Dees & Associates, Inc.
Geotechnical Engineers
501 Mission Street, Suite 8A Santa Cruz, CA 95060 Phone (831) 427-1770

April 1, 2022 Project No. SCR-1221.1

ENVISION I, LLC
% Alyssa Willett
1040 Mystery Spot Road
Santa Cruz, California 95065

Subject: Slope Stability Analysis

Reference: 900 High Street
APN 001-022-40
Santa Cruz, California

Dear Ms. Willett:

A new apartment building is proposed in the vicinity of the upper parking lot of the Peace United Church property. The parking lot is located at the base of a steep, 25 to 30 feet high cut slope. This report presents the results of our slope stability investigation performed to evaluate the stability of the cut slope behind the proposed apartment building.

Scope of Services

The specific scope of our services was as follows:

1. Site reconnaissance and review of available data in our files pertinent to the site and vicinity, including review of our borings drilled in the parking lot area at the base of the slope.

2. Discussions with the project geologist, Erik Zinn.

3. Exploration of subsurface conditions consisting of logging and sampling of three (3) exploratory borings drilled at the top of the slope to depths of 33 and 40 feet. We also reviewed ten (10) borings drilled by our firm in the parking area at the base of the slope in 2018. The borings were co-logged by the project geologist.

4. Laboratory testing to evaluate the engineering properties of the subsoils.

5. Computerized stability analyses to evaluate the stability of the cut slope.

6. Preparation of this report presenting the results of our study.

Project Location and Description

The project area is located at 900 High Street in Santa Cruz, California, Figure 1. The 5.9-acre site is located on the upslope side of High Street on a moderate slope. The site is developed with a church that includes several buildings, parking areas and driveways. The site has been extensively graded for the existing improvements. The upper parking area of the church is a flat bench that was mostly cut into the hillside. The cut slope above the parking lot is about 25 to 30 feet high and inclined around 60 percent with localized areas that slope between 35 and 70 percent.

The purpose of our investigation was to perform a stability analysis of the cut slope above the upper parking area.

Field Investigation

Subsurface conditions in the parking area at the base of the slope were explored on 7 May 2018 with ten (10) exploratory borings. These preliminary borings were drilled to determine the depth to marble and to determine if dolines existed in the marble below the proposed building. Two of these borings are included with this report because they were used by the project geologist in developing the geologic cross sections for our stability analysis.

Subsurface conditions at the top of the slope were explored on February 11, 2022 with three (3) exploratory borings drilled 33 and 40 feet below grade. Our borings were advanced with 6-inch diameter tractor mounted drilling equipment. The approximate locations of our exploratory borings are indicated on our Boring Site Plan, Figure 2.

Representative soil samples were obtained from the exploratory borings at selected depths, or at major strata changes. These samples were recovered using the 3.0-inch O.D. Modified California Sampler (L) or the Standard Terzaghi Sampler (T). The penetration resistance blow counts for the (L) and (T) noted on the boring logs were obtained as the sampler was dynamically driven into the in-situ soil. The process was performed by dropping a 140-pound hammer a 30-inch free fall distance and driving the sampler 6 to 18 inches and recording the number of blows for each 6-inch penetration interval. The blows recorded on the boring logs present the accumulated number of blows that were required to drive the last 12 inches. The blow counts indicated on the logs have been converted to equivalent standard penetration test (SPT) values.

The soils observed in the test borings were logged in the field and described in accordance with the Unified Soil Classification System (ASTM D2487 and ASTM D2488), Figure 3. The Test Boring Logs, Figures 4 to 8, denote subsurface conditions at the locations and times observed, and it is not warranted they are representative of subsurface conditions at other locations or times.

Laboratory Testing

The laboratory testing program was directed toward a determination of the physical and engineering properties of the soils underlying the site. Moisture content and dry density tests were performed on representative undisturbed soil samples to determine the consistency of the soil and the moisture variation throughout the explored soil profile. Direct shear tests were performed to determine the strength characteristics of the soil. The results of our field and laboratory testing appear on the "Test Boring Logs", opposite the sample tested.

Subsurface Soil Conditions

The site is mapped as being primarily underlain by Marble with Coastal Terrace Deposits mapped nearby. Our borings indicate the entire cut slope is comprised of marine terrace deposits. Marble lies below the terrace deposits at an elevation that is roughly 5 to 10 feet below the elevation of the parking area at the base of the slope.

The terrace deposits generally consisted of clayey sand with sandy clay in the upper few feet. The lower part of the slope is comprised of fine sand with clay at the far west end of the slope. The soils were medium dense.

Groundwater

No groundwater was encountered in our borings. The soils are well draining and the underlying marble is highly fractured, so a developed groundwater table is not anticipated to develop within the slope. The boring logs denote groundwater conditions at the locations and times observed, and it is not warranted they are representative of groundwater conditions at other locations and times. Groundwater levels at the site may vary due to seasonal variations and other factors not evident during our investigation.

Seismicity

The site is located in a highly seismic region near several major fault zones. The cut slope will most likely experience strong seismic shaking during its lifetime. The OHSPD Seismic Design Calculator indicates peak ground accelerations at the site will be on the order of 0.75 g for the design earthquake.

Liquefaction

Liquefaction occurs when saturated fine grained sands, silts and sensitive clays are subject to shaking during an earthquake and the water pressure within the pores build up leading to loss of strength. There is a low potential for liquefaction to develop on or beneath the slope due to the lack of groundwater.

Slope Stability Analysis

The slope was analyzed using the computer program STABL for Windows, Version 2.0, developed by Geotechnical Software Solutions, LLC. STABL is a computer program for analysis of slopes by limit equilibrium methods.

Three geologic cross sections were provided to us by the project geologist. The slope was modeled using the tallest, steepest section located above the proposed apartment building, which was Section C. See Figure 3.

Soil strengths for the terrace deposits were determined from in-situ direct shear tests performed in the laboratory. The strength of the marble was estimated. The maximum considered peak ground acceleration of 0.75g was factored using reductions presented in the Recommended Procedures for Implementation of DMG Special Publication 117. This value was further factored to account for the relationship between slide depth and slope height. A seismic coefficient (Ky) of 0.4 g was used for our seismic analyses.

Our analyses indicate the slope has a static (non-seismic) factor-of-safety of 4.7 and a seismic factor-of-safety of 2.2, both of which are well above the minimum factor-of-safety indicating a stable slope.

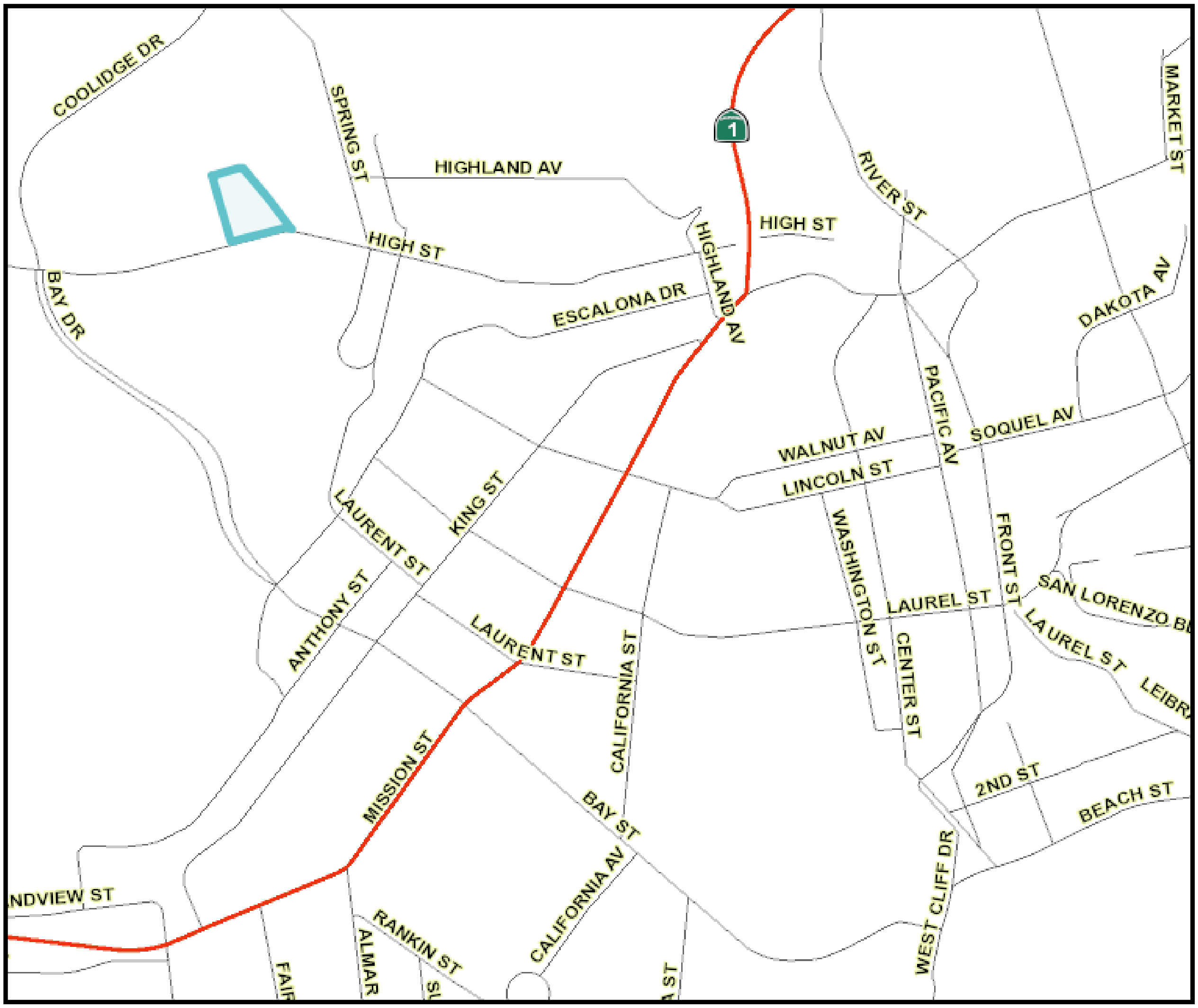
Graphical representations of our slope stability analyses are included on Figures 9 and 10, attached.

Very truly yours,

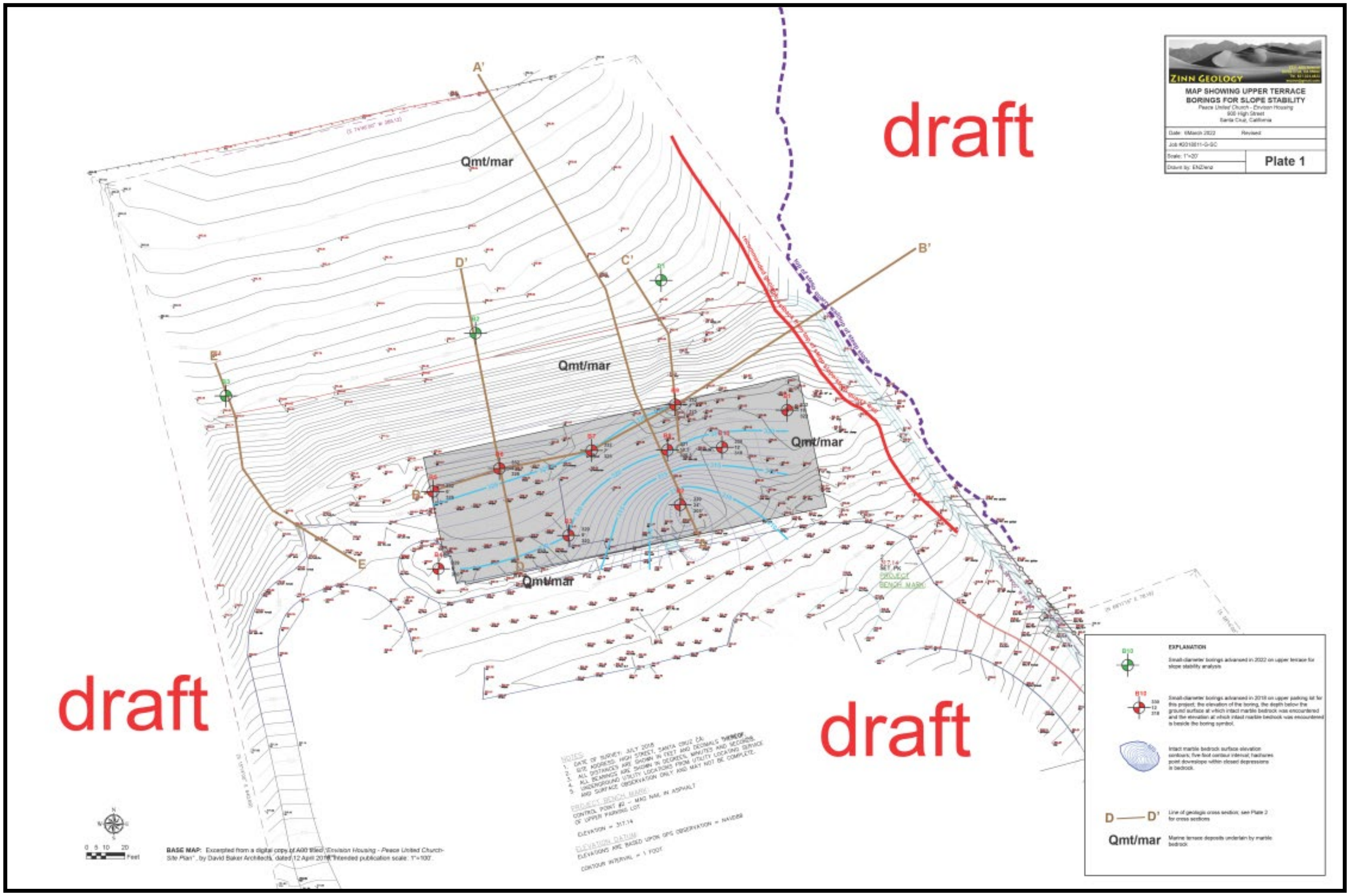
DEES & ASSOCIATES

Rebecca L. Dees
Geotechnical Engineer
G.E. 2623

Attachments
Copies: 1 to Addressee
1 to Zinn Geology



SITE VICINITY MAP
Figure 1



BORING SITE PLAN
Figure 2

THE UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES	CLASSIFICATION CRITERIA	
COARSE-GRAINED SOILS* MORE THAN HALF OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE (THE NO. 200 SIEVE SIZE IS ABOUT THE SMALLEST PARTICLE VISIBLE TO THE NAKED EYE)	**GRAVELS** MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELS (< 5% FINES)	**GW**	Well-graded gravels, gravel-sand mixtures, little or no fines	Wide range in grain sizes and substantial amounts of all intermediate particle sizes	
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines	Predominantly one size or a range of sizes with some intermediate sizes missing Not meeting all gradation requirements for GW	
		GRAVELS WITH FINES (>12% FINES)	**GM**	Silty gravels, gravel-sand-silt mixtures	Non plastic fines or fines with low plasticity Atterberg limits below "A" line or PI < 4	Above "A" line with 4 < PI < 7 are borderline cases requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures	Plastic fines Atterberg limits above "A" line with PI > 7	
	SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDS (<5% FINES)	**SW**	Well-graded sands, gravelly sands, little or no fines	Wide range in grain sizes and substantial amounts of all intermediate sizes missing	
			SP	Poorly graded sands, gravelly sands, little or no fines	Predominantly one size or a range of sizes with some intermediate sizes missing Not meeting all gradation requirements for SW	
		SANDS WITH FINES (>12% FINES)	**SM**	Silty sands, sand-silt mixtures	Non plastic fines or fines with low plasticity Atterberg limits below "A" line or PI < 4	Limits plotting in hatched zone with 4 < PI < 7 are borderline cases requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures	Plastic fines Atterberg limits above "A" line with PI > 7	
FINE-GRAINED SOILS MORE THAN HALF OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE (THE NO. 200 SIEVE SIZE IS ABOUT THE SMALLEST PARTICLE VISIBLE TO THE NAKED EYE)	SILTS AND CLAYS (LIQUID LIMIT < 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 > 50)		**MH**	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts		
			CH	Inorganic clays of medium to high plasticity, organic silts		
			OH	Organic clays of medium to high plasticity, organic silts		

*Gravels and sands with 5% to 12 % fines are borderline cases requiring use of dual symbols.

RELATIVE DENSITY OF SANDS AND GRAVELS

DESCRIPTION	BLOW / FT**
VERY LOOSE	0 – 4
LOOSE	4 – 10
MEDIUM DENSE	10 – 30
DENSE	30 – 50
VERY DENSE	OVER 50

CONSISTENCY OF SILTS AND CLAYS

DESCRIPTION	BLOWS / FT**
VERY SOFT	0 – 2
SOFT	2 – 4
FIRM	4 – 8
STIFF	8 – 16
VERY STIFF	16 – 32
HARD	OVER 32

**Number of blows of 140 pound hammer falling 30 inches to drive a 2 inch O.D. 12 vertical inches.

Figure 3

TEST BORING LOG

SCR-1222.1
700 High Street

LOGGED BY: SC	DATE DRILLED: 2/11/22	BORING TYPE: 6" SOLID STEM	BORING NO:1

DEPTH (feet)	SAMPLE NO.	SOIL DESCRIPTION	USCS SOIL TYPE	FIELD BLOW COUNT	SPT BLOW COUNT*	DRY DENSITY (PCF)	MOISTURE (%) IN-SITU	MOISTURE (%) SATURATED	COHESION (PSF)	PHI ANGLE	% PASSING 200 SIEVE	PLASTICITY INDEX
-												
1				5								
-	1-1-1	Dark brown Sandy CLAY, moist, reddish mottling	CL	7								
2	L			12	10							
-		Reddish-brown Clayey SAND/gray Sandy CLAY, moist, medium dense, mottled	CL/	4								
3	1-2		SC	5								
-	T			6	11							
4												
-				6								
5				9								
-	1-3-1	Reddish-brown Clayey SAND with seams of gray Clay, moist, medium dense, some small Gravel		12	11							
6	L			4								
-				6								
7	1-4	Reddish-brown Clayey SAND with seams of gray CLAY, moist, medium dense, iron oxide nodules, rootlets		8	14		22.3					
-	T											
8												
-												
9												
-												
10				12								
-	1-5	Mottled yellowish-brown/pale brown Clayey SAND, dry/damp, dense, trace rootlets	SC	15								
11	T			20	35		10.7					
-												
12												
-												
13												
-												
14												
-												
15				7								
-	1-6	White fine SAND with seam of Clay around root, dry, medium dense, yellowish-brown mottling	SP	9								
16	T			12	21							
-												
17												
-												
18												
-												
19												
-												
20												
-	1-7-1	Pale brown fine SAND, dry- damp, medium dense, mottled strong brown		17								
21	L			20								
-				22	21							
22	1-8	White fine SAND, dry, dense, mottled strong brown		12								
-	T			19								
23				30	49		8.5					
-												
24												
-												

DEES & ASSOCIATES, INC.
501 MISSION ST. STE. 8A | SANTA CRUZ, CA 95060
www.deesgeo.com | (831) 427-1770

Figure 4

* Blow count converted:
L = Field Blow Count / 2
M = Field Blow Count / 1.5

TEST BORING LOG

SCR-1222.1
700 High Street

LOGGED BY: SC	DATE DRILLED: 2/11/22	BORING TYPE: 6" SOLID STEM	BORING NO:1 con't.

DEPTH (feet)	SAMPLE NO.	SOIL DESCRIPTION	USCS SOIL TYPE	FIELD BLOW COUNT	SPT BLOW COUNT*	DRY DENSITY (PCF)	MOISTURE (%) IN-SITU	MOISTURE (%) SATURATED	COHESION (PSF)	PHI ANGLE	% PASSING 200 SIEVE	PLASTICITY INDEX
25	1-9 T	White fine SAND, damp, very dense	SP	12 20 32	52							
26–29			SP									
31	1-10 T	Yellow fine SAND, damp, small patch of brown Clay around root, some small sub-round Gravels, very dense		15 24 34	58							
32		Doline Infill										
35			SP/ SC									
36	1-11 T	Brown and reddish-brown SAND and Clayey SAND, damp, very loose		5 2 3	5		8.6					
37	1-12 T	Brown and reddish-brown SAND and Clayey SAND, damp, very loose (mixture of Granite Gravel, shist fragment, Sand and Clayey Sand) Rocky drilling below 38 feet Marble Rubble No recovery, white marble powder from grinding		1 2 3	5							
40		Boring Terminated at 40 Feet No Groundwater Encountered										
41–48												

DEES & ASSOCIATES, INC.
501 MISSION ST. STE. 8A | SANTA CRUZ, CA 95060
www.deesgeo.com | (831) 427-1770

Figure 4a

* Blow count converted:
L = Field Blow Count / 2
M = Field Blow Count / 1.5

TEST BORING LOG

SCR-1222.1
700 High Street

LOGGED BY: SC | **DATE DRILLED: 2/11/22** | **BORING TYPE: 6" SOLID STEM** | **BORING NO:2**

DEPTH (feet)	SAMPLE NO.		SOIL DESCRIPTION	USCS SOIL TYPE	FIELD BLOW COUNT	SPT BLOW COUNT*	DRY DENSITY (PCF)	MOISTURE (%) IN-SITU		COHESION (PSF)	PHI ANGLE	% PASSING 200 SIEVE	PLASTICITY INDEX
-													
1													
-													
2													
-													
3													
-													
4													
-													
5					4								
-	2-1		Yellowish-brown Clayey SAND, damp, medium dense, strong	SC	5								
6	T		brown mottling		8	13							
-													
7													
-													
8													
-													
9													
-													
10					9								
-	2-2-1		Yellowish-brown Clayey SAND, damp, medium dense, gray		10								
11	L		mottling		12	11	96.9	17.3					
-													
12													
-			Gradational change with depth										
13													
-													
14													
-													
15					7								
-	2-3-1		Yellowish-brown Clayey SAND, damp, loose, trace roots and		7								
16	L		some coarse SAND		9	8	107.4	14.0		1648.4	51.7		
-													
17													
-													
18			Gradational change										
-													
19													
-													
20					4								
-	2-4		Yellowish-brown Clayey SAND, damp, loose		3								
21	T		White fine SAND, damp, mottled yellowish-brown		4	7							
-			Gradational change near base										
22													
-													
23													
-													
24													
-													

DEES & ASSOCIATES, INC.
501 MISSION ST. STE. 8A | SANTA CRUZ, CA 95060
www.deesgeo.com | (831) 427-1770

Figure 5

* Blow count converted:
L = Field Blow Count / 2
M = Field Blow Count / 1.5

TEST BORING LOG

SCR-1222.1
700 High Street

LOGGED BY: SC	DATE DRILLED: 2/11/22	BORING TYPE: 6" SOLID STEM	BORING NO:2

DEPTH (feet)	SAMPLE NO.		SOIL DESCRIPTION	USCS SOIL TYPE	FIELD BLOW COUNT	SPT BLOW COUNT*	DRY DENSITY (PCF)	MOISTURE (%) IN-SITU		COHESION (PSF)	PHI ANGLE	% PASSING 200 SIEVE	PLASTICITY INDEX
-													
25					8								
-	2-5-1		Doline Infill??		8								
26	L		Yellowish-brown/white Clayey fine SAND (fractured) damp,		9	9	97.3	10.6		1522.6	40.6		
-			loose, mottled										
27													
-													
28													
-													
29													
-													
30					7								
-	2-6-1		Variegated yellowish-brown and pale brown Clayey very fine		13								
31	L		SAND, with schist and Granite Gravel, roots, damp, loose		11	12							
-					7								
32	2-7		Variegated white, yellowish-brown Clayey (granitic) SAND and		5								
-	T		Gravel, damp, loose, black manganese oxide mottling		3	8							
33													
-			Doline Infill										
34													
-			Marble rubble										
35													
-													
36													
-													
37													
-													
38													
-													
39													
-													
40													
-													
41			Boring Terminated at 40 Feet										
-			No Groundwater Encountered										
42													
-													
43													
-													
44													
-													
45													
-													
46													
-													
47													
-													
48													
-													

DEES & ASSOCIATES, INC.
501 MISSION ST. STE. 8A | SANTA CRUZ, CA 95060
www.deesgeo.com | (831) 427-1770

Figure 5a

* Blow count converted:
L = Field Blow Count / 2
M = Field Blow Count / 1.5

TEST BORING LOG

SCR-1222.1
700 High Street

LOGGED BY: SC	DATE DRILLED: 2/11/22	BORING TYPE: 6" SOLID STEM	BORING NO: 3

DEPTH (feet)	SAMPLE NO.	SOIL DESCRIPTION	USCS SOIL TYPE	FIELD BLOW COUNT	SPT BLOW COUNT*	DRY DENSITY (PCF)	MOISTURE (%) IN-SITU	MOISTURE (%) SATURATED	COHESION (PSF)	PHI ANGLE	% PASSING 200 SIEVE	PLASTICITY INDEX
1 - 2	3-1-1 L	Gray and reddish-brown Sandy CLAY, moist, stiff	CL	3 6 7	7							
3 - 4		Decreasing Clay Content										
5 - 6	3-2-1 L	Reddish-brown Clayey SAND with pocket/seams of gray Sandy CLAY, moist, medium dense	SC	6 12 19	16							
7		Increasing Sand Content										
8												
9		Gradational change										
10 - 11	3-3-1 L	Brown minimal Clayey fine SAND, damp, dense, mottled light gray	SC	15 27 41	34							
12												
13												
14												
15 - 16	3-4-1 L	Brown minimal Clayey fine SAND, damp, medium dense, some reddish-brown mottling	SC	21 26 26	26							
17												
18												
19												
20 - 21	3-5-1 L	Yellowish-brown very fine SAND, damp, medium dense, slight strong brown mottling	SP	17 28 26	27							
22												
23												
24												

DEES & ASSOCIATES, INC. 501 MISSION ST. STE. 8A | SANTA CRUZ, CA 95060 www.deesgeo.com | (831) 427-1770	**Figure 6**	* Blow count converted: L = Field Blow Count / 2 M = Field Blow Count / 1.5

TEST BORING LOG

SCR-1222.1
700 High Street

LOGGED BY: SC	DATE DRILLED: 2/11/22	BORING TYPE: 6" SOLID STEM	BORING NO: 3

DEPTH (feet)	SAMPLE NO.		SOIL DESCRIPTION	USCS SOIL TYPE	FIELD BLOW COUNT	SPT BLOW COUNT*	DRY DENSITY (PCF)	MOISTURE (%) IN-SITU	MOISTURE (%) SATURATED	COHESION (PSF)	PHI ANGLE	% PASSING 200 SIEVE	PLASTICITY INDEX
25 – 26	3-6-1 L		Yellowish-brown very fine SAND, damp, medium dense	SP	32 20 30	25							
27 – 29			Dark yellowish-brown Clayey SAND with friable yellowish-brown SAND fragments (angular), damp, medium dense	SC									
30 – 31	3-7-1 L		Doline Infill Dark yellowish-brown Sandy CLAY with marble Gravel (highly angular), moist, loose	CL	10 10 13	12							
32 – 33	3-8 T		Dark yellowish-brown Sandy CLAY with more marble cobble/gravel inside sample (highly angular), moist, loose		8 15*	50+							
34 – 48			*Sampler bouncing off marble – sample abandoned during sampling Boring Terminated at 33 Feet No Groundwater Encountered										

DEES & ASSOCIATES, INC.
501 MISSION ST. STE. 8A | SANTA CRUZ, CA 95060
www.deesgeo.com | (831) 427-1770

Figure 6a

* Blow count converted:
L = Field Blow Count / 2
M = Field Blow Count / 1.5

TEST BORING LOG

SC-1212
900 High Street

LOGGED BY: BD	DATE DRILLED: 5/7/2018	BORING TYPE: 6” TRUCK CCD	BORING NO: 6

DEPTH (feet)	SAMPLE NO.	SOIL DESCRIPTION	USCS SOIL TYPE	FIELD BLOW COUNT	SPT BLOW COUNT*	DRY DENSITY (PCF)	MOISTURE (%) IN-SITU	MOISTURE (%) SATURATED	COHESION (PSF)	PHI ANGLE	% PASSING 200 SIEVE	PLASTICITY INDEX
1 – 2	6-1-1 L	Light yellowish brown Silty SAND damp, dense		16 30 50/6	40							
2 – 4	6-2 T	Yellowish brown Silty SAND damp, very dense		13 30 38	68							
5 – 6	6-3 T	Grayish Silty SAND, slightly damp, very dense marble at bottom		12 freefall								
7		3” in 5 min										
8 – 26		Auger Refusal at 6 Feet No Groundwater Encountered										

DEES & ASSOCIATES, INC.
501 MISSION ST. STE. 8A | SANTA CRUZ, CA 95060
www.deesgeo.com | (831) 427-1770 | Fax: (831) 427-1794

Figure 7

* Blow count converted:
L = Field Blow Count / 2
M = Field Blow Count / 1.5

TEST BORING LOG

SC-1212
900 High Street

LOGGED BY: BD	DATE DRILLED: 5/7/2018	BORING TYPE: 6" SOLID STEM	BORING NO: 9

DEPTH (feet)	SAMPLE NO.	SOIL DESCRIPTION	USCS SOIL TYPE	FIELD BLOW COUNT	SPT BLOW COUNT*	DRY DENSITY (PCF)	MOISTURE (%) IN-SITU	MOISTURE (%) SATURATED	COHESION (PSF)	PHI ANGLE	% PASSING 200 SIEVE	PLASTICITY INDEX
1	9-1-1 L	Yellow brown to dark yellow brown fine Silty SAND, damp, dense		10 12 18	30							
2–3	9-2 T	Yellow brown fine Silty SAND/Sandy SILT, damp-moist, medium dense		8 12 14	26							
5	9-3 T			10 24 19	43							
7–8		3" in 5 min										

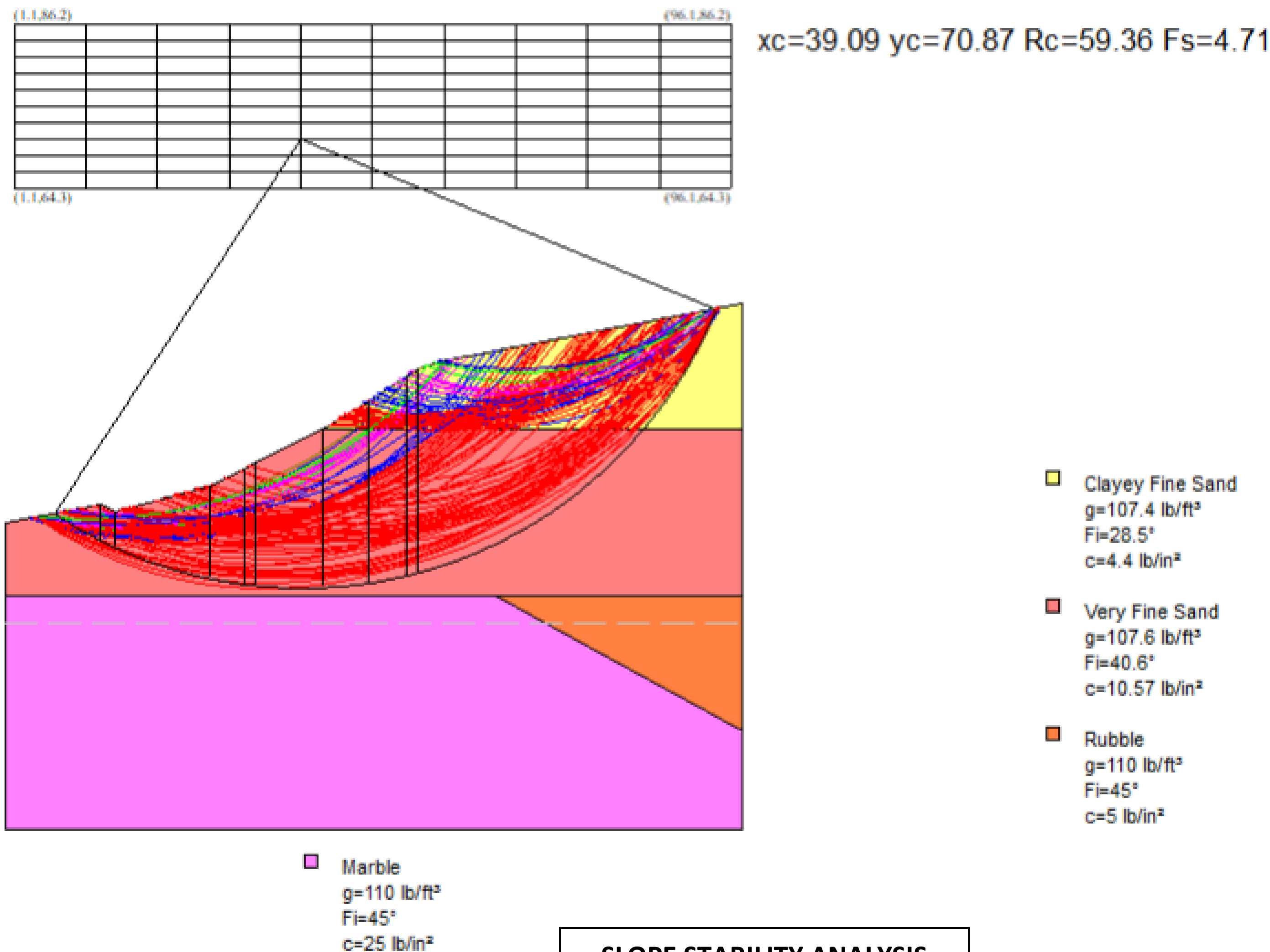
Depth scale: 1 – 26 feet

Boring Terminated at 7 Feet
No Groundwater Encountered

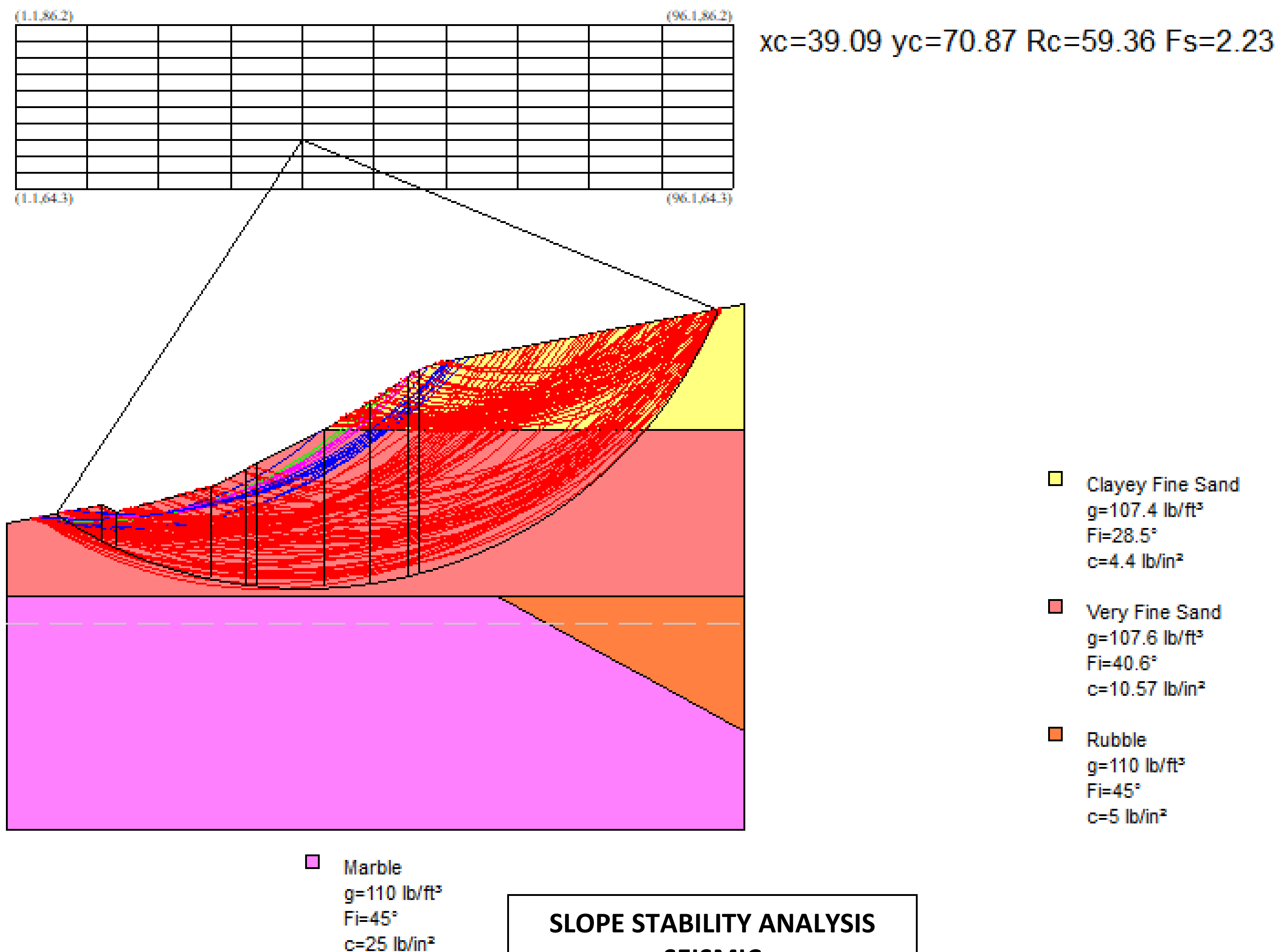
DEES & ASSOCIATES, INC.
501 MISSION ST. STE. 8A | SANTA CRUZ, CA 95060
www.deesgeo.com | (831) 427-1770 | Fax: (831) 427-1794

Figure 8

* Blow count converted:
L = Field Blow Count / 2
M = Field Blow Count / 1.5



SLOPE STABILITY ANALYSIS
STATIC
Figure 9



SLOPE STABILITY ANALYSIS
SEISMIC
Figure 10