Appendix F
Geotechnical Report

ESA

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March 22, 2010
Work Order 700281

Attention: Mr. Michael Eadie

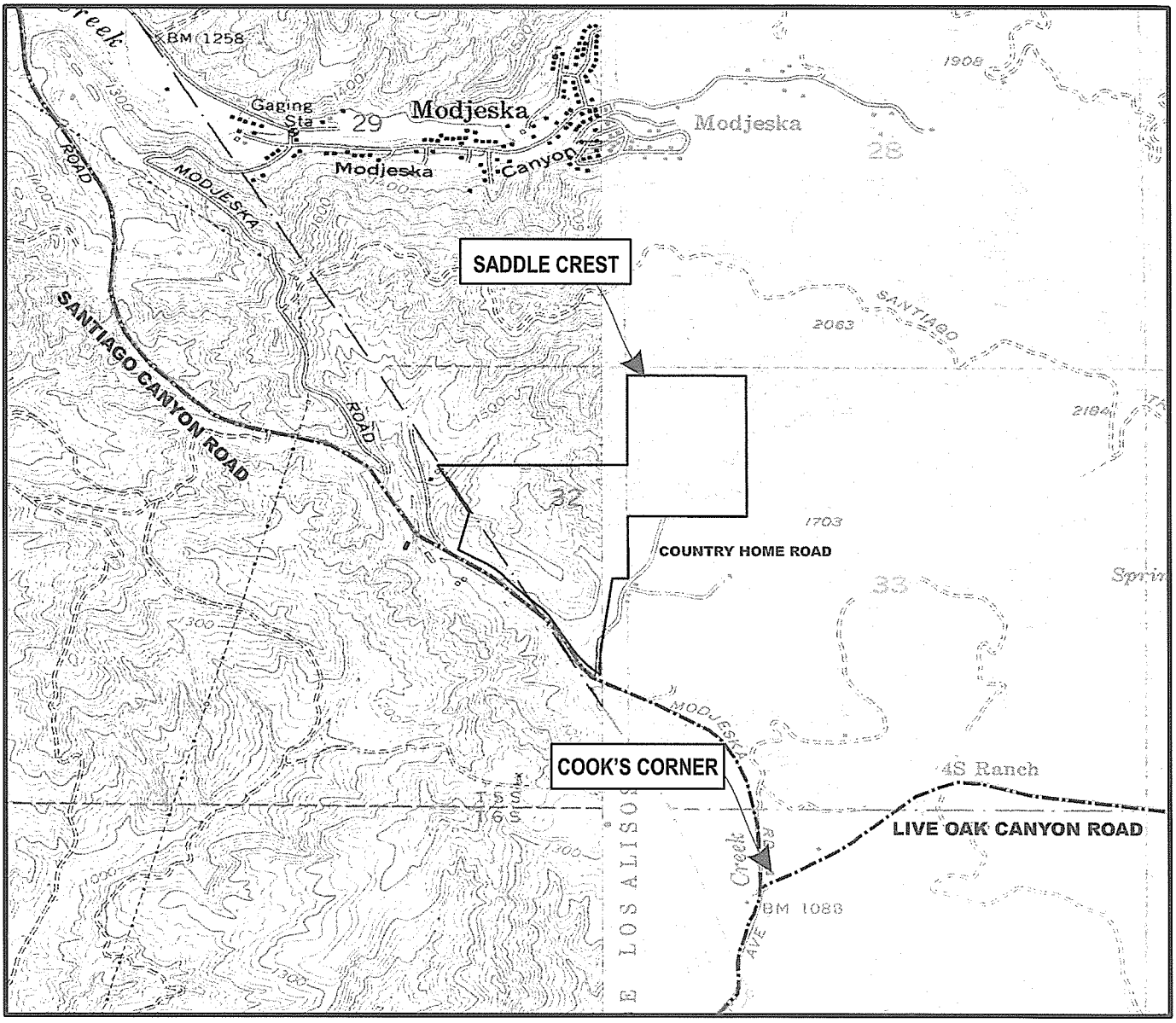
Subject: **GEOTECHNICAL INPUT IN SUPPORT OF THE ENVIRONMENTAL IMPACT REPORT**
Saddle Crest Parcel
Orange County, California

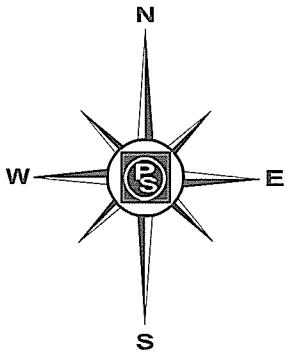
Gentlemen:

Pursuant to your request, presented herein is Pacific Soils Engineering, Inc.'s (PSE) geotechnical review in support of Environmental Impact Report (EIR) processing for the Saddle Crest Property. The site is located easterly of Santiago Canyon Road in the Orange County, California (See Figure 1, Site Location Map).

Based on our review of the available geotechnical data, the primary geologic hazards that could potentially affect development of the site include the stability of slopes, presence of existing native soils that are unsuitable in their existing condition for the support of structures, and potential for expansion when subjected to moisture and/or stress changes. It is anticipated that the known geologic hazards can be mitigated with proper planning and implementation of remedial measures. Therefore, based on PSE's review, it is our opinion that development of the property is feasible from a geotechnical point of view, provided that recommendations presented herein are incorporated into design and construction of the project. Additional subsurface investigations may be necessary and geotechnical review is required when tentative tract and grading plans are prepared.

PSE prepared this document for the sole use of the project team and design consultants, the only intended beneficiaries of this work. No other party should rely on the information contained herein without the prior written consent of PSE and Rutter Santiago, LP. This report and interpretations, conclusions, and recommendations contained within are based in part on





SITE LOCATION MAP

Saddle Crest
County of Orange, California

SCALE: 1"=2,000'

FIGURE 1

SOURCE MAP - USGS TOPOGRAPHIC MAPS OF THE
EL TORO AND SANTIAGO PEAK 7.5 MINUTE QUADRANGLES

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information presented in other documents that are cited in the text and listed in the references. Therefore, this report is subject to the limitations and qualifications presented in the referenced documents.

This report has been prepared in accordance with generally accepted engineering geologic and geotechnical engineering practices. No other warranty, expressed or implied, is made. In the event that any changes in or additions to the nature, design, or location of the project are planned, the conclusions and recommendations contained in this report should not be considered valid unless the changes are reviewed and conclusions of this report are modified or verified in writing.

It should be noted that this study focused on the evaluation and analysis of the geotechnical conditions of the subject site. It is our understanding that investigation or assessment of the potential presence of toxic or hazardous substances has been performed by others.

We at Pacific Soils Engineering, Inc., appreciate the opportunity to be of service to you and your organization. Should you have any questions or require additional information, please do not hesitate to contact the undersigned at (951) 582-0170.

Respectfully submitted,
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1.0 INTRODUCTION

1.1 Background and Purpose

Pacific Soils Engineering, Inc. (PSE) has been retained to conduct a geotechnical review of available information in support of the EIR for the subject project. The property is located easterly of Santiago Canyon Road, County of Orange, California (Figure 1). Presented in this report are the results of our review, identification of geotechnical issues that could impact site development, and discussion of available mitigations.

1.2 Scope of Study

This study is aimed at providing preliminary geotechnical information for the development of the property as it relates to: 1) existing site conditions; 2) remedial grading; 3) engineering and excavation characteristics of earth materials; 4) preliminary remedial recommendations; 5) cut and fill slope stability; 6) seismic hazard analysis.

The scope of our study included the following tasks:

- Reviewing pertinent published and unpublished geologic and geotechnical literature, maps, and aerial photographs (Appendix A).
- Site geologic mapping.
- Presentation of geologic information on the base topographic map (Plates 1 and 2), prepared by Hunsaker and Associates, and geologic cross sections (Plate 3). These plates have been reduced to 11" x 17" from their original size, and are attachments to this report.
- Preparing this report with accompanying exhibits.

1.3 Site Location and Description

The subject site comprises an approximate 113.6-acre parcel and is located in the northeastern portion of the County of Orange, California (Figure 1). The site consists of two blocks of land that are connected in a central area. The first area (hereafter referred to as the Southwestern Parcel) is roughly triangular in shape

and is bounded by Santiago Canyon Road on the southwest and Country Home road on the southeast. To the west and north is private property. The second portion (referred to as the Northeastern Parcel) is located generally to the northeast of the first parcel and is rectangular shaped. To the south, east and west of this parcel is privately owned property and to the north is open space property that is part of the Cleveland National Forest. In general, the land surrounding the entire property is vacant or has corrals, stables, riding rings and a few homes. The subject property is largely undeveloped and generally vacant except as discussed below.

In the northwestern corner of the southwest parcel is an area that is used for horses to graze and feed. Throughout the site are remnants of access roads that were used during previous mining attempts and for access during previous geotechnical investigations. Previous mining operations appear to have been focused in a narrow band in the southeastern portion of the site. The mining did not appear to be extensive and there is no remaining mining equipment. In the central portion between the two parcels is a previously used detention basin or stock pond that is dry throughout most of the year. A previous home site in this central property area (southern portion of the Northeastern Parcel) has also been abandoned and mostly removed. A small building and remnants of several concrete foundations and other structures remain. Most of the property lines are delineated with barbed wire fences.

The topography of the southwestern portion of the property is characterized by two northwest-southeast trending ridgelines separated by a relatively wide valley. There is also a relatively gently sloping planar area that connects the two ridgelines in the northwest portion of this parcel. The irregular-shaped western edge of the property consists of a relatively large but gently sloping canyon.

The topography of the northeast portion of the parcel is dominated by a generally north trending canyon along the western edge and a single ridge along the eastern

portion. At the very southern edge of this parcel of land is a generally east-west trending canyon.

Elevations range from a low of approximately 1,222 feet at the southeastern corner of the site to a high of approximately 1,795 feet along a ridgeline in the northeastern corner of the site.

The northeastern portion of the property is primarily covered with low brush and grasses along the slopes. The canyon areas support a few oak woodland type growths. The southwestern parcel is similar in vegetation except where the horses have been grazing, where there is little brush, and within the canyon which forms the western border, where it is wooded with oak trees.

1.4 Proposed Development

Two development concepts have been evaluated as part of this review. The "Preferred Plan" is the proposed concept for the project site. Based on a review of a 100-scale plan prepared by Hunsaker and Associates (Hunsaker) and received in March 2010 (Plate 1), the proposed site improvements will employ typical cut/fill construction grading techniques that will create 65 residential building pads, a reservoir site, a pad for a pump station, and associated streets. The development would also include construction of gas, sewer, water, storm drain and other essential utilities. The plan indicates that maximum proposed cuts and fills on the order of 70 and 80 feet in depth, respectively, will be required. Access to the development would be via a proposed street that enters the site from Santiago Canyon Road. The entire development footprint is located within the Southwestern Parcel area. The Northeastern Parcel would be used solely as open space.

A second plan (the "Baseline Plan") was also generated by Hunsaker (Plate 2). This second plan was developed under the guidelines in the Foothill/Trabuco Specific Plan This plan includes grading to create access to the proposed

development from Santiago Canyon Road and includes a relatively sinuous road that winds throughout the southwestern and northeastern parcels of the property. Several roads branch off the main road for access to other portions of the property. 65 residential lots are proposed; however, this plan does not include graded pad areas for these residential lots. Grading or development of each residential lot will be the responsibility of individual lot buyers, and thus will require further geological investigation once detailed plans are prepared.

1.5 Prior Geotechnical Investigations

Two previous geotechnical investigations are known to have been conducted within the property. In 1990 Geosoils Inc. conducted a preliminary geotechnical investigation that included 13 large diameter borings and 22 backhoe test pits in the southwestern portion of the project. In 1999 Leighton and Associates Inc. (Leighton) also conducted a preliminary geotechnical investigation, primarily within the southwestern portion of the property, as part of a project that included non-adjacent properties. Leighton's investigation included excavation of 6 large diameter borings and 4 backhoe test pits. The approximate locations of the borings and trenches are shown on Plates 1 and 2. The logs are included in Appendix B. Laboratory test data are presented in Appendix C only for the Leighton investigation.

2.0 GEOTECHNICAL CONDITIONS

2.1 Geomorphic Setting

The site is located on the southwestern flank of the Santa Ana Mountains within the Peninsular Range Physiographic Province. The Peninsular Range Physiographic Province is approximately 775 miles in length and is characterized by north-trending mountain ranges that extend from the southern tip of the Baja Peninsula to the Los Angeles Basin. The Santa Ana Mountains lie on the northern edge of this mountain range and are bounded by the San Joaquin Hills to

the south-southwest, the Los Angeles Basin to the northwest, the Puente Hills to the north, and the Perris Block to the east (Figure 2).

2.2 Earth Materials

The earth materials present at the site consist of surficial soil deposits including undocumented artificial fill, colluvium, alluvium, terrace deposits, and landslide debris. These relatively shallow deposits overlie bedrock of the Santiago, Silverado, Williams and Ladd Formations. The potential for mineral deposits and mining uses is discussed in Section 2.6. The composition of each earth material is discussed below and summarized in Table 1.

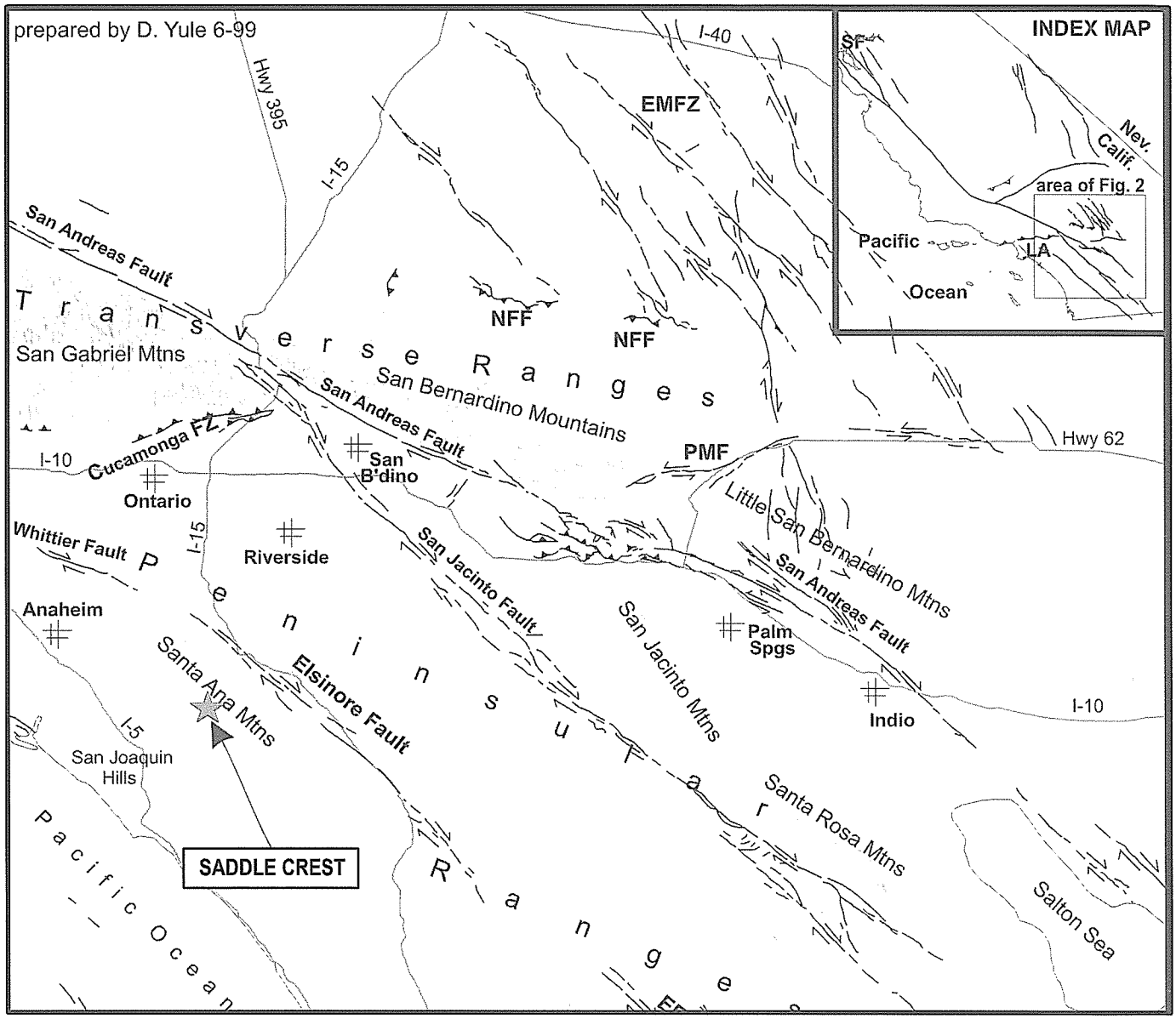
2.3 Surficial Materials

2.3.1 Undocumented Artificial Fill (Afu):

Undocumented artificial fill is locally present throughout the site and overlies other surficial deposits and bedrock formations. The fill materials are estimated to range from about 2 to 25 feet in thickness and generally consist of dry to moist, loose to dense, silty gravelly sand to sandy gravels. The fill deposits are most likely thickest where they form an embankment to create the stock pond in the central portion of the site. Elsewhere on the site, fills are locally present as part of creating access roads, tailings from the mining operation, and to create pads for the structures that have since been removed. These undocumented deposits were most likely placed in a manner that is inconsistent with current standards of practice and therefore, unsuitable to support proposed structural elements of the proposed project.

2.3.2 Colluvium (Col)

Colluvium (topsoil included) was encountered in several trenches excavated at the site (see references and Appendix B) and consists of a sandy silt to a sandy clay, which is brown to dark brown, dry to moist and



REGIONAL PROVINCE MAP
SOUTHERN CALIFORNIA

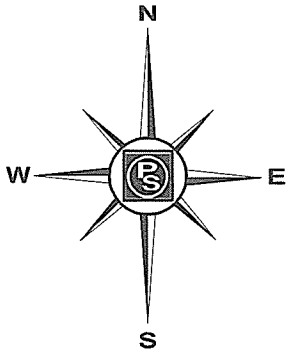


FIGURE 2

SOURCE MAP - FIGURE ONE OF YULE, 1999

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Table 1
General Characteristics of Earth Materials

Name of Formation	Map Symb	Location Within Study Area	Description	General Engineering Properties
Undocumented Artificial Fill	afu	Locally present throughout the site to a depth of 2 to 25 feet.	Silty, gravelly sand, and sandy gravel, brown, loose to dense.	Highly collapsible, significantly compressible, low to very low expansion potential, negligible soluble sulfate potential, low to moderate potential for liquefaction.
Colluvium	Qcol	Generally from ground surface to 3 or 15 feet below ground surface in areas with slope wash.	Sandy silts and sandy clay, brown to dark brown, firm to soft.	Highly collapsible, significantly compressible, medium to very low expansion potential, negligible soluble sulfate potential, low potential for liquefaction.
Alluvium	Qal	At the bottom of the larger canyons to an estimated depth of approximately 15 feet..	Alluvium consists of sandy gravels and cobbles with silt and/or sand lenses, brown to gray-brown, loose to dense.	Collapsible, significantly compressible, low to very low expansion potential, negligible soluble sulfate potential, may be susceptible to liquefaction.
Landslide Deposits	Qls	In the Southwestern Parcel on a side slope to the main canyon. In the Northeastern Parcel on the steeper slopes as shallow debris flows.	Landslide deposits consist of intermixed, bedrock derived debris and colluvial deposits. Sand, gravel, silt, brown to tan, loose, blocky	Collapsible, compressible, low to moderate expansion potential, unstable slopes, locally saturated.
Terrace Deposits	Qt	Present in the central and western edge of the southwestern parcel.	Silty sand to sandy silt with local clayey zones and occasional cobbles. Layered to laminated.	Generally not susceptible to hydro-collapse and not significantly compressible, low expansion potential, negligible soluble sulfate potential, low potential for liquefaction.
Santiago Formation	Tsa	Present in the southwestern corner of the parcel, and is locally overlain by surficial deposits.	Primarily medium- to coarse-grained sandstone, silty sandstone, and occasional siltstone or shale layers, mostly yellow-gray, moderately hard to hard, moderately cemented.	Generally not susceptible to hydro-collapse, not significantly compressible, negligible soluble sulfate potential, low potential for liquefaction.

Silverado Formation	Tsi	Present in the subsurface in most of the southwestern portion of the project. It is overlain by surficial deposits, including alluvium, colluvium, terrace deposits and landslide deposits.	Sandstone and siltstone, medium- to coarse-grained silty sandstone, pebble and cobble conglomerate, and occasional carbonaceous shale, mostly yellow-gray, moderately hard to hard, moderately cemented.	Generally not susceptible to hydro-collapse, not significantly compressible, negligible soluble sulfate potential, low potential for liquefaction.
Williams Formation - Pleasants Sandstone Member	Kwp	Present in the southwestern portion of the northeast portion of the property. Locally overlain by artificial fill and landslide deposits	Generally a fine-grained shaly, silty sandstone inter-bedded with calcareous sandstone and medium-to fine-grained sandstone. This formation is generally poorly bedded to massive and hard to very hard.	Generally not susceptible to hydro-collapse, not significantly compressible, negligible soluble sulfate potential, low potential for liquefaction.
Williams Formation - Shulz Ranch Member	Kws	Present in the central portion of the northeast portion of the property.	Sandstone member consists of coarse-grained sandstone to conglomerate, siltstone and silty sandstone. This member is also massively bedded and often cross-bedded.	Generally not susceptible to hydro-collapse, not significantly compressible, negligible soluble sulfate potential, low potential for liquefaction.
Ladd Formation-Holz Shale Member	Klh	Present in the northeast corner of the property.	A marine silty shale with minor interbedded lenses of conglomerate, silty sandstone, and conglomeratic sandstone. This formation is typically poorly to irregularly bedded in the shale portions and is massive where it is a sandstone or conglomerate.	Generally not susceptible to hydro-collapse, not significantly compressible, negligible soluble sulfate potential, low potential for liquefaction.

is firm to soft. The colluvium encountered is probably derived from slope wash and weathering of the underlying and superjacent geologic units. It is anticipated that the depth of the colluvium ranges from 2 to 15 feet; however, it may be deeper in other places. Talus, slope wash and other similar shallow soil deposits have accumulated at the base of many of the slopes and side drainages and may be 5 to 15 feet in thickness.

2.3.3 Alluvium (Qal)

Quaternary alluvium is found in the bottom of the canyons and other drainages throughout the site. Alluvium was transported and deposited by water and is derived from local surficial and bedrock units. The alluvium varies from brown to gray brown, consists of silty sand, with minor clay and gravel and is dry to very moist, and loose to dense. It is anticipated to range from a few feet in thickness near the upper portion of the drainages, where active erosion is occurring, to up to 20 feet in depth near the lower portion of the larger drainages.

2.3.4 Landslide Debris (Qls)

Based primarily on geomorphic evidence three possible landslides have been interpreted at the site. It is surmised that they are a result of near surface weathering of the underlying bedrock and related to local steep slopes. The landslide debris onsite is presumed to be derived from the onsite surficial and bedrock materials and consists of slightly moist, loose silty sand. One of the landslides is in an area that is underlain by a siltstone unit (Southwestern Parcel). It is anticipated that the landslides are less than 25 feet in thickness. There may be many other shallow landslide or debris flow deposits at the base of some of the steeper slopes; however these deposits are generally shallow and not related to underlying bedrock instabilities. Debris flow type deposits are generally related to the

steeper slopes that are much more prevalent in the northeastern portion of the site.

2.3.5 Terrace Deposits (Qt)

The terrace deposits are Pleistocene-aged, fine grained silty sand to sandy silt with local clayey zones and occasional cobbles. During the previous investigations, the terrace deposits (Qt_1) were found to be up to 61 feet in thickness in the northwestern portion of the site in a broad gently sloping area. These are interpreted to be the remnants of a relatively old, broad stream system that flowed from northwest to southeast and covered a fairly large portion of this part of the foothills. These ancient stream deposits consist of remnants that have been dissected and removed by the erosional pattern that is currently present at the site. Well rounded and highly weathered cobbles and gravels were observed locally in several areas of the site and are also most likely related to older terrace deposits of this ancient stream system.

2.4 Bedrock Units

2.4.1 Santiago Formation (Tsa)

The Santiago Formation encountered and observed within the limits of this project consists of a sequence of primarily massive sandstone and interbedded siltstone and minor claystones. This formation also included local laminated sand lenses and cobbles lenses. Minor faulting across bedding and moderate shearing of the siltstone and claystone units along bedding were observed in the borings. Colors vary between various browns, reds, and grays. The mapped contact with the underlying Silverado formation is a resistant buff, white to tan sandstone that forms small ledges, especially in the western portion of the site.

2.4.2 Silverado Formation (Tsi)

The Silverado Formation (Tsi) was observed underlying most of the central portion of the site. This sequence of non-marine and marine lithologies is characterized by siltstones to primarily medium to coarse-grained silty sandstones to pebble/cobble conglomerates and occasional carbonaceous shale lenses (Miller and Morton, 1984, and Tan, Miller and Fife, 1984). The bedding onsite is generally crude to massive in the sandstone units. Local cross beds and laminated sands provide indicators of the bedding inclinations.

The upper boundary of this formation is reportedly a clay bed consisting of a variety of colors, ranging from white and red, to purplish (Serrano Clay bed of Woodring and Popenoe, 1945). Exposures and excavations at the site did not encounter this clay deposit; however, there was a light to white silty sandstone near the contact with the overlying Santiago formation that is often associated with this clay. An old excavation near the southeastern portion of the site indicates that there had been attempts to exploit this deposit as a mining resource. Lenses may be present but were not observed during field mapping and previous geotechnical excavations at the site.

The lower boundary of this formation is characterized by a basal conglomerate. The sandstones and pebble/cobble conglomerates are commonly yellowish gray, moderately hard to hard and, moderately cemented. This basal conglomerate has been mapped parallel to a side canyon that trends northwest-southeast near the central portion of the site.

2.4.3 Williams Formation (Map Symbol Kwp and Kws):

The northeastern portion of the property has been mapped as primarily the Cretaceous-aged Williams Formation. In this area the Williams Formation is separated into the Pleasants Sandstone Member and the Schulz Ranch

Sandstone Member (Morton and Miller, 1984,). The Pleasants Sandstone Member generally consists of fine-grained shaly, silty sandstone inter-bedded with calcareous sandstone and medium-to fine-grained sandstone. This formation is generally poorly bedded to massive. The Shulz Ranch sandstone member of the Williams Formation was formed as a result of shallow seas and possible shoreline deposits. The Schulz Ranch Sandstone member consists of coarse-grained sandstone to conglomerate, siltstone and silty sandstone. It is generally massively bedded and often cross-bedded. The base of this member is a well-cemented, conglomerated, and fossil-rich unit. It was found at several locations in the northeastern portion of the property. This member grades conformably into the overlying Pleasants Sandstone Member.

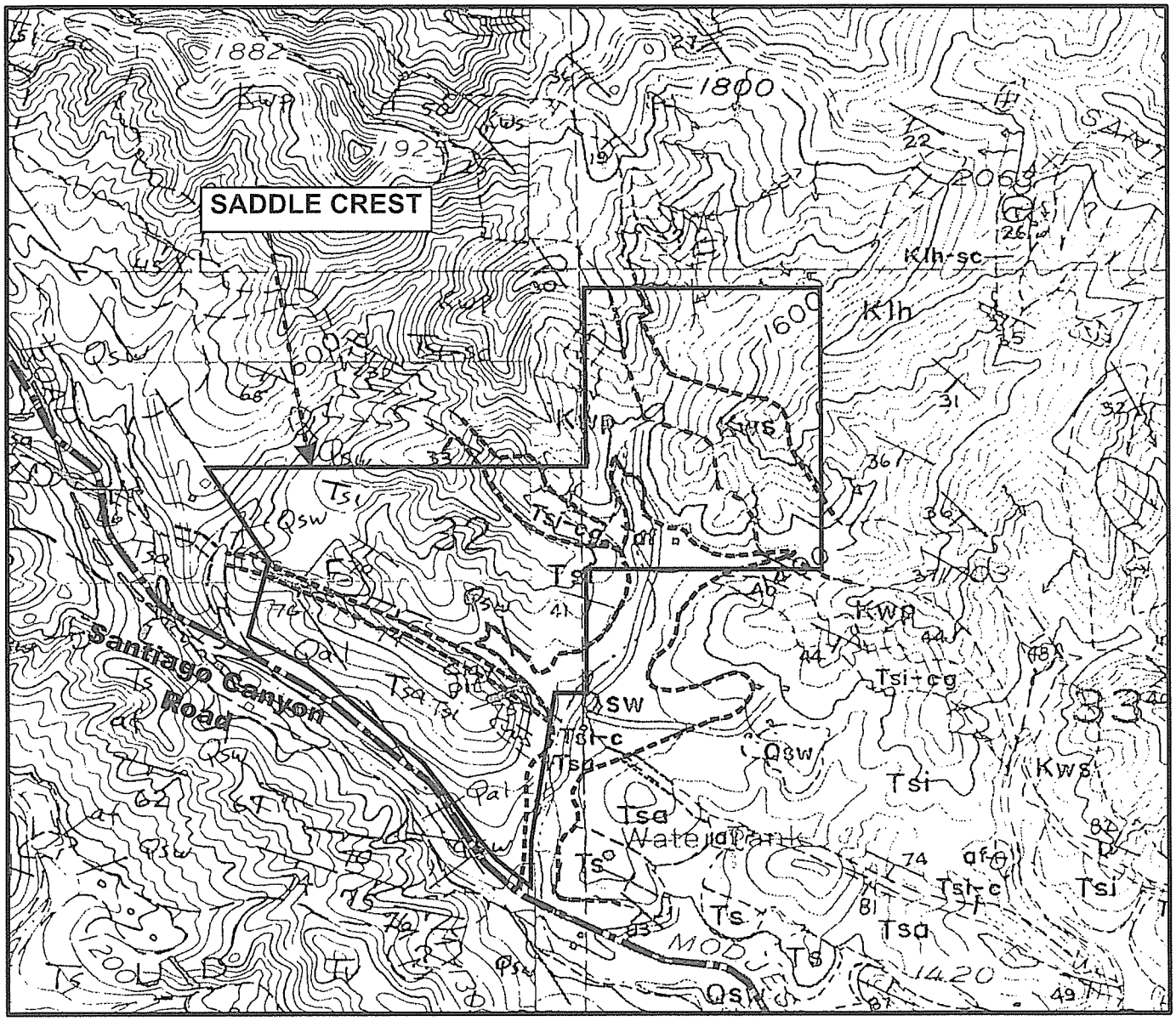
2.4.4 Ladd Formation (Map Symbol Klh):

The Holz Shale member of Cretaceous Ladd Formation has been mapped by others (Miller and Morton, 1984, Figure 3) at the northeastern corner of the project. In this area the bedrock unit consists of marine silty shale with minor interbedded lenses of conglomerate, silty sandstone, and conglomeratic sandstone. This formation is typically poorly to irregularly bedded in the shale portions and is massive where it is a sandstone or conglomerate.

2.5 Geologic Structure

2.5.1 Tectonic Framework

Jennings (1985) has defined eight (8) structural provinces within California that have been classified by predominant regional fault trends and similar fold structure (Figure 2). These provinces are in turn divided into blocks and sub-blocks that are defined by "major Quaternary faults". These blocks and sub-blocks exhibit similar structural features. Within this framework, the subject site can be classified as belonging to the



REGIONAL GEOLOGY OF SADDLE CREST PARCEL

LEGEND

Qs	SLOPE WASH DEPOSITS
Qal	QUARTERANY ALLUVIUM
Ts	SESPE FORMATION
Tsa	SANTIAGO FORMATION
Tsi, Tsi-c,Tsi-cg	SILVERADO FORMATION
Kwp, Kwp-f, Kwp-sc	WILLIAMS FORMATION PLEASANT SANDSTONE MEMBER
Kws	WILLIAMS FORMATION SCHULZ RANCH SANDSTONE MEMBER
Klh, Klh-sc	LADD FORMATION

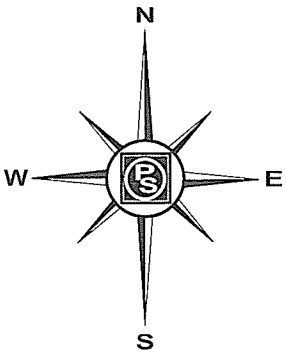


FIGURE 3

SOURCE MAP - CALIFORNIA DIVISION OF MINES AND GEOLOGY: GEOLOGY OF PART OF THE WESTERN HALF OF THE SANTIAGO PEAK QUADRANGLE, and GEOLOGY OF THE NORTH HALF OF THE EL TORO QUADRANGLE

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Peninsular Range Block. This Province is controlled by the dominant northwest trend of the San Andreas Fault. The Peninsular Range Block is characterized by a series of parallel northwest-trending faults that exhibit right lateral dip-slip movement. These faults are terminated by the Transverse Range Block to the north and extend southward to the Baja Peninsula.

2.5.2 Regionally Mapped Active Faults

There are several large active fault systems in the southern California region surrounding the subject site. These fault systems have been studied extensively and in a large part, control the geologic structure of Southern California. The prominent active regional fault systems are the San Joaquin Hills Thrust, Whittier-Elsinore, Newport-Inglewood and San Andreas Faults (Figure 4).

San Joaquin Hills Blind Thrust

This recently-postulated fault system is based on Grant and others (1999, 2002) research findings. The fault system approximately extends from San Clemente State Beach to the Santa Ana River. The model assumed in the analysis for this fault has a twenty-three- (23) degree southwest dip extending from two- (2) km to eight- (8) km depth. The rupture bottom is approximately coincident with the location of the offshore Newport-Inglewood Fault Zone. The slip rate is 0.50 +/-0.20 mm/yr., based on the average late Quaternary uplift rate of the San Joaquin Hills of 0.21 to 0.27 mm/yr. and inferred dip of twenty (20) to thirty (30) degrees. The maximum magnitude (Mw) earthquake is estimated at 6.6. The closest distance from the site to the projection of the postulated rupture area along the fault trace is approximately seven (7) miles.

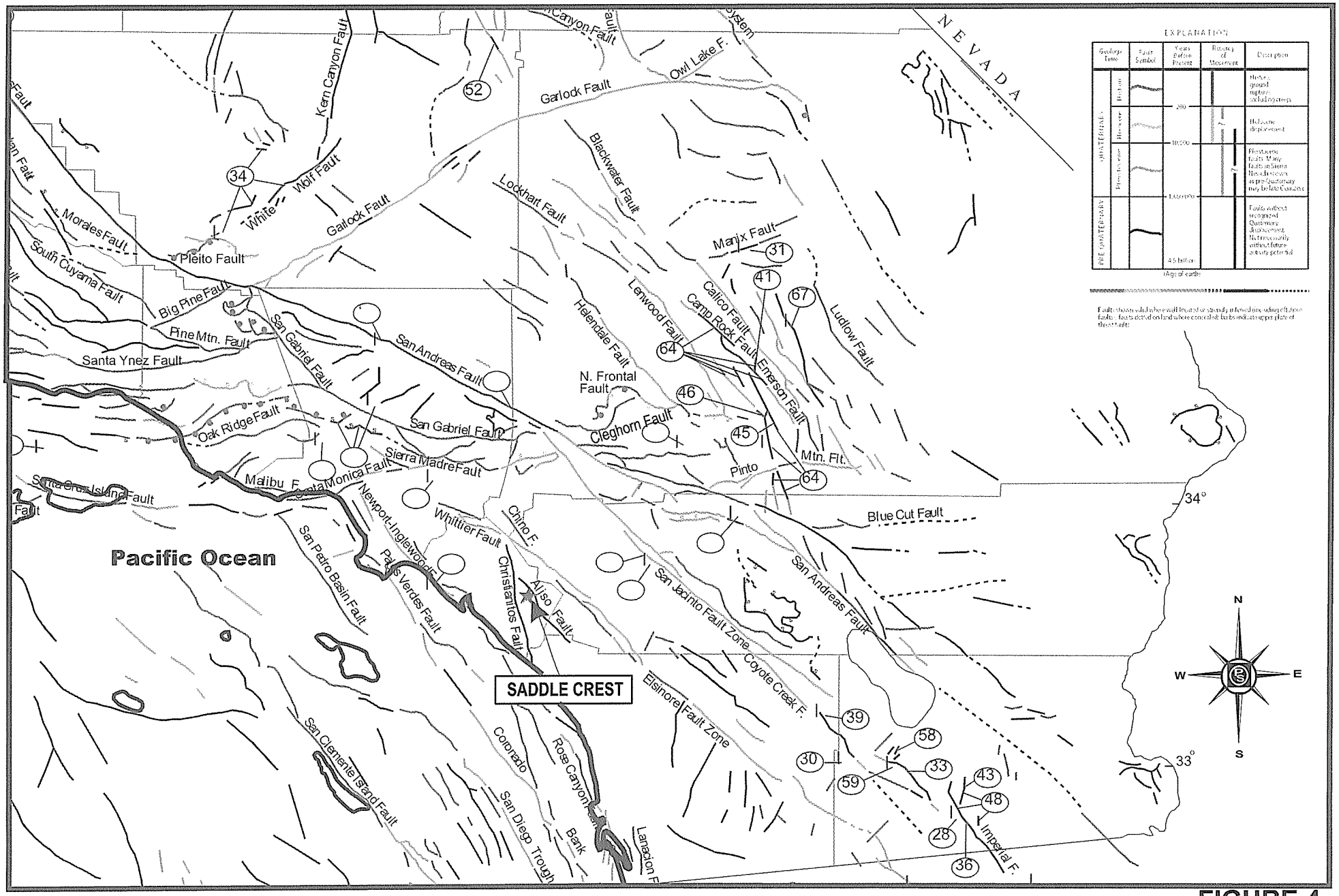

FIGURE 4

SIMPLIFIED FAULT ACTIVITY MAP OF CALIFORNIA

Compiled by Charles W. Jennings and George J. Saucedo
1999 (Revised 2002, Tousson Toppozada and David Branum)

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Newport-Inglewood Fault System

The Newport-Inglewood Fault system is located approximately sixteen (16) miles south westerly of the subject site. This fault system extends northwesterly from a point approximately five (5) miles offshore of Laguna Beach to the Santa Monica Mountains. The Newport-Inglewood Fault system is characterized by a series of en echelon (sub-parallel) faults. These faults exhibit considerable offset at depth with minor evidence of surface displacement.

Whittier-Elsinore Fault System

The Whittier-Elsinore Fault system is located approximately ten (10) miles north of the subject site. The Whittier Fault is the main spur of the Whittier-Elsinore Fault system and extends northwesterly from the Santa Ana Canyon through the Puente Hills to the Santa Monica Mountains. The Whittier Fault system is a right-lateral reverse fault that dips to the northeast.

San Andreas Fault System

The San Andreas Fault system lies approximately thirty-eight (38) miles northeasterly of the subject site. In California, the San Andreas extends northwesterly from the Mexican border to Point Arena, where it continues offshore before turning to the west in the vicinity of Cape Mendocino. The San Andreas is the major structural feature in California and defines a transform boundary between the Pacific and North American tectonic plates. Due to the length and complexity of this fault system, it has been divided into sections on the basis of general trend. The southern portion of the San Andreas, which extends from the Gulf of California to the Transverse Ranges, is closest to the subject site. Displacement along this section, as is characteristic of the entire length, is right-lateral.

2.5.3 Onsite Geologic Structure

The bedrock units at the site generally consist of a monoclinal sequence of tertiary to cretaceous sedimentary rocks that have been mapped as dipping moderately to steeply to the southwest. Within the site, this contact between the Silverado and Santiago formations has been mapped as a fault that is referred to in literature as the 4S Fault (Morton and Others, 1973; Morton and Miller, 1981). The fault is postulated to be a nearly vertical feature with the northeast side of the fault up relative to the southwest side. It appears to coincide with the basal section of the Silverado Formation referred to as the Serrano Clay bed (Morton, and others, 1973 Schoellhammer, 1981). This contact has also been mapped as a disconformity between the two formations with no prominent regional fault (Miller and Morton, 1984, and Tan, Miller and Fife, 1983). Based on the data gathered onsite it appears that there is a steepening of bedding near this contact, and an increase in fracturing. However, a prominent fault was not observed in exposures which were present where the 4S fault is postulated to be. For the purposes of this investigation this geologic feature has been mapped as a contact between the Silverado and Santiago formation.

Many small scale faults were observed in exploratory borings and trenches; however, no active faulting was observed, and no faulting defined as "potentially active" or "active" by the State of California has been mapped onsite or within close proximity to the site.

Bedding of the bedrock formations strike generally northwesterly and dip at twenty five (25) to seventy five (75) degrees to the southwest.

2.6 Groundwater

No springs or water has been observed in the drainages in the Southwestern Parcel during the summer months. Seepage was not observed in any of the

borings excavated by Geosoils (1990). Some of these borings were located in the bottom of the main canyon in the southwestern portion of the site. Seepage and groundwater was observed in all of the borings excavated by Leighton (1999). Within borings LB-12, LB-13, LB-15 and LB-19 groundwater was observed as minor seepage from fractures or primarily at the contact between two dissimilar materials. In Boring LB-18 the bottom 10 feet of the boring was observed to have groundwater which was weeping from the sandstone. The groundwater encountered in all of these borings is interpreted to be isolated and perched within the bedrock units. It is unlikely related to a regional groundwater table. The perched ground water is likely to fluctuate in location and intensity, and is likely based on seasonal rainfall.

In the central area of the Northeastern Parcel, a spring was observed seeping out of a small cave at the bottom of the canyon. Water could be heard dripping and a small pond had formed at the mouth of the cave. Flowing water was not observed downstream from this area. The area does have a stand of oak trees and supports vegetation that is more prolific than the surrounding areas. The location of the spring was within a hard ledge-forming sandstone unit within the Williams Formation. It is inferred that the water for the spring is groundwater that is trapped within the fractures of the relatively impermeable sandstone and the underlying cobble conglomerate. Several pipes were observed heading into this area indicating that it had been used in the historic past as a source of water.

2.7 Mass Movement

Three landslides have been mapped within the property boundary. All appear to be relatively shallow and are probably the result of single or multiple debris flow type events that result from the down slope movement of highly weathered, near surface bedrock and soils. These shallow landslides probably occurred during periods of intense rainfall activity.

Erosion by seasonal rainfall runoff is also a principal agent of mass wasting at the site. The thickness of soil developed on slopes underlain by bedrock is generally minor, therefore the volume of soil washed off (debris flow or mudflow) is inferred to be generally low. However, it is possible that thicker accumulations of colluvial soils exist in pockets on the steeper natural slopes.

In general, debris flow potential increases with increasing slope angles, and is most common on slopes ranging from a 3:1 to 1:1 inclination. In the fall of 2007, a fire burned nearly the entire property. The lack of vegetation as a result of this fire has, therefore, temporarily increased the potential for debris flow or mudslide hazards at the site. The potential for these hazards should decrease as the vegetation is re-established.

2.8 Mineral Resources

Orange County has had a history of mining several mineral and material resources. The primary resources have been petroleum, sand and gravel, other construction materials, and clay (Morton, Miller and Evans, 1976). In the eastern portion of Orange County near the subject site, the primary deposits that have been mined in the past are clay and silica sand. The closest gravel quarries which are common in south Orange County are greater than five miles from the site. Several clay mines or prospects existed within a few miles of the site. These mines were focused on narrow clay beds within the base of the Silverado Formation. These clays have a very low iron content which is useful in the manufacturing of white cement and white ceramic ware. A by-product of this process is white, high quartz content sand.

According to Morton and Miller (1981) the Serrano Mine was located within this site at the contact of the Silverado and Santiago Formations. This mine apparently was used to provide silica sand and clay. No heavy mining equipment was observed during field mapping at the site. Historical aerial photographs do

not indicate significant mining operations at the site. Two, near vertical, approximately 15 to 20 feet high slopes were observed near the southeastern corner where the mining operations likely existed. Due to the lack of construction debris, it is surmised that the mining operations may have consisted solely of removal of materials from the site, and that the processing of the mined materials occurred at a distant location. According to Morton and Miller (1981) this mine has not been active since at least 1953. No other economically significant earth materials are known to exist at the site.

3.0 POTENTIAL GEOLOGIC/GEOTECHNICAL IMPACTS

The major geotechnical issues that require consideration during planning, and preliminary design are those that could have the most significant impact on the safety and ultimate development costs. Based on review of the available information, the listed references, and a recent site visit, PSE is of the opinion that the issues set forth below will likely have the greatest influence on the economic and technical aspects of development of the property. A brief summary of each issue is presented. Where the potential implications are different for the Preferred Plan and the Baseline Plan, they are identified and addressed.

3.1 Earthquake Hazards

The subject site is located in southern California—a tectonically active area. The kind and severity of earthquake hazards that could potentially impose constraints on development of the site are to a greater degree dependent on the distance of future earthquakes from the site, the magnitude of those earthquakes, the earth materials along the travel paths of waves generated by those events, and the properties of the soil and rock underlying the site. Potential hazards stemming from local and regional earthquakes may be primary, such as surface rupture and ground motion, or secondary, such as liquefaction and/or seismically induced slope failures.

3.1.1 Ground Motion

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. Based on the Probabilistic Seismic Hazards Mapping Ground Motion Page on the California Geologic Survey website, using input of Longitude –117.6273 and Latitude 33.6949, a peak ground acceleration (Pga) of 0.36g was calculated for the site for soft rock conditions (Site Category C) and 0.40g for alluvial conditions (Site Category D). This acceleration has a 10 percent probability of being exceeded in 50 years. These values were interpolated using the published USGS/CGS Probabilistic Seismic Hazards Assessment (PHSA) Model (revised April 2003), and are not intended for design or analysis.

Potential Implications:

Structures must be designed in accordance with the prevailing seismic codes. It may be anticipated that codes may change during the ongoing development of the Saddle Crest Project. Each change must then be implemented at its point of adoption.

The 2007 California Building Code does not mandate the use of raw PGA estimates for structure design, but rather requires the use of modified spectral accelerations and velocities for most designs. Presented below are seismic design parameters for the subject site that are compliant with the 2007 CBC. The site is located at Latitude 33.6949° and Longitude –117.6273°. The proposed site has been identified to be a "D" site class in accordance with Table 1613.5.2 of the 2007 CBC. Utilizing this information, the computer program Seismic Hazard Curves and Uniform Hazard Response Spectra, Java Ground Motion Parameter Calculator – Version 5.0.8, provided by the United States Geological Survey

(http://earthquake.usgs.gov/research/hazmaps/design/) and ASCE 7 criterion, the seismic design category for 0.20 second (S_s) and 1.0 second (S_1) period response accelerations can be determined (2007 CBC, Section 1613.5.1) along with the design spectral response accelerations (2007 CBC, Sections 1613.5.3 and 1613.5.4).

Seismic slope stability analyses, critical structures, water tanks and unusual structural designs will likely require ground motion input as presented herein and as required by the particular controlling agency. Proposed structures as well as cut, fill, and natural slopes should be designed in accordance with prevailing seismic codes. Such design procedures can effectively mitigate this geologic hazard. In sum, this issue is of safety/economic concern, but is considered less than significant with mitigation, and is not an insurmountable constraint to development.

3.1.2 Surface Rupture

Surface rupture is a break in the ground surface during or as a consequence of seismic activity. The site is not located within an A-P zone nor is any A-P identified fault zones located near the site. No active faults have been identified in the reviewed literature or observed onsite during the referenced studies.

Potential Implications:

The potential for surface fault rupture on-site is low; and, based on current knowledge of the region is less than significant and not a constraint to site development.

3.1.3 Dynamic Settlement and Liquefaction

Dynamic settlement is the process of non-uniform settlement of the ground surface during a seismic event. Dynamic settlement includes liquefaction and dry-sand settlement.

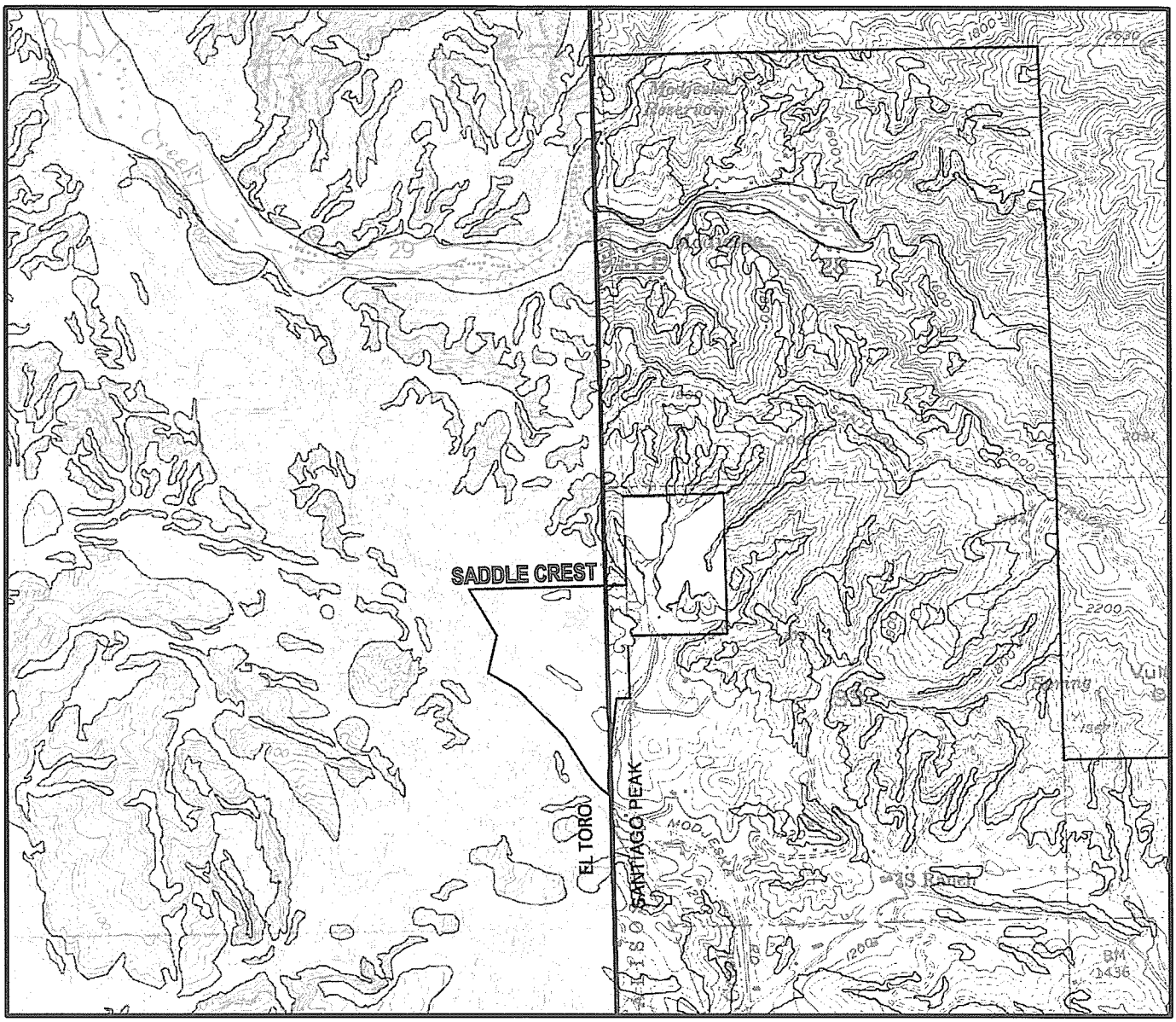
Liquefaction is the phenomenon wherein seismic agitation of loose, saturated sands and silty sands can result in a buildup of pore pressures and, if sufficient to overcome overburden stresses, can produce a temporary quick condition. Localized loose lenses/layers of sandy soils may be subject to liquefaction when a large, prolonged, seismic event affects the site. Once the excess pore water pressure dissipates, the liquefied zones/lenses can consolidate, causing settlement.

Potential Implications:

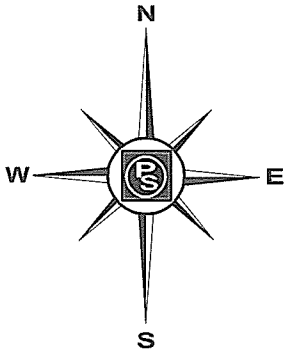
No portions of the site have been identified by State Seismic Hazards Maps for the El Toro and Santiago Peak Quadrangle as having a potential for earthquake-induced liquefaction (Figure 5). However, local saturated alluvium could be subjected to this phenomenon. Mitigation of this hazard can be accomplished by overexcavation and recompaction of the susceptible soils. This potential hazard is considered less than significant with mitigation.

3.1.4 Earthquake Induced Landsliding, or Rockfall

Portions of the Saddle Crest site have been identified by State Seismic Hazards Maps for the El Toro and Santiago Peak Quadrangles as having a potential for earthquake-induced landsliding as shown on Figure 5. The potential for seismically-induced landslides is related to the strength of the underlying bedrock and the gradient of the slope. Most seismically induced landslides occur in steeply sloping terrain (slopes significantly steeper than 45 degrees in inclination). Most of the site does not have slopes which are susceptible to seismically induced landslides; however, there are several areas in the northeastern portion of the project that do have steep and potentially unstable slopes that could have a potential to generate minor rock falls during a seismic event.



SEISMIC HAZARDS MAP



SCALE: 1 in. = 2000 ft.

MAP EXPLANATION

Zones of Required Investigation:

Liquefaction

Areas where historic occurrence of liquefaction, or local geological, geotechnical and groundwater 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.

FIGURE 5

SOURCE MAP - CALIFORNIA GEOLOGICAL SURVEY
SEISMIC HAZARDS ZONATION PROGRAM, EL TORO
AND SANTIAGO PEAK 7.5 MINUTE QUADRANGLES

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Potential Implications:

Deep-seated, seismically induced landsliding is not anticipated to pose a danger to improvements for the Preferred Plan or the Baseline Plan. The potential for shallow seismically induced landslides or rock falls for the Prefered Plan will be mitigated by the proposed design and standard storm water conveyance design elements. No significant additional mitigation is considered necessary, therefore this potential hazard is considered less than significant with mitigation for the Prefered Plan.

For the Baseline Plan minor rock falls may occur in natural areas where the slope gradients are steeper than 1:1 (horizontal to vertical). Any area that is above or below the proposed development footprint must be carefully evaluated for this potential. Mitigation of the potential for seismically induced landsliding and rock fall potential is generally through avoidance or stabilization by layback of slope, buttressing, or other similar widely utilized methods. In addition rock fall potential can also be mitigated through the use of debris walls, barriers, tie-backs/soil-nails, or netting of slopes. This issue it has a potentially significant impact for the Baseline Plan, however can be mitigated with proper design and implementation of remediation.

3.1.5 Seiches and Flooding

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.

Due to the relatively elevated terrain and lack of lakes or reservoirs above the site, flooding is not anticipated. A fill embankment creates a stock pond within the central portions of the site. Current development plans

are not impacted by this feature; however, downstream (offsite) areas will remain to be potentially impacted.

Potential Implications:

Due to the lack of large basins in the projects vicinity, the potential for a seiche impacting the property is considered to be non-existent. The fill embankment and previous stock pond in the central portion of the site between the Southwestern and Northeastern parcels can only retain minor amounts of water based on seasonal rainfall. This pond has no significant geotechnical impact on the Preferred Plan due its location away from the development footprint. The pond and embankment would require total removal for the Baseline Plan and therefore, the potential for seiches would be eliminated. This potential hazard has a less than significant impact on either of the plans.

3.2 Excavation Characteristics

Generally the soil, alluvium, colluvium, and terrace deposits that underlie the site were easily excavated with the backhoes and drill rigs used during the site investigations (see references and Appendix B). The borings and backhoe test pits encountered bedrock, which was generally hard and dense within 30 feet of the ground surface. Several of the deeper borings encountered zones within the bedrock that required coring due to the very dense nature of the sandstone. These zones that required coring were in both the Santiago and Silverado formations and generally more than 70 feet below the ground surface. The maximum depth excavated was 93 feet (Appendix B). No excavations were made into the older Cretaceous age bedrock units in the Northeastern Parcel. These older bedrock units include massive sandstone and conglomerate layers that often form ledges and small cliffs. In addition, the steepness of the terrain indicates that they are generally harder than the Tertiary bedrock units. Large boulders were observed in the drainage bottoms only in this northeastern portion of the property.

Potential Implications:

The surficial soils at the site are likely to be easily excavated with standard earth moving equipment. The bedrock at the site varies in hardness; therefore, the rippability at the site will likely be highly variable.

The proposed grading for the Preferred Plan includes excavations up to 75 feet in depth. In this portion of the site where the bedrock is of Tertiary age, it is likely that most of the earth materials can be excavated with conventional earthmoving equipment. Heavy ripping will likely be required for the deeper cuts (cuts deeper than approximately 30 feet). This heavy ripping may also require the use of larger than typical bulldozers (D-10 or equivalent) with single shanks. In addition, excavation could produce some oversized (greater than 12-inch) rock fragments. The production of oversize materials will require that suitable disposal techniques and logistics be implemented. Blasting is not anticipated.

The Baseline Plan includes excavations in both the southwestern and the northeastern portions of the site. These excavations are generally less than 20 feet in depth. In the Southwestern Parcel it is anticipated that nearly all the proposed excavations can be achieved with standard earthmoving equipment. Portions of the Northeastern Parcel may require extremely heavy ripping with larger than normal bulldozers. Blasting is not anticipated for the depth of excavations currently proposed; however, it is likely that significant oversized material will be encountered in the northeast portion of the property. The generation of oversize material requires careful planning on the part of the grading contractor to properly dispose of these materials within the deeper fill areas. Alternatively, crushing, offsite disposal or stockpiling for use as decorative stones can be considered.

Excavations for utilities in the cut areas within bedrock may encounter material that is difficult to excavate with conventional trenching equipment. Consideration should be given to overexcavating these areas to facilitate utility trenching. If

pools, deep foundation elements, basements, or underground garages are proposed, then overexcavation of these areas should also be considered. For the Preferred Plan this is less than a significant impact and is generally only an economic concern, it is usually not a significant constraint to development of properties in Southern California.

For the individual lots within the Baseline Plan, the earthmoving and construction equipment is typically not as powerful as for larger graded areas. Therefore, the rippability of earth materials during development of the individual lots will potentially have more significance from a cost standpoint and because potions of the site will already be developed. Mitigation will likely include use of specialty equipment that can break up hard rock in smaller spaces. This issue will require further evaluation and careful planning during later stages of plan development. This potential concern however, should be considered less than significant for the Baseline Plan.

3.3 Collapse and/or Hydro-Consolidation Potential

Based on experience in the project area and the previous excavations at the site, the surficial soils, alluvium, colluvium, landslide debris, and the highly weathered portions of the terrace deposit, and bedrock are typically dry and porous, and therefore exhibit a significant hydro-consolidation potential.

Geosoils excavated seven borings in the terrace deposits near the western edge of the site. In 1999 Leighton reviewed the findings of Geosoils investigation and concluded that these deposits did not have a significant potential for collapse or consolidation, except within the upper 15 feet. In 2002 PSE collected and tested eight soil samples of a similar terrace deposit located approximately ½ mile northwest of the site. Three of these samples showed a potential for hydro-consolidation of generally less than 1 percent. The other samples of these terrace deposits indicated a slight potential for expansion.

Potential Implications:

Where encountered during excavations at the site, undocumented artificial fill, Holocene alluvium and colluvium, landslide debris, and highly weathered terrace deposits and bedrock, should be removed and replaced with engineered fills. In general it is anticipated that these deposits will be on the order of fifteen (15) feet or less in depth. Removals must be completed within a 1:1(H:V) projection of the structural elements of the proposed development.

Terrace deposits were encountered to depths of 61 feet at the site. The proposed projects indicate that the area that is underlain by terrace deposits will be mostly in areas of proposed cuts of up to 25 feet in depth. It is anticipated that a minimum of 15 feet of these materials will be required to be removed. In some areas deeper removal may be required based on specific conditions. Additional investigation of these deposits may be necessary to further evaluate the lateral extent and the potential consolidation characteristics of these soils. Final evaluation of these deposits should be made during grading. Lots exposing terrace deposits at finish grades should be overexcavated a minimum of 5 feet below finish design grades to provide a more uniform and consistent support for building foundations. In sum, mitigation of hydro-collapse potential can be accomplished through overexcavation and re-compaction of the susceptible soils.

This issue is considered less than significant with mitigation for the Preferred Plan. For the Baseline Plan there may be pockets of potentially collapsible material that extend above or below the proposed development footprint (streets and lots) and require significant removals in order to achieve the 1:1 projection removal criteria. Alternative mitigation methods are also available to mitigate this potential hazard. These alternative methods include avoidance and various ground improvement methods. Therefore, this issue is considered less than significant with mitigation for the Baseline Plan.

3.4 Compressibility

The topsoil, alluvium, colluvium deposits, debris flow, landslide, and the weathered terrace deposits and bedrock are of low density and considered compressible and unsuitable for support of structures or proposed fills.

Potential Implications:

The low-density surficial soils will require removal from fill areas prior to fill placement and where exposed at grade in cut areas. Initial studies indicate that the upper 5- to 25-ft., with local deeper and shallower areas, will require removal and replacement with engineered fill. Removals must be completed within a 1:1(H:V) projection of the structural elements of the proposed development. These materials will be suitable for reuse in engineered fills.

This issue is considered less than significant with mitigation for the Preferred Plan. For the Baseline Plan there may be pockets of potentially compressible material that extend above or below the proposed development footprint (streets and lots) and require significant removals in order to achieve the 1:1 projection removal criteria. Alternative mitigation methods are also available to mitigate this potential hazard. Therefore, this issue is considered less than significant with mitigation for the Baseline Plan.

3.5 Expansive Soils

The materials encountered at the site are anticipated to be primarily composed of sand and silt, and therefore have a very low to medium expansion potential. Expansion test results of the onsite materials from previous investigations could not be obtained; however expansion test results by PSE (2008) and others (Leighton 1999) on similar nearby sites with similar materials when tested in accordance with ASTM D4829 ranged from “low" to "medium" (Appendix C). These test results are likely characteristic of the majority of the onsite materials.

Some highly to very highly expansive material may be encountered in shear zones or clay seams related to weathering and faulting.

Occasional subtle red beds and other layers within the Santiago and Silverado Formations can be very highly expansive in nature. In addition, where deeper (> 30 feet) cuts are proposed, gradual rebound as a result of stress relief can be realized over an extended period of several months or years.

Potential Implications:

Further expansion testing should be performed as the project evolves. Foundation systems should be designed based upon expansion testing performed on as-graded, near surface soils.

The juxtaposition of highly expansive material with the more predominant lower expansive material has led to significant damage of structures in the southern California area. In areas with more highly consolidated bedrock, such as this project, it is our experience that typical lot overexcavation (approximately 3 feet below the lowest structural elements of a foundation) has not always been sufficient to mitigate the resulting differential expansion. Therefore, lots exposing red beds, faults, and clay seams at or near finish grades should be closely evaluated and may require overexcavation to depths of 10 feet or more.

Mitigation of bedrock rebound can be reduced by overexcavation and recompaction of exposed materials. The exact depth of overexcavation can vary between 5 feet and 20 feet or more depending upon the depth of original cut and rebound potential.

Proper foundation designs and remedial grading measures can effectively mitigate expansive soil and bedrock heave potential. Therefore, this issue is less than significant with mitigation.

3.6 Soluble Sulfates/Corrosion

Previous investigations at the site and nearby adjacent sites in similar materials indicate negligible sulfate concentrations in accordance with Table 4.3.1 of ACI (American Concrete Institute) 318-05. Chemical test results are presented in Appendix C.

Preliminary resistivity testing indicates that the soils most likely to be encountered at the site can be classified as "severely corrosive" towards ferrous metals based on commonly accepted correlations between resistivity and corrosivity.

Potential Implications:

The presence of soluble sulfates in soils can be detrimental to concrete. As the project evolves, additional testing should be performed. If soluble sulfates are present in sufficient concentrations, special concrete mix designs will be required, increasing costs of the concrete.

Low resistivity soils can be corrosive to metals and may require the use of above ground connections or alternative building products/procedures to mitigate the corrosive effects. A corrosion engineer should be consulted during the design process so that adequate measures to provide corrosion resistance are incorporated as necessary. Therefore, this issue is less than significant with mitigation.

3.7 Slope Stability

All sloping areas of the proposed projects must be evaluated to determine if the slopes are stable. If they are not stable then remedial measures must be implemented. A critical aspect of evaluating the stability of a project is to evaluate the perimeter areas where the designed development meets the natural slope. Often remedial measures to stabilize the perimeter conditions must extend significantly into areas that are not planned for development.

Cut, fill and natural slope stability can be affected by several factors including geologic structure, strength of materials, and height, inclination, and orientation of design slopes. Recognition of the inter-relationships of the various combinations of slope configuration, geologic structure, and material strength characteristics can reduce costs associated with remedial grading requirements and/or design restrictions.

3.7.1 Cut and Natural Slope Stability

Typically, the bedrock onsite exhibits beds dipping moderately to the south and southwest. Near the contact between the Santiago and Silverado formations, bedding steepens. A few weak, plastic, clay beds were encountered in the borings (Appendix B).

Southerly and southwesterly facing cut and natural slopes are likely to be grossly unstable unless underlain by relatively massive bedrock. Cut and natural slopes facing to the north and northeast are likely to be grossly stable.

The surficial stability of the current natural slopes has decreased significantly due to the lack of vegetation as a result of the recent fire (2007). In general, any of the existing natural slopes with an inclination steeper than approximately 3:1 (H:V) has a potential for initiation of mudflows or debris flow in its natural condition.

Potential Implications:

For Preferred and the Baseline plans, the potential for cut and natural slope stability to impact development must be assessed during future design studies. Some cut and natural slopes may require local mitigation, particularly those that face to the south and southwest. Mitigation would typically include replacement or stabilization with a buttressed fill slope. Evaluation of each slope should be accomplished at the 100-scale

Tentative Tract phase and refined during preparation of the 40-scale grading plans. In addition, final analysis of each slope should be conducted during grading operations when actual conditions are exposed.

Surficial stability of natural burned slopes will improve as the vegetation is re-established. Natural slopes that are steeper than approximately 3:1 should be evaluated for the potential for debris flows or other forms of mass wasting if they are adjacent to the proposed development. Mitigation of the potential for surficial slope stability concerns is through avoidance, proper drainage, landscaping, maintenance, or design and construction of a debris barrier. These should also be further developed during the progress of the project.

The Preferred Plan has proposed cut slopes up to 70 feet in height, however most are significantly less in height. As discussed earlier, most of these can probably be mitigated using standard remedial grading techniques. In a few areas proposed cut slopes are adjacent to slopes that are to remain in their natural condition. These natural slope areas that are above proposed cut slopes of the Preferred Plan are generally not very high or steep and therefore, do not appear to have a significant impact on the proposed project. The Preferred Plan has less than 10 proposed residential lots with significant adjacent natural slopes. Remedial and/or setback criteria may be necessary for these conditions. Specific remedial recommendations should be provided during later stages of the project development. The potential impact of cut and natural slope stability is considered less than significant with mitigation for the Preferred Plan.

The proposed Baseline Plan has designated cut slopes that are less than 30 feet in height. However, many of these cut slopes are below natural slopes that are proposed to remain in their natural state. In addition most

of the proposed lots will be adjacent to natural slopes. In the Southwestern Parcel of the Baseline Plan these combined cut/natural slopes exceed 100 feet in height. In the Northeastern Parcel some perimeter natural slopes are over 300 feet in height. These cut and natural sloping conditions that are to remain above or below proposed street areas require careful evaluation and analysis.

A wide variety of remediation measures may be necessary to mitigate the varying slopes and geologic conditions. These could include slope layback, buttressing, soils nails, tie-backs, additional reinforcement, earth walls, netting or avoidance through re-design. In some cases the remedial measures may be considered extreme and not economically feasible. Similarly nearly all of the proposed residential lot areas proposed as part of the Baseline Plan have significant ascending or descending adjacent natural slopes. The final configurations of each lot will not be known until after rough grading is completed and the lots are individually purchased and planned. At that stage each lot owner must have a geotechnical investigation and analysis performed to determine what remedial measures are necessary for their specific home and lot configuration. In many cases the necessary remediation for their preferred design may be economically significant, may not be feasible, or may only be feasible with access from the adjoining lot(s). Mitigation in some cases, may require the use of soil nails, tie-backs and/or caisson and grade-beam systems.

This issue is considered to have a less than significant impact for the proposed access road and future lot developments of the Baseline Plan, but requires careful analysis and possible construction of special mitigation measures.

3.7.2 Fill Slope Stability

Based on the engineering characteristics described in this report, onsite earth materials are generally suitable for use as engineered fill and, when properly constructed, can be expected to perform satisfactorily in embankments and fill slopes. Fill slopes constructed with code-compliant compaction standards should be grossly stable to the heights and inclinations proposed. Properly constructed and maintained fill slopes can be designed and expected to perform satisfactorily to heights approaching 100 feet; however, the material derived solely from sandstones and conglomerates may be erodible.

Potential Implications:

Similar to cut slopes, where fill slopes are proposed above natural slopes the combined slope areas must be considered during analysis. For the Preferred Plan most of these combined fill/natural perimeter slopes are not significantly different than the designed slope. Therefore, this potential hazard is considered less than significant with mitigation.

The Baseline Plan has several proposed fill slopes on top of significant natural slopes the will require analysis during further stages of plan development. In addition many fill slopes over high natural slopes may be proposed by individual lot owners. These will also require detailed slope stability analysis. Remediation of these types of slope conditions may require additional buttressing, tiebacks, soil nails, reinforced earth materials or walls, or avoidance through re-design. For individual lot owners the most desirable remedial measure may require access onto adjacent lots. This issue is considered less than significant with mitigation for the proposed Baseline Plan.

Implementation of the following recommendations can also enhance performance of graded slopes and embankments.

- *Fill slopes should be designed at 2:1 or flatter ratios.*
- *Whenever practical fill slopes should not be constructed with earth materials that are cohesionless.*
- *Terrace drains to intercept and convey surface water should be provided at approximately 30 vertical foot intervals.*
- *Higher compaction standards (93 to 95 percent) should be implemented in deeper fills (> 50 feet).*
- *Subsurface drainage should be provided.*
- *Proper landscape, irrigation and erosion control measures should be implemented and maintained until vegetation is well established.*
- *Long term maintenance is critical for maintaining surficial slope stability.*

3.8 Utility Trench Stability

Utility trenches may be excavated in fill, bedrock and/or terrace deposits. Depending on the orientation of these trenches with respect to the bedrock strike and dip, some adverse conditions may be encountered. In general, trench walls that face to the south and southwest may expose out of slope bedding and therefore be unstable. However, because the bedrock encountered had fractures and faults in various orientations, any trench wall may be unstable locally. Additionally, poorly cemented bedrock may result in unstable trench sidewalls

Potential Implications:

Where potentially adverse conditions are anticipated or encountered, the trenches may be laid back to inclinations flatter then the bedrock structure. Excavations in cohesionless sands will require lay back to 1-1 or flatter inclinations in order to reduce the potential for sidewall failures. All excavations should follow Cal OSHA guidelines. This issue is considered less than significant with planned mitigation.

3.9 Erosion

The onsite surficial materials are considered moderately to highly erodible. The bedrock formations in their unweathered state are only slightly erodible. Local zones of looser sand deposits in the Silverado and Santiago formations may be moderately erodible.

Potential Implications:

Mitigation of the erosive nature of the highly erodible materials is through surface drainage control as well as removal and re-compaction with artificial fill. Artificial fill placed using the onsite materials may also be granular and therefore still have a potential for erosion. Mitigation of the erosive nature of properly compacted fill materials may be accomplished through mixing with more cohesive materials and through proper construction of erosion control devices, planting, irrigation, and possible protective covering of sloping areas.

The Preferred Plan is designed within a footprint that will be graded and constructed to include many erosion control measures such as drainage ditches and debris basins. In addition the proposed slope areas will be landscaped and maintained by set guidelines. Therefore, this issue is considered less than significant with the planned mitigation.

The Baseline Plan has some erosion control devices for the proposed road and design slope areas, however the adjacent natural slopes will not be maintained. Therefore, the potential for erosion of loose natural soils is more significant. Mitigation of the potential for erosion is through construction of additional erosion control devices, such as debris walls, drainage ditches and design catchment areas, and through a consistent long term and active maintenance program. This issue is considered less than significant with mitigation for the baseline plan.

3.10 Other Geotechnical Hazards, Constraints, and Impacts

Other potential geotechnical hazards (Figure 6) affecting the study area either do not apply or are expected to be of no, or very low significance. As such these hazards are considered mitigable by design or procedures prescribed by applicable

codes, and therefore are not specifically addressed in this discussion. These potential hazards are considered less than significant.

3.11 General Earthwork and Grading Specifications

Prior to the commencement of grading operations, all vegetation and organic topsoil should be cleared and disposed of offsite. Once removal of compressible and collapsible material is accomplished, all areas to receive fill must be scarified, moisture conditioned, and compacted to a minimum of 90 percent relative compaction. Fill materials should be compacted to a minimum of 90 percent of the maximum dry density determined in accordance with ASTM Test Method: D-1557. Deeper fills will require higher compaction standards. Fill materials should be placed at, or slightly over the optimum moisture content. It is recommended that grading be accomplished in accordance with County of Orange Grading Codes and recommendations presented in this and future geotechnical reports.

Potential Implications:

Design and implementation of industry accepted and code-compliant earthwork procedures, specifications, and maintenance can produce satisfactory long term performance.

4.0 SIGNIFICANT IMPACTS AND MITIGATION MEASURES SUMMARIZED

Development of the project site will have geotechnical conditions and constraints similar to other projects in the area. The primary geotechnical constraints that require mitigation are slope stability, landslides, bedrock heave and soil expansion, compressible and collapsible soils, and possible effects of erosion. In general, mitigation of these potential hazards is through commonly performed and widely accepted mitigation methods practiced in the Orange County area as previously discussed.

The Preferred Plan and the Baseline Plan are significantly different from a geotechnical viewpoint. The Project Plan is contained within a well defined perimeter. The existing slopes are generally flatter and not as high in the Preferred Plan as compared to the

Baseline Plan. In the Preferred Plan, most of the lots are surrounded by areas of proposed grading. Only a few of the lots (42 through 46 and 58 through 62) are adjacent to proposed natural areas. Within the Preferred Plan any unstable internal slopes can be mitigated during the grading process by commonly used remedial measures. The perimeter conditions shown on this plan can also most likely be mitigated with standard earthwork grading solutions. The lots adjacent to steep natural slopes should be evaluated to determine if special remedial measures are necessary. Overall the potential geologic hazards for the Preferred Plan should be less than significant with the necessary mitigation.

The Baseline Plan has a footprint for the access road that is well defined, however the final configuration for all the lots cannot be determined until they have been designed/developed by the individual owners. The access road and lots have many natural sloping perimeters to the development footprint. Many of these steep slopes are potentially unstable. Each slope will require separate analysis and possibly unique remedial solutions. In some cases grading solutions for steep natural slopes may not be feasible. Possible remedial solutions may involve special design elements such as reinforced earth slopes. caissons to support foundations or walls, tie-backs or soil nails, or other similar proprietary methods. Often the actual geologic conditions can only be determined during the grading process when access to the steep areas is possible.

For the Baseline Plan, each individual residential lot will require a separate geotechnical evaluation based on that specific owners desired structure and use area. This geotechnical evaluation must determine if their desired development is feasible. Because many of the natural slope areas above and below proposed lots may be unstable, mitigation measures will be required that take into account the lot owners proposed structure and pad area. These must be compatible with the mitigation measure that will be already implemented for the access road and any other lots that have been developed. In some cases the most economical remediation may require access to and from adjacent lots, association areas, and/or open space areas. In some cases it may be determined that

the desired structure is not geotechnically or economically feasible with the conditions on the desired lot. Because of the steep terrain many of the future residential structures may not be accompanied by relatively flat pad areas. This may result in structures supported on caissons, and the buildings cantilevered over the natural slopes. This potential geologic hazards is considered as less than significant for the Baseline Plan provided the additional analysis is performed and specialty mitigation measures implemented, if necessary.

In summary, the Preferred Plan can be better defined and mitigation plans formulated in the early stages of the project. The Baseline Plan requires much more careful evaluation throughout the development process and the potential for unforeseen conditions that are difficult to mitigate is much greater.

APPENDIX A

Cited References

APPENDIX A

Cited References

California Building Standards Commission. (2007). *California Building Code* (CBC).

California Geological Survey, Department of Conservation. (2002). "State of California Seismic Hazard Zones, Santiago Peak Quadrangle, Official Map." December 20, 2002.

Gath, E. M. (2002). "Is the Elsinore fault responsible for the uplift of the Santa Ana Mountains." *Los Angeles Geological Society Newsletter*, October 2002.

Grant, Lisa B., Ballanger, Leslie J., and Runnerstrom, Eric E. (2002). "Coastal uplift of the San Joaquin Hills, southern Los Angeles Basin, California, by a large earthquake since A.D. 1635." *Bulletin of the Seismological Society of America*, Vol. 92, No. 2, March 2002.

Hauksson, E. (1992). "Seismicity, faults and earthquake potential in Los Angeles, southern California." *Engineering Geology Practice in Southern California*, Association of Engineering Geologists, Special Publication No. 4.

Huftile, G.J., and Yeats, R.S. (1995). "Convergence rates across a displacement transfer zone in the western Traverse Ranges, Ventura basin, California." *Journal of Geophysical Research*, Vol. 100, No. B2, pp.2043-2067.

Jennings, C. W. (1994). "An Explanatory Text to Accompany the Fault Activity Map of California and Adjacent Areas." California Division of Mines and Geology.

---. (1994) "Fault Activity Map of California and Adjacent Areas, with Locations and Ages of Recent Volcanic Eruptions." California Division of Mines and Geology, Geologic Map No. 6, Scale 1:750,000.

Joyner W. B., and Fumal T. E. (1985). "Predictive Mapping of Earthquake Ground Motion in the Los Angeles Region – A Earth-science Perspective." United States Geological Survey, Professional Paper 1360.

Leighton and Associates, Inc. 1999, Preliminary Geotechnical Geotechnical Investigation of Saddle Creek and Saddle Crest Parcels, County of Orange, California, Project No. 1990077-02, dated December 17, 1999.

McCulloh, T. H., Beyer, L. A., and Enrico, R. J. (2000). "Paleogene strata of the eastern Los Angeles basin, California: paleogeography and constraints on Neogene structural evolution." *Geological Society of America Bulletin*, Vol. 112, pp. 1155-1178.

Miller, R. V., and Morton, P. K. (1984). "Engineering Geology of the Western Half of the Santiago Peak Quadrangle, Orange County, California." California Division of Mines and Geology, Open File Report 84-58LA.

Morton, P. K., Miller, R. V., and Fife, D. L. (1973). "Preliminary Geo-Environmental Maps of Orange County, California." California Division of Mines and Geology, Preliminary Report 15, Scale 1:48,000.

Morton, P. K., Miller, R. V., and Evans, J. R. (1976). "Environmental Geology of Orange County, California." California Divisions of Mines and Geology, Open File Report 79-8 LA.

Morton, P. K., Miller, R. V. (1981). "Geologic Map of Orange County, California, showing Mines and Mineral Deposits." California Division of Mines and Geology, Bulletin 204, Plate 1.

Pacific Soils Engineering, Inc. 2008, Preliminary Geotechnical Investigation Saddleback Vineyards 100, Orange County, California, Work Order 500622, dated March 19, 2008.

Rockwell, T. W., Gath, E. M., and Gonzalez, T. (1992). "Sense and rate of slip on the Whittier fault zone, eastern Los Angeles basin, California." *Proceedings of the 35th Annual Meeting: Association of Engineering Geologists*, October 2-9, 1992, Long Beach, California, p. 679.

Rolston, Jack W. (1988). Chairman of Seismic Slope Stability Task Committee, Geotechnical Engineering Group, Los Angeles Section ASCE, Letter to Rudy Roodsari, Chairman of Geotechnical Engineering Group, Los Angeles Section ASCE, Review of Permanent Seismic Deformation (PSD) Method, June 21, 1988.

Schoellhamer, J.E. et al. (1981). "Geology of the northern Santa Ana Mountains, California." United States Geological Survey, Professional Paper r 420-D.

Shaw, J. H., and Shearer, P. M. (1999). "An elusive blind thrust fault beneath metropolitan Los Angeles." *Science*, Vol. 283, pp. 1516-1518.

Shaw, J. H., and Suppe, J. (1996). "Earthquake hazards of active blind-thrust faults under the central Los Angeles basin, California." *Journal of Geophysical Research*, Vol. 101, No. B4. pp. 8623-8642.

Tan, Siang S., Miller, Russell V., Fife, Donald L., 1984, Engineering Geology of the North half of the El Toro Quadrangle, Orange County, California, California Division of Mines and Geology, Open File Report 84-28 LA.

Tan, Siang S., Miller, Russell V., Fife, Donald L., 1978 Geology of the Northern Half of the El Toro 7 ½ Quadrangle, Orange County, California, California Division of Mines & Geology, Open File Report 81-2 L.A.

Working Group on California Earthquake Probabilities. (1995). "Seismic hazards in southern California: probable earthquakes 1994 to 2024." Seismological Society of America Bulletin, Vol. 85, No. 2, pp. 379-439.

Wright, T. L. (1991). "Structural geology and tectonic evolution of the Los Angeles basin, California." *Active Margin Basins*, American Association of Petroleum Geologists, Memoir 52, pp. 35-134.

Ziony , Joseph I., and Jones, Lucile M. (1989). "Map Showing Late Quaternary Faults and 1978 – 84 Seismicity of the Los Angeles Region, California."

APPENDIX B

Boring and Trench Logs

GEOTECHNICAL BORING LOG B-12

Date 8-11-99
Project 45 Ranch
Drilling Co. Gallagher
Hole Diameter 30"
Elevation Top of Hole ±1284'
Drive Weight 0-30' : 5742 lbs
Location

Sheet 1 of 2
Project No. 990077-002
Type of Rig E2 Bore
Drop 12

Logged By DRT/DRI
Sampled By DRI

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0								Topsoil / Colluvium 0' Sandy clay, beige and dark brown, damp, stiff, rootlets, sandy zones, gravels up to 1".	
				B-1						
	5			B-2					Santiago Formation (Tsa) 5' Silty Sandstone with clay, light beige, damp, dense, massive, irregular weathered contact with soil above down to 6', dark brown organic flecks, very abundant in areas, jointed, faulted, FeO_2 staining rare	
	10			R-1	5/6" bouncy	117.7	4.3		@10' (R-1). Silty Sandstone beige to orange, sl. damp, v. dense, homogenous, FeO_2 staining, sand is fine to med. grained	
	15		@14' B:74E,47SE @16' F:35E,76NW						14' bedding B:74E,47SE 16' fault offsetting bedding, fault continuous to 30'	
	20			R-2	4				18' moisture increasing to "moist", increasing organics 19' Silty Sandstone and Silty Sandstone with clay, white and dark brown, organic rich, moist, dense @20' (R-2). Silty Sandstone, light brown to beige, with clay, damp, v. dense, homogenous, fine to med. grained, rolls when wet in some zones (clayey), scarce organics.	DS
	25									
	30		@29.5' B:72E,38SE						29.5' possible bedding B:72E,38SE	

SAMPLE TYPES:
S SPLIT SPOON
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
G GRAB SAMPLE
C CORE SAMPLE

TYPE OF TESTS:
DS DIRECT SHEAR
MD MAXIMUM DENSITY
CN CONSOLIDATION
CR CORROSION
SA SIEVE ANALYSIS
AL ATTERBERG LIMITS
EI EXPANSION INDEX
RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-12

Date 8-11-99 | Sheet 2 of 2
Project 4S Ranch | Project No. 990077-002
Drilling Co. Gallagher | Type of Rig EZ-Bore
Hole Diameter 30" | Drive Weight 30'-58': 430 2 lbs 58'-87': 310 2 lbs | Drop 12
Elevation Top of Hole ±1234' | Location

Logged By DRT/DPJ
Sampled By DPJ

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	30		@30', F N20E, 90	R-3	5/4" bouncy	111.8	7.2		@30', (R-3), Silty Sandstone, beige, damp, hard, homogenous, mainly fine grained, scattered white clayey pods	
	35		@34', F 20E, 70SE						34', possible fault, F: 20E, 70SE; minor seepage 36', seepage, flowing H_2O	
	40			R-4	5/4"	107.4	10.8		@40', (R-4), Silty Sandstone, beige, v. moist, hard, homogeneous, massive, small ('1/16") FeO_2 stained pods, fine to med. grained 41', unsafe to log below - not downhole - logged below	
	45			B-3					@46', Silty Clay to Clay, Olive green, v. moist, v. stiff, FeO_2 staining, d. brown, organic(?) rich zones, grades to olive green sandy clay then to silty sandstone, as above except lt. beige w/ green.	
	50								@48', seepage @50', too hard to sample	
	55								T.D. 60' Downhole logged to 41' Seepage @ 34', 36', & 48' Caving @ 35' & below due to faulting Backfilled & tamped w/ native on 8-11-99	
	60									

SAMPLE TYPES:
S SPLIT SPOON
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
G GRAB SAMPLE
C CORE SAMPLE

TYPE OF TESTS:
DS DIRECT SHEAR
MD MAXIMUM DENSITY
CN CONSOLIDATION
CR CORROSION
SA SIEVE ANALYSIS
AL ATTERBERG LIMITS
EI EXPANSION INDEX
RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-13

Date 7-29-99
Project 45 Ranch
Drilling Co. Discovery
Hole Diameter 26"
Elevation Top of Hole ±1391
Drive Weight see log for B-1
Location

Sheet 1 of 4
Project No. 990077-002
Type of Rig Bucket Auger
Drop 12

Logged By LLB/DRT
Sampled By LLB

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0								Bedrock - Santiago Formation (Tsa) 0', silty fine sandstone, l. grnsh gray, dry to damp, firm, moderately weathered	
									4', as above, sl. weathered, scattered fractures, rare cobbles	
	5			B-1						
									8'4", as above, slightly clayey	
	10			R-1	9	120.8	10.9		@10', (R-1) silty fine sandstone, brown, damp, firm to v. firm 10', base of weathered zone	
	15									
									18', no more clay 19'8", lens of pebbles & cobbles, lens is slightly clayey, south wall, 4" thick, not cont. around boring	
	20			R-2	10	117.4	14.1		@20', (R-2) as above, color is grayish-brown 20', silty sandstone, l. gray, damp & firm, massive, micaceous	
	25		@24'6" CS: N80E, 33SW FR: N58W, 78S						24'6", clay seam, very thin & discontinuous, not continuous around boring, highly undulatory, base of clay CS: N80E, 33SW, prominent fracture below clay F: N58W, 78S	
	30									

SAMPLE TYPES:
S SPLIT SPOON
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
G GRAB SAMPLE
C CORE SAMPLE

TYPE OF TESTS:
DS DIRECT SHEAR
MD MAXIMUM DENSITY
CN CONSOLIDATION
CR CORROSION
SA SIEVE ANALYSIS
AL ATTERBERG LIMITS
EI EXPANSION INDEX
RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-13

Date 7-29-99 | Sheet 2 of 4
Project 45 Ranch | Project No. 990072-002
Drilling Co. Discovery | Type of Rig Bucket Auger
Hole Diameter 26" | Drive Weight See log for B-1 | Drop 72
Elevation Top of Hole 1339' | Location

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION (Logged By LLB/DRT; Sampled By LLB)	Type of Tests
	30			R-3	15				@30', (R-3) as above, micaceous.	DS
									33', grades to fine sandstone, l. gray, sl moist, very firm, massive, abundant biotite, micaceous	
									34½', color change to pale brown	
	35								34'4", very minor seepage	
									36½', grades to silty sandstone, brownish gray, contact is slightly dipping to South	
			@37½', Small B:N57E,53SW						37½', B: N57E, 53SW	
	40		@40', S:N72W,72S C:N60W,44S	R-4 B-2	14	117.5	14.5		@40', (R-4) Silty fine sandstone, brownish gray, sl. moist, firm to v. firm, micaceous	
									40', contact, below is clayey siltstone, reddish brown & gray, slightly moist, very firm, abundant polished surfaces, below 6" is less clayey, polished surface, S: N72°W, 72°S; C: N60W, 44S	
	45		@45', C:N36E,22SE						41', grades back to sandstone	
			@46' B:N45E,34SW						45', contact, gradational, below is sandstone, reddish brown & gray, fractured, fractures are tight, lined w/ orange staining, C: N36E, 22SE, probable bedding, may be cross-bedding or cross-staining	
	50			R-5	16	116.6	13.8		@50. (R-5) Silty sandstone, brownish gray, sl. moist, v. firm, micaceous	
									46', B: N45E, 34SW	
									47'2", lt. gray sandstone lens, pinches out on S wall of boring	
									47'4", minor seepage on west wall	
	55								48', grades back to lt. gray sandstone	
									50½', grades to siltstone, as above	
			@56½', F:N74W,54S						52', lt. gray siltstone lens pinches out on E wall, 1' thick	
									56½', fracture, F: N74W, 54S	
									53'8", grades back to lt. gray sandstone	
	60									

SAMPLE TYPES:
S SPLIT SPOON
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
G GRAB SAMPLE
C CORE SAMPLE

TYPE OF TESTS:
DS DIRECT SHEAR
MD MAXIMUM DENSITY
CN CONSOLIDATION
CR CORROSION
SA SIEVE ANALYSIS
AL ATTERBERG LIMITS
EI EXPANSION INDEX
RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-13

Date 7-29-99 | Sheet 3 of 4
Project 45 Ranch | Project No. 99D077-002
Drilling Co. Discovery | Type of Rig Bucket Auger
Hole Diameter 26" | Drive Weight see log for B-1 | Drop 12
Elevation Top of Hole 1391' | Location

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION (Logged By LLB/DRT; Sampled By LLB)	Type of Tests
	60								@60, same as above, color is m. gray	
									61, grades back to siltstone	
	65								66'7" seepage on N wall, on top of contact w/sandstone, contact has 3" thick orange rind, sandstone is lt. gray, upper 2', below is blue gray, massive, sl. moist, dense, hard, fine to medium grained, below scattered concretions up to 4" diameter; contact is steply dipping, low point @ 74', above contact on S wall abundant rip up clasts, siltstone above clayey, sandstone same to bottom of boring	
	70									
	75			B-3 R-6	15/9"				@75, (R-6) Sandstone, as above, rare pebbles	
	80								@79, Sandstone, l. gray, sl. moist, v. firm, fine to med. grained	
	85									
	90									

SAMPLE TYPES:
S SPLIT SPOON
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
G GRAB SAMPLE
C CORE SAMPLE

TYPE OF TESTS:
DS DIRECT SHEAR
MD MAXIMUM DENSITY
CN CONSOLIDATION
CR CORROSION
SA SIEVE ANALYSIS
AL ATTERBERG LIMITS
EI EXPANSION INDEX
RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-13

Date 7-29-99
Project 45 Ranch
Drilling Co. Discovery
Hole Diameter 26"
Drive Weight See log for B-1
Drop 12
Elevation Top of Hole ±1391'
Location

Sheet 4 of 4
Project No. 990077-002
Type of Rig Bucket Auger

Logged By LLB/ORT
Sampled By LLB

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	90									
	95								T.D. 93' No Caving Seepage @ 34'4", 47'4", 68'7" Backfilled & tamped w/native on 7-29-99	
	100									

SAMPLE TYPES:
S SPLIT SPOON
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
G GRAB SAMPLE
C CORE SAMPLE

TYPE OF TESTS:
DS DIRECT SHEAR
MD MAXIMUM DENSITY
CN CONSOLIDATION
CR CORROSION
SA SIEVE ANALYSIS
AL ATTERBERG LIMITS
EI EXPANSION INDEX
RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-15

Date 8-11-99 to 8-12-99
Project 45 Ranch
Drilling Co. Gallagher
Hole Diameter 30"
Drive Weight See log for B-12
Elevation Top of Hole ±1420'
Location

Sheet 1 of 3
Project No. 990077-002
Type of Rig E2-Bore
Drop 12

Logged By DRJ/DRT
Sampled By DRJ

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0								TOPSOIL 0' Sandy Clay, m. brown, sl. moist, cobbles to 1', rootlets Santiago Formation (Tsa) @3' (B-1), Silty sandstone, beige and red-brown, w/ gravel, damp, dense, gravel to 2", fine-grained, gravel consists of dark brown, dry sandy clay.	
	5		@5' B:46W, 36SW	B-1					3' contact w/ sandstone, beige, fine to med. grained, massive w/ jointing 5' lt. beige sand lamination B:46W, 36SW 9' Silty lens, 1' thick olive green, sand around is olive green, some polished surfaces, possible bedding, becoming beige, massive	
	10			R-1	4/4" bounce	110.2	6.5		@10' (R-1) Silty Sandstone, greenish beige, damp, very dense, hard, homogenous, fine to med. grained 13' Some FeO_2 staining along joint surfaces	
	15		@16' B:51W, 63SW						16' sand lamination, possible bedding, interbedded sandstone & siltstone, B:N51W, 63SW 18' Siltstone has many fine fractures, tight @18' Sandy siltstone, damp, hard 20' FeO_2 staining, B:N50W, 79SW	
	20		@20' B:50W, 79SW	B-2 R-2	5	120.7	8.5		@20' (R-2), Sandy Siltstone, olive green, damp, v. dense, hard, homogenous, fining downward, massive 25' Interbedded olive and orange-beige siltstone and sandstone, damp, hard, abundant small fractures, tight, abundant FeO_2 staining, silty clay/clayey siltbed, varies in thickness 3"-9", 1½" thick plastic local clay bed on top, B:N72W, 73SW	
	25		@25' B:72W, 73SW							
	30									

SAMPLE TYPES:
S SPLIT SPOON
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
G GRAB SAMPLE
C CORE SAMPLE

TYPE OF TESTS:
DS DIRECT SHEAR
MD MAXIMUM DENSITY
CN CONSOLIDATION
CR CORROSION
SA SIEVE ANALYSIS
AL ATTERBERG LIMITS
EI EXPANSION INDEX
RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-15

Date 9-1-99 to 9-12-99
Project 45 Ranch
Drilling Co. Gallagher
Hole Diameter 30"
Drive Weight See log for B-12
Elevation Top of Hole ± 1420'
Location

Sheet 2 of 3
Project No. 99-177-002
Type of Rig E2-Bore
Drop 12

Logged By DRJ/ORT
Sampled By DRJ

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	30			R-3	4/6" bouncy	120.7	9.0		@30', (R-3), Silty Sandstone, and Sandy Siltstone, beige and gray, damp, v. stiff, dense, massive, some sandier zones 30', predominantly sandstone, med. grained, massive, w/iron oxide staining along joints, joints are near vertical	
	35									
			@38', GB: 61W, 53SW						38', general bedding along fine sand lamination GB: N61W, 53SW 39', Siltstone, orange-gray, moist, hard, abundant small fractures w/iron oxide staining	
	40			R-4	7/4" bouncy	122.4	9.2		@40', (R-4), Silty Sandstone, beige to white, damp, hard, slight FeO_2 staining, jointing exposed in tip, massive 40', Clay, paper thin, polished, near vertical	
	45		@46', C: 32W, 37SW						45', becoming very chaotic 45-46', red staining along fractures in siltstone, C: 32W, 37SW 47', Sandy Siltstone, medium gray, damp, hard, massive @49', Siltstone, greenish gray, damp, hard, massive	
	50								@50', too hard to sample; as above	
	55								54', vertical contact, siltstone, gray and olive 55', minor seepage @55', Silty Sandstone, orange brown, damp, dense, FeO_2 staining, fine to med. grained 57', Siltstone, gray sandy, no olive color, FeO_2 staining	
	60									

SAMPLE TYPES:
S SPLIT SPOON
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
G GRAB SAMPLE
C CORE SAMPLE

TYPE OF TESTS:
DS DIRECT SHEAR
MD MAXIMUM DENSITY
CN CONSOLIDATION
CR CORROSION
SA SIEVE ANALYSIS
AL ATTERBERG LIMITS
EI EXPANSION INDEX
RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-15

Date 8-11-99 to 8-12-99
Project 45 Ranch
Drilling Co. Gallagher
Hole Diameter 30"
Elevation Top of Hole ± 1420'

Drive Weight See log for B-12
Location

Sheet 3 of 3
Project No. 990077-002
Type of Rig E2-Bore
Drop 12

Logged By DPJ / DRT
Sampled By DPJ

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	60		@61', B:50W,37SW	R-5	7/4" bouncy	121.9	9.9		@61', (R-5), Silty Sandstone, orange brown, very damp, dense to hard, FeO_2 staining, massive @62', 1/8"-thick olive green clay, moist, sl. stiff, pinches and swells, plastic, clay is locally sandy B: N50W,37SW, layer btwn sandstone above, ~4" thick olive green clayey sandstone, and back to orange brown sandstone at 62.5' 64', Siltstone bed, gray, near vertical, olive sandy siltstone next to it w/iron oxide staining, other half silty sandstone, moist and hard, massive 69', abundant FeO_2 staining, jointed, red staining, microshears, very tight 70', contact w/orange sandstone, weathered, pale brown sandstone below, possible fault F: N57W, 58SW @75', too hard to sample; light gray, silty sandstone, damp, v. dense, hard, med-grained, homogeneous 75', contact between orange brown, siltstone and light gray sandstone, v. dense, hard, damp, massive @79', becomes v. hard, switch to coring bucket @81', (B-3), Silty Sandstone, white, dry to sl. damp, v. hard, v. dense, massive, homogeneous, fine to med. grained.	
	65									
	70		@70', C: 57W, 58SW							
	75									
	80			B-3						
	85								T.D. 85' Downhole logged to 82' No GW. Minor Seeps @ 65' No Caving Backfilled & tamped w/native 8-12-99	
	90									

SAMPLE TYPES:
S SPLIT SPOON
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
G GRAB SAMPLE
C CORE SAMPLE

TYPE OF TESTS:
DS DIRECT SHEAR
MD MAXIMUM DENSITY
CN CONSOLIDATION
CR CORROSION
SA SIEVE ANALYSIS
AL ATTERBERG LIMITS
EI EXPANSION INDEX
RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-18

Date 7-27-99 to 7-28-99
Project 45 Ranch
Drilling Co. Discovery
Hole Diameter 26"
Elevation Top of Hole ±1498'

Drive Weight see log for B-1
Location

Sheet 1 of 3
Project No. 990077-002
Type of Rig Bucket Auger
Drop 12

Logged By LLB
Sampled By LLB

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0								Bedrock - Silverado Formation (Tsi) 0', Coarse Sandstone, pale orange-brown, damp, v. firm, scattered pebbles, rare cobbles, rare soil-filled fractures, lined w/ roothairs, massive, moderately weathered	
	5			B-1					5' scattered siltstone fragments, scattered pebbles 9', cobbles, rare gypsum fragments 6', Sandstone becomes medium grained, fining downward	
	10								10', becomes unweathered	
				R-1	10/7"	119.4	7.8		@11½', (R-1) Sandstone, orange-brown, damp, v. firm to hard, medium to coarse-grained; too 3 rings disturbed 13', Sandstone is fine-grained, coarsening downward	
	15									
									18', Sandstone is coarse-grained	
	20								@20', too hard to sample	
			@22', C: N81E, 26S @24', J: N77E, 44S						22', contact, wavy, sl. diffuse, below is Siltstone, orange-brown, damp, very firm, C: N81E, 26S 24', joint, J: N77E, 44S 24½', Sandstone, orange-brown, sl. moist, hard, siltstone rip-up clasts w/in Sandstone, up to 6" thick, may be overturned bedding; Sandstone is coarse-grained, very poorly bedded, dipping to S; below, scattered to rare siltstone pods to bottom of boring	
	25									
	30									

SAMPLE TYPES:
S SPLIT SPOON
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
G GRAB SAMPLE
C CORE SAMPLE

TYPE OF TESTS:
DS DIRECT SHEAR
MD MAXIMUM DENSITY
CN CONSOLIDATION
CR CORROSION
SA SIEVE ANALYSIS
AL ATTERBERG LIMITS
EI EXPANSION INDEX
RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-18

Date 7-27-99 to 7-28-99
Project 45 Ranch
Drilling Co. Discovery
Hole Diameter 26"
Elevation Top of Hole ±1428'

Drive Weight Soil log for B-1
Location

Sheet 2 of 3
Project No. 990077-002
Type of Rig Bucket Auger
Drop 12

Logged By LLB
Sampled By LLB

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	30								@30, too hard to sample	
	35								34½', medium to coarse grained sandstone, as above, massive 37', grades to coarse-grained 39' large pod of siltstone, not continuous around boring, 2' thick, 2' long, dipping South @40, too hard to sample, using pull-down crowds	
	40								42', as above, sl. harder	
	45		@40', C:N68W, 36S						48', color change to blue-gray, coarse-grained sandstone, micaceous, sl. moist to moist, hard to v. hard, x-hole attitude C. N68W, 36S	
	50								@50', too hard to sample 50½', medium to coarse grained @52', color changes to blue-gray	
	55								55', becomes very hard	
	60								59', minor seepage on N wall	

SAMPLE TYPES:
S SPLIT SPOON
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
G GRAB SAMPLE
C CORE SAMPLE

TYPE OF TESTS:
DS DIRECT SHEAR
MD MAXIMUM DENSITY
CN CONSOLIDATION
CR CORROSION
SA SIEVE ANALYSIS
AL ATTERBERG LIMITS
EI EXPANSION INDEX
RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-13

Date 7-27-99 to 7-29-99
Project 45 Ranch
Drilling Co. Discovery
Hole Diameter 24"
Drive Weight See log for B-1
Elevation Top of Hole ±1498'
Location

Sheet 3 of 3
Project No. 990077-002
Type of Rig Bucket Auger
Drop 12

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION (Logged By LLB; Sampled By LLB)	Type of Tests
	60								61', large siltstone pod on west wall, 8" thick, 1' long, dipping South	
	65								67', as above, medium grained	
	70								70', as above, coarse-grained, minor seepage to 80', same to bottom of boring	
	75								@75', too hard to sample	
									@77', minor seepage, omitch to boring bucket, sandstone, blue-gray, moist, v. hard, c grained	
									@79', back to auger bucket	
	80								79', 2" of cave on walls, seepage around boring	
									82', standing water during logging	
									@84', very hard, using core bucket	
	85								T.D. 84'	
									No caving	
									Minor seepage at 59', below 70'	
									Downhole logged to 80'	
	90								BACKFILLED & tamped w/ native on 7-28	

SAMPLE TYPES:
S SPLIT SPOON
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
G GRAB SAMPLE
C CORE SAMPLE

TYPE OF TESTS:
DS DIRECT SHEAR
MD MAXIMUM DENSITY
CN CONSOLIDATION
CR CORROSION
SA SIEVE ANALYSIS
AL ATTERBERG LIMITS
EI EXPANSION INDEX
RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-19

Date 7-26-99 to 7-27-99
Project 45 Ranch
Drilling Co. Discovery
Hole Diameter 26"
Elevation Top of Hole 1457'

Drive Weight see log for B-1
Location

Sheet 1 of 4
Project No. 990077-002
Type of Rig Bucket Auger
Drop 12

Logged By LLB/DRT
Sampled By LLB

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0								0', Siltstone, brown to orange brown, damp, firm, moderately weathered, scattered rootlets	
									3'6", becomes less weathered	
	5								6'8", grades into sandstone, brown, damp, very firm, massive, contact appears to be dipping S	
	10			R-1	10/10"	120.8	9.0		@10', (R-1) Silty Sand to Sand, brown, damp, v. firm, sl. weathered, scattered caliche, massive?, med. grained	
				B-1					10', base of weathered zone	
									14', scattered concretions, micaceous, massive	
	15									
									18', V. coarse grained sandstone bed, not continuous around boring, scattered gypsum.	
	20			R-2	13/10"	122.8	9.6		@20', (R-2) Sandstone, brown, sl. moist, v. firm, coarse-grained, sl. cemented, scattered cobbles of well-cemented sandstone	
									20', Sandstone becomes hard	
									23', V. coarse grained Sandstone bed, not continuous around boring	
	25								27½', Siltstone pod, 1' thick, 2' wide, on N wall	
									29', as above, moderately well-cemented, hard	
	30									

SAMPLE TYPES:
S SPLIT SPOON
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
G GRAB SAMPLE
C CORE SAMPLE

TYPE OF TESTS:
DS DIRECT SHEAR
MD MAXIMUM DENSITY
CN CONSOLIDATION
CR CORROSION
SA SIEVE ANALYSIS
AL ATTERBERG LIMITS
EI EXPANSION INDEX
RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-19

Date 7-26-99 to 7-27-99
Project 4S Ranch
Drilling Co. Discovery
Hole Diameter 24"
Drive Weight See log for B-1
Elevation Top of Hole ±1457'
Location

Sheet 2 of 4
Project No. 990077-002
Type of Rig Bucket Auger
Drop 12

Logged By LLB/DRT
Sampled By LLB

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	30		@31', B: N28W, 37S						@30', Sandstone, pale tan to l. brown, sl. moist, v. firm to hard, v. coarse grained, occasional to rare cobbles, too hard to sample	
			@34', C: N70W, 44S						@31', gradual contact w/ sandstone, white, black (salt & pepper) sl. moist, hard, abundant biotite, possible bedding B: N28W, 37 34', color changes to orange-brown, coarse grained, C: N70W, 44S	
	35								36½', as above, very hard, scattered pebbles	
									39', Contact w/ fine sandstone, blue gray, sl. moist, very firm, contact is undulatory, large frame structure on S wall, generally dipping south	
	40			R-3	15/9" bouncy	125.2	6.5		@40', (R-3) Sandstone, brown and blue gray mottled, sl. moist, v. firm to hard, massive?, coarse-grained 39', large inclusions of or-brn sandstn, soft sed. deformation appears that both units are included in each other. 42', back into orange-brown v. coarse sandstone; gray sandstone pod, 6" thick, 1' long, 1" thick clay rind	
	45								@45', color change to blue gray, still sandstone 45', color gradually changes to white & black (biotite); below becomes moister	
									@46', replace all teeth 48½', correction on N wall, below sand is v. moist	
	50			R-4	15/8"	113.4	5.8		@50', (R-4) Sandstone, pale gray to blue gray, sl. moist, hard, v. coarse grained, micaceous, sand inclusions	
									53½', minor seepage on N wall down to 56'	
	55								58', seepage on E wall	
									@59', possible seepage	
	60									

SAMPLE TYPES:
S SPLIT SPOON
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
G GRAB SAMPLE
C CORE SAMPLE

TYPE OF TESTS:
DS DIRECT SHEAR
MD MAXIMUM DENSITY
CN CONSOLIDATION
CR CORROSION
SA SIEVE ANALYSIS
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EI EXPANSION INDEX
RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-19

Date 7-26-99 to 7-27-99
Project 4S Ranch
Drilling Co. Discovery
Hole Diameter 26"
Elevation Top of Hole ±1457'

Sheet 3 of 4
Project No. 990077-002
Type of Rig Bucket Auger
Drive Weight see log for B-1
Drop 12
Location

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION (Logged By LLB/DRT; Sampled By LLB)	Type of Tests
	60								@62' using pull-down crowds	
	65		@64', B: N68W, 44SE						64', 6" thick sandy cobbly siltstone bed B: N68W, 44SE	
	70								70'-73', massive sandstone, becomes coarser, up to cobble-sized, no bedding observed, same to bottom of boring	
	75								@75' too hard to sample	
	80									
	85									
	90									

SAMPLE TYPES:
S SPLIT SPOON
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
G GRAB SAMPLE
C CORE SAMPLE

TYPE OF TESTS:
DS DIRECT SHEAR
MD MAXIMUM DENSITY
CN CONSOLIDATION
CR CORROSION
SA SIEVE ANALYSIS
AL ATTERBERG LIMITS
EI EXPANSION INDEX
RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-19

Date 7-26-99 to 7-27-99
Project 45 Ranch
Drilling Co. Discovery
Hole Diameter 26"
Drive Weight See log for B-1
Elevation Top of Hole ±1457'
Location

Sheet 4 of 4
Project No. 990077-002
Type of Rig Bucket Auger
Drop 12

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION Logged By LLB/DRT Sampled By LLB	Type of Tests
	90									
	95								T.D. 93' No Caving Seepage btwn 53½'-60' Logged to 87' Standing H_2O @ 90' @ 8:30am (7-27- Backfilled & tamped w/ native on 7-27-99	
	100									

SAMPLE TYPES:
S SPLIT SPOON
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
G GRAB SAMPLE
C CORE SAMPLE

TYPE OF TESTS:
DS DIRECT SHEAR
MD MAXIMUM DENSITY
CN CONSOLIDATION
CR CORROSION
SA SIEVE ANALYSIS
AL ATTERBERG LIMITS
EI EXPANSION INDEX
RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-20

Date 8-13-99
Project 4S Ranch
Drilling Co. Gallagher
Hole Diameter 30"
Elevation Top of Hole ± 1457'

Sheet 1 of 2
Project No. 990077-002
Type of Rig E2. Ford
Drive Weight see log for B-12
Drop 12
Location

Logged By DRI/WAS
Sampled By DW

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0								Alluvium (Qal) 0', Sandy Clay to Clayey Silt, w/ sand, med. brown, cobbles up to 18", abundant gravel, siltstone clasts, subangular to round, sl. stiff to stiff, moist, scattered sandy & clayey zones	
	5			B-1					@3' (B-1), Sandy Silty Clay, med. brown, w/ gravels and cobbles, damp, soft to sl. stiff, cobbles up to 1', homogeneous	
	10			R-1	Push	102.9	9.9		@10', (R-1), Sandy Silty Clay, m. brown, w/ gravel, moist, soft to sl. stiff, gravel up to 1", scarce, homogeneous, sl porous, sandy lenses	
	15									
	20			R-2	1				@20', (R-2), Sandy Silty Clay w/ gravel & cobbles, med. brown, moist, sl. stiff, cobbles to 3", homogenous, sl. porous 21'-22', sand pocket	DS
	25									
	30									

SAMPLE TYPES:
S SPLIT SPOON
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
G GRAB SAMPLE
C CORE SAMPLE

TYPE OF TESTS:
DS DIRECT SHEAR
MD MAXIMUM DENSITY
CN CONSOLIDATION
CR CORROSION
SA SIEVE ANALYSIS
AL ATTERBERG LIMITS
EI EXPANSION INDEX
RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-20

Date 8-13-99
Project 45 Ranch
Drilling Co. Gallagher
Hole Diameter 30"
Elevation Top of Hole ± 1457'

Drive Weight see log for B-12
Location

Sheet 2 of 2
Project No. 990077-002
Type of Rig E2-Bore
Drop 12

Logged By DRJ/WAS
Sampled By DRJ

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Tube Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	30			R-3	1	109.5	11.9		@30', (R-3), Sandy silty clay, med. brown, w/gravel & cobbles, moist, sl. stiff, cobbles to 1', abundant gravel to ½", clasts subangular to subrounded, porous.	
									31'-32', Sand pocket, becomes moister w/ depth	
									33', increasing clay to clayey silt, v. moist	
	35								39', organic debris, weathered roots	
									40', Sandy clay, med. red to rust red and beige, abundant rocks & cobbles, v. stiff, moist to v. moist	
	40			R-4	1 (hit cobble)	106.2	14.6		@40', (R-4), Sandy silty clay, med. brown to dark brown, moist, stiff, cobbles to 3", porous, abundant siltstone and sandstone clasts to 1", cobble in tip	
									44'-44.5', large boulder, clay, wet, seepage, v. minor	
									@45', hard drilling due to boulders & cobbles up to 18"	
	45								Silverado Formation, Conglomerate Member (Tsicg)	
									46', contact, gradational, undulatory, dark green gray, sandy siltstone w/ cobbles, v. hard, damp, wet from seepage, cobbles are sandstone to granitic	
									47', sl. seepage	
	50			B-2					@51', (B-2), sandstone, l. bluish green, damp, v. hard, homogeneous, conglomerate	
	55								T.D. 52' Downhole logged to 49.5' Seepage @ 44' & 47' Minor caving Backfilled & tamped w/ native on 8-13-99.	
	60									

SAMPLE TYPES:
S SPLIT SPOON
R RING SAMPLE
B BULK SAMPLE
T TUBE SAMPLE
G GRAB SAMPLE
C CORE SAMPLE

TYPE OF TESTS:
DS DIRECT SHEAR
MD MAXIMUM DENSITY
CN CONSOLIDATION
CR CORROSION
SA SIEVE ANALYSIS
AL ATTERBERG LIMITS
EI EXPANSION INDEX
RV R-VALUE

LEIGHTON AND ASSOCIATES, INC.

501-A - (3/77)

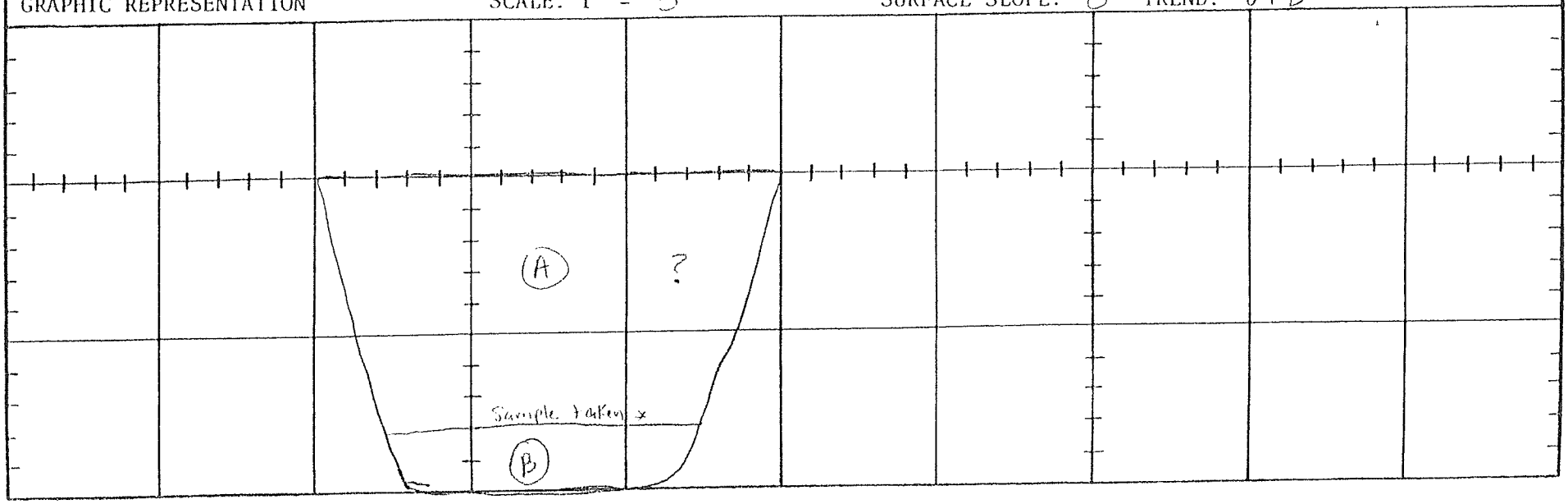
Project Name: 4S-Ranch
Project Number: 990077-002
Equipment: Extendahoe

Logged By: LLB/KDS
Elevation: ± 1280'
Location: Parker Ranch South

TRENCH NO. TP-11

GEOLOGIC ATTITUDES	DATE: 9-14-99 DESCRIPTION:	GEOLOGIC UNIT	ENGINEERING PROPERTIES U.S.C.S.	Sample No.	Moisture (%)	Density (pcf)
	(A) Colluvium/Landslide Debris (?): sandy clay, dk brown mottled w/red; homogenous; few pebbles (? see sample) upper 2½': dry to damp; highly weathered below 2½': sl. moist between 4'-5': scattered to abundant caliche pods					
	(B) Bedrock - Santiago Fm (Tsa): m. to c. sandstone; lt grayish tan; well sorted; micaceous; sl. moist; loose to sl. dense; not cemented; firm to v. firm; prob. massive; FeO staining					

GRAPHIC REPRESENTATION SCALE: 1" = 5' SURFACE SLOPE: 0° TREND: 84 E



LOG OF TRENCH NO: TP-11

Leighton & Associates

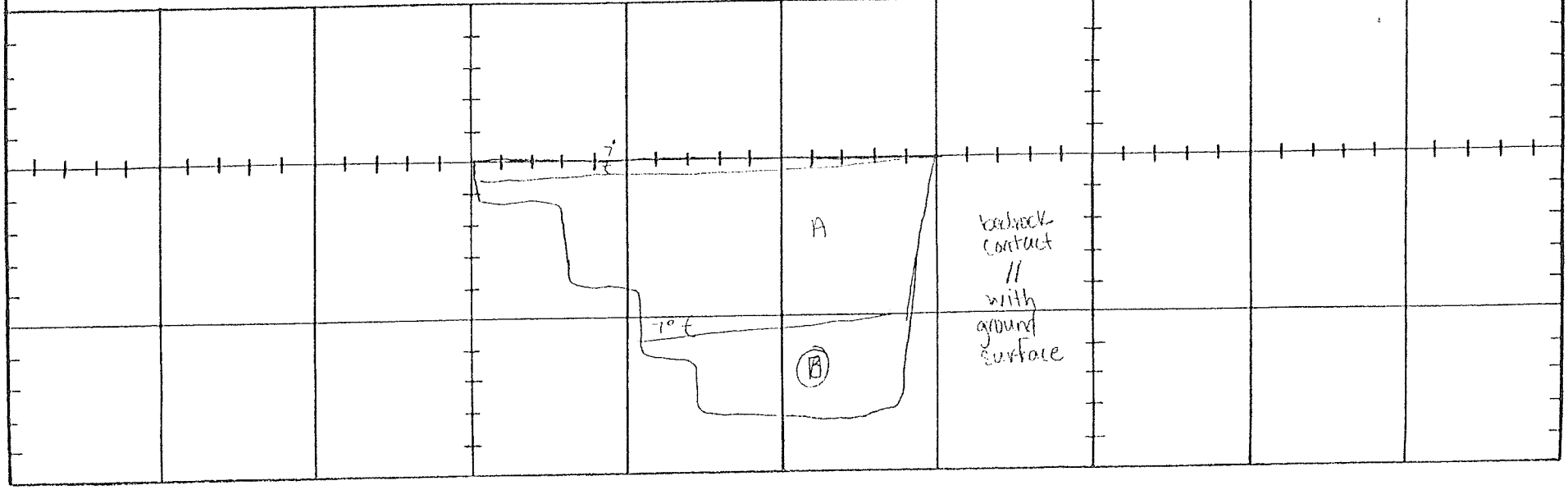
Project Name: 4S Ranch
Project Number: 990077-002
Equipment: Extendahoe

Logged By: LLB/KDS
Elevation: ± 1300'
Location: Panter Ranch South

TRENCH NO. TP-12

GEOLOGIC ATTITUDES	DATE: 9-14-99 DESCRIPTION:	GEOLOGIC UNIT	ENGINEERING PROPERTIES U.S.C.S.	Sample No.	Moisture (%)	Density (pcf)
	(A) Topsoil / Landslide (?): clayey sand, dk brown; pockets of sandy clay; dry to damp; firm; m. to highly weathered; well devlpd ped surfaces scattered root hairs; rare pebbles					
	(B) Bedrock - Santiago Fm. (Tsa): med to v. coarse sandstone; lt. tan; poorly sorted; subangular; v. firm; friable; damp; massive					

GRAPHIC REPRESENTATION SCALE: 1" = 5' SURFACE SLOPE: 7° TREND: 15W



LOG OF TRENCH NO: TP-12

501-A - (3/77)

Leighton & Associates

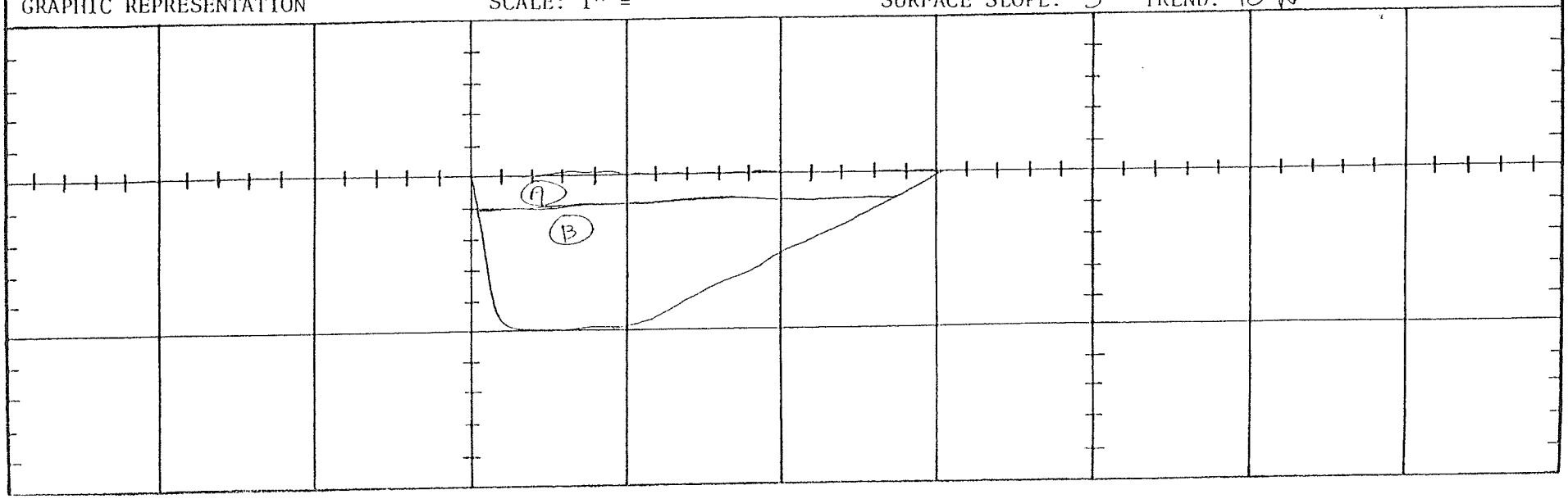
Project Name: 4S Ranch
Project Number: 990077-002
Equipment: Extendahoe

Logged By: LLB/KDS
Elevation: ±1255'
Location: Panter Ranch South

TRENCH NO. TP-13

GEOLOGIC ATTITUDES	DATE: 9-14-99 DESCRIPTION:	GEOLOGIC UNIT	ENGINEERING PROPERTIES U.S.C.S.	Sample No.	Moisture (%)	Density (pcf)
	(A) Topsoil: silty sand, dk-brown; dry; v. firm; loose; abundant root hairs					
	(B) Bedrock - Scripps Fm (Ts): silty sandstone w/pebbles; pinkish gray; damp; friable; v. firm; moderately weathered in upper 4'; massive					

GRAPHIC REPRESENTATION SCALE: 1" = SURFACE SLOPE: 5° TREND: 10 W



LOG OF TRENCH NO: TP-13

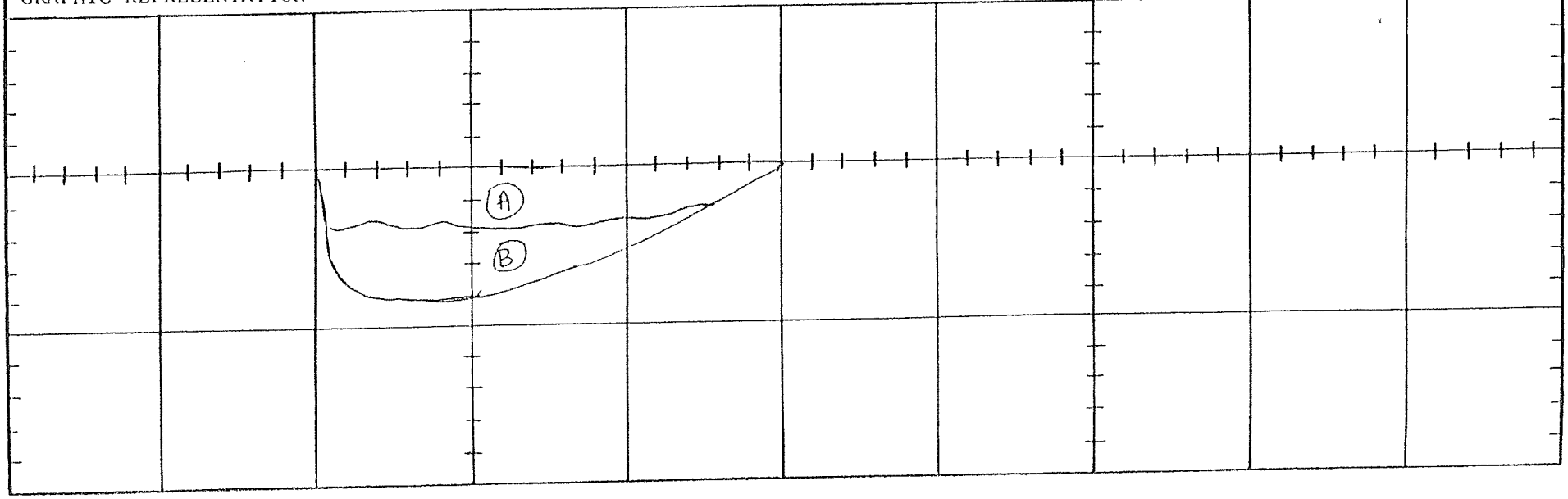
Project Name: 4S Ranch
Project Number: 990077-002
Equipment: Backhoe

Logged By: LKB/KDS
Elevation: ± 1260'
Location: Panter Ranch South

TRENCH NO. TP-14

GEOLOGIC ATTITUDES	DATE: 9-14-99 DESCRIPTION:	GEOLOGIC UNIT	ENGINEERING PROPERTIES U.S.C.S.	Sample No.	Moisture (%)	Density (pcf)
	(A) Topsoil: silty sand, dk brown; dry; scattered root hairs					
	(B) Bedrock - Santiago Fm (Tsa): m to coarse sandstone with abundant pebbles + cobbles, lt yellowish tan; damp; friable; v. firm; FeO staining; scattered root hairs					

GRAPHIC REPRESENTATION SCALE: 1" = SURFACE SLOPE: 0° TREND: 10E



LOG OF TRENCH NO: TP-14

GeoSoil Inc.

BORING LOG B-1

CLIENT INTERAMERICAN W.O. 2108-1-00 DATE DRILLED 5-2-90 LOGGED BY ABE/SB

PROJECT PANTER RANCH SURFACE ELEV. 1406' ± DRIVING WT. 3200 lbs

DRILL RIG BUCKET AUGER BORING DIAMETER 24" 840

WATER	DEPTH (FEET)	GRAPHIC LOG (S / N)	GEOLOGIC/ENGINEERING DESCRIPTION	GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C-CORE B-BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
	0		0-6" Topsoil, sandy silt (SM), firm, dry, light brown, roots common		3	B,C		
			SANTIAGO FM (Tsa)					
	5		Silty sandstone, firm, dry, very light gray to offwhite to light yellow gray, very fine grained, friable, with streaks or seams of white chalky material, pinpoint porosity, becomes more yellow downhole, @ 6' clay seams 1/4"-1/2" thick N20W 80NE, N80E 70NW					
	10		Sandstone, dense, hard to very hard, dry to slightly damp, yellowish brown to orange yellow, with interbeds of hard claystone and light gray calcareous ss., w/thin seams of gray clay, with interbeds of softer and more fria. ss., abundant mica flakes, @ 11' bedding E-W, 85S @ 14'-18' siliceous concretions up to 6" long @ 19' Bedding N70W 40NE, possible cross-bedding		4	B,C	113.9	11.6
	15							
	20		Interbedded Sandstone, siltstone, and claystone, moderately hard, dry to damp, olive gray to light gray, claystones show some slick surfaces, w/some hard concretions		7	B,C		
	25		@ 23' Clayey siltstone, light gray, massive @ 25½' Irregular contact between siltstone and yellow sandstone; discontinuous ss. inclusions					
	30		Clayey siltstone, massive, light gray, with irregular and discontinuous pockets of plastic clay seams up to 1/2" thick @ 32'-34' hard concretions		12/1680	C		
	35		@ 34' very hard drilling, siliceous siltstone					

This log is a representation of subsurface conditions at the time and place of drilling. With the passage of time or at any other location there may be consequential changes in conditions.

PLATE A-1

GSSI Inc.

BORING LOG B-1

CLIENT INTERAMERICAN W.O. 2108-A-0C DATE DRILLED 5-2-90 LOGGED BY ABE/SB

PROJECT PANTER RANCH SURFACE ELEV. 1406' ± DRIVING WT. 3200/1680/840

DRILL RIG BUCKET AUGER BORING DIAMETER 24"

WATER	DEPTH (FEET)	GRAPHIC LOG	GEOLOGIC/ENGINEERING DESCRIPTION	GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C-CORE B-BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
	35		Some rusty orange oxidation @ 35'-40' in sandy siltstone, massive, mica flakes common					
	40				18/840	B, C		
			TD 40'					
			No ground water					
			No caving					
			Hole backfilled					

This log is a representation of subsurface conditions at the time and place of drilling. With the passage of time or at any other location there may be consequential changes in conditions.

PLATE A-2

GeoSoils Inc. • BORING LOG B-2

CLIENT INTERAMERICAN W.O. 2108-A-0C DATE DRILLED 5-2-90 LOGGED BY [illegible]

PROJECT PANTER RANCH SURFACE ELEV. 1423' ± DRIVING WT. 3200/1680/840'

DRILL RIG BUCKET AUGER BORING DIAMETER 24"

WATER	DEPTH (FEET)	GRAPHIC LOG (SW / NE)	GEOLOGIC/ENGINEERING DESCRIPTION	GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C-CORE B-BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
	0		SILVERADO FM. (Tsi): Silty sandstone, firm, damp, red brown, very fine grained, very friable, weathered, oxidized, becomes medium to coarse grained, harder, and changes color to mottled light gray and yellow brown, quartzose		5	B, C	115.8	5.7
	5							
	10		Silty sandstone, moderately hard, light yellow to light yellow gray mottled with orange brown, fine to medium grained w/ some coarse sands, pebbles and cobbles of quartzite and chert, massive, becomes very friable below 16' and more uniform light yellow in color, porous, faint laminations, quartzose		5	C	120.3	9.1
	15		@ 14' concretion 12" thick x 24" long, @ 15' smaller concretions.					
	20		Sandstone, silty, light yellow, fine to coarse grained, fair to poor cementation, very friable, porous, massive, quartzose		10/8"	B, C		
	25		Hard drilling @ 25', coarse sandstone					
			Orange oxidation @ 28', very friable Bedding @ 28' N70W, 60SW Concretion of dark gray claystone @ 29'-30'					
	30		Sandstone, moderately hard to hard, fine to coarse grained, light orange, friable, mass., pinpoint porosity, quartzose		30/10"	C		
	35							

This log is a representation of subsurface conditions at the time and place of drilling. With the passage of time or at any other location there may be consequential changes in conditions.

PLATE: A-3

GeoSoil Inc.

BORING LOG B-2

CLIENT INTERAMERICAN W.O. 2108-A-00 DATE DRILLED 5-2-90 LOGGED BY ABE/SB

PROJECT PANTER RANCH SURFACE ELEV. 1423' ± DRIVING WT. 3200/1680/840

DRILL RIG BUCKET AUGER BORING DIAMETER 24"

WATER	DEPTH (FEET)	GRAPHIC LOG (SW | NE)	GEOLOGIC/ENGINEERING DESCRIPTION	GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C-CORE B-BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
	35		Sandstone as @ 30'					
			@ 39'-40' Contact between sandstone and orange silty sandstone, irregular at the top, sharp at the sides, N55W, 55SW					
	40		Sandstone, light orange, medium to coarse grained, poor sorting, poorly cemented, friable, massive, quartzose		30/8"	B, C		
			@ 40' Changed to Silty sandstone, very fine grained, hard, with very thin streaks of plastic clay, light gray to light blue gray, w/occasional hard streaks of darker ss., massive, unoxidized, w/ inclusions of oxidized ss., mica flakes common					
	45							
	50				50/8"	B, C		
			@ 52' Bedding? Attitude taken on a 1/8" thick gray clay seam, N35W, 80SW					
	55							
	60		As above, massive, moderately hard to hard		50/6"	C		
	65		TD 65' No Ground water No Caving Hole Backfilled					

This log is a representation of subsurface conditions at the time and place of drilling. With the passage of time or at any other location there may be consequential changes in conditions.

PLATE A-6

GSSI Inc.

BORING LOG B-3

CLIENT INTERAMERICAN W.O. 2108-1-00 DATE DRILLED 5-2-90 LOGGED BY ABE/SB

PROJECT PANTER RANCH SURFACE ELEV. 1424'± DRIVING WT. 3200/1680/840

DRILL RIG BUCKET AUGER BORING DIAMETER 24"

WATER	DEPTH (FEET)	GRAPHIC LOG	GEOLOGIC/ENGINEERING DESCRIPTION	GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C-CORE B-BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
	0		SLOPEWASH/TOPSOIL (Qsw): Sandy silt to silty sand (SM), loose and dry @ 0-½', moist from ½' to 4½', firm below ½', red brown, roots common	SM	3	B,C		
	5		TERRACE DEPOSITS (Qt): Silty sand to sandy silt (SM), @ 4½' to 10, firm, moist, yellow orange to orange brown, massive, friable, oxidized	SM-ML				
	10		As above		1	C	97.6	9.2
	15		@ 17' Roots common, pinpoint porosity w/ occasional pores up to ⅛"					
	20		Silty sand to sandy silt (SM), moderately stiff to stiff, moist, mottled light gray, orange brown, massive, occasional carbon flecks, oxidized	SM-ML	4	B,C	105.0	15.0
	25							
	30		As above, less weathered, moist, some vuggy porosity		6	C	107.4	8.2
			Stratified below 32'					
	35		Silty sand to sandy silt (SM), porous, moist, occasional roots	SM-ML				
			@ 36' thin gravel layer 1"-3" thick					

This log is a representation of subsurface conditions at the time and place of drilling. With the passage of time or at any other location there may be consequential changes in conditions.

GeoSoil Inc. • BORING LOG B-3

CLIENT INTERAMERICAN W.O. 2108-A-OC DATE DRILLED 5-2-90 LOGGED BY ABE/KB

PROJECT PANTER RANCH SURFACE ELEV. 1424'± DRIVING WT. 3200/1680/840

DRILL RIG _____ BORING DIAMETER 24"

WATER	DEPTH (FEET)	GRAPHIC LOG	GEOLOGIC/ENGINEERING DESCRIPTION	GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C-CORE B-BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
	35		appears to be horizontal					
			No visible pores below 37'					
	40		Silty sand (SM) firm, damp to moist, mottled light gray and orange brown, oxidized	SM	7	C	110.0	11.6
			@ 42.4 Top of alluvium, wedges of alluvium variable in thickness from 1"-4", clayey silt (ML), firm, moist, underlain by sandy silt, moist, orange brown	ML				
	45		@ 44.5' Wedge of alluvium, sandy silt-clay, soft to firm, moist to very moist, carbonaceous flecks common, occasional rotted roots,	ML-CL				
	50		@ 45.8' Silty sand to sandy silt (SM)	SM	4/1680#	B, C	112.1	13.9
			@ 46.4'-47.1' Wedge of alluvium, w/roots visible, sands between sandy to clayey silt	ML				
	55		@ 47.8'-49.1' Wedge of alluvium, contact w/ sands irregular, approx. horizontal					
			@ 48.3' soft clay, moist, plastic like Playdo, interbedded w/ stringers of coarse sand,	CL	12	C		
	60	BEDROCK	@ 49.5' Sandy silt, very stiff, very moist, orange brown	ML				
			@ 51' Alluvium, 1"-2" clay bed, very soft, abundant carbonaceous material, clay seam halfway around the hole, discontin.	CL				
	65	TD 65'	@ 53.6'-54.7' Wedge of alluvium, mostly coarse sand	SP				
			@ 54.7'-55.6' silty sand and sandy silt, red to orange brown	SM-ML				

This log is a representation of subsurface conditions at the time and place of drilling. With the passage of time or at any other location there may be consequential changes in conditions.

PLATE A-6

GeoSoil Inc. • BORING LOG B-3

CLIENT INTERAMERICAN W.O. 2108-2-00 DATE DRILLED 5-2-90 LOGGED BY ABE/SR

PROJECT PANTER RANCH SURFACE ELEV. 1424'± DRIVING WT. 3700/1680/840

DRILL RIG BUCKET AUGER BORING DIAMETER 24"

WATER	DEPTH (FEET)	GRAPHIC LOG	GEOLOGIC/ENGINEERING DESCRIPTION	GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C-CORE B-BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
			CONTINUED					
			@ 57' clays (CL), firm, moist, yellow brown	CL				
			@ 59' Silty sand, firm, light yellow, coarse grained	SM				
			@ 60.5' Clay seam, extends about 1/4 around the hole, 1" thick, soft, very moist, medium brown, abundant carbonaceous flecks.	CL				
			SILVERADO FM (Tsi)					
			Below 60.5' clayey sandstone, firm, very moist, yellow brown, fine to coarse grained, occassional carbonaceous flecks					
			TD 65'					
			No Ground water					
			No Caving					
			Hole Backfilled					

This log is a representation of subsurface conditions at the time and place of drilling. With the passage of time or at any other location there may be consequential changes in conditions.

PLATE A-7

GeoSoil Inc.

BORING LOG B-4

CLIENT INTERAMERICAN W.O. 2108-A-00 DATE DRILLED 5-2-90 LOGGED BY ABE/SB

PROJECT PANTER RANCH SURFACE ELEV. 1434' ± DRIVING WT. 3200/1680/840

DRILL RIG BUCKET AUGER BORING DIAMETER 24"

WATER	DEPTH (FEET)	GRAPHIC LOG	GEOLOGIC/ENGINEERING DESCRIPTION	GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C-CORE B-BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
	0		TERRACE DEPOSITS (Qt): Sandy silt to silty sand (SM), firm to very stiff, becomes very clayey (ML), damp to moist, pinpoint porosity, brown, changes color to red brown below 4'; TOPSOIL AND COLLUVIUM		3	C		
	5							
	10		Sandy silt, firm to stiff, moist, porous.					
			~~MASSIVE~~ COLLUVIUM - Silty Sand -, stiff, moist, deeply weathered, orange brown, w/ flecks of carbonaceous material, friable, w/small concretions of hard siliceous sandstone	SM	2	C	106.7	11.0
	15							
	20		Clayey silt (ML), soft to firm, moist, slightly plastic to moderately plastic, dark brown, @ 23'-24' mottled w/ light gray, w/ thin laminations, flecks of carbonaceous material	ML	3	B,C	112.1	14.9
	25		— Silty sand to sandy silt (SM), firm, moist, mottled yellow orange and very light gray	SM-ML				
	30				7	C	112.5	10.1
			Sandy silt to silty sand (SM), soft to firm, moist, dark red brow mottled w/ light gray slightly clayey carbonaceous	ML-SM				
	35							

This log is a representation of subsurface conditions at the time and place of drilling. With the passage of time or at any other location there may be consequential changes in conditions.

GeoSoil Inc.

BORING LOG B-4

PAGE 2 OF 2

CLIENT INTERAMERICAN W.O. 2108-2-OC DATE DRILLED 5-2-90 LOGGED BY ABE/SB

PROJECT PANTER RANCH SURFACE ELEV. 1434'± DRIVING WT. 3200/1680/840

DRILL RIG BUCKET AUGER BORING DIAMETER 24"

WATER	DEPTH (FEET)	GRAPHIC LOG	GEOLOGIC/ENGINEERING DESCRIPTION	GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C-CORE B-BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
	35		Same as @ 32', w/ some rounded cobbles					
	40		Same as above, clayey, very carbonaceous		7	C	116.2	15.5
	45	BEDROCK	SILVERADO FM. (Tsi): Sandstone, silty, firm, moist, yellow brown, fine to coarse grained, massive, with nodules of hard, well cemented, siliceous sandstone, quartzose					
	50		TD 50' No Ground water No caving Hole Backfilled					

This log is a representation of subsurface conditions at the time and place of drilling. With the passage of time or at any other location there may be consequential changes in conditions.

PLATE A-9

GSI Inc. • BORING LOG B-5

CLIENT INTERAMERICAN W.O. 2108-A-0C DATE DRILLED 5-3-90 LOGGED BY LBE

PROJECT DANTER RANCH SURFACE ELEV. 1376' ± DRIVING WT. 3200/1680/240

DRILL RIG BUCKET AUGER BORING DIAMETER 24"

WATER	DEPTH (FEET)	GRAPHIC LOG (SW | NE)	GEOLOGIC/ENGINEERING DESCRIPTION	GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C-CORE B-BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
	0		ALLUVIUM (Qal): Silty sand to sandy silt (SM) firm, damp to moist, yellow brown, small roots common, pinpoint porosity		Push	C		
	5		SILVERADO FM. (Tsi): silty sandstone, firm, damp, orange yellow, very fine grained, friable, oxidized, weathered, massive					
	10		Silty sandstone, moderately hard to hard, very fine grained, well cemented, light blue gray, massive, unoxidized		7	C	113.8	14.7
	15		@ 13.5' Gradational contact between oxidized and unoxidized bedrock					
			@ 15' w/ concretions of hard sandstone					
			@ 19' Hard drilling, well cemented sandstone					
	20		@ 18.5' Bedding N70W 65SW, concretions of hard, well cemented sandstone common @ 18.5'-20'		10/8"	B, C		
			@ 20'-24' with interbeds of dark gray siltstone		10	C		
	25		TD 24'					
			No Ground Water					
			No Caving					
			Hole Backfilled					

This log is a representation of subsurface conditions at the time and place of drilling. With the passage of time or at any other location there may be consequential changes in conditions.

PLATE A-10

GeoSoil Inc. • BORING LOG B-6

CLIENT INTERAMERICAN W.O. 2108-1-0C DATE DRILLED 5-3-90 LOGGED BY ABE

PROJECT PANTER RANCH SURFACE ELEV. 1366'± DRIVING WT. 3200/1680/840

DRILL RIG BUCKET AUGER BORING DIAMETER 24"

WATER	DEPTH (FEET)	GRAPHIC LOG	GEOLOGIC/ENGINEERING DESCRIPTION	GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C-CORE B-BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
	0		ALLUVIUM (Qal): Mix of silty sand (SM), sandy silt (SM), and silty clay (ML), firm, moist, roots common to abundant		Push	B, C		
	5		SILVERADO FM. (Tsi): Sandstone, firm, dry, yellow brown, medium to coarse grained, massive, quartzose w/ abundant ferromags, oxidized		10/6"	C		
	10		@ 14' Gradational contact between oxidized and unoxidized bedrock					
	15		@ 15' Sandstone, hard to very hard, dry, light gray, well cemented, quartzose, 50-50 quartz and ferromags, massive, unoxidized		10/8"	B, C		
	20		@ 17' Siltstone, hard to very hard, dry, dark gray, abundant mica flakes, thinly laminated grading to massive, Bedding N70W 65SW					
	25		@ 20' Silty sandstone, hard, dry, light gray, very fine grained, massive, friable, downhole becomes less silty, harder, and more well cemented					
	30		Silty sandstone, hard, dry, medium gray, fine to medium grained, massive, quartzose, w/ abundant ferromags.		25	C		
			TD 30' NO Groundwater — No Caving, Hole Backfilled					

This log is a representation of subsurface conditions at the time and place of drilling. With the passage of time or at any other location there may be consequential changes in conditions.

GeoSoil Inc. • BORING LOG B-7

CLIENT INTERAMERICAN W.O. 210K-A-OC DATE DRILLED 5-3-90 LOGGED BY LBE

PROJECT PANTER RANCH SURFACE ELEV. 1325' ± DRIVING WT. 3000/1680/840

DRILL RIG BUCKET AUGER BORING DIAMETER 24"

WATER	DEPTH (FEET)	GRAPHIC LOG	GEOLOGIC/ENGINEERING DESCRIPTION	GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C-CORE B-BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
	0		ALLUVIUM (Qal): silty sand (SM), in part clayey (ML), firm, moist, yellowbrown to light brown, roots common		Push	B,C		
	5							
			SILVERAD FM. (Tsi): Sandstone, firm, damp to moist, light yellow to orange yellow, medium to coarse grained, massive, quartzose with abundant ferromags, oxidized					
	10				10	C		
	15							
	20		Sandstone, as above		10	C		
			@ 24' Gradational contact between oxidized and unoxidized bedrock					
	25		@ 25' Sandstone, firm, hard, dry, light gray, silty, very fine to medium grained, massive, fairly to well cemented					
	30		Silty sandstone, hard, dry, very light gray, massive, friable, fairly cemented		10	C		
			TD 30'					
			No Ground Water — No Caving, Hole Backfilled					

This log is a representation of subsurface conditions at the time and place of drilling. With the passage of time or at any other location there may be consequential changes in conditions.

PLATE A-12

GeoSoils Inc. • BORING LOG B-8

CLIENT Inter Am. W.O. 2108-A DATE DRILLED 5-9-90 LOGGED BY HDP/SPB

PROJECT Panter Ranch SURFACE ELEV. 1422'± DRIVING WT. 1680# @ 0-25

DRILL RIG Bucket Auger BORING DIAMETER 24" 840# @ 25-50

WATER	DEPTH (FEET)	GRAPHIC LOG (S N)	GEOLOGIC/ENGINEERING DESCRIPTION	GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C-CORE B-BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
	0		TERRACE DEPOSITS (Qt):					
			SANDY SILT, STIFF, DRY TO 1½', THEN SL. MOIST, REDDISH BROWN, VERY POROUS TO 1'.					
			@3' GRADATIONAL COLOR CHANGE TO YELLOW BROWN.					
	5		@5' GRADES TO CLAYEY SILT, STIFF TO HARD, SL. MOIST, YELLOW BROWN, SLIGHTLY POROUS.					
			@8' SANDY SILT, SOIL-LIKE					
	10		@10½' HORIZONTAL GRAVELLY-SAND-LAYER (SM-GM) FAINT STRATIFICATION - FLUVIAL FACIES					
			@11-13½' STRATIFIED SILTS AND SANDS (ML-SM)		8	C	113.3	11.6
	15		@13½' CLAY (CL); CONTACT SHARP, UNDULATING, HORIZONTAL, PARALLELS STRATIFICATION					
			@15½' GRADES TO SANDY SILT (ML) GRAY W/ORANGE OXIDES					
			@17½-22' STRATIFIED CLAYEY SILT (ML), HORIZONTAL LAMINATIONS					
	20		@20½' SAND LAYER, DISCONTINUOUS HORIZONTAL TO N60E 20SE - DIPS WHERE PINCHES OUT					
			@22' - 35' SANDY CLAY (CL) DARK GRAY STIFF, MOIST, MASSIVE, COLLUVIAL LIKE FACIES					
	25							
			@29 NOTED TRACES OF CHARCOAL					
	30		@30½' ROUGHLY HORIZONTAL GRAVELS		20	C	122.9	6.5
	35		@35' GRADES TO SANDY SILT W/ CLAY (ML)					

This log is a representation of subsurface conditions at the time and place of drilling. With the passage of time or at any other location there may be consequential changes in conditions.

PLATE A-13

GeoSoil Inc.

BORING LOG B-8 CONTINUED

CLIENT INTER AMERICAN W.O. 2108-A DATE DRILLED 5-9-90 LOGGED BY HDP / SB

PROJECT PANTER RANCH SURFACE ELEV. 1422'± DRIVING WT. _____

DRILL RIG BUCKET AUGER BORING DIAMETER 24"

WATER	DEPTH (FEET)	GRAPHIC LOG	GEOLOGIC/ENGINEERING DESCRIPTION	GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C-CORE B-BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
			SILVERADO FM. (Tsi): SANDSTONE - MODERETELY HARD, YELLOW, SLIGHTLY MOIST, MASSIVE, VERY WEATHERED @ 37' RED SOIL MOTTLING ALONG CONTACT					
	40		@ 42' HARDER, MODERATELY CEMENTED, LESS WEATHERED					
	45							
	50		T.D. = 50' NO GROUNDWATER. NO CAVING, HOLE BACKFILLED		25/6"	C		

This log is a representation of subsurface conditions at the time and place of drilling. With the passage of time or at any other location there may be consequential changes in conditions.

PLATE A-16

GeoSoils Inc. • BORING LOG B-9

CLIENT Inter American W. O. 2108-A DATE DRILLED 5-9-90 LOGGED BY HDP/SPB

PROJECT Panter Ranch SURFACE ELEV. 1423'± DRIVING WT. 0-25' 1680

DRILL RIG Bucket Auger BORING DIAMETER 24" 25-50' 840

WATER	DEPTH (FEET)	GRAPHIC LOG	GEOLOGIC/ENGINEERING DESCRIPTION	GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C-CORE B-BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
	0		TERRACE DEPOSITS (Qt):					
			SANDY SILT W/ CLAY (ML) - STIFF, RED BROWN, DRY, POROUS, MASSIVE					
			@ 2½' BECOMES VERY STIFF, MOIST					
	5				9	CB		
			CLAYEY SILT W/ SAND (ML-CL) - VERY STIFF, LIGHT GRAY AND BROWN W/ ORANGE OXIDES, ALTERNATING CLAY AND SANDS. MOIST					
	10		@ 9-10½' CRUDELY STRATIFIED SILTY SAND AND GRAVEL (SM), HORIZONTAL		9	C	115.2	10.2
			@ 13' HORIZONTAL LAMINATIONS					
			@ 13½-15½' DARK BROWN SOIL					
	15		@ 16' CRUDELY STRATIFIED SANDS HORIZONTAL, 1" THICK					
			@ 19' ROUGHLY HORIZONTAL SAND LAYERS AND LENSES					
	20		@ 19½' DARK SOIL LAYER, N35W12W		7	C	118.8	10.4
			@ 22' FAINT HORIZ. STRATIFICATION					
	25		@ 27½' CONTACT ROUGHLY HORIZONTAL					
			SILTY CLAY TO CLAYEY SILT W/ SAND (CL-ML) - VERY STIFF, GRAY AND BROWN W/ ORANGE OXIDES. ALT. CLAY AND SANDS					
	30		@ 30½' CHARCOAL FRAGMENTS, FEW		12	CB	114.4	11.2
			@ 33-34' DARKER SOIL ZONES					
	35							

This log is a representation of subsurface conditions at the time and place of drilling. With the passage of time or at any other location there may be consequential changes in conditions.

GeoSoils Inc. • BORING LOG B-9

CLIENT _____ W.O. 2108-A DATE DRILLED _____ LOGGED BY _____

PROJECT _____ SURFACE ELEV. 1423 DRIVING WT. 0-25 1680 25-50 840

DRILL RIG _____ BORING DIAMETER _____

WATER	DEPTH (FEET)	GRAPHIC LOG	GEOLOGIC/ENGINEERING DESCRIPTION	GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C-CORE B-BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
	35		SILTY CLAY TO CLAYEY SILT W/ SAND- CONTINUED @37' MINOR ROOTS AND CHARCOAL					
	40		SILVERADO Fm. (Tsi): SANDSTONE - MODERATELY HARD, YELLOW, SLIGHTLY MOIST, VERY WEATHERED @39' GRADATIONAL CONTACT		14	C		
	45		TD = 45' NO GROUNDWATER, NO CAVING, HOLE BACKFILLED		15	CB		

This log is a representation of subsurface conditions at the time and place of drilling. With the passage of time or at any other location there may be consequential changes in conditions.

PLATE A-15

GeoSoil Inc. • BORING LOG B-10

CLIENT INTERAMERICAN W. O. 2108 A DATE DRILLED 5-9-90 LOGGED BY HDP/SPG

PROJECT PANTER RANCH SURFACE ELEV. 1432' DRIVING WT. 1680 # @ 0-2

DRILL RIG BUCKET AUGER BORING DIAMETER 24" 840 # @ 25-5

WATER	DEPTH (FEET)	GRAPHIC LOG (S / N)	GEOLOGIC/ENGINEERING DESCRIPTION	GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C-CORE B-BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
			TERRACE DEPOSITS (Qt):					
			SANDY SILT W/ CLAY (ML) - RED BROWN, STIFF, DRY, POROUS					
			@ 1½' BECOMES VERY STIFF, MOIST					
			@ 0-6' SCATTERED PEBBLES					
	5		@ 5' SCATTERED CHARCOAL		6	C		
			@ 0-10' COLLUVIAL LIKE					
			SANDY SILT (ML) - VERY STIFF, YELLOW BROWN, SLIGHTLY MOIST, SLIGHTLY POROUS, SANDY AND CLAYEY INTERBEDS (SM AND CL)					
	10		@ 10' BECOMES SANDIER, FLUVIAL					
			@ 11½' HORIZONTAL SANDY LAMINATIONS					
			@ 12½-14' SAND FILLED CHANNEL HORIZONTAL STRATIFICATION					
	15		@ 14'-17½' RED BROWN CLAY (CL) LAYERS HORIZ TO N 80 E 5 S		10	C	101.6	9.2
			@ 17½' BASE RED BRN CLAY (CL) LAYERS HORIZ TO 5° DIP SOUTH					
	20		@ 21½' HORIZ STRATIFIED SANDS					
			@ 22-25' CHANNEL FILLED W/ HORIZONTALLY STRATIFIED SANDS, N 25 W 65 W TAKEN ON CUT-FILL, EROSIONAL-DEPOSITIONAL CONTACT					
	25				5	C		
			@ 26-27½' CHANNEL FILLED W/ HORIZONTALLY STRATIFIED SANDS ON WEST SIDE OF HOLE					
			CLAYEY SILT (ML-CL) - VERY STIFF, BROWN, MOIST					
	30		@ 30' RED CLAY: 4" THICK N 75 W 5 S					
			@ 31' RED CLAY, 1" THICK N 75 W 5 S					
	35				14	C,B		
			SILVERADO FM (Tsl):					

This log is a representation of subsurface conditions at the time and place of drilling. With the passage of time or at any other location there may be consequential changes in conditions.

GeoSoil Inc.

BORING LOG B-10 CONTINUED

CLIENT INTERAMERICAN W.O. 2108 A DATE DRILLED 5-9-90 LOGGED BY HDP/SP

PROJECT PANTER RANCH SURFACE ELEV. 1432'± DRIVING WT. 840# @ 25-

DRILL RIG BUCKET AUGER BORING DIAMETER 24"

WATER	DEPTH (FEET)	GRAPHIC LOG S	GRAPHIC LOG N	GEOLOGIC/ENGINEERING DESCRIPTION	GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C-CORE B-BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
				SILVERADO Fm. (TSI):					
				SANDSTONE - MODERATELY HARD, LIGHT GRAY W/ ORANGE OXIDES, MOIST, MASSIVE, VERY WEATHERED - SOIL LIKE					
	40			@35-35½' CONTACT - DARK BROWN SOIL ZONE, ROUGHLY HORIZONTAL					
				@39' FAINT BEDDING LAMINATIONS N 80 W 65 S, BECOMES HARDER, LESS WEATHERED					
	45			@43' BEDDING LAMINATIONS N 70 W 40-55 S		25	C		
				@46' BEDDING LAMINATIONS N 72 W 55 S					
	50								
				TOTAL DEPTH = 52'					
				NO GROUNDWATER					
				NO CAVING					
				HOLE BACKFILLED					

This log is a representation of subsurface conditions at the time and place of drilling. With the passage of time or at any other location there may be consequential changes in conditions.

GeoSoils Inc. • BORING LOG B-11

CLIENT INTERAMERICAN J.O. 2108A DATE DRILLED 5-10-90 LOGGED BY HDP

PROJECT PANTER RANCH SURFACE ELEV. 1418'± DRIVING WT. 1680# @0-25'

DRILL RIG BUCKET AUGER BORING DIAMETER 24" 840# @25-40'

WATER	DEPTH (FEET)	GRAPHIC LOG (S / N)	GEOLOGIC/ENGINEERING DESCRIPTION	GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C-CORE B-BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
			TERRACE DEPOSITS (Qt): SANDY SILT W/ CLAY (ML-CL) - STIFF, RED BROWN, DRY POROUS					
	5		SANDY SILT (ML) - VERY STIFF, YELLOW BROWN, SLIGHTLY MOIST		5	C	103.2	10.1
	10		SANDY SILTS & SAND (ML & SM) - DENSE, YELLOW, SLIGHTLY MOIST @ 9½-10' SAND BED N5W/5W HORIZONTAL LAMINATIONS @ 12½-13½' STRATIFIED SANDS-SILTS HORIZ. TO CROSS BEDDED; DIPPING N5 5-10 W; CHANNEL TRENDS N56SE @15' SAND LAMINATIONS N5 5W		7	C	100.6	4.7
	15		CLAYEY SILTS (ML-CL) AND SANDY SILTS (ML-SM) - VERY STIFF, GRAY AND YELLOW, SLIGHTLY MOIST					
	20		SAND-SILTS (ML-SM) W/ FEWER CLAYEY SILTS (ML-CL) - VERY STIFF/DENSE, YELLOW AND GRAY, SLIGHTLY MOIST @ 21-21½' STRATIFIED SANDS, ROUGHLY HORIZONTAL @ 21½' RED CLAY ¼-1" THICK N45E 0-5NW @ 28-29 HORIZONTAL STRATIFIED SANDS		12	C	110.1	5.4
	25							
	30		@ 30-31 GRAY SILTS		18	C	108.8	13.5
	35		SILTY SANDS AND CLAYEY SANDS					

This log is a representation of subsurface conditions at the time and place of drilling. With the passage of time or at any other location there may be consequential changes in conditions.

GeoSoil Inc.

BORING LOG B-11 CONTINUED

CLIENT INTERAMERICAN W.O. 2108 A DATE DRILLED 5-10-90 LOGGED BY HDP

PROJECT PANTER RANCH SURFACE ELEV. 1418'± DRIVING WT. 840# @ 25-5

DRILL RIG BUCKET AUGER BORING DIAMETER 24" ±1440 @ 50'-

WATER	DEPTH (FEET)	GRAPHIC LOG	GEOLOGIC/ENGINEERING DESCRIPTION	GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C-CORE B-BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
	35		SILTY SANDS AND CLAYEY SANDS (SM-SC) - DENSE, YELLOW, MOIST, W/ GRAY SILT (ML) INTERBEDS					
			@ 35-36½' HORIZONTAL STRATIFIED SANDS					
	40		@ 36½-37' LAMINATED SILTS		20	C	115.2	6.2
			@ 39½-40½' HORIZ. STRAT. SANDS					
			@ 42-43' GRAY SILTS W/ SCAT. CHARCOAL					
	45		@ 45½' HORIZONTAL SILTS N55W 0-5SW, 1-2" THICK					
	50		@ 50-51' GRAY SILTS W/ SCAT. CHARCOAL		25	C		
			@ 51 & 53 HORIZONTAL ±PEBBLE LAYERS					
			@ 58' HORIZ. PEBBLE LAYERS					
			@ 59' ~~SHARP UNDULATING~~ DEPOSITIONAL CONTACT					
	60		SILVERADO Fm (Tsi):		15	C		
			SANDSTONE - MODERATELY HARD, BUFF, SLIGHTLY MOIST, MASSIVE, VERY WEATHERED					
			@ 59½'-63½' GRAY SILTSTONE BED N68W 65S					
	65		TOTAL DEPTH = 70' NO GROUNDWATER NO CAVING HOLE BACKFILLED					
	70							

This log is a representation of subsurface conditions at the time and place of drilling. With the passage of time or at any other location there may be consequential changes in conditions.

GeoSoil Inc. • BORING LOG B-12

CLIENT _____ W.O. 2108 DATE DRILLED _____ LOGGED BY HDP

PROJECT _____ SURFACE ELEV. 1449' DRIVING WT. 1680* @ 0-25

DRILL RIG _____ BORING DIAMETER _____

WATER	DEPTH (FEET)	GRAPHIC LOG (S / N)	GEOLOGIC/ENGINEERING DESCRIPTION	GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C-CORE B-BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
			CLAYEY SILT W/ SAND (ML-CL) - STIFF, RED BROWN, SLIGHTLY MOIST					
			@ 1' BECOMES VERY STIFF, MOIST					
	5		YELLOW BROWN, MASS., @ 6' COLOR GRADES TO GRAY AND YELLOW BROWN		8	C		
			@ 6' SOME CHARCOAL FRAGMENTS,					
			@ 13' SCATTERED CHARCOAL FRAGMENTS, ROUGHLY HORIZONTAL					
	10		@ 13½' - 14½' SAND LAMIN., ROUGHLY HORIZONTAL		7	C		
			@ 17½' VERY MOIST					
			@ 18½' STRATIF. SAND 2"-6" THK, CONTACT OVER SILT N40W 15SW					
	15		@ 21'-22 COLLUVIAL-LIKE, SOME ANG. FRAGS					
			@ 20-22' CONTACT E-W 50S, SHARP, UNDULATING, EROSIONAL DEPOSITIONAL, MAINLY SILTS					
	20		SILVERADO Fm (Tsi):		10	C		
			SANDSTONE - MODERATELY HARD, YELLOW TO BUFF, SLIGHTLY MOIST, MASSIVE, VERY WEATHERED,					
	25							
	30		TD = 30' NO GROUNDWATER NO CAVING HOLE BACKFILLED					

This log is a representation of subsurface conditions at the time and place of drilling. With the passage of time or at any other location there may be consequential changes in conditions.

PLATE A-21

GSI Inc. • BORING LOG B-13

CLIENT INTERAMERICAN W. O. 2108-OC DATE DRILLED 5-10-90 LOGGED BY ABE

PROJECT PANTER RANCH SURFACE ELEV. 1383' ± DRIVING WT. _____

DRILL RIG BUCKET AUGER BORING DIAMETER 24"

WATER	DEPTH (FEET)	GRAPHIC LOG	GEOLOGIC/ENGINEERING DESCRIPTION	GROUP SYMB. USCS	PENE. RESIST. BLOWS/FOOT	C-CORE B-BAG	DRY DENSITY pcf	MOISTURE CONTENT (%)
	0		SLOPE WASH (Qaw)					
			Sandy silt to silty sand (SM), in part clayey, stiff, damp to moist, brown, becomes yellow brown with depth					
	5							
			SILVERADO FM (Tsi)					
	10		Sandstone stiff, massive, damp to dry, light gray weathered to yellow brown, very fine to medium grained					
	15		@ 8½' gray silty sand, soft, 4"-6" thk					
			@ 9' Sandstone, light yellow, mass.					
	20		@ 10' Contact between orange silty fine sandstone and coarse grained light yellow sandstone N50E 35SE					
			Below 11' mostly massive, medium to coarse sandstone, hard					
			TD 20'					
			NO GROUND WATER					
			NO CAVING					
			HOLE BACKFILLED					

This log is a representation of subsurface conditions at the time and place of drilling. With the passage of time or at any other location there may be consequential changes in conditions.

TABLE I

GeoSoils, Inc.

TEST PIT LOGS

W.O. 2108-A-OC
Client INTERAMERICAN
Project PINTER RANCH
Date 5-14-90
Logged By SB

Test Pit No.	Depth (Ft.)	Attitudes	Description
T-1	0-2		TOPSOIL: CLAYEY SILT (ML), FIRM-STIFF, DRY-SL. MOIST, ABUNDANT PORES AND ROOTLETS.
	2-7½	BEDDING @ 5' (APPROX.) N75W, 16NE	BEDROCK (Tsa): CLAYEY SILTSTONE, HIGHLY WEATHERED AND SOIL-LIKE TO 4½', MOD. HARD, SL. MOIST, MED. TO DARK GRAY MOTTLED W/ WHITE, COMMON CALICHE. @ 4½' MOD. HARD-HARD, MOIST, DARK GRAY, HIGHLY FRACTURED, OCC. DISCONTINUOUS SAND LENSES.
T-2	0-2½		TOPSOIL: CLAYEY SILT W/ SAND (ML-SM), FIRM-STIFF, DRY-SL MOIST, ABUNDANT PORES AND ROOTLETS.
	2½-7½	BEDDING @ 6½ N80W, 20NE	BEDROCK (Tsa): CLAYEY SILT W/ SILTY SAND INTERBEDS, MOD. HARD, SL. MOIST-MOIST, DK GRAY W/ LT. GRAY SAND LENSES, COMMON ORANGE OXIDES.
T-3	0-7½		BEDROCK (Tsi): FINE SANDY SILT, LOOSE, DRY, RED BROWN, OCC. ROUNDED COBBLES, HIGHLY WEATHERED. @ 2' SANDSTONE, MOD. DENSE, DRY-SL. MOIST, ORANGE BROWN, MASSIVE, FRIABLE, ABUNDANT OXIDES. @ 4' CLAYSTONE CLAST/CONCRETION, ON NW WALL ONLY @ 7' CONT. MASSIVE SANDSTONE, BECOMES V. HARD.
T-4	0-½		TOPSOIL: SANDY SILT (SM), LOOSE-MOD. DENSE, DRY, RED BROWN, POROUS, ROOTLETS.
	½-5	JOINT @ 3' N65E, 65NW JOINT @ 5' N45E, 73NW	BEDROCK (Tsi): SANDSTONE, MOD. DENSE, SL. MOIST, ORANGE BROWN, V. SCATTERED PORES, MASSIVE @ 4' BECOMES HARD, YELLOW BROWN @ 5' V. HARD.
T-5	0-1½		TOPSOIL: SANDY SILT (SM), LOOSE-MOD. DENSE, DRY, RED BROWN, SCATTERED PEBBLES & COBBLES.
	1½-6		BEDROCK (Tsi): SANDSTONE, MOD. HARD, DRY-SL. MOIST, YELLOW BROWN, FRIABLE, MICACEOUS, MASSIVE, OCC. ORANGE OXIDATION ZONES. @ 4' BECOMES HARD, RARE COBBLES. @ 6' BECOMES V. HARD.
T-6	0-7½	JOINTS @ 4' N65W, 42S @ 5' N26E, 77NW @ 6' N80W, 85SW @ 6' N75E, 18SE	BEDROCK (Tsi): SANDSTONE, MOD. HARD, DRY, YELLOW BROWN, HIGHLY WEATHERED, ROOTS TO 1½'. @ 2' BECOMES HARD, LT. GRAY @ 6' HARD-V. HARD, SL. MOIST, YELLOW BROWN, MICACEOUS JOINT SURFACES COATED W/ CALICHE.

TABLE I

GeoSoils, Inc.

TEST PIT LOGS

W.O. 2108-A-OC
Client INTERAMERICAN
Project PANTER RANCH
Date 5-14-90
Logged By SB

Test Pit No.	Depth (Ft.)	Attitudes	Description
T-7	0-2'		ALLUVIUM (Qal): CLAYEY SILT (ML), SOFT-FIRM, MOIST, RED BROWN.
	2-5½'	BEDDING @ 3'N85E, 14SE 4'N60W, 24SW	BEDROCK (Tsi-cg): SHALE, HARD, SL. MOIST-MOIST, DARK RUSTY BROWN, FRACTURED, CLAY FILMS ON FRACTURE SURFACES.
T-8	0-1'		TOPSOIL: SANDY SILT (SM), DRY, SOFT-FIRM, GRAY BROWN, POROUS.
	1'-7'(?)		SLOPEWASH: SILTY SAND TO SANDY SILT (SM), MED. DENSE, SL. MOIST, RED BROWN, SCATTERED COBBLES, PINPOINT PORES, HAIRLINE ROOTS, CONTACT W/ BEDROCK IS POORLY DEFINED.
	7(?)-10'		BEDROCK (Tsi-cg): CONGLOMERATE, HARD, SL. MOIST-MOIST, YELLOW BROWN, SILTY SAND MATRIX, COMMON 4"-5" COBBLES. @9' DIFFICULT EXCAVATING.
T-9	0-6'		BEDROCK (Tsi-cg): CONGLOMERATE, LOOSE, DRY, RED BROWN, COMMON ROOTS TO 2'. @ 2' BECOMES MOD. HARD, DAMP. @ 6' BECOMES V. HARD, DIFFICULT EXCAVATING. SUB-ROUNDED PEBBLES AND COBBLES W/CLAYEY TO SILTY SAND MATRIX, MOIST, RED BROWN. NO DISTINCT BEDDING HOWEVER, FABRIC APPEARS TO DIP DOWNSLOPE (≈ S25W @ 20-30°).
T-10	0-6'		ALLUVIUM (Qal): CLAYEY TO SANDY SILT (SM-ML), LOOSE TO FIRM, DRY TO SL. MOIST, GRAY BROWN, POROUS, ROOTY. @ 2' BECOMES MOIST, REDDISH BROWN. @ 5' BECOMES COBBLELY, OCC. SMALL BOULDERS, ROOTS END.
	6'-8'		BEDROCK (Tsi-cg): CONGLOMERATE W/ SILTY SAND MATRIX, MOD. HARD, MOIST, YELLOW BROWN TO ORANGE BROWN, MASSIVE, WEATHERED. @ 6-7' BECOMES V. MOIST @ 7' BECOMES REDDISH BROWN. @ 8' BECOMES V. HARD DIFFICULT EXCAVATING.
T-11	0-2'		ALLUVIUM (Qal): SANDY SILT (SM), SOFT TO FIRM, DRY TO DAMP, RED BROWN, POROUS.
	2'-6'	BEDDING @ 5 N75W, 25SW	BEDROCK (Tsi-cg): CONGLOMERATE, MOD. HARD TO HARD, MOIST, RED BROWN, MOSTLY MASSIVE, HIGHLY WEATHERED TO 3'. MATRIX IS SANDY SILT TO SILTY SAND TO CLAYEY SILT, PREDOMINATELY RED BROWN W/ OCC. YELLOW BROWN.

TABLE I

GeoSoils, Inc.

TEST PIT LOGS

W.O. 210E-H-OC
Client INTERAMERICAN
Project PANTER RANCH
Date 5-14-90
Logged By SB

Test Pit No.	Depth (Ft.)	Attitudes	Description
T-12	0-1'		TOPSOIL: SANDY SILT (SM), LOOSE - MOD. DENSE, DRY, GRAY BROWN, POROUS, ROOTY.
	1'-8'	BEDDING(?) @ 6' N60W, 37SW JOINT @ 6' N15E, 85SE	BEDROCK (Tsi): SANDSTONE, MOD HARD, DAMP, YELLOW BROWN, FRIABLE, PREDOMINATELY MASSIVE, BECOMES COARSER GRAINED W/ DEPTH. @ 6' BECOMES HARD, ORANGE BROWN, FRACTURED. @ 6-7' CONCENTRATION OF ROOTS TO ½" DIAMETER @ 8' CLAYSTONE CONCRETION.
T-13	0-1'		TOPSOIL: SANDY SILT (SM) W/ GRAVEL, STIFF, DAMP, SL POROUS.
	1'-3'		TERRACE DEPOSITS (Qt)?: SILTY SAND (SM), MOD. HARD, SL. MOIST, YELLOW BROWN
	3'-8'	BEDDING @ 7': N25W, 17SW	BEDROCK (Tsi): SANDY SILT TO SILTY SAND (SM), OCC. THIN CLAYSTONE LENSES, MOD. HARD, MOIST, YELLOW BROWN TO ORANGE BROWN. @ 5½' CLAYSTONE, MOD. HARD, MOIST, DARK GRAY, SHEARED, SLICKENSIDES IN RANDOM ORIENTATIONS. @ 7' SANDSTONE, HARD, MOTTLED ORANGE BROWN & WHITE
T-14	0'-3'	JOINT @ 7' N55W, 80SW	BEDROCK (Tsi): SANDSTONE, MOD. HARD, DRY, YELLOW BROWN, COARSE GRAINED, MASSIVE, SL. OXIDIZED. @ 1' SCATTERED COBBLES. @ 5' BECOMES HARD, LT. GRAY BROWN, DK BROWN COATING ON FRACTURE SURFACES, OCC. CONCRETIONS
T-15	0-8'	BEDDING @ 2' N10E, 45SW	BEDROCK (Tsi): SANDSTONE, MOD. HARD, DRY TO DAMP, LT. GRAY BROWN, MASSIVE, COMMON ORANGE OXIDE MOTTLING. @ 3' CLAYSTONE CONCRETION, APPROXIMATELY 5' THICK, EXPOSED ON NW WALL ON BACK OF TRENCH WALL, CONTACT W/ SANDSTONE IS VERY IRREGULAR.
T-16	0-4'		ALLUVIUM (Qal): SILTY SAND (SM), LOOSE - MOD. DENSE, SL. MOIST - MOIST, ORANGE BROWN TO LT GRAY, OCC. SILTY LENSES, OCC. ROUNDED COBBLES, ABUNDANT ROOTS TO 3/4" DIAMETER.
	4'-6½'	JOINT @ 5' N50W, VERT.	BEDROCK (Tsi): SANDSTONE, HARD, SL. MOIST, LT. ORANGE BROWN, FRIABLE, MASSIVE, OCC. ROOTS.

PLATE

TABLE I

GeoSoils, Inc.

TEST PIT LOGS

W.O. 2108-A-OC
Client INTERAMERICAN
Project PANTER RANCH
Date 5-15-90
Logged By SB

Test Pit No.	Depth (Ft.)	Attitudes	Description
T-17	0-1		SLOPEWASH (Qsw): SANDY SILT (SM), STIFF, DAMP - SL. MOIST, YELLOW BROWN, POROUS, ROOTY.
	1-6		BEDROCK (Tsi): SANDSTONE, MOD. HARD - HARD, DAMP, LT. GRAY WHITE, COMMON MICA, FRIABLE, MASSIVE, OCC. PEBBLES. BECOMES HARDER W/ DEPTH.
T-18	0-4		SLOPEWASH (Qsw): SANDY SILT W/ CLAY (SM-ML), SOFT-FIRM, MOIST, GRAY BROWN - YELLOW BROWN, ROOTS TO 1" IN DIAMETER.
	4-8		BEDROCK (Tsi): SANDSTONE, MOD. HARD, SL. MOIST, YELLOW BROWN, UPPER 2' IS HIGHLY WEATHERED, COMMON MICA, MASSIVE - NO APPARENT STRUCTURE, BECOMES HARDER W/ DEPTH.
T-19	0-4½		ALLUVIUM (Qal): SANDY SILT (SM), SOFT - FIRM, MOIST, GRAY BROWN, POROUS, ROOTS TO 1" IN DIAMETER. @1½' CLAYEY SAND (SC), FIRM - MOD. DENSE, MOIST, ORANGE BROWN. @3½' SILTY SAND (SM) W/ COBBLES, MOD. DENSE, MOIST, YELLOW BROWN, COMMON BEDROCK-TYPE CLASTS.
	4½-7½	BEDDING @5' N60W, 50-65SW	BEDROCK (Tsi): SILTY CLAYSTONE, MOD. HARD, MOIST, DARK GRAY W/ RUST COLORED OXIDATION, UPPER FOOT IS THINLY BEDDED. @6½' GRADES TO SANDY SILTSTONE, HARD, MOIST, OLIVE GRAY, MASSIVE.
T-20	0-3½		ALLUVIUM (Qal): SILTY SAND (SM), UPPER ½' CLAYEY, MOIST, COMMON ROOTS.
	3½-5		BEDROCK (Tsi): SANDSTONE, MOD. HARD, FRIABLE, MASSIVE, MED - COARSE GRAINED, LT YELLOW.
T-21	0-1½		TOPSOIL: SANDY SILT (SM), STIFF, DRY TO SL. MOIST, GRAY BROWN, POROUS, ROOTLETS.
	1½-6	BEDDING CONTACT @ N64W, 66SW	BEDROCK (Tsa): SANDSTONE, HARD, DAMP, LT. GRAY W/ COMMON ORANGE OXIDE STAINS. INTERBEDDED W/ VARICOLORED CLAYSTONES. DIPS FLATTEN TOWARDS THE NORTH TO APPROXIMATELY 33° SW.
T-22	0-2		TOPSOIL: CLAYEY SILT (ML) W/ SAND, STIFF, DAMP - SL. MOIST, DARK GRAY BROWN, POROUS, ROOTLETS.
	2-6	BEDDING CONTACT @ N70W, 48SW.	BEDROCK (Tsa): PREDOMINATELY SANDSTONE, MOD HARD - HARD, DAMP - SL. MOIST, LT. GRAY W/ OCC. ORANGE BANDING. INTERBEDS OF CLAYSTONE & SHALE, MOD. HARD - HARD, MOIST, DARK GRAY - GRAY GREEN.
	—		

APPENDIX C

Laboratory Test Results

APPENDIX E

Laboratory Test Results

Laboratory tests were conducted in our geotechnical laboratory on representative soil and bedrock samples for the purpose of evaluating the physical properties and engineering characteristics of the sampled materials. A summary of the various laboratory tests conducted is presented below.

In-Situ Moisture Content and Dry Density

Data obtained from these tests performed on relatively undisturbed ring samples obtained from the field, were used to aid in the classification and correlation of the earth materials and to provide qualitative information regarding strength and compressibility. The percent of moisture as a function of dry weight, and the measured dry density in units of pounds-per-cubic-foot (pcf) are presented on the exploration logs.

Atterberg Limits

An Atterberg Limits test was performed on one soil sample to verify the soil classification. The liquid limit (LL), plastic limit (PL), and plasticity index (PI) of the samples were determined in accordance with ASTM D 4318-84 test method. Test results are presented in the following Table.

BORING NUMBER	DEPTH (feet)	SOIL DESCRIPTION	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
B-1	71	SILTY CLAY	55	24	31

Expansion Index Test

Expansion Index tests were performed on two bulk samples obtained from the site. The test was performed in accordance with the 1994 Uniform Building Code Standards 18-2 (ASTM D4829-88). The test consisted of remolding a four-inch-diameter, one-inch-high sample at nearly 50% saturation. The specimen was placed in a consolidometer and subjected to a one-pound-per-square-inch (psi) vertical stress and submerged. Total swell of the specimen is recorded, from which the Expansion Index (EI) of the soil is calculated. Test results are presented as follows:

BORING NUMBER	DEPTH (feet)	SOIL DESCRIPTION	EXPANSION INDEX
B-1	5 – 10	SILTY CLAY	121
B-7	5 – 10	SANDY SILT	30

APPENDIX E (Cont'd)

Laboratory Test Results

Laboratory Maximum Density and Optimum Moisture Test

Two bulk samples were tested in the laboratory to determine the laboratory maximum density and optimum moisture relationships. Testing was performed in general accordance with the ASTM D1557-91 Standard Test Method. The laboratory maximum density and optimum moisture curve is plotted on Figure E-1, Maximum Density Test.

Direct Shear Test

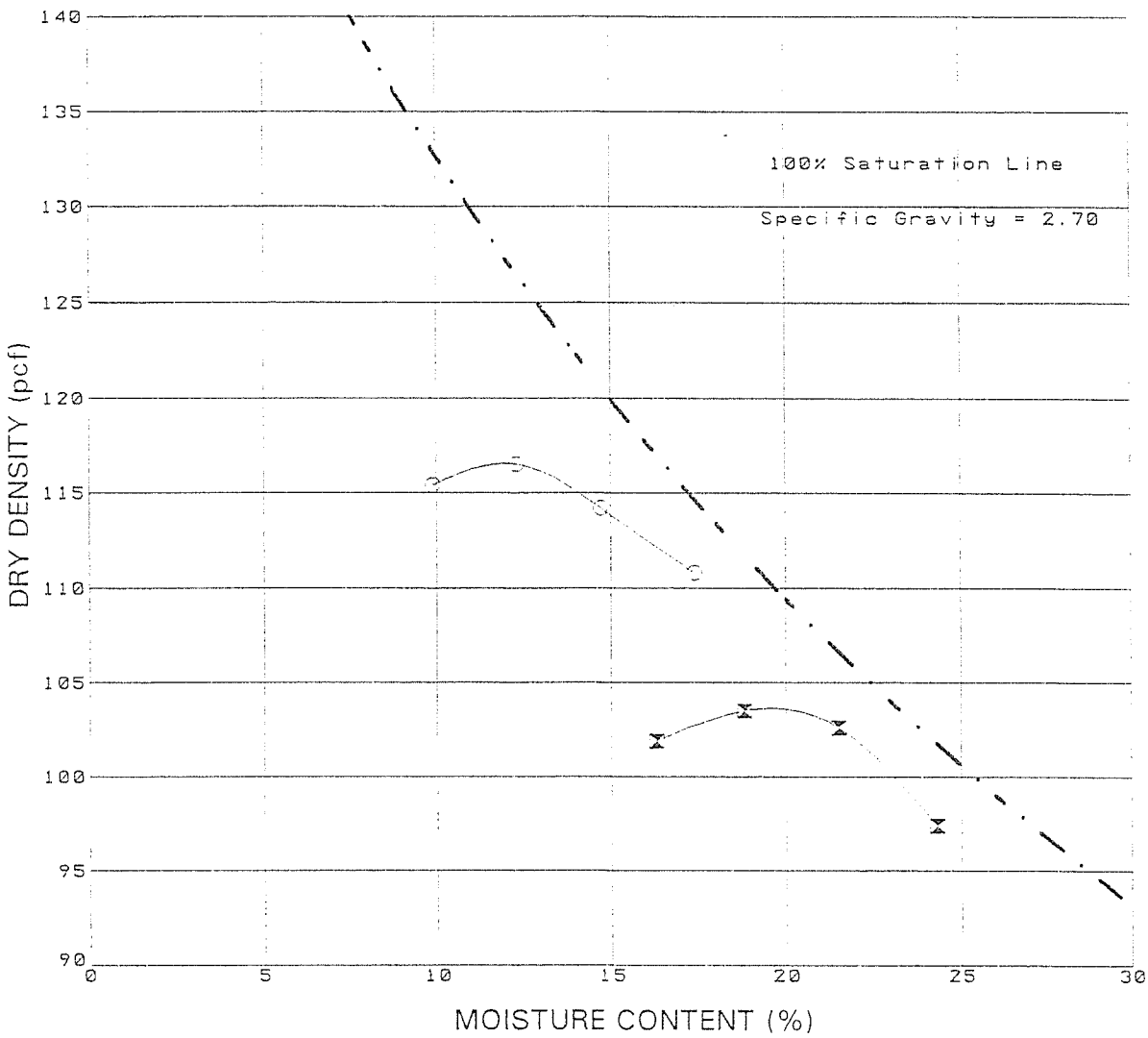
Direct shear tests were performed on seven relatively undisturbed ring samples, two samples remolded to approximately 90 percent of the ASTM D1557 laboratory density near optimum moisture content, and one sample to a density and moisture content similar to in-situ conditions. Specimens were soaked prior to shearing. Individual specimens were prepared and different vertical normal stresses were applied. Samples were sheared at a constant rate of strain. Based upon the range of normal loads applied, peak, ultimate and/or residual shear strength envelopes were determined. Results of the test are presented on Figures E-2 through E-20, Direct Shear Test Results.

Consolidation Tests

Consolidation tests were performed on one relatively undisturbed ring sample and one bulk sample. For the bulk sample, the specimen was remolded to approximately 90 percent of the ASTM D1557 maximum density at near optimum moisture content. These tests were performed to evaluate the compressibility and moisture sensitivity of site soils under load. This test involved loading specimens into a consolidometer which contained porous stones top and bottom to accommodate vertical drainage during testing. Normal vertical axial loads were applied through the porous stones, and the resulting deflections were recorded at various time periods. Normal loads were applied at a constant load-increment ratio, successive loads being generally twice the preceding load. Samples were tested at field and submerged moisture contents. Test results are shown on Figures E-21 and E-22, *Consolidation Curve*.

Soil Corrosivity

Resistivity, pH, soluble sulfate and chloride concentrations were determined for two samples to evaluate the corrosion potential of common construction materials in contact with the site earth materials. Test results are enclosed at the end of this appendix.



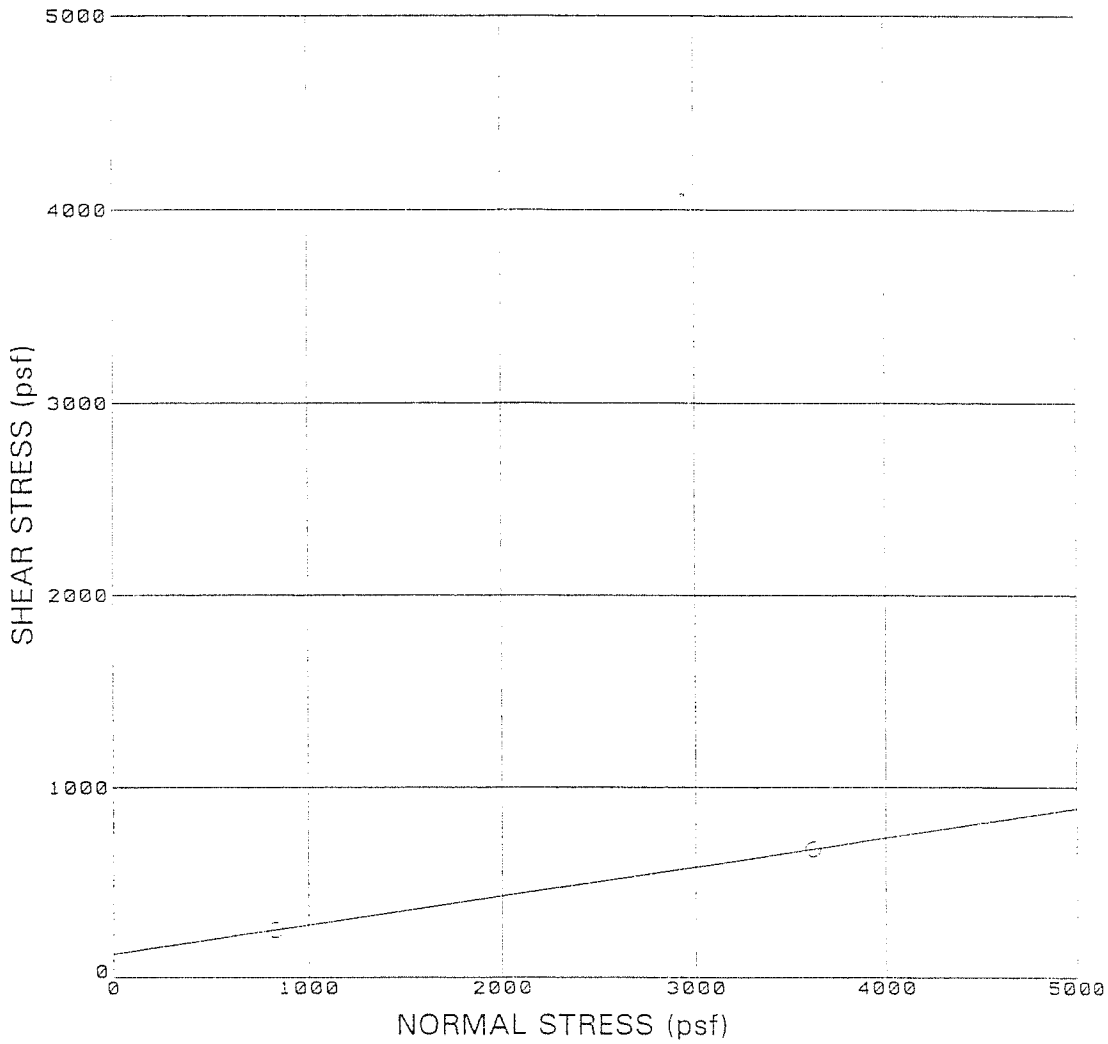
Symbol	Boring Number	Depth (feet)	Soil Description	Optimum Moisture (%)	Maximum Dry Density (pcf)
○	B-10	5.0	Grayish Brown Sand w/trace of Clay	11.5	116.5
⧗	B-7	5.0	Gray Sandy Silt w/Siltstone	19.5	103.5

MAXIMUM DENSITY TEST
ASTM D1557

Project No. 990077-002

Project Name 4S RANCH

Date 10/99 Figure No. _____



Test Method : ASTM D3080-90	Type of Specimen :
Rate of Shear (in/min): 0.05	Remolded

Boring No.	B-1	Dry Density (pcf)	111
Sample No.	SB-1	Moisture Content (%)	
Depth (ft)	71.0	Before Test :	16.0
Des.	Brown Clayey Siltstone	After Test :	20.1

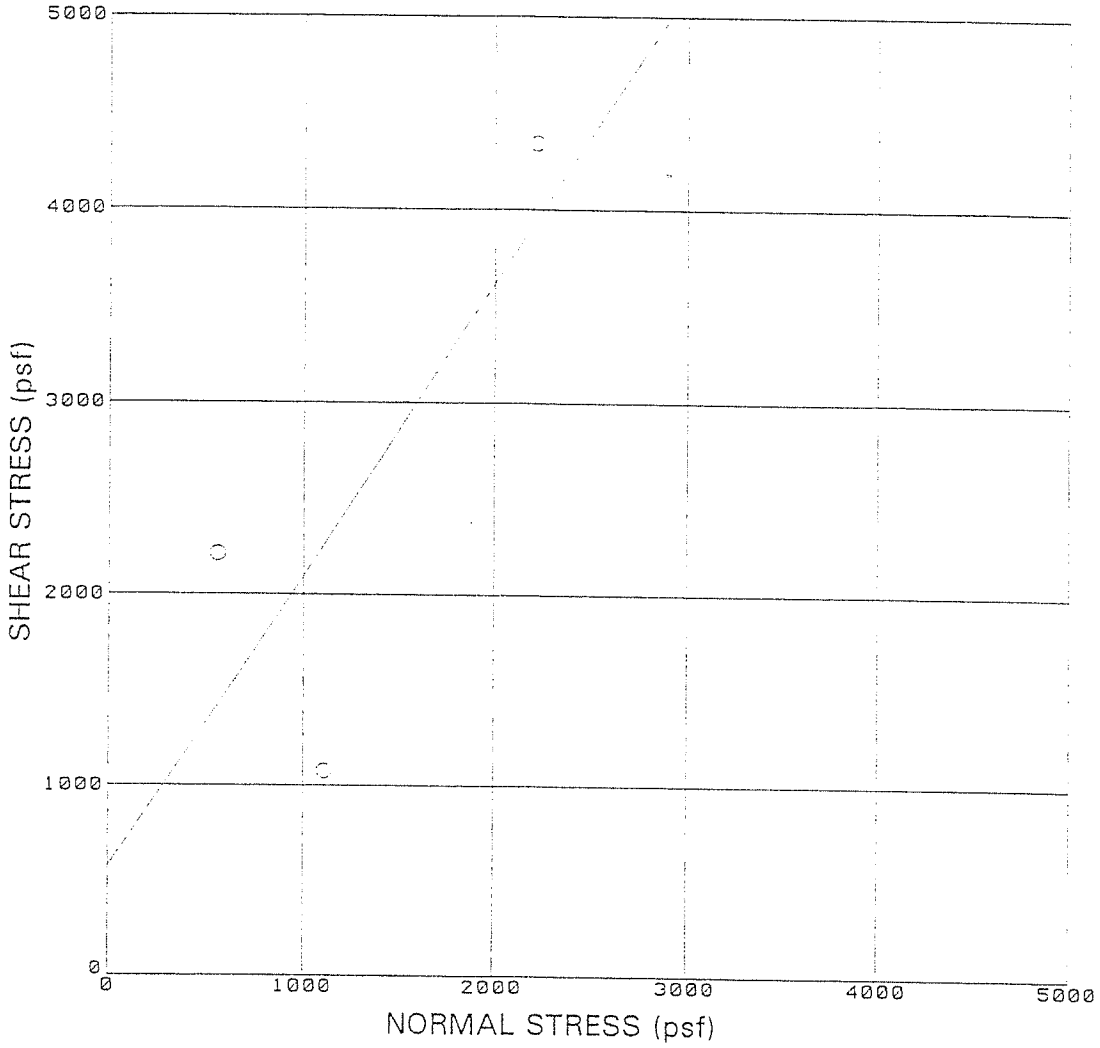
Friction Angle (deg.) 10.0	Remarks :
Cohesion (psf) 70	Residual Strength

DIRECT SHEAR TEST RESULTS

Project No. 990077-002

Project Name 4S RANCH

Date 10/99 Figure No.



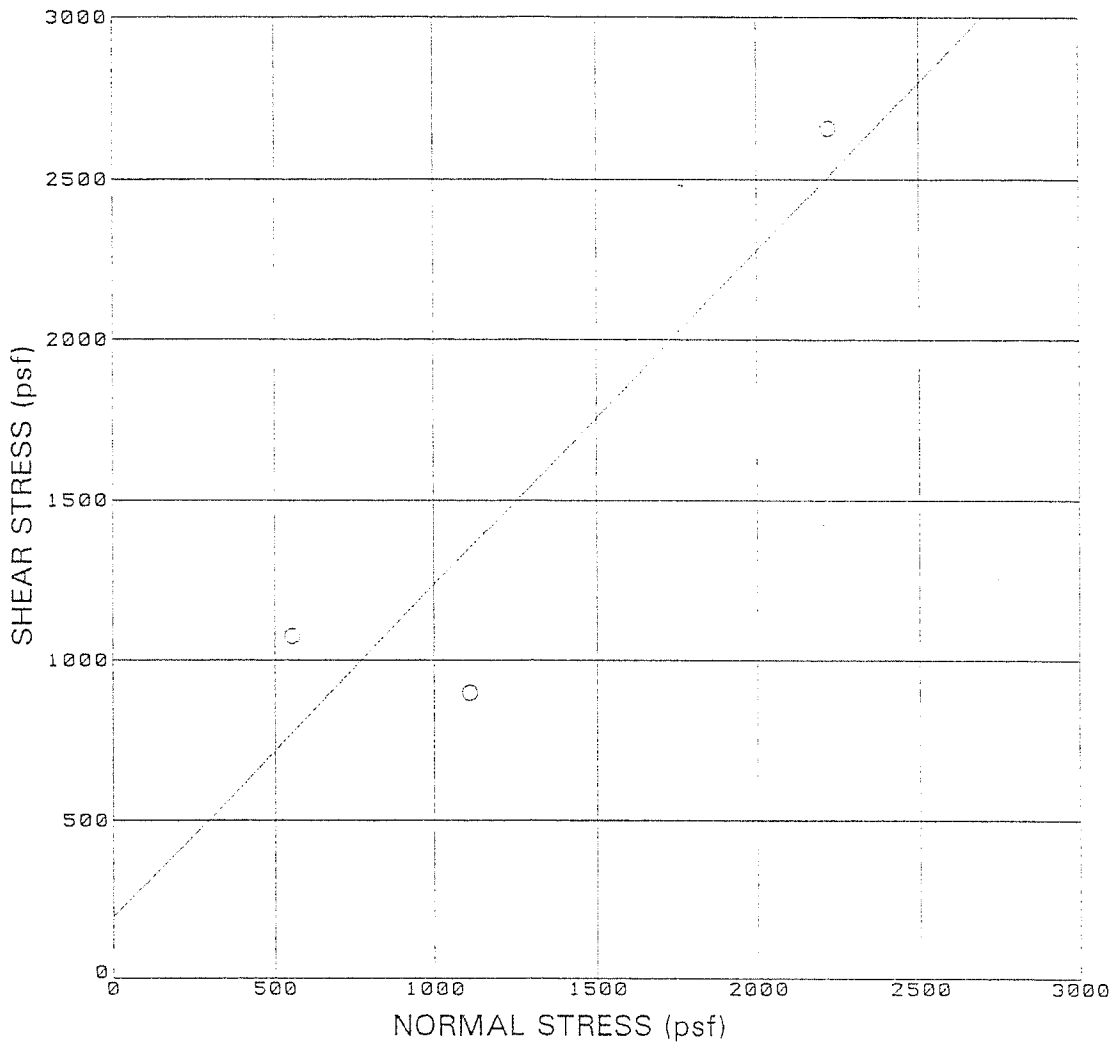
Test Method : ASTM D3080-90	Type of Specimen :
Rate of Shear (in/min): 0.05	Undisturbed

Boring No.	B-6	Dry Density (pcf)	117
Sample No.	R-2	Moisture Content (%)	
Depth (ft)	20.0	Before Test :	15.6
Description	Olive Brown Clayey Siltstone	After Test :	18.0

Friction Angle (deg.)	57.0	Remarks :
Cohesion (psf)	575	Peak Strength

DIRECT SHEAR TEST RESULTS

Project No.	990077-002
Project Name	4S RANCH
Date	9/99
Figure No.	



Test Method : ASTM D3080-90	Type of Specimen :
Rate of Shear (in/min): 0.05	Undisturbed

Boring No.	B-6	Dry Density (pcf)	117
Sample No.	R-2	Moisture Content (%)	
Depth (ft)	20.1	Before Test :	15.6
Description	Olive Brown Clayey Siltstone	After Test :	18.0

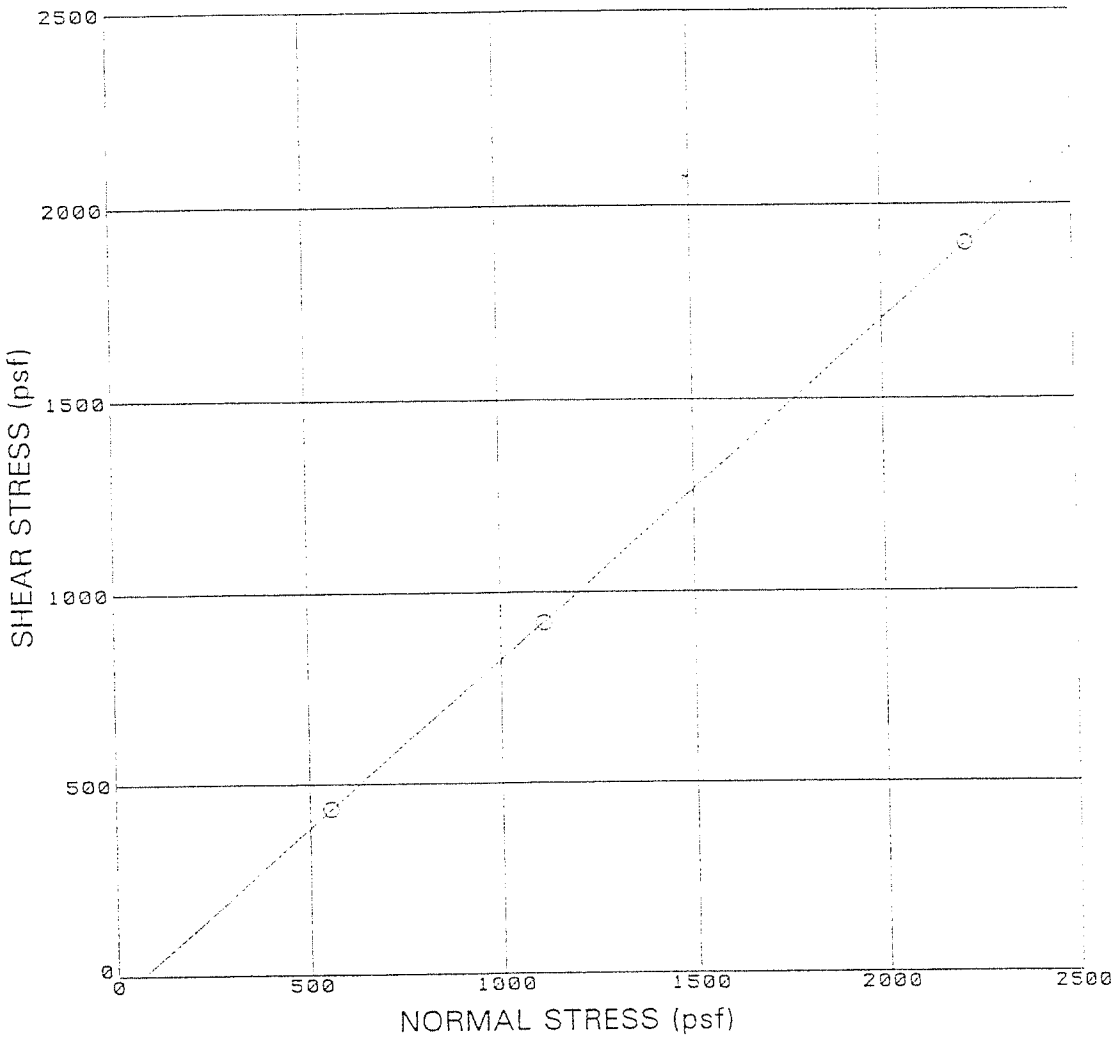
Friction Angle (deg.)	46.0	Remarks :
Cohesion (psf)	196	Ultimate Strength

DIRECT SHEAR TEST RESULTS

Project No. 990077-002

Project Name 4S RANCH

Date 9/99 Figure No.



Test Method : ASTM D3080-90	Type of Specimen :
Rate of Shear (in/min): 0.05	Remolded

Boring No.	B-7	Dry Density (pcf)	93
Sample No.	B-1	Moisture Content (%)	
Depth (ft)	5.0-10.0	Before Test :	19.5
Des.	Olive Brown Sandy Silt	After Test :	26.6

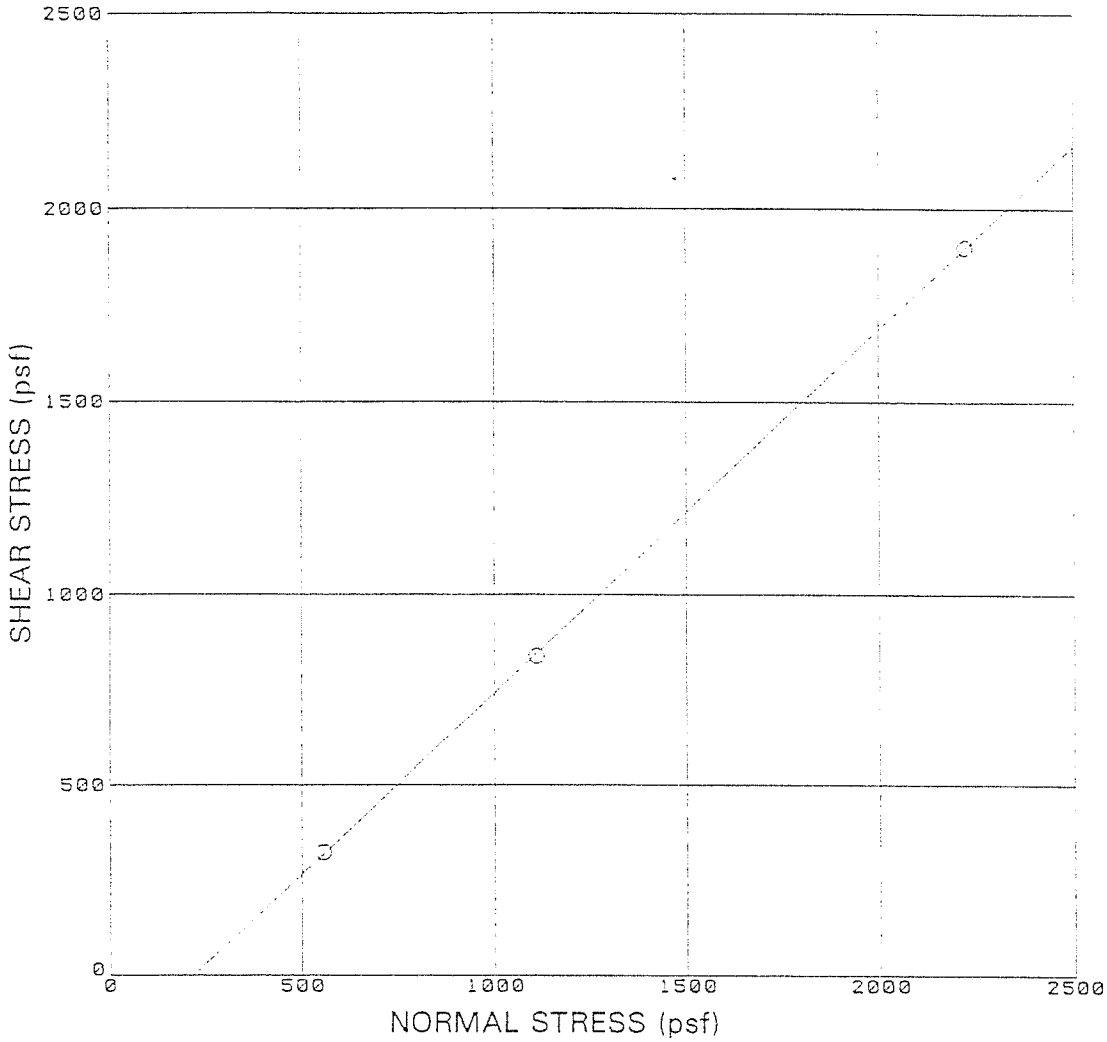
Friction Angle (deg.)	41.0	Remarks :
Cohesion (psf)	0	Peak Strength

DIRECT SHEAR TEST RESULTS

Project No. 990077-002

Project Name 4S RANCH

Date 10/99 Figure No.



Test Method : ASTM D3080-90	Type of Specimen :
Rate of Shear (in/min): 0.05	Remolded

Boring No.	B-7	Dry Density (pcf)	93
Sample No.	B-1	Moisture Content (%)	
Depth (ft)	5.0-10.0	Before Test :	19.5
Des.	Olive Brown Sandy Silt	After Test :	26.6

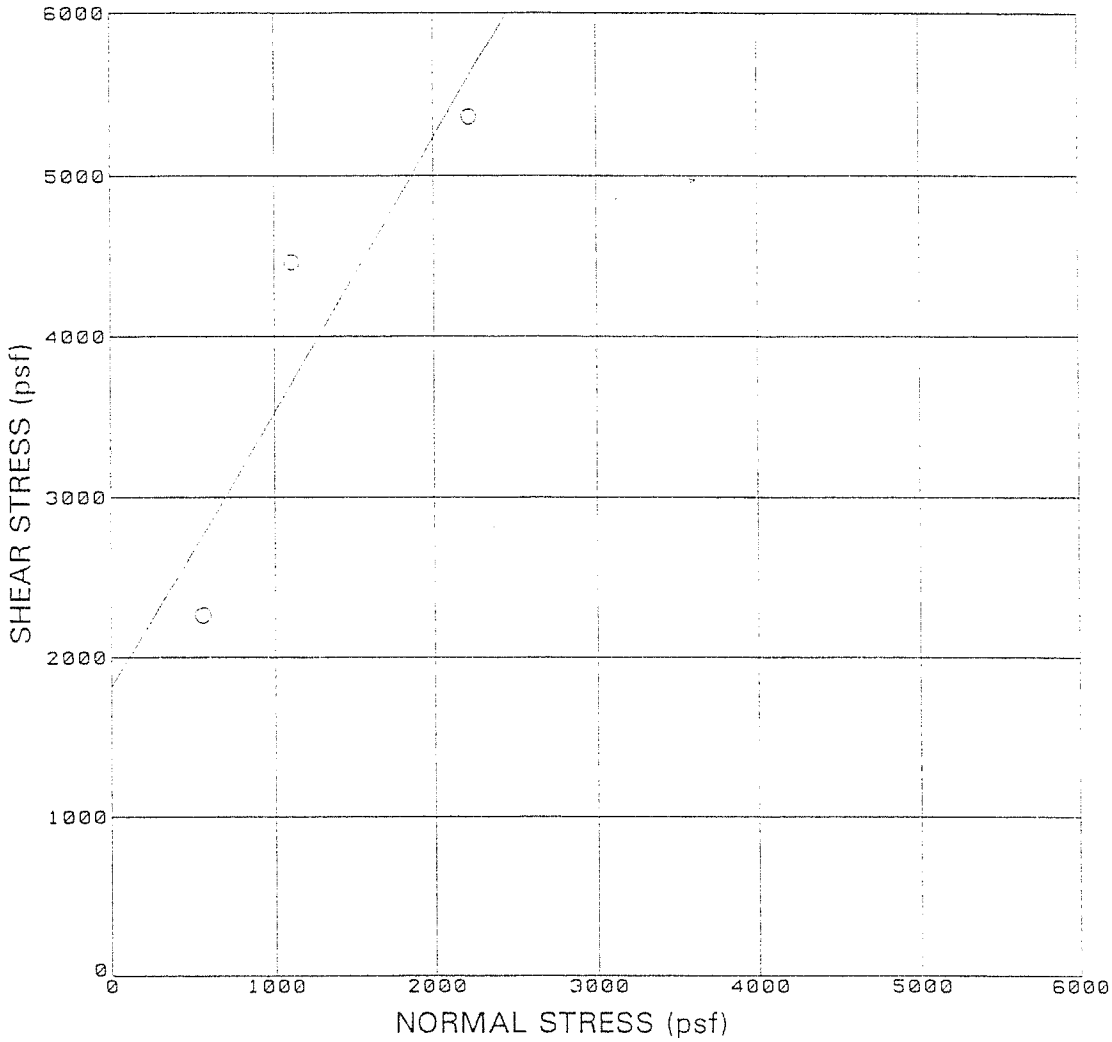
Friction Angle (deg.)	43.0	Remarks :
Cohesion (psf)	0	Ultimate Strength

DIRECT SHEAR TEST RESULTS

Project No. 990077-002

Project Name 4S RANCH

Date 10/99 Figure No.



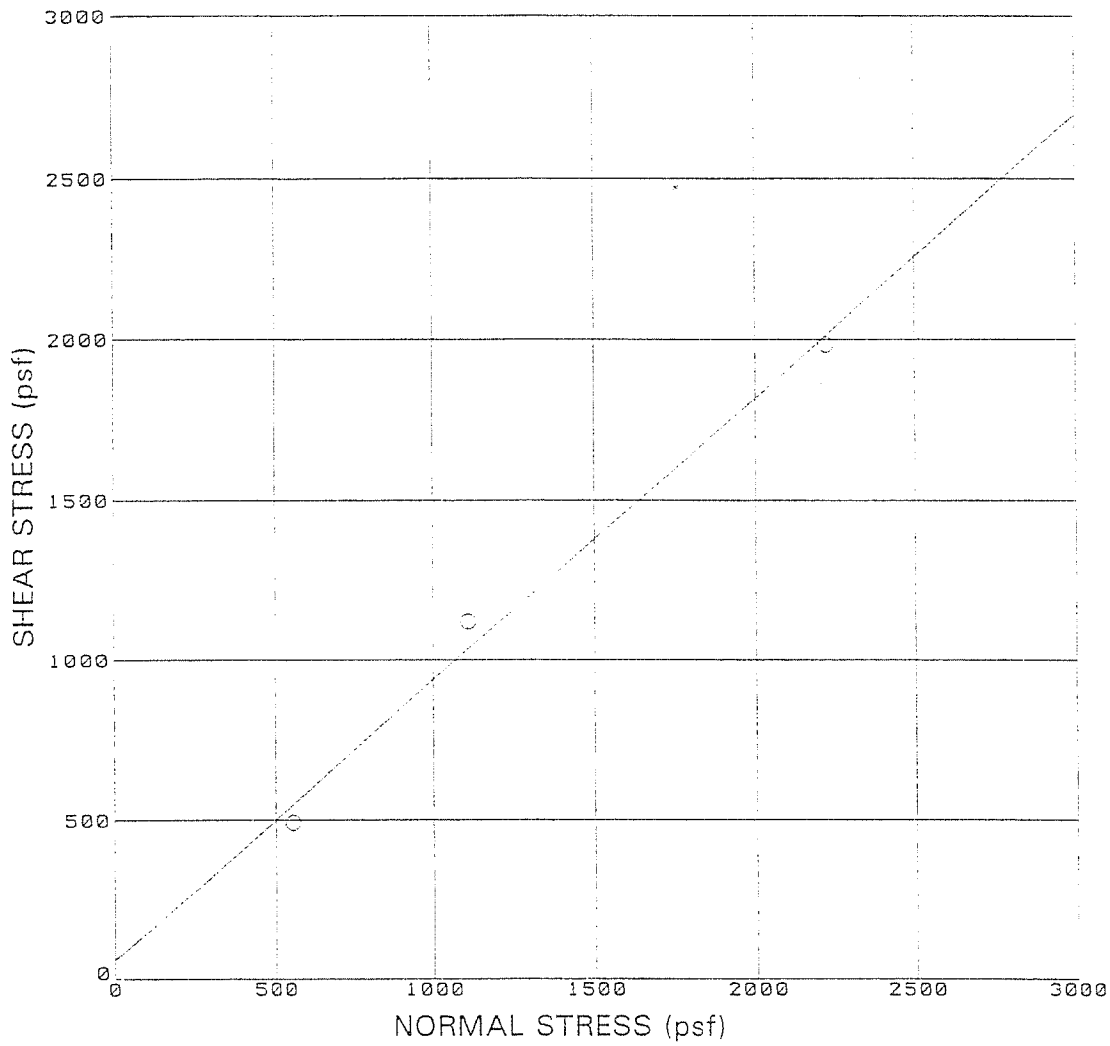
Test Method : ASTM D3080-90	Type of Specimen :
Rate of Shear (in/min): 0.05	Undisturbed

Boring No.	B-7	Dry Density (pcf)	120
Sample No.	R-4	Moisture Content (%)	
Depth (ft)	40.0	Before Test :	13.7
Description	Olive Brown Sandy Siltstone	After Test :	16.7

Friction Angle (deg.)	60.0	Remarks :
Cohesion (psf)	1810	Peak Strength

DIRECT SHEAR TEST RESULTS

Project No.	990077-002
Project Name	4S RANCH
Date	9/99
Figure No.	



Test Method : ASTM D3080-90	Type of Specimen :
Rate of Shear (in/min): 0.05	**Undisturbed**

Boring No. B-7 Dry Density (pcf) 120

Sample No. R-4 Moisture Content (%)

Depth (ft) 40.1 Before Test : 13.7

Description Olvie Brown Sandy Siltstone After Test : 16.7

Friction Angle (deg.) 41.0 Remarks :

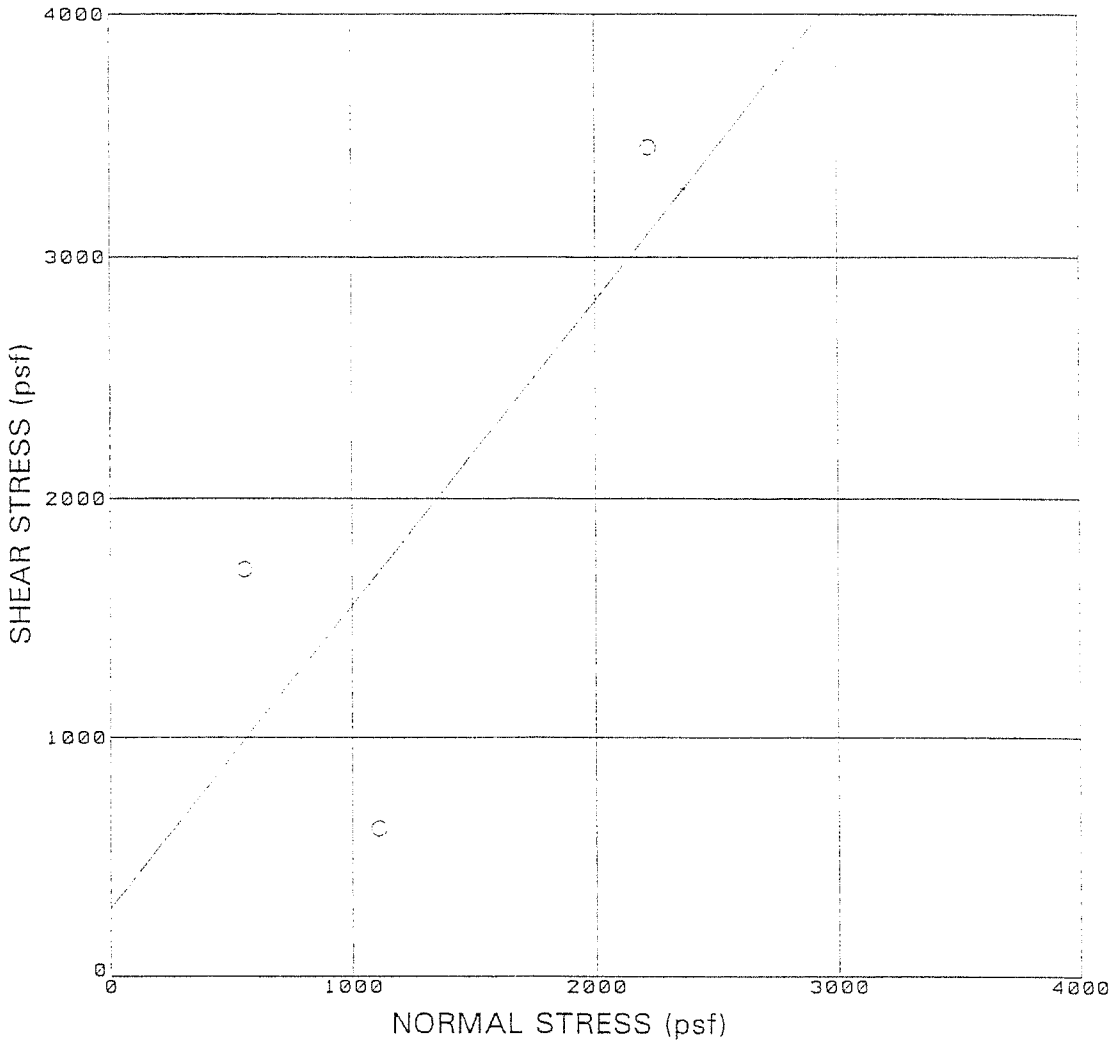
Cohesion (psf) 61 **Ultimate Strength**

DIRECT SHEAR TEST RESULTS

Project No. 990077-002

Project Name 4S RANCH

Date 9/99 Figure No.



Test Method : ASTM D3080-90	Type of Specimen :
Rate of Shear (in/min): 0.05	Undisturbed

Boring No.	B-8	Dry Density (pcf)	113
Sample No.	R-4	Moisture Content (%)	
Depth (ft)	40.0	Before Test :	17.3
Description	Gray Sandy Siltstone	After Test :	20.8

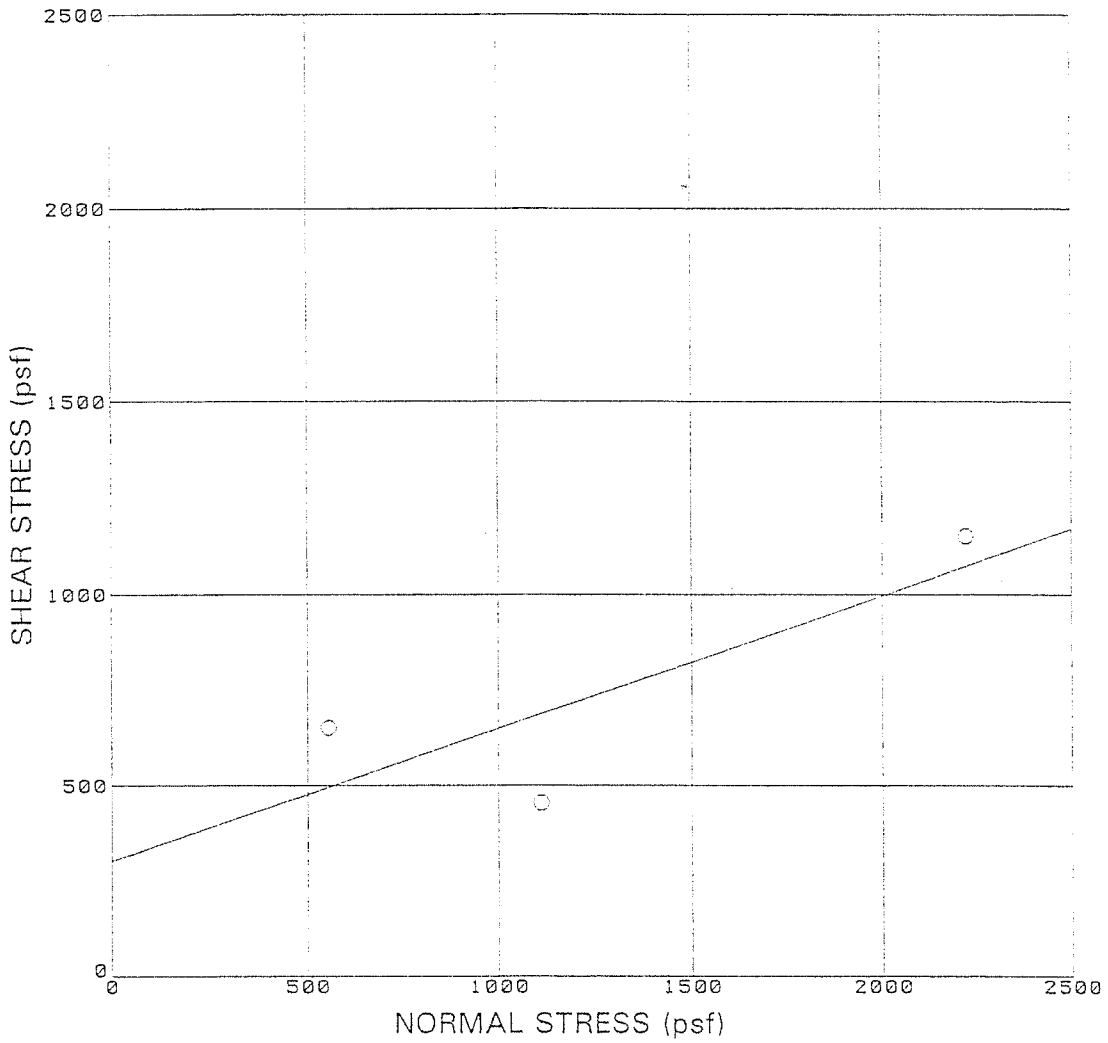
Friction Angle (deg.)	52.0	Remarks :
Cohesion (psf)	290	Peak Strength

DIRECT SHEAR TEST RESULTS

Project No. 990077-002

Project Name 4S RANCH

Date 9/99 Figure No.



Test Method : ASTM D3080-90	Type of Specimen :
Rate of Shear (in/min): 0.05	Undisturbed

Boring No.	B-8	Dry Density (pcf)	113
Sample No.	R-4	Moisture Content (%)	
Depth (ft)	40.1	Before Test :	17.3
Description	Gray Sandy Silstone	After Test :	20.8

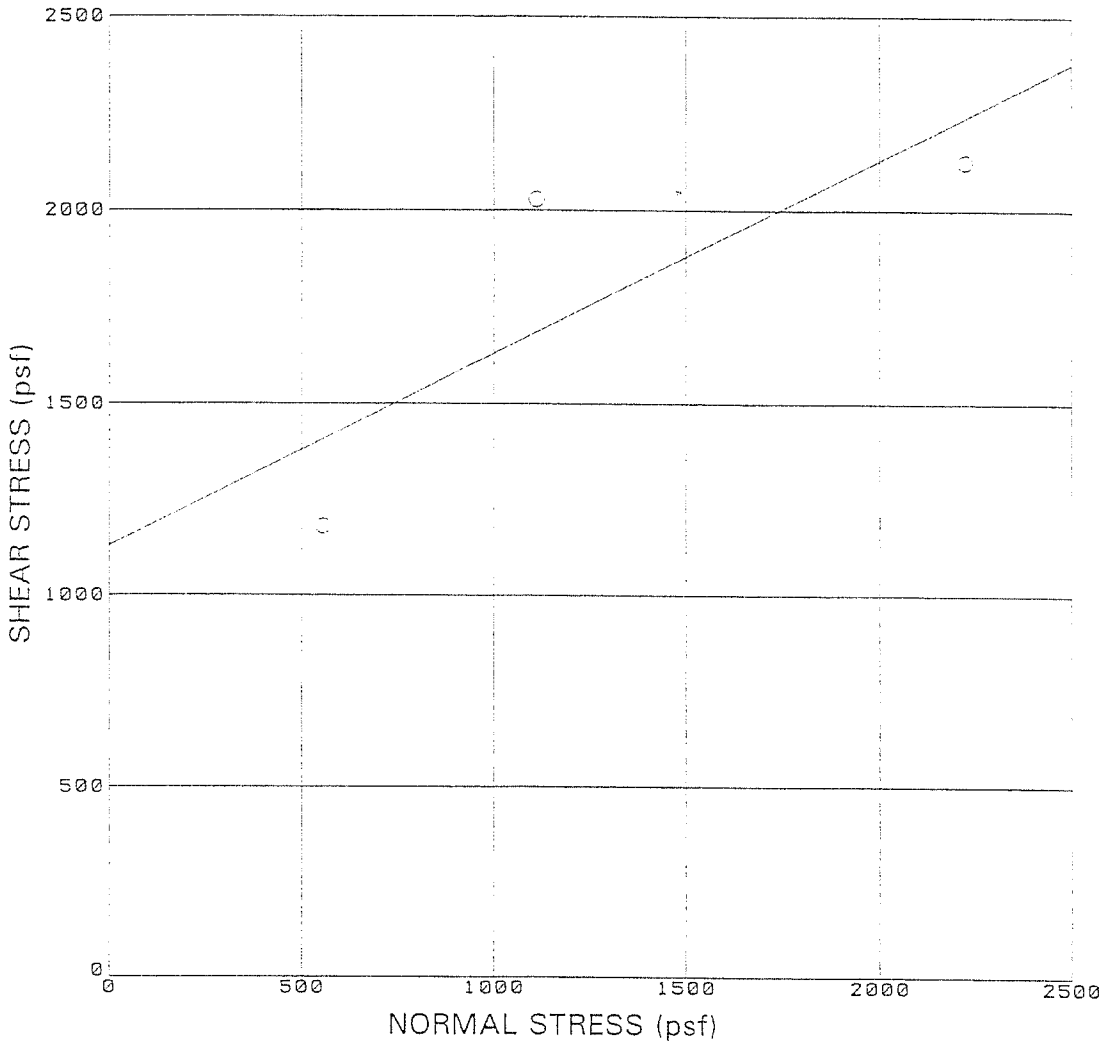
Friction Angle (deg.)	19.0	Remarks :
Cohesion (psf)	300	Ultimate Strength

DIRECT SHEAR TEST RESULTS

Project No. 990077-002

Project Name 4S RANCH

Date 9/99 Figure No.



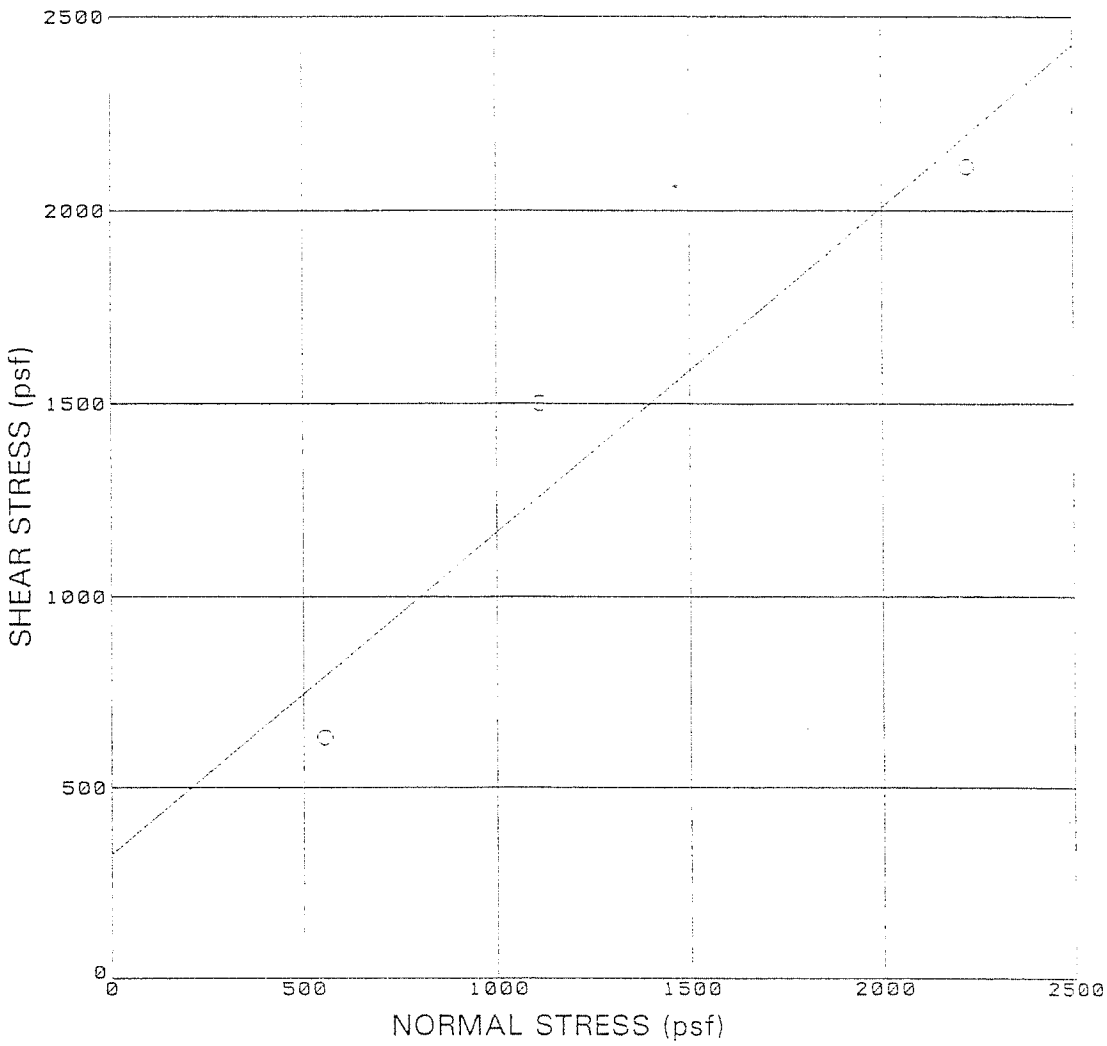
Test Method : ASTM D3080-90	Type of Specimen :
Rate of Shear (in/min): 0.05	Undisturbed

Boring No.	B-9	Dry Density (pcf)	125
Sample No.	R-2	Moisture Content (%)	
Depth (ft)	30.0	Before Test :	7.7
Description	Pink Silty Sandstone	After Test :	11.6

Friction Angle (deg.)	27.0	Remarks :	
Cohesion (psf)	1130	Peak Strength	

DIRECT SHEAR TEST RESULTS

Project No.	990077-002
Project Name	4S RANCH
Date	9/99
Figure No.	



Test Method : ASTM D3080-90	Type of Specimen :
Rate of Shear (in/min): 0.05	Undisturbed

Boring No.	B-9	Dry Density (pcf)	125
Sample No.	R-2	Moisture Content (%)	
Depth (ft)	30.1	Before Test :	7.7
Description	Pink Silty Sandstone	After Test :	11.6

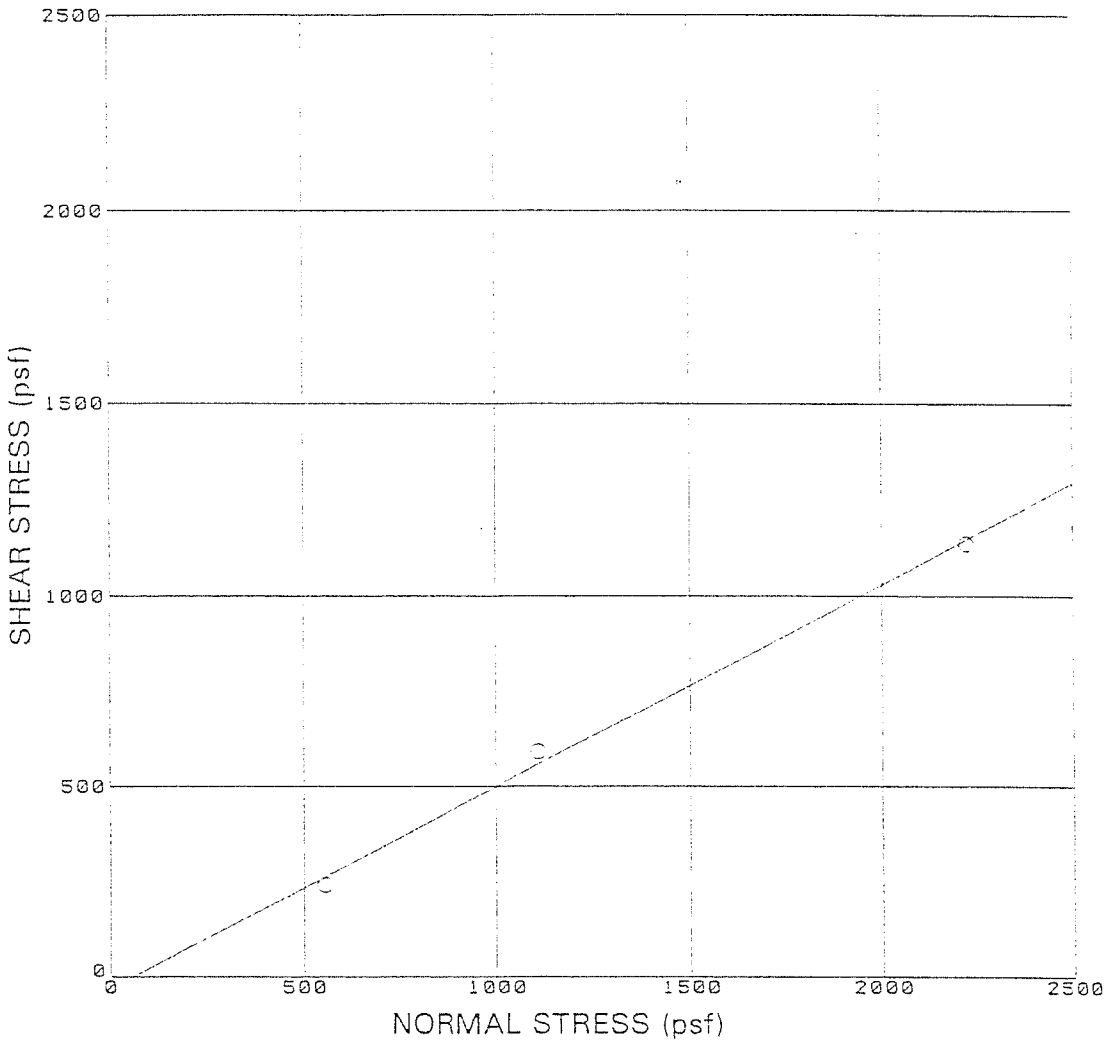
Friction Angle (deg.)	40.0	Remarks :
Cohesion (psf)	325	Ultimate Strength

DIRECT SHEAR TEST RESULTS

Project No. 990077-002

Project Name 4S RANCH

Date 9/99 Figure No.



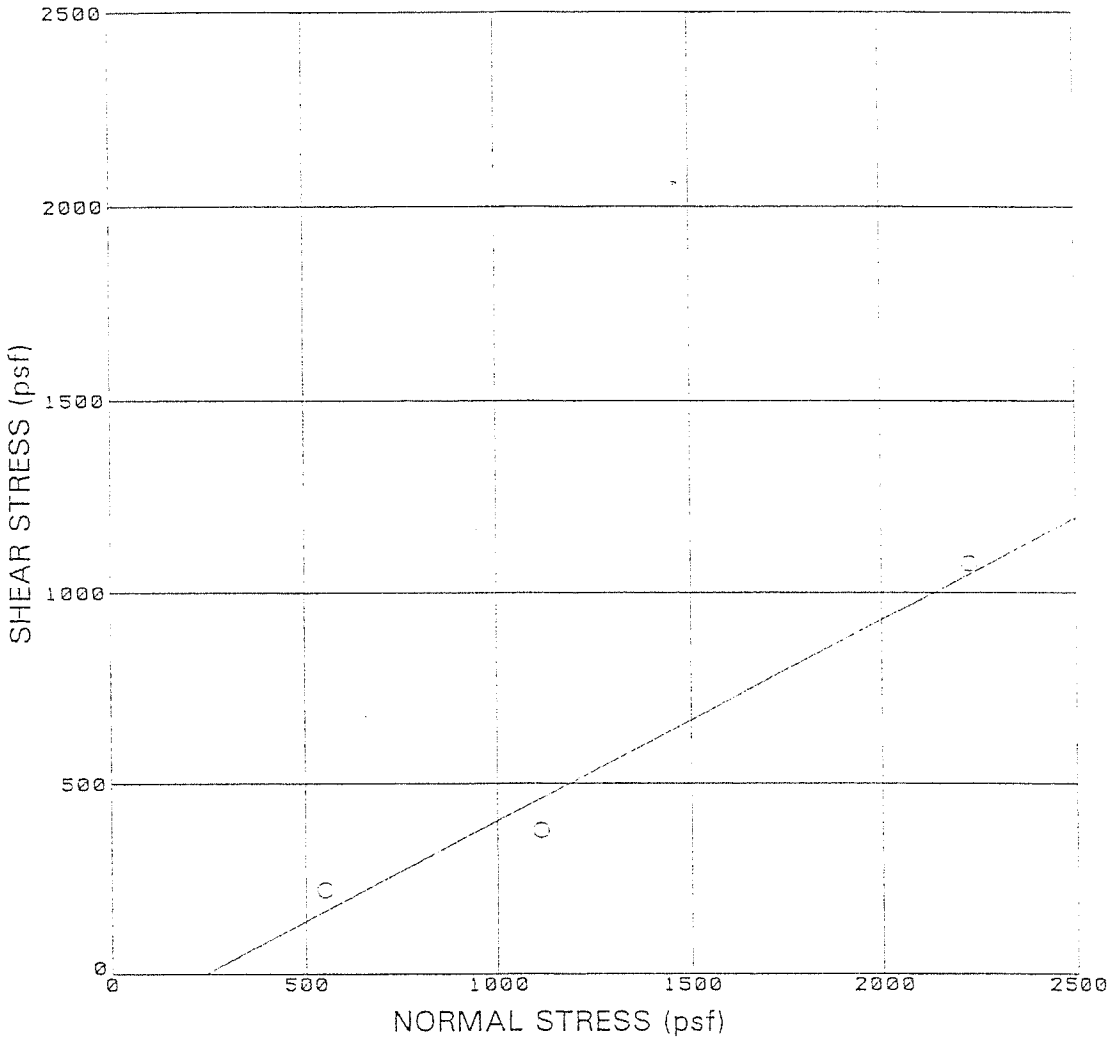
Test Method : ASTM D3080-90	Type of Specimen :
Rate of Shear (in/min): 0.05	Remolded

Boring No.	B-10	Dry Density (pcf)	105
Sample No.	B-1	Moisture Content (%)	
Depth (ft)	5.0-10.0	Before Test :	11.5
Des.	Grayish Brown Sandy Silt	After Test :	24.4

Friction Angle (deg.)	28.0	Remarks :
Cohesion (psf)	0	Peak Strength

DIRECT SHEAR TEST RESULTS

Project No.	990077-002
Project Name	4S RANCH
Date	10/99
Figure No.	



Test Method : ASTM D3080-90	Type of Specimen :
Rate of Shear (in/min): 0.05	Remolded

Boring No.	B-10	Dry Density (pcf)	105
Sample No.	B-1	Moisture Content (%)	
Depth (ft)	5.0-10.0	Before Test :	11.5
Des.	Grayish Brown Sandy Silt	After Test :	24.4

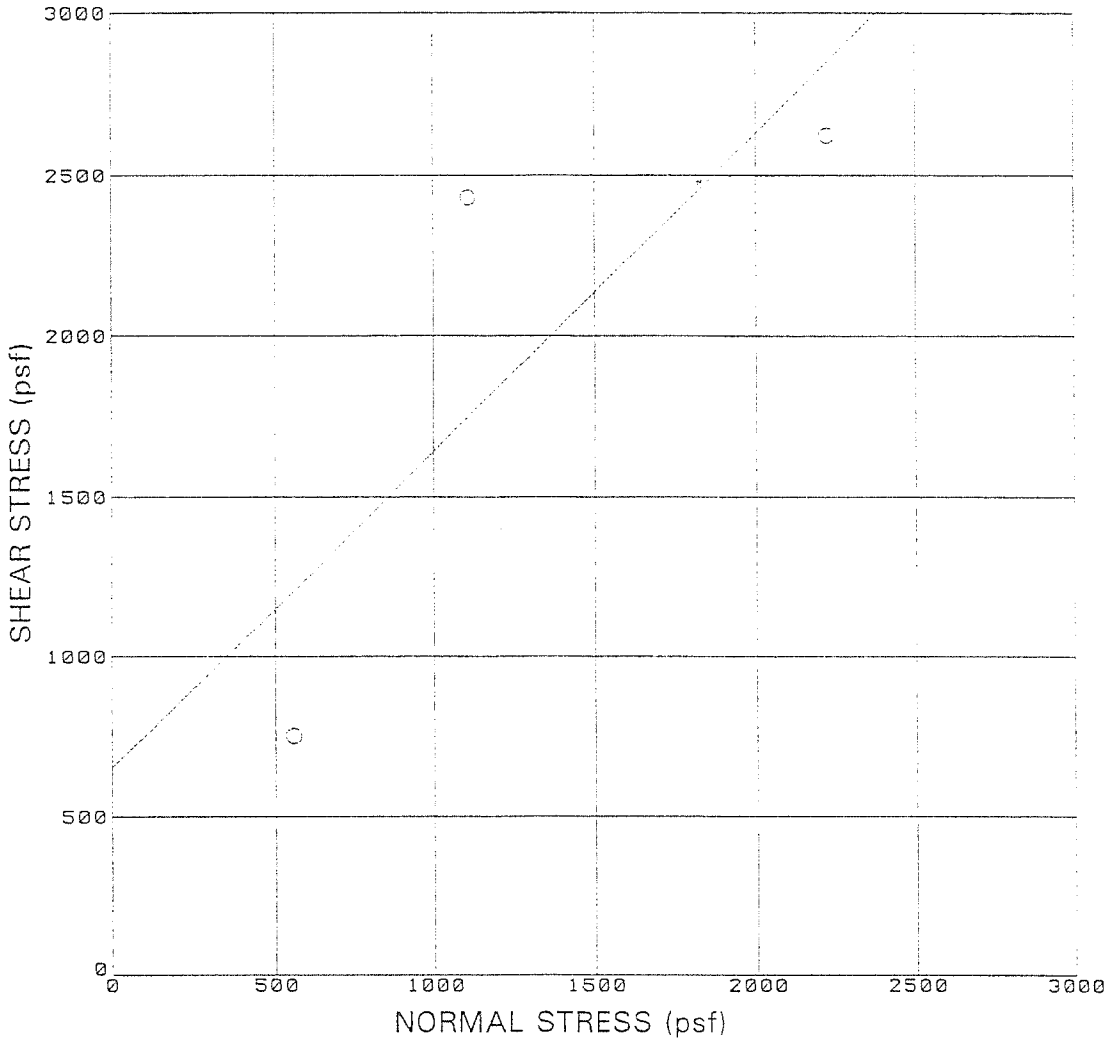
Friction Angle (deg.)	27.0	Remarks :
Cohesion (psf)	0	Ultimate Strength

DIRECT SHEAR TEST RESULTS

Project No. 990077-002

Project Name 4S RANCH

Date 10/99 Figure No.



Test Method : ASTM D3080-90	Type of Specimen :
Rate of Shear (in/min): 0.05	Undisturbed

Boring No.	B-10	Dry Density (pcf)	114
Sample No.	R-5	Moisture Content (%)	
Depth (ft)	50.0	Before Test :	16.8
Description	Brown Clayey Siltstone	After Test :	20.1

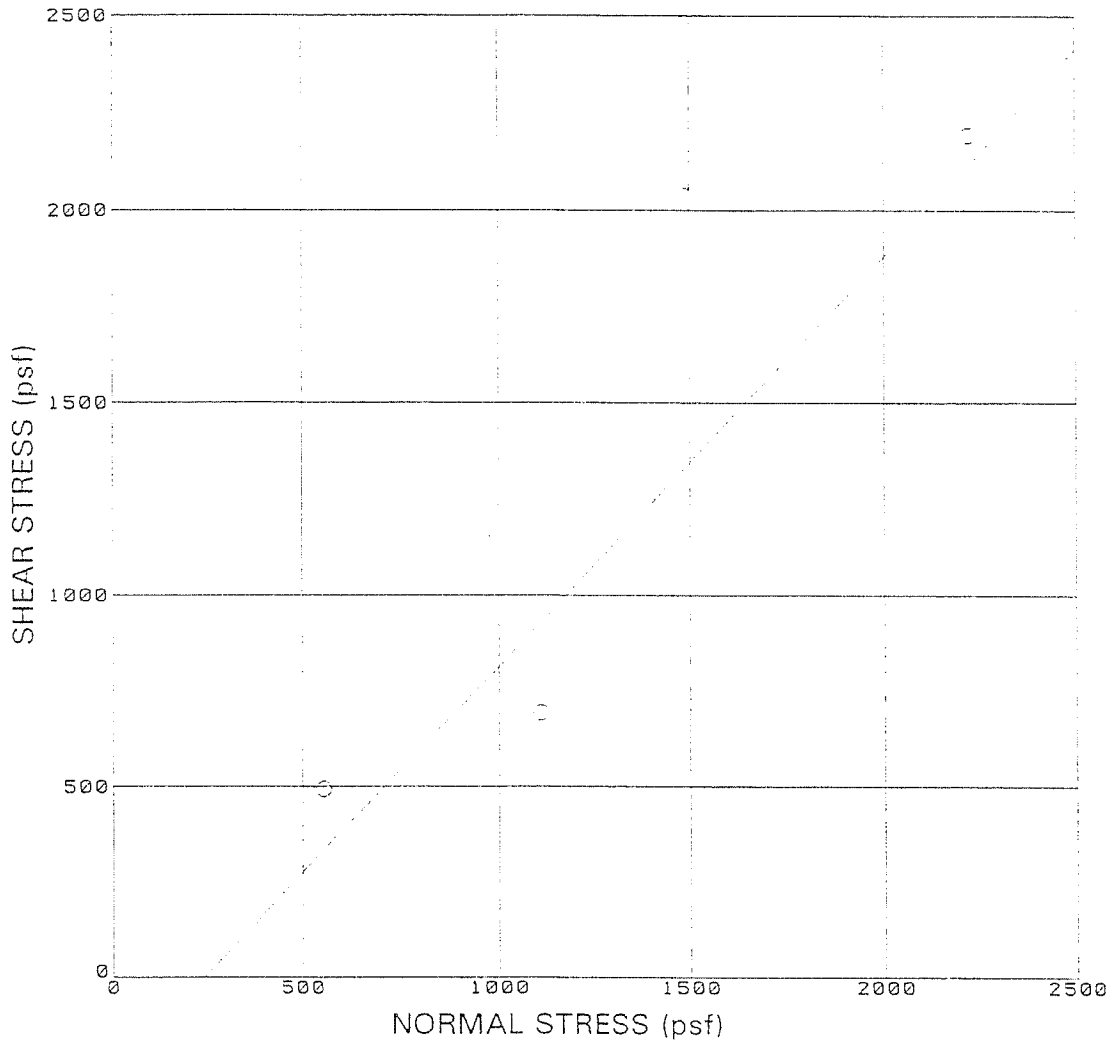
Friction Angle (deg.)	45.0	Remarks :
Cohesion (psf)	655	Peak Strength

DIRECT SHEAR TEST RESULTS

Project No. 990077-002

Project Name 4S RANCH

Date 9/99 Figure No.



Test Method : ASTM D3080-90

Type of Specimen : **Undisturbed**

Rate of Shear (in/min): 0.05

Boring No. B-10

Dry Density (pcf) 114

Sample No. R-5

Moisture Content (%)

Depth (ft) 50.1

Before Test : 16.8

Description Brown Clayey Siltstone

After Test : 20.1

Friction Angle (deg.) 47.0

Remarks :

Cohesion (psf) 0

Ultimate Strength

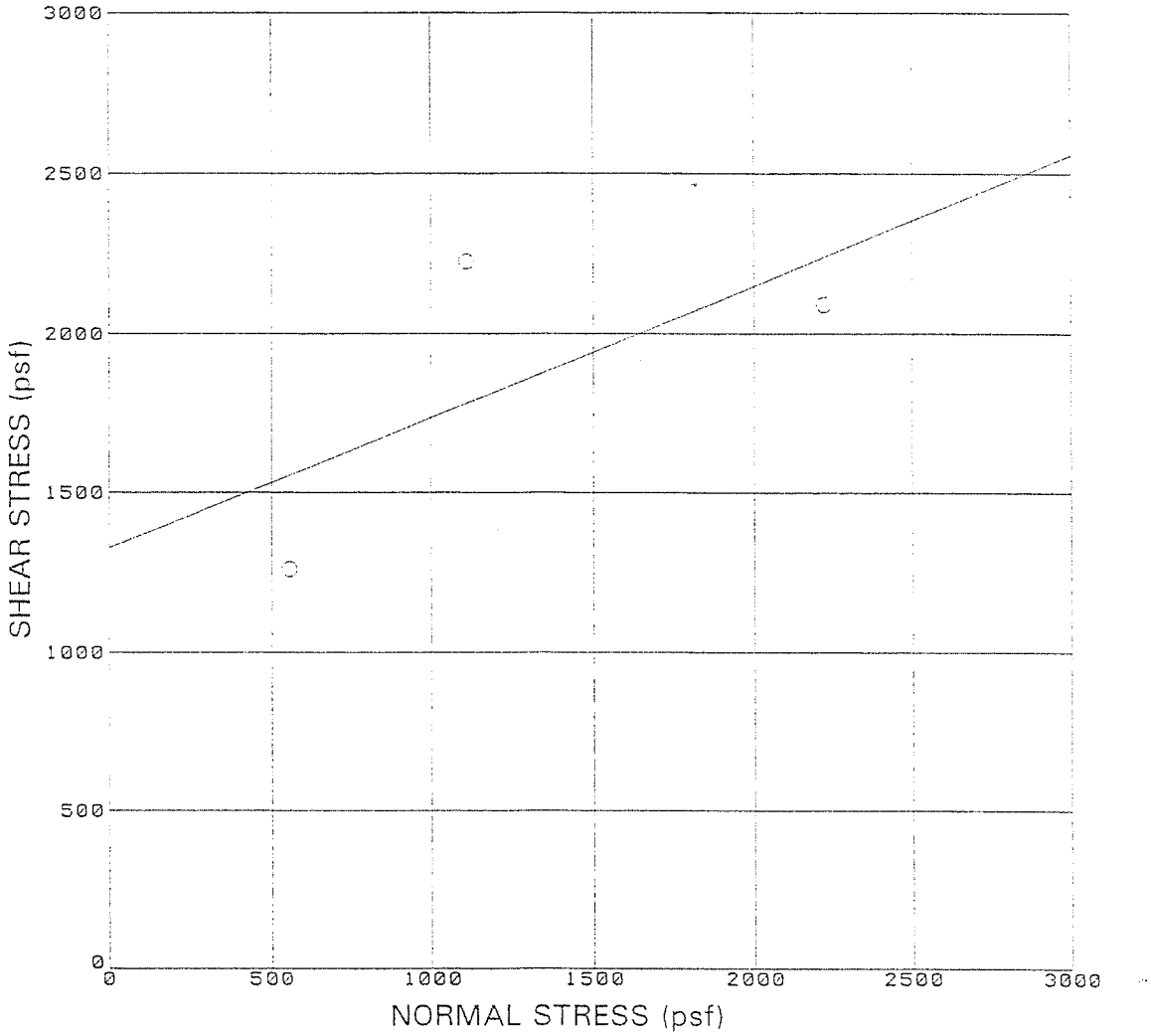
DIRECT SHEAR TEST RESULTS

Project No. 990077-002

Project Name 4S RANCH

Date 10/99

Figure No.



Test Method : ASTM D3080-90	Type of Specimen :
Rate of Shear (in/min): 0.05	Undisturbed

Boring No.	B-12	Dry Density (pcf)	118
Sample No.	R-2	Moisture Content (%)	
Depth (ft)	20.0	Before Test :	13.8
Description	Yellow Brown Sandy Silt	After Test :	16.0

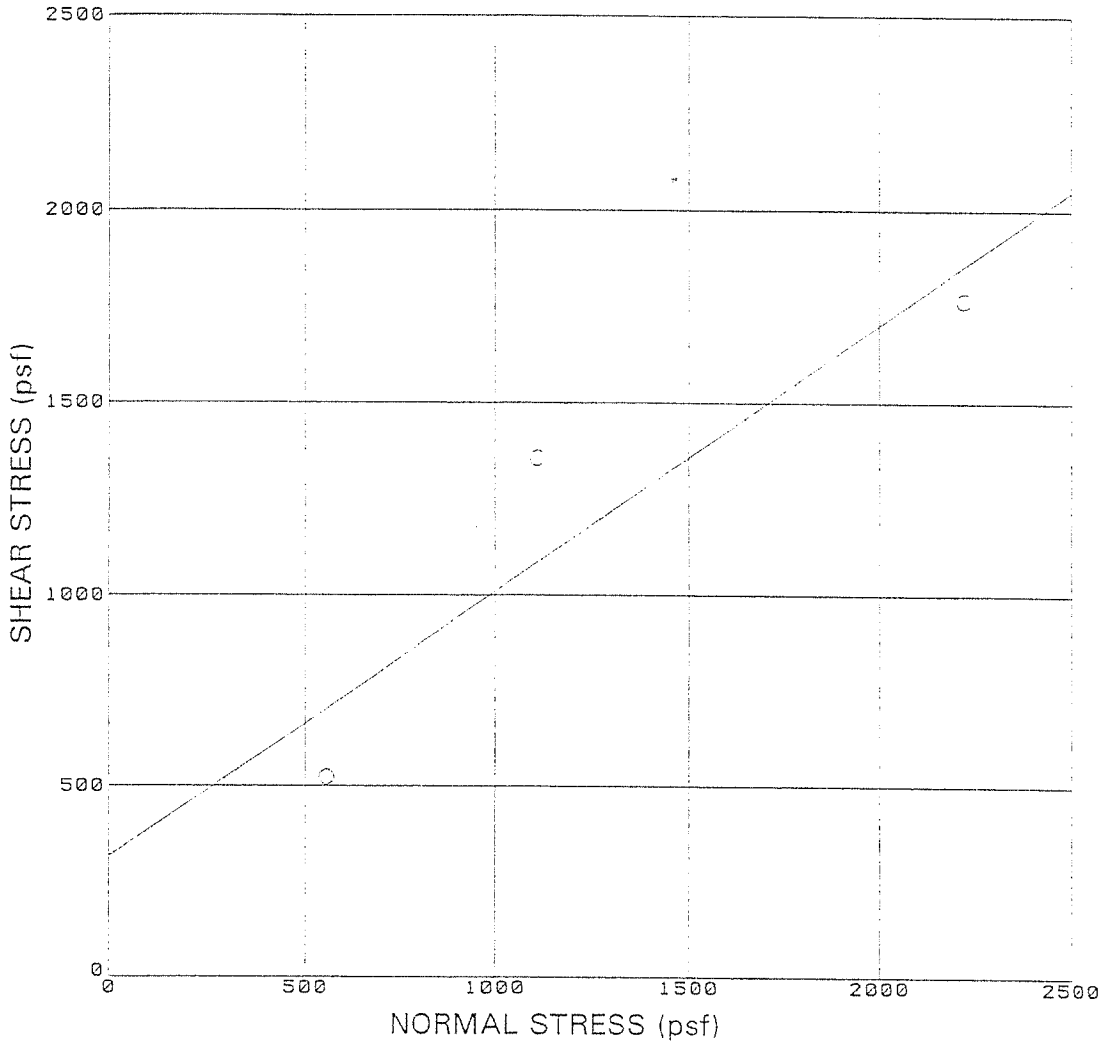
Friction Angle (deg.)	22.0	Remarks :
Cohesion (psf)	1326	Peak Strength

DIRECT SHEAR TEST RESULTS

Project No. 990077-002

Project Name 4S RANCH

Date 9/99 Figure No.



Test Method : ASTM D3080-90	Type of Specimen :
Rate of Shear (in/min): 0.05	Undisturbed

Boring No.	B-12	Dry Density (pcf)	118
Sample No.	R-2	Moisture Content (%)	
Depth (ft)	20.1	Before Test :	13.8
Description	Yellow Brown Sandy Silt	After Test :	16.0

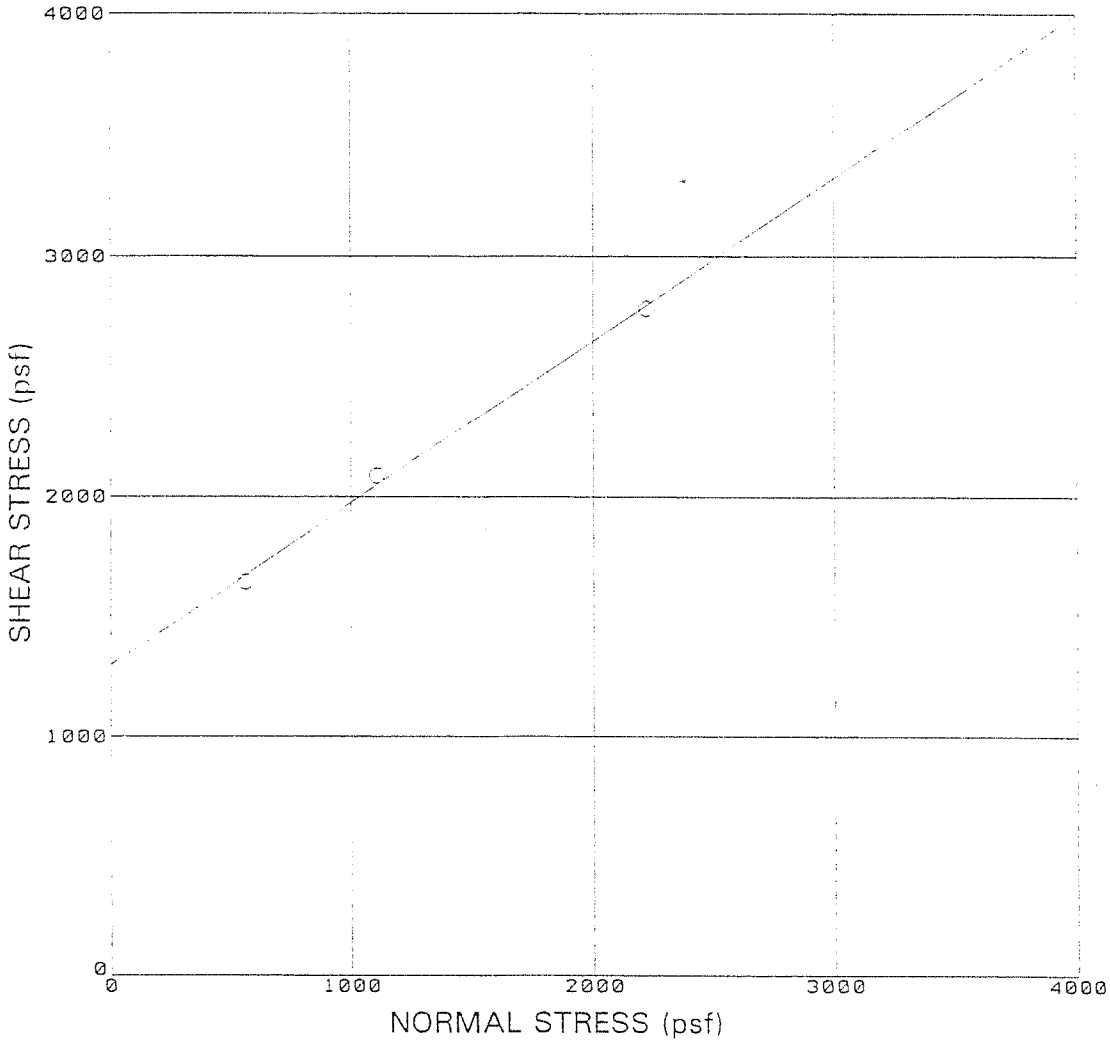
Friction Angle (deg.)	35.0	Remarks :	
Cohesion (psf)	320	Ultimate Strength	

DIRECT SHEAR TEST RESULTS

Project No. 990077-002

Project Name 4S RANCH

Date 9/99 Figure No.



Test Method : ASTM D3080-90	Type of Specimen :
Rate of Shear (in/min): 0.05	Undisturbed

Boring No.	B-13	Dry Density (pcf)	115
Sample No.	R-3	Moisture Content (%)	
Depth (ft)	30.0	Before Test :	16.1
Description	Olive Brown Silty Sandstone	After Test :	19.1

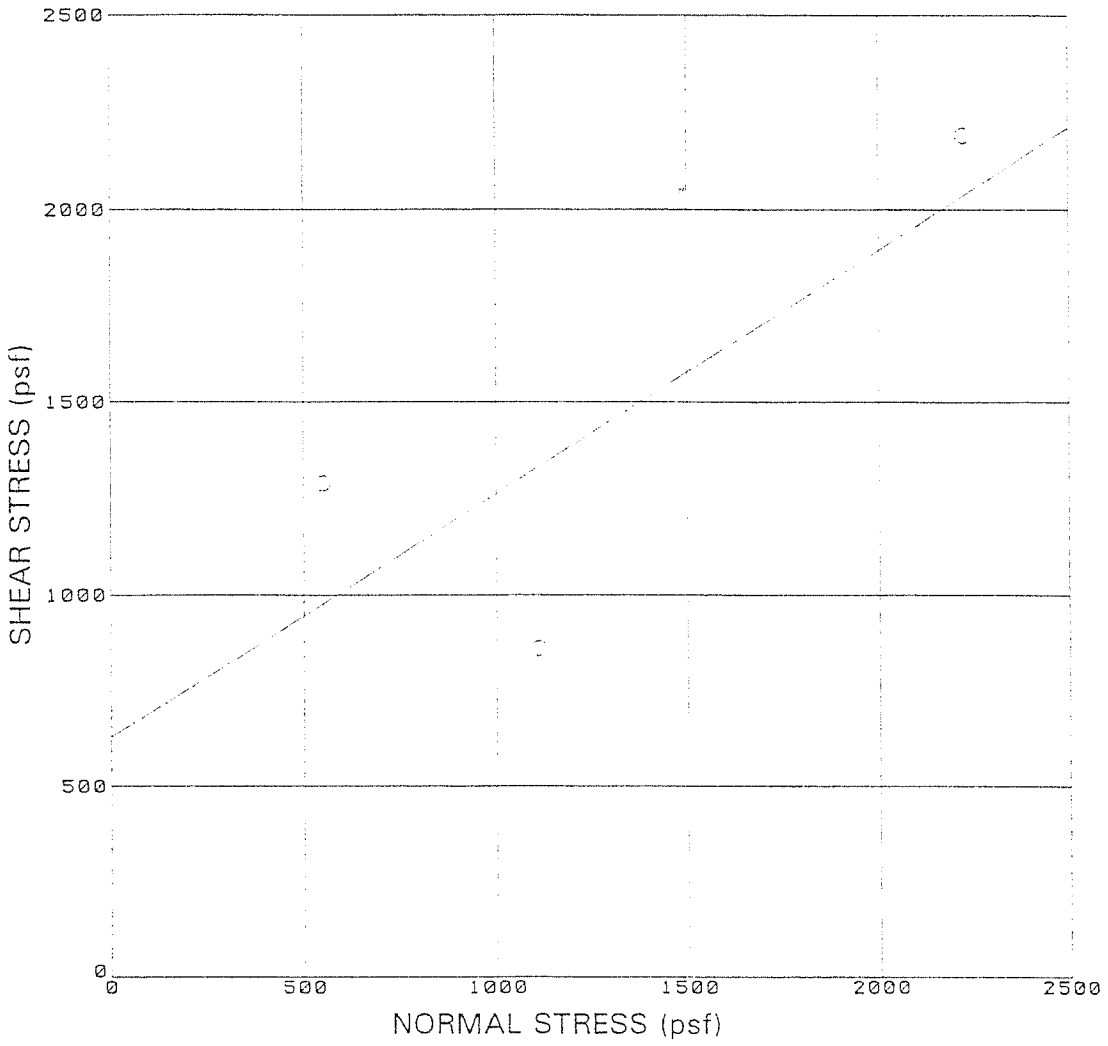
Friction Angle (deg.)	33.0	Remarks :
Cohesion (psf)	1300	Peak Strength

DIRECT SHEAR TEST RESULTS

Project No. 990077-002

Project Name 4S RANCH

Date 10/99 Figure No.



Test Method : ASTM D3080-90	Type of Specimen :
Rate of Shear (in/min): 0.05	Undisturbed

Boring No.	B-13	Dry Density (pcf)	115
Sample No.	R-3	Moisture Content (%)	
Depth (ft)	30.1	Before Test :	16.1
Description	Olive Brown Silty Sandstone	After Test :	19.1

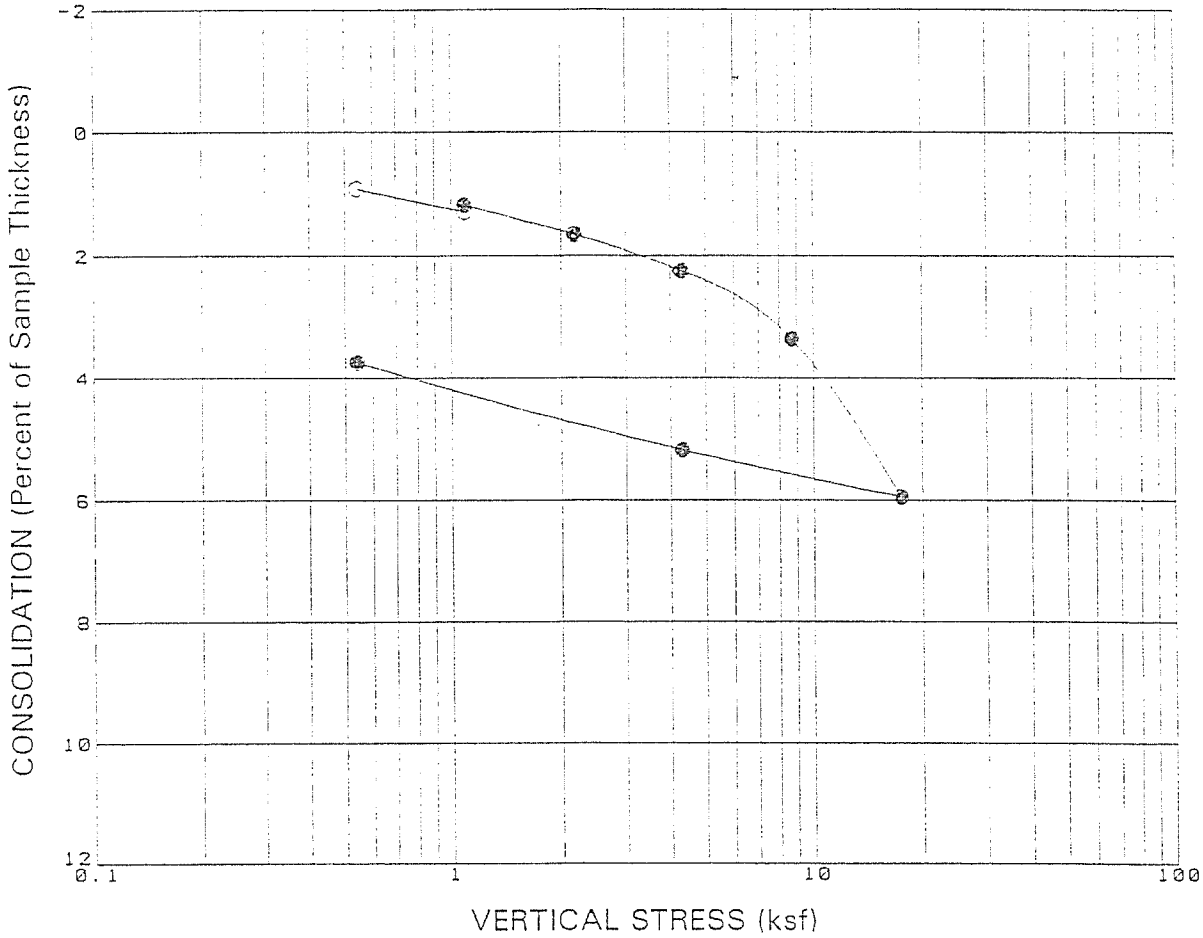
Friction Angle (deg.)	32.0	Remarks :
Cohesion (psf)	627	Ultimate Strength

DIRECT SHEAR TEST RESULTS

Project No. 990077-002

Project Name 4S RANCH

Date 10/99 Figure No.



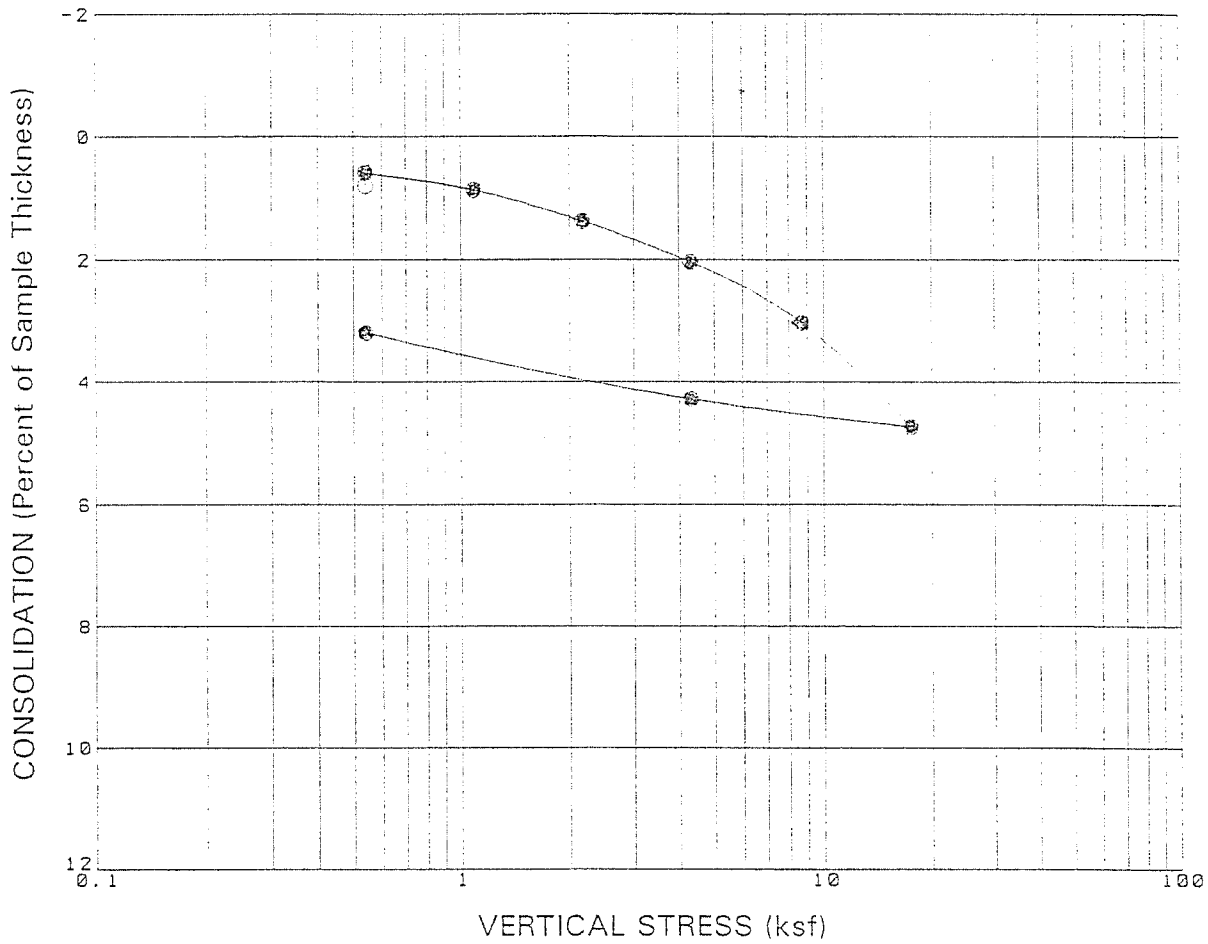
LEGEND: ○ At Field Moisture
● After Addition of Water

Boring No.	B-7	Dry Density (psf)	100
Sample No.	B-1	Moisture Content (%):	
Depth (ft)	5.0-10.0	Before	19.5
Soil Type	MH	After	25.6

Sample Description Clayey Sandy Silt

CONSOLIDATION CURVE
ASTM D2435

Project No. 990077-002
Project Name 4S RANCH
Date 9/99 Figure No.



LEGEND: ○ At Field Moisture
○ After Addition of Water

Boring No.	B-20	Dry Density (psf)	109
Sample No.	R-2	Moisture Content (%):	
Depth (ft)	20.0	Before	9.6
Soil Type	SM	After	16.5

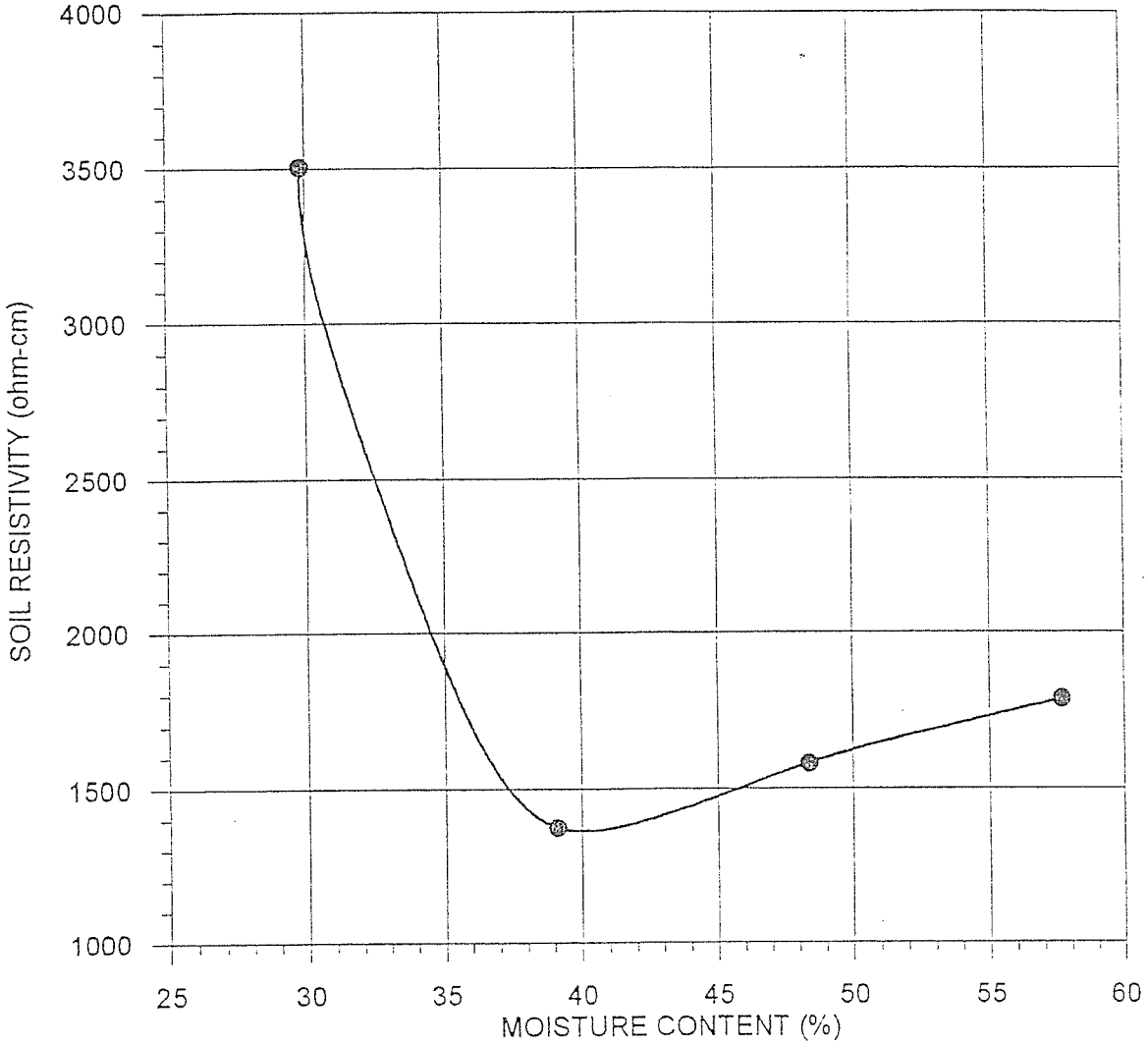
Sample Description Brown Silty Sand

CONSOLIDATION CURVE
ASTM D2435

Project No. 990077-002

Project Name 4S RANCH

Date 9/99 Figure No.



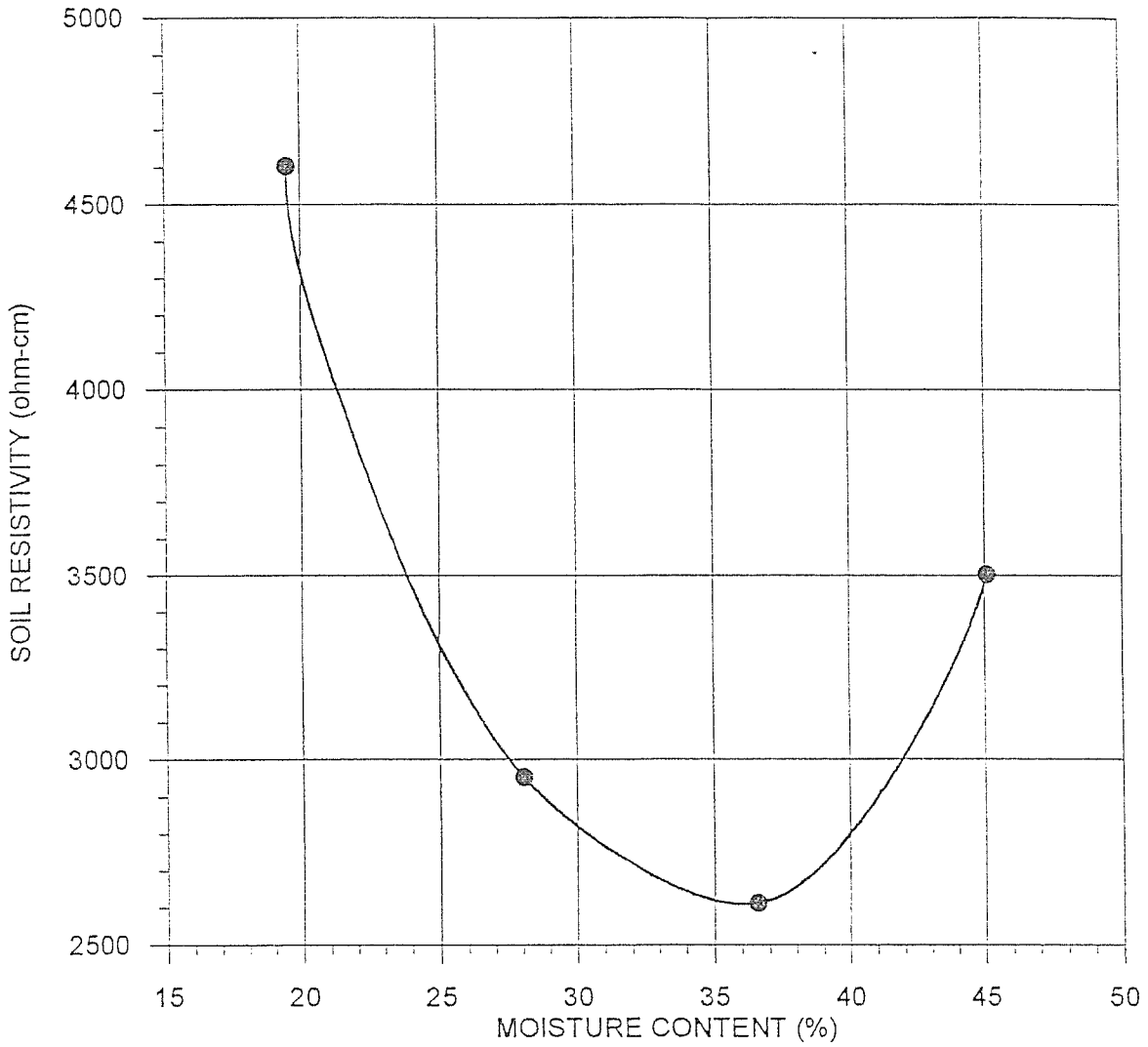
BORING NO.	SAMPLE NO.	DEPTH (ft)	MINIMUM RESISTIVITY (ohm-cm)	MOISTURE CONTENT (%)	SOIL TYPE
B-1	B-1	5.0-10.0	1,374	39.1	ML

Soil pH: 7.86
Sulfate Content (ppm): 35
Chloride Content (ppm): 73

TERATEST LABS, Inc.	Project No. 1990077-02 4S Ranch

MINIMUM SOIL RESISTIVITY & SOIL pH
(DOT CA Test 532 / 643)
Sulfate Content (DOT CA Test 417-B)
Chloride Content (DOT CA Test 422)

09-99



BORING NO.	SAMPLE NO.	DEPTH (ft)	MINIMUM RESISTIVITY (ohm-cm)	MOISTURE CONTENT (%)	SOIL TYPE
B-12	B-1	3.0-5.0	2,611	36.6	SC

Soil pH: 6.88
Sulfate Content (ppm): 28
Chloride Content (ppm): 56

TERATEST LABS, Inc.	Project No. 1990077-02 4S Ranch

MINIMUM SOIL RESISTIVITY & SOIL pH
(DOT CA Test 532 / 643)
Sulfate Content (DOT CA Test 417-B)
Chloride Content (DOT CA Test 422)

09-99

LEGEND

afu	UNDOCUMENTED ARTIFICIAL FILL
Qal	ALLUVIUM
Qcol	COLLUVIUM
Qls	LANDSLIDE DEBRIS
Qt	QUATERNARY TERRACE DEPOSITS
Tsa	TERTIARY SANTIAGO FORMATION
Tsi	TERTIARY SILVERADO FORMATION
Kwp	CRETACEOUS WILLIAMS FORMATION, PLEASANTS SANDSTONE MEMBER
Kws	CRETACEOUS WILLIAMS FORMATION, SHULZ RANCH SANDSTONE MEMBER
Klh	CRETACEOUS LADD FORMATION, HOLZ SLATE MEMBER

*UNITS CIRCLED WHERE BURIED

NW = NO WATER

APPROXIMATE GEOLOGIC CONTACT (DOTTED WHERE CONCEALED)

APPROXIMATE LIMITS OF LANDSLIDE (WITH ESTIMATED DIRECTION OF MOVEMENT)

45 N65W — STRIKE AND DIP OF BEDDING

45 N65W — STRIKE AND DIP OF CLAY BED

45 N65W — STRIKE AND DIP OF CONTACT

X — MARKER BED

SHALLOW SLIDE OR DEBRIS FLOW DEPOSITS

0 0' — APPROXIMATE LOCATION OF GEOLOGIC CROSS-SECTION

LB-19 — APPROXIMATE LOCATION OF BORING BY LEIGHTON & ASSOC., INC. 1999

GB-13 — APPROXIMATE LOCATION OF BORING BY GEOSOILS, INC. 1990

LT-14 — APPROXIMATE LOCATION OF TRENCH BY LEIGHTON & ASSOC., INC. 1999

GT-22 — APPROXIMATE LOCATION OF TRENCH BY LEIGHTON & ASSOC., INC. 1990

GB-1	GB-2	GB-3	GB-4
Tsa 0-40'	Tsi 0-65'	Qt 0-61'	Qt 0-43'
E-W 85 @ 11'	T.D. 65'	Tsi 61'-65'	Tsi 43'-50'
T.D. 40'	NW	T.D. 65'	T.D. 50'
NW		NW	NW

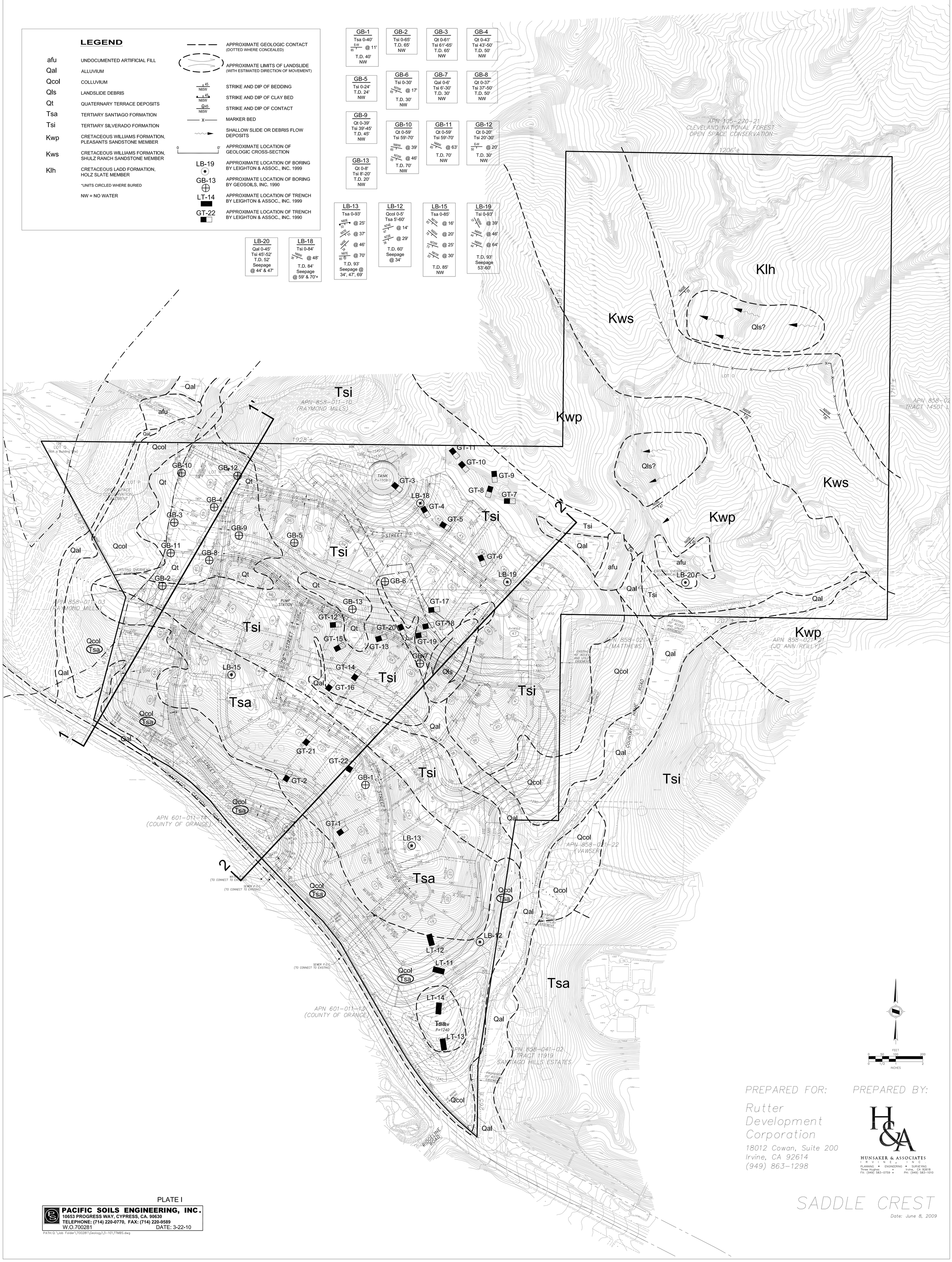
GB-5	GB-6	GB-7	GB-8
Tsi 0-24'	Tsi 0-30'	Qal 0-6'	Qt 0-37'
T.D. 24'	N70W 65 @ 17'	Tsi 6'-30'	Tsi 37'-50'
NW	T.D. 30'	T.D. 30'	T.D. 50'
	NW	NW	NW

GB-9	GB-10	GB-11	GB-12
Qt 0-39'	Qt 0-59'	Qt 0-59'	Qt 0-20'
Tsi 39'-45'	Tsi 59'-70'	Tsi 59'-70'	Tsi 20'-30'
T.D. 45'	N80W 65 @ 39'	N88W 65 @ 63'	E-W 50 @ 20'
NW	N72W 55 @ 46'	T.D. 70'	T.D. 30'
	T.D. 70'	NW	NW
	NW		

GB-13
Qt 0-8'
Tsi 8'-20'
T.D. 20'
NW

LB-13	LB-12	LB-15	LB-19
Tsa 0-93'	Qcol 0-5'	Tsa 0-85'	Tsi 0-93'
N80E 53 @ 25'	Tsa 5'-60'	N61W 65 @ 16'	N30W 57 @ 39'
N57E 55 @ 37'	N74E 41 @ 14'	N60W 79 @ 20'	N68W 44 @ 46'
N45E 74 @ 46'	N72E 38 @ 29'	N72W 73 @ 25'	N68W 44 @ 64'
N87E 60 @ 70'	T.D. 60'	N61W 53 @ 30'	T.D. 93'
T.D. 93'	Seepage	T.D. 85'	Seepage
Seepage @	@ 34'	NW	53'-60'
34', 47', 69'			

LB-20	LB-18
Qal 0-45'	Tsi 0-84'
Tsi 45'-52'	N88W 38 @ 48'
T.D. 52'	T.D. 84'
Seepage	Seepage
@ 44' & 47'	@ 59' & 70'+



PREPARED FOR:

Rutter Development Corporation
18012 Cowan, Suite 200
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(949) 863-1298

PREPARED BY:

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SADDLE CREST

Date: June 8, 2009

PLATE I

PACIFIC SOILS ENGINEERING, INC.
10653 PROGRESS WAY, CYPRESS, CA. 90630
TELEPHONE: (714) 220-0770, FAX: (714) 220-9589
W.O.700281 DATE: 3-22-10

PATH: Q:\Job Folder\700281\Geology\3-10\TTMBS.dwg

LEGEND

afu	UNDOCUMENTED ARTIFICIAL FILL
Qal	ALLUVIUM
Qcol	COLLUVIUM
Qls	LANDSLIDE DEBRIS
Qt	QUATERNARY TERRACE DEPOSITS
Tsa	TERTIARY SANTIAGO FORMATION
Tsi	TERTIARY SILVERADO FORMATION
Kwp	CRETACEOUS WILLIAMS FORMATION, PLEASANTS SANDSTONE MEMBER
Kws	CRETACEOUS WILLIAMS FORMATION, SHULZ RANCH SANDSTONE MEMBER
Klh	CRETACEOUS LADD FORMATION, HOLZ SLATE MEMBER

*UNITS CIRCLED WHERE BURIED

NW = NO WATER

APPROXIMATE GEOLOGIC CONTACT (DOTTED WHERE CONCEALED)

APPROXIMATE LIMITS OF LANDSLIDE (WITH ESTIMATED DIRECTION OF MOVEMENT)

45 N65W — STRIKE AND DIP OF BEDDING

45 N65W — STRIKE AND DIP OF CLAY BED

45 N65W — STRIKE AND DIP OF CONTACT

X — MARKER BED

SHALLOW SLIDE OR DEBRIS FLOW DEPOSITS

0 — 0' — APPROXIMATE LOCATION OF GEOLOGIC CROSS-SECTION

LB-19 — APPROXIMATE LOCATION OF BORING BY LEIGHTON & ASSOC., INC. 1999

GB-13 — APPROXIMATE LOCATION OF BORING BY GEOSOILS, INC. 1990

LT-14 — APPROXIMATE LOCATION OF TRENCH BY LEIGHTON & ASSOC., INC. 1999

GT-22 — APPROXIMATE LOCATION OF TRENCH BY LEIGHTON & ASSOC., INC. 1990

GB-1
Tsa 0-40'
E-W 85 @ 11'
T.D. 40'
NW

GB-2
Tsi 0-65'
T.D. 65'
NW

GB-3
Qt 0-61'
Tsi 61'-65'
T.D. 65'
NW

GB-4
Qt 0-43'
Tsi 43'-50'
T.D. 50'
NW

GB-5
Tsi 0-24'
T.D. 24'
NW

GB-6
Tsi 0-30'
N70W 65 @ 17'
T.D. 30'
NW

GB-7
Qal 0-6'
Tsi 6'-30'
T.D. 30'
NW

GB-8
Qt 0-37'
Tsi 37'-50'
T.D. 50'
NW

GB-9
Qt 0-39'
Tsi 39'-45'
T.D. 45'
NW

GB-10
Qt 0-59'
Tsi 59'-70'
N80W 65 @ 39'
N72W 55 @ 46'
T.D. 70'
NW

GB-11
Qt 0-59'
Tsi 59'-70'
N68W 65 @ 63'
T.D. 70'
NW

GB-12
Qt 0-20'
Tsi 20'-30'
E-W 50 @ 20'
T.D. 30'
NW

GB-13
Qt 0-8'
Tsi 8'-20'
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LB-13
Tsa 0-93'
N80E 53 @ 25'
N67E 50 @ 37'
N48E 54 @ 46'
N67E 60 @ 70'
T.D. 93'
Seepage @ 34', 47', 69'

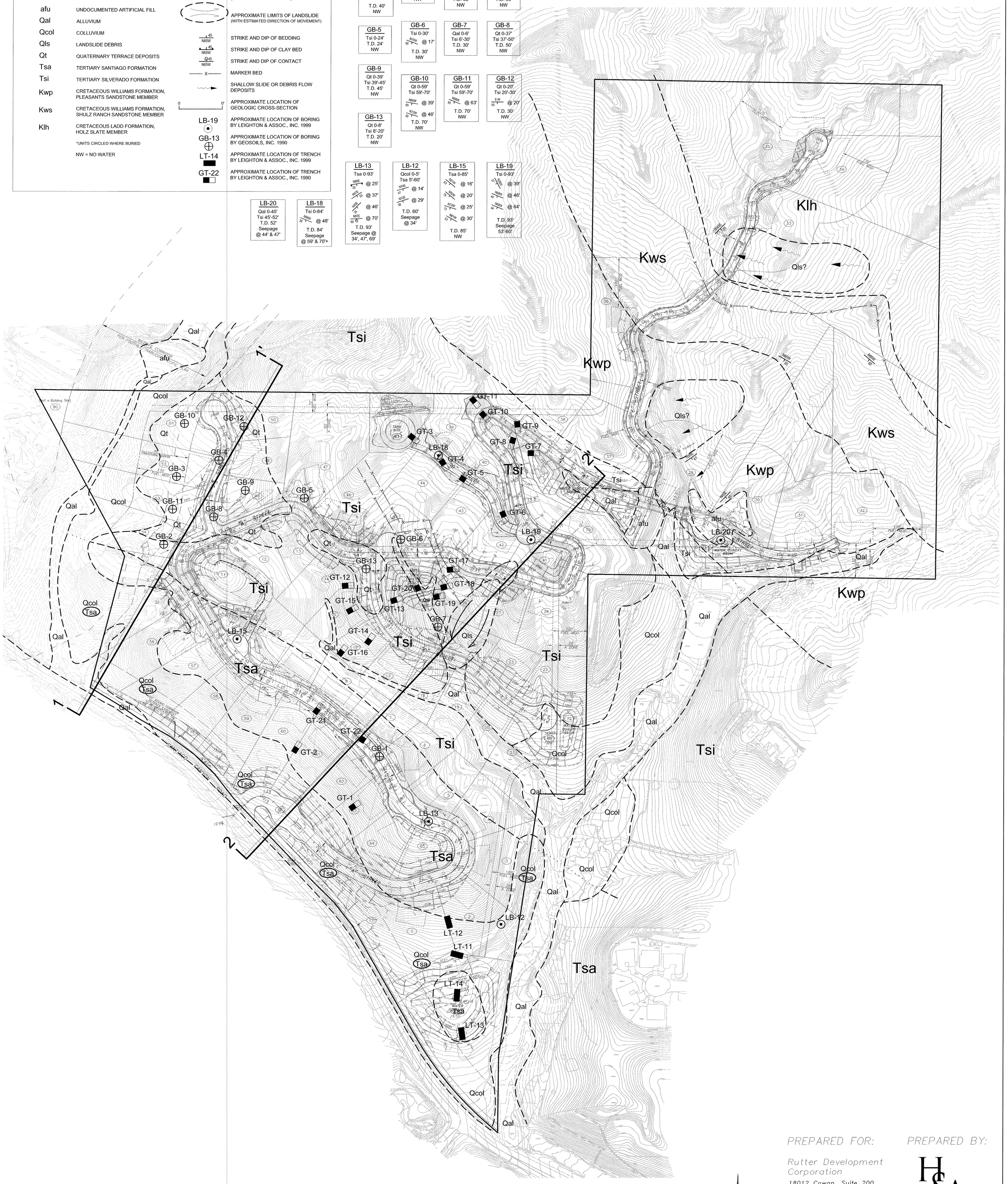
LB-12
Qcol 0-5'
Tsa 5'-60'
N74E 47 @ 14'
N72E 56 @ 29'
T.D. 60'
Seepage @ 34'

LB-15
Tsa 0-85'
N61W 65 @ 16'
N60W 79 @ 20'
N72W 73 @ 25'
N61W 53 @ 30'
T.D. 85'
NW

LB-19
Tsi 0-93'
N68W 57 @ 39'
N68W 44 @ 46'
N68W 44 @ 64'
T.D. 93'
Seepage 53'-60'

LB-20
Qal 0-45'
Tsi 45'-52'
T.D. 52'
Seepage @ 44' & 47'

LB-18
Tsi 0-84'
N68W 56 @ 48'
T.D. 84'
Seepage @ 59' & 70'+



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FEET 0 50 100 200
INCHES 0 1/2 1 2

SADDLE CREST

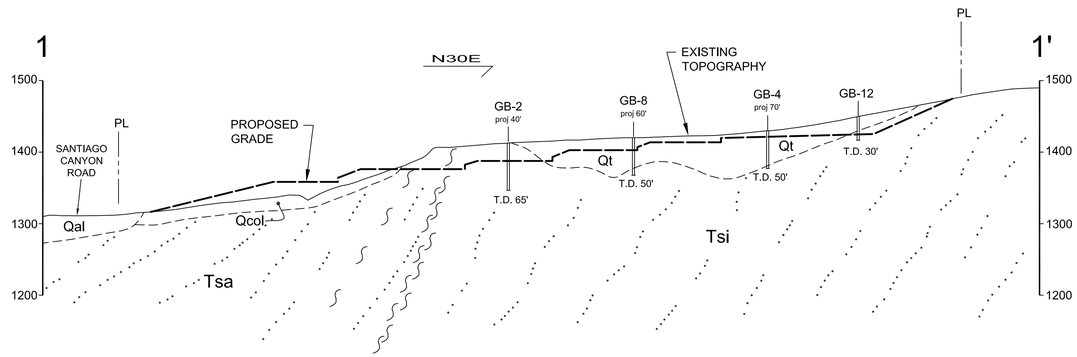
DATE: FEBRUARY 4, 2010

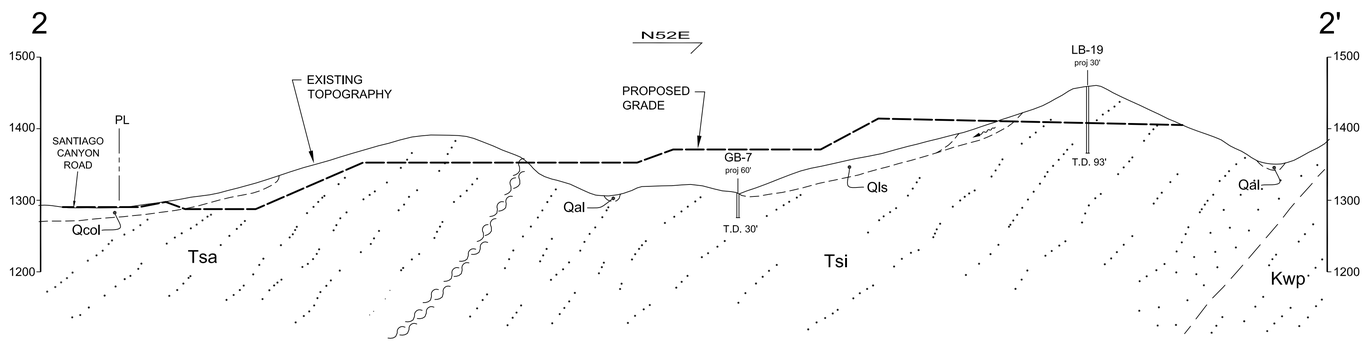
PLATE II

PACIFIC SOILS ENGINEERING, INC.
10653 PROGRESS WAY, CYPRESS, CA. 90630
TELEPHONE: (714) 220-0770, FAX: (714) 220-9589

W.O.700281 DATE: 3-22-10

PATH: Q:\Job Folder\700281\Geology\3-10\Additional 5000 SF Area - Buildable.dwg





CROSS-SECTIONS 1-1' & 2-2'

SCALE : 1" = 100' H&V

PLATE III

PACIFIC SOILS ENGINEERING, INC.
10653 PROGRESS WAY, CYPRESS, CA. 90630
TELEPHONE: (714) 220-0770, FAX: (714) 220-9589
W.O. 700281 DATE: 3-22-10