BLUFF STUDY REPORT

4677 VIA ROBLADA

HOPE RANCH AREA OF

SANTA BARBARA COUNTY, CALIFORNIA

PROJECT NO.: 301995-001

NOVEMBER 30, 2022

(REVISED OCTOBER 4, 2023)

PREPARED FOR

HR PROPERTY TRUST

ATTENTION: TIM PASQUINELLI

C/O ROBERT GOODWIN

BY

EARTH SYSTEMS PACIFIC

5917 OLIVAS PARK DRIVE, SUITE F

VENTURA, CALIFORNIA 93003

November 30, 2022
(Revised October 4, 2023)

Project No.: 301995-001
Report No.: 22-11-93

HR Property Trust
Attention: Tim Pasquinelli
4677 Via Roblada
Santa Barbara, CA 93110
c/o Robert Goodwin

Project: 4677 Via Roblada
Hope Ranch Area of Santa Barbara County, California
Subject: Bluff Study Report

As authorized, Earth Systems Pacific (Earth Systems) has prepared this Bluff Study Report for a proposed future construction at 4677 Via Roblada in the Hope Ranch area of Santa Barbara County, California. The accompanying Bluff Study Report presents the results of our subsurface exploration and laboratory testing programs, and our conclusions and recommendations pertaining to geotechnical aspects of project design. This report completes Phase 1 of the scope of services described within our Proposal No. SBA-21-02-008 dated February 24, 2021, revised March 22, 2022, and authorized by Tim Pasquinelli on May 2, 2022.

We have appreciated the opportunity to be of service to you on this project. Please call if you have any questions, or if we can be of further service.

Respectfully submitted,

EARTH SYSTEMS PACIFIC

REGISTERED PROFESSIONAL ENGINEER
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Meng Wei Lu
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Copies: 1 - Client (email)
1 - Project File

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INTRODUCTION

Project Description

This report presents results of a bluff study performed for a proposed future construction at 4677 Via Roblada in the Hope Ranch area of Santa Barbara County, California (see Vicinity Map in Appendix A). Current plans indicate that the proposed future construction will include a new residence with a basement.

Purpose and Scope of Work

The purpose of the bluff study that led to this report was to analyze the soil/bedrock conditions at the project site and to provide bluff study recommendations for design and construction. The soil conditions include surface and subsurface soil types, soil expansion potential, soil strength, slope stability, and the presence or absence of subsurface water. The scope of work included:

- Reviewing historical stereographic aerial photographs of project site.
- Performing a reconnaissance of the project site.
- Drilling, sampling, and down-hole logging two bucket-auger borings to study bedrock, soil, and groundwater conditions.
- Laboratory testing soil samples obtained during the subsurface exploration to determine their physical and engineering properties.
- Analyzing the data obtained.
- Preparing this report.

Site Setting

An existing residence currently occupies the project site. The area surrounding the existing residence is covered by landscaping (planters, lawns, and trees) and hardscaping (walkways and driveways). There is a descending slope (sea cliff or bluff) located about 130 feet south of the existing residence. This descending slope is about 130-foot high and ranges in slope gradient from about 0.7- to 4- horizontal versus 1-vertical.

The geographic coordinates of the proposed future construction are 34.4173˚ North Latitude and 119.7849° West Longitude.

AERIAL PHOTO REVIEW

An aerial photograph study was performed by Dr. Larry Gurrola (subcontracted geologist) on July 13-14, 2022. The following aerial photographs were reviewed for the subject property:

Date	Flight and Frame Numbers	Scale
1928	C-311 C-Section: A5, A6	18,000
1929	C-430: A8, A9	24,000
1938	C-4950: SF-39, SF-40	1938
1943	BTM-1943: 4B-190, 4B-191	20,000
1944	C-9113: 6-53, 6-54	7,200
1953	GS-YO: 2-112	37,400
1954	BTM-1954: 6K-118, 6K-119	20,000
1956	HA-AN: 1-38, 1-39	9,600
1957	HA-BY: 87, 88	4,200
1961	BTM-1961: 7BB-65, 7BB-66	20,000
1962	HA-OI: 85, 86	12,000
1964	HB-VX: 70, 71	12,000
1965	HB-FV: 88, 89, 90	6,000
1968	HB-LC: 45, 46	12,000
1968	HB-LI: 45, 46	12,000
1969	HB-QD: 17, 18	12,000
1971	HB-SJ: 14, 15	12,000
1973	HB-WL: 40, 41	12,000
1975	HB-XQ: 11, 12	12,000
1992	PW-SB-8: 5 (non-stereo)	24,000
1997	PW-SB-10: 10 (non-stereo)	24,000
2001	CCC-BQK-C: 72-8 (non-stereo)	12,000

Google Earth images dated: 2002-2019, 2020-2022.
California Coastline images dated 1972, 1979, and 1987.

The aerial photographs listed in Table 1 were supplemented with Google Earth, California Coastline images, and County of Santa Barbara GIS Mapping tool. The use of stereo and non-stereo aerial photographs permits observation and evaluation of the site conditions for the last 95-year time period, landslide mapping, estimation of erosion and bluff retreat. In addition, the performance of the subject slopes was evaluated following both above average and below average rainfall seasons.

A mirrored stereoscope with 3X magnification was used to view aerial photographs for the subject property in 3-D and to map areas of instability on the subject slopes. Areas of instability such as flows, rock falls, rock topples and slides, in addition to development history of the site vicinity were recorded.

The subject property is situated on an elevated marine terrace (bench feature) where the southern portion of the property forms a coastal sea cliff slope. The sea cliff forms a sub-vertical, approximately 130-foot high, bluff slope that descends to the beach. The relatively flat terrace exhibits a topographic step with a slightly higher ground surface on the landward side and this topographic step is likely a paleo beach shoreline and buried sea cliff.

The bluff slope was mostly absent of vegetation and a gully was present at the top of bluff in the earliest 1920's aerials. In this period, the elevated terrace area and surrounding vicinity was mostly undeveloped except for the Via Roblada roadway. A few trees were present on the bluff top and a few small gullies on the bluff face in the late 1930's. The eastern portion of Via Roblada (east of the subject site) was developed but the subject property appears to be cultivated for agriculture. The gullies were apparently the result of runoff from the agricultural field.

Agricultural activities continued and were observed on the subject property in the 1940's and 1950's period. An orchard was observed on the higher terrace and a grass field observed on the lower, seaward terrace. A drainage ditch was observed on the lower terrace that apparently drained the fields and directed runoff to the west to a drainage ditch along the west property line. The bluff face remained mostly free of vegetation suggesting the face was actively spalling. The lower terrace was cultivated into small rectangular fields in the late 1950's. Also, an elongate landslide was observed on the eastern portion of the bluff face and embayments formed at the top of bluff appear to be result of active spalling of the bluff face and small rock topples and shallow slides.

A topographically low area which was drained by a former drainage ditch has formed a small area where runoff has collected in 1961 and this area was scarified and graded in 1962, no longer forming a topographic depression. The eastern top of bluff appeared embayed or "scalloped" by recent erosion indicating that shallow slides or rock topples recently occurred in

1967. The western top of bluff appeared embayed in 1968 with recent shallow, rockslides that occurred near the upper portions of the bluff. A small debris cone that was partially vegetated and present on the beach indicated rockslides or topples had occurred in 1969.

The residence on the subject property was observed in 1973 and a swath of ground along the bluff top was grubbed with some grasses and shrubs remaining. The eastern portion of the bluff face was thickly vegetated, however the top of bluff is highly embayed indicating that erosion along occurred in 1987. Evidence of rock falls and topples from near the upper bluff slope was observed in the 1990's to 2000's. Retreat of both headlands and embayments occurred at the top of bluff from about 2011 to 2019, and this period, a few feet to several feet of bluff retreat was estimated.

It is noted that deep seated, large landslides where significant portions of the bluff slid or failed were not observed over the course of the last 95 years. Most of the landslides appear to be rock topples, shallow rockslides, and spalling of the bluff face. A few of the rockslides from the upper portion of the slope appear to have entrained rock materials from the lower slope, and some of these slides and topples produced small debris cones at the base of the slope. Areas immediately above the topples and slides subsequently became over steepened, and ultimately collapsed shortly thereafter.

Large scale stereo pair aerial photographs dated 1944 were used as a base reference measurement for the estimation of bluff retreat for the last 78 years. A field survey was performed in 2022 and these data were used for the calculated rate of bluff retreat. The rate of retreat is discussed in detail in the Rate of Retreat section.

SOIL/BEDROCK AND GROUNDWATER CONDITIONS

In Borings BA-1 and BA-2, Earth Systems encountered a veneer of soil (about 2 feet in thickness, comprised of silty sand) overlying marine terrace deposits (about 14 feet in thickness, comprised of interbedded sand, silt, and clay), which is underlain by Monterey Formation bedrock (comprised of siltstone, mudstone, and shale).

Testing indicates that anticipated bearing soils lie in the "Very Low" expansion range based on a measured expansion index of 15, although layers of expansive soil/marine terrace were observed during logging of the borings to depths representing the depth of the proposed basement. A version of this classification of soil expansion is incorporated into a Minimum Foundation Design Table, which is included in Appendix C of this report. It appears that soils can be cut by normal grading equipment.

Groundwater was not encountered in either boring BA-1 or BA-2 to a maximum depth of about 71 feet below the existing ground surface. It should be noted that fluctuations in groundwater levels may occur because of variations in rainfall, regional climate, and other factors.

GROSS (GLOBAL) SLOPE STABILITY

Slope stability analyses were performed for Section A-A’ shown on the Site Plan/Geologic Map in Appendix A. Section A-A’ is believed to be representative of the crtitical slope condition (height and gradient) for descending slope on the south side of the project site.

Strength Parameters

The unit weights, ultimate shear strengths, and peak shear strengths of the marine terrace deposit (Qt) and Monterey Formation bedrock (Tm) for the slope stability analyses were selected based on results of laboratory testing on samples that were obtained from the project site. The direct shear tests were performed with the samples saturated. The shear data were composited to determine the average shear strength parameters of the relatively undisturbed samples of Monterey Formation bedrock that were tested.

The residual shear strengths of the Monterey Formation bedrock were determined by utilizing a chart developed by Timothy D. Stark; Hangseok Choi; and Sean McCone (May 2005). Using a liquid limit of 93 and a clay fraction of 46.7% (tested from a Monterey Formation bedrock’s weak bed sample collected during field exploration), a residual friction angle of 9 degrees with zero cohesion was determined.

Ultimate shear strength parameters were used in the analyses of static conditions, while peak shear strength parameters were used in the analyses of seismic (earthquake, pseudostatic) conditions. Residual shear strength parameters were used in both static and seismic conditions.

Results of the composite shear strength graphs are included in Appendix B. The composited results are summarized in the following table:

Unit	Unit Weight (pcf)	Cohesion (psf)	Friction Angle
Marine Terrace Deposit (Ultimate)	113 (Moist)	0	30
Marine Terrace Deposit (Peak)	113 (Moist)	0	31

Monterey Formation Bedrock (Ultimate)	95 (Moist)	329	34.4°
Monterey Formation Bedrock (Peak)	95 (Moist)	1,021	32.4°
Monterey Formation Bedrock (Residual)	95 (Moist)	0	9°

The ultimate strength parameters for the section shown above yielded a safety factor of smaller than 1.0 under static condition, which intuitively is incorrect because the slope is actually stable, see Appendix D. Hence, it appears that the ultimate strength parameters do not reflect the in-situ condition at the project site.

Consequently, Earth Systems performed back-calculations on ultimate shear strengths to determine strength parameters that yield a safety factor of at least 1.0. These values represent the minimum of potential strength values. The following table presents strength parameters determined, and that are used in the slope stability analyses that follow. It should be noted that because the back-calculated ultimate shear strengths for the marine terrace deposit are higher than the originally composited peak shear strengths, the peak shear strengths used in the analyses were increased to be identical to the back-calculated ultimate shear strengths.

Unit	Unit Weight (pcf)	Cohesion (psf)	Friction Angle
Marine Terrace Deposit (Ultimate)	113 (Moist)	100	34°
Marine Terrace Deposit (Peak)	113 (Moist)	100	34°
Monterey Formation Bedrock (Ultimate)	95 (Moist)	515	35°
Monterey Formation Bedrock (Peak)	95 (Moist)	1,021	32.4°
Monterey Formation Bedrock (Residual)	95 (Moist)	0	9°

Slope Stability Analyses Criteria

The stability of Section A-A' was analyzed using the SLIDE2 program for anisotropic material with circular and planar types of failures because Monterey Formation bedrock's apparent dip for Section A-A' is calculated to be about 42 degrees along the slope. Hence, along bedding failures should be considered. Spencer's method was used to analyze the slope. Approximately 112,200 circular-type and 50,000 planar-type failure surfaces were analyzed during each solution.

A seismic coefficient of 0.15 g was used for the pseudostatic analyses performed, and a minimum safety factor of 1.10 is required by the County of Santa Barbara. For gross static stability, the County of Santa Barbara requires a minimum safety factor of 1.50.

Results of Slope Stability Analyses

The slope stability plots and printouts are included in Appendix D. The following table summarizes the minimum safety factors that were computed for gross (global) stability analyses of Section A-A’ using the back-calculated shear strengths mentioned earlier:

Cross-Section Analyzed	Case	Minimum Safety Factor
A-A’	Static, Circular	1.018
A-A’	Seismic, Circular, k=0.15g	1.057
A-A’	Static, Planar	1.008
A-A’	Seismic, Planar, k=0.15g	1.056

Failure surfaces with safety factors less than 1.50 (for static conditions) and 1.10 (for seismic conditions) were found. The unacceptable failure surfaces reached into the property pad to a maximum distance of about 117 feet behind the top of slope, which is considered the slope stability setback line. See Site Plan/Geologic Map in Appendix A.

BUILDING CODE SETBACK

The foundation system the proposed future construction should satisfy the minimum setback clearances from descending slopes in accordance with Section 1808.7 of the 2019 CBC. Because this slope appears to be steeper than 1H:1V, any inhabited structures should be setback from the top of slope a distance equal to the full height to the slope divided by three (H/3), measured from an imaginary plane projected from the toe of the slope at an angle of 45 degrees from vertical. In general, when adjacent slopes are steeper than 3-horizontal versus 1-vertical, foundations should be setback from descending slopes by a distance equal to the slope height divided by three (H/3). The setback from descending slopes should not be less than 5 feet and need not exceed 40 feet. See the Slope Setbacks for Foundations on or Adjacent to Slopes in Appendix C. Because the slope on the southwest side of the project site appears to have a height of about 130 feet, a building code setback of 40 feet will be needed.

RATE OF RETREAT

An analysis of the rate of retreat was performed to determine the amount of bluff retreat of the southern slope of the subject property. The analysis was performed along two survey transects located within the property limits and the transect with the highest amount of retreat was used to calculate a rate of retreat. It is necessary to utilize the same geographic reference point to accurately determine the amount of retreat that has occurred for a given time period, in this case, 78 years. Horizontal distances were measured from the geographic reference points to the top of bluff along the survey.

The earliest measurements of the distance to top of bluff on the eastern side of the property were made on large scale 1944 aerial photos and a field survey was performed in November 2022. Therefore, the amount of bluff top retreat was estimated for a 78-year period between 1944 and 2022.

Utilizing the distance to the bluff top in 1944 photos as a base reference and utilizing the field measurements, the estimated total amount of retreat from 1944 to 2022 is approximately 38.5 feet which is rounded up to 39 feet. Therefore, the long-term rate of retreat for the eastern survey is approximately 0.50 feet per year (6 inches per year). It is well established that bluff retreat is episodic in nature and does not occur on an annual basis, that is, 6 inches of retreat every year (Johnson, 2003). Rather, bluff retreat occurs episodically, which results in a few feet to several feet of the bluff top lost due to erosion, rock topples, and slides. The total amount of bluff retreat is measured for a specific time period and divided by the time period that the retreat occurred to establish an average rate of retreat. This rate of retreat is applied to the County of Santa Barbara's 100 year required development setback from the top of bluff, that is the rate of retreat is multiplied by 100 years to determine the required erosion setback.

Based on a rate of retreat of 0.50 feet per year, the estimated amount of retreat of the subject property in 100 years is 55 feet. However, we anticipate that the construction of new home will require 2 ½ years to build, so 2 ½ years is added to the 100 years development setback which equals 102 ½ years for the development setback. Therefore, a rate of retreat of 0.5 feet per year multiplied by 102 ½ years equals 51.25 feet which is rounded up to 52 feet.

The estimated amount of 52 feet of retreat in 102 ½ years does not account for accelerated rates of bluff retreat due to sea level rise. The following section presents the analysis that accounts for accelerating sea level rise and estimates the increased rates of bluff retreat in Santa Barbara for the next 100-year period.

SEA LEVEL RISE AND RATE OF RETREAT

Due to climatic changes over the past 100 years, average worldwide sea level has been rising approximately 1 to 2 millimeters per years since the end of the "Little Ice Age" in the 19th century (USGS, 2000 and Douglas, 1995). This rise is not globally uniform and there is considerable debate regarding the accuracy of predicted future sea level changes. However, there is general scientific consensus that sea levels will rise at an accelerating rate in the coming decades. A recently adopted California Coastal Commission guidance document, the "Sea Level Rise Policy" dated November 7, 2018 contains future sea level rise projections under various time scales and risk scenarios, which were developed in a 2017 report by the California Ocean Protection Council under direction of the State of California (OPC, 2017).

For Santa Barbara (see Table G-8 in Appendix E), the projected sea level rise (SLR) at the year 2100 is 3.1 feet in the "Low Risk Aversion" category, which is defined as 17 percent likely that sea level rise will exceed the 3.1 feet estimate. In the "Medium – High Risk Aversion" category, an estimate of 0.5 percent probability that sea level rise will be higher than 6.6 feet at the year 2100. The 2018 state guidance recommends that the "Medium-High Risk" category be used for establishing setbacks for residential development given the uncertainty of the sea level rise projections, the limitation of adaptation options, and the potential risk to life and property. The sea level rise projections are presented in 10-year increments (see Table G-8 in Appendix A) and have utilized this data for 20 year "periods" to estimate accelerated rate of sea cliff retreat, as described below.

Projected Coastal Bluff Retreat

The future rate of coastal bluff retreat is estimated by application of a percentage increase to the site-specific historical retreat rate shown in Appendix B, estimated as described above, based on the increase in the rate of bluff retreat determined by the U.S. Geological Survey's Coastal Storm Modeling System also known as CoSMoS. This widely recognized model simulates coastal hazards that predicts ocean wave data input, storm surge, tides, and sea level rise.

The CoSMoS model (current version is CoSMoS 3.0) includes a shoreline hazard map with various historic and projected bluff edge retreat rates at noted transect locations. The transects with numerical identifiers are separated roughly 300 feet horizontally along the coastline in the Hope Ranch area. The CoSMoS transect number 4061 is located within the subject property limits near the eastern property line. The aerial photography rate of retreat transect line presents the increase of bluff retreat based on various amounts of sea level rise (see Appendix B). The data for this transect lists the historical sea cliff retreat rate at 0.19738 meters per year (0.65 feet per year). The reported CoSMoS historical retreat rate is based on the USGS's evaluation of historic regional topographic maps and regional aerial imagery (Hapke and Reid, 2007). This retreat rate uses 19th century coast surveys and early 1928 aerial photos that typically have a degree of error associated with them due to spatial distortions and surveys were based on outdated coordinate systems. This is the reason that site specific surveys are performed to estimate a site specific rate of retreat, in this case, 0.5 feet per year for the subject property.

The California Coastal Commission (CCC, 2018) "Sea Level Rise Policy Guidance" projections for the Santa Barbara area are used in conjunction with the CoSMoS projections. The CACC guidance projects the upper limit of sea level rise to be 1.1 feet (0.34 meter) at year 2040 under the "Medium-High Risk Aversion" category (see Table G-8 in Appendix A). The CoSMoS model at transect number 4061 (see Appendix B) shows that for a sea level that has risen by 0.25 meter (the closest value to the 0.34 meter rise projected at 2040 by the 2018 CACC document), the sea cliff retreat rate is by that time forecast to increase to 0.23931 meters per year (1.1 feet per year). The comparison of the projected future CoSMoS retreat rate at 2040 to the historical CoSMoS retreat rate (.239 m/yr minus .197 m/yr) shows an increase rate of retreat equivalent to 0.042 m/year. An increase from 0.19757 m per year to 0.239 m per year (0.042/0.197) is equivalent to a 21.3 percent increase in the CoSMoS model retreat rate. The increase of 21.3% is then applied to the site-specific historical retreat rate of 0.55 ft/year to derive a new retreat rate of 0.67 feet per year. The new retreat rate for the 17 year period from 2023 to 2040 is calculated to be 10.4 feet which is the estimated amount of retreat due to sea level rise for this time period. The percentage increase of the rate of retreat for the subsequent 20-year period from 2040 to 2060 is estimated to be 56.9% and percentage increase for the 2060 to 2080 period is 201%.

Since there is considerable debate among scientists of the predicted amount of sea level rise and associated increase in the bluff erosion rate, we use the conservative yet reasonable percentage increase of 201% for the remaining period from year 2080 to 2025½. The incremental changes in sea level (CACC, 2018) at Santa Barbara and the corresponding sea cliff retreat rate percentage change we use in our analysis are summarized in the following matrix. Also included is the incremental percentage change in retreat rate applied to the site-specific historical retreat rate and the resulting total horizontal cliff edge retreat for the noted time period increment.

Applying the site-specific historical retreat rate of 0.50 feet/year for the subject property and accounting for predicted sea level rise, the total estimated amount of retreat for the next 102 ½ years is approximately 92 feet.

CoSMoS Historical Retreat Rate (baseline) = 0.19738 meters per year (=0.65 feet per year) for CoSMoS Site specific rate of retreat = 0.50 feet per year. Transect Station 4061 located on the subject property: 4677 Via Roblada, Santa Barbara.					
Time Increment (Years)	Change in Sea Level (meters/feet) CACC Medium-High Risk Aversion	Percentage Increase in Retreat Rate from CoSMoS Historical Rate	Site Specific Historical Retreat Rate (ft/year)	Projected Average Site Specific Annual Retreat Rate (ft/year)	Incremental Estimated Retreat (feet)
2023-2040 (17 years)	0.34 m (1.1 ft)	21.3%	0.50	0.61	10.4
2040-2060	0.76 m (2.5 ft)	56.9%	0.50	0. 78	15.6
2060-2080	1.31 m/ 4.3 ft	201.0%	0.50	1.0	20.0
2080-2100*	1.31 m/ 4.3 ft	201.0%	0.50	1.0	20.0
2100-2120*	1.31 m/ 4.3 ft	201.0%	0.50	1.0	20.0
2120-2125½ *	1.31 m/ 4.3 ft	201.0%	0.50	1.0	5.5

* We use the estimated percentage increase of the 2060 -2080 time period for the period from 2080 to 2125½ for the estimated amount of retreat for the next 102½ years.

Total Retreat at year 2125 ½ = 91.5 feet = 92 feet

CONCLUSIONS AND RECOMMENDATIONS

Based on the established slope stability setback of 117 feet, the building code (Section 1808.7 of the 2019 CBC) setback of 40 feet, and the bluff retreat setback of 92 feet, it appears that the total cumulative setback from the bluff edge should be 209 feet, which is the summation of a slope stability setback of 117 feet and a bluff retreat setback of 92 feet. Any proposed future construction should be built northeast of this 209-foot setback zone. See Site Plan/Geologic Map in Appendix A.

The proposed basement is located approximately 109 feet from the closest potential slope failure surface with a factor-of-safety of 1.5 and the top of bluff is 117 feet from the same point. 1.5 is the minimum acceptable factor-of-safety. The basement is well beyond this potential failure surface. Hence, it has no influence on slope stability and will not change the location of the potential minimum factor-of-safety failure surface.

The lawn area in front of the proposed residence will be enclosed by a low wall that will retain a maximum of 3 feet of fill near the residence and about 2 feet of fill at the seaward limit of this area. The seaward limit of the enclosed area is about 80 to 90 feet from the top of bluff. In the area between the top of bluff and the enclosed area no fill will be placed, and the amount of cutting is limited in area and less than 0.5 feet in depth and can be ignored. We compared the volume of material captured by the minimum factor of safety (1.5) failure surface and estimate it to be about 9,980 cubic feet per lateral foot of bluff. The amount of fill added to the yard area is about 120 cubic feet per lateral foot of bluff. This equates to about a 1.2% increase in the weight of the potential slide mass. Although this would shift the minimum factor-of-safety line closer to the residence, that change is probably less than 2 feet and would not change the conclusion of our report with regard to slope stability.

The proposed basement will have no effect of bluff retreat caused by erosion because there is no relationship between the bluff retreat process and the existence of a basement over 200 feet from the top of the bluff. Nor will the thin veneer of fill placed in the yard between the residence and the top of bluff influence the geologic process of bluff retreat because there is no mechanistic relationship between the process and the fill.

The construction is not thought to have a negative impact on the current ground water regime. The proposed basement and service tunnels will be constructed with drains that will collect excess groundwater and direct it to sumps so that it can be disposed of properly and, thereby, reducing any impact groundwater may have on erosion or stability.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

The analyses and recommendations submitted in this report are based in part upon the data obtained from the on-site borings. The nature and extent of variations between and beyond the points of exploration may not become evident until construction. If variations then appear evident, it will be necessary to reevaluate the recommendations of this report.

The scope of services did not include any environmental assessment or investigation for the presence or absence of wetlands, hazardous or toxic materials in the soil, surface water, groundwater or air, on, below, or around this site. Any statements in this report or on the soil boring logs regarding odors noted, unusual or suspicious items or conditions observed, are strictly for the information of the client.

Findings of this report are valid as of this date; however, changes in conditions of a property can occur with passage of time whether they are because of natural processes or works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur whether they result from legislation or broadening of knowledge. Accordingly, findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of 1 year.

In the event that any changes in the nature, design, or location of the proposed future construction and/or other improvements are planned, the conclusions and recommendations contained in this report should not be considered valid unless the changes are reviewed and the conclusions of this report modified or verified in writing.

This report is issued with the understanding that it is the responsibility of the Owner, or of his representative to ensure that the information and recommendations contained herein are called to the attention of the Architect and Engineers for the project and incorporated into the plan and that the necessary steps are taken to see that the Contractor and Subcontractors carry out such recommendations in the field.

As the Geotechnical Engineers for this project, Earth Systems has striven to provide services in accordance with generally accepted geotechnical engineering practices in this community at this time. No warranty or guarantee is expressed or implied. This report was prepared for the exclusive use of the Client for the purposes stated in this document for the referenced project only. No third party may use or rely on this report without express written authorization from Earth Systems for such use or reliance.

It is recommended that Earth Systems be provided the opportunity for a general review of final design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications. If Earth Systems is not accorded the privilege of making this recommended review, it can assume no responsibility for misinterpretation of the recommendations contained herein.

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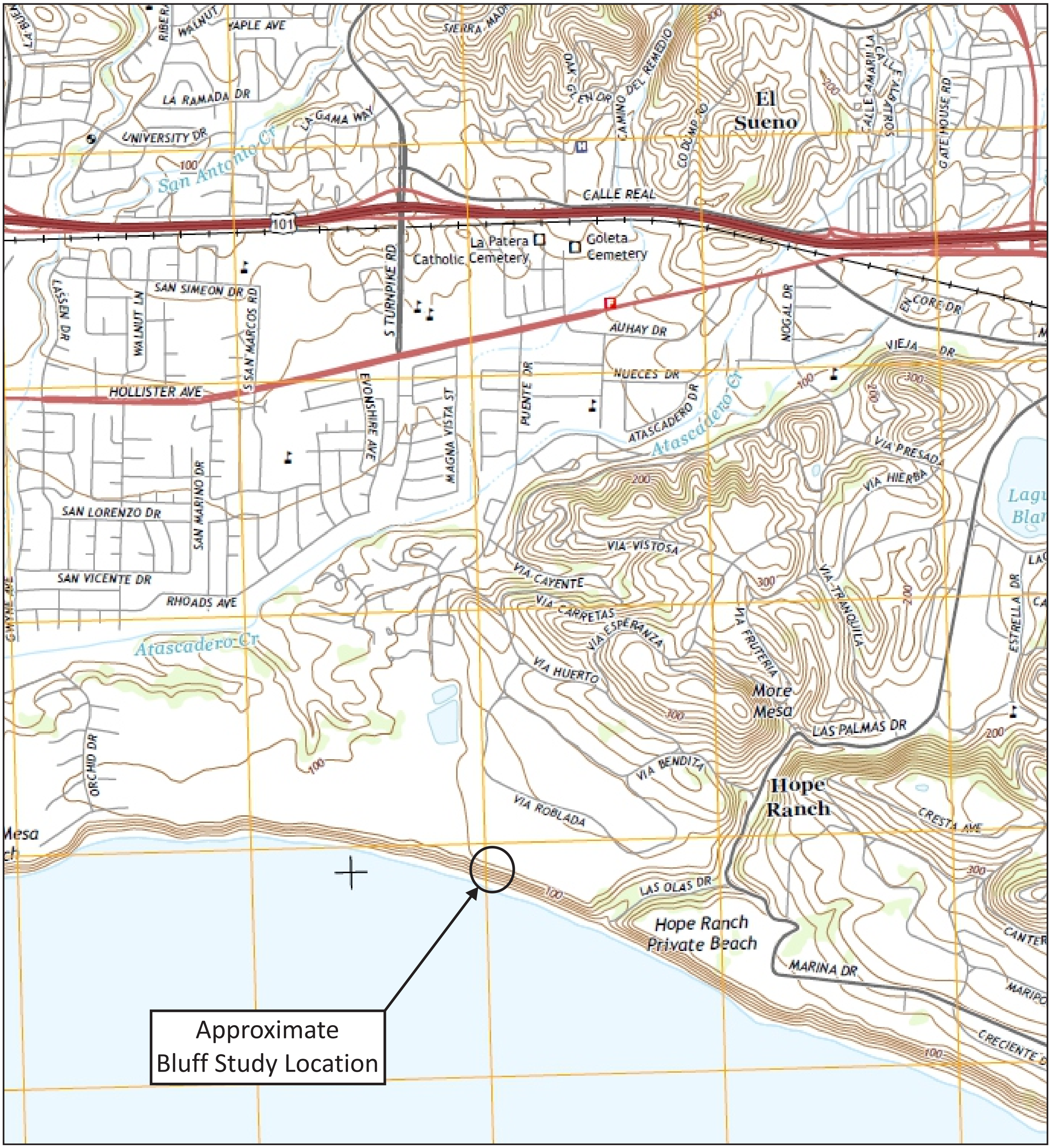
APPENDIX A

Vicinity Map
Regional Geologic Map 1 (Dibblee)
Regional Geologic Map 2 (USGS)
Field Study
Site Plan/Geologic Map
Geologic Cross-Section A-A’
Logs of Borings
Boring Log Symbols
Unified Soil Classification System



*Taken from USGS Topo Map, Goleta Quadrangle, California, 2015.

Approximate Scale: 1" = 2,000’

0 2,000’ 4,000’

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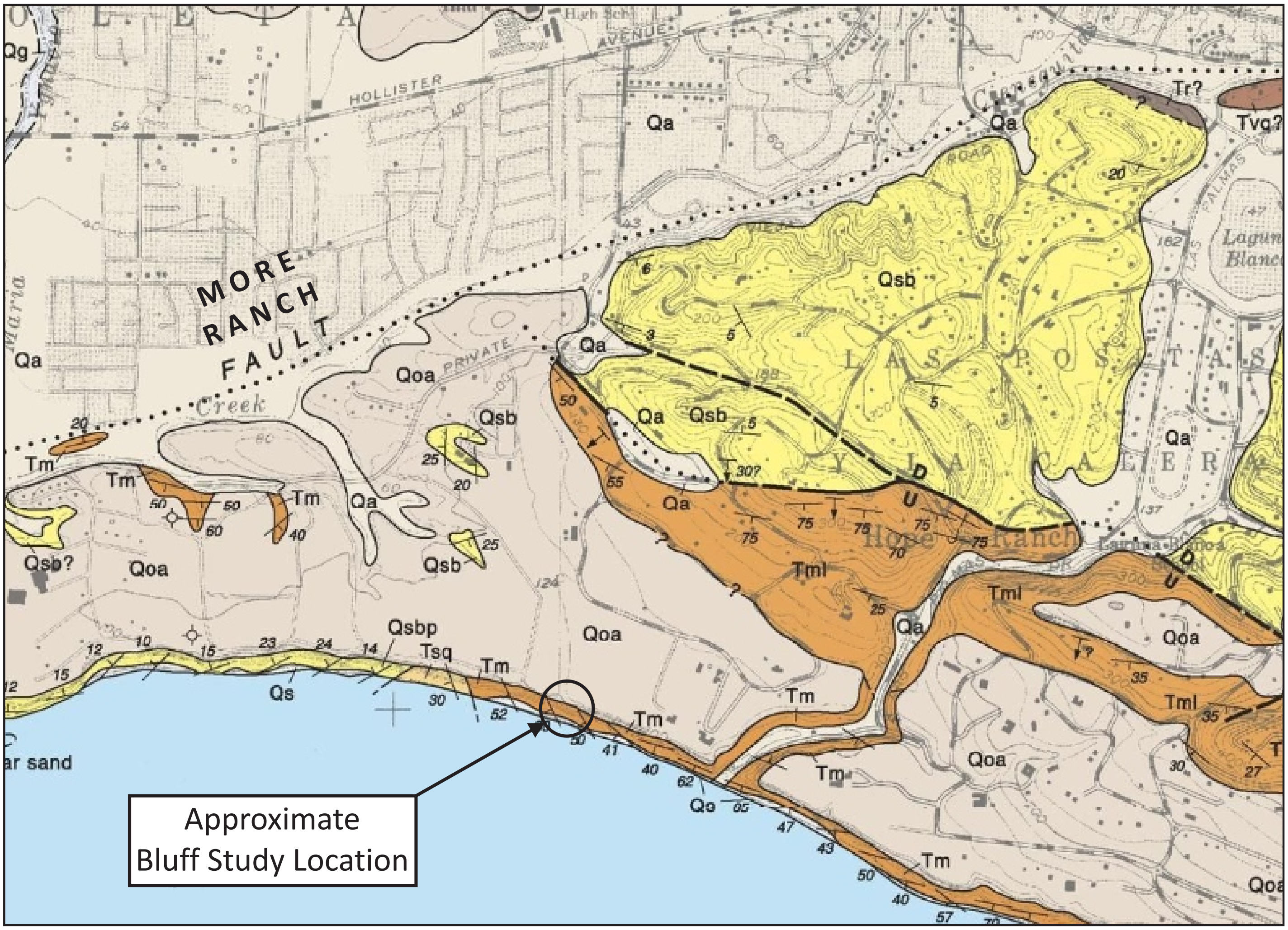
VICINITY MAP

4677 Via Roblada
Hope Ranch Area of Santa Barbara County, California

Earth Systems

November 2022	301995-001



*Taken from Dibblee, Jr., Geologic Map of The Goleta Quadrangle, Santa Barbara County, California, 1987, DF-07.

Qoa	Qog

OLDER DISSECTED SURFICIAL SEDIMENTS

Qoa *Former alluvial deposits of silt, sand and gravel, in places weakly consolidated; local unconformities at base*

Qog *Cobble-boulder fan gravel and fanglomerate deposits composed largely of sandstone detritus*

Tm
Tml

MONTEREY SHALE

Marine; early to late Miocene age

Tm *Upper shale unit: white-weathering, thin bedded, hard, platy to brittle siliceous shale; Mohnian Stage*

Tml *Lower shale unit: white weathering, soft, fissle to punky organic, phosphatic, and calcareous shale with thin interbeds of hard siliceous shale and limestone; Luisian to uppermost Saucesian Stages*

GEOLOGIC SYMBOLS

not all symbols shown on each map

FORMATION CONTACT *dashed where inferred or indefinite dotted where concealed*

MEMBER CONTACT *between units of a formation* .... **Prominent bed**

CONTACT BETWEEN SURFICIAL SEDIMENTS *located only approximately in places*

FAULT: *Dashed where indefinite or inferred, dotted where concealed, queried where existence is doubtful. Parallel arrows indicate inferred relative lateral movement. Relative vertical movement is shown by U/D (U=upthrown side, D=downthrown side). Short arrow indicates dip of fault plane. Sawteeth are on upper plate of low angle thrust fault.* U D 25 ?

FOLDS: *overturned* **ANTICLINE** **SYNCLINE**

arrow on axial trace of fold indicates direction of plunge; dotted where concealed by surficial sediments

Strike and dip of sedimentary rocks: 18 *inclined*; 20 *inclined (approximate)*; 80 *overturned*; *horizontal*; *vertical*

Strike and dip of metamorphic or igneous rock foliation or flow banding or compositional layers: 75 *inclined*; *inclined (approximate)*; *vertical*; 80 *overturned*

OTHER SYMBOLS: *Direction of landslide movement*; *outline of water bodies shown on map*; *water well*; *oil well*; *springs*

N

Approximate Scale: 1" = 2,000'

0 2,000' 4,000'

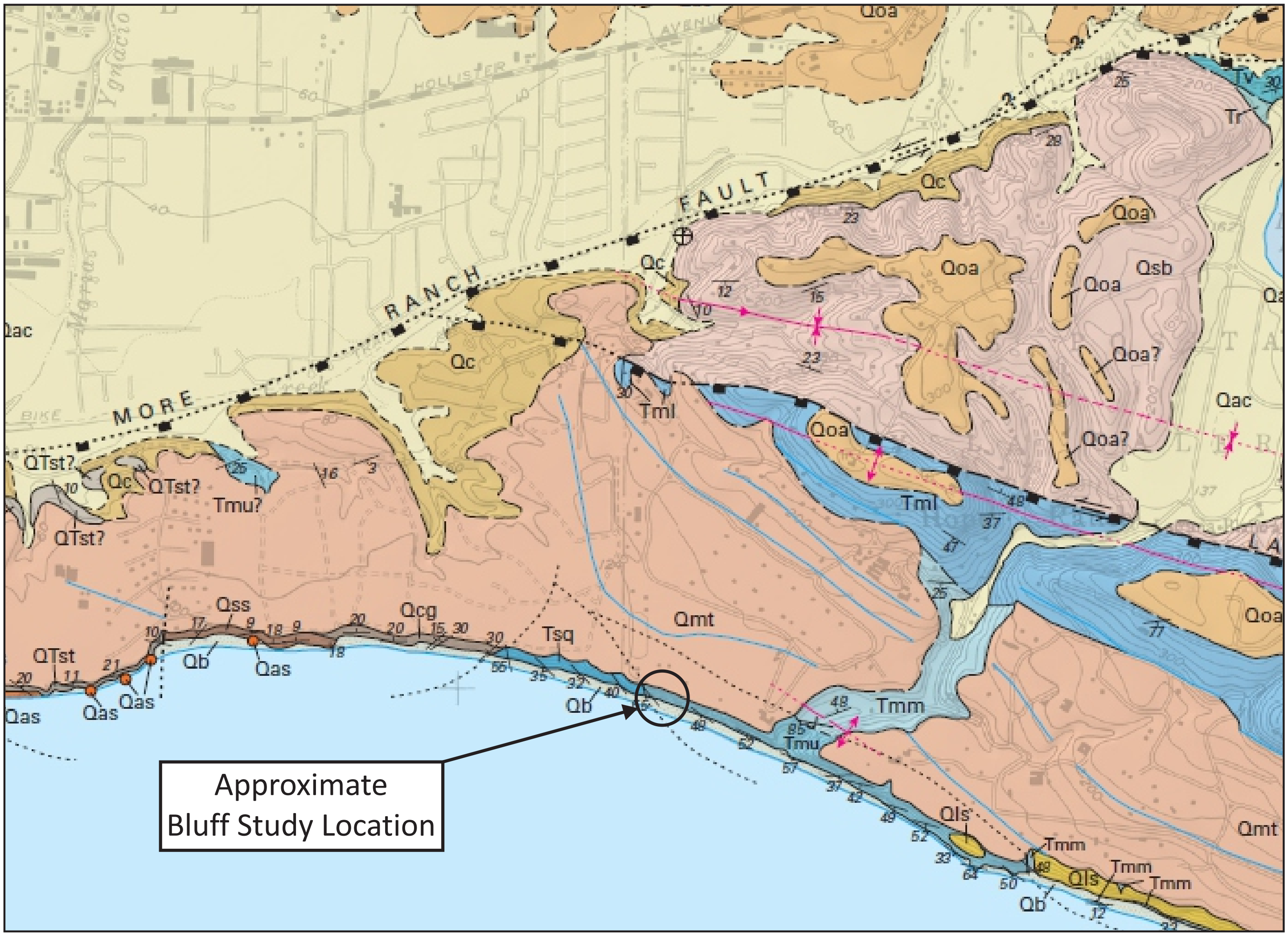
REGIONAL GEOLOGIC MAP 1

4677 Via Roblada

Hope Ranch Area of Santa Barbara County, California

Earth Systems

November 2022	301995-001



*Taken from Geologic Map of the Santa Barbara Coastal Plain Area, Santa Barbara County, California, 2009.

Contact—Long-dashed where approximately located; short-dashed where inferred; dotted where concealed; tic shows direction and angle of dip

Trace of marker bed

Outline of erosionally beveled geomorphic surface

Marine-terrace shoreline angle—Approximately located based on subtle to strong topographic steps of terrace surface; locally coincides with contact between Qmt and older units

Faults—Long-dashed where approximately located; short dashed where inferred; dotted where concealed; queried where uncertain; small red arrow shows direction and angle of dip; red diamond-headed arrow shows bearing and rake of slickenlines and inferred slip direction of hanging-wall block

Strike-slip fault—Opposing arrows show sense of strike-slip movement, queried where uncertain; bi-directional arrows indicate superposed dextral and sinistral slip on same fault

Normal fault—Ball and bar on apparent downthrown side

Reverse fault—Rectangles on apparent upthrown side

Thrust fault—Sawteeth on apparent upthrown side

Fault-line scarp—Inferred from aerial photographs; hachures point downscarp

Slide-block boundary—Inferred; hachures on slide block

Fold and warp axial traces—Long-dashed where approximately located; short-dashed where inferred; dotted where concealed

Anticline—Large arrow indicates plunge direction

Overturned anticline

Upwarp axis—Large arrow indicates plunge direction; mapped in Quaternary deposits where geomorphically expressed

Syncline—Large arrow indicates plunge direction

Overturned syncline

Downwarp axis—Mapped in Quaternary deposits where geomorphically expressed

Horizontal bedding

Inclined bedding—Showing strike and dip

Inclined bedding—Showing approximate strike and dip

Inclined bedding—Showing strike and dip of beds calculated from bedding trace

Vertical bedding—Showing strike

Overturned bedding—Showing strike and dip

(Tsq) **Concealed bedding**—Measured in unit indicated where temporarily exposed at low tide or in construction excavation

Qmt: Marine-terrace deposits (upper Pleistocene)

Approximate Scale: 1" = 2,000’

0 2,000’ 4,000’

N

REGIONAL GEOLOGIC MAP 2

4677 Via Roblada

Hope Ranch Area of Santa Barbara County, California

Earth Systems

November 2022	301995-001

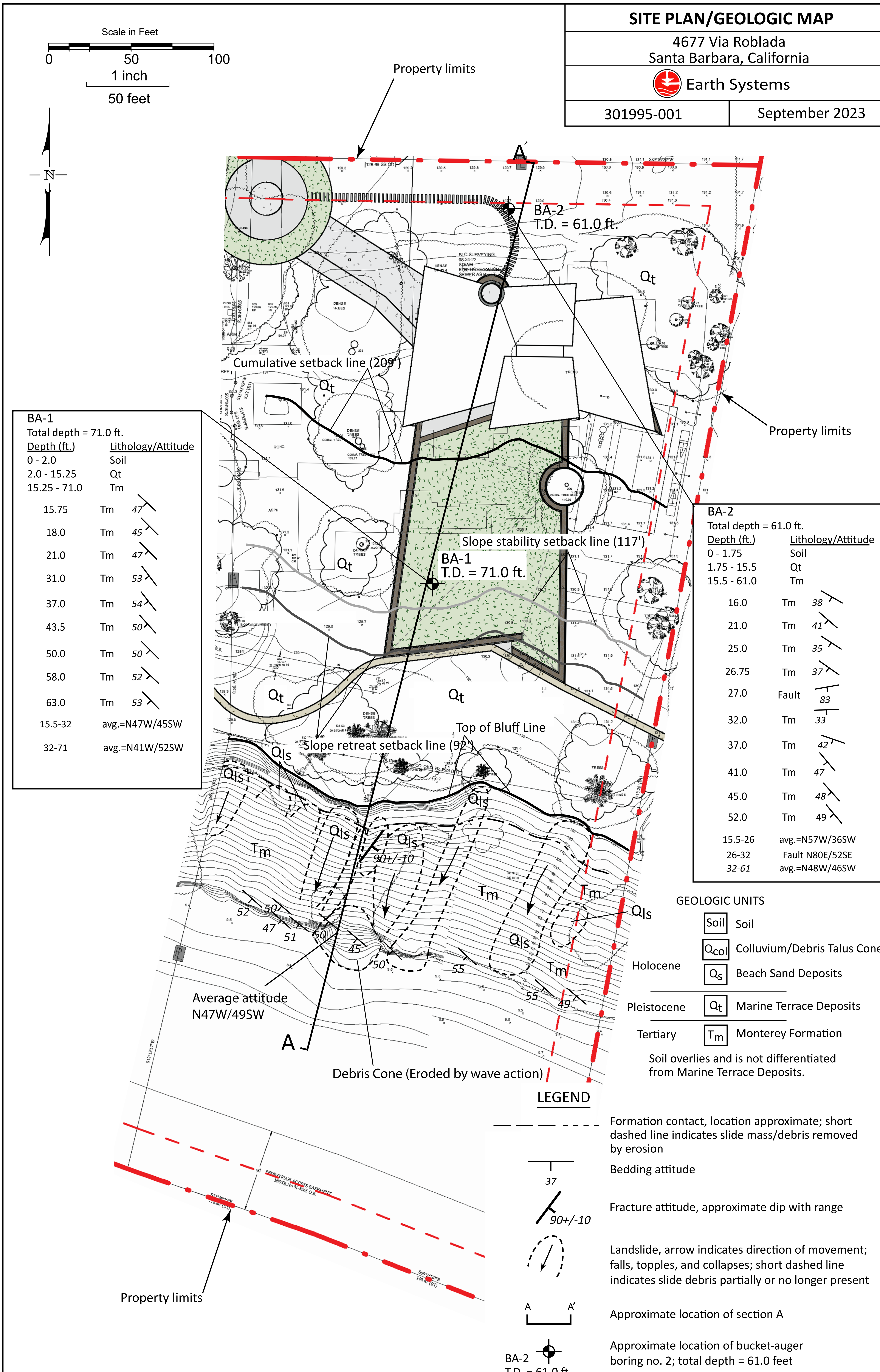
FIELD STUDY

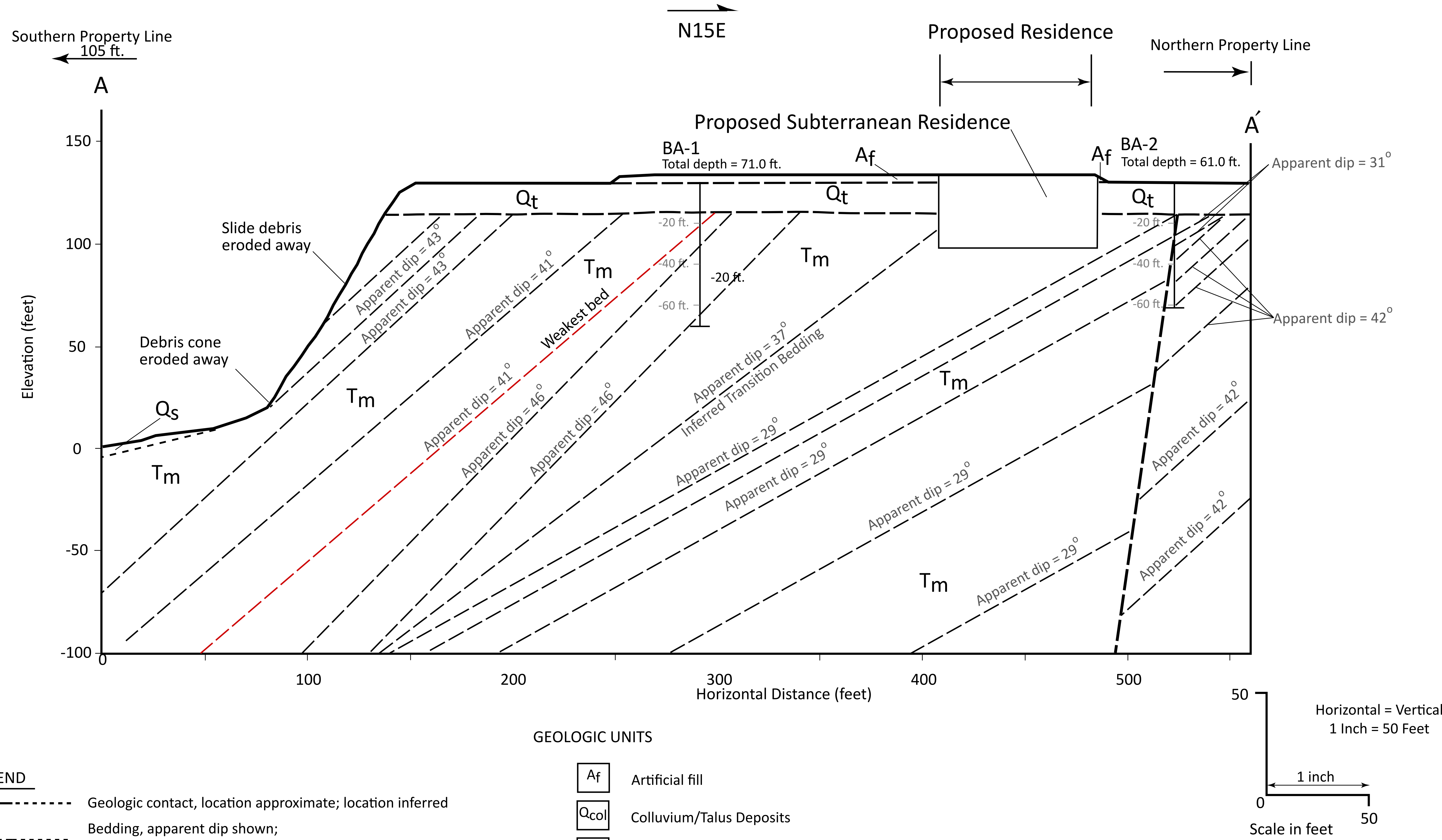
A. On July 7 and 8, 2022, two large-diameter borings (BA-1 and BA-2) were drilled to depths of about 71 and 61 feet, respectively, below the existing ground surface to observe the soil profile and to obtain samples for laboratory analyses. The borings were drilled using a 24-inch diameter bucket-auger powered by a GEAX EK110. The approximate locations of these borings were determined in the field by pacing and sighting, and are shown on the Site Plan/Geologic Map in this Appendix.

B. Samples were obtained within the borings with a Modified California (M.C.) ring sampler (ASTM D 3550 with shoe similar to ASTM D 1586). The M.C. sampler has a 3-inch outside diameter, and a 2.42-inch inside diameter when used with brass ring liners (as it was during this study). The samples were obtained by driving the sampler with a machine-operated hammer.

C. Bulk soil samples were collected from the cuttings of the soils encountered in Borings BA-1 and BA-2 between depths of zero and 5 feet.

D. The final logs of the borings represent interpretations of the contents of the field logs obtained during the subsurface study and the results of laboratory testing performed on the samples. The final logs are included in this Appendix.


SITE PLAN/GEOLOGIC MAP
4677 Via Roblada
Santa Barbara, California
Earth Systems
301995-001
September 2023
Scale in Feet
0
50
100
1 inch
50 feet
N
Property limits
A′
BA-2
T.D. = 61.0 ft.
Qt
Cumulative setback line (209')
Property limits
BA-1
Total depth = 71.0 ft.
Depth (ft.) Lithology/Attitude
0 - 2.0 Soil
2.0 - 15.25 Qt
15.25 - 71.0 Tm
15.75 Tm 47
18.0 Tm 45
21.0 Tm 47
31.0 Tm 53
37.0 Tm 54
43.5 Tm 50
50.0 Tm 50
58.0 Tm 52
63.0 Tm 53
15.5-32 avg.=N47W/45SW
32-71 avg.=N41W/52SW
Slope stability setback line (117')
BA-1
T.D. = 71.0 ft.
BA-2
Total depth = 61.0 ft.
Depth (ft.) Lithology/Attitude
0 - 1.75 Soil
1.75 - 15.5 Qt
15.5 - 61.0 Tm
16.0 Tm 38
21.0 Tm 41
25.0 Tm 35
26.75 Tm 37
27.0 Fault 83
32.0 Tm 33
37.0 Tm 42
41.0 Tm 47
45.0 Tm 48
52.0 Tm 49
15.5-26 avg.=N57W/36SW
26-32 Fault N80E/52SE
32-61 avg.=N48W/46SW
Top of Bluff Line
Slope retreat setback line (92')
Qls
Tm
90+/-10
Average attitude
N47W/49SW
A
Debris Cone (Eroded by wave action)
GEOLOGIC UNITS
Soil Soil
Holocene
Qcol Colluvium/Debris Talus Cone
Qs Beach Sand Deposits
Pleistocene
Qt Marine Terrace Deposits
Tertiary
Tm Monterey Formation
Soil overlies and is not differentiated from Marine Terrace Deposits.
LEGEND
Formation contact, location approximate; short dashed line indicates slide mass/debris removed by erosion
37
Bedding attitude
90+/-10
Fracture attitude, approximate dip with range
Landslide, arrow indicates direction of movement; falls, topples, and collapses; short dashed line indicates slide debris partially or no longer present
A A′
Approximate location of section A
BA-2
T.D. = 61.0 ft.
Approximate location of bucket-auger boring no. 2; total depth = 61.0 feet
Property limits



LEGEND

- Geologic contact, location approximate; location inferred
- Bedding, apparent dip shown; short dashed lines represents inferred bedding
- Seepage observed in bucket-auger boring

GEOLOGIC UNITS

Holocene	Af	Artificial fill
	Qcol	Colluvium/Talus Deposits
	Qs	Beach Sand Deposits
	Qls	Landslides, rockfalls and rock avalanches; removed by erosion
Pleistocene	Qt	Marine Terrace Deposits
Tertiary	Tm	Monterey Formation

GEOLOGIC CROSS-SECTION A-A'

4677 Via Roblada
Hope Ranch Area of Santa Barbara County, California

Earth Systems

301995-001	November 2022

Logs of Borings

Earth Systems
5917 Olivas Park Drive, Suite F, Ventura, CA 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: BA-1
PROJECT NAME: 4677 Via Roblada
PROJECT NUMBER: 301995-001
BORING LOCATION: Per Plan

DRILLING DATE: July 7-8, 2022
DRILL RIG: GEAX EK 110
DRILLING METHOD: 24-inch Bucket Auger
LOGGED BY: LG

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/12")	SYMBOL	MATERIAL TYPE	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTIONS
0						Soil			**SOIL:** Dark brown silty fine sand, SM; damp to moist, moderately loose, fine roots.
			■	10		Qt	112.7	17.4	**Marine Terrace Deposits:** Pale gray clay to silty clay, CH; highly plastic, soft, moist; mottled orange brown; becomes moderately soft at 4.0 ft.
5			■	10		Qt	108.9	17.1	
									Marine Terrace Deposits: Pale brown clean fine to coarse sands, SW; medium dense, moist.
10			■	10		Qt	101.2	11.5	**Marine Terrace Deposits:** Gray sandy gravel with few cobbles, GW; moist, dense.
									Marine Terrace Deposits: Pale brown clenar fine sand, SP; medium dense, moist.
15			■	10		Qt	40.9	96.9	**Marine Terrace Deposits:** Gray sandy gravel with few cobbles, GW; dense, moist.
						Tm			**Monterey Formation:** White diatomaceous shale at 15.25 ft, moderately weathered, thinly bedded to laminated, weak competency; N47W/42SW bedding at 15.75 ft. Bedding N45W/47SW at 18.0 ft.
20	■		■	15		Tm	45.00	94.7	**Monterey Formation:** Weakest bed, diatomaceous shale, highly weathered to clayey silt at 20.5 ft, 0.25 ft. thick, ML; damp, N52W/47SW. **Monterey Formation:** Contact, N45W/47SW to olive gray mudshale, laminated, damp, weak competency.
25			■	15		Tm	47.9	80.0	**Monterey Formation:** Dark olive gray mudshale, thinly bedded to laminated, damp, strong competency.
30			■	20		Tm	52.1	82.8	
									Monterey Formation: Bedding N33W/53SW. **Monterey Formation:** Blue gray volcanic ash, glassy texture, slightly weathered, silt to fine sand, N38W/54SW, 3 in. thick. **Monterey Formation:** Dark olive brown mud shale, damp, moderately strong, thinly bedded to laminated.
35			■	20		Tm	57.2	61.1	

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
5917 Olivas Park Drive, Suite F, Ventura, CA 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: BA-1 (Continued)	DRILLING DATE: July 7-8, 2022
PROJECT NAME: 4677 Via Roblada	DRILL RIG: GEAX EK 110
PROJECT NUMBER: 301995-001	DRILLING METHOD: 24-inch Bucket Auger
BORING LOCATION: Per Plan	LOGGED BY: LG

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/12")	SYMBOL	MATERIAL TYPE	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
40			■	20		Tm	59.3	70.1	**Monterey Formation:** Dark brown to black bituminous shale, moderately silica cemented, moderately strong to strong competency, N42W/50SW bedding.
45			■	20		Tm	50.1	63.5	
50			■	25		Tm	48.1	73.9	Bedding N45W/55SW.
55			■	45		Tm	62.1	57.2	**Monterey Formation:** Dark brown to black bituminous shale, highly silica cemented, strong to strong competency. Bedding N47W/52SW.
60			■	45		Tm	55.1	63.6	Bedding N44W/53SW.
65			■	45		Tm	57.9	52.8	
70			■	45		Tm	57.6	47.7	
75									Total depth = 71.0 ft. Groundwater not encountered. Backfilled with cuttings, moistened with water and tamped.

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
5917 Olivas Park Drive, Suite F, Ventura, CA 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: BA-2
PROJECT NAME: 4677 Via Roblada
PROJECT NUMBER: 301995-001
BORING LOCATION: Per Plan

DRILLING DATE: July 8, 11 2022
DRILL RIG: GEAX EK 110
DRILLING METHOD: 24-inch Bucket Auger
LOGGED BY: LG

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/12")	SYMBOL	MATERIAL TYPE	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTIONS
0						Soil			**SOIL: B**rown silty fine sand, SM; damp to moist, moderately loose, few fine pores and fine roots.
									Marine Terrace Deposits: Dark brown clay, CH; plastic, stiff to very stiff, moist; trace few gravel.
			■	10		Qt	114.8	13.7	
5									**Marine Terrace Deposits:** Pale brown slightly clayey silt, ML; damp, firm, non-plastic, orange brown and black mottles.
			■	10		Qt	111.0	13.4	
									Marine Terrace Deposits: Brown medium to coarse sand, SP; medium dense to dense, damp.
10			■	10		Qt	93.6	4.6	
									Marine Terrace Formation: Gray sandy gravel and cobble lag, erosional contact, N83E/10NE
15			■	15		Qt Tm	66.5	37.5	**Monterey Formation:** Pale gray and brown siltstone-mudstone, moderately weathered, weak comptency, moist, bedding N60W/38SW at 16.0 ft.
20			■	15		Tm	48.4	90.6	
									Monterey Formation: Planar contact, N49W/47SW, to pale brown, pale gray clay shale, bedded to laminated, moderately weathered, weak competency, moist.
									Monterey Fromation: Planar contact at 25.0 ft, N57W/35SW, to dark olive pale brown gray clay shale, slightly weathered, bedded to laminated, weak competency, moist; N55W/37SW beds at 26.75 ft.
25			■	20		Tm	41.1	113.3	
									Fault: N80E/83SE, 4 inch zone of sub-parallel splays, silty clay.
									Monterey Formation: Dark olive brown mud shale, weak to moderately strong competency, damp.
30			■	25		Tm	55.0	71.8	
									Monterey Formation: Planar contact, N88E/33SE to dark brown mud shale to mudstone, bedded to massive, weak to moderately strong comptency, damp.
35			■	25		Tm	50.7	66.2	
									Bedding N71W/42SW.

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems
5917 Olivas Park Drive, Suite F, Ventura, CA 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: BA-2 (Continued)
PROJECT NAME: 4677 Via Roblada
PROJECT NUMBER: 301995-001
BORING LOCATION: Per Plan

DRILLING DATE: July 8, 11 2022
DRILL RIG: GEAX EK 110
DRILLING METHOD: 24-inch Bucket Auger
LOGGED BY: LG

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/12")	SYMBOL	MATERIAL TYPE	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
40			■	30		Tm	56.0	60.5	**Monterey Formation:** Dark brown to black bituminous shale, moderately silica cemented, moderately strong to strong competency, N40W/47SW bedding.
45			■	35		Tm	58.3	55.1	Laminae N42W/48SW.
50			■	35		Tm	60.3	47.8	**Monterey Formation:** Bedded sequence, N40W/49SW, black carbonaceous shale, highly cemented with silica, damp, strong competency.
55			■	35		Tm	52.7	56.5	
60			■	40		Tm	54.7	52.6	
									Total depth = 61.0 ft. Groundwater not encountered. Backfilled with cuttings, moistened with water and tamped.
65									
70									
75									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

BORING LOG SYMBOLS

Modified California Split Barrel Sampler

Modified California Split Barrel Sampler - No Recovery

Standard Penetration Test (SPT) Sampler

Standard Penetration Test (SPT) Sampler - No Recovery

Perched Water Level

Water Level First Encountered

Water Level After Drilling

Pocket Penetrometer (tsf)

Vane Shear (ksf)

1. The location of borings were approximately determined by pacing and/or siting from visible features. Elevations of borings are approximately determined by interpolating between plan contours. The location and elevation of the borings should be considered.

2. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

3. Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. This data has been reviewed and interpretations made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, tides, temperature, and other factors at the time measurements were made.

BORING LOG SYMBOLS

Earth Systems

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			*GRAPH SYMBOL*	*LETTER SYMBOL*	*TYPICAL DESCRIPTIONS*
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNTOF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENT

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

UNIFIED SOIL CLASSIFICATION SYSTEM

Earth Systems

APPENDIX B

Laboratory Testing
Tabulated Laboratory Test Results
Individual Laboratory Test Results
Composited Direct Shear Graphs

LABORATORY TESTING

A. Samples were reviewed along with field logs to determine which would be analyzed further. Those chosen for laboratory analyses were considered representative of soils that would be exposed and/or used during grading, and those deemed to be within the influence of proposed construction. Test results are presented in graphic and tabular form in this Appendix.

B. In-situ moisture content and dry unit weight for the ring samples were determined in general accordance with ASTM D 2937.

C. A maximum density test was performed to estimate the moisture-density relationship of typical soil materials. The test was performed in accordance with ASTM D 1557.

D. The relative strength characteristics of soils were determined from the results of direct shear tests on one remolded sample and seven relatively undisturbed ring sample. The specimens were placed in contact with water at least 24 hours before testing, and then sheared under normal loads ranging from 0.5 to 10 ksf in general accordance with ASTM D 3080.

E. An expansion index test was performed on a bulk soil sample in accordance with ASTM D 4829. The sample was surcharged under 144 pounds per square foot at moisture content of near 50 percent saturation. The sample was then submerged in water for 24 hours, and the amount of expansion was recorded with a dial indicator.

F. The gradation characteristics of the bulk sample were evaluated by hydrometer (in accordance with ASTM D 7928) and sieve analysis procedures. The sample was soaked in water until individual soil particles were separated, then washed on the No. 200 mesh sieve, oven dried, weighed to calculate the percent passing the No. 200 sieve, and mechanically sieved. Additionally, a hydrometer analysis was performed to assess the distribution of the particles that passed the No. 200 screen. The hydrometer portion of the test was run using sodium hexametaphosphate as a dispersing agent.

G. The Plasticity Indices of a selected sample was evaluated in accordance with ASTM D 4318.

TABULATED LABORATORY TEST RESULTS

REMOLDED SAMPLE

BORING AND DEPTH	BA-1@0'-0'	BA-1@20.5'
USCS	SC	MH
MAXIMUM DRY DENSITY (pcf)	126.5	--
OPTIMUM MOISTURE (%)	8	--
PEAK COHESION (psf)	80	--
PEAK FRICTION ANGLE	29°	--
ULTIMATE COHESION (psf)	40	--
ULTIMATE FRICTION ANGLE	29°	--
EXPANSION INDEX	15	--
GRAIN SIZE DISTRIBUTION (%)		
GRAVEL	--	0.0
SAND	--	11.7
SILT	--	26.5
CLAY (2ųm to 5ųm)	--	15.1
CLAY (≤2ųm)	--	46.7
LIQUID LIMIT	--	93
PLASTIC LIMIT	--	64
PLASTICITY INDEX	--	28

TABULATED LABORATORY TEST RESULTS (Continued)

RELATIVELY UNDISTURBED SAMPLES

BORING AND DEPTH	BA-1@10'	BA-1@20'	BA-1@30'	BA-1@40'
IN-PLACE DRY DENSITY (pcf)	101.2	45.0	52.1	59.3
IN-PLACE MOISTURE (%)	11.5	94.7	82.8	70.1
PEAK COHESION (psf)	0	370	0	0
PEAK FRICTION ANGLE	31°	33°	47°	44°
ULTIMATE COHESION (psf)	0	0	0	0
ULTIMATE FRICTION ANGLE	30°	36°	38°	38°

BORING AND DEPTH	BA-1@50'	BA-1@60'	BA-1@70'
IN-PLACE DRY DENSITY (pcf)	62.1	55.1	57.6
IN-PLACE MOISTURE (%)	57.2	63.6	47.7
PEAK COHESION (psf)	4,450	2,660	3,240
PEAK FRICTION ANGLE	0°	24°	18°
ULTIMATE COHESION (psf)	2,090	1,340	3,240
ULTIMATE FRICTION ANGLE	21°	30°	18°

COMPOSITED DIRECT SHEAR RESULTS

MATERIAL TYPE	Monterey Formation Bedrock (Peak)	Monterey Formation Bedrock (Ultimate)
COHESION (psf)	1,021	329
FRICTION ANGLE	32.4°	34.4°

Individual Laboratory Test Results

File Number: 301995-001 Lab Number:

MAXIMUM DENSITY / OPTIMUM MOISTURE

ASTM D 1557-12 (Modified)

Job Name: 4677 Via Roblada
Sample ID: B A 1 @ 0-5'

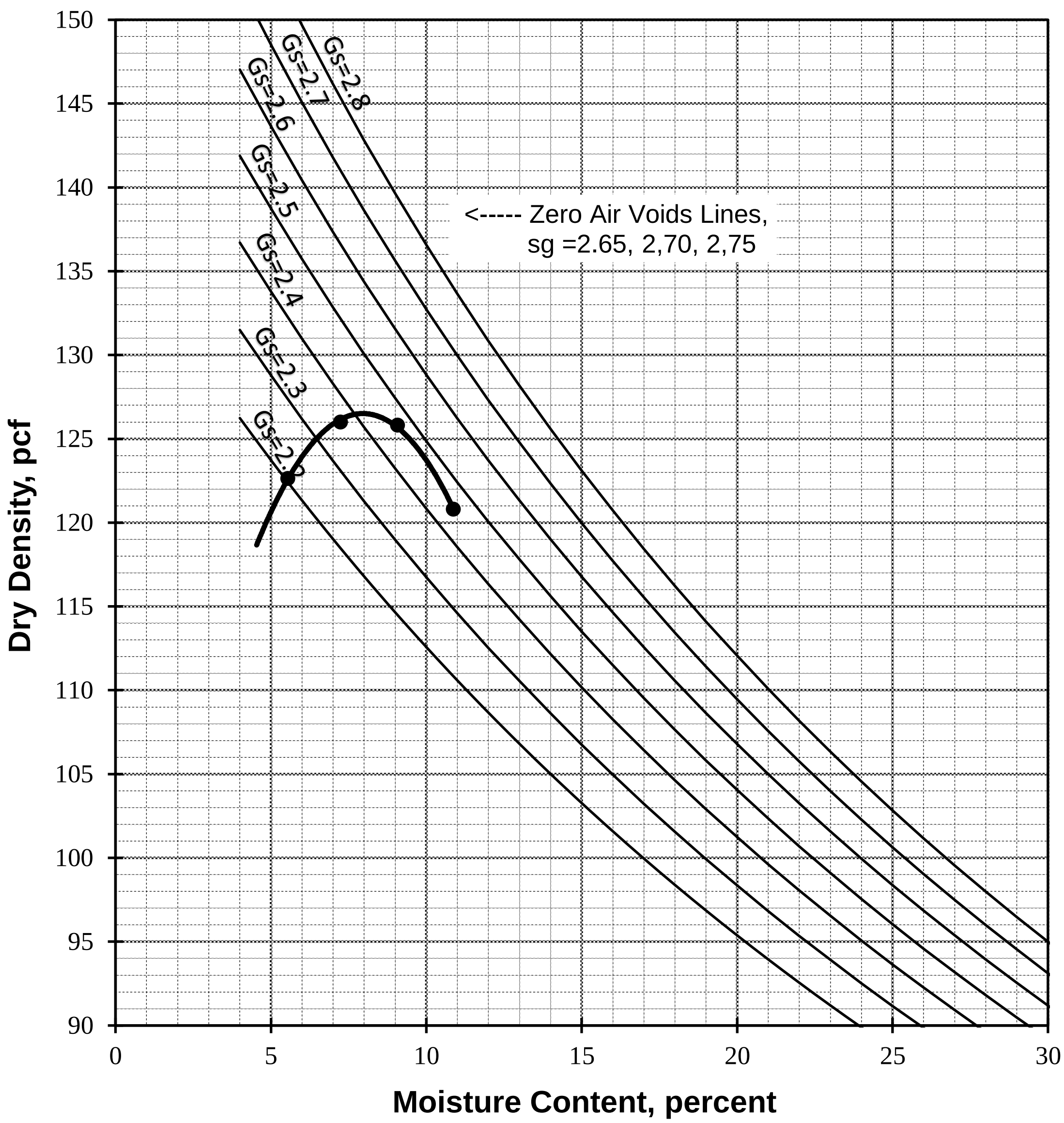
Procedure Used: A
Prep. Method: Moist

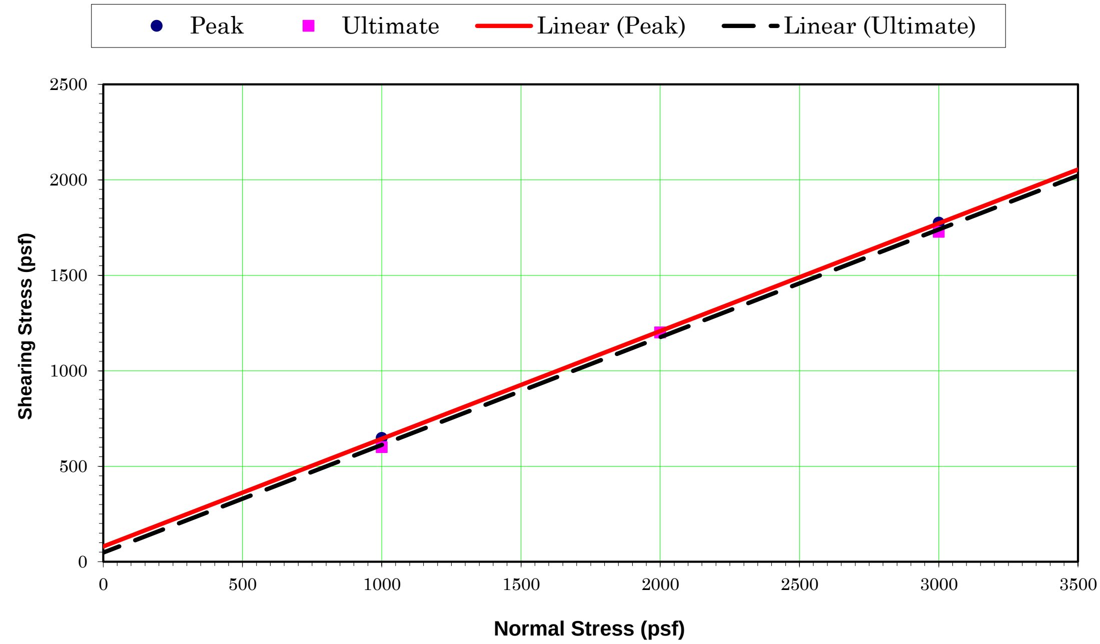
Date: 10/26/2022
Description: Clayey Sand

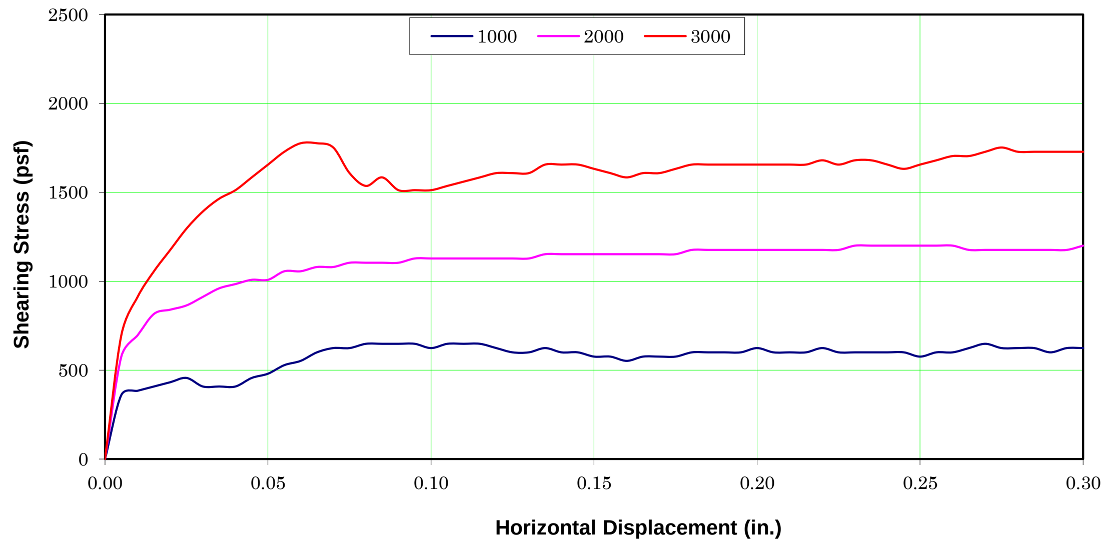
Rammer Type: Automatic

Maximum Density: **126.5 pcf**
Optimum Moisture: **8%**

Sieve Size	% Retained
3/4"	0.0
3/8"	0.0
#4	2.1







DIRECT SHEAR DATA*

Sample Location: B A 1 @ 0-5'
Sample Description: Clayey Sand
Dry Density (pcf): 113.1
Intial % Moisture: 8
Average Degree of Saturation: 99.7
Shear Rate (in/min): 0.005 in/min

Normal stress (psf)	1000	2000	3000
Peak stress (psf)	648	1200	1776
Ultimate stress (psf)	600	1200	1728

	Peak	Ultimate
ϕ Angle of Friction (degrees):	29	29
c Cohesive Strength (psf):	80	40

Test Type: Peak & Ultimate

* Test Method: ASTM D-3080

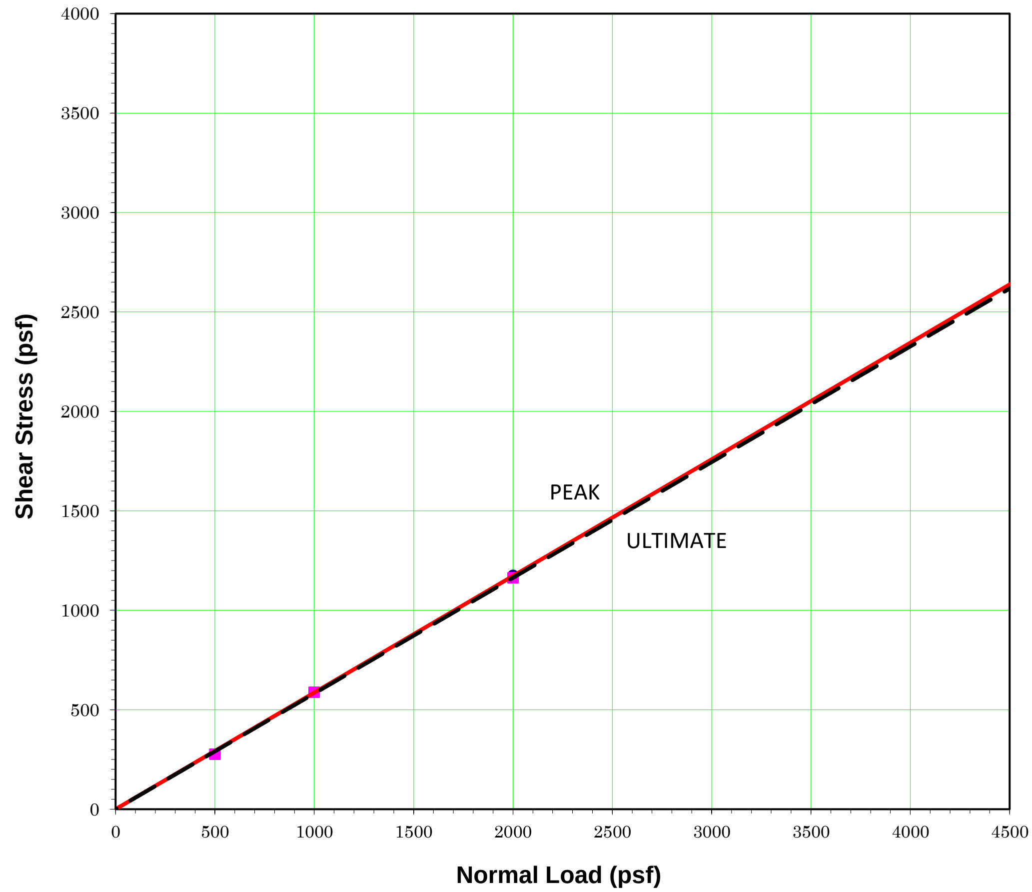
Note: Sample specimens were initially saturated before testing by partially immersing the specimens in water for about 24 hours while the specimens were restrained from swelling. Initial saturation was not performed in the direct shear machine, and is not prescribed by ASTM D 3080.

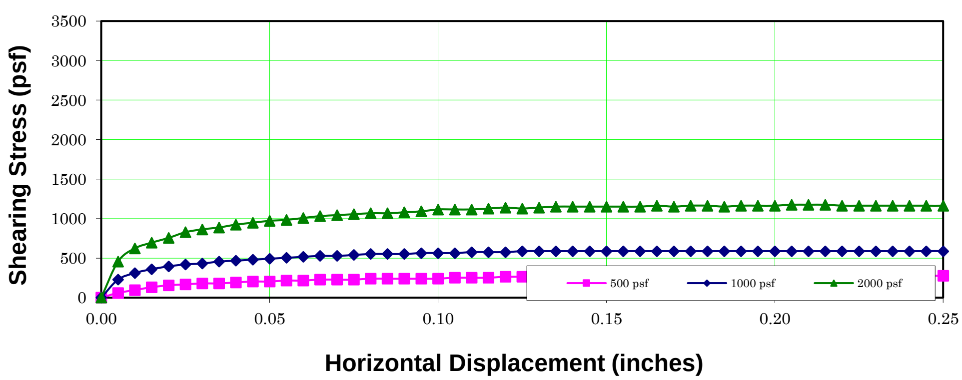
DIRECT SHEAR TEST

4677 Via Roblada

Earth Systems

11/28/2022	301995-001





DIRECT SHEAR DATA*

Sample Location:	BA-1-4 at 10 feet	
Material:	Poorly-Graded SAND (SP)	
Dry Density:	101.2 pcf	
	Initial	Final
Moisture Content:	11.5%	23.9%
Saturation:	48%	100%
	Peak	Ultimate
ϕ Angle of Friction (degrees):	31	30
c Cohesive Strength (psf):	0	0

Test Type: Peak and Ultimate   Shear Rate (in/min): 0.005

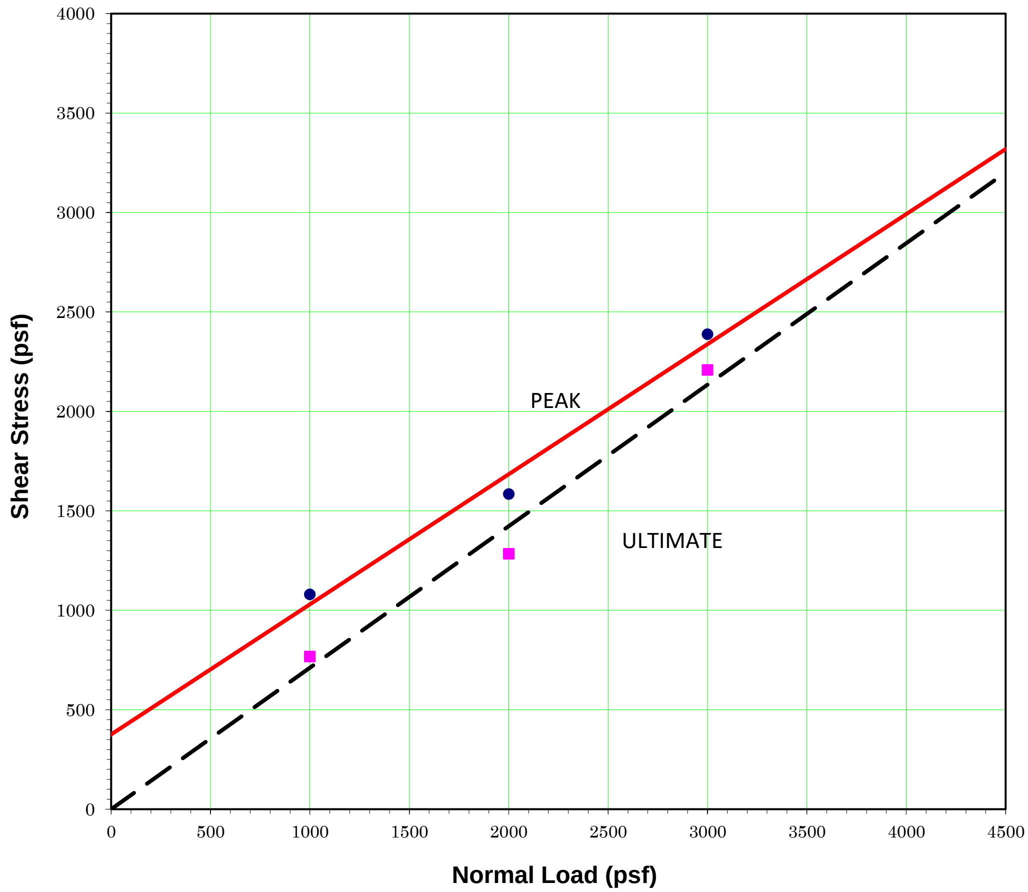
* Test Method: ASTM D-3080

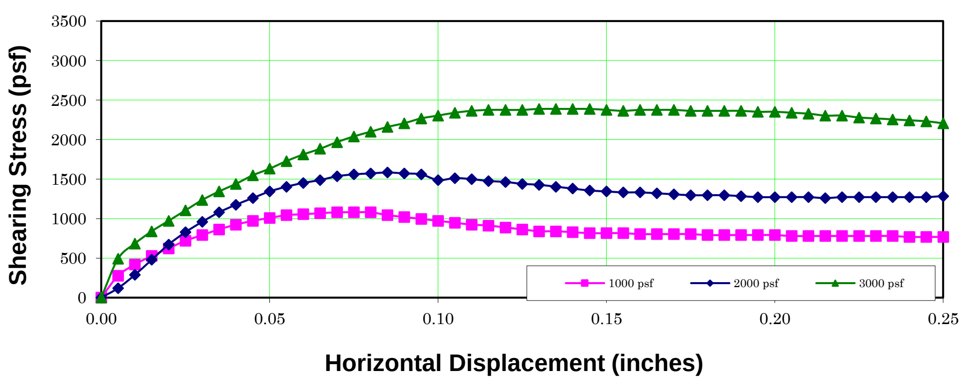
DIRECT SHEAR TEST

4677 VIA ROBLADA

Earth Systems

OCTOBER 2022	301995-001





DIRECT SHEAR DATA*

Sample Location:	BA-1-6 at 20 feet	
Material:	Bedrock	
Dry Density:	45 pcf	
	Initial	Final
Moisture Content:	94.7%	100.9%
Saturation:	94%	100%
	Peak	Ultimate
ϕ Angle of Friction (degrees):	33	36
c Cohesive Strength (psf):	370	0

Test Type: Peak and Ultimate   Shear Rate (in/min): 0.005

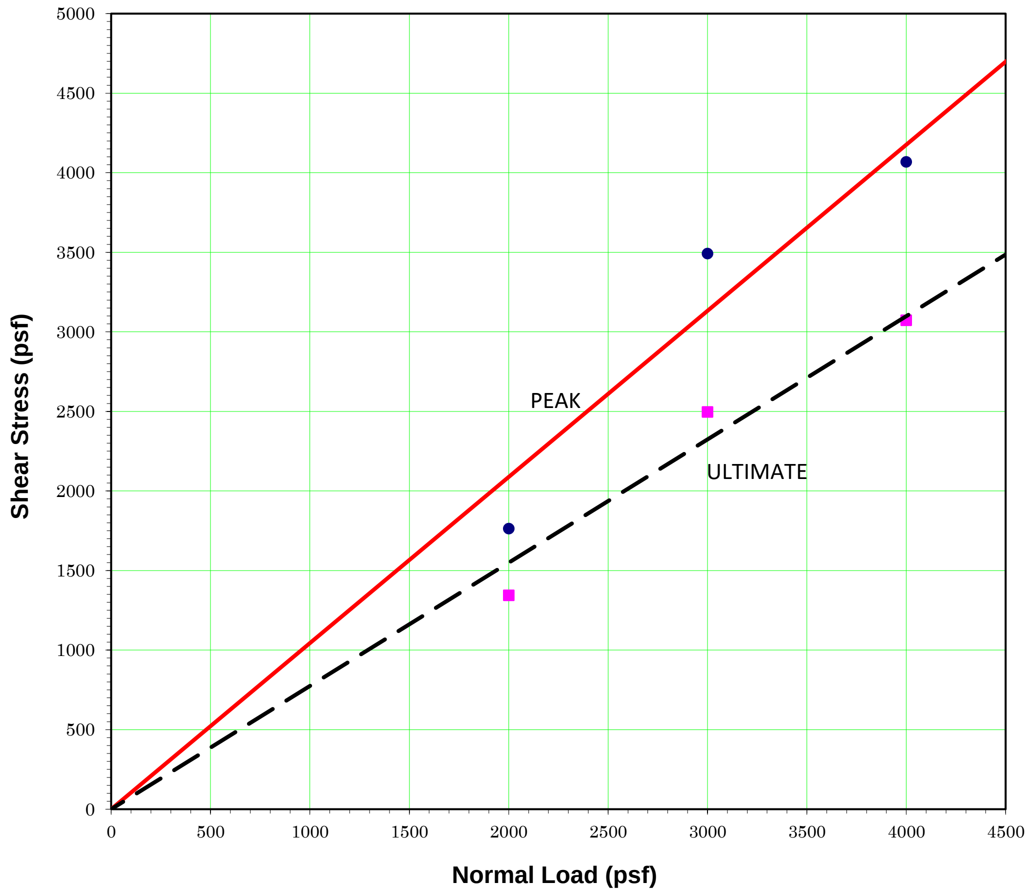
* Test Method: ASTM D-3080

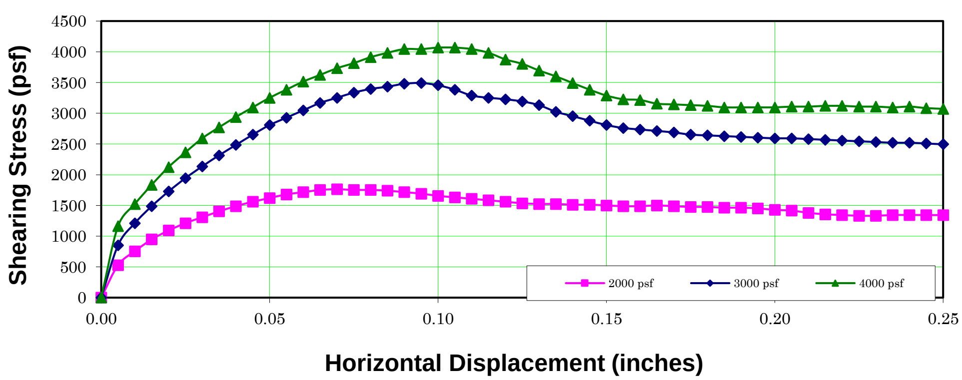
DIRECT SHEAR TEST

4677 VIA ROBLADA

Earth Systems

OCTOBER 2022   301995-001





DIRECT SHEAR DATA*

Sample Location:	BA-1-8 at 30 feet		
Material:	Bedrock		
Dry Density:	52.1 pcf		
		Initial	Final
Moisture Content:		82.8%	82.0%
Saturation:		101%	100%
		Peak	Ultimate
φ Angle of Friction (degrees):		47	38
c Cohesive Strength (psf):		0	0

Test Type: Peak and Ultimate Shear Rate (in/min): 0.005

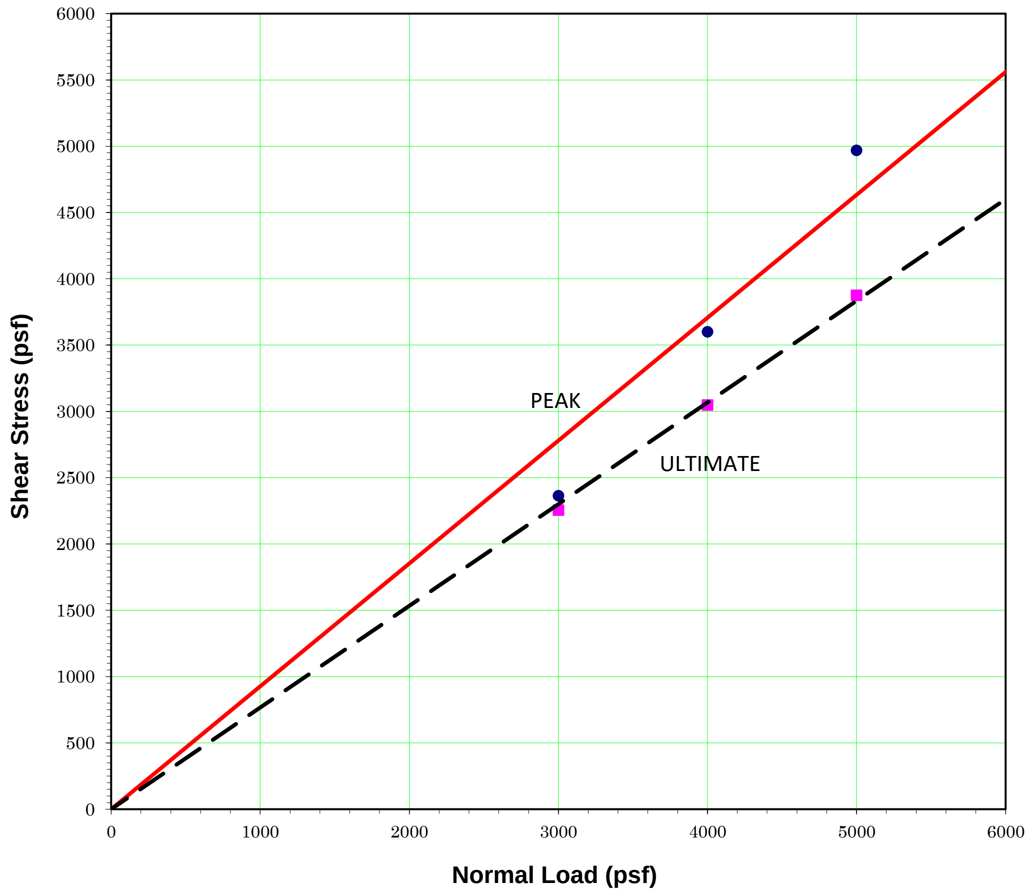
* Test Method: ASTM D-3080

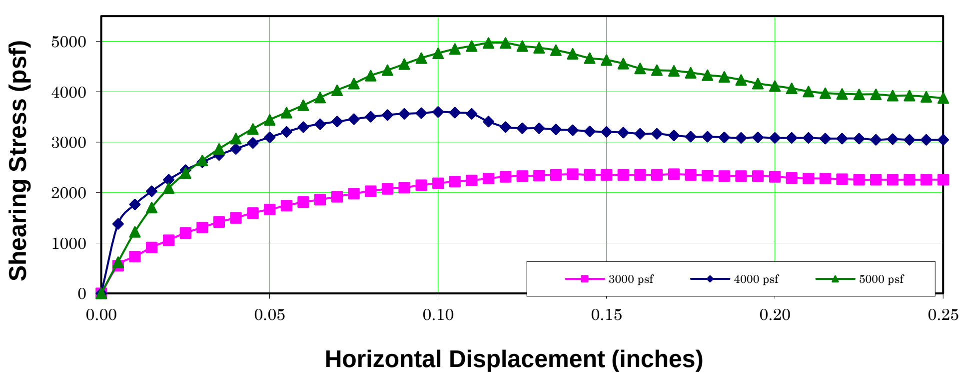
DIRECT SHEAR TEST

4677 VIA ROBLADA

Earth Systems

OCTOBER 2022 | 301995-001





DIRECT SHEAR DATA*

Sample Location:	BA-1-10 at 40 feet	
Material:	Bedrock	
Dry Density:	59.3 pcf	
	Initial	Final
Moisture Content:	70.1%	67.5%
Saturation:	104%	100%
	Peak	Ultimate
ϕ Angle of Friction (degrees):	44	38
c Cohesive Strength (psf):	0	0

Test Type: Peak and Ultimate   Shear Rate (in/min): 0.005

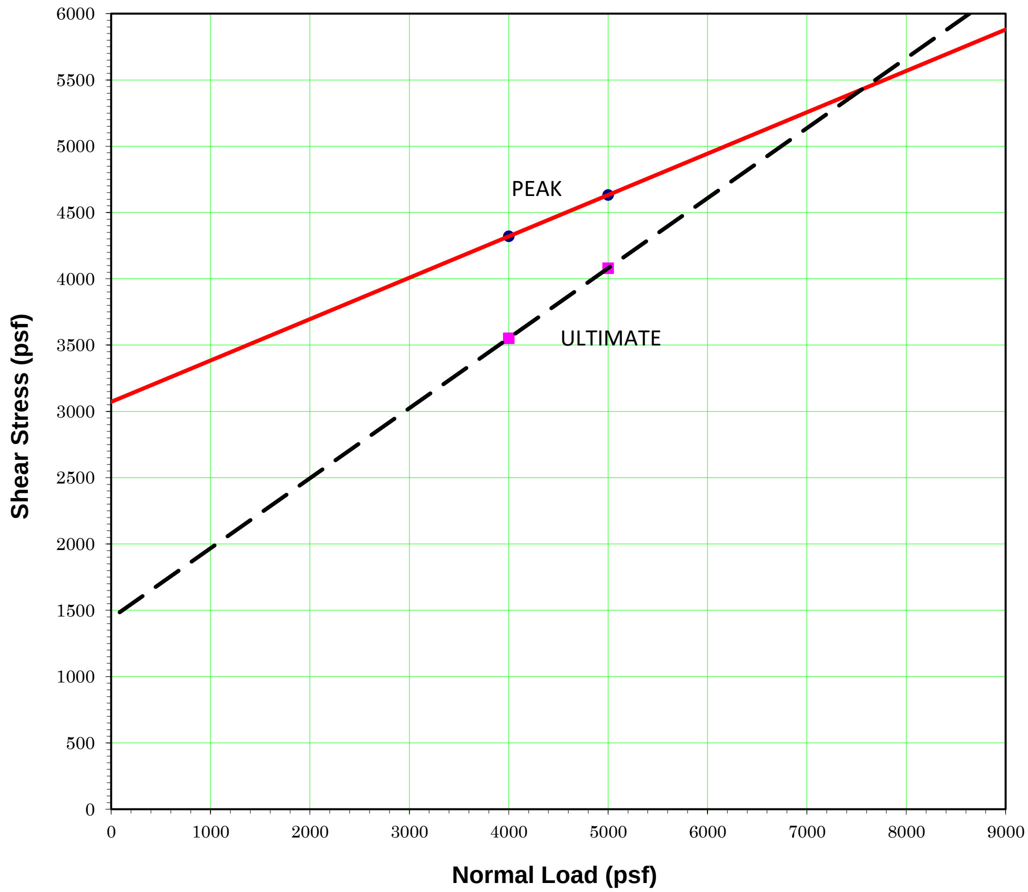
* Test Method: ASTM D-3080

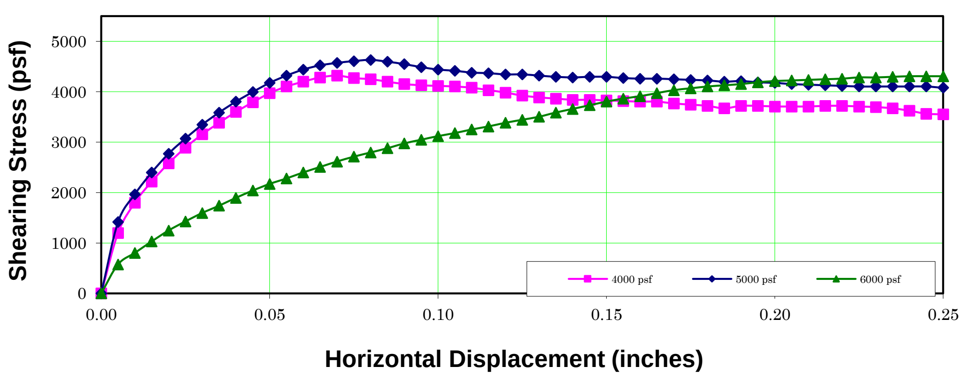
DIRECT SHEAR TEST

4677 VIA ROBLADA

Earth Systems

OCTOBER 2022 | 301995-001





DIRECT SHEAR DATA*

Sample Location:	BA-1-12 at 50 feet	
Material:	Bedrock	
Dry Density:	62.1 pcf	
	Initial	Final
Moisture Content:	57.2%	62.7%
Saturation:	91%	100%
	Peak	Ultimate
ϕ Angle of Friction (degrees):	0	21
c Cohesive Strength (psf):	4450	2090

Test Type: Peak and Ultimate Shear Rate (in/min): 0.005

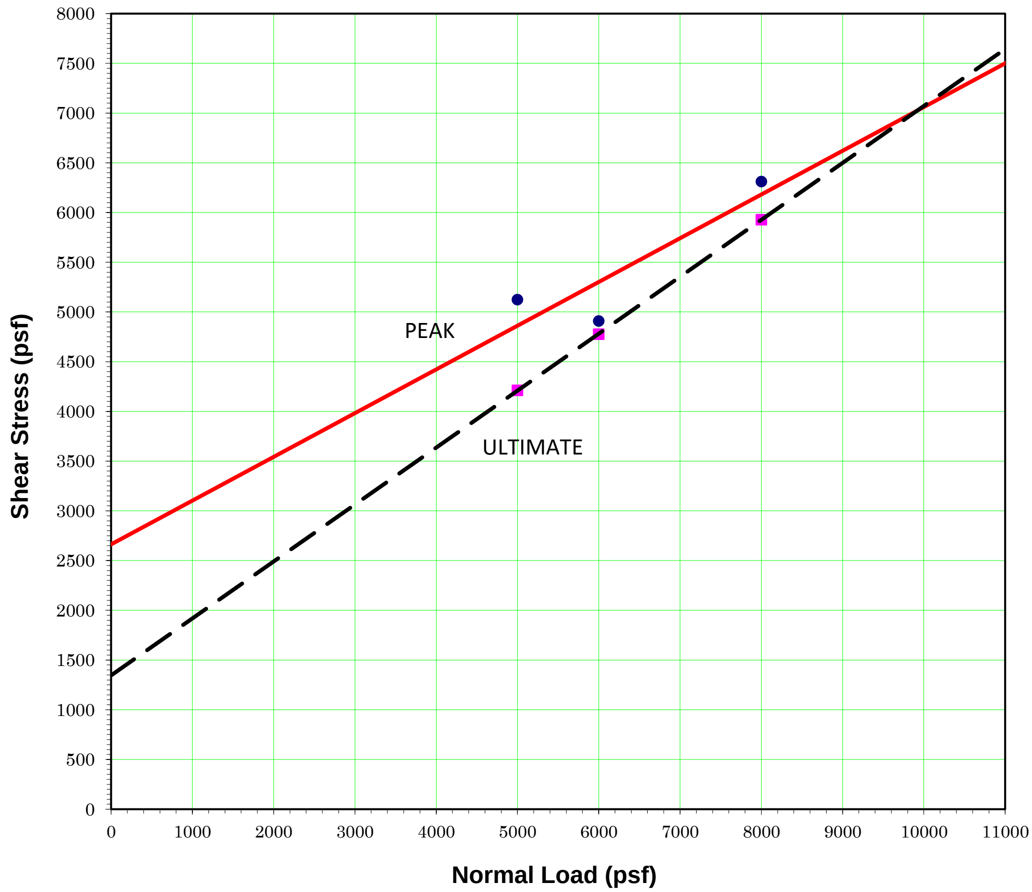
* Test Method: ASTM D-3080

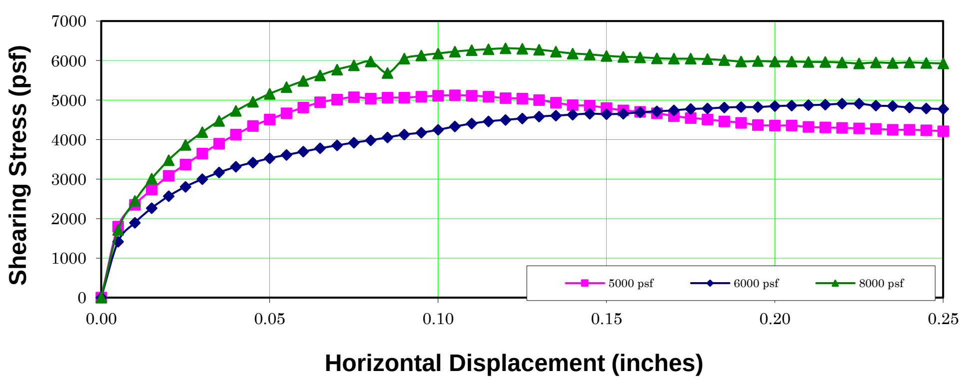
DIRECT SHEAR TEST

4677 VIA ROBLADA

Earth Systems

NOVEMBER 2022 | 301995-001





DIRECT SHEAR DATA*

Sample Location:	BA-1-14 at 60 feet	
Material:	Bedrock	
Dry Density:	55.1 pcf	
	Initial	Final
Moisture Content:	63.6%	75.5%
Saturation:	84%	100%
	Peak	Ultimate
ϕ Angle of Friction (degrees):	24	30
c Cohesive Strength (psf):	2660	1340

Test Type: Peak and Ultimate   Shear Rate (in/min): 0.005

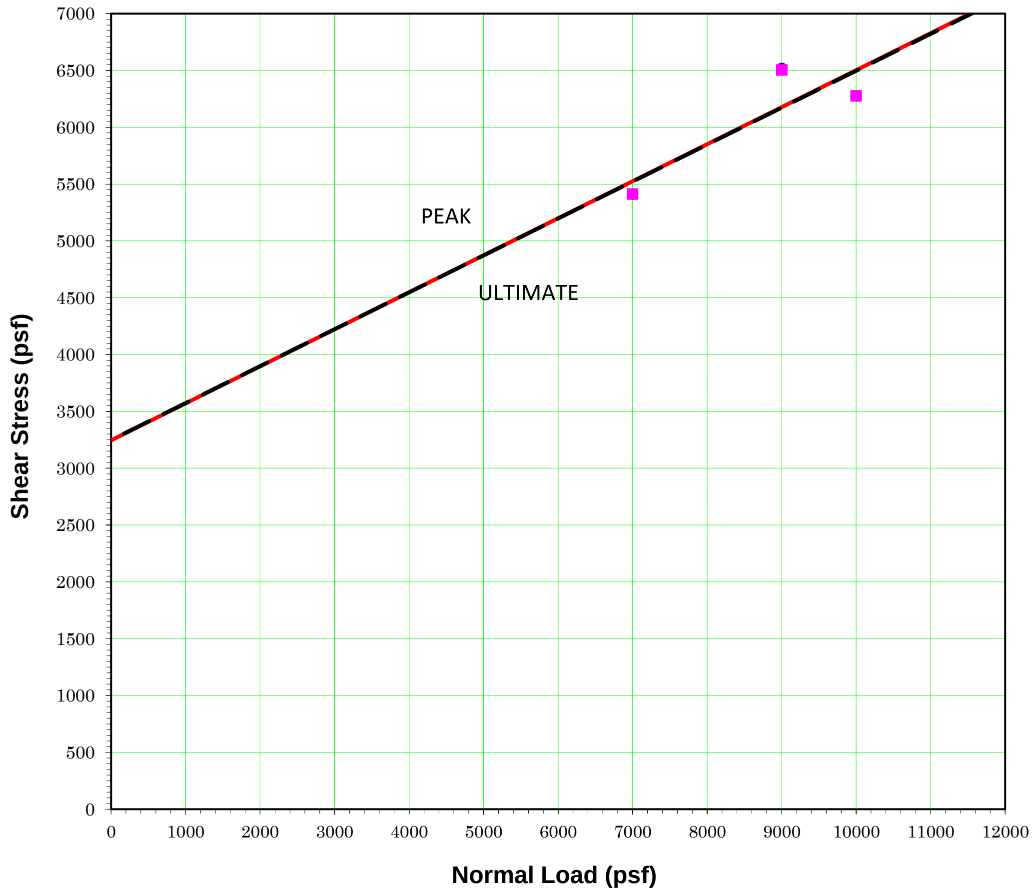
* Test Method: ASTM D-3080

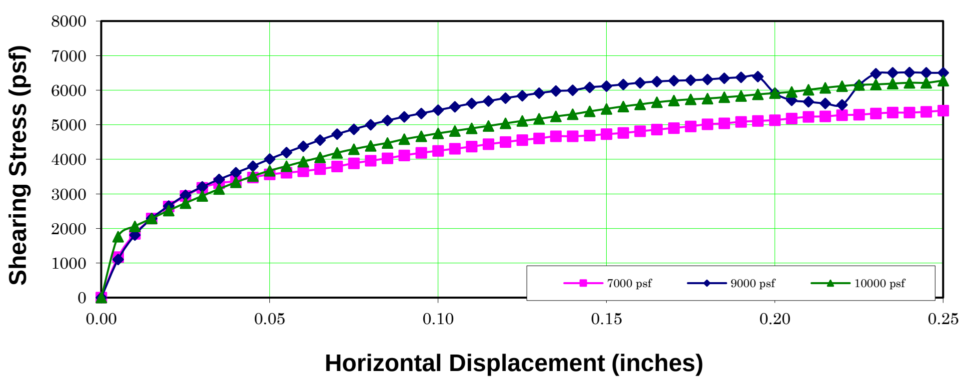
DIRECT SHEAR TEST

4677 VIA ROBLADA

Earth Systems

NOVEMBER 2022   301995-001





DIRECT SHEAR DATA*

Sample Location:	BA-1-16 at 70 feet	
Material:	Bedrock	
Dry Density:	57.6 pcf	
	Initial	Final
Moisture Content:	47.7%	70.6%
Saturation:	68%	100%
	Peak	Ultimate
ϕ Angle of Friction (degrees):	18	18
c Cohesive Strength (psf):	3240	3240

Test Type: Peak and Ultimate   Shear Rate (in/min): 0.005

* Test Method: ASTM D-3080

DIRECT SHEAR TEST

4677 VIA ROBLADA

Earth Systems

NOVEMBER 2022 | 301995-001

File No.: 301995-001

EXPANSION INDEX

ASTM D-4829, UBC 18-2

Job Name: 4677 Via Roblada
Sample ID: B A 1 @ 0-5'
Soil Description: SC

Initial Moisture, %:	7.9
Initial Compacted Dry Density, pcf:	116.4
Initial Saturation, %:	48
Final Moisture, %:	21.2
Volumetric Swell, %:	1.5

Expansion Index: 15 Very Low

EI	UBC Classification
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
130+	Very High

MECHANICAL ANALYSIS

CTM 203-08

Job Name:	4677 Via Roblada
Job No.:	301995-001
Sample ID:	**B A 1 @ 20.5'**
Soil Description:	**Bedrock**
Hydrometer ID:	504229

Hydroscopic Moisture

Air Dry Wt, g:	100.0
Oven Dry Wt, g	100.0
% Moisture:	0.0

Air Dry Sample Wt., g:	183.5
Corrected Wt., g:	183.5

Sieve Analysis for +#10 Material

Sieve Size	Wt Ret	% Ret	% Passing
1/2 inch	0.0	0.00	100.00
3/8 inch	0.0	0.00	100.00
#4	0.0	0.00	100.00
#8	0.0	0.00	100.00
#10	0.0	0.00	100.00

Air Dry Hydro Sample Wt., g:	52.9
Corrected Wt., g:	52.9
Calculation Factor	0.5290

Hydrometer Analysis for <#10 Material

Start time: 12:39:00 AM

Short Hydro	Time of Reading	Hydro Reading	Temp. at Reading, °C	Correction Factor	Corrected Hydro Reading
20 sec	12:39:20 AM	52	19	5.3	46.7
1 hour	1:39:00 AM	38	19	5.3	32.7
6 hour	6:39:00 AM	30	19	5.3	24.7

% Gravel:	0.0
% Sand(2mm - 74µm):	11.7
% Silt(74µm- 5µm):	26.5
% Clay(5µm - 2µm):	15.1
% Clay(≤2µm):	46.7

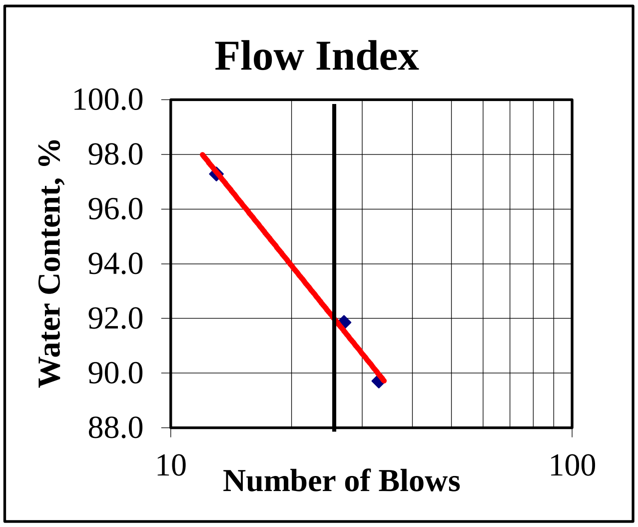
File No.: 301995-001 November 21, 2022

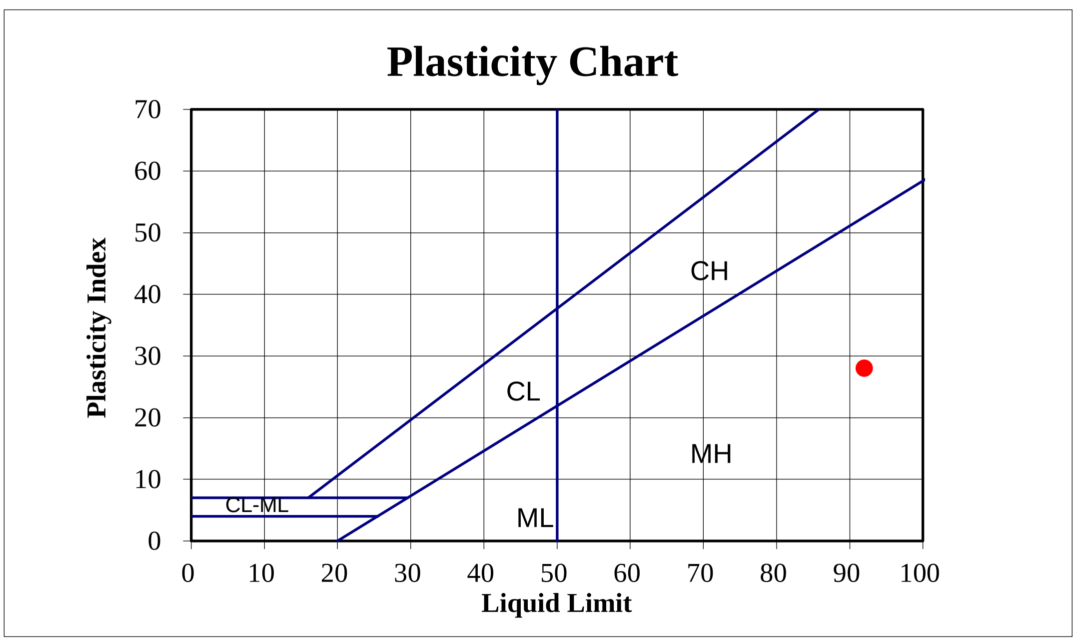
PLASTICITY INDEX

ASTM D-4318

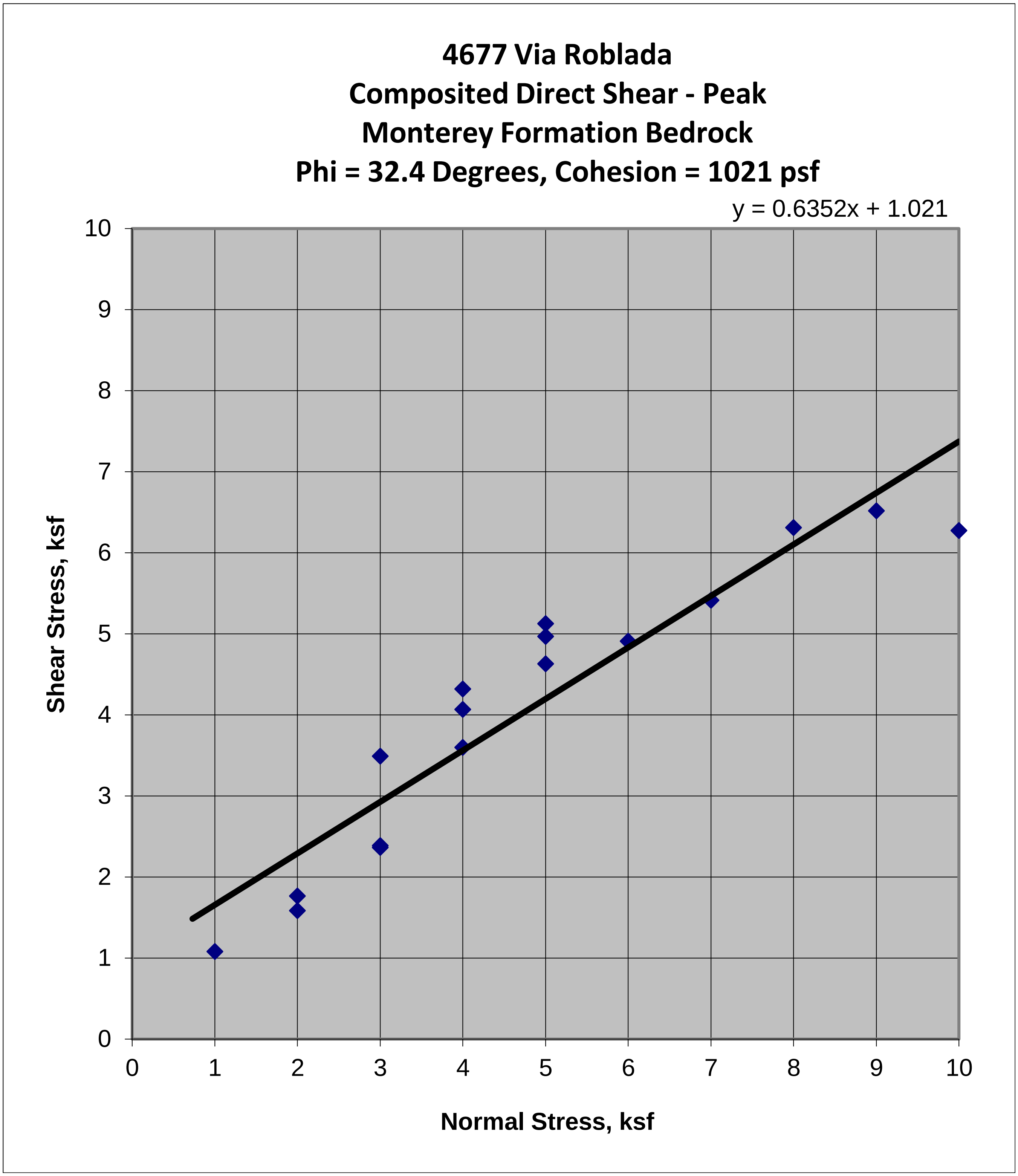
Job Name: 4677 Via Roblada
Sample ID: B A 1 @ 20.5'
Soil Description: Bedrock

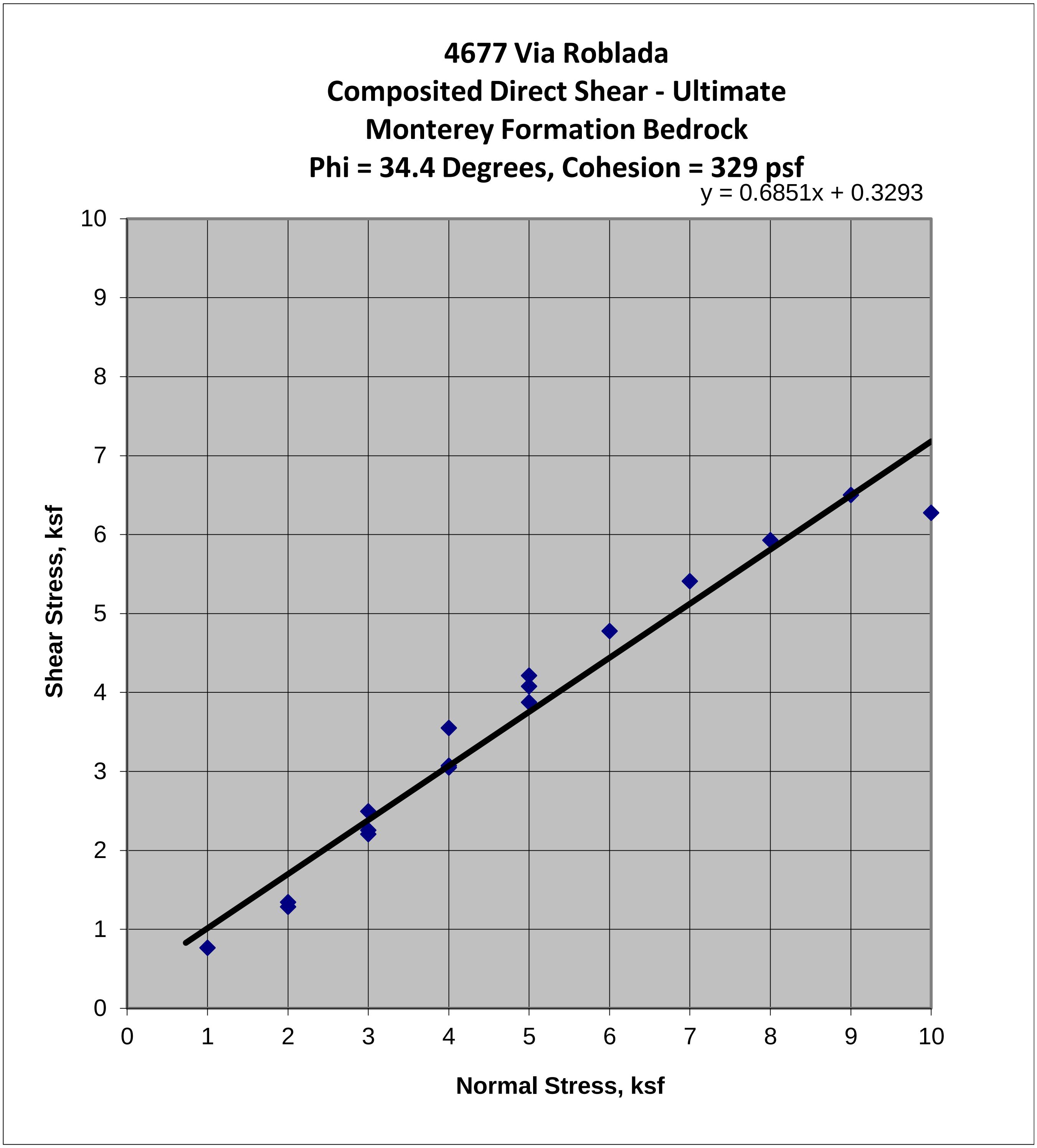
DATA SUMMARY				TEST RESULTS	
Number of Blows:	13	27	33	**LIQUID LIMIT**	**93**
Water Content, %	97.3	91.9	89.7	**PLASTIC LIMIT**	**64**
Plastic Limit:	63.5	64.4		**PLASTICITY INDEX**	**28**





Composited Direct Shear Graphs


4677 Via Roblada
Composited Direct Shear - Peak
Monterey Formation Bedrock
Phi = 32.4 Degrees, Cohesion = 1021 psf
y = 0.6352x + 1.021
Shear Stress, ksf
Normal Stress, ksf
0
1
2
3
4
5
6
7
8
9
10


4677 Via Roblada
Composited Direct Shear - Ultimate
Monterey Formation Bedrock
Phi = 34.4 Degrees, Cohesion = 329 psf
y = 0.6851x + 0.3293
Shear Stress, ksf
Normal Stress, ksf
0
1
2
3
4
5
6
7
8
9
10

APPENDIX C

Minimum Foundation Design Table
Slope Setbacks for Foundations on or Adjacent to Slopes

MINIMUM FOUNDATION DESIGN

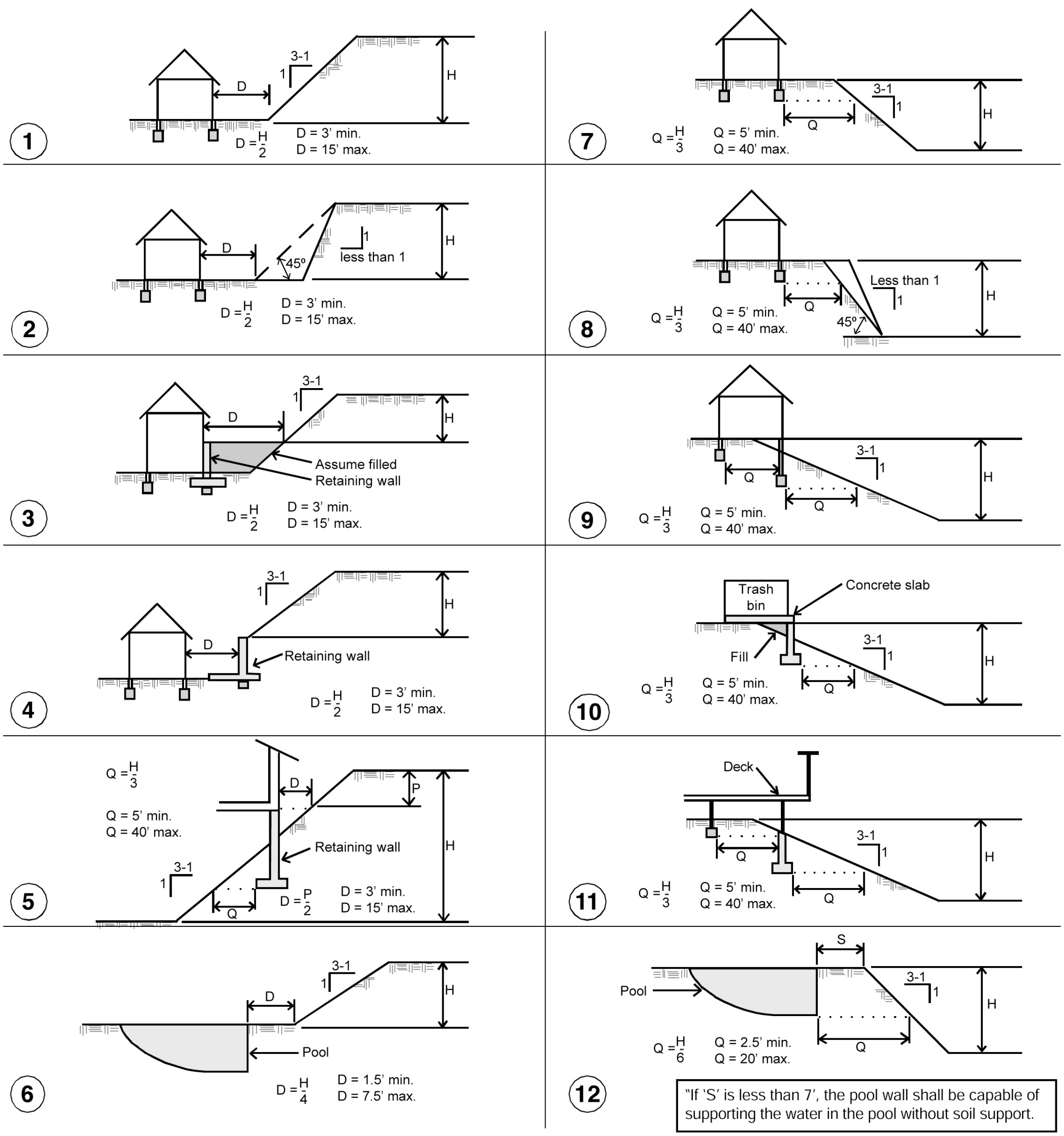
FOUNDATIONS FOR STUD BEARING WALLS – MINIMUM REQUIREMENTS

EXPANSION INDEX (E. I.)	FOUNDATIONS FOR SLAB AND RAISED FLOOR SYSTEM: NUMBER OF STORIES	STEM THICKNESS (INCHES)	FOOTING WIDTH (INCHES)	FOOTING THICKNESS (INCHES)	ALL PERIMETER FOOTINGS (DEPTH BELOW NATURAL SURFACE OF GROUND & FINISH GRADE, INCHES)	INTERIOR FOOTINGS FOR SLAB AND RAISED FLOORS (DEPTH BELOW NATURAL SURFACE OF GROUND & FINISH GRADE, INCHES)	REINFORCEMENT FOR FOUNDATIONS	CONCRETE SLAB 3-1/2" MINIMUM THICKNESS (4" WHEN OVER 51, E. I.): REINFORCEMENT	CONCRETE SLAB: TOTAL THICKNESS OF SAND	PREMOISTENING CONTROLS FOR SOILS UNDER FOOTINGS, PEIRS AND SLABS	PIERS UNDER RAISED FLOORS
0 -20 VERY LOW (NON-EXPANSIVE)	1 2 3	6 8 10	12 15 18	6 7 8	12 18 24	12 18 24	1 - #4 @ TOP AND BOTTOM	#3 @ 24" O.C. EACH WAY	2"	MOISTENING OF GROUND PRIOR TO PLACING CONCRETE IS RECOMMENDED	PIERS ALLOWED FOR SINGLE FLOOR LOADS ONLY
21-50 LOW	1 2 3	6 8 10	12 15 18	6 7 8	15 18 24	12 18 24	1 - #4 @ TOP AND BOTTOM	#3 @ 24" O.C. EACH WAY	4"	3% OVER OPTIMUM MOISTURE CONTENT TO A DEPTH OF 18" BELOW LOWEST ADJACENT GRADE TESTING REQ'D	PIERS ALLOWED FO SINGLE FLOOR LOADS ONLY
51-90 MEDIUM	1 2 3	6 8 10	12 15 18	6 8 8	21 21 24	12 18 24	1 - #4 @ TOP AND BOTTOM #3 BARS @ 24" O.C. 12" INTO FOOTING AND BENT 3' INTO SLAB	#3 @ 24" O.C. EACH WAY	4"	3% OVER OPTIMUM MOISTURE CONTENT TO A DEPTH OF 18" BELOW LOWEST ADJ ACENT GRADE TESTING REQ'D	PIERS NOT ALLOWED
91-130 HIGH	1 2 3	6 8 10	12 15 18	8 8 8	27 27 27	12 18 24	2 - #4 @ TOP AND BOTTOM #3 BARS @ 24" O.C. 12" INTO FOOTING AND BENT 3' INTO SLAB	#3 @ 24" O.C. EACH WAY	4"	3% OVER OPTIMUM MOISTURE CONTENT TO A DEPTH OF 24" BELOW LOWEST ADJACENT GRADE TESTING REQ'D	PIERS NOT ALLOWED
ABOVE 130 VERY HIGH	REQUIRES SPECIAL DESIGN BY A STATE LICENSED SOILS PROFESSIONAL										

SLOPE SETBACKS

Based on 2019 California Building Code Section 1808.7

FOUNDATIONS ON OR ADJACENT TO SLOPES:
The placement of buildings and structures on or adjacent to slopes steeper than 3 horizontal to 1 vertical shall be in accordance with the following illustrations. The provisions are intended to provide protection for the building from slope drainage, erosion and mudflow, loose slope debris, shallow slope failures, and foundation movement.



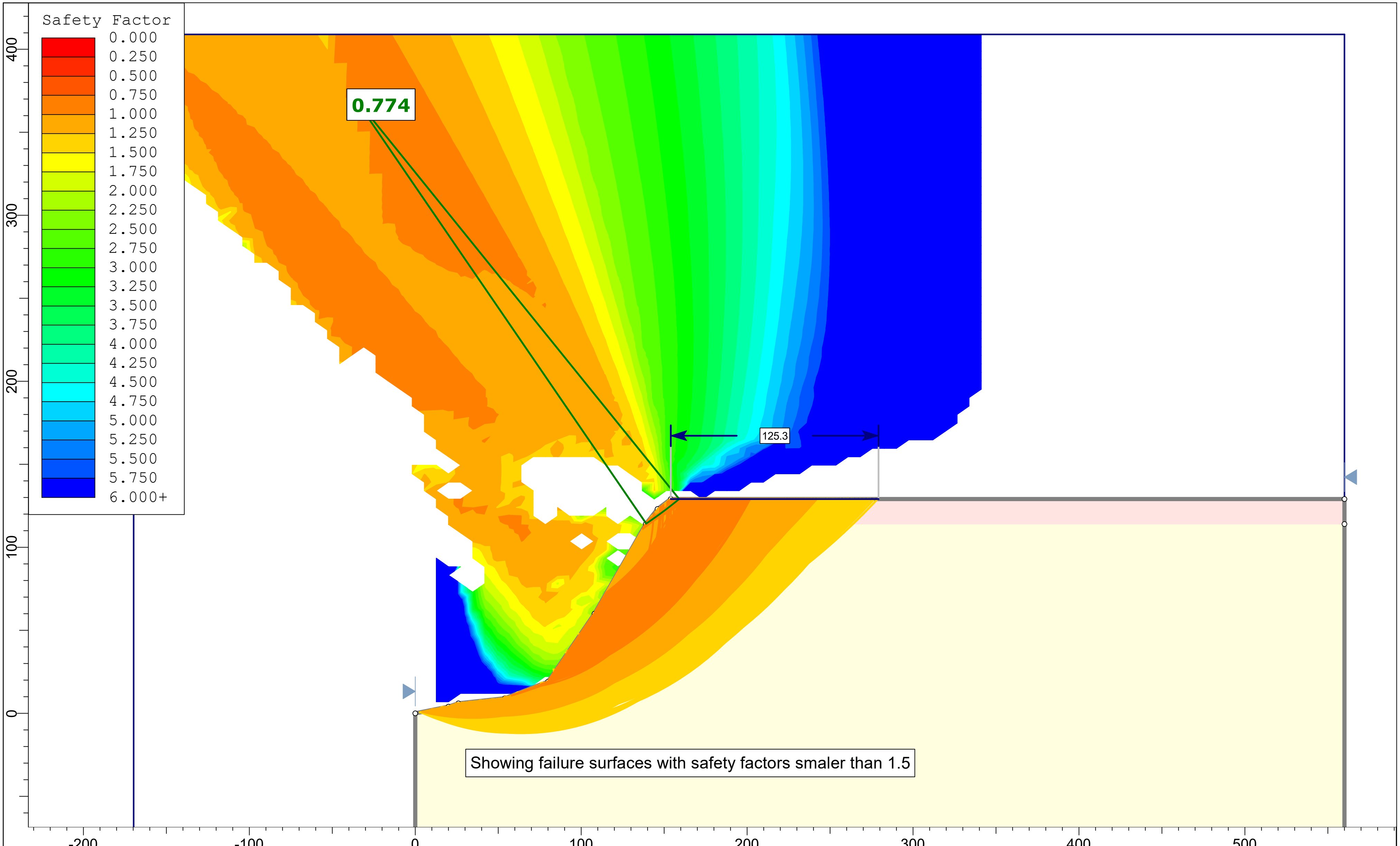
SLOPE SETBACKS FOR FOUNDATIONS ON OR ADJACENT TO SLOPES

Earth Systems

APPENDIX D

Slope Stability Analyses Results - Using Composited Shear Strengths
Slope Stability Analyses Results - Using Back-Calculated Shear Strengths

Slope Stability Analyses Results - Using Composited Shear Strengths



rocscience	*Project* 1. 301995-001 4677 Via Roblada Bluff Study.slmd		
	Analysis Description Section A-A', Circular-Type Failure - Static, Circular		
	Date 11/23/2022	*Scale* 1:960	*Company* Earth Systems Pacific
SLIDEINTERPRET 9.024			

Slide2 Analysis Information

1. 301995-001 4677 Via Roblada Bluff Study

Project Summary

File Name:	1. 301995-001 4677 Via Roblada Bluff Study.slmd
Slide2 Modeler Version:	9.024
Compute Time:	00h:00m:13.140s
Project Title:	Slide2 - An Interactive Slope Stability Program
Date Created:	11/15/2022, 2:09:35 PM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Spencer
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes
Eliminate vertical segments in non-circular search	Yes

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Enabled
Reverse Curvature:	Create Tension Crack
Minimum Elevation:	Not Defined
Minimum Depth [ft]:	4
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

Qt (Ultimate)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	113
Cohesion [psf]	0
Friction Angle [deg]	30
Water Surface	None
Ru Value	0
Tm (Ultimate)	
Color	
Strength Type	Anisotropic function
Unit Weight [lbs/ft3]	95
Water Surface	None
Ru Value	0

Anisotropic Functions

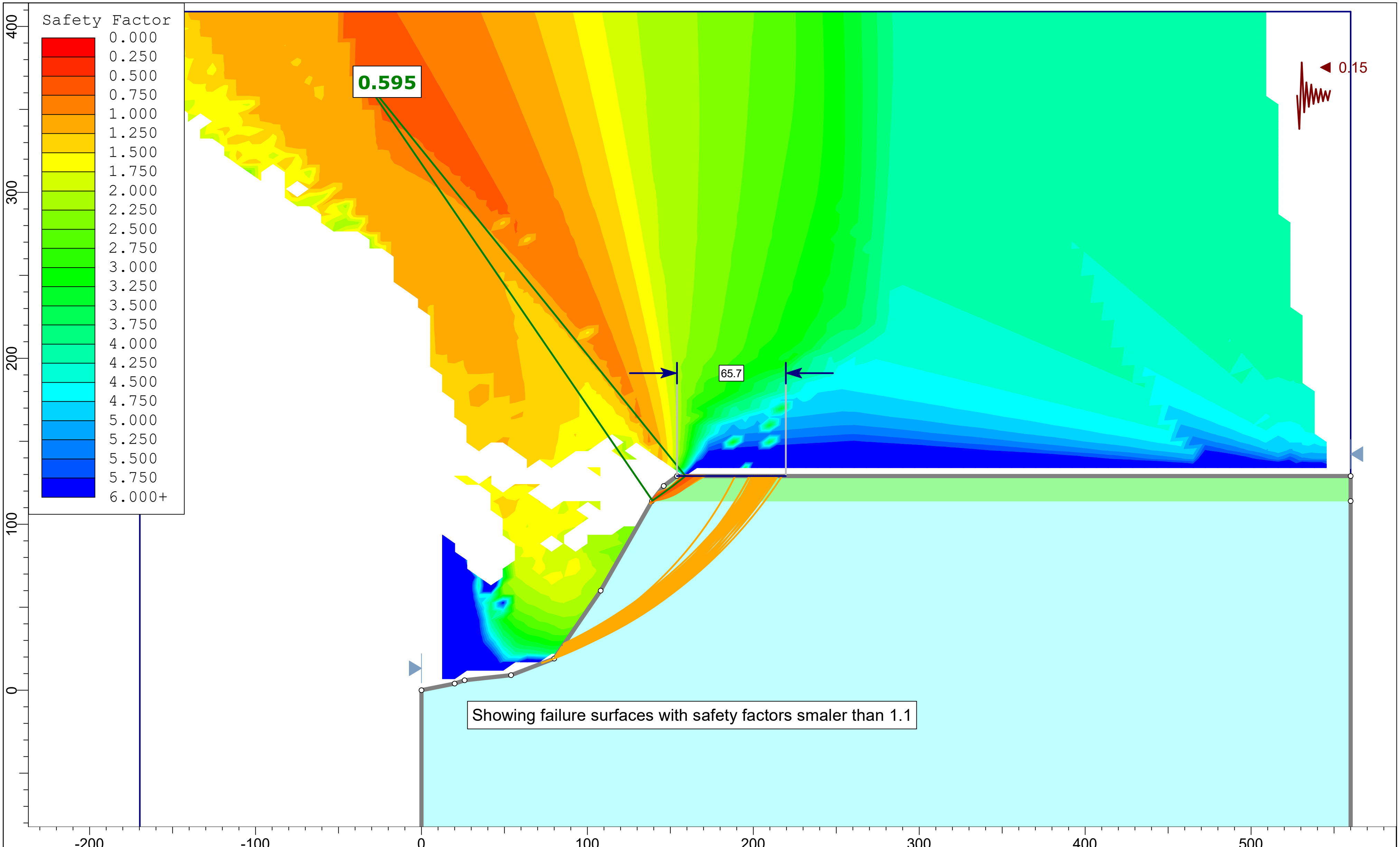
Name: Tm (Ultimate)

Angle From	Angle To	c	phi
-90	-44	329	34.4
-44	-40	0	9
-40	90	329	34.4

Global Minimums

Method: spencer

FS	0.773518
Center:	-38.359, 373.296
Radius:	314.072
Left Slip Surface Endpoint:	139.157, 114.202
Right Slip Surface Endpoint:	159.027, 129.000
Resisting Moment:	917609 lb-ft
Driving Moment:	1.18628e+06 lb-ft
Resisting Horizontal Force:	2341.72 lb
Driving Horizontal Force:	3027.36 lb
Total Slice Area:	55.8902 ft2
Surface Horizontal Width:	19.8695 ft
Surface Average Height:	2.81286 ft



rocscience

SLIDEINTERPRET 9.024

Project	1. 301995-001 4677 Via Roblada Bluff Study.slmd
Analysis Description	Section A-A', Circular-Type Failure - Seismic, Circular
Date 11/23/2022	*Scale* 1:960
Company	Earth Systems Pacific

Slide2 Analysis Information

1. 301995-001 4677 Via Roblada Bluff Study

Project Summary

File Name:	1. 301995-001 4677 Via Roblada Bluff Study.slmd
Slide2 Modeler Version:	9.024
Compute Time:	00h:00m:16.851s
Project Title:	Slide2 - An Interactive Slope Stability Program
Date Created:	11/15/2022, 2:09:35 PM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Spencer
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes
Eliminate vertical segments in non-circular search	Yes

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Enabled
Reverse Curvature:	Create Tension Crack
Minimum Elevation:	Not Defined
Minimum Depth [ft]:	4
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No
Seismic Load Coefficient (Horizontal):	0.15

Materials

Qt (Peak)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	113
Cohesion [psf]	0
Friction Angle [deg]	31
Water Surface	None
Ru Value	0
Tm (Peak)	
Color	
Strength Type	Anisotropic function
Unit Weight [lbs/ft3]	95
Water Surface	None
Ru Value	0

Anisotropic Functions

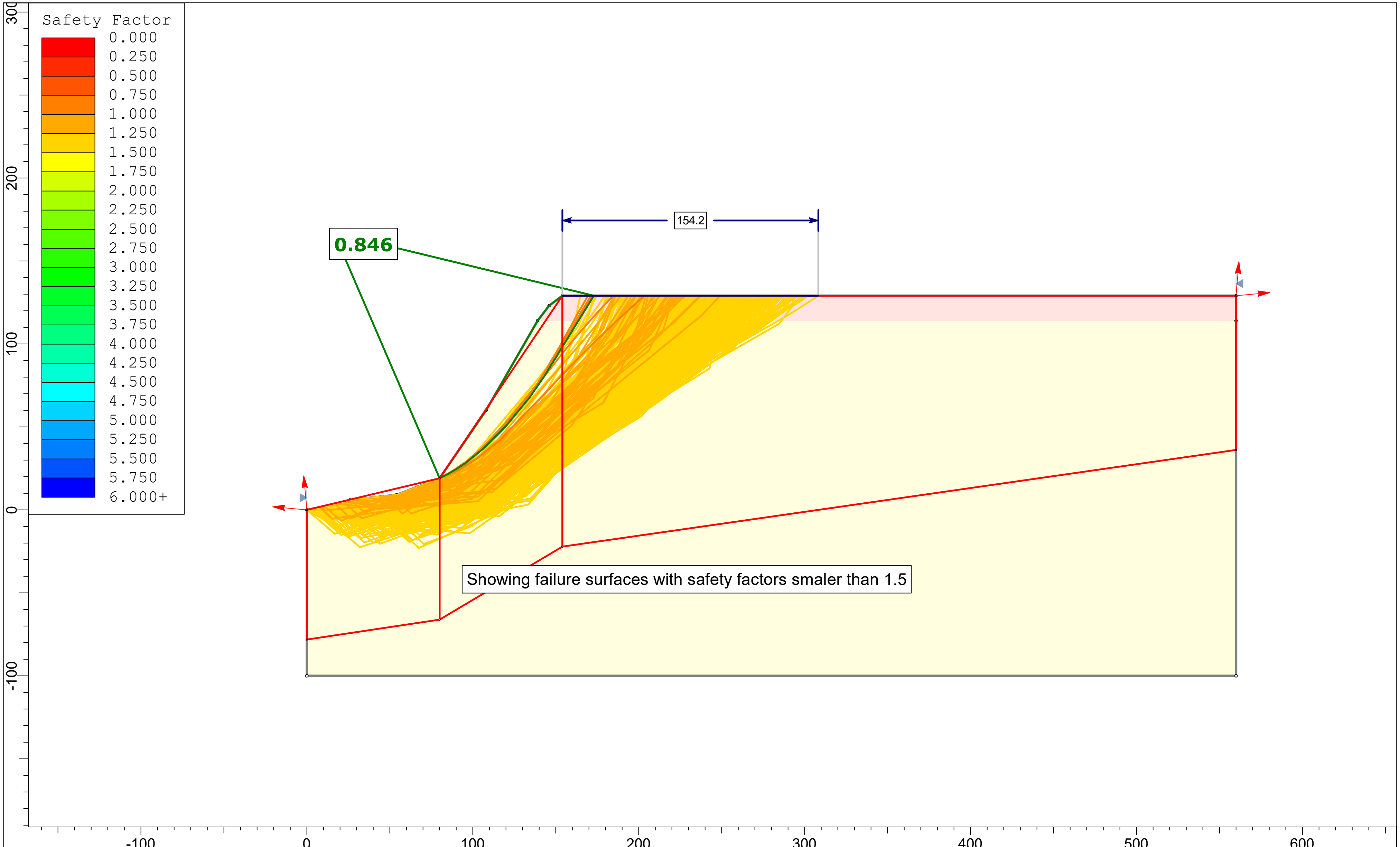
Name: Tm (Peak)

Angle From	Angle To	c	phi
-90	-44	1021	32.4
-44	-40	0	9
-40	90	1021	32.4

Global Minimums

Method: spencer

FS	0.595329
Center:	-38.359, 373.296
Radius:	314.072
Left Slip Surface Endpoint:	139.157, 114.202
Right Slip Surface Endpoint:	159.027, 129.000
Resisting Moment:	847187 lb-ft
Driving Moment:	1.42306e+06 lb-ft
Resisting Horizontal Force:	2164.61 lb
Driving Horizontal Force:	3635.98 lb
Total Slice Area:	55.8902 ft2
Surface Horizontal Width:	19.8695 ft
Surface Average Height:	2.81286 ft



rocscience	*Project* 1. 301995-001 4677 Via Roblada Bluff Study.slmd		
	Analysis Description Section A-A', Planar-Type Failure - Static, Planar		
	Date 11/23/2022	*Scale* 1:960	*Company* Earth Systems Pacific
SLIDEINTERPRET 9.024			

Slide2 Analysis Information

1. 301995-001 4677 Via Roblada Bluff Study

Project Summary

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Slide2 Modeler Version:	9.024
Compute Time:	00h:00m:11.979s
Project Title:	Slide2 - An Interactive Slope Stability Program
Date Created:	11/15/2022, 2:09:35 PM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Spencer
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes
Eliminate vertical segments in non-circular search	Yes

Surface Options

Surface Type:	Non-Circular Block Search
Number of Surfaces:	50000
Multiple Groups:	Disabled
Pseudo-Random Surfaces:	Enabled
Convex Surfaces Only:	Enabled
Left Projection Angle (Start Angle) [deg]:	95
Left Projection Angle (End Angle) [deg]:	175
Right Projection Angle (Start Angle) [deg]:	5
Right Projection Angle (End Angle) [deg]:	85
Minimum Elevation:	Not Defined
Minimum Depth [ft]:	4
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

Qt (Ultimate)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	113
Cohesion [psf]	0
Friction Angle [deg]	30
Water Surface	None
Ru Value	0
Tm (Ultimate)	
Color	
Strength Type	Anisotropic function
Unit Weight [lbs/ft3]	95
Water Surface	None
Ru Value	0

Anisotropic Functions

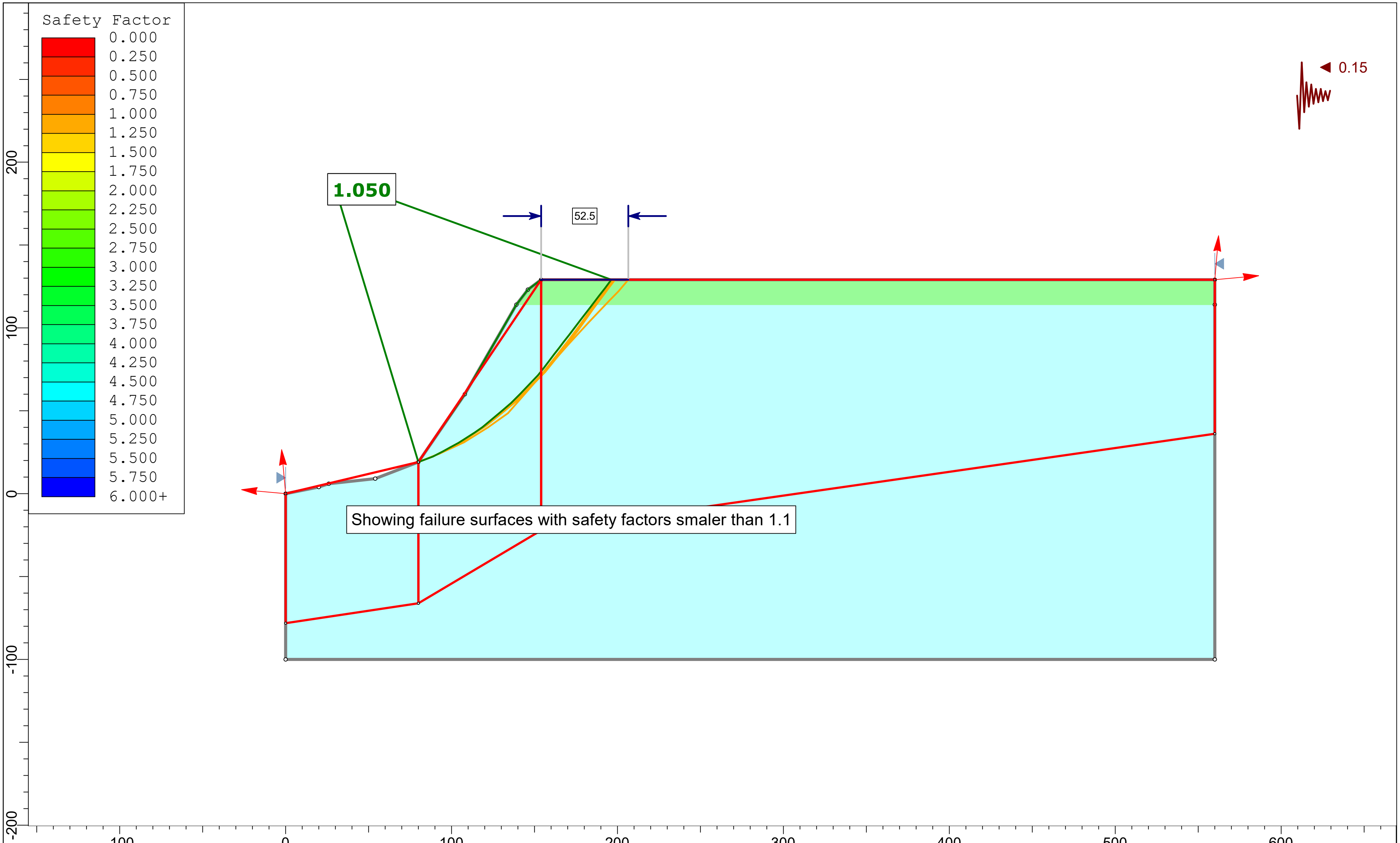
Name: Tm (Ultimate)

Angle From	Angle To	c	phi
-90	-44	329	34.4
-44	-40	0	9
-40	90	329	34.4

Global Minimums

Method: spencer

FS	0.846126
Axis Location:	16.432, 166.865
Left Slip Surface Endpoint:	80.000, 19.000
Right Slip Surface Endpoint:	172.865, 129.000
Resisting Moment:	2.1155e+07 lb-ft
Driving Moment:	2.50022e+07 lb-ft
Resisting Horizontal Force:	88163.9 lb
Driving Horizontal Force:	104197 lb
Total Slice Area:	2142.8 ft2
Surface Horizontal Width:	92.8648 ft
Surface Average Height:	23.0744 ft



rocscience			
	Project	1. 301995-001 4677 Via Roblada Bluff Study.slmd	
	Analysis Description	Section A-A', Planar-Type Failure - Seismic, Planar	
	Date 11/23/2022	Scale 1:960	Company Earth Systems Pacific
SLIDEINTERPRET 9.024			

Slide2 Analysis Information

1. 301995-001 4677 Via Roblada Bluff Study

Project Summary

File Name:	1. 301995-001 4677 Via Roblada Bluff Study.slmd
Slide2 Modeler Version:	9.024
Compute Time:	00h:00m:14.959s
Project Title:	Slide2 - An Interactive Slope Stability Program
Date Created:	11/15/2022, 2:09:35 PM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Spencer
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes
Eliminate vertical segments in non-circular search	Yes

Surface Options

Surface Type:	Non-Circular Block Search
Number of Surfaces:	50000
Multiple Groups:	Disabled
Pseudo-Random Surfaces:	Enabled
Convex Surfaces Only:	Enabled
Left Projection Angle (Start Angle) [deg]:	95
Left Projection Angle (End Angle) [deg]:	175
Right Projection Angle (Start Angle) [deg]:	5
Right Projection Angle (End Angle) [deg]:	85
Minimum Elevation:	Not Defined
Minimum Depth [ft]:	4
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No
Seismic Load Coefficient (Horizontal):	0.15

Materials

Qt (Peak)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	113
Cohesion [psf]	0
Friction Angle [deg]	31
Water Surface	None
Ru Value	0
Tm (Peak)	
Color	
Strength Type	Anisotropic function
Unit Weight [lbs/ft3]	95
Water Surface	None
Ru Value	0

Anisotropic Functions

Name: Tm (Peak)

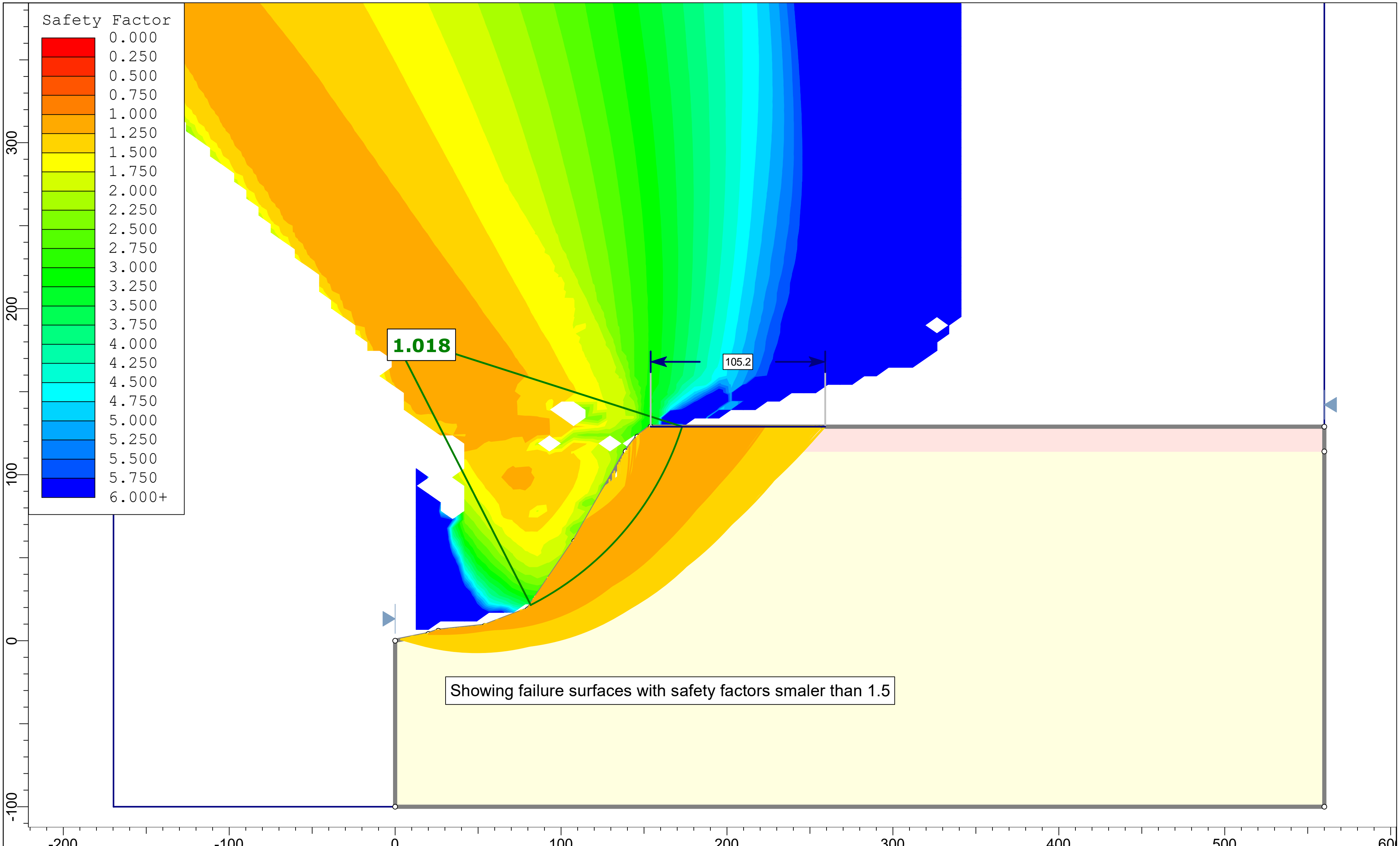
Angle From	Angle To	c	phi
-90	-44	1021	32.4
-44	-40	0	9
-40	90	1021	32.4

Global Minimums

Method: spencer

FS	1.049940
Axis Location:	28.128, 190.256
Left Slip Surface Endpoint:	80.000, 19.000
Right Slip Surface Endpoint:	196.256, 129.000
Resisting Moment:	5.19589e+07 lb-ft
Driving Moment:	4.94874e+07 lb-ft
Resisting Horizontal Force:	221274 lb
Driving Horizontal Force:	210749 lb
Total Slice Area:	3731.63 ft2
Surface Horizontal Width:	116.256 ft
Surface Average Height:	32.0984 ft

Slope Stability Analyses Results - Using Back-Calculated Shear Strengths



Project	2. 301995-001 4677 Via Roblada Bluff Study (Back Calculation).slmd
Analysis Description	Section A-A', Circular-Type Failure - Static, Circular
Date	11/23/2022
Scale	1:960
Company	Earth Systems Pacific

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Slide2 Analysis Information

2. 301995-001 4677 Via Roblada Bluff Study (Back Calculation)

Project Summary

File Name:	2. 301995-001 4677 Via Roblada Bluff Study (Back Calculation).slmd
Slide2 Modeler Version:	9.024
Compute Time:	00h:00m:12.205s
Project Title:	Slide2 - An Interactive Slope Stability Program
Date Created:	11/15/2022, 2:09:35 PM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Spencer
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes
Eliminate vertical segments in non-circular search	Yes

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Enabled
Reverse Curvature:	Create Tension Crack
Minimum Elevation:	Not Defined
Minimum Depth [ft]:	4
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

Qt (Ultimate)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	113
Cohesion [psf]	100
Friction Angle [deg]	34
Water Surface	None
Ru Value	0
Tm (Ultimate)	
Color	
Strength Type	Anisotropic function
Unit Weight [lbs/ft3]	95
Water Surface	None
Ru Value	0

Anisotropic Functions

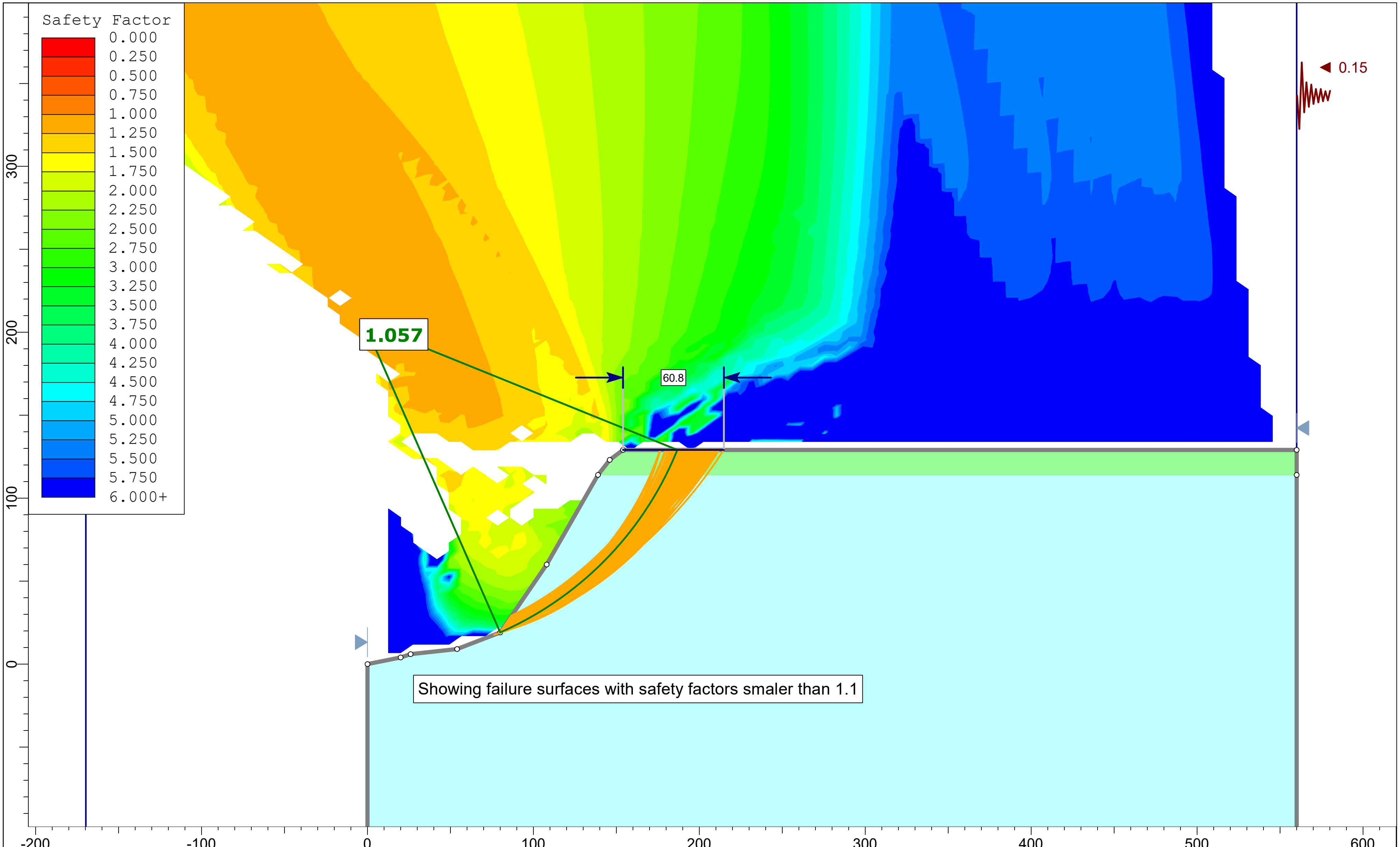
Name: Tm (Ultimate)

Angle From	Angle To	c	phi
-90	-44	515	35
-44	-40	0	9
-40	90	515	35

Global Minimums

Method: spencer

FS	1.018110
Center:	-1.874, 184.995
Radius:	183.630
Left Slip Surface Endpoint:	81.696, 21.483
Right Slip Surface Endpoint:	173.011, 129.000
Resisting Moment:	3.42078e+07 lb-ft
Driving Moment:	3.35995e+07 lb-ft
Resisting Horizontal Force:	124301 lb
Driving Horizontal Force:	122090 lb
Total Slice Area:	2522.29 ft2
Surface Horizontal Width:	91.3156 ft
Surface Average Height:	27.6217 ft



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Project 2. 301995-001 4677 Via Roblada Bluff Study (Back Calculation).slmd

Analysis Description Section A-A', Circular-Type Failure - Seismic, Circular

Date 11/23/2022 | *Scale* 1:960 | *Company* Earth Systems Pacific

SLIDEINTERPRET 9.024

Slide2 Analysis Information

2. 301995-001 4677 Via Roblada Bluff Study (Back Calculation)

Project Summary

File Name:	2. 301995-001 4677 Via Roblada Bluff Study (Back Calculation).slmd
Slide2 Modeler Version:	9.024
Compute Time:	00h:00m:16.419s
Project Title:	Slide2 - An Interactive Slope Stability Program
Date Created:	11/15/2022, 2:09:35 PM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Spencer
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes
Eliminate vertical segments in non-circular search	Yes

Surface Options

Surface Type:	Circular
Search Method:	Grid Search
Radius Increment:	10
Composite Surfaces:	Enabled
Reverse Curvature:	Create Tension Crack
Minimum Elevation:	Not Defined
Minimum Depth [ft]:	4
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No
Seismic Load Coefficient (Horizontal):	0.15

Materials

Qt (Peak)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	113
Cohesion [psf]	100
Friction Angle [deg]	34
Water Surface	None
Ru Value	0
Tm (Peak)	
Color	
Strength Type	Anisotropic function
Unit Weight [lbs/ft3]	95
Water Surface	None
Ru Value	0

Anisotropic Functions

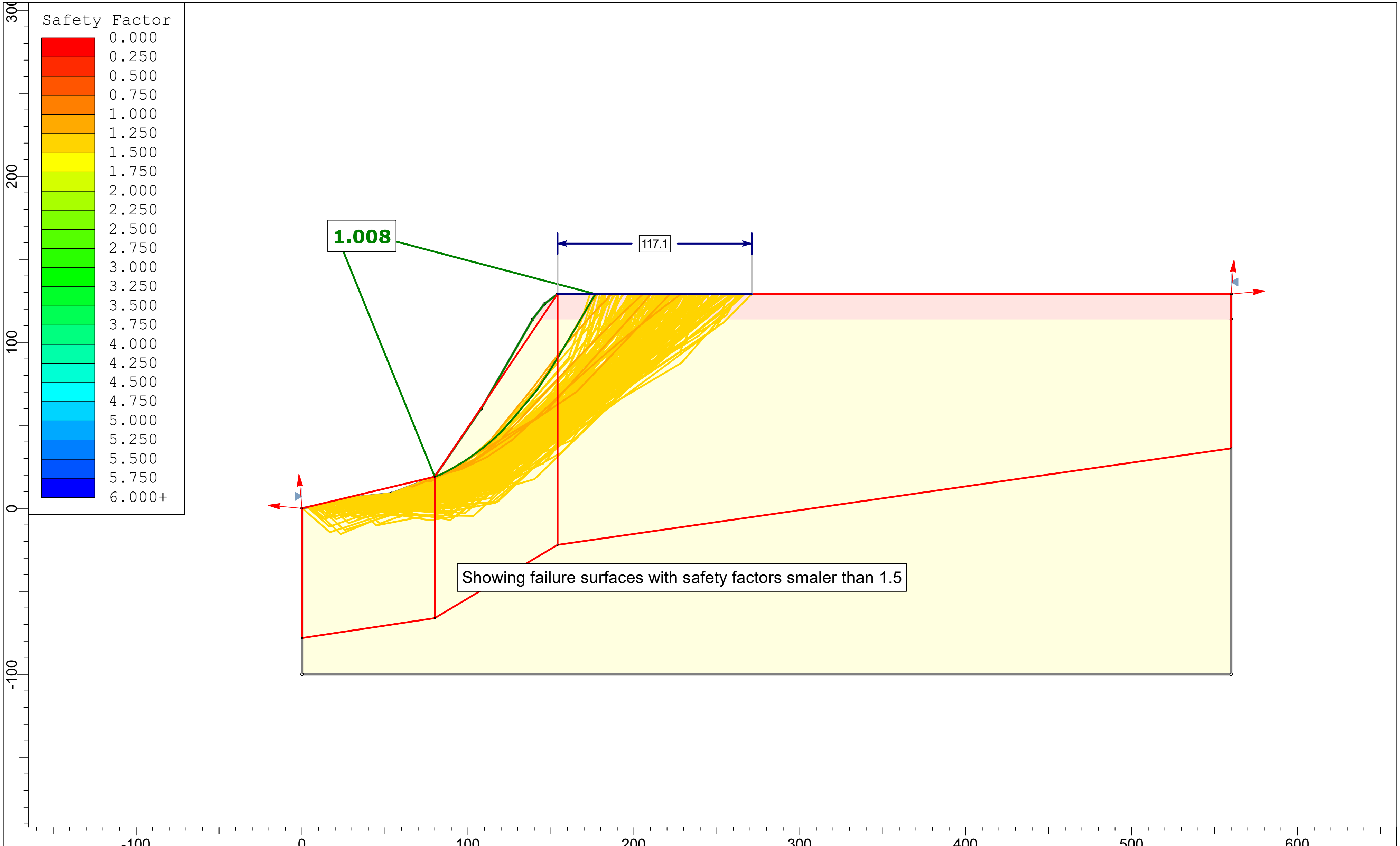
Name: Tm (Peak)

Angle From	Angle To	c	phi
-90	-44	1021	32.4
-44	-40	0	9
-40	90	1021	32.4

Global Minimums

Method: spencer

FS	1.057100
Center:	-1.874, 205.352
Radius:	203.488
Left Slip Surface Endpoint:	80.061, 19.089
Right Slip Surface Endpoint:	186.747, 129.000
Resisting Moment:	5.79452e+07 lb-ft
Driving Moment:	5.4815e+07 lb-ft
Resisting Horizontal Force:	206129 lb
Driving Horizontal Force:	194994 lb
Total Slice Area:	3502.9 ft2
Surface Horizontal Width:	106.686 ft
Surface Average Height:	32.8338 ft



rocscience	*Project* 2. 301995-001 4677 Via Roblada Bluff Study (Back Calculation).slmd		
	Analysis Description Section A-A', Planar-Type Failure - Static, Planar		
	Date 11/23/2022	*Scale* 1:960	*Company* Earth Systems Pacific

SLIDEINTERPRET 9.024

Slide2 Analysis Information

2. 301995-001 4677 Via Roblada Bluff Study (Back Calculation)

Project Summary

File Name:	2. 301995-001 4677 Via Roblada Bluff Study (Back Calculation).slmd
Slide2 Modeler Version:	9.024
Compute Time:	00h:00m:10.915s
Project Title:	Slide2 - An Interactive Slope Stability Program
Date Created:	11/15/2022, 2:09:35 PM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Spencer
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes
Eliminate vertical segments in non-circular search	Yes

Surface Options

Surface Type:	Non-Circular Block Search
Number of Surfaces:	50000
Multiple Groups:	Disabled
Pseudo-Random Surfaces:	Enabled
Convex Surfaces Only:	Enabled
Left Projection Angle (Start Angle) [deg]:	95
Left Projection Angle (End Angle) [deg]:	175
Right Projection Angle (Start Angle) [deg]:	5
Right Projection Angle (End Angle) [deg]:	85
Minimum Elevation:	Not Defined
Minimum Depth [ft]:	4
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No

Materials

Qt (Ultimate)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	113
Cohesion [psf]	100
Friction Angle [deg]	34
Water Surface	None
Ru Value	0
Tm (Ultimate)	
Color	
Strength Type	Anisotropic function
Unit Weight [lbs/ft3]	95
Water Surface	None
Ru Value	0

Anisotropic Functions

Name: Tm (Ultimate)

Angle From	Angle To	c	phi
-90	-44	515	35
-44	-40	0	9
-40	90	515	35

Global Minimums

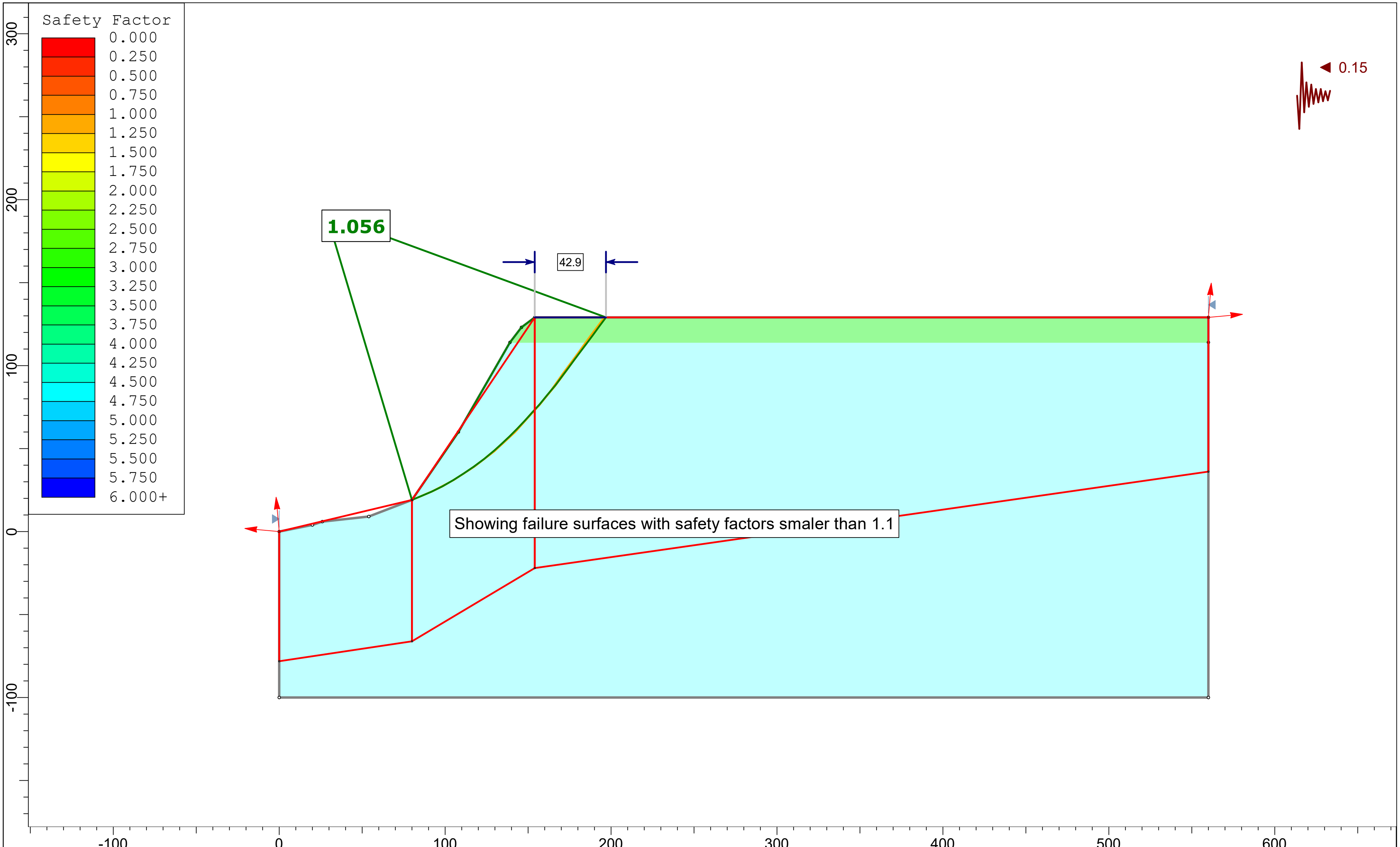
Method: spencer

FS	1.008030
Axis Location:	18.385, 170.770
Left Slip Surface Endpoint:	80.000, 19.000
Right Slip Surface Endpoint:	176.770, 129.000
Resisting Moment:	3.05589e+07 lb-ft
Driving Moment:	3.03155e+07 lb-ft
Resisting Horizontal Force:	127353 lb
Driving Horizontal Force:	126339 lb
Total Slice Area:	2594.09 ft2
Surface Horizontal Width:	96.7696 ft
Surface Average Height:	26.8068 ft

Global Minimum Coordinates

Method: spencer

X	Y
80	19
83.3107	20.1976
87.8849	22.4089
92.3018	24.9617
97.5621	28.1384
101.742	31.0176
105.095	33.3603
108.674	36.0635
112.572	39.1775
115.826	42.1073
119.08	45.0681
122.489	48.7523
125.898	52.5761
128.988	56.2323
132.079	59.8886
135.169	63.5448
138.259	67.201
141.946	71.608
145.634	77.2094
149.322	82.9126
152.417	87.9346
155.077	92.2515
157.632	96.4908
159.857	100.192
161.777	103.461
163.474	106.352
165.528	109.852
167.583	113.352
170.929	119.051
173.849	124.025
176.77	129



rocscience

Project	2. 301995-001 4677 Via Roblada Bluff Study (Back Calculation).slmd
Analysis Description	Section A-A', Planar-Type Failure - Seismic, Planar
Date 11/23/2022	*Scale* 1:960
Company	Earth Systems Pacific

SLIDEINTERPRET 9.024

Slide2 Analysis Information

2. 301995-001 4677 Via Roblada Bluff Study (Back Calculation)

Project Summary

File Name:	2. 301995-001 4677 Via Roblada Bluff Study (Back Calculation).slmd
Slide2 Modeler Version:	9.024
Compute Time:	00h:00m:13.228s
Project Title:	Slide2 - An Interactive Slope Stability Program
Date Created:	11/15/2022, 2:09:35 PM

General Settings

Units of Measurement:	Imperial Units
Time Units:	days
Permeability Units:	feet/second
Data Output:	Standard
Failure Direction:	Right to Left

Analysis Options

Slices Type:	Vertical
Analysis Methods Used	
	Spencer
Number of slices:	50
Tolerance:	0.005
Maximum number of iterations:	75
Check malpha < 0.2:	Yes
Create Interslice boundaries at intersections with water tables and piezos:	Yes
Initial trial value of FS:	1
Steffensen Iteration:	Yes
Eliminate vertical segments in non-circular search	Yes

Surface Options

Surface Type:	Non-Circular Block Search
Number of Surfaces:	50000
Multiple Groups:	Disabled
Pseudo-Random Surfaces:	Enabled
Convex Surfaces Only:	Enabled
Left Projection Angle (Start Angle) [deg]:	95
Left Projection Angle (End Angle) [deg]:	175
Right Projection Angle (Start Angle) [deg]:	5
Right Projection Angle (End Angle) [deg]:	85
Minimum Elevation:	Not Defined
Minimum Depth [ft]:	4
Minimum Area:	Not Defined
Minimum Weight:	Not Defined

Seismic Loading

Advanced seismic analysis:	No
Staged pseudostatic analysis:	No
Seismic Load Coefficient (Horizontal):	0.15

Materials

Qt (Peak)	
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	113
Cohesion [psf]	100
Friction Angle [deg]	34
Water Surface	None
Ru Value	0
Tm (Peak)	
Color	
Strength Type	Anisotropic function
Unit Weight [lbs/ft3]	95
Water Surface	None
Ru Value	0

Anisotropic Functions

Name: Tm (Peak)

Angle From	Angle To	c	phi
-90	-44	1021	32.4
-44	-40	0	9
-40	90	1021	32.4

Global Minimums

Method: spencer

FS	1.056050
Axis Location:	28.472, 190.945
Left Slip Surface Endpoint:	80.000, 19.000
Right Slip Surface Endpoint:	196.945, 129.000
Resisting Moment:	5.32331e+07 lb-ft
Driving Moment:	5.04077e+07 lb-ft
Resisting Horizontal Force:	226472 lb
Driving Horizontal Force:	214451 lb
Total Slice Area:	3800.42 ft2
Surface Horizontal Width:	116.945 ft
Surface Average Height:	32.4976 ft

Global Minimum Coordinates

Method: spencer

X	Y
80	19
85.4795	21.3051
91.7709	23.9958
98.249	27.1773
104.728	30.9345
111.024	34.9486
117.194	39.0811
123.457	43.6891
129.719	48.9354
134.263	52.9814
138.808	57.2904
143.352	61.8014
147.923	66.7806
152.494	71.7599
157.065	76.8201
161.769	82.5036
166.474	88.187
170.431	93.4874
174.388	98.7877
177.755	103.297
181.287	108.028
185.031	113.043
189.002	118.362
192.974	123.681
196.945	129

APPENDIX E

Table G-8 (CACC 2018)
Transect ID 4061 Site Data

Table G-8. Sea Level Rise Projections for the Santa Barbara Tide Gauge[113] (OPC 2018)

Projected Sea Level Rise (in feet): *Santa Barbara*			
	Probabilistic Projections (in feet) (based on Kopp et al. 2014)		H++ Scenario (Sweet et al. 2017)
	Low Risk Aversion	**Medium-High Risk Aversion**	**Extreme Risk Aversion**
	Upper limit of "likely range" (~17% probability SLR exceeds...)	*1-in-200 chance (0.5% probability SLR exceeds...)*	*Single scenario (no associated probability)*
2030	0.4	0.7	1.0
2040	0.7	1.1	1.6
2050	1.0	1.8	2.5
2060	1.3	2.5	3.6
2070	1.7	3.3	4.9
2080	2.1	4.3	6.3
2090	2.6	5.3	7.9
2100	3.1	6.6	9.8
2110*	3.2	6.9	11.5
2120	3.7	8.2	13.7
2130	4.2	9.5	16.0
2140	4.8	11.0	18.6
2150	5.3	12.6	21.4

**Most of the available climate model experiments do not extend beyond 2100. The resulting reduction in model availability causes a small dip in projections between 2100 and 2110, as well as a shift in uncertainty estimates (see Kopp et al., 2014). Use of 2110 projections should be done with caution and acknowledgement of increased uncertainty around these projections.*

[113] Probabilistic projections for the height of sea level rise and the H++ scenario are presented. The H++ projection is a single scenario and does not have an associated likelihood of occurrence. Projections are with respect to a baseline year of 2000 (or more specifically, the average relative sea level over 1991-2009). Table is adapted from the 2018 OPC SLR Guidance to present only the three scenarios OPC recommends evaluating. Additionally, while the OPC tables include low emissions scenarios, only high emissions scenarios, which represent RCP 8.5, are included here because global greenhouse gas emissions are currently tracking along this trajectory. The Coastal Commission will continue to update best available science as necessary, including if emissions trajectories change.

California Coastal Commission Sea Level Rise Policy Guidance
Final Adopted Science Update | November 7, 2018
Appendix G: Sea Level Rise Projections for 12 California Tide

TABLE G-8

4121 Creciente Drive
Hope Ranch Area, Santa Barbara County, California

Earth Systems

November 2021	304649-001

TRANSECT ID 4061 SITE DATA

Transect ID	4061
Historical cliff retreat rate (m/yr)	0.197
Historical retreat rate uncertainty (m/yr)	0.15
Cliff retreat rate (m/yr), 0.25 m SLR	0.239
Cliff retreat rate (m/yr), 0.50 m SLR	0.282
Cliff retreat rate (m/yr), 0.75 m SLR	0.309
Cliff retreat rate (m/yr), 1.00 m SLR	0.351
Cliff retreat rate (m/yr), 1.25 m SLR	0.395
Cliff retreat rate (m/yr), 1.50 m SLR	0.461
Cliff retreat rate (m/yr), 1.75 m SLR	0.521
Cliff retreat rate (m/yr), 2.00 m SLR	0.611
Cliff retreat rate (m/yr), 5.00 m SLR	1.370