SOILS ENGINEERING REPORT
LA PANZA ROAD WIDENING
CRESTON AREA
SAN LUIS OBISPO COUNTY, CALIFORNIA

PROJECT SL07791-1

Prepared for

San Luis Obispo County
Department of Public Works
1050 Monterey Street, Room 207
San Luis Obispo, California 93408

Prepared by

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August 17, 2011

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August 17, 2011
Project No. SL07791-1

Attn: Michelle Matson, PE
San Luis Obispo County
Department of Public Works
1050 Monterey Street, Room 207
San Luis Obispo, California 93408

Subject: **Soils Engineering Report**
La Panza Road Widening
1.7 miles SE of State Route 41 to 3.1 miles SE of State Route 41
Creston Area, San Luis Obispo County, California

Dear Ms. Matson:

GeoSolutions, Inc. has prepared this soils engineering report for the design of the proposed widening of La Panza Road, 1.7 miles SE of State Route 41 to 3.1 miles SE of State Route 41, Creston area of San Luis Obispo County, California. This report characterizes the soil conditions at the site to provide the enclosed geotechnical recommendations for design. The results of the slope stability analysis indicate that the proposed 1.5:1 (horizontal: vertical) slope configuration for the drainage ditch is adequate

Thank you for the opportunity to have been of service in preparing this report. If you have any questions or require additional assistance, please feel free to contact the undersigned at (805) 543-8539.

Sincerely,
GeoSolutions, Inc.

REGISTERED PROFESSIONAL ENGINEER
KRAIG ROBERT CROZIER
No. C61361
EXP. 6/30/13
CIVIL
STATE OF CALIFORNIA

Kraig R. Crozier, PE
Principal, C61361

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SAN LUIS OBISPO COUNTY, CALIFORNIA

PROJECT SL07791-1

1.0 INTRODUCTION

This report presents the results of the geotechnical investigation for the proposed widening of La Panza Road from 1.7 miles southeast of State Route 41 to 3.1 miles southeast of State Route 41, in the Creston area of San Luis Obispo County, California. See Figure 1: Site Location Map for the general location of the project area. Figure 1: Site Location Map was obtained from the computer program *Topo USA 6.0* (DeLorme, 2006).

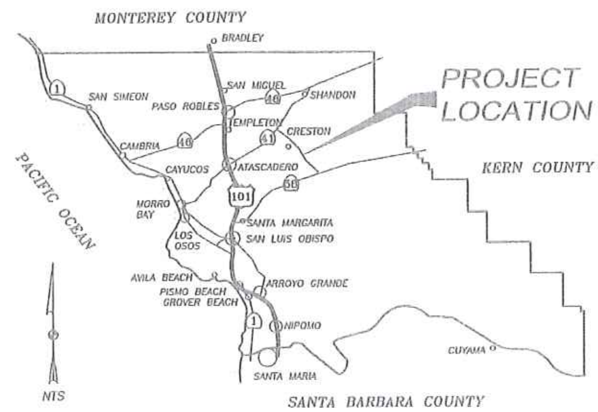

Figure 1: Site Location Map

The subject section of La Panza Road is located between the intersection with Ryan Road (approx. Station 419+00) and the intersection with Hord Valley Road (approx. Station 349+00). This segment of the roadway is relatively flat with an overall elevation drop to the south of approximately 60 feet. The subject section of roadway will hereafter be referred to as the "Site." See Figure 2: Site Plan for the general layout of the Site. Figure 2: Site Plan was obtained from the County of San Luis Obispo Public Works Department

It is our understanding that the road widening project will include; widening of sections of La Panza Road to accommodate flatter slopes along the edge of the roadway, replacement of existing driveway culverts and construction of new pavement structural sections.

2.0 PURPOSE AND SCOPE

The purpose of this study was to explore and evaluate the surface and sub-surface soil conditions at the Site and to develop geotechnical information and design criteria. The scope of this study includes the following items:

1. A field study consisting of site reconnaissance and field sampling program in order to formulate a description of the near-surface soil conditions at the Site.

2. Laboratory testing performed on representative soil samples that were collected during our field study, including testing for soil resistivity and the presence of asbestos.

3. Engineering analysis of the data gathered during our literature review, field study, and laboratory testing.

4. Development of recommendations for site preparation and grading as well as geotechnical design criteria for graded slopes, pavement sections and drainage facilities.

3.0 FIELD AND LABORATORY INVESTIGATION

The field investigation was conducted on July 6, 2011 using hand-sampling equipment. Bulk soil samples were obtained at multiple locations along La Panza Road. Data gathered during the field investigation suggest that the soil materials at the Site consist of varying shades of yellowish and grayish brown clayey SAND (SC) and sandy CLAY (CL) soils, encountered in a slightly moist to dry and medium dense/stiff to dense/very stiff conditions. The soil types encountered were representative of alluvial materials.

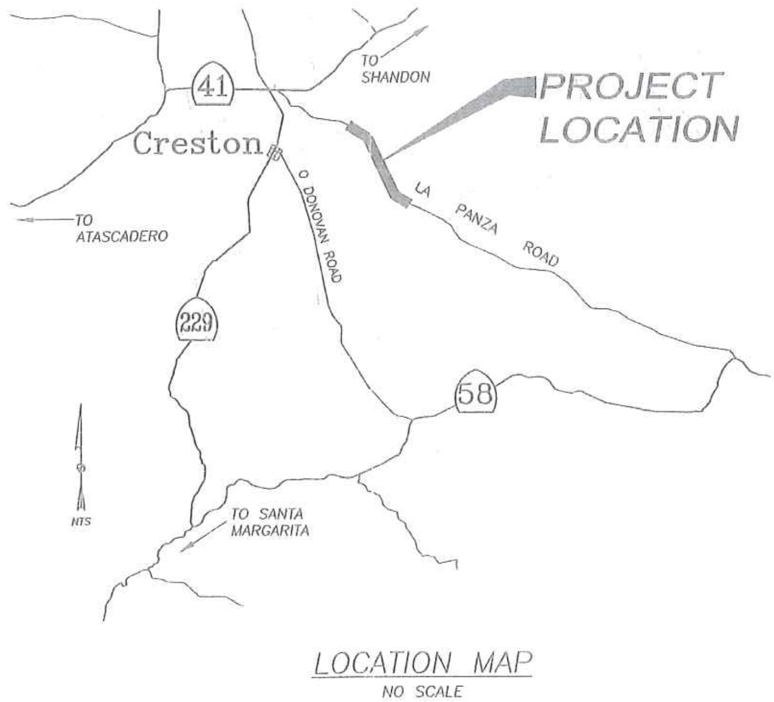

Figure 2: Site Plan

During the field investigation the soils encountered were continuously examined, visually classified, and sampled for general laboratory testing. Laboratory tests were performed on soil samples that were obtained from the Site during the field investigation. The results of these tests are listed below in Table 1: Engineering Properties. Laboratory data reports and detailed explanations of the laboratory tests performed during this investigation are provided in **Appendix A**.

Table 1: Engineering Properties

Sample Name and Location	Sample Description	USCS Specification	Expansion Index	Expansion Potential	Maximum Dry Density, γ_d (pcf)	Optimum Moisture (%)	Angle of Internal Friction, ϕ (deg.)	Cohesion, c (psf)	R-Value
A Station 355+00	Brown Clayey SAND	SC	-	-	-	-	-	-	13
B Station 353+00	Light Yellowish Brown Sandy CLAY	CL	43	Low	109.6	14.9	22	402	-
C Station 376+50	Dark Grayish Brown Clayey SAND	SC	3	Very Low	115.8	12.4	33	187	-
E Station 421+00	Dark Brown Clayey SAND	SC	-	-	-	-	-	-	19
F Station 423+00	Dark Grayish Brown Clayey SAND	SC	0	Very Low	114.6	12.3	30	306	-

4.0 GENERAL SOIL DISCUSSION

4.1 Asbestos Testing

Representative composite samples of soil taken during the field investigation were tested for the presence of naturally occurring asbestos in accordance with the Air Resources Board Method 435. Test results are presented below in Table 2: Asbestos Testing Results, results indicate that no asbestos was detected in the soil samples from the roadway widening area.

Table 2: Asbestos Testing Results

Sample Location	Sample Description	Asbestos Type(s) Detected
Station 348+00 to 356+50	Brown Soil	None Detected
Station 356+50 to 366+00	Brown Soil	None Detected
Station 366+00 to 380+00	Brown Soil	None Detected
Station 380+00 to 404+00	Brown Soil	None Detected
Station 404+00 to 425+00	Brown Soil	None Detected

4.2 Soil Corrosivity Testing

Representative bulk samples of soil taken during the field investigation were tested for chlorides, sulfates, pH, redox potential and analyzed for corrosion potential. The results are presented below in Table 3: Corrosivity Test Results. The results indicate that all samples are classified as "moderately corrosive." All buried iron, steel, cast iron, ductile iron, galvanized steel and dielectric coated steel or iron should be protected against corrosion depending on the critical nature of the structure. All buried metallic pressure piping such as ductile iron firewater pipelines should be protected against corrosion.

Table 3: Corrosivity Test Results

Sample Name and Location	Sample Description	USCS Specification	Redox (mV)	pH	Chloride (mg/kg)	Sulfate (mg/kg)
B-Station 353+00	Light Yellowish Brown Sandy CLAY	CL	460	8.3	N.D.	41
C-Station 376+50	Dark Grayish Brown Clayey SAND	SC	450	8.2	N.D.	N.D.
D-Station 391+00	Dark Brown Clayey SAND	SC	460	8.1	N.D.	N.D.
E-Station 421+00	Dark Brown Clayey SAND	SC	450	8.0	N.D.	N.D.
F-Station 423+00	Dark Grayish Brown Clayey SAND	SC	450	8.3	N.D.	N.D.

The chloride ion concentrations reflect none detected with a detection limit of 15 mg/kg. The sulfate ion concentrations ranged from none detected to 41 mg/kg and are determined to be insufficient to damage reinforced concrete structures and cement mortar-coated steel at these locations. The pH of the soils ranged from 8.0 to 8.3, which does not present corrosion problems for steel, mortar-coated steel and reinforced concrete structures. The redox potentials ranged from 450 to 460-mV, which are indicative of aerobic soil conditions.

5.0 SLOPE STABILITY

Based on the proposed cut slopes shown on the project plan, a slope stability analysis was performed to determine the stability of the 1.5 to 1.0 (Horizontal to Vertical) cut slopes along the edge of the roadway alignment. Typically slopes steeper than 2 to 1 require additional analysis to determine long term stability. Our analysis was performed utilizing soil properties determined during laboratory testing on representative soil samples and the maximum proposed cut slope configuration from the project plans of approximately 5 vertical feet.

5.1 Numerical Slope Stability Analysis – Rotational Analysis

Table 4: Engineering Properties Utilized in Numerical Analysis

The Numerical Analysis was Performed Utilizing Following Data:
Alluvial Deposits:
γ = 130.2 pcf - from laboratory test data (Sample F)
ø = 30.2° - from laboratory test data (Remolded Shear, Sample F)
c = 306 psf - from laboratory test data (Remolded Shear, Sample F)

The purpose of the numerical slope stability analysis was to determine the stability of the proposed 1.5-to-1 drainage ditch slope for a factor of safety of 1.5 for static conditions and 1.1 for psuedo-static conditions. As the slope may be affected by seismic events, a dynamic loading condition was applied to the existing slope (pseudo-static conditions). As stated in *Guidelines for Evaluating and Mitigating Seismic Hazards in California* (CGS, 2008), "In California, many state and local agencies, on the basis of local experience, require the use of a seismic coefficient of 0.15, and a minimum computed pseudo-static factor of safety of 1.0 to 1.2 for analysis of natural, cut, and fill slopes. Basic guidelines for making preliminary evaluations of embankments to ensure acceptable performance…were: using a pseudo-static coefficient of 0.10 for magnitude 6.5 earthquakes and 0.15 for magnitude 8.25 earthquakes, with an acceptable factor of safety of the order of 1.15." Calculations for pseudo-static numerical analysis utilized a seismic coefficient of 0.15 g.

5.2 Modeling Conditions

The stability of the proposed 1.5:1 (horizontal: vertical) drainage ditch slope configuration was evaluated by performing an analysis on a model Profile A-A'. The surface profile was modeled from the information presented in the Grading Plan provided by the County of San Luis Obispo Public Works Department. The modeling conditions included: 1) alluvial deposits; 2) 4.5 feet of surface water within the drainage ditch, and 3) bare slope surfaces. The surface water used in the model is representative of temporary, seasonal flows from rainfall runoff and a maximum flow depth based on data supplied by the County of San Luis Obispo Public Works Department, indicating a 4.5-foot deep flow depth. The velocity of this maximum flow depth is not a factor in the static model as water velocity does not affect overall slope stability. Laboratory testing was performed on representative samples of soil from the area of the proposed slopes and utilized in the slope stability analysis. The laboratory test result sheets depict the dry unit weight of soil and have been converted to the unit weight (γ) for use in the stability analysis.

5.3 Discussion of Results of Numerical Analysis

Table 5: Static and Psuedo-static Analysis Results

Profile	Static Factor of Safety	Psuedo-Static Factor of Safety
Profile A-A'	4.15	3.17

The global critical factor of safety values for both static and psuedo-static conditions for the proposed slope configuration along Section A-A' were above 1.5 and 1.1, respectively. The static and psuedo-static analysis results are presented in Table 5. Figure 3 and 4 illustrates the slopes along Section A-A' with the potential critical slip surfaces for static and psuedo-static conditions. The results indicate that the stability of the proposed cut slopes, as designed exceeds the minimum required values. Due to the fine grained nature of the site soils, the potential exists for erosion of the proposed slopes regardless of whether the slope configuration is 2.0:1.0 or 1.5:1.0. Erosion of the slopes may be affected by surface drainage, direct rainfall, irrigation run-off, rodent burrows, and debris within the drainage ditch. The potential for erosion requires that the surface of the excavated slopes be periodically maintained and indicates that the accumulation of soil material at the base of the slopes, within the ditch, may occur.

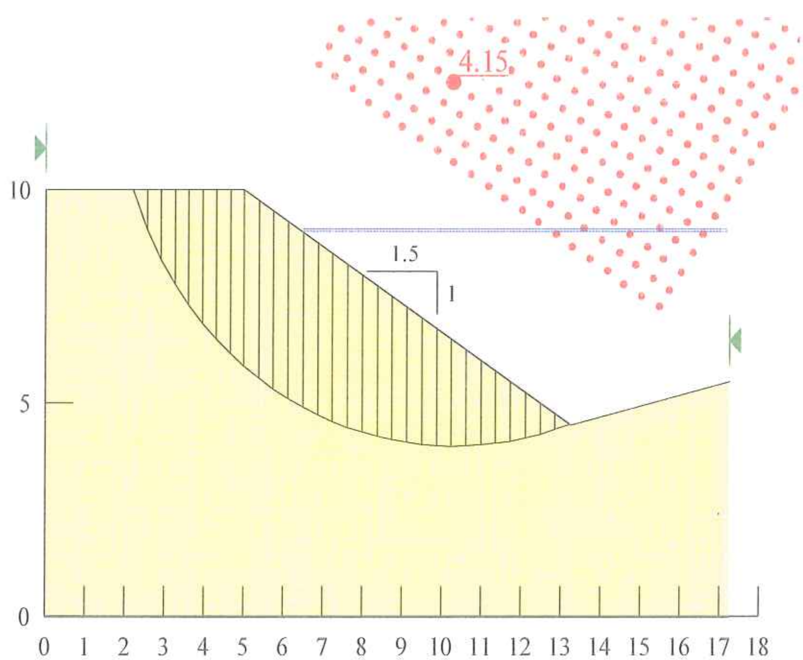

Figure 3: Profile A-A' (static)

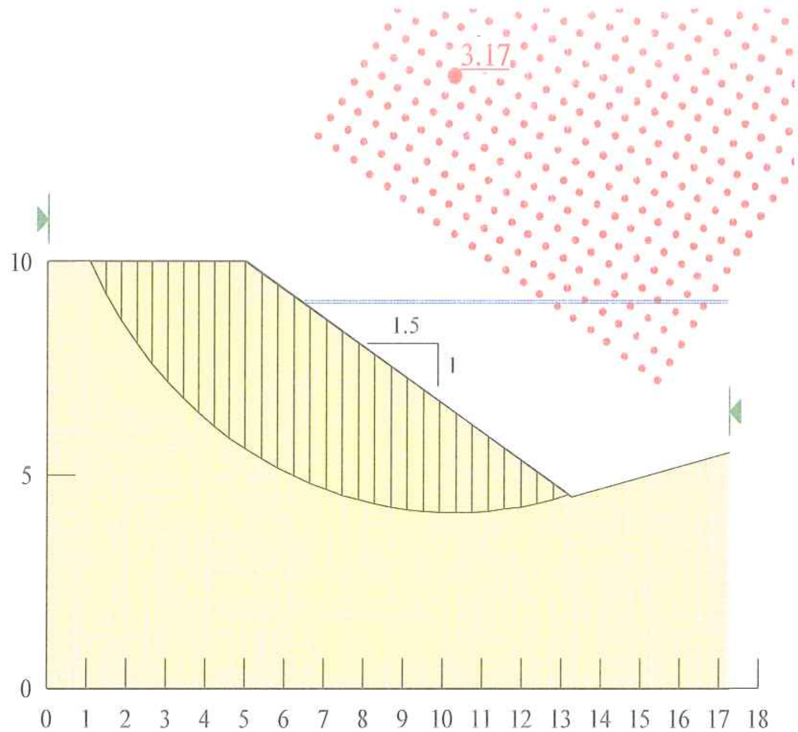

Figure 4: Profile A-A' (psuedo-static)

6.0 CONCLUSIONS AND RECOMMENDATIONS

The Site is suitable for the proposed development provided the recommendations presented in this report are incorporated into the project plans and specifications.

The results of the slope stability analysis indicate that the proposed 1.5:1 (horizontal: vertical) slope configuration for the drainage ditch is adequate. The factor of safety values for the proposed slope of 4.15 for static and 3.17 for pseudo-static (seismic) are more than double the industry standard values. The slope model included water levels within the ditch based on maximum flow values but does not include the velocity associated with this depth of water, as the gross stability and surficial stability of the proposed slope configuration is not affected by water velocity. As stated previously, to the fine grained nature of the site soils, the potential exists for erosion of the proposed slopes regardless of whether the slope configuration is 2.0:1.0 or 1.5:1.0. Erosion of the slopes may be affected by surface drainage, direct rainfall, irrigation run-off, rodent burrows, and debris within the drainage ditch. The potential for erosion requires that the surface of the excavated slopes be periodically maintained, particularly within the first three years following construction, and indicates that the accumulation of soil material at the base of the slopes, within the ditch, may occur. If water velocities within the drainage ditch of greater than 6 feet per second (fps) are anticipated, protection of the soil surfaces within the drainage ditch should be considered.

6.1 Preparation of Paved Areas

1. Prior to the placement of fill in any areas to receive fill, preparation of original ground will require the removal of loose material and organic debris. The exposed surface should be scarified an additional depth of twelve inches, moisture conditioned to near optimum moisture content, and compacted to a minimum relative density of 90 percent (ASTM D1557-07 test method).

2. Pavement areas should be excavated to finished sub-grade elevation or competent material; whichever is deeper. The exposed surface should be scarified an additional depth of twelve inches, moisture conditioned to near optimum moisture content, and compacted to a minimum relative density of 95 percent (ASTM D1557-07 test method). The top 12 inches of sub-grade soil under all pavement sections should be compacted to a minimum relative density of 95 percent at slightly above optimum moisture content.

3. Sub-grade soils should not be allowed to dry out or have excessive construction traffic between moisture conditioning and compaction, and placement of the pavement structural section.

6.2 Pavement Design

1. All pavement construction and materials used should conform to Sections 25, 26 and 39 of the latest edition of the State of California Department of Transportation Standard Specifications (State of California, 1999).

2. As indicated previously in Section 6.2, the top 12 inches of sub-grade soil under pavement sections should be compacted to a minimum relative density of 95 percent based on the ASTM D1557-07 test method at slightly above optimum moisture content. Aggregate bases and sub-bases should also be compacted to a minimum relative density of 95 percent based on the aforementioned test method.

3. Based on the information presented in the referenced plans, the roadway widening areas are to receive an initial layer of asphaltic concrete pavement, followed by an overlay layer that is to cover the entire width of the roadway. Minimum asphaltic concrete and aggregate base layer thicknesses have been determined based on the results of the R-value testing performed and the proposed Traffic Index value of 7.0 provided by the County of San Luis Obispo. Table 6: Pavement Design Sections presents the minimum required sections by design as well as a modification of the proposed typical section presented in the project plans.

4. Although testing indicated R-Value results of 13 and 19, the lower value was utilized in design due to the inherent variability in R-Value test results of +/- 5 points. It is our opinion that the R-Value of 13 is most representative of the soil conditions along this section of La Panza Road.

Table 6: Pavement Design Sections

Section	Traffic Index	R-Value	Asphaltic Concrete	Class II Aggregate Base
Typical Section – Per Plans	7.0	13	3.6 inches	14.5 inches
Minimum Required – by Design	7.0	13	3.0 inches	15.5 inches

6.3 Culvert Headwalls - Retaining Walls

1. Preparation of original ground in areas to receive headwall or retaining wall construction will require processing of the near surface soils. The native soil should be excavated a minimum of 12 inches below the proposed foundation depth or to competent material, whichever is greater. The exposed surfaces should then be scarified, moisture conditioned

to near optimum moisture content, and compacted to a minimum relative density of 90 percent (ASTM D1557-07 test method).

2. Any proposed culvert headwalls and retaining walls should be designed to resist lateral pressures from adjacent soils and surcharge loads applied behind the walls. We recommend using the lateral pressures presented in Table 7: Retaining Wall Design Parameters and Figure 5: Standard Retaining Wall Detail for the design of earth retaining structures at the Site. The Active Case may be used for the design of unrestrained walls, and the At-Rest Case may be used for the design of restrained walls.

Table 7: Retaining Wall Design Parameters

Lateral Pressure and Condition	Equivalent Fluid Pressure, pcf
Static, Active Case, Engineered Fill ($\gamma' K_A$)	45
Static, At-Rest Case, Engineered Fill ($\gamma' K_O$)	65
Static, Passive Case, Engineered Fill ($\gamma' K_P$)	350

3. The above values for equivalent fluid pressures are based on retaining walls having level retained surfaces, having an approximately vertical surface against the retained material, and retaining granular backfill material or engineered fill composed of native soil within the active wedge. See **Error! Reference source not found.** for a description of the location of the active wedge behind a retaining wall.

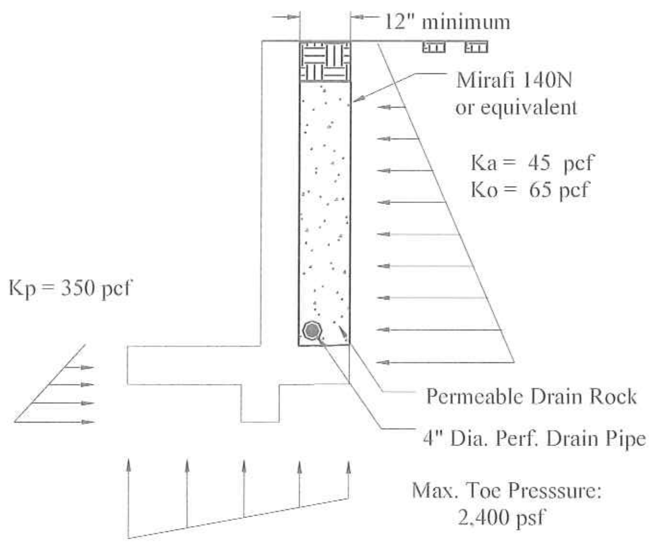

Figure 5: Standard Retaining Wall Detail

4. Proposed headwall and/or retaining wall foundations should be founded a minimum of 12 inches below lowest adjacent grade in engineered fill as observed and approved by a representative of GeoSolutions, Inc. A coefficient of friction of **0.30** may be used between engineered fill and concrete footings. Project designers may use a maximum toe pressure of **2,400 psf** for the design of retaining wall footings founded in engineered fill.

5. For hydrostatic loading conditions (i.e. no free drainage behind retaining wall), an additional loading of 45-pcf equivalent fluid weight should be added to the active and at-rest lateral earth pressures. If it is necessary to design retaining structures for submerged

conditions, the allowed bearing and passive pressures should be reduced by 50 percent. In addition, soil friction beneath the base of the foundations should be neglected.

6. Precautions should be taken to ensure that heavy compaction equipment is not used adjacent to walls, so as to prevent undue pressure against, and movement of the walls.

7.0 ADDITIONAL GEOTECHNICAL SERVICES

The recommendations contained in this report are based on a limited number of soil samples and on the continuity of the near surface conditions encountered. GeoSolutions, Inc. assumes that it will be retained to provide additional services during future phases of the proposed project. These services would be provided by GeoSolutions, Inc. as required by County of San Luis Obispo, the 2010 CBC, and/or industry standard practices. These services would be in addition to those included in this report and would include, but are not limited to, the following services:

1. Consultation during plan development.

2. Plan review of grading and foundation documents prior to construction and a report certifying that the reviewed plans are in conformance with our geotechnical recommendations.

3. Construction inspections and testing, as required, during all grading and excavating operations beginning with the stripping of vegetation at the Site, at which time a site meeting or pre-job meeting would be appropriate.

4. Preparation of construction reports certifying that grading operations and foundation excavations are in conformance with our geotechnical recommendations.

5. In addition to the construction inspections listed above, section 1704.7 of the 2010 CBC (CBSC, 2010) requires the following inspections by the Soils Engineer for controlled fill thicknesses greater than 12 inches as shown in Table 8: Required Verification and Inspections of Soils:

Table 8: Required Verification and Inspections of Soils

Verification and Inspection Task	Continuous During Task Listed	Periodically During Task Listed
1. Verify materials below footings are adequate to achieve the design bearing capacity.	-	X
2. Verify excavations are extended to proper depth and have reached proper material.	-	X
3. Perform classification and testing of controlled fill materials.	-	X
4. Verify use of proper materials, densities and lift thicknesses during placement and compaction of controlled fill.	X	-
5. Prior to placement of controlled fill, observe sub-grade and verify that site has been prepared properly.	-	X

8.0 LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The recommendations of this report are based upon the assumption that the soil conditions do not deviate from those disclosed during our study. Should any variations or undesirable conditions be encountered during the development of the Site, GeoSolutions, Inc. should be notified

immediately and GeoSolutions, Inc. will provide supplemental recommendations as dictated by the field conditions.

2. This report is issued with the understanding that it is the responsibility of the owner or his/her representative to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project, and incorporated into the project plans and specifications. The owner or his/her representative is responsible to ensure that the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

3. As of the present date, the findings of this report are valid for the property studied. With the passage of time, changes in the conditions of a property can occur whether they are due to natural processes or to the works of man on this or adjacent properties. Therefore, this report should not be relied upon after a period of 3 years without our review nor should it be used or is it applicable for any properties other than those studied. However many events such as floods, earthquakes, grading of the adjacent properties and building and municipal code changes could render sections of this report invalid in less than 3 years.

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REFERENCES

REFERENCES

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California Building Standards Commission (CBSC). *2010 California Building Code, California Code of Regulations*. Title 24. Part 2. Vol. 2. California Building Standards Commission: June 2010.

DeLorme. *Topo USA 6.0*. Vers.6.0.0 – F2.3 – 21.027.1970.1153. Computer software. DeLorme, 2006. Microsoft Windows XP/2000 SP3, 128 MB RAM, Intel Pentium III 600 MHz processor, 700 MB of available hard-disk space, 3D-capable video card with 32 MB VRAM, Microsoft Internet Explorer 5.01 or later, DVD-ROM drive.

State of California, Department of Transportation. *Standard Specifications*. State of California Department of Transportation Central Publication Distribution Unit: July 1999.

California Geological Survey, 2008, *Guidelines for Evaluating and Mitigating Seismic Hazards in California*, Special Publication 117A, California Department of Conservation, California Geological Survey, dated September 11, 2008.

County of San Luis Obispo, Public Works Department, Design Division, *Plans for Widening of La Panza Road from 1.7 Miles Southeast of State Route 41 to 3.1 Miles Southeast of State Route 41 Near Creston, CA., County Contract No. 300397,* 30% submittal, undated.

APPENDIX A

Soil Classification Chart

Laboratory Testing

Soil Test Reports

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS		LABORATORY CLASSIFICATION CRITERIA		GROUP SYMBOLS	PRIMARY DIVISIONS
COARSE GRAINED SOILS More than 50% retained on No. 200 sieve	GRAVELS More than 50% of coarse fraction retained on No. 4 (4.75mm) sieve	Clean gravels (less than 5% fines*)	C_u greater than 4 and C_z between 1 and 3	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			Not meeting both criteria for GW	GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		Gravel with fines (more than 12% fines*)	Atterberg limits plot below "A" line or plasticity index less than 4	GM	Silty gravels, gravel-sand-silt mixtures
			Atterberg limits plot below "A" line and plasticity index greater than 7	GC	Clayey gravels, gravel-sand-clay mixtures
	SANDS More than 50% of coarse fraction passes No. 4 (4.75mm) sieve	Clean sand (less than 5% fines*)	C_u greater than 6 and C_z between 1 and 3	SW	Well graded sands, gravely sands, little or no fines
			Not meeting both criteria for SW	SP	Poorly graded sands and gravelly and sands, little or no fines
		Sand with fines (more than 12% fines*)	Atterberg limits plot below "A" line or plasticity index less than 4	SM	Silty sands, sand-silt mixtures
			Atterberg limits plot above "A" line and plasticity index greater than 7	SC	Clayey sands, sand-clay mixtures
FINE GRAINED SOILS 50% or more passes No. 200 sieve	SILTS AND CLAYS (liquid limit less than 50)	Inorganic soil	PI < 4 or plots below "A"-line	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
		Inorganic soil	PI > 7 and plots on or above "A" line**	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		Organic Soil	LL (oven dried)/LL (not dried) < 0.75	OL	Organic silts and organic silty clays of low plasticity
	SILTS AND CLAYS (liquid limit 50 or more)	Inorganic soil	Plots below "A" line	MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
		Inorganic soil	Plots on or above "A" line	CH	Inorganic clays of high plasticity, fat clays
		Organic Soil	LL (oven dried)/LL (not dried) < 0.75	OH	Organic silts and organic clays of high plasticity
Peat	Highly Organic	Primarily organic matter, dark in color, and organic odor		PT	Peat, muck and other highly organic soils

*Fines are those soil particles that pass the No. 200 sieve. For gravels and sands with between 5 and 12% fines, use of dual symbols is required (i.e. GW-GM, GW-GC, GP-GM, or GP-GC).

**If the plasticity index is between 4 and 7 and it plots above the "A" line, then dual symbols (i.e. CL-ML) are required.

CONSISTENCY

CLAYS AND PLASTIC SILTS	STRENGTH TON/SQ. FT ++	BLOWS/ FOOT +
VERY SOFT	0 - 1/4	0 - 2
SOFT	1/4 - 1/2	2 - 4
FIRM	1/2 - 1	4 - 8
STIFF	1 - 2	8 - 16
VERY STIFF	2 - 4	16 - 32
HARD	Over 4	Over 32

RELATIVE DENSITY

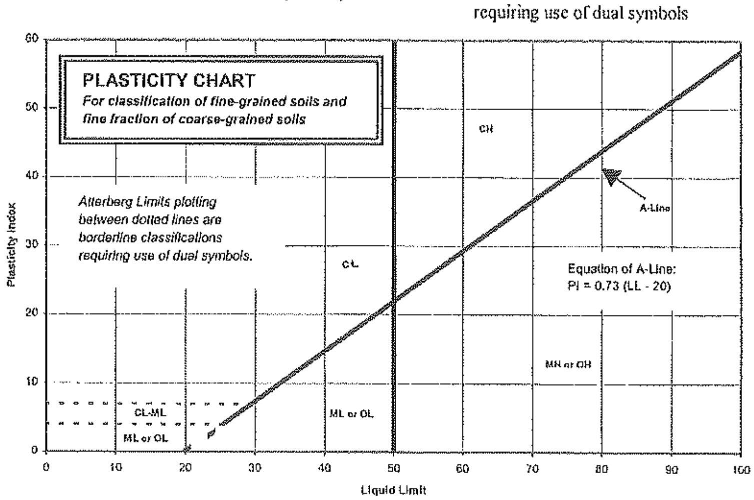
SANDS, GRAVELS AND NON-PLASTIC SILTS	BLOWS/ FOOT +
VERY LOOSE	0 - 4
LOOSE	4 - 10
MEDIUM DENSE	10 - 30
DENSE	30 - 50
VERY DENSE	Over 50

\+ Number of blows of a 140-pound hammer falling 30-inches to drive a 2-inch O.D. (1-3/8-inch I.D.) split spoon (ASTM D1586).

++ Unconfined compressive strength in tons/sq.ft. as determined by laboratory testing or approximated by the standard penetration test (ASTM D1586), pocket penetrometer, torvane, or visual observation.

CLASSIFICATIONS BASED ON PERCENTAGE OF FINES

Less than 5%, Pass No. 200 (75mm)sieve)	GW, GP, SW, SP
More than 12% Pass N. 200 (75 mm) sieve	GM, GC, SM, SC
5%-12% Pass No. 200 (75 mm) sieve	Borderline Classification requiring use of dual symbols



Drilling Notes:

1. Sampling and blow counts
   a. California Modified – number of blows per foot of a 140 pound hammer falling 30 inches
   b. Standard Penetration Test – number of blows per 12 inches of a 140 pound hammer falling 30 inches

Types of Samples:
X – In-Situ
SPT - Standard Penetration
CA - California Modified
N - Nuclear Gauge
PO – Pocket Penetrometer (tons/sq.ft.)

Forensic Analytical Laboratories

Final Report

Bulk Asbestos Material Analysis

(Air Resources Board Method 435, June 6, 1991)

GeoSolutions, Inc.
John Kammer
220 High St.

San Luis Obispo, CA 93401

Client ID: 4947
Report Number: N003817
Date Received: 07/11/11
Date Analyzed: 07/14/11
Date Printed: 07/14/11

Job ID/Site: SL7791-1 - La Panza Road

FALI Job ID: 4947
Total Samples Submitted: 5
Total Samples Analyzed: 5

Sample Preparation and Analysis:

Samples were analyzed by the Air Resources Board's Method 435, Determination of Asbestos Content of Serpentine Aggregate. Samples were ground to 200 particle size in the laboratory. Approximately 1 pint was retained for analysis. Samples were prepared for observation according to the guidelines of Exception I and Exception II as defined by the 435 Method. Samples which contained less than 10% asbestos were prepared for observation according to the point count technique as defined by the 435 Method. This analysis was performed with a standard cross-hair reticle.

Sample ID	Lab Number	Layer Description
A	11139503	**Brown Soil**

Visual Estimation Results:

Matrix percentage of entire: 100
Visual estimation percentage: None Detected
Asbestos type(s) detected: None Detected

Comment: This result meets the requirements of Exception I as defined by the 435 Method.

Sample ID	Lab Number	Layer Description
B	11139504	**Brown Soil**

Visual Estimation Results:

Matrix percentage of entire: 100
Visual estimation percentage: None Detected
Asbestos type(s) detected: None Detected

Comment: This result meets the requirements of Exception I as defined by the 435 Method.

Sample ID	Lab Number	Layer Description
C	11139505	**Brown Soil**

Visual Estimation Results:

Matrix percentage of entire: 100
Visual estimation percentage: None Detected
Asbestos type(s) detected: None Detected

Comment: This result meets the requirements of Exception I as defined by the 435 Method.

3777 Depot Road, Suite 409, Hayward, CA 94545 / Telephone: (510) 887-8828 (800) 827-FASI / Fax: (510) 887-421

Bulk Asbestos Material Analysis

(Air Resources Board Method 435, June 6, 1991)

GeoSolutions, Inc.
John Kammer
220 High St.

San Luis Obispo, CA 93401

Client ID: 4947
Report Number: N003817
Date Received: 07/11/11
Date Analyzed: 07/14/11
Date Printed: 07/14/11

Job ID/Site: SL7791-1 - La Panza Road

FALI Job ID: 4947
Total Samples Submitted: 5
Total Samples Analyzed: 5

Sample Preparation and Analysis:

Samples were analyzed by the Air Resources Board's Method 435, Determination of Asbestos Content of Serpentine Aggregate. Samples were ground to 200 particle size in the laboratory. Approximately 1 pint was retained for analysis. Samples were prepared for observation according to the guidelines of Exception I and Exception II as defined by the 435 Method. Samples which contained less than 10% asbestos were prepared for observation according to the point count technique as defined by the 435 Method. This analysis was performed with a standard cross-hair reticle.

Sample ID	Lab Number	Layer Description
D	11139506	**Brown Soil**

Visual Estimation Results:

Matrix percentage of entire	100
Visual estimation percentage:	None Detected
Asbestos type(s) detected:	None Detected

Comment: This result meets the requirements of Exception I as defined by the 435 Method.

Sample ID	Lab Number	Layer Description
E	11139507	**Brown Soil**

Visual Estimation Results:

Matrix percentage of entire	100
Visual estimation percentage:	None Detected
Asbestos type(s) detected:	None Detected

Comment: This result meets the requirements of Exception I as defined by the 435 Method.

Tad Thrower

Tad Thrower, Laboratory Supervisor, Hayward Laboratory

Note: Limit of Quantification (LOQ) = 0.25%. Trace denotes the presence of asbestos below the LOQ. ND = None Detected.

3777 Depot Road, Suite 409, Hayward, CA 94545 / Telephone: (510) 887-8828 (800) 827-FASI / Fax: (510) 887-4218

California State Certified Laboratory No. 2153

CERCO analytical
1100 Willow Pass Court, Suite A
Concord, CA 94520-1006
925 462 2771 Fax: 925 462 2775
www.cercoanalytical.com

Client: GeoSolutions, Inc.
Client's Project No.: SLO7791-1
Client's Project Name: La Panza Road
Date Sampled: Not Indicated
Date Received: 8-Jul-11
Matrix: Soil
Authorization: Laboratory Receiving Order and Schedule of Tests dated 07/06/11

Date of Report: 14-Jul-2011

Job/Sample No.	Sample I.D.	Redox (mV)	pH	Conductivity (umhos/cm)*	Resistivity (100% Saturation) (ohms-cm)	Sulfide (mg/kg)*	Chloride (mg/kg)*	Sulfate (mg/kg)*
1107048-001	B Sta 353+00	460	8.3	400	-	-	N.D.	41
1107048-002	C Sta 376+50	450	8.2	300	-	-	N.D.	N.D.
1107048-003	D Sta 391+00	460	8.1	220	-	-	N.D.	N.D.
1107048-004	E Sta 421+00	450	8.0	320	-	-	N.D.	N.D.
1107048-005	F Stac423+00	450	8.3	300	-	-	N.D.	N.D.

Method:	ASTM D1498	ASTM D4972	ASTM D1125M	ASTM G57	ASTM D4658M	ASTM D4327	ASTM D4327
Detection Limit:	-	-	10	-	50	15	15
Date Analyzed:	13-Jul-2011	13-Jul-2011	14-Jul-2011	-	-	12-Jul-2011	12-Jul-2011

* Results Reported on "As Received" Basis

N.D. - None Detected

Cheryl McMillen
Laboratory Director

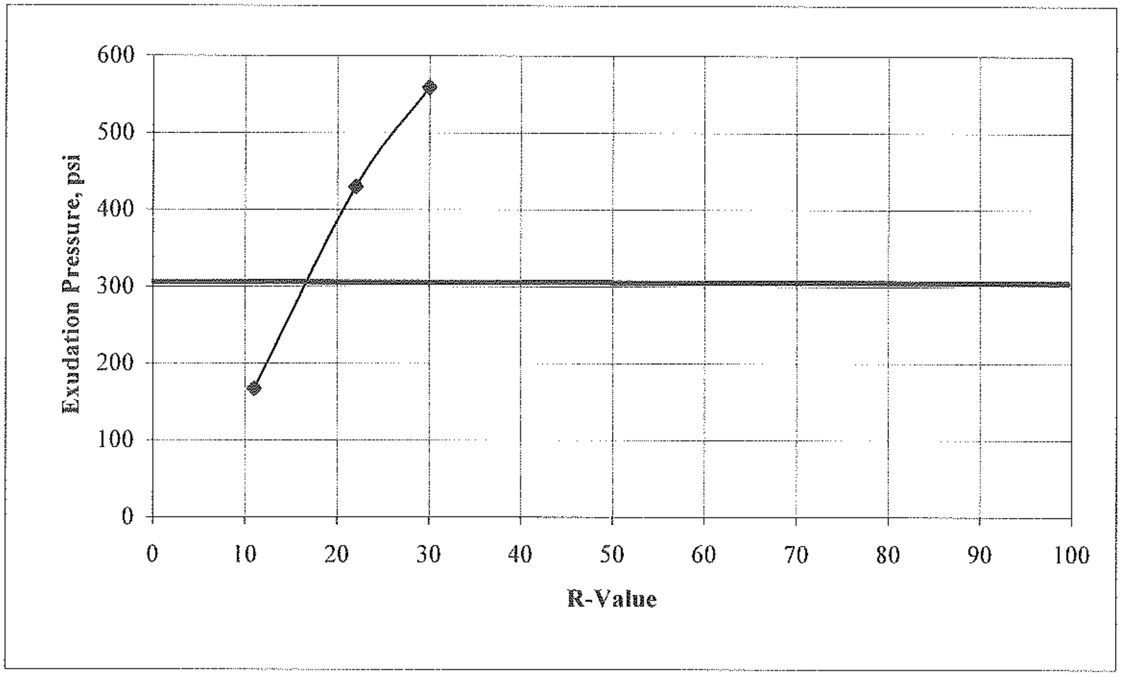
Quality Control Summary - All laboratory quality control parameters were found to be within established limits

GeoSolutions, Inc.

R-VALUE TEST REPORT
ASTM D2844-07

(805) 543-8539

Project:	La Panza Roadway	Date Tested:	July 11, 2011
Client:		Project #:	SL07791-1
Sample #:	A Depth:	Lab #:	14706
Location:	Sta 355+00	Sample Date:	July 6, 2011
Material:	Brown Clayey SAND	Sampled By:	KRC



Specimen No.	A	B	C
Exudation Pressure, psi	167	430	559
Expansion Pressure, psf	22	52	0
R-Value	11	22	30
Moisture Content at test, %	17.1	12.0	14.4
Dry Density at Test, pcf	109.9	116.1	115.7

R-Value @ 300 psi Exudation Pressure:	**13**

Report By: Aaron Eichman

GeoSolutions, Inc. — **SOILS REPORT** — (805) 543-8539

Project:	La Panza Roadway	Date Tested:	July 7, 2011
Client:		Project #:	SL07791-1
Sample:	B Depth:	Lab #:	14706
Location:	Sta 353+00	Sample Date:	July 6, 2011
		Sampled By:	KRC

Soil Classification
ASTM D2487-06, D2488-06

Result: Light Yellowish Brown Sandy CLAY

Specification: CL

Sieve Analysis
ASTM D422-63R02

Sieve Size	Percent Passing	Project Specifications
3"		
2"		
1 1/2"		
1"		
3/4"		
No. 4	93	
No. 8	92	
No. 16	90	
No. 30	84	
No. 50	74	
No. 100	61	
No. 200	52.4	

Sand Equivalent Cal 217 (11/1999)

1		SE
2		
3		
4		

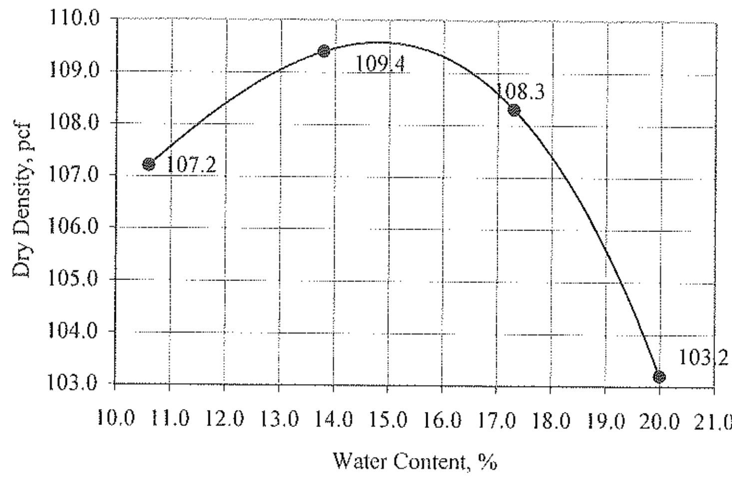
Plasticity Index
ASTM D4318-05

Liquid Limit:	
Plastic Limit:	
Plasticity Index:	

Expansion Index
ASTM D4829-08

Expansion Index:	**43**
Expansion Potential:	Low
Initial Saturation, %:	50

Laboratory Maximum Density
ASTM D1557-07



Mold ID	n/a	Mold Diameter, ins.	4.00
No. of Layers	5	Weight of Rammer, lbs.	10.00
No. of Blows	25		

Estimated Specific Gravity for 100% Saturation Curve = 2.5

Trial #	1	2	3	4
Water Content:	10.6	13.8	17.3	20.0
Dry Density:	107.2	109.4	108.3	103.2
Maximum Dry Density, pcf:		**109.6**		
Optimum Water Content, %:		**14.9**		

Moisture-Density ASTM D2937-04, **Moisture Content** ASTM D2216-05

Sample	Depth (ft)	Water Content (%)	Dry Density (pcf)	Relative Density	Sample Description

Report By: Aaron Eichman

GeoSolutions, Inc.

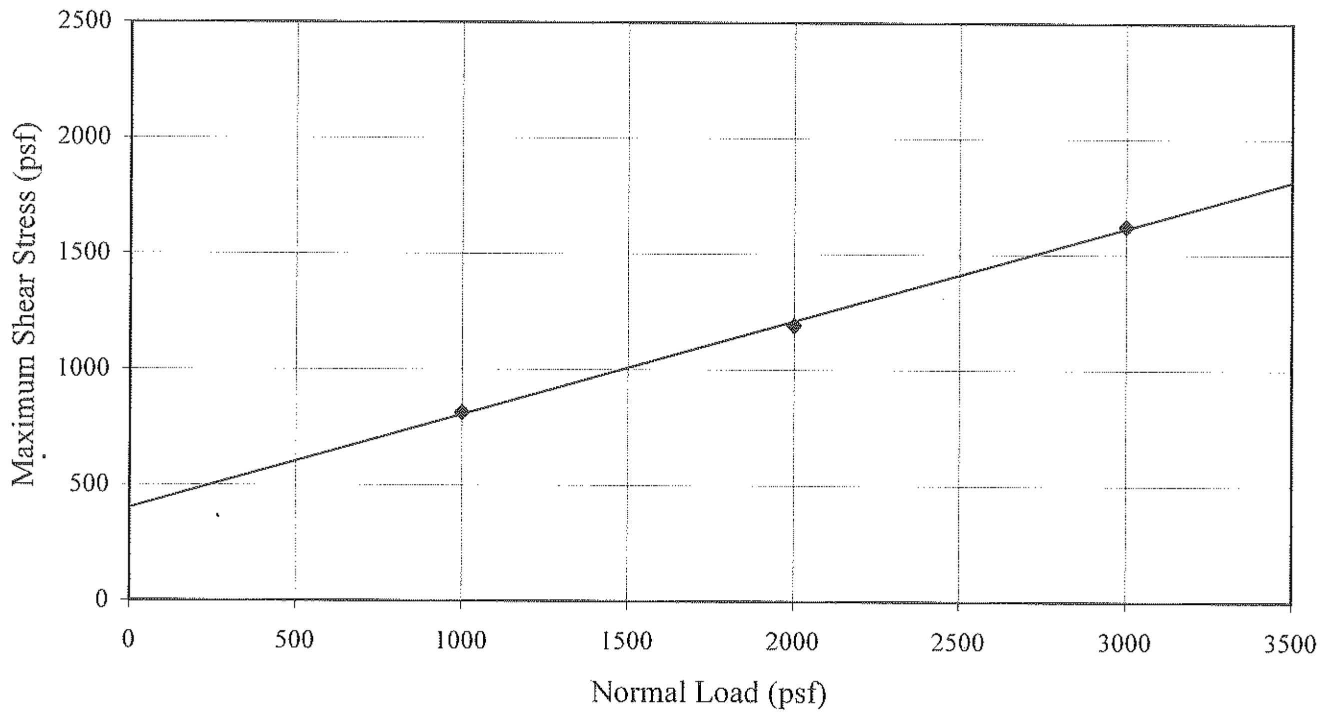
DIRECT SHEAR TEST REPORT
D3080-04

(805) 543-8539

Project:	La Panza Roadway	Date Tested:	July 11, 2011
Client:		Project #:	SL07791-1
Sample #:	B Depth:	Lab #:	14706
Location:	Sta 353+00	Sample Date:	July 6, 2011
Material:	Light Yellowish Brown Sandy CLAY	Sampled By:	KRC

Test Data

Specimen Number	Void Ratio	Saturation, %	Normal Load, psf	Max Shear Stress, psf	Water Content, %	Dry Density, pcf	Relative Density*,%
1	-	-	1000	815	26.7	97.1	90
2	-	-	2000	1191	26.0	97.1	90
3	-	-	3000	1622	25.3	97.1	90
4							
5							



*The test specimens were initially remolded at 90% of the maximum dry density (ASTM D1557) and at 2% above the optimum moisture content of the material.

Maximum Dry Density, pcf:	109.6	Optimum Moisture, %:	14.9

Angle of Internal Friction @ 90% Rel. Compaction, Phi:	22.0 °
Cohesion @ 90% Relative Compaction, C:	402 psf

Report By: Aaron Eichman

GeoSolutions, Inc. **SOILS REPORT** (805) 543-8539

Project:	La Panza Roadway	Date Tested:	July 7, 2011
Client:		Project #:	SL07791-1
Sample:	C Depth:	Lab #:	14706
Location:	Sta 376+50	Sample Date:	July 6, 2011
		Sampled By:	KRC

Soil Classification
ASTM D2487-06, D2488-06

Result: Dark Grayish Brown Clayey SAND

Specification: SC

Sieve Analysis
ASTM D422-63R02

Sieve Size	Percent Passing	Project Specifications
3"		
2"		
1 1/2"		
1"		
3/4"		
No. 4	95	
No. 8	92	
No. 16	87	
No. 30	79	
No. 50	63	
No. 100	38	
No. 200	27.7	

Sand Equivalent Cal 217 (11/1999)

1		SE
2		
3		
4		

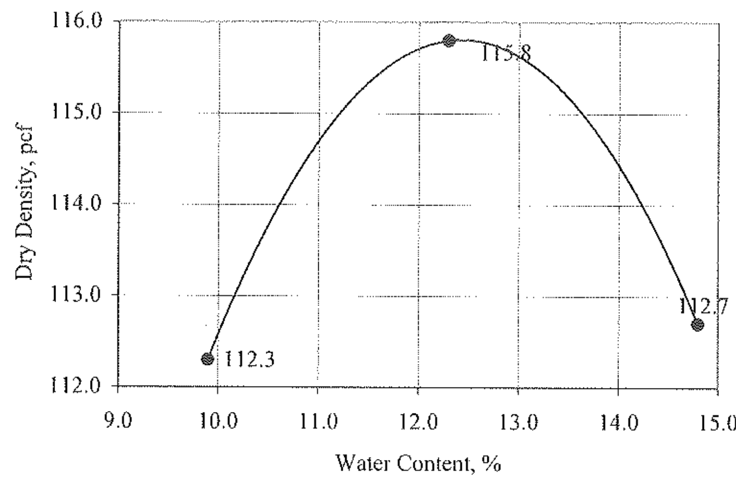
Plasticity Index
ASTM D4318-05

Liquid Limit:	
Plastic Limit:	
Plasticity Index:	

Expansion Index
ASTM D4829-08

Expansion Index:	3
Expansion Potential:	Very Low
Initial Saturation, %:	50

Laboratory Maximum Density
ASTM D1557-07



Mold ID	n/a	Mold Diameter, ins.	4.00
No. of Layers	5	Weight of Rammer, lbs.	10.00
No. of Blows	25		

Estimated Specific Gravity for 100% Saturation Curve = 2.5

Trial #	1	2	3	4
Water Content:	9.9	12.3	14.8	
Dry Density:	112.3	115.8	112.7	
Maximum Dry Density, pcf:		**115.8**		
Optimum Water Content, %:		**12.4**		

Moisture-Density ASTM D2937-04, **Moisture Content** ASTM D2216-05

Sample	Depth (ft)	Water Content (%)	Dry Density (pcf)	Relative Density	Sample Description

Report By: Aaron Eichman

GeoSolutions, Inc.

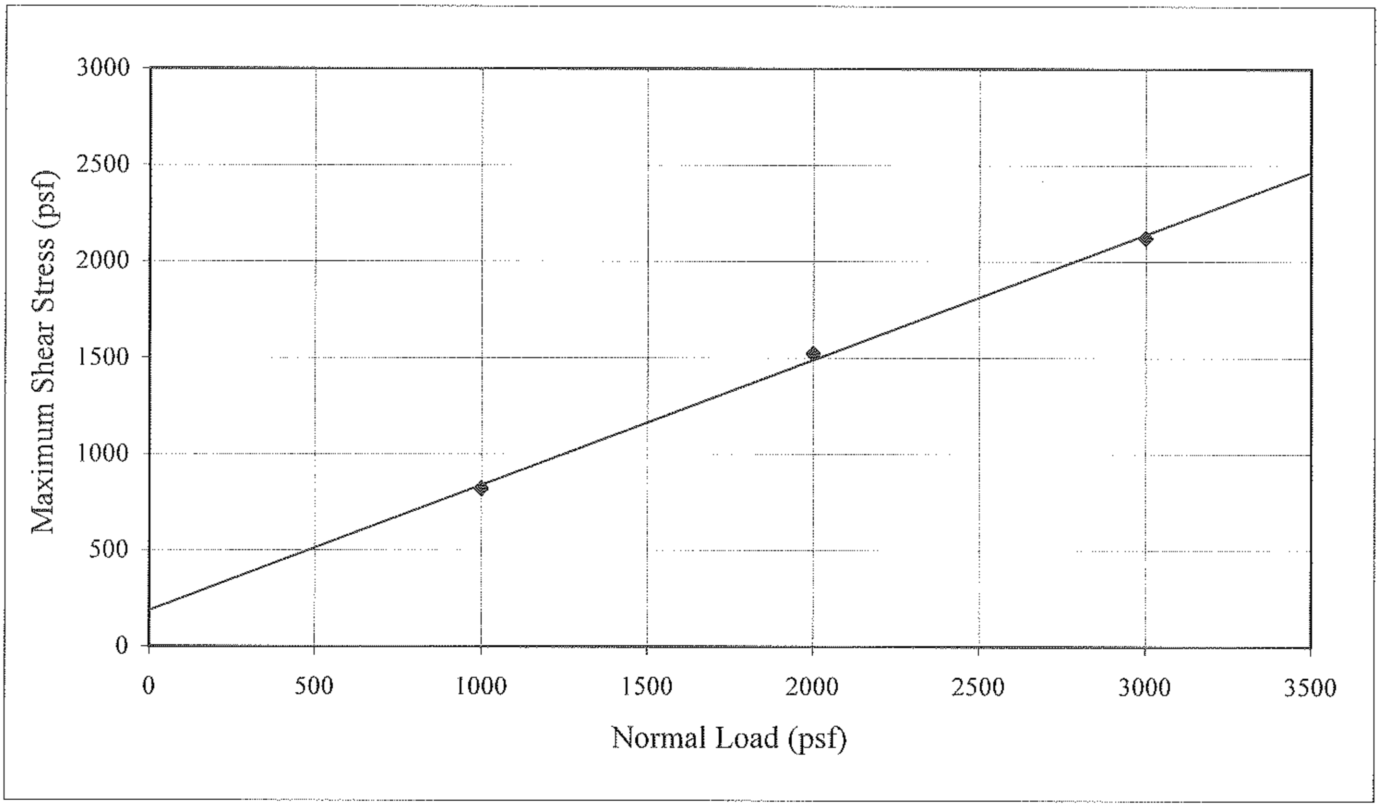
DIRECT SHEAR TEST REPORT
D3080-04

(805) 543-8539

Project:	La Panza Roadway	Date Tested:	July 11, 2011
Client:		Project #:	SL07791-1
Sample #:	C Depth:	Lab #:	14706
Location:	Sta 376+50	Sample Date:	July 6, 2011
Material:	Dark Grayish Brown Clayey SAND	Sampled By:	KRC

Test Data

Specimen Number	Void Ratio	Saturation, %	Normal Load, psf	Max Shear Stress, psf	Water Content, %	Dry Density, pcf	Relative Density*,%
1	-	-	1000	821	20.1	102.5	90
2	-	-	2000	1522	19.7	102.5	90
3	-	-	3000	2122	19.2	102.5	90
4							
5							



*The test specimens were initially remolded at 90% of the maximum dry density (ASTM D1557) and at 2% above the optimum moisture content of the material.

Maximum Dry Density, pcf:	115.8	Optimum Moisture, %:	12.4

Angle of Internal Friction @ 90% Rel. Compaction, Phi:	33.0 °
Cohesion @ 90% Relative Compaction, C:	187 psf

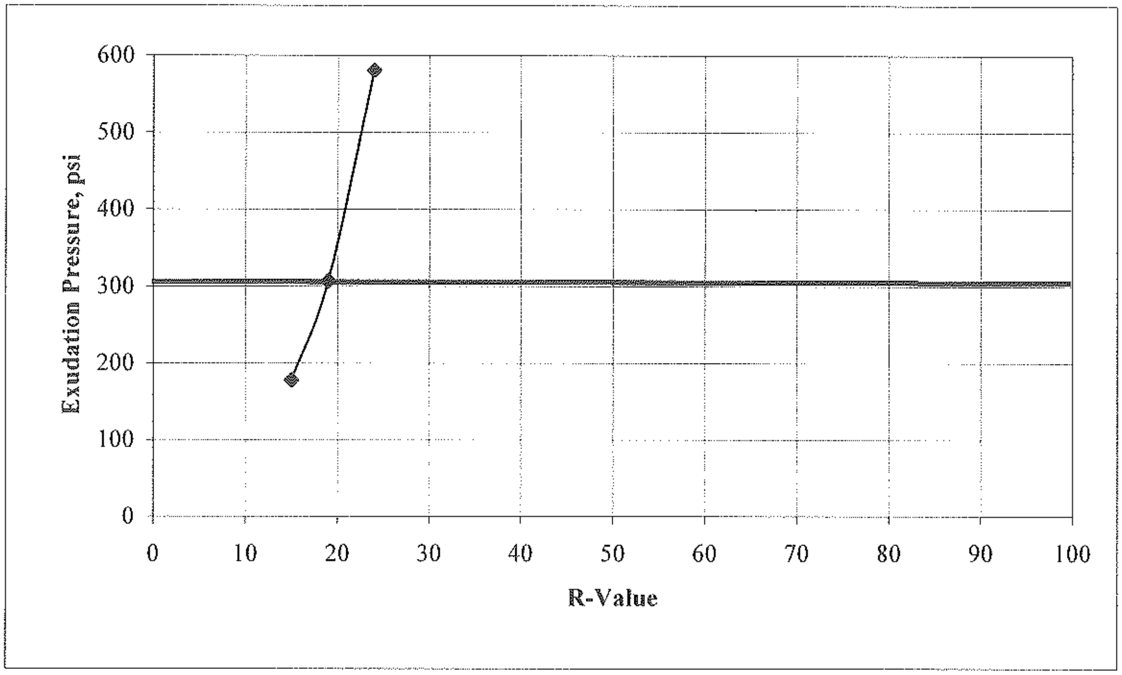
Report By: Aaron Eichman

GeoSolutions, Inc.

R-VALUE TEST REPORT
ASTM D2844-07

(805) 543-8539

Project:	La Panza Roadway	Date Tested:	July 11, 2011
Client:		Project #:	SL07791-1
Sample #:	E Depth:	Lab #:	14706
Location:	Sta 421+00	Sample Date:	July 6, 2011
Material:	Dark Brown Clayey SAND	Sampled By:	KRC



Specimen No.	A	B	C
Exudation Pressure, psi	178	307	581
Expansion Pressure, psf	0	0	22
R-Value	15	19	24
Moisture Content at test, %	15.9	15.0	12.0
Dry Density at Test, pcf	111.8	113.9	118.2

R-Value @ 300 psi Exudation Pressure:	**19**

Report By: Aaron Eichman

GeoSolutions, Inc.	SOILS REPORT	(805) 543-8539

Project:	La Panza Roadway	Date Tested:	July 7, 2011
Client:		Project #:	SL07791-1
Sample:	F Depth:	Lab #:	14706
Location:	Sta 423+00	Sample Date:	July 6, 2011
		Sampled By:	KRC

Soil Classification
ASTM D2487-06, D2488-06

Result: Dark Grayish Brown Clayey SAND

Specification: SC

Sieve Analysis
ASTM D422-63R02

Sieve Size	Percent Passing	Project Specifications
3"		
2"		
1 1/2"		
1"		
3/4"		
No. 4	97	
No. 8	94	
No. 16	88	
No. 30	78	
No. 50	64	
No. 100	37	
No. 200	24.1	

Sand Equivalent Cal 217 (11/1999)

1		SE
2		
3		
4		

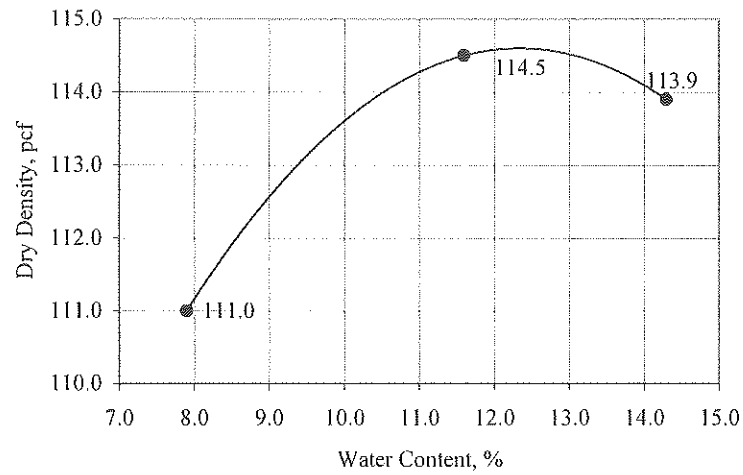
Plasticity Index
ASTM D4318-05

Liquid Limit:	
Plastic Limit:	
Plasticity Index:	

Expansion Index
ASTM D4829-08

Expansion Index:	**0**
Expansion Potential:	Very Low
Initial Saturation, %:	50

Laboratory Maximum Density
ASTM D1557-07



Mold ID	n/a	Mold Diameter, ins.	4.00
No. of Layers	5	Weight of Rammer, lbs.	10.00
No. of Blows	25		

Estimated Specific Gravity for 100% Saturation Curve = 2.5

Trial #	1	2	3	4
Water Content:	7.9	11.6	14.3	
Dry Density:	111.0	114.5	113.9	
Maximum Dry Density, pcf:		**114.6**		
Optimum Water Content, %:		**12.3**		

Moisture-Density ASTM D2937-04, **Moisture Content** ASTM D2216-05

Sample	Depth (ft)	Water Content (%)	Dry Density (pcf)	Relative Density	Sample Description

Report By: Aaron Eichman

GeoSolutions, Inc.

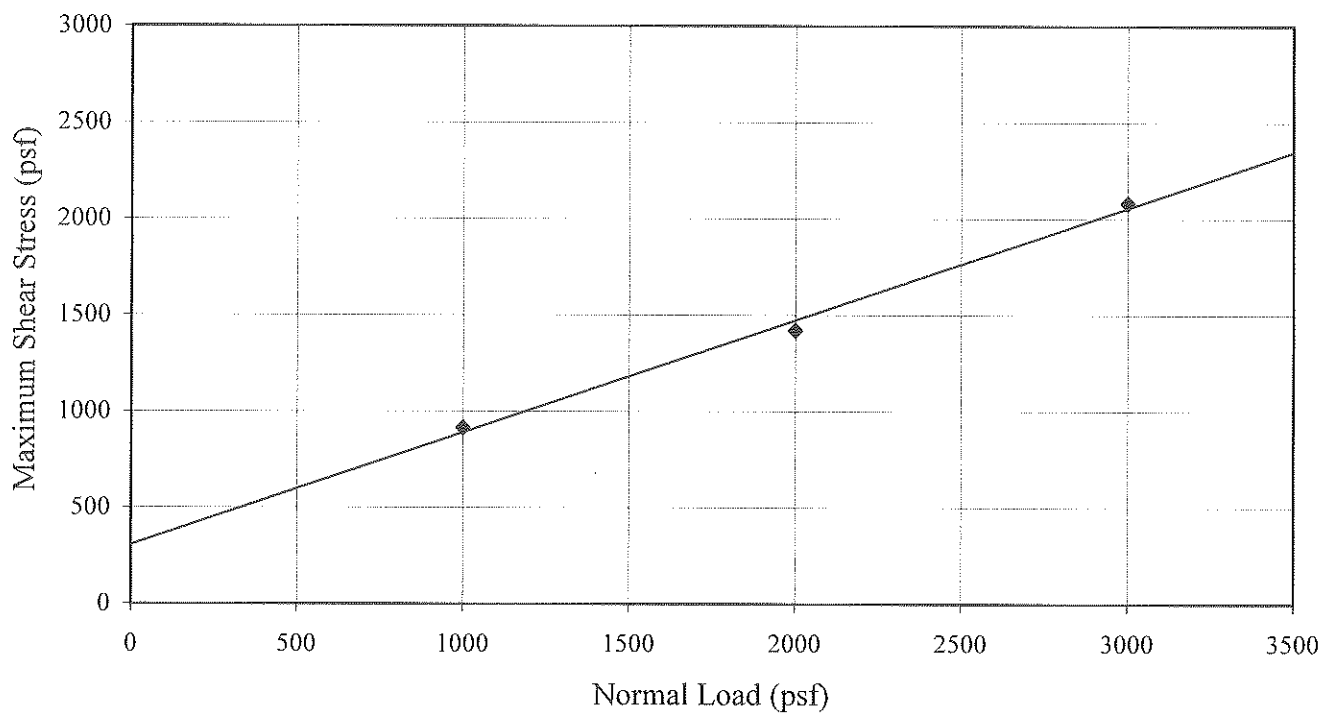
DIRECT SHEAR TEST REPORT
D3080-04

(805) 543-8539

Project:	La Panza Roadway	Date Tested:	July 11, 2011
Client:		Project #:	SL07791-1
Sample #:	F Depth:	Lab #:	14706
Location:	Sta 423+00	Sample Date:	July 6, 2011
Material:	Dark Grayish Brown Clayey SAND	Sampled By:	KRC

Test Data

Specimen Number	Void Ratio	Saturation, %	Normal Load, psf	Max Shear Stress, psf	Water Content, %	Dry Density, pcf	Relative Density*,%
1	-	-	1000	915	20.0	101.5	90
2	-	-	2000	1421	19.3	101.5	90
3	-	-	3000	2081	20.1	101.5	90
4							
5							



*The test specimens were initially remolded at 90% of the maximum dry density (ASTM D1557) and at 2% above the optimum moisture content of the material.

Maximum Dry Density, pcf:	115.8	Optimum Moisture, %:	12.4

Angle of Internal Friction @ 90% Rel. Compaction, Phi:	30.2 °
Cohesion @ 90% Relative Compaction, C:	306 psf

Report By: Aaron Eichman