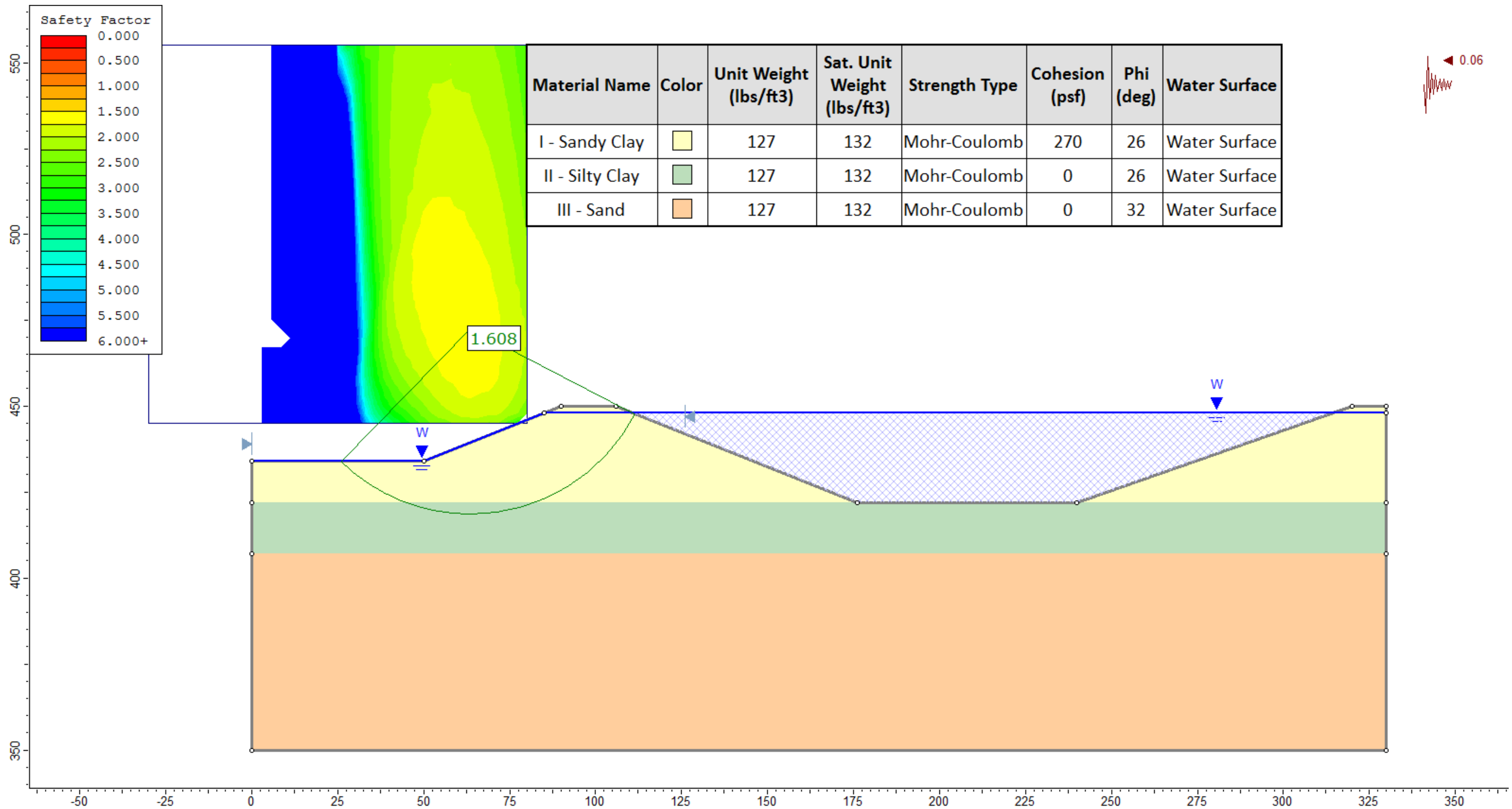


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
I - Sandy Clay		127	132	Mohr-Coulomb	270	26	Water Surface
II - Silty Clay		127	132	Mohr-Coulomb	0	26	Water Surface
III - Sand		127	132	Mohr-Coulomb	0	32	Water Surface

FIGURE **C.1**

Results of Stability Analysis – FGD–A: A–A' – Case 1a

Stability and Safety Factor Assessment, Oak Grove SES

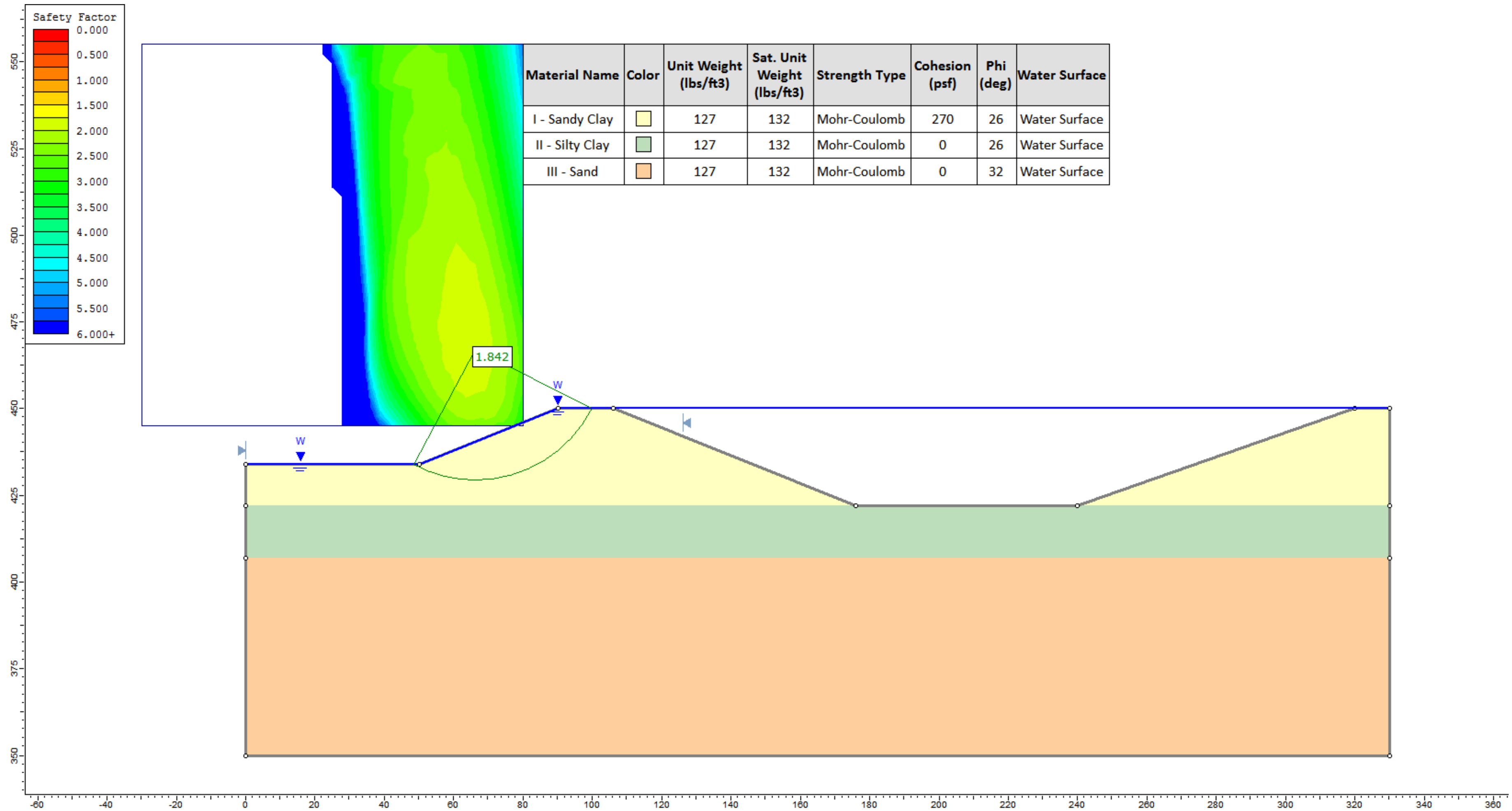


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
I - Sandy Clay		127	132	Mohr-Coulomb	270	26	Water Surface
II - Silty Clay		127	132	Mohr-Coulomb	0	26	Water Surface
III - Sand		127	132	Mohr-Coulomb	0	32	Water Surface

FIGURE **C.2**

Results of Stability Analysis – FGD–A: A–A' – Case 1b

Stability and Safety Factor Assessment, Oak Grove SES

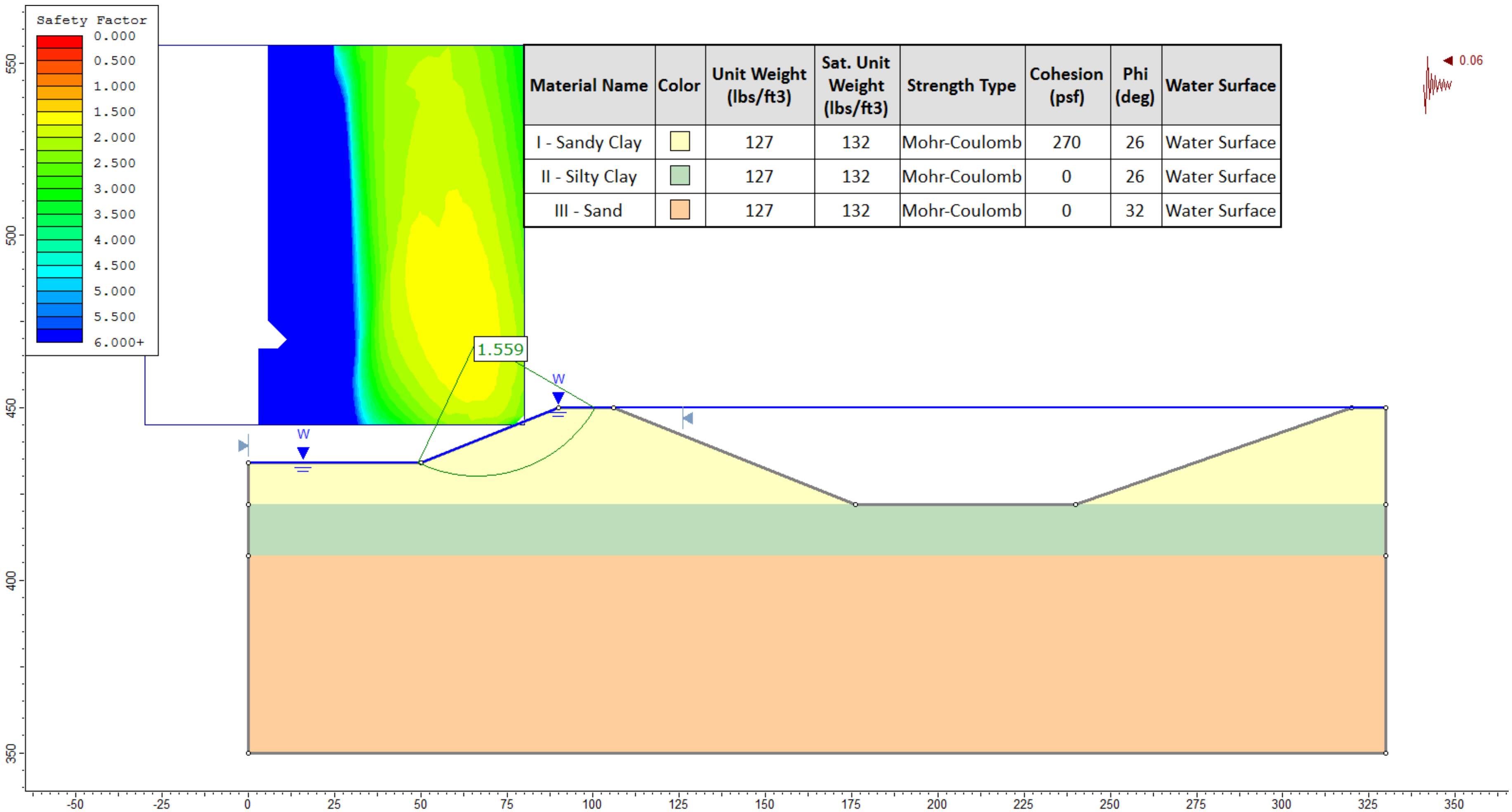


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
I - Sandy Clay		127	132	Mohr-Coulomb	270	26	Water Surface
II - Silty Clay		127	132	Mohr-Coulomb	0	26	Water Surface
III - Sand		127	132	Mohr-Coulomb	0	32	Water Surface

FIGURE **C.3**

Results of Stability Analysis − FGD−A: A−A' − Case 2a

Stability and Safety Factor Assessment, Oak Grove SES

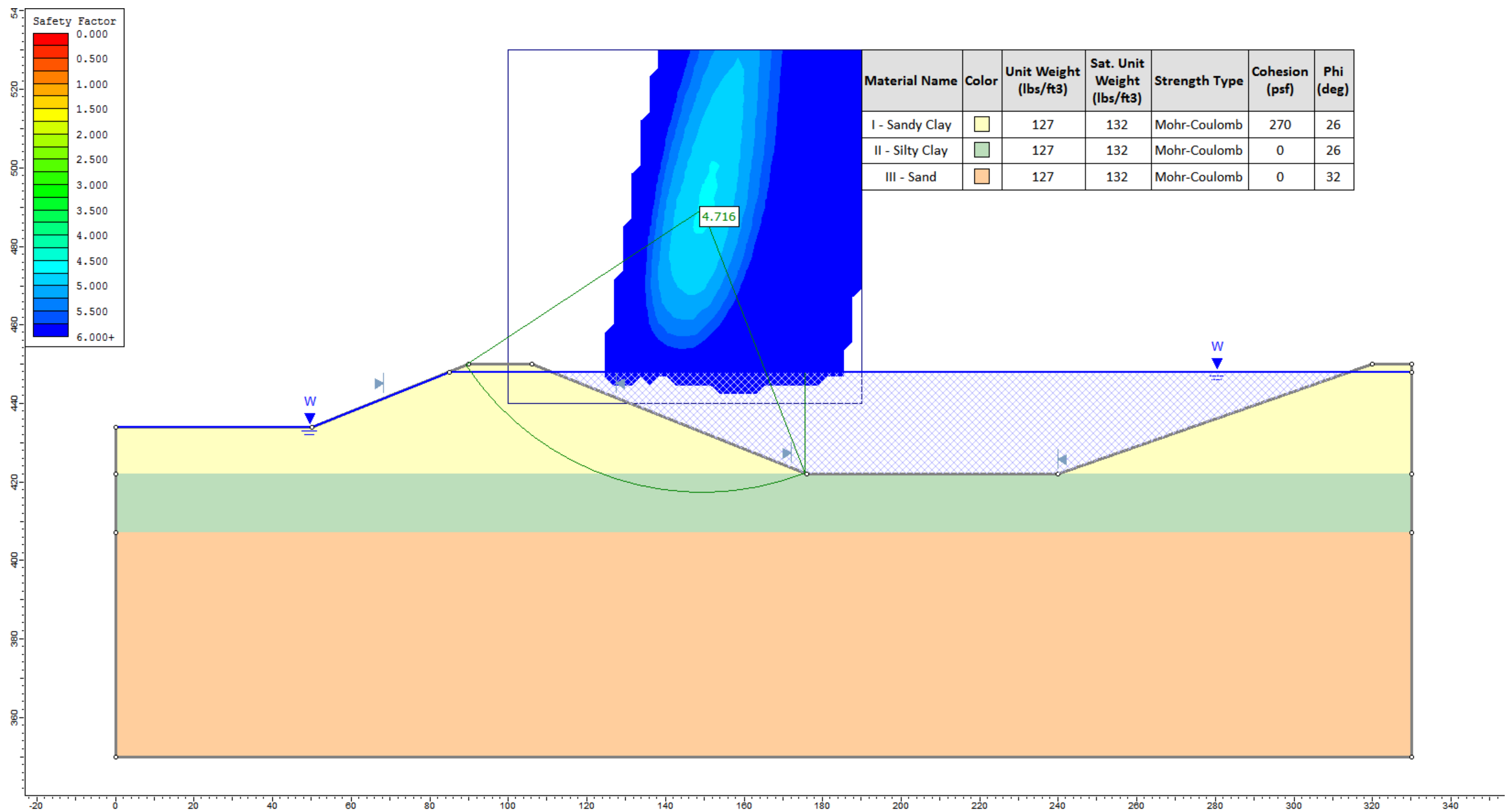


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
I - Sandy Clay		127	132	Mohr-Coulomb	270	26	Water Surface
II - Silty Clay		127	132	Mohr-Coulomb	0	26	Water Surface
III - Sand		127	132	Mohr-Coulomb	0	32	Water Surface

FIGURE **C.4**

Results of Stability Analysis – FGD–A: A–A' – Case 2b

Stability and Safety Factor Assessment, Oak Grove SES

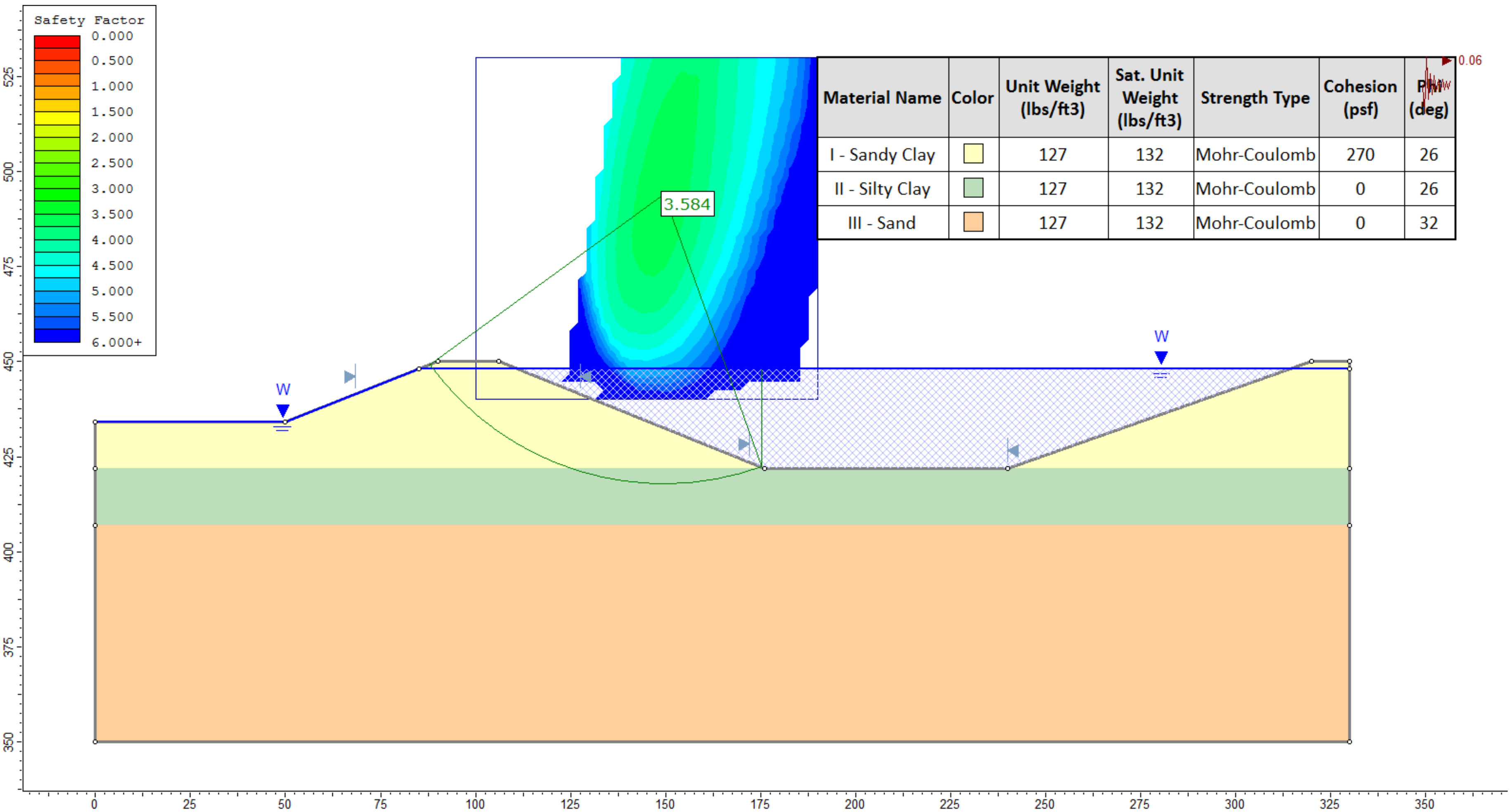


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
I - Sandy Clay		127	132	Mohr-Coulomb	270	26
II - Silty Clay		127	132	Mohr-Coulomb	0	26
III - Sand		127	132	Mohr-Coulomb	0	32

FIGURE **C.5**

Results of Stability Analysis – FGD–A: A–A' – Case 3a

Stability and Safety Factor Assessment, Oak Grove SES

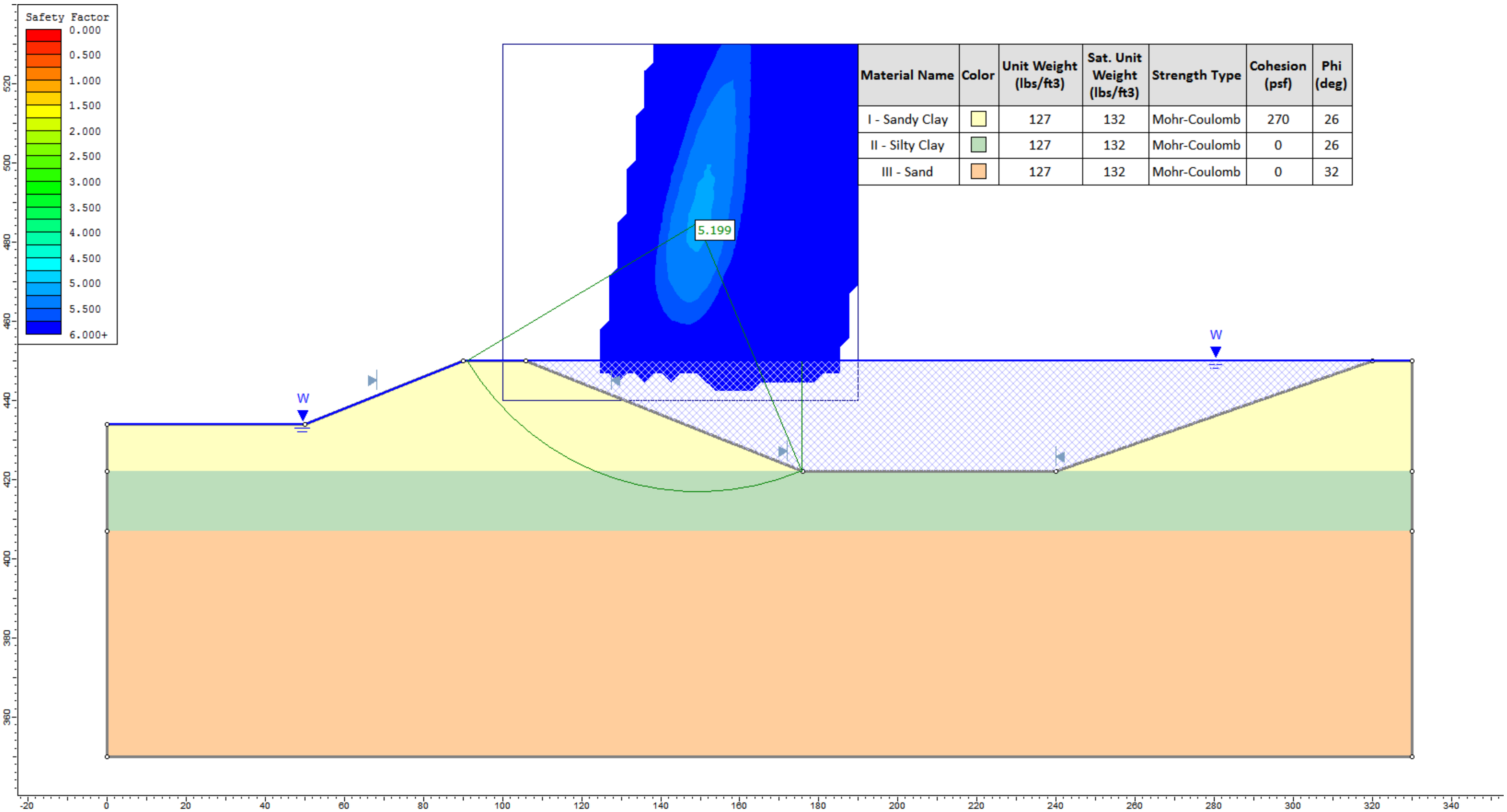


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
I - Sandy Clay		127	132	Mohr-Coulomb	270	26
II - Silty Clay		127	132	Mohr-Coulomb	0	26
III - Sand		127	132	Mohr-Coulomb	0	32

FIGURE **C.6**

Results of Stability Analysis – FGD–A: A–A' – Case 3b

Stability and Safety Factor Assessment, Oak Grove SES

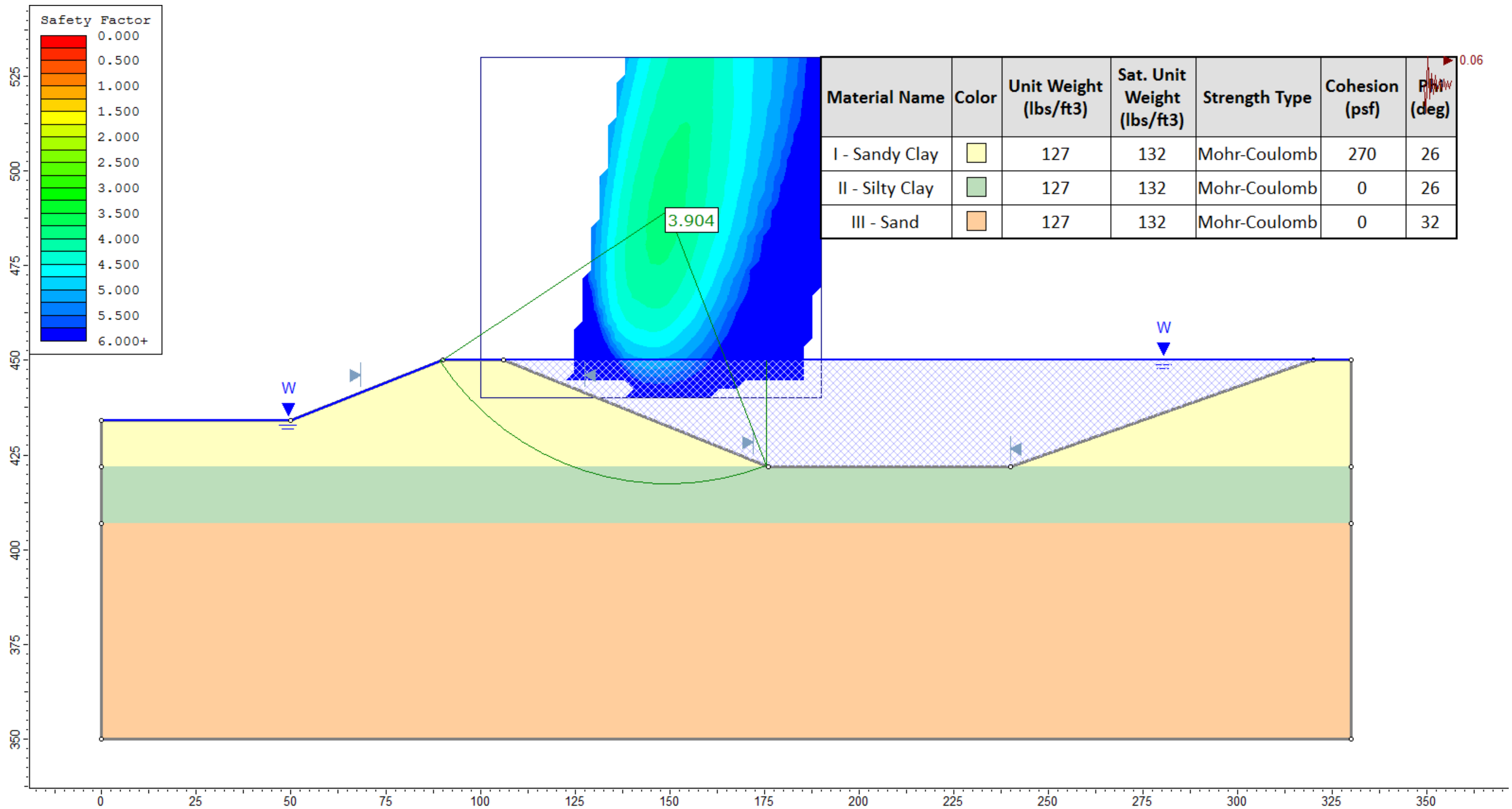


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
I - Sandy Clay		127	132	Mohr-Coulomb	270	26
II - Silty Clay		127	132	Mohr-Coulomb	0	26
III - Sand		127	132	Mohr-Coulomb	0	32

FIGURE **C.7**

Results of Stability Analysis – FGD–A: A–A' – Case 4a

Stability and Safety Factor Assessment, Oak Grove SES

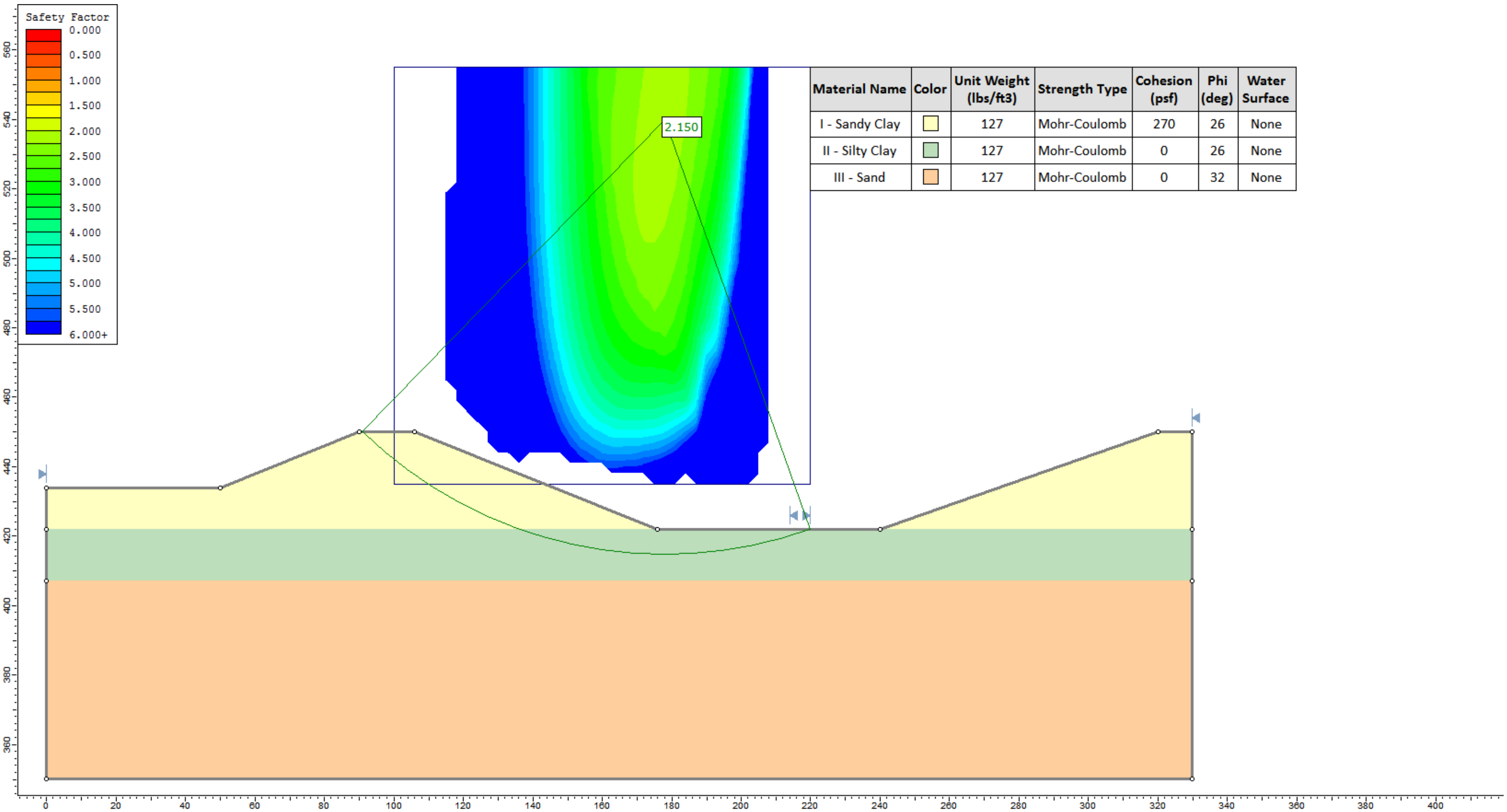


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)
I - Sandy Clay		127	132	Mohr-Coulomb	270	26
II - Silty Clay		127	132	Mohr-Coulomb	0	26
III - Sand		127	132	Mohr-Coulomb	0	32

FIGURE **C.8**

Results of Stability Analysis – FGD–A: A–A' – Case 4b

Stability and Safety Factor Assessment, Oak Grove SES

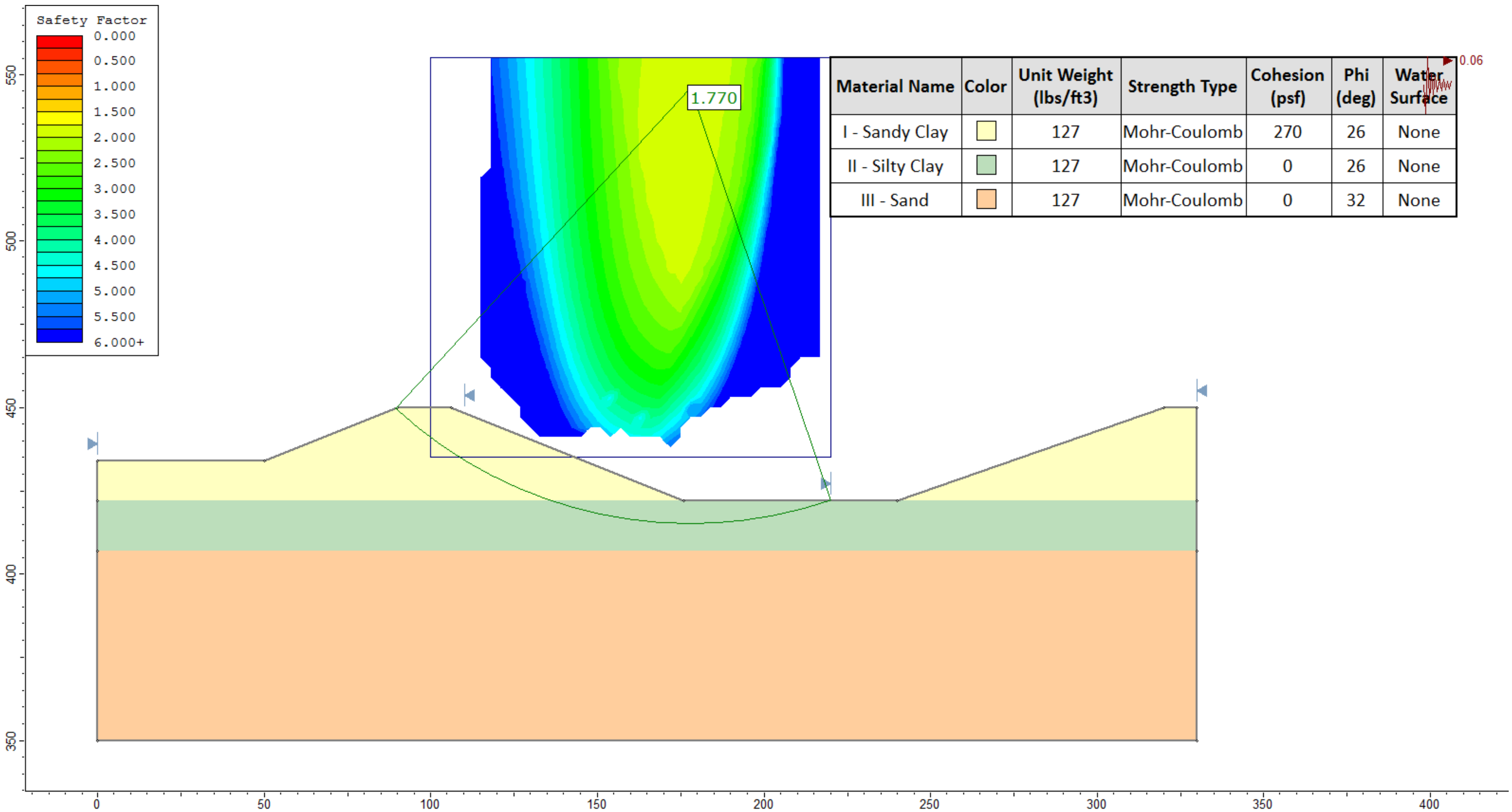


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
I - Sandy Clay		127	Mohr-Coulomb	270	26	None
II - Silty Clay		127	Mohr-Coulomb	0	26	None
III - Sand		127	Mohr-Coulomb	0	32	None

FIGURE **C.9**

Results of Stability Analysis – FGD–A: A–A' – Case 5a

Stability and Safety Factor Assessment, Oak Grove SES

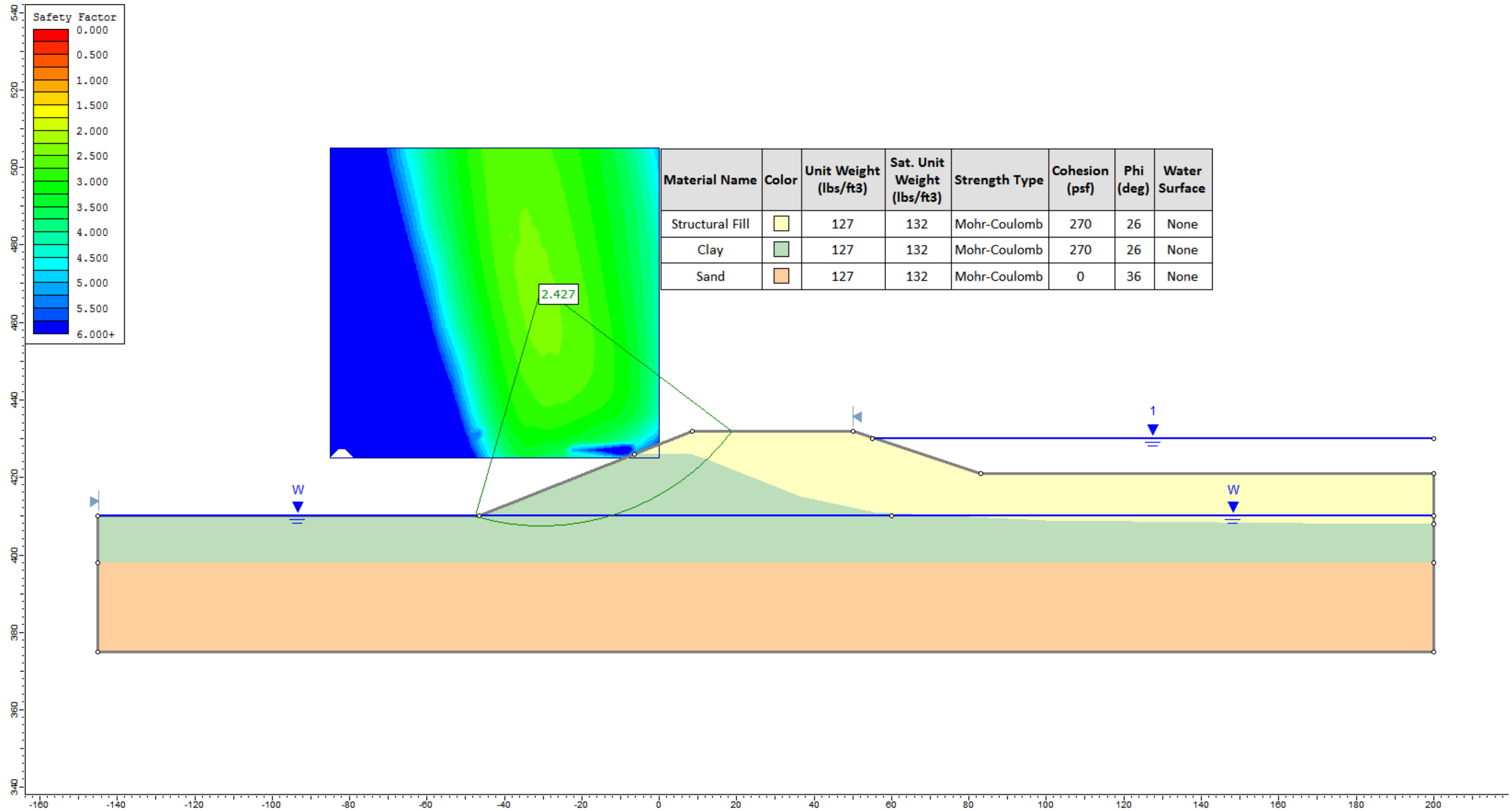


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
I - Sandy Clay		127	Mohr-Coulomb	270	26	None
II - Silty Clay		127	Mohr-Coulomb	0	26	None
III - Sand		127	Mohr-Coulomb	0	32	None

FIGURE **C.10**

Results of Stability Analysis – FGD–A: A–A' – Case 5b

Stability and Safety Factor Assessment, Oak Grove SES

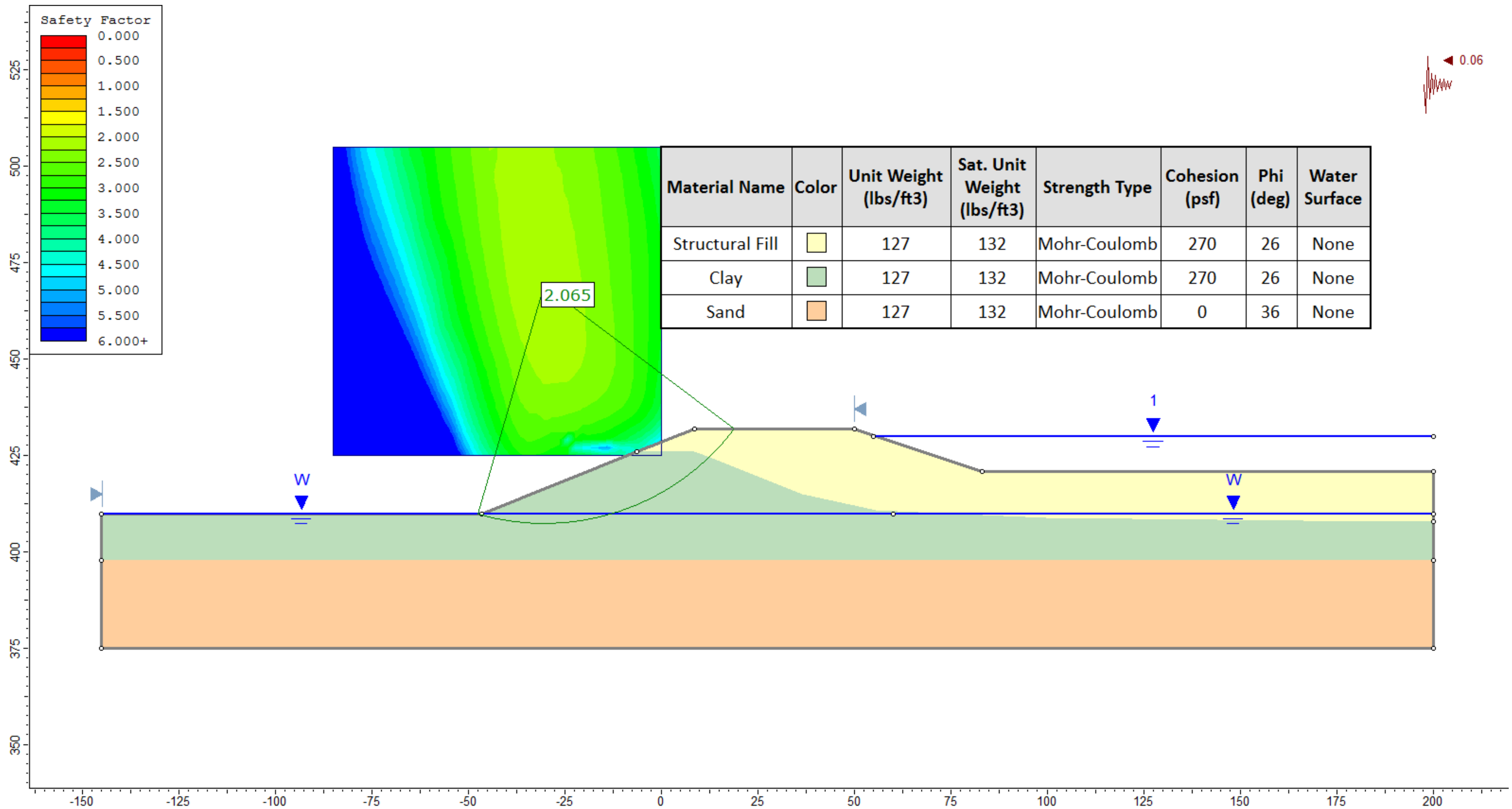


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Structural Fill		127	132	Mohr-Coulomb	270	26	None
Clay		127	132	Mohr-Coulomb	270	26	None
Sand		127	132	Mohr-Coulomb	0	36	None

FIGURE **C.11**

Results of Stability Analysis – FGD–B: B–B' – Case 1a

Stability and Safety Factor Assessment, Oak Grove SES

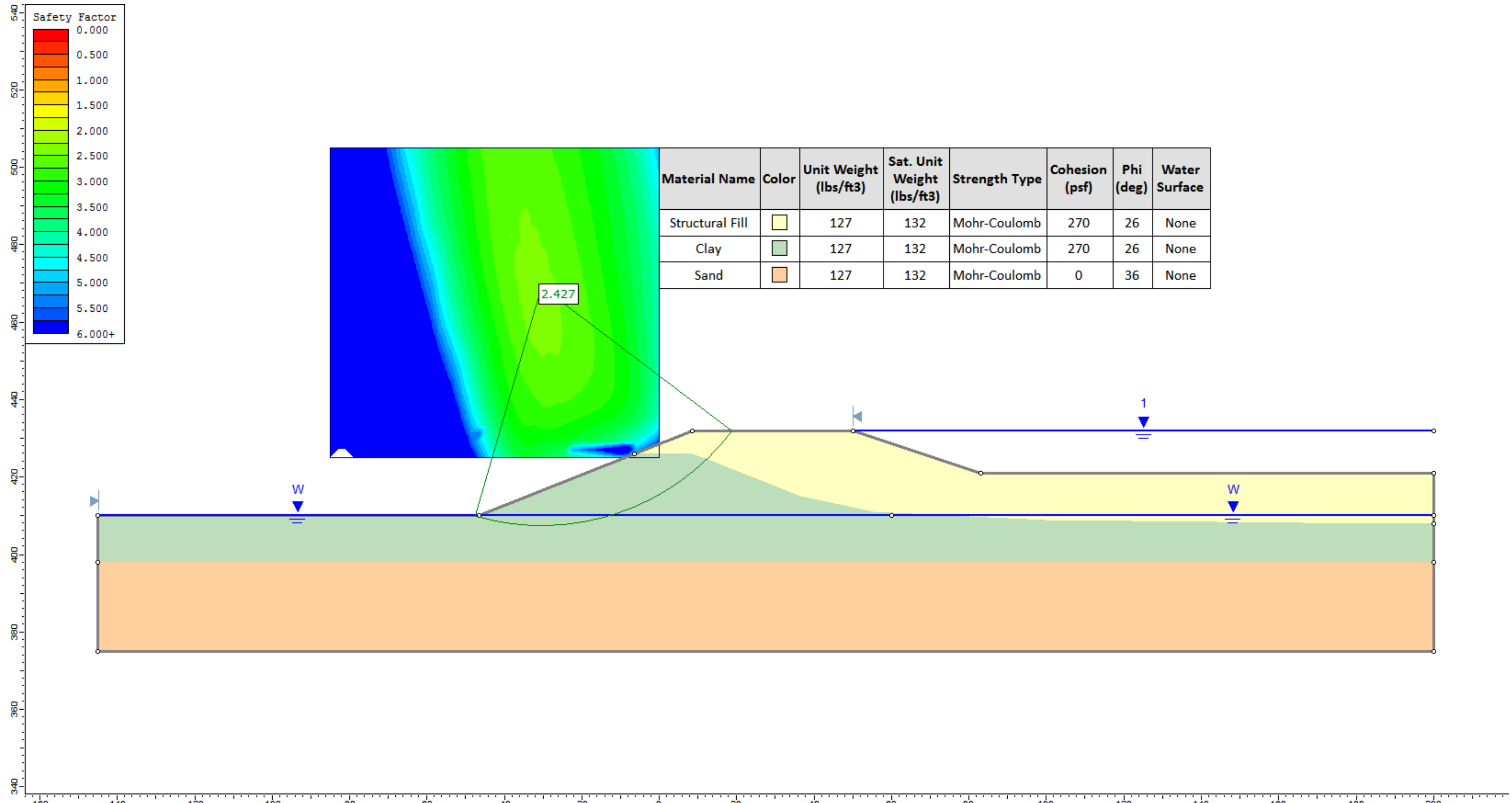


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Structural Fill		127	132	Mohr-Coulomb	270	26	None
Clay		127	132	Mohr-Coulomb	270	26	None
Sand		127	132	Mohr-Coulomb	0	36	None

FIGURE **C.12**

Results of Stability Analysis – FGD–B: B–B' – Case 1b

Stability and Safety Factor Assessment, Oak Grove SES

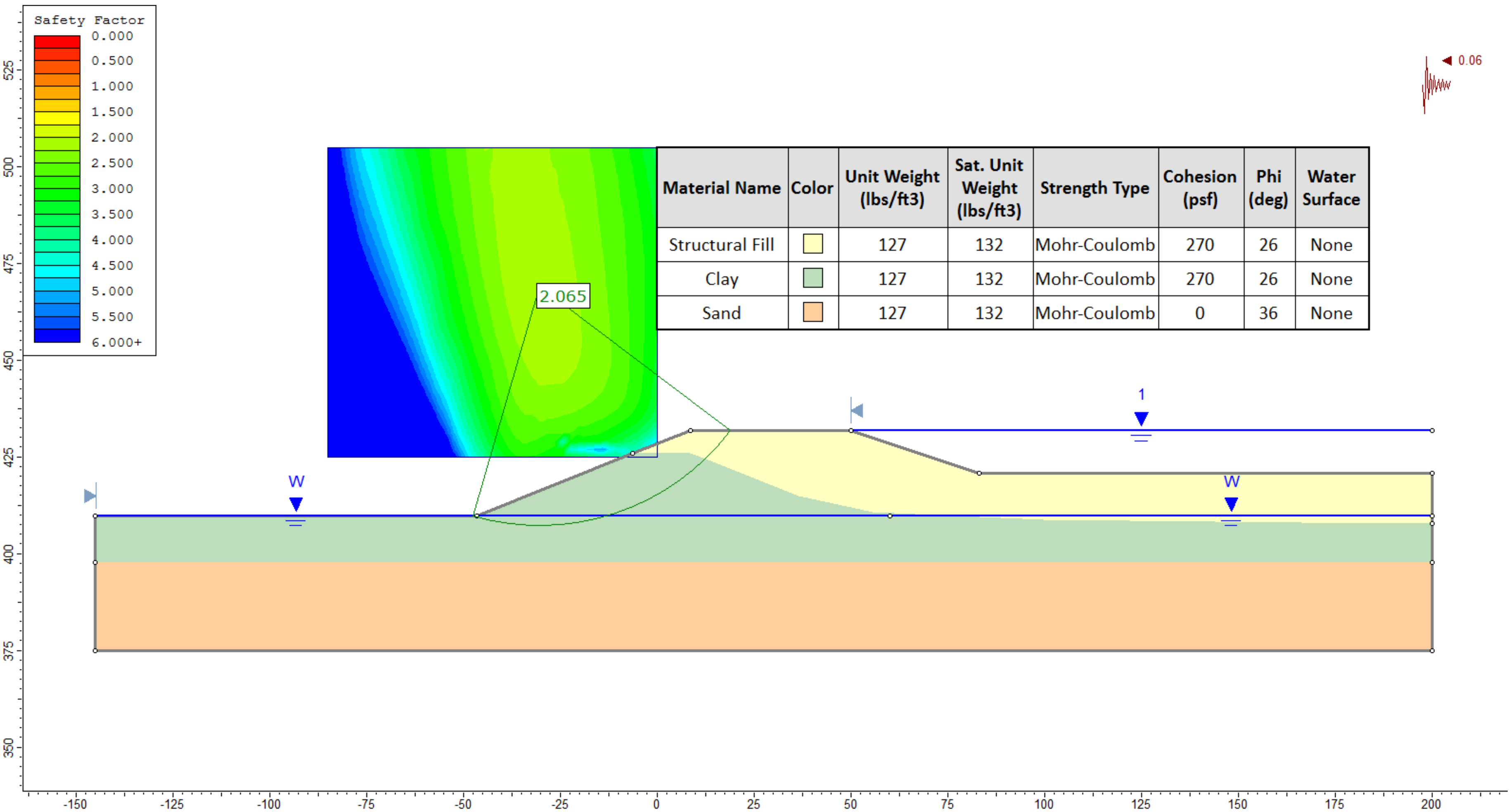


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Structural Fill		127	132	Mohr-Coulomb	270	26	None
Clay		127	132	Mohr-Coulomb	270	26	None
Sand		127	132	Mohr-Coulomb	0	36	None

FIGURE **C.13**

Results of Stability Analysis – FGD–B: B–B' – Case 2a

Stability and Safety Factor Assessment, Oak Grove SES

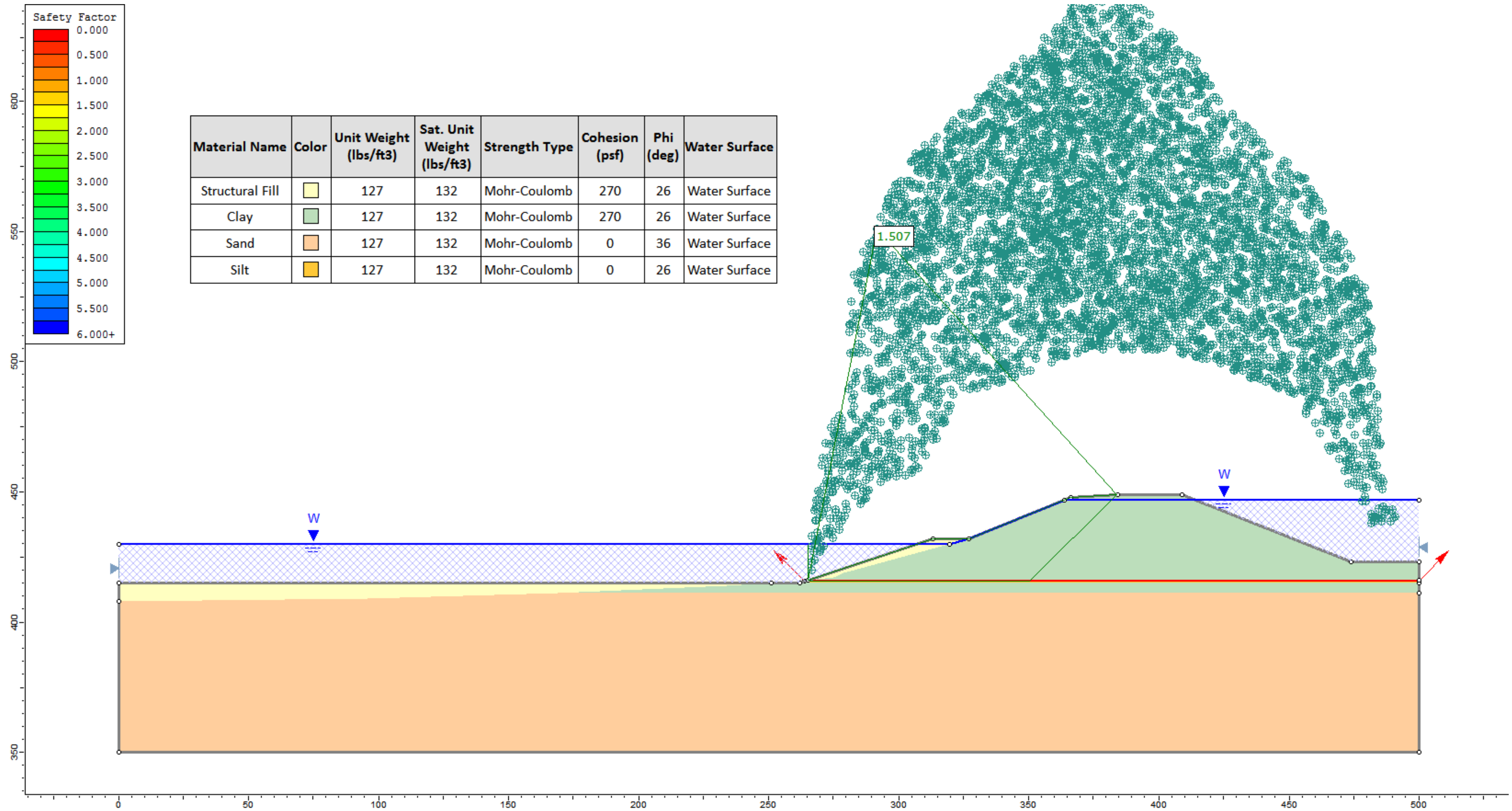


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Structural Fill		127	132	Mohr-Coulomb	270	26	None
Clay		127	132	Mohr-Coulomb	270	26	None
Sand		127	132	Mohr-Coulomb	0	36	None

FIGURE **C.14**

Results of Stability Analysis – FGD–B: B–B' – Case 2b

Stability and Safety Factor Assessment, Oak Grove SES



Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Structural Fill		127	132	Mohr-Coulomb	270	26	Water Surface
Clay		127	132	Mohr-Coulomb	270	26	Water Surface
Sand		127	132	Mohr-Coulomb	0	36	Water Surface
Silt		127	132	Mohr-Coulomb	0	26	Water Surface

FIGURE **C.15**

Results of Stability Analysis – FGD–B: B1–B1' – Case 3a

Stability and Safety Factor Assessment, Oak Grove SES

Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type
Structural Fill		127	132	Mohr-Coulomb	270	26	Water Surface	Custom
Clay		127	132	Mohr-Coulomb	270	26	Water Surface	Custom
Sand		127	132	Mohr-Coulomb	0	36	Water Surface	Custom
Silt		127	132	Mohr-Coulomb	0	26	Water Surface	Custom

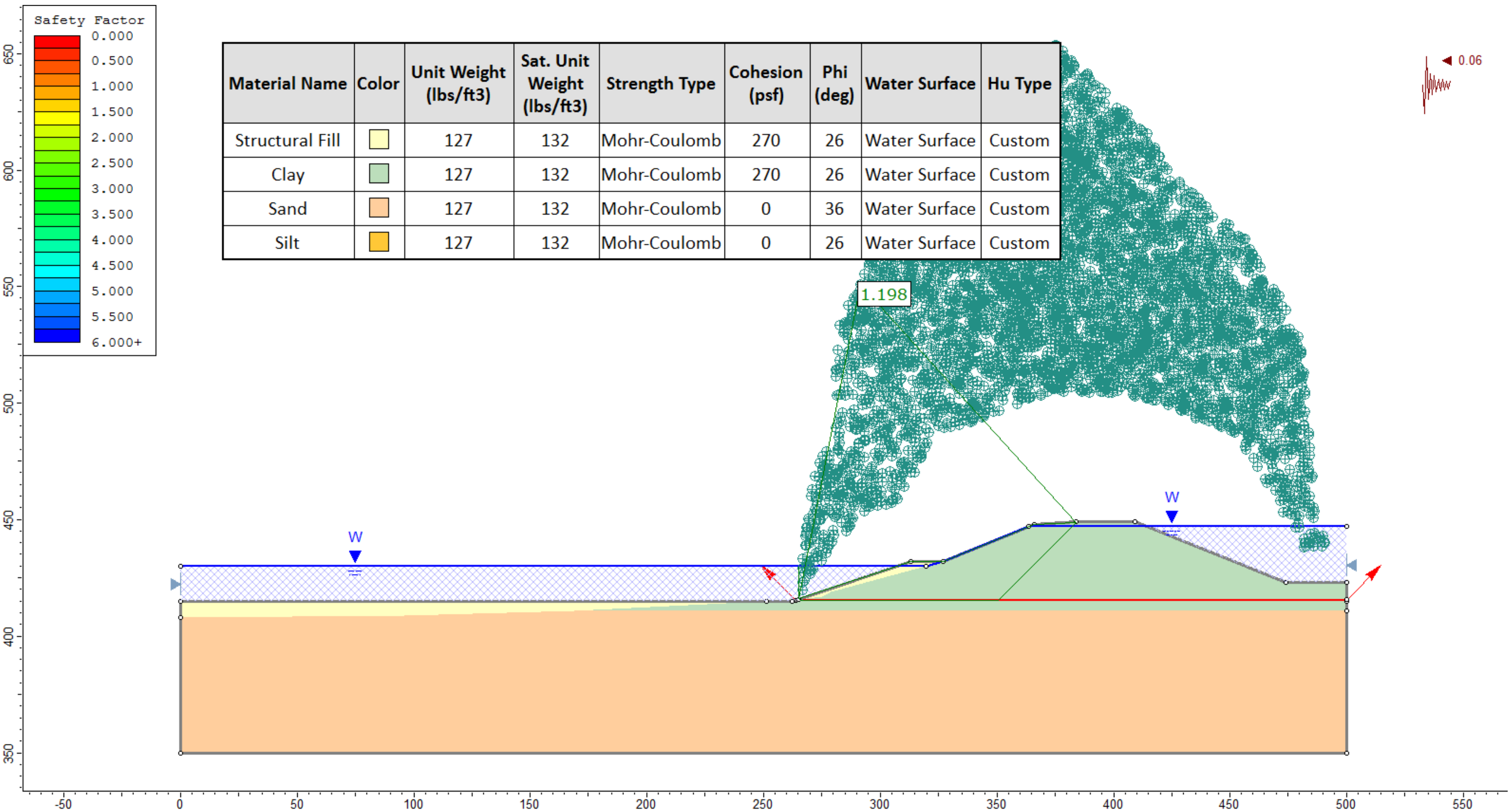
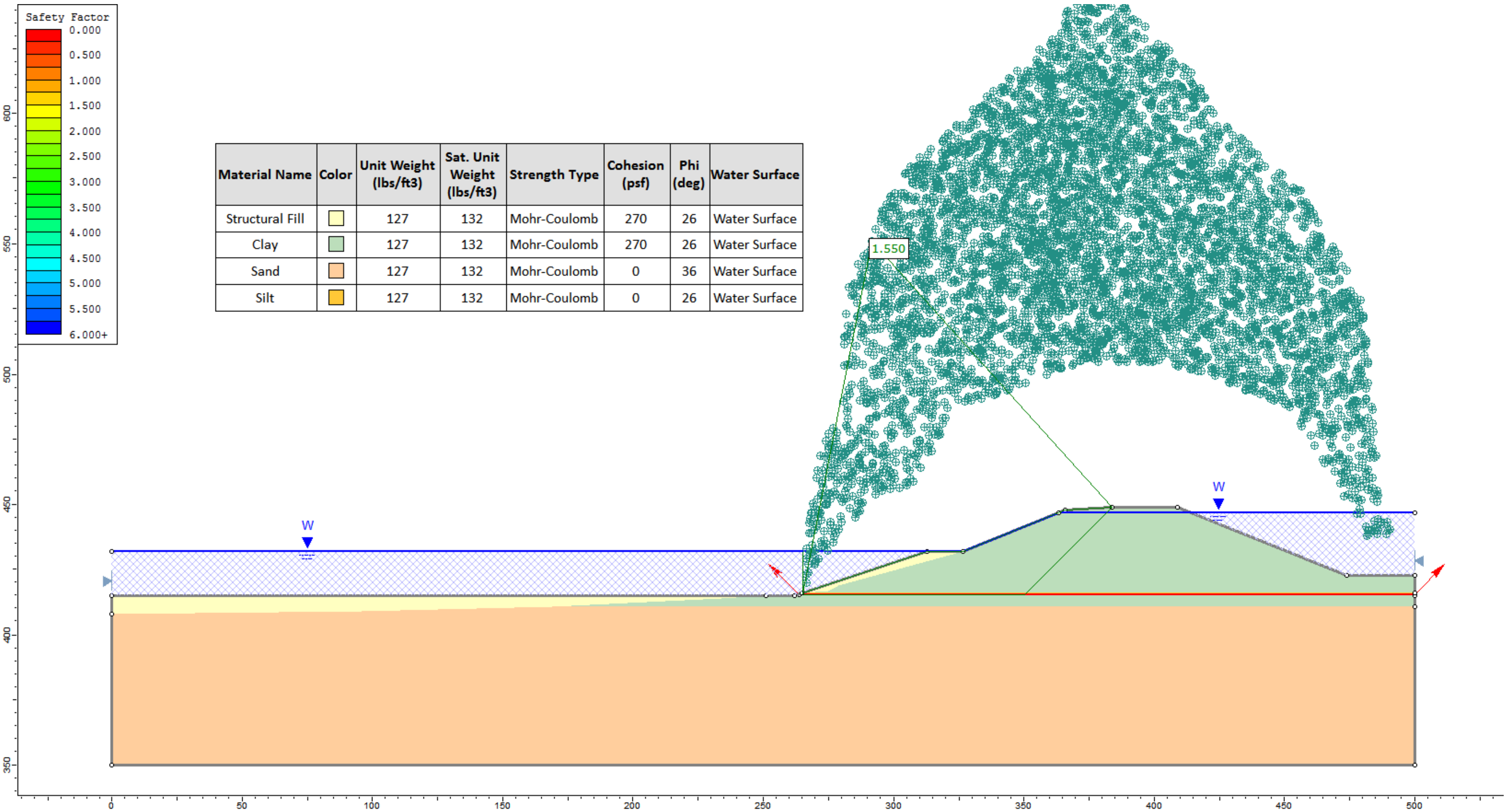


FIGURE **C.16**

Results of Stability Analysis – FGD–B: B1–B1' – Case 3b

Stability and Safety Factor Assessment, Oak Grove SES

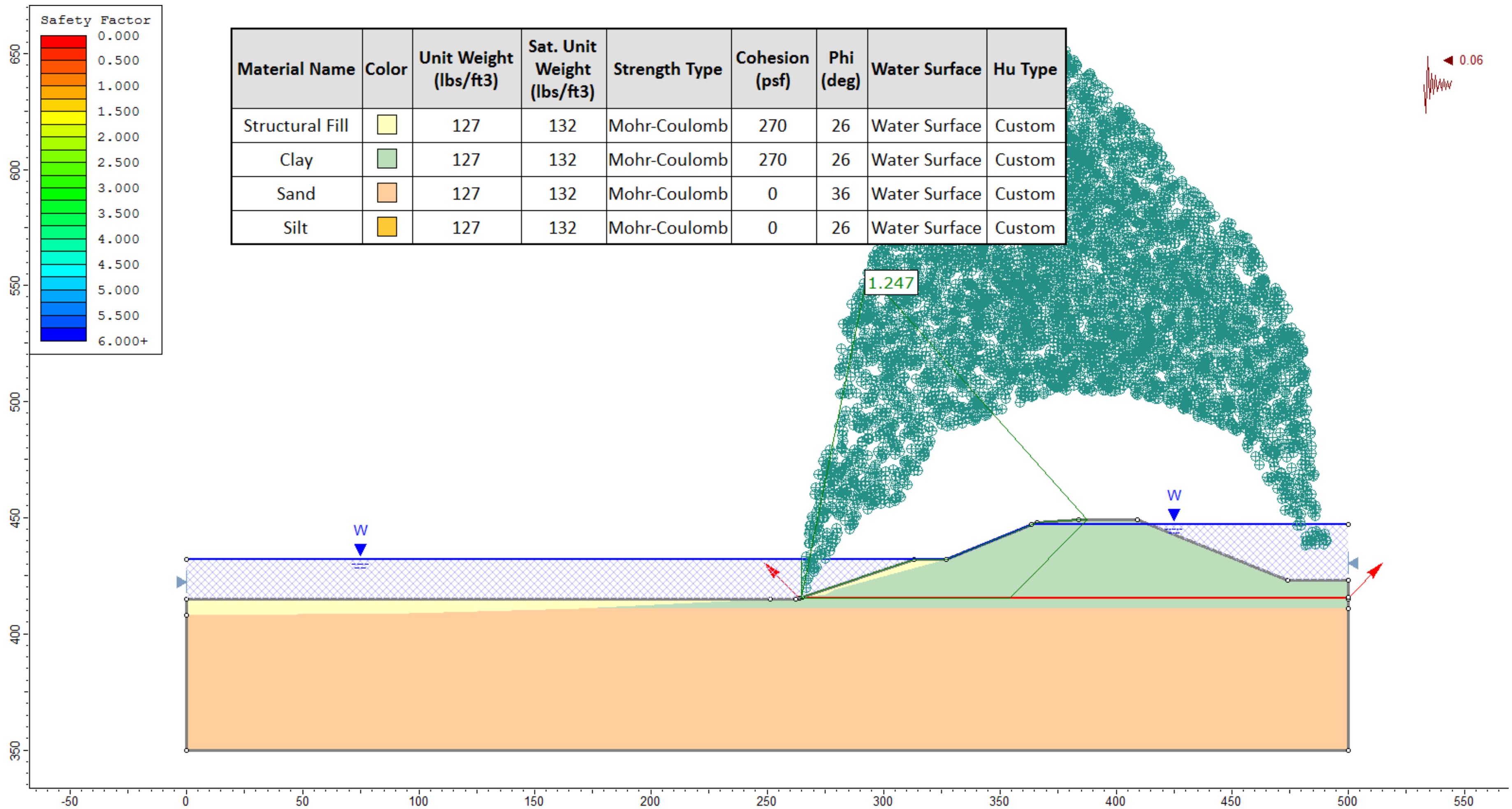


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Structural Fill		127	132	Mohr-Coulomb	270	26	Water Surface
Clay		127	132	Mohr-Coulomb	270	26	Water Surface
Sand		127	132	Mohr-Coulomb	0	36	Water Surface
Silt		127	132	Mohr-Coulomb	0	26	Water Surface

FIGURE **C.17**

Results of Stability Analysis – FGD–B: B1–B1' – Case 4a

Stability and Safety Factor Assessment, Oak Grove SES

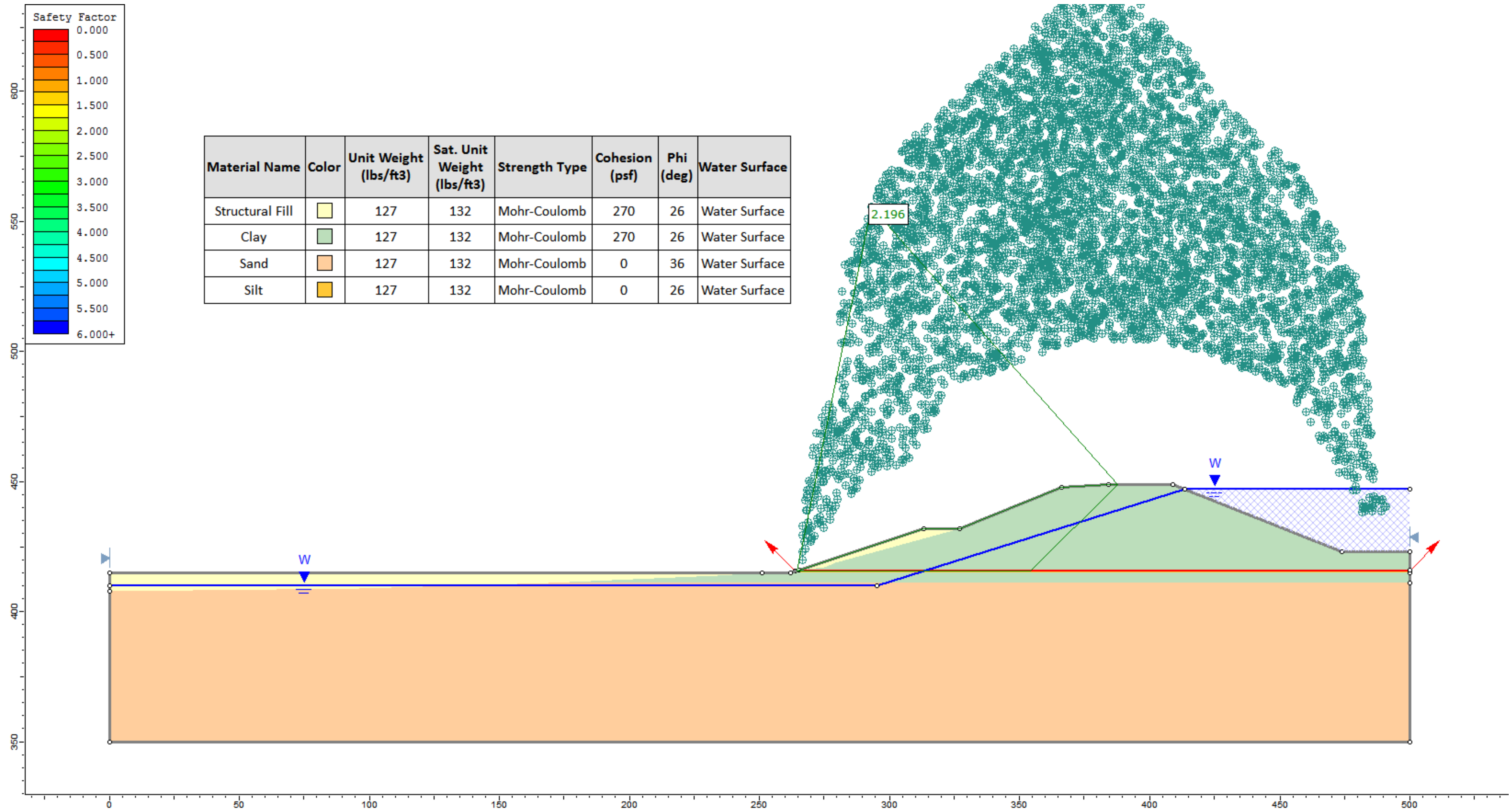


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Hu Type
Structural Fill		127	132	Mohr-Coulomb	270	26	Water Surface	Custom
Clay		127	132	Mohr-Coulomb	270	26	Water Surface	Custom
Sand		127	132	Mohr-Coulomb	0	36	Water Surface	Custom
Silt		127	132	Mohr-Coulomb	0	26	Water Surface	Custom

FIGURE **C.18**

Results of Stability Analysis – FGD–B: B1–B1' – Case 4b

Stability and Safety Factor Assessment, Oak Grove SES

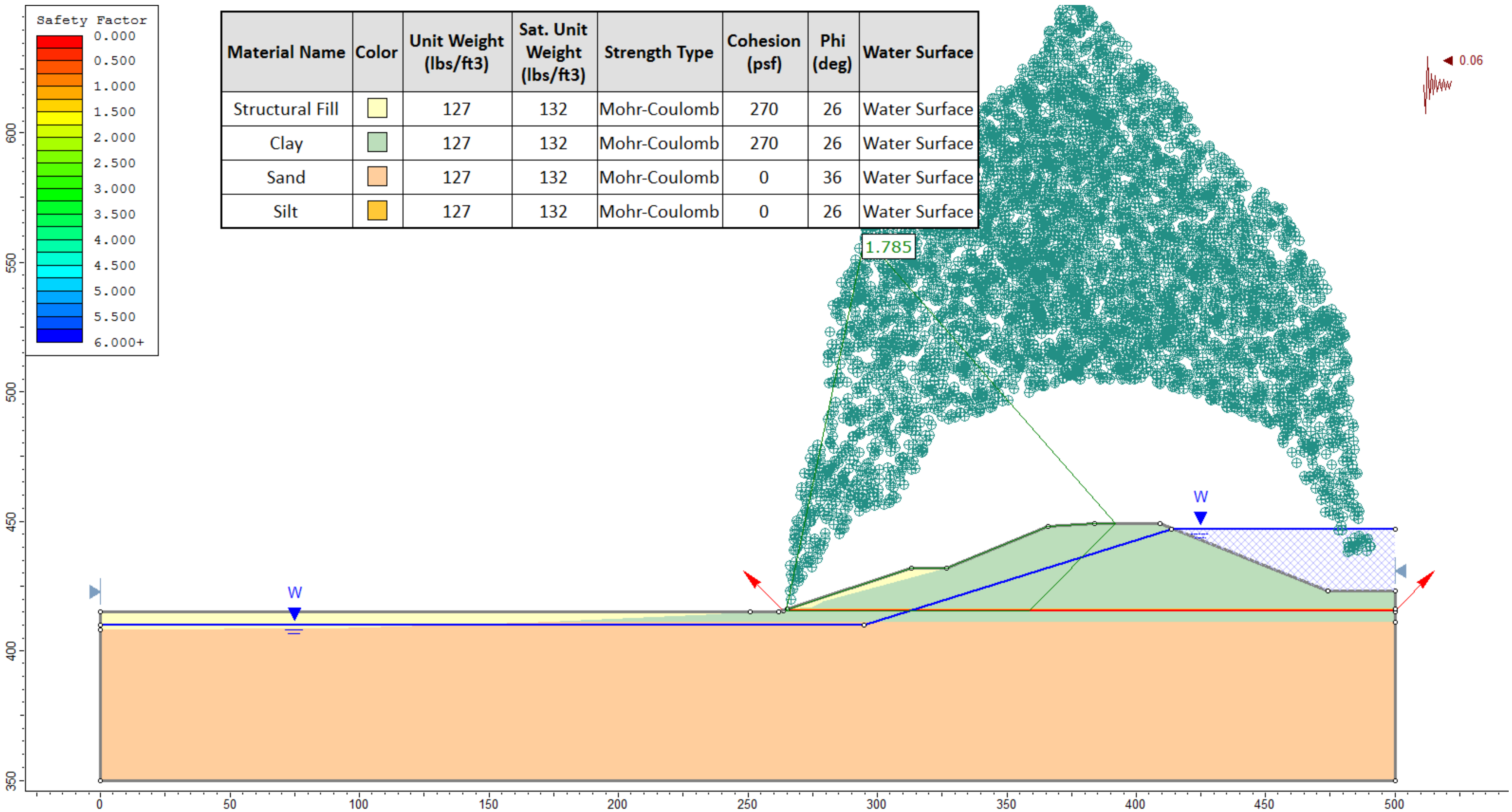


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Structural Fill		127	132	Mohr-Coulomb	270	26	Water Surface
Clay		127	132	Mohr-Coulomb	270	26	Water Surface
Sand		127	132	Mohr-Coulomb	0	36	Water Surface
Silt		127	132	Mohr-Coulomb	0	26	Water Surface

FIGURE **C.19**

Results of Stability Analysis – FGD–B: B1–B1' – Case 5a

Stability and Safety Factor Assessment, Oak Grove SES

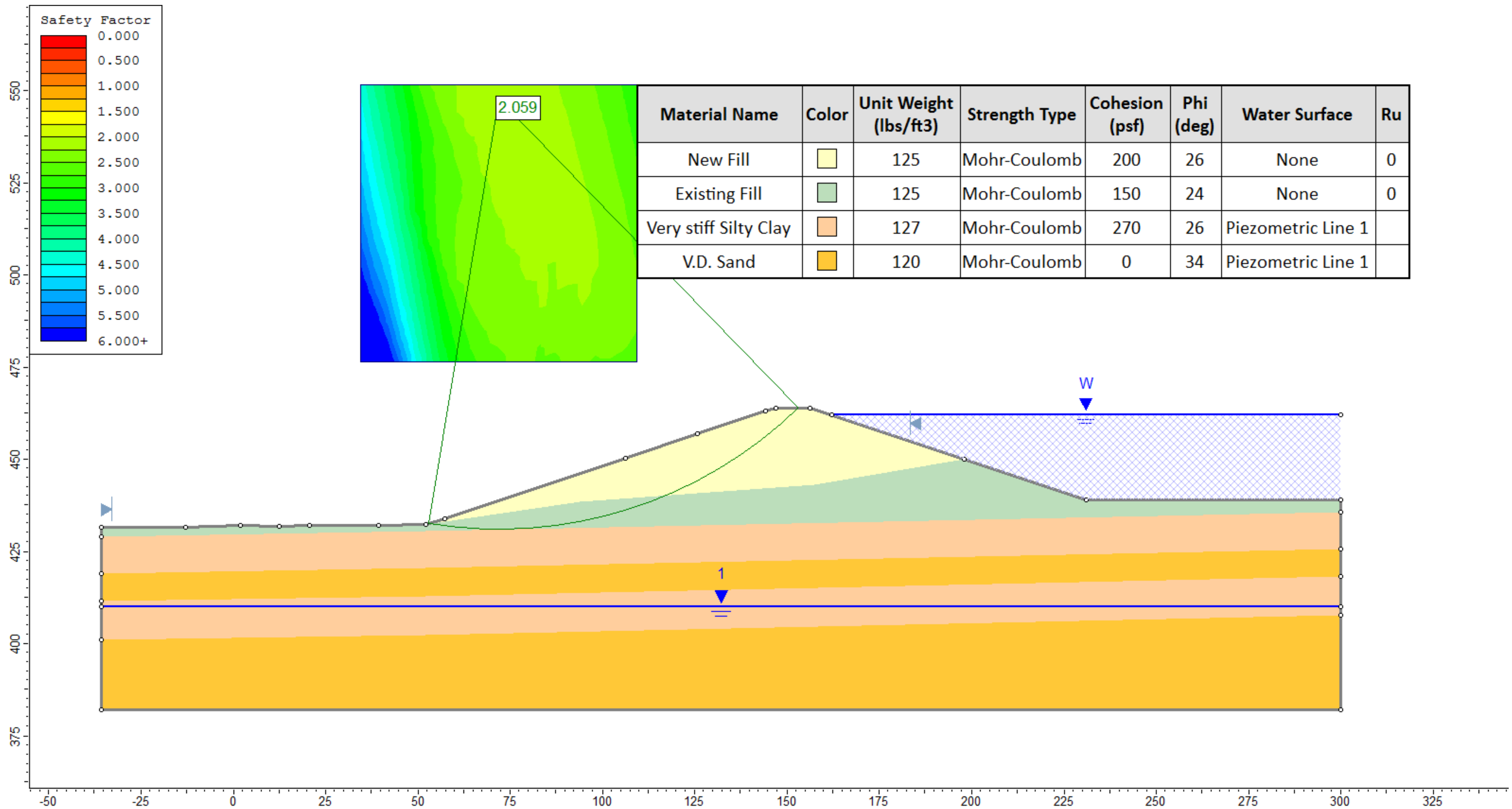


Material Name	Color	Unit Weight (lbs/ft3)	Sat. Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Structural Fill		127	132	Mohr-Coulomb	270	26	Water Surface
Clay		127	132	Mohr-Coulomb	270	26	Water Surface
Sand		127	132	Mohr-Coulomb	0	36	Water Surface
Silt		127	132	Mohr-Coulomb	0	26	Water Surface

FIGURE **C.20**

Results of Stability Analysis – FGD–B: B1–B1' – Case 5b

Stability and Safety Factor Assessment, Oak Grove SES

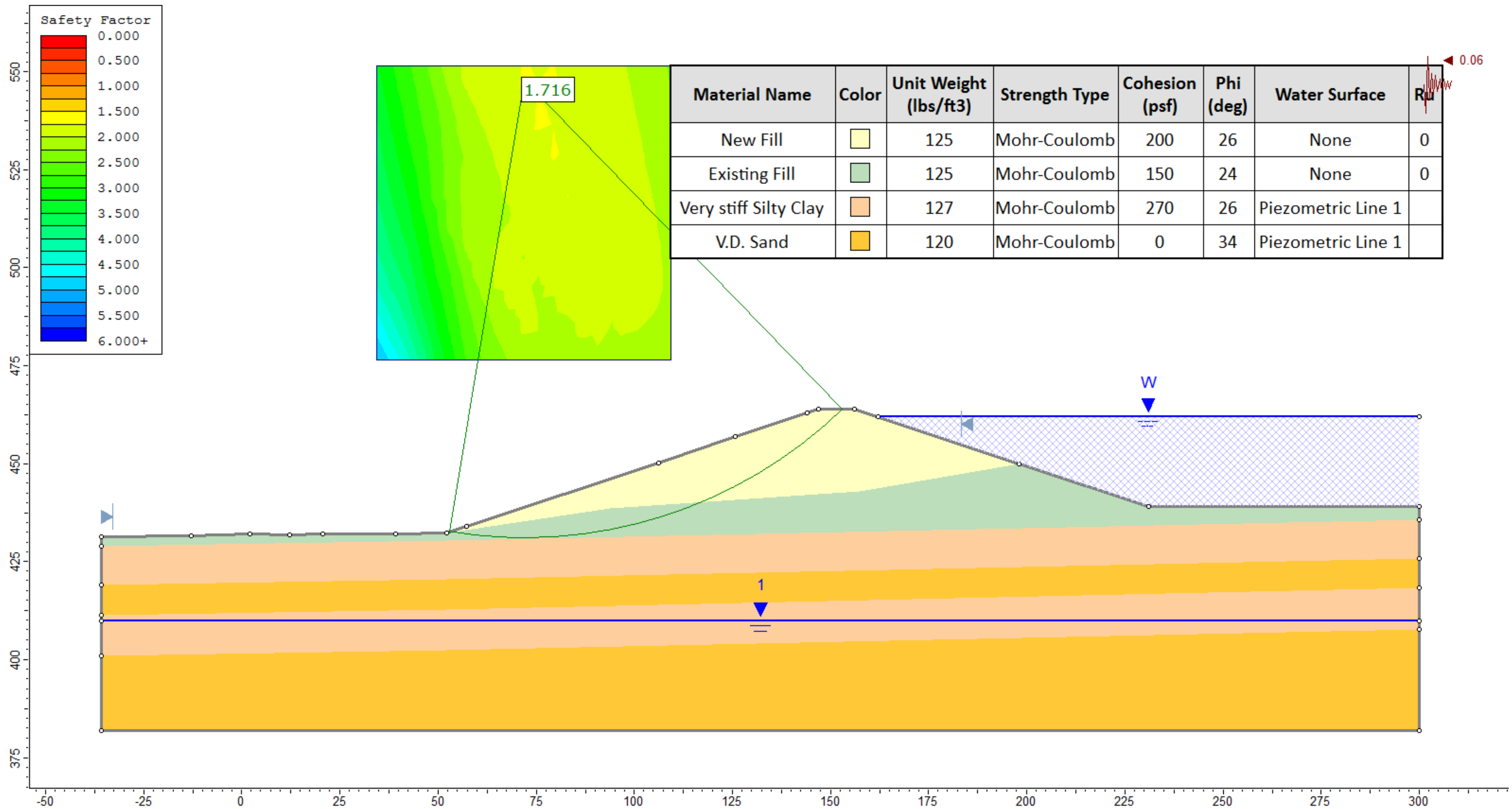


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
New Fill		125	Mohr-Coulomb	200	26	None	0
Existing Fill		125	Mohr-Coulomb	150	24	None	0
Very stiff Silty Clay		127	Mohr-Coulomb	270	26	Piezometric Line 1	
V.D. Sand		120	Mohr-Coulomb	0	34	Piezometric Line 1	

FIGURE **C.21**

Results of Stability Analysis – FGD–C: C–C' – Case 1a

Stability and Safety Factor Assessment, Oak Grove SES

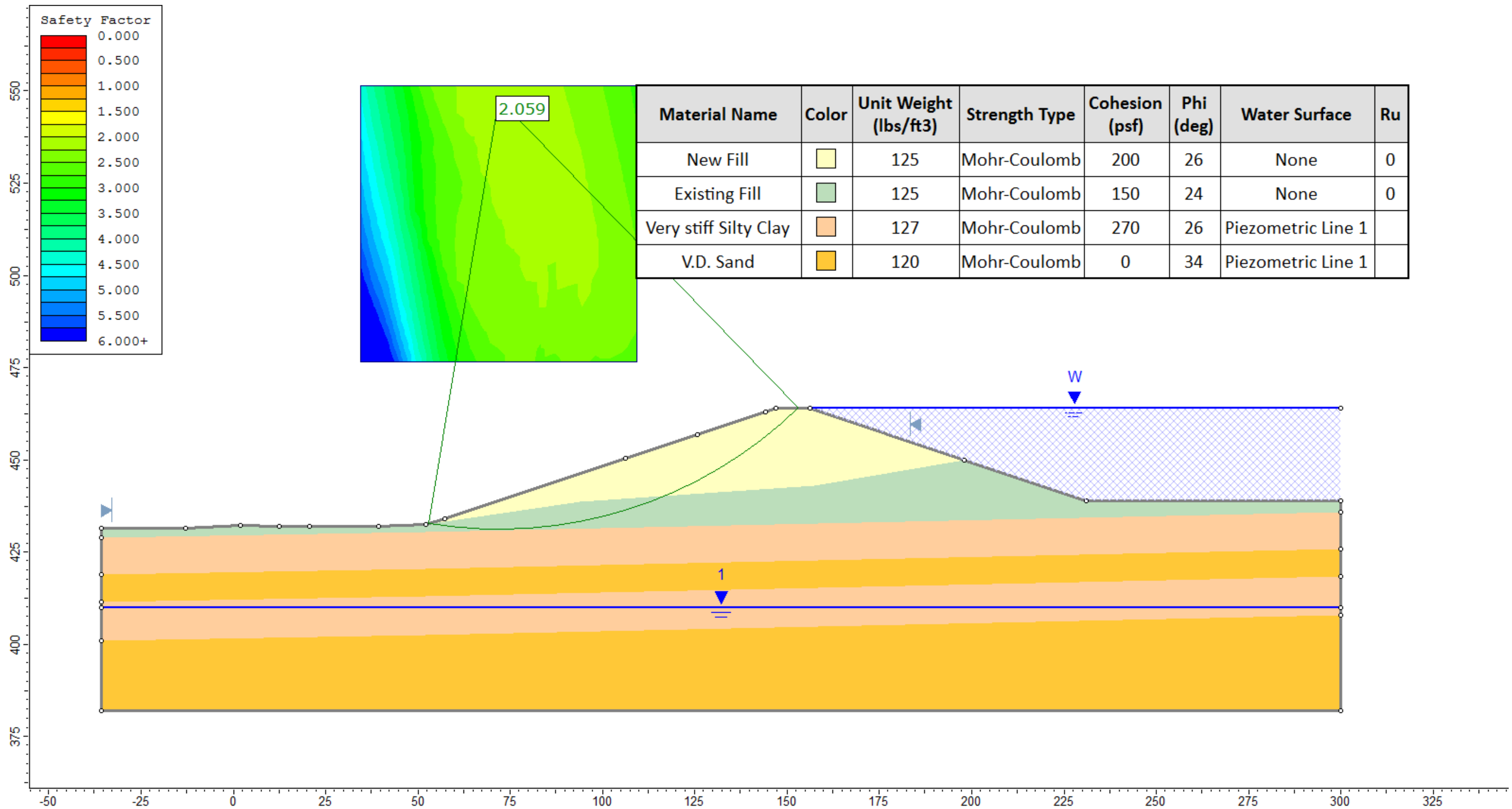


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
New Fill		125	Mohr-Coulomb	200	26	None	0
Existing Fill		125	Mohr-Coulomb	150	24	None	0
Very stiff Silty Clay		127	Mohr-Coulomb	270	26	Piezometric Line 1	
V.D. Sand		120	Mohr-Coulomb	0	34	Piezometric Line 1	

FIGURE **C.22**

Results of Stability Analysis – FGD–C: C–C' – Case 1b

Stability and Safety Factor Assessment, Oak Grove SES

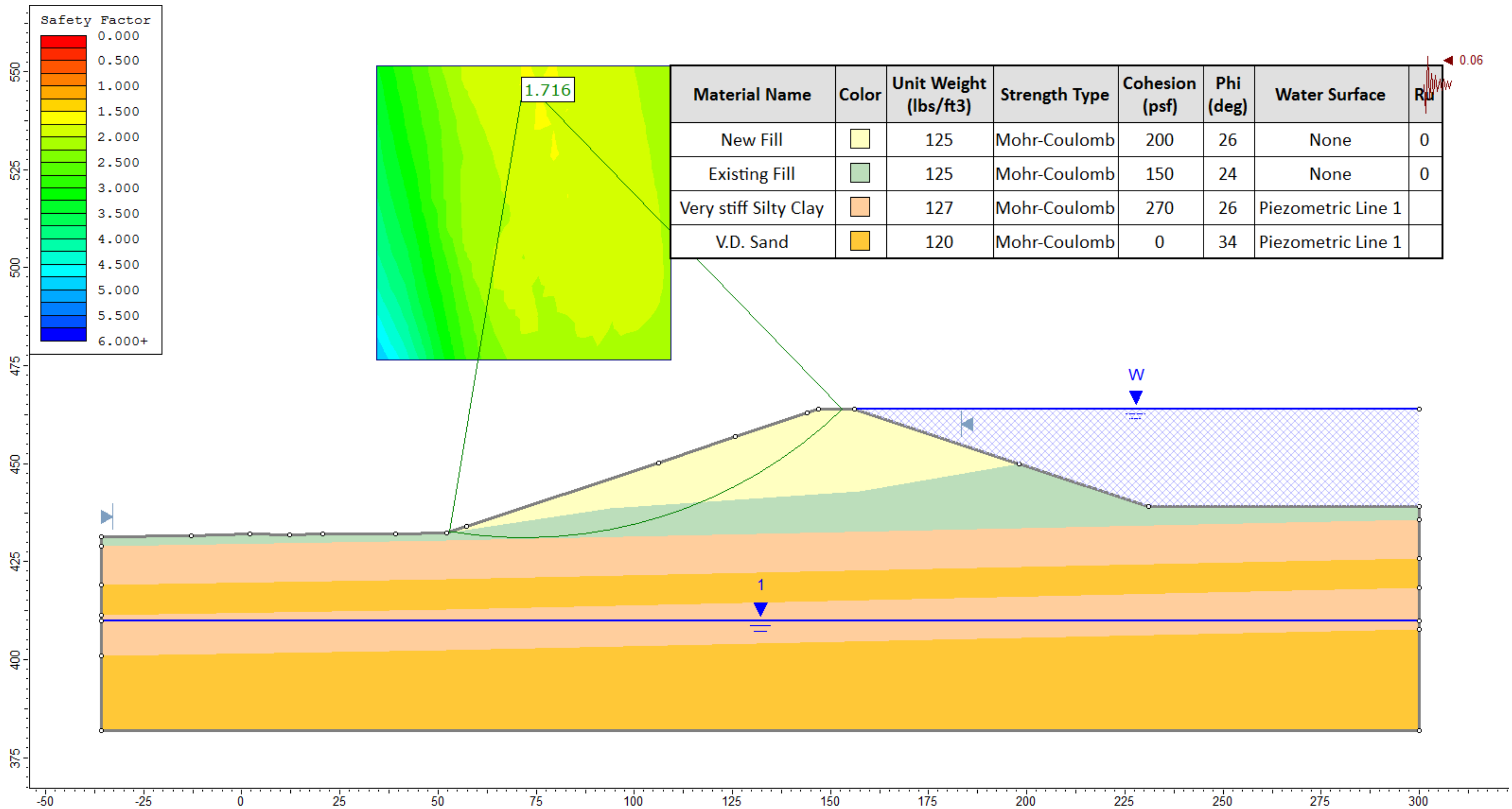


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
New Fill		125	Mohr-Coulomb	200	26	None	0
Existing Fill		125	Mohr-Coulomb	150	24	None	0
Very stiff Silty Clay		127	Mohr-Coulomb	270	26	Piezometric Line 1	
V.D. Sand		120	Mohr-Coulomb	0	34	Piezometric Line 1	

FIGURE **C.23**

Results of Stability Analysis – FGD–C: C–C' – Case 2a

Stability and Safety Factor Assessment, Oak Grove SES

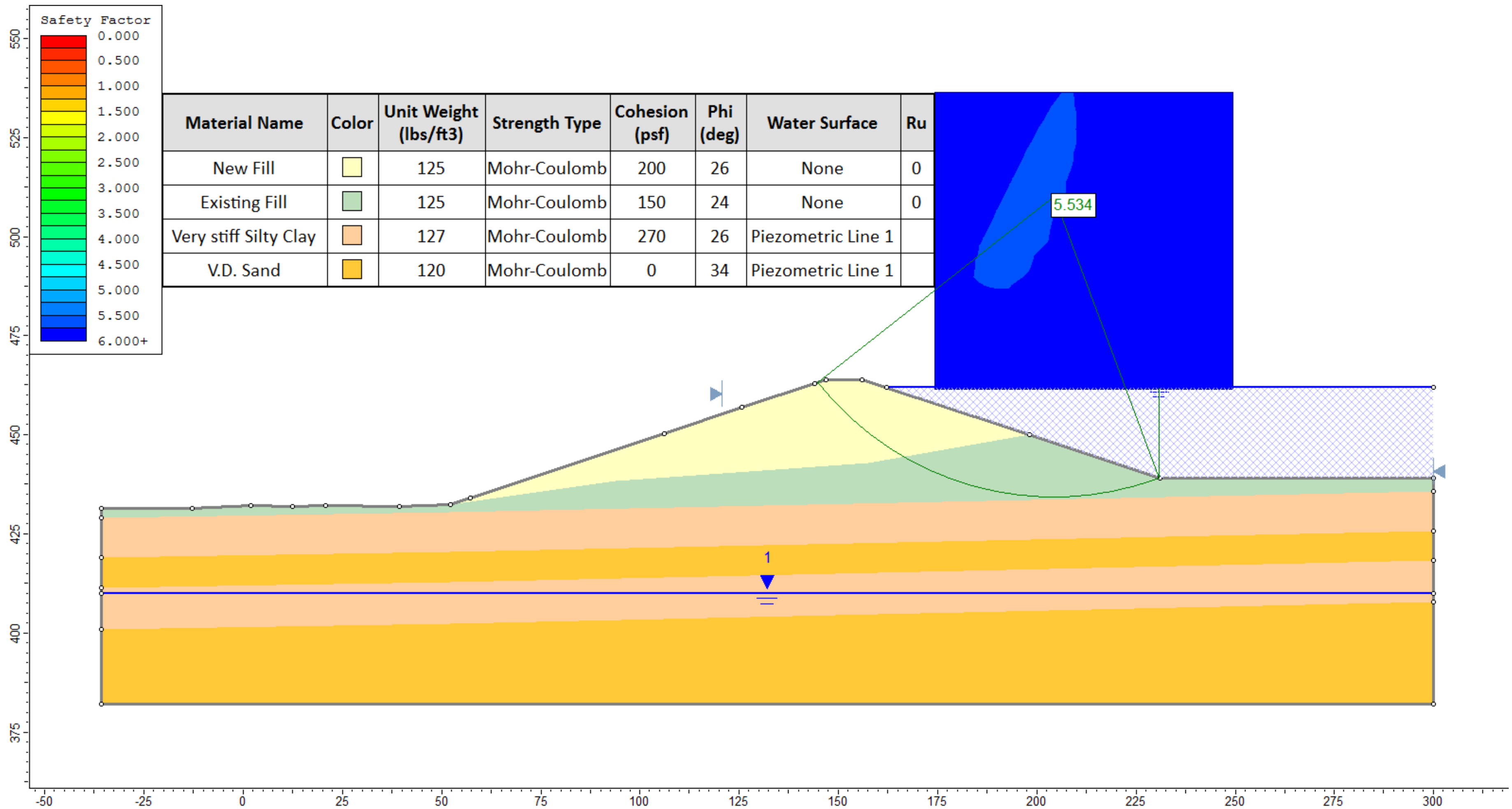


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
New Fill		125	Mohr-Coulomb	200	26	None	0
Existing Fill		125	Mohr-Coulomb	150	24	None	0
Very stiff Silty Clay		127	Mohr-Coulomb	270	26	Piezometric Line 1	
V.D. Sand		120	Mohr-Coulomb	0	34	Piezometric Line 1	

FIGURE **C.24**

Results of Stability Analysis – FGD–C: C–C' – Case 2b

Stability and Safety Factor Assessment, Oak Grove SES

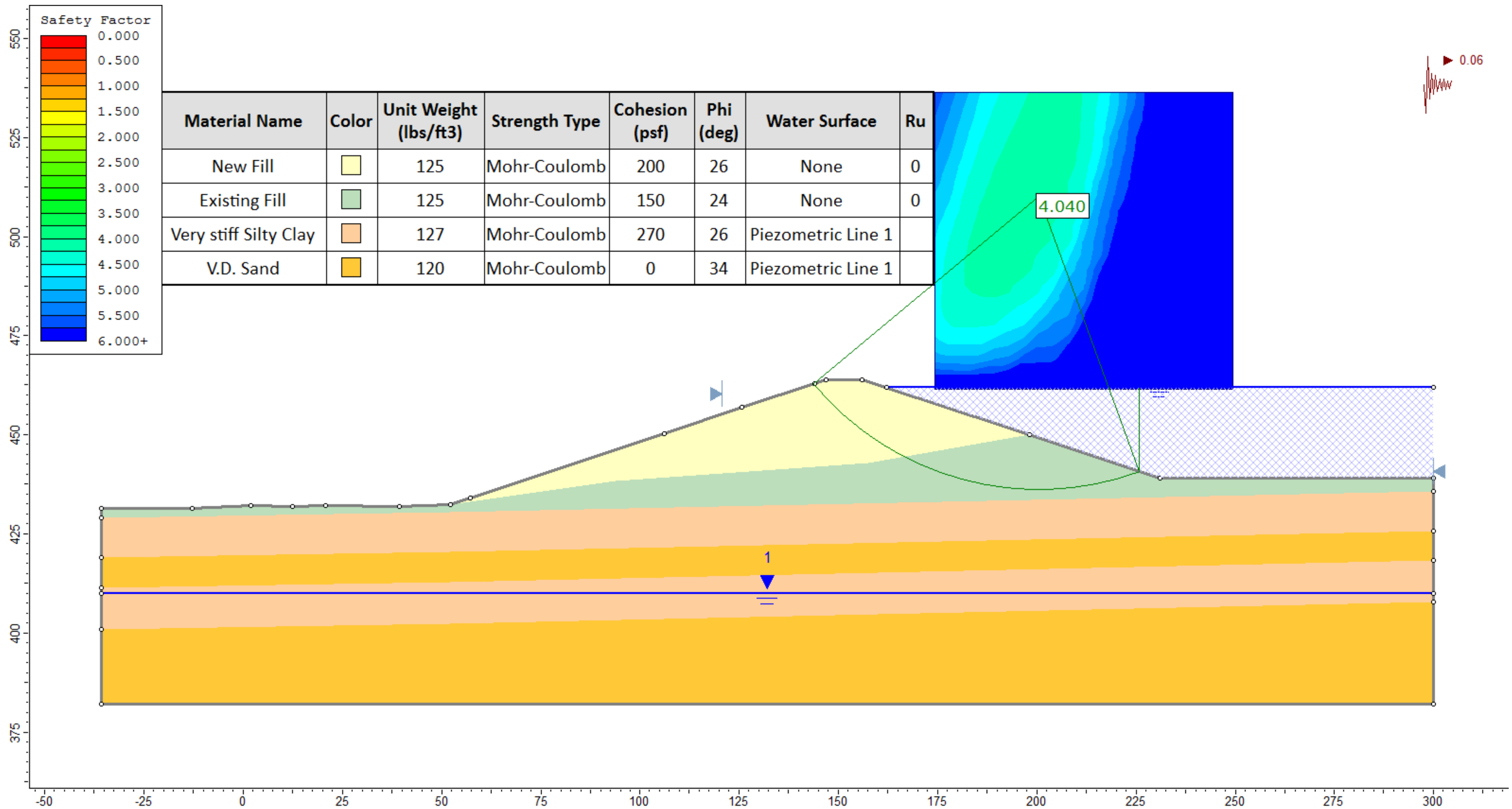


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
New Fill		125	Mohr-Coulomb	200	26	None	0
Existing Fill		125	Mohr-Coulomb	150	24	None	0
Very stiff Silty Clay		127	Mohr-Coulomb	270	26	Piezometric Line 1	
V.D. Sand		120	Mohr-Coulomb	0	34	Piezometric Line 1	

FIGURE **C.25**

Results of Stability Analysis – FGD–C: C–C' – Case 3a

Stability and Safety Factor Assessment, Oak Grove SES

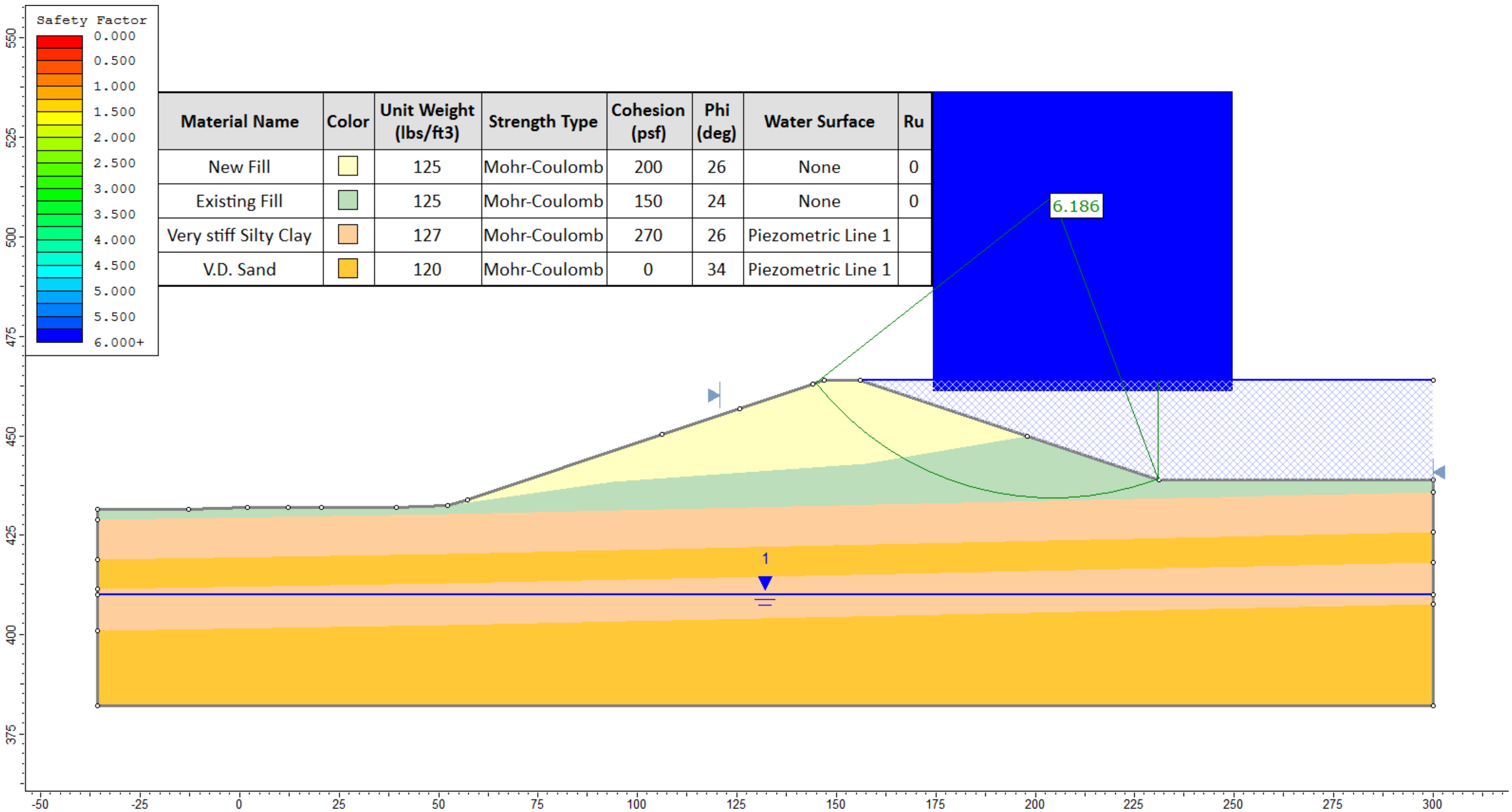


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
New Fill		125	Mohr-Coulomb	200	26	None	0
Existing Fill		125	Mohr-Coulomb	150	24	None	0
Very stiff Silty Clay		127	Mohr-Coulomb	270	26	Piezometric Line 1	
V.D. Sand		120	Mohr-Coulomb	0	34	Piezometric Line 1	

FIGURE **C.26**

Results of Stability Analysis – FGD–C: C–C' – Case 3b

Stability and Safety Factor Assessment, Oak Grove SES

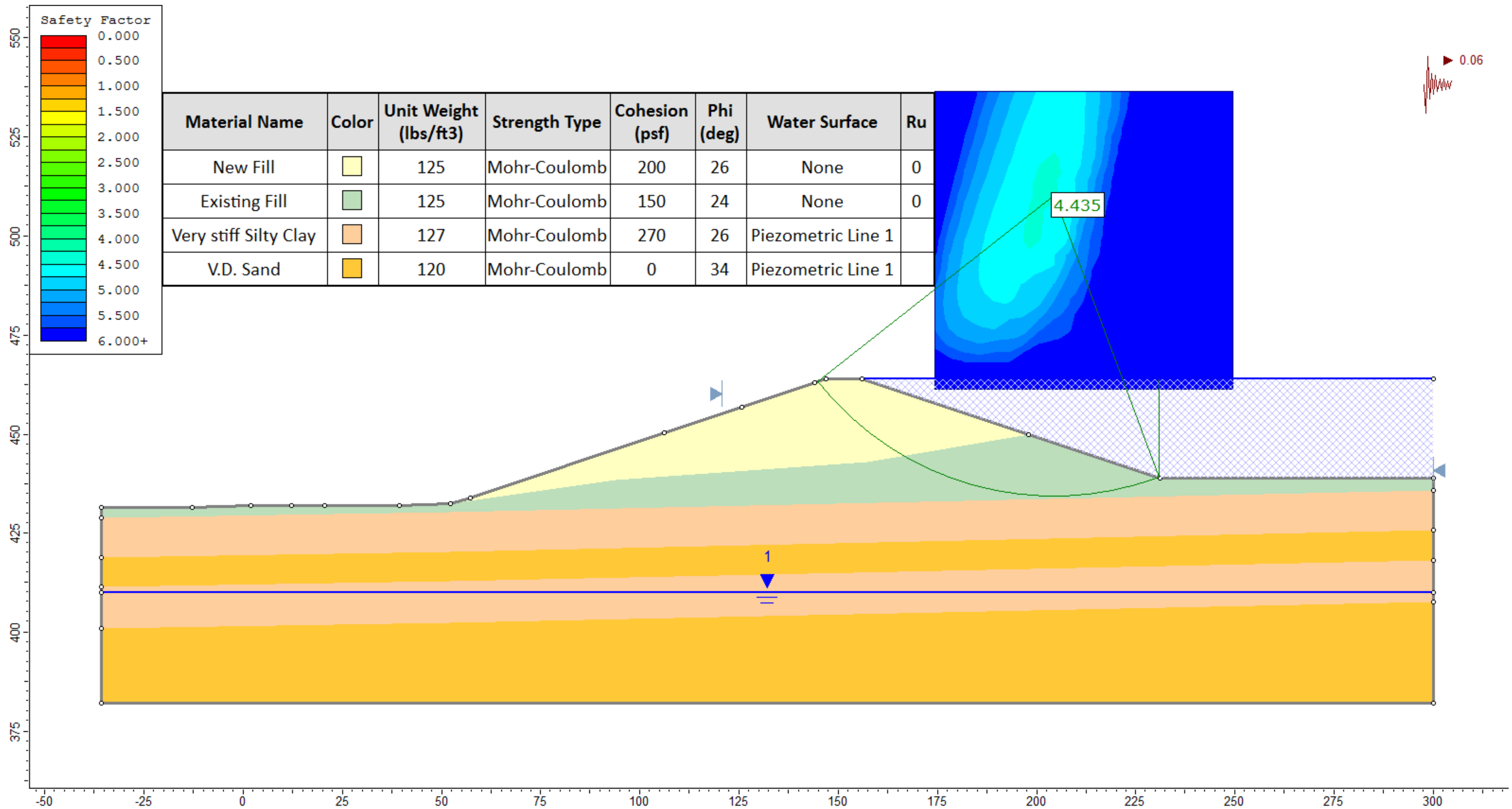


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
New Fill		125	Mohr-Coulomb	200	26	None	0
Existing Fill		125	Mohr-Coulomb	150	24	None	0
Very stiff Silty Clay		127	Mohr-Coulomb	270	26	Piezometric Line 1	
V.D. Sand		120	Mohr-Coulomb	0	34	Piezometric Line 1	

FIGURE **C.27**

Results of Stability Analysis – FGD–C: C–C' – Case 4a

Stability and Safety Factor Assessment, Oak Grove SES

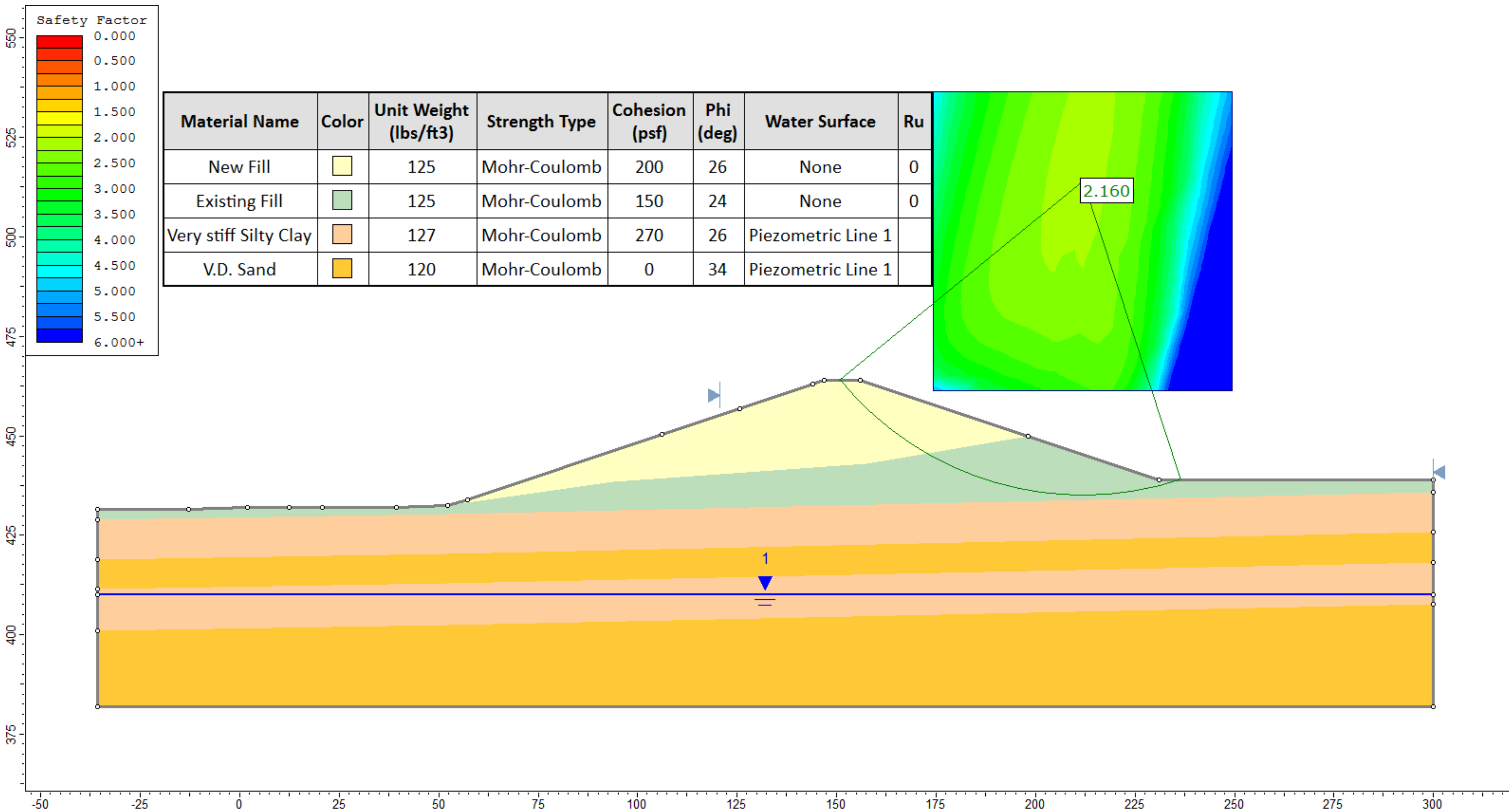


Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
New Fill		125	Mohr-Coulomb	200	26	None	0
Existing Fill		125	Mohr-Coulomb	150	24	None	0
Very stiff Silty Clay		127	Mohr-Coulomb	270	26	Piezometric Line 1	
V.D. Sand		120	Mohr-Coulomb	0	34	Piezometric Line 1	

FIGURE **C.28**

Results of Stability Analysis – FGD–C: C–C' – Case 4b

Stability and Safety Factor Assessment, Oak Grove SES



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
New Fill		125	Mohr-Coulomb	200	26	None	0
Existing Fill		125	Mohr-Coulomb	150	24	None	0
Very stiff Silty Clay		127	Mohr-Coulomb	270	26	Piezometric Line 1	
V.D. Sand		120	Mohr-Coulomb	0	34	Piezometric Line 1	

FIGURE **C.29**

Results of Stability Analysis – FGD–C: C–C' – Case 5a

Stability and Safety Factor Assessment, Oak Grove SES

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
New Fill		125	Mohr-Coulomb	200	26	None	0
Existing Fill		125	Mohr-Coulomb	150	24	None	0
Very stiff Silty Clay		127	Mohr-Coulomb	270	26	Piezometric Line 1	
V.D. Sand		120	Mohr-Coulomb	0	34	Piezometric Line 1	

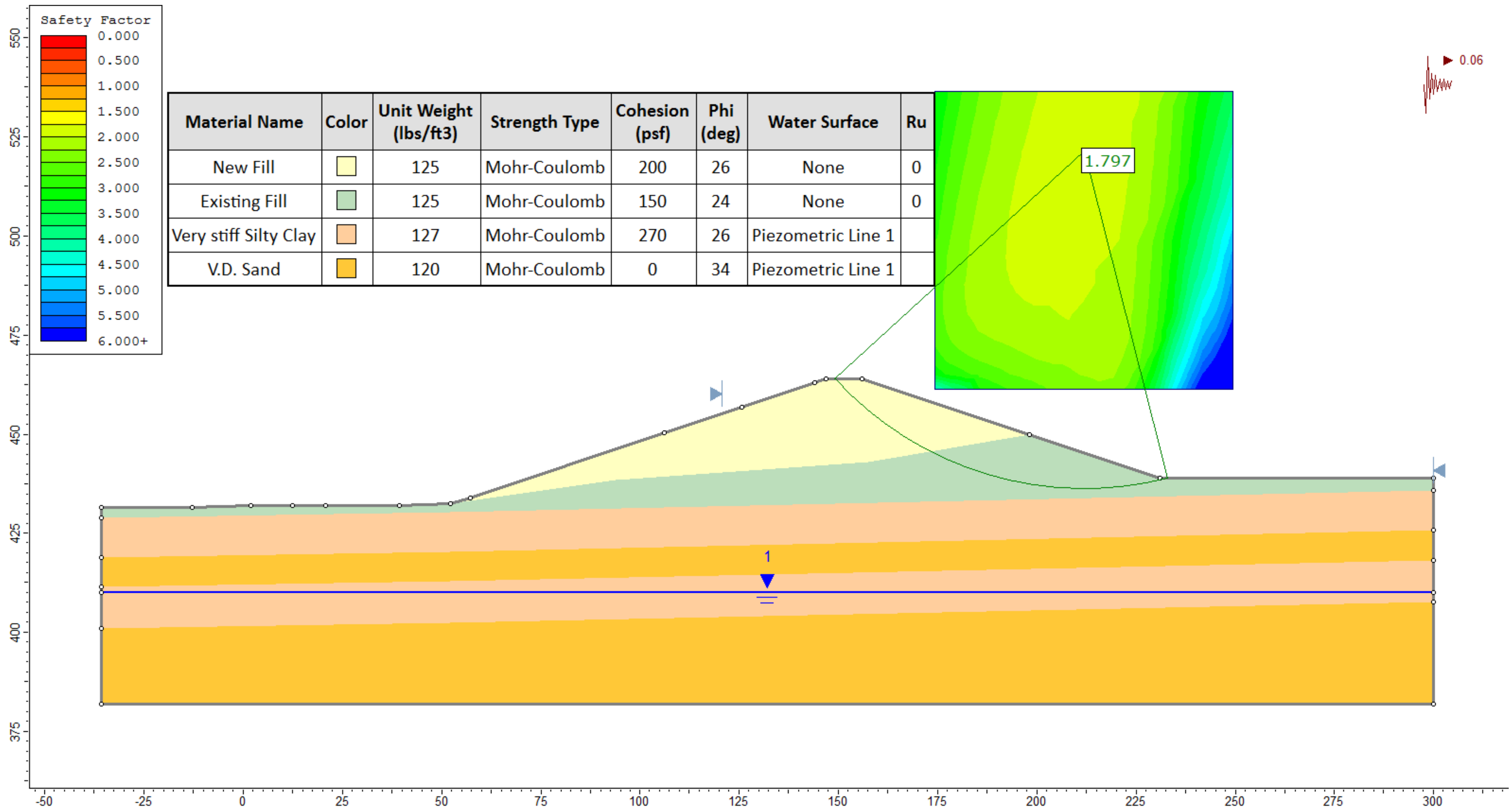


FIGURE **C.30**

Results of Stability Analysis – FGD–C: C–C' – Case 5b

Stability and Safety Factor Assessment, Oak Grove SES

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