Appendix L

Soil Engineering and Engineering Geology Investigation

SOIL ENGINEERING AND ENGINEERING GEOLOGY INVESTIGATION
FOR
WHITTIER MAIN OILFIELD DEVELOPMENT PROJECT
CONSOLIDATED CENTRAL SITE
LOCATED AT
OPEN SPACE AREA
WHITTIER, CA
FOR
MATRIX OIL CORPORATION

January 13, 2011

HEATHCOTE GEOTECHNICAL

SOIL TESTING • FOUNDATIONS • INSPECTION

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Job: 09020
Date: January 13, 2011

Ladies/Gentlemen:

We are pleased to present this soil engineering and engineering geology report for you to aid in the design of your proposed project. We previously performed two previous studies within the open space area. The dates of these reports are April 20, 2009 and January 6, 2010.

This report presents the principal findings, conclusions and recommendation of the geotechnical and engineering geology investigation based upon review of the most current grading plans.

GENERAL DEVELOPMENT

It is planned to construct well sites and processing/ storage facilities as detailed by Matrix Oil Corporation. The proposed well sites and facilities are to be located within the confines of an Open Space Area within the City of Whittier, California. This area is managed by the Puente Hills Landfill Native Habitat Preservation Authority.

Consolidated site development description

It is proposed that a truck receiving area be placed in the lower southern portion of the consolidated site. A processing facility is proposed immediately adjacent to and west of the truck receiving area. Storage tanks are planned in the processing facility area. It is also proposed to construct a gas plant to the north of the truck receiving area. Well pads are to be constructed in the northern portion of the project site. One office building is proposed in the

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southern portion of the site. The existing roadways are to be realigned as part of the site development.

There is proposed substantial grading to accomplish the site development. Included in this development are large cut slopes, fill slopes and retaining walls. Pads will be constructed of cut and fill areas. At this time, cut slopes are proposed to a maximum height of over 100 feet. It is possible to have retaining walls of up to 27 feet in height.

SCOPE OF WORK

The scope of our investigation was developed through meetings and discussions with Mr. Michael McCaskey of Matrix Oil Corporation and Les Toth of Processes Unlimited International, Inc.

Submittal of this report to appropriate governmental agencies is the responsibility of the owner or their representatives.

The project will be safe for intended use as long as the recommendations of the report are followed.

The report will follow and includes; a comprehensive task list, observations and findings, recommendations, basis of report, results of testing, plot plan, borings, and slope stability sections with calculations.

It has been our pleasure to serve you and if you have any questions or need additional service, please contact us.

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COMPREHENSIVE TASK LIST

GENERAL

This portion of the report specifies all the work that was performed and the procedures used.

This investigation did not address the possibility of any contaminants in the soil, although none were noted. Our report addresses geologic issues raised in the geology section of the report with engineering strengths, calculations, recommendations, and factors of safety. The following is the comprehensive task list.

GEOLOGIC REVIEW

Review of available literature pertinent to the site and review of aerial photographs of the area. Additionally, geologic structure was mapped throughout the areas of proposed development. This was accomplished by actual field review of site conditions.

SITE WORK

1. Reviewed surface of site for geologic and engineering problems that can be associated with the soil and bedrock.
2. Previously, 18 borings were excavated throughout the open space area in reports dated April 20, 2009 and January 6, 2010. Within the consolidated site, 8 borings from previous work were used. Current work included 2 additional borings. Maximum depth for previous and current borings is 60 feet. Undisturbed samples were taken at frequent intervals using hand auger equipment and hollow stem augers. These borings were used for geology, foundation and slope stability.
3. Previously, 18 test pits were excavated throughout the open space area in a report dated January 6, 2010. Within the consolidated site, 5 test pits from previous work were used. Current work included 11 additional test pits. Samples were taken at frequent intervals using backhoe equipment. Varying depths were excavated for the test pits. These test pits were used for geology, foundations and slope stability.
4. Logging of soils in the borings and samples for geologic and engineering properties.
5. Obtained a bulk samples for laboratory testing.

TESTING

1. Moisture and density of the undisturbed samples
2. Maximum density and optimum moisture contents of soils on site for grading purposes
3. Expansion index tests
4. Shear testing for slope stability studies
5. Consolidation testing

Results of testing are presented in the appendix and on the boring logs.

REPORT

Main body

1. Comprehensive task list
2. Findings and observations
3. Recommendations
4. Basis of report
5. References

Appendices

1. Testing
2. Maps
3. Boring and test pit logs
4. Slope stability
5. Regional geology maps
6. Faulting and seismicity
7. Geology sections
8. Liquefaction analysis

FINDINGS AND OBSERVATIONS

SETTINGS

Regional Setting:

The Puente Hills together with the Repetto Hills form a northwest-trending arc marking the northeastern edge of the Los Angeles basin and the boundary zone where the eastern edge of the Pacific tectonic plate and the western edge of the North American Plate converge. The boundary zone is characterized by the intersection of two major active fault systems; the northwest-trending strike-slip San Andreas type faults of the Peninsular Geomorphic province and the east-west-trending mostly left-lateral and/or compressional reverse faults of the Transverse Ranges Geomorphic province. In general, the Puente Hills comprise a roughly triangular area extending from southeastern Los Angeles County into parts of Orange, San Bernardino Counties (figure 1). Geomorphically, the Puente Hills are bounded on the northwest by the San Gabriel Valley, on the northeast by the San Bernardino Valley and on the south by the Los Angeles plain. They are separated from the northern tip of the Santa Ana Mountains by a gap through which the Santa Ana River flows. The Whittier Narrows at the northeast end of the hills is another gap occupied by the Rio Hondo and San Gabriel rivers, separates the Puente Hills from the Repetto Hills.

Structurally, the Puente Hills comprise a structural northwest-southeast-trending anticline that has been uplifted between the Whittier Fault which bounds the south-southwest side of the hills and the Chino Fault which bounds the hills on the northeast. The Whittier Fault zone is exposed along the south slopes of the Puente Hills and is seen north of the study area. Topographically the backbone of the Puente Hills runs in a northwest-southeast direction and rises to altitudes of 1000 feet to 1800 feet.

Local Setting:

The proposed development sites, as delineated on the enclosed geologic map, is located in the northwestern portion of the Puente Hills within the City of Whittier, Los Angeles County, California.

Site Location:

The consolidated site is located along the valley floor of the La Canada Verde Creek and is delineated on the enclosed geologic map (Plates M-1). Access to the Open Space area and the subject valley is through a residential housing tract, off the north end of paved Catalina Avenue.

Catalina Avenue extends northerly beyond the residential area through gates which mark the southerly boundary of the Open Area and continues as a partially paved but less well maintained roadway following the valley floor of La Canada Verde Creek which is an antecedent stream that heads northeast of the backbone of the Puente Hills and north of the Whittier Fault zone and drains south through the southerly slopes of the hills and onto the Downey/Los Angeles plain. The stream bed is relatively broad with a flat-floor and bordered on each side by slopes having gradients estimated at two horizontal to one vertical (2:1) or steeper. The steeper slopes are generally caused by grading. The proposed site is irregular in shape. Generally, the site does not extend into the active stream area but locally include the base of the intervening hillsides.

This site is elongate running parallel to the valley floor. The site is bordered on the west by the roadway with the active stream channel being offset to the west side of the valley. The westerly portion of the site occupies the relatively flat alluvial surface with the easterly side of the site including the ascending west-facing slopes of a south-trending ridge. The average elevation is estimated at 470 feet mean sea level with elevational differences ranging from 460 feet to 650 feet.

Several paved roadways traverse the site. The topography has been significantly altered by prior grading. Several roughly level pads, developed terraced fashion, are located along the west-facing slope.

Vegetation:

Area vegetation includes some native chaparral-type shrubs and wild grasses mixed with an abundance of non-native plant varieties including eucalyptus, pepper and palm trees, and wild mustard.

SITE HISTORY

General:

Oil was discovered in the Whittier and Puente hills in 1884, and by 1900, the oil fields produced 50,000 barrels of oil per month. In the late 1980s and early 1990's, wells began to be shut down because they were not economical to operate. In 1995, the City of Whittier bought more than 1,200 acres from Chevron Corp. and Unocal with county Proposition A money, and the land was left as open space and hundreds of oil derricks were removed. The open space is currently managed by the Puente Hills Landfill Native Habitat Authority. The Habitat Authority manages 3,860 acres in the Puente Hills of which the City of Whittier owns 1,280 acres.

Past Grading:

The Open Area including all of the site have been extensively altered by past grading. Roadways, both paved and unpaved, maintained and not traverse most of the area and are cut into the hillsides and run up the canyons. In ground culverts and/or Arizona crossings allow roadways to traverse the stream beds. Level building pads are cut into the hillsides and occupy much of the flat-lying alluviated areas. Portions of the slopes have been over-steepened as a result of prior grading operations.
A residence and out buildings plus corrals are present and currently occupied and/or in use by the ranger. Most of the pipelines that traverse the area have been abandoned but have not been removed and are exposed locally. Cut slopes are abundant and exposed along the roadways. Fill areas are also present and may not be obviously reflected by the topography.

GEOLOGY

General

The Puente Hills expose Miocene marine sedimentary rocks assigned to the Monterey (Puente) Formation and Sycamore Canyon Formation overlain conformably by the Pliocene mostly marine clastic sequence of the Fernando Formation and unconformably overlain by the shallow marine sand of the Pleistocene San Pedro Formation capped by the La Habra alluvial sediments.

The Fernando Formation (Tf and Tfs) is exposed in the study area. Other earth materials exposed at the site include artificial fill (af), landslide deposits (Qls), younger alluvium (Qal) and older alluvium (Qoal). Regional geologic conditions are indicated on the enclosed Plate RG-2.

Earth Materials

Artificial Fill (af) (afu):

Where explored the fill appeared to have been placed in a loose uncompacted manner. Fill within the project site appears dumped, but some compaction may be present locally.

It consists of sandy clay to sandy silt containing concrete and/or asphalt. Expansion potential ranges from very low to medium. We have encountered fill soils ranging up to 10 feet in depth in some areas. See boring and test pit logs.

Landslide Deposits:
Previous exploratory mapping suggested a landslide on the northern portion of the well extraction area of the consolidated site. Further studies indicate that there is no slide in this area.

Younger Alluvium (Qal):
The younger alluvial deposits consists of loose sand and/or gravels associated with the active area of the stream beds.

Older Alluvium(Qoal):
Older alluvial deposits consist of silty sand, which is tan to light brown or light reddish brown, and contains small subrounded gravel, These deposits are generally dense. These soils have a very low to medium expansion potential.

1. Soils
   c=150 psf
   ϕ=29°
   γ=120 pcf

Fernando Formation (Tf) (Tfs):
The Fernando formation was found to consist of tan to yellow brown siltstone and silty fine-grained sandstone vaguely interbedded with gray claystone, or buff fine to medium-grained sandstone, locally micaceous. The sandstone facies (tfs) consists of light gray to rust brown fine to coarse-grained thickly bedded sandstone and pebble conglomerate. Locally fossiliferous. The sequence is moderately well cemented albeit friable on weathered surfaces. Bedding surfaces are generally planar with strikes trending east-westerly and dips ranging from 34 to 68 degrees to the south.

The bedrock materials are fairly dense and firm. The strengths are shown below. These soils are not susceptible to hydroconsolidation. These soils have a mild consolidation potential.

The following shows the strength values used in analysis for the bedrock formations. These strengths are based on the conservative use of ultimate shear strength for the cross bedding. Adverse bedding is present. Residual shear was considered necessary for the along bedding case.

1. Cross bedding
   $c=150$ psf
   $\phi=40°$
   $\gamma=120$ pcf

2. Along bedding
   $c=150$ psf
   $\phi=26°$
   $\gamma=120$ pcf

LANDSLIDES

According to the State of California Seismic Hazards Zones Map (Plate RG-3), the project site is located within an area of earthquake induced landslides. Review of the aerial photographs indicates that, overall, the topography is prone to surficial failure due to the friable nature of the Fernando Formation which forms the slopes within the entire project site. Small, cross-bedding landslides and surficial slope failures were noted in our previous studies along La Canada Verde Creek.

GROUNDWATER

Groundwater was not encountered in any of our exploratory excavations (maximum depth 60 feet). It should be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, temperature, and other factors not evident at the time of our study. Ground-water conditions were investigated in the Whittier Quadrangle by the State of California, Division of Mines and Geology (1998) to evaluate the depth to saturated materials. Their subsurface water data indicating depths to first-encountered unconfined ground water are shown on (Plate RG-4). Other than creek areas, historical groundwater is deeper than 100 feet according to the State of California Seismic Hazard Report for the Whittier Quadrangle.

SURFACE WATER

La Canada Verde Creek is designated as blue-line stream on the U.S.G.S. Whittier Quadrangle indicating that it is a stream which flows for most or all of the year.

FAULTING AND SEISMICITY

The project site is located within the Puente Hills blind-thrust system, an active blind-thrust system in the northern Los Angeles basin. The blind thrust extends for more than 40 km along strike in the northern Los Angeles basin from downtown Los Angeles east to Brea in northern

Orange County and consists of at least three distinct geometric segments, which from west to east include the Los Angeles, Santa Fe Springs, and Coyote Hills segments, from west to east(Shaw, et.al., 2002). The project site appears to be located within the Coyote Hills segment of the thrust fault. The Puente Hills Blind Thrust appears to have generated the 1987 Whittier Narrows Earthquake (magnitude 5.9, focal depth 9.5 km) (USGS). Aftershocks from this earthquake occurred on the northwestern splay of the Whittier fault system which may indicate that two major fault systems may have linked slip and rupture histories. Moreover, Shaw(2002) postulates that the Puente Hills Blind Thrust segments could rupture separately and produce magnitude 6.5 to 6.6 earthquakes or if multi-segments were to rupture, magnitude 7.1 earthquakes could be produced. Slip rates suggest that earthquakes would occur every 400 to 1320 years on individual and segments and 780 to 2600 years on multi-segments.

The Whittier fault system extends across the Santa Fe Springs and Coyote Hills segments of the Puente Hills Thrust. The Whittier Fault zone is exposed along the south slopes of the Puente Hills and is seen north of the study area. It has a length of approximately 25 miles between the Whittier Narrows at the northwest end of the hills and the Santa Ana River near the southeast end. In the vicinity of the river it joins or becomes the southeast-trending Elsinore fault zone. In the Puente Hills fault consists of one to three subparallel reverse right oblique fault strands in a zones as wide as 1.3 km. The zone strikes N65° to 75°W and most strands dip 65° to 75° NE with the northeast (Puente Hills) block upthrown. Stratigraphic separation of upper Miocene rock across the zone increases from about 2000 feet near its southeast end to a maximum of about 14000 feet near the center of the Puente Hills segment, northwest of which it decreases to about 3000 feet near the Whittier Narrows. Stream courses in the central part of the segment may have been offset about 5500 in a right lateral sense. A narrow band of east-plunging drag folds extends for about 10 miles along the fault zone in the upthrown block of the fault. The plunges of these folds steepen progressively from about 35 degrees in the Brea-Olinda oil field to about 75 degrees in the Whittier oil field . On the basis of this evidence, oblique net slip of about 15000 feet may be computed for post-Miocene including Holocene movement on the Puente Hills segment of the fault.

The site, as with all sites in southern California, will experience significantly strong seismic ground motions caused by activity on regional faults at some time in the future. Those which are of major significance to the project include, among others, the San Andreas Fault, the Whittier Fault, the Elysian Park Thrust, and the San Jose Fault. Within the last 60 years at least 60 events of magnitude 5.0 or greater have occurred in the southern California region. There is a high probability that other significant events will occur in this century. Potential hazards from earthquakes in the project area include ground shaking, fault rupture, liquefaction, lateral spreading and seismic settlement.

Ground Shaking

Strong to severe ground shaking will be experienced in the project area if a large magnitude earthquake occurs on one of the nearby active or potentially active faults. Strong to severe ground shaking will be experienced in the project area if a large magnitude earthquake occurs on one of the nearby active or potentially active faults.

A maximum earthquake site acceleration value of 0.4861g was calculated (Plate F.2). These values were estimated using the attenuation and statistical relationships developed by Borzognia, Campell and Niazi (1999- Soft Rock) for faults within a 100 mile radius of the site. This is based on on 6.8 predominant earthquake.

A maximum earthquake site acceleration value of 0.475g was calculated (Plate 1.7). These values were taken from the State of California Seismic Hazard Reports for the Whittier Quadrangle using the 10% Exceedance Peak Ground Acceleration for Alluvium Conditions. This is based on on 6.8 predominant earthquake.

Based upon the predicted ground acceleration and underlying earth material conditions, moderate to severe ground shaking due to a seismic event on a nearby fault could potentially cause damage to the proposed and existing structures.

Fault Rupture

Surface rupture usually occurs along the traces of known active or potentially active faults, although many historic and recent events occurred on faults not previously known to be active. Inasmuch as the proposed development is not planned within 50 feet from any feature which may be fault related, the potential for damage as a result of ground rupture is considered to be low.

Liquefaction and seismic shaking
The potential for liquefaction is defined by several factors which include: magnitude and proximity of the earthquake, duration of shaking, soil types, grain size distribution, density, effective overburden, groundwater level, as well as others.

As with most of Southern California, this area is bordered by faults which are active potentially active and inactive. The faults which is of most concern from a ground shaking viewpoint is the Whittier fault. This fault is capable of generating large to moderate earthquakes and of causing significant shaking at the site. The site will experience significantly strong coseismic ground motions caused by activity on regional faults at some time in the future.

The earthquake magnitudes used was formulated using maximum probable values. These values are used with the distances from the site to formulate the accelerations. The probabilistic methods are used to determine the accelerations from emperical data. The chart of this data is presented in the addendum.

The accelaration used in the liquefaction analysis is 0.48. We utilize the maximum probable acceleration at the site to develop estimates of field loading equivalent uniform cyclic stress ratios used to represent cyclic loading.

Groundwater was not found below the surface. We are assuming a historical high water level of 30 feet in the liquefaction analysis. The standard penetration numbers are presented on the boring logs.

To convert standard penetration data to a $N1_{60}$ value, corrections are made for the overburden, and rod length. No corrections are needed for the sampling method of a cathead. No corrections are needed for liners in the spt device.

The soil profile will most likely not experience liquefaction on any of the sites. The liquefaction induced settlement is on the order of 0 inches. Emperical data has been developed to relate standard penetration values with bulk modulus of settlement. These values are used to determine the settlement in the layers.

Lateral Spreading

Lateral spreading occurs as a result of liquefaction in which a subsurface layer becomes a liquefied mass, and gravitational and inertial forces cause the mass the move downslope. In light of the materials described in the exploratory borings within La Canada Verde Creek, the potential of lateral spreading during a strong seismic event was considered and evaluated. Evaluation shows that liquefaction induced lateral spreading is not anticipated to occur due to the lack of liquefaction.

SLOPE STABILITY

We used the value of the ultimate shear strength in the analysis for the cross bedding areas. We have used residual shear strength for the along bedding strength. This is in compliance with the classification analysis.

Since there is adverse bedding on the project, we are using planar failures in some cases to determine the factor of safety for gross stability. We have analyzed the failures at different depths and different angles through the bedding to fail through the site.

Gross Stability

The overall gross stability of the slopes that are directly above the consolidated site were evaluated. The physical testing and inspection did not reveal a slide plane underneath the proposed developments. No gross stability failures were noted.

Bishops and Spencers method was used with computer analysis to determine gross stability. Factors of safety are all above 1.5 after the construction procedures and designs are followed.

The gross factor of safety for the overall stability of the entire hillside range have a factor of safety of 1.93.

The standards from the CBC(2010) mandate a factor of safety of 1.5 for finished stability, 1.1 for seismic stability.

The seismic gross factor of safety for the overall stability of the entire hillside range is 1.47. All areas will have a factor of safety above 1.1 for seismic.

Surficial Stability

The slopes around the project are not surficially stable in general. Surficial failures are seen in abundance. Some stabilization of slopes is recommended. See Construction Procedures.

2003 NEHRP Seismic Design Provisions

Latitude = 33.97
Longitude = -118.01

Spectral Response Accelerations SMs and SM1
SMs = Fa x Ss and SM1 = Fv x S1
Site Class D - Fa = 1.0 ,Fv = 1.5

Period (sec)	Sa (g)	
0.2	2.025	(SMs, Site Class D) Ss=2.025/1=2.025
1.0	1.098	(SM1, Site Class D) S1=1.098/1.5=0.732

Design Spectral Response Accelerations SDs and SD1
SDs = 2/3 x SMs and SD1 = 2/3 x SM1
Site Class D - Fa = 1.0 ,Fv = 1.5

Period (sec)	Sa (g)	
0.2	1.350	(SDs, Site Class D)
1.0	0.732	(SD1, Site Class D)

Site Modified Response Spectrum for Site Class D
SMs = FaSs and SM1 = FvS1
Site Class D - Fa = 1.0 ,Fv = 1.5

Period (sec)	Sa (g)	Sd (inches)
0.000	0.810	0.000
0.108	2.025	0.233
0.200	2.025	0.791
0.542	2.025	5.819
0.600	1.830	6.437
0.700	1.569	7.510
0.800	1.373	8.583
0.900	1.220	9.656
1.000	1.098	10.729
1.100	0.998	11.802
1.200	0.915	12.875
1.300	0.845	13.948
1.400	0.784	15.021
1.500	0.732	16.094
1.600	0.686	17.167
1.700	0.646	18.240
1.800	0.610	19.312
1.900	0.578	20.385
2.000	0.549	21.458

RECOMMENDATIONS

General

In general, most of the structures can be supported on compacted fill soils using spread foundations.

Depending on foundation locations, loads and other factors, some pile foundations may be needed. Piles are anticipated for large retaining walls(15 feet high) and may be needed for equipment with excessive vibration.

The hillsides are subject to surficial failure due to the friable nature of the underlying siltstone and sandstone units. Due to the potential for debris flows, the slopes steeper than 3:1 above the well pads, are required to be rebuilt per our specifications shown in the Construction Procedures section of this report. The slopes to the east of the well pads are required to be rebuilt regardless of whether or not retaining walls are utilized.

The grading plan(Plate M1) indicate the possibility of removing the retaining walls that are planned at the toe of the slopes to the east of the well pads. Due to the extensive nature of the rebuilding process of the slopes above the well pads, it is anticipated that these retaining walls will become unnecessary.

Spread Foundations

The expansion potential of the natural soils indicates a foundation design for medium expansion soils is needed for the foundations.

Supporting Soils

For shallow foundations, the proposed structures shall be supported on the properly compacted fill soils resulting from following the recommendations in the Construction Procedures section.

Depth and Width

The footings must extend at least 21 inches below finished grade. Minimum width for the footings is 12 inches.

Allowable Bearing Value

The proposed foundations may be designed for an allowable bearing pressure of 3000 pounds per square foot on the compacted fill soils. This value may be increased by 1/3 for wind or seismic forces. No change in bearing pressure for mat foundations up to 15 feet by 15 feet. For mat foundations over this size, the allowable bearing pressure shall be reduced to 2000 pounds per square foot.

Settlement

Load induced settlement of the structures should not exceed 1/2 inch. Differential settlement should be less than 1/4 inch. Larger tanks are expected to have settlements not to exceed 2 inches with 1 inch of differential settlement. The settlement is expected to be immediate with some small amount of creep settlement. Loading of tanks for a period of 2 months is sufficient for the settlement to occur.

Lateral Values

The coefficient of friction for the foundations shall use a maximum value of 0.4. The allowable passive pressure is equal to a fluid density of 250 pounds per cubic foot. This value may be increased by 1/3 for wind or seismic forces. Sliding resistance and passive pressure may be combined to resist lateral forces without reduction.

Pile Foundations

General

Due to load considerations, some of the structures will need to be supported on deepened foundations. Deepened foundations will be in the form of drilled piles. The drilled piles will form the support for the structures. These structures may include the high retaining walls and the equipment with excessive vibration.Piles shall be designed for corrosive elements that are normal for clay soils.

Supporting Soils

Pile foundations for the structures will be founded in the firm, natural soils and siltstone and sandstone bedrock. We will need to verify depths of each pile during construction.

Spacing and Size
The piles shall be no closer than 2-1/2 times the pile diameters. The piles must be at least 2 feet in diameter. Larger diameters may be used as needed for structural sections of the piles and for vertical and horizontal capacities. Maximum pile spacing will be at the discretion of the structural engineer.

Depth and vertical capacities
Piles must be drilled to a depth at least 25 feet below finished grade a minimum of 10 feet into firm bedrock. The anticipated downward vertical capacity based on shear testing is as shown below. Upward vertical capacity is half the downward vertical capacities.

24" Diameter	70 kips
30" Diameter	100 kips

These values are based on the friction capabilities of the soil and bedrock on the piles. Actual capacities may be less due to the capacity of the concrete and steel in the piles. No load testing required.

Lateral Pile Capacity
The passive pressure of the bedrock shall be designed for 400 pounds per cubic foot. This value shall be limited to 10 times this amount. All seismic designs shall include this lateral loading.

Settlement
The drilled piles should not settle more than 1/2 inch and less than 1/4 differential settlement.

Installation
Piles shall be installed by a competent company. Large equipment should be used for the drilling process. Piles will need to have steel and concrete placed immediately upon completion of drilling of each pile.

Retaining Walls

Lateral values
The retaining walls must be designed to resist a lateral pressure equal to a fluid density of 60 pounds per cubic foot assuming a level backfill behind the walls to accommodate active pressures. The retaining

walls must be designed to resist a lateral pressure equal to a fluid density of 75 pounds per cubic foot assuming a 2:1 backfill behind the wall.

If desired, the retaining walls can be designed to resist a lateral pressure equal to a fluid density of 100 pounds per cubic foot assuming a level backfill behind the walls to accommodate at rest pressures. For a 2:1 backfill, the retaining walls can be designed to resist a lateral pressure equal to a fluid density of 115 pounds per cubic foot to accommodate at rest pressures.

All walls shall have a 15% increase in the active pressures for seismic loadings.

Drainage

The space behind the retaining walls should be filled with a granular material as outlined in the earthwork section of construction procedures.

A method of drainage should be provided in the form of a slotted pipe with Class 2 permeable material. Felt shall be placed over the gravel at about the 1 foot level.

Slabs on Grade

The slabs may be placed on the resulting compacted fill from proper grading. The slabs should be designed for soils of medium expansion. Reinforcing should have a minimum of #4 bars at 18 inches on centers each way.

For buildings, a visquene covering shall be used to serve as a water vapor barrier. A 2 inch layer of sand should be placed on top of the visquene.

Drains and Grades

All grades shall drain away from the foundations. Downspouts should be drained away from the foundations.

Slope Setbacks

All structures must maintain a 15 feet buffer from hillsides. Debris flows are not anticipated due to extensive rebuilding of the slopes above the site. Slopes steeper than 3:1 will be rebuilt to preclude the possibility of debris flows. This is shown on the accompanying grading plan in the report.

Construction Procedures

Slopes

All temporary slopes must maintain 1 to 1 horizontal to vertical. Vertical cuts over 4 feet are not allowed by OSHA.

Hillsides should be planted for erosion control. Some compacted fill slopes may be generated for the project. **All cut and compacted fill slopes shall not exceed 3:1 without geofabric reinforcing. Slopes shall not exceed 2:1 with reinforcing.**

All appropriate drains and slope interceptor drains shall be installed as required by the local jurisdiction.

Excavations

To support structures and any proposed fill soils the following must be excavated.

1) In the area of the proposed grading all organic material should be removed and taken off site.

2) All loose fill soils on the proposed site. Loose fill soils were encountered up to depths of 10 feet. Deeper loose fill soils may be encountered.

3) All soils to at least a depth of 6 feet below finished grade and 4 feet beneath proposed spread foundations **in the northern portion of the site designated as the gas plant.**

4) All soils to at least a depth of 5 feet below any fill soils into alluvial soils and or bedrock **in the northern portion of the site designated as the gas plant.**

5) All older alluvium soils down to bedrock in the tank areas **designated as the truck receiving area and processing facility.**

6) Keyways shall be placed at the bottom of all

rebuilt cut slopes, rebuilt slopes and fill slopes to a depth of at least 5 feet into competent alluvial soils and or bedrock. Width shall be a minimum of 15 feet. A 20 feet keyway shall be placed at the bottom of the largest cut slopes above the well pads. A drain shall be placed in the keyway.

7) For all cut slopes and hillside rebuild areas, remove all soils to a depth of 15 feet. Benches shall be placed into hillside. Benching shall consist of at least 10 feet of level area into firm bedrock.

Standard grading procedure

After excavation the following must be accomplished.

1) All bottoms of the excavations shall be scarified and compacted to 90% compaction.

2) All fills and backfills should be placed in horizontal layers less than 8 inches in loose thickness.

3) The soils shall be compacted to a minimum of 90% of the maximum density rendered by the latest ASTM version D-1557.

4) The moisture content should not vary more than 2% from the optimum moisture content, although the grading process will be more easily accomplished with the soils being 1 to 2% wetter than optimum moisture content.

5) Any utility trenches will need to be properly backfilled as detailed in 2,3 and 4 above.

6) All on site soils may be used. Any import soils should be approved by our firm.

7) All fill slopes shall be compacted by tracking or cutting back to firm.

8) For all fill, cut and rebuild slopes(steeper than 3:1), place geofabric in outer 15 feet of slope at 4 feet intervals. Fabric to wrap around slope face.

9) Place subdrains in rebuilt slopes, rebuilt cut slopes and fill slopes every 15 vertical feet. Subdrains consist of slotted pipe, 12 inch gravel pack and a felt layer.

Inspection

This is an important step to obtain quality construction and to obtain correct design. The following will need inspection by our firm.

* Foundations
* All earthwork
    - a) All bottoms of excavations(geology and soils)
    - b) All keyways and benches(geology and soils)
    - c) Testing every 2 vertical feet of fill
* Subgrade preparation for slabs on grade

Inspection, by our firm, is needed to assure that the soil conditions are consistent with this report and design assumptions. Inspection by local government agencies may also be needed.

ASPHALTIC PAVING

The asphaltic paving is designed using a R value of 10 for the type of soil. The Asphalt Institute Method is used for designing the paving.

The following design will be satisfactory assuming a stable and compacted subgrade. The following sections will address this issue. The pavement sections are designed for traffic indices of 4-1/2 and 5-1/2. Both are presented.

Areas that are subject to purely auto traffic may use a Traffic Index of 4-1/2. Areas subject to some truck traffic must use a traffic index of at least 5-1/2. Areas subject to heavy traffic must use a traffic index of at least 6-1/2.

TI=4-1/2

3" Asphaltic paving over

6" Base course

TI=5-1/2
4" Asphaltic paving over
8" Base course

TI=5-1/2
4" Asphaltic paving over
12" Base course

Base course shall use class 2 aggregate base compacted to 95% of maximum compaction. Asphalt shall be similarly compacted. Proper drainage of paved areas will increase the life of the paving.

Construction Procedures for pavement

Excavations

To support pavements the following must be excavated.

1) In the area of the proposed grading all organic material should be removed and taken off site.

2) All soils to at least a depth of 2 feet below existing and finished grade.

3) All fill soils. Substantial fill soils will be encountered over the drainage pipe at the southern entrance to the consolidated site.

Standard grading procedure

After excavation the following must be accomplished.

1) All bottoms of the excavations shall be scarified and compacted to 90% compaction.

2) All fills and backfills should be placed in horizontal layers less than 8 inches in loose thickness.

3) The soils shall be compacted to a minimum of 90% of the maximum density rendered by the latest ASTM version of D-1557.

4) The moisture content should not vary more than 2% from the optimum moisture content, although the grading process will be more easily accomplished with the soils being 1 to 2% wetter than optimum moisture content.

5) Any utility trenches will need to be properly backfilled as detailed in 2,3 and 4 above.

6) All on site soils may be used. Any import soils should be approved by our firm.

7) All fill slopes shall be compacted by tracking or cutting back to firm.

8) For fill slopes(steeper than 3:1), place geofabric in outer 15 feet of slope at 4 feet intervals. Fabric to wrap around slope face.

9) Drainage area(southern entrance to the consolidated site) shall have rip-rap to prevent erosion and be properly designed for peak flows with proper inlet by the Civil Engineer.

Inspection

This is an important step to obtain quality construction and to obtain correct design. The following will need inspection by our firm or as detailed by the Local Jurisdiction.

* All earthwork
    a) All bottoms of excavations(geology and soils)
    b) All keyways and benches(geology and soils)
    c) Testing every 2 vertical feet of fill and as quantities needed for local jurisdiction
    d) Base compaction

* Subgrade preparation for slabs on grade

Inspection, by our firm, is needed to assure that the soil conditions are consistent with this report and design assumptions. Inspection by local government agencies may also be needed.

BASIS OF REPORT

RIGHT OF USE

This report is intended exclusively for the use of Matrix Oil Corporation and their project designers.

METHODS

This report has been developed based on our understanding of the project details, field review, boring excavations, laboratory testing, engineering analyses, and experience with similar soil conditions with similar use and loads.

DEGREE OF PERFORMANCE

The work was performed using the methods and degree of care used by other soil engineering firms operating in this vicinity, for similar projects, in this time period. This firm is responsible only for our own negligent errors and negligent omissions. Any error or omission that results in an unexpected cost that normally would have been present, is not the responsibility of our firm. Nothing else is warranted, implied or expressed, as to the details presented in this report.

VALIDITY OF REPORT

Changes

This report is valid for this specific project as described in the text of the report and on the plot plan. Any change in project size, loads, location, grade or use would require a review of this report.

Inspection

The recommendations given in this report are based on the assumption that all necessary inspection work will be performed during the construction phase of the project. The initial soil engineering investigation is only a part of the work needed to obtain correct engineering design. The soil conditions are only anticipated in the initial report. The inspection work verifies the conditions are as expected and allow our firm the ability to modify the recommendations in the event that the soil conditions are different.

The presence of inspection will provide the owner with the ability to obtain advice as to soil related construction procedures and answer related questions as to the implementation of the recommendations provided in this report.

If another firm is used to perform the construction inspection of the soil related aspects, our professional liability and responsibility would be drastically reduced to the point that we would no longer be the soils engineer of record.

Should the project be delayed beyond the period of one year after the date of this report, the site should be examined and the report reviewed to consider possible changed conditions.

This report is issued with the understanding that it is the responsibility of the owner, or his representative, to assure that the information and recommendations contained herein are called to the attention of the designers and builders for the project.

The subsurface conditions, excavations, characteristics, and geologic structure described herein and shown on the enclosed cross sections have been projected from individual excavations and outcrops on the subject property. The subsurface conditions, excavation characteristics, and geologic structure shown should in no way be construed to reflect any variations which may occur between these excavations and outcrops.

If conditions encountered during construction appear to differ from those disclosed, this office should be notified so as to consider the need for modifications. No responsibility for construction compliance with the design concepts, specifications, or recommendations is assumed unless on-site construction review is performed during the course of construction which pertains to the specific recommendations contained herein.

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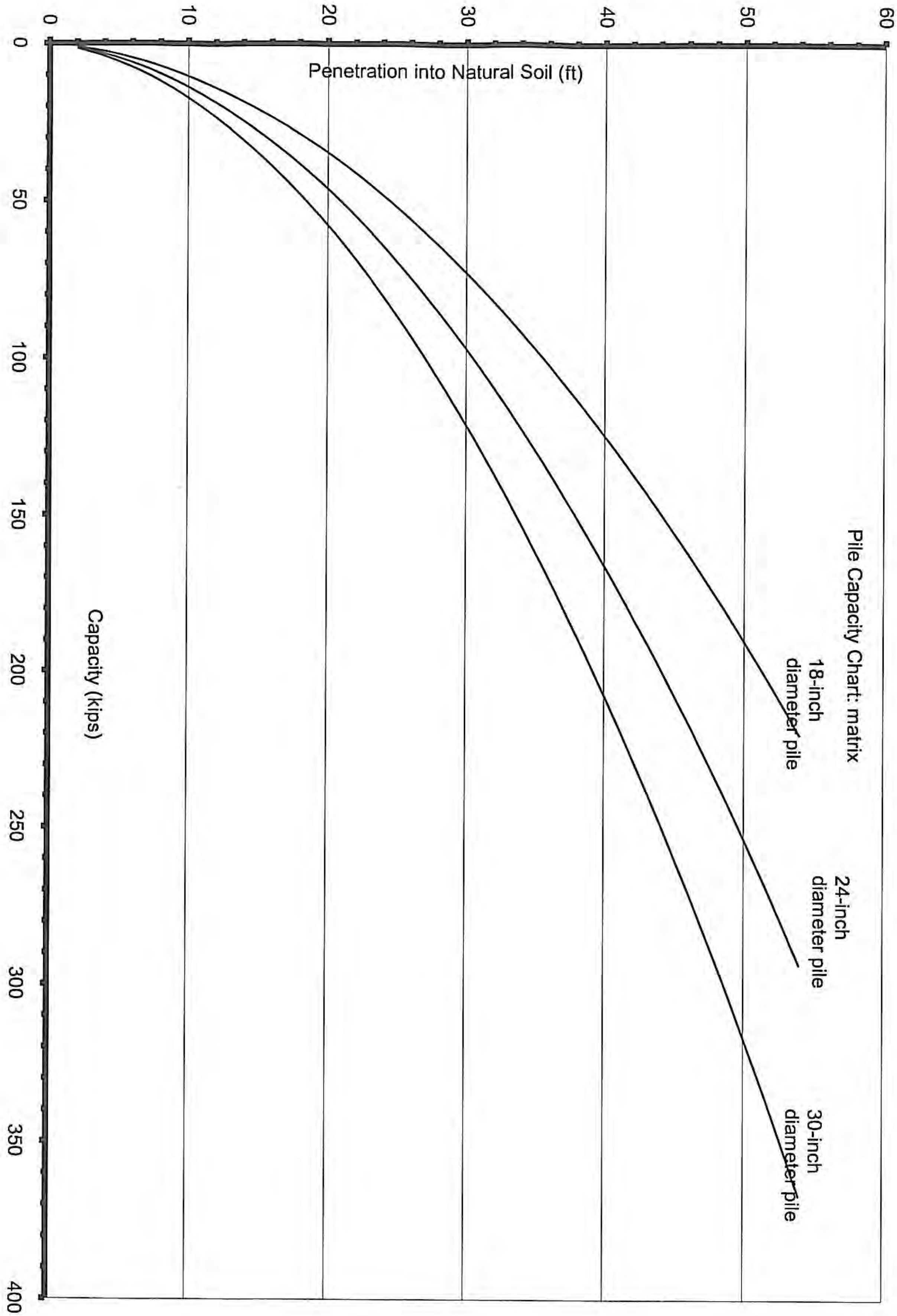
Plate R

Pile Capacity Charts
matrix

C=	150
phi=	26
gamma=	120
f.s.d.f.	0.5

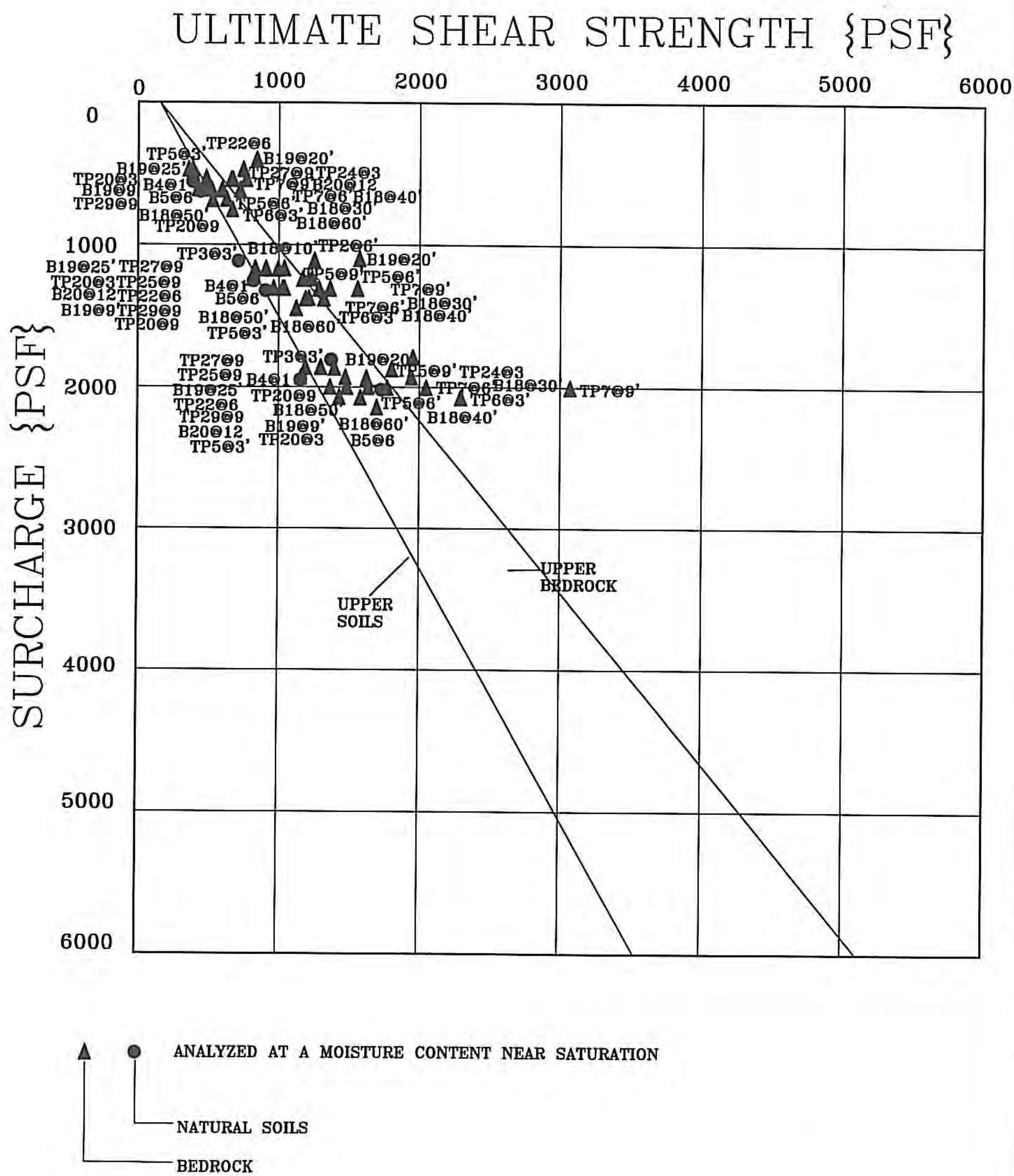
Penetration into natural	Drilled Pile Capacities (kips) 18-inch	24-inch	30-inch
54	220.1	293.5	366.9
52	204.8	273.1	341.4
50	190.0	253.4	316.7
48	175.8	234.4	293.0
46	162.1	216.2	270.2
44	149.0	198.7	248.4
42	136.5	182.0	227.4
40	124.5	165.9	207.4
38	113.0	150.7	188.3
36	102.1	136.1	170.1
34	91.7	122.3	152.9
32	81.9	109.2	136.5
30	72.7	96.9	121.1
28	64.0	85.3	106.6
26	55.8	74.4	93.0
24	48.2	64.3	80.3
22	41.1	54.9	68.6
20	34.6	46.2	57.7
18	28.7	38.3	47.8
16	23.3	31.1	38.8
14	18.5	24.6	30.8
12	14.2	18.9	23.6
10	10.4	13.9	17.4
8	7.2	9.7	12.1
6	4.6	6.1	7.7
4	2.5	3.4	4.2
2	1.0	1.3	1.6


Pile Capacity Chart: matrix
Penetration into Natural Soil (ft)
Capacity (kips)
18-inch diameter pile
24-inch diameter pile
30-inch diameter pile
0
10
20
30
40
50
60
0
50
100
150
200
250
300
350
400

APPENDIX

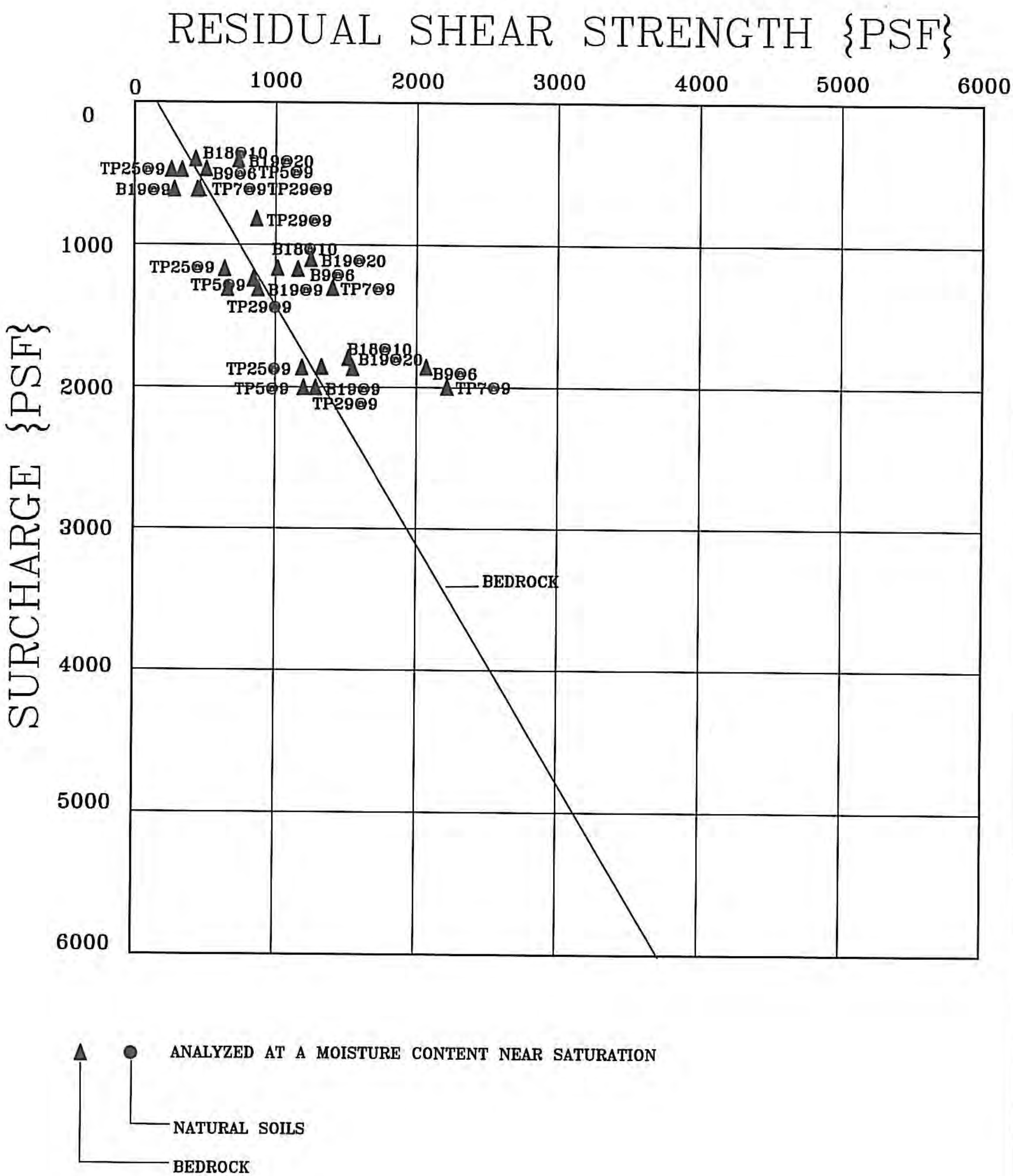
TESTING

DIRECT SHEAR TESTS
CONSOLIDATED SITE



T-1

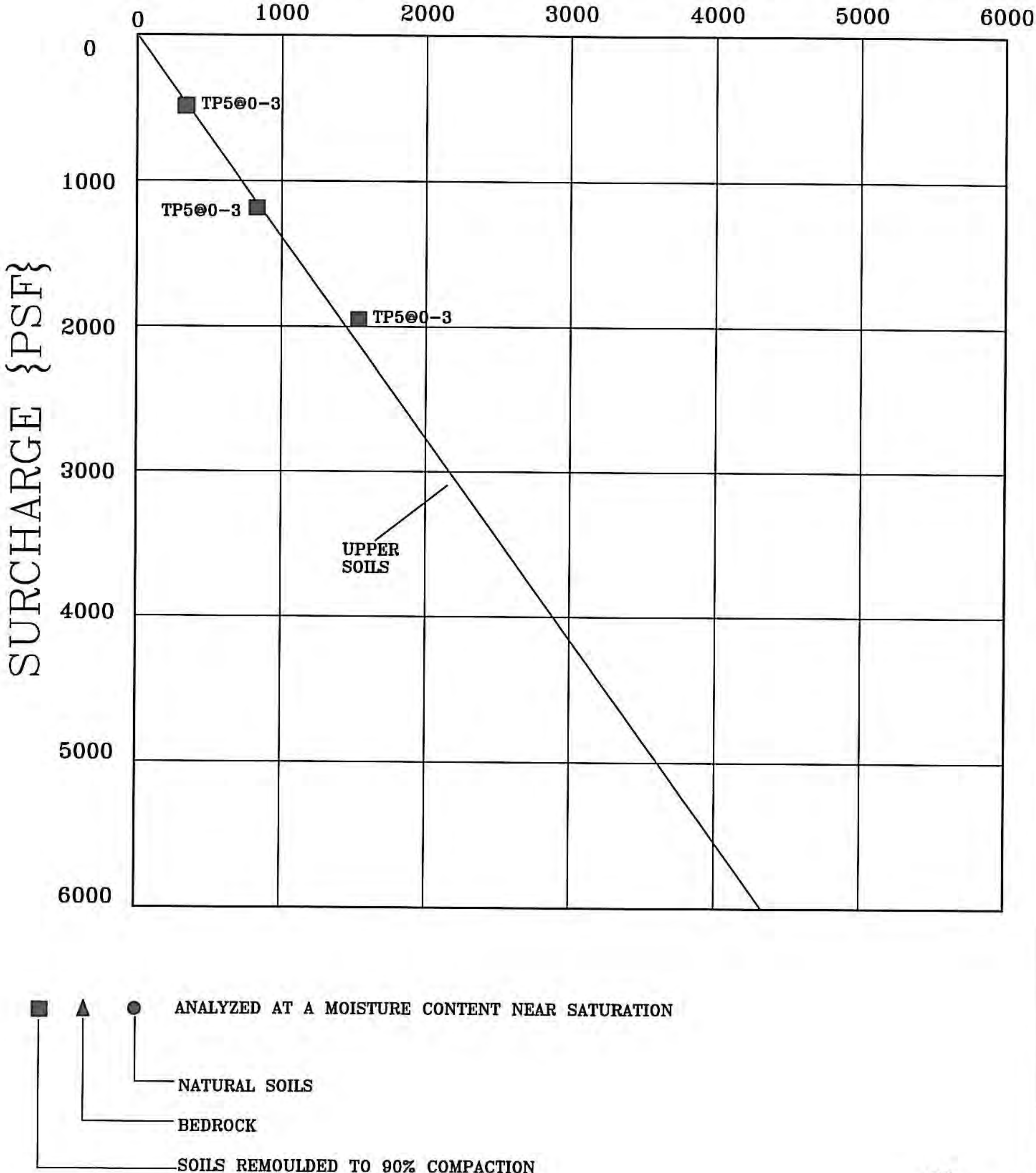
DIRECT SHEAR TESTS CONSOLIDATED SITE



T-2

DIRECT SHEAR TESTS CONSOLIDATED SITES

COMPACTED FILL SOILS ULTIMATE SHEAR STRENGTH {PSF}



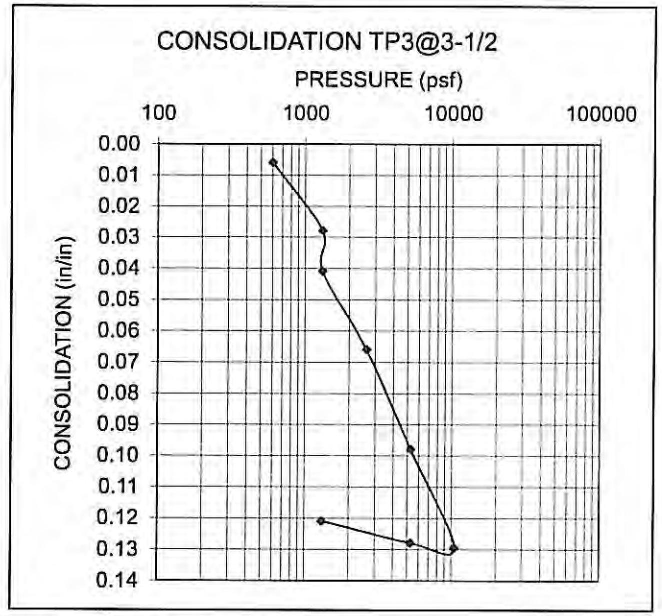
T-3

CONSOLIDATION

TP3@3-1/2

Reading	Water?	Load (g)	Dial	Displacement (in.)	Pressure (psf)
1		0	0	0	0
2		590	6	0.006	600
3		1290	28	0.028	1313
4	yes	1290	41	0.041	1313
5	yes	2580	66	0.066	2625
6	yes	5160	98	0.098	5250
7	yes	10320	129.5	0.1295	10501
8	yes	5160	128	0.128	5250
9	yes	1290	121	0.121	1313

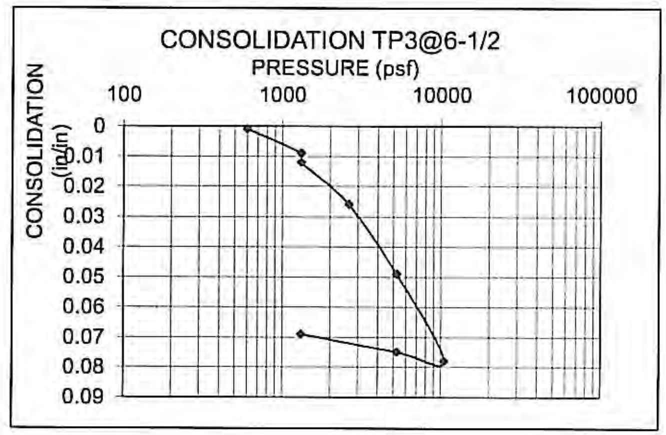
Pressure (psf)	Consol (in/in)
600	0.01
1313	0.03
1313	0.04
2625	0.07
5250	0.10
10501	0.13
5250	0.13
1313	0.12



TP3@6-1/2

Reading	Water?	Load (g)	Dial	Displacement (in.)	Pressure (psf)
1		0	0	0	0
2		590	1	0.001	600
3		1290	9	0.009	1313
4	yes	1290	12	0.012	1313
5	yes	2580	26	0.026	2625
6	yes	5160	49	0.049	5250
7	yes	10320	78	0.078	10501
8	yes	5160	75	0.075	5250
9	yes	1290	69	0.069	1313

Pressure (psf)	Consol (in/in)
600	0.001
1313	0.009
1313	0.012
2625	0.026
5250	0.049
10501	0.078
5250	0.075
1313	0.069



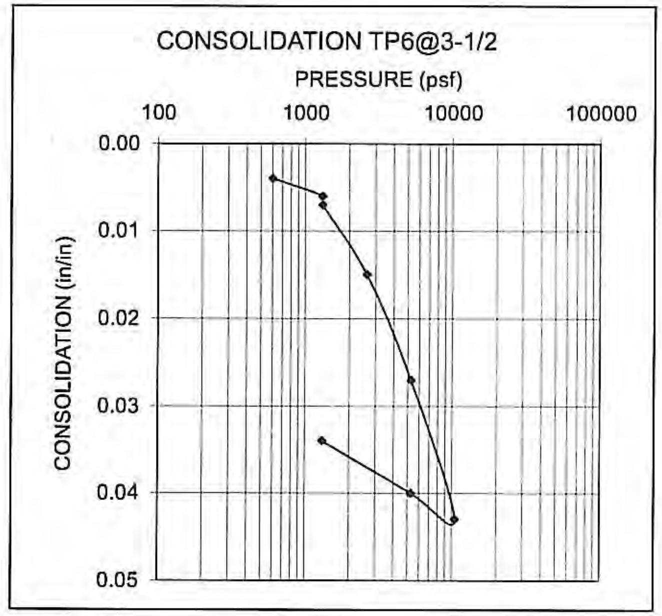
T-4

CONSOLIDATION

TP6@3-1/2

Reading	Water?	Load (g)	Dial	Displacement (in.)	Pressure (psf)
1		0	0	0	0
2		590	4	0.004	600
3		1290	6	0.006	1313
4	yes	1290	7	0.007	1313
5	yes	2580	15	0.015	2625
6	yes	5160	27	0.027	5250
7	yes	10320	43	0.043	10501
8	yes	5160	40	0.04	5250
9	yes	1290	34	0.034	1313

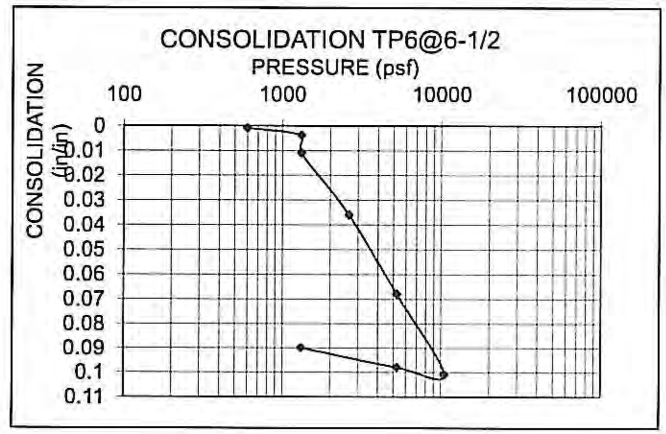
Pressure (psf)	Consol (in/in)
600	0.00
1313	0.01
1313	0.01
2625	0.02
5250	0.03
10501	0.04
5250	0.04
1313	0.03



TP6@6-1/2

Reading	Water?	Load (g)	Dial	Displacement (in.)	Pressure (psf)
1		0	0	0	0
2		590	1	0.001	600
3		1290	4	0.004	1313
4	yes	1290	11	0.011	1313
5	yes	2580	36	0.036	2625
6	yes	5160	68	0.068	5250
7	yes	10320	101	0.101	10501
8	yes	5160	98	0.098	5250
9	yes	1290	90	0.09	1313

Pressure (psf)	Consol (in/in)
600	0.001
1313	0.004
1313	0.011
2625	0.036
5250	0.068
10501	0.101
5250	0.098
1313	0.09



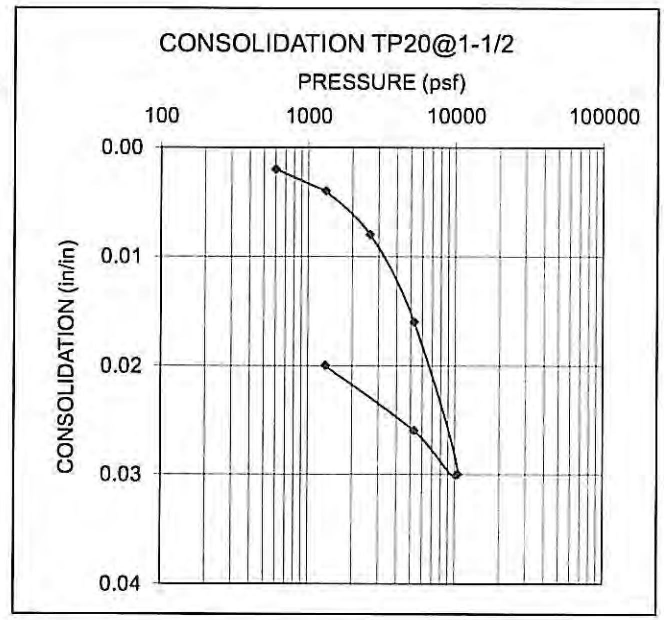
T-5

CONSOLIDATION

TP20@1-1/2

Reading	Water?	Load (g)	Dial	Displacement (in.)	Pressure (psf)
1		0	0	0	0
2		590	2	0.002	600
3		1290	4	0.004	1313
4	yes	1290	4	0.004	1313
5	yes	2580	8	0.008	2625
6	yes	5160	16	0.016	5250
7	yes	10320	30	0.03	10501
8	yes	5160	26	0.026	5250
9	yes	1290	20	0.02	1313

Pressure (psf)	Consol (in/in)
600	0.00
1313	0.00
1313	0.00
2625	0.01
5250	0.02
10501	0.03
5250	0.03
1313	0.02



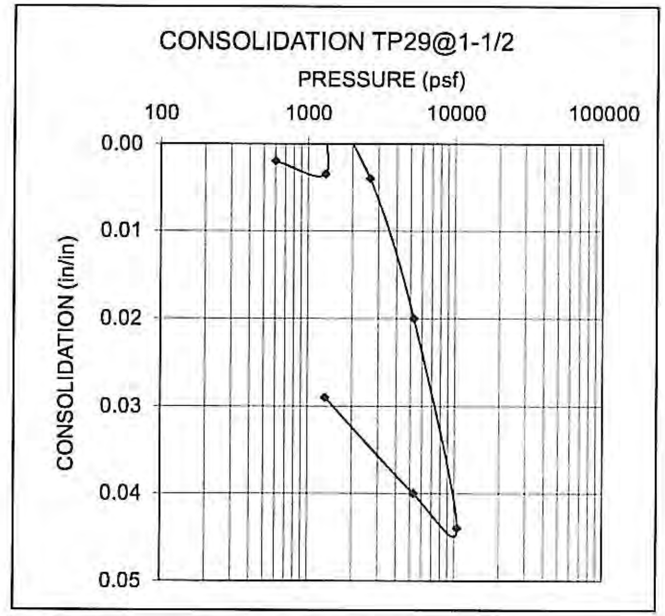
T-6

CONSOLIDATION

TP29@1-1/2

Reading	Water?	Load (g)	Dial	Displacement (in.)	Pressure (psf)
1		0	0	0	0
2		590	2	0.002	600
3		1290	3.5	0.0035	1313
4	yes	1290	-4	-0.004	1313
5	yes	2580	4	0.004	2625
6	yes	5160	20	0.02	5250
7	yes	10320	44	0.044	10501
8	yes	5160	40	0.04	5250
9	yes	1290	29	0.029	1313

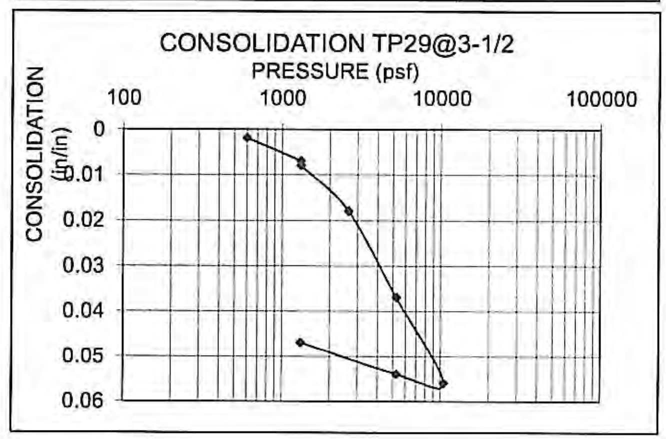
Pressure (psf)	Consol (in/in)
600	0.00
1313	0.00
1313	0.00
2625	0.00
5250	0.02
10501	0.04
5250	0.04
1313	0.03



TP29@3-1/2

Reading	Water?	Load (g)	Dial	Displacement (in.)	Pressure (psf)
1		0	0	0	0
2		590	2	0.002	600
3		1290	7	0.007	1313
4	yes	1290	8	0.008	1313
5	yes	2580	18	0.018	2625
6	yes	5160	37	0.037	5250
7	yes	10320	56	0.056	10501
8	yes	5160	54	0.054	5250
9	yes	1290	47	0.047	1313

Pressure (psf)	Consol (in/in)
600	0.002
1313	0.007
1313	0.008
2625	0.018
5250	0.037
10501	0.056
5250	0.054
1313	0.047



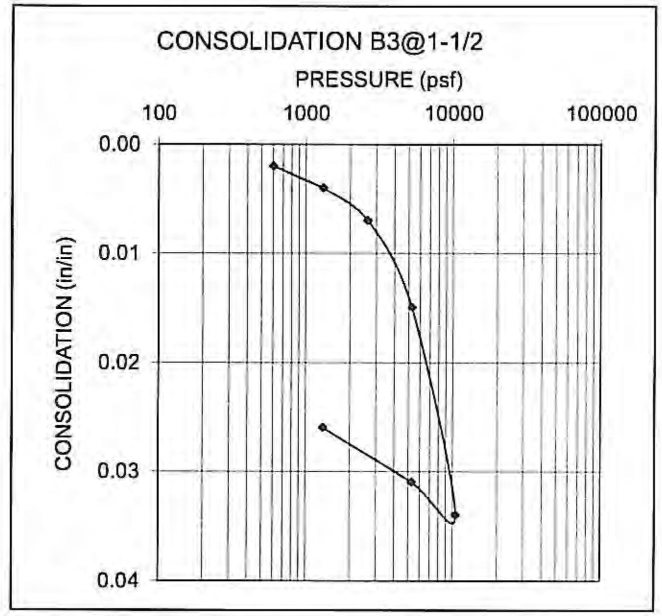
T-7

CONSOLIDATION

B3@1-1/2

Reading	Water?	Load (g)	Dial	Displacement (in.)	Pressure (psf)
1		0	0	0	0
2		590	2	0.002	600
3		1290	4	0.004	1313
4	yes	1290	4	0.004	1313
5	yes	2580	7	0.007	2625
6	yes	5160	15	0.015	5250
7	yes	10320	34	0.034	10501
8	yes	5160	31	0.031	5250
9	yes	1290	26	0.026	1313

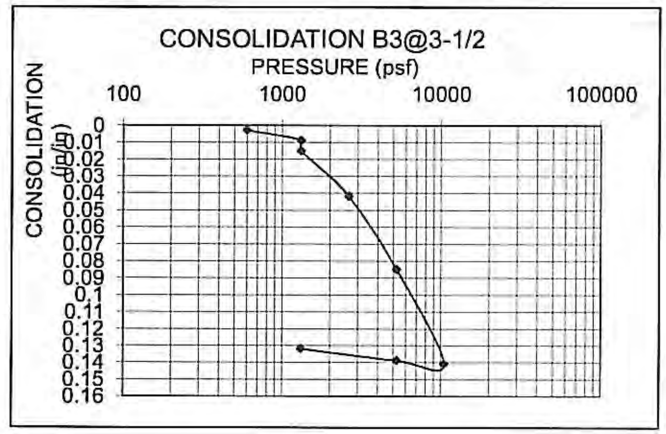
Pressure (psf)	Consol (in/in)
600	0.00
1313	0.00
1313	0.00
2625	0.01
5250	0.02
10501	0.03
5250	0.03
1313	0.03



B3@3-1/2

Reading	Water?	Load (g)	Dial	Displacement (in.)	Pressure (psf)
1		0	0	0	0
2		590	3	0.003	600
3		1290	9	0.009	1313
4	yes	1290	15	0.015	1313
5	yes	2580	42	0.042	2625
6	yes	5160	85	0.085	5250
7	yes	10320	141	0.141	10501
8	yes	5160	139	0.139	5250
9	yes	1290	132	0.132	1313

Pressure (psf)	Consol (in/in)
600	0.003
1313	0.009
1313	0.015
2625	0.042
5250	0.085
10501	0.141
5250	0.139
1313	0.132



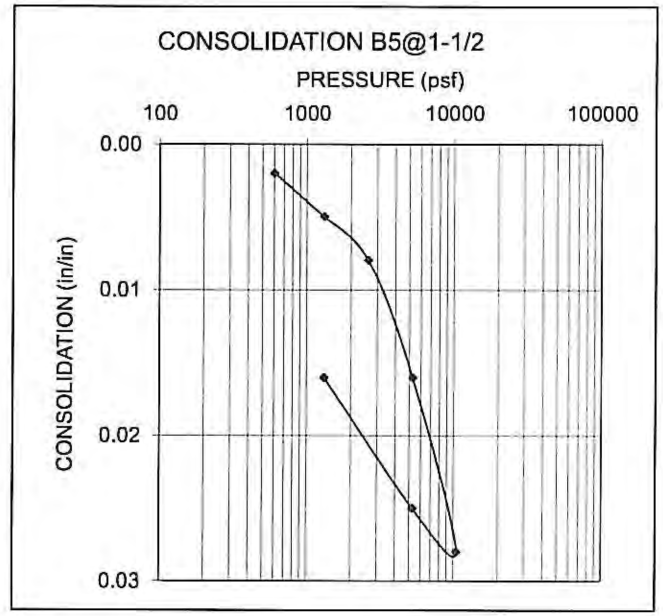
T-8

CONSOLIDATION

B5@1-1/2

Reading	Water?	Load (g)	Dial	Displacement (in.)	Pressure (psf)
1		0	0	0	0
2		590	2	0.002	600
3		1290	5	0.005	1313
4	yes	1290	5	0.005	1313
5	yes	2580	8	0.008	2625
6	yes	5160	16	0.016	5250
7	yes	10320	28	0.028	10501
8	yes	5160	25	0.025	5250
9	yes	1290	16	0.016	1313

Pressure (psf)	Consol (in/in)
600	0.00
1313	0.01
1313	0.01
2625	0.01
5250	0.02
10501	0.03
5250	0.03
1313	0.02



T-9

EXPANSION INDEX TESTS

Sample Location:	Boring 3@1-3	Boring 4@1-3'
Soil type:	Silty Clay	Sandy Silt
Confining Pressure:	144 psf	144 psf
Initial Moisture Content: (% of dry wt.)	12.0	12.5
Final Moisture Content: (% of dry wt.)	20.8	20.3
Dry Density:	102 pcf	101 pcf
Expansion Index:	52	0

TEST METHOD:
THE LATEST ASTM VERSION
EXPANSION INDEX TEST

EXPANSION INDEX TESTS

Sample Location:	Boring 8@1-3	Boring 9@1-3'
Soil type:	Clayey Silt	Fill-Silty Sand
Confining Pressure:	144 psf	144 psf
Initial Moisture Content: (% of dry wt.)	12.8	11.1
Final Moisture Content: (% of dry wt.)	21.8	16.5
Dry Density:	99 pcf	106 pcf
Expansion Index:	17	3

TEST METHOD:
THE LATEST ASTM VERSION
EXPANSION INDEX TEST

EXPANSION INDEX TESTS

Sample Location:	Boring 11@1-3	Boring 13@1-3'
Soil type:	Fill-Silty Clay	Fill-Silty Clay
Confining Pressure:	144 psf	144 psf
Initial Moisture Content: (% of dry wt.)	12.7	14.9
Final Moisture Content: (% of dry wt.)	23.6	30.2
Dry Density:	100 pcf	93 pcf
Expansion Index:	38	67

TEST METHOD:
THE LATEST ASTM VERSION
EXPANSION INDEX TEST

EXPANSION INDEX TESTS

Sample Location:	Test pit1@1-3	Test pit2@1-3'
Soil type:	Sandy Silt	Sandy Silt
Confining Pressure:	144 psf	144 psf
Initial Moisture Content: (% of dry wt.)	12.4	10.4
Final Moisture Content: (% of dry wt.)	19.5	14.9
Dry Density:	101 pcf	108 pcf
Expansion Index:	19	0

TEST METHOD:
THE LATEST ASTM VERSION
EXPANSION INDEX TEST

EXPANSION INDEX TESTS

Sample Location:	Test pit3@1-3	Test pit4@1-3'
Soil type:	Sandy Silt	Fill-Sandy Silt
Confining Pressure:	144 psf	144 psf
Initial Moisture Content: (% of dry wt.)	11.0	10.4
Final Moisture Content: (% of dry wt.)	15.7	12.5
Dry Density:	106 pcf	108 pcf
Expansion Index:	0	1

TEST METHOD:
THE LATEST ASTM VERSION
EXPANSION INDEX TEST

EXPANSION INDEX TESTS

Sample Location:	Test pit5@1-3	Test pit6@1-3'
Soil type:	Sandy Silt	Fill-Sandy Silt
Confining Pressure:	144 psf	144 psf
Initial Moisture Content: (% of dry wt.)	13.9	11.0
Final Moisture Content: (% of dry wt.)	18.4	16.2
Dry Density:	96 pcf	106 pcf
Expansion Index:	0	2

TEST METHOD:
THE LATEST ASTM VERSION
EXPANSION INDEX TEST

EXPANSION INDEX TESTS

Sample Location:	Test pit7@1-3	Test pit19@1-3'
Soil type:	Fill-Sandy Silt	Fill-Sandy Silt
Confining Pressure:	144 psf	144 psf
Initial Moisture Content: (% of dry wt.)	11.7	11.6
Final Moisture Content: (% of dry wt.)	13.7	17.1
Dry Density:	103 pcf	104 pcf
Expansion Index:	0	13

TEST METHOD:
THE LATEST ASTM VERSION
EXPANSION INDEX TEST

EXPANSION INDEX TESTS

Sample Location:	Test pit20@1-3	Test pit22@1-3'
Soil type:	Clayey Silt	Sandy Silt
Confining Pressure:	144 psf	144 psf
Initial Moisture Content: (% of dry wt.)	11.5	14.9
Final Moisture Content: (% of dry wt.)	16.7	23.4
Dry Density:	104 pcf	93 pcf
Expansion Index:	10	30

TEST METHOD:
THE LATEST ASTM VERSION
EXPANSION INDEX TEST

EXPANSION INDEX TESTS

Sample Location:	Test pit23@1-3	Test pit24@1-3'
Soil type:	Fill-Sandy Silt	Sandstone/Siltstone
Confining Pressure:	144 psf	144 psf
Initial Moisture Content: (% of dry wt.)	14.1	13.7
Final Moisture Content: (% of dry wt.)	25.0	16.2
Dry Density:	96 pcf	97 pcf
Expansion Index:	70	0

TEST METHOD:
THE LATEST ASTM VERSION
EXPANSION INDEX TEST

EXPANSION INDEX TESTS

Sample Location:	Test pit25@1-3	Test pit26@1-3'
Soil type:	Fill-Sandy Silt	Sandy Silt
Confining Pressure:	144 psf	144 psf
Initial Moisture Content: (% of dry wt.)	9.5	12.0
Final Moisture Content: (% of dry wt.)	14.9	19.2
Dry Density:	111 pcf	102 pcf
Expansion Index:	48	62

TEST METHOD:
THE LATEST ASTM VERSION
EXPANSION INDEX TEST

EXPANSION INDEX TESTS

Sample Location:	Test pit27@1-3	Test pit28@1-3'
Soil type:	Siltstone	Fill-Sandy Silt
Confining Pressure:	144 psf	144 psf
Initial Moisture Content: (% of dry wt.)	14.6	12.7
Final Moisture Content: (% of dry wt.)	26.9	21.1
Dry Density:	94 pcf	100 pcf
Expansion Index:	62	42

TEST METHOD:
THE LATEST ASTM VERSION
EXPANSION INDEX TEST

EXPANSION INDEX TESTS

Sample Location: Test pit29@1-3

Soil type: Fill-Sandy Silt

Confining Pressure: 144 psf

Initial Moisture Content: 12.0
(% of dry wt.)

Final Moisture Content: 16.1
(% of dry wt.)

Dry Density: 102 pcf

Expansion Index: 10

TEST METHOD:
THE LATEST ASTM VERSION
EXPANSION INDEX TEST

COMPACTION TEST

Sample Location:	Boring 3@1-3	Boring 4@1-3'
Soil type:	Silty Clay	Sandy Silt
Maximum Dry Density:	118 pcf	117 pcf
Optimum Moisture Content: (% of dry wt.)	12	12

TEST METHOD:
LATEST ASTM VERSION
COMPACTION TEST

COMPACTION TEST

Sample Location:	Boring 9@1-3'
Soil type:	Fill-Silty Sand
Maximum Dry Density:	121 pcf
Optimum Moisture Content: (% of dry wt.)	11

TEST METHOD:
LATEST ASTM VERSION
COMPACTION TEST

COMPACTION TEST

Sample Location:	Test Pit 3@1-3	Test Pit 4@1-3'
Soil type:	Sandy Silt	Fill-Sandy Silt
Maximum Dry Density:	124 pcf	125 pcf
Optimum Moisture Content: (% of dry wt.)	10	10

TEST METHOD:
LATEST ASTM VERSION
COMPACTION TEST

COMPACTION TEST

Sample Location:	Test Pit 5@1-3	Test Pit 6@1-3'
Soil type:	Sandy Silt	Fill-Sandy Silt
Maximum Dry Density:	116 pcf	123 pcf
Optimum Moisture Content: (% of dry wt.)	11	9

TEST METHOD:
LATEST ASTM VERSION
COMPACTION TEST

COMPACTION TEST

Sample Location: Test Pit 7@1-3

Soil type: Fill-Sandy Silt

Maximum Dry Density: 123 pcf

Optimum Moisture Content: 9
(% of dry wt.)

TEST METHOD:
LATEST ASTM VERSION
COMPACTION TEST

T-26

COMPACTION TEST

Sample Location:	Test Pit 19@1-3	Test Pit 20@1-3'
Soil type:	Fill-Sandy Silt	Clayey Silt
Maximum Dry Density:	121 pcf	120 pcf
Optimum Moisture Content: (% of dry wt.)	11	11

TEST METHOD:
LATEST ASTM VERSION
COMPACTION TEST

COMPACTION TEST

Sample Location:	Test Pit 22@1-3'
Soil type:	Sandy Silt
Maximum Dry Density:	112 pcf
Optimum Moisture Content: (% of dry wt.)	14

TEST METHOD:
LATEST ASTM VERSION
COMPACTION TEST

COMPACTION TEST

Sample Location:	Test Pit 23@1-3	Test Pit 24@1-3'
Soil type:	Fill-Sandy Silt	Sandstone
Maximum Dry Density:	110 pcf	114 pcf
Optimum Moisture Content: (% of dry wt.)	16	13

TEST METHOD:
LATEST ASTM VERSION
COMPACTION TEST

COMPACTION TEST

Sample Location:	Test Pit 25@1-3	Test Pit 26@1-3'
Soil type:	Fill-Sandy Silt	Sandy Silt
Maximum Dry Density:	126 pcf	120 pcf
Optimum Moisture Content: (% of dry wt.)	10	12

TEST METHOD:
LATEST ASTM VERSION
COMPACTION TEST

T-30

COMPACTION TEST

Sample Location:	Test Pit 27@1-3	Test Pit 28@1-3'
Soil type:	Siltstone	Fill-Sandy Silt
Maximum Dry Density:	115 pcf	119 pcf
Optimum Moisture Content: (% of dry wt.)	14	11

TEST METHOD:
LATEST ASTM VERSION
COMPACTION TEST

COMPACTION TEST

Sample Location:	Test Pit 29@1-3
Soil type:	Fill-Sandy Silt
Maximum Dry Density:	115 pcf
Optimum Moisture Content: (% of dry wt.)	14

TEST METHOD:
LATEST ASTM VERSION
COMPACTION TEST

APPENDIX

MAPS

PRELIMINARY-NOT FOR CONSTRUCTION
PLOT DATE 8-05-10
MATRIX - WHITTIER MAIN FIELD
CONCEPTUAL GRADING STUDY 5
ALTERNATIVE SITE LAYOUT
SHEET 1 OF 1
CIVIL ENGINEER
Adams Streeter
CIVIL ENGINEERS, INC.
GRAPHIC SCALE: 1"=50'
EXPLANATION
af - artificial fill
afu - artificial fill undifferentiated
Qls - landslide debris
Qal - alluvial deposits
Qoal - older alluvial deposits
Tf - Fernando Formation - claystone to fine sandstone facies
Tfs - Fernando Formation - sandstone to pebble conglomerate facies
strike and dip of bedding
geologic contact
surface water course
fault
geologic section
boring location
test pit location
fossil locality
TIE-IN TO EXISTING ROAD
RE-ALIGNED 26' ROAD
CONCRETE BLOCK WALL
EXISTING ROAD TO BE RE-ALIGNED
WELL PAD 1
WELL PAD 2
WELL PAD 3
PAD EL = 530
FLARE
PAD = 476
GAS PLANT
PAD = 473
PROCESSING FACILITY
PAD = 465
TRUCK RECEIVING AREA
PARKING
OFFICE 30'x 80'
EXISTING ROAD
RETAINING WALL
ACCESS ROAD

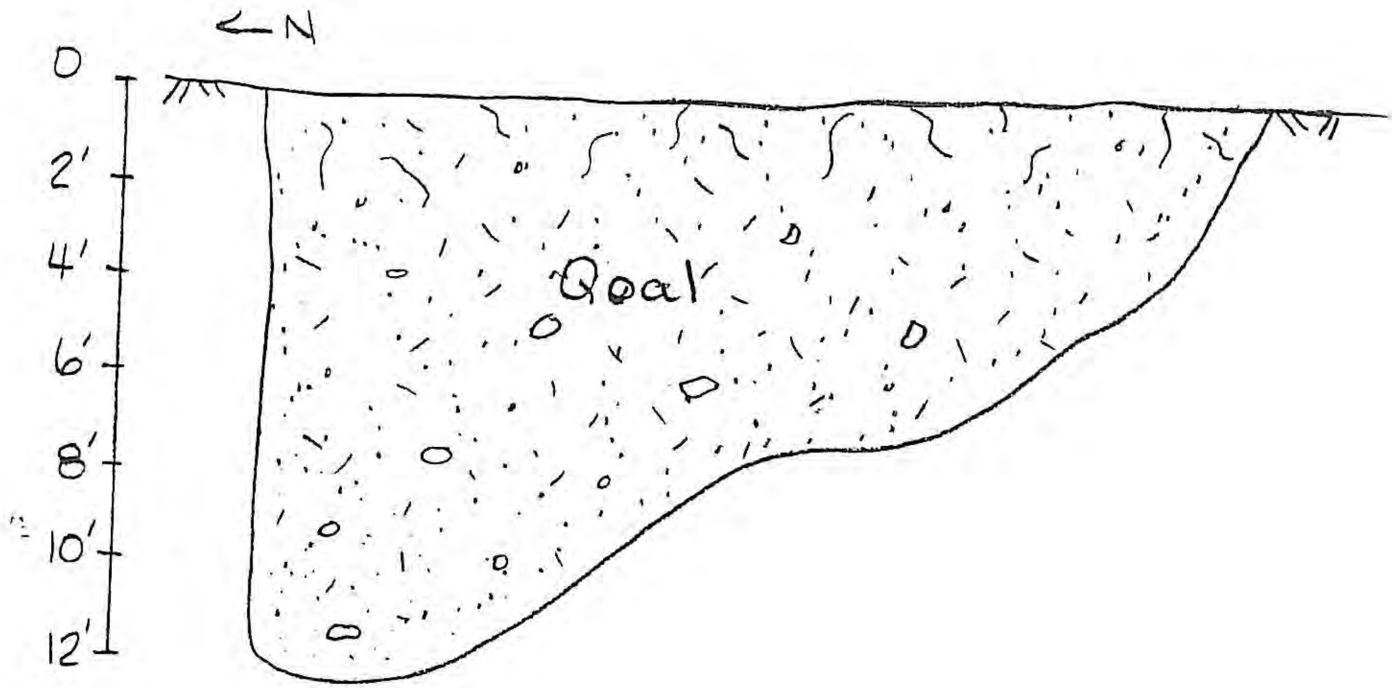
Plate M1

APPENDIX

BORING AND TEST PIT LOGS

Excavation Log: TP-3

Feet	Description
0 - 11 feet	Older Alluvial Deposits (Qoal)- Sandy Silt (ML) - tan to light brown, dry, dense below 3 ½ ft, scattered subangular gravels and cobbles to 6 in., occasional clay stringers, roots to upper 3 ½ ft, porous to 3 ft.



Total Depth 11 feet. No Groundwater. No Seepage. No caving. Test Pit Backfilled.

@ 1 ½ ft	Moisture= 3.9 %	Density= 89 PCF
@ 3 ft	Moisture= 4.8 %	Density= 98 PCF
@ 6 ft	Moisture=11.0 %	Density= 89 PCF
@ 9 ft	Moisture=10.2 %	Density= 93 PCF

The log of subsurface conditions hereon applies only at the specific location and the date indicated. It is not warranted to be representative of subsurface conditions at other times and locations

Date Excavated: October 5, 2009

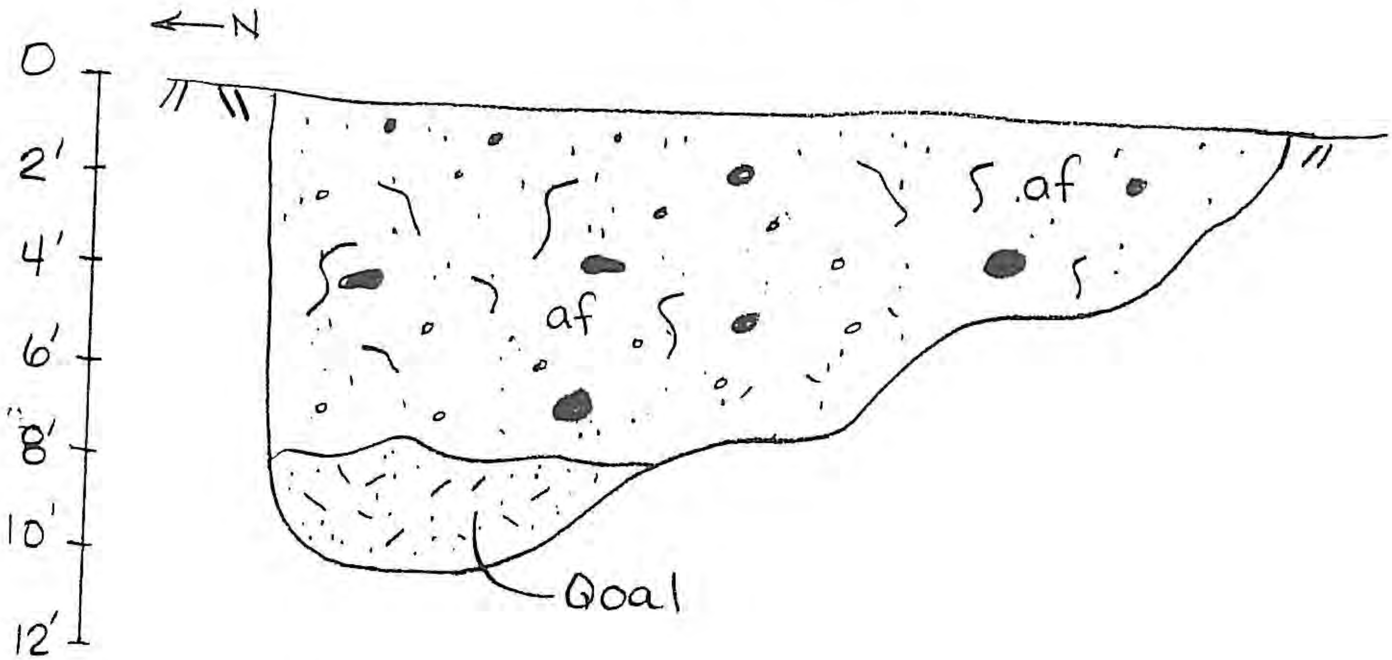
Terry A. Mayer
Consulting Geologist

Date: December 6, 2009
Job Number # 090202
Matrix/Whittier

Plate BTP 1

Excavation Log: TP-4

Feet	Description
0 - 8 feet	Artificial Fill (af)- Sandy Silt (ML) -with abundant asphalt chunks and fragment, scattered gravels and cobbles, dry, loose to moderately dense, roots to 6 feet
8 - 10 feet	Older Alluvial Deposits (Qoal)- Sandy Silt (ML) - tan to yellow brown, dry, dense, scattered subangular gravels.



Total Depth 10 feet. No Groundwater. No Seepage. No caving. Test Pit Backfilled.

@ 1 ½ ft	Moisture= 2.3 %	Density= 90 PCF
@ 3 ft	Moisture= 6.6 %	Density= 85 PCF
@ 6 ft	Moisture= 4.1 %	Density=100 PCF
@ 9 ft	Moisture= 3.0 %	Density= 96 PCF

The log of subsurface conditions hereon applies only at the specific location and the date indicated. It is not warranted to be representative of subsurface conditions at other times and locations

Date Excavated: October 6, 2009

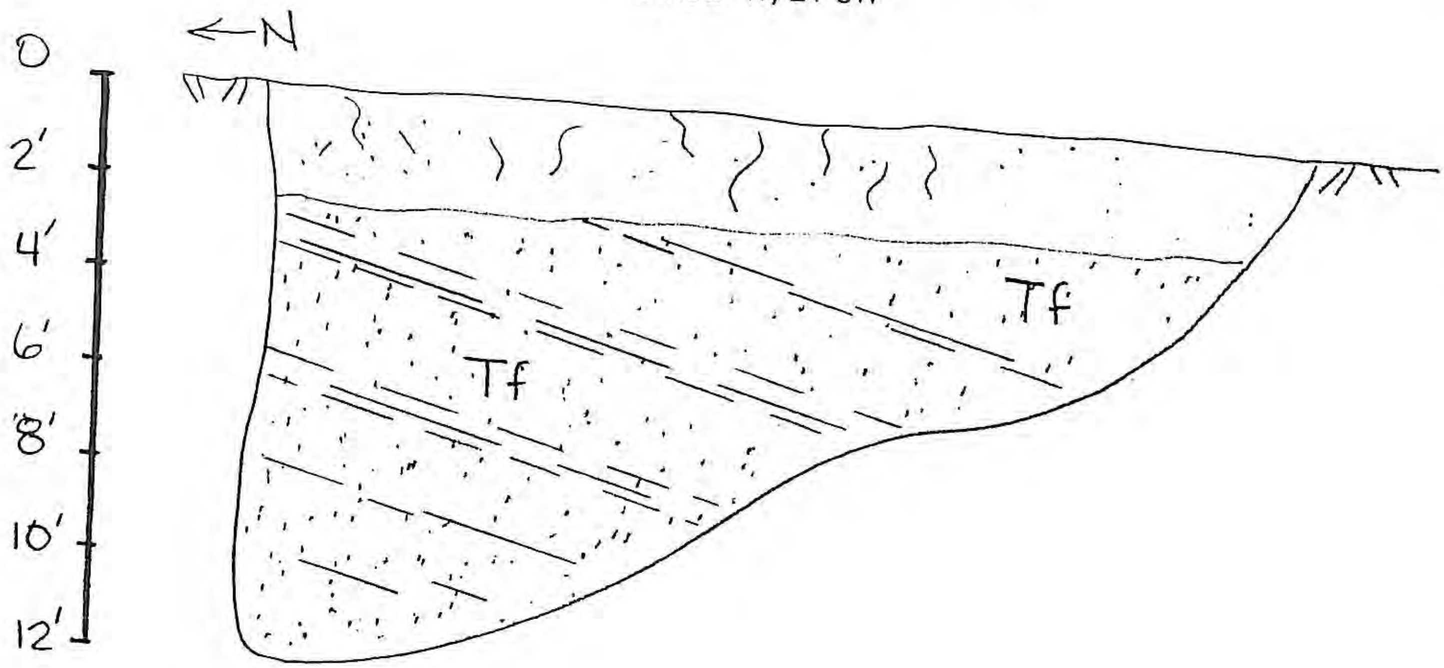
Terry A. Mayer
Consulting Geologist

Date: December 6, 2009
Job Number # 090202
Matrix/Whittier

Plate BTP 2

Excavation Log: TP-5

Feet	Description
0 - 2 1/2 feet	Topsoil - Sandy Silt (ML) -green to tan brown, abundant siltstone fragments, minor to moderate roots, dry
2 1/2 ft - 12 ft	Fernando Formation (Tf)- Sandstone - medium to coarse grained with occasional thin (less than 4") siltstone interbeds, poorly cemented, very friable, dense, gray-green to rust brown B N82° W, 21°SW



Total Depth 12 feet. No Groundwater. No Seepage. No caving. Test Pit Backfilled.

@ 1 ½ ft	Moisture= 2.7 %	Density= 94 PCF
@ 3 ft	Moisture= 5.1 %	Density= 98 PCF
@ 6 ft	Moisture= 1.7 %	Density= 105 PCF
@ 9 ft	Moisture= 4.5 %	Density= 100 PCF

The log of subsurface conditions hereon applies only at the specific location and the date indicated. It is not warranted to be representative of subsurface conditions at other times and locations

Date Excavated: October 6, 2009

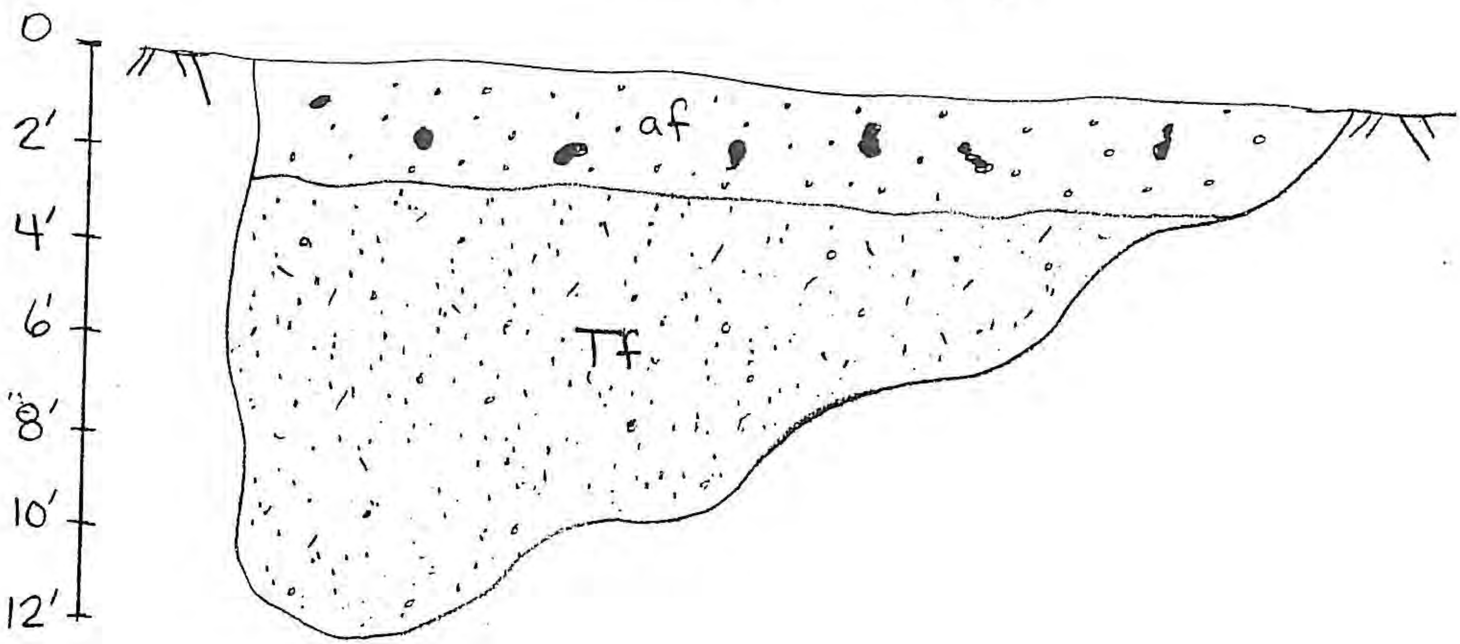
Terry A. Mayer
Consulting Geologist

Date: December 6, 2009
Job Number # 090202
Matrix/Whittier

Plate BTP 3

Excavation Log: TP-6

Feet	Description
0 - 2 1/2 feet	Artificial Fill (af) - Sandy Silt (ML) -with abundant asphalt fragments, scattered gravels, dry, moderately dense
2 1/2 ft - 12 ft	Fernando Formation (Tf)- Silty Sandstone -highly weathered to 5 feet, moderately weathered below, fine grained, dense, friable, minor cementation, scattered gravels and pebbles, tan to yellow-brown, no observed bedding



Total Depth 12 feet. No Groundwater. No Seepage. No caving. Test Pit Backfilled.

@ 1 ½ ft	Moisture= 5.3 %	Density= 96 PCF
@ 3 ft	Moisture= 8.4 %	Density= 107 PCF
@ 6 ft	Moisture= 8.8 %	Density= 98 PCF
@ 9 ft	Moisture= 8.7 %	Density= 89 PCF

The log of subsurface conditions hereon applies only at the specific location and the date indicated. It is not warranted to be representative of subsurface conditions at other times and locations

Date Excavated: October 7, 2009

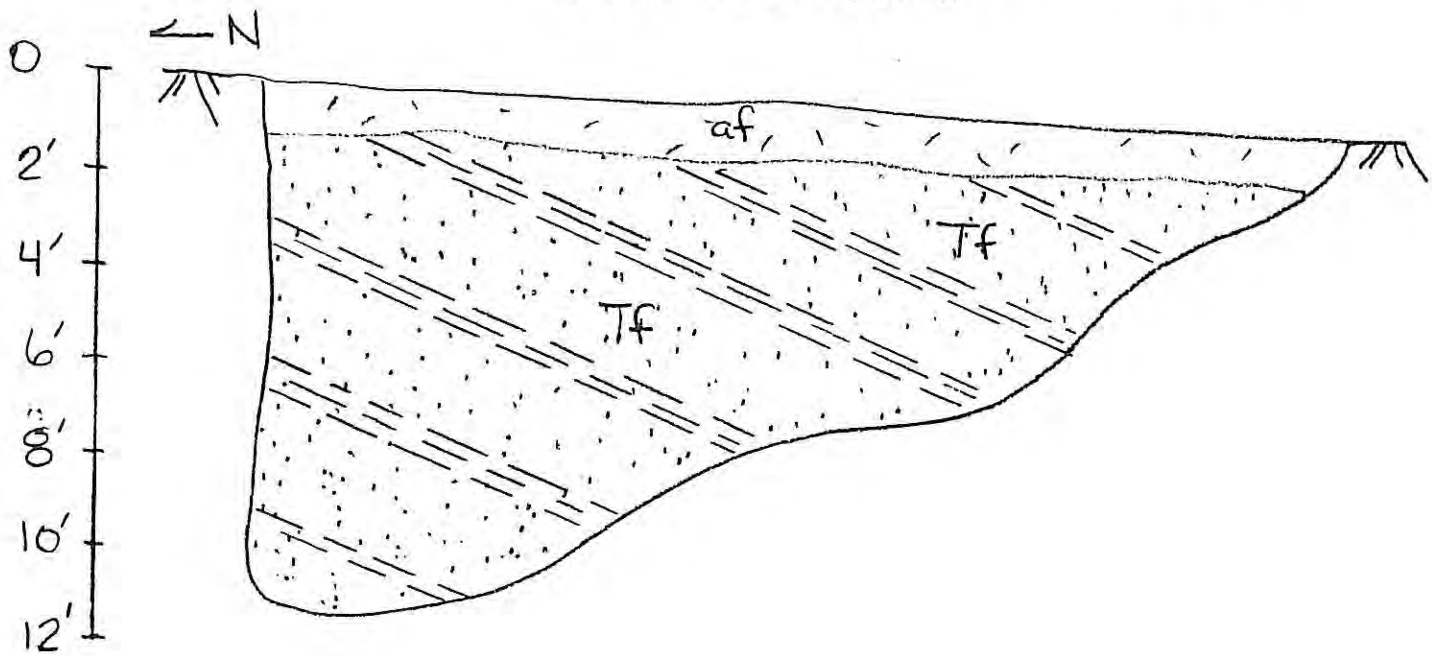
Terry A. Mayer
Consulting Geologist

Date: December 6, 2009
Job Number # 090202
Matrix/Whittier

Plate BTP 4

Excavation Log: TP-7

Feet	Description
0 - 1 ft	Artificial Fill (af) - Sandy Silt (ML) -gray-green, scattered gravels, dry, loose
1 ft - 11 ft	Fernando Formation (Tf)- interbedded coarse Sandstone and fine-grained Silty Sandstone -beds 12" to 2 ½ ft in thickness, gray-green to tan brown, very friable, very poorly cemented, occasional calcium carbonate deposits, minor roots to 5 ft in depth, scattered gravel @ 8 feet B N67° W, 34°SW



Total Depth 11 feet. No Groundwater. No Seepage. No caving. Test Pit Backfilled.

@ 1 ½ ft	Moisture= 7.2 %	Density= 116 PCF
@ 3 ft	Moisture= 5.3 %	Density= 98 PCF
@ 6 ft	Moisture= 1.4 %	Density= — PCF
@ 9 ft	Moisture= 1.4 %	Density= 91 PCF

The log of subsurface conditions hereon applies only at the specific location and the date indicated. It is not warranted to be representative of subsurface conditions at other times and locations

Date Excavated: October 7, 2009

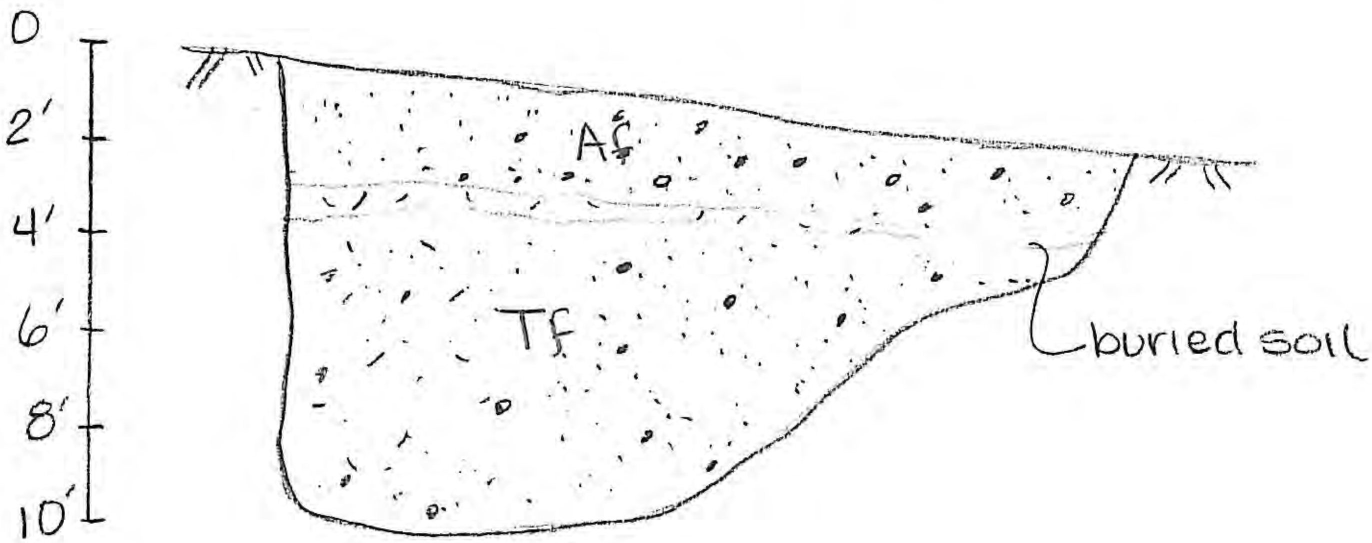
Terry A. Mayer
Consulting Geologist

Date: December 6, 2009
Job Number # 090202
Matrix/Whittier

Plate BTP5

Excavation Log: TP-19

Feet	Description
0 - 3 ft	Artificial Fill (af) - Sandy Silt (ML) -tan to light brown, abundant gravels and cobbles, dry to damp, roots in upper 2 feet
3 - 3 ½ ft	Buried Soil - Clayey Silt (ML) - medium brown, moist, minor grave
3 ½ ft - 10 ft	Fernando Formation (Tf)- Siltstone -tan to light brown, cobbles to 6 inches, damp, very friable, no cementation, structureless, few scattered gravels



Total Depth 10 feet. No Groundwater. No Seepage. No caving. Test Pit Backfilled.

@ 1 ½ ft	Moisture= 7.5 %	Density= 95 PCF
@ 3 ft	Moisture= 7.8 %	Density= 94 PCF
@ 6 ft	Moisture= 5.3 %	Density= 96 PCF
@ 9 ft	Moisture= 7.3 %	Density= 99 PCF

The log of subsurface conditions hereon applies only at the specific location and the date indicated. It is not warranted to be representative of subsurface conditions at other times and locations

Date Excavated: September 15, 2010

Terry A. Mayer
Consulting Geologist

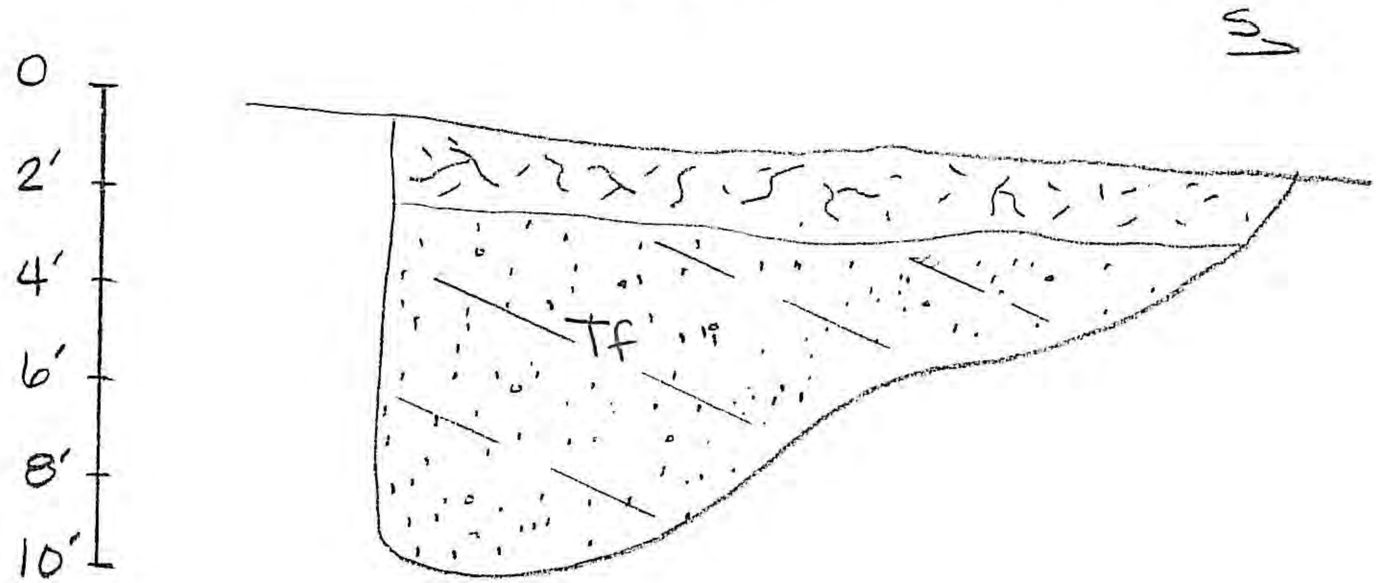
Date: November 1, 2010
Job Number # 090202
Matrix/Whittier

Plate BTP 6

Appendix L

Excavation Log: TP-20

Feet	Description
0 - 2 ft	Soil - Clayey Silt (ML) -tan to light brown, abundant gravels and cobbles, dry to damp, roots in upper 2 feet,
2 ft - 10 ft	Fernando Formation (Tf)- Sandstone -tan to light brown, friable to well-cemented, well bedded, damp, beds 2 inches to 6 inches in thickness, few scattered gravels B N68° W, 36°SW



Total Depth 10 feet. No Groundwater. No Seepage. No caving. Test Pit Backfilled.

@ 1 ½ ft	Moisture= 7.5 %	Density= 95 PCF
@ 3 ft	Moisture= 9.6 %	Density= 93 PCF
@ 6 ft	Moisture= 11.6 %	Density= 102 PCF
@ 9 ft	Moisture= 4.4 %	Density= 107 PCF

The log of subsurface conditions hereon applies only at the specific location and the date indicated. It is not warranted to be representative of subsurface conditions at other times and locations

Date Excavated: September 15, 2010

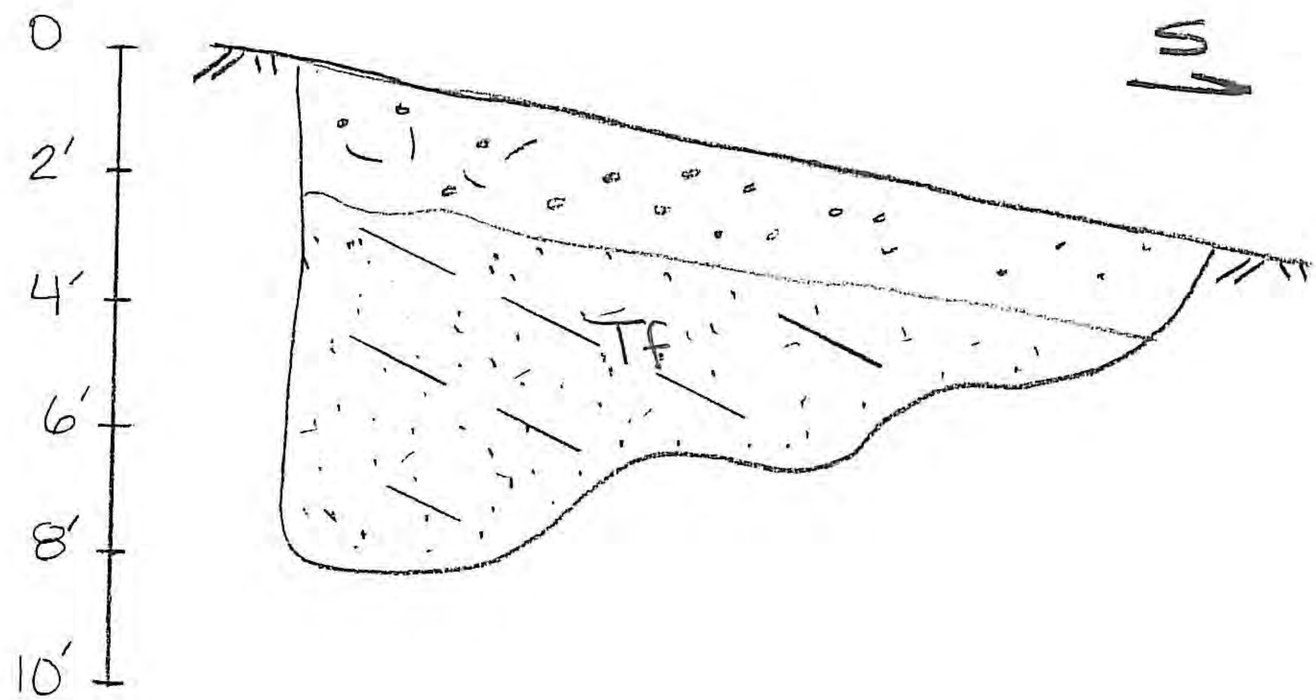
Terry A. Mayer
Consulting Geologist

Date: November 1, 2010
Job Number # 090202
Matrix/Whittier

Plate BTP 7

Excavation Log: TP-21

Feet	Description
0 - 2 ft	Soil - Clayey Silt (ML) -tan to light brown, abundant gravels, minor cobbles, dry to damp, roots in upper 2 feet, dry, loose
2 ft - 8 ft	Fernando Formation (Tf)- Silty Sandstone -tan to light brown, very friable, moderately to poorly bedded, damp, beds 6 inches to 10 inches in thickness B N65° W, 46°SW



Total Depth 8 feet. No Groundwater. No Seepage. No caving. Test Pit Backfilled.

The log of subsurface conditions hereon applies only at the specific location and the date indicated. It is not warranted to be representative of subsurface conditions at other times and locations

Date Excavated: September 15, 2010

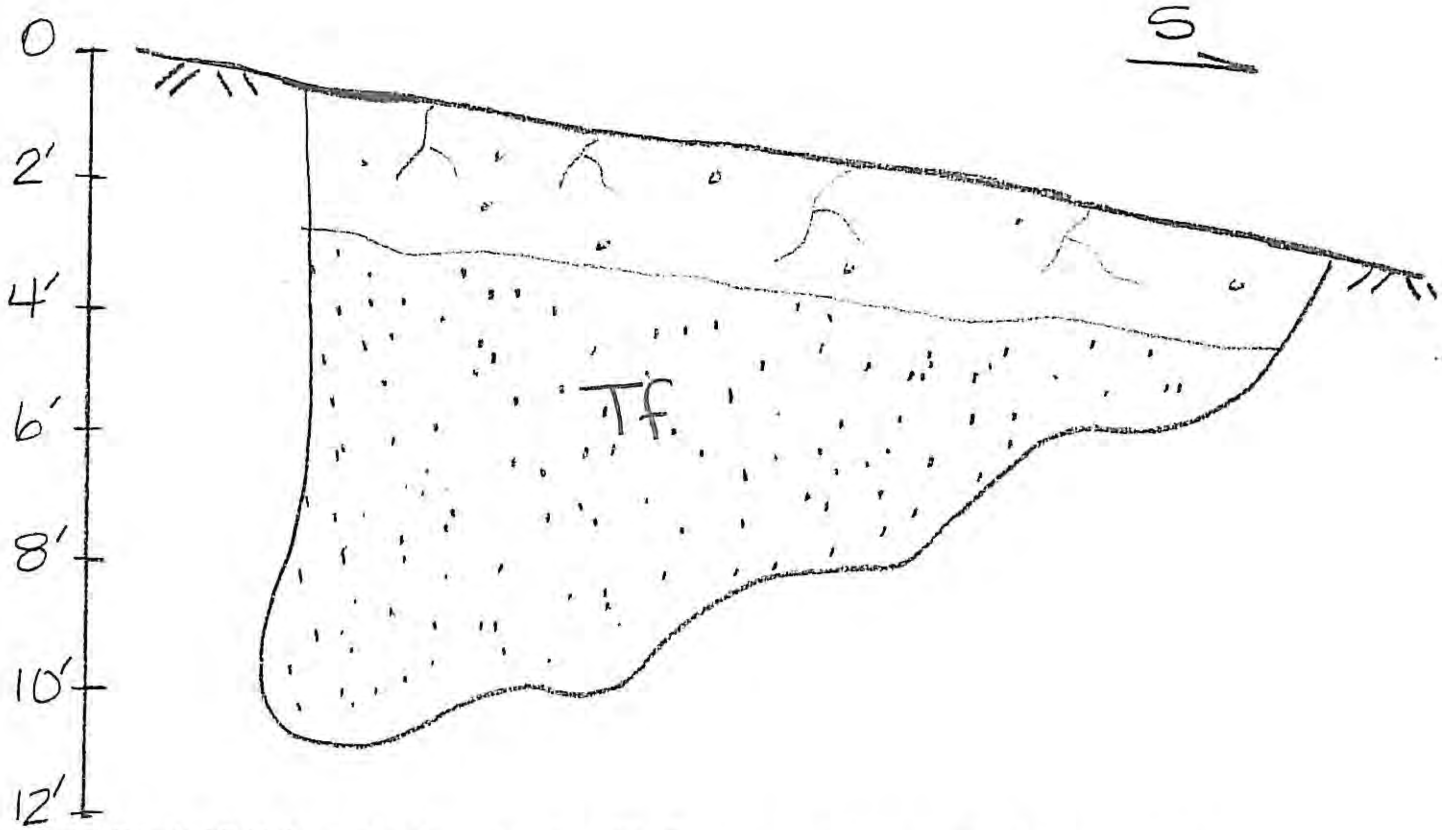
Terry A. Mayer
Consulting Geologist

Date: November 1, 2010
Job Number # 090202
Matrix/Whittier

Plate BT P8

Excavation Log: TP-22

Feet	Description
0 - 2 ½ ft	Soil - Sandy Silt (ML) -light brown, minor gravel, dry to damp, minor roots in upper 2 feet, loose
2 ½ ft - 10 1/2 ft	Fernando Formation (Tf)- Sandy Siltstone -gray with iron oxide staining, massive, friable to well-cemented, damp, minor to moderate fracturing



Total Depth 10 ½ feet. No Groundwater. No Seepage. No caving. Test Pit Backfilled.

@ 1 ½ ft	Moisture= 6.6 %	Density= 99 PCF
@ 3 ft	Moisture= 12.7 %	Density= 110 PCF
@ 6 ft	Moisture= 11.0 %	Density= 119 PCF

The log of subsurface conditions hereon applies only at the specific location and the date indicated. It is not warranted to be representative of subsurface conditions at other times and locations

Date Excavated: September 15, 2010

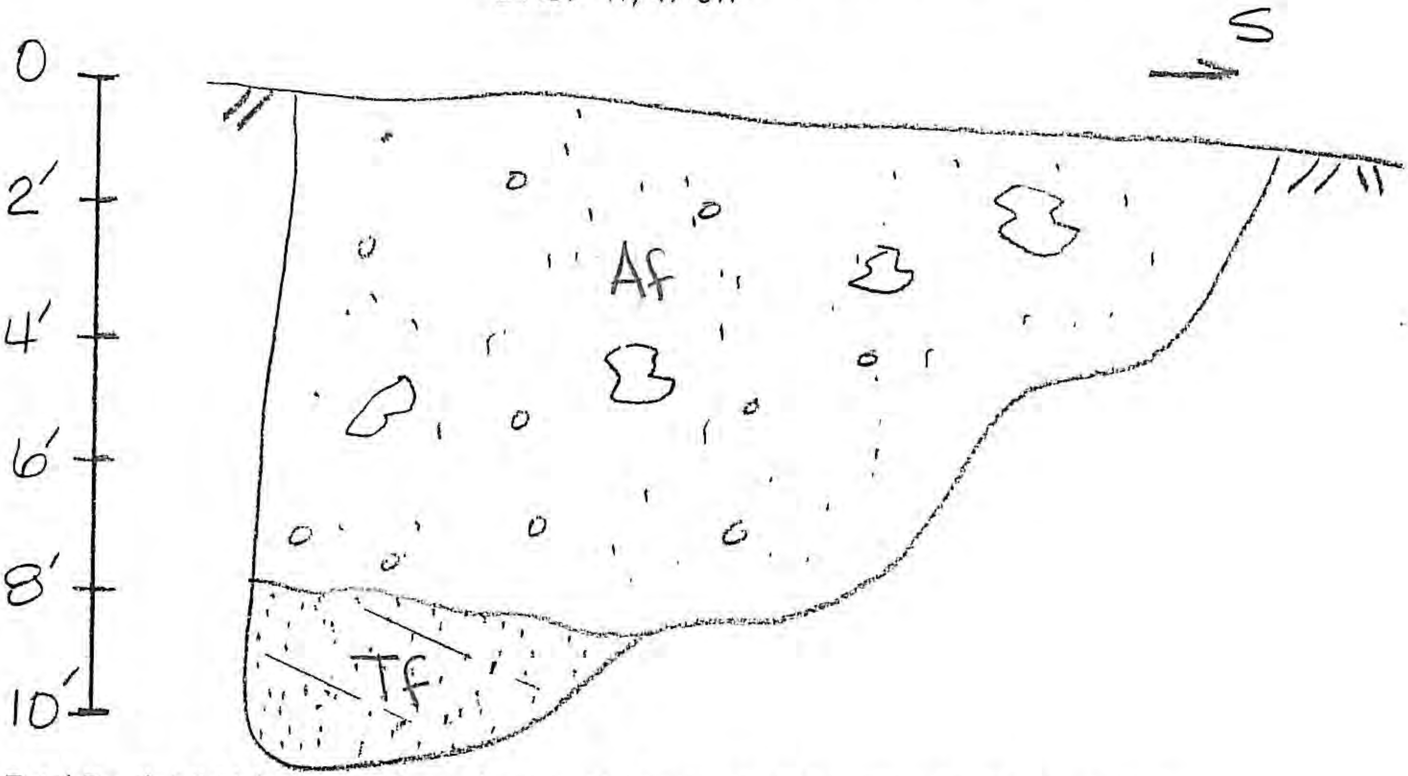
Terry A. Mayer
Consulting Geologist

Date: November 1, 2010
Job Number # 090202
Matrix/Whittier

Plate BTP9

Excavation Log: TP-23

Feet	Description
0 - 7 ½ ft	Artificial Fill (af) -Sandy Silt (ML) - light brown, abundant cobbles and rock fragments, minor to moderate caving, dry to damp, loose
7 ½ ft - 10 ½ ft	Fernando Formation (Tf)- Sandstone - with occasional thin (< 6 inch) gravel layers, dry, friable, tan to medium brown, moderately well-defined bedding B N69° W, 47°SW



Total Depth 10 ½ feet. No Groundwater. No Seepage. No caving. Test Pit Backfilled.

@ 1 ½ ft	Moisture= 11.4 %	Density= 100 PCF
@ 3 ft	Moisture= 7.3 %	Density= 105 PCF
@ 6 ft	Moisture= 5.2 %	Density= 109 PCF
@ 9 ft	Moisture= 9.0 %	Density= 100 PCF

The log of subsurface conditions hereon applies only at the specific location and the date indicated. It is not warranted to be representative of subsurface conditions at other times and locations

Date Excavated: September 18, 2010

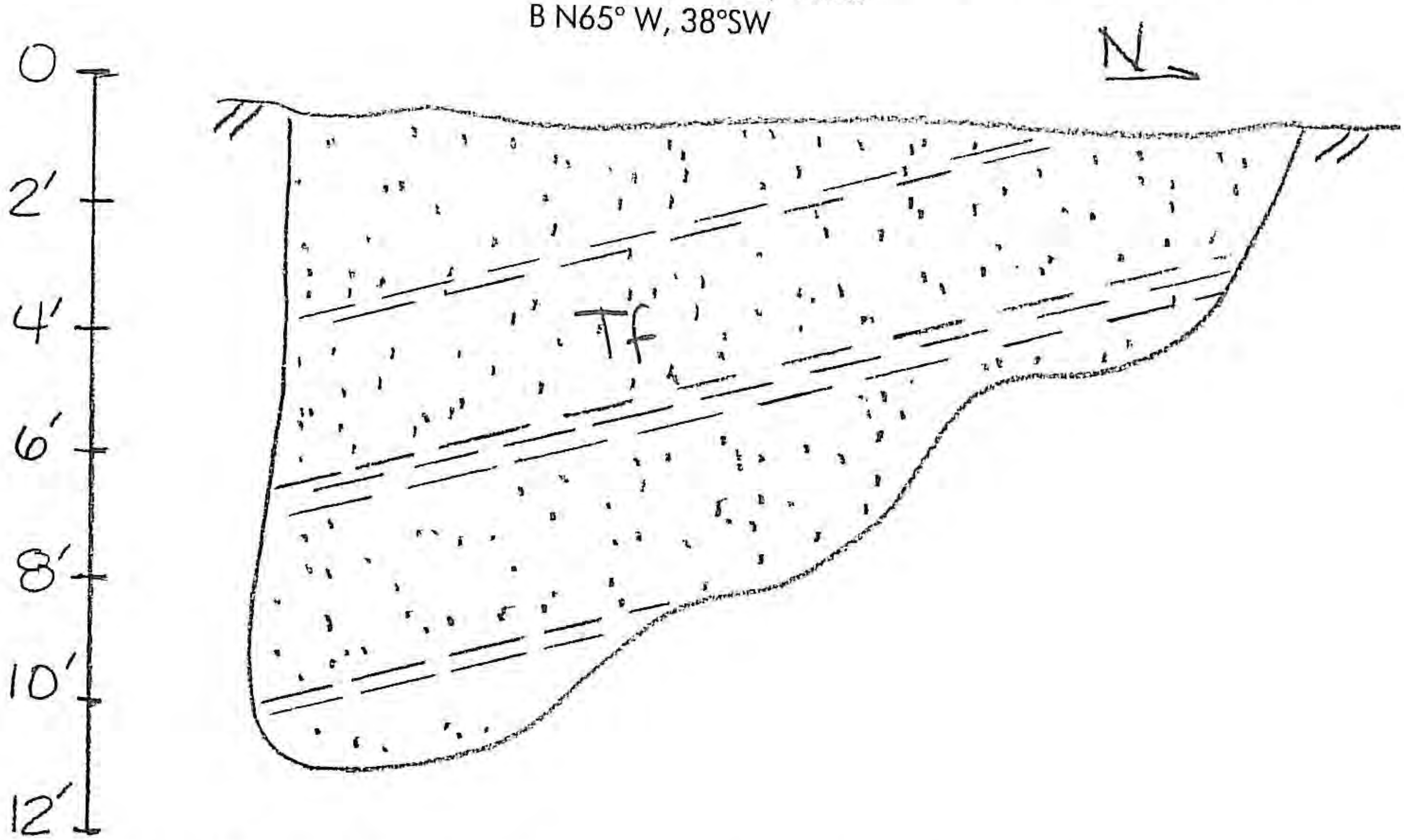
Terry A. Mayer
Consulting Geologist

Date: November 1, 2010
Job Number # 090202
Matrix/Whittier

Plate BTP 10

Excavation Log: TP-24

Feet	Description
0 - 11 ft	Fernando Formation (Tf)- Sandstone with Siltstone interbeds- medium to coarse-grained sandstone with well-rounded cobbles, tan to light brown, dense, well-developed bedding, dry to damp, beds 1 ½ inch to 2 inches in thickness, friable B N65° W, 38°SW



Total Depth 11 feet. No Groundwater. No Seepage. No caving. Test Pit Backfilled.

@ 1 ½ ft	Moisture= 5.3 %	Density= 105 PCF
@ 3 ft	Moisture= 7.6 %	Density= 112 PCF

The log of subsurface conditions hereon applies only at the specific location and the date indicated. It is not warranted to be representative of subsurface conditions at other times and locations

Date Excavated: September 16, 2010

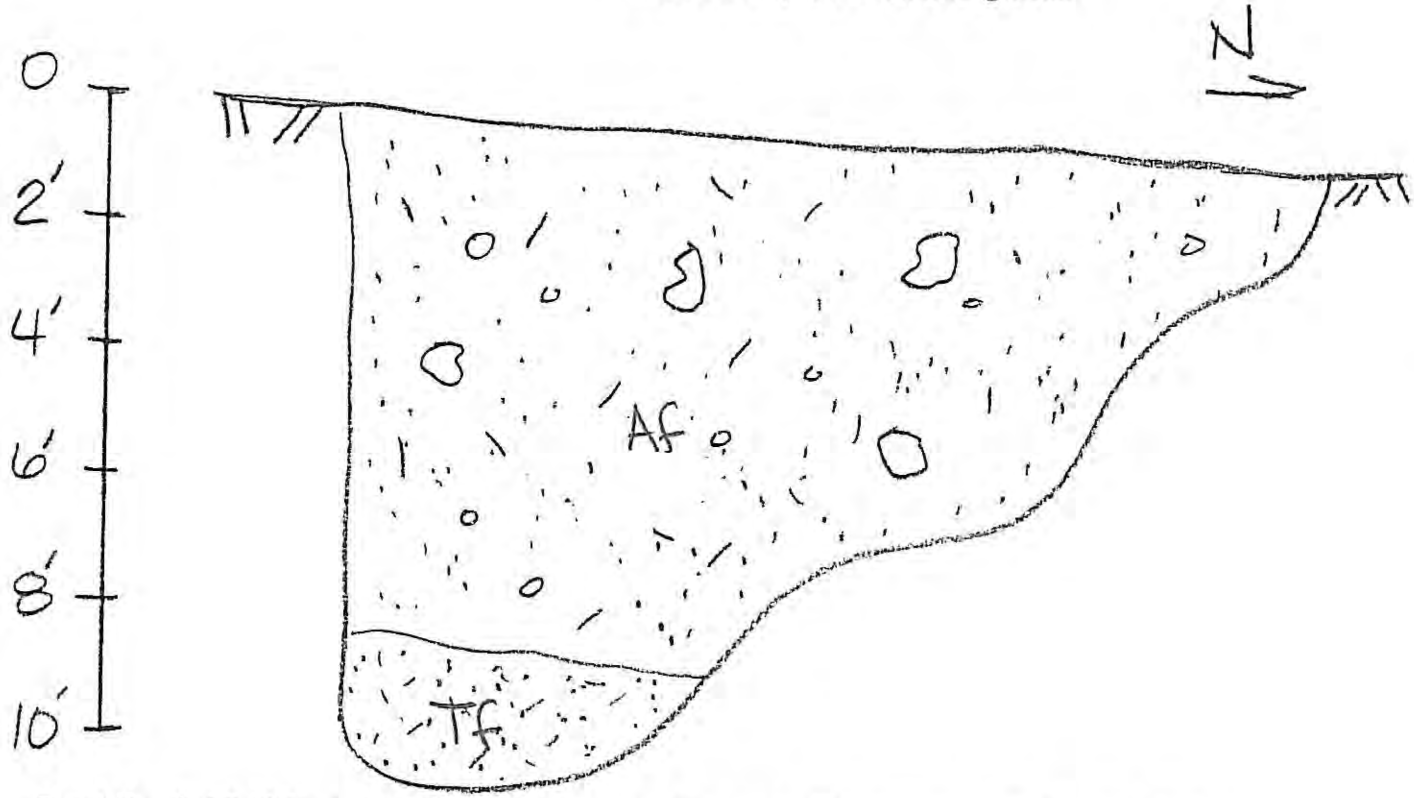
Terry A. Mayer
Consulting Geologist

Date: November 1, 2010
Job Number # 090202
Matrix/Whittier

Plate BTP 11

Excavation Log: TP-25

Feet	Description
0 - 8 ½ ft	Artificial Fill (af) - Sandy Silt (ML) -tan to light brown, abundant gravels and cobbles, scattered asphalt chunks and fragments, dry to damp, loose
8 ½ ft - 10 ½ ft	Fernando Formation (Tf)- Silty Sandstone - moderately friable, light brown, massive, damp, structureless, few scattered gravels



Total Depth 10 ½ feet. No Groundwater. No Seepage. No caving. Test Pit Backfilled.

@ 1 ½ ft	Moisture= 11.9 %	Density= 106 PCF
@ 3 ft	Moisture= 10.5 %	Density= 108 PCF
@ 6 ft	Moisture= 8.8 %	Density= 111 PCF
@ 9 ft	Moisture= 9.3 %	Density= 112 PCF

The log of subsurface conditions hereon applies only at the specific location and the date indicated. It is not warranted to be representative of subsurface conditions at other times and locations

Date Excavated: September 16, 2010

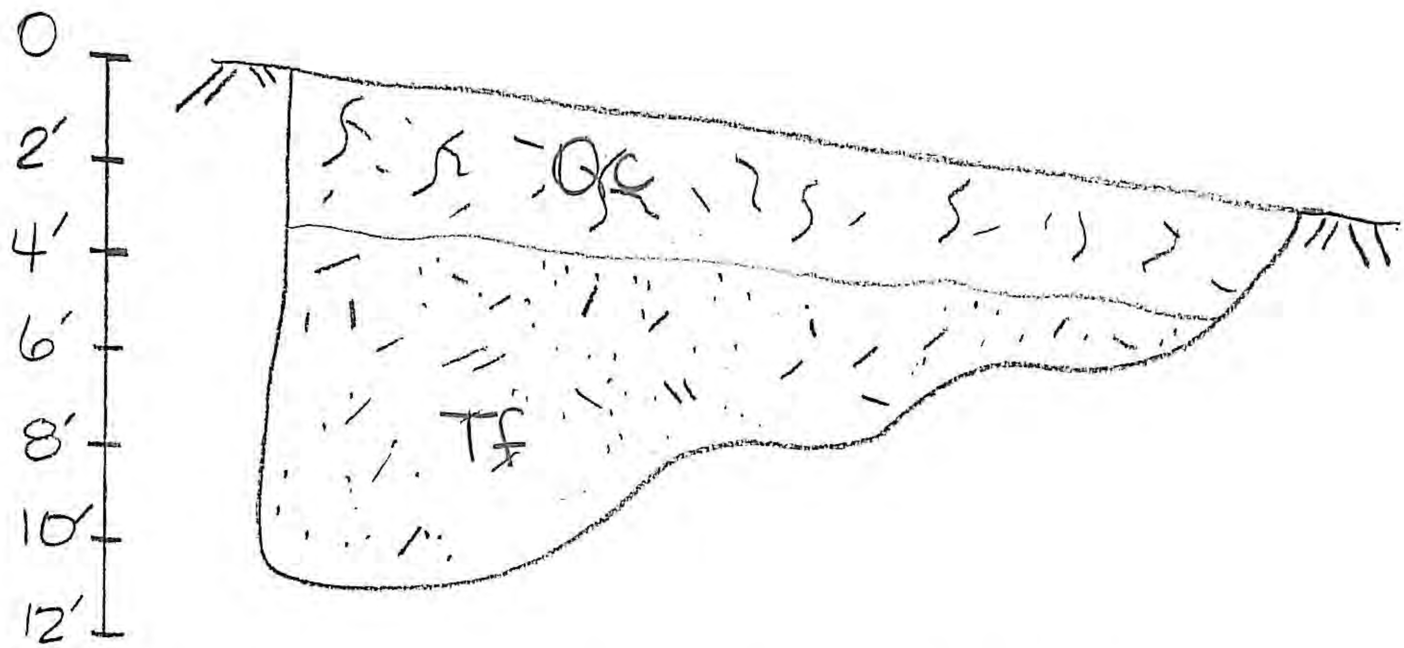
Terry A. Mayer
Consulting Geologist

Date: November 1, 2010
Job Number # 090202
Matrix/Whittier

Plate BTP 12

Excavation Log: TP-26

Feet	Description
0 - 3 ft	Soil/Colluvium (Qc) - Sandy Silt (ML) -medium to dark brown, moderate roots, minor rock fragments, loose to moderately defense, dry to damp, loose
3 ft - 10 ½ ft	Fernando Formation (Tf)- Siltstone -tan to chocolate brown, minor fine sand, massive, dense, damp, fractured



Total Depth 10 ½ feet. No Groundwater. No Seepage. No caving. Test Pit Backfilled.

@ 1 ½ ft	Moisture= 11.3 %	Density= 103 PCF
@ 3 ft	Moisture= 9.9 %	Density= 114 PCF
@ 6 ft	Moisture= 11.6 %	Density= 106 PCF
@ 9 ft	Moisture= 9.3 %	Density= 110 PCF

The log of subsurface conditions hereon applies only at the specific location and the date indicated. It is not warranted to be representative of subsurface conditions at other times and locations

Date Excavated: September 16, 2010

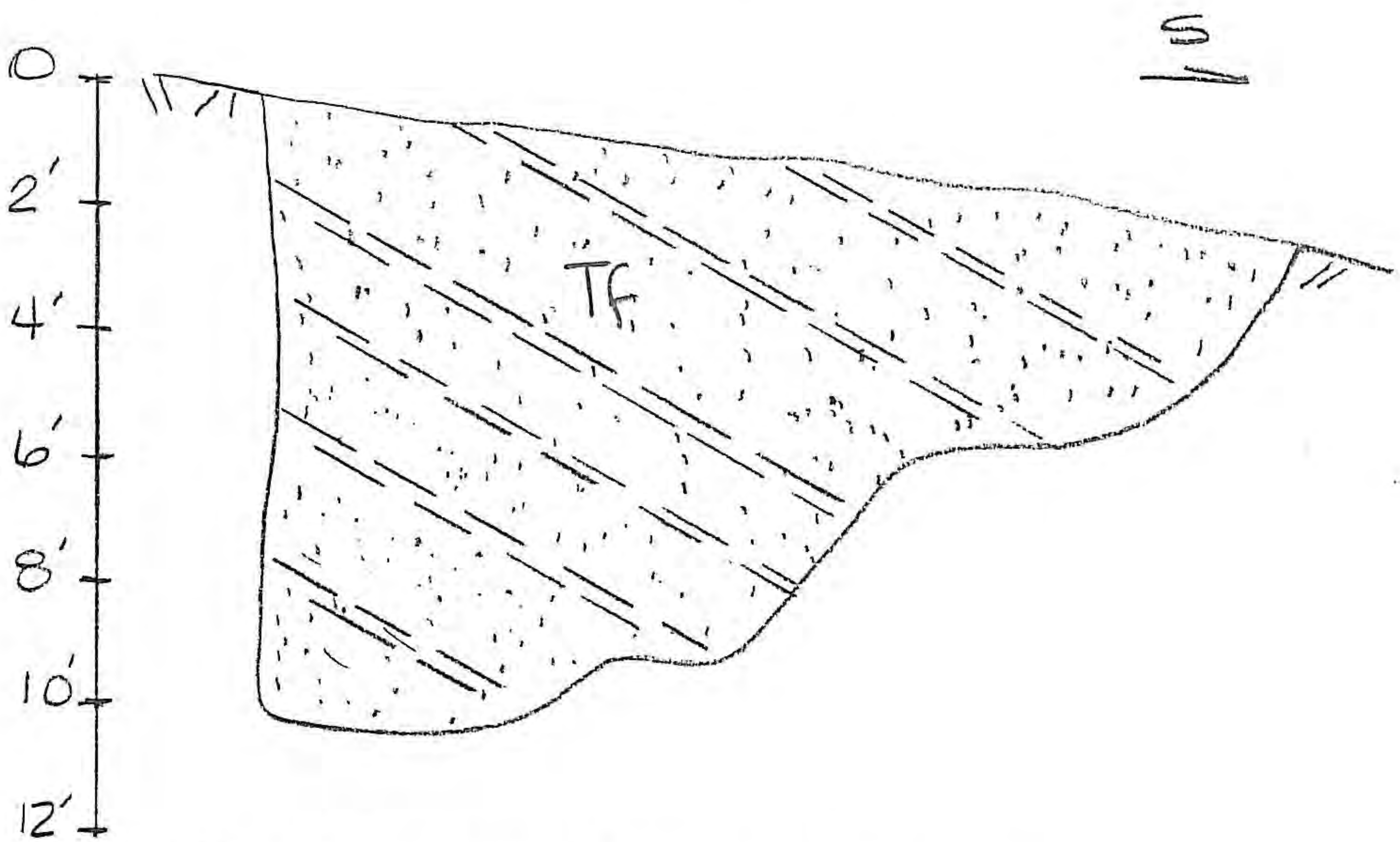
Terry A. Mayer
Consulting Geologist

Date: November 1, 2010
Job Number # 090202
Matrix/Whittier

Plate BTP 13

Excavation Log: TP-27

Feet	Description
0 ft - 10 ft	Fernando Formation (Tf)- Sandy Siltstone -gray to light tan, well-bedded, dense, beds ½ " to 3", fine-grained sand, fractured B E-W 48°SW



Total Depth 10 feet. No Groundwater. No Seepage. No caving. Test Pit Backfilled.

@ 1 ½ ft	Moisture= 12.2 %	Density= 100 PCF
@ 3 ft	Moisture= 8.5 %	Density= 111 PCF
@ 6 ft	Moisture= 10.5 %	Density= 107 PCF
@ 9 ft	Moisture= 14.8 %	Density= 109 PCF

The log of subsurface conditions hereon applies only at the specific location and the date indicated. It is not warranted to be representative of subsurface conditions at other times and locations

Date Excavated: September 18, 2010

Terry A. Mayer
Consulting Geologist

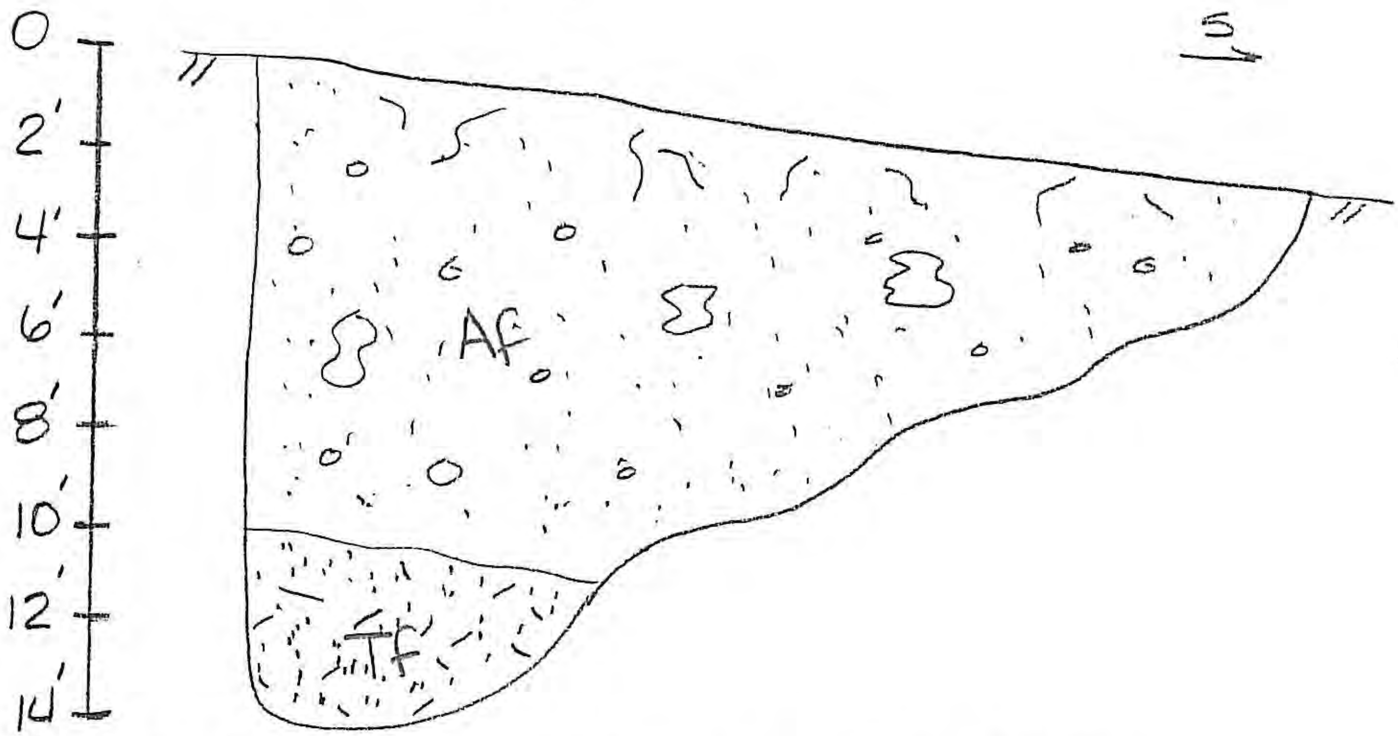
Date: November 1, 2010
Job Number # 090202
Matrix/Whittier

Plate BTP 14

Appendix L

Excavation Log: TP-28

Feet	Description
0 - 9 ½ ft	Artificial Fill - Sandy Silt (ML) -abundant asphalt fragments, abundant gravels and cobbles, dry, roots in upper foot, loose
9 ½ ft - 14 ft	Fernando Formation (Tf)- Sandy Siltstone -medium brown, damp, massive, fine to medium-grained sand, dense



Total Depth 14 feet. No Groundwater. No Seepage. No caving. Test Pit Backfilled.

@ 1 ½ ft	Moisture= 6.9 %	Density= 103 PCF
@ 3 ft	Moisture= 9.1 %	Density= 102 PCF
@ 6 ft	Moisture= 11.4 %	Density= 103 PCF
@ 9 ft	Moisture= 7.3 %	Density= 106 PCF

The log of subsurface conditions hereon applies only at the specific location and the date indicated. It is not warranted to be representative of subsurface conditions at other times and locations

Date Excavated: September 18, 2010

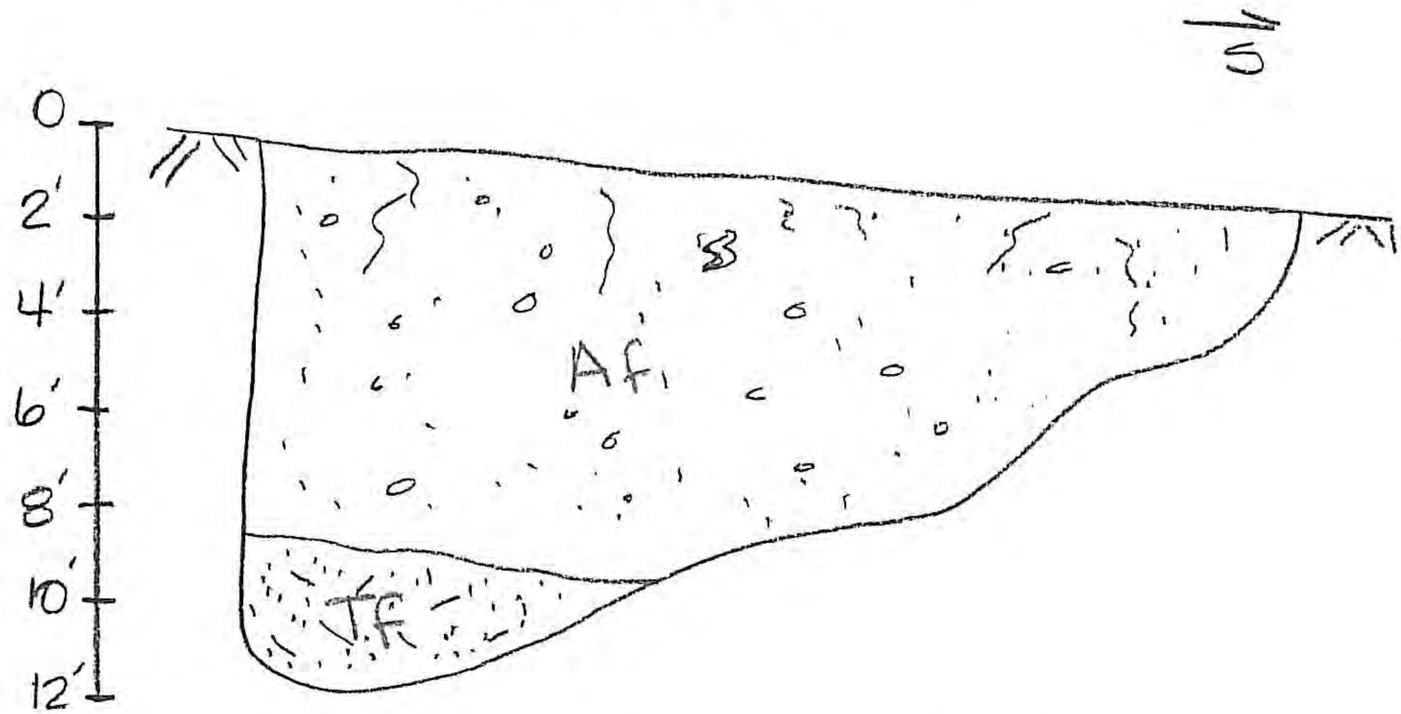
Terry A. Mayer
Consulting Geologist

Date: November 1, 2010
Job Number # 090202
Matrix/Whittier

Plate BTP 15

Excavation Log: TP-29

Feet	Description
0 - 8 ½ ft	Artificial Fill - Sandy Silt (ML) -abundant gravel and cobbles, dry, minor to moderate caving, roots in upper foot, loose
8 ½ ft - 11 ½ ft	Fernando Formation (Tf)- Sandy Siltstone -tan to medium brown, damp, massive, fine to medium-grained sand, scattered gravels, dense



Total Depth 11 ½ feet. No Groundwater. No Seepage. No caving. Test Pit Backfilled.

@ 1 ½ ft	Moisture= 11.1 %	Density= 101 PCF
@ 3 ft	Moisture= 9.6 %	Density= 95 PCF
@ 6 ft	Moisture= 7.3 %	Density= 98 PCF
@ 9 ft	Moisture= 9.0 %	Density= 100 PCF

The log of subsurface conditions hereon applies only at the specific location and the date indicated. It is not warranted to be representative of subsurface conditions at other times and locations

Date Excavated: September 18, 2010

Terry A. Mayer
Consulting Geologist

Date: November 1, 2010
Job Number # 090202
Matrix/Whittier

Plate BTP 16

Terry A. Mayer
Consulting Geologist
Ventura, CA

LOG OF BORING B-3

(Page 1 of 1)

Matrix Oil Corporation
Puente Hills Habitat Preservation
Site Investigation
Whittier, CA
Project #090202

Date Started	3-24-09	Company Rep	:
Date Completed		Northing Coord	:
Hole Diameter	:	Easting Coord	:
Drilling Method	:	Survey By	:
Sampling Method	:	Logged By	:

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Dry Density	% Moisture
0	CL		Older Alluvial Deposits (Qoal) - SILTY CLAY - medium to dark brown, damp, firm, minor sand	X	60/12"	107	12.2
				X	80/12"	83	12.1
5	ML		SANDY SILT - tan to light brown, Scattered gravel and pebbles, damp, moderately dense	X	80/12"	95	14.5
				X	88/12"	88	7.9
10			Total Depth 9½ ft. No groundwater Boring backfilled				
15							
20							

Terry A. Mayer
Consulting Geologist
Ventura, CA

LOG OF BORING B- 4

(Page 1 of 1)

Matrix Oil Corporation
Puente Hills Habitat Preservation
Site Investigation
Whittier, CA
Project #090202

Date Started	: 3-24-09
Date Completed	: 3-24-09
Hole Diameter	: 4"
Drilling Method	: Hand Auger
Sampling Method	:
Company Rep.	:
Northing Coord.	:
Easting Coord.	:
Survey By	:
Logged By	: F. Heathcote

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Dry Density	% Moisture
0			Older Alluvial Deposits (Qoal) - SANDY SILT - medium to dark brown damp to moist, moderately loose	X	20/12"	96	12.9
			@3½' scattered gravels and pebbles becoming light brown, moderately dense	X	30/12"	108	14.8
5							
				X	80/12"	86	10.0
			Total Depth 7 feet. No groundwater Boring backfilled.				
10							
15							
20							

Terry A. Mayer
Consulting Geologist
Ventura, CA

LOG OF BORING B- 5

(Page 1 of 1)

Matrix Oil Corporation Puente Hills Habitat Preservation Site Investigation	Date Started: 3-24-09	Company Rep:	
Whittier, CA	Date Completed: 3-24-09	Northing Coord:	
Project #090202	Hole Diameter: 4"	Easting Coord:	
	Drilling Method: Hand Auger	Survey By:	
	Sampling Method:	Logged By: F. Heathcote	

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Dry Density	% Moisture
0	CL		Older Alluvial Deposits (Qoal) - SILTY CLAY - dark brown, scattered sand, damp to moist, soft to moderately firm	X	30/12"	104	15.5
5			Fernando Formation (Tf) - Sandy Siltstone - tan to buff-brown, damp, minor gravel, moderately dense	X	30/12"	88	9.9
				X	50/12"	98	10.0
			Total Depth 7 feet. No groundwater Boring backfilled.				
10							
15							
20							

BTP 19

Terry A. Mayer
Consulting Geologist
Ventura, CA

LOG OF BORING B-6

Matrix Oil Corporation
Puente Hills Habitat Preservation
Site Investigation
Whittier, CA
Project #090202

Date Started	3-24-09	Company Rep	
Date Completed	3-24-09	Northing Coord	
Hole Diameter	4in.	Easting Coord	
Drilling Method	Hand Auger	Survey By	
Sampling Method		Logged By	F. Heathcote

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Dry Density	% Moisture
0	CL		Artificial Fill (af) - SILTY CLAY - dark brown, scattered concrete, trash				
				X	40/12"	94	6.9
				X	60/12"	96	12.9
5	ML		SANDY SILT - tan to light brown, minor to moderate sand				
			@7' becoming black, oily	X	60/12"	107	11.0
			@8'. becoming clayey				
			@9' becoming sandy, oily, black				
10				X	80/12"	105	9.7
			Total Depth 10½ feet. No groundwater Boring backfilled.				
15							
20							

Terry A. Mayer
Consulting Geologist
Ventura, CA

LOG OF BORING B-9

(Page 1 of 1)

Matrix Oil Corporation
Puente Hills Habitat Preservation
Site Investigation
Whittier, CA
Project #090202

Date Started	3-26-09	Company Rep.	
Date Completed	3-26-09	Northing Coord.	
Hole Diameter	4"	Easting Coord.	
Drilling Method	Hand Auger	Survey By	
Sampling Method		Logged By	F. Heathcote

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Dry Density	% Moisture
0	SM		Artificial Fill (afu) - Silty Sand - fine-grained, damp, moderately firm, asphaltic concrete fragments throughout	X	42/12"	107	10.6
				X	45/12"	112	13.2
5			Fernando Formation (Tfs) - Sandstone - tan to buff brown, friable, damp, firm, scattered gravel and pebbles	X	130/12"	112	5.8
10				X	80/12"	114	11.3
			Total Depth 10½ feet. No groundwater. No caving.				
15							
20							

BTPR 1

Terry A. Mayer
Consulting Geologist
Ventura, CA

LOG OF BORING B-1D

(Page 1 of 1)

Matrix Oil Corporation
Puente Hills Habitat Preservation
Site Investigation
Whittier, CA
Project #090202

Date Started	: 3-26-09	Company Rep.	:
Date Completed	: 3-26-09	Northing Coord.	:
Hole Diameter	: 4"	Easting Coord.	:
Drilling Method	: Hand Auger	Survey By	:
Sampling Method	:	Logged By	: F. Heathcote

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Dry Density	% Moisture
0	ML		Soil- SANDY SILT- light brown, damp loose to moderately firm				
				X	40/12"	90	7.5
			Fernando Formation (Tfs) - SILTSTONE light brown, minor to moderate Sand content, abundant gravel, damp, firm	X	100/12"	101	16.9
5							
			Total Depth 8 feet. No groundwater No caving				
10							
15							
20							

Terry A. Mayer
Consulting Geologist
Ventura, CA

LOG OF BORING B- 16

Matrix Oil Corporation
Puente Hills Habitat Preservation
Site Investigation
Whittier, CA
Project #090202

Date Started	10-19-09	Company Rep.	
Date Completed	10-19-09	Northing Coord	
Hole Diameter	6"	Easting Coord.	
Drilling Method	Hollow Stem	Survey By	
Sampling Method	Cal. Split Spoon/SPT	Logged By	T. Mayer

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Dry Density	% Moisture
0			Artificial Fill(af)-CLAYEY SILT(ML)-dark brown, minor gravel, damp, roots in upper 2 ft.				
				X		79	7.5
5			GRAVELLY SAND(SC)-dense, dry				
				X	100	109	6.6
			Older Alluvial Deposits (Qoal)-SANDY SILT(ML)- tan to gray-green, fine-grained sand				
10				X	45	85	5.2
15				SPT	15 15 15		
20			increase in sand				

Plate 22a

Terry A. Mayer
Consulting Geologist
Ventura, CA

LOG OF BORING B- 16(cont.)

Matrix Oil Corporation
Puente Hills Habitat Preservation
Site Investigation
Whittier, CA
Project #090202

Date Started	:	Company Rep.	:
Date Completed	:	Northing Coord.	:
Hole Diameter	:	Easting Coord.	:
Drilling Method	:	Survey By	:
Sampling Method	:	Logged By	:

Depth In Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Dry Density	% Moisture
20							
				SPT	20 20 25		
25				SPT	17 18 25		
			Fernando Formation (Tf) - SILTY SANDSTONE gray-green in color, fine-grained, damp, minor caliche mottling	X	60	80	8.5
30				X	45	80	9.6
35			increase in silt content	SPT	40 40 50		
40							

Total Depth 40 feet. No groundwater encountered; B[illegible]

Plate BTP 22b

Terry A. Mayer
Consulting Geologist
Ventura, CA

LOG OF BORING B-18

Matrix Oil Corporation
Puente Hills Habitat Preservation
Site Investigation
Whittier, CA
Project #090202

Date Started	10-19-09	Company Rep.	
Date Completed	10-19-09	Northing Coord.	
Hole Diameter	6"	Easting Coord.	
Drilling Method	Hollow Stem	Survey By	
Sampling Method	Cal. Split Spoon/SPT	Logged By	T. Mayer

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Dry Density	% Moisture
0			Fernando Formation (Tf) - SANDSTONE - tan to light brown, iron oxide stained, minor silt, fine to medium grained, dense, dry	X	20	96	4.1
5			becoming medium to coarse grained, very friable	X	90	108	6.0
10			becoming tan to buff, no cementation	X	75	100	3.4
15			gray, fine-grained, very poorly cemented	X	100	95	5.2
20							

Terry A. Mayer
Consulting Geologist
Ventura, CA

LOG OF BORING B- 18(cont.)

Matrix Oil Corporation
Puente Hills Habitat Preservation
Site Investigation
Whittier, CA
Project #090202

Date Started :
Date Completed :
Hole Diameter :
Drilling Method :
Sampling Method :

Company Rep. :
Northing Coord. :
Easting Coord. :
Survey By :
Logged By :

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Dry Density	% Moisture
20			SILTSTONE - gray, minor to moderate fine sand, slightly cemented	X	120	94	4.5
25			SANDSTONE · fine-grained, tan to rust-brown, poorly cemented, minor silt	X	120	88	3.9
30				X	90	93	3.4
35				X	90	96	2.6
40			becoming moderately well-cemented				

Terry A. Mayer
Consulting Geologist
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LOG OF BORING B- 18(cont.)

Matrix Oil Corporation
Puente Hills Habitat Preservation
Site Investigation
Whittier, CA
Project #090202

Date Started :
Date Completed :
Hole Diameter :
Drilling Method :
Sampling Method :

Company Rep. :
Northing Coord. :
Easting Coord. :
Survey By :
Logged By :

Depth in Feet	USCS	GRAPHIC	DESCRIPTION	Samples	Blow Count	Dry Density	% Moisture
40				X	80	97	8.2
45			SILTY SANDSTONE · tan to lt gray, iron oxide streaks, medium grained, poorly cemented	X	75	92	6.9
50			becoming fine to medium grained	X	90	92	2.7
55				X	72	92	2.1
60			becoming gray green, increase in silt	X	88	80	4.9

Total Depth 60 feet [illegible]

Plate BTP 23C

Depth (ft.)	Graphic Log		BORING LOG # B-19 Page 1 of 2
0			Soil - Sandy Silt (ML) - light brown, fine to medium grained, dry, loose minor roots
1			
2			
3			Fernando Formation (Tf) - interbedded siltstone and fine-sandstone, dry to damp, dense
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15	X	M=12.7%	
16		D=107 PCF	very fine sand, gray-green, dense
17			
18			
19			
20	X	M=11.3% D=102 PCF	decreasing in sand

The log of subsurface conditions shown hereon applies only at the specific location and the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

DRILL DATE:

DATE Sept. 28, 2010

WORK ORDER #

BTP 24a

Depth (ft.)		Blow Count	Graphic Log	BORING LOG #B-19 Page 2of2
21	X			
22				
23				
24				
25	X	M=13.0 D=104PCF		minor cementation, dense
26				
27				
28				
29				
30	X	M=11.4 D=102PCF		yellow brown, fine sandstone, friable
31				Total Depth 31feet. No groundwater No caving. Boring backfilled.
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				

The log of subsurface conditions shown hereon applies only at the specific location and the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

DRILL DATE:

DATE Sept 28, 2010

WORK ORDER #

PLATE BTP24b

Depth (ft.)	Graphic Log		BORING LOG # B-20 Page 1 of 1
0			Fernando Formation (TF) - fine sandstone - friable, scatter gravel and pebbles, yellow brown
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			becoming very hard
11			
12	X	M=6.9 D=102 PCF	moderately well-cemented sandstone very hard
13			
14			
15			Practical refusal @ 15 feet.
16			Total Depth 15 feet. No groundwater. No caving. Boring backfilled.
17			
18			
19			
20			

The log of subsurface conditions shown hereon applies only at the specific location and the date indicated. It is not warranted to be representative of subsurface conditions at other locations and times.

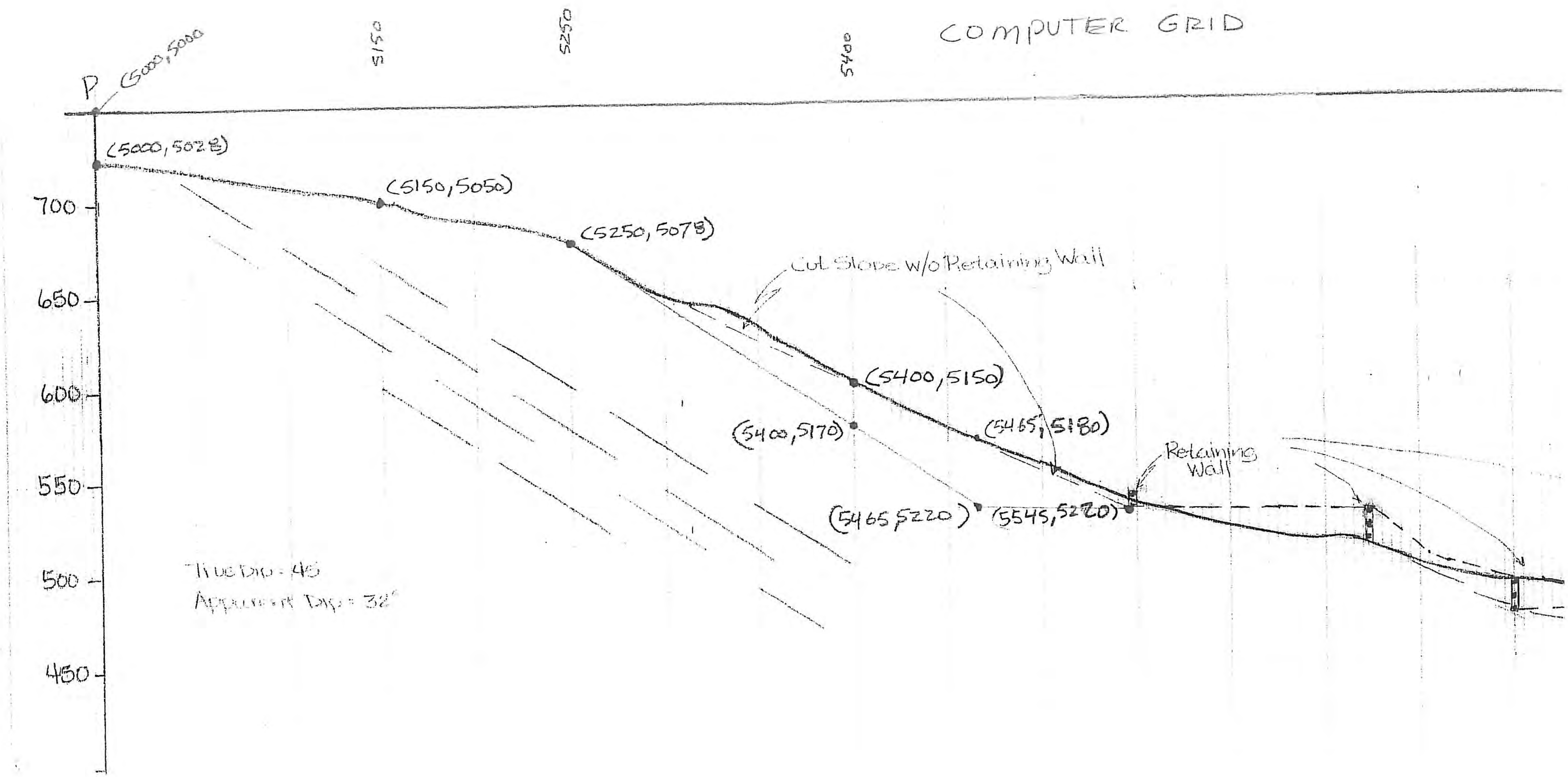
DRILL DATE:

DATE Sept. 28, 2010

WORK ORDER #

APPENDIX

SLOPE STABILITY


COMPUTER GRID
P
(5000,5000)
5150
5250
5400
(5000,5028)
(5150,5050)
(5250,5078)
Cut Slope w/o Retaining Wall
(5400,5150)
(5400,5170)
(5465,5180)
Retaining Wall
(5465,5220)
(5545,5220)
700
650
600
550
500
450

OT11

```
********************************************************************************
  SECTION P-P STATIC PLANAR

********************************************************************************
*************
  INPUT DATA
*************

 CONTROL DATA,
     NUMBER OF TRIAL SLIP SURFACES        1
     NUMBER OF SPECIFIED SLOPE POINTS     4
     NUMBER OF POINT LOADS                0
     NUMBER OF PRESSURE LOADS             0

     INITIAL ESTIMATE OF F          =      1.500
     INITIAL ESTIMATE OF THETA      =     12.000
     ALLOWABLE FORCE IMBALANCE      =     10.000
     ALLOWABLE MOMENT IMBALANCE     =    100.000
     SEISMIC COEFFICIENT            =       .000
     ATMOSPHERIC PRESSURE           =       .000
     UNIT WEIGHT OF WATER           =     62.400

 SLOPE POINTS COORDINATES
        X             Y
     5250.00       5078.00
     5400.00       5150.00
     5465.00       5180.00
     5545.00       5220.00

 NUMBER OF SLICES =    3

 SLICE DATA
```

X	Y	GAMMA	U	CEE	PHI	DPHI
5250.00	5078.00					
		120.00	.00	150.00	26.00	.00
5400.00	5170.00					
		120.00	.00	150.00	26.00	.00
5465.00	5220.00					
		120.00	.00	150.00	40.00	.00
5545.00	5220.00					

```
***********
  RESULTS
***********
```

ITERATION	F	THETA DEGREES	EXCESS FORCE	EXCESS MOMENT
1	1.500	12.0	36614.5	-150365100.0
2	1.739	22.0	16733.3	-50959020.0
3	1.812	19.9	1741.4	-6830112.0
4	1.982	29.9	1416.6	-2159164.0
5	2.156	39.9	7508.5	-1561053.0
6	1.932	29.9	7720.3	-15201610.0
7	1.770	19.9	7614.5	-25796960.0
8	1.851	21.9	707.5	-2953348.0
9	1.917	25.8	194.2	-589568.3
10	1.927	26.2	.0	336.7
11	1.927	26.2	.0	9.0

OT11

SECTION SURFACE NUMBER	X COORDINATE	INTERSLICE FORCES FORCE	THETA	POA	EFFECTIVE STRESSES ON SLIP NORMAL	SHEAR
0	5250.00	0.0	0.0	0.0	.0	.0
NO TENSION CRACK						
1	5400.00	40784.6	26.2	.30	893.4	304.0
2	5465.00	127493.5	26.2	.33	2469.9	703.1
3	5545.00	.0	26.2	.00	3104.0	1429.8

OT11SEIS

****

SECTION P-P Seismic PLANAR

****
****

INPUT DATA

****

CONTROL DATA,

NUMBER OF TRIAL SLIP SURFACES	1
NUMBER OF SPECIFIED SLOPE POINTS	4
NUMBER OF POINT LOADS	0
NUMBER OF PRESSURE LOADS	0

INITIAL ESTIMATE OF F	=	1.500
INITIAL ESTIMATE OF THETA	=	12.000
ALLOWABLE FORCE IMBALANCE	=	10.000
ALLOWABLE MOMENT IMBALANCE	=	100.000
SEISMIC COEFFICIENT	=	.150
ATMOSPHERIC PRESSURE	=	.000
UNIT WEIGHT OF WATER	=	62.400

SLOPE POINTS COORDINATES

X	Y
5250.00	5078.00
5400.00	5150.00
5465.00	5180.00
5545.00	5220.00

NUMBER OF SLICES = 3

SLICE DATA

X	Y	GAMMA	U	CEE	PHI	DPHI
5250.00	5078.00					
		120.00	.00	150.00	26.00	.00
5400.00	5170.00					
		120.00	.00	150.00	26.00	.00
5465.00	5220.00					
		120.00	.00	150.00	40.00	.00
5545.00	5220.00					

****

RESULTS

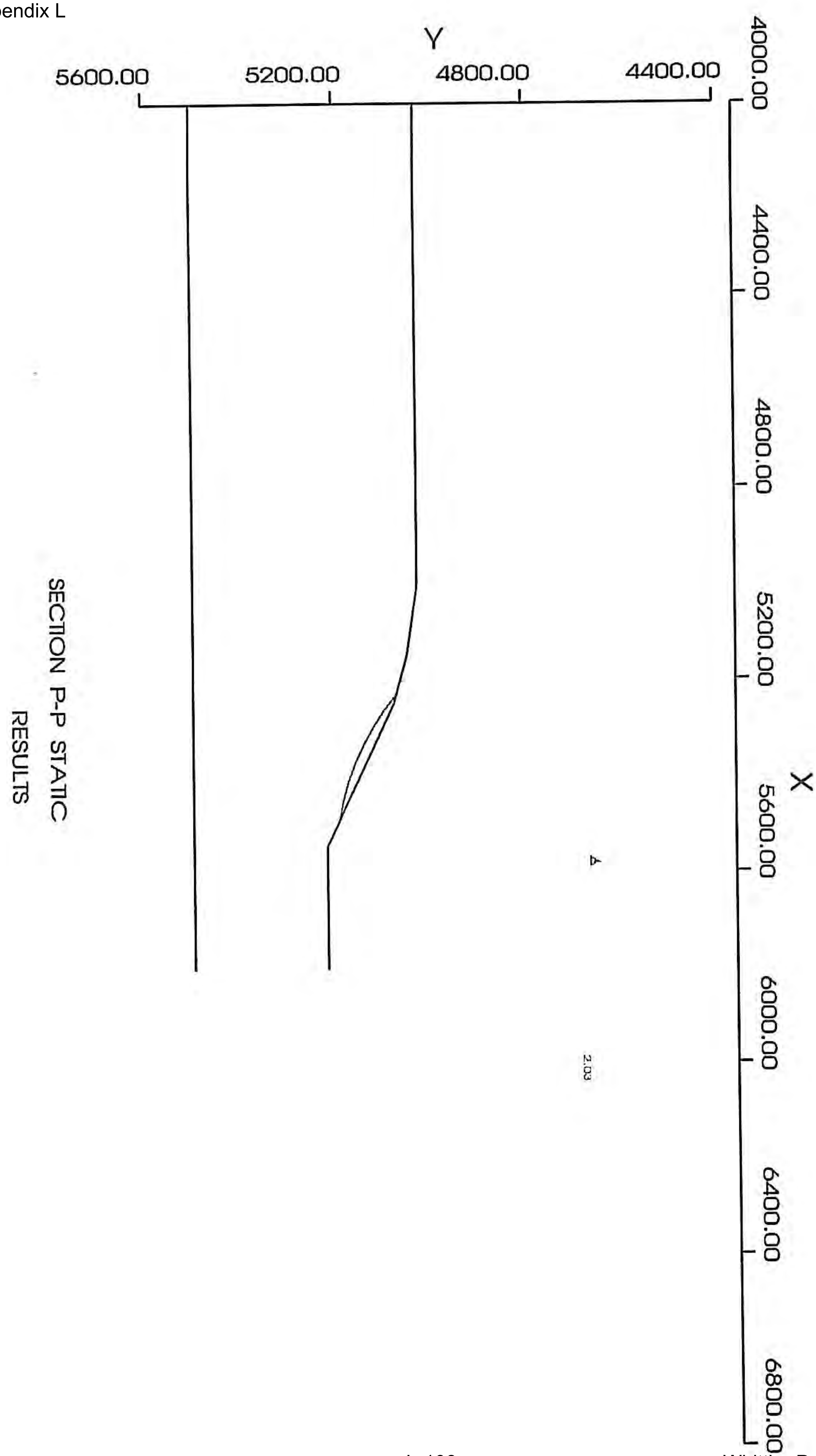
****

ITERATION	F	THETA DEGREES	EXCESS FORCE	EXCESS MOMENT
1	1.500	12.0	-54396.0	215630300.0
2	1.464	22.0	-25186.2	73305940.0
3	1.394	26.0	2605.7	-7879480.0
4	1.516	34.2	1469.1	-1297663.0
5	1.435	28.5	474.7	-1726702.0
6	1.488	32.0	37.0	204205.3
7	1.472	31.0	-.8	-6984.7
8	1.473	31.0	.0	37.0

SECTION NUMBER	X COORDINATE	INTERSLICE FORCES FORCE	THETA	POA	EFFECTIVE STRESSES ON SLIP SURFACE NORMAL	SHEAR

OT11SEIS

0	5250.00	0.0	0.0	0.0	.0	.0
NO TENSION CRACK						
1	5400.00	52914.7	31.0	.41	794.4	365.0
2	5465.00	157455.6	31.0	.35	2146.3	812.8
3	5545.00	.0	31.0	.00	3414.1	2046.1


Y
5600.00
5200.00
4800.00
4400.00
X
4000.00
4400.00
4800.00
5200.00
5600.00
6000.00
6400.00
6800.00
2.03
SECTION P-P STATIC
RESULTS

SS-6

OT5

```
************************************************************************
  SECTION P-P STATIC
************************************************************************
*******************************************
  ANALYSIS BY BISHOP'S SIMPLIFIED METHOD
*******************************************

**************
  INPUT DATA
**************

 CONTROL DATA,
      AUTOMATIC SEARCH FOR CRITICAL CIRCLE
      NUMBER OF DEPTH LIMITING TANGENTS                     0
      NUMBER OF VERTICAL SECTIONS                           7
      NUMBER OF SOIL LAYER BOUNDARIES                       2
      NUMBER OF POINTS DEFINING COHESION PROFILE            0
      NUMBER OF CURVES DEFINING COHESION ANISOTROPY         0
      NUMBER OF BOUNDARY LINE LOADS                         0
      NUMBER OF BOUNDARY PRESSURE LOADS                     0

      SEISMIC COEFFICIENT                      =         .000
      ATMOSPHERIC PRESSURE                     =         .000
      UNIT WEIGHT OF WATER                     =       62.400
      UNIT WEIGHT OF WATER IN TENSION CRACK    =       62.400

 SEARCH STARTS AT CENTER (5550.0,4650.0),WITH FINAL GRID OF 10.0

 ALL CIRCLES PASS THROUGH THE POINT (5545.0,5200.0)

 GEOMETRY
```

SECTIONS	4000.00	5000.00	5150.00	5250.00	5400.00	5545.00	5800.00
T. CRACKS	5028.00	5028.00	5050.00	5078.00	5150.00	5220.00	5220.00
W IN CRACK	5028.00	5028.00	5050.00	5078.00	5150.00	5220.00	5220.00
BOUNDARY 1	5028.00	5028.00	5050.00	5078.00	5150.00	5220.00	5220.00
BOUNDARY 2	5500.00	5500.00	5500.00	5500.00	5500.00	5500.00	5500.00

SOIL PROPERTIES

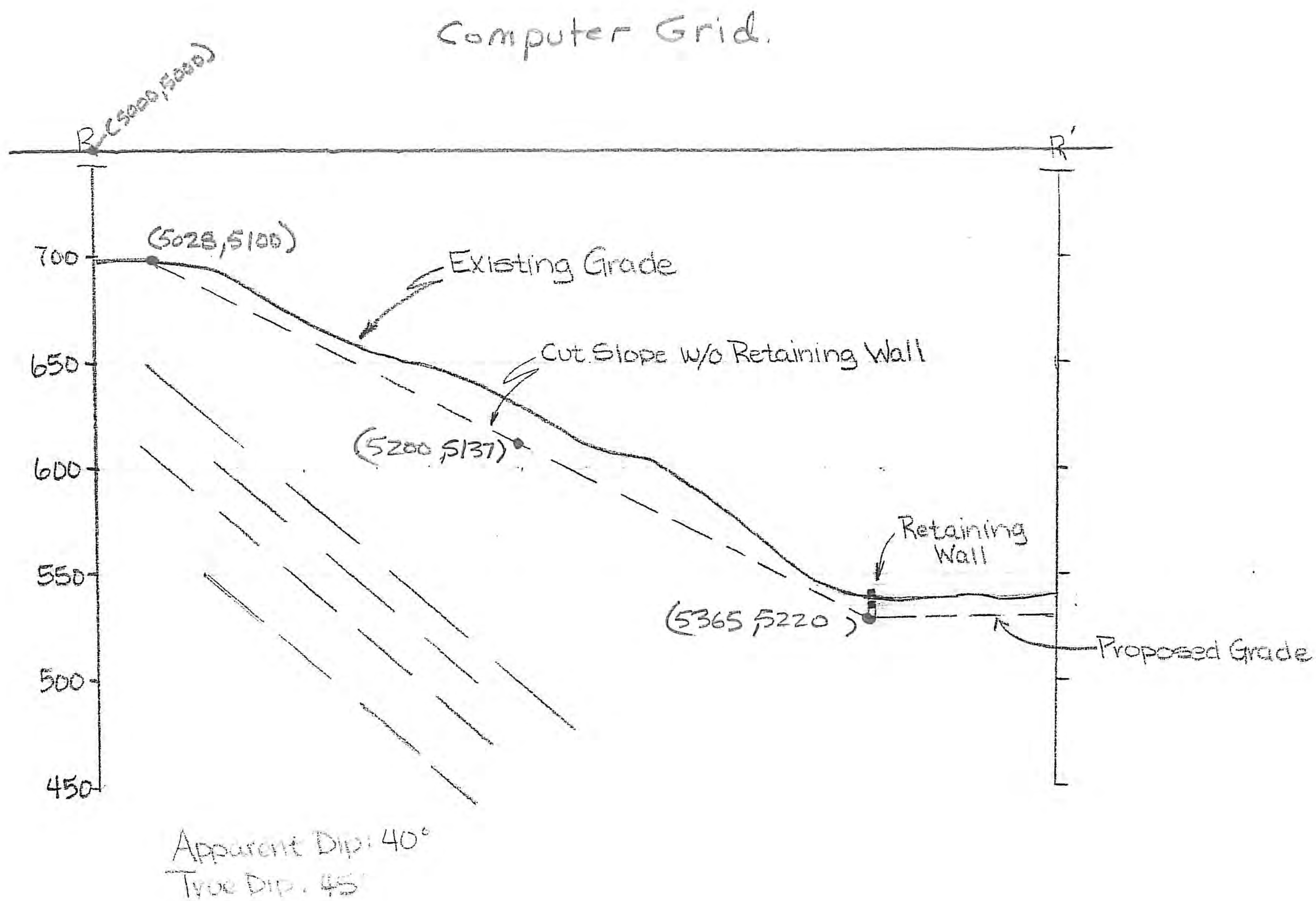
LAYER	DENSITY	COHESION	FRICTION ANGLE	DELTA PHI
1	120.00	150.00	40.00	.00

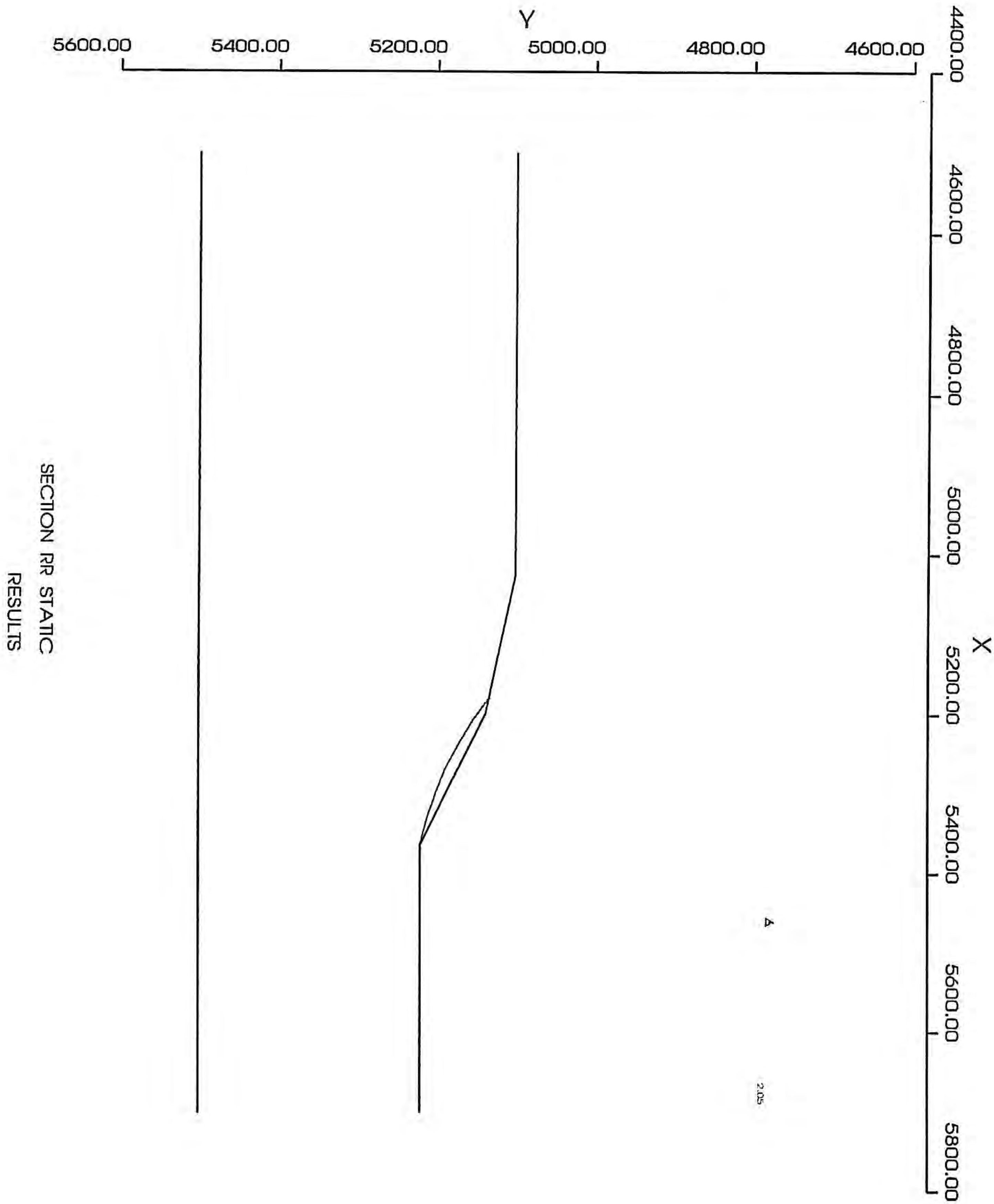
```
***********
 RESULTS
***********
```

NUMBER	TANGENT	RADIUS	(X) CENTER	(Y) CENTER	F.S.
1	5200.0	550.0	5550.0	4650.0	2.090
2	5200.2	550.2	5530.0	4650.0	2.153
3	5200.0	570.0	5550.0	4630.0	2.110
4	5200.6	550.6	5570.0	4650.0	2.045
5	5200.0	530.0	5550.0	4670.0	2.071
6	5200.2	550.2	5560.0	4650.0	2.064
7	5200.6	560.6	5570.0	4640.0	2.052
8	5201.1	551.1	5580.0	4650.0	2.036
9	5200.6	540.6	5570.0	4660.0	2.040
10	5201.1	561.1	5580.0	4640.0	2.039
11	5201.8	551.8	5590.0	4650.0	2.043
12	5201.1	541.1	5580.0	4660.0	2.035
13	5200.6	540.6	5570.0	4660.0	2.040

				OT5	
14	5201.9	541.9	5590.0	4660.0	2.050
15	5201.2	531.2	5580.0	4670.0	2.036
16	5200.6	550.6	5570.0	4650.0	2.045
17	5201.8	551.8	5590.0	4650.0	2.043
18	5201.9	531.9	5590.0	4670.0	2.061
19	5200.6	530.6	5570.0	4670.0	2.035

F.S. MINIMUM= 2.035 FOR THE CIRCLE OF CENTER (5580.0,4660.0)


Computer Grid.
R (5000,5000)
R'
700
650
600
550
500
450
(5028,5100)
Existing Grade
Cut Slope w/o Retaining Wall
(5200,5137)
Retaining Wall
(5365,5220)
Proposed Grade
Apparent Dip: 40°
True Dip: 45°


Y
5600.00
5400.00
5200.00
5000.00
4800.00
4600.00
X
4400.00
4600.00
4800.00
5000.00
5200.00
5400.00
5600.00
5800.00
2.05
SECTION RR STATIC
RESULTS

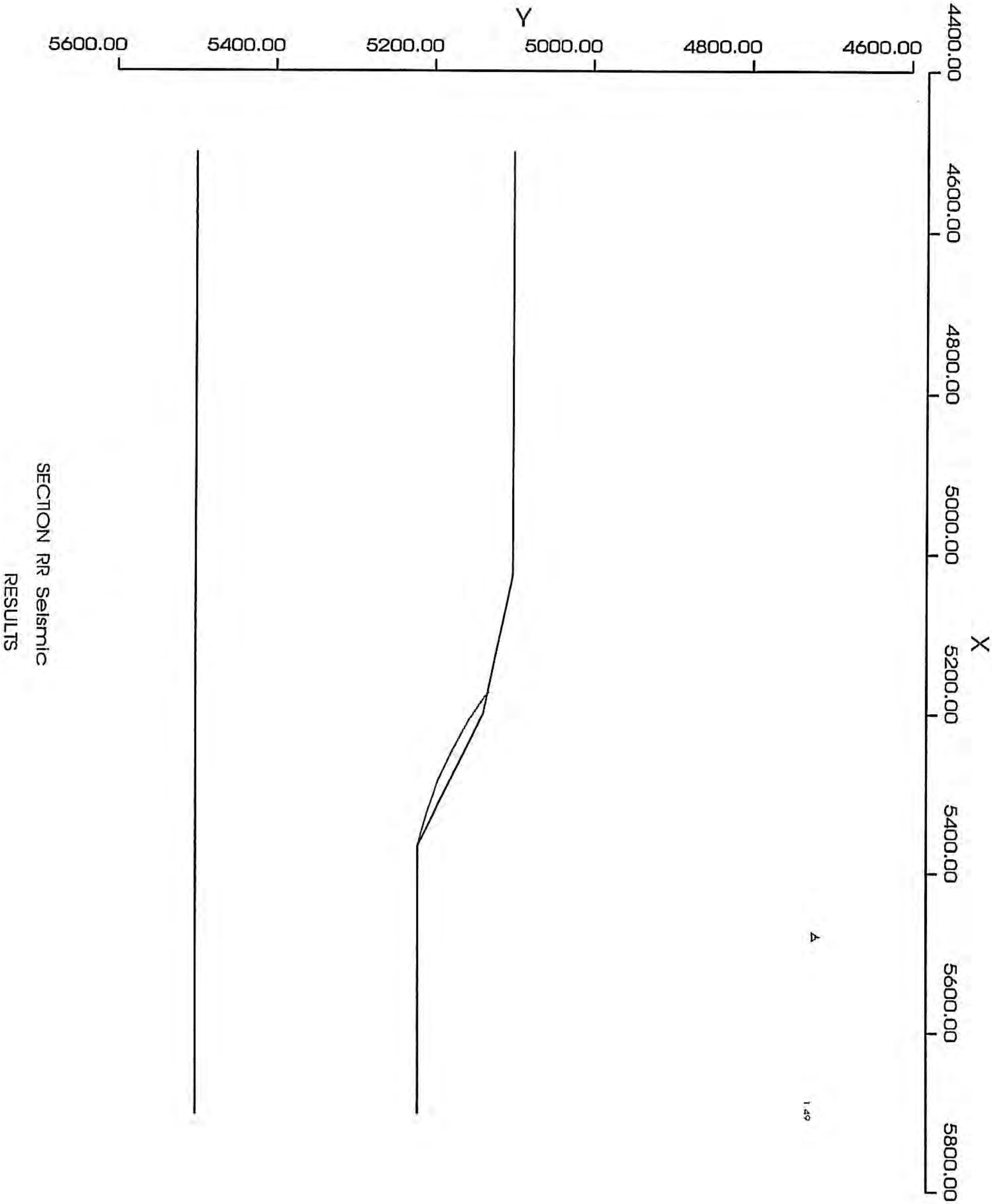
55-10

OT6

```
**************************************************************************
  SECTION RR STATIC
**************************************************************************
**********************************************
  ANALYSIS BY BISHOP'S SIMPLIFIED METHOD
**********************************************

**************
  INPUT DATA
**************

 CONTROL DATA,
      AUTOMATIC SEARCH FOR CRITICAL CIRCLE
      NUMBER OF DEPTH LIMITING TANGENTS                       0
      NUMBER OF VERTICAL SECTIONS                             5
      NUMBER OF SOIL LAYER BOUNDARIES                         2
      NUMBER OF POINTS DEFINING COHESION PROFILE              0
      NUMBER OF CURVES DEFINING COHESION ANISOTROPY           0
      NUMBER OF BOUNDARY LINE LOADS                           0
      NUMBER OF BOUNDARY PRESSURE LOADS                       0

      SEISMIC COEFFICIENT                      =        .000
      ATMOSPHERIC PRESSURE                     =        .000
      UNIT WEIGHT OF WATER                     =      62.400
      UNIT WEIGHT OF WATER IN TENSION CRACK =         62.400

 SEARCH STARTS AT CENTER (5200.0,4700.0),WITH FINAL GRID OF 20.0

 ALL CIRCLES PASS THROUGH THE POINT (5365.0,5220.0)

 GEOMETRY

    SECTIONS     4500.00  5028.00  5200.00  5365.00  5700.00

    T. CRACKS    5100.00  5100.00  5137.00  5220.00  5220.00
    W IN CRACK   5100.00  5100.00  5137.00  5220.00  5220.00
    BOUNDARY 1   5100.00  5100.00  5137.00  5220.00  5220.00
    BOUNDARY 2   5500.00  5500.00  5500.00  5500.00  5500.00

 SOIL PROPERTIES

     LAYER   DENSITY    COHESION   FRICTION ANGLE   DELTA PHI
       1     120.00      150.00       40.00            .00

***********
  RESULTS
***********

 NUMBER  TANGENT  RADIUS   (X) CENTER  (Y) CENTER     F.S.

    1    5245.6   545.6     5200.0      4700.0       4.531
    2    5258.9   558.9     5160.0      4700.0       5.309
    3    5243.8   583.8     5200.0      4660.0       4.604
    4    5234.8   534.8     5240.0      4700.0       3.885
    5    5247.6   507.6     5200.0      4740.0       4.462
    6    5233.8   573.8     5240.0      4660.0       3.970
    7    5226.9   526.9     5280.0      4700.0       3.359
    8    5236.0   496.0     5240.0      4740.0       3.802
    9    5226.4   566.4     5280.0      4660.0       3.448
   10    5221.9   521.9     5320.0      4700.0       2.945
   11    5227.5   487.5     5280.0      4740.0       3.271
   12    5221.8   561.8     5320.0      4660.0       3.030
   13    5220.0   520.0     5360.0      4700.0       2.644
```

				OT6	
14	5222.1	482.1	5320.0	4740.0	2.863
15	5220.0	560.0	5360.0	4660.0	2.713
16	5221.2	521.2	5400.0	4700.0	2.412
17	5220.0	480.0	5360.0	4740.0	2.575
18	5221.1	561.1	5400.0	4660.0	2.485
19	5225.4	525.4	5440.0	4700.0	2.215
20	5221.3	481.3	5400.0	4740.0	2.336
21	5225.0	565.0	5440.0	4660.0	2.286
22	5232.6	532.6	5480.0	4700.0	2.090
23	5225.8	485.8	5440.0	4740.0	2.146
24	5231.7	571.7	5480.0	4660.0	2.137
25	5242.6	542.6	5520.0	4700.0	2.189
26	5233.6	493.6	5480.0	4740.0	2.069
27	5229.3	489.3	5460.0	4740.0	2.085
28	5233.1	513.1	5480.0	4720.0	2.075
29	5238.6	498.6	5500.0	4740.0	2.156
30	5234.2	474.2	5480.0	4760.0	2.081
31	5228.9	508.9	5460.0	4720.0	2.111
32	5237.9	517.9	5500.0	4720.0	2.105
33	5239.4	479.4	5500.0	4760.0	2.237
34	5229.7	469.7	5460.0	4760.0	2.065
35	5226.1	466.1	5440.0	4760.0	2.114
36	5230.1	450.1	5460.0	4780.0	2.055
37	5226.3	446.3	5440.0	4780.0	2.084
38	5234.8	454.8	5480.0	4780.0	2.124
39	5230.6	430.6	5460.0	4800.0	2.060
40	5226.1	466.1	5440.0	4760.0	2.114
41	5234.2	474.2	5480.0	4760.0	2.081
42	5235.5	435.5	5480.0	4800.0	2.195
43	5226.6	426.6	5440.0	4800.0	2.060

F.S. MINIMUM= 2.055 FOR THE CIRCLE OF CENTER (5460.0,4780.0)


Y
5600.00
5400.00
5200.00
5000.00
4800.00
4600.00
X
4400.00
4600.00
4800.00
5000.00
5200.00
5400.00
5600.00
5800.00
SECTION RR Seismic
RESULTS

OT6SEIS

```
*************************************************************************
  SECTION RR Seismic
*************************************************************************
*******************************************
  ANALYSIS BY BISHOP'S SIMPLIFIED METHOD
*******************************************

**************
  INPUT DATA
**************

 CONTROL DATA,
      AUTOMATIC SEARCH FOR CRITICAL CIRCLE
      NUMBER OF DEPTH LIMITING TANGENTS                 0
      NUMBER OF VERTICAL SECTIONS                       5
      NUMBER OF SOIL LAYER BOUNDARIES                   2
      NUMBER OF POINTS DEFINING COHESION PROFILE        0
      NUMBER OF CURVES DEFINING COHESION ANISOTROPY     0
      NUMBER OF BOUNDARY LINE LOADS                     0
      NUMBER OF BOUNDARY PRESSURE LOADS                 0

      SEISMIC COEFFICIENT                    =       .150
      ATMOSPHERIC PRESSURE                   =       .000
      UNIT WEIGHT OF WATER                   =     62.400
      UNIT WEIGHT OF WATER IN TENSION CRACK  =     62.400

 SEARCH STARTS AT CENTER (5200.0,4700.0),WITH FINAL GRID OF 20.0

 ALL CIRCLES PASS THROUGH THE POINT (5365.0,5220.0)

 GEOMETRY

    SECTIONS     4500.00  5028.00  5200.00  5365.00  5700.00

    T. CRACKS    5100.00  5100.00  5137.00  5220.00  5220.00
    W IN CRACK   5100.00  5100.00  5137.00  5220.00  5220.00
    BOUNDARY 1   5100.00  5100.00  5137.00  5220.00  5220.00
    BOUNDARY 2   5500.00  5500.00  5500.00  5500.00  5500.00

 SOIL PROPERTIES

     LAYER   DENSITY    COHESION  FRICTION ANGLE  DELTA PHI
       1     120.00      150.00       40.00          .00

***********
  RESULTS
***********
```

NUMBER	TANGENT	RADIUS	(X) CENTER	(Y) CENTER	F.S.
1	5245.6	545.6	5200.0	4700.0	2.628
2	5258.9	558.9	5160.0	4700.0	2.918
3	5243.8	583.8	5200.0	4660.0	2.640
4	5234.8	534.8	5240.0	4700.0	2.364
5	5247.6	507.6	5200.0	4740.0	2.621
6	5233.8	573.8	5240.0	4660.0	2.388
7	5226.9	526.9	5280.0	4700.0	2.129
8	5236.0	496.0	5240.0	4740.0	2.342
9	5226.4	566.4	5280.0	4660.0	2.161
10	5221.9	521.9	5320.0	4700.0	1.931
11	5227.5	487.5	5280.0	4740.0	2.098
12	5221.8	561.8	5320.0	4660.0	1.966
13	5220.0	520.0	5360.0	4700.0	1.778

OT6SEIS

14	5222.1	482.1	5320.0	4740.0	1.896
15	5220.0	560.0	5360.0	4660.0	1.809
16	5221.2	521.2	5400.0	4700.0	1.656
17	5220.0	480.0	5360.0	4740.0	1.746
18	5221.1	561.1	5400.0	4660.0	1.691
19	5225.4	525.4	5440.0	4700.0	1.552
20	5221.3	481.3	5400.0	4740.0	1.618
21	5225.0	565.0	5440.0	4660.0	1.588
22	5232.6	532.6	5480.0	4700.0	1.492
23	5225.8	485.8	5440.0	4740.0	1.517
24	5228.6	528.6	5460.0	4700.0	1.514
25	5232.1	552.1	5480.0	4680.0	1.501
26	5237.2	537.2	5500.0	4700.0	1.503
27	5233.1	513.1	5480.0	4720.0	1.488
28	5228.9	508.9	5460.0	4720.0	1.500
29	5237.9	517.9	5500.0	4720.0	1.523
30	5233.6	493.6	5480.0	4740.0	1.490
31	5228.6	528.6	5460.0	4700.0	1.514
32	5237.2	537.2	5500.0	4700.0	1.503
33	5238.6	498.6	5500.0	4740.0	1.565
34	5229.3	489.3	5460.0	4740.0	1.488

F.S. MINIMUM= 1.488 FOR THE CIRCLE OF CENTER (5480.0,4720.0)

APPENDIX

REGIONAL GEOLOGY

Location Map

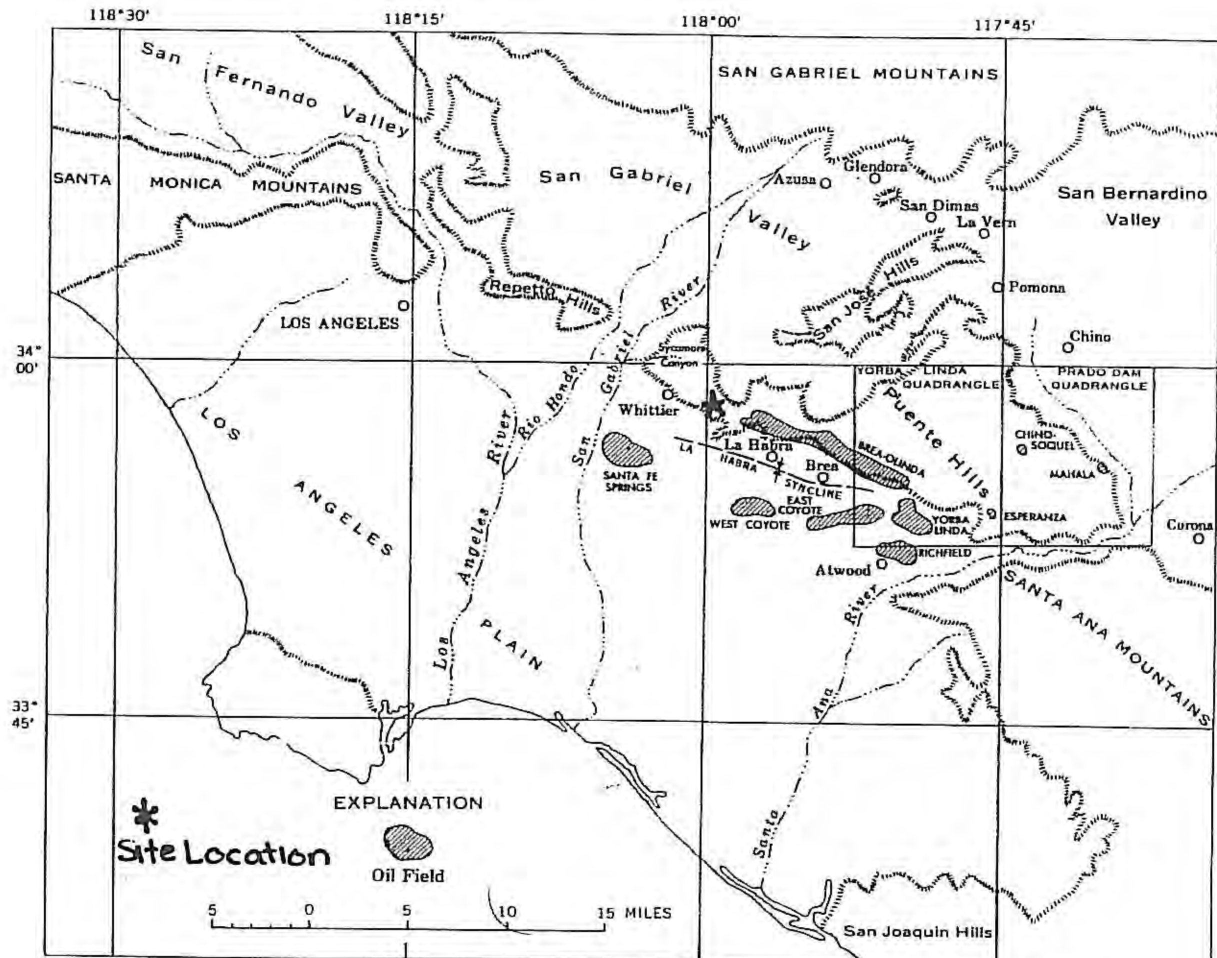


Plate RG 1

Regional Geologic Map

Dibblee, T. W., 2001,
Geologic Map of the Whittier and La Habra and Newbury Park Quadrangles,
Los Angeles and Orange Counties, Dibblee Foundation Map #DF-74.

Scale 1:24,000

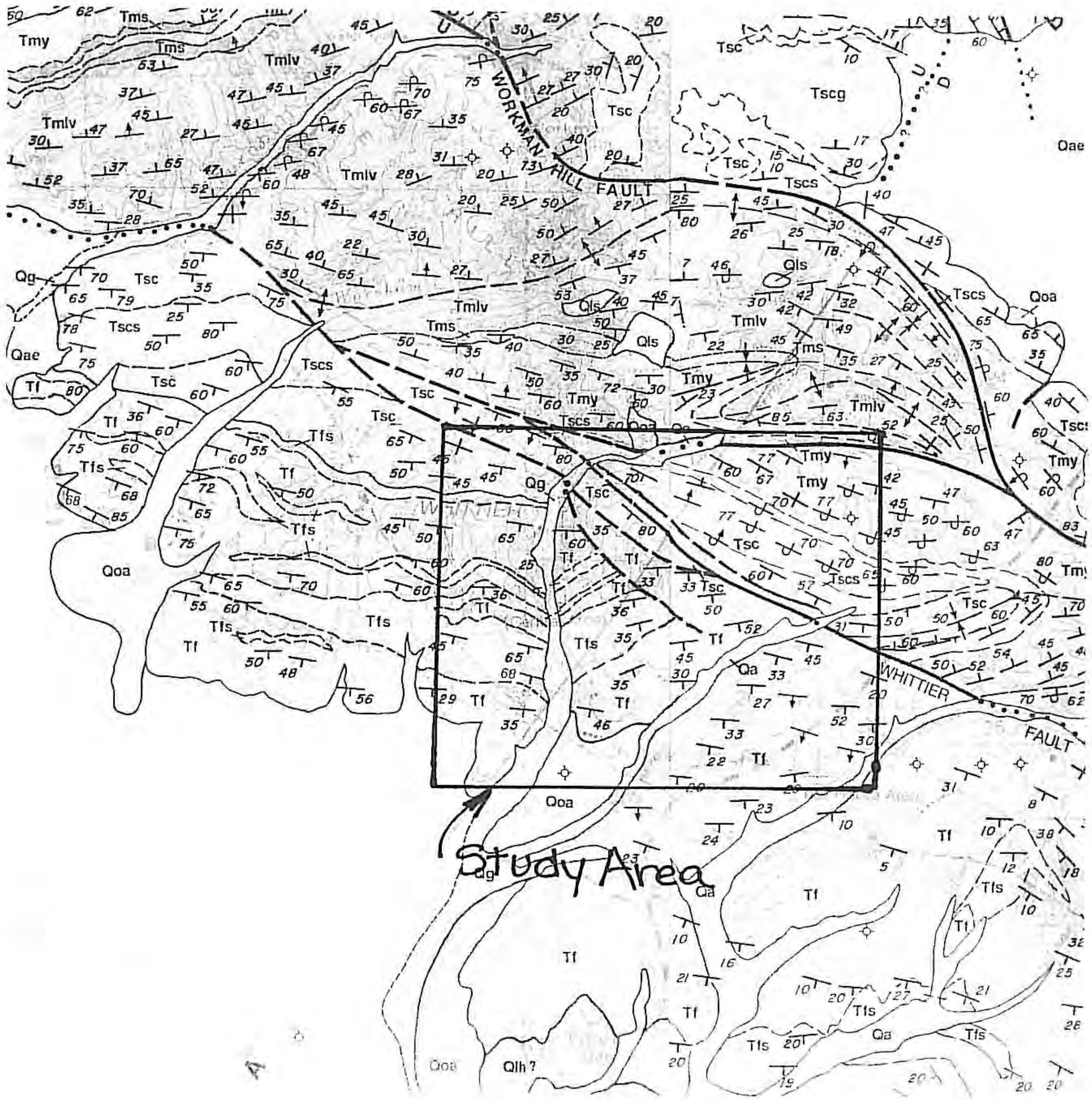


Plate RG2

State of California
Seismic Hazards Map

Whittier Quadrangle, March 25, 1999
Scale: 1inch = 400 feet

Plate RG 3

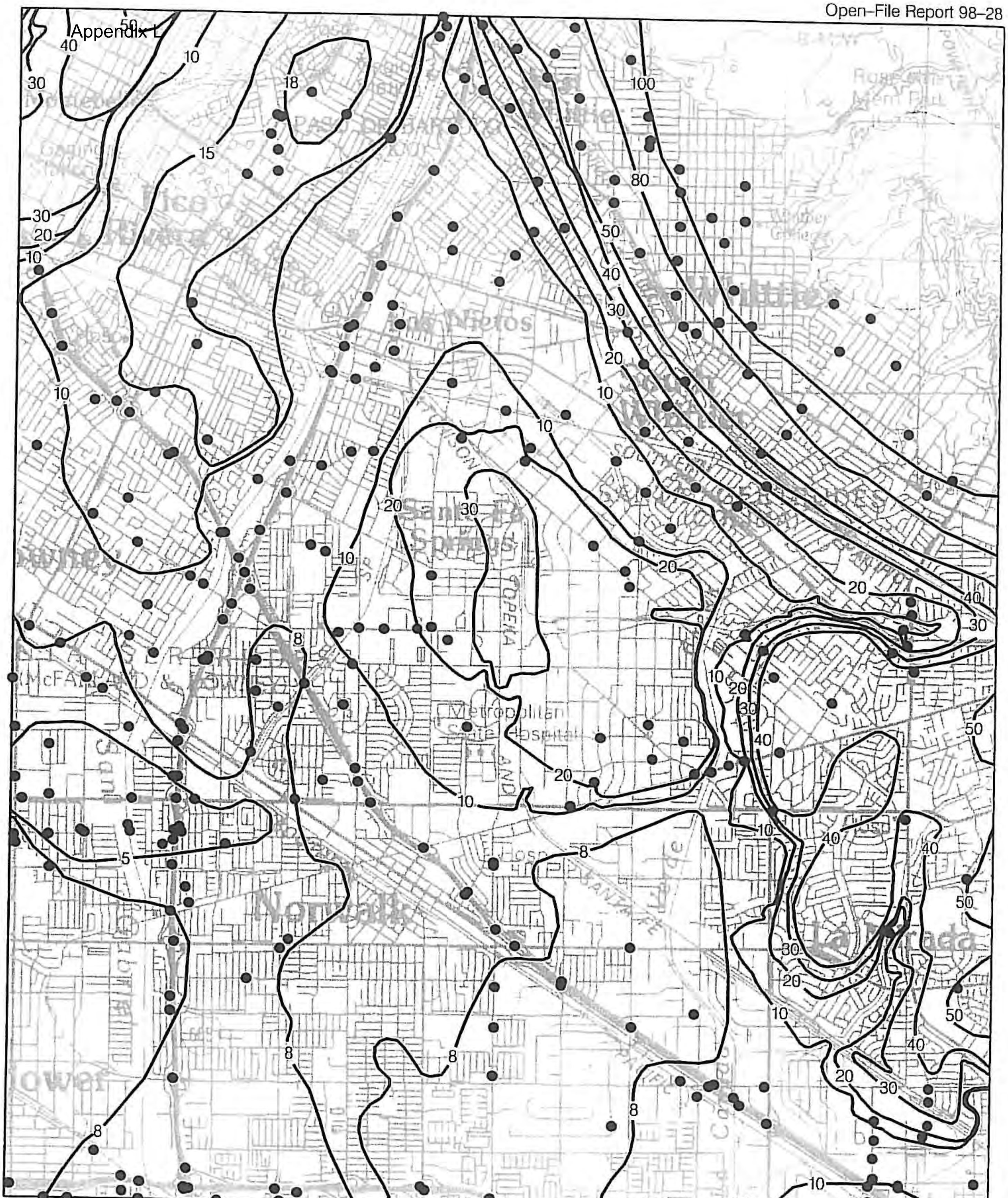


Plate 1.2 Historically Highest Ground Water Contours and Borehole Log Data Locations, Whittier Quadrangle.

● Borehole Site

— 30 — Depth to ground water in feet

ONE MILE

SCALE

Plate RG-4

WHITTIER 7.5 MINUTE QUADRANGLE AND PORTIONS OF ADJACENT QUADRANGLES

10% EXCEEDANCE IN 50 YEARS PEAK GROUND ACCELERATION (g)

1998

ALLUVIUM CONDITIONS

Base map modified from MapInfo Street Works ©1998 MapInfo Corporation

0 2.5 5

Kilometers

Department of Conservation
Division of Mines and Geology

Figure 3.3

RG-5

APPENDIX

FAULTING AND SEISMICITY

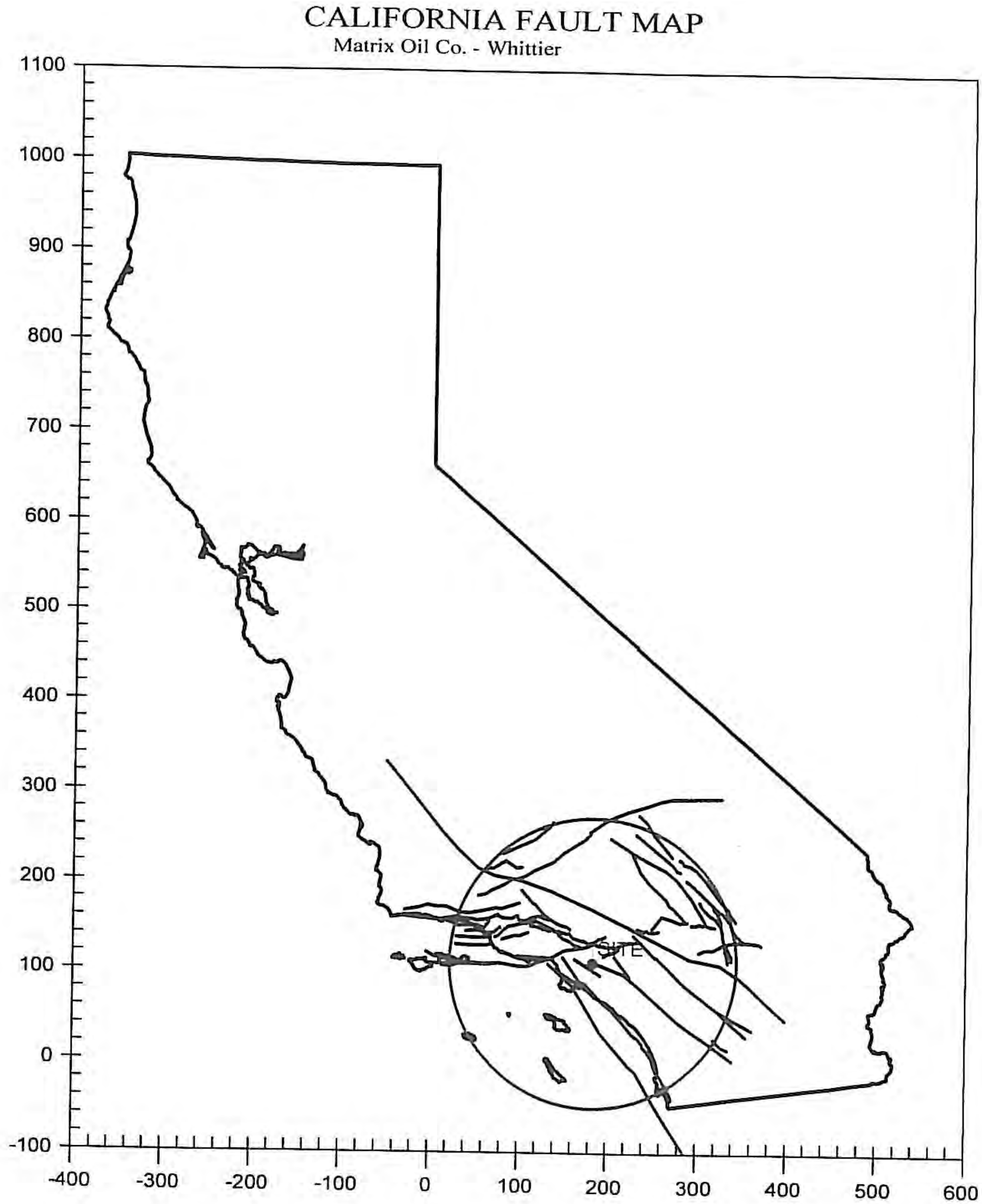

CALIFORNIA FAULT MAP
Matrix Oil Co. - Whittier
1100
1000
900
800
700
600
500
400
300
200
100
0
-100
-400
-300
-200
-100
0
100
200
300
400
500
600
SITE

Plate F.1

EQFAULT SUMMARY

DETERMINISTIC SITE PARAMETERS

Page 1

ABBREVIATED FAULT NAME	APPROXIMATE DISTANCE mi (km)	ESTIMATED MAX. EARTHQUAKE EVENT: MAXIMUM EARTHQUAKE MAG.(Mw)	PEAK SITE ACCEL. g	EST. SITE INTENSITY MOD.MERC.
WHITTIER	2.1(3.3)	6.8	0.486	X
ELYSIAN PARK THRUST	7.3(11.7)	6.7	0.392	X
SAN JOSE	9.0(14.5)	6.5	0.257	IX
COMPTON THRUST	10.9(17.5)	6.8	0.291	IX
RAYMOND	13.0(21.0)	6.5	0.174	VIII
CHINO-CENTRAL AVE. (Elsinore)	14.3(23.0)	6.7	0.180	VIII
VERDUGO	14.8(23.8)	6.7	0.173	VIII
NEWPORT-INGLEWOOD (L.A.Basin)	14.9(24.0)	6.9	0.165	VIII
SIERRA MADRE	15.0(24.2)	7.0	0.208	VIII
CLAMSHELL-SAWPIT	16.0(25.8)	6.5	0.137	VIII
HOLLYWOOD	17.0(27.4)	6.4	0.118	VII
CUCAMONGA	19.7(31.7)	7.0	0.154	VIII
PALOS VERDES	21.4(34.5)	7.1	0.126	VIII
ELSINORE-GLEN IVY	22.7(36.6)	6.8	0.094	VII
SANTA MONICA	24.7(39.8)	6.6	0.087	VII
NEWPORT-INGLEWOOD (Offshore)	26.8(43.1)	6.9	0.083	VII
SIERRA MADRE (San Fernando)	28.5(45.8)	6.7	0.079	VII
SAN GABRIEL	28.8(46.3)	7.0	0.082	VII
MALIBU COAST	30.5(49.1)	6.7	0.072	VI
NORTHRIDGE (E. Oak Ridge)	31.2(50.2)	6.9	0.093	VII
SAN ANDREAS - 1857 Rupture	33.4(53.8)	7.8	0.124	VII
SAN ANDREAS - Mojave	33.4(53.8)	7.1	0.073	VII
SAN JACINTO-SAN BERNARDINO	34.4(55.3)	6.7	0.052	VI
SAN ANDREAS - Southern	36.0(58.0)	7.4	0.084	VII
SAN ANDREAS - San Bernardino	36.0(58.0)	7.3	0.078	VII
SANTA SUSANA	38.1(61.3)	6.6	0.050	VI
CLEGHORN	39.1(62.9)	6.5	0.037	V
ANACAPA-DUME	40.2(64.7)	7.3	0.081	VII
HOLSER	43.2(69.5)	6.5	0.039	V
ELSINORE-TEMECULA	44.1(70.9)	6.8	0.041	V
SAN JACINTO-SAN JACINTO VALLEY	44.3(71.3)	6.9	0.044	VI
NORTH FRONTAL FAULT ZONE (West)	48.5(78.0)	7.0	0.051	VI
CORONADO BANK	48.7(78.4)	7.4	0.058	VI
OAK RIDGE (Onshore)	49.5(79.7)	6.9	0.045	VI
SIMI-SANTA ROSA	51.0(82.0)	6.7	0.037	V
SAN CAYETANO	54.9(88.4)	6.8	0.037	V
SAN ANDREAS - Carrizo	58.1(93.5)	7.2	0.039	V
SAN JACINTO-ANZA	64.5(103.8)	7.2	0.034	V
SANTA YNEZ (East)	66.1(106.4)	7.0	0.028	V
HELENDALE - S. LOCKHARDT	66.7(107.4)	7.1	0.030	V

Plate F.2

DETERMINISTIC SITE PARAMETERS

Page 2

ABBREVIATED FAULT NAME	APPROXIMATE DISTANCE mi (km)	ESTIMATED MAX. EARTHQUAKE EVENT: MAXIMUM EARTHQUAKE MAG.(Mw)	PEAK SITE ACCEL. g	EST. SITE INTENSITY MOD.MERC.
ROSE CANYON	67.0(107.8)	6.9	0.026	V
ELSINORE-JULIAN	70.2(113.0)	7.1	0.028	V
VENTURA - PITAS POINT	70.3(113.1)	6.8	0.027	V
OAK RIDGE(Blind Thrust Offshore)	70.3(113.2)	6.9	0.033	V
NORTH FRONTAL FAULT ZONE (East)	71.2(114.6)	6.7	0.024	V
CHANNEL IS. THRUST (Eastern)	72.2(116.2)	7.4	0.047	VI
PINTO MOUNTAIN	73.9(118.9)	7.0	0.024	V
MONTALVO-OAK RIDGE TREND	75.3(121.2)	6.6	0.023	IV
M.RIDGE-ARROYO PARIDA-SANTA ANA	75.7(121.8)	6.7	0.022	IV
GARLOCK (West)	75.8(122.0)	7.1	0.026	V
PLEITO THRUST	78.2(125.8)	7.2	0.032	V
RED MOUNTAIN	79.9(128.6)	6.8	0.022	IV
LENWOOD-LOCKHART-OLD WOMAN SPRGS	80.8(130.0)	7.3	0.028	V
BIG PINE	82.1(132.2)	6.7	0.017	IV
JOHNSON VALLEY (Northern)	85.2(137.1)	6.7	0.016	IV
SANTA CRUZ ISLAND	86.4(139.1)	6.8	0.020	IV
GRAVEL HILLS - HARPER LAKE	87.3(140.5)	6.9	0.018	IV
LANDERS	87.3(140.5)	7.3	0.025	V
SAN ANDREAS - Coachella	88.2(141.9)	7.1	0.021	IV
WHITE WOLF	89.2(143.5)	7.2	0.027	V
GARLOCK (East)	90.9(146.3)	7.3	0.024	IV
BURNT MTN.	92.1(148.3)	6.4	0.011	III
BLACKWATER	92.3(148.6)	6.9	0.017	IV
EMERSON So. - COPPER MTN.	92.7(149.2)	6.9	0.017	IV
SAN JACINTO-COYOTE CREEK	93.0(149.6)	6.8	0.015	IV
EUREKA PEAK	93.1(149.8)	6.4	0.011	III
CALICO - HIDALGO	94.0(151.3)	7.1	0.019	IV
EARTHQUAKE VALLEY	98.2(158.0)	6.5	0.011	III
NORTH CHANNEL SLOPE	99.6 (160.3)	7.1	0.021	IV
SANTA YNEZ (West)	99.8 (160.6)	6.9	0.015	IV

-END OF SEARCH- 70 FAULTS FOUND WITHIN THE SPECIFIED SEARCH RADIUS.

THE WHITTIER FAULT IS CLOSEST TO THE SITE.
IT IS ABOUT 2.1 MILES (3.3 km) AWAY.

LARGEST MAXIMUM-EARTHQUAKE SITE ACCELERATION: 0.4861 g

Plate F.2(cont)

MAXIMUM EARTHQUAKES

Matrix Oil - Whittier

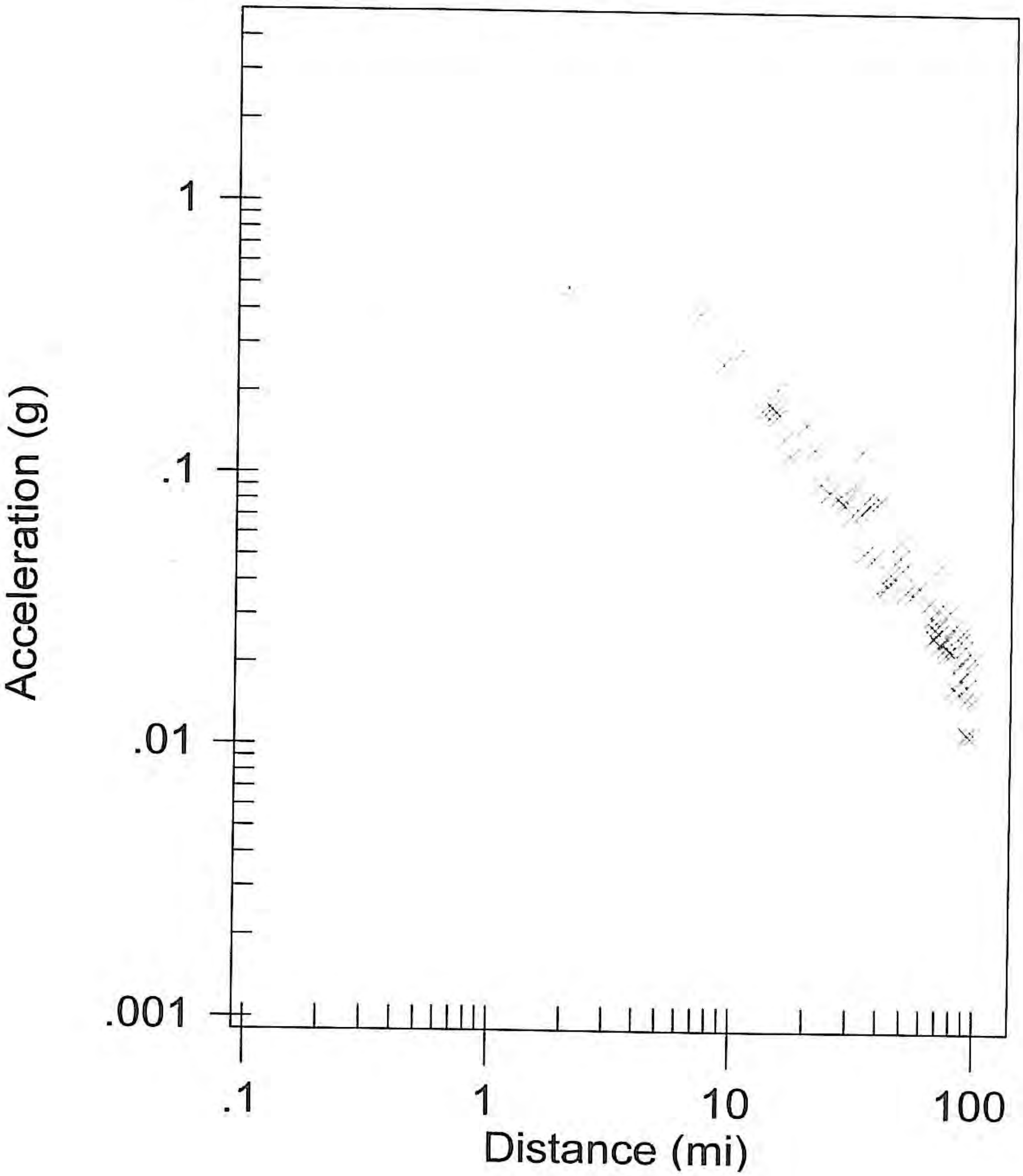


Plate E.3

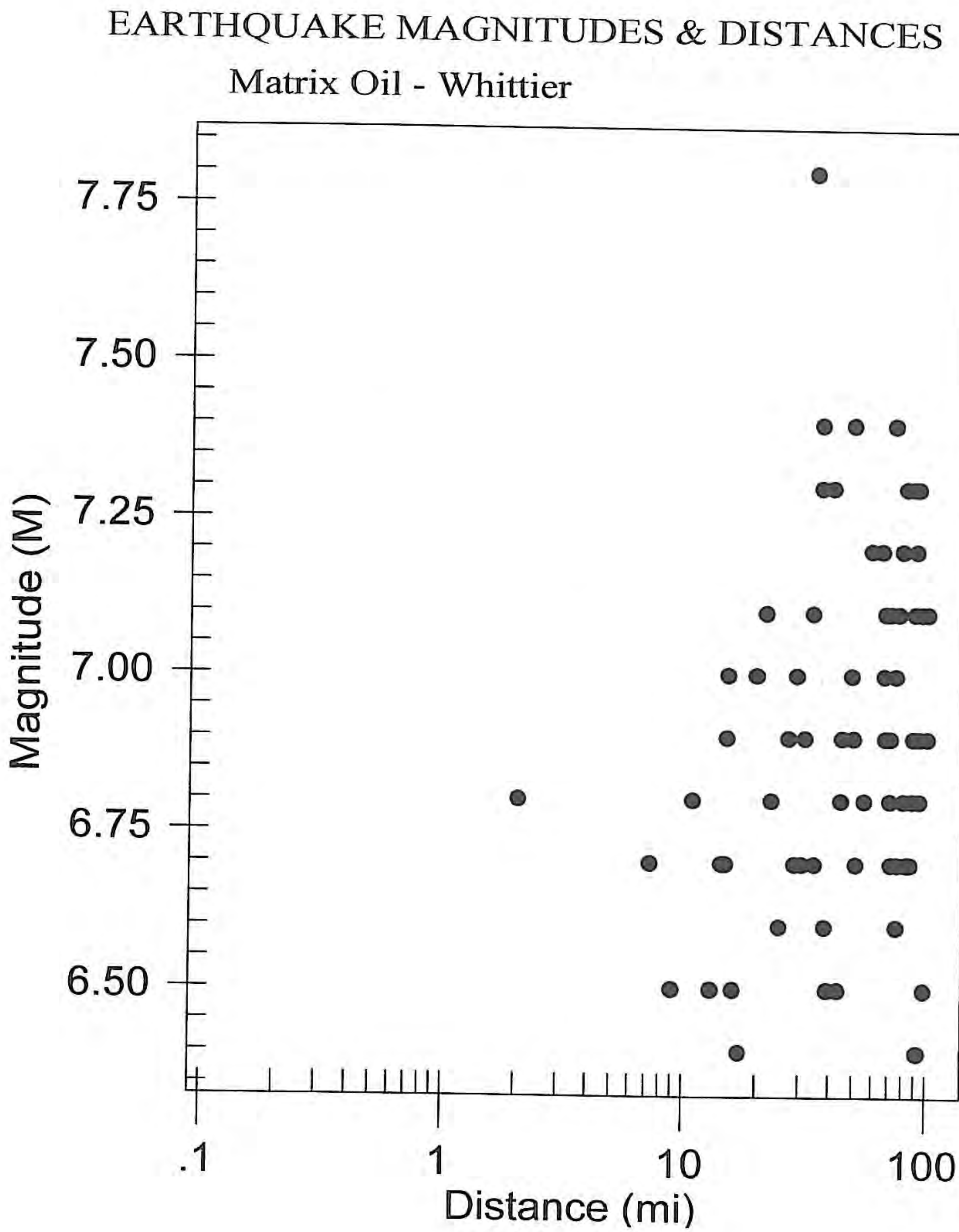

EARTHQUAKE MAGNITUDES & DISTANCES
Matrix Oil - Whittier
Magnitude (M)
7.75
7.50
7.25
7.00
6.75
6.50
Distance (mi)
.1
1
10
100

Plate F.4

APPENDIX

GEOLOGY CROSS-SECTIONS


P
P'
Q
Q'
400
450
500
550
600
650
700
Tfs
Qoal
Qal
True Dip = 45
Apparent Dip = 32°
Apparent Dip = 45°
True Dip 10°
Cut Slope w/o Retaining Wall
Retaining Wall
Proposed Grade
Proposed Grading

Plate GCS-2

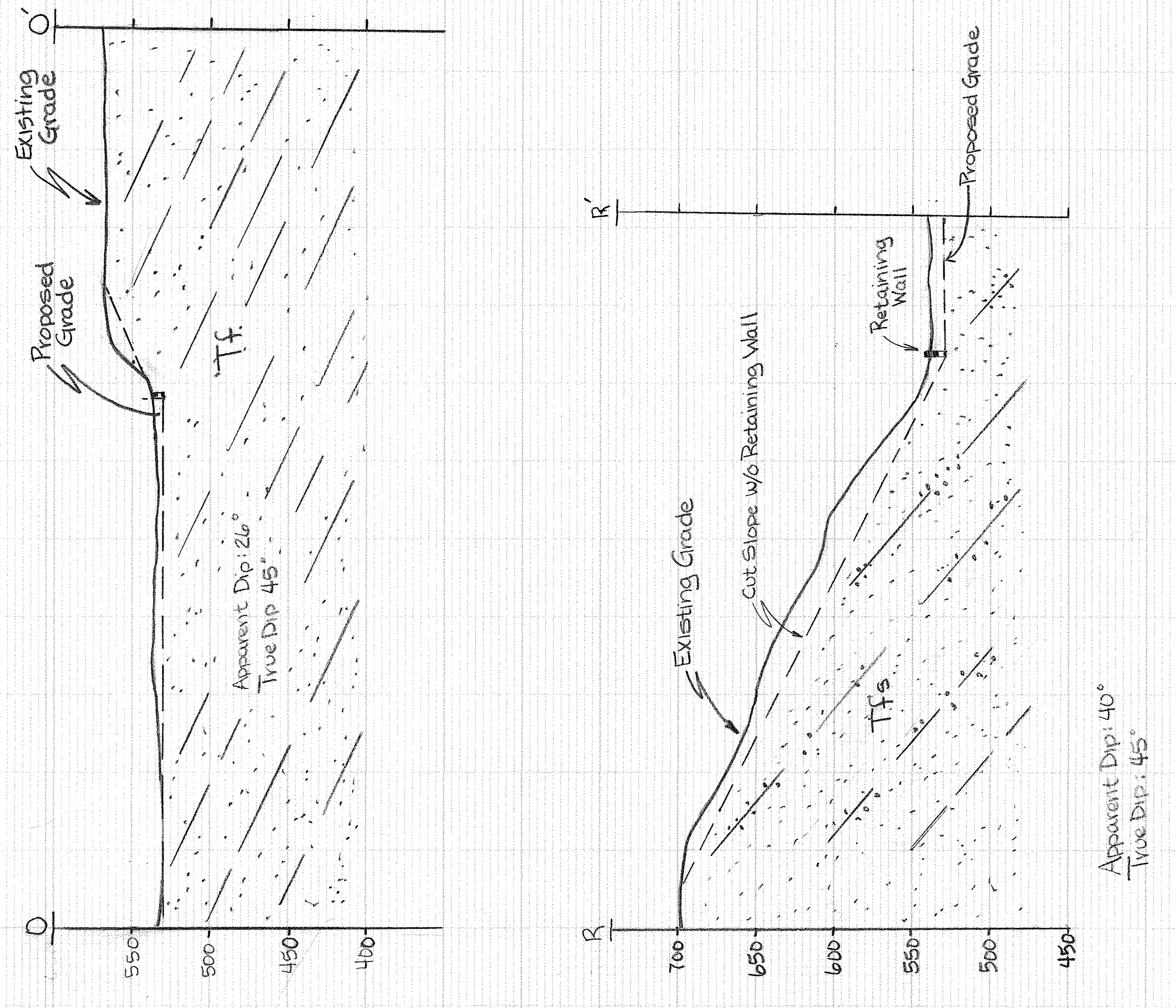

O'
Existing Grade
Proposed Grade
Tf
Apparent Dip: 26°
True Dip 45°
O
550
500
450
400
R'
Proposed Grade
Retaining Wall
Cut Slope w/o Retaining Wall
Existing Grade
Tfs
Apparent Dip: 40°
True Dip: 45°
R
700
650
600
550
500
450

Plate GCS-1

APPENDIX

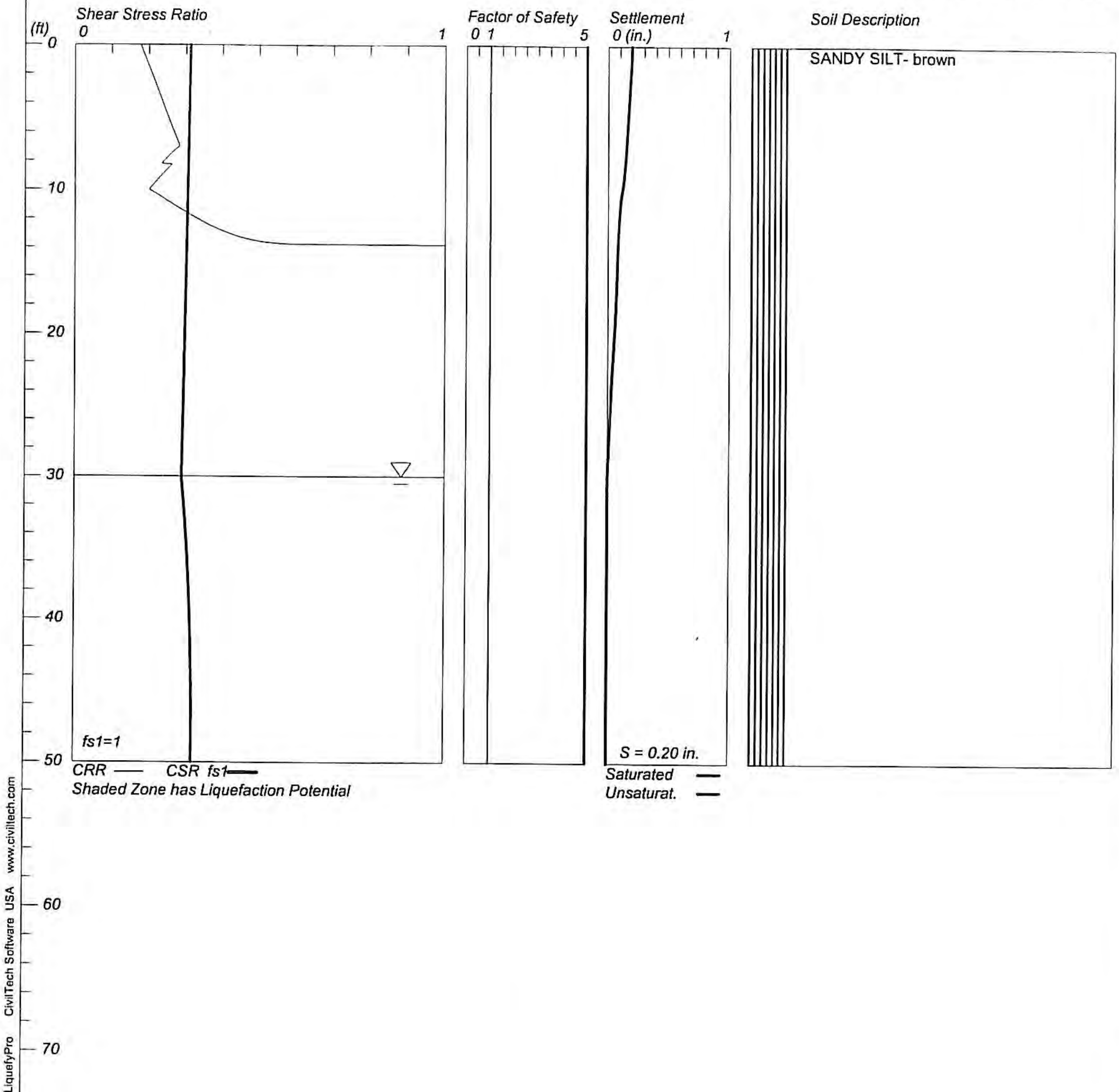
LIQUEFACTION

LIQUEFACTION ANALYSIS

matrix

Hole No.=B-15 Water Depth=30 ft

Magnitude=6.8
Acceleration=.48g



CivilTech Corporation **south central** **Plate A-1**

****

LIQUEFACTION ANALYSIS CALCULATION SHEET

****

Licensed to , 1/6/2010 5:13:53 PM

Input File Name: C:\Liquefy5\09020-15.liq
Title: matrix
Subtitle: south central

Surface Elev.=
Hole No.=B-15
Depth of Hole= 50.0 ft
Water Table during Earthquake= 30.0 ft
Water Table during In-Situ Testing= 60.0 ft
Max. Acceleration= 0.48 g
Earthquake Magnitude= 6.8

Input Data:
Surface Elev.=
Hole No.=B-15
Depth of Hole=50.0 ft
Water Table during Earthquake= 30.0 ft
Water Table during In-Situ Testing= 60.0 ft
Max. Acceleration=0.48 g
Earthquake Magnitude=6.8

1. SPT or BPT Calculation.
2. Settlement Analysis Method: Ishihara / Yoshimine*
3. Fines Correction for Liquefaction: Stark/Olson et al.*
4. Fine Correction for Settlement: During Liquefaction*
5. Settlement Calculation in: All zones*
6. Hammer Energy Ratio, Ce = 1
7. Borehole Diameter, Cb= 1
8. Sampling Method, Cs= 1
9. User request factor of safety (apply to CSR) , User= 1
   Plot one CSR curve (fs1=1)
10. Use Curve Smoothing: Yes*
* Recommended Options

In-Situ Test Data:

Depth ft	SPT	gamma pcf	Fines %
0.0	10.0	100.0	0.0
7.0	16.0	100.0	0.0
10.0	12.0	100.0	0.0
15.0	35.0	100.0	0.0
20.0	33.0	100.0	0.0
25.0	40.0	100.0	0.0
30.0	45.0	100.0	0.0
35.0	45.0	100.0	0.0
40.0	53.0	100.0	0.0
45.0	65.0	100.0	0.0
50.0	65.0	100.0	0.0

1.2

Output Results:
Settlement of Saturated Sands=0.00 in.
Settlement of Unsaturated Sands=0.20 in.
Total Settlement of Saturated and Unsaturated Sands=0.20 in.
Differential Settlement=0.098 to 0.129 in.

Depth ft	CRRm	CSRsf	F.S.	S_sat. in.	S_dry in.	S_all in.
0.00	0.18	0.31	5.00	0.00	0.20	0.20
1.00	0.19	0.31	5.00	0.00	0.19	0.19
2.00	0.21	0.31	5.00	0.00	0.19	0.19
3.00	0.22	0.31	5.00	0.00	0.18	0.18
4.00	0.24	0.31	5.00	0.00	0.17	0.17
5.00	0.25	0.31	5.00	0.00	0.17	0.17
6.00	0.27	0.31	5.00	0.00	0.16	0.16
7.00	0.28	0.31	5.00	0.00	0.15	0.15
8.00	0.24	0.31	5.00	0.00	0.14	0.14
9.00	0.23	0.31	5.00	0.00	0.13	0.13
10.00	0.20	0.30	5.00	0.00	0.12	0.12
11.00	0.26	0.30	5.00	0.00	0.10	0.10
12.00	0.33	0.30	5.00	0.00	0.09	0.09
13.00	0.42	0.30	5.00	0.00	0.09	0.09
14.00	2.57	0.30	5.00	0.00	0.08	0.08
15.00	2.57	0.30	5.00	0.00	0.08	0.08
16.00	2.57	0.30	5.00	0.00	0.07	0.07
17.00	2.57	0.30	5.00	0.00	0.07	0.07
18.00	2.57	0.30	5.00	0.00	0.07	0.07
19.00	2.57	0.30	5.00	0.00	0.06	0.06
20.00	2.57	0.30	5.00	0.00	0.05	0.05
21.00	2.57	0.30	5.00	0.00	0.05	0.05
22.00	2.57	0.30	5.00	0.00	0.04	0.04
23.00	2.57	0.30	5.00	0.00	0.03	0.03
24.00	2.57	0.29	5.00	0.00	0.03	0.03
25.00	2.57	0.29	5.00	0.00	0.02	0.02
26.00	2.57	0.29	5.00	0.00	0.02	0.02
27.00	2.57	0.29	5.00	0.00	0.01	0.01
28.00	2.57	0.29	5.00	0.00	0.01	0.01
29.00	2.57	0.29	5.00	0.00	0.00	0.00
30.00	2.57	0.29	5.00	0.00	0.00	0.00
31.00	2.58	0.29	5.00	0.00	0.00	0.00
32.00	2.57	0.30	5.00	0.00	0.00	0.00
33.00	2.56	0.30	5.00	0.00	0.00	0.00
34.00	2.54	0.30	5.00	0.00	0.00	0.00
35.00	2.53	0.30	5.00	0.00	0.00	0.00
36.00	2.52	0.31	5.00	0.00	0.00	0.00
37.00	2.50	0.31	5.00	0.00	0.00	0.00
38.00	2.49	0.31	5.00	0.00	0.00	0.00
39.00	2.48	0.31	5.00	0.00	0.00	0.00
40.00	2.47	0.31	5.00	0.00	0.00	0.00
41.00	2.46	0.31	5.00	0.00	0.00	0.00
42.00	2.44	0.32	5.00	0.00	0.00	0.00
43.00	2.43	0.32	5.00	0.00	0.00	0.00
44.00	2.42	0.32	5.00	0.00	0.00	0.00
45.00	2.41	0.32	5.00	0.00	0.00	0.00
46.00	2.40	0.32	5.00	0.00	0.00	0.00
47.00	2.39	0.32	5.00	0.00	0.00	0.00
48.00	2.38	0.32	5.00	0.00	0.00	0.00
49.00	2.37	0.32	5.00	0.00	0.00	0.00
50.00	2.35	0.32	5.00	0.00	0.00	0.00

L.3

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* F.S.<1, Liquefaction Potential Zone
(F.S. is limited to 5, CRR is limited to 2, CSR is limited to 2)

Units Depth = ft, Stress or Pressure = tsf (atm), Unit Weight = pcf, Settlement = in.

CRRm	Cyclic resistance ratio from soils
CSRsf	Cyclic stress ratio induced by a given earthquake (with user request factor of safety)
F.S.	Factor of Safety against liquefaction, F.S.=CRRm/CSRsf
S_sat	Settlement from saturated sands
S_dry	Settlement from Unsaturated Sands
S_all	Total Settlement from Saturated and Unsaturated Sands
NoLiq	No-Liquefy Soils

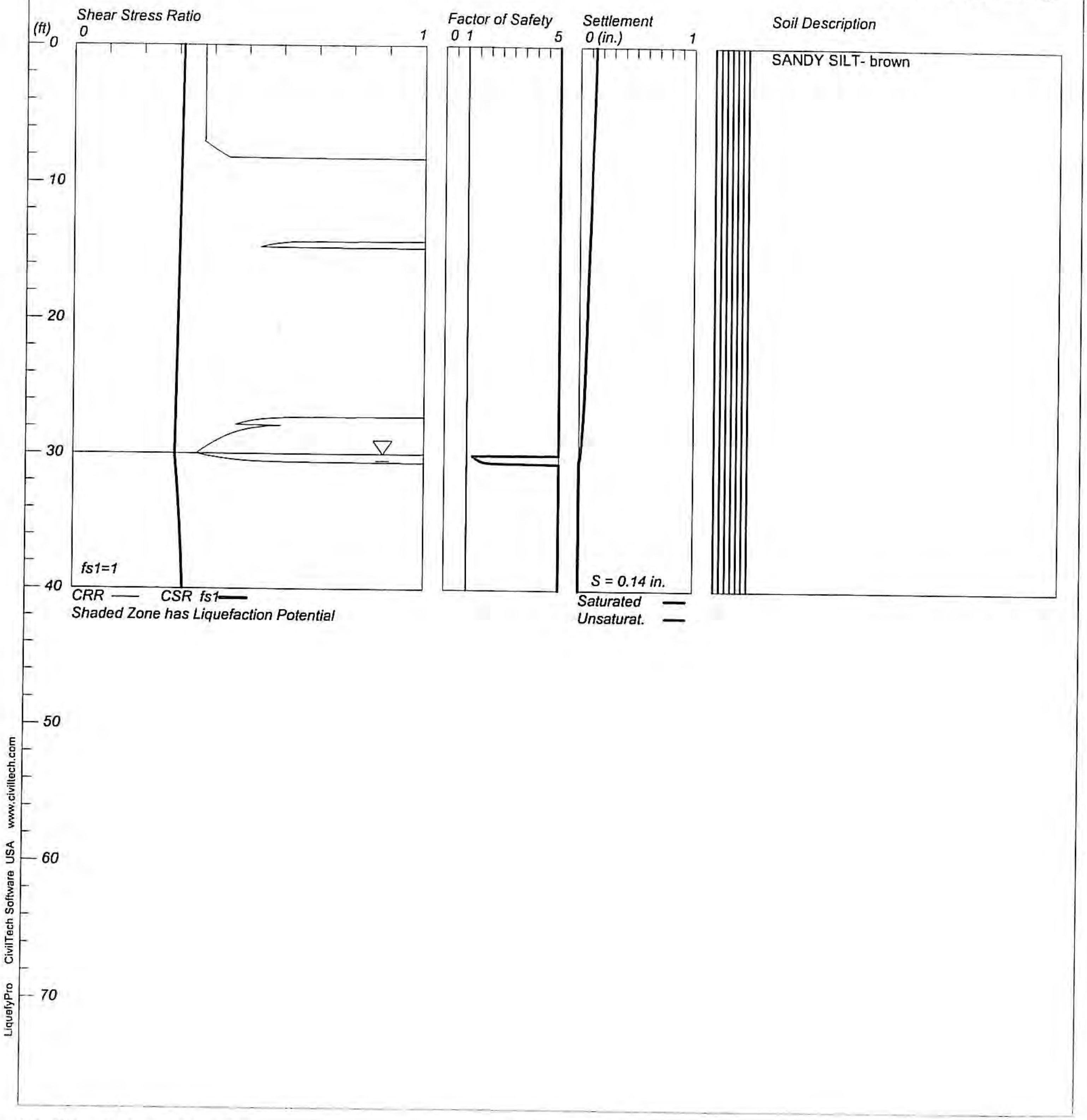
Appendix L

LIQUEFACTION ANALYSIS

matrix

Hole No.=B-16   Water Depth=30 ft

Magnitude=6.8
Acceleration=.48g



CivilTech Corporation

north central

Plate A-1

1.5

09020-16.sum

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LIQUEFACTION ANALYSIS CALCULATION SHEET

****

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Input File Name: C:\Liquefy5\09020-16.liq
Title: matrix
Subtitle: north central

Surface Elev.=
Hole No.=B-16
Depth of Hole= 40.0 ft
Water Table during Earthquake= 30.0 ft
Water Table during In-Situ Testing= 40.0 ft
Max. Acceleration= 0.48 g
Earthquake Magnitude= 6.8

Input Data:
Surface Elev.=
Hole No.=B-16
Depth of Hole=40.0 ft
Water Table during Earthquake= 30.0 ft
Water Table during In-Situ Testing= 40.0 ft
Max. Acceleration=0.48 g
Earthquake Magnitude=6.8

1. SPT or BPT Calculation.
2. Settlement Analysis Method: Ishihara / Yoshimine*
3. Fines Correction for Liquefaction: Stark/Olson et al.*
4. Fine Correction for Settlement: During Liquefaction*
5. Settlement Calculation in: All zones*
6. Hammer Energy Ratio, Ce = 1
7. Borehole Diameter, Cb= 1
8. Sampling Method, Cs= 1
9. User request factor of safety (apply to CSR) , User= 1
   Plot one CSR curve (fs1=1)
10. Use Curve Smoothing: Yes*
* Recommended Options

In-Situ Test Data:

Depth ft	SPT	gamma pcf	Fines %
0.0	20.0	100.0	0.0
7.0	20.0	100.0	0.0
10.0	30.0	100.0	0.0
15.0	30.0	100.0	0.0
20.0	45.0	100.0	0.0
25.0	43.0	100.0	0.0
30.0	30.0	100.0	0.0
35.0	90.0	100.0	0.0
40.0	53.0	100.0	0.0

Output Results:
Settlement of Saturated Sands=0.01 in.
Settlement of Unsaturated Sands=0.12 in.
Total Settlement of Saturated and Unsaturated Sands=0.14 in.
Differential Settlement=0.068 to 0.090 in.

Depth ft	CRRm	CSRsf	F.S.	S_sat. in.	S_dry in.	S_all in.
0.00	0.37	0.31	5.00	0.01	0.12	0.14
1.00	0.37	0.31	5.00	0.01	0.12	0.14
2.00	0.37	0.31	5.00	0.01	0.12	0.13
3.00	0.37	0.31	5.00	0.01	0.12	0.13
4.00	0.37	0.31	5.00	0.01	0.11	0.13
5.00	0.37	0.31	5.00	0.01	0.11	0.12
6.00	0.37	0.31	5.00	0.01	0.11	0.12
7.00	0.37	0.31	5.00	0.01	0.10	0.11
8.00	0.43	0.31	5.00	0.01	0.10	0.11
9.00	2.57	0.31	5.00	0.01	0.09	0.11
10.00	2.57	0.30	5.00	0.01	0.09	0.10
11.00	2.57	0.30	5.00	0.01	0.09	0.10
12.00	2.57	0.30	5.00	0.01	0.09	0.10
13.00	2.57	0.30	5.00	0.01	0.08	0.09
14.00	2.57	0.30	5.00	0.01	0.08	0.09
15.00	2.57	0.30	5.00	0.01	0.07	0.08
16.00	2.57	0.30	5.00	0.01	0.07	0.08
17.00	2.57	0.30	5.00	0.01	0.06	0.08
18.00	2.57	0.30	5.00	0.01	0.06	0.07
19.00	2.57	0.30	5.00	0.01	0.06	0.07
20.00	2.57	0.30	5.00	0.01	0.05	0.07
21.00	2.57	0.30	5.00	0.01	0.05	0.06
22.00	2.57	0.30	5.00	0.01	0.05	0.06
23.00	2.57	0.30	5.00	0.01	0.04	0.06
24.00	2.57	0.29	5.00	0.01	0.04	0.05
25.00	2.57	0.29	5.00	0.01	0.04	0.05
26.00	2.57	0.29	5.00	0.01	0.03	0.04
27.00	2.57	0.29	5.00	0.01	0.03	0.04
28.00	0.54	0.29	5.00	0.01	0.02	0.03
29.00	0.41	0.29	5.00	0.01	0.01	0.02
30.00	0.35	0.29	5.00	0.01	0.00	0.01
31.00	2.58	0.29	5.00	0.00	0.00	0.00
32.00	2.57	0.30	5.00	0.00	0.00	0.00
33.00	2.56	0.30	5.00	0.00	0.00	0.00
34.00	2.54	0.30	5.00	0.00	0.00	0.00
35.00	2.53	0.30	5.00	0.00	0.00	0.00
36.00	2.52	0.31	5.00	0.00	0.00	0.00
37.00	2.50	0.31	5.00	0.00	0.00	0.00
38.00	2.49	0.31	5.00	0.00	0.00	0.00
39.00	2.48	0.31	5.00	0.00	0.00	0.00
40.00	2.47	0.31	5.00	0.00	0.00	0.00

* F.S.<1, Liquefaction Potential Zone
(F.S. is limited to 5, CRR is limited to 2, CSR is limited to 2)

Units Depth = ft, Stress or Pressure = tsf (atm), Unit Weight = pcf, Settlement = in.

CRRm Cyclic resistance ratio from soils
CSRsf Cyclic stress ratio induced by a given earthquake (with user request factor of safety)
F.S. Factor of Safety against liquefaction, F.S.=CRRm/CSRsf
S_sat Settlement from saturated sands

1.7

09020-16.sum

S_dry	Settlement from Unsaturated Sands
S_all	Total Settlement from Saturated and Unsaturated Sands
NoLiq	No-Liquefy Soils

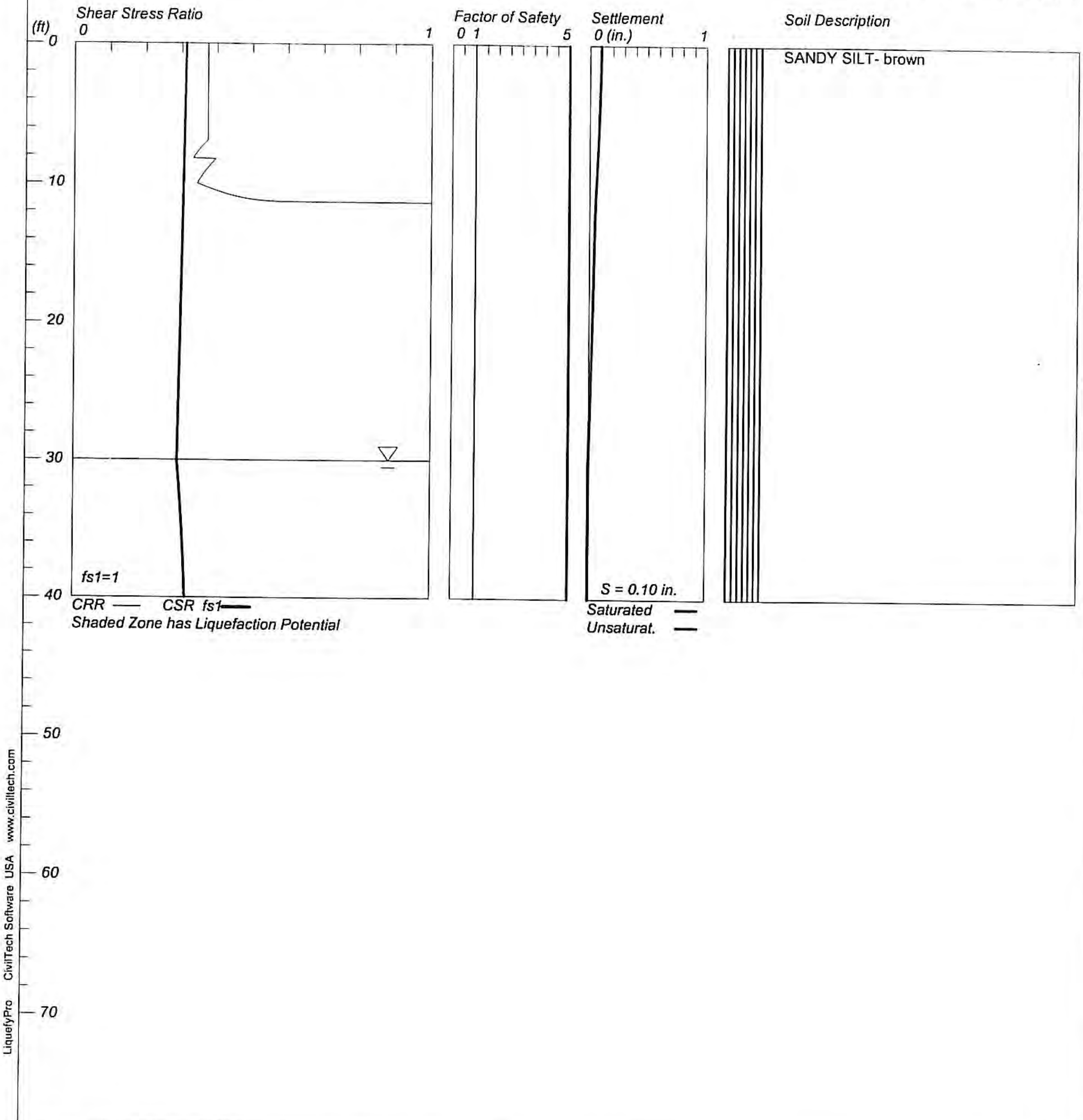
L8

LIQUEFACTION ANALYSIS

matrix

Hole No.=B-17 Water Depth=30 ft

Magnitude=6.8
Acceleration=.48g



CivilTech Corporation **south central** **Plate A-1**

L9

09020-17.sum

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LIQUEFACTION ANALYSIS CALCULATION SHEET

****

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Input File Name: C:\Liquefy5\09020-17.liq
Title: matrix
Subtitle: south central

Surface Elev.=
Hole No.=B-17
Depth of Hole= 40.0 ft
Water Table during Earthquake= 30.0 ft
Water Table during In-Situ Testing= 40.0 ft
Max. Acceleration= 0.48 g
Earthquake Magnitude= 6.8

Input Data:
Surface Elev.=
Hole No.=B-17
Depth of Hole=40.0 ft
Water Table during Earthquake= 30.0 ft
Water Table during In-Situ Testing= 40.0 ft
Max. Acceleration=0.48 g
Earthquake Magnitude=6.8

1. SPT or BPT Calculation.
2. Settlement Analysis Method: Ishihara / Yoshimine*
3. Fines Correction for Liquefaction: Stark/Olson et al.*
4. Fine Correction for Settlement: During Liquefaction*
5. Settlement Calculation in: All zones*
6. Hammer Energy Ratio, Ce = 1
7. Borehole Diameter, Cb= 1
8. Sampling Method, Cs= 1
9. User request factor of safety (apply to CSR) , User= 1
   Plot one CSR curve (fs1=1)
10. Use Curve Smoothing: Yes*
* Recommended Options

In-Situ Test Data:

Depth ft	SPT	gamma pcf	Fines %
0.0	20.0	100.0	0.0
7.0	20.0	100.0	0.0
10.0	20.0	100.0	0.0
15.0	45.0	100.0	0.0
20.0	55.0	100.0	0.0
25.0	60.0	100.0	0.0
30.0	65.0	100.0	0.0
35.0	60.0	100.0	0.0
40.0	100.0	100.0	0.0

Page 1

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Output Results:
Settlement of Saturated Sands=0.00 in.
Settlement of Unsaturated Sands=0.10 in.
Total Settlement of Saturated and Unsaturated Sands=0.10 in.
Differential Settlement=0.048 to 0.063 in.

Depth ft	CRRm	CSRsf	F.S.	S_sat. in.	S_dry in.	S_all in.
0.00	0.37	0.31	5.00	0.00	0.10	0.10
1.00	0.37	0.31	5.00	0.00	0.10	0.10
2.00	0.37	0.31	5.00	0.00	0.09	0.09
3.00	0.37	0.31	5.00	0.00	0.09	0.09
4.00	0.37	0.31	5.00	0.00	0.09	0.09
5.00	0.37	0.31	5.00	0.00	0.08	0.08
6.00	0.37	0.31	5.00	0.00	0.08	0.08
7.00	0.37	0.31	5.00	0.00	0.07	0.07
8.00	0.34	0.31	5.00	0.00	0.07	0.07
9.00	0.37	0.31	5.00	0.00	0.06	0.06
10.00	0.34	0.30	5.00	0.00	0.06	0.06
11.00	0.47	0.30	5.00	0.00	0.05	0.05
12.00	2.57	0.30	5.00	0.00	0.05	0.05
13.00	2.57	0.30	5.00	0.00	0.04	0.04
14.00	2.57	0.30	5.00	0.00	0.04	0.04
15.00	2.57	0.30	5.00	0.00	0.04	0.04
16.00	2.57	0.30	5.00	0.00	0.04	0.04
17.00	2.57	0.30	5.00	0.00	0.04	0.04
18.00	2.57	0.30	5.00	0.00	0.03	0.03
19.00	2.57	0.30	5.00	0.00	0.03	0.03
20.00	2.57	0.30	5.00	0.00	0.03	0.03
21.00	2.57	0.30	5.00	0.00	0.03	0.03
22.00	2.57	0.30	5.00	0.00	0.02	0.02
23.00	2.57	0.30	5.00	0.00	0.02	0.02
24.00	2.57	0.29	5.00	0.00	0.02	0.02
25.00	2.57	0.29	5.00	0.00	0.01	0.01
26.00	2.57	0.29	5.00	0.00	0.01	0.01
27.00	2.57	0.29	5.00	0.00	0.01	0.01
28.00	2.57	0.29	5.00	0.00	0.01	0.01
29.00	2.57	0.29	5.00	0.00	0.00	0.00
30.00	2.57	0.29	5.00	0.00	0.00	0.00
31.00	2.58	0.29	5.00	0.00	0.00	0.00
32.00	2.57	0.30	5.00	0.00	0.00	0.00
33.00	2.56	0.30	5.00	0.00	0.00	0.00
34.00	2.54	0.30	5.00	0.00	0.00	0.00
35.00	2.53	0.30	5.00	0.00	0.00	0.00
36.00	2.52	0.31	5.00	0.00	0.00	0.00
37.00	2.50	0.31	5.00	0.00	0.00	0.00
38.00	2.49	0.31	5.00	0.00	0.00	0.00
39.00	2.48	0.31	5.00	0.00	0.00	0.00
40.00	2.47	0.31	5.00	0.00	0.00	0.00

* F.S.<1, Liquefaction Potential Zone
(F.S. is limited to 5, CRR is limited to 2, CSR is limited to 2)

Units Depth = ft, Stress or Pressure = tsf (atm), Unit Weight = pcf, Settlement = in.

CRRm	Cyclic resistance ratio from soils
CSRsf	Cyclic stress ratio induced by a given earthquake (with user request factor of safety)
F.S.	Factor of Safety against liquefaction, F.S.=CRRm/CSRsf
S_sat	Settlement from saturated sands

L_11

S_dry	Settlement from Unsaturated Sands
S_all	Total Settlement from Saturated and Unsaturated Sands
NoLiq	No-Liquefy Soils

L 12