Appendix E

Geology Study

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June 8, 2006
Work Order 500674

Attention: Mr. Larry Netherington

Subject: **GEOLOGIC AND GEOTECHNICAL EVALUATION**
In Support of Your Due Diligence Evaluation
"Travis" Property
City of Yorba Linda, County of Orange, California

References: Appendix A

Gentlemen:

Presented herein is a summary of Pacific Soils Engineering, Inc.'s (PSE's) geologic and geotechnical evaluation in support of your due diligence evaluation for proposed development of the Travis property located in Yorba Linda, County of Orange, California (Figure 1). This report presents a summary of the major geologic and geotechnical issues that should be considered during purchase and planning of the proposed project. This study is based on review of the cited references, as well as PSE's experience within the project vicinity. It is our understanding that the proposed project will consist of typical hillside cut and fill grading to create a series of terraced pads for development of single-family homes and associated access roads. Development of the site may also include large box culverts and/or bridge structures to cross the major drainages.

1.0 SCOPE OF WORK

The scope of work that has been performed to date for the subject property consisted of the following:

- Review of the cited published and unpublished geotechnical data and aerial photographs;
- Geologic field mapping of exposed conditions;

- Compilation of the acquired data;
- Analysis and preparation of this summary report;

Evaluations regarding the onsite presence or absence of environmentally sensitive materials is beyond the scope of this firm's services.

2.0 SITE AND PROJECT DESCRIPTION

The property is located in the County of Orange, north of Yorba Linda Boulevard in the eastern portion of the City of Yorba Linda. Tract 9813 that is accessed via San Antonio Road bounds the site on the west. To the north is the recently completed Casino Ridge Development (Tracts 15501 and 16186), while to the south the site is bordered by a Metropolitan Water District (MWD) easement and residential developments that are accessed by Stonehaven Drive. To the east is undeveloped land that has commonly been referred to as the Murdock Property. A Southern California Gas easement is located within the property along the western edge.

The studied parcel consists of undeveloped hillsides along the southeastern terminus of the Puente Hills. Steep, V-shaped canyons and interfluves typify local topography. Most notably, a westerly draining canyon about 100 to 200 feet deep with sidewall slope ratios on the order of 1.5:1 to 2:1 (horizontal:vertical), with locally steeper and flatter elements, bisects the parcel. Other similar canyons are in the southeast corner (Blue Mud Canyon) and in the northern half of the project.

The site is part of the historic Esperanza Oil Field that now is independently operated by Santa Ana River Development. Both active and seemingly inactive oil pumps and tank batteries are onsite. Unimproved roads and drill pads, common to oilfields, are scattered over the site.

Review of aerial photographs indicates that prior to the 1950's, no significant human activities modified the site topography. In the late 1950's the first oil wells were being developed on the adjacent Murdock property. In addition, the MWD water pipeline along the southern boundary had been constructed. In the 1960's, the onsite wells were developed and the Southern California Gas line was constructed along the parcel's western boundary. The homes along the western perimeter of the project were developed in the mid 1980's (Figure 2). The site has remained relatively unchanged since the 1960's. In the 1950's, the vegetation appeared to consist primarily of annual grasses with occasional chaparral and tree's. There appears to have been a gradual increase in both chaparral and tree cover from the 1950's through present time.

3.0 GEOLOGIC SUMMARY

The project is located within the southern Puente Hills at the northwestern end of the Santa Ana Mountains. These hills and mountains are one of many northwest-trending chains that typify the Peninsular Ranges Geomorphic Province of California (Woodford and others, 1971; Gray, 1961). The Province extends from the Transverse Ranges in the north to Baja California in the south (Figure 3).

The northwest trend of the blocks within the Peninsular Ranges stems from the presence of several northwest trending continental borderland fault zones that extend from the Mojave Desert in the east to the Channel Islands in the west (Figure 4, Jennings, 1994). These faults typically have right-lateral strike-slip with at least local thrust and normal-slip components.

The approximately 150-mile long Whittier-Elsinore Fault Zone that forms the northeast boundary of the Santa Ana Mountains and the southwestern boundary of the Puente Hills is a classic example of the aforementioned set of faults. The northwest-trending Elsinore Fault Zone bifurcates about 10 miles southeast of the site into the Chino Fault that continues northwest across the Santa Ana River and then along the east margin of the Puente Hills. The Whittier Fault Zone (WFZ) trends northwest from the bifurcation point. Near Fresno Canyon, this fault "bends" west-northwest across Santa Ana Canyon, and then resumes a northwest trend along the west flank of the Puente Hills. The Travis Property is traversed by this branch of the fault.

This fault was mapped and a habitable structures setback zone was established along it during development of the adjacent housing tract (Tract 9813) to the west (Earth Research Associates, Inc. (ERA), 1985, 1986). The fault and setback zone are shown on Plate 1 where they abut against the Travis Property boundary. The location of the ERA fault was apparently based on data developed during their preliminary investigations. A few fault trenches were excavated by ERA (1985) across the suspected fault. The trench logs showed a primary fault zone and a few other shears or faults. Only the primary fault zone was placed in a setback zone on Tract 9813. Limited documentation of the fault location and geometry and no detailed fault descriptions were presented in the documents representing the rough graded conditions (ERA, 1986). The fault zone defined during the preliminary investigation was used as the basis for the final fault location and setback zone for the project.

Regional mapping projects by multiple publishers have also located the WFZ within the subject site (Miller, et.al., 1977, Durham and Yerkes, 1964, Dibblee, 2001). Each author located the main branch of the fault in slightly different locations. One has multiple branches of the fault in the area of the project. However, in general, the location of the "traditional" main branch of the fault as mapped by these authors is within a relatively narrow band. The shaded zone identified on Plate 1 represents this narrow band of the "likely" location of the main trace of this fault; although active fault splays could occur outside of this band.

In this project area the underlying bedrock is Tertiary aged sedimentary rock. The bedrock is composed of mainly sandstone and siltstone of the upper Miocene Puente Formation that are both faulted and folded (Figure 5, Plate 1). In this area the Puente Formation has been divided into two separate geologic units (formally the Sycamore Canyon and Yorba Members) that have been mapped within or near the project boundaries. The Sycamore Canyon Member of the Puente Formation consists of inter-bedded sandstone and siltstone and the Yorba Member of the Puente Formation consists of thinly bedded siltstone and diatomaceous siltstone with minor sandstone. Surficial deposits present at the site include alluvium, colluvium, landslides, terrace deposits and other similar Quaternary units.

Bedding attitudes observed adjacent to the site were highly variable in both strike and dip. The variability is probably related to the presence of the WFZ within the site. However, the Puente Formation is often highly folded and faulted even where it is encountered away from major fault zones. Within the site boundaries there are very few exposures of bedrock. The few bedrock-bedding attitudes observed varied in orientation.

Based on observation of aerial photographs and interpretation of geomorphic features, portions of the site appear to be underlain by landslides. The majority of the features indicating possible landslides are located north of the central canyon area and along the primarily northwest facing slope area. PSE's analysis indicates that these landslides (if present) may either be less than 50 feet in thickness and have occurred as primarily wedge-type debris flows, or as deep-seated (greater than 100 feet in depth block failures based on the bedrock geologic structures. One or more of these landslides may extend offsite onto adjacent properties. To our knowledge, no site-specific subsurface geotechnical investigations have been conducted to verify the existence or geometry of these potential landslide features.

Groundwater is likely to exist within the larger drainages of the site. The groundwater levels probably fluctuate seasonally owing to rainfall and other factors. It is likely that the alluvium is saturated within a few feet of the ground surface throughout the year. It is also likely that the groundwater is trapped on either side of the WFZ within the bedrock; and possibly within Quaternary deposits.

4.0 POTENTIAL GEOLOGIC AND GEOTECHNICAL IMPACTS

The major geologic and geotechnical issues that are likely to have the most significant economic impact on the development are summarized below.

4.1 Earthquake Hazards

The subject site is located in southern California, which is a tectonically active area. The type and magnitude of seismic hazards affecting a site are dependent on the distance to the causative fault and the intensity and magnitude of the seismic event. The seismic hazard may be primary, such as surface rupture and/or ground shaking, or secondary, such as liquefaction and/or ground lurching. The State of California has mandated by the Alquist-Priolo Earthquake Fault Zoning Act (A-P) to delineate Fault-Rupture Hazard Zones in California and by the Urban Seismic Hazards Mapping Act (USHMA) to delineate zones identified as being potentially susceptible to the secondary seismic hazards of liquefaction and earthquake-induced landsliding. The subject parcel is traversed by an A-P zone (Figure 6) and has been evaluated and mapped per USHMA requirements. Seismic hazards relating to these two acts are discussed below.

4.2 Surface Rupture

Surface rupture is displacement of the ground surface by actual fault slip during seismic events. Such rupture often occurs along pre-existing fault traces. The Puente Hills have been and are being uplifted along the WFZ as postulated by some investigators and/or by blind faults beneath the hills as suggested by others. Nonetheless, the WFZ that trends through the site contains faults that are clearly active (last ~11,000 years) as evidenced by tectonic geomorphic features such as right-laterally displaced drainages (Blue Mud Canyon and an unnamed canyon to its north), aligned valleys, and scarp lines. Displacements of alluvial deposits that also typify active faults are well documented along elements of the WFZ. These are typical of features that led the State of California to place the WFZ in an Alquist-Priolo Fault Hazard (AP) Zone. The limits of this zone are shown on Figure 6 and the attached Plate 1.

Implications and Mitigations

The State requires that a field investigation be performed to delineate the fault location and its potential activity if habital structure development is proposed within an A-P zone. A building setback would be required by the State wherever an active fault exists. The " likely" location of the main branch of this fault is shown on the attached Plate 1. Setback zones are typically a minimum *of 50 feet on either side of the fault, but can vary owing to the geometry and structure of the fault, and/or whether it is in a fill or cut area. For example, setback zones at the surface of deep fills are typically wider than 50 feet owing to propagation of the rupture through the fill. In addition, there may be other branches of this fault within or outside of the designated AP-Zone that are active and would require a structural setback. Minimally, the A-P zone will require further exploration to accurately delineate the location and character of any active branches of the fault zone. Also, trenching outside of the A-P zone may be required to demonstrate the presence or absence of active faults. Professional standards of practice are increasingly dictating such investigations.*

4.3 Seismicity

The active Whittier Fault reportedly exists within the project limits. Furthermore, the site will experience ground motion and effects from potential earthquakes generated along active faults located offsite.

To estimate the potential ground shaking, PSE has performed a probabilistic seismic hazard analysis (PBSHA) utilizing the California Geological Survey's Probabilistic Seismic Hazards Mapping Ground Motion Page. Ground motions (10% probability of being exceeded in 50 years) are expressed as a fraction of gravitational acceleration (g). An average Probabilistic Ground Acceleration (PGA) of 0.48 was derived for firm rock, soft rock, and alluvium.

A probabilistic seismic hazard analysis of the site was also performed using FRISKSP software (R. Blake, 1994-2004). PSE selected Boore (1997), Campbell and Bozognia (1997 Rev.), and Sadigh et al. (1997) attenuation relationships for both soil and rock type conditions considering the Design-Basis Earthquake (DBE) Ground Motion (10% probability of exceedance in 50 years). This level of ground motion corresponds to return periods of approximately 475 years. Average peak ground acceleration for the site was calculated, using the attenuation relationships listed above. The FRISKSP analysis resulted in an acceleration of 0.66g and 0.70g for the DBE considering soil and rock conditions, respectively. Included in Appendix B is the complete seismic analysis

Implications and Mitigations

Southern California, in general, is a seismically active region and the proposed improvements are likely to be subjected to significant ground motion during the design life of the project. Remedial grading in conjunction with the design of structures in accordance with prevailing seismic codes is held to be an appropriate mitigation for this condition.

4.4 Liquefaction and Dynamic Settlement

Liquefaction and dynamic settlement are the processes by which saturated sediments lose their strength during strong ground motion generated by earthquakes. The State of California (California Division of Mines, 1997) has mandated that the California Geological Survey identify areas that may be susceptible to liquefaction, and provide USHMA quadrangle maps showing these zones, as well as establish procedures for studies prior to project approval. The State of California has delineated (Figure 7) a small portion of the site, near the southwest corner, within Blue Mud Canyon as having a potential for liquefaction. In addition, it is possible the alluvial sediments within the two main canyons that exist within the central and northern portion of the project are also susceptible to liquefaction and seismic settlement.

The occurrence of liquefaction may be manifested in several ways, including:

4.4.1 Lateral Spreading:

The lateral displacement of surficial blocks of sediment can occur as a result of liquefaction in a subsurface layer.

4.4.2 Surface Manifestation:

Ground oscillations take place if liquefaction occurs at depth. Non-liquefied upper soil blocks oscillate on the liquefied substrata, resulting in a traveling ground wave. Ground settlements, opening and closing of fissures and sand boils may accompany the oscillations. This type of failure could affect structures founded over or within the influence of saturated left-in-place alluvium. Based on previous work (Ishihara, 1985) a non-liquefiable soil above a liquefiable soil can reduce surface effects. The surface damage is dependent upon: 1) the thickness of the non-liquefiable surface layer; 2) the thickness of the liquefiable sand layer; and 3) anticipated site accelerations.

4.4.3 Settlement:

Settlement due to seismic shaking can occur as a result of both liquefaction of saturated sediments or rearrangement of dry sand particles.

Implications and Mitigations

The alluvial and colluvial sediments in Blue Mud Creek may be susceptible to liquefaction (where saturated) and dry sand settlements (where above groundwater). The older alluvium and Terrace deposits are not likely to be susceptible to these phenomena. Mitigations, if required, would likely include overexcavation/recompaction, ground modification, increase of overburden stresses through embankment construction, foundation design, and/or combinations of those techniques. Evaluation of the potential for dynamic settlement and liquefaction will be required in *the future and it is likely that, minimally, remedial grading and use of post tensioned slab/foundations will be required to mitigate this condition.*

4.5 Seismically and Non-Seismically Induced Landsliding

The State of California has designated much of the site as having a potential for seismically induced landsliding per USHMA (Figure 7). In addition numerous landslides have been postulated to exist within the site that may be unstable without seismic influences. Since no site-specific subsurface investigation has been performed the existence, depth, geometry and other characteristic of landsliding have not been determined.

Implications and Mitigations

It is PSE's understanding that most of the proposed development is presently planned to avoid areas suspected to be underlain by landslides. If areas of development are proposed near or within suspected landslide, then subsurface investigations will be necessary to further identify the existence and geometry of these areas of potential instability. Similarly assessment of the stability of cut, fill and natural slopes during design seismic events will be required to conform with state and local agency requirements. Grading and design in accordance with current industry standards can effectively mitigate this potential hazard. However, the costs associated with mitigating these hazards needs to be evaluated versus the potential reward and therefore, needs further evaluation. In addition, some remedial solutions may require offsite grading.

4.6 Seiches

A seiche is a free or standing-wave oscillation on the surface of water in an enclosed or semi-enclosed basin. The wave can be initiated by an earthquake and can vary in height from several centimeters to a few meters.

Implications and Mitigations

The potential for a seiche impacting the property is considered to be non-existent.

4.7 Compressible Soils

A detailed subsurface and laboratory study will be necessary to evaluate the compressibility of site soils prior to geotechnical review of proposed designs. Based upon this firm's review of available information and experience on adjacent sites, alluvial, colluvial, landslide and terrace deposits consisting of sands, silty sands and sandy silts are likely to be susceptible to hydro-collapse.

Implications and Mitigations

Unmitigated, the presence of compressible soils can produce excessive settlements and can be manifested differentially on engineered structures. Typically, the process can be mitigated by overexcavation of the susceptible soils and recompaction as engineered fills. Based upon PSE's review of available information, all partially saturated alluvium and other potentially compressible surficial deposits will require removal and replacement with engineered fill. PSE estimates that during remedial grading of the compressible soils, removals in surficial deposits of five (5) to twenty (20) feet will be required. All undocumented fills will require total removal. Removed soils will generally be suitable for reuse as engineered fill when properly moisture conditioned and compacted

4.8 Slope Stability Issues

The project site is in a hillside area with existing landslides and variable bedrock conditions within relatively weak geologic formations that typically are prone to landsliding and/or unstable slopes. It is our understanding that the proposed grading concept will include cut and fill grading that will result in terraced pads with associated cut/fill and natural sloping conditions.

Implications and Mitigations

The extent and potential for the above issues to impact development must be assessed during preliminary investigations and plan analyses. In general, cut slopes that expose landslide or out-of-slope or neutral bedding conditions will require remediation. In cases where cut slopes expose into-slope bedding conditions a replacement fill may be appropriate to reduce the potential for surficial stability concerns and/or to provide a more suitable soils condition for desired landscaping. Stability of any natural slope ascending or descending from planned development will also require condition specific investigation and analysis.

4.9 Utility Protection

An MWD easement and Southern California Gas easement exist on the site. In addition other drains, pipelines and/or utilities may exist within the site boundaries. It is our understanding that several of the oil wells are planned to remain within the project limits. This will also require retention of other facilities and pipelines associated with these operations.

Implications and Mitigation

Where development is to encroach into areas currently supporting existing utilities, removal of the facility and associated backfill and replacement of the resulting void will be required. Abandonment and/or relocation will likely be required for some underground pipelines associated with the existing oil wells. If deep removals and or landslides exist in the area of the existing wells then structural setbacks may be necessary. The Southern California Gas line and the MWD waterline will require protection in-place. This may require setbacks, additional remediation and/or other restrictions so as not to undermine the stability of these very sensitive utilities. Typically specific reports are required by these *agencies to address their specific concerns. Evaluation of the impacts of the grading on those existing improvements should be provided prior to grading.*

4.10 Excavation Characteristics

Based upon PSE's experience on an adjacent site and geologic mapping of this site, the earth materials likely to be encountered during grading will include alluvium and other surfical deposits and bedrock.

Implications and Mitigation

It is anticipated that the earth materials can be excavated using conventional earth moving equipment.

4.11 Foundation Design

Foundation design is typically governed by the settlement potential and expansive soil characteristics of the site soils. The expansion potential of site soils that will be encountered during grading are anticipated to range from "medium" to "high".

Implications and Mitigations

It is anticipated that post-tensioned slabs on grade can be engineered to mitigate against the potential detrimental effects related to fill settlement and expansive soils characteristics.

Settlement monitoring will be required for fill areas in excess of 50 feet in depth. Such monitoring is intended to allow a significant portion of the fill settlement to occur prior to construction so that the remaining settlement can be tolerated by commonly utilized foundation systems. Engineered fills placed deeper than 50 feet should be placed using a minimum relative compaction standard of 93 percent of the laboratory maximum. This reduces the settlement potential of the fill mass and typically facilitates a quicker release from building restrictions related settlement monitoring.

Post-grading testing should be performed to evaluate the expansion characteristics of the as-graded soil conditions.

Final foundation design should consider both the effects of expansive soils as well as a design settlement value related to both the fill thickness and the geometry of the underlying bedrock materials.

4.12 Corrosion

The presence of soluble sulfates in soils can be detrimental to concrete. Low resistivity soils can have a detrimental effect on metals. Based upon our previous experience in the general area, onsite soils will likely exhibit "negligible" to "moderate" sulfate exposure and "low" to "moderate" resistivities.

Implications and Mitigations

Consultation with a corrosion engineer is recommended and final mitigations should be based on testing of as-graded soil conditions.

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on PSE's review of the referenced reports, site reconnaissance, and experience with similar projects, PSE offers the following opinions:

- Development of the site is feasible from a geotechnical standpoint. Standard cut/fill grading techniques can likely be implemented throughout of the site.
- The site is in a State of California Urban Seismic Hazards Zone and an Alquist-Priolo Earthquake Fault Zone. A fault considered capable of producing ground surface rupture has been mapped within the site and must be setback from a minimum of 50 feet. Further geotechnical investigations are required to identify the specific location of this fault and the recommended setback zone.
- Several landslides are suspected to underlie the site and must be further investigated if the proposed development is within the zone of influence of these potentially unstable areas.
- It is anticipated that planned cut, fill and/or natural slopes in and adjacent to the proposed project may be unstable and require evaluation for stabilization.

- The identified geotechnical issues will require mitigation measures. A geotechnical subsurface investigation and laboratory-testing program should be performed, as soon a sufficient design is available.
- Future exploration, analysis, and development should be in accordance with current local building codes, as well as the recommendations of the geotechnical consultant. Abandonment of on site wells and septic systems should be done in accordance with the County of Orange Department of Environmental Health.
- Post-tensioned slab/foundations can be utilized for typical single-family residential structures. Those foundations should be design in consideration of the as-graded soil conditions, including expansion and settlement potential. The majority of on site soils are anticipated to be "moderate" in expansion potential.
- As plans are formulated, the geologist/geotechnical engineer should be consulted for their opinion and recommendations.

The opportunity to be of service is appreciated. If you have any questions or require additional information, please contact the undersigned at (714) 730-2122.

Respectfully submitted,
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Distribution: (6) Addressee
(2) Mr. Horst Schor

DT:DCA:RAR:rb-500674, June 8, 2006 (Due Diligence Travis Property City of Yorba Linda)

APPENDIX A

Cited References

and

Aerial Photographs Reviewed

APPENDIX A

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AERIAL PHOTOGRAPHS REVIEWED

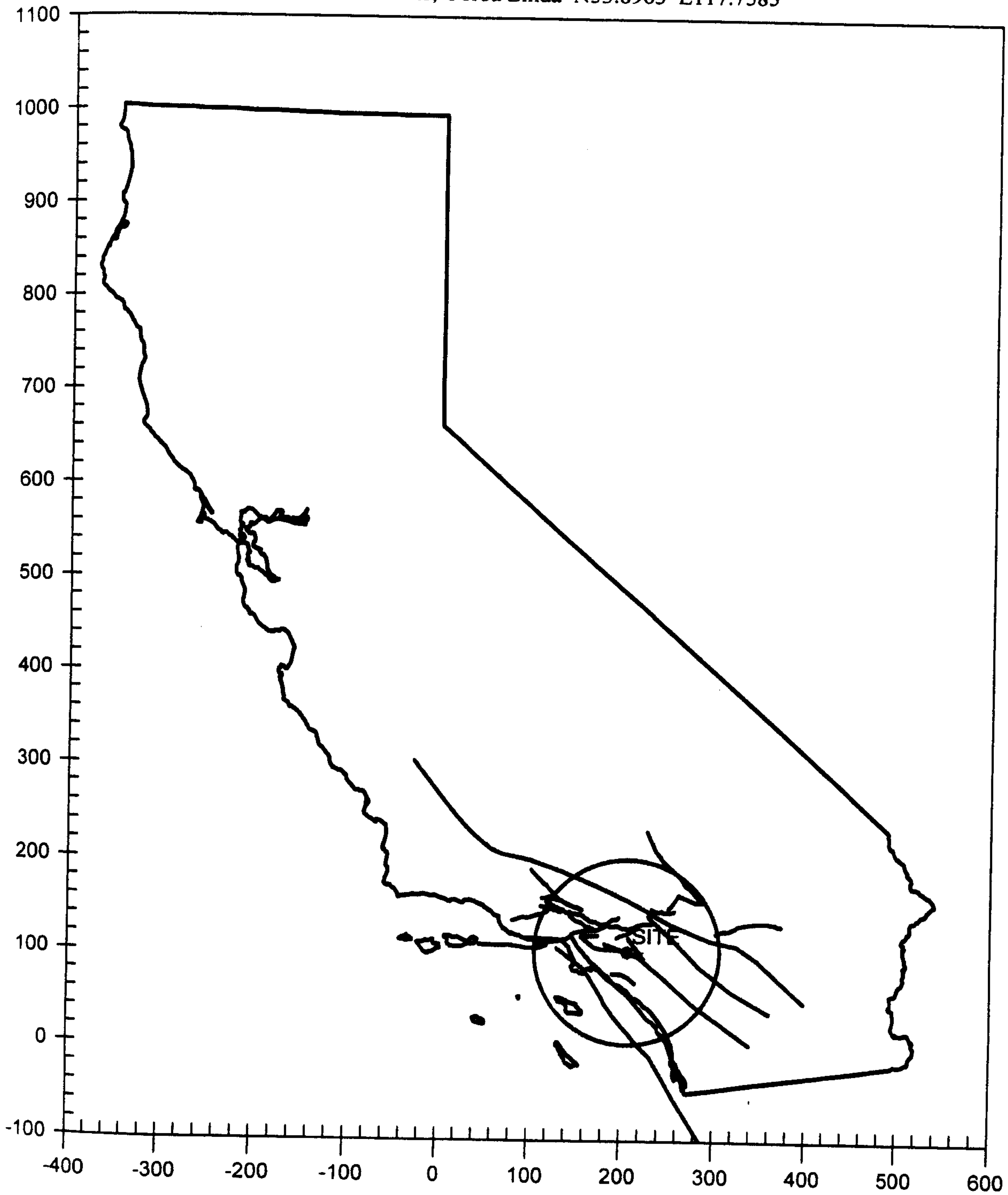
Year	Flight No.	Frame
1952	5K	61 & 62
1959	261-5R21	57 & 58
1967	2	72 & 73
1970	60-4	104 & 105
1973	132	9-3 & 9-4
1975	157	10-3 & 10-4
1978	203	10-6 & 10-7
1981	211	10-6 & 10-7
1983	218	10-8 & 10-9
1986	F-112	
1988	Yorba Linda	2-6 & 2-7
1992	C85	4-7 & 4-8
1999	C133-32	169 & 170

APPENDIX B

Seismic Hazard Analysis

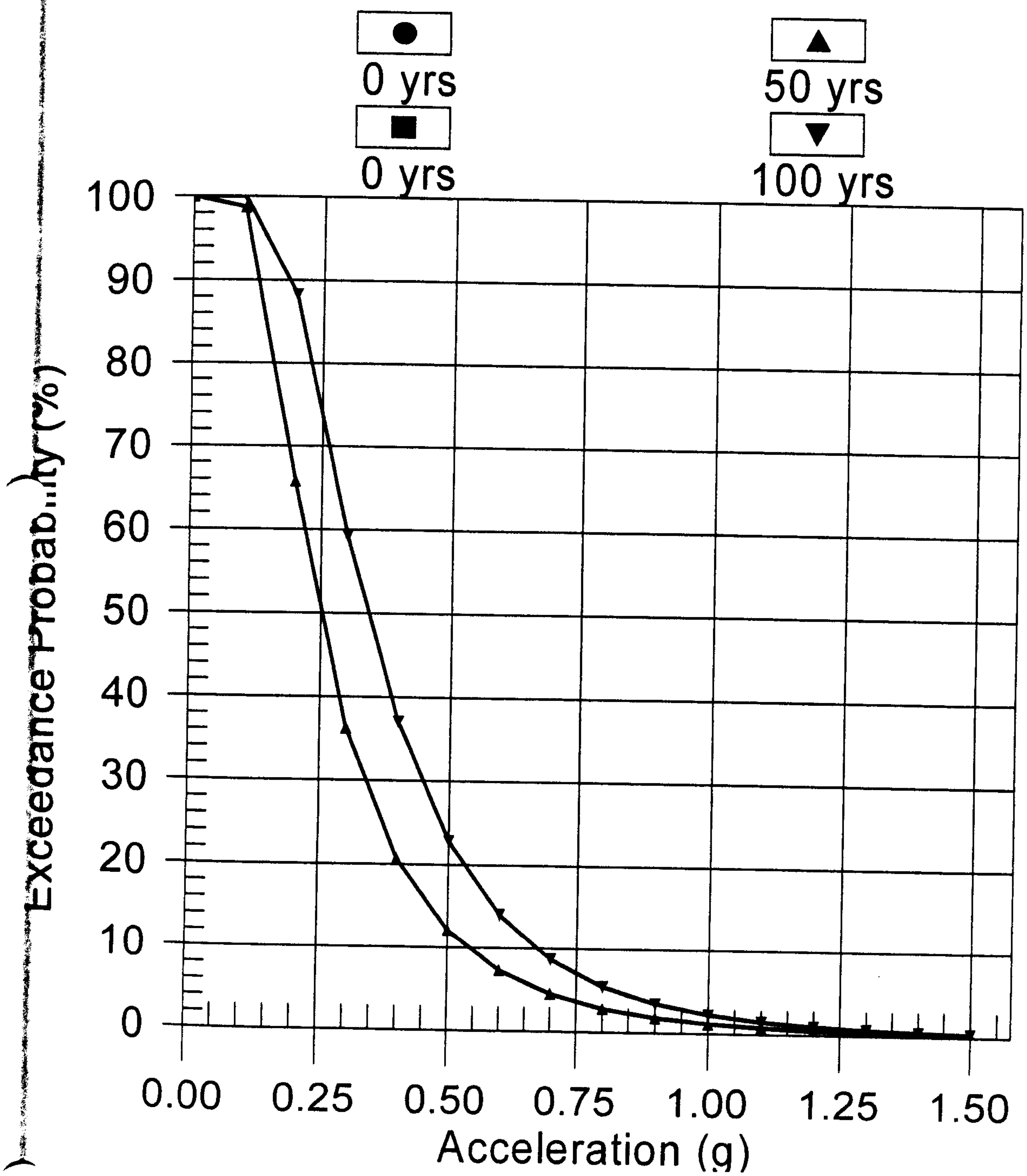
CALIFORNIA FAULT MAP

WO 500674 Travis, Yorba Linda N33.8963 E117.7585



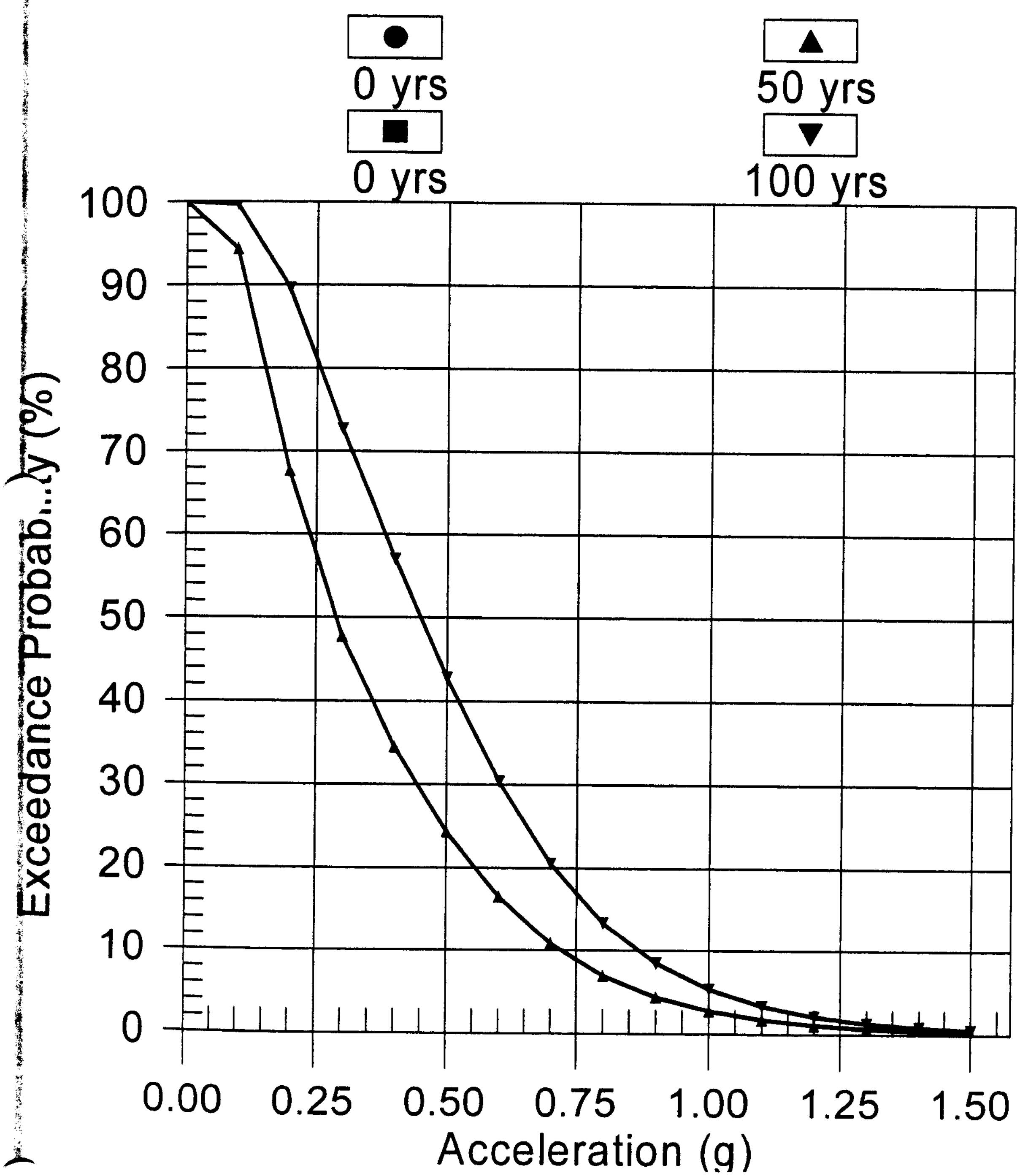
PROBABILITY OF EXCEEDANCE

BOORE ET AL(1997) NEHRP C (520)1 WO 500674



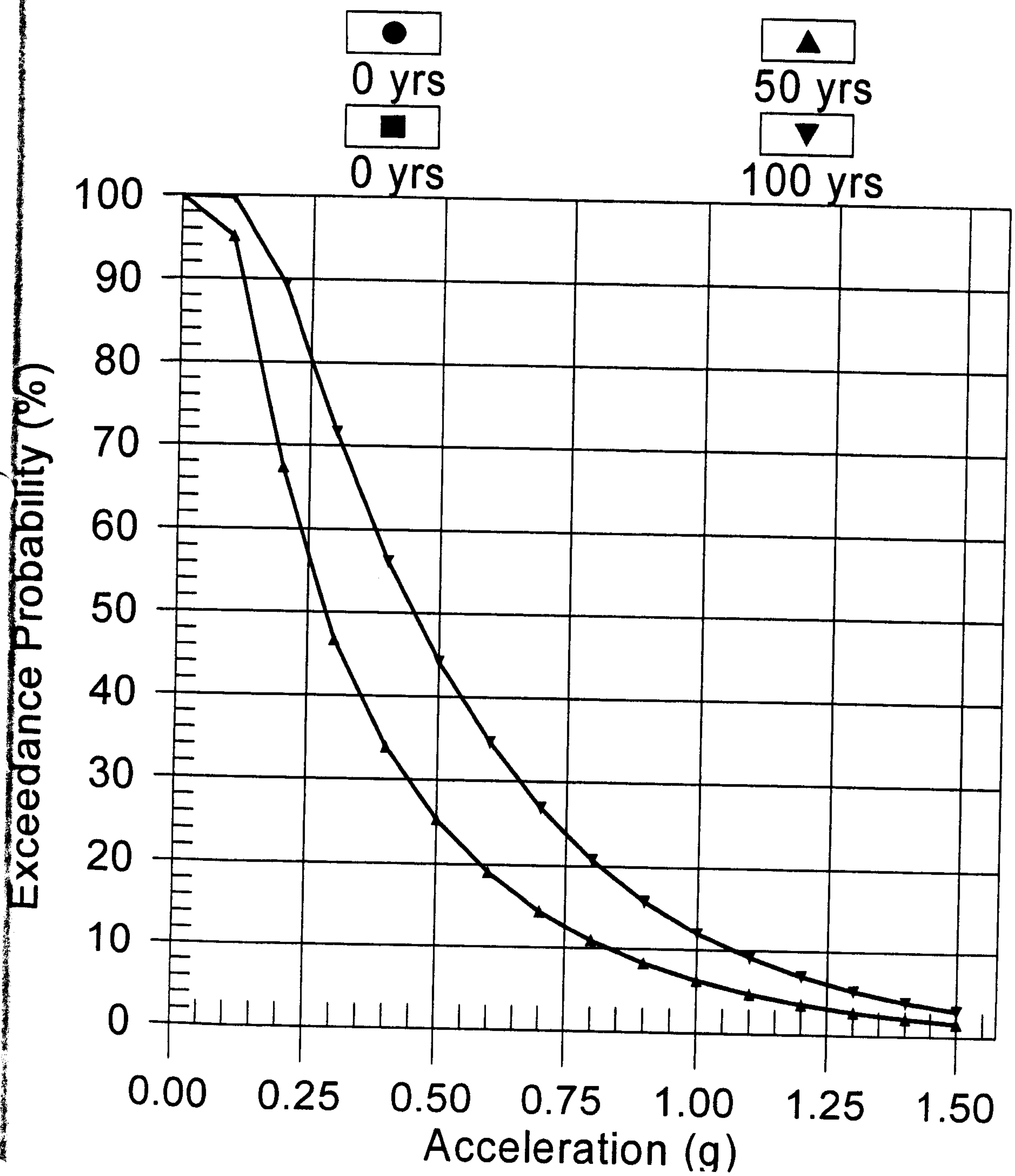
PROBABILITY OF EXCEEDANCE

CAMP. & BOZ. (1997 Rev.) SR 1 WO 500674



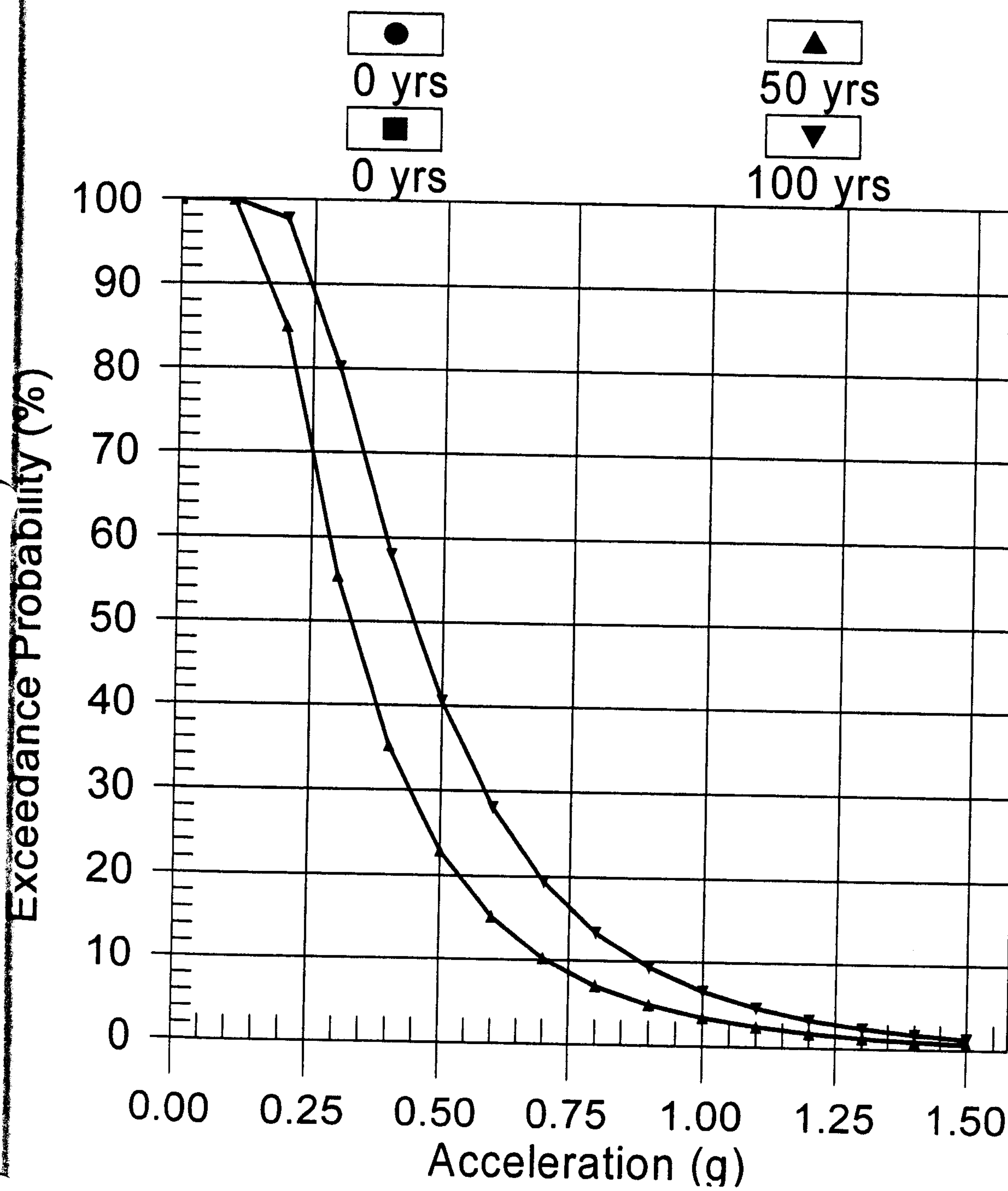
PROBABILITY OF EXCEEDANCE

SADIGH ET AL. (1997) ROCK 1 WO 500674



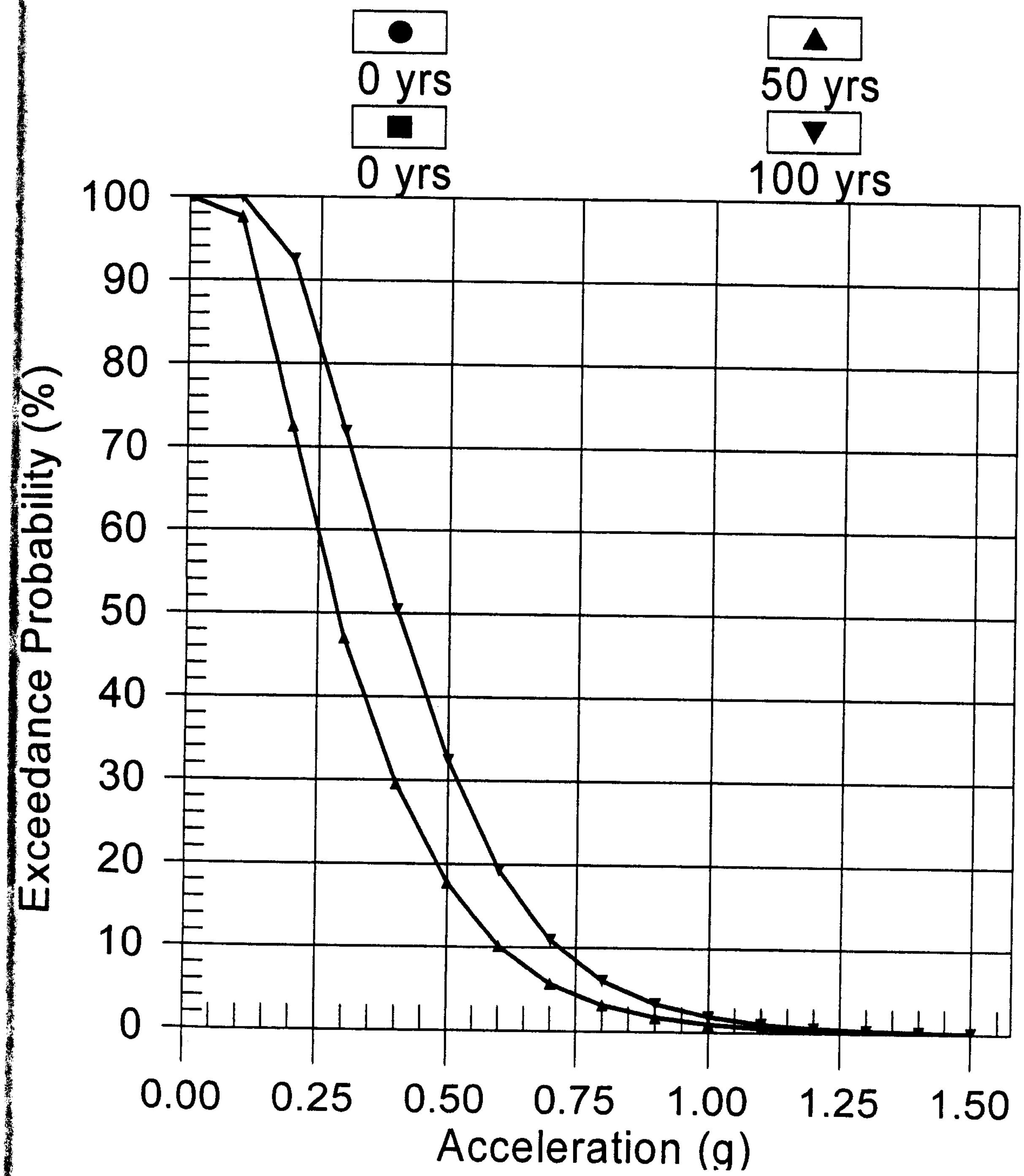
PROBABILITY OF EXCEEDANCE

BOORE ET AL(1997) NEHRP D (250)1 WO 500674



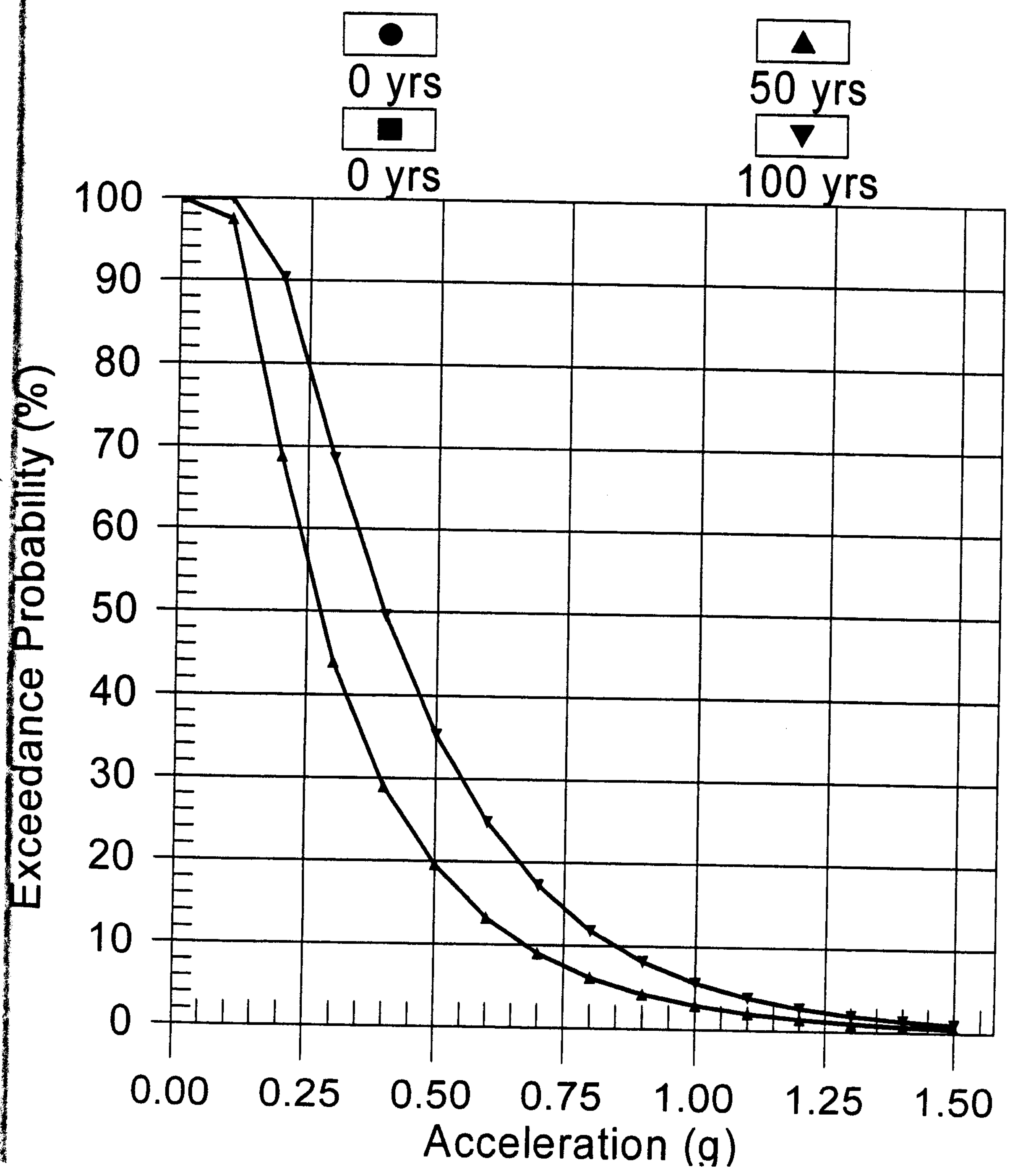
PROBABILITY OF EXCEEDANCE

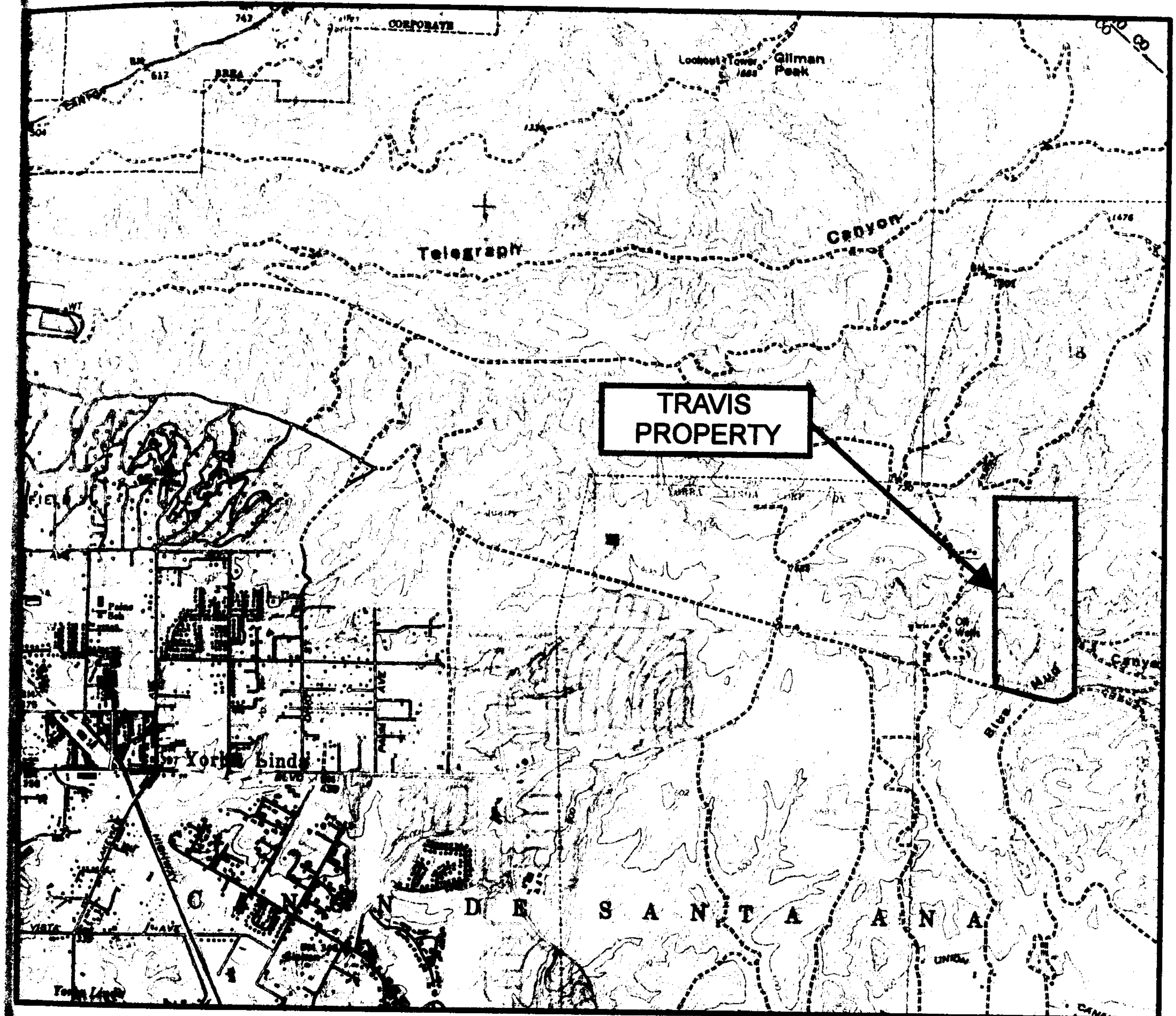
CAMP. & BOZ. (1997 Rev.) AL 1 WO 500674

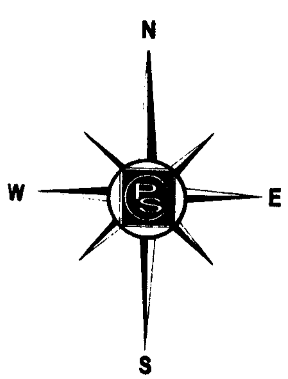


PROBABILITY OF EXCEEDANCE

SADIGH ET AL. (1997) DEEP SOIL 1 WO 500674





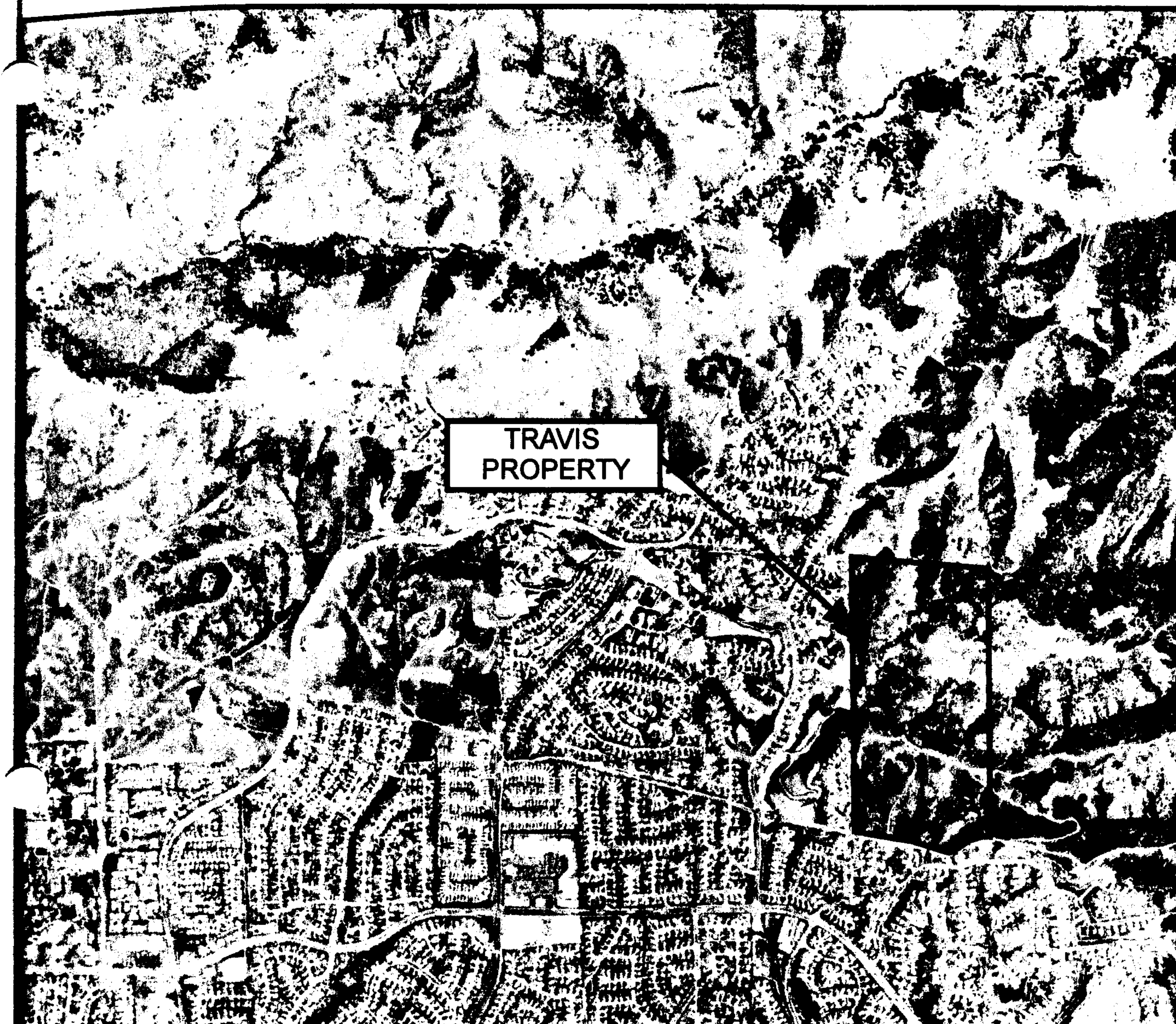


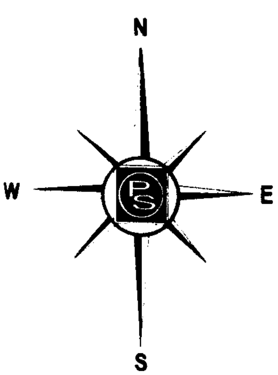
SITE LOCATION MAP
TRAVIS PROPERTY

FIGURE 1

SOURCE MAP: U.S.G.S. YORBA LINDA QUADRANGLE

PACIFIC SOILS ENGINEERING, INC.
3002 DOW AVE. SUITE 514, TUSTIN, CA. 92780
TELEPHONE: (714) 730-2122, FAX: (714) 730-5191
W.O 500674
DATE: 6-8-06





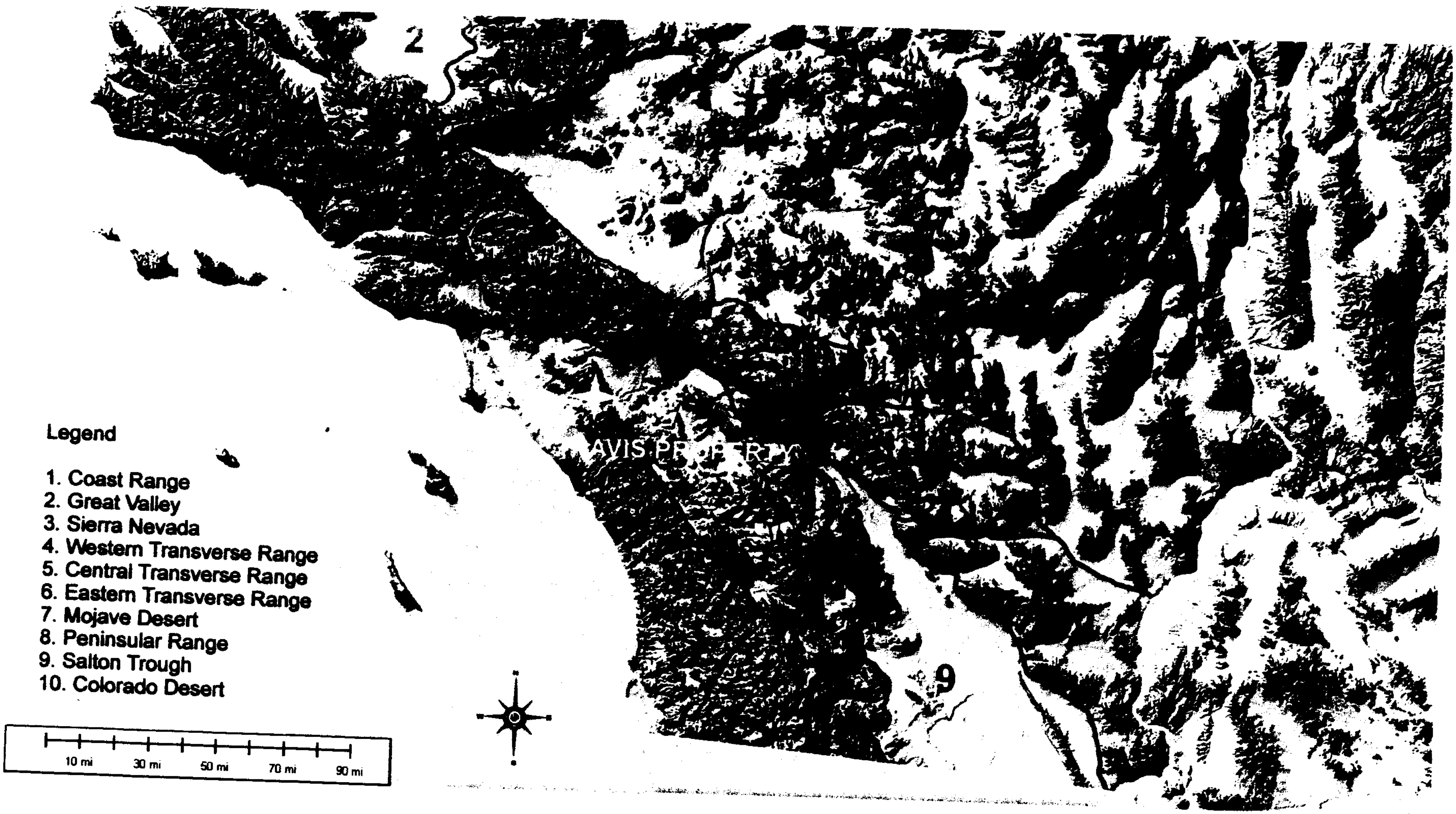
AERIAL PHOTO
TRAVIS PROPERTY

FIGURE 2

SOURCE MAP: AERIAL PHOTO

PACIFIC SOILS ENGINEERING, INC.
3002 DOW AVE. SUITE 514, TUSTIN, CA. 92780
TELEPHONE: (714) 730-2122, FAX: (714) 730-5191
W.O 500674 DATE: 6-8-06

GEOMORPHIC PROVINCES



rovince Source: C.G.S. Note 36
ap Base: U.S.G.S. NED

FIGURE 3

PACIFIC SOILS ENGINEERING, INC
3002 DOW AVENUE, SUITE #514, TUSTIN CALIFORNIA 92780
TELEPHONE: (714) 730-2122, FAX: (714) 730-5191

W.O. 500674 **DATE: 6-8-06**

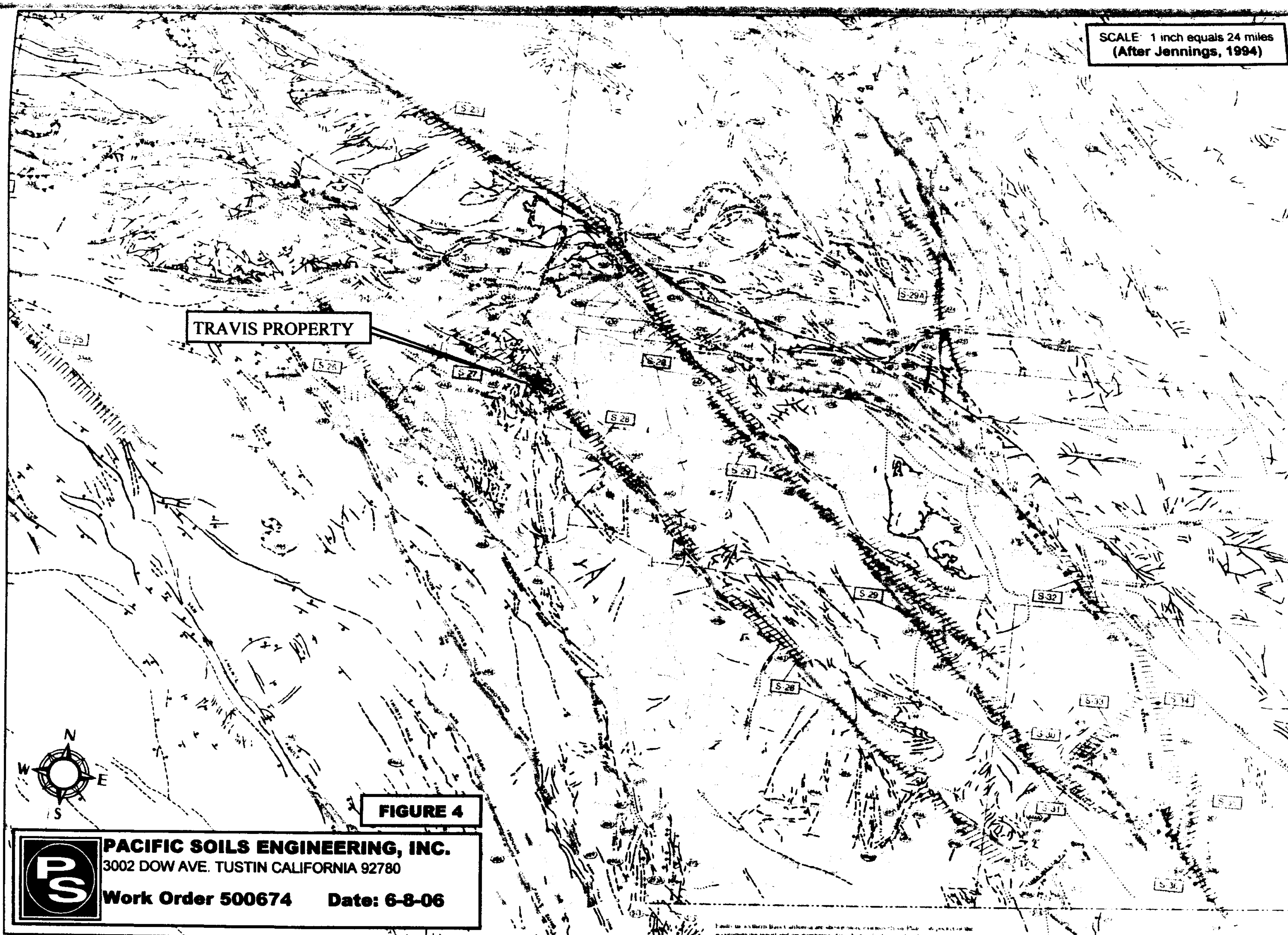
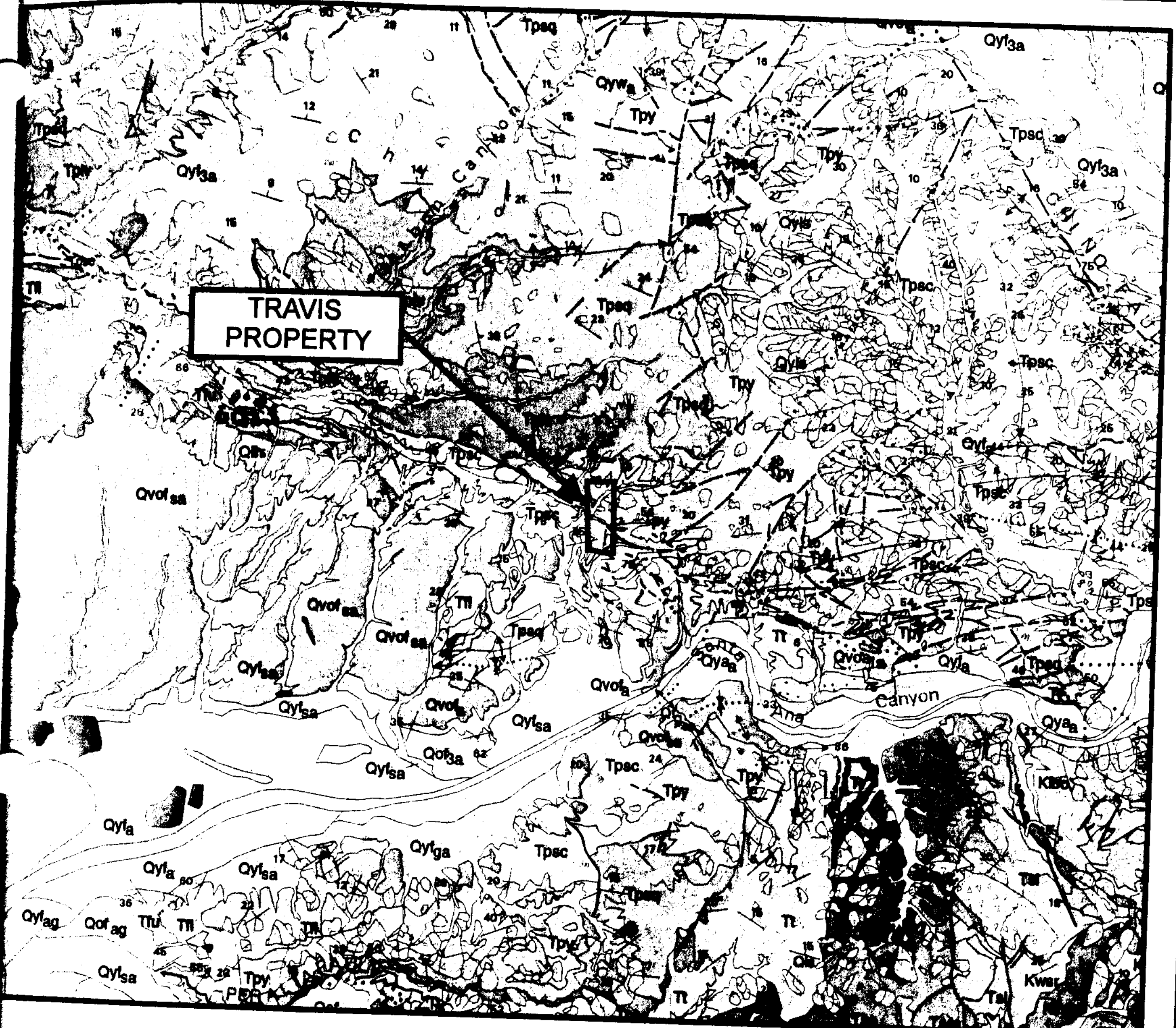
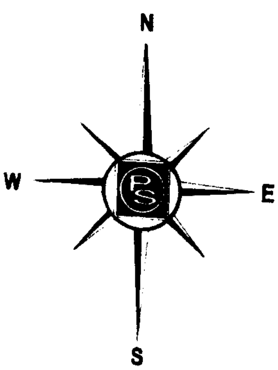


FIGURE 4

PACIFIC SOILS ENGINEERING, INC.
3002 DOW AVE. TUSTIN CALIFORNIA 92780
Work Order 500674 Date: 6-8-06



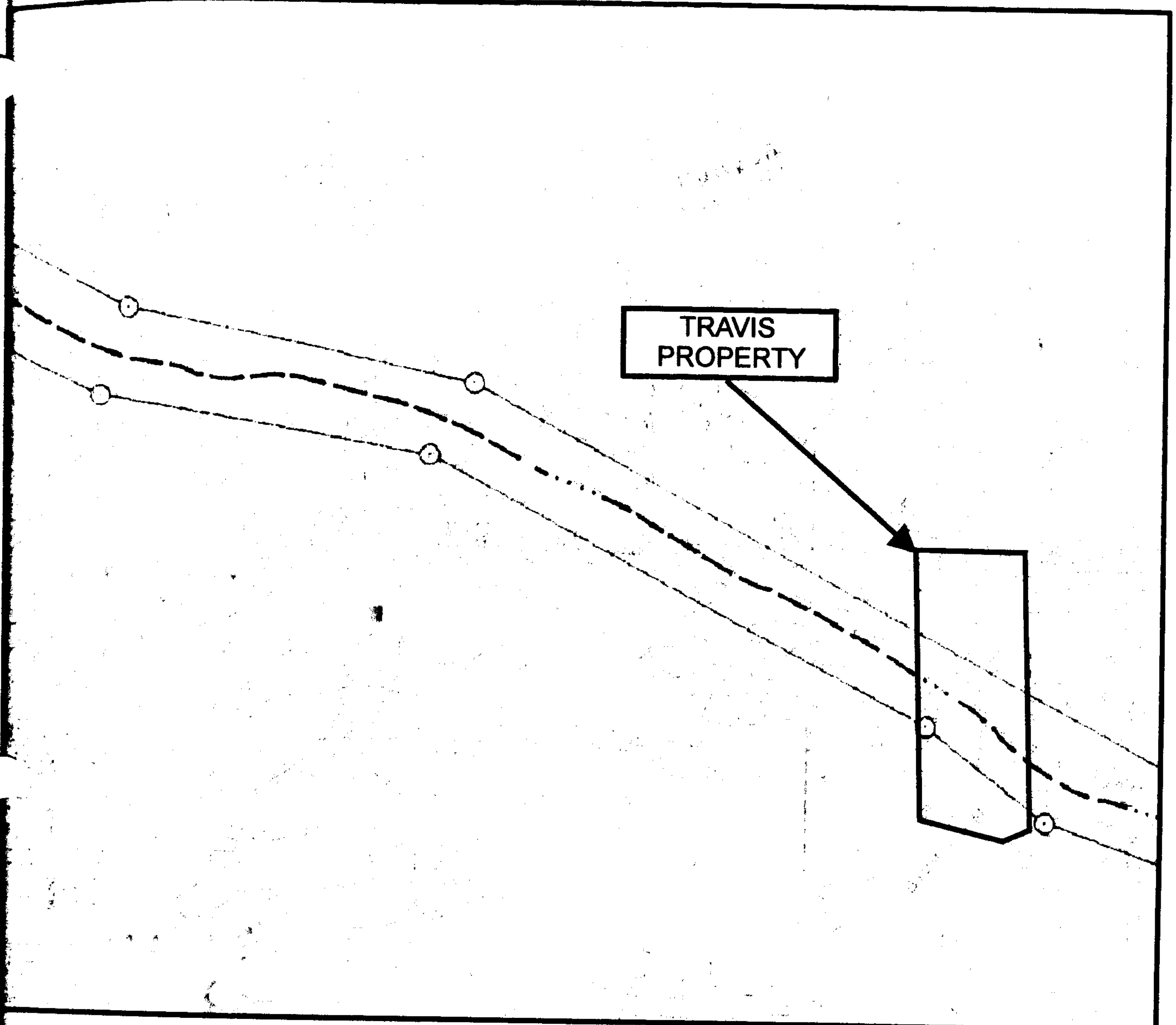


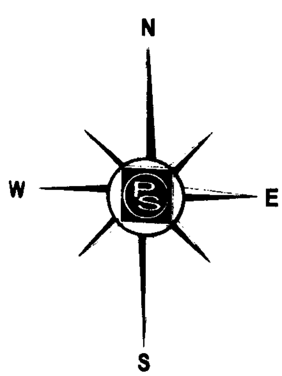
REGIONAL GEOLOGY MAP
TRAVIS PROPERTY

FIGURE 5

OURCE MAP: U.S.G.S .SANTA ANA
HEET VER. 2

PACIFIC SOILS ENGINEERING, INC.
3002 DOW AVE. SUITE 514, TUSTIN, CA. 92780
TELEPHONE: (714) 730-2122, FAX: (714) 730-5191
W.O 500674
DATE: 6-8-06





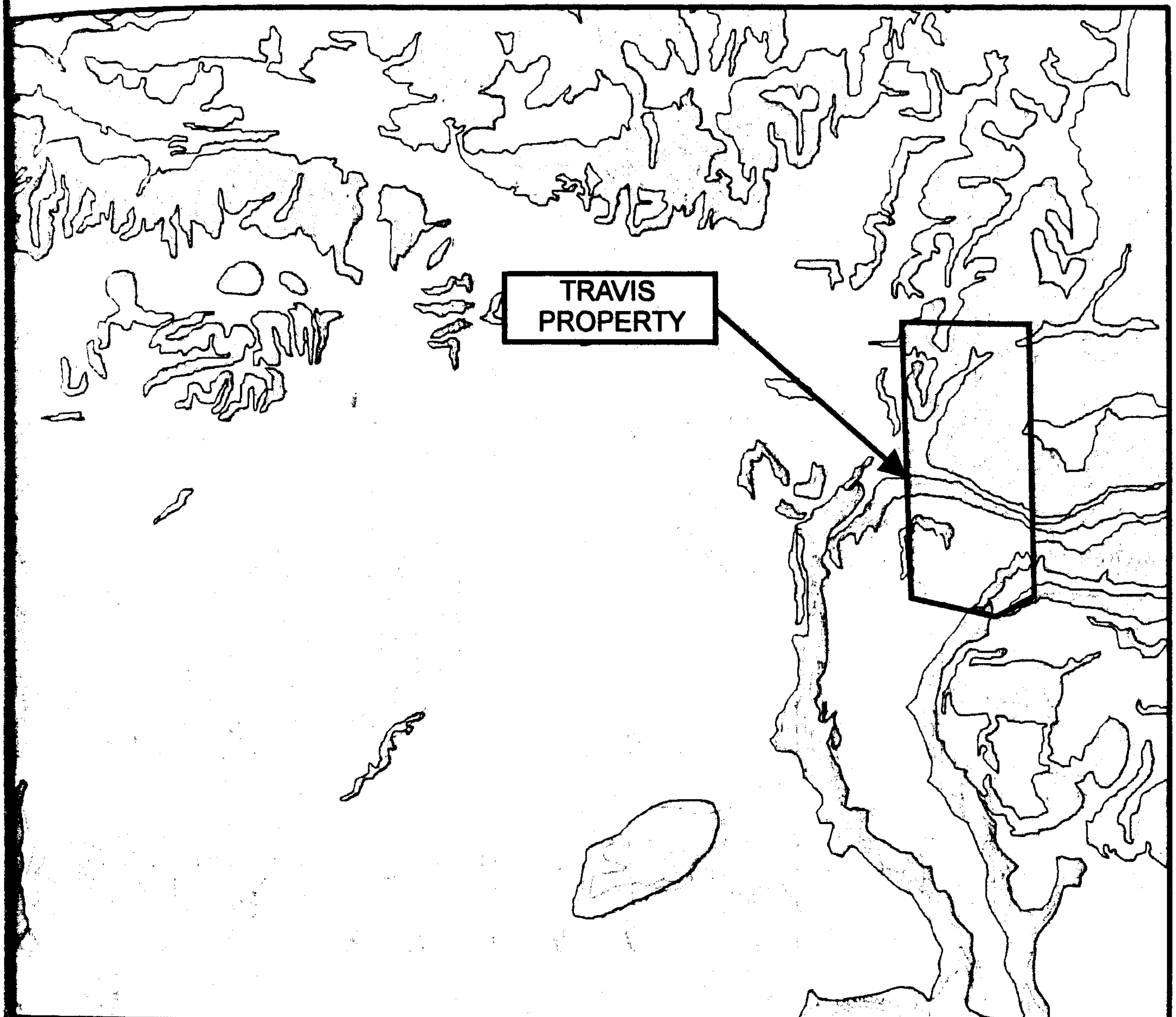
ALQUIST-PRIOLO SPECIAL STUDIES ZONE

TRAVIS PROPERTY

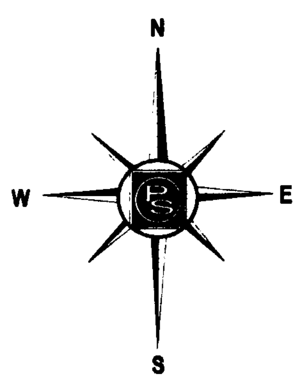
FIGURE 6

OURCE MAP: C.G.S. A-P MAP
ORBA LINDA QUADRANGLE

PACIFIC SOILS ENGINEERING, INC.
3002 DOW AVE. SUITE 514, TUSTIN, CA. 92780
TELEPHONE: (714) 730-2122, FAX: (714) 730-5191
W.O 500674
DATE: 6-8-06



SOURCE MAP: USHMA MAPS



USHMA MAP

TRAVIS PROPERTY

MAP EXPLANATION

Zones of Required Investigation:

Liquefaction

Areas where historical occurrence of liquefaction, or local geological, geotechnical and ground-water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

Earthquake-Induced Landslides

Areas where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

NOTE: Seismic Hazard Zones identified on this map may include developed land where delineated hazards have already been mitigated to city or county standards. Check with your local building/planning department for information regarding the location of such mitigated areas.

FIGURE 7

PACIFIC SOILS ENGINEERING, INC.
3002 DOW AVE. SUITE 514, TUSTIN, CA. 92780
TELEPHONE: (714) 730-2122, FAX: (714) 730-5191
W.O 500674 DATE: 6-8-06

March 1, 2013 Project No. 10106-01

Mr. Larry Netherton
North County BRS Project, LLC
3 Corporate Plaza, Suite 102
Newport Beach, California 92660

Subject: ***Geotechnical Feasibility Study, Proposed Development of Tentative Tract Map No. 17341, County of Orange, California***

Introduction

In accordance with your request, LGC Geotechnical, Inc. has performed a geotechnical feasibility study for the proposed development of Tentative Tract Map No. 17341 in Orange County, California. The purpose of our limited study was to evaluate the existing site geotechnical conditions and provide preliminary geotechnical findings and conclusions relative to the feasibility of the proposed development of the site.

Based on the results of our limited study and understanding of the planned improvements, the proposed development of the subject site is considered feasible from a geotechnical standpoint. This report presents our preliminary geotechnical findings and conclusions regarding the site.

It should be noted that a subsurface geotechnical evaluation of the site is currently in-progress as of the date of this report. The purpose of our geotechnical evaluation is to address the potential geotechnical constraints to the project discussed herein and to provide project specific geotechnical parameters and recommendations for development of the site.

Existing Site Conditions and Proposed Development

We understand that the proposed development will ultimately include construction of 112 lots for detached, single-family residential homes and associated streets and utilities.

The subject site consists of an 84-acre approximately “L”-shaped area, generally located east of the eastern terminus of Aspen Way in unincorporated Orange County (Figure 1). The area of proposed development is bordered to the west and south by existing residential developments and to the north and east by relatively undeveloped land.

Topography of the site is characterized by moderately to steeply inclined slopes with three deeply incised southerly and westerly draining canyons along with moderately incised secondary canyons. The site ranges in elevation from approximately 605 to 805 feet above mean sea level. Previous earthwork has included minor cuts and fills for dirt access roads and pads associated with several currently active oil wells, fuel storage tanks, pipelines, and associated improvements.

The currently proposed development of the site will include hillside cut and fill grading for the proposed 112 residential lots and associated streets and infrastructure.

Geologic Summary

The subject site is located in the southern Puente Hills which are generally the foothills of the northwestern portion of the Santa Ana Mountains, separated from the mountain range by the Santa Ana River. The Puente Hills and Santa Ana Mountains form the eastern boundary of the larger Los Angeles Basin, within the Peninsular Ranges Geomorphic Province of California. The Peninsular Ranges are generally characterized by regional northwest trending mountain ranges, intervening valleys, and numerous sub-parallel fault systems. The major, currently active faults are dominated by right-lateral strike slip motion, with local variations.

The dominant structural feature of the subject site is the presence of the Whittier Fault trace through the center of the site. The right lateral strike-slip fault has greatly influenced the development of the regional geomorphic landforms. The Whittier Fault, which is considered to be “active” by the State of California, crosses the central portion of the site in a roughly northwest orientation, as identified on the State Fault Rupture Hazard Zone map for the Yorba Linda Quadrangle (CDMG, 1980). A fault that has ruptured within the Holocene, approximately the last 11,000 years, is considered active. The State of California Fault-Rupture Hazard Zone for the Whittier Fault is approximately 1,000-foot-wide across the site. While the proposed development does not cross the inferred active trace of the fault, residential structures have been proposed within the Fault Rupture Hazard Zone (a.k.a. Alquist-Priolo Special Studies Zone). Where developments for human occupation are proposed within these zones, the state requires detailed fault investigations be performed so that engineering geologists can mitigate the hazards associated with active faulting by identifying the location of active faults and allowing for a setback from the zone of previous ground rupture.

The underlying bedrock formation at the site is a Miocene-age sedimentary bedrock mapped as the Tertiary Puente Formation. This bedrock unit consists of predominately thinly to massively bedded sandstone, siltstone, and shale with minor amounts of overlying topsoil and colluvium. Abandoned stream terrace deposits are noted in the upper reaches of the southern portion of the site, and alluvium deposits mapped along canyon bottoms. Although the bedrock is moderately hard, thin weak planes along and across bedding are subject to localized instability within unsupported slopes. Several large-scale landslides are identified at the northwestern portion of the subject site.

Based on our review of the State of California Seismic Hazard Zones Yorba Linda 7.5 Minute Quadrangle (CDMG, 2005b), one small zone of potential earthquake induced liquefaction has been mapped at the southeastern portion of the proposed development. Additionally, the State of California Seismic Hazard Zones Yorba Linda 7.5 Minute Quadrangle depicts several potential earthquake induced landslide areas within and adjacent to the limits of the proposed development.

Oil wells located at the site, drilled within a portion of the Esperanza Oil Field, are understood to be pumping small volumes of oil from great depth, exceeding 2,000 feet below ground. Apart from surface mitigation of well heads and potential mitigation of directly adjacent soils, oil wells are not anticipated to affect site geotechnical conditions.

Site Geology

Based on our review of available geologic maps and site reconnaissance visit, the site is underlain by a minor amount of artificial fill, topsoil/colluvium, alluvium, terrace deposits, landslide debris, and bedrock. A brief description of the geologic units on the site is presented below (from youngest to oldest).

Artificial Fill - Undocumented

Minor amounts of undocumented artificial fill were observed in various locations throughout the site as associated with the existing dirt roads and oil derrick pads. The material was observed to be up to several feet thick and was likely derived from onsite soils.

Topsoil/Colluvium

Topsoil at the site generally consists of 1 to 3-foot-thick dark brown, silty sand with clay. This unit mantles most of the site except for the steeper canyon sides, and is typically porous with roots and desiccation cracks. Colluvium is a residual soil derived from accumulation of slopewash and deep weathering of onsite terrace materials and bedrock. It generally consists of gray to dark brown, clayey residuum and scattered clasts of sandstone**,** commonly with abundant carbonate stringers.

Quaternary Alluvium (Map Symbol: Qal)

Quaternary alluvial deposits at the site are generally observed within the lower portions of the drainages. These deposits typically consist of dark brown to light brown, unconsolidated, loose mixtures of sand, silt, and clay with scattered pebbles and cobbles. The alluvium is expected to be up to approximately 10 feet thick in the minor drainages, and as thick as approximately 20 feet in major drainages.

Quaternary Terrace Deposits (Map Symbol: Qt)

The non-marine Terrace Deposits at the site are interpreted to be abandoned deposits of the Santa Ana River that currently flows to the south of the site. The material consists of moderately consolidated sands, silts, and clays.

Quaternary Landslide (Map Symbol: Qls)

The landslides identified on the regional maps are shown as large block features with steep surface expression and vertically extensive limits. The landslides are derived from the onsite bedrock, the Puente Formation, described below. Smaller, surficial landslides and shallow failures, not depicted on regional maps, can be expected at local hillside areas throughout the site.

Tertiary Puente Formation (Map Symbol: Tp)

The Tertiary Puente Formation has several members, and two of them are mapped within the limits of the site. The Yorba Member of the Puente Formation is noted north of the Whittier Fault on regional maps of the area, and the Sycamore Canyon Member of the Puente Formation is noted south of the Whittier Fault. The members are not significantly different within the subject area and are not differentiated on the map herein. The Puente Formation onsite has been described as light yellowish brown, massive to thinly interbedded fine-grained sandstone, brownish gray to dark gray siltstone with zones of platy shale, and pebble conglomerate. The material can be dry to moist and dense to very dense. Variable materials such as clay lenses and concretions are typical. The formation can be tightly folded and exhibits signs of along-bedding flexural slip within zones of folding, plus minor, tight, pre-lithification shears of small offset.

Geologic Structure

Review of available literature and maps indicate that portions of the Puente Formation bedrock at the site are highly folded with multiple east-west trending synclines and anticlines, likely due to regional uplift and the close proximity of the Whittier Fault. Bedding generally strikes N45W to E-W with layers dipping both to the north and the south between 25 and 75 degrees, with local variations. The folding and variable dip of bedding is observed on both sides of the northwest trending Whittier Fault. Bedrock structure can be expected to be highly weathered and jointed near the surface, especially along ridges, and fresher with depth. Minor cementation and zones of concretions can also be expected within the bedrock. Some localized along bedding flexural-slip and pre-lithification shearing is typical for the formation.

Based on review of regional maps and aerial photos, it appears that portions of the planned development may be affected by existing landslides at the northern portion of the site. Details about the potential landslides such as thickness, mode of failure, and extents are unknown at this time. These details will be necessary for slope stability evaluation of the hillsides within and adjacent to the proposed development as part of the geotechnical field study.

Groundwater

Based on our review of the State of California Seismic Hazard Zone Report for the Yorba Linda 7.5-Minute Quadrangle (CDMG, 2005a), historic high groundwater is estimated to be from 0 to 30 feet below the surface in the canyon area in the southern portion of the site. During our reconnaissance site visits, surface water has been observed in the stream bottom in the canyon areas in the central and northern portion of the site.

Slope Stability

Based on our site reconnaissance and review, there is significant information indicating the presence of landslides and other gross slope instability conditions within the site. Evaluation of the slopes should be one of the main focuses of a geotechnical evaluation through bucket auger drilling for downhole logging and slope stability analyses.

Geotechnical Impacts on the Proposed Development

Based on our review of available geologic maps and geotechnical reports applicable to the site, our limited site reconnaissance visit, and our professional knowledge of the geotechnical conditions in the general vicinity and experience with nearby projects having similar conditions, the pertinent geotechnical conditions impacting site development are presented below. Our methodologies for evaluating each geotechnical constraint as well as possible measures, which may be recommended to mitigate adverse impacts, are also included herein.

1) Faulting

For the subject site, the State requirements would dictate that a subsurface fault investigation be performed within the onsite State of California Fault-Rupture Hazard Zone in the central portion of the site. The purpose of the trench excavations would be to allow a qualified geologist to evaluate the native materials and determine if and where faults transect the area of proposed development. The fault trench study would need to excavate continuous trenches within the portions of the proposed development area where faulting is suspected in an orientation approximately perpendicular to the primary fault trend. The trenches would need to expose "datable" material that is unfaulted and older than 11,000 years to show the absence of active faulting. If faulting is encountered and determined to be active, a restricted use zone would likely need to be created, where structures for human occupancy (structures to be occupied a cumulative total of 2,000 person hours per year) should not be constructed. Such zones typically include the traces of the mapped faults plus a buffer zone on either side of the faults.

A subsurface fault study is to be performed as part of the in-progress subsurface geotechnical evaluation of the site.

2) Compressible Soils

The surficial soils on the site should be evaluated in a subsurface geotechnical evaluation of the site to determine if they are potentially compressible. Structural loads imposed on compressible soils could result in adverse settlement. Investigating the extent of potentially compressible soils on the site should be part of the focus of upcoming subsurface evaluation. Removal and recompaction of compressible materials may be necessary to mitigate the adverse settlement of these soils.

3) Potential for Hydro-Collapse

Unconsolidated alluvial soils can have a potential for hydro-collapse. Although not anticipated to be an issue at the site, investigation and evaluation of this potential should be addressed in a subsurface geotechnical evaluation of the site.

4) Landslides and Slope Stability

From a cursory review, many of the slopes located within and adjacent to the property could be include existing landslides and/or have the potential to move. In addition, some of the existing natural slopes are relatively steep and may not be suitably stable for the proposed development. A subsurface evaluation consisting of down-hole logging of large-diameter borings in the areas of suspected landslides and other areas of potential slope stability issues should be performed to characterize the slopes and engineering analysis should be performed to determine if stabilization measures are necessary.

5) Expansive Soils

A large portion of the site has been mapped as a thinly bedded shale. Shale typically contains appreciable amounts of expansive clay that have a Medium to High expansion potential when processed and placed as artificial fill. Representative sampling and preliminary laboratory expansion testing of the onsite soils should be performed during the upcoming subsurface investigation of the site. Geotechnical observation and laboratory testing upon completion of the building subgrade is recommended to confirm the expansion characteristics of typical onsite materials.

6) Infiltration of Storm Water Runoff

The majority of the site is anticipated to be unsuitable for infiltration of storm water runoff. The site is considered a hillside grading project, with steep slopes in a landslide prone area. Infiltration of storm water runoff could result in a reduction of the stability of site slopes. Once graded, the site will consist of compacted fill and bedrock material, neither of which are anticipated to infiltrate at a sufficient rate. Opportunities for or alternatives to infiltration should be evaluated during the subsurface evaluation phase of the project.

7) Corrosion Potential

In general, soil environments that are detrimental to concrete have high concentrations of soluble sulfates and/or pH values of less than 5.5. Table 4.2.1 of the ACI 318 Building Code provides specific guidelines for the concrete mix design when the soluble sulfate content of the soils exceeds 0.1 percent by weight or 1,000 ppm. The minimum amount of chloride ions in the soil environment that are corrosive to steel, either in the form of reinforcement protected by concrete cover, or plain steel substructures such as steel pipes or piles, is 500 ppm per California Test 532. Based on our knowledge of the local area, we anticipate that concrete for the proposed development may minimally be designed in accordance with the "not applicable" or "moderate" category of Table 4.2.1 of the ACI 318 Building Code. These assumptions are based on our experience in the area and should be evaluated during upcoming investigations and must be confirmed at the completion of grading.

For appropriate evaluation and mitigation recommendations for other substructures exposed to the potential influence from corrosive soils, a corrosion engineer specialist should be consulted.

8) Temporary Excavations

Excavations should be made in accordance with Cal OSHA, as a general guideline. Due to the anticipated landslide prone conditions, additional precautions may be necessary, such as flatter backcuts, during grading. Recommendations for buttress excavations should be addressed in the site geotechnical investigation based on the proposed development plan and the findings of the preliminary geotechnical investigation. Excavation safety is the sole responsibility of the contractor.

9) Fills Placement

Laboratory testing is recommended to evaluate the materials to be used as compacted fill. Onsite soils are anticipated to be suitable for use as compacted fill provided the soils are free of organics, oversized rock and other deleterious material.

10) Groundwater

Groundwater has been observed and should be anticipated within the alluvial canyon areas of the site. A static groundwater table is not expected to be present in the higher elevations of the site, but may be locally encountered in perched conditions. Part of the focus of upcoming subsurface evaluations will be to characterize the site groundwater conditions. If surface water or groundwater seepage conditions are present in areas of proposed development, recommended mitigative measures such as surface drains and/or subdrains can be provided.

11) Liquefaction

For the majority of the site, due to the anticipated post-grading lack of a shallow groundwater table below the site and dense nature of the majority of the onsite material and proposed compacted fill, liquefaction is not anticipated to be a potential hazard to the development. In the absence of a shallow groundwater table, loose sandy soils may have the potential for seismically-induced, dry sand settlement. Liquefaction potential and related potential seismic related hazards will be investigated in our upcoming subsurface investigation.

12) Rippability

It is anticipated that the onsite materials will be excavatable with conventional heavy-duty construction equipment. However, it should be anticipated that localized well cemented zones and concretions will be encountered, which may pose a rippability issue and may require some breaking in order to excavate. Evaluation of the rippability of the onsite materials should be part of an upcoming subsurface investigation on the site.

13) Oversize Material

Oversize material, mostly in the form of concretions in the bedrock, should be expected during site grading and development, however, in small quantities. If oversized material is encountered, the material will need to broken down to workable dimensions and/or placed in deeper fills following special placement guidelines outlined in an upcoming geotechnical evaluation report.

14) Seismicity

The site seismic characteristics were evaluated per the guidelines set forth in Chapter 16, Section 1613 of the 2010 C.B.C. Site coordinates of latitude 33.899061 degrees north and longitude -117.761111 degrees west, which are representative of the site, were utilized in our analyses. The initial results of our analyses for the maximum considered earthquake spectral response accelerations (S_S and S_1) are presented in Table 1.

TABLE 1

Seismic Design Values

Selected Parameters from the 2010 C.B.C. Section 1613 - Earthquake Loads	Seismic Design Values
Site Class per Table 1613.5.2	D
Spectral Acceleration for Short Periods (S_S)*	1.992 g
Spectral Accelerations for 1-Second Periods (S_1)*	0.748 g
Site Coefficient F_a per Table 1613.5.3(1)	1.0
Site Coefficient F_v per Table 1613.5.3(2)	1.5

* Calculated from the USGS computer program "Seismic Hazard Curves, Response Parameters and Design Parameters" v5.1.0 (02/20/11)

The spectral response accelerations (S_{MS} and S_{M1}) and design spectral response acceleration parameters (S_{DS} and S_{D1}), adjusted for Site Class D, were evaluated for the site in general accordance with section 1613 of the 2010 C.B.C. These site class adjusted parameters are presented in Table 2.

TABLE 2

Seismic Design Values Modified for Site Class D

Selected Parameters from the 2010 C.B.C. Section 1613 - Earthquake Loads	Seismic Design Values Modified for Site Class D
Site Modified Spectral Acceleration for Short Periods (S_{MS}) for Site Class D [Note: $S_{MS} = F_a S_S$]	1.992 g
Site Modified Spectral Acceleration for 1-Second Periods (S_{M1}) for Site Class D [Note: $S_{M1} = F_v S_1$]	1.123 g
Design Spectral Acceleration for Short Periods (S_{DS}) for Site Class D [Note: $S_{DS} = (^2/_3)S_{MS}$]	1.328 g
Design Spectral Acceleration for 1-Second Periods (S_{D1}) for Site Class D [Note: $S_{D1} = (^2/_3)S_{M1}$]	0.748 g

In accordance with Tables 1613.5.6 (1 & 2), the seismic design category for the subject site is Category D, where $S_{DS} \geq 0.50g$ and $S_{D1} \geq 0.20g$.

Section 1803.5.12 of the 2010 C.B.C. states that the PGA for a site may be defined as $S_{DS}/2.5$. The S_{DS} for the subject site has been calculated as 1.328 g. Therefore, PGA = 1.328 /2.5 = 0.53 **g.**

There is a potential for significant ground shaking at the subject site during a strong seismic event on the Whittier fault. New improvements will need to be designed for seismic forces in accordance with current building codes and regulations. However, there is still a risk that the proposed residential structure could be damaged as a result of an earthquake. Repair of the proposed structure may be needed after a seismic event.

15) Preliminary Foundation Recommendations

Depending on the results of our in-progress geotechnical evaluation and the proposed building loads, the proposed foundation system will likely consist of a post-tensioned slab foundation.

Conclusions and Recommendations

From our limited study of the site to date, it is our opinion that development of the subject site is feasible from a geotechnical standpoint. Detailed geotechnical studies, including subsurface exploration, will be needed to provide more specific geotechnical design recommendations. The next phase of investigation should include a subsurface evaluation of the site, laboratory testing, geotechnical analysis and preparation of a preliminary geotechnical report presenting geotechnical recommendations concerning site grading, and development based on the proposed grading and development plan.

Should you have any questions regarding this report, please do not hesitate to contact this office. We appreciate this opportunity to be of service.

Sincerely,

LGC Geotechnical, Inc.

Kevin B. Colson, CEG 2210
Vice President

PROFESSIONAL GEOLOGIST • KEVIN B. COLSON • NO. 2210 CERTIFIED ENGINEERING GEOLOGIST Exp. 7-31-14 • STATE OF CALIFORNIA

KTM/BJE/KBC/kmh

Attachments: References
Figure 1 - Geologic Map

Distribution: (4) Addressee (wet-signed copies)
(2) PCR
Attn: Mr. Michael Harden (wet-signed copies)

References

California Building Standards Commission, 2010, California Building Code, California Code of Regulations Title 24, Part 2, Volume 2 of 2, dated June 2010.

California Department of Conservation, Division of Mines and Geology, 1980, State of California Special Studies zones, Yorba Linda Quadrangle, Official Map Effective: January 1, 1980.

______, 1997, Guidelines for Evaluating and Mitigating Seismic Hazards in California, CDMG Special Publication 117.

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Geologic Map

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PROJECT NAME	Cielo Vista
PROJECT NO.	10106-01
GEOL.	KBC
SCALE	1" : 100'
DATE	March 2013

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