INFORMATION HANDOUT

For Contract No. 04-3G0204
At State Route 35

Identified by
Project ID 0412000015

MATERIALS INFORMATION

Final Foundation Report for Distressed Slope Repair for Slope Failure Repair Skyline Boulevard, Bridge No. 35E0046

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

M e m o r a n d u m

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Be energy efficient!

To: MR. BRIAN MORI
Senior Bridge Engineer
Office of Bridge Design - West

Date: April 18, 2013

Attention: D. Romero

File: 04-SM-035 PM 13.1
04-3G0200
Efis# 0412000015
Slope Failure Repair
Skyline Boulevard

From: JOHN MOORE JM
Transportation Engineer
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

MAHMOOD MOMENZADEH
Chief, Branch C
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

Subject: Final Foundation Report for Distressed Slope Repair

This memo provides our final recommendations for the design and construction of a soldier beam and lagging wall to retain a slope failure located on the northbound shoulder of State Route 35, near postmile 13.1, in San Mateo County, California (refer to Figure A1 – Project Location Map).

SCOPE OF WORK

We have performed a geotechnical investigation to determine the possible causes of the slope failure, and developed a repair plan. The scope of work includes the following:

- Visual observations of the failed slope during site visits during 2012.
- Subsurface exploration consisting of one exploratory boring advanced to a depth of approximately 60-ft. on November 27th, 2012.
- Engineering analyses and preparation of the repair recommendations.

PROJECT SITE DESCRIPTION AND BACKGROUND

Site Description

The subject site is located on the northbound shoulder of State Route 35 (also known as Skyline Boulevard), postmile 13.1, San Mateo County, California.

Site History

Initially, this project was scheduled for delivery in FY 2013/2014; however, due to substantial demand for immediate repair by local residents, this project has been expedited and is scheduled for repair this year.

Site Observations

The slipout is approximately 35-feet wide by approximately 50-feet long. With respect to the hinge point created by the northbound shoulder of Route 35 and the slope, the scarp height is approximately 12-feet. The slipout is located on the northbound shoulder of Route 35 (Skyline Boulevard) at post mile 13.1 in San Mateo County and occurred sometime in the past and extends beyond Caltrans' right-of-way (ROW) and in designated Open Space. The existing slope adjacent to the slipout is between 1:1 and 1-½:1.

SITE GEOLOGY AND SEISMICITY

Geology

According to the geologic map of the area, the project is underlain by Middle and Lower Eocene aged (48.6 to 33.9 million years ago) Butano Sandstone (Brabb, Graymer, and Jones, 1998). The Butano Sandstone is a light−gray to buff, very fine− to very coarse−grained arkosic sandstone in thin to very thick beds interbedded with dark−gray to brown mudstone and shale. Conglomerate, containing boulders of granitic and metamorphic rocks and well−rounded cobbles and pebbles of quartzite and porphyry, is present locally in lower part of section. The amount of mudstone and shale varies from 10 to 40 percent of volume of formation. The unit is approximately 3,000 meters thick. The relevant portion of the map is included as Figure A-2, Geologic Map.

According to the General Soil Map of San Mateo County, the project is underlain by Alambique-McGarvey Soils. This unit is 45 percent Alambique gravelly loam and 35 percent McGarvey loam, with minor percentages of smaller, similar soils. The Alambique soil is moderately deep and well drained, forming from material weathered from soft sandstone. The McGarvey soil is moderately deep and well drained, also forming from material weathered from soft sandstone. Permeability is moderate in the Alambique and slow in the McGarvey soil. The available water capacity is low or moderate in both soils. Runoff is rapid or very rapid so the hazard for water erosion is high to very high. The McGarvey soil has a high shrink-swell potential. A relevant portion of soil map is included as Figure A-3, Soils Map.

Seismicity

The project is located in the San Francisco Bay Area, which is an active seismic region. Historic earthquakes have occurred in the region on the San Andreas Fault, in 1906 with a magnitude of 7.9 and 1989 magnitude of 6.9, and also on the Hayward Fault, 1868 with a magnitude of 6.8.

The controlling fault is the San Andreas, which has a maximum credible earthquake of 7.9. Table 1 presents the controlling fault.

The site is not in the vicinity of any Alquist Priolo earthquake fault zones; therefore, surface rupture should not be an issue.

Table 1. Predicted Maximum Credible Earthquake and Acceleration*

FAULT	DISTANCE FROM PROJECT (MILES)	MAXIMUM CREDIBLE EARTHQUAKE (MW)	PEAK GROUND ACCELERATION (g)
San Andreas	5.57	7.9	0.475

* Caltrans ARS v1.0.4

FIELD INVESTIGATION AND FINDINGS

Field Exploration and In-Situ Testing

A subsurface investigation was conducted November 27th, 2012, and consisted of one rotary wash boring. The borehole location is shown on the Log-Of-Test Boring (LOTB) sheet, which is attached to this memo. Borehole RW-12-001 was drilled to a depth of 59.5- feet. In-situ Standard Penetration Test (SPT) blow counts were recorded at 5-ft. intervals to evaluate the consistency of the on-site soils and soil samples were obtained. When rock was encountered, core samples were obtained. Selected soil/and or rock core samples were then transported to the geotechnical laboratory in Sacramento for testing.

Laboratory Testing

Selected soil samples retrieved from the boring have been tested to evaluate properties pertinent to our analyses. The types of laboratory tests performed include the following:

- Atterberg Limits (AASHTO T 89, AASHTO T 90).
- Moisture Content (AASHTO T 265, ASTM D 2216).
- Corrosion Content California Test Methods (CTM 643, CTM 442, CTM 417).
- Mechanical Analysis (ASTM D 422)
- Unconfined Compressive Strength (CTM 221).

Laboratory test results are attached to this report.

Subsurface Soil Conditions

The soil/rock encountered during the subsurface investigation, as interpreted from boring RW-12-001 consisted of loose Clayey SAND with Gravel, which was orange-brown in color and moist to a depth of 14.5-feet. Below 14.5-feet, Sandy lean CLAY, orange-brown and moist was encountered, and extends approximately to 18.5-feet below grade. Clayey SAND with Gravel is encountered again at approximately 18.5-feet below grade and extends to 24.5-feet below grade. SEDIMENTARY ROCK (Mudstone), (laminated bedding, dark brown color, moderately weathered, very intensely fractured, and moderately hard) is encountered at 24.5-feet below grade and extends to 39.5-feet below grade. SEDIMENTARY ROCK (Sandstone), (fine grained, massive bedding, light gray in color, slightly weathered, hard, slightly fractured) is encountered at 39.5-feet below grade and extends to 44.5-feet below grade. Between 44.5- and 51-feet below grade, SEDIMENTARY ROCK (Mudstone), (laminated bedding, dark brown color, moderately weathered, very intensely fractured, and moderately hard) is encountered again, followed by SEDIMENTARY ROCK (Sandstone), (fine grained, massive bedding, light gray in color, slightly weathered, hard, slightly fractured) between 51-and 59.5-feet below grade.

Please review the Log-of-Test-Boring (LOTB) sheet, which is attached to this memo.

Groundwater Conditions

Due to the Rotary Wash method being used and tight time constraints on lane closures, groundwater was not measured. We anticipate that groundwater could be encountered due to seasonal fluctuations.

GEOTECHNICAL RECOMMENDATIONS

Wall Type and Construction Method

The most viable repair strategy for this location is to construct a soldier beam and lagging wall, because of its narrow footprint and due to the close proximity of designated Open Space. Other repairs, such as rock slope protection (RSP), are not practical because of the necessity for

permits. Considering the conditions of the slopes on both sides of the current slide, a wall with an approximate length of 85-ft. would be required. This length will have to be refined in the field during slide debris removal and construction. The wall would be offset approximately 21-ft. from the roadway centerline. The soldier beam and lagging wall shall be designed for a slide plane depth of approximately 12 feet and will have a maximum retained height of 12 feet.

The wall is constructed by developing a working bench near the base of the slide, cutting back all slide debris to a cut slope no steeper than 1V:1H. Soldier beam piles will be installed in the drilled holes located as specified on the plans. The wall backfill shall conform to structural backfill in accordance with Section 19-3.03E of Caltrans' 2010 Standard Specifications.

Design Parameters

The soldier pile wall should be designed using the lateral earth pressure diagram, Figure 5.5.5.6-1 of Section 5, Retaining Walls, from the Bridge Design Specifications (August 2004). This figure is attached.

Based on the site conditions and proposed construction summarized above, we recommend the following requirements/criteria for the proposed soldier beam and lagging wall design:

- Assume a design height of 12-ft. Assuming that a slope of not steeper than 1V:4H is developed above the wall top below the roadway level.

- For lateral loads against the wall, use the following soil parameters (internal friction angle, $\phi = 30°$, cohesion, c = 0 psf, and a soil total unit weight, Υ = 125 lbs/ft.^{3}).

- Calculate passive pressure against the piles using the log spiral method with a friction angle, $\phi = 30°$, cohesion, c = 0 psf, and a unit weight (γ) of 120 lbs/ft.^{3}. For design purposes, use a minimum bench width of 5-ft. at the base of the retaining wall, followed by a 3H:1V slope.

- Because of the potential for high ground acceleration, the seismic stability of the wall should be checked. For seismic earth pressure against the wall/piles, use a constant pressure of 19H psf (rectangular pressure diagram), where H is the full design height.

Drainage

We recommend that non-woven Type B rock slope protection fabric be placed along the vertical face of the wall lagging to limit the piping of fines. No special drainage is needed since drainage is facilitated by the use of wood lagging without having any other permanent facing.

CORROSION

Corrosion testing was performed for this project. The site was determined to not be corrosive. Corrosion test results are attached to this memo.

CONSTRUCTION CONSIDERATIONS AND REQUIREMENTS

The following construction considerations and requirements should be included in the design and construction specifications for the proposed wall.

- After the "bench" has been graded the soldier piles should be installed in accordance with Section 49-4 of the most current Caltrans Standard Specifications.

- Drilling and concrete placement for soldier pile construction shall be staggered. No two adjacent holes can be open at the same time. Drilled holes for soldier piles can't be left open overnight.

- The installation of the soldier piles must be completed prior to the placement of any fill required for a construction bench behind the face of wall. No fill shall be placed on the slide area before all piles and lagging are in place.

- During the drilling operation for the proposed soldier beam piles, we believe that some caving of the drilled holes will likely occur. Thus, use of temporary casing is required. Groundwater elevations are likely to be variable at the site so the installation of soldier piles will likely require dewatering of the borehole before the concrete is placed. The current Caltrans practice for soldier beam pile construction does not allow the use of slurry. Therefore, the use of temporary casing and dewatering is required when groundwater is encountered during construction of the soldier beam pile.

- Ensure that material used for backfill conforms to the specifications listed in Section 19-3.03E, Structural Backfill, of the 2010 Caltrans Standard Specifications.

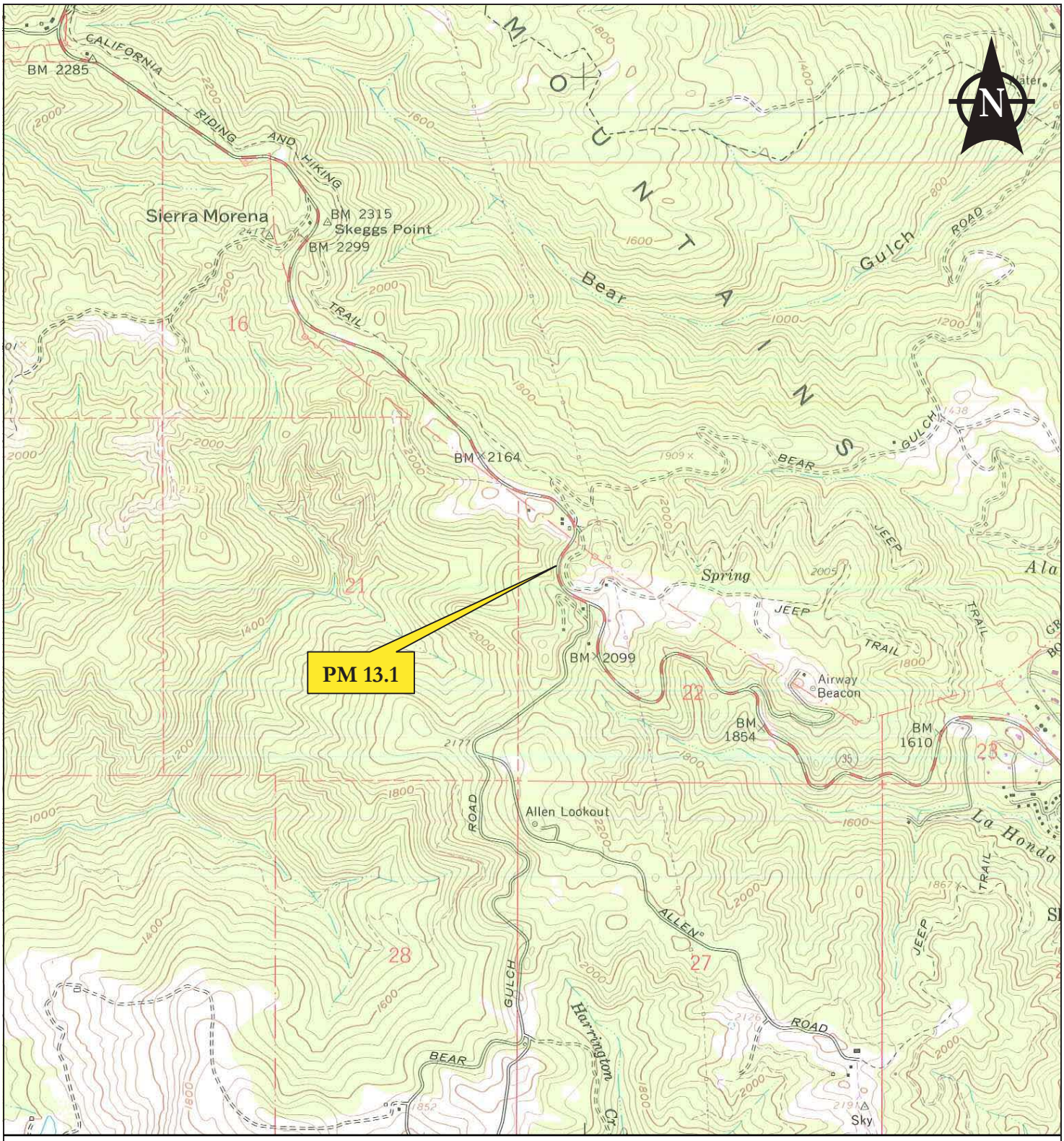
* * * * *

Should you have any questions, please call me at (510) 622-8742 or Mahmood Momenzadeh at (510) 286-5732.

Attachments:

c: TPokrywka, MMomenzadeh, SRajendra, Structures RE, Pending File, Archive.

JMoore/jm

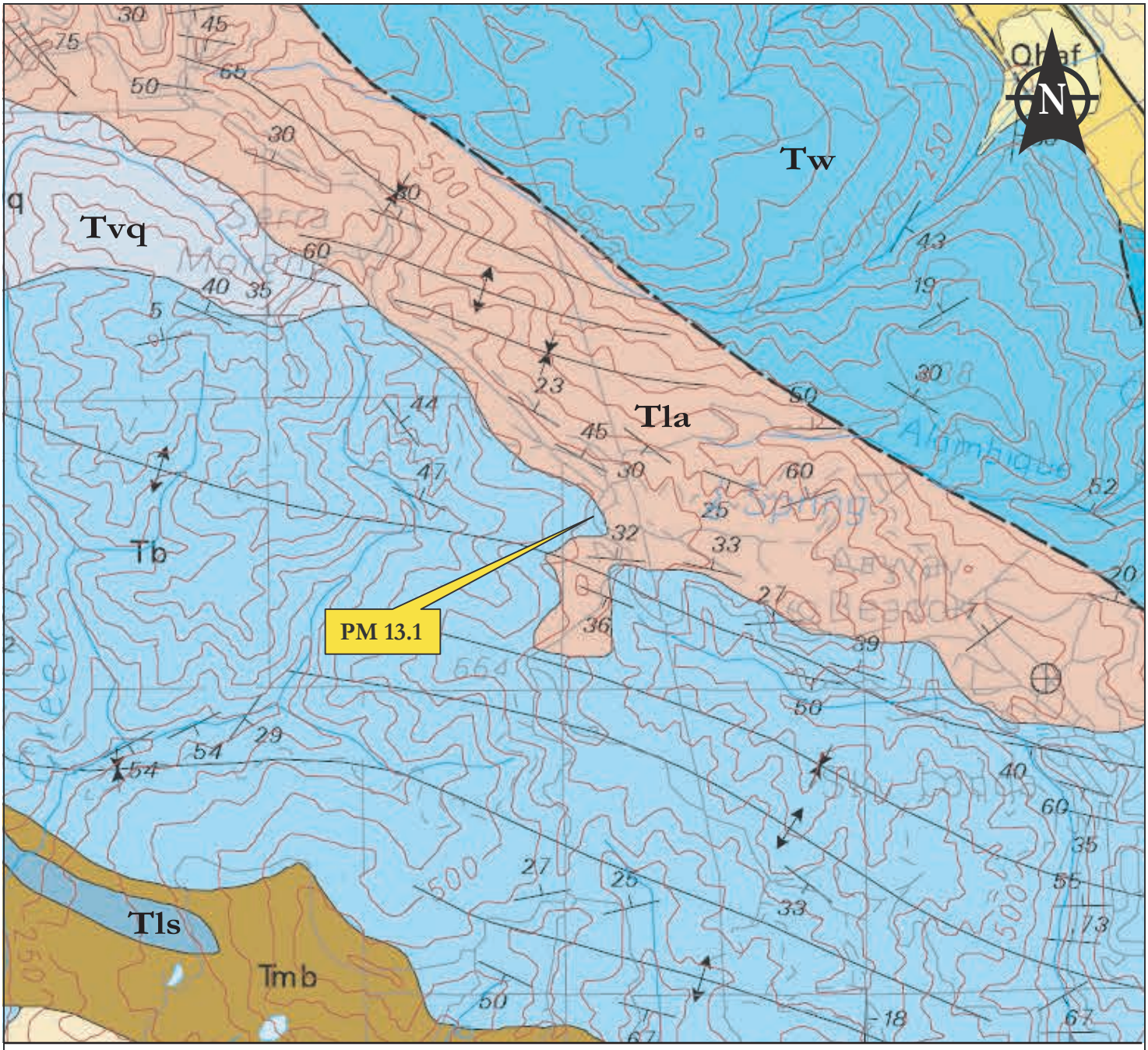


LEGEND

Base: USGS 7.5 Minute Topographic Map, Woodside Quadrangle, 1980

Scale: 1 inch = 2,000 feet

Caltrans	**LANDSLIDE REPAIR** **HIGHWAY 35, POST MILE 13.1** **SAN MATEO COUNTY, CALIFORNIA**	**VICINITY MAP**
	JANUARY 2013	**FIGURE A-1**



LEGEND

Tb Butano Sandsotone

Tls Lambert Shale and San Lorenzo

Tla Lambert Shale

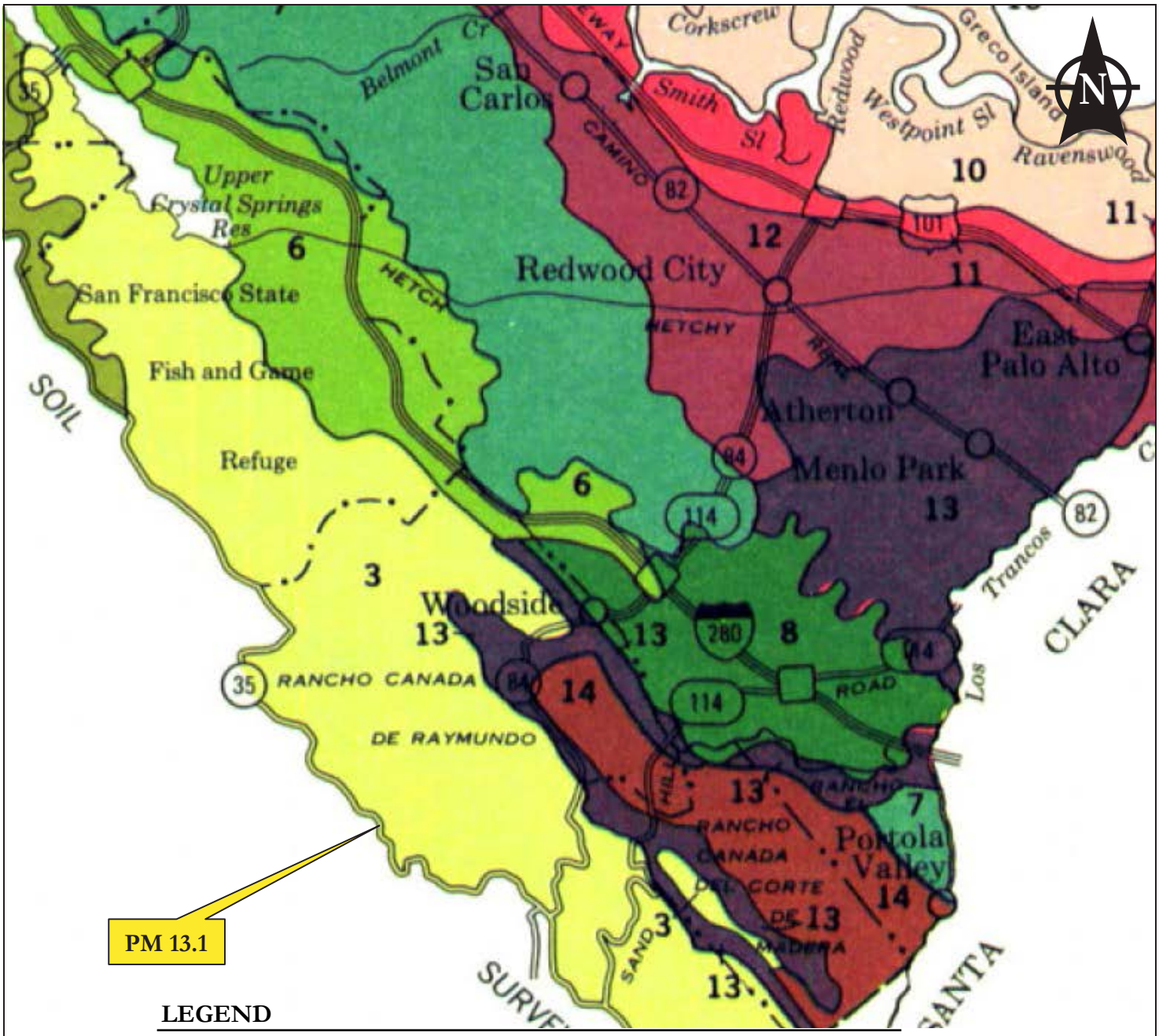
Tw Whiskey Hill Formation

Tmb Mindego Bassalt and related volcanic rocks

Base: Geology of the Onshore part of San Mateo County, California: Derived from the Digital Database Open-File 98-137 (Brabb, Graymer, and Jones, 1998)

Not to scale

Caltrans	LANDSLIDE REPAIR HIGHWAY 35, POST MILE 13.1 SAN MATEO COUNTY, CALIFORNIA	VICINITY GEOLOGIC MAP
	JANUARY 2013	FIGURE A-2



LEGEND

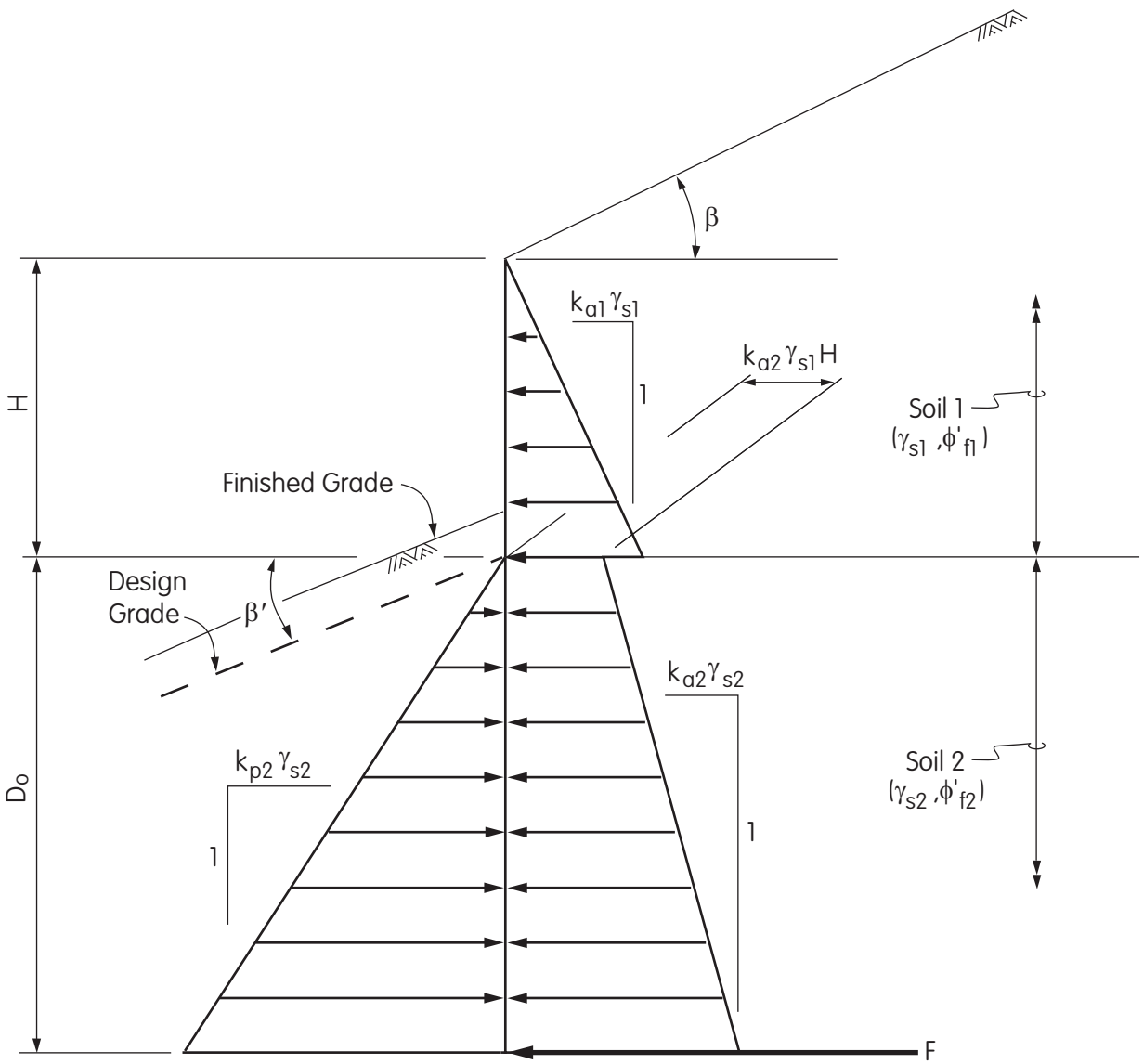
3	Alambique-McGarvey: Moderately deep, moderately steep to very steep, well drained soils underlain by sandstone; on uplands
8	Accelerator-Fagan-Urban land: Deep, gently rolling and rolling, well drained soils underlain by sandstone, shale, and siltstone, and Urban land; on uplands
13	Botella-Urban land: Very deep, nearly level and gently sloping, well drained soils, and Urban land; on alluvial fans, flood plains, and stream terraces

Base: General Soil Map of San Mateo County and Eastern Part of San Francisco, USDA 1991

Caltrans	LANDSLIDE REPAIR HIGHWAY 35, POST MILE 13.1 SAN MATEO COUNTY, CALIFORNIA	SOIL MAP
	JANUARY 2013	FIGURE A-3

For temporary walls with vertical elements embedded in granular soil or rock and retaining cohesive soil, Figures 5.5.5.6-1 and 5.5.5.6-2 may be used to determine the lateral earth pressure distributions on the embedded portion of the vertical elements and Figure 5.5.5.6-4 may be used to determine the lateral earth pressure distribution due to the retained cohesive soil.

The lateral earth pressure distributions in Figures 5.5.5.6-1 thru 5.5.5.6-4 shown acting on the embedded portion of vertical wall elements shall be applied to the effective width, b', of discrete vertical wall elements. See Article 5.7.6 for effective widths of discrete vertical wall elements to be used.



Note: The value of β′ is negative for the slope shown.

Figure 5.5.5.6-1 Simplified Lateral Earth Pressure Distributions for Permanent Non-gravity Cantilevered Walls with Vertical Wall Elements Embedded in Granular Soil and Retaining Granular Soil

DIVISION OF
ENGINEERING SERVICES
OFFICE OF GEOTECHNICAL SUPPORT
GEOTECHNICAL LABORATORY
5900 Folsom Boulevard
Sacramento, CA 95819

Date: 1/14/2013

To: John Moore / GDW

From: Lilibeth C. Purta / (916) 227-5239

RE: Laboratory Test Report -- EA: 04-3G0200
GL 12-092

Partial test results.

AASHTO R18

CALIFORNIA DEPARTMENT OF TRANSPORTATION
GEOTECHNICAL LABORATORY

GL TRACKING NO : 12-092
Dist - EA: 04-3G0200
Report Date: January 14, 2013
Page: 1/1

CLASSIFICATION TEST SUMMARY

SAMPLE ID	% FINER THAN																	ATTERBERG LIMITS		AS RECEIVED		Gs
	3"	2 1/2"	2"	1 1/2"	1"	3/4"	1/2"	3/8"	No. 4	No. 8	No. 16	No. 30	No. 50	No. 100	No. 200	5μ	1μ	LL	PI	γd (pcf)	%m	
RW-12-001_04.5'					100	93	87	85	73	69	66	63	58	49	43	24	15	32	13		18.6	
RW-12-001_09.5'						100	87	82	71	66	61	58	53	47	41	22	12	31	9		27.0	
RW-12-001_14.5'								100	97	92	83	75	68	59	52	22	11	36	14		20.8	
RW-12-001_19.5'						100	96	91	78	66	52	42	35	30	26	13	7	31	9		16.3	
RW-12-001_24.5'																						
RW-12-001_29.5'					100	95	92	84	68	57	45	37	31	28	25	12	5	29	9		17.2	
RW-12-001_39.5'						100	95	89	74	63	54	48	42	36	29	13	7	22	6		13.8	
RW-12-001_54'																						

DIVISION OF
ENGINEERING SERVICES
OFFICE OF GEOTECHNICAL SUPPORT
GEOTECHNICAL LABORATORY
5900 Folsom Boulevard
Sacramento, CA 95819

Date: 1/24/2013

To: John Moore / GDW

From: Lilibeth C. Purta / (916) 227-5239

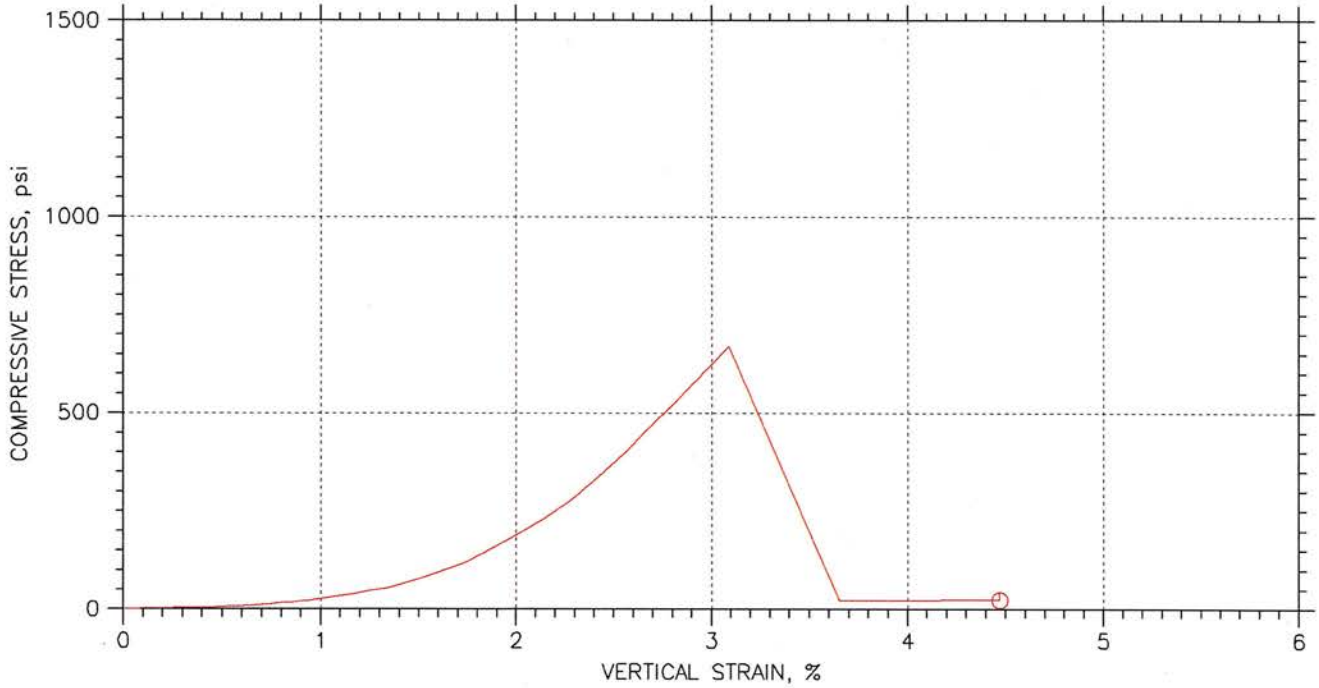
RE: Laboratory Test Report -- EA: 04-3G0200
Project: 0412000015
GL 12-092

Final test results.

Note: All remaining test specimens will be disposed of in 30 calendar days from the release date of the final test results.

AASHTO R18

UNCONFINED COMPRESSION TEST REPORT



Symbol		⏲
Test No.		Q12-362
Initial	Diameter, in	2.37
	Height, in	3.98
	Water Content, %	6.45
	Dry Density, pcf	137.9
	Saturation, %	
	Void Ratio	
Unconfined Compressive Strength, psi		670.4
Undrained Shear Strength, psi		
Time to Failure, min		
Strain Rate, %/min		1
Implied Specific Gravity		
Liquid Limit		---
Plastic Limit		---
Plasticity Index		---
Failure Sketch		

Caltrans	Project: RW-12-001-54'
	Location: 04-SM-35-13.1
	Project No.: 04-3G0200
	Boring No.: RW-12-001
	Sample No.: 54'
	Description: MOIST,GREY, SILT W/FINE SAND
	Remarks: ASTM- D2166 L/D < 2.0 WP 1/24/13

Wed, 23-JAN-2013 10:32:23

Results sent to: JOHN MOORE

Division of Engineering Services
Materials Engineering and Testing Services
Corrosion and Structural Concrete Field Investigation Branch

Report Date: 1/2/2013

Reported by Michael Mifkovic

CORROSION TEST SUMMARY REPORT - SOIL

EA

EFIS: **0412000015**

Dist/Co/Rte/PM **04 / SM /035/ / 13.1 PM**

CORROSION LAB #	TL101 #	BORE #	DEPTH (FT) START	DEPTH (FT) END	MINIMUM RESISTIVITY[1] (ohm-cm)	pH[1]	CHLORIDE CONTENT[2] (ppm)	SULFATE CONTENT[3] (ppm)	IS SAMPLE CORROSIVE?
SOIL SAMPLE FROM:									
CR20120503	C232346	RW-12-001	24.5	24.5	1499	7.56			NO

This site is not corrosive to foundation elements (see note below).

Note: For structural elements, the Department considers a site corrosive if one or more of the following conditions exist: pH is 5.5 or less, chloride concentration is 500 ppm or greater, sulfate concentration is 2000 ppm or greater. MSE backfill shall conform to the requirements of section 47-2.02C Structure Backfill in the 2010 Standard Specifications.

[1]CT 643, [2]CT 422, [3]CT 417

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	SM	35	13.1		

John C. Moore 04-09-13
REGISTERED CIVIL ENGINEER

PLANS APPROVAL DATE

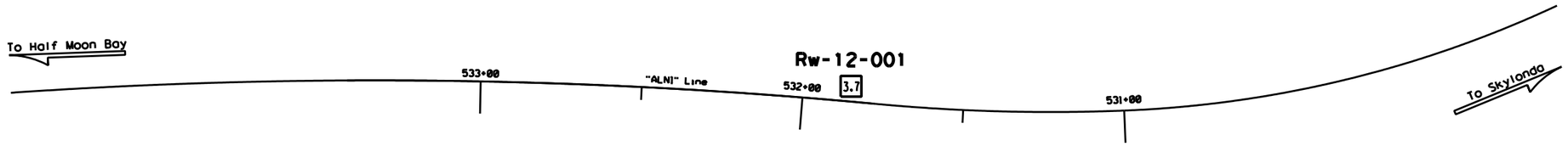
REGISTERED PROFESSIONAL ENGINEER John C. Moore NO. C61792 EXP. 6-30-13 CIVIL STATE OF CALIFORNIA

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet.

This LOTB sheet was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, & Presentation Manual (2010 Edition).

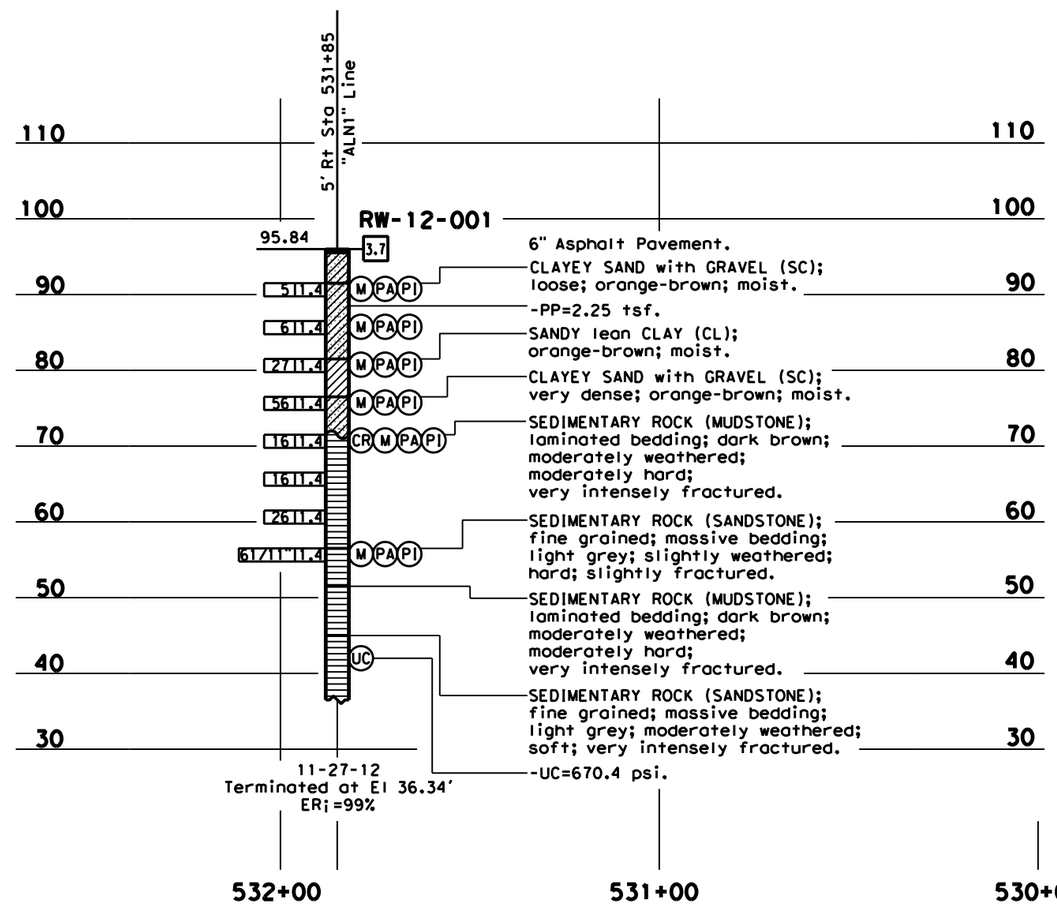
BENCH MARK

Location of boring is based on GPS coordinates.



PLAN

1"=20'



PROFILE

HOR. 1"=20'
VER. 1"=10'

ENGINEERING SERVICES		GEOTECHNICAL SERVICES	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES OFFICE OF GEOTECHNICAL DESIGN BRANCH	BRIDGE NO. / POST MILES 13.1	RETAINING WALL LOG OF TEST BORINGS 1 OF 1
FUNCTIONAL SUPERVISOR	DRAWN BY: M. Reynolds 03/13	FIELD INVESTIGATION BY: J. Moore				
NAME: M. Momenzadeh	CHECKED BY: D. Nesbitt					

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS 0 1 2 3

UNIT: 3660
PROJECT NUMBER & PHASE: 04120000151 CONTRACT NO.: 04-3g0200

DISREGARD PRINTS BEARING EARLIER REVISION DATES → REVISION DATES SHEET OF

USERNAME => $USER DATE PLOTTED => $DATE TIME PLOTTED => $TIME

FILE => $REQUEST

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