ENGINEERING GEOLOGY
AND
GEOTECHNICAL ENGINEERING REPORT
FOR
226 & 232 EUCALYPTUS HILL DRIVE
PROPOSED 2-LOT RESIDENTIAL SUBDIVISION
SANTA BARBARA, CALIFORNIA

VT-23720-01
JULY 14, 2006

PREPARED FOR
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Classic Properties
232 Eucalyptus Hill Drive
Santa Barbara, California 93108

Project: 226 and 232 Eucalyptus Hill Drive
Proposed Two-Lot Residential Subdivision
Santa Barbara, California

As authorized, we have performed an engineering geology and geotechnical engineering study for a proposed two-lot residential subdivision to be located at 226 and 232 Eucalyptus Hill Drive in Santa Barbara, California. The accompanying Engineering Geology and Geotechnical Engineering Report presents the results of our research, as well as our conclusions and recommendations pertaining to geotechnical aspects of project design.

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,

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INTRODUCTION

Project Description

This report presents results of an Engineering Geology and Geotechnical Engineering study performed for a proposed two-lot residential subdivision to be located at 226 and 232 Eucalyptus Hill Drive in Santa Barbara, California. The site is currently occupied by an existing residence that will be demolished. The lot line between the two addresses will be realigned from a north-south direction to a east-west direction. It is proposed to construct a main residence, guest house, and detached garage on each of the two new lots. It is assumed herein that the proposed structures will be one- to two-story, wood-framed and/or masonry/concrete construction with raised and/or slab-on-grade floors. Structural considerations for building column loads of up to 25 kips with maximum wall loads of 2.0 kips per lineal foot were used as a basis for the recommendations of this report. If actual loads vary significantly from these assumed loads, Earth Systems Southern California should be notified since reevaluation of the recommendations contained in this report may be required.

Purpose and Scope of Work

The purpose of the geotechnical study that led to this report was to analyze the geology and soil conditions of the site with respect to the proposed construction. These conditions include potential geohazards, surface and subsurface soil/bedrock types, expansion potential, settlement potential, bearing capacity, and the presence or absence of subsurface water. The scope of our work included:

1. Reconnaissance of the site.
2. Reviewing pertinent geologic literature.
3. Excavating, logging and sampling of seven backhoe test pits to study bedrock, soil and groundwater conditions.
4. Laboratory testing of bedrock/soil samples obtained from the subsurface exploration to determine their physical and engineering properties.
5. Consulting with owner representatives.
6. Analyzing the geotechnical data.
7. Preparing this report.

Contained in this report are:

1. Descriptions and results of field and laboratory tests that were performed.

2. Discussions pertaining to the local bedrock, soil and groundwater conditions.
3. Conclusions and recommendations pertaining to site grading and structural design.

Site Setting

The site of the proposed improvements is located at 226 and 232 Eucalyptus Hill Dive in Santa Barbara, California (see Vicinity Map and Site Map in Appendix A). An existing residence occupies the northeast corner of the site. The site lies near the top of slope on a east-west trending ridge spur. The northern portion of the site (about 100 to 150 feet south of Eucalyptus Hill Road) has a south-facing descending slope gradient of about 7:1. Below this the slope gradient steepens to about 5:1 with isolated areas of slope gradient up to 2.5:1. The site is covered with a growth of Eucalyptus trees. Dirt access roads have been graded on the site with minor cuts and fills. The slope is covered with sparse annual grasses and brush. The site is bound by Eucalyptus Hill Road to the north, and residential lots to the east, west, and south.

REGIONAL GEOLOGY

The proposed road lies within the Santa Barbara foothills in the western portion of the Transverse Ranges geologic province. Numerous east-west trending folds and reverse faults indicative of active north-south transpressional tectonics characterize the region. The ongoing regional compression produces the east-west trending faults which deforms early Pleistocene to Tertiary aged marine and non-marine sedimentary bedrock units. These sedimentary bedrock units underlie the property (see Regional Geologic Maps by Dibblee and Gurrola in Appendix A). The site does not lie within any study zones for fault rupture hazard or landslides. No faults or landslides were encountered during field studies.

STRUCTURE

The subject site is underlain by areas of artificial fill over topsoil/colluvium over Monterey Formation bedrock. Bedrock units encountered within the exploratory test pits had strikes of bedding ranging from about N89°W to N75°E and dips ranging from 53° to the north and 73° to the south forming a synclinal structure across the site. These strikes appear to be consistent with the regional strikes of other bedrock units in the general area of the subject site according to Dibblee (Geologic Map of the Santa Barbara Quadrangle, 1986).

GEOLOGIC HAZARDS

Geologic hazards that may impact a site include seismic shaking, fault rupture, landsliding, liquefaction and flooding.

Seismic Shaking

The site is located in an active seismic region where large numbers of earthquakes are recorded each year. Historically, major earthquakes felt in the vicinity of the subject site have originated from faults outside the area. These include the December 21, 1812 "Santa Barbara Region" earthquake, that was presumably centered in the Santa Barbara Channel (CDMG, 1975), the 1857 Fort Tejon earthquake, the 1872 Owens Valley earthquake, and the 1952 Arvin-Tehachapi earthquake.

Table No. 1, Summary of Deterministic Site Parameters, presents approximate distance, maximum earthquake magnitude Mw, peak site acceleration and estimated site intensity according modified Mercalli scale for seismic events which could initiated by various nearby active faults.

Fault Name	Approximate Distance mi (km)	Estimated Maximum Earthquake Event		
		Maximum Earthquake Magnitude (Mw)	Peak Site Acceleration (g)	Estimated Site Intensity Modified Mercalli
M.RIDGE-ARROYO PARIDA-SANTA ANA	2.58 (4.5)	6.7	0.628	X
RED MOUNTAIN	4.3 (6.9)	6.8	0.545	X
SANTA YNEZ (West)	4.8 (7.7)	6.9	0.416	X
SANTA YNEZ (East)	4.8 (7.8)	7.0	0.426	X
NORTH CHANNEL SLOPE	6.6 (10.6)	7.1	0.467	X
MONTALVO-OAK RIDGE TREND	9.1 (14.6)	6.6	0.302	IX
VENTURA - PITAS POINT	10.7 (17.2)	6.8	0.285	IX
CHANNEL IS. THRUST (Eastern)	14.5 (23.4)	7.4	0.286	IX
OAK RIDGE(Blind Thrust Offshore)	18.1 (29.2)	6.9	0.167	VIII
BIG PINE	22.1 (35.6)	6.7	0.104	VII

As with most of Southern California, the site is within a highly active seismic area. As a result, the proposed development may be subject to severe seismically induced ground shaking from any of a number of regional and local faults during its design life.

According to the California Building Code, the proposed site is located in Seismic Zone 4. Seismic Zone 4 includes those areas of California that have experienced major (Richter magnitude greater than eight) historic earthquakes and high levels of recent seismicity. As noted above, the site is located about 2.58 miles (4.5 km) southeast of the active Mission Ridge-Arroyo Parida-Santa Ana Fault (Seismic Source Type B). The program EQFAULT indicated that the Mission Ridge-Arroyo Parida-Santa Ana Fault is closest to the site and can generated earthquake with magnitude 6.7M and peak ground acceleration of 0.6282g (EQFAULT, Blake, 2004).

It is the standard of practice, when evaluating the seismicity of residential type development, to consider the design basis (10% probability of exceedance in 50 years) accelerations. The California Division of Mines and Geology, in concert with the U.S. Geological Survey and the scientific community, has recently presented results of a statewide probabilistic seismic hazard assessment (CDMG, Seismic Shaking Map Sheets, Map Sheet 48, 1999). The focus of the assessment was to generate a seismic hazard map showing zones of estimated peak ground accelerations at a hazard level of 10% probability of exceedance in 50 years. The site location plots between 0.50 g to 0.60 g acceleration potential. A contour map of the estimated magnitude of earthquake that causes the dominant hazard for peak ground acceleration at 10% probability of exceedance in 50 years with alluvial site conditions was also prepared as part of the statewide seismic hazard assessment survey. The site location plots within a zone of magnitude 6.5 to 7.0 that were estimated by using the program FRISKSP (FRISKSP, Blake, 2004), the revised faults systems provided by CAO, TIANQING, et. al., 2003 (see publication CAO, TIANQING, et. al., 2003, and the Revised 2002 California Probabilistic Seismic Hazard Maps, June 2003, pp. 1-11, Appendix A.).

For the project site the 2001 California Building Code (CBC) Seismic Design Parameters are:

Parameter	Table No.	Value
Seismic Zone Factor (Z)	16-I	0.40
Soil Type Profile	16-J	S_C
Seismic Coefficient (C_a)	16-Q	$0.40N_a$
Seismic Coefficient (C_v)	16-R	$0.56N_v$
Near Source Factor (N_a)	16-S	1.3
Near Source Factor (N_v)	16-T	1.6
Seismic Source Type	16-U	B

These values are based on a distance of less than 2 kilometers from the Red Mountain fault as determined from the 1997 Uniform Building Code (UBC) Maps of Known Active Fault Near-Source Zones in California and Adjacent Portions of Nevada.

Where N_a is greater than 1.0, the vertical ground acceleration cannot be taken as two-thirds of the horizontal ground acceleration. CBC Section 1631.2 recommends conducting a site-specific vertical spectra analysis. This analysis was not included as part of the scope of work. The results of our seismic analyses include preparing a 1) a California Fault Map, 2) graphs of probability of exceedance, 3) graphs of attenuation relation for different faults, 4) graph of earthquake magnitude & distance, 5) graph of maximum earthquakes, and 6) design response spectrum (presented in Appendix C).

Fault Rupture

The parcel does not lie within a State of California designated fault hazard zone. Dibblee (1986) does not map a fault crossing the subject site. Gurrola (2004) indicates an approximately located fault crossing the site near its southernmost property line. The fault is located where the Monterey Formation bedrock abuts an Older Fanglomerate unit. The City of Santa Barbara Geologic Map (prepared by Mike Hoover, 1982) does show a fault crossing the site, but does show a fault trending towards the site from the west. Test pits excavated across the site in a north-south direction (perpendicular to the fault trend) encountered Monterey Formation bedrock but no Older Fanglomerate units. Therefore, it appears the faulting is located south of the subject site and thus the potential for fault rupture hazard on the subject site is considered low.

Table No. 2, Summary of Regional Faults, presents nearest distances of the site to various nearby active faults. Of those listed in Table No. 1, the nearest known active fault is the Mission Ridge-Arroyo Parida-Santa Ana Fault, located about 1 mile (1.6 km) away of the site. Ground shaking from earthquakes associated with both nearby and more distant faults is expected to occur during the lifetime of the project.

Fault Name	Closest Distance To The Site (km)	Seismic Source Type (A, B, C)	Maximum Magnitude (Mw)	Slip Rate (mm/yr)	Fault Type (SS, DS, BT)
M.RIDGE-ARROYO PARIDA-SANTA ANA	1.6	B	6.7	0.4	DS
RED MOUNTAIN	2.3	B	6.8	2.0	DS
SANTA YNEZ (West)	5.8	B	6.9	2.0	SS

SANTA YNEZ (East)	6.0	B	7.0	2.0	SS
VENTURA - PITAS POINT	15.5	B	6.8	1.0	DS
BIG PINE	35.5	B	6.7	0.8	SS

SS - Strike-Slip Fault; DS - Dip-Slip Fault; BT – Buried Thrust Fault

Liquefaction

A major cause of damage during earthquakes is a significant reduction of soil strength or stiffness, generally referred to as liquefaction. Liquefaction can cause translational instability, bearing failure, settlement, ground loss, and other related phenomena. Translational instabilities can be slope failures or lateral spreading. Bearing failure can occur when soil strength loss is near a foundation. Settlement can occur when bearing failure is precluded, but volumetric compression occurs. Ground loss results from sand boils and is usually very localized. Liquefaction is typically a design problem only if it occurs in the upper 50 feet of the subsurface soils. However, on sloping ground or when foundations reach beyond that depth, liquefaction should be considered to a greater depth.

The soils most susceptible to liquefaction are sandy soils and silty soils of low plasticity. Cohesive soils with fines content greater than 30% are generally not susceptible to liquefaction if their fines classify as clays, or they have a plasticity index greater than 30%. Generally, if a soil has a clay content greater than 20%, or the water content is less than 0.9 times the liquid limit, liquefaction can be a ruled out. However, cohesive soils, if sensitive, can lose significant strength even if they cannot liquefy, and there may be a need to address this problem. Although widely believed to be non-liquefiable, gravelly soils can be susceptible to liquefaction if internal drainage is impeded. In order for liquefaction to occur, a potentially liquefiable soil must be saturated and subjected to rapid cyclic loading that is sufficiently intense to overcome a soil's internal resistance to liquefaction.

Because the site lies stiff to hard, clayey colluvium over dense Monterey Formation bedrock, liquefaction is not considered a potential hazard at the subject site.

Landsliding

No existing landslides were observed on, or trending into the site. In addition, regional dips of bedding in the Monterey Formation bedrock units are not dipping out of slope (based on test pits data, Dibblee mapping, and Gurrola mapping) and this is typically considered to be a relatively stable geologic condition.

Rockfall
The slope above the site was traversed by a representative of this office. No potential rockfall hazard was observed.

Flooding
Earthquake-induced flooding types include tsunamis, seiches, and reservoir failure. Due to the inland location of the site, hazards from tsunamis and seiches are considered extremely unlikely. Any nearby reservoir that may fail would normally drain into established major drainage channels, and away from the site; therefore, flooding should not be considered a potential hazard.

SOIL/BEDROCK CONDITIONS

Near-surface soils underlying the proposed building areas generally consist of artificial fill over topsoil/colluvium over Monterey Formation bedrock. About 1 to 5 feet of artificial fill was encountered in Test Pits Nos. 1 to 4. The artificial fill consisted of clayey silts to silty clays with common construction debris. In Test Pit No. 3 organic yard cutting were found to a depth of about 2 to 3 feet below the existing grade. In Test Pit No. 4 about 5 feet of trash debris (i.e. bottles, ceramics, etc.) was encountered. Below the artificial fill was topsoil/colluvium consisting of clayey silt to silty clay with common angular clasts of shale. The topsoil/colluvium varied in thickness from 2 to 9 feet. Monterey Formation bedrock was encountered below the topsoil/colluvium. The Monterey Formation bedrock consisted of diatomaceous shale that is bedded to laminated and moderately to highly weathered. The generally east-west striking bedrock units dipped steeply to the south along the northern portion of the site and dipped to north along the southern portion of the site forming a synclinal structure. Testing indicates that anticipated bearing soils lie in the "very low" expansion range of Table 18-I-B of the 2001 California Building Code.

Samples of near-surface soils were tested for pH, resistivity, soluble sulfates and soluble chlorides. Testing indicates that anticipated bearing soils lie within the "negligible" sulfate exposure range in Table 19-A-4 of the 2001 California Building Code. Hence, special concrete designs do not appear necessary to combat sulfate attack. A soil resistivity measurement indicates that the soil is "corrosive" to ferrous metals in the bedrock units and "mildly corrosive in the topsoil/colluvial units. The test results provided in Appendix B should be provided to the project designers for their interpretations pertaining to the corrosivity or reactivity of various construction materials (such as concrete and piping) with the soils.

CONCLUSIONS AND RECOMMENDATIONS

The site is suitable for the proposed development from an Engineering Geology and Geotechnical Engineering standpoint provided that the recommendations contained in this report are successfully implemented into the project.

A. Grading

1. General Grading

a. Grading at a minimum should conform to Chapter 33 of the 2001 California Building Code.

b. The existing ground surface should be initially prepared for grading by removing vegetation, debris piles, large roots, any other organics, and any noncomplying fill. All organics and vegetation should be removed from the site to preclude their incorporation in site fills. Voids created by removing such material should be properly backfilled and compacted. No compacted fill should be placed unless a representative of the Geotechnical Engineer has observed the underlying soil.

c. Fill and backfill placed at near optimum moisture in layers with loose thickness not greater than 8 inches should be compacted to a minimum of 90% of the maximum dry density obtainable by the ASTM D 1557 test method unless otherwise recommended or specified. Random compaction tests by Earth Systems Southern California can assist the Grading Contractor in evaluating whether the Grading Contractor is meeting compaction requirements. Compaction tests pertain only to a specific location, however, and do not guaranty that all fill has been compacted to the prescribed percentage of maximum density. It is the ultimate responsibility of the Grading Contractor to achieve uniform compaction in accordance with the requirements of this report and the grading ordinance.

d. Shrinkage of soils that will be affected by compaction and from rock removal is about 5%.

e. Import soils used to raise site grade should be equal to, or better than, on-site soils in strength, expansion, and compressibility characteristics. Import soil can be evaluated, but will not be prequalified by the Geotechnical Engineer. Final comments on the characteristics of the import will be given after the material is at the project site.

f. Roof draining systems should be designed so that water is not discharged into bearing soils or near the structures. Final site grade could be such that all water is diverted away from the structures, and is not allowed to pond. In landscape areas adjacent to the buildings we recommend a minimum gradient of 2% toward either hardscapes or drain inlets.

g. Earth Systems Southern California should be retained to provide Geotechnical Engineering services during site development and grading, and foundation construction phases of the work to observe compliance with the design concepts, specifications and recommendations. This will allow for timely design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

h. Plans and specifications should be provided to Earth Systems Southern California prior to grading. Plans should include the grading plans, foundation plans, and foundation details. Earth Systems Southern California will review these plans only for conformity with geotechnical parameters not including drainage. It is the responsibility of the Client and other Engineers to review and approve designs and plans for conformity with all engineering and design requirements necessary to the proper function and performance of the structures.

2. <u>Site Grading/Development</u>

a. Overexcavation and recompaction of soils in the building areas will be necessary to decrease the potential for differential settlement and provide more uniform bearing conditions. Soils should be overexcavated throughout the building areas to the deeper depth of either: 1) through the existing uncertified fill and topsoil/colluvium (approximately 2 to 9 feet thick), 2) to a depth of 5 feet below finish pad grade throughout the building areas, or 3) 2 feet below the bottom of the footings and to a distance of at least 5 feet, but not less than the depth of overexcavation relative to the final grading, beyond the perimeter of the buildings. The resulting surface should then be scarified an additional 1 foot, moisture conditioned and recompacted to at least 90% of maximum density.

b. Areas outside of the building areas to receive fill, exterior slabs-on-grade, sidewalks or paving should be overexcavated through the artificial fill and topsoil, scarified to a depth of 1 foot, moisture conditioned and recompacted.

The overexcavation should be performed to a distance equal to the depth of overexcavation relative to the final grading

c. On-site soils may be used for fill once they are cleaned of all organic material, rock, debris and irreducible material larger than 8 inches. Alternately, import soils meeting the criteria previously discussed can be used.

d. If pumping soils or otherwise unstable soils are encountered, stabilization of the excavation bottom will be required prior to placing fill. This can be accomplished by drying the soils, working thin lifts of 1-1/2 inch (minimum size) float rock into the excavation bottom until stabilization is achieved, or by lime or cement treatment of the soils. Use of geotextiles in combination with rock is another possibility.

3. Slope Construction

a. Any construction of fill slopes should conform to the minimum standards listed in Chapter 33 of the 2001 California Uniform Building Code. It is recommended that the Geotechnical Engineer and Engineering Geologist review the grading plans prior to grading and site development.

b. Fill slopes should be keyed and benched through the existing artificial fill and topsoil/colluvium into dense bedrock when the existing slope to receive fill is 5:1 or steeper, horizontal to vertical. The keys should be tilted into the slope, should be a minimum of 12 feet wide, should be a minimum of 2 feet deep on their outside edge, and should be into firm, natural materials.

c. Fill slopes should be overfilled, compacted, and then cut back to the planned configurations. This will yield better compaction on the slope faces than other methods.

d. Backdrains should be placed within fill slopes to minimize the potential of seepage of water from the fill slope faces. A backdrain should consist of a minimum of 1 cubic foot of Class 2 permeable Filter Material per lineal foot of pipe surrounding a 4-inch diameter perforated PVC pipe (holes down). As an alternative to the filter material, ¾ -inch gravel can be used surrounded by a drain filter fabric. The drain should have a solid pipe extending out of the slope face to a concrete swale or a non-erosive surface. The backdrains should be placed at 10-foot vertical intervals in order to provide sufficient drainage.

e. Fill and cut slopes are anticipated to be less than 10 feet in height.

4. Utility Trenches

a. The provisions of this report relating to minimum compaction standards should govern utility trench backfill. In general, on-site service lines may be backfilled with native soils compacted to 90% of maximum density. Backfill of offsite service lines will be subject to the specifications of the jurisdictional agency or this report, whichever are greater. Oversized rocks should not be used in the backfill

b. Jetting of native soils is not recommended.

B. Structural Design

1. Foundations:

a. An expansion index test was found to be in the "low" expansion range.

b. A combination of conventional continuous footings and isolated pad footings bearing into recompacted fill may be used to support the structures. Isolated footings should be tied together with grade beams or by the slab-on-grade floors.

c. Foundation excavations should be observed by a representative of Earth Systems Southern California after excavation, but prior to placing of reinforcing steel or concrete, to verify bearing conditions.

d. Conventional continuous footings may be designed based on an allowable bearing value of 1,500 psf for an assumed footing size of 12 inches wide (18 inches wide for two-story) and a minimum of 15 inches deep for one-story and 18 inches deep for two-story construction.

e. Isolated pad footings interior to perimeter continuous footings may be designed based on an allowable bearing value of 2,000 psf for an assumed square footing size of 24 inches by 24 inches by a minimum of 15 inches deep for one-story and 18 inches deep for two-story construction.

f. Allowable bearing values are net (weight of footing and soil surcharge may be neglected) and are applicable for dead plus reasonable live loads.

g. Bearing values may be increased by one-third when transient loads such as wind and/or seismicity are included.

h. Lateral loads may be resisted by soil friction on floor slabs and foundations and by passive resistance of the soils acting on foundation stem walls. Lateral capacity is based on the assumption that any required backfill adjacent to foundations and grade beams is properly compacted.

i. Conventional continuous footings for buildings where the ground surface slopes at 10:1 horizontal to vertical or steeper should be level or should be stepped so that both the top and the bottom are level.

j. For structures to be constructed above slopes that are steeper than 3:1 (horizontal to vertical), the outside faces at the bottom of the footings should be at a minimum horizontal distance from the slope face equal to the complete height of the slope divided by three, unless stated otherwise herein. This distance should not be less than 10 feet, but need not exceed 40 feet. For structures constructed below slopes, the outside faces of the structures should be at a minimum horizontal distance from the slope face equal to the complete height of the slope divided by two, unless stated otherwise herein. This distance need not exceed 15 feet.

k. The information that follows regarding reinforcement and premoistening for footings is the same as that given in Table 18-I-D (Rev.) for the "low" expansion range. Actual footing designs should be provided by the Structural Engineer, but the dimensions and reinforcement recommended should not be less than the criteria set forth in Table 18-I-D (Rev.) for the appropriate expansion range.

l. Continuous footings bottomed in soils in the "low" expansion range should be reinforced, at a minimum, with one No. 4 bar along the bottom and one No. 4 bar along the top.

m. Bearing soils in the "low" expansion range should be premoistened to 120% of optimum moisture content to a depth of 21 inches below lowest adjacent grade. Premoistening should be confirmed by testing.

2. Slabs-on-Grade

a. Concrete slabs should be supported by compacted structural fill.

b. It is recommended that perimeter slabs (walks, patios, etc.) be designed relatively independent of footing stems (i.e., free floating) so foundation adjustment will be less likely to cause cracking.

c. The slab designs should be provided by the project Structural Engineer.

d. Slabs should be underlain with a minimum of 4 inches of sand. Areas where floor wetness would be undesirable should be underlain with a vapor retarder or barrier (as specified by the project Architect or Civil Engineer) to reduce moisture transmission from the subgrade soils to the slab. The retarder/barrier should be placed per the recommendations of the project Architect or Manufacturer.

e. Slabs should at a minimum be reinforced at mid-slab with No. 3 bars on 24-inch centers, each way.

f. Soils underlying slabs that are in the "low" expansion range should be premoistened to 120% of optimum moisture content to a depth of 21 inches below lowest adjacent grade. Premoistening should be confirmed by testing.

3. <u>Frictional and Lateral Coefficients</u>

a. Resistance to lateral loading may be provided by friction acting on the base of foundations. A coefficient of friction of 0.5 may be applied to dead load forces. This value does not include a factor of safety.

b. Passive resistance acting on the sides of foundation stems equal to 206 pcf of equivalent fluid weight may be included for resistance to lateral load. This value does not include a factor of safety.

c. A minimum factor of safety of 1.5 should be incorporated into designs for sliding or overturning.

d. Passive resistance may be combined with frictional resistance provided that a one-third reduction in the coefficient of friction is used.

4. <u>Retaining Walls</u>

a. Conventional cantilever retaining walls should not be backfilled with onsite expansive soils. Retaining walls backfilled with compacted imported granular soils may be designed for active pressures of 35 pcf of equivalent fluid weight for well-drained, level backfill, and 46 pcf for 2:1 sloping backfilled. This backfill should comprise an envelope defined by a 1:1 upward projection from the heel of the retaining wall foundation to the ground surface, and the back of the wall.

b. The pressures listed above were based on the assumption that backfill soils will be compacted to 90% of maximum dry density as determined by the ASTM D 1557 Test Method.

c. The lateral earth pressure to be resisted by the retaining walls or similar structures should be increased to allow for surcharge loads. The surcharge considered should include the loads from any structures or temporary loads that would influence the wall design.

d. A system of backfill drainage and waterproofing should be incorporated into the retaining wall designs. Backfill comprising the drainage system immediately behind the retaining structures should be a free-draining granular material with a filter fabric between it and the rest of the backfill soils. As an alternative, the back of the wall could be lined with a geodrain system. The backdrain should extend from the bottom of the wall to about 18 inches from finished backfill grade. In addition to waterproofing retaining walls that are a part of the buildings, waterproofing of exterior retaining walls should be considered to help mitigate efflorescence on wall faces.

e. Compaction on the uphill side of the wall within a horizontal distance equal to one wall height should be performed by hand-operated or other light weight compaction equipment. This is intended to reduce potential "locked-in" lateral pressures caused by compaction with heavy grading equipment.

f. Water should not be allowed to pond near the top of the wall. To accomplish this the final backfill site grade should be such that all water is diverted away from the retaining wall.

5. Settlement Considerations

Maximum expected settlement of less than 1 inch is anticipated for foundations and floor slabs designed as recommended and subjected to static loading. Differential settlement between adjacent load bearing members should be less than one-half the total settlement.

ADDITIONAL SERVICES

This report is based on the assumption that an adequate program of monitoring and testing will be performed by Earth Systems Southern California during construction to check compliance with the recommendations given in this report. The recommended tests and observations include, but are not necessarily limited to the following:

1. Review of the building and grading plans during the design phase of the project.
2. Observation and testing during site preparation, grading, placing of engineered fill, and foundation construction.
3. Consultation as required during construction.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

The analysis and recommendations submitted in this report are based in part upon the data obtained from the test pits excavated on the site. The nature and extent of variations between and beyond the pits 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 our 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 test pit logs regarding odors noted, unusual or suspicious items or conditions observed, are strictly for the information of our 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 be due to 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 construction and other improvements are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and 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 insure 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 Southern California strives to provide our services in accordance with the 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 and their authorized agents.

It is recommended that Earth Systems Southern California 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 Southern California is not accorded the privilege of making this recommended review, we can assume no responsibility for misinterpretation of our recommendations.

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APPENDIX A

Field Study
Vicinity Map
Site Map
Satellite Site Image
Regional Geology Map (Dibblee)
Regional Geology Map (Gurrola)
Trench Location Map
Test Pit Logs
Symbols Commonly Used on Boring Logs
Unified Soil Classification

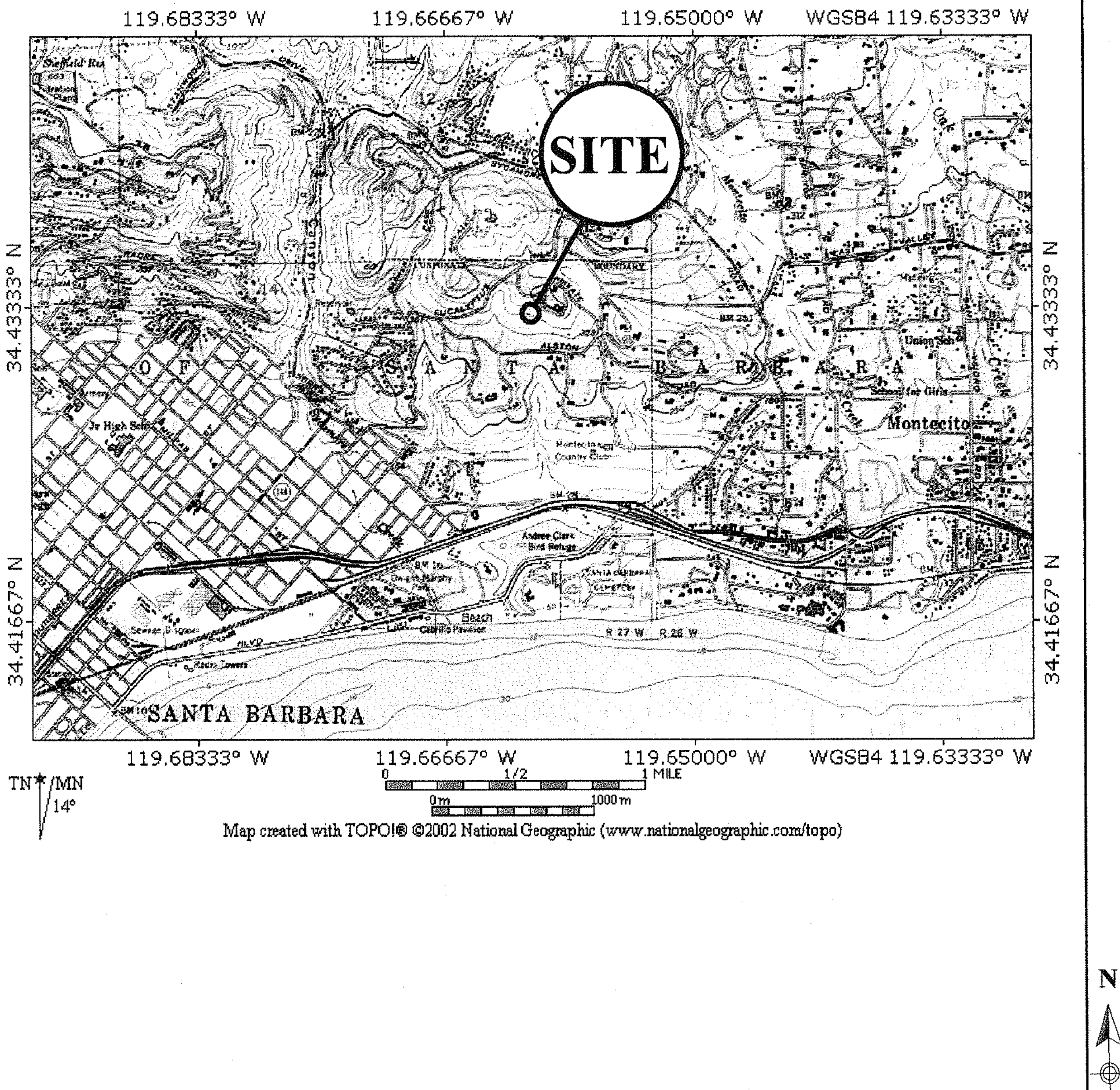
FIELD STUDY

A. On June 12, 2006, seven backhoe test pits were excavated with a subcontracted backhoe to a depth range of about 5 to 12 feet below the existing grade in the general area of the proposed construction. The test pits were performed to observe the soil/bedrock profile and to obtain samples for laboratory analysis. The approximate locations of the pits were determined in the field by pacing and sighting, and are shown on the Trench Location Map in this appendix.

B. Samples were obtained within the test pits 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 2.37-inch inside diameter. The samples in the test pits were obtained by driving the sampler with a lightweight hand operated slide hammer.

C. A bulk sample of the soils encountered was gathered from the excavation cuttings.

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



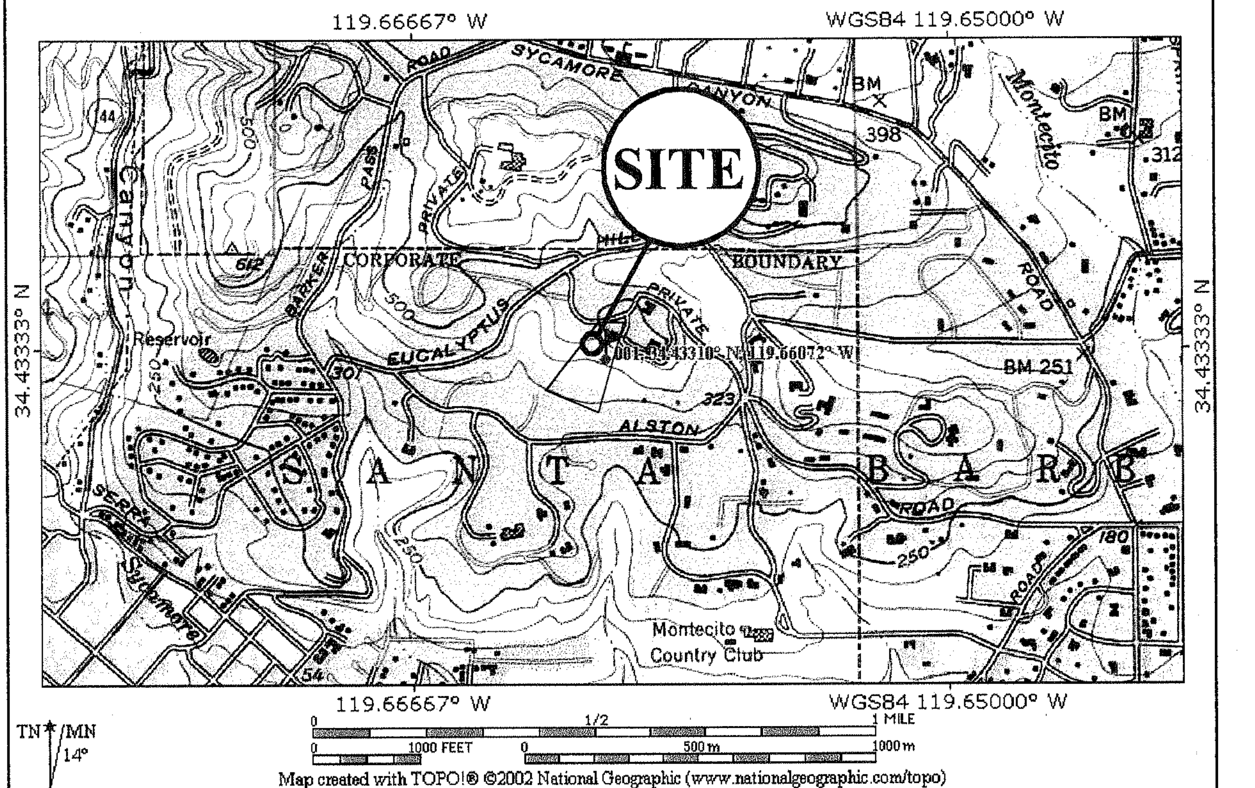
Map created with TOPO!® ©2002 National Geographic (www.nationalgeographic.com/topo)

VICINITY MAP

226 & 232 EUCALYPTUS HILL DRIVE,
SANTA BARBARA, CALIFORNIA

Earth Systems
Southern California

July, 2006	VT-23720-01



SITE MAP

226 & 232 EUCALYPTUS HILL DRIVE,
SANTA BARBARA, CALIFORNIA

Earth Systems
Southern California

July, 2006	VT-23720-01

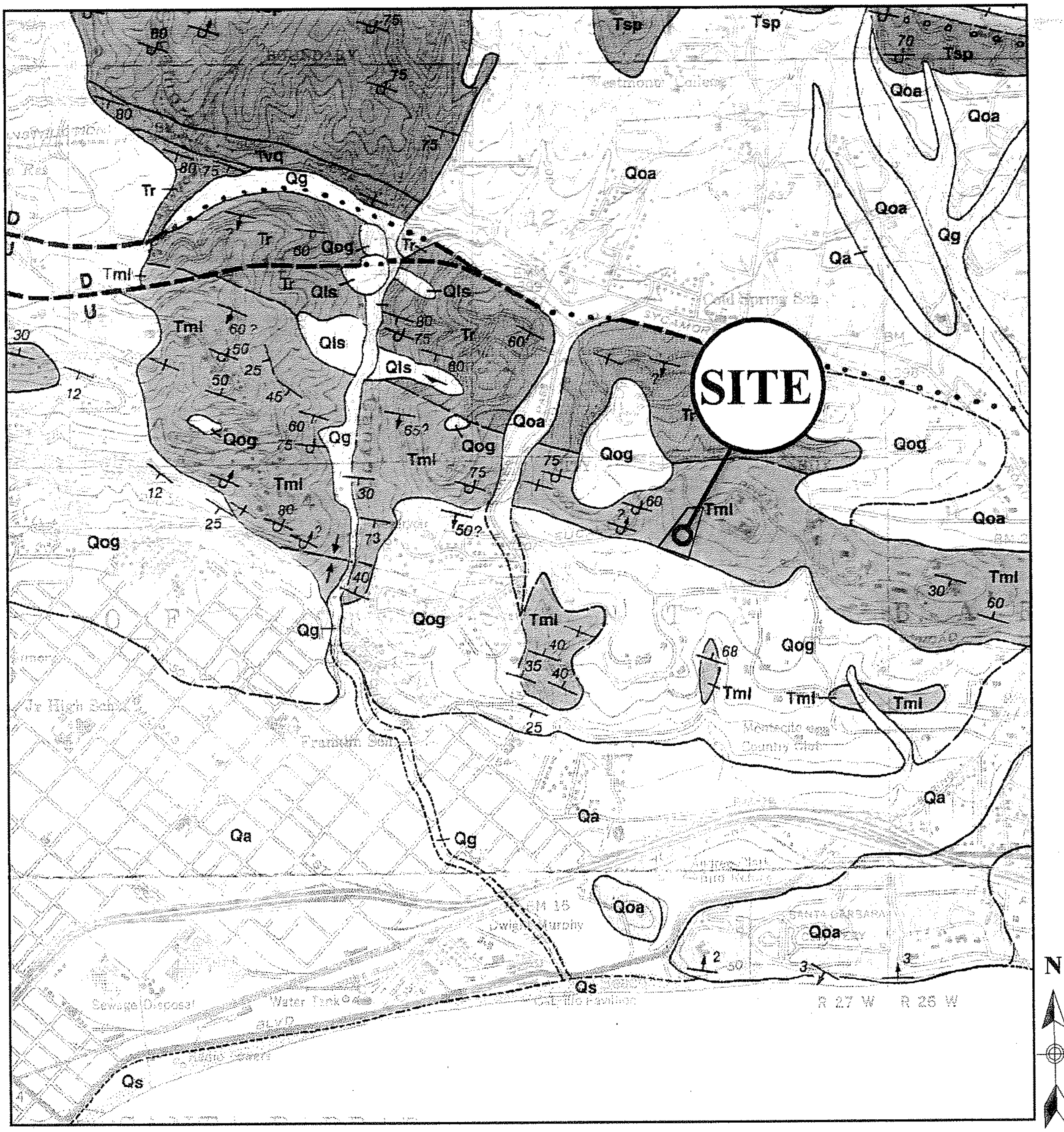
N

SATELLITE SITE IMAGE

226 & 232 EUCALYPTUS HILL DRIVE,
SANTA BARBARA, CALIFORNIA

Earth Systems
Southern California

July, 2006	VT-23720-01



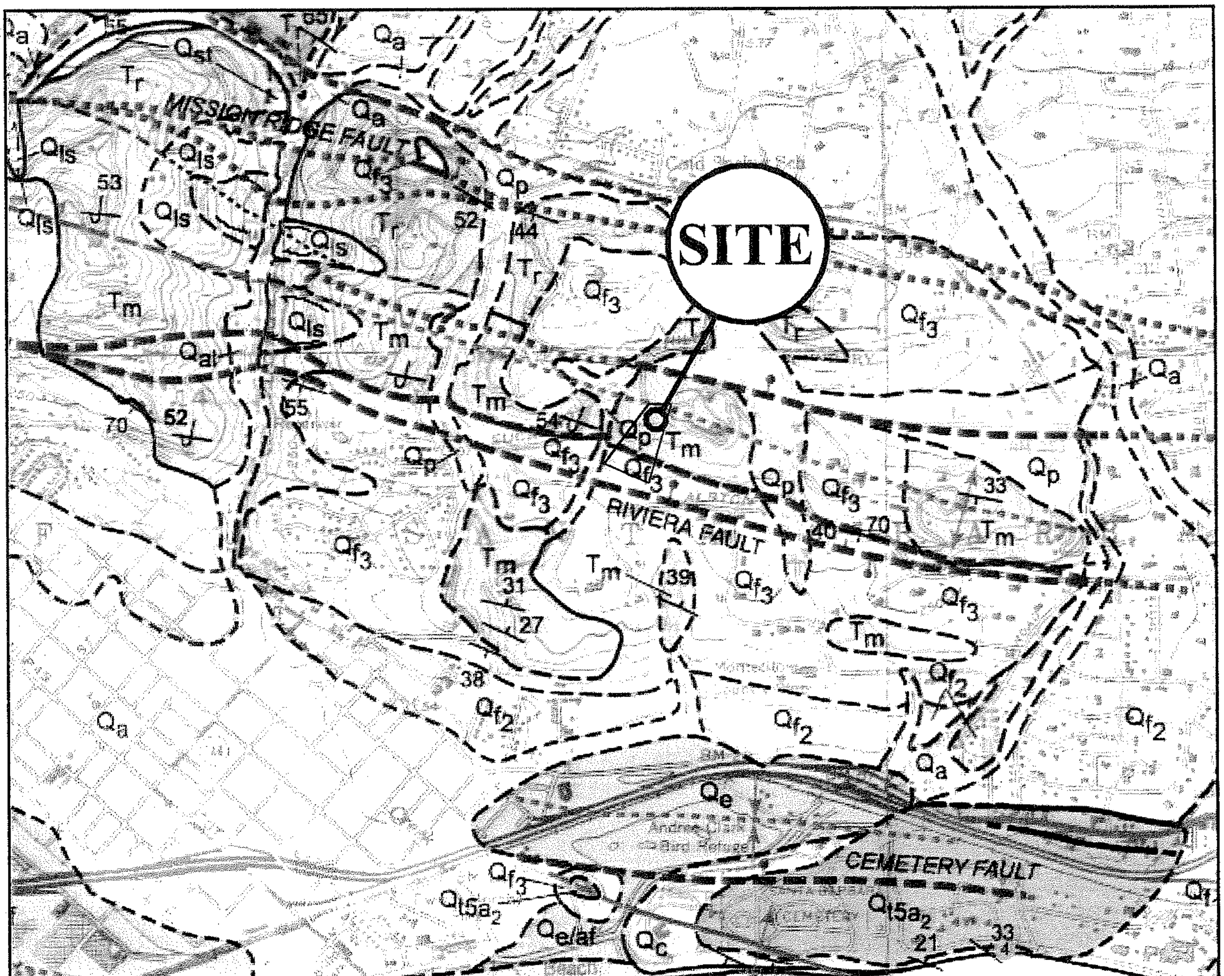
*Taken from T.W. Dibblee, Jr., Geologic Map of the Santa Barbara County Quadrangle, 1986

REGIONAL GEOLOGY

226 & 232 EUCALYPTUS HILL DRIVE
SANTA BARBARA, CALIFORNIA

Earth Systems
Southern California

July, 2006	VT-23720-01



EXPLANATION

Geologic contact, location approximate, concealed or inferred

Fault, location approximate where dashed, location concealed (blind) or inferred where dotted; ball and bar on downthrown side, tic indicates dip of fault; single arrow indicates minor component of strike-slip, double arrows indicate strike-slip fault

Anticline, location approximate where dashed, inferred where dotted; plunge direction indicated

Syncline, location approximate where dashed, inferred where dotted; plunge direction indicated

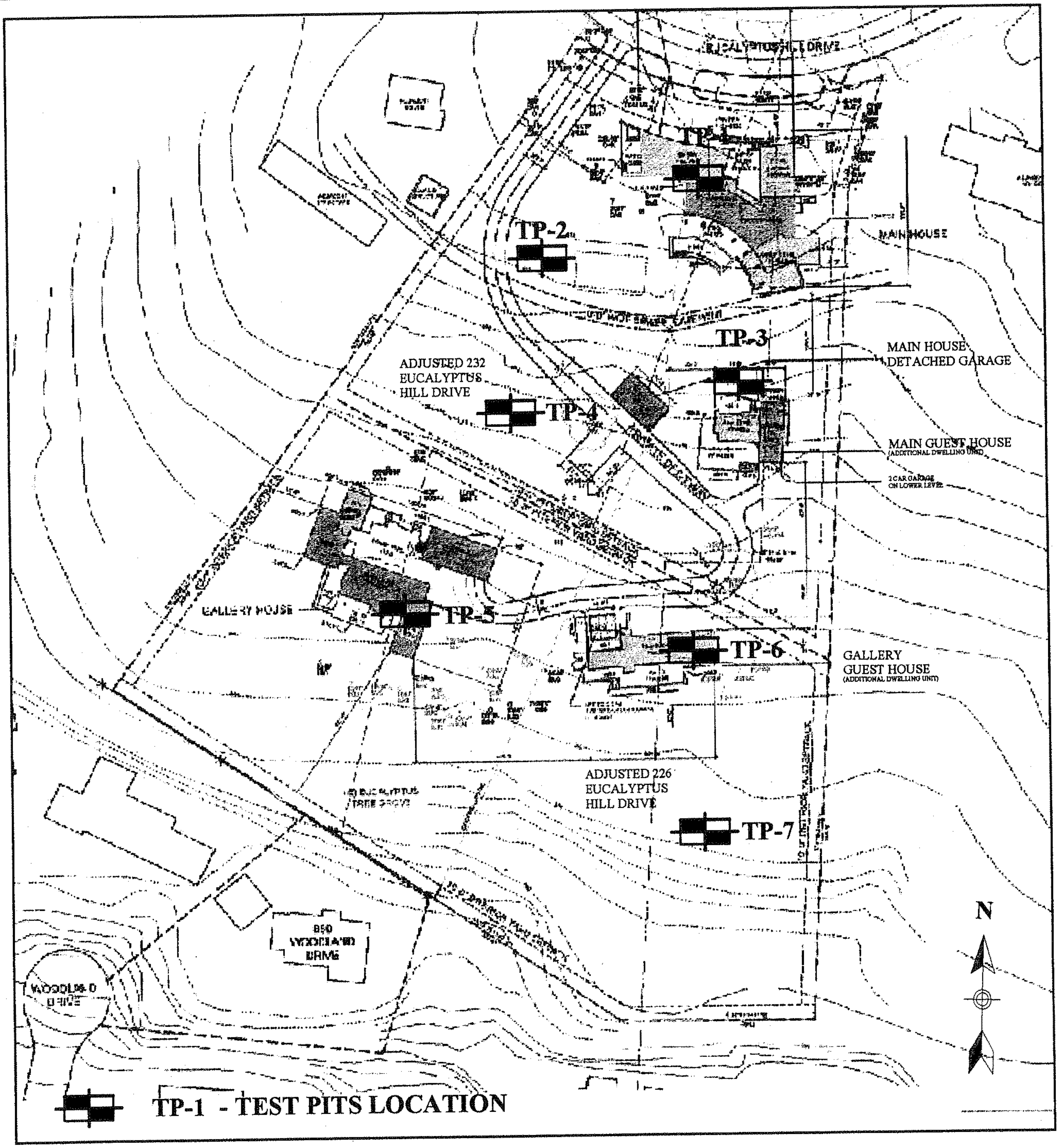
Marine terrace shoreline or strandline, location approximate

35 Strike and dip of inclined beds

N

*Taken from Larry D. Gurrola Geologic Map of the Eastern Santa Barbara Fold Belt, Santa Barbara, 2004

TECTONIC MAP	
226 & 232 EUCALYPTUS HILL DRIVE SANTA BARBARA, CALIFORNIA	
Earth Systems **Southern California**	
July, 2006	VT-23720-01

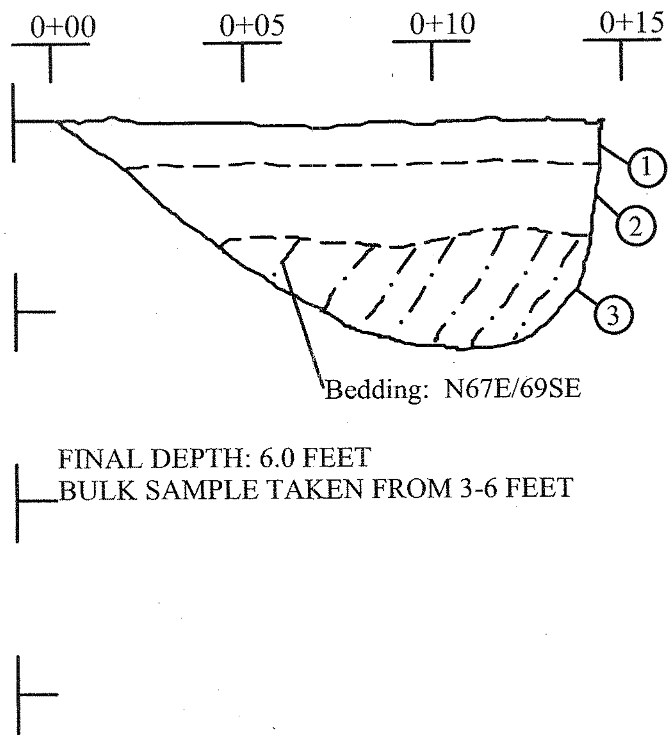


TRENCH LOCATION MAP

226 & 232 EUCALYPTUS HILL DRIVE,
SANTA BARBARA, CALIFORNIA

Earth Systems
Southern California

July, 2006	VT-23720-01



TREND: N30E

FINAL DEPTH: 6.0 FEET
BULK SAMPLE TAKEN FROM 3-6 FEET

DESCRIPTIONS

1. ARTIFICIAL FILL (ML): Very fine sandy silt with fine gravel, occasional fine cobble and clay with fine gravel, some construction debris, many roots in upper 3' ranging from 1/4" to 2" in diameter, slightly moist, stiff to medium stiff, pale orangish brown to black.

2. SOIL (CL): Clay with fine gravel, plastic, roots ranging from 1/2" to 2" in diameter, moist, stiff, black.

3. MONTEREY FORMATION (Tm): Diatomaceous shale, highly weathered, bedded to laminated, 1/16" to 1/4" fractures along bedding with black clay, stiff, pale olive.

RING SAMPLE@ 5 FEET: IN-PLACE DENSITY 60.7 pcf; IN-PLACE MOISTURE 52.7%

SCALE: 1" = 5' (VERTICAL & HORIZONTAL)

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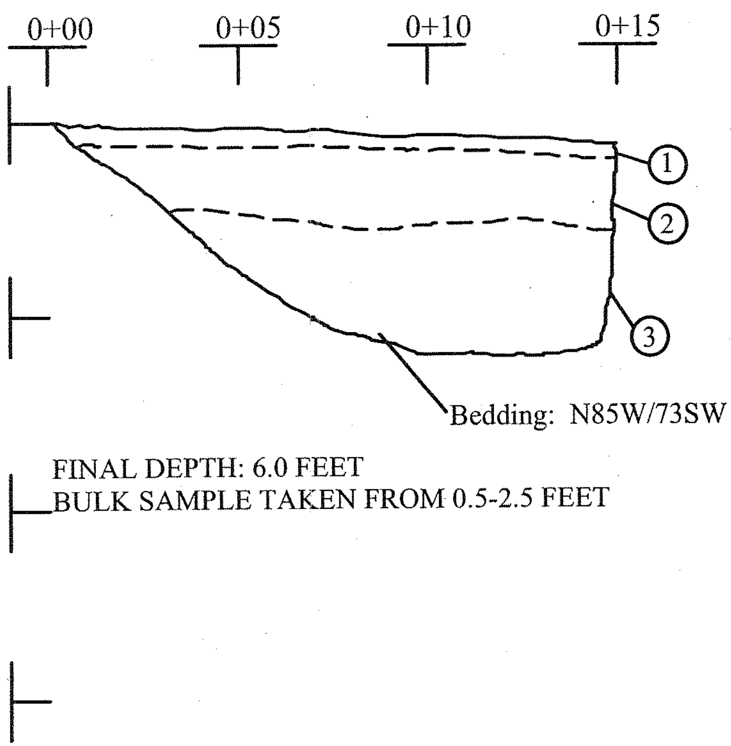
TEST PIT #1

226 & 236 Eucalyptus Hill Drive

June 12, 2006 | VT-23720-01



TREND: N28E

FINAL DEPTH: 6.0 FEET
BULK SAMPLE TAKEN FROM 0.5-2.5 FEET

DESCRIPTIONS

1. ARTIFICIAL FILL (ML): Very fine sandy silt, decaying wood debris, fine roots in upper 6", slightly moist, medium stiff to stiff, pale brown.

2. SOIL (CL): Silty clay, some fine gravel, many roots ranging from 1/4" to 2" in diameter, occasional cobble up to 4" in diameter, moist, medium stiff, black.

3. MONTEREY FORMATION (Tm): Diatomaceous shale, highly weathered to slightly clayey silt, bedded to laminated, pale olive to orangish brown.

RING SAMPLE@ 2.5 FEET: IN-PLACE DENSITY 66.6 pcf; IN-PLACE MOISTURE 47.6%

SCALE: 1" = 5' (VERTICAL & HORIZONTAL)

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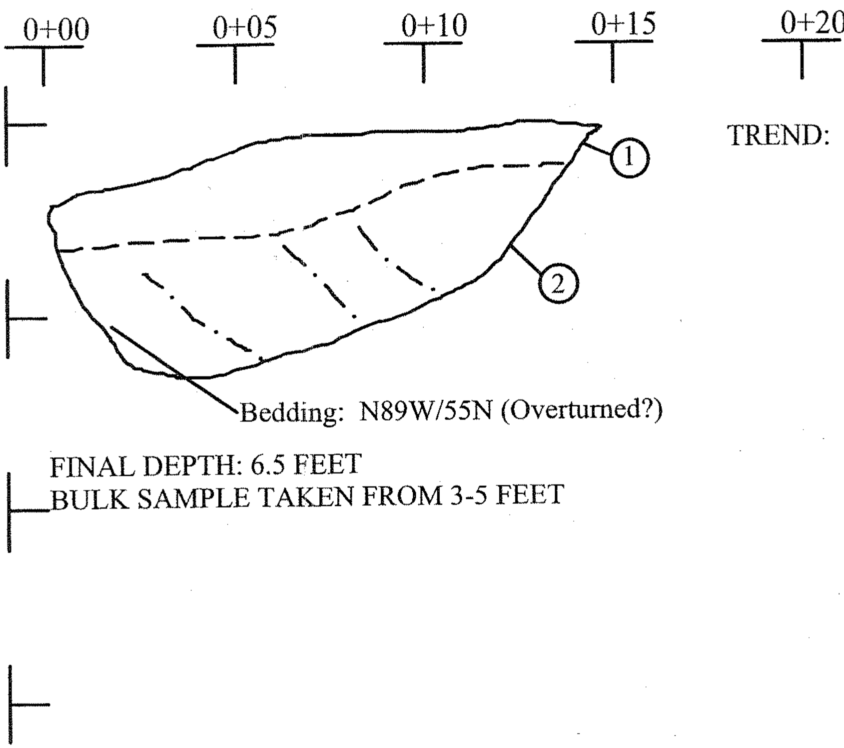
TEST PIT #2

226 & 236 Eucalyptus Hill Drive

June 12, 2006

VT-23720-01



FINAL DEPTH: 6.5 FEET
BULK SAMPLE TAKEN FROM 3-5 FEET

TREND: N33E

DESCRIPTIONS

1. ARTIFICIAL FILL (OL): Sandy silt with gravels and cobbles, collapsing into test pit, abundant decaying leaf/grass cuttings, many fine roots, some construction debris, dry, very soft, dark brown.

2. MONTEREY FORMATION (Tm): Diatomite, laminated, highly fractured with black clay in fractures that are 1/16" to 1/4" wide, pale olive to whitish olive.

SCALE: 1" = 5' (VERTICAL & HORIZONTAL)

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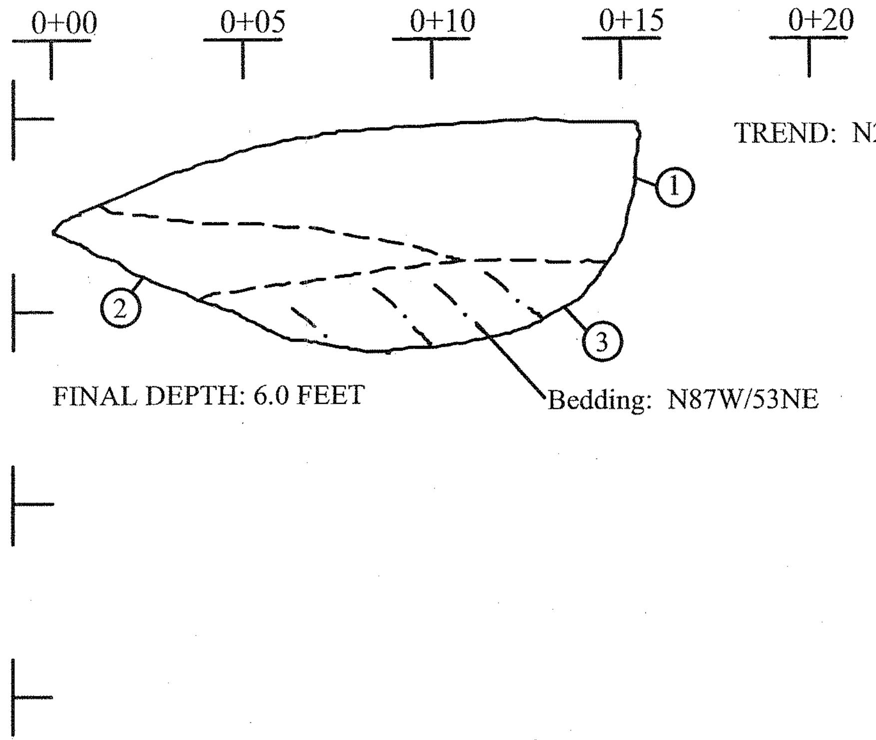
TEST PIT #3

226 & 236 Eucalyptus Hill Drive

June 12, 2006 | VT-23720-01



DESCRIPTIONS

1. **TRASH DEBRIS: Buried trash debris consisting of bottles, ceramics, etc. with artificial fill matrix, slightly moist, loose.**

2. **ARTIFICIAL FILL (ML/CL): Clayey silt to silty clay, trace fine gravel, scattered trash debris, roots up to 1/16" in diameter, locally soft to stiff, black.**

3. **MONTEREY FORMATION (Tm): Diatomaceous shale, highly weathered to clayey silt, laminated, low density, pale olive.**

RING SAMPLE@ 2 FEET: IN-PLACE DENSITY 63.7 pcf; IN-PLACE MOISTURE 27.6%

SCALE: 1" = 5' (VERTICAL & HORIZONTAL)

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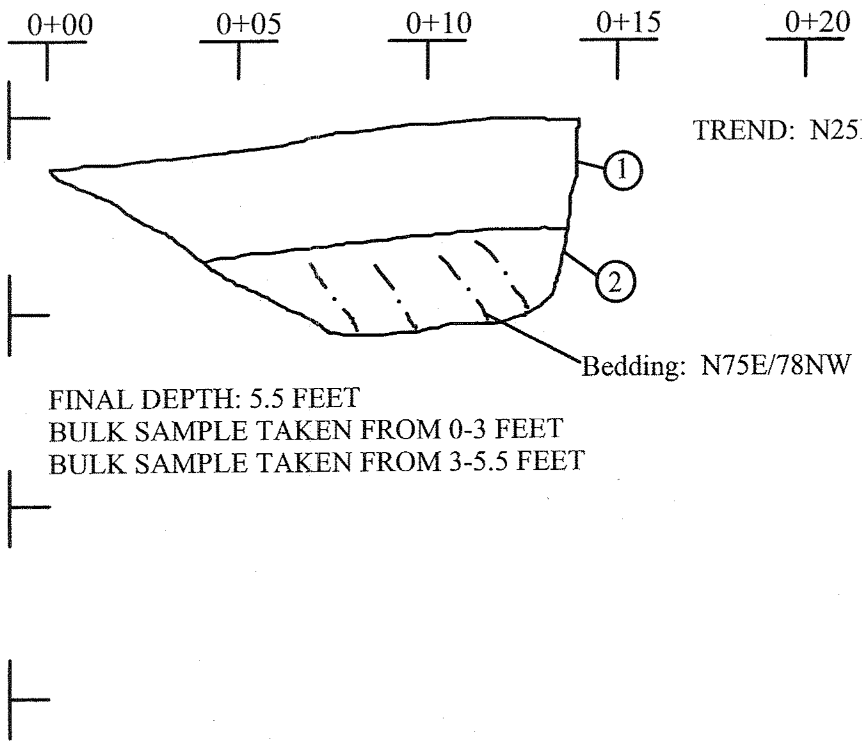
TEST PIT #4

226 & 236 Eucalyptus Hill Drive

June 12, 2006

VT-23720-01



TREND: N25E

FINAL DEPTH: 5.5 FEET
BULK SAMPLE TAKEN FROM 0-3 FEET
BULK SAMPLE TAKEN FROM 3-5.5 FEET

DESCRIPTIONS

1. SOIL (ML): Slightly clayey silt, many roots ranging from 1/4" to 2" in diameter, very few pores up to 1/32" in diameter, sharp contact to shale, moist, stiff, black.

2. MONTEREY FORMATION (Tm): Diatomaceous shale,weathers to silty gravel, fractures with black clay 1/8" to 1/2" wide, discontinued factures across and along bedding, bedded to laminated, low density shale, olive.

RING SAMPLE@ 5 FEET: IN-PLACE DENSITY 52.1 pcf; IN-PLACE MOISTURE 39.0%

SCALE: 1" = 5' (VERTICAL & HORIZONTAL)

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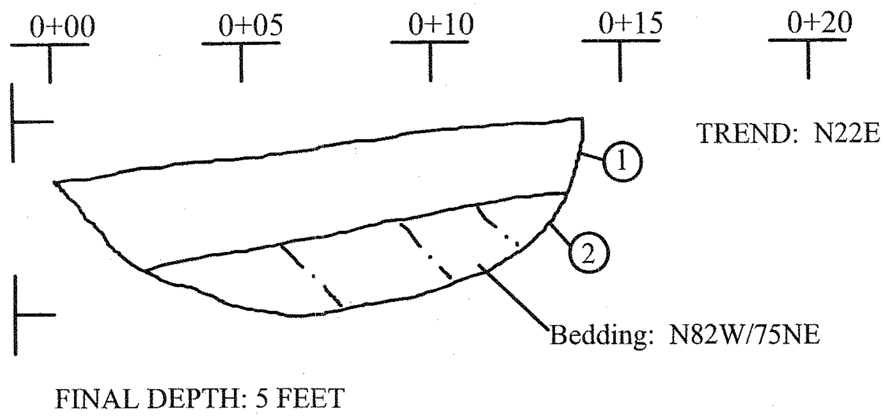
TEST PIT #5

226 & 236 Eucalyptus Hill Drive

June 12, 2006

VT-23720-01



DESCRIPTIONS

1. **SOIL (ML/CL): Clayey silt to silty clay, plastic, many fine roots in upper 1.5' to 1" in diameter, some roots ranging from 1.5" to 3" in diameter, moist, medium stiff to stiff, dark brown to black. Sharp contact to shale.**

2. **MONTEREY FORMATION (Tm): Shale, well cemented, laminated, hard, pale olive.**

SCALE: 1" = 5' (VERTICAL & HORIZONTAL)

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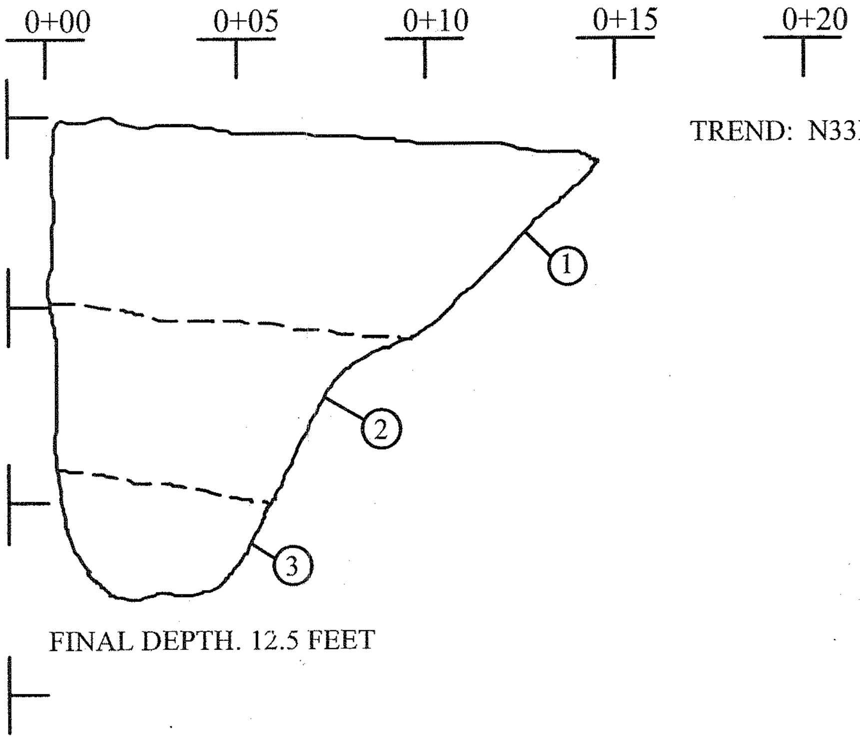
TEST PIT #6

226 & 236 Eucalyptus Hill Drive

June 12, 2006

VT-23720-01



TREND: N33E

DESCRIPTIONS

1. COLLUVIUM (CL): Slightly silty clay with gravel, occasional cobbles, plastic, subangular to angular clasts, many roots to 2" in diameter, moist, medium stiff to stiff, black. Gradational contact to next layer.

2. COLLUVIUM (CL): Gravelly clay to locally clayey gravels, some fine roots, moist, stiff to medium dense, black to pale olive.

3. MONTEREY FORMATION (Tm): Shale, laminated, moderately hard, pale olive to gray.

SCALE: 1" = 5' (VERTICAL & HORIZONTAL)

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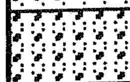
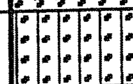
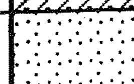
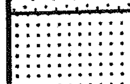
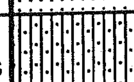
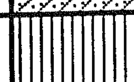
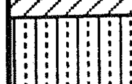
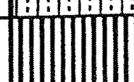
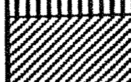
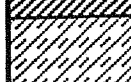
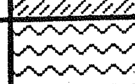
TEST PIT #7

226 & 236 Eucalyptus Hill Drive

June 12, 2006

VT-23720-01

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)		G W	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				G P	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		G M	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				G C	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SAND (LITTLE OR NO FINES)		S W	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				S P	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SAND WITH FINES (APPRECIABLE AMOUNT OF FINES)		S M	SILTY SANDS, SAND-SILT MIXTURES
				S C	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		M L	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				C L	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				O L	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		M H	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				C H	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				O H	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				P T	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS.

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Unified Soil Classification System (USCS)

- 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 approximate locations of borings were determined by sighting and pacing from nearby prominent topographic or cultural features. Borehole elevations were estimated by interpolating between available plan contour intervals. The location and elevation of each boring should be considered accurate only to the degree implied by this method.

2. Stratification lines represent the approximate boundary between soil and/or rock types. The transition between statigraphic units may be gradual.

3. Water level readings taken in boreholes are approximate and apply only to the time and date of drilling. Fluctuations in the level of groundwater from the time of initial measurement may occur due to variations in rainfall, tides, barometric pressure, temperature, or other factors.

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Symbols Commonly Used on Boring Logs

APPENDIX B

Laboratory Testing
Tabulated Test Results
Individual Test Results
Soil Chemistry Results
Table 18-I-D (Rev.) with Footnotes

LABORATORY TESTING

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

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

C. The relative strength characteristics of the soils were determined from the results of direct shear tests on undisturbed and remolded samples. Shear specimens were placed in contact with water at least 24 hours before testing, and were then sheared under normal loads ranging from 1 to 3 kips per square foot in general accordance with ASTM D 3080.

D. Settlement characteristics were developed from the results of one dimensional consolidation tests performed in general accordance with ASTM D 2435. The samples were loaded to 0.125, 0.25 and 0.5, then flooded with water, and then incrementally loaded to 1.0, 2.0 and 4.0 ksf. The samples were allowed to consolidate under each load increment. Rebound was measured under reverse alternate loading. Compression was measured by dial gauges accurate to 0.0001 inch. Results of the consolidation tests in the form of percent consolidation versus log of pressure curves are presented in this Appendix.

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

F. Maximum density tests were performed to estimate the moisture-density relationship of typical soil materials. The tests were performed in accordance with ASTM designation D 1557.

G. The gradation characteristics of the bulk samples were made by hydrometer (in accordance with ASTM D 422) and sieve analysis procedures. The samples were soaked in water until individual soil particles were separated and then washed on the No. 200 mesh sieve, oven dried, weighed to calculate the percent passing the No. 200 sieve and then mechanically sieved.

H. Concrete and metal corrosion potential of the near surface soil was determined by measuring pH, resistivity, and soluble sulfate and soluble chloride contents. The tests were performed Capco Analytical.

TABULATED TEST RESULTS

REMOLDED SAMPLE

TEST PIT AND DEPTH	TP-2 @ 0.5-2.5'	TP-5 @ 3-5.5'
DESCRIPTION	Topsoil	Monterey Formation
SOIL TYPE	CL	- -
MAXIMUM DENSITY (pcf)	86	57.5
OPTIMUM MOISTURE (%)	27	50.5
PEAK COHESION (psf)	320	660
PEAK ANGLE OF INTERNAL FRICTION	27°	31°
ULTIMATE COHESION (psf)	220	270
ULTIMATE ANGLE OF INTERNAL FRICTION	28°	32°
EXPANSION INDEX	21	0
GRAIN SIZE DISTRIBUTION (%)		
GRAVEL	0.1	0
SAND	28.8	58.4
SILT	20.6	13.9
CLAY	50.5	27.7
CHLORIDE (mg/Kg)	BQL	430
pH (S.U.)	5.9	4.4
RESISTIVITY (ohms-cm)	19,600	1,820
SULFATE (mg/Kg)	BQL	120

RELATIVELY UNDISTURBED SAMPLES

BORING AND DEPTH	TP-1 @ 5'	TP-5 @ 5'
SOIL TYPE	ML	- -
IN-PLACE DENSITY (pcf)	60.7	52.1
IN-PLACE MOISTURE (%)	52.7	39
PEAK COHESION (psf)	560	920
PEAK ANGLE OF INTERNAL FRICTION	48°	34°
ULTIMATE COHESION (psf)	380	1,040
ULTIMATE ANGLE OF INTERNAL FRICTION	33°	29°

MAXIMUM DENSITY / OPTIMUM MOISTURE

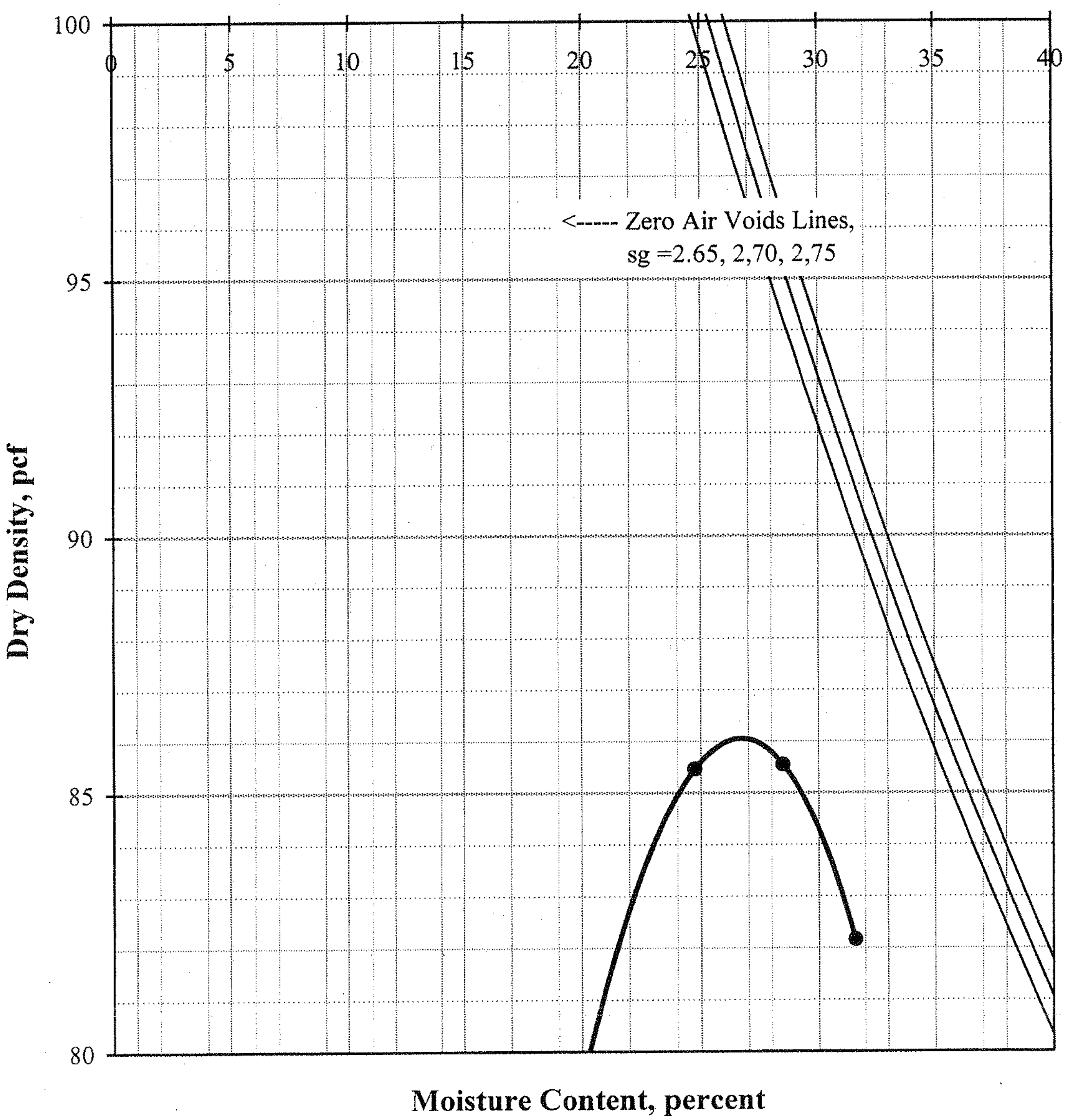
ASTM D 1557-91 (Modified)

Job Name: Eucalyptus Hill Drive
Sample ID: T P 2 @ 0.5-2.5
Location: 0.5-2.5
Description: Silty Sandy Clay

Procedure Used: A
Prep. Method: Moist
Rammer Type: Automatic

Maximum Density: **86 pcf**
Optimum Moisture: **27%**

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



VT-23720-01

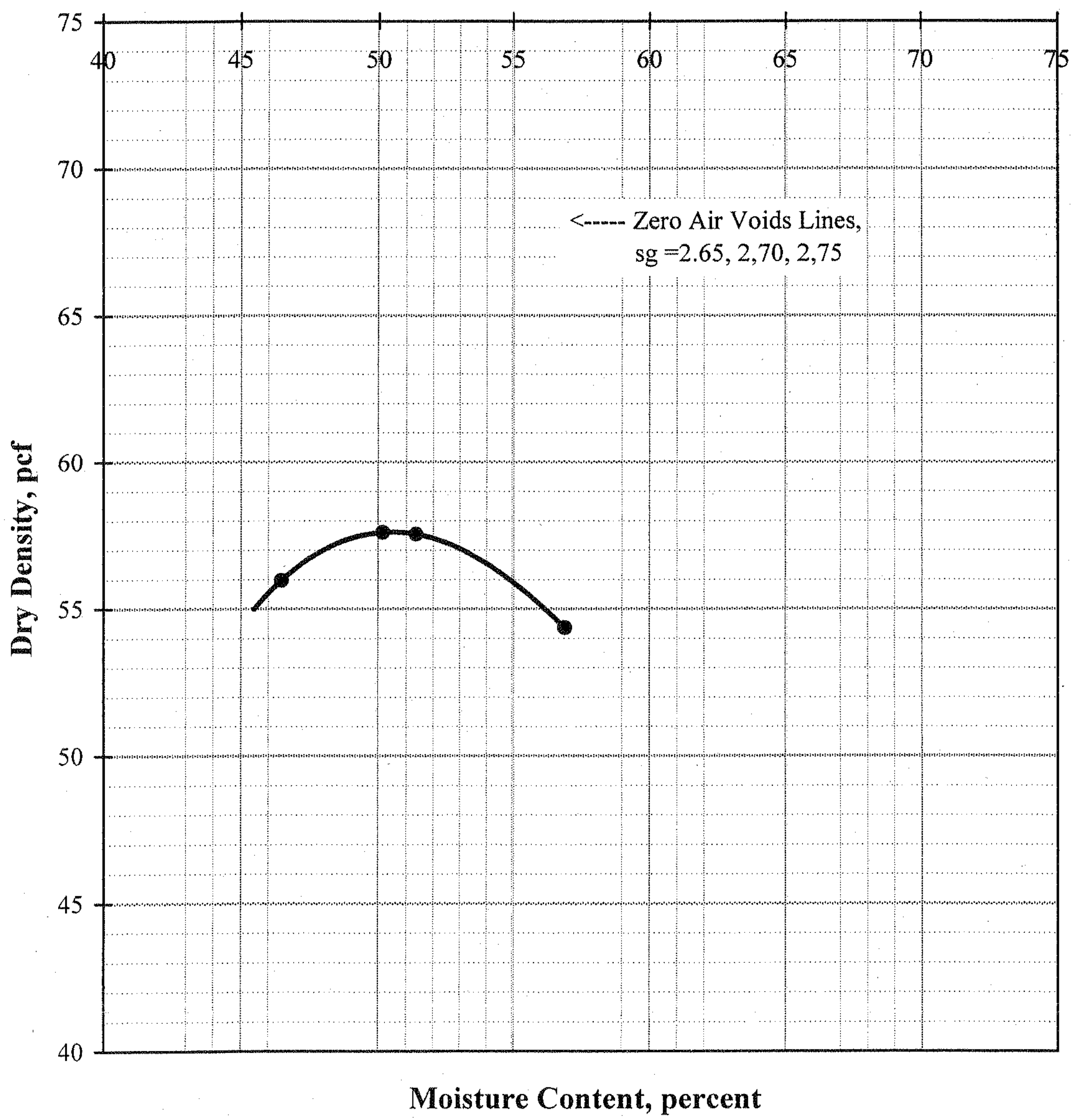
MAXIMUM DENSITY / OPTIMUM MOISTURE

ASTM D 1557-91 (Modified)

Job Name:	Eucalyptus Hill Rd	Procedure Used:	A
Sample ID:	TP 5 @ 3-5.5	Prep. Method:	Moist
Location:		Rammer Type:	Automatic
Description:	Silt Clay Sand/ Pale Yellowish Grey Brown		

Maximum Density: **57.5 pcf**
Optimum Moisture: **50.5%**

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



SHORT HYDRO

Job Name:	Eucalyptus Hill Drive
Job No.:	VT-23720-01
Sample ID:	**TP2 @ .5-2.5**
Soil Description:	**Silty sandy clay**

Hydroscopic Moisture

Air Dry Wt, g:	100.0
Oven Dry Wt, g	98.0
% Moisture:	2.0

Air Dry Sample Wt., g:	406.5
Corrected Wt., g:	398.4

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	0.3	0.07	99.93
#8	3.0	0.74	99.26
#10	6.0	1.48	98.52

Air Dry Hydro Sample Wt., g:	63.5
Corrected Wt., g:	62.2
Calculation Factor	0.6316

Hydrometer Analysis for <#10 Material

Start time: 7:39:00 AM

Short Hydro	Time of Reading	Hydro Reading	Temp. at Reading, °C	Correction Factor	Corrected Hydro Reading
20 sec	7:39:20 AM	53	21	8.1	44.9
1 hour	8:39:00 AM	40	21	8.1	31.9

% Gravel:	0.1
% Sand:	28.8
% Silt:	20.6
% Clay:	50.5

SHORT HYDRO

Job Name:	Eucalyptus Hill Drive
Job No.:	VT-23720-01
Sample ID:	**TP5 @ 3-5.5'**
Soil Description:	**Silty clayey sand**

Hydroscopic Moisture

Air Dry Wt, g:	100.0
Oven Dry Wt, g	98.0
% Moisture:	2.0

Air Dry Sample Wt., g:	406.1
Corrected Wt., g:	398.0

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	0.1	0.02	99.98

Air Dry Hydro Sample Wt., g:	66.1
Corrected Wt., g:	64.8
Calculation Factor	0.6479

Hydrometer Analysis for <#10 Material

Start time: 7:24:00 AM

Short Hydro	Time of Reading	Hydro Reading	Temp. at Reading, °C	Correction Factor	Corrected Hydro Reading
20 sec	7:24:20 AM	35	21	8.1	26.9
1 hour	8:24:00 AM	26	21	8.1	17.9

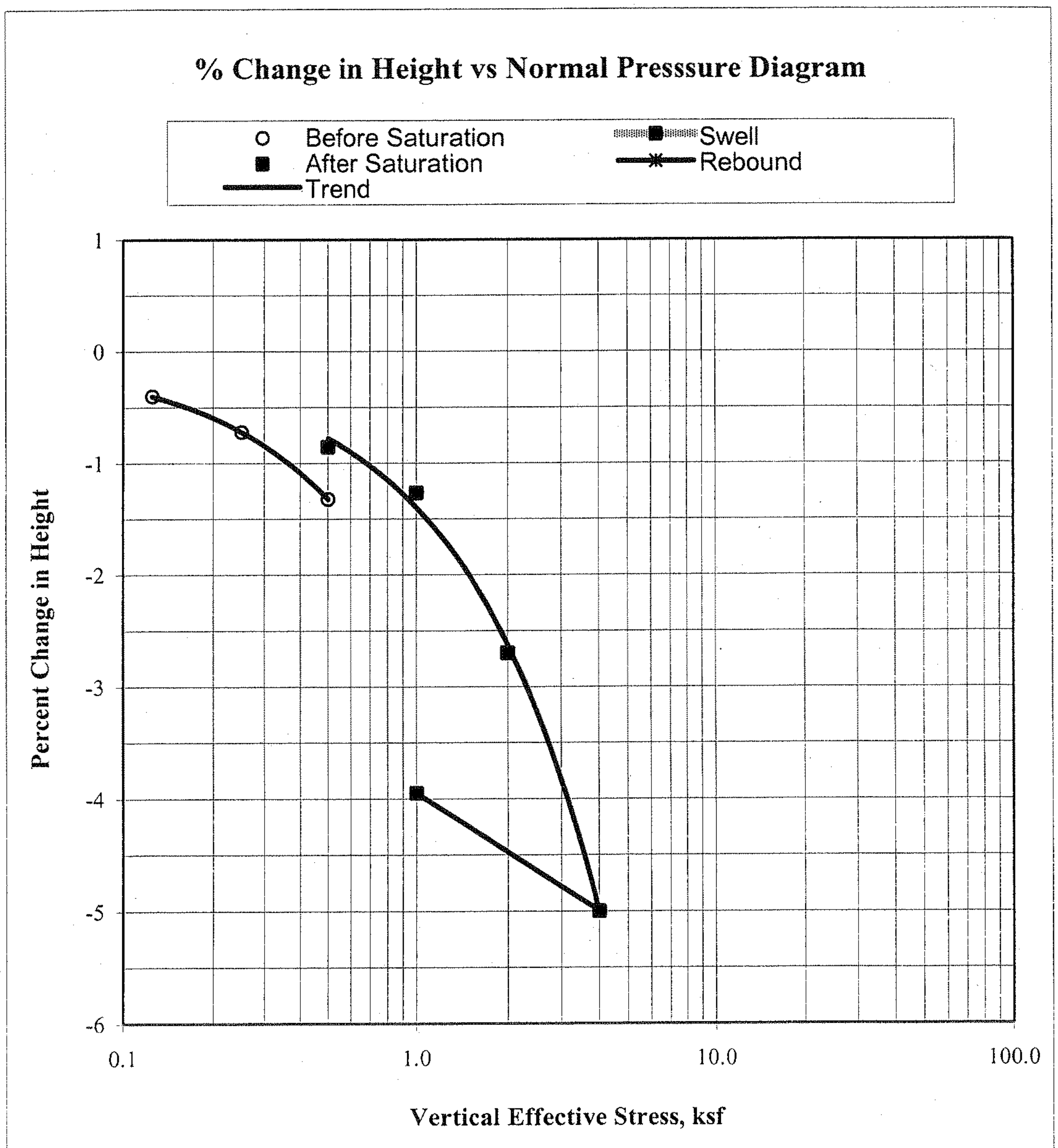
% Gravel:	0.0
% Sand:	58.4
% Silt:	13.9
% Clay:	27.7

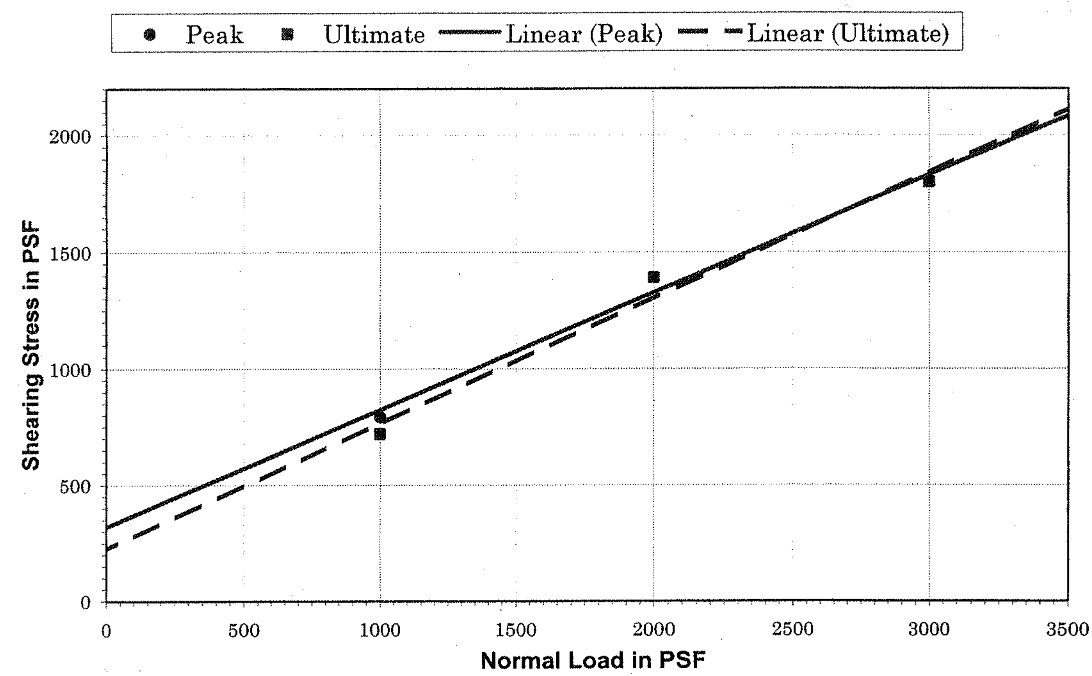
CONSOLIDATION TEST

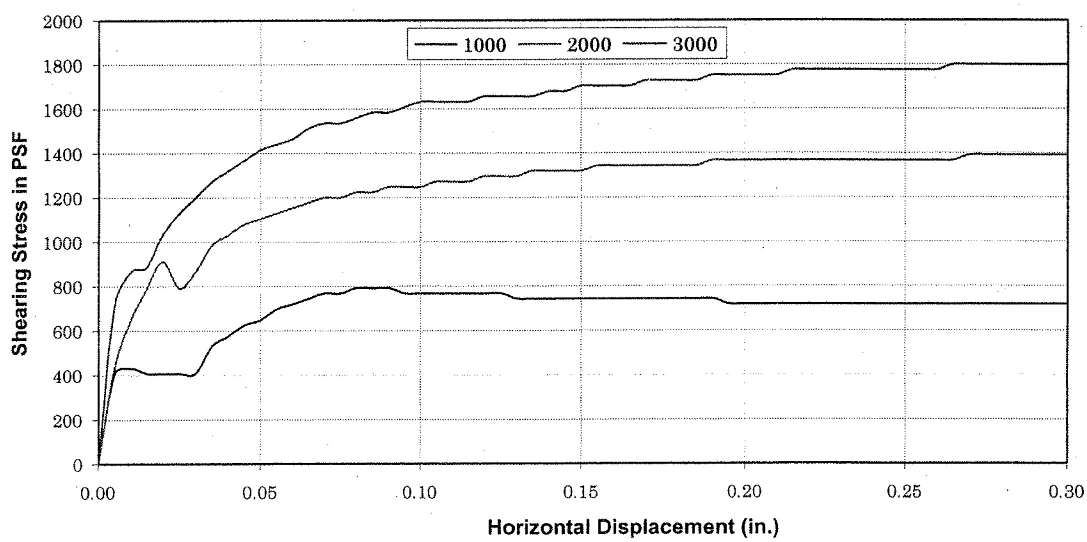
ASTM D 2435-90

Eucalyptus Hill Dr
TP 2 @ 2.5
OL
Ring Sample

Initial Dry Density: 66.6 pcf
Initial Moisture, %: 47.6%
Specific Gravity: 2.67 (assumed
Initial Void Ratio: 1.503







DIRECT SHEAR DATA*

Sample Location: T P 2 @ 0.5-2.5
Sample Description: Silty Sandy Clay
Dry Density (pcf): 77.0
Intial % Moisture: 26.8
Average Degree of Saturation: 90.3
Shear Rate (in/min): 0.018 in/min

Normal stress (psf)	1000	2000	3000
Peak stress (psf)	792	1392	1800
Ultimate stress (psf)	720	1392	1800

	Peak	Ultimate
ϕ Angle of Friction (degrees):	27	28
c Cohesive Strength (psf):	320	220

Test Type: Peak,Ultimate

* Test Method: ASTM D-3080

DIRECT SHEAR TEST

Eucalyptus Hill Drive

Earth Systems
Southern California

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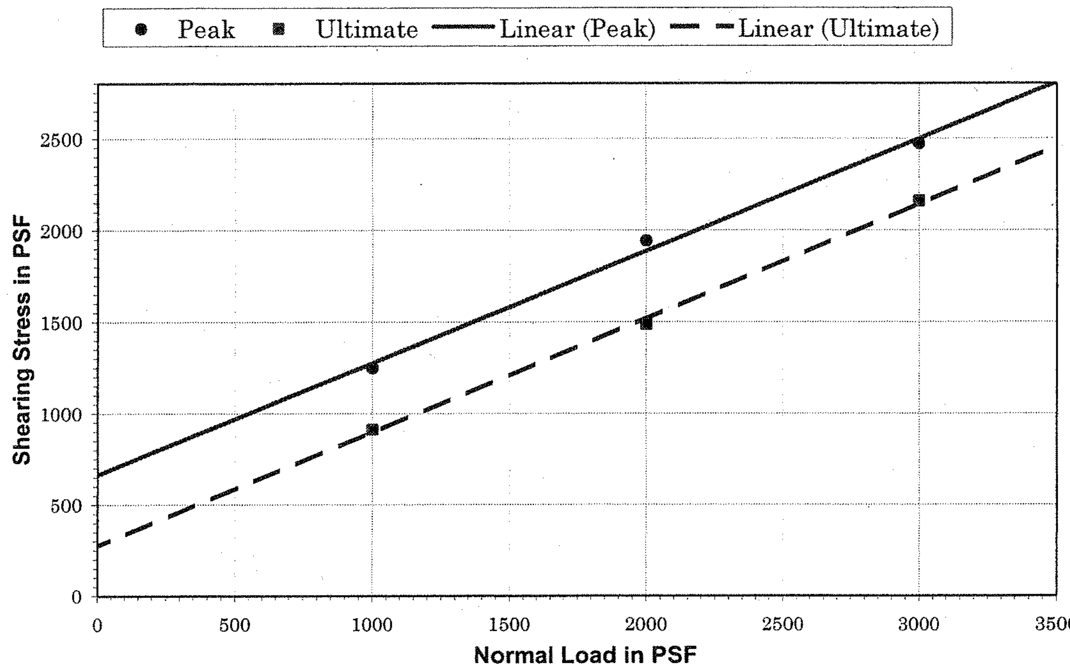
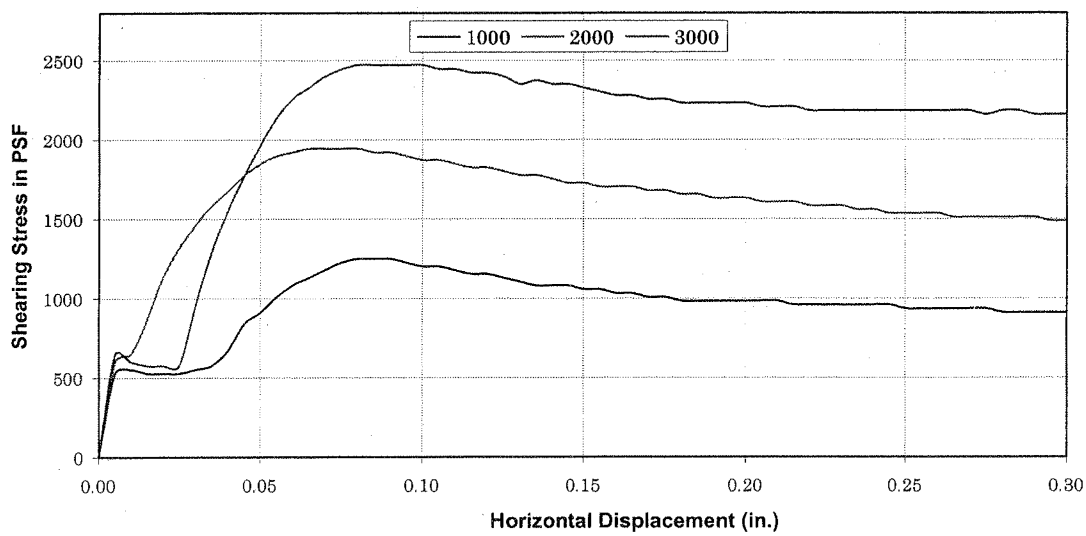




DIRECT SHEAR DATA*

Sample Location: T P 5 @ 3-5.5
Sample Description: Silty Clayey Sand
Dry Density (pcf): 51.5
Intial % Moisture: 55
Average Degree of Saturation: 93.5
Shear Rate (in/min): 0.0327 in/min

Normal stress (psf)	1000	2000	3000
Peak stress (psf)	1248	1944	2472
Ultimate stress (psf)	912	1488	2160

	Peak	Ultimate
ϕ Angle of Friction (degrees):	31	32
c Cohesive Strength (psf):	660	270

Test Type: Peak,Ultimate

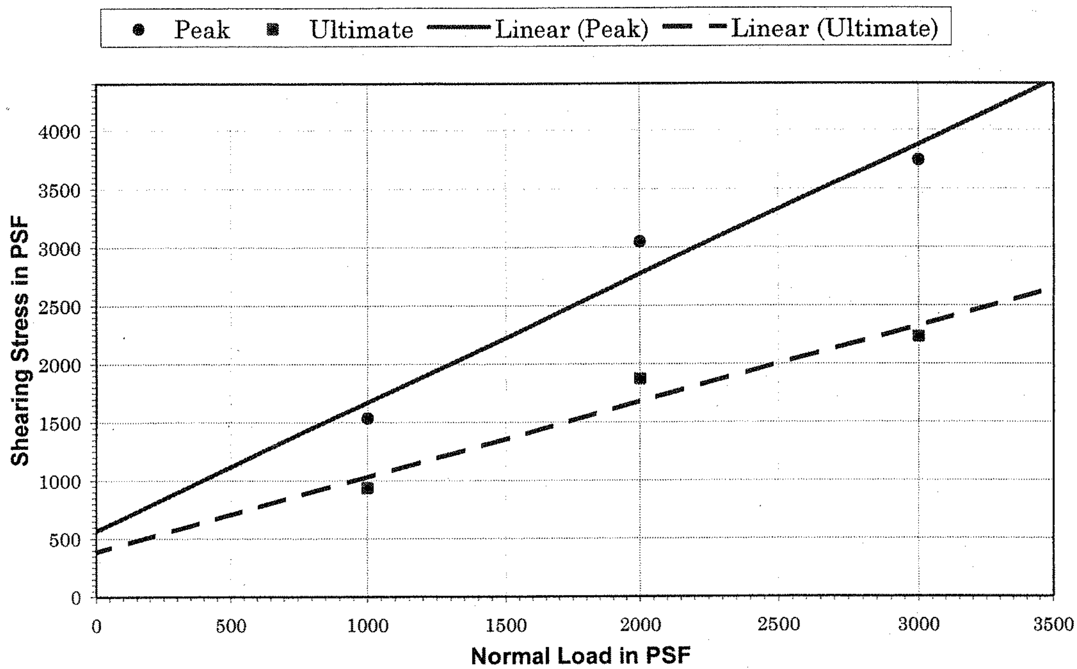
* Test Method: ASTM D-3080

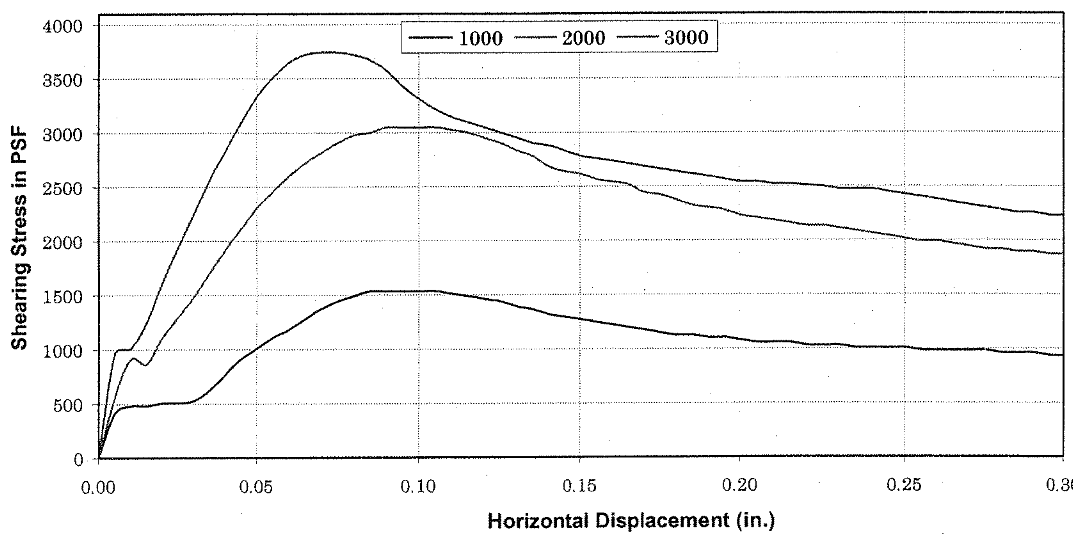
DIRECT SHEAR TEST

Eucalyptus Hill Drive

Earth Systems
Southern California

7/14/2006	VT-23720-01





DIRECT SHEAR DATA*

Sample Location: T P 1 @ 5
Sample Description: Sandt Clayey Silt (Diatomaceous)
Dry Density (pcf): 60.7
Intial % Moisture: 52.7
Average Degree of Saturation: 96.8
Shear Rate (in/min): 0.02 in/min

Normal stress (psf)	1000	2000	3000
Peak stress (psf)	1536	3048	3744
Ultimate stress (psf)	936	1872	2232

	Peak	Ultimate
ϕ Angle of Friction (degrees):	48	33
c Cohesive Strength (psf):	560	380

Test Type: Peak,Ultimate

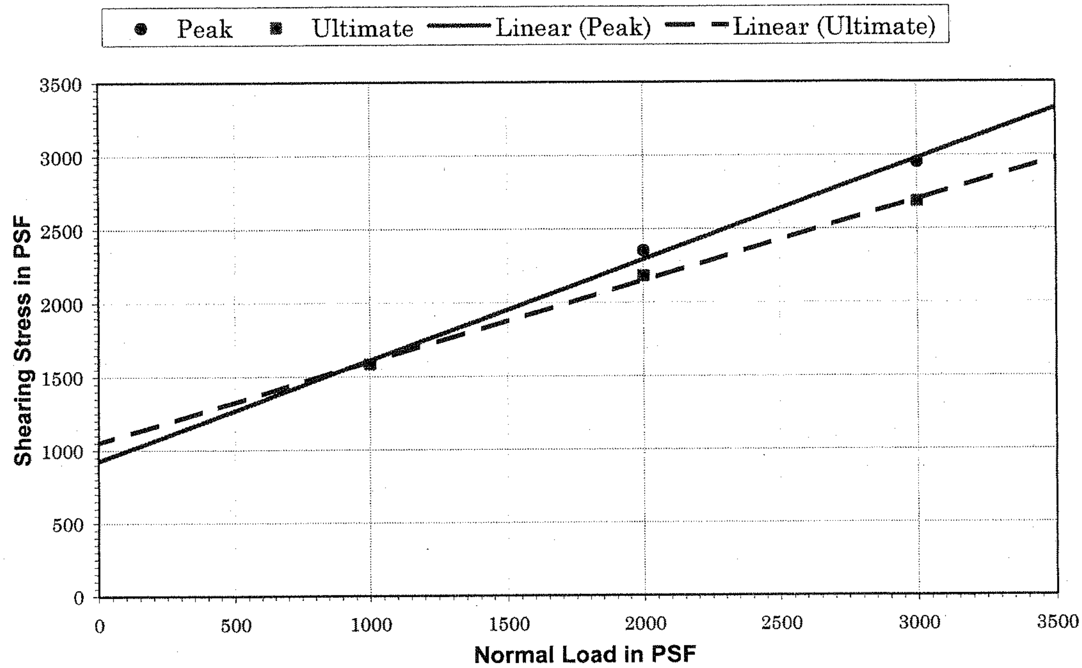
* Test Method: ASTM D-3080

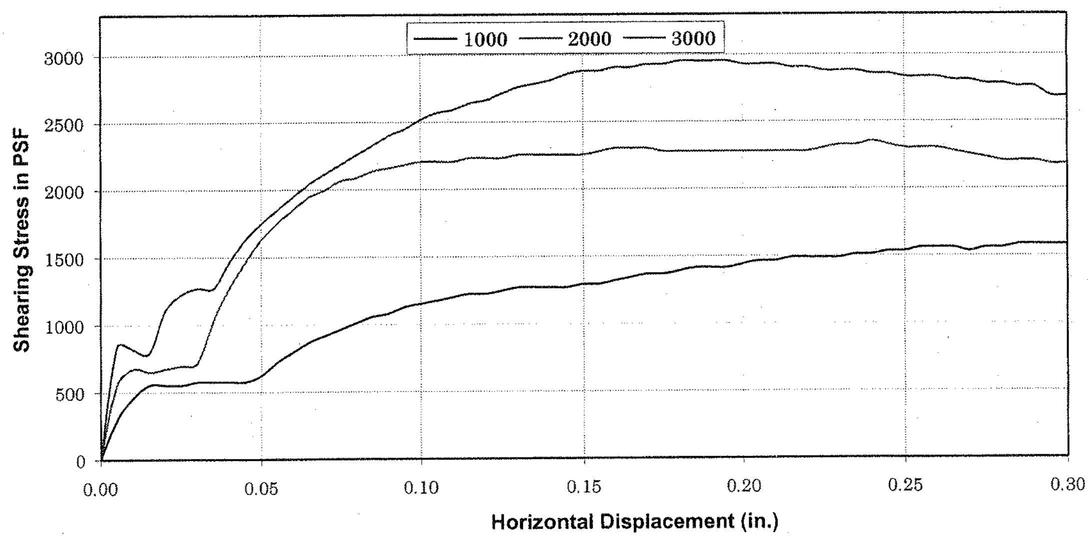
DIRECT SHEAR TEST

Eucalyptus Hill Drive

Earth Systems
Southern California

7/14/2006 | VT-23720-01





DIRECT SHEAR DATA*

Sample Location: T P 5 @ 5
Sample Description: Diatomaceous Silty Gravel
Dry Density (pcf): 52.1
Intial % Moisture: 39
Average Degree of Saturation: 88.0
Shear Rate (in/min): 0.024 in/min

Normal stress (psf)	1000	2000	3000
Peak stress (psf)	1584	2352	2952
Ultimate stress (psf)	1584	2184	2688

	Peak	Ultimate
ϕ Angle of Friction (degrees):	34	29
c Cohesive Strength (psf):	920	1040

Test Type: Peak,Ultimate

* Test Method: ASTM D-3080

DIRECT SHEAR TEST

Eucalyptus Hill Drive

Earth Systems
Southern California

7/14/2006 | VT-23720-01

Capco Analytical Services, INC. (CAS)
1536 Eastman Avenue, Suite B
Ventura CA 93003
(805) 644-1095

Client: Earth Systems Southern CA
Sample ID: TP-2 @ .5-2.5
Date Received: 06/16/06

Sample Matrix: Soil
CAS LAB NO: 06131302
Date Sampled: 06/16/06

WET CHEMISTRY ANALYSIS SUMMARY

COMPOUND	RESULT	UNITS	DF	PQL	METHOD	ANALYZED
*Chloride	BQL	mg/Kg	1	10	300.0M	06/22/06
pH	5.9	S.U.	1	--	9045	06/21/06
*Resistivity	19600	ohms-cm	1	3	CA Test 424	06/22/06
*Sulfate	BQL	mg/Kg	1	10	300.0M	06/22/06

***Sample was extracted using a 1:3 ratio of soil and DI water. Results were based on the original sample weight.**

PQL: Practical Quantitation Limit
BQL: Below Practical Quantitation Limit

Principal Analyst

CAPCO Analytical Services, Inc.

Capco Analytical Services, INC. (CAS)
1536 Eastman Avenue, Suite B
Ventura CA 93003
(805) 644-1095

Client: Earth Systems Southern CA
Sample ID: TP-5 @ 3-5.5
Date Received: 06/16/06

Sample Matrix: Soil
CAS LAB NO: 06131301
Date Sampled: 06/15/06

WET CHEMISTRY ANALYSIS SUMMARY

COMPOUND	RESULT	UNITS	DF	PQL	METHOD	ANALYZED
*Chloride	430	mg/Kg	1	10	300.0M	06/22/06
pH	4.4	S.U.	1	--	9045	06/21/06
*Resistivity	1820	ohms-cm	1	3	CA Test 424	06/22/06
*Sulfate	120	mg/Kg	1	10	300.0M	06/22/06

***Sample was extracted using a 1:3 ratio of soil and DI water. Results were based on the original sample weight.**

PQL: Practical Quantitation Limit
BQL: Below Practical Quantitation Limit

Principal Analyst

CAPCO Analytical Services, Inc.

TABLE 18-1-D (REV.)
MINIMUM FOUNDATION REQUIREMENTS*

WEIGHTED EXPANSION INDEX	FOUNDATION FOR SLAB & RAISED FLOOR SYSTEM (4) (8)							CONCRETE SLABS (8)		PREMOISTENING OF SOILS UNDER FOOTINGS, PIERS AND SLABS (4) (5)	RESTRICTION ON PIERS UNDER RAISED FLOORS
	NUMBER OF STORIES	STEM THICKNESS	FOOTING WIDTH	FOOTING THICKNESS	ALL PERIMETER FOOTINGS (5)	INTERIOR FOOTINGS FOR SLAB AND RAISED FLOORS (5)	REINFORCEMENT FOR CONTINUOUS FOUNDATIONS (2) (6)	3-1/2" MINIMUM THICKNESS			
					DEPTH BELOW NATURAL SURFACE OF GROUND AND FINISH GRADE			REINFORCEMENT (3)	TOTAL THICKNESS OF SAND (10)		
		(INCHES)									
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	#4 @ 48" o.c. each way, or #3 @ 36" o.c. each way	2"	Moistening of ground recommended prior to placing concrete	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	#4 @ 48" o.c. each way, or #3 @ 36" o.c. each way	4"	120% of optimum moisture required to a depth of 21" below lowest adjacent grade. Testing required.	Piers allowed for single floor loads only
51-90 Medium	1 2	6 8	12 12	6 8	21 21	12 18	1-#4 top and bottom	#3 @ 24" o.c. each way	4"	130% of optimum moisture required to a depth of 27" below lowest adjacent grade. Testing required	Piers not allowed
	3	10	15	8	24	24	#3 bars @ 24" in ext. footing Bend 3' into slab (7)				
91-130 High	1 2	6 8	12 12	8 8	27 27	12 18	~~2-#4 Top and Bottom~~	~~#3 @ 24" o.c. each way~~	4"	140% of optimum moisture required to a depth of 33" below lowest adjacent grade. Testing required.	Piers not allowed
	3	10	15	8	27	24	#3 bars @ 24" in ext. footing Bend 3' into slab (7)				
Above 130 Very High	Special design by licensed engineer/architect										

*Refer to next page for footnotes (1) through (11).

FOOTNOTES TO TABLE UBC 18-1-D (Rev)

1. Premoistening is required where specified in Table UBC 18-1-D in order to achieve maximum and uniform expansion of the soil prior to construction and thus limit structural distress caused by uneven expansion and shrinkage. Other systems which do not include premoistening may be approved by the Building Official when such alternatives are shown to provide equivalent safeguards against the adverse effects of expansive soil.

2. Reinforcement for continuous foundations shall be placed not less that 3" above the bottom of the footing and not less than 3" below the top of the stem.

3. Reinforcement shall be placed at mid-depth of slab.

4. After premoistening, the specified moisture content of soils shall be maintained until concrete is placed. Required moisture content shall be verified by an approved testing laboratory not more than 24 hours prior to placement of concrete.

5. Crawl spaces under raised floors need not be premoistened except under interior footings. Interior footings which are not enclosed by a continuous perimeter foundation system or equivalent concrete or masonry moisture barrier complying with UBC 1804.7.3 in this ordinance shall be designed and constructed as specified for perimeter footings in Table UBC 18-1-D (Rev.).

6. Foundation stem walls which exceed a height of three times the stem thickness above lowest adjacent grade shall be reinforced in accordance with Chapter 21 and Sec. 1914 in the UBC, or as required by engineering design, whichever is more restrictive.

7. Bent reinforcing bars between exterior footing and slab shall be omitted when floor is designed as an independent, "floating' slab.

8. Where frost conditions or unusual conditions beyond the scope of this table are found, design shall be in accordance with recommendations of a foundation investigation. Concrete slabs shall have a minimum thickness of 4 inches when the expansion index exceeds 50.

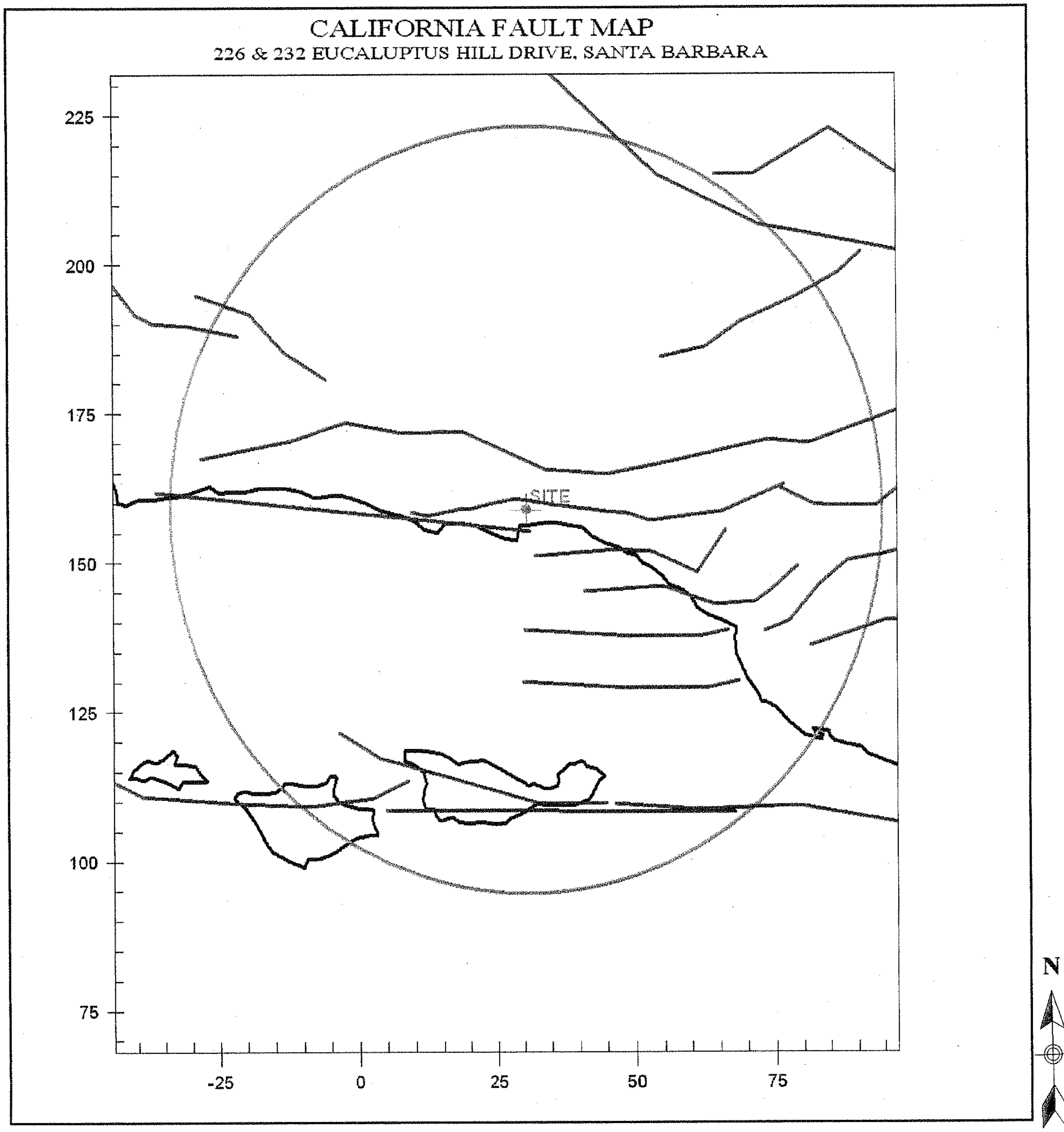
9. The ground under a raised floor system may be excavated to the elevation of the top of the perimeter footing, except where otherwise required by engineering design or to mitigate groundwater conditions.

10. When subsoil drainage is required by the building official, refer to Sec. UBC APPENDIX 18.

11. Where a post-tensioning slab system is used, the width and depth of the perimeter footings shall meet the requirements of this table.

APPENDIX C

California Fault Map
Attenuation Plot for Strike Slip Faults
Attenuation Plot for Dip Slip Faults
Attenuation Relation for Blind Thrust Faults
Earthquake Magnitudes
Maximum Earthquakes
Probability of Exceedance for SR-1
Probability of Exceedance for SR-2
Design Response Spectrum



CALIFORNIA FAULT MAP

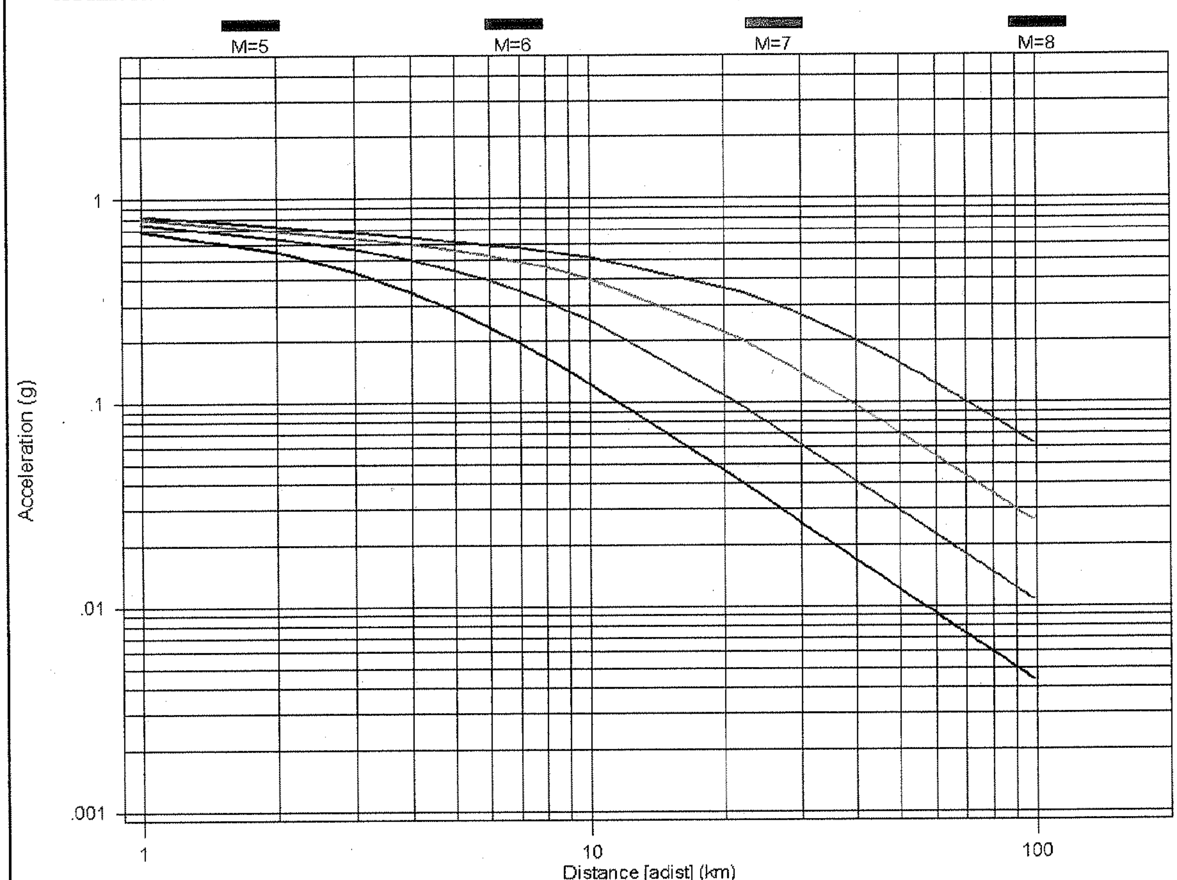
226 & 232 EUCALYPTUS HILL DRIVE,
SANTA BARBARA, CALIFORNIA

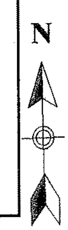
Earth Systems
Southern California

July, 2006	VT-23720-01

STRIKE-SLIP FAULTS

ATTENUATION RELATION FOR 226&232 EUCALUPTUS HILL DRIVE (Campbell & Bozorgnia (1994/1997) - Soft Rock)



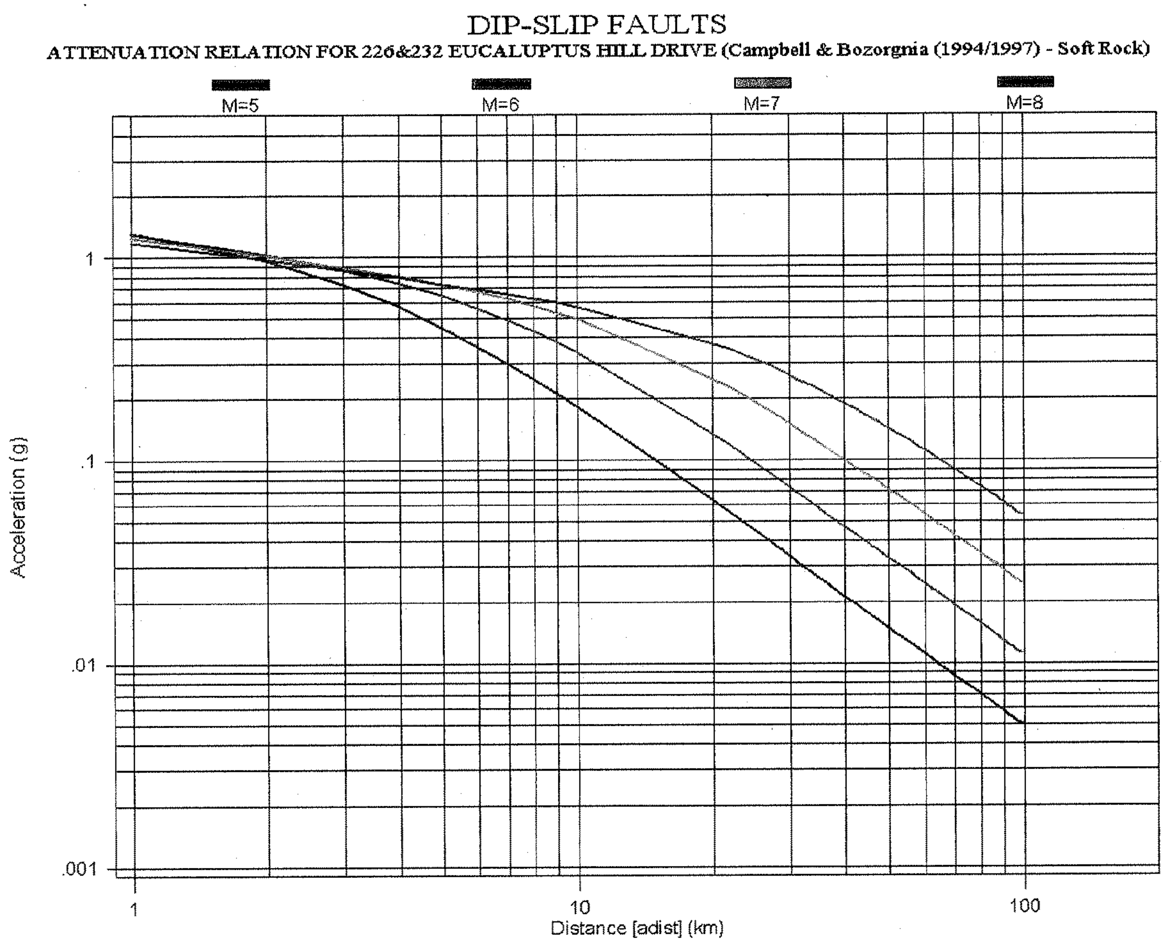


ATTENUATION RELATION FOR SS FAULTS

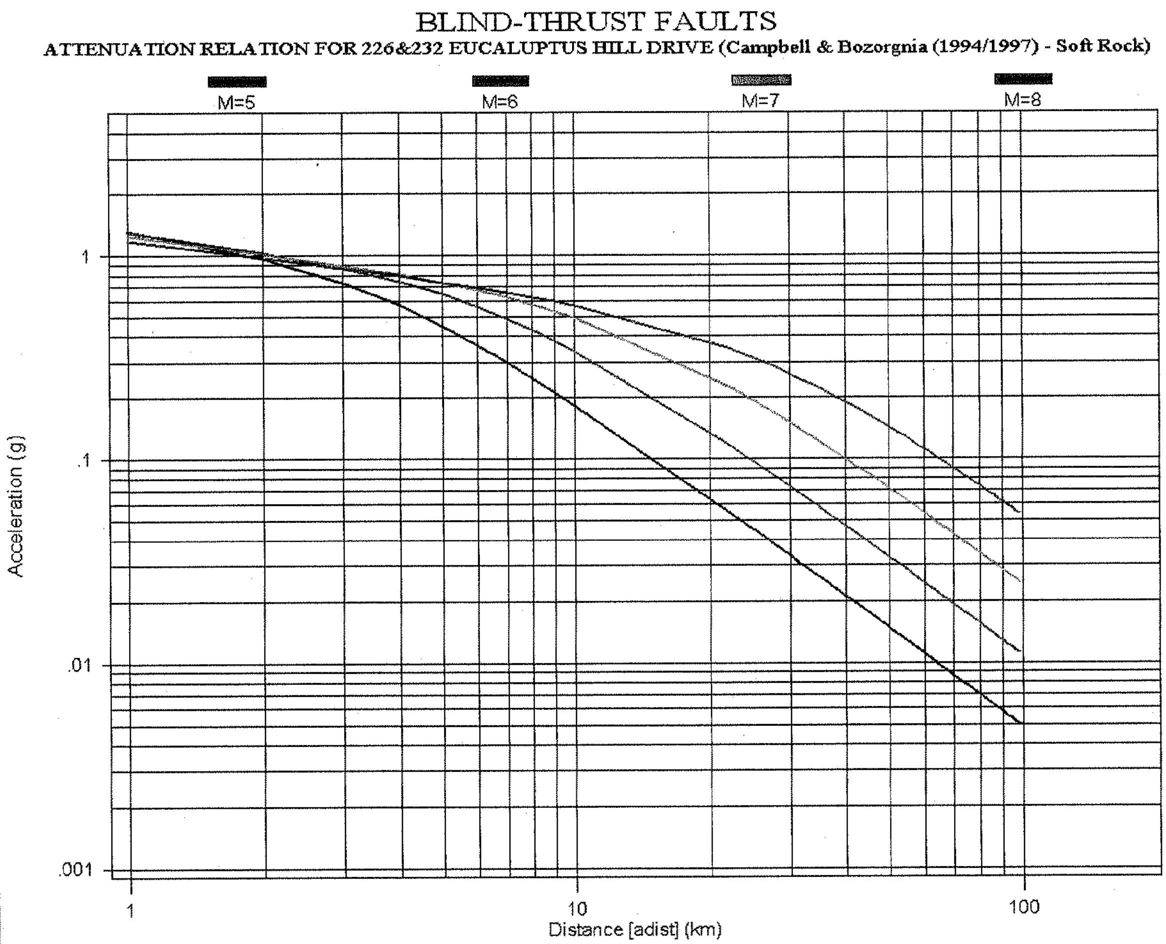
226 & 232 EUCALYPTUS HILL DRIVE,
SANTA BARBARA, CALIFORNIA

Earth Systems
Southern California

July, 2006	VT-23720-01



ATTENUATION RELATION FOR DS FAULTS	
226 & 232 EUCALYPTUS HILL DRIVE, SANTA BARBARA, CALIFORNIA	
Earth Systems Southern California	
July, 2006	VT-23720-01

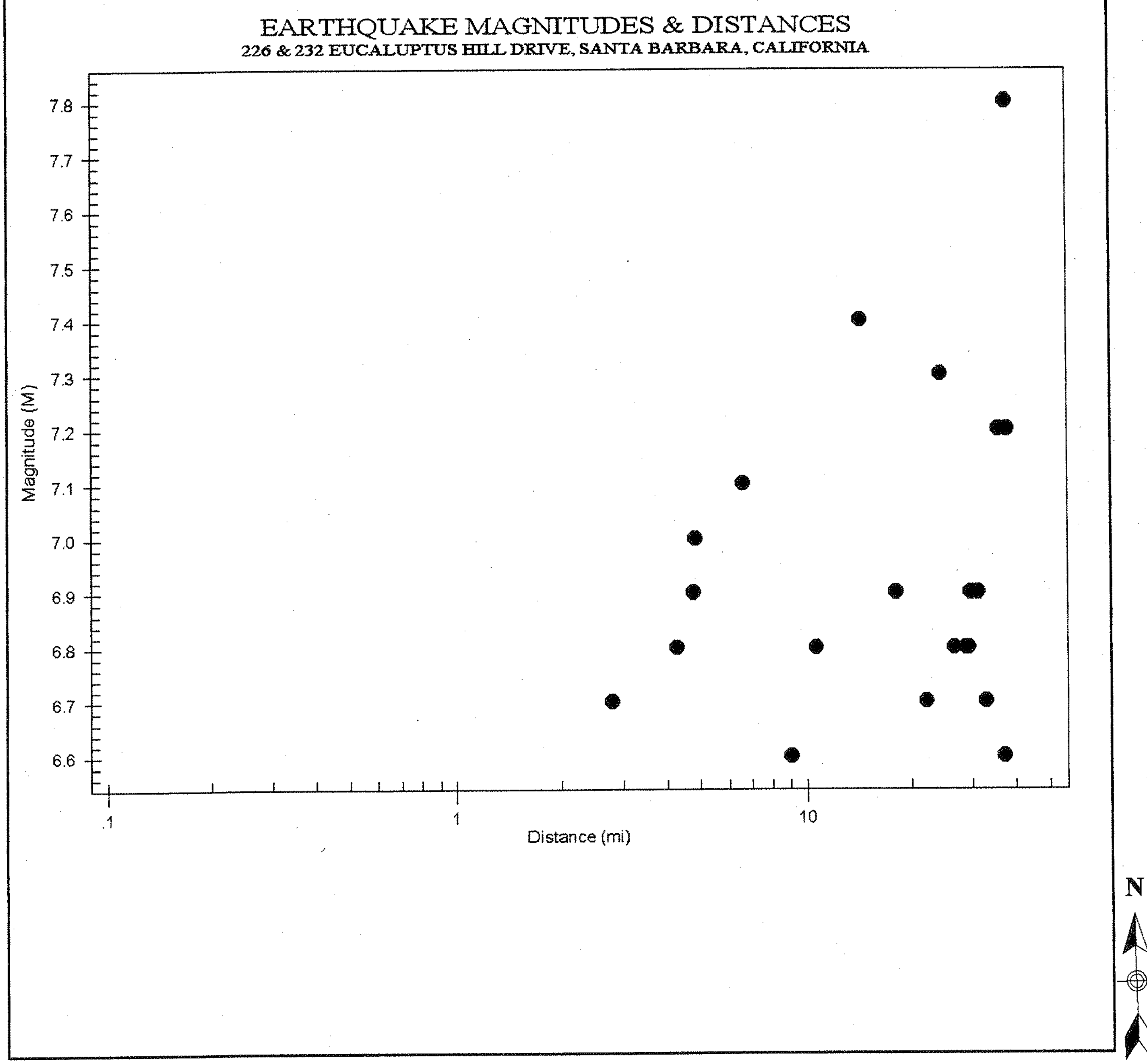


ATTENUATION RELATION FOR BT FAULTS

226 & 232 EUCALYPTUS HILL DRIVE,
SANTA BARBARA, CALIFORNIA

Earth Systems
Southern California

July, 2006	VT-23720-01

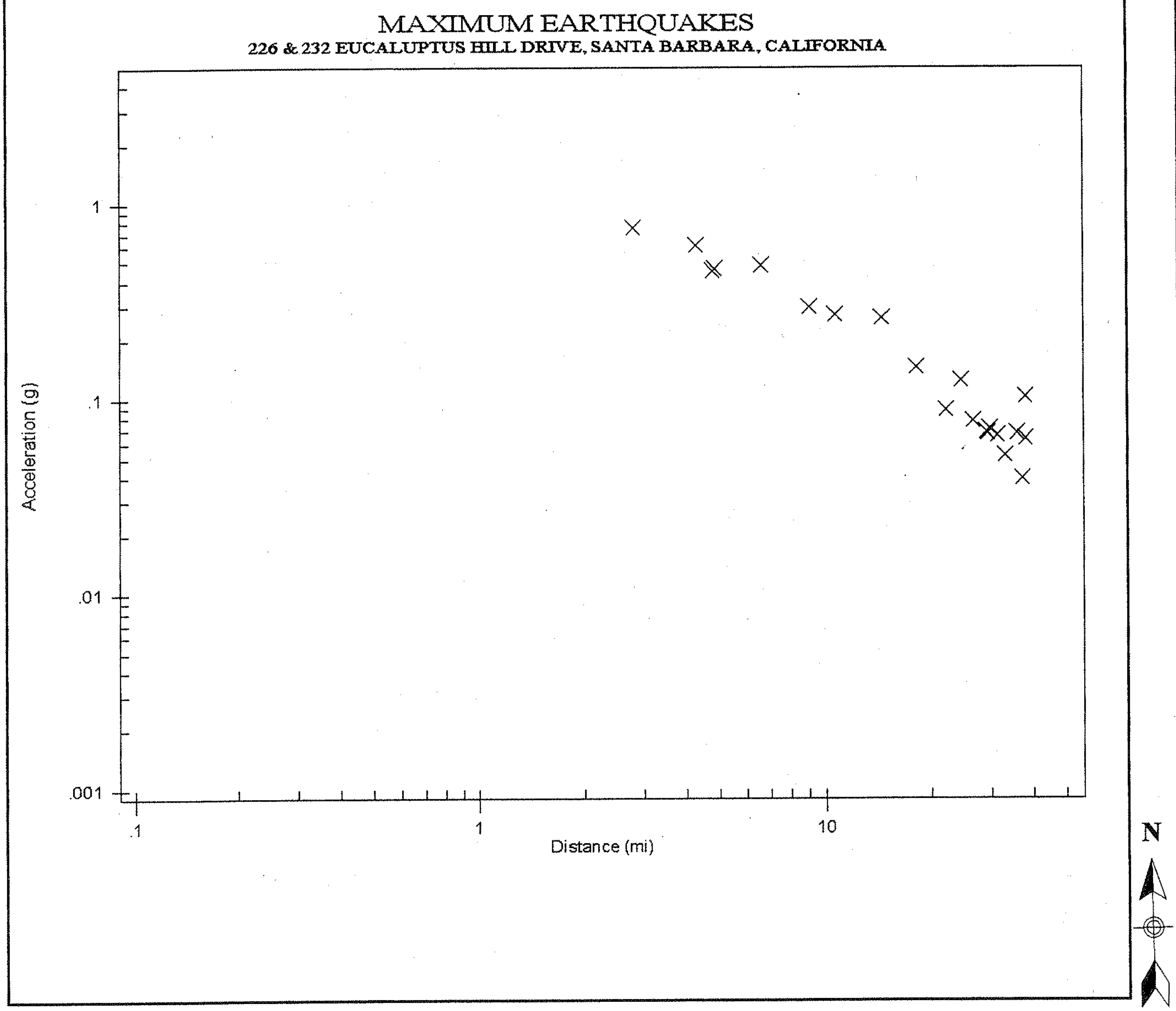


EARTHQUAKE MAGNITUDES

226 & 232 EUCALYPTUS HILL DRIVE,
SANTA BARBARA, CALIFORNIA

Earth Systems
Southern California

July, 2006	VT-23720-01

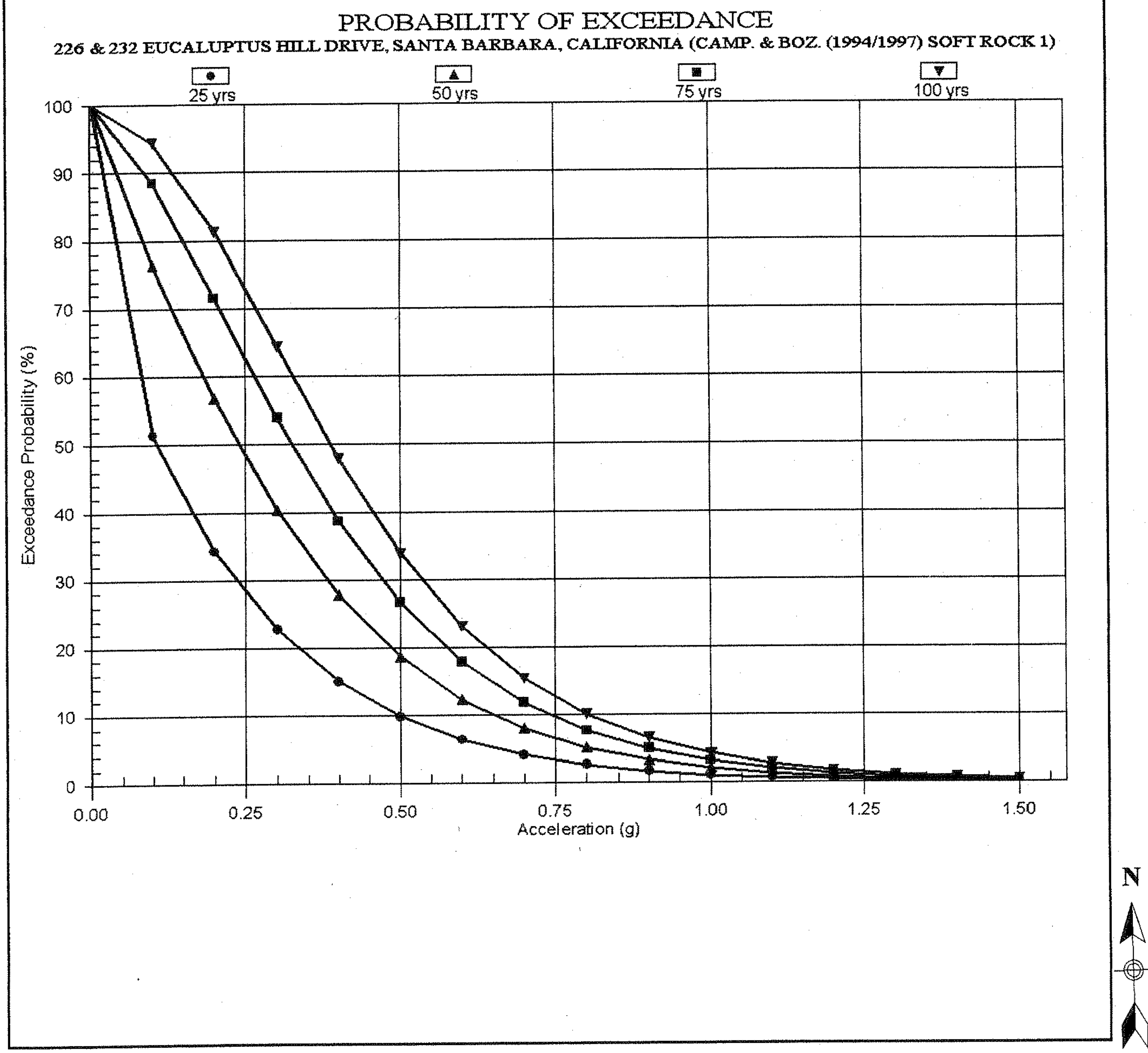


MAXIMUM EARTHQUAKES

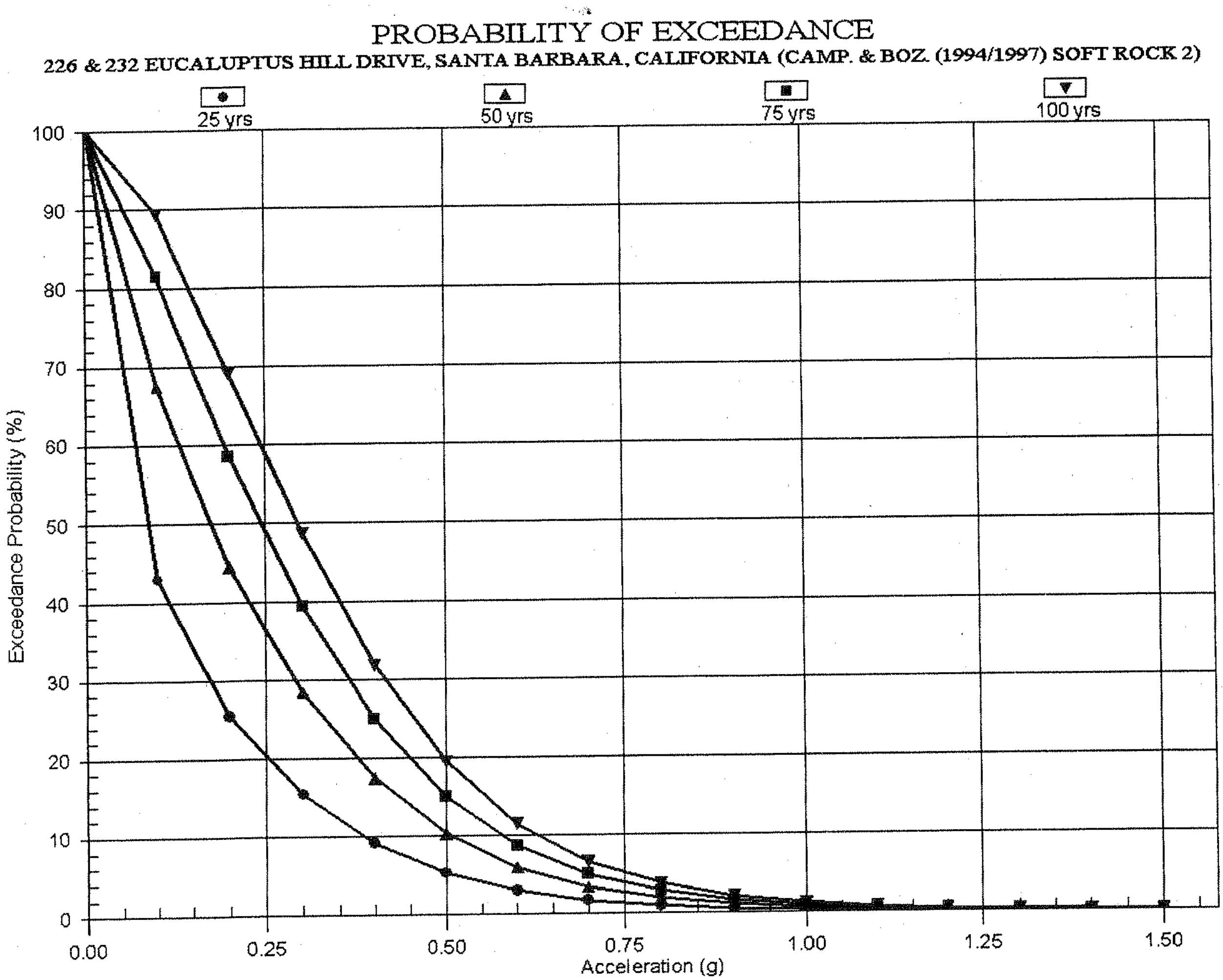
226 & 232 EUCALYPTUS HILL DRIVE, SANTA BARBARA, CALIFORNIA

Earth Systems
Southern California

July, 2006	VT-23720-01



PROBABILITY OF EXCEEDANCE FOR SR-1	
226 & 232 EUCALYPTUS HILL DRIVE, SANTA BARBARA, CALIFORNIA	
Earth Systems Southern California	
July, 2006	VT-23720-01



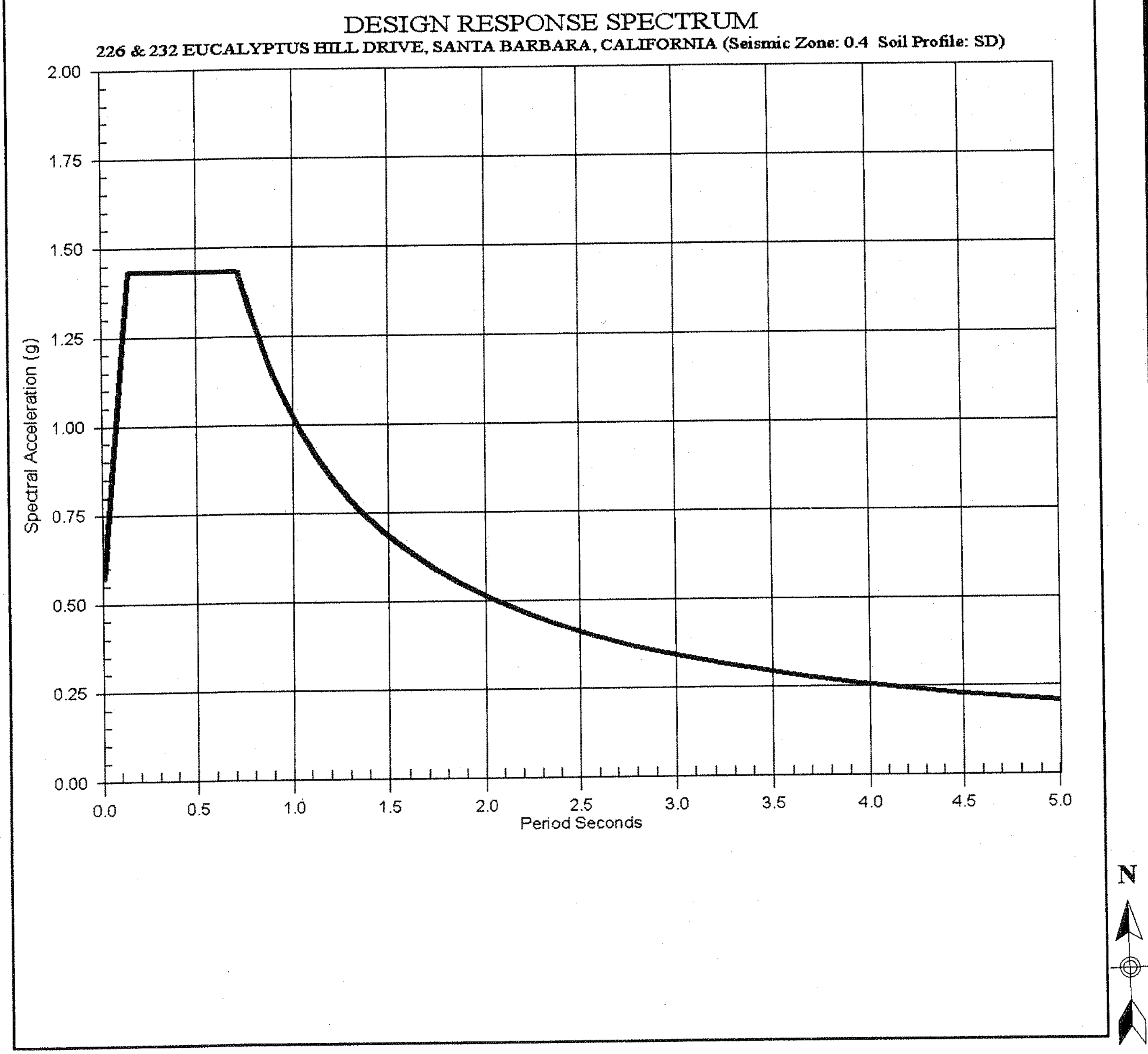
N

PROBABILITY OF EXCEEDANCE FOR SR-2

226 & 232 EUCALYPTUS HILL DRIVE,
SANTA BARBARA, CALIFORNIA

Earth Systems
Southern California

July, 2006	VT-23720-01



DESIGN RESPONSE SPECTRUM

226 & 232 EUCALYPTUS HILL DRIVE,
SANTA BARBARA, CALIFORNIA

Earth Systems
Southern California

July, 2006	VT-23720-01