APPENDIX 6.3-A – GEOTECHNICAL REPORTS

APPENDIX 6.3-A.1 – PALA SUBSTATION GEOTECHNICAL REPORT

4289
Geotech-Report

GEOTECHNICAL ENGINEERING INVESTIGATION

FOR

PALA SUBSTATION

SAN DIEGO COUNTY, CALIFORNIA

PREPARED FOR

SAN DIEGO GAS AND ELECTRIC COMPANY

SAN DIEGO, CALIFORNIA

PREPARED BY

GEOCON INCORPORATED

SAN DIEGO, CALIFORNIA

APRIL 1994

GEOCON
INCORPORATED

Geotechnical Engineers and
Engineering Geologists

Project No. 05257-32-01
April 18, 1994

San Diego Gas and Electric Company
Post Office Box 1831
San Diego, California 92112

Attention: Mr. Craig Riker

Subject: PALA SUBSTATION
SAN DIEGO COUNTY, CALIFORNIA
GEOTECHNICAL ENGINEERING INVESTIGATION

Gentlemen:

In accordance with your authorization, and our proposal No. L-4035, dated December 3, 1993, we have performed a geotechnical engineering investigation for the proposed Pala Substation. The accompanying report presents the findings from our study, and our conclusions and recommendations pertaining to the site development. Based on the results of our study, it is our opinion that the site can be developed as proposed, provided the recommendations of this report are followed.

Should you have any questions regarding this report, or if we may be of further service, please contact the undersigned at your convenience.

Very truly yours,

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Project No. 05257-32-01
April 18, 1994

GEOTECHNICAL ENGINEERING INVESTIGATION

PURPOSE AND SCOPE

This report presents the results of a geotechnical investigation for the proposed San Diego Gas and Electric Company (SDG&E) Pala Substation. The site is located in the county of San Diego, California (see Vicinity Map, Figure 1). The purpose of the investigation was to observe and sample the prevailing surface and subsurface soil and geologic conditions at the site and to provide recommendations relative to the geotechnical engineering aspects of the project development. The recommendations presented herein are based on an analysis of the data obtained in the various phases of the investigation and experience with similar soil and geologic conditions.

The scope of work consisted of a review of the following reports, plans, and documents.

1. *Preliminary Geotechnical Investigation for proposed 500/230 kV Pala Substation Site,* prepared by Benton Engineering Incorporated, dated July 25, 1975.

2. USDA, Stereo Aerial Photographs, Flight Nos. AXM-3M-137 and 138; and 17M-81 and 82, 1953.

3. *Mines and Mineral Resources of San Diego County, California, County 3 Report,* California Division of Mines and Geology (CDMG), 1963.

4. *Geologic Map of California Santa Ana Sheet,* 1:250,000, CDMG, 1966.

5. *Preliminary Fault Activity Map of California,* CDMG, 1992.

6. Fault Evaluation Report (FER) for the Transverse Ranges, California (FER-78), OFR90-13, CDMG.

7. *Grading Plans for: San Diego Gas & Electric, Pala Substation,* sheets 1 through 11, prepared by San Diego Gas and Electric Company, dated March 3, 1994.

8. Alquist-Priolo Earthquake Fault Zones Map, Pala Quadrangle, CDMG, effective date January 1, 1980.

9. Unpublished maps and reports on file at Geocon Incorporated.

The scope of the geotechnical investigation included a reconnaissance of the site by a senior project engineer, the excavation of 17 small-diameter borings, 6 large-diameter borings, 12 exploratory trenches, and the performance of 8 refraction seismic traverses. During drilling and trenching, samples of the predominant soil types encountered were obtained and returned to our laboratory. Laboratory tests were performed on selected soil samples to evaluate pertinent physical properties. Details of the field and laboratory tests are presented in Appendixes A and B, respectively.

SITE AND PROJECT DESCRIPTION

The site is located in the Pala area of San Diego County, California. More specifically, the proposed substation will be located immediately north of the existing Pala 69/12 kV substation, approximately one mile west of the town of Pala along the north side of Highway 76 (see Vicinity Map, Figure 1).

The site is bordered to the west and south by Pala Del Norte Road and Highway 76, respectively, to the north by open land and to the east by a citrus orchard. Most of the area planned to receive

the substation and associated improvements is being used as a citrus orchard, with the exception of the southern portion which is occupied by the Pala Passive Solar project. Existing improvements consist of two electric fans mounted on steel towers, irrigation lines, two access dirt roads from Highway 76 and one from Pala Del Norte Road, and the cut-fill pad where the Passive Solar project is situated. Topographically, the site slopes very gently toward the south from a high elevation of approximately 440 feet above Mean Sea Level (MSL) at the northern limit to a low of 350 feet MSL along the southeastern portions adjacent to Highway 76. A drainage channel is located between the citrus orchard and Pala Del Norte Road.

It is understood that proposed development will consist of the demolition of the existing solar test facility structures and the citrus orchard and construction of a new substation. The new substation pad will occupy approximately 10 acres. The proposed structures at the site will include:

1. A 1-story masonry block control house with wall loads on the order of 2 kips per linear foot (klf),
2. Transformers weighing up to 500 kips each when filled with oil,
3. Oil breakers weighing 75 kips each,
4. 230kV, steel A-frame structures,
5. 230kV steel switch stands,
6. 69kV steel rack,
7. 69kV steel capacitor stand, and other miscellaneous structures.

All of the steel structures are planned to be placed on drilled pier foundations and expected to have moderate to heavy loads. Substation equipment, such as transformers, breakers, and capacitors, will be placed on mat foundations. The control house will have continuous wall footings with an interior slab-on-grade. The actual loads for some of the steel structures are not known at this time; however, anticipated loads on drilled piers may include downward, upward, and lateral forces. The substation pad will be paved with asphalt concrete while decomposed granitic (D. G.) or Class 2 base material will be placed in the remaining open areas of the yard adjacent to the aforementioned ancillary equipment. In addition, overhead transmission line structures consisting of 230kV steel towers/poles and 69kV wood poles will be located on or adjacent to the pad. A paved, 30-foot-wide access road to the pad is planned along with narrower, unpaved access roads for the perimeter areas of the substation. Site grading will include cuts and fills up to 35 feet in order to construct the substation pad at a finish elevation of 392 feet above MSL. The Site Plan and Geologic Map, Figure 2, depicts the configuration of the property, as well as the approximate locations of the exploratory borings, trenches and seismic traverses.

The locations and descriptions contained herein are based upon a site reconnaissance, discussions with Mr. Craig Riker, and a review of the referenced project plans. If project details vary significantly from those indicated above, Geocon Incorporated should be notified for review and possible revision of the recommendations presented herein prior to design submittal.

SOIL AND GEOLOGIC CONDITIONS

In general, four surficial soil types and one bedrock geologic unit occur at the site. The surficial soil types consist of undocumented fill soils, topsoils, alluvial soils, and slopewash deposits. The geologic bedrock unit consists of granitic rock of the southern California batholith. Each of these soil types and geologic unit is described below. Figure 2, Site Plan and Geologic Map, shows the approximate extent of the soil and geologic units.

Undocumented Fill Soils (Qudf)

Undocumented fill soils were observed on the access road to the pad of the Passive Solar project and on the south end of the pad. These materials are characterized as moderately dense, dry to damp, olive-brown, silty, fine to coarse sands. Geocon has no opinion regarding the compaction of these fill soils; however, it is recommended that they be removed and incorporated to the structural fill soils in accordance with the recommendations presented in the grading section.

Topsoils (Unmapped)

Topsoils mantle the majority of the site with a thickness varying from 1 to 4 feet. These soils are characterized as loose, dry to damp to moist, dark reddish brown, silty and clayey sands with angular gravels, cobbles, and few boulders up to 24 inches. These soils, in their present condition, are unsuitable to receive structural fill soils and/or settlement-sensitive improvements; therefore, topsoils

should be removed and recompacted in accordance with the recommendations presented in the grading section of this report.

Alluvium (Qal)

Alluvial soils were observed at the bottom of the major drainage channels that trend toward the south along the east and west ends of the site. The alluvial soils extend to depths of approximately 10 feet in the immediate vicinity of exploratory Trenches 10 and 11. These soils are characterized as loose, dry to very moist, orange-brown to dark brown, cohesionless sands with abundant subangular gravels, cobbles, and boulders up to 24 inches. These soils are considered unsuitable to receive structural fill soils; therefore, they should be removed and recompacted in accordance with the specifications presented in the grading recommendations section of this report.

Slopewash (Qsw)

Slopewash deposits underlie the topsoils throughout the majority of the site and extend from a few feet at the western portion to as much as 40 feet near the northeastern corner of the pad, in the vicinity of large-diameter boring No. 4. These soils are characterized as loose to very dense, damp to very moist, reddish brown to olive-brown, silty and clayey, sands with varying amounts of angular gravels, cobbles, and boulders up to 24 inches. Partial removal of the slopewash materials will be required during the construction of the "keyway" at the toe of the fill slope and "benching" into the

loose surficial portion during the fill operation as indicated in the grading section of this report. The denser portion of these soils should provide adequate bearing characteristics for the proposed improvements.

Granitic Rock (Kgr)

Granitic rocks of the southern California batholith, in varying stages of decomposition, were encountered at depth in the vicinity of large-diameter boring Nos. 1, 2, and 3, small-diameter boring Nos. 7 and 11 and exploratory trench Nos. 7, 8, 10 and 11. These materials (when excavated) are characterized as dense to very dense, damp, red to yellowish-green, silty, fine to very coarse sands. It should be noted that it is typical to encountered dense, nonrippable "floaters" within this unit. During the performance of field work, it was observed that several outcrops of granitic rock were exposed at the surface within the area mapped as slopewash; however, these were not mapped due to the relatively small scale of the base topographic map. It is unknown if the boulders are connected to a larger rock mass below, or if they are separate. The less weathered portion of these materials should provide adequate bearing characteristics in either a dense natural or properly compacted state.

GROUNDWATER

No groundwater was encountered in any of the exploratory excavations at the time of our investigation. It is not uncommon, however, for seeps to occur when fractures are left exposed for long

periods of time, as during grading and/or construction. It is, therefore, recommended that a contingency be made in the event that groundwater and/or seepage is encountered during construction.

GEOLOGIC HAZARDS

General

A site reconnaissance, and a review of the referenced geologic reports, indicates that no geologic hazards, such as active faults or landslides, were observed or are known to occur on the site.

Faulting and Seismicity

A review of the previously referenced geologic literature indicates that there are no known active or potentially active faults at the site or in the immediate vicinity. The referenced CDMG documents (*Preliminary Fault Map*, *Santa Ana Sheet* and *County 3 Report*) indicate that an approximately 5-mile-long, southwest-northeast trending fault trace (referred to as the Pala Fault in the referenced Benton Engineering report) is mapped in the vicinity of the site. The Benton Engineering report, which investigated a larger area surrounding the subject site, performed detailed reconnaissance mapping of the area. Based on their reconnaissance, a trace of the "Pala Fault" was mapped (as questionably existing) at the extreme northern portion of the original site, placing it off-site of the subject project area. Benton Engineering also reported additional minor faults located off-site of the project. Our review of the referenced Preliminary Fault Map of California indicates that the "Pala Fault" is

classified as a pre-Quaternary fault (older than approximately 1.6 Million years old). In addition, review of the referenced CDMG Fault Investigation Report (FER 78) indicates that the "Pala Fault," which terminates near the Elsinore Fault, is not considered part of northwest-southeast trending active Elsinore Fault Zone.

The Elsinore Fault Zone is located approximately 5 miles to the east of the site. This fault has been classified as active by the California Division of Mines and Geology (CDMG). An active fault is defined by CDMG as a seismically active fault with evidence of Holocene activity (within the last approximately 11,000 years).The Elsinore Fault Zone is contained within the referenced *Alquist-Priolo Earthquake Fault Zone Map*.

The seismicity of the site is influenced by both local and regional fault systems within the southern California region. In the event of a major earthquake on these or other faults in the southern California region, the site could be subjected to severe ground shaking. With respect to this hazard, this site is comparable to others in the general vicinity. The following table represents a list of significant active faults, their distance from the site, and the maximum credible and maximum probable magnitude for each fault.

TABLE I
DETERMINISTIC SITE PARAMETERS FOR SELECTED ACTIVE FAULTS

Fault Name	Distance From Site (miles)	Maximum Credible Event Magnitude	Maximum Credible Event Acceleration (g)	Maximum Probable Event Magnitude	Maximum Probable Event Acceleration (g)
Casa Loma Clark (San Jacinto)	28	7.50	0.10	7.00	0.08
Coyote Creek (San Jacinto)	35	7.50	0.08	7.00	0.06
Elsinore	5	7.50	0.49	6.75	0.32
Glen Helen-Lytle Creek-Clairemont	32	7.50	0.08	7.00	0.06
Hot S Buck Ridge (San Jacinto)	32	7.50	0.08	6.25	0.04
Offshore Zone of Deformation	25	7.50	0.12	6.50	0.07
Rose Canyon	27	7.00	0.08	6.50	0.06

Liquefaction

It is our opinion that, due to the relatively high density of the in situ soils and the lack of permanent near-surface groundwater and the proposed grading operations, the potential for liquefaction is not a consideration for this project.

EXCAVATION CHARACTERISTICS

The fill soils, alluvial soils, topsoils, and the slopewash deposits should be able to be excavated with conventional heavy-duty grading equipment. In general, the upper 15 to 20 feet of the decomposed granitic rocks should be rippable. However, the presence of outcrops throughout the site suggests

that oversize rocks and floaters, that may require breaking and splitting by blasting or mechanical procedures, may be encountered in the cut areas. All oversize rocks should be placed in the fill areas as shown on Figure 3, Oversize Rock Disposal, and in accordance with the specifications presented in Appendix C. Some difficulties should be expected during the excavation for the caissons due to the presence of very dense granitic rocks and the cobble and boulder content of the soil matrix of the slopewash deposits.

CONCLUSIONS AND RECOMMENDATIONS

General

1. It is our opinion that the proposed Pala Substation can be constructed as planned provided the recommendations of this report are followed.

2. The field investigation revealed that surficial soils and granitic rocks of the southern California batholith underlie the site. The surficial soils are composed of undocumented fill soils, alluvial soils, topsoils, and slopewash deposits. The undocumented fill soils, alluvial soils, topsoils, and the upper portion (approximately 1 to 2 feet) of the slopewash deposits are in an unsuitable condition to support additional structural fill soils and/or settlement-sensitive improvements; therefore, they should be removed and recompacted in accordance with the recommendations presented in the grading section.

3. The grading operations will consist of the removal and recompaction of the surficial soils and the placement of approximately 150,000 cubic yards of fill soils which will generate vertical cuts and fills on the order of 35 feet. The fill and cut slopes will have inclinations of 2 to 1 (horizontal to vertical), or flatter.

4. It is estimated that the maximum thickness of the undocumented fill soils, topsoils, alluvial soils requiring removal and recompaction will be on the order of 7, 4, and 10 feet, respectively. Similarly, it is estimated that the upper 2 feet of the slopewash deposits will

require removal and recompaction. It should be noted that localized areas of fill soils, alluvial soils, topsoils, and slopewash deposits deeper than those indicated requiring further removal may be encountered. The actual depth of removal will be determined by the geotechnical engineer during the grading operations.

Potential Geologic Hazards

5. The closest known active fault is the Elsinore Fault Zone, located approximately 5 miles to the east. The site could be subjected to moderate to severe ground shaking in the event of a major earthquake along any of the active faults in the southern California area. It is our opinion, however, that the seismic risk at this site is not significantly greater than that of the nearby developments.

6. No landslides were observed on the site. In our opinion, the potential for landsliding should not be a constraint to development of the site.

Soil Expansion Characteristics

7. The undocumented fill soils, alluvial soils, the sandy soils of the slopewash deposits, and the materials of the decomposed granitic rocks exhibit "very low" expansion characteristics. The topsoils exhibit "low" expansion characteristics. Materials on the site are anticipated to provide adequate foundation support in either a dense, natural or properly compacted state.

Grading

8. All grading for site development should be performed in accordance with the San Diego County grading ordinance and the *Recommended Grading Specifications* contained in Appendix C of this report. Where the recommendations of Appendix C conflict with this section of the report, the recommendations of this section shall take precedence.

9. It is recommended that a prebid conference be held at the site with the owner, contractor, civil engineer, and soil engineer in attendance. Special soil handling, as outlined in the specifications and/or the grading plans, can be discussed at that time.

10. Grading of the site should commence with the removal of all the vegetation and existing improvements from the area to be graded. Any deleterious debris should be exported from the site and should not be mixed with the fill soils. Any abandoned foundations and underground improvements should be removed and the resulting depression(s) properly backfilled in accordance with the procedures described herein.

11. All undocumented fill soils, alluvial soils, topsoils, and the loose, upper portions of the slopewash deposits in areas to receive structural fill soils should be removed until competent soils are exposed. It is anticipated that the loose slopewash deposits, topsoils, alluvial soils, and fill soils, will have an average thickness on the order of 2, 4, 10, and 7 feet, respectively, in the areas mapped in the Site Plan and Geologic Map, Figure 2. However,

the actual depth of removal should be determined during grading. The bottom of the excavation should be scarified to a depth of at least 12 inches, moisture conditioned to approximately 1 to 3 percent above optimum moisture content and compacted to at least 90 percent of maximum dry density. The excavated materials can then be moisture conditioned, placed and compacted in layers until final grade elevations are reached. Layers of fill should be no thicker than will allow for adequate bonding and compaction.

12. All fill and backfill should be compacted to at least 90 percent of maximum dry density as determined by ASTM Test Procedure D1557-91, at moisture contents ranging from approximately 1 to 3 percent above optimum moisture content.

13. Oversize materials, defined as material greater than 6 inches, should be placed in accordance with Section 6 of Appendix C and as shown on Figure 3.

Slope Stability

14. Slope stability analysis utilizing average shear strength parameters based on laboratory testing and our experience with similar soil types of nearby areas indicates that cut and fill slopes having a maximum height on the order of 35 feet and inclined at 2:1 (horizontal to vertical) will have factors of safety against deep-seated failure in excess of 1.5 for both deep-seated failure and surficial sloughage (see Figures 4 and 5). Slope stability under seismic conditions were analyzed using the Modified Bishop's Method and a ground acceleration of 0.32 g

(maximum probable acceleration). A factor of safety of approximately 1.2 has been determined for this condition.

15. All cut slopes should be observed by an engineering geologist during grading to verify that the soil and geologic conditions exposed do not differ significantly from those anticipated. Relatively weak lenses and fractures may be exposed in cut slopes. If these materials are exposed, recommendations for remedial grading or construction of buttress fills or stability fills may be necessary. In addition, if perched water or seepage conditions are observed, they will be noted and appropriate recommendations for drainage control will be made.

16. All fill slopes should either be overbuilt and cut back. As an alternative, slopes may be compacted by backrolling with a sheepsfoot compactor and track-walked upon completion. Slopes should be backrolled at intervals not exceeding 4 feet in height.

17. Only predominantly granular soils approved by Geocon Incorporated should be placed in the outer 15 feet of the fill slopes.

18. We recommend that slopes be planted with light weight, deep-rooted, drought-tolerant ground cover to reduce the potential for erosion of the slopes. Slope watering should be kept to a minimum to just support the plant growth.

Bulking and Shrinkage Factors

19. Estimates of embankment bulking and shrinkage factors are based on comparing laboratory compaction tests with the density of the material in it natural state as encountered in the test trenches. It should be emphasized that variations in existing soil density, as well as in compacted fill densities, render shrinkage value estimates very approximate. As an example, the contractor can compact the fill soils to any relative compaction of 90 percent or higher of the maximum laboratory density. Thus, the contractor has approximately a 10 percent range of control over the fill volume. Based on the limited work performed to date, in our opinion, the following shrinkage factors can be used as a basis for estimating how much the on-site soils may shrink or swell (bulk) when excavated from their existing state and placed as compacted fills.

TABLE II
SHRINKAGE AND BULK FACTORS

Soil Unit	Shrink/Bulk Factor
Topsoils	15 to 20 percent shrink
Alluvial Soils	15 to 20 percent shrink
Slopewash Deposits and Undocumented Fill Soils	5 to 10 percent shrink
Decomposed Granitic Rock	10 to 20 percent bulk

Settlement Potential

20. As previously stated, the field and laboratory data revealed that the fill soils, alluvial soils, topsoils, and the weathered soils of the slopewash deposits are the potentially compressible materials encountered at the site. These materials should be removed and recompacted to a relative compaction of at least 90 percent in conjunction with the site grading. The materials of the granitic rock were found in general to have a consistency of dense to very dense. Therefore, it is estimated that a maximum total and differential settlement of less than 0.75 inches may be anticipated based on the proposed type of structures and the recommended allowable soil bearing pressure.

Foundations - Substation Steel A-Frame and Transmission Line Towers/Poles

21. The use of straight shaft drilled piers extending through surficial soil and into the granitic rocks is recommended for support of the proposed "A"-frames and towers. Drilled pier foundations should be at least 2 feet in diameter and should extend at least 3 feet into dense, decomposed granitic rock. Pier foundations constructed with these minimum dimensions may be designed for an allowable end bearing pressure of 10,000 pounds per square foot (psf) plus 750 psf skin friction (in both tension and compression) for that portion of the pier deeper than 5 feet. The allowable end-bearing pressure may be increased by 1,000 psf for each additional foot of penetration into dense formational soil to a maximum of 30,000 psf. The weight of the shaft concrete may be neglected when determining foundation loads. Drilled pier reinforcement should be designed by the project structural engineer.

22. All piers should be carefully cleaned of loose soil cuttings by spinning of the auger or other suitable means.

23. No casing of pier holes should be necessary. Concrete should be placed immediately after drilling each pier hole to reduce the potential for caving soils and/or water seepage accumulation (i.e., "drill and pour" method). Concrete should not be placed in more than three inches of water.

24. It is recommended that piers be spaced no closer than three pier diameters (center to center). If piers must be spaced closer than three pier diameters, a reduction in axial and/or lateral loading capacities may be required. A reduction factor can be provided after final foundation locations and loads have been determined.

25. Pier drilling should be continuously observed by a representative of Geocon Incorporated to determine that bearing strata has been properly encountered and appropriate drilling procedures are being used.

Foundations - Substation Equipment and Masonry-Block Control House

26. The use of conventional spread and continuous footings founded in properly compacted fill or undisturbed formational soils is recommended for the support of the transformers and masonry-block control house. Conventional continuous footings should have a minimum

width of 12 inches and should have a minimum depth of embedment of 18 inches below the lowest adjacent subgrade. Isolated spread footings should have a minimum side dimension of 18 inches and should be founded at least 18 inches below the lowest adjacent subgrade.

27. Footings with the above minimum dimensions may be designed for an allowable soil bearing pressure of 2,000 psf for properly compacted fill soils and 3,000 psf for undisturbed formational soils. Footings founded in compacted fill soils may have the allowable soil bearing pressure increased by 500 psf for each additional foot of footing depth and 300 psf for each additional foot of footing width to a maximum allowable soil bearing pressure of 5,000 psf. Footings founded in dense undisturbed formational soil and/or decomposed granitic rock may have the allowable soil bearing pressure increased by 700 psf for each additional foot of footing depth and 400 psf for each additional foot of footing width to a maximum allowable soil bearing pressure of 8,000 psf.

28. The continuous footings should be reinforced with at least four No. 4 bars, two placed near the top and two placed near the bottom. The reinforcement for the isolated spread footings should be provided by the structural engineer.

29. If mat foundations are to be used for substation equipment, reinforcement and mat thickness should be designed by the project structural engineer. As a minimum, however, mat foundations should have perimeter continuous footings with minimum widths of 12 inches and

minimum depths of 12 inches below the lowest adjacent subgrade. Mat foundations may be designed for an allowable bearing capacity of 1,500 psf.

Foundations - General

30. Steel reinforcement is based only on soil support characteristics and is not intended to be in lieu of structural requirements.

31. All bearing capacities recommended above are for dead plus live loads and may be increased by one-third when considering transient loads due to wind or seismic forces.

32. Conventional foundations situated near the top of cut or fill slopes are not recommended. Where such a situation cannot be avoided the footings should be deepened such that the bottom outside edge of the footing is at least 7 feet horizontally inside the face of slope.

33. The exposed soils below all concrete slabs and foundations should be moistened as necessary to maintain a moist soil condition just prior to placing concrete as would be expected in any ordinary concrete construction. It is recommended that all interior and exterior slabs contain weakened plane joints in accordance with the Portland Cement Association criteria.

34. All foundation excavations should be observed by the soil engineer or his representative to verify that they penetrate the recommended bearing materials to the desired depth and geometry and that loose disturbed materials are cleaned from their bases.

Foundation Design Parameters

35. The following table presents input soil parameters for use with the MFAD Computer program. It is noted that these parameters represent conservative generalized values for each of the soil types.

TABLE III
MFAD COMPUTER PROGRAM SOIL PARAMETERS

Soil Type	Cohesive Strength, c (psf)	Friction Angle ϕ (degrees)	Unit Weight (pcf)	Deformation Modulus, Ep (ksi)
Compacted Fill Soils*	400	26	125	2.0
Dense Slopewash	400	32	125	4.0
Alluvium	400	26	115	1.0
Highly Weathered Decomposed Granitic Rock	400	33	130	5.0
Decomposed Granitic Rock	600	35	135	8.0

*Assumes fill soils are derived from topsoils and upper portions of the slopewash materials

Concrete Slabs-On-Grade

36. Concrete slab-on-grade for the masonry-block control house and exterior flat work should be at least 4 inches thick and should be reinforced with at least No. 3 steel reinforcing bars placed 18 inches on-center in both directions at the slab midpoint. Interior and exterior concrete slabs-on-grade planned to receive heavy equipment and or heavy vehicular loads should be at least 6 inches thick and should be reinforced with at least No. 3 steel reinforcing bars placed 18 inches on centers in both directions. Proper steel reinforcing positioning is critical to future performance of the slabs. Concrete slabs-on-grade subject to vehicular loads should have transfer load dowels in accordance with the Portland Cement Association criteria. The slab for the masonry-block control house should be underlain by at least 4 inches of clean sand. Where moisture-sensitive floor coverings are planned, the slabs should also be underlain by a visqueen moisture barrier. At least 2 inches of the sand should be placed above the visqueen to allow for proper concrete curing.

Retaining Walls

37. Unrestrained retaining walls should be designed to resist the pressure exerted by an equivalent fluid weight of 30 pcf. This value assumes that granular on-site material will be used for backfill, that the backfill surface will be level, and that no surcharge loads will be acting on the wall. For walls with backfill surfaces inclined at no steeper than 2.0 to 1.0, an active pressure exerted by an equivalent fluid weight of 43 pcf should be used.

38. For walls restrained from movement at the top, such as basement walls, an additional uniform horizontal pressure of 7H psf (H equals the height of the wall in feet) should be applied in addition to the active lateral pressures given above.

39. All retaining walls should be provided with a drainage system adequate to prevent the buildup of hydrostatic forces and should be properly waterproofed. Drainage of retaining wall backfill is especially critical when landscape irrigation systems are located near the retaining walls. The location and type of drainage system outlets should be such that a nuisance seepage condition will not result along the base of the walls. The above recommendations assume a properly compacted granular backfill material with no hydrostatic forces or imposed surcharge loads. A suggested wall drainage scheme is attached as Figure 6. If conditions different than those described are anticipated, or if specific drainage details are desired, Geocon Incorporated should be contacted for additional recommendations.

Lateral Loads

40. The pressure exerted by an equivalent fluid weight of 300 pcf may be used to provide resistance to design lateral loads. This design value assumes that footings or shear keys are poured neat against properly compacted granular fill soils or undisturbed formational soils and that the soil mass extends at least 10 feet horizontally from the face of the footing or three times the height of the surface generating passive pressure, whichever is greater. The

upper 12 inches of material not protected by floor slabs or pavement should not be included in design for passive resistance.

41. If friction is to be used to resist lateral loads, a coefficient of friction between soil and concrete of 0.40 may be utilized. If necessary, the coefficient of friction can be combined with the passive pressure.

42. The values presented herein for lateral load resistance and coefficient of friction are presented as "allowable" values, incorporating a factor of safety equal to 1.5.

Pavement Design

43. Results of Resistance Value (R-Value) testing performed on a sample of material anticipated to be representative of future subgrade conditions are presented in Table B-IV.

44. Recommended pavement sections are summarized below and are based upon the soils within the upper two feet of subgrade having a minimum R-Value of 15. When pad and access road subgrades are achieved, additional R-Value tests should be performed to verify that subgrade materials have a minimum R-Value of 15. If such testing indicates R-Values less than 15, or greater than 20, pavement recommendations may require modifications.

TABLE IV PAVEMENT RECOMMENDATIONS		
Location	Asphalt Concrete (inches)	Class 2 Base (inches)
"Yard" Area subjected only to Light Traffic	4	8
Access Road and Heavy Truck Traffic Areas	5	11

45. Prior to placing base material, the subgrade should be scarified, moisture conditioned and recompacted to a minimum of 95 percent relative compaction. The depth of compaction should be at least 8 inches. The base material should also be compacted to at least 95 percent relative compaction.

46. Class 2 base should conform to Section 26-1.02B of the *Specifications of the State of California, Department of Transportation* (Caltrans). Asphalt concrete should conform to Section 203-6 of the *Standard Specifications for Public Works Construction* (Green Book).

47. Landscape and pavement areas should be properly drained to reduce the potential for water entering the subgrade beneath these areas; surface grades should not be less than one percent.

48. If trash bin enclosures or heavy equipment loading areas are planned, the pavement sections should consist of 6 inches of portland cement concrete and should be reinforced with a

minimum of No. 3 bars spaced at 24 inches in each direction. The concrete should extend into the roadway sufficiently so that the front wheels of the trucks are on the concrete when loading. Concrete used as pavement should have a minimum modulus of rupture (MR) of 600 psi.

Site Drainage

49. Adequate site drainage is critical to the future performance of the project. Infiltration of irrigation excess and storm runoff into supporting soils can adversely affect the performance of the planned improvements. Positive site drainage should be provided to swales or other controlled drainage structures away from structures, pavement and the top of slopes.

50. Site irrigation should be monitored for a sufficient period after installation of irrigation facilities to determine the appropriate amount of irrigation necessary to maintain the landscaping without over watering.

51. Area drains and other site drainage facilities should be properly maintained.

Grading and Foundation Plan Review

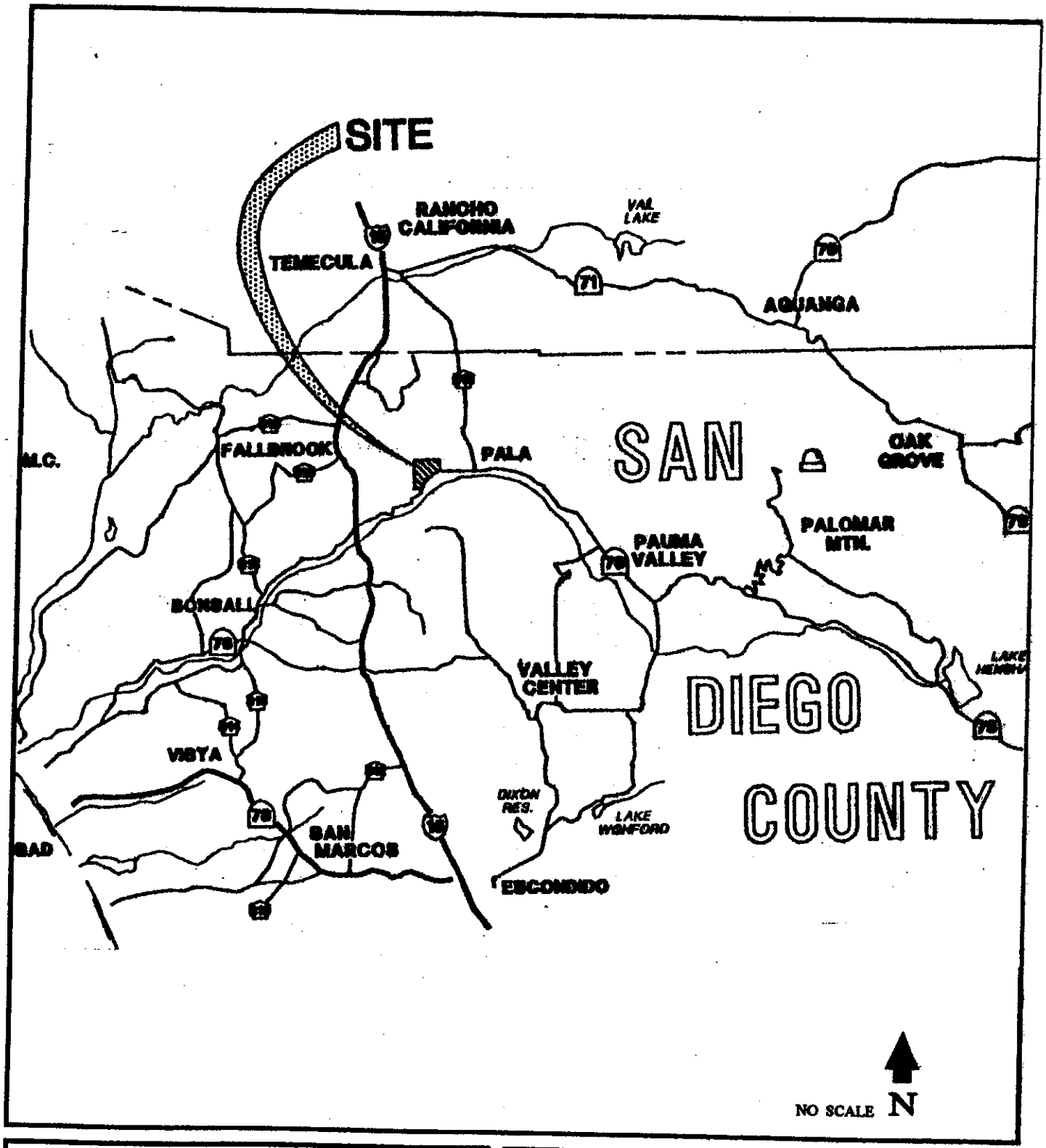
52. It is recommended that Geocon Incorporated review proposed grading and/or foundation plans prior to finalizing. The need for additional analysis or comments can be determined at that time.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The recommendations of this report pertain only to the site investigated and are based upon the assumption that the soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon Incorporated should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon Incorporated.

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

3. The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.



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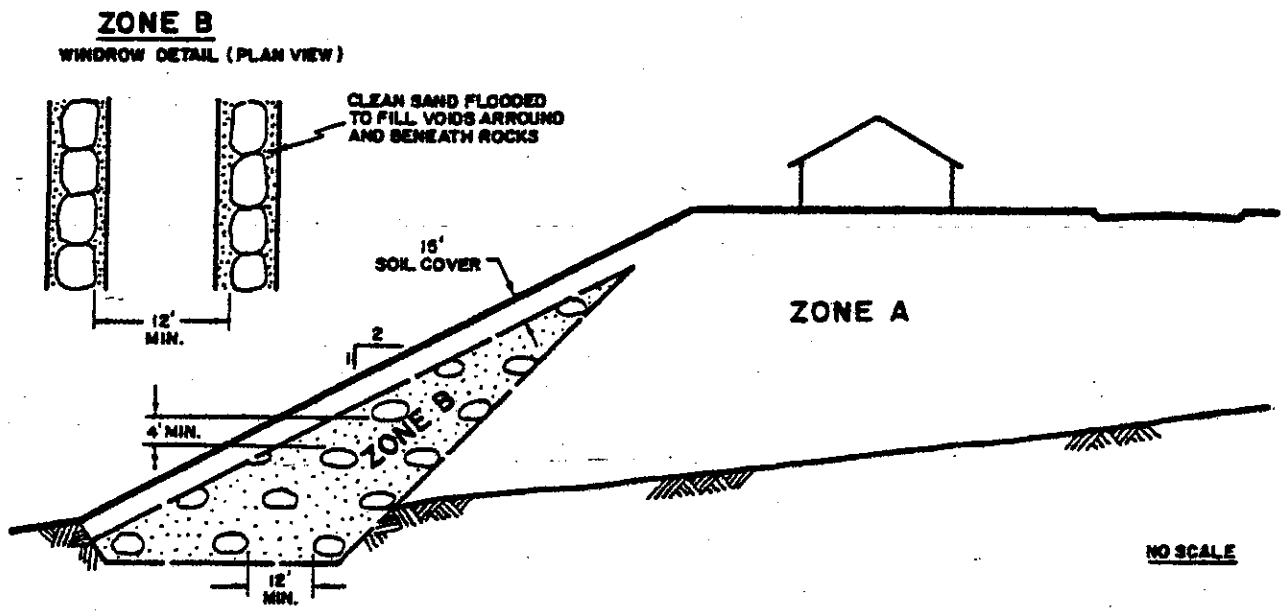
RG / RS

VICINITY MAP

SAN DIEGO GAS & ELECTRIC
PALA SUBSTATION
SAN DIEGO, CALIFORNIA

DATE 4 - 18 -1994	PROJ. NO. 05257 - 32 - 01	FIG. 1



ZONE A: SHOULD BE 15 FEET MINIMUM, MEASURED HORIZONTALLY FROM THE FACE OF THE SLOPE AND BENEATH STRUCTURES THAT WILL BE SUPPORTED BY DRILLED PIERS. ZONE A SHOULD CONSIST OF COMPACTED SOIL ONLY, NO ROCK FRAGMENTS OVER 6 INCHES IN MAXIMUM DIMENSION.

ZONE B: OVERSIZE ROCKS (I.E., ROCKS GREATER THAN 6 INCHES IN MAXIMUM DIMENSION) SHOULD BE PLACED IN FILL SLOPES, UNDER STRUCTURES THAT WILL BE SUPPORTED BY CONVENTIONAL, SHALLOW FOUNDATIONS OR BENEATH PAVEMENT AREAS. OVERSIZE ROCKS SHOULD EITHER BE INDIVIDUALLY PLACED OR WINDROWED. FOR INDIVIDUAL PLACEMENT, ROCK UP TO 4 FEET MAXIMUM DIMENSION MUST BE UNIFORMLY DISTRIBUTED AND WELL SPACED IN COMPACTED FILL SOIL CONFORMING TO ZONE A. FOR WINDROWS, ROCKS UP TO 3 FEET IN MAXIMUM DIMENSION MUST BE PLACED IN TRENCHES EXCAVATED IN WELL COMPACTED SOIL CONFORMING TO ZONE A. APPROVED GRANULAR SOIL (SE>30) SHOULD BE FLOODED IN THE WINDROWS TO FILL THE VOIDS AROUND BENEATH ROCKS. ALL WINDROWS SHOULD BE PARALLEL AND MAY BE PLACED EITHER PARALLEL OR PERPENDICULAR TO FACE OF SLOPE DEPENDING ON SITE GEOMETRY. WINDROWS SHOULD BE 100 FEET IN MAXIMUM LENGTH WITH 12-FOOT SPACING BETWEEN ENDS.

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OVERSIZE ROCK DISPOSAL

PALA SUBSTATION

SAN DIEGO COUNTY, CALIFORNIA

DATE 4 - 18 - 1994	PROJ. NO. 05257 - 32 - 01	FIG. 3

ASSUMED CONDITIONS:

Slope Height	$H = 35$ feet
Slope Inclination	2:1 (Horizontal:Vertical)
Total Unit Weight of Soil	$\gamma = 130$ pounds per cubic foot
Angle of Internal Friction	$\phi = 26$ degrees
Apparent Cohesion	$C = 400$ pounds per square foot
No Seepage Forces	

ANALYSIS:

$\lambda_{c\phi} = \frac{\gamma H \tan \phi}{C}$ Equation (3-3), Reference 1

$FS = \frac{N_{cf} C}{\gamma H}$ Equation (3-2), Reference 1

$\lambda_{c\phi} = 5.6$ Calculated Using Eq. (3-3)

$N_{cf} = 21$ Determined Using Figure 10, Reference 2

$FS = 1.85$ Factor of Safety Calculated Using Eq. (3-2)

REFERENCES

(1) Janbu, N., *Stability Analysis of Slopes with Dimensionless Parameters*, Harvard Soil Mechanics, Series No. 46, 1954.

(2) Janbu, N., Discussion of J.M. Bell, *Dimensionless Parameters for Homogeneous Earth Slopes*, Journal of Soil Mechanics and Foundation Design, No. SM6, November 1967.

SLOPE STABILITY ANALYSIS

PALA SUBSTATION

SAN DIEGO COUNTY, CALIFORNIA

FIGURE 4

ASSUMED CONDITIONS:

Slope Height	H	=	Infinite
Depth of Saturation	Z	=	3 feet
Slope Inclination	2:1 (Horizontal:Vertical)		
Slope Angle	i	=	26.6 degrees
Unit Weight of Water	γ_w	=	62.4 pounds per cubic foot
Total Unit Weight of Soil	γ_t	=	130 pounds per cubic foot
Angle of Internal Friction	ϕ	=	26 degrees
Apparent Cohesion	C	=	400 pounds per square foot

Slope saturated to vertical depth Z below slope face.
Seepage forces parallel to slope face.

ANALYSIS:

$$FS = \frac{C + (\gamma_t - \gamma_w)\, Z \cos^2 i \tan\phi}{\gamma_t\, Z \sin i \cos i} = 3.07$$

REFERENCES

(1) Haefeli, R. *The Stability of Slopes Acted Upon by Parallel Seepage,* Proc. Second International Conference, SMFE, Rotterdam, 1948, 1, 57-62.

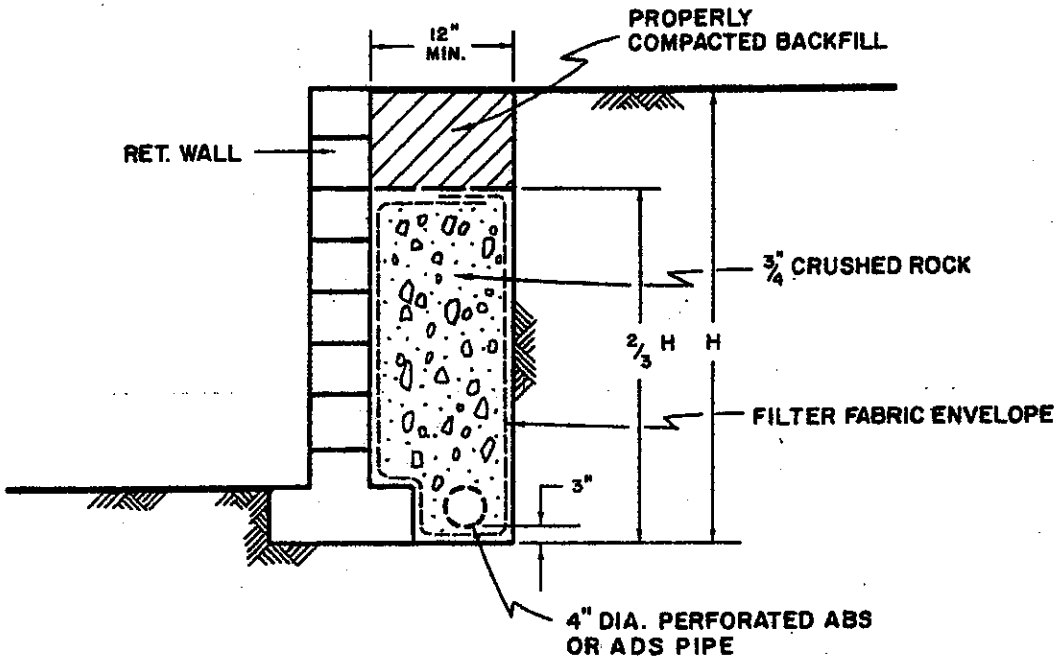
(2) Skempton, A. W., and F. A. Delory, *Stability of Natural Slopes in London Clay,* Proc. Fourth International Conference, SMFE, London, 1957, 2, 378-81.

SURFICIAL SLOPE STABILITY ANALYSIS

PALA SUBSTATION

SAN DIEGO COUNTY, CALIFORNIA

FIGURE 5



NOTE: IF CLASS 2 PERMEABLE MATERIAL
(PER SEC-68-1.025 CALTRANS STD. SPECS)
IS USED THE FILTER FABRIC MAYBE DELETED

NO SCALE

RETAINING WALL DRAIN DETAIL

PALA SUBSTATION

SAN DIEGO COUNTY, CALIFORNIA

FIGURE 6

APPENDIX B

APPENDIX B

LABORATORY TESTING

Laboratory tests were performed in accordance with generally accepted test methods of the American Society for Testing and Materials (ASTM) or other suggested procedures. Selected samples were tested for their in-place density and moisture content, direct shear, grain size, maximum dry density, optimum moisture content, resistance value expansion and consolidation characteristics. The results of these tests are summarized in Tables B-I through B-IV and Figures B-1 through B-3. In-place dry density and moisture contents are also presented on the logs of the exploratory trenches and borings, Figures A-1 through A-37.

Project No. 05257-32-01
April 18, 1994

TABLE B-I

SUMMARY OF LABORATORY MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT TEST RESULTS

ASTM D1557-91

Sample No.	Description	Maximum Dry Density (pcf)	Optimum Moisture Content (% Dry Weight)
T4-1	Orange-brown, clayey, fine to coarse SAND with gravel	115.2	17.7

TABLE B-II

SUMMARY OF IN-PLACE MOISTURE-DENSITY AND DIRECT SHEAR TEST RESULTS

Sample No.	Dry Density (pcf)	Moisture Content (%)	Unit Cohesion (psf)	Angle of Shear Resistance (degrees)
T4-1*	103.2	18.4	450	26
SB7-1	111.8	13.9	500	32
LB1-3**	146.7	3.5	850	35
LB4-4	120.8	11.1	700	35

*Sample remolded to approximately 90 percent of maximum dry density at near optimum moisture content.

**Sample remolded to the approximate density and moisture content of Sample LB1-4.

TABLE B-III

SUMMARY OF LABORATORY EXPANSION INDEX TEST RESULTS

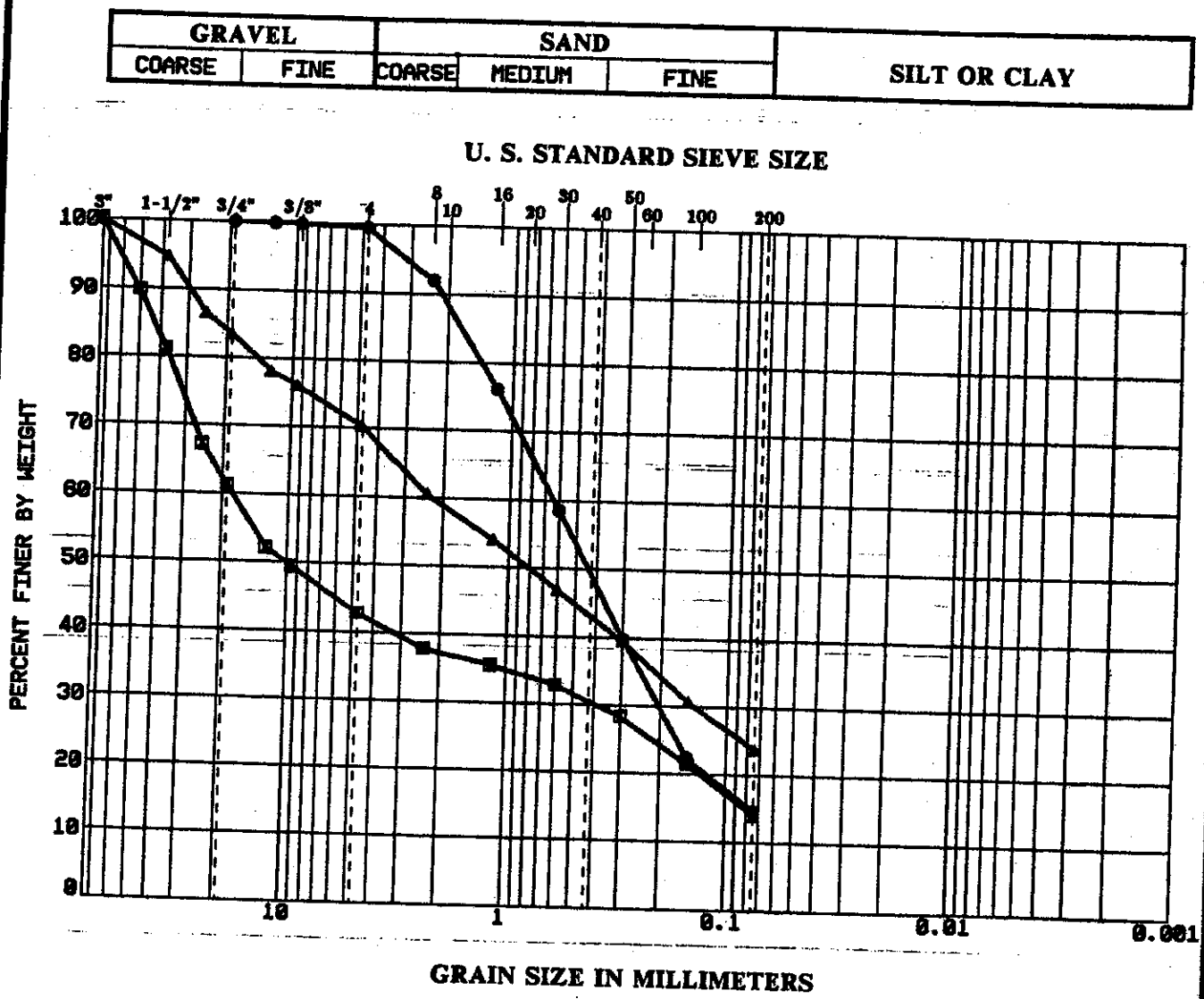
Sample No.	Moisture Content		Dry Density (pcf)	Expansion Index	Type of Soil
	Before Test (%)	After Test (%)			
T1-2	12.1	32.0	101.9	0	Slopewash Deposits
SB2-1	13.2	33.3	99.9	26	Topsoil
SB7-2	7.9	17.4	118.5	13	Granitic Rock
LB4-1	11.2	28.7	106.2	3	Slopewash Deposits

TABLE B-IV

SUMMARY OF LABORATORY RESISTANCE VALUE TEST RESULTS

Sample No.	Resistance Value	Type of Soil
SB7-2	15	Granitic Rock
LB4-1	16	Slopewash Deposits

PROJECT NO. 05257-32-01



	SAMPLE	Depth (ft)	CLASSIFICATION	NAT WC	LL	PL	PI
●	SB11-5	16.0	(SM) Fine to coarse Silty SAND				
■	T1-1	1.0	(SM) Silty SAND w/ gravels				
▲	T1-2	5.0	(SC) Clayey SAND w/ gravels				

GRADATION CURVE

PALA SUBSTATION

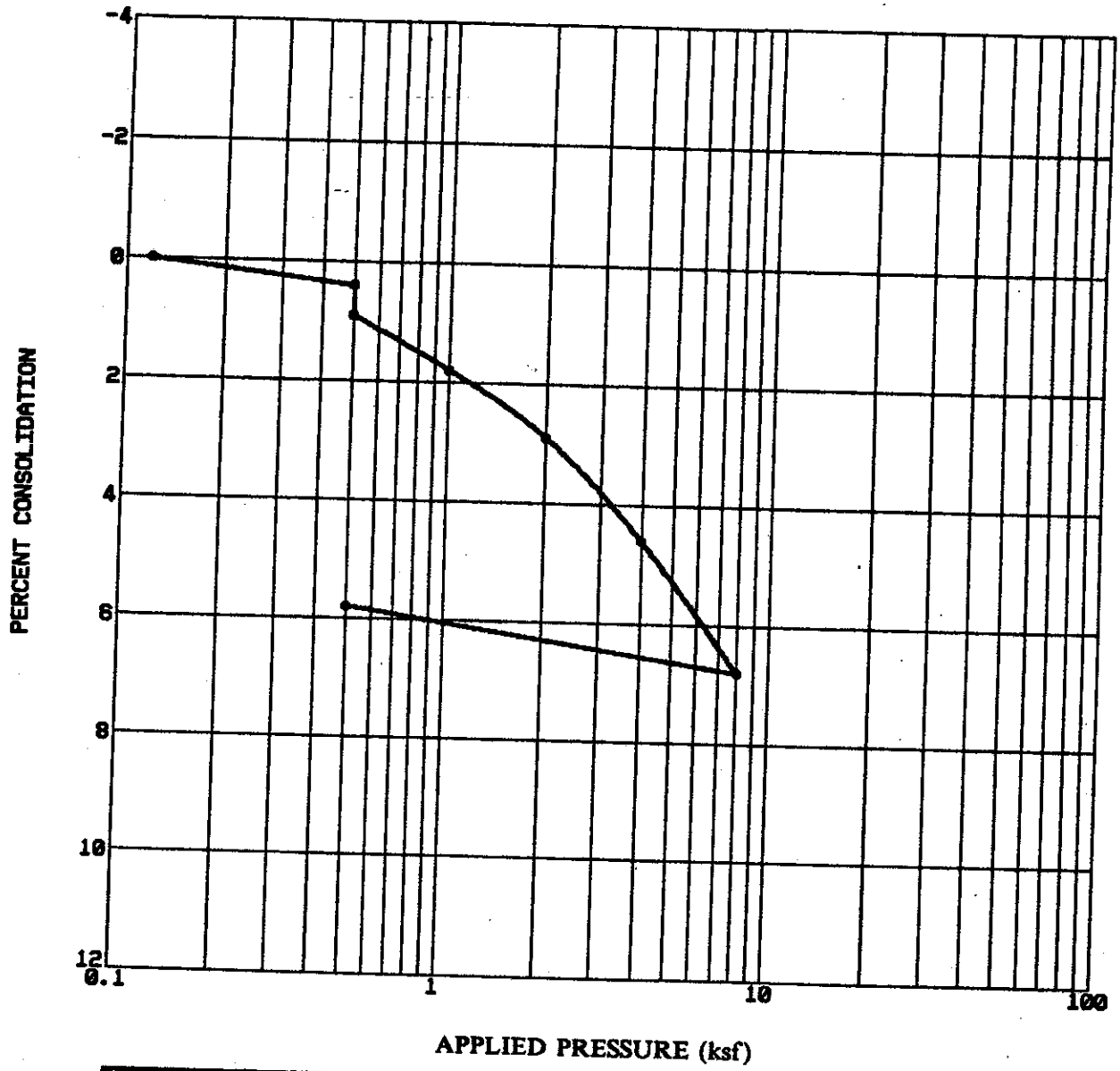
SAN DIEGO COUNTY, CALIFORNIA

PLSUB

Figure B-1

PROJECT NO. 05257-32-01

SAMPLE NO. SB14-1



Initial Dry Density (pcf)	111.5
Initial Water Content (%)	8.2

Initial Saturation (%)	44.7
Sample Saturated at (ksf)	0.5

CONSOLIDATION CURVE

PALA SUBSTATION

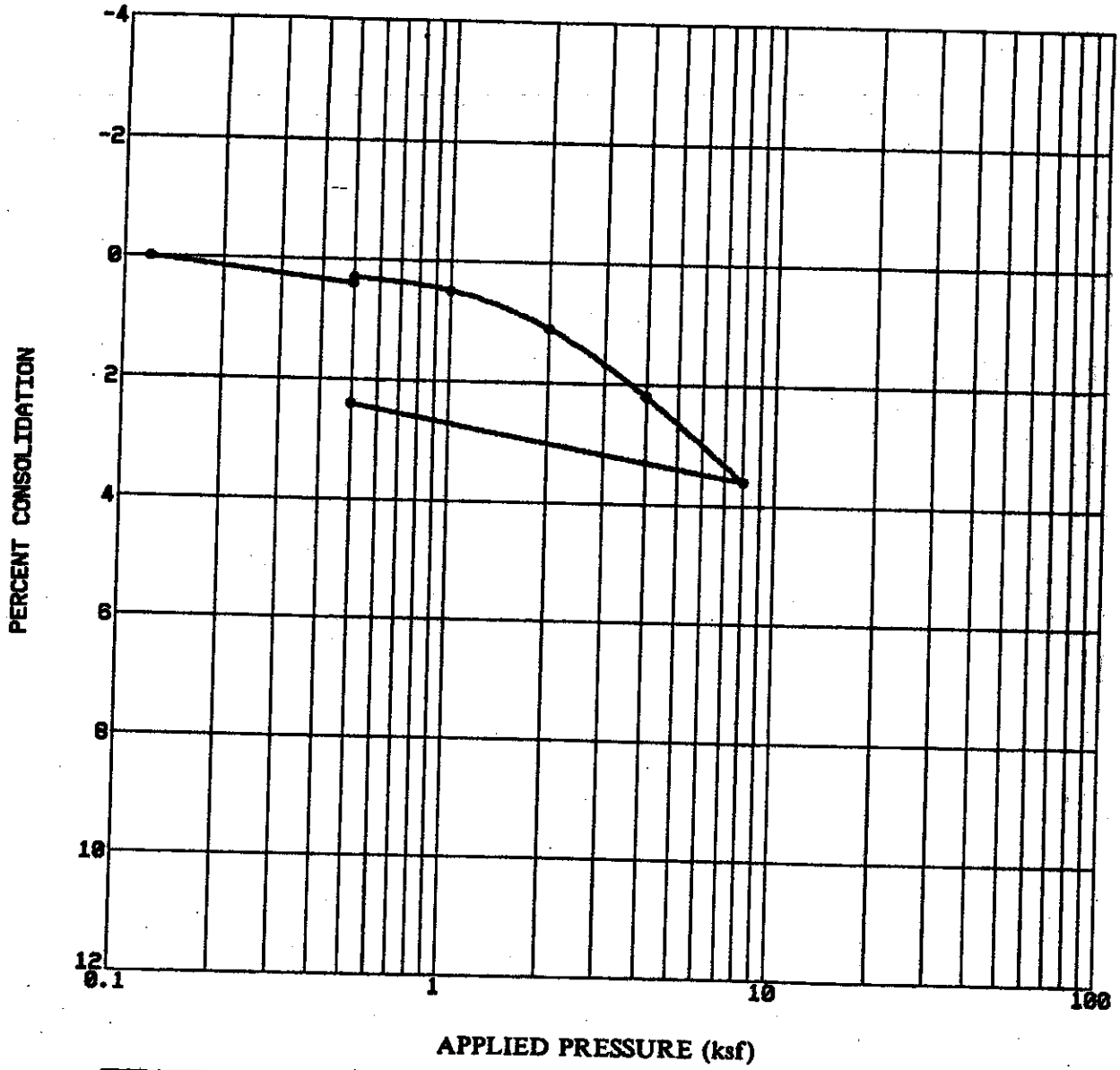
SAN DIEGO COUNTY, CALIFORNIA

PLSUB

Figure B-2

PROJECT NO. 05257-32-01

SAMPLE NO. SB17-1



Initial Dry Density (pcf)	114.3
Initial Water Content (%)	18.7

Initial Saturation (%)	100+
Sample Saturated at (ksf)	0.5

CONSOLIDATION CURVE

PALA SUBSTATION

SAN DIEGO COUNTY, CALIFORNIA

PLSUB

Figure B-3

APPENDIX C

RECOMMENDED GRADING SPECIFICATIONS

FOR

PALA SUBSTATION

SAN DIEGO COUNTY, CALIFORNIA

Project No. 05257-32-01

RECOMMENDED GRADING SPECIFICATIONS

1 GENERAL

1.1 These Recommended Grading Specifications shall be used in conjunction with the Geotechnical Report for the project prepared by Geocon Incorporated. The recommendations contained in the text of the Geotechnical Report are a part of the earthwork and grading specifications and shall supersede the provisions contained hereinafter in the case of conflict.

1.2 Prior to the commencement of grading, a geotechnical consultant (Consultant) shall be employed for the purpose of observing earthwork procedures and testing the fills for substantial conformance with the recommendations of the Geotechnical Report and these specifications. It will be necessary that the Consultant provide adequate testing and observation services so that he may determine that, in his opinion, the work was performed in substantial conformance with these specifications. It shall be the responsibility of the Contractor to assist the Consultant and keep him apprised of work schedules and changes so that personnel may be scheduled accordingly.

1.3 It shall be the sole responsibility of the Contractor to provide adequate equipment and methods to accomplish the work in accordance with applicable grading codes or agency ordinances, these specifications and the approved grading plans. If, in the opinion of the Consultant, unsatisfactory conditions such as questionable soil materials, poor moisture condition, inadequate compaction, adverse weather, and so forth, result in a quality of work not in conformance with these specifications, the Consultant will be empowered to reject the work and recommend to the Owner that construction be stopped until the unacceptable conditions are corrected.

2 DEFINITIONS

2.1 **Owner** shall refer to the owner of the property or the entity on whose behalf the grading work is being performed and who has contracted with the Contractor to have grading performed.

2.2 **Contractor** shall refer to the Contractor performing the site grading work.

2.3 **Civil Engineer** or **Engineer of Work** shall refer to the California licensed Civil Engineer or consulting firm responsible for preparation of the grading plans, surveying and verifying as-graded topography.

2.4 **Consultant** shall refer to the soil engineering and engineering geology consulting firm retained to provide geotechnical services for the project.

2.5 **Soil Engineer** shall refer to a California licensed Civil Engineer retained by the Owner, who is experienced in the practice of geotechnical engineering. The Soil Engineer shall be responsible for having qualified representatives on-site to observe and test the Contractor's work for conformance with these specifications.

2.6 **Engineering Geologist** shall refer to a California licensed Engineering Geologist retained by the Owner to provide geologic observations and recommendations during the site grading.

2.7 **Geotechnical Report** shall refer to a soil report (including all addendums) which may include a geologic reconnaissance or geologic investigation that was prepared specifically for the development of the project for which these Recommended Grading Specifications are intended to apply.

3 MATERIALS

3.1 Materials for compacted fill shall consist of any soil excavated from the cut areas or imported to the site that, in the opinion of the Consultant, is suitable for use in construction of fills. In general, fill materials can be classified as *soil* fills, *soil-rock* fills or *rock* fills, as defined below.

3.1.1 **Soil fills** are defined as fills containing no rocks or hard lumps greater than 12 inches in maximum dimension and containing at least 40 percent by weight of material smaller than 3/4 inch in size.

3.1.2 **Soil-rock fills** are defined as fills containing no rocks or hard lumps larger than 4 feet in maximum dimension and containing a sufficient matrix of *soil* fill to allow for proper compaction of *soil* fill around the rock fragments or hard lumps as specified in Paragraph 6.2. **Oversize** rock is defined as material greater than 12 inches.

3.1.3 **Rock fills** are defined as fills containing no rocks or hard lumps larger than 3 feet in maximum dimension and containing little or no fines. Fines are defined as material smaller than 3/4 inch in maximum dimension. The quantity of fines shall be less than approximately 20 percent of the rock fill quantity.

3.2 Material of a perishable, spongy, or otherwise unsuitable nature as determined by the Consultant shall not be used in fills.

3.3 Materials used for fill, either imported or on-site, shall not contain hazardous materials as defined by the California Code of Regulations, Title 22, Division 4, Chapter 30, Articles 9 and 10; 40CFR; and any other applicable local, state or federal laws. The Consultant shall not be responsible for the identification or analysis of the potential presence of hazardous materials. However, if observations, odors or soil discoloration cause Consultant to suspect the presence of hazardous materials, the Consultant may request from the Owner the termination of grading operations within the affected area. Prior to resuming grading operations, the Owner shall provide a written report to the Consultant indicating that the suspected materials are not hazardous as defined by applicable laws and regulations.

3.4 The outer 15 feet of *soil-rock* fill slopes, measured horizontally, should be composed of properly compacted *soil* fill materials approved by the Consultant. *Rock* fill may extend to the slope face, provided that the slope is not steeper than 2:1 (horizontal:vertical) and a soil layer no thicker than 12 inches is track-walked onto the face for landscaping purposes. This procedure may be utilized, provided it is acceptable to the governing agency, Owner and Consultant.

3.5 Representative samples of soil materials to be used for fill shall be tested in the laboratory by the Consultant to determine the maximum density, optimum moisture content, and, where appropriate, shear strength, expansion, and gradation characteristics of the soil.

3.6 During grading, soil or groundwater conditions other than those identified in the Geotechnical Report may be encountered by the Contractor. The Consultant shall be notified immediately to evaluate the significance of the unanticipated condition.

4 CLEARING AND PREPARING AREAS TO BE FILLED

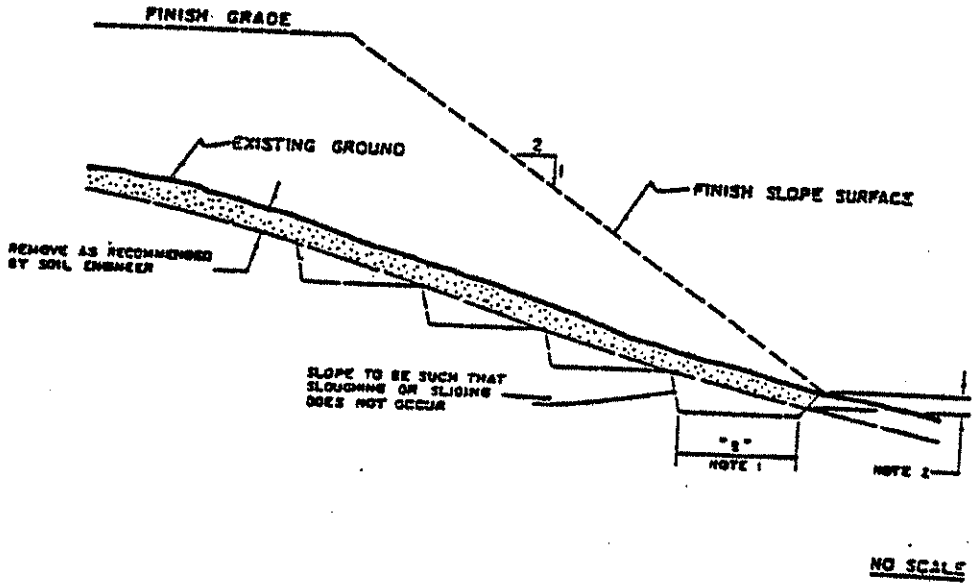
4.1 Areas to be excavated and filled shall be cleared and grubbed. Clearing shall consist of complete removal above the ground surface of trees, stumps, brush, vegetation, man-made structures and similar debris. Grubbing shall consist of removal of stumps, roots, buried logs and other unsuitable material and shall be performed in areas to be graded. Roots and other projections exceeding 1-1/2 inches in diameter shall be removed to a depth of 3 feet below the surface of the ground. Borrow areas shall be grubbed to the extent necessary to provide suitable fill materials.

4.2 Any asphalt pavement material removed during clearing operations should be properly disposed at an approved off-site facility. Concrete fragments which are free of reinforcing steel may be placed in fills, provided they are placed in accordance with Section 6.2 or 6.3 of this document.

4.3 After clearing and grubbing of organic matter or other unsuitable material, loose or porous soils shall be removed to the depth recommended in the Geotechnical Report. The depth of removal and compaction shall be observed and approved by a representative of the Consultant. The exposed surface shall then be plowed or scarified to a minimum depth of 6 inches and until the surface is free from uneven features that would tend to prevent uniform compaction by the equipment to be used.

4.4 Where the slope ratio of the original ground is steeper than 6:1 (horizontal:vertical), or where recommended by the Consultant, the original ground should be benched in accordance with the following illustration.

TYPICAL BENCHING DETAIL



NOTES:

(1) Key width "B" should be a minimum of 10 feet wide, or sufficiently wide to permit complete coverage with the compaction equipment used. The base of the key should be graded horizontal, or inclined slightly into the natural slope.

(2) The outside of the bottom key should be below the topsoil or unsuitable surficial material and at least 2 feet into dense formational material. Where hard rock is exposed in the bottom of the key, the depth and configuration of the key may be modified as approved by the Consultant.

4.5 After areas to receive fill have been cleared, plowed or scarified, the surface should be disced or bladed by the Contractor until it is uniform and free from large clods. The area should then be moisture conditioned to achieve the proper moisture content, and compacted as recommended in Section 6.0 of these specifications.

5 COMPACTION EQUIPMENT

5.1 Compaction of *soil* or *soil-rock* fill shall be accomplished by sheepsfoot or segmented-steel wheeled rollers, vibratory rollers, multiple-wheel pneumatic-tired rollers, or other types of acceptable compaction equipment. Equipment shall be of such a design that it will be capable of compacting the *soil* or *soil-rock* fill to the specified relative compaction at the specified moisture content.

5.2 Compaction of *rock* fills shall be performed in accordance with Section 6.3.

6 PLACING, SPREADING AND COMPACTION OF FILL MATERIAL

6.1 *Soil* fill, as defined in Paragraph 3.1.1, shall be placed by the Contractor in accordance with the following recommendations:

6.1.1 *Soil* fill shall be placed by the Contractor in layers that, when compacted, should generally not exceed 8 inches. Each layer shall be spread evenly and shall be thoroughly mixed during spreading to obtain uniformity of material and moisture in each layer. The entire fill shall be constructed as a unit in nearly level lifts. Rock materials greater than 12 inches in maximum dimension shall be placed in accordance with Section 6.2 or 6.3 of these specifications.

6.1.2 In general, the *soil* fill shall be compacted at a moisture content at or above the optimum moisture content as determined by ASTM D1557-91.

6.1.3 When the moisture content of *soil* fill is below that specified by the Consultant, water shall be added by the Contractor until the moisture content is in the range specified.

6.1.4 When the moisture content of the *soil* fill is above the range specified by the Consultant or too wet to achieve proper compaction, the *soil* fill shall be aerated by the Contractor by blading/mixing, or other satisfactory methods until the moisture content is within the range specified.

6.1.5 After each layer has been placed, mixed, and spread evenly, it shall be thoroughly compacted by the Contractor to a relative compaction of at least 90 percent. Relative compaction is defined as the ratio (expressed in percent) of the in-place dry density of the compacted fill to the maximum laboratory dry density as determined in accordance with ASTM D1557-91. Compaction shall be continuous over the entire area, and compaction equipment shall make sufficient passes so that the specified minimum density has been achieved throughout the entire fill.

6.1.6 Soils having an Expansion Index of greater than 50 may be used in fills if placed at least 3 feet below finish pad grade and should be compacted at a moisture content generally 2 to 4 percent greater than the optimum moisture content for the material.

6.1.7 Properly compacted *soil* fill shall extend to the design surface of fill slopes. To achieve proper compaction, it is recommended that fill slopes be over-built by at least 3 feet and then cut to the design grade. This procedure is considered preferable to track-walking of slopes, as described in the following paragraph.

6.1.8 As an alternative to over-building of slopes, slope faces may be back-rolled with a heavy-duty loaded sheepsfoot or vibratory roller at maximum 4-foot fill height intervals. Upon completion, slopes should then be track-walked with a D-8 dozer or similar equipment, such that a dozer track covers all slope surfaces at least twice.

6.2 *Soil-rock* fill, as defined in Paragraph 3.1.2, shall be placed by the Contractor in accordance with the following recommendations:

6.2.1 Rocks larger than 12 inches but less than 4 feet in maximum dimension may be incorporated into the compacted *soil* fill, but shall be limited to the area measured 15 feet minimum horizontally from the slope face and 5 feet below finish grade or 3 feet below the deepest utility, whichever is deeper.

6.2.2 Rocks or rock fragments up to 4 feet in maximum dimension may either be individually placed or placed in windrows. Under certain conditions, rocks or rock fragments up to 10 feet in maximum dimension may be placed using similar methods. The acceptability of placing rock materials greater than 4 feet in maximum dimension shall be evaluated during grading, as specific cases arise and shall be approved by the Consultant prior to placement.

6.2.3 For individual placement, sufficient space shall be provided between rocks to allow for passage of compaction equipment.

6.2.4 For windrow placement, the rocks should be placed in trenches excavated in properly compacted *soil* fill. Trenches should be approximately 5 feet wide and 4 feet deep in maximum dimension. The voids around and beneath rocks should be filled with approved granular soil having a Sand Equivalent of 30 or greater and should be compacted by flooding. Windrows may also be placed utilizing an "open-face" method in lieu of the trench procedure, however, this method should first be approved by the Consultant.

6.2.5 Windrows should generally be parallel to each other and may be placed either parallel to or perpendicular to the face of the slope depending on the site geometry. The minimum horizontal spacing for windrows shall be 12 feet center-to-center with a 5-foot stagger or offset from lower courses to next overlying course. The minimum vertical spacing between windrow courses shall be 2 feet from the top of a lower windrow to the bottom of the next higher windrow.

6.2.6 All rock placement, fill placement and flooding of approved granular soil in the windrows must be continuously observed by the Consultant or his representative.

6.3 *Rock* fills, as defined in Section 3.1.3, shall be placed by the Contractor in accordance with the following recommendations:

6.3.1 The base of the *rock* fill shall be placed on a sloping surface (minimum slope of 2 percent, maximum slope of 5 percent). The surface shall slope toward suitable subdrainage outlet facilities. The *rock* fills shall be provided with subdrains during construction so that a hydrostatic pressure buildup does not develop. The subdrains shall be permanently connected to controlled drainage facilities to control post-construction infiltration of water.

6.3.2 *Rock* fills shall be placed in lifts not exceeding 3 feet. Placement shall be by rock trucks traversing previously placed lifts and dumping at the edge of the currently placed lift. Spreading of the *rock* fill shall be by dozer to facilitate *seating* of the rock. The *rock* fill shall be watered heavily during placement. Watering shall consist of water trucks traversing in front of the current rock lift face and spraying water continuously during rock placement. Compaction equipment with compactive energy comparable to or greater than that of a 20-ton steel vibratory roller or other compaction equipment providing suitable energy to achieve the required compaction or deflection as recommended in Paragraph 6.3.3 shall be utilized. The number of passes to be made will be determined as described in Paragraph 6.3.3. Once a rock fill lift has been covered with soil fill, no additional rock fill lifts will be permitted over the soil fill.

6.3.3 Plate bearing tests, in accordance with ASTM D1196-64, may be performed in both the compacted *soil* fill and in the *rock* fill to aid in determining the number of passes of the compaction equipment to be performed. If performed, a minimum of three plate bearing tests shall be performed in the properly compacted *soil* fill (minimum relative compaction of 90 percent). Plate bearing tests shall then be performed on areas of *rock* fill having two passes, four passes and six passes of the compaction equipment, respectively. The number of passes required for the *rock* fill shall be determined by comparing the results of the plate bearing tests for the *soil* fill and the *rock* fill and by evaluating the deflection variation with number of passes. The required number of passes of the compaction equipment will be performed as necessary until the plate bearing deflections are equal to or less than that determined for the properly compacted soil fill. In no case will the required number of passes be less than two.

6.3.4 A representative of the Consultant shall be present during rock fill operations to verify that the minimum number of "passes" have been obtained, that water is being properly applied and that specified procedures are being followed. The actual number of plate bearing tests will be determined by the Consultant during grading. In general, at least one test should be performed for each approximately 5,000 to 10,000 cubic yards of *rock* fill placed.

6.3.5 Test pits shall be excavated by the Contractor so that the Consultant can state that, in his opinion, sufficient water is present and that voids between large rocks are properly filled with smaller rock material. In-place density testing will not be required in the *rock* fills.

6.3.6 To reduce the potential for "piping" of fines into the *rock* fill from overlying *soil* fill material, a 2-foot layer of graded filter material shall be placed above the uppermost lift of *rock* fill. The need to place graded filter material below the *rock* should be determined by the Consultant prior to commencing grading. The gradation of the graded filter material will be determined at the time the *rock* fill is being excavated. Materials typical of the *rock* fill should be submitted to the Consultant in a timely manner, to allow design of the graded filter prior to the commencement of *rock* fill placement.

6.3.7 All *rock* fill placement shall be continuously observed during placement by representatives of the Consultant.

7 OBSERVATION AND TESTING

7.1 The Consultant shall be the Owners representative to observe and perform tests during clearing, grubbing, filling and compaction operations. In general, no more than 2 feet in vertical elevation of *soil* or *soil-rock* fill shall be placed without at least one field density test being performed within that interval. In addition, a minimum of one field density test shall be performed for every 2,000 cubic yards of *soil* or *soil-rock* fill placed and compacted.

7.2 The Consultant shall perform random field density tests of the compacted *soil* or *soil-rock* fill to provide a basis for expressing an opinion as to whether the fill material is compacted as specified. Density tests shall be performed in the compacted materials below any disturbed surface. When these tests indicate that the density of any layer of fill or portion thereof is below that specified, the particular layer or areas represented by the test shall be reworked until the specified density has been achieved.

7.3 During placement of *rock* fill, the Consultant shall verify that the minimum number of passes have been obtained per the criteria discussed in Section 6.3.3. The Consultant shall request the excavation of observation pits and may perform plate bearing tests on the placed *rock* fills. The observation pits will be excavated to provide a basis for expressing an opinion as to whether the *rock* fill is properly seated and sufficient moisture has been applied to the material. If performed, plate bearing tests will be performed randomly on the surface of the most-recently placed lift. Plate bearing tests will be performed to provide a basis for expressing an opinion as to whether the *rock* fill is adequately seated. The maximum deflection in the *rock* fill determined in Section 6.3.3 shall be less than the maximum deflection of the properly compacted *soil* fill. When any of the above criteria indicate that a layer of *rock* fill or any portion thereof is below that specified, the affected layer or area shall be reworked until the *rock* fill has been adequately seated and sufficient moisture applied.

7.4 A settlement monitoring program designed by the Consultant may be conducted in areas of *rock* fill placement. The specific design of the monitoring program shall be as recommended in the Conclusions and Recommendations section of the project Geotechnical Report or in the final report of testing and observation services performed during grading.

7.5 The Consultant shall observe the placement of subdrains, to verify that the drainage devices have been placed and constructed in substantial conformance with project specifications.

7.6 Testing procedures shall conform to the following Standards as appropriate:

7.6.1 **Soil and Soil-Rock Fills:**

7.6.1.1 Field Density Test, ASTM D1556-82, *Density of Soil In-Place By the Sand-Cone Method.*

7.6.1.2 Field Density Test, Nuclear Method, ASTM D2922-81, *Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth).*

7.6.1.3 Laboratory Compaction Test, ASTM D1557-91, *Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-Pound Hammer and 18-Inch Drop.*

7.6.1.4 Expansion Index Test, Uniform Building Code Standard 29-2, *Expansion Index Test.*

7.6.2 **Rock Fills:**

7.6.2.1 Field Plate Bearing Test, ASTM D1196-64 (Reapproved 1977) *Standard Method for Nonrepresentative Static Plate Load Tests of Soils and Flexible Pavement Components, For Use in Evaluation and Design of Airport and Highway Pavements.*

8 PROTECTION OF WORK

8.1 During construction, the Contractor shall properly grade all excavated surfaces to provide positive drainage and prevent ponding of water. Drainage of surface water shall be controlled to avoid damage to adjoining properties or to finished work on the site. The Contractor shall take remedial measures to prevent erosion of freshly graded areas until such time as permanent drainage and erosion control features have been installed. Areas subjected to erosion or sedimentation shall be properly prepared in accordance with the Specifications prior to placing additional fill or structures.

8.2 After completion of grading as observed and tested by the Consultant, no further excavation or filling shall be conducted except in conjunction with the services of the Consultant.

9 CERTIFICATIONS AND FINAL REPORTS

9.1 Upon completion of the work, Contractor shall furnish Owner a certification by the Civil Engineer stating that the lots and/or building pads are graded to within 0.1 foot vertically of elevations shown on the grading plan and that all tops and toes of slopes are within 0.5 foot horizontally of the positions shown on the grading plans. After installation of a section of subdrain, the project Civil Engineer should survey its location and prepare an *as-built* plan of the subdrain location. The project Civil Engineer should verify the proper outlet for the subdrains and the Contractor should ensure that the drain system is free of obstructions.

9.2 The Owner is responsible for furnishing a final as-graded soil and geologic report satisfactory to the appropriate governing or accepting agencies. The as-graded report should be prepared and signed by a California licensed Civil Engineer experienced in geotechnical engineering and by a California Certified Engineering Geologist, indicating that the geotechnical aspects of the grading were performed in substantial conformance with the Specifications or approved changes to the Specifications.

APPENDIX A

APPENDIX A

FIELD INVESTIGATION

The field work was performed between January 12, 13, 14, 18, and 30, 1994, and consisted of a geologic reconnaissance, the excavation of 12 exploratory trenches, 17 small-diameter exploratory borings, and 6 large diameter borings. In addition, a seismic survey consisting of 8 seismic traverses was performed. The exploratory trenches were performed with a John Deere 510B rubber-tire backhoe and extended to depths from approximately 4.5 to 17 feet. The small-diameter exploratory borings were drilled by means of an Ingersoll-Rand A-300 hollow stem drill rig to depths ranging from 1.2 to 27.5 feet. The large-diameter exploratory borings were drilled by means of a Watson 2000 auger drill rig to depths ranging from 7 to 40 feet. Relatively "undisturbed" samples were obtained using a California split-spoon sampler with blows from a 140-pound hammer falling 30 inches (Ingersoll-Rand A-300 drill rig) and from blows of a 1,350-pound Kelly bar falling 12 inches (Watson 2000). The seismic traverses were performed by means of an EG&G geometrics ES-1225 12-channel exploration seismograph. Relatively undisturbed and disturbed bulk samples were obtained during the trenching and drilling operations. The samples were returned to our laboratory for testing.

During the investigation, the soils encountered were continuously examined, visually classified and logged. Logs of the exploratory trenches and borings are presented on Figures A-1 through A-37 in Appendix A. The logs depict the depth and description of the various soil types encountered and include the depths at which samples were obtained.

Project No. 05257-32-01
April 18, 1994

TABLE A-I

SEISMIC TRAVERSES

Seismic Traverse	Velocity (feet/sec)			Depth (feet)		Length of Traverse (feet)	Approximate Maximum Depth Explored (feet ±)
	V_1	V_2	V_3	D_1	D_2		
S-1	2600	3600	—	4.1	66.0	200	66
S-2	1900	3900	6670	9.0	41.0	200	66
S-3	2000	5250	—	10.2	33.0	100	33
S-4	1850	3360	—	6.7	33.0	100	33
S-5	1740	3410	—	7.5	33.0	100	33
S-6	1620	2870	3470	5.1	10.4	100	33
S-7	1250	3330	6900	1.9	16.4	100	33
S-8	4100	7800	—	1.5	33.0	100	33

NOTE:

For mass grading, materials with velocities of less than 4500 fps are generally rippable with a D9 Caterpillar Tractor equipped with a single shank hydraulic ripper. Velocities of 4500 to 5500 fps indicate marginal ripping and blasting. Velocities greater than 5500 fps generally require pre-blasting. For trenching, materials with velocities less than 3800 fps are generally rippable depending upon the degree of fracturing and the presence or absence of boulders. Velocities between 3800 and 4300 fps generally indicate marginal ripping, and velocities greater than 4300 fps generally indicate non-rippable conditions. The above velocities are based on a Kohring 505.

The reported velocities represent average velocities over the length of each traverse, and should not generally be used for subsurface interpretation greater than 100 feet from a traverse.

PROJECT NO. 05257-32-01

BORING LB 1

ELEV. (MSL.) 380 DATE COMPLETED 1/18/94

EQUIPMENT WATSON 2000

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**DECOMPOSED GRANITIC ROCK** Very dense, dry, red, Silty, fine to very coarse SAND			
2					-Becomes damp at 1 feet			
4					-Becomes green, fine to very coarse at 3 feet			
6	LB1-1			SM				
8	LB1-2							
10								
12								
14								
16								
18	LB1-3 LB1-4				-Becomes less coarse at 17 feet		146.8	3.4
20					-Slow drilling at 20 feet			
22					-Rock across bottom of hole (switch to 16" auger)			

BORING TERMINATED AT 23 FEET AT REFUSAL ON ROCK

Figure A-1 Log of Boring LB 1, page 1 of 1

PLSUB

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

BORING LB 2

ELEV. (MSL.) 480 DATE COMPLETED 1/18/94

EQUIPMENT WATSON 2000

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
2				SM	**DECOMPOSED GRANITIC ROCK** Very dense, damp, yellowish green, Silty, fine to very coarse SAND with mica			
4					-Becomes very dense at 3 feet Drilling becomes very slow from 3 feet to 4 feet			
6	LB2-1 LB2-2						144.8	4.2
8								
					-At 9 feet switch to 16" auger			
					BOTTOM OF HOLE AT 9.5 FEET AT REFUSAL ON ROCK			

Figure A-2 Log of Boring LB 2, page 1 of 1

PLSUB

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

BORING LB 3

ELEV. (MSL.) 410 DATE COMPLETED 1/18/94

EQUIPMENT WATSON 2000

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**DECOMPOSED GRANITIC ROCK** Dense, dry to damp, light brown to olive brown, Silty, fine to medium SAND			
2								
4					-Becomes very dense, damp, yellowish green, fine to very coarse sand at 3 feet			
6				SM				
8								
10								
12								
14								
16								
18								
20								
22								
24					-Becomes less dense at 24 feet			
26								
28					-Becomes more dense at 27 feet (encountered rock)			

Figure A-3 Log of Boring LB 3, page 1 of 2

PLSUB

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING LB 3 ELEV. (MSL.) 410 DATE COMPLETED 1/18/94 EQUIPMENT WATSON 2000 MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30								
32				SM				
					BOTTOM OF HOLE AT 33 FEET At REFUSAL ON ROCK			

Figure A-4 **Log of Boring LB 3, page 2 of 2**

PLSUB

SAMPLE SYMBOLS
☐ ... SAMPLING UNSUCCESSFUL
◧ ... STANDARD PENETRATION TEST
■ ... DRIVE SAMPLE (UNDISTURBED)
⊠ ... DISTURBED OR BAG SAMPLE
▤ ... CHUNK SAMPLE
▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

BORING LB 4

ELEV. (MSL.) 410 DATE COMPLETED 1/18/94

EQUIPMENT WATSON 2000

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
2				SM	**TOPSOIL** Loose, dry to damp, dark reddish brown, Silty very fine to medium SAND with angular gravel and cobbles			
4	LB4-1			SC	**SLOPEWASH** Moderately dense to dense, moist, olive brown Clayey to very Clayey, fine to coarse SAND with cobbles to 10"			
6	LB4-2				-Switch augers from 30" to 16" at 5 feet			
8				SM	Dense, damp to moist, orange, Silty, fine to very coarse SAND with some gravel			
10								
12								
14					-Becomes yellowish grey green with some cobbles			
16								
18								
20	LB4-3				Becomes very dense, damp, yellowish light brown to brown, Silty, fine to medium SAND	6/4"		
22				SM				
24								
26					-Becomes grayish yellow brown, fine to coarse grained with gravel			
28					-Layer of cobbles up to 4 inches from 28 to 29 feet			
	LB4-4					9/7"	120.8	11.1

Figure A-5 **Log of Boring LB 4, page 1 of 2**

PLSUB

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING LB 4 ELEV. (MSL.) 410 DATE COMPLETED 1/18/94 EQUIPMENT† WATSON 2000 MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30								
32				SP	Becomes dense, moist, brown with pockets of clean grayish white and pockets of clean grayish white and pockets of red, fine to coarse SAND with gravel up to 2 inches			
34								
36								
38								
40					-Very slow drilling at 39.5 feet on rock BOTTOM OF HOLE AT 40 FEET AT NEAR REFUSAL ON ROCK			

Figure A-6 **Log of Boring LB 4, page 2 of 2**

PLSUB

SAMPLE SYMBOLS
☐ ... SAMPLING UNSUCCESSFUL
◧ ... STANDARD PENETRATION TEST
■ ... DRIVE SAMPLE (UNDISTURBED)
⊠ ... DISTURBED OR BAG SAMPLE
▤ ... CHUNK SAMPLE
▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

BORING LB 5

ELEV. (MSL.) 452 DATE COMPLETED 1/18/94

EQUIPMENT WATSON 2000

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
2				SM	**TOPSOIL** Loose, dry, red brown, Silty, fine to medium SAND with angular rocks up to 24" in size			
4 6				SM	**SLOPEWASH** Medium loose, damp, greenish brown, Silty, fine to coarse SAND with abundant subangular gravels and cobbles -Becomes medium loose dry to damp			

BOTTOM OF HOLE AT 7 FEET
REFUSAL ON ROCKS IN THE SOIL MATRIX

Figure A-7 **Log of Boring LB 5, page 1 of 1**

PLSUB

SAMPLE SYMBOLS
... SAMPLING UNSUCCESSFUL
... STANDARD PENETRATION TEST
... DRIVE SAMPLE (UNDISTURBED)
... DISTURBED OR BAG SAMPLE
... CHUNK SAMPLE
... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

BORING LB 6

ELEV. (MSL.) 452 DATE COMPLETED 1/18/94

EQUIPMENT WATSON 2000

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
2				SM	**TOPSOIL** Loose, dry, olive brown, Silty, fine to coarse SAND with abundant subangular gravels-cobbles and few cobbles up to 10"			
4					**SLOPEWASH** Medium loose, damp, greenish brown, Silty, fine to coarse SAND with abundant subangular gravels, cobbles			
6				SM				
8					-Becomes fine to very coarse grained at 7 feet			
					BORING TERMINATED AT 9 FEET AT REFUSAL ON ROCK			

Figure A-8 Log of Boring LB 6, page 1 of 1

PLSUB

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

BORING SB 1

ELEV. (MSL.) 362 DATE COMPLETED 1/12/94

EQUIPMENT HOLLOW STEM I-R A300

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
2	SB1-1			MH	**TOPSOIL** Medium loose, moist, reddish brown, very Clayey SILT			
				SP	**SLOPEWASH** Medium dense, red brown, fine, to medium SAND with angular gravels and cobbles			
4	SB1-2							
6	SB1-3			SP-SC	Dense, moist, red brown, very Clayey, very fine to fine SAND, few angular gravels	28/12"	118.4	14.3
8								
10	SB1-4			SM	Becomes very dense, damp to moist, orange, very Silty, very fine to fine SAND	50/10.5"	117.3	14.2
12					-Layer of gravel from 11 to 11.5 feet and from 13 to 14 feet			
14	SB1-5			SM	**DECOMPOSED GRANITIC ROCK** Very dense, damp to moist, yellowish orange, Silty, very fine to very coarse grained SAND	50/5.5"	90.7	28.8
16								
					BORING TERMINATED AT 17.5 FEET			

Figure A-9 Log of Boring SB 1, page 1 of 1

PLSUB

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

BORING SB 2

ELEV. (MSL.) 385 DATE COMPLETED 1/12/94

EQUIPMENT HOLLOW STEM I-R A300

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
2	SB2-1			CH	**TOPSOIL** Medium soft, very moist, dark red brown, slightly Sandy CLAY			
4	SB2-2				**SLOPEWASH**			
6	SB2-3			SM	Very dense, moist, red brown, Silty, fine to medium SAND with few angular gravels	50/8"	116.1	11.9
8								
10	SB2-4					50/11.5"	118.5	12.7
12								
14	SB2-5				-Bouncing on rock -Slow drilling at 15 feet	50/0"		
16								
18								
					BORING TERMINATED AT 19 FEET AT REFUSAL ON ROCK IN THE SOIL MATRIX			

Figure A-10 Log of Boring SB 2, page 1 of 1

PLSUB

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

BORING SB 3

ELEV. (MSL.) 413 DATE COMPLETED 1/12/94

EQUIPMENT HOLLOW STEM I-R A300

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
2				SP-SM	**TOPSOIL** Loose, moist, dark olive brown, very Silty, very fine to medium SAND -Layer of angular gravels from 2 to 31/2 feet			
4					BORING TERMINATED AT 4 FEET ON ROCK IN THE SOIL MATRIX			

Figure A-11 Log of Boring SB 3, page 1 of 1

PLSUB

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING SB 4 ELEV. (MSL.) 413 DATE COMPLETED 1/12/94 EQUIPMENT 580K CASE EXTENDAHOE	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	TOPSOIL Medium loose, damp, red brown, Silty, fine to very coarse SAND with abundant gravel, cobbles and rocks			
					BORING TERMINATED AT 0.5 FEET REFUSAL ON ROCK IN THE SOIL MATRIX			

Figure A-12 Log of Boring SB 4, page 1 of 1

PLSUB

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

BORING SB 5

ELEV. (MSL.) 430 DATE COMPLETED 1/12/94

EQUIPMENT HOLLOW STEM I-R A300

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, damp, dark olive brown, very Silty very fine to fine SAND with abundant gravels cobbles and rocks			
					BORING TERMINATED AT 20 INCHES AT REFUSAL ON ROCK IN THE SOIL MATRIX			

Figure A-13 Log of Boring SB 5, page 1 of 1

PLSUB

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING SB 6	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					ELEV. (MSL.) 415 DATE COMPLETED 1/12/94			
					EQUIPMENT HOLLOW STEM I-R A300			
0					MATERIAL DESCRIPTION			
				SM	**TOPSOIL** Loose, dry, olive brown, very Silty, very fine to coarse grained SAND with abundant gravels cobbles and rocks			
2					BORING TERMINATED AT 2 FEET AT REFUSAL ON ROCKS IN THE SOIL MATRIX			

Figure A-14 Log of Boring SB 6, page 1 of 1

PLSUB

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

BORING SB 7

ELEV. (MSL.) 388 DATE COMPLETED 1/12/94

EQUIPMENT HOLLOW STEM I-R A300

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
2				SM	**TOPSOIL** Loose, dry, olive brown, Silty, very fine to medium SAND -Becomes medium dense, damp, orange, few angular gravels at 1.5 feet			
4	SB7-1				**DECOMPOSED GRANITIC ROCK** Very dense, damp, yellowish orange, fine to very coarse SAND	50/8.5"	111.8	13.9
6	SB7-2			SP				
8								
10	SB7-3				-Hammer bouncing	25/0"		
12					-Becomes gray green at 11 feet.			
14	SB7-4				-Hammer bouncing	50/2"		
16								
18								
20	SB7-5				-Hammer bouncing	25/0"		
					BORING TERMINATED AT 20 FEET			

Figure A-15 Log of Boring SB 7, page 1 of 1

PLSUB

SAMPLE SYMBOLS
☐ ... SAMPLING UNSUCCESSFUL
◧ ... STANDARD PENETRATION TEST
■ ... DRIVE SAMPLE (UNDISTURBED)
⊠ ... DISTURBED OR BAG SAMPLE
▤ ... CHUNK SAMPLE
▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

BORING SB 8

ELEV. (MSL.) 400 DATE COMPLETED 1/12/94

EQUIPMENT HOLLOW STEM I-R A300

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
				SM	**TOPSOIL** Loose, dry, reddish brown, Silty, very fine to coarse SAND			
2				CL	**SLOPEWASH** Medium soft, very moist, dark red brown, Sandy CLAY with rocks up to 12 inches			
					BORING TERMINATED AT 2.7 FEET ON ROCK IN THE SOIL MATRIX			

Figure A-16 Log of Boring SB 8, page 1 of 1

PLSUB

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING SB 9 ELEV. (MSL.) 392 DATE COMPLETED 1/12/94 EQUIPMENT HOLLOW STEM I-R A300	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**TOPSOIL** Loose, damp, olive brown, Silty, very fine to coarse grained SAND			
					BORING TERMINATED AT 18 INCHES AT REFUSAL ON ROCK IN THE SOIL MATRIX			

Figure A-17 Log of Boring SB 9, page 1 of 1

PLSUB

SAMPLE SYMBOLS
☐ ... SAMPLING UNSUCCESSFUL
◧ ... STANDARD PENETRATION TEST
■ ... DRIVE SAMPLE (UNDISTURBED)
⊠ ... DISTURBED OR BAG SAMPLE
▤ ... CHUNK SAMPLE
▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

BORING SB 10

ELEV. (MSL.)_____ DATE COMPLETED 1/12/94

EQUIPMENT HOLLOW STEM I-R A300

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
				SM	**TOPSOIL** Loose, damp, dark olive brown, Silty, very fine to coarse SAND with abundant rock			
2					BORING TERMINATED AT 2 FEET AT REFUSAL ON ROCK IN THE SOIL MATRIX			

Figure A-18 Log of Boring SB 10, page 1 of 1

PLSUB

SAMPLE SYMBOLS
- ☐ ... SAMPLING UNSUCCESSFUL
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ▤ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

BORING SB 11

ELEV. (MSL.) 372 DATE COMPLETED 1/13/94

EQUIPMENT HOLLOW STEM I-R A300

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SC	**TOPSOIL** Loose, dry, olive brown, Clayey, fine to medium SAND			
2					**SLOPEWASH** Medium dense to dense, damp, brown, clayey fine to coarse SAND			
4	SB11-1			SP-SC				
	SB11-2					50/7.5"	117.4	6.7
6					-Few gravels from 6 to 6.5 feet			
8				CL	Stiff to very stiff, moist to very moist, greenish brown, Sandy CLAY			
	SB11-3							
10					**DECOMPOSED GRANITIC ROCK** Very dense, moist, yellowish gray, fine to very coarse SAND	50/8"	120.1	5.8
12								
14	SB11-4			SP	-Hammer bouncing	25/0"		
16	SB11-5							
18								
	SB11-6				-Hammer bouncing			
20						25/0"		
22								
24	SB11-7				-Hammer bouncing			
26						25/0"		
					BORING TERMINATED AT 27.5 FEET AT REFUSAL ON ROCK			

Figure A-19 Log of Boring SB 11, page 1 of 1

PLSUB

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

BORING SB 12

ELEV. (MSL.) 353 DATE COMPLETED 1/13/94

EQUIPMENT HOLLOW STEM I-R A300

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
				SM	**TOPSOIL** Loose, dry, olive brown, Silty, very fine to coarse grained SAND with cobbles up to 6 inch			
2					BORING TERMINATED AT 2 FEET AT REFUSAL ON ROCK IN THE SOIL MATRIX			

Figure A-20 Log of Boring SB 12, page 1 of 1

PLSUB

SAMPLE SYMBOLS
- ☐ ... SAMPLING UNSUCCESSFUL
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ▤ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

BORING SB 13

ELEV. (MSL.) 353 DATE COMPLETED 1/13/94

EQUIPMENT HOLLOW STEM I-R A300

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	SB13-1			SM	**TOPSOIL** Loose, dry, dark to red brown, Silty, very fine to medium grained SAND -Hammer bouncing			
2								
4	SB13-2			SC	**SLOPEWASH** Very dense, damp, light olive brown, Clayey, fine to very coarse SAND	25/0"		
6					-Becomes very light at 6 feet			
8								

BORING TERMINATED AT 8 FEET
AT REFUSAL ON ROCKS
IN THE SOIL MATRIX

Figure A-21 Log of Boring SB 13, page 1 of 1

PLSUB

SAMPLE SYMBOLS
- ☐ ... SAMPLING UNSUCCESSFUL
- ▨ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ▤ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

BORING SB 14

ELEV. (MSL.) 363 DATE COMPLETED 1/13/94

EQUIPMENT HOLLOW STEM I-R A300

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry, olive brown, Silty, very fine to medium SAND			
2					**SLOPEWASH** Medium dense, damp to moist, dark orange brown, Silty fine to coarse SAND -Becomes very dense at 4 feet			
4	SB14-1			SM		50/11"	111.5	8.2
6								
8					-Layer of gravels from 9 to 9.5 feet			
10	SB14-2					50/12"	116.8	6.4
12								
14	SB14-3					50/8"	115.1	13.9
16								
18								
20								
22					-Very slow drilling starting at 21 feet			

BORING TERMINATED AT 22.5 FEET AT REFUSAL ON ROCK

Figure A-22 Log of Boring SB 14, page 1 of 1

PLSUB

SAMPLE SYMBOLS
- ☐ ... SAMPLING UNSUCCESSFUL
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ▤ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

BORING SB 15

ELEV. (MSL.) 363 DATE COMPLETED 1/13/94

EQUIPMENT HOLLOW STEM I-R A300

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, damp to moist, reddish brown, Silty, very fine to coarse grained SAND with a few angular gravels and cobbles			
2				CL	**SLOPEWASH** Stiff to very stiff, moist, red orange brown, very Sandy CLAY			
4	SB15-1			SM	Dense, moist, orange brown, Silty, very fine to coarse SAND	33/12"	121.2	14.7
6								
8								
10					BORING TERMINATED AT 10 FEET AT REFUSAL ON ROCKS IN THE SOIL MATRIX			

Figure A-23 Log of Boring SB 15, page 1 of 1

PLSUB

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING SB 16	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					ELEV. (MSL.) 367 DATE COMPLETED 1/13/94			
					EQUIPMENT HOLLOW STEM I-R A300			
0					MATERIAL DESCRIPTION			
				SM	**TOPSOIL** Loose, dry, reddish brown, Silty, slightly Clayey, very fine to coarse SAND			
2					BORING TERMINATED AT 2 FEET REFUSAL ON ROCKS AFTER 5 ATTEMPTS			

Figure A-24 Log of Boring SB 16, page 1 of 1

PLSUB

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... STANDARD PENETRATION TEST
- ... DRIVE SAMPLE (UNDISTURBED)
- ... DISTURBED OR BAG SAMPLE
- ... CHUNK SAMPLE
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

BORING SB 17

ELEV. (MSL.) 380 DATE COMPLETED 1/13/94

EQUIPMENT HOLLOW STEM I-R A300

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry, reddish brown, Silty, slightly Clayey very fine to coarse SAND			
2					**SLOPEWASH** Medium dense, damp to moist, orange reddish brown Clayey fine to coarse grained SAND -Becomes very moist at 3.5 feet			
4	SB17-1			SP-SC		23/12"	114.3	18.7
6							114.3	18.7
8								

BORING TERMINATED AT 8 FEET
AT REFUSAL ON ROCKS
IN THE SOIL MATRIX

Figure A-25 Log of Boring SB 17, page 1 of 1

PLSUB

SAMPLE SYMBOLS
☐ ... SAMPLING UNSUCCESSFUL
◧ ... STANDARD PENETRATION TEST
■ ... DRIVE SAMPLE (UNDISTURBED)
⊠ ... DISTURBED OR BAG SAMPLE
▤ ... CHUNK SAMPLE
▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

TRENCH T 1

ELEV. (MSL.) 438 DATE COMPLETED 1/14/94

EQUIPMENT 580K CASE EXTENDAHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
	T1-1			SP-SM	**TOPSOIL** Loose, dry, dark brown, Silty, very fine to coarse SAND with abundant angular gravels and cobbles up to 8"			
2								
4				SC	**SLOPEWASH** Medium dense, damp, yellow brown, Clayey, fine to coarse grained SAND with abundant angular gravels, cobbles and rocks up to 12" in the sand matrix			
6	T1-2				-Becomes moist, greyish brown, no cobbles and rocks - few angular gravels at 5 feet			
8								
10								
12					-Becomes reddish brown, slightly clayey with few subangular gravels and cobbles at 11 feet			
14								
16								
					TRENCH TERMINATED AT 17 FEET			

Figure A-26, Log of Trench T 1

PLSUB

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

TRENCH T 1

ELEV. (MSL.) 438 DATE COMPLETED 1/14/94

EQUIPMENT 580K CASE EXTENDAHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	T1-1			SP-SM	**TOPSOIL** Loose, dry, dark brown, Silty, very fine to coarse SAND with abundant angular gravels and cobbles up to 8"			
2								
4				SC	**SLOPEWASH** Medium dense, damp, yellow brown, Clayey, fine to coarse grained SAND with abundant angular gravels, cobbles and rocks up to 12" in the sand matrix			
6	T1-2				-Becomes moist, greyish brown, no cobbles and rocks - few angular gravels at 5 feet			
8								
10								
12					-Becomes reddish brown, slightly clayey with few subangular gravels and cobbles at 11 feet			
14								
16								
					TRENCH TERMINATED AT 17 FEET			

Figure A-26, Log of Trench T 1

PLSUB

SAMPLE SYMBOLS
- ☐ ... SAMPLING UNSUCCESSFUL
- ▨ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ▤ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

TRENCH T 2

ELEV. (MSL.) 430 DATE COMPLETED 1/14/94

EQUIPMENT 580K CASE EXTENDAHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry to damp, reddish brown, Silty fine to medium SAND with few angular cobbles and rocks up to 20"			
2				CL	**SLOPEWASH** Very hard, damp to moist, light reddish brown, Sandy CLAY with angular rocks up to 24" in the sandy clay matrix -Very slow digging-moderately cemented at 3.5 feet			
4	T2-1						112.6	15.4

TRENCH TERMINATED AT 5 FEET

Figure A-27, Log of Trench T 2

PLSUB

SAMPLE SYMBOLS
☐ ... SAMPLING UNSUCCESSFUL
◧ ... STANDARD PENETRATION TEST
■ ... DRIVE SAMPLE (UNDISTURBED)
⊠ ... DISTURBED OR BAG SAMPLE
▤ ... CHUNK SAMPLE
▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

TRENCH T 3

ELEV. (MSL.) 415 DATE COMPLETED 1/14/94

EQUIPMENT 580K CASE EXTENDAHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
2				SM	**TOPSOIL** Loose, dry, brown, Silty, fine to coarse grained SAND with abundant angular cobbles and rocks up to 30" (loose rock with soil)			
4								
6				SP-SM	**SLOPEWASH** Medium loose, dry to damp, Silty, fine to coarse SAND with abundant subangular gravels, cobbles and rocks up to 24 inches -Becomes damp at 7 feet -Cave-in at 8 feet			
8								
10								
12					-Becomes medium dense to dense at 12 feet			
14								
16					TRENCH TERMINATED AT 16 FEET			

Figure A-28, Log of Trench T 3

PLSUB

SAMPLE SYMBOLS
- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ▤ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

TRENCH T 4

ELEV. (MSL.) 400 DATE COMPLETED 1/14/94

EQUIPMENT 580K CASE EXTENDAHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SP-SM	**TOPSOIL** Loose, dry, olive brown, Silty, fine to medium SAND with few angular cobbles			
2					**SLOPEWASH** Medium dense, damp, orange brown, very Clayey fine to coarse SAND with angular cobbles			
4	T4-1 T4-2			SP-SC	-Becomes dense, moist, yellowish, slightly Clayey less gravelly and cobbly at 3 feet		118.5	9.2
6								
8	T4-3			CL	Very hard, moist, red, Sandy CLAY			
				SP	Very dense, moist, olive brown, fine to very coarse SAND		123.3	15.7

TRENCH TERMINATED AT 9 FEET AT NEAR REFUSAL

Figure A-29, Log of Trench T 4

PLSUB

SAMPLE SYMBOLS
□ ... SAMPLING UNSUCCESSFUL
◧ ... STANDARD PENETRATION TEST
■ ... DRIVE SAMPLE (UNDISTURBED)
▩ ... DISTURBED OR BAG SAMPLE
▤ ... CHUNK SAMPLE
▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

TRENCH T 5

ELEV. (MSL.) 410 DATE COMPLETED 1/14/94

EQUIPMENT 580K CASE EXTENDAHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, very moist, dark olive brown, Silty, fine to medium SAND with few angular gravel			
2				CL	**SLOPEWASH** Stiff, moist to very moist, yellowish brown, Silty , slightly Sandy CLAY with few angular cobbles			
4					TRENCH TERMINATED T 4.5 FEET			

Figure A-30, Log of Trench T 5

PLSUB

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 6	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					ELEV. (MSL.) 365 DATE COMPLETED 1/31/94			
					EQUIPMENT JD 510 BACKHOE			
0					MATERIAL DESCRIPTION			
				SM	**TOPSOIL** Loose, very moist, dark brown, Silty, fine to medium SAND			
2								
				SM	**SLOPEWASH** Medium loose to medium dense, moist to very moist, orange to reddish orange, Clayey to very Clayey SAND with pockets (few) of green fine to very coarse SAND with sub-angular gravel and cobbles			
4								
6					-Becomes dense, to very dense, moist, red orange Silty, very fine to medium grained with few subangular cobbles and rocks at 2.5 feet -Becomes very gravelly, cobbly with abundant rocks up to 20 inches at 5.5 feet			
					BOTTOM OF TRENCH AT 6.5 FEET AT NEAR REFUSAL ON COBBLES AND ROCKS			

Figure A-31, Log of Trench T 6

PLSUB

SAMPLE SYMBOLS
- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ▤ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

TRENCH T 7

ELEV. (MSL.) 360 DATE COMPLETED 1/31/94

EQUIPMENT JD 510 BACKHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, very moist, dark brown, Silty, fine to medium SAND			
2				SP-SC	**SLOPEWASH** Medium loose to medium dense, moist to very moist, Clayey, fine to coarse SAND with few cobbles and rocks 15" -Becomes dense to very dense at 4 feet			
4								
6				SP-SM	**DECOMPOSED GRANITIC ROCK** Medium dense to dense, damp to moist, green to grayish green, Silty, fine to very coarse SAND weathered -Becomes very dense at 6.5 feet			
8					TRENCH TERMINATED AT 8.5 FEET			

Figure A-32, Log of Trench T 7

PLSUB

SAMPLE SYMBOLS
- ☐ ... SAMPLING UNSUCCESSFUL
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ▤ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

TRENCH T 8

ELEV. (MSL.) 349 DATE COMPLETED 1/31/94

EQUIPMENT JD 510 BACKHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SP-SM	**TOPSOIL** Very moist to wet, dark brown, Silty, fine to medium SAND			
2				SP-SC	-Becomes dry at 0.5 feet			
4				SP-SM	**SLOPEWASH** Very dense, damp to moist, reddish brown Clayey fine to coarse SAND with few angular cobble to boulder clasts up to 18"			
					DECOMPOSED GRANITIC ROCK Very dense, damp, grayish brown, Silty fine to coarse SAND			
					BOTTOM OF TRENCH AT 5 FEET			

Figure A-33, Log of Trench T 8

PLSUB

SAMPLE SYMBOLS
☐ ... SAMPLING UNSUCCESSFUL
▩ ... DISTURBED OR BAG SAMPLE
◧ ... STANDARD PENETRATION TEST
▤ ... CHUNK SAMPLE
■ ... DRIVE SAMPLE (UNDISTURBED)
▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

TRENCH T 9

ELEV. (MSL.) 359 DATE COMPLETED 1/31/94

EQUIPMENT JD 510 BACKHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
				SM	**TOPSOIL** Loose, moist to wet, brown to dark brown, Silty fine to medium SAND -Becomes dry at 0.5 feet			
2								
4				SM	**SLOPEWASH** Dense, to very dense, damp to moist, reddish brown Silty fine to coarse SAND with very few cobbles			
					BOTTOM OF HOLE AT 5.5 FEET			

Figure A-34, Log of Trench T 9

PLSUB

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

TRENCH T 10

ELEV. (MSL.) 348 DATE COMPLETED 1/31/94

EQUIPMENT JD 510 BACKHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
2				SP	**ALLUVIUM** Loose, very moist to wet, dark brown, gravelly fine to coarse SAND -Becomes gravelly, with cobbles and rocks up to 30" at 1.5 feet -Becomes grey green, fine to very coarse, very cohesionless at 3 feet			
4								
6					-Becomes very gravelly, cobbly with rocks up to 20" at 6.5 feet			
8								
10				SP-SM	**DECOMPOSED GRANITIC ROCK** Medium dense, very moist, green, Silty, fine to very coarse SAND - Very weathered -Becomes dense at 12 feet			
12								
					TRENCH TERMINATED AT 13 FEET			

Figure A-35, Log of Trench T 10

PLSUB

SAMPLE SYMBOLS
- ... SAMPLING UNSUCCESSFUL
- ... DISTURBED OR BAG SAMPLE
- ... STANDARD PENETRATION TEST
- ... CHUNK SAMPLE
- ... DRIVE SAMPLE (UNDISTURBED)
- ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

TRENCH T 11

ELEV. (MSL.) 360 DATE COMPLETED 1/31/94

EQUIPMENT† JD 510 BACKHOE

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
2				SP	**ALLUVIUM** Loose, moist, olive brown, fine to very coarse SAND with abundant angular gravels, cobbles and rocks up to 30"			
4								
6				SM	**SLOPEWASH** Medium dense, very moist, olive brown, Silty CLAY, fine to coarse SAND with angular gravel and cobbles and few rock up to 24"			
8								
10				SP	**DECOMPOSED GRANITIC ROCK** Dense, very moist, green, fine to coarse SAND			

BOTTOM OF TRENCH AT 11 FEET

Figure A-36, Log of Trench T 11

PLSUB

SAMPLE SYMBOLS
- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ▤ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 05257-32-01

TRENCH T 12

ELEV. (MSL.) 358 DATE COMPLETED 1/31/94

EQUIPMENT JD 510 BACKHOE

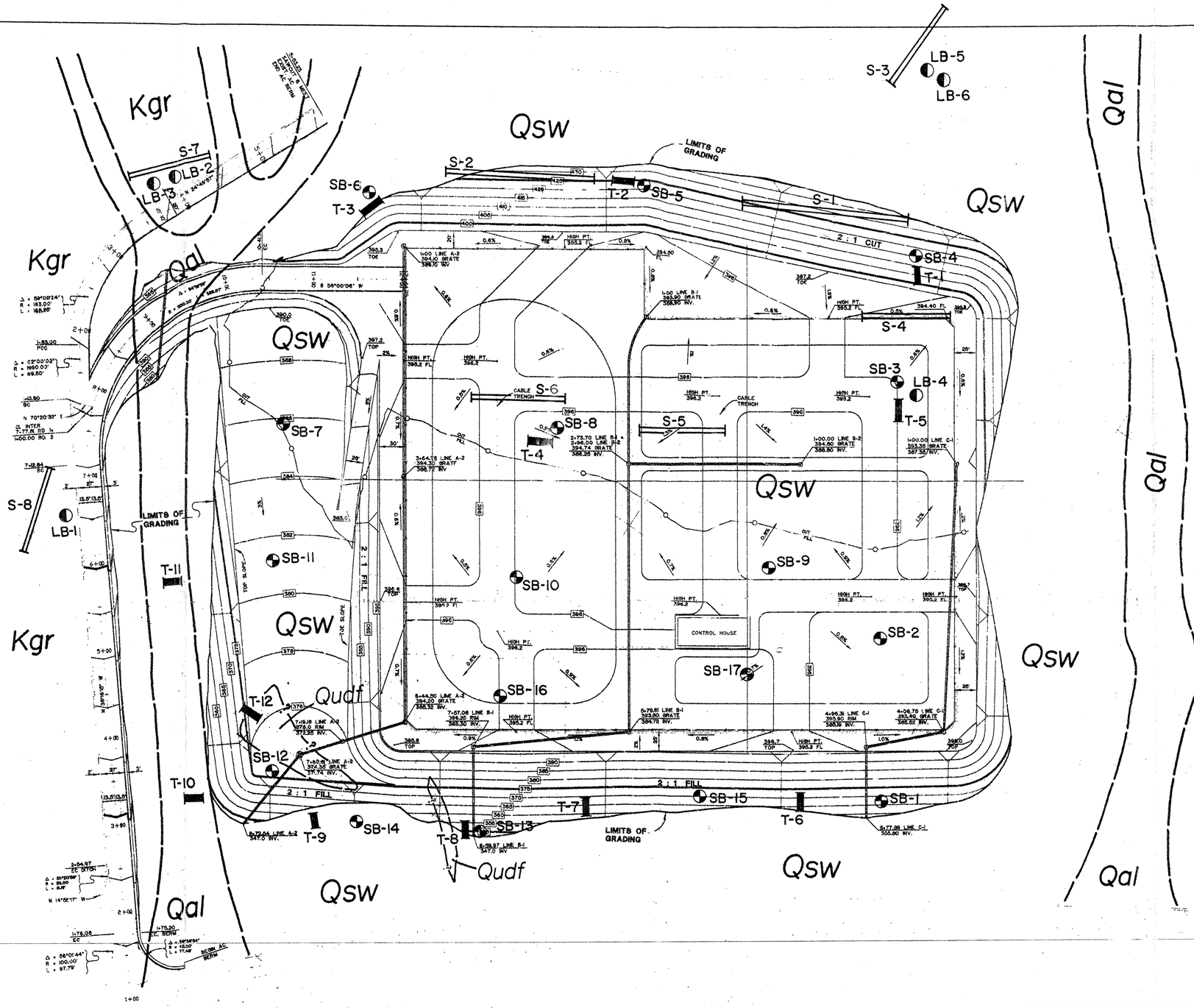
DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0								
2				SM	**FILL SOIL** Medium loose, dry to damp, olive brown, Silty fine to medium SAND -Becomes dense, damp at 1 feet			
4								
6					-Becomes dense, damp, dark brown, fine to coarse sand			
8				SM	**SLOPEWASH** Dense to very dense, damp, red, Silty, fine to coarse SAND few cobbles and rocks			
10					TRENCH TERMINATED AT 10 FEET			

Figure A-37, Log of Trench T 12

SAMPLE SYMBOLS
☐ ... SAMPLING UNSUCCESSFUL
⊠ ... DISTURBED OR BAG SAMPLE
◧ ... STANDARD PENETRATION TEST
▤ ... CHUNK SAMPLE
■ ... DRIVE SAMPLE (UNDISTURBED)
▼ ... WATER TABLE OR SEEPAGE

PLSUB

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.



LEGEND

- *Qudf* ..... UNDOCUMENTED FILL
- *Qsw* ..... SLOPEWASH
- *Qal* ..... ALLUVIUM
- *Kgr* ..... GRANITIC ROCK
- SB-1 ..... APPROX. LOCATION OF SMALL DIAMETER BORING
- LB-1 ..... APPROX. LOCATION OF LARGE DIAMETER BORING
- T-1 ..... APPROX. LOCATION OF TRENCH
- S-1 ..... APPROX. LOCATION OF SEISMIC REFRACTION TRAVERSE
- ..... APPROX. LOCATION OF GEOLOGIC CONTACT

SITE PLAN AND GEOLOGIC MAP

PALA SUBSTATION

GEOCON

PROJECT NO. 05257-32-01

DATE 4-18-1994

FIGURE 2

PRIVATE CONTRACT

SHEET 1 | COUNTY OF SAN DIEGO DEPARTMENT OF PUBLIC WORKS | 1 SHEETS

GRADING PLANS FOR:

SAN DIEGO GAS & ELECTRIC
PALA SUBSTATION
GRADING EXHIBIT

CALIFORNIA COORDINATE INDEX:

Approved BRUCE BOLAND, ACTING DIRECTOR OF PUBLIC WORKS
By:
Date

Engineer of work

Grading Permit No.

PERMITS

RECLAMATION PLAN NO.

TENTATIVE MAP NO.

BENCH MARK

DESCRIPTION:

LOCATION:

RECORD FROM:

ELEVATION: DATUM:

COUNTY APPROVED CHANGES

No.	Description	Approved by	Date

ENGINEER'S NAME:

PHONE NO.

FILE NO.

APPENDIX 6.3-A.2 – SITE GEOTECHNICAL REPORT

Information To Build On
Engineering • Consulting • Testing

November 20, 2007 - Revised December 17, 2007

Mr. Bill Romines, Jr.
Sega, Inc.
16041 Foster, P.O. Box 1000
Stilwell, Kansas 66085-1000

Subject: Geotechnical Exploration Report, Proposed Orange Grove Power Plant, Northeast Corner of Pala Road (SR 76) and Pala Del Norte Road, Pala, California.
PSI Project No. 070-75051

Dear Mr. Romines:

Professional Service Industries, Inc. (PSI) is pleased to submit our Geotechnical Exploration Report for the referenced project. This report includes the results of our field and laboratory testing. Also presented are our recommendations for foundation and general site development.

We appreciate the opportunity to perform this Geotechnical Study and look forward to continued participation during the design and construction phases of this project. If you have any questions pertaining to this report, or if we may be of further service, please contact Md. Shaheed of our office.

Respectfully submitted,

PROFESSIONAL SERVICE INDUSTRIES, INC.

Patrick Nacey, EIT
Project Manager

Md. Shaheed, PE
Department Manager

Reviewed By: Balakrishna Rao, GE, Principal Consultant

GEOTECHNICAL EXPLORATION REPORT

PROPOSED ORANGE GROVE POWER PLANT
PALA ROAD (SR 76) AND PALA DEL NORTE ROAD
PALA, CALIFORNIA

PSI PROJECT NO. 070-75051

PREPARED FOR

MR. BILL ROMINES, JR., PE
SEGA, INC.
16041 FOSTER, P. O. BOX 1000
STILWELL, KANSAS 66085-1000

NOVEMBER 20, 2007 – REVISED DECEMBER 17, 2007

BY

PROFESSIONAL SERVICE INDUSTRIES, INC.

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EXECUTIVE SUMMARY

As requested, Professional Service Industries, Inc. (PSI) has conducted a geotechnical investigation for the proposed Orange Grove Power Plant in Pala, California. Based on the observations and our subsurface exploration, the site is underlain by thin poorly developed topsoil and thick alluvial fan deposits that emanated from the steep slopes north of the proposed project site. The topsoil is approximately 12 to 18 inches in depth. Below the surficial soils the Plutonic Rocks consisted of Gabbro and Dark Dioritic Rocks; chiefly Mesozoic (Jennings,C.W., 1977) extended to the maximum explored depth of about 40 feet below the existing ground surface (bgs). This material was sampled as firm to hard sandy lean clay with gravels and rocks to soft highly weathered fanglomeratic claystone and sandstone with gravel to cobble size granitic rock and extends at least to the maximum explored depth of 40 feet bgs.

Continuous and isolated spread footings and mat foundation are suitable for use at this site, assuming that they bear entirely into engineered fill material or entirely on native formational soils. Footings should not straddle cut/fill interfaces. For conventional or mat foundations the foundation dimensions and reinforcements should be based on a net dead plus live load bearing pressure of 3,000 pounds per square foot (psf) for properly compacted engineered fill soils or Formational soils, provided that the foundations are a minimum of 24 inches below lowest adjacent finished grade. The allowable bearing value may be increased by one-third for short duration loading which includes the effects of wind or seismic forces.

Based on the known subsurface conditions and site geology, and past experience with similar projects in the area, we anticipate that properly designed and constructed foundations supported on the recommended materials may experience maximum total and differential settlements of less than one inch and 1/2 inch, respectively. Due to the absence of shallow groundwater and the generally dense to very dense nature of underlying materials, dynamic settlement is not expected to adversely effect the proposed improvements.

Details related to site development, foundation and pavement design, seismicity, and construction considerations are included in subsequent sections of this report. The owner/designer should not rely solely on this Executive Summary and must read and evaluate

the entire contents of this report before using our preliminary engineering recommendations in preparation of design/construction documents.

PROJECT INFORMATION

Project Authorization

PSI has completed this geotechnical investigation report for the proposed Orange Grove Power Plant Project in Pala, California. Our services were authorized by Mr. Joseph K. Bondank of Sega, Inc. in the form of signed PSI Proposal No. 070-750059, dated September 26, 2007.

Project Description

Preliminary project information was provided by Mr. Bill Romines of Sega, Inc. and included a copy of the proposed site layout. We understand that the proposed construction will consist of combustion turbines with associated improvements. More specifically, the following major improvements are being proposed:

- Turbine Generators, dimensioned approximately 20 feet by 70 feet with equipment weight of 800,000 pounds.
- GSU Transformers, dimensioned approximately 12 feet by 12 feet with equipment weight of 140,000 pounds.
- Gas Compressor, dimensioned approximately 15 feet by 35 feet with equipment weight of 60,000 pounds.
- Blackstart Diesel Generator, dimensioned approximately 12 feet by 20 feet with equipment weight of 100,000 pounds.
- Demin Water Tank, dimensioned approximately 25 feet diameter with approximate weight of 850,000 pounds.
- Service Building Column with approximate weight of 10,000 pounds.
- Bridge abutments, each with anticipated non-factored dead load and live load of 300 kips and 250 kips respectively.

The geotechnical recommendations presented in this report are based on the provided project information, proposed locations, and the subsurface materials described in this report. If any of the noted information is incorrect, please inform PSI in writing so that we may amend the recommendations presented in this report if appropriate. PSI will not be responsible for the implementation of its recommendations when it is not notified of changes in the project.

Purpose and Scope of Services

The purpose of this study was to provide an assessment of geotechnical and geologic issues at the site and present recommendations for use in design of the proposed construction. Specifically, this report presents the results of our investigations including testing procedures, a description of the site and subsurface conditions, and presents recommendations regarding the following:

- Grading procedures for site development.
- Foundation types, depths, allowable bearing capacities, and an estimate of potential settlement.
- Comments regarding factors that will impact construction and performance of the proposed construction

Our scope of services did not include an environmental assessment for determining the presence or absence of wetlands, or hazardous or toxic materials in the soil, bedrock, surface water, groundwater, or air on or below, or around this site. Any statement in this report or on the boring logs regarding odors, colors, and unusual or suspicious items or conditions are strictly for informational purposes. Appendix A contains a list of references cited in this report. Figures 1 and 2 are site and boring location map.

SITE AND SUBSURFACE CONDITIONS & SEISMICITY

Site Location and Description

The site is located at the northeast corner of Pala Road (SR 76) and Pala Del Norte Road in Pala, San Diego County, California. The proposed site has an area of approximately 12.7 acres. The site is currently partially an orange grove on a foot of the steep hill south of Palomar Mountain. Access to the site is from Pala Road (SR 76) through an existing dirt access road adjacent to the Pala Del Norte Road entrance to the Pala Road (SR 76) winding northeast to the proposed project site. However, the proposed site access road will be from Pala road to the site. The site is general moderately sloping downward to the south from approximate elevation of 450 feet above mean sea level (AMSL) to 340 feet AMSL. On the west end portion of the site a stream runs almost parallel to Pala Del Norte Road. A bridge is proposed to cross this drainage channel and create another access way to the site from Pala Del Norte Road. The approximate location of the site is shown on the Figure 1.

Site Geology and Subsurface Conditions

The site is located near the medial portion of a large alluvial fan emanating from the steep hills surrounding the site on the west, north, and east. Just south of the property, the fan terminates at the northern edge of the floodplain of the San Luis Rey River. The soils comprising the fan consist of fine to coarse-grained, well-to moderately-sorted sands and silty sands containing scattered sub-rounded to angular, cobble-to boulder-sized granitic rocks or clasts. The sands are interbedded with cobble and boulder conglomerates with a matrix of nearly cohesionless medium to coarse-grained sand.

Our subsurface exploration was conducted in two phases including a geophysical testing program and soil test borings including rock coring. Details of these exploration and testing phases are presented in the sections below.

Soil Test and Rock Core Borings

The subsurface conditions in the location of the proposed Orange Grove Power Plant were explored by a total of 14 soil test and rock core borings. Figure 2 (Exploration Location Map) presents approximate locations of our borings. The ground surface elevations of the borings shown on the logs were approximated based on site topographic survey maps provided to us. PSI notified Underground Service Alert (USA) of Southern California for utility clearance prior to drilling. The borings were extended to depths between 2.5 to 40 feet bgs. Standard Penetration Tests (SPT) were performed and split spoon samples were obtained in general accordance with ASTM test method D-1586. Bulk soil samples were also collected from auger cuttings. Rock coring methods of sampling were utilized in general conformance with ASTM Standard D-2113 at locations B-1, B-2 and B-4 using a diamond core barrel to evaluate the composition and continuity of the material. The Rock Quality Designation (RQD) is a measure of the rock mass quality, and is defined as the total length of intact rock core pieces four (4) inches or more in length, divided by the length of the rock core run, expressed as a percentage.

Based on the observations and our subsurface exploration, the site is underlain by thin poorly developed topsoil and thick alluvial fan deposits that emanated from the steep slopes north of the proposed project. The topsoil is approximately 12 to 18 inches in depth. Below the surficial soils the Plutonic Rocks consisted of Gabbro and Dark Dioritic Rocks; chiefly Mesozoic

(Jennings,C.W., 1977) extended to the maximum explored depth of about 40 feet below the existing ground surface (bgs). This material was sampled as firm to hard sandy lean clay with gravel and cobbles to soft highly weathered fanglomaratic claystone and sandstone with gravel to cobble size granitic rock. Large boulders several feet in diameter were also noticed at the ground surface across the site. Further details of the conditions encountered during drilling are presented in the exploration logs in Appendix B.

The soil samples and rock cores were brought into our laboratory for further analysis. PSI visually classified the soils and rock encountered in test borings. Laboratory testing was also conducted to verify classifications and material properties. The results of the visual classifications, the SPT N-values, rock core recoveries, RQDs, and water level observations are presented in the boring logs in Appendix B of this report.

Geophysical Testing

For the purposes of generally characterizing the subsurface profile within the limits of the site, we also employed the Refraction Microtremor (ReMi) method, which is a form of Multi Channel Analysis of Surface Waves (MASW). The method uses standard P-wave recording equipment and ambient noise to produce average one-dimensional shear-wave profiles to depths of up to 100 meters.

Two array locations were used to evaluate conditions within this site, both oriented parallel to the slope contours (see Appendix E Figure 1). Each of the lines was 345 feet long, and incorporated 24 geophone locations. Data were recorded in 20 second sample intervals, with a 2 millisecond sampling rate per channel. All lines used a geophone spacing of 15 feet. Once collected, the data were checked for their fidelity. To assure that a robust profile was being made, both individual recordings and multiple summed (stacked) recordings were evaluated.

Two dimensional velocity profiles were created for each of the lines. The purpose of the two dimensional profiles was to provide details of the shear wave velocities across the array length to depths of up to 75 feet. It should be noted that due to the nature of the analysis, it is not

possible to interpret conditions at the extreme ends of the seismic array. As a consequence, the results omit the outer 80 feet of each array.

The results of the geophysical testing are presented on individual profiles that indicate variations in shear wave velocities along and below the ground surface along the length of the array by means of various colors (Figures 3 and 6 in Appendix E). By way of interpretation, materials with higher shear wave velocities (partially weathered rock and bedrock) are indicated by red, yellow and green shades. Materials with lower shear wave velocities (soil) are indicated by light to dark blue shades.

As may be seen in the presented Figures, the site of the proposed hotel project is underlain by a variable thickness of overburden soil (ranging from about 10 to 50 feet), underlain by partially weathered rock, fractured rock, and competent bedrock.

Groundwater Information

Groundwater was not encountered within the maximum explored depth of our air hammer boring of approximately 30.5 feet below existing site grades. However, it is possible that transient oversaturated ground conditions at shallower depths could develop at a later time due to periods of heavy precipitation, landscape watering, leaking water lines, or other unforeseen causes. The narrow drainage channel and surrounding areas may get flooded and saturated during rainfall event.

Seismicity

The site will be affected by seismic shaking as a result of earthquakes on major active faults located throughout the southern California area. The nearest of these fault systems, the Elsinore (Temecula) fault, is approximately 5 miles from the site and is the most significant fault to the site with respect to the potential for seismic activity. Vaughn (1987) indicates that the fault in the Agua Tibia Mountains west of Palomar Mountain, seems to be in a “locked mode” and that the characteristic earthquakes are probably large, around M7 with recurrence times varying from 175 years for a M7 quake and 400 yrs. for a 7.3 earthquake.

Effective January 1, 2008, the State of California will employ the 2007 California Building Code. As part of this code, the design of structures must consider dynamic forces resulting from seismic events. These forces are dependent upon the magnitude of the earthquake event as well as the properties of the soils that underlie the site. As part of the procedure to evaluate seismic forces, the code requires the evaluation of the Seismic Site Class, which categorizes the site based upon the characteristics of the subsurface profile within the upper 100 feet of the ground surface.

To define the Site Class for this project, we employed the Refraction Microtremor (ReMi) method as described previously. Based upon the results of this test the average shear wave velocity of the site will be at least 1,200 feet per second. Based upon this, the subsurface conditions within the site are consistent with the characteristics of Site Class C as defined in Table 1613.5.2 of the building code.

The USGS-NEHRP probabilistic ground motion values for latitude 33.358^{o} and longitude 117.111^{o} obtained from the USGS geohazards web page are as follows:

Period (seconds)	2% Probability of Event in 50 years (g)	Site Coefficient F_a	Site Coefficient F_v
0.2 (S_s)	1.500	1.0	N/A
1.0 (S_1)	0.600	N/A	1.3

The Site Coefficients, Fa and Fv, presented in the above table, were obtained from IBC Tables 1613.5.3(1) and 1615.5.3(2) as a function of the site classification and mapped spectral response acceleration at the short (S_s) and 1 second (S_1) periods.

Given the proposed use of the construction and the design spectral accelerations, we expect the structures/equipment to fall within Seismic Design Category D. Design of structures should comply with the requirements of the governing jurisdiction's building codes and standard practices of the Structural Engineers Association of California.

ASSESSMENT OF GEOLOGIC HAZARDS

The following sections present a summary of other seismic hazards considering the site class, the subsurface soil properties, the groundwater elevation, and probabilistic ground motions:

Seismically-Induced Settlement of Soils

The underlying Gabbro and Dark Dioritic Rocks; chiefly Mesozoic Rocks were found to be dense to very dense fanglomerate. Based on the anticipated earthquake effect and the stratigraphy of the site, relatively minor seismically-induced settlement is likely to occur. Such settlement will probably affect relatively large areas so that differential settlements over short distances are likely to be very small.

Liquefaction

Liquefaction involves the substantial loss of shear strength in saturated soil, usually taking place within a soil medium exhibiting a uniform fine-grained characteristic, loose relative density, and low confining pressures when subjected to impact by seismic or dynamic loading. Based on the geotechnical evaluation including; area seismicity, on-site soil conditions, the relative densities of the encountered soils, and the observed lack of a near-surface, static groundwater table, the site is considered to have a relatively low risk potential for soil liquefaction.

Lurching and Shallow Ground Rupture

Breaking of the ground because of active faulting is not likely due to the absence of known fault traces within the project limits. However, due to the active seismicity of California, this possibility cannot be completely ruled out. In this light, the unlikely hazard of lurching or ground-rupture should not preclude consideration of “flexible” design for on-site utility lines and connections.

Tsunamis and Seiches

Inundation by tsunamis (seismic or "tidal waves") or seiches ("tidal waves" in confined bodies of water) are not considered to be a significant threat to the subject site due to the absence of proximal large bodies of water and the site’s elevation.

Landslides and Rockslides

From a review of the San Diego County’s online database maps (SANGIS) no landslides are mapped on or near the subject site. Further, based on the very dense condition of the formational materials encountered in our exploratory borings and the lack of nearby steep

slopes, it is our opinion that landslides or rockslides are not considered geologic hazards to this site.

EARTHWORK RECOMMENDATIONS

The proposed construction at the site should be performed in accordance with the following recommendations and guidelines set by local or federal governing agencies. Our exploration was limited to the area of the proposed construction. Therefore, our recommendations are based on our observation of subsurface conditions in the area of the proposed construction only and as found in our borings. PSI should be contacted immediately if soil conditions noted during construction vary from those described in this report, so that site improvement recommendation may be modified, if required.

Site Preparation

Initially, any topsoil, loose soil, asphalt/concrete pavement, foundations, utilities, trees, debris, organics, undocumented fill and any other deleterious material should be completely removed from the area proposed for construction. PSI should observe the exposed underlying subgrade to confirm that all unsuitable materials have been removed prior to placement of any fill.

Fill Placement and Compaction

As mentioned, PSI should be allowed to inspect the subgrade prior to backfilling. At the discretion of the geotechnical engineer or soils inspector, the subgrade should be first scarified to a minimum of 12 inches, moisture conditioned to within ±2% of optimum moisture content (as determined by ASTM test method D1557) and rolled with a heavy roller to achieve a minimum of 95% relative compaction prior to proceeding with backfilling. Engineered fill required to bring the site to proper grades should be placed in maximum loose lifts of eight inches and compacted to at least 95% of the maximum dry density at ±2% of optimum moisture content (based on ASTM D1557 test). Each lift of compacted, engineered fill should be tested by a representative of PSI prior to placement of subsequent lifts. If water must be added, it should be uniformly applied and thoroughly mixed into the soil by disking or scarifying. Non-structural fill adjacent to structural fill should be placed in unison to provide lateral support. The top two feet at a minimum of the subgrade within the footprints of ring-wall foundations for water tanks

should be backfilled with Class II aggregate base material at a minimum relative compaction of 95% (ASTM D1557). This Class II aggregate base should extend a minimum of two feet horizontally past the perimeter of the foundation.

If cut/fill transitions are encountered across a proposed structure footprint, the entire cut portion within that footprint and five feet out laterally should be over-excavated to a minimum depth of two feet below the bottom of the deepest proposed foundation or a minimum of one half the depth of the deepest fill in the structure footprint, whichever is deeper. All excavated/over-excavated areas should be replaced with compacted fill. Over-excavations should extend laterally in all directions a minimum of five feet from the proposed structure footprint.

It is anticipated that some of the on-site soils may be suitable for reuse as engineered fill, as long as they meet the requirements set forth in this report. However, in some areas, clayey soils may be encountered and import fill may be required to be brought in, specially for areas under slabs and foundations. Engineered fill should be free of organics and rocks greater than three inches in dimension. Oversized rock, if encountered, may be removed off-site or used above grade for security barriers or landscaping. A rock-screen may need to be used during grading at the site. Sufficient time should be provided for testing fill materials in the laboratory prior to their use. However, all fill soils should be tested by the geotechnical engineer prior to placement to determine their suitability of use as fill. In addition, any fill material including any import fill should possess an expansion index of less than 30 and have a maximum of 25% passing #200 sieve.

Temporary Excavations and Slope Stability

It is recommended that temporary construction slopes not greater than 10 feet in height be no steeper than 1.5:1 (horizontal:vertical) for either the formational deposits of properly compacted engineered fill. All temporary slopes, including trenches for buried pipes and other utilities should comply with the California Occupational Safety and Health Administration (Cal-OSHA), and all other applicable safety ordinances. The tops of all excavations should be graded to prevent runoff from entering the excavation. A representative from PSI should be present during the slope construction to verify soil condition. It should be recognized that the safety of all temporary construction slopes

is the responsibility of the contractor. The contractor should perform an independent assessment of the proposed temporary slope conditions and any dewatering requirements.

We understand that a number of constructed slopes are proposed at the site. Some of the slopes appear to be cut slopes, whereas others will be fill slopes. According to the San Diego County grading requirements guidelines, all slopes proposed at the site should have a maximum steepness of 2:1 (horizontal:vertical). A PSI representative must be present at the site to evaluate soil condition for any slope excavation greater than five feet in height. The constructed slopes should be properly vegetated with light and non-water retaining type of plants. Heavy landscape watering should be avoided. The slopes should have a berm or concrete swale at the top to direct runoff water away from the slope face. Fill slopes should be properly benched into native material. Grading should follow the recommendation set forth in the body of this report and the Guidelines for Grading Projects presented under Appendix E. Please note that a slope-stability analysis was not a part of our scope of work.

Site Excavation Conditions

It is anticipated that relatively shallow excavations can be achieved with conventional earthmoving equipment. However, some deeper excavations may encounter weathered rock or rock which may require special methods and equipment for removal such as rippers or hydraulic hoe-rams. All grading operations should be performed in accordance with the requirements of the California Building Code (2001 edition), and local governmental standards, which have jurisdiction over this project.

Final excavations to desired subgrade should be accomplished immediately prior to the placement of rebar and concrete to avoid extended exposure of the subgrade to weathering. Surface run-off should be directed away from the excavations and should not be allowed to pond. If possible, the foundation concrete should be placed during the same day the excavation is made. If it is required that foundation excavations be left open for more than one day, they should be protected to reduce evaporation or impounding of moisture.

DESIGN RECOMMENDATIONS

Conventional and Mat Foundations

As noted, we understand that some structures may be supported on conventional or mat foundation systems on properly compacted fill material or native soils. In addition, we understand that the water holding tank(s) at the site will have a typical ring-foundation. From our subsurface investigation, the near surface materials (Topsoil) were found to be unsuitable for the proposed construction in their present condition. Site preparation should follow the recommendations presented in the earthwork section of this report. Foundation design parameters for conventional and mat foundations and ring foundation are given in following sections of this report.

It is recommended that footings and floors be constructed and reinforced in accordance with the following minimum criteria. Minor modifications may be required for fill depths and fill depth differentials generated by grading operations. Additional slab thickness, footing sizes and reinforcement should be provided as required by the project architect or structural engineer.

- Standard depth footings may be used with respect to building code requirements for the planned construction. All footing should be founded a minimum of 24 inches below lowest adjacent finish grade.
- Continuous footings should have a minimum width of 12 inches, as indicated in CBC Table 18-I-D.
- All continuous footings should be reinforced with a minimum of four No. 4 bars, two near the top of the footing and two near the bottom. Additional reinforcement may be required by the structural engineer based on design considerations.
- Exterior isolated pad footings should be a minimum of 24 inches square and founded at minimum depth of 18 inches below the lowest adjacent final grade. The pad footings should be reinforced with No. 4 bars spaced 18 inches on center, both ways, near the bottom of the footings.

Please note that as a part of the foundation design selection process, there is always a cost/benefit evaluation. Although we are providing recommendations for a specific foundation type, we have not carried out the cost/benefit evaluation.

Allowable Soil Bearing Capacities and Dynamic Shear Modulus

Continuous and isolated spread footings and mat footings are suitable for use at this site, assuming that they bear entirely into engineered fill material or entirely native formational soils. Footings should not straddle cut/fill interfaces. If cut/fill transitions are encountered within a proposed structure footprint the recommendations in the Fill Placement and Compaction section above should be followed. For conventional or mat foundations the foundation dimensions and reinforcements should be based on a net dead plus live load bearing pressure of 3,000 pounds per square foot (psf) for engineered fill soils or formational soils. The allowable bearing value may be increased by one-third for short duration loading which includes the effects of wind or seismic forces. As noted, the footings should extend a minimum of 24 inches below the lowest adjacent exterior subgrade.

For the purposes of design a soil dynamic shear modulus of 2,000 psi can be assumed for the near-surface soils and compacted fill. For weathered rock condition, a 5,000 psi dynamic shear modulus can be assumed.

Bridge Abutment Pier Foundations

We understand the proposed bridge crossing the creak in the northwest quadrant of the site is anticipated to be constructed on drilled piers. The bridge abutments can be supported by drilled piers designed using a combination of skin friction and end bearing. Scour protection for the bridge abutment and piers should be taken into consideration by the Civil engineer.

Piers that are a minimum of 10 feet deep and supported by dense native formational material can be designed for an allowable skin friction and end bearing of 1,000 psf and 4,000 respectively, neglecting the any skin friction in the top five feet below ground surface. For loads of short duration, such as those generated by wind or seismic events, the allowable end bearing value may be increased by 1/3. To eliminate the effect of any capacity reduction due to group effect, piers should be spaced a minimum of three times their diameter (center to center).

For preliminary sizing of piers, we recommend a minimum of 24 inch diameter pier with a minimum of 20 feet embedment. Actual pier lengths and sizes may vary dependent upon the conditions encountered at specific locations, final factored design loads and based on the structural engineer's calculations. Uplift capacity will be supported by skin friction in the soil and dead weight of the caisson. For uplift we recommend 500 psf of skin friction be used for design.

For the purposes of lateral load design, we recommend the use of the L-Pile program in conjunction with the following soil parameters, assuming that the upper materials will behave as cohesive sands:

Unit Weight	Modulus of Subgrade Reaction	Friction Angle	Cohesion
115 pcf	90 pci	30 degrees	100

To penetrate the subsurface conditions to the desired bearing stratum, it may be necessary to employ heavy drilling equipment. For this purpose we recommend the use of equipment with at least 50,000 pounds of downward force and 1 million in-pounds of continuous torque equipped with rock auger bits and core barrels. In general, such equipment can penetrate partially weathered rock as well as bedrock with an RQD in the range of 10 to 40 percent. It should be noted that large boulders are prevalent across the site as well as in the area of the bridge.

Temporary casing should be employed to support the sides of the borehole during the drilling and inspection process if necessary. If piers are to extend below the elevation of the groundwater table, it may be necessary to install pumps to remove excess water during drilling.

Each pier should be inspected by a representative of the geotechnical engineer. The inspection should include measurement of the pier diameter, evaluation of plumbness, logging of material penetrated, and observation of the bearing stratum. If subsurface conditions encountered vary from those in the boring logs, the contractor may be directed to advance the pier to greater depth, as necessary, to achieve the required bearing condition.

Immediately prior to placing concrete, the base of the pier should be properly cleaned of loose material, and water pumped out or otherwise removed. Concrete used to form the pier should have a slump in the range of 6 to 9 inches. Concrete may be placed by the free fall method provided that it is directed through the center of the reinforcing cage by means of a chute. At least a 5-foot head of concrete should be maintained in each section of the temporary casing as it is withdrawn to prevent sloughing of soils into the pier.

If the infiltration of water is such that more than 6 inches or more of water remains in the pier hole after pumping, it may be necessary to employ a tremie to introduce concrete into the borehole. If a tremie is used, a minimum 5-foot head of concrete should be maintained above the discharge point as the tremie is withdrawn.

Concrete Slabs

Concrete slabs, if constructed, may be grade supported by properly compacted structural fill. The concrete slabs should be designed by the structural engineer using a coefficient of subgrade reaction of 130 pci and assuming a low expansion potential for the near-surface soils at the site. Based on geotechnical considerations, it is recommended that the slabs be at least five inches in thickness. Minimum slab reinforcement should consist of #3 reinforcing bars placed on 18-inch centers, each way, at mid-slab height. Care should be taken by the contractor to ensure that the reinforcement is placed and maintained at slab mid-depth Floor slabs should be suitably reinforced and jointed (in accordance with Structural Engineer's recommendations) so that a small amount of independent movement can occur without causing damage. These recommendations are intended for use in slab areas with conventional loading. If heavy traffic is expected then additional recommendations may be required.

Slabs should be underlain by a capillary break of a thickness of at least four inches, consisting of gravel or Class II base material. In moisture sensitive flooring areas, such as carpeted or linoleum-covered areas, a 15-mil visqueen sheet should be placed midheight within the capillary break material. The visqueen sheet should be sealed along the edges to prevent lateral migration of soil moisture from adjacent non-visqueen areas. Prior to placement of slab-on-grade, the visqueen sheet be thoroughly inspected for cracks, punctures, tears, and holes. If necessary, the visqueen should be replaced or patched to assure a fully functional entity. As

noted, slabs subjected to heavier loads may require thicker slab sections and/or increased reinforcement.

Some minor cracking of slabs can be expected due to shrinkage. The potential for this slab cracking can be reduced by careful control of water/cement ratios in the concrete. The contractor should take appropriate curing precautions during the pouring of concrete in hot weather to minimize the cracking of slabs. We recommend that a slip-sheet (or equivalent) be utilized if grouted fill, tile, or other crack-sensitive floor covering is planned directly on concrete slabs. All slabs should be designed in accordance with structural considerations.

Ring Foundation

The proposed steel water storage tank(s) may be supported by conventional shallow ringwall foundation(s) after the soil within the tank area is over-excavated and replaced with engineered fill, as described herein. Footings which are at least 18 inches wide and a minimum of 24 inches deep (in accordance with 2007 California Building Code, CBC), may be designed for an allowable bearing pressure of 3,000 psf, provided the footings are supported by properly compacted engineered fill material or native soils. Final footing dimensions and appropriate reinforcements should be designed, based upon structural loading considerations. Footings should not straddle between cut/fill interface.

Settlement

Based on the known subsurface conditions, site geology, and our experience, we anticipate that properly designed and constructed foundations supported on the recommended materials could experience total and differential settlements of less than 1-inch and 1/2-inch respectively over a horizontal distance of 20 feet. According to geotechnical considerations, dynamic settlement is not expected to adversely affect the proposed improvements.

Lateral Resistance

Lateral loads may be resisted by any rational method that incorporates sliding friction and/or passive earth pressure. An allowable friction coefficient of 0.35 may be utilized at the concrete-soil interface (total frictional resistance equals the coefficient of friction times the dead load).

The design may incorporate a passive earth pressure of 300 psf per foot of depth, below a depth of one foot, provided that the footing is poured tightly against in-place competent native materials. The allowable lateral resistance can be taken as the sum of the frictional resistance and the passive resistance, provided the passive resistance does not exceed two-thirds of the total allowable resistance. Where sliding friction and passive pressure are used conjunctively, the passive pressure value should be reduced by 1/2. An increase of one-third of the above values may be used when designing for short-duration wind and seismic forces.

Below Grade Walls and Retaining Walls

Site retaining walls may be designed with conventional shallow continuous (strip) footings bearing in engineered fill placed in accordance with the recommendations of this report. A net allowable bearing pressure of 3,000 psf may be used for the design, provided the retaining wall foundation is a minimum of 24 inches below lowest adjacent finished grade. Retaining wall footings must meet minimum foundation recommendations described herein. The project structural engineer should determine minimum footing widths and reinforcements for continuous footings.

The following lateral earth pressures should be used for the design of below grade walls backfilled with suitable granular soils possessing an internal friction angle of at least 30 degrees.

Table of Equivalent Fluid Weight (pcf)		
Wall Type	Level Backfill	2:1 Sloped Backfill
Active	40	55
At-Rest (fixed at top)	55	70
Passive	350	150

The above values assume backfill soils will have a very low expansion potential and free-draining condition. If conditions other than those covered herein are anticipated, the geotechnical engineer should provide the equivalent fluid pressures on an individual basis.

Basement walls should be designed using the at-rest equivalent fluid weights. These parameters assume that the existing slope is stable. It should be noted that a slope stability analysis was not within the scope of services for this project. Proper benching or shoring as required should be provided during construction to support overburden and protect workers during basement excavations.

Below-grade walls and retaining walls should include a positive foundation drainage system. A typical below-grade wall drain consists of a minimum 4-inch flexible or rigid perforated pipe surrounded by ¾-inch crushed rock. The crushed rock backfill should be brought up to within one foot of ground surface. The rocks should be completely wrapped in a non-woven geotextile filter fabric (consisting of Mirafi 140N or approved equivalent). The perforations of the pipe should face upward (**not downward**), and cleanouts should be provided on corners/bends. The subsurface drainage system should be tied to the storm drainage system, allowed to daylight down slope, or collected in a sump and pumped out. This system typically is installed directly on top of the retaining wall footing on the retained soil side of the wall.

Retaining wall backfill should consist of approved granular material. This fill material should be compacted to at least 90% of the maximum dry density (as determined by ASTM D1557). Flooding or jetting of the backfill should not be permitted. Granular backfill should be capped with relatively impervious fill to seal the backfill and reduce the potential for saturation.

Cantilever or restrained walls subject to uniform surcharge loads should be designed for an additional uniform lateral pressure equal to one-third the anticipated surcharge pressure in the case of the cantilevered walls (active conditions). It should be noted that the use of heavy compaction equipment in close proximity to retaining structures can result in wall pressures exceeding design values and corresponding wall movement greater than normally associated with the development of active conditions. In this regard, the contractor should take appropriate precautions during the backfill placement.

Foundation Setback

Foundations adjacent to other structures or utilities should bear below an imaginary 1:1 plane extending up from the nearest bottom edge of adjacent parallel trenches or excavations. If required, recommendations for underpinning of adjacent structures can be provided. The minimum daylight distance for any footing (measured from the outside edge of a footing to the surface of any slope) should be 15 feet. Deepening of affected footings may be a suitable means of attaining the prescribed setbacks.

Preliminary Pavement Recommendations

Preliminary pavement sections for the proposed development are based on assumed traffic indexes and an assumed R-Value for the on-site soils. For purposes of design, a traffic index of 7.0 for drive routes was assumed. Proposed asphaltic concrete (AC) driveways and parking are anticipated to be supported by the on-site clayey or silty sand soils, which are assumed to possess an R-Value of 25. With this assumed R-value and the assumed traffic indexes, preliminary pavement sections of 5.0 inches of AC over 7.0 inches aggregate base are recommended for heavy vehicle loading conditions. Where heavy construction load is expected, the soil contained within the upper 3 feet should be compacted to 100% of maximum (based on test method ASTM D1557) and surfaced with 6 to 8 inch thick gravel bed. For this condition we anticipate only one or two cycles of such heavy load could occur only during construction. If required 1"-thick temporary steel sheets may be placed over gravel to assist in the load distribution in critical areas of construction. Areas identified as only for light vehicle parking may be constructed with at least 3.5 inches of AC over 6.0 inches of aggregate base.

The project architect or civil engineer may design concrete pavement by using a coefficient of subgrade reaction of 110 pci and assuming a low to moderate expansion potential (UBC 18-2). Based on geotechnical considerations, concrete pavement for driveways should be at least six inches thick underlain by at least four inches aggregate base. Appropriate reinforcement should be provided by the structural engineer's requirement.

Aggregate base should be compacted to a minimum of 95 percent relative compaction (based on ASTM Test Method D1557) prior to placement of AC. The upper 12 inches of pavement subgrade should be scarified; moisture conditioned as necessary to achieve near optimum moisture content and recompacted to at least 95 percent of the maximum dry density (based on ASTM D1557) at ±2% of optimum moisture content.

We understand that a heavy load will be carried to the site through a large hauling truck, approximately once in every 10 years. The anticipated load on a pair of tires will be a maximum of 30,000 lbs, with a tire footprint on pavement of 16"x18" with 10" clear between the tires. We also understand that crushed rock aggregate surfacing is desired for this roadway. The following recommendations should be used in preparation for this roadway and hauling. First,

all topsoil, organics, debris and all other deleterious materials should be removed from the area of the pavement. Any loose soil pockets should be overexcavated under the inspection of a representative of the geotechnical engineer. The subgrade then should be overexcavated to a minimum depth of 24 inches, moisture conditioned to slightly over optimum moisture content and compacted to a minimum of 95 to 98% of relative compaction (based on ASTM D1557). A crushed rock section of 18 inches can be used for this heavy vehicle loading condition. The crushed rock aggregates should be laid in two layers of 9" thickness, and each layer rolled with a heavy vibratory roller to achieve a stable unyielding base before placement of the next layer.

Please note that deformation of specially the gravel layer may occur during the heavy load transport even with the above mentioned section. In that regard, we would like to suggest you consider use of M8 Landing Mat or similar during the heavy haul, which can be purchased from Army or other Airport surplus stores. The mats help distribute the load in a wide area and can be easily placed during the haul, and dismantled and removed after the haul is completed.

As discussed previously, these recommendations are preliminary and are based on given assumptions. After completion of the grading operations, representative samples of the subgrade soils should be obtained to confirm Resistance Values (R-Values). Alternatives to the design of the various pavement sections can be derived as the project progresses through discussions with the owner, Civil Engineer, Local Jurisdiction and PSI personnel.

Plan Review

After the plans and specifications are complete, PSI should be retained and provided the opportunity to review the final design plans and specifications to check that our engineering recommendations have been properly incorporated into the design documents. Comments from our review should be properly incorporated into the design. PSI will not be responsible for any deviation of foundation design from our recommendations presented in this report if we are not retained for foundation plan review.

CONSTRUCTION CONSIDERATIONS

Construction Inspection

The building code requires special inspection of a number of critical structural elements by the geotechnical engineer of record. Such inspections include existing site soil conditions, fill placement and compaction and assessment of the load bearing capacity of soils for the support of foundations. If not engaged to provide these construction observation and testing services for this project, PSI will not be responsible for the future performance of the foundations or any other geotechnical or geologic performance of the site, and will not remain the Geotechnical Engineer of Records for the site.

Utility Trench Backfill

Utility trenches should be properly backfilled and compacted. Utilities should be properly bedded and backfilled with approved granular soil to a depth of at least one (1) foot over the top of the pipe. This backfill should be uniformly moisture conditioned and firmly compacted for pipe support. The remainder of the backfill should consist of on-site soil, or imported soil, placed in lifts not exceeding 6 inches in thickness, moistened or aerated to slightly above optimum moisture content, and mechanically compacted to at least 90% of the maximum dry density (ASTM D1557).

It should be noted that, even when placed under optimum conditions, utility trench backfill sometimes settle. Foundations, sidewalks, and paved areas placed over utility trenches should be designed to span over localized areas of settlement, or be designed to allow for the anticipated settlement.

Corrosion Protection

Laboratory chemical analysis of the recovered soil samples indicated that the on-site soils possess the potential for a ‘severe’ degree of attack from soluble sulfates. Therefore, based on the 2007 California Building Code (CBC) requirements, Type V Cement should be used for all concrete that will be in contact with soils at the site (e.g. foundation, retaining wall, slab). This concrete should have a minimum compressive strength of 4,500 pounds per square inch (psi) and

be placed at a maximum water/cement ratio of 0.45. The final concrete specifications should be made by the structural engineer.

Field soil resistivity measurements were performed in perpendicular directions at 2.5, 5, 10, 25, 50 and 100 feet pin spacings. The tests were performed in general accordance with California test method 643, using four point method. The locations of our tests are shown on the Exploration Location Map. The results of our tests are presented in Appendix C. From the results, the site soils can be classified as 'moderately corrosive' to 'corrosive'. However, the project design engineer should interpret the results and incorporate the implications into the design of buried objects.

Groundwater Control

Groundwater was not encountered within the maximum air hammer (dry boring) explored depth of approximately 30 feet below existing site grade. It should be noted, however, that fluctuations in the groundwater level might occur due to variations in ground surface topography, subsurface stratification, rainfall, irrigation and other factors that may not have been evident at the time of our exploration. Every effort should be made to keep the excavations dry. PSI should be contacted to evaluate excessive seepage conditions.

Drainage Recommendations

Drainage should be designed to direct surface waters away from foundations. Berms, positive surface gradients, and other drainage controls should be included in the construction considerations to minimize discharging or ponding of water near the foundation line. Drainage patterns approved at the completion of construction should be maintained throughout the life of the project.

As mentioned before, there is a natural drainage channel towards the western boundary of the site. This area has a potential to get flooded during rain events. Proper drainage and erosion control should be implemented in this drainage channel. These items will be especially important and should be analyzed individually at the proposed bridge crossing the channel or culverts.

Safety Requirements

Prior to the commencement of construction, the owner and the contractor should make themselves aware of, and become familiar with, the applicable local, state, and federal safety regulations. Construction safety is generally the sole responsibility of the contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations.

REPORT LIMITATIONS

Information submitted in this report is based on the available surface and subsurface information obtained by PSI and the design details furnished by Sega, Inc. for the proposed project. If any change to the proposed improvements is desired, PSI should be informed immediately in writing, and further recommendation from PSI may be required.

The recommendations and design criteria provided herein are considered "minimums", in keeping with the current standard-of-practice. They do not preclude more restrictive criteria by the governing agency or structural considerations. The project structural engineer should evaluate the foundation configurations and reinforcement requirements for actual structural loadings. The final choice of foundation type should be based on the engineering/construction advantages and disadvantages, while keeping in mind the risks associated with any type of foundation and economic considerations.

This report has been prepared for the exclusive use of Sega, Inc.(client) for the specific application to the proposed Orange Grove Power Plant Project in Pala, San Diego County, California, under the agreement between the client and PSI, and is not intended for use by any third party absent specific written authorization from PSI. In all cases, any third party seeking to rely upon this report must agree to be bound by PSI's general conditions.

Our scope of services did not include an environmental assessment for determining the presence or absence of wetlands, or hazardous or toxic materials in the soil, bedrock, surface water, groundwater, or air on, below, or around this site. Any statement in this report or on the boring log regarding odors, colors, and unusual or suspicious items or conditions is strictly for informational purposes.

The Geotechnical Engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.

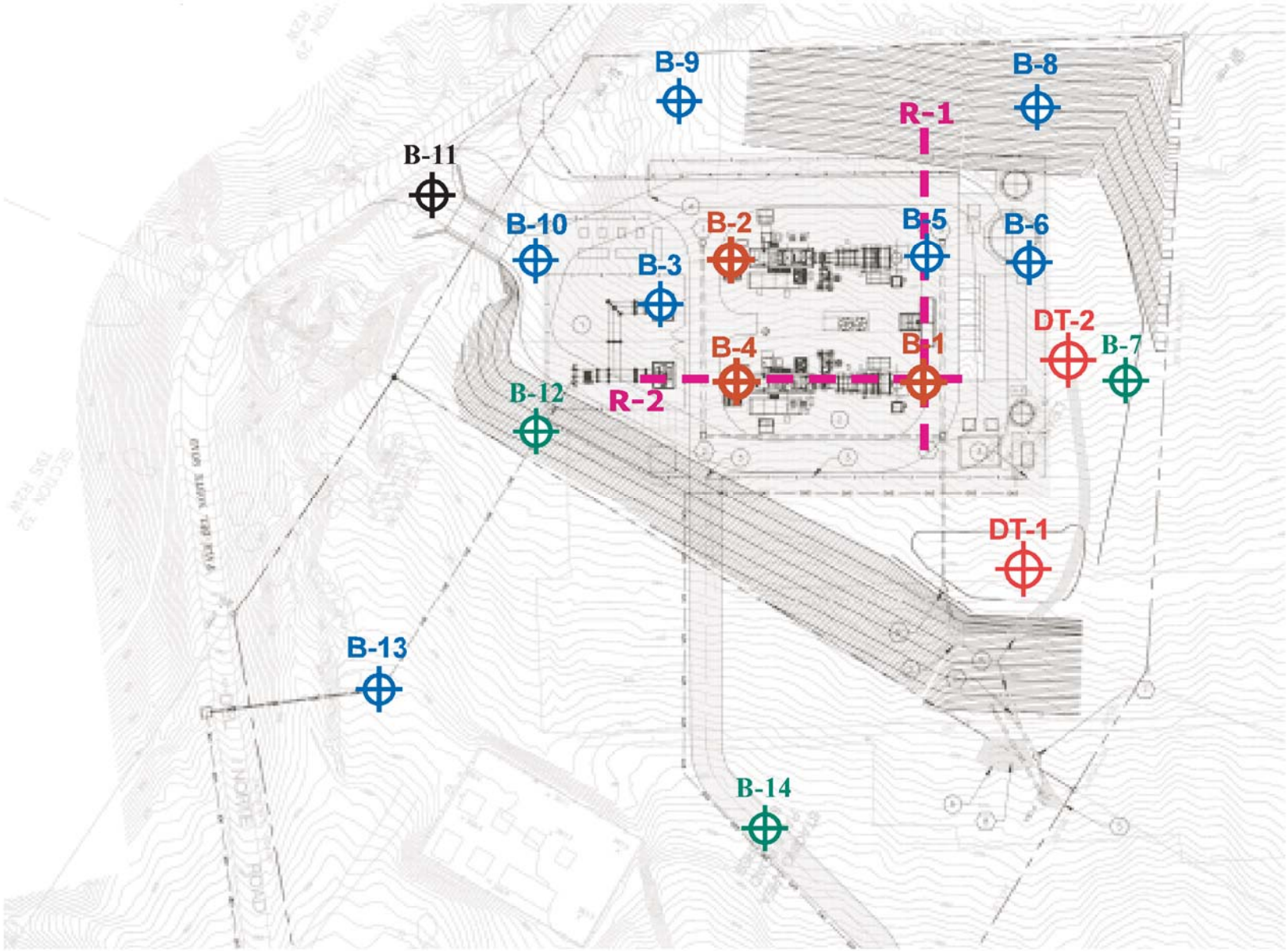
FIGURES

Information To Build On
Engineering • Consulting • Testing

6867 NANCY RIDGE DRIVE, SUITE E
SAN DIEGO, CALIFORNIA 92121
PHONE: 858.455.0544, FAX: 858.455.1170

SITE LOCATION MAP
PROPOSED ORANGE GROVE POWER PLANT
NE OF HWY 76 & PALA DEL NORTE ROAD
PALA, CALIFORNIA 92059

PSI PROJECT NO: **070-75051**
SCALE: **NOT TO SCALE**
FIGURE: **1**



REFERENCE: GRADING AND DRAINAGE PLAN, ORANGE GROVE POWER PLANT, Drawing No. C300, Rev. B, By: Sega, Inc.

Legend

- B-10 — Approx Drag-Auger/Air-Hammer Test Boring
- B-1 — Approx Hollow-Stem-Auger/Rock-Core Boring
- B-7 — Approx Hollow-Stem-Auger Boring
- B-11 — Approx Hand-Auger Boring
- DT-1 — Approx Drit Test Location
- R-1 — Approx Resistivity Test

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6867 NANCY RIDGE DRIVE, SUITE E
SAN DIEGO, CALIFORNIA 92121
PHONE: 858.455.0544, FAX: 858.455.1170

EXPLORATION LOCATION MAP
PROPOSED ORANGE GROVE POWER PLANT
NE OF HWY 76 AND PALA DEL NORTE ROAD
PALA, CALIFORNIA 92059

PSI JOB NO: 070-75051
SCALE: NO SCALE
FIGURE: 2

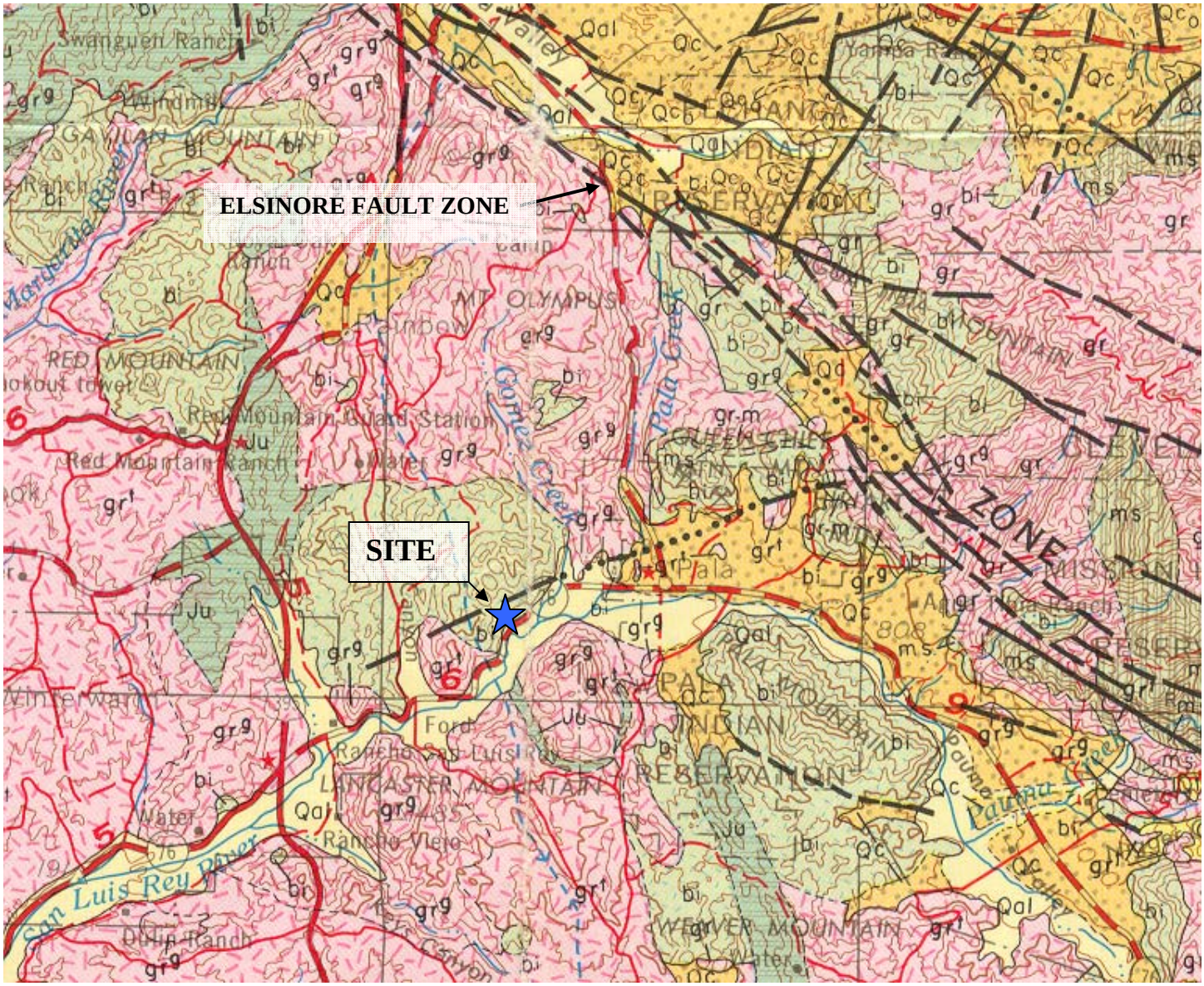

FIGURE 3

REGIONAL GEOLOGIC MAP and SITE LOCATION

ORANGE GROVE POWER PLANT

Qal: alluvium; gr^g granodiorite: bi: basic intrusive rocks (gabbro), gr^t tonalite,
(after Rogers, 1965)

SIX MILES

N

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Engineering • Consulting • Testing

APPENDIX A

REFERENCES CITED

REFERENCES CITED

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APPENDIX B

EXPLORATION LOGS

SOIL CLASSIFICATION CHART

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

MAJOR DIVISIONS			SYMBOLS GRAPH	SYMBOLS LETTER	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

SAMPLE TYPES

Grab Sample | **Modified California Sample** | **SPT Sample** | **Undisturbed Sample**

Ground Water Table

BORING LOG

PSI Project No.: **070-75051**		Name of Project: **Proposed Orange Grove Power Plant**	
Address: **Pala, California**		Boring Location: **East End of Prop. Turbine #2**	Elev: **Approximately 415 ft**
Boring No.: **B-1**	Total Depth **40.0'**	Logged by: **D. Ebuengan**	Drilling Equipment: **CME-75**
Type of Boring: **8"Ø HSA, 4"Ø CORE**		Started: **10/16/07** Completed: **10/17/07**	Driller: **Tri-County (Bill Klein)**

Elevation	Depth	Graphic Log	Sample Type	Sample Blows	Sample Recovery (%)	RQD (%)	USCS Classification	DESCRIPTION OF MATERIALS (Surface Condition)	Remarks
	0.0							**Topsoil:** Firm, Dry, Orangish Brown, Sandy Lean Clay with Gravels. Ground Covered with Dry Low Brushes with some Rocks and Cobbles.	
414.0							CL	**Gabbro and Dark Dioritic Rocks; Chiefly Mesozoic(gb):** Firm to Stiff, Dry, Orangish Brown, Sandy Lean Clay with Gravels. (CL)	1'-4' ASTM 5-Layer(Proctor), Remolded to 95% Direct Shear, Sulfate Content.
412.5	2.5			22 50/3"	100		GC	Dense, Dry, Light Brown, Clayey Gravel with Sand. (GC)	
	5.0			50/6"				Very Dense, Dry, Reddish Brown, Clayey Gravel with Sand. (GC)	
409.0								Very Soft, Gray and Brown, Moderately to Highly Weathered Clayey Coarse Sand with very Broken Rocks and Cobbles.	Auger refusal at approx. 6'. Coring started at 6'.
	7.5				36	0	SP-SC		
	10.0								
404.0								Soft, Gray with Brown, Moderately to Highly Weathered Very Broken (gravel to cobble size) Granite with Fine to Coarse Sand.	
	12.5				60	0			
	15.0								
								Soft, Gray and Reddish Brown, Moderately to Highly Weathered Very Broken (gravel to cobble size) Granitic Rock with Clayey Sand.	
	17.5				20	0	GP-GC		
	20.0								
								Soft, Gray and Reddish Brown, Moderately to Highly Weathered Broken to Very Broken (cobble size) Granitic Rock with Clayey Sand and Gravel.	
	22.5				50	6			
	25.0								

BORING LOG

PSI Project No.: **070-75051**		Name of Project: **Proposed Orange Grove Power Plant**	
Address: **Pala, California**		Boring Location: **East End of Prop. Turbine #2**	Elev: **Approximately 415 ft**
Boring No.: **B-1**	Total Depth **40.0'**	Logged by: **D. Ebuengan**	Drilling Equipment: **CME-75**
Type of Boring: **8"Ø HSA, 4"Ø CORE**		Started: **10/16/07** Completed: **10/17/07**	Driller: **Tri-County (Bill Klein)**

Elevation	Depth	Graphic Log	Sample Type	Sample Blows	Sample Recovery (%)	RQD (%)	USCS Classification	DESCRIPTION OF MATERIALS (Surface Condition)	Remarks
	25.0				50	6	GP-GC		
389.0								Very Soft, Completely Weathered, Brown and Gray, Decomposed Granitic Silty to Clayey Sand with Interbedded Broken (cobble size) Granitic Rock.	
	27.5				100	0	SC-SM		
	30.0								
384.0								Very Soft, Completely Weathered, Light Brown and Gray, Decomposed Granitic Clayey Fine to Coarse Sand with Gravel.	
	32.5				60	0	SC		
	35.0								
379.0								Soft to Medium Hard, Completely Weathered, Light Brown and Gray, Gravels and Cobbles. (Very Broken Rock in 3/8"Ø to 2"Ø size).	End of Drilling at depth of approximately 40'.
	37.5				25	0	GC		
375.0	40.0							Auger Refusal at Approximately 6 feet. Rock Coring Started at Approximately 6 Feet. End of Coring at Approximately 40 feet. Bored Hole Backfilled with Bentonite on 10/17/2007.	
	42.5								
	45.0								
	47.5								
	50.0								

BORING LOG

PSI Project No.: **070-75051**		Name of Project: **Proposed Orange Grove Power Plant**	
Address: **Pala, California**		Boring Location: **West End of Prop. Turbine #1**	Elev: **Approximately 425 ft**
Boring No.: **B-2**	Total Depth **20.0'**	Logged by: **P. Nacey**	Drilling Equipment: **CME-75**
Type of Boring: **8"Ø HSA, 4"Ø CORE**		Started: **10/17/07** Completed: **10/18/07**	Driller: **Tri-County (Bill Klein)**

Elevation	Depth	Graphic Log	Sample Type	Sample Blows	Sample Recovery (%)	RQD (%)	USCS Classification	DESCRIPTION OF MATERIALS (Surface Condition)	Remarks
424.0	0.0							**Topsoil:** Firm, Dry, Light Brown, Sandy Lean Clay with Rocks and Cobbles. Ground Covered with Dry Low Brushes with Rocks and Boulders.	
	2.5			9 30 44			CL	**Gabbro and Dark Dioritic Rocks; Chiefly Mesozoic(gb):** Firm to Stiff, Dry, Light Brown, Sandy Lean Clay with Gravels. (CL) Hard, Dry, Reddish Brown, Sandy Lean Clay with Rock and Gravels. (CL)	2.5'-4' Sieve Analysis, Sulfate Content
420.0	5.0							Soft, Reddish to Light Orangish Brown, Highly Weathered Fanglomeratic Claystone with Cobble size Rock.	
	7.5				100	0	CL		
415.0	10.0							Soft, Light Orangish Brown, Highly Weathered Fanglomeratic Clayey Sandstone with gravels.	
	12.5				100	0			
	15.0						SC-SM	Soft, Light Orangish Brown, Highly Weathered Fanglomeratic Clayey Sandstone with gravels.	End of drilling at approximately 20'.
	17.5				50	0			
405.0	20.0							Auger Refusal at Approximately 5 feet. Rock Coring Started at Approximately 5 Feet. End of Coring at Approximately 20 feet. Bored Hole Backfilled with Bentonite on 10/18/2007.	
	22.5								
	25.0								

BORING LOG

PSI Project No.: **070-75051**		Name of Project: **Proposed Orange Grove Power Plant**	
Address: **Pala, California**		Boring Location: **South of Prop. Switch Gear/Generator**	Elev: **Approximately 420 ft**
Boring No.: **B-3**	Total Depth **30.5'**	Logged by: **D. Ebuengan**	Drilling Equipment: **CME-75 with 750 CFM Air Comp**
Type of Boring: **5"Ø Air Hammer**		Started: **10/19/07** Completed: **10/19/07**	Driller: **Tri-County (James Sauer,Bill Klein)**

Elevation	Depth	Graphic Log	Sample Type	Sample Blows	Sample Recovery (%)	RQD (%)	USCS Classification	DESCRIPTION OF MATERIALS (Surface Condition)	Remarks
419.0	0.0							**Topsoil:** Firm, Dry, Light Brown, Sandy Lean Clay with Rocks and Cobbles. Ground Covered with Dry Low Brushes with Rocks and Cobbles.	
	2.5						CL	**Gabbro and Dark Dioritic Rocks; Chiefly Mesozoic(gb):** Firm to Stiff, Dry, Light Brown, Sandy Lean Clay with Gravels. (CL)	
415.0	5.0			50/6"	100			Very Dense, Dry, Brown and Gray, Fanglomeratic Clayey Sand with Gravel size Rock.	
	7.5						SC		
410.0	10.0			17 25 50/3"	100			Dense, Yellowish Brown, Decomposed Granitic Silty Fine to Coarse Sand. (Rock on tip of shoe).	
	12.5								
	15.0			25 50/1"	91		SM	Very Dense, Light Brown, decomposed Granitic Silty Fine to Coarse Sand.	
	17.5								
400.0	20.0			21 50/5"	54			Very Dense, Light Brown, decomposed Granitic Silty Fine to Coarse Sand and Gravel.	
	22.5						SP		
395.0	25.0								

BORING LOG

PSI Project No.: **070-75051**		Name of Project: **Proposed Orange Grove Power Plant**	
Address: **Pala, California**		Boring Location: **South of Prop. Switch Gear/Generator**	Elev: **Approximately 420 ft**
Boring No.: **B-3**	Total Depth **30.5'**	Logged by: **D. Ebuengan**	Drilling Equipment: **CME-75 with 750 CFM Air Comp**
Type of Boring: **5"Ø Air Hammer**		Started: **10/19/07** Completed: **10/19/07**	Driller: **Tri-County (James Sauer,Bill Klein)**

Elevation	Depth	Graphic Log	Sample Type	Sample Blows	Sample Recovery (%)	RQD (%)	USCS Classification	DESCRIPTION OF MATERIALS (Surface Condition)	Remarks
	25.0		☒	33 50/2"	100		SM	Very Dense, Light Brown, decomposed Granitic Silty Fine to Coarse Sand.	
	27.5								
389.5	30.0		☒	50/5"	100			Very Dense, Light Gray, Decomposed Granitic Silty Fine to Coarse Sand.	
	32.5							End of Boring at Approximately 30.5 feet. No Ground Water Table Encountered. Bored Hole Backfilled with Bentonite on 10/19/2007.	
	35.0								
	37.5								
	40.0								
	42.5								
	45.0								
	47.5								
	50.0								

BORING LOG

PSI Project No.: **070-75051**		Name of Project: **Proposed Orange Grove Power Plant**	
Address: **Pala, California**		Boring Location: **West End of Prop. Turbine #2**	Elev: **Approximately 412 ft**
Boring No.: **B-4**	Total Depth **25.0'**	Logged by: **P. Nacey**	Drilling Equipment: **CME-75**
Type of Boring: **8"Ø HSA, 4"Ø CORE**		Started: **10/18/07** Completed: **10/18/07**	Driller: **Tri-County (Bill Klein)**

Elevation	Depth	Graphic Log	Sample Type	Sample Blows	Sample Recovery (%)	RQD (%)	USCS Classification	DESCRIPTION OF MATERIALS (Surface Condition)	Remarks
411.0	0.0							**Topsoil:** Firm, Dry, Light Brown, Sandy Lean Clay with Rocks and Cobbles. Ground Covered with Dry Low Brushes with Rocks and Boulders.	
	2.5			25 41 50/5"			CL-ML CL	**Gabbro and Dark Dioritic Rocks; Chiefly Mesozoic(gb):** Firm to Stiff, Dry, Light Brown, Sandy Lean Clay with Gravels. (CL) Hard, Dry, Reddish Brown, Sandy Silty Clay with Gravels. (CL-ML)	2.5'-3.5' Sieve Analysis
407.0	5.0							Soft to Medium Hard, Gray and Light Orangish Brown, Highly Weathered to Moderately Weathered Granitic Gravel and Cobbles in Clayey Sand.	Auger refusal at approximately 5'. Coring started at 5'.
	7.5				24	0			
	10.0							Soft to Medium Hard, Gray and Light Orangish Brown, Highly Weathered to Moderately Weathered Granitic Gravel and Cobbles in Clayey Sand.	
	12.5				30	0			
	15.0						GP-GC	Soft to Medium Hard, Gray and Light Orangish Brown, Highly Weathered to Moderately Weathered Granitic Gravel and Cobbles in Clayey Sand.	
	17.5				30	0			
					50	0			
	20.0							Soft to Medium Hard, Gray and Light Orangish Brown, Highly Weathered to Moderately Weathered Granitic Gravel and Cobbles in Clayey Sand.	End of drilling at approximately 25'.
	22.5				10	0			
387.0	25.0								

BORING LOG

PSI Project No.: **070-75051**		Name of Project: **Proposed Orange Grove Power Plant**	
Address: **Pala, California**		Boring Location: **West End of Prop. Turbine #2**	Elev: **Approximately 412 ft**
Boring No.: **B-4**	Total Depth **25.0'**	Logged by: **P. Nacey**	Drilling Equipment: **CME-75**
Type of Boring: **8"Ø HSA, 4"Ø CORE**		Started: **10/18/07** Completed: **10/18/07**	Driller: **Tri-County (Bill Klein)**

Elevation	Depth	Graphic Log	Sample Type	Sample Blows	Sample Recovery (%)	RQD (%)	USCS Classification	DESCRIPTION OF MATERIALS (Surface Condition)	Remarks
	25.0							Auger Refusal at Approximately 5 feet. Rock Coring Started at Approximately 5 Feet. End of Coring at Approximately 25 feet. Bored Hole Backfilled with Bentonite on 10/18/2007.	
	27.5								
	30.0								
	32.5								
	35.0								
	37.5								
	40.0								
	42.5								
	45.0								
	47.5								
	50.0								

BORING LOG

PSI Project No.: **070-75051**		Name of Project: **Proposed Orange Grove Power Plant**	
Address: **Pala, California**		Boring Location: **East End of Prop. Turbine #1**	Elev: **Approximately 428 ft**
Boring No.: **B-5**	Total Depth **20.5'**	Logged by: **D. Ebuengan**	Drilling Equipment: **CME-75 with 750 CFM Air Comp**
Type of Boring: **5"Ø Air Hammer**		Started: **10/19/07** Completed: **10/19/07**	Driller: **Tri-County (James Sauer,Bill Klein)**

Elevation	Depth	Graphic Log	Sample Type	Sample Blows	Sample Recovery (%)	RQD (%)	USCS Classification	DESCRIPTION OF MATERIALS (Surface Condition)	Remarks
	0.0							**Topsoil:** Firm, Dry, Light Brown, Sandy Lean Clay with Rocks and Cobbles.	
427.0								Ground Covered with Dry Low Brushes with Rocks and Boulders.	
	2.5						CL	**Gabbro and Dark Dioritic Rocks; Chiefly Mesozoic(gb):**Firm to Stiff, Dry, Light Brown, Sandy Lean Clay with Gravels. (CL)	
423.0	5.0			22 18 15	100			Dense, Dry, Orangish Brown, Clayey Sand Trace DG Silty Sand. (SC)	
	7.5						SC		
418.0	10.0			26 50/3"	100			Very Dense, Dry, Yellowish Brown and Gray, Silty Fine to Coarse Sand Trace Gravel. (SM)	
	12.5								
	15.0			22 50/4"	100		SM	Very Dense, Dry, Yellowish Brown and Gray, Silty Fine to Coarse Sand Trace Gravel. (SM)	
	17.5								
407.5	20.0			50/2"	100			Very Dense, Dry, Light Gray, Decomposed Granitic Silty Fine to Coarse Sand. (SM)	
	22.5							End of Boring at Approximately 20.5 feet. No Ground Water Table Encountered. Bored Hole Backfilled with Bentonite on 10/19/2007.	
	25.0								

BORING LOG

PSI Project No.: **070-75051**		Name of Project: **Proposed Orange Grove Power Plant**	
Address: **Pala, California**		Boring Location: **Prop. Fire Water Storage Tank Area**	Elev: **Approximately 430 ft**
Boring No.: **B-6**	Total Depth **21.0'**	Logged by: **D. Ebuengan**	Drilling Equipment: **CME-75 with 750 CFM Air Comp**
Type of Boring: **5"Ø Air Hammer**		Started: **10/19/07** Completed: **10/19/07**	Driller: **Tri-County (Bill Klein)**

Elevation	Depth	Graphic Log	Sample Type	Sample Blows	Sample Recovery (%)	RQD (%)	USCS Classification	DESCRIPTION OF MATERIALS (Surface Condition)	Remarks
429.0	0.0							**Topsoil:** Firm, Dry, Light Brown, Sandy Lean Clay with Rocks and Cobbles. Ground Covered with Dry Low Brushes with Rocks and Boulders.	
	2.5						SP-SM	**Gabbro and Dark Dioritic Rocks; Chiefly Mesozoic(gb):** Medium Dense to Dense, Dry, Light Brown and Gray, Fine to Coarse Sand with Gravel. (SP-SM)	
425.0	5.0			50/3"	100			Very Dense, Dry, Light Brown, Clayey Sand with Gravel. (SC)	
	7.5						SC		
420.0	10.0			30 50/3"	100			Very Dense, Dry, Orangish Brown, Fine to Coarse Sand, some Gravel. (SP-SM)	
	12.5						SP-SM		
415.0	15.0			17 50/3"	100			Very Dense, Dry, Orangish Brown, Decomposed Granitic Fine to Coarse Sand. (SM) Observed iron oxide staining.	
	17.5						SM		
409.0	20.0			24 50/4"	100			Very Dense, Dry, Light Yellowish Brown, Decomposed Granitic Fine to Coarse Sand. (SM)	
	22.5							End of Boring at Approximately 21 feet. No Ground Water Table Encountered. Bored Hole Backfilled with Bentonite on 10/30/2007.	
	25.0								

BORING LOG

PSI Project No.: **070-75051**		Name of Project: **Proposed Orange Grove Power Plant**	
Address: **Pala, California**		Boring Location: **Middle East Side of Prop. Facility**	Elev: **Approximately 418 ft**
Boring No.: **B-7**	Total Depth **11.0'**	Logged by: **D. Ebuengan**	Drilling Equipment: **CME-75**
Type of Boring: **8"Ø HSA**		Started: **10/16/07** Completed: **10/16/07**	Driller: **Tri-County (Bill Klein)**

Elevation	Depth	Graphic Log	Sample Type	Sample Blows	Sample Recovery (%)	RQD (%)	USCS Classification	DESCRIPTION OF MATERIALS (Surface Condition)	Remarks
417.0	0.0							**Topsoil:** Firm, Dry, Light Brown, Sandy Lean Clay with Cobbles. Ground Covered with Dry Low Brushes with Rocks and Cobbles.	
	2.5			13 29 33	100		CL-ML	**Gabbro and Dark Dioritic Rocks; Chiefly Mesozoic(gb):** Firm to Hard, Dry, Orangish Brown, Sandy Silty Clay Trace Gravel. (CL-ML) Hard, Dry, Reddish Brown, Sandy Silty Clay Trace Gravel. (CL-ML)	1'-5' ASTM 5-layer (Proctor), Remolded to 95% Direct Shear, Sieve Analysis 2.5'-4' Sulfate Content
413.0	5.0			10 21 25	100		CL	Hard, Dry, Reddish Brown, Sandy Lean Clay Trace Gravel. (CL)	5'-6.5' Sieve Analysis
410.5	7.5			14 50/5"	89		GC	Very Dense, Dry, Reddish Brown, Clayey Gravel with Sand. (GC)	
408.0 407.0	10.0			12 50/6"	100		SC	Very Dense, Slightly Moist, Brown and Gray, Clayey Sand with Gravel. (SC)	10'-11' Sieve Analysis
	12.5							End of Boring at Approximately 11 feet. No Ground Water Encountered. Bored Hole Backfilled with Bentonite on 10/16/2007.	
	15.0								
	17.5								
	20.0								
	22.5								
	25.0								

BORING LOG

PSI Project No.: **070-75051**		Name of Project: **Proposed Orange Grove Power Plant**	
Address: **Pala, California**		Boring Location: **Northeastern of Prop. Facility**	Elev: **Approximately 449 ft**
Boring No.: **B-8**	Total Depth **10.5'**	Logged by: **D. Ebuengan**	Drilling Equipment: **CME-75 with 750 CFM Air Comp**
Type of Boring: **5"Ø Air Hammer**		Started: **10/30/07** Completed: **10/30/07**	Driller: **Tri-County (Bill Klein)**

Elevation	Depth	Graphic Log	Sample Type	Sample Blows	Sample Recovery (%)	RQD (%)	USCS Classification	DESCRIPTION OF MATERIALS (Surface Condition)	Remarks
	0.0							**Topsoil:** Firm, Dry, Light Brown, Sandy Lean Clay with Rocks and Cobbles. Ground Covered with Dry Low Brushes with Big Rocks and Boulders.	
448.0							SP-SC	**Gabbro and Dark Dioritic Rocks; Chiefly Mesozoic(gb):** Medium Dense to Dense, Dry, Reddish Brown and Gray, Clayey Coarse Sand with Gravels. (SP-SC)	
	2.5								
446.0							SM	Dense, Dry, Brown and Gray, Fine to Coarse Sand with Gravels. (SM)	
444.0	5.0			50/5"	75			Very Dense, Dry, Light Gray, Sandy Gravel. (GP-GM)	
	7.5						GP-GM		
439.0	10.0			50/6"	100		SC-SM	Very Dense, Dry, Light Orangish Brown and Gray, Silty Clayey Fine to Coarse Sand with Gravel. (SC-SC)	
438.5								End of Boring at Approximately 10.5 feet. No Ground Water Encountered. Bored Hole Backfilled with Bentonite on 10/30/2007.	
	12.5								
	15.0								
	17.5								
	20.0								
	22.5								
	25.0								

BORING LOG

PSI Project No.: **070-75051**		Name of Project: **Proposed Orange Grove Power Plant**	
Address: **Pala, California**		Boring Location: **Northwestern of Prop. Facility**	Elev: **Approximately 437 ft**
Boring No.: **B-9**	Total Depth **10.5'**	Logged by: **D. Ebuengan**	Drilling Equipment: **CME-75 with 750 CFM Air Comp**
Type of Boring: **5"Ø Air Hammer**		Started: **10/30/07** Completed: **10/30/07**	Driller: **Tri-County (Bill Klein)**

Elevation	Depth	Graphic Log	Sample Type	Sample Blows	Sample Recovery (%)	RQD (%)	USCS Classification	DESCRIPTION OF MATERIALS (Surface Condition)	Remarks
436.0	0.0							**Topsoil:** Firm, Dry, Light Brown, Sandy Lean Clay with Rocks and Cobbles. Ground Covered with Dry Low Brushes and Small to Medium Size Bushes with Big Rocks and Boulders.	
	2.5						SP-SC	**Gabbro and Dark Dioritic Rocks; Chiefly Mesozoic(gb):** Medium Dense to Dense, Dry, Brown and Gray, Clayey Sand with Gravels. (SP-SC)	
432.0	5.0			31 50/3"	100			Very Dense, Dry, Light Orangish Brown, Clayey Fine to Coarse Sand, some Gravels. (SC)	
	7.5						SC		
427.0	10.0			50/6"	100		SC-SM	Very Dense, Dry, Light Orangish Brown, Silty Clayey Fine to Coarse Sand. (SC-SM)	
426.5								End of Boring at Approximately 10.5 feet. No Ground Water Encountered. Bored Hole Backfilled with Bentonite on 10/30/2007.	
	12.5								
	15.0								
	17.5								
	20.0								
	22.5								
	25.0								

BORING LOG

PSI Project No.: **070-75051**		Name of Project: **Proposed Orange Grove Power Plant**	
Address: **Pala, California**		Boring Location: **Southeast of Prop. Bridge**	Elev: **Approximately 413 ft**
Boring No.: **B-10**	Total Depth **11.0'**	Logged by: **D. Ebuengan**	Drilling Equipment: **CME-75 with 750 CFM Air Comp**
Type of Boring: **5"Ø Air Hammer**		Started: **10/30/07** Completed: **10/30/07**	Driller: **Tri-County (Bill Klein)**

Elevation	Depth	Graphic Log	Sample Type	Sample Blows	Sample Recovery (%)	RQD (%)	USCS Classification	DESCRIPTION OF MATERIALS (Surface Condition)	Remarks
412.0	0.0							**Topsoil:** Firm, Dry, Light Brown, Sandy Lean Clay with Rocks and Cobbles. Ground Covered with Dry Sparse Brushes with Rocks and Cobbles.	
	2.5						SP-SC	**Gabbro and Dark Dioritic Rocks; Chiefly Mesozoic(gb):** Medium Dense to Dense, Dry, Brown and Gray, Clayey Sand with Gravels. (SP-SC)	
408.0	5.0			30 38 47	100			Very Dense, Dry, Light yellowish Brown, Clayey Fine to Coarse Sand, Trace Gravels. (SC) Switched to Auger Boring at approximately 5' due to broken Air Hose connector.	
	7.5						SC		
	10.0			10 50/3"	100		SC	Very Dense, Dry, Light Reddish Brown, Clayey Fine to Coarse Sand, Trace Gravels. (SC)	
402.0									
	12.5							End of Boring at Approximately 11 feet. No Ground Water Encountered. Bored Hole Backfilled with Bentonite on 10/30/2007.	
	15.0								
	17.5								
	20.0								
	22.5								
	25.0								

BORING LOG

PSI Project No.: **070-75051**		Name of Project: **Proposed Orange Grove Power Plant**	
Address: **Pala, California**		Boring Location: **Northwest of Prop. Bridge**	Elev: **Approximately 412 ft**
Boring No.: **B-11**	Total Depth **2.5'**	Logged by: **D. Ebuengan**	Drilling Equipment: **4"Ø Hand Auger**
Type of Boring: **4"Ø Hand Auger**		Started: **11/6/07** Completed: **11/6/07**	Driller: **D. Ebuengan**

Elevation	Depth	Graphic Log	Sample Type	Sample Blows	Sample Recovery (%)	RQD (%)	USCS Classification	DESCRIPTION OF MATERIALS (Surface Condition)	Remarks
	0.0							**Topsoil:** Very Loose to Loose, Dry, Light Brown, Silty to Clayey Fine to Coarse Sand, some Gravels and Cobbles with Roots. Ground Covered with Dry Low Brushes and Small to Medium Size Bushes with Big Rocks and Boulders.	
410.5							SP-SC		
409.5	2.5							**Gabbro and Dark Dioritic Rocks; Chiefly Mesozoic(gb):** Medium Dense to Dense, Dry, Light Brown, Silty to Clayey Fine to Coarse Sand, some Gravels with Cobbles. (SP-SC)	
								Hand Auger Refusal at Approximately 2.5 feet.	
								No Ground Water Encountered.	
								Bored Hole Backfilled with Site Soil Cuttings on 11/06/2007.	
	5.0								
	7.5								
	10.0								
	12.5								
	15.0								
	17.5								
	20.0								
	22.5								
	25.0								

BORING LOG

PSI Project No.: **070-75051**		Name of Project: **Proposed Orange Grove Power Plant**	
Address: **Pala, California**		Boring Location: **Southwest Slope of Prop. Facility**	Elev: **Approximately 398 ft**
Boring No.: **B-12**	Total Depth **9.0'**	Logged by: **P. Nacey**	Drilling Equipment: **CME-75 with 750 CFM Air Comp**
Type of Boring: **8"Ø HSA**		Started: **10/18/07** Completed: **10/18/07**	Driller: **Tri-County (Bill Klein)**

Elevation	Depth	Graphic Log	Sample Type	Sample Blows	Sample Recovery (%)	RQD (%)	USCS Classification	DESCRIPTION OF MATERIALS (Surface Condition)	Remarks
	0.0							**Topsoil:** Firm, Dry, Light Brown, Sandy Lean Clay with Gravels and Cobbles.	
397.0								**Gabbro and Dark Dioritic Rocks; Chiefly Mesozoic(gb):** Very Dense, Dry, Brown, Silty to Clayey Fine Sand, Some Gravel. (SC-SM)	
	2.5		X	26 28 28	100			Very Dense, Dry, Brown, Silty to Clayey Fine Sand, Some Gravel. (SC-SM)	2.5'-4' Sieve Analysis
	5.0		X	13 20 28	100		SC-SM	Dense, Dry, Brown, Silty to Clayey Fine Sand, Some Gravel. (SC-SM)	
	7.5		X	17 36 50/3"	92			Very Dense, Dry, Brown, Silty to Clayey Fine Sand, Some Gravel. (SC-SM)	7.5'-9' Sieve Analysis
389.0									
	10.0							Auger Refusal at Approximately 9 feet. No Ground Water Encountered. Bored Hole Backfilled with Bentonite on 10/18/2007.	
	12.5								
	15.0								
	17.5								
	20.0								
	22.5								
	25.0								

BORING LOG

PSI Project No.: **070-75051**		Name of Project: **Proposed Orange Grove Power Plant**	
Address: **Pala, California**		Boring Location: **Nortwest of Existing Building Enclosure**	Elev: **Approximately 369 ft**
Boring No.: **B-13**	Total Depth **11.0'**	Logged by: **D. Ebuengan**	Drilling Equipment: **CME-75**
Type of Boring: **5"Ø DA, 4.5"Ø Air Hammer**		Started: **10/19/07** Completed: **10/19/07**	Driller: **Tri-County (Bill Klein)**

Elevation	Depth	Graphic Log	Sample Type	Sample Blows	Sample Recovery (%)	RQD (%)	USCS Classification	DESCRIPTION OF MATERIALS (Surface Condition)	Remarks
	0.0							**Topsoil:** Firm, Dry, Light Brown, Sandy Lean Clay with Gravels and Cobbles.	
368.0								**Gabbro and Dark Dioritic Rocks; Chiefly Mesozoic(gb):** Very Dense, Dry, Gray, Gravel with Sand. (GP)	
	2.5			14 50/2"	83				
	5.0			7 10 50/2"	45		GP		
	7.5								
359.0	10.0			28 50/2"	83		SC-SM	Very Dense, Dry, Light Orangish Brown, Silty to Clayey Fine Sand. (SC-SM)	
358.0									
	12.5							End of Boring at Approximately 11 feet. No Ground Water Encountered. Bored Hole Backfilled with Bentonite on 10/19/2007.	
	15.0								
	17.5								
	20.0								
	22.5								
	25.0								

BORING LOG

PSI Project No.: **070-75051**		Name of Project: **Proposed Orange Grove Power Plant**	
Address: **Pala, California**		Boring Location: **On Proposed Access Road Southwest Side**	Elev: **Approximately 368 ft**
Boring No.: **B-14**	Total Depth **11.5'**	Logged by: **D. Ebuengan**	Drilling Equipment: **CME-75**
Type of Boring: **8"Ø HSA**		Started: **9/23/07** Completed: **9/23/07**	Driller: **Tri-County (Bill Klein)**

Elevation	Depth	Graphic Log	Sample Type	Sample Blows	Sample Recovery (%)	RQD (%)	USCS Classification	DESCRIPTION OF MATERIALS (Surface Condition)	Remarks
	0.0							**Topsoil:** Firm, Dry, Reddish Brown, Sandy Lean Clay with Gravels and Cobbles. Ground Covered with Dry Low Brushes.	
366.5								**Gabbro and Dark Dioritic Rocks; Chiefly Mesozoic(gb):** Medium Dense, Dry, Reddish Brown, Clayey Fine to Medium Sand, with Gravel. (SC)	
	2.5			12 32 14	100			Dense, Dry, Reddish Brown, Clayey Fine to Medium Sand, with Gravel. (SC)	
	5.0			19 50/2"	100		SC	Very Dense, Dry, Reddish Brown, Clayey Fine to Medium Sand, with Gravel. (SC)	
	7.5			11 50/6"	100			Very Dense, Dry, Reddish Brown, Clayey Fine to Medium Sand, with Gravel. (SC)	
	10.0			12 25 25	100			Dense, Dry, Reddish Brown, Clayey Fine to Coarse Sand. (SC)	
356.5									
	12.5							End of Boring at Approximately 11.5 feet. No Ground Water Encountered. Bored Hole Backfilled with Bentonite on 10/16/2007.	
	15.0								
	17.5								
	20.0								
	22.5								
	25.0								

APPENDIX C

LABORATORY TEST METHODS AND RESULTS

LABORATORY TEST METHODS

Laboratory Testing Program

Laboratory tests were performed on representative soil samples to determine their relative engineering properties. Tests were performed in general accordance with test methods of the American Society for Testing Materials or other accepted standards. The following presents a brief description of the various test methods used.

Classification - Soils were classified visually according to the Unified Soil Classification System. Visual classifications were supplemented by laboratory testing of selected samples in accordance with ASTM D2487. The soil classifications are shown on the Exploration Log, Appendix B.

Soil Sulfate Test - In order to estimate the concrete degradation potential of soils, the content of soluble sulfates was determined in accordance with Cal Test Method 417A.

Percent Finer Than #200 Sieve – Percent Finer Than #200 Sieve analyses were performed on selected representative samples in accordance with ASTM D1140.

Particle Size Analysis - Particle Size Analyses were performed on selected representative samples in accordance with ASTM D422.

Moisture-Density Relationship - Laboratory compaction tests were performed in accordance with ASTM D1557, Method A. A mechanically-operated ram was used during the compaction process.

Direct Shear Tests - Consolidated, drained, direct shear tests were performed on 95% Remolded from bulk samples in accordance with ASTM D-3080. The remolded samples were tested in a saturated condition using normal loads of 1 ksf, 2 ksf, and 4 ksf.

Drit Test – Infiltration rate of soils in field were performed in general accordance with ASTM D 3385. This test method describes a procedure for field measurement of the rate of infiltration of liquid (typically water) into soils using double-ring infiltrometers.

Soil Resistivity Measurements – Field soil resistivity test were performed in general accordance with California Test 643 (November 1999). This test method describes a procedure for field measurement of soil resistivity. Field soil resistivity measurements were determined using four point method, which is used by the AEMC instruments Model 4610 ground tester.

LABORATORY TEST RESULTS

SOIL SULFATE TEST (CAL TEST 417A)		
SAMPLE LOCATION	**SOLUBLE SULFATES (parts per million)**	**SULFATE EXPOSURE (per ACI 318, Section 4.3)**
B-1 @ 1.0'-4.0'	ppm	849 (moderate)
B-2 @ 2.5' – 4.0'	ppm	6100 (severe)
B-7 @ 2.5' – 4.0'	ppm	3150 (severe)

PERCENT PASSING #200 SIEVE (ASTM D 1140)		
SAMPLE LOCATION	**PERCENT PASSING #200 SIEVE**	**CLASSIFICATION**
B-2 @ 2.5 – 4.0'	55.0	CL
B-4 @ 2.5 – 3.5'	44.9	CL-ML
B-7 @ 1.0 – 5.0'	44.3	CL-ML
B-7 @ 5.0 – 6.5'	61.4	CL
B-7 @ 10.0 – 11.0'	32.5	SC
B-12 @ 2.5 – 4.0'	39.2	SC-SM
B-12 @ 7.5 – 9.0'	20.9	SM

DIRECT SHEAR TEST (REMOLDED TO 95%/SATURATED) (ASTM D 3080)		
SAMPLE LOCATION	**COHESION INTERCEPT**	**ANGLE OF INTERNAL FRICTION (degrees)**
B-1 @ 1.0' – 4.0'	145 psf	32.9
B-7 @ 1.0' – 5.0'	247 psf	28.8

MAXIMUM DENSITY TEST ASTM D 1557		
SAMPLE LOCATION	**MAXIMUM DRY DENSITY (pounds per cubic foot)**	**OPTIMUM MOISTURE CONTENT (%)**
B-1 @ 1.0’ – 4.0’	132.7	8.6 %
B-7 @ 1.0’ – 5.0’	130.7	10.5 %

DRIT TEST ASTM D 3385	
TEST LOCATION	**INFILTRATION RATE**
DT-1	0.07 cm/hr
DT-2	2.41 cm/hr

FIELD RESISTIVITY TEST CALIFORNIA TEST 643 (November 1999)		
TEST LOCATION	**Distance Between Pins (feet)**	**SOIL RESISTIVITY (ohm-cm)**
R-2	2.5	106,235
	5	20,577
	10	9,379
	25	8,614 (moderately corrosive)
	50	22,970
	100	135,900
R-1	2.5	106,714
	5	8,231
	10	6,317
	25	4,785 (corrosive)
	50	13,399
	100	57,424

DIRECT SHEAR TEST REGRESSION ANALYSIS
ASTM D 3080
CURVE FIT BY LEAST SQUARES METHOD

PROJECT: Proposed Orange Grove Power Plant
PROJECT NO.: 070-75051
DATE: 11/12/2007

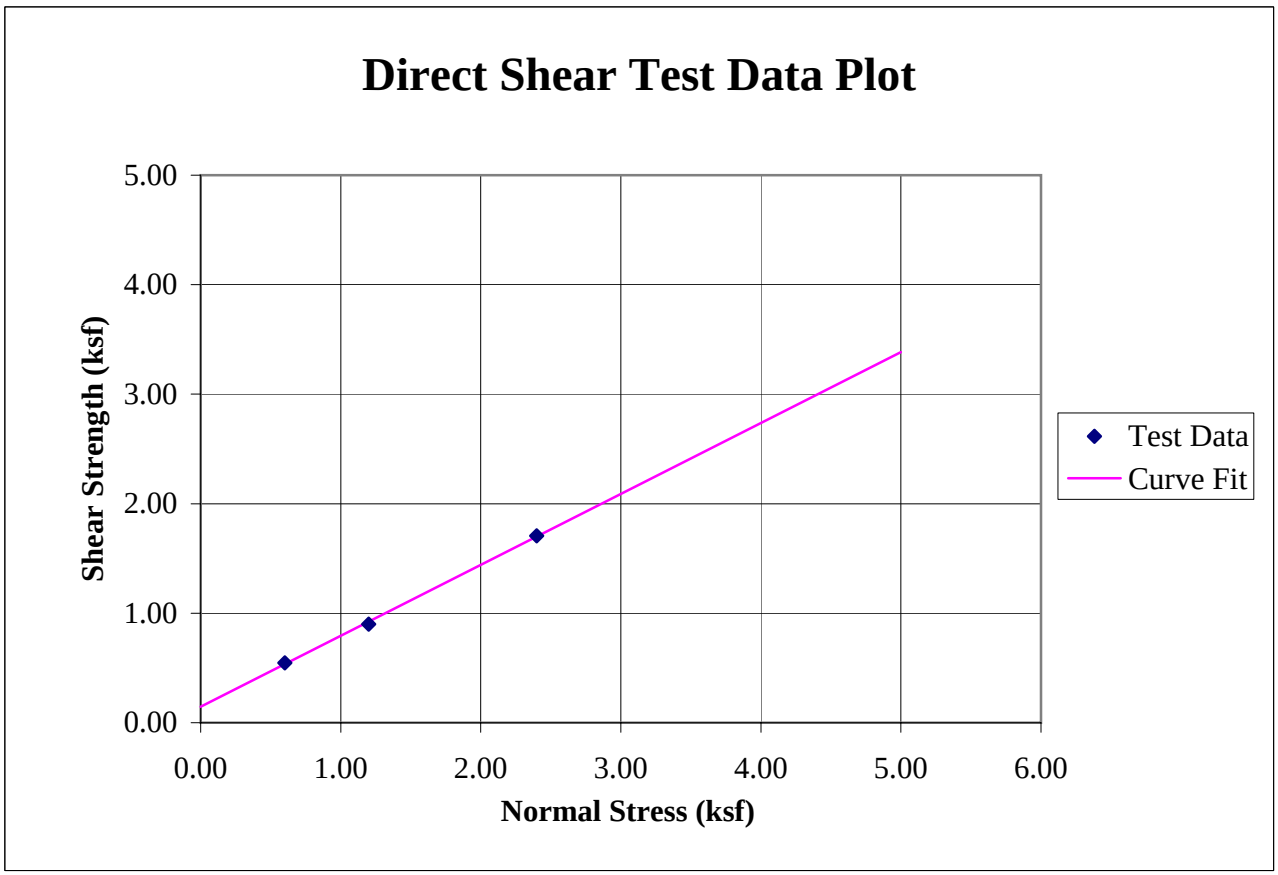
BORING NO.: B-1
DEPTH: 1'-4'
SAMPLE TYPE: Remolded to Appox. 95%
MOISTURE: Saturated

DATA POINTS

X (ksf)	Y (ksf)
0.60	0.55
1.20	0.90
2.40	1.71

RESULTS

Angle *phi* = 32.9 degrees
Cohesion = 145 lb/sq ft



* Shear stress at 0.20 inches of horizontal displacement used as max shear stress.

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DIRECT SHEAR TEST REGRESSION ANALYSIS
ASTM D 3080
CURVE FIT BY LEAST SQUARES METHOD

PROJECT: Proposed Orange Grove Power Plant
PROJECT NO.: 070-75051
DATE: 11/12/2007

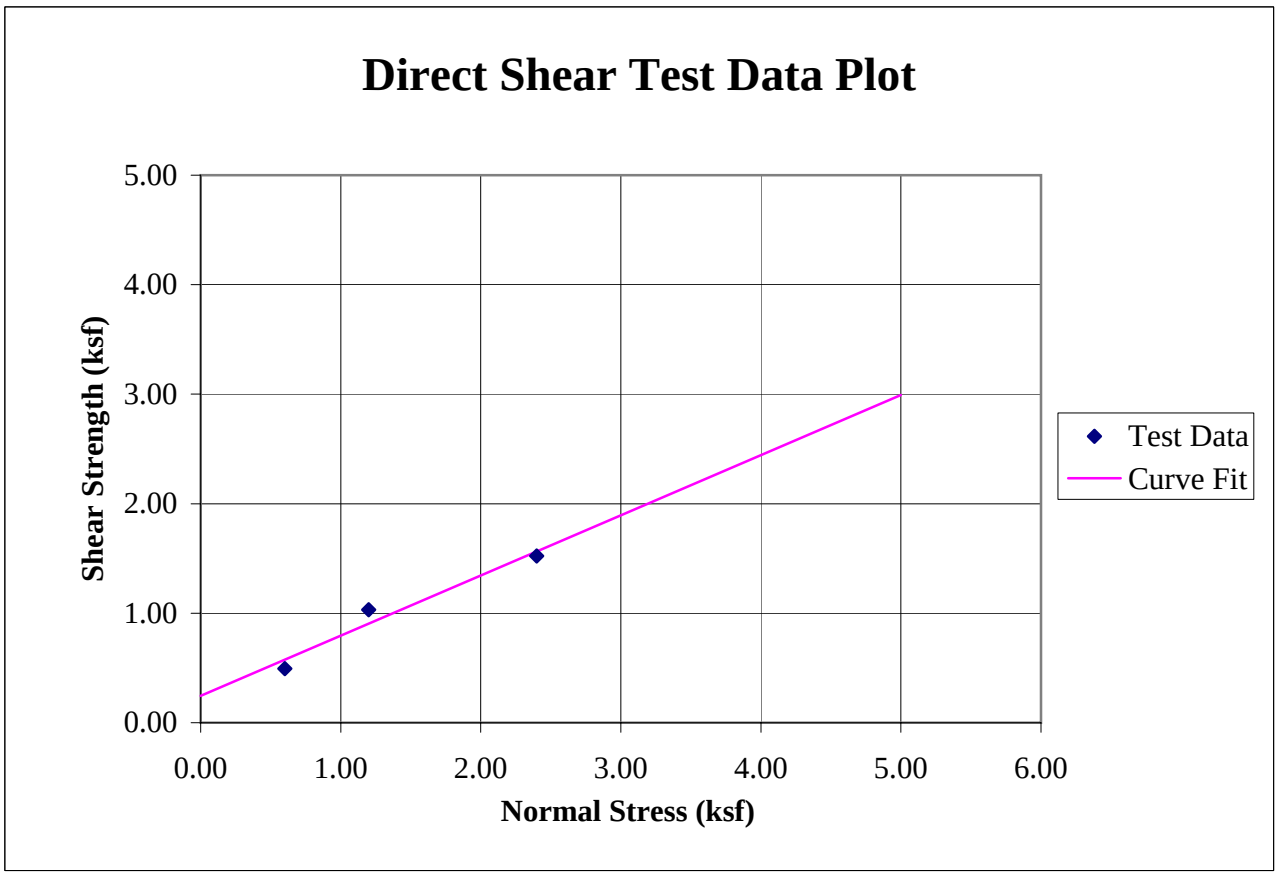
BORING NO.: B-7
DEPTH: 1'-5'
SAMPLE TYPE: Remolded to Appox. 95%
MOISTURE: Saturated

DATA POINTS

X (ksf)	Y (ksf)
0.60	0.49
1.20	1.03
2.40	1.52

RESULTS

Angle *phi* = 28.8 degrees
Cohesion = 247 lb/sq ft



* Shear stress at 0.20 inches of horizontal displacement used as max shear stress.

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Information To Build On
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Report of Moisture Density Relationship of Soil
ASTM D 1557

Tested For : Remolded Direct Shear

Project: Proposed Orange Grove Power Plant

Date: 11/12/07

Report No.: 070-75051

Lab Report No.:

Test Data

Visual Classification: Reddish Brown Silty to Clayey SAND (Mat'l Passing #4 Sieve)

Sample Source: B-1 @ 1'-4' (Bulk)

Test Results

Maximum Dry Density: 132.7 lbs/ft^3

Optimum Moisture Content: 8.6 %

Lab Tech.: Darlino Ebuengan

Method of Determination:

Mold Size: 4 in. dia.

Hammer: 10 lb.

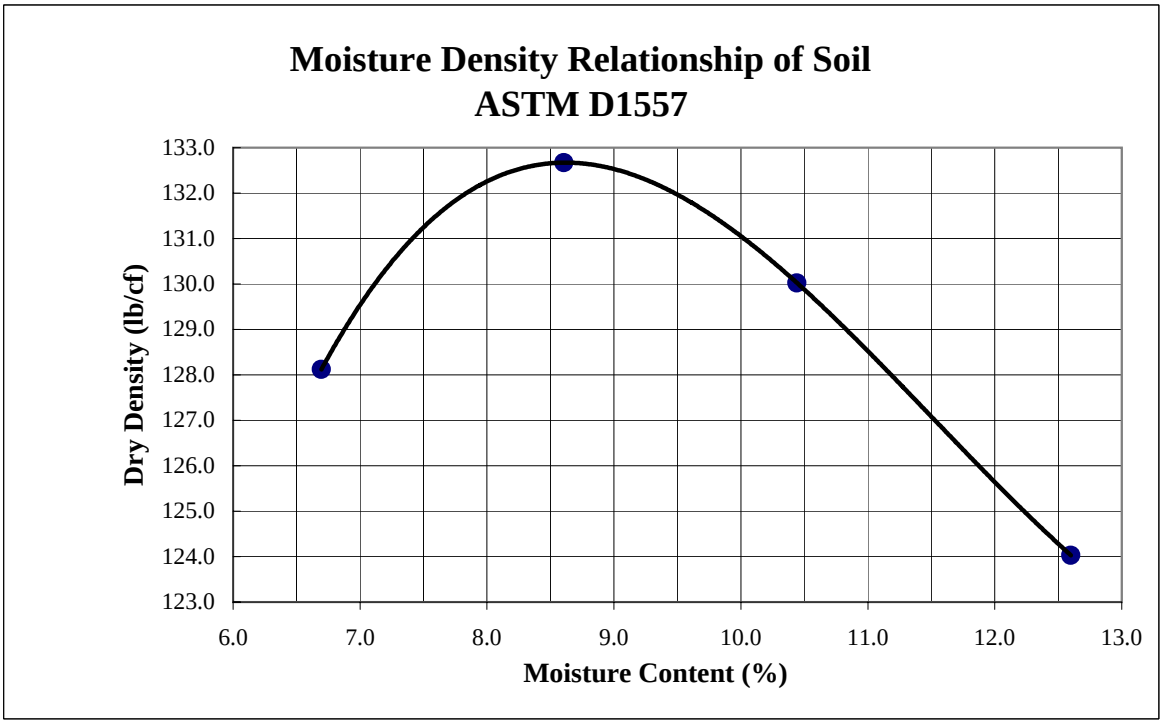
Hammer drop: 18 in.

Soil Layers: 5

Blows/layer: 25

Preparation Method: Wet Dry

Rammer Type: Mechanical Manual



Respectfully Submitted,
Professional Service Industries, Inc.

Md Shaheed, P.E.
Geotechnical Services Dept. Manager

Information To Build On
Engineering • Consulting • Testing

Report of Moisture Density Relationship of Soil
ASTM D 1557

Tested For : Remolded Direct Shear

Project: Proposed Orange Grove Power Plant

Date: 11/13/07

Report No.: 070-75051

Lab Report No.:

Test Data

Visual Classification: Reddish Brown Silty to Clayey SAND (Mat'l Passing #4 Sieve)

Sample Source: B-7 @ 1'-5' (Bulk)

Test Results

Maximum Dry Density: 130.7 lbs/ft^3

Optimum Moisture Content: 10.5 %

Lab Tech.: Darlino Ebuengan

Method of Determination:

Mold Size: 4 in. dia.

Hammer: 10 lb.

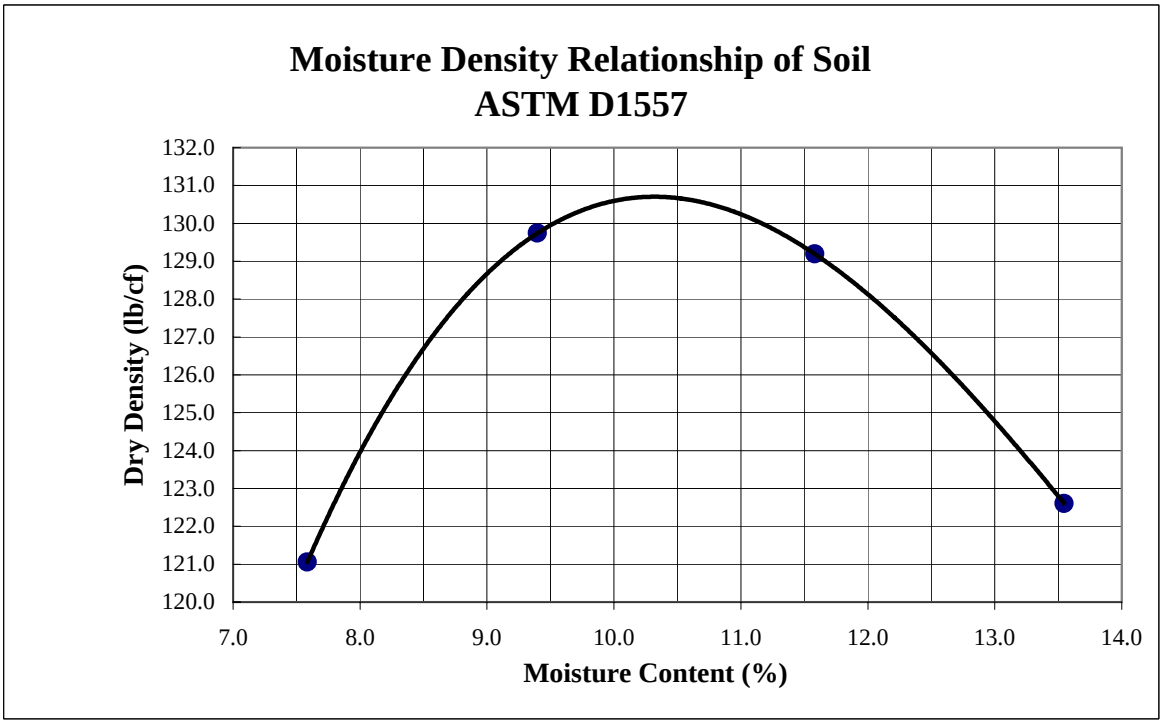
Hammer drop: 18 in.

Soil Layers: 5

Blows/layer: 25

Preparation Method: Wet Dry

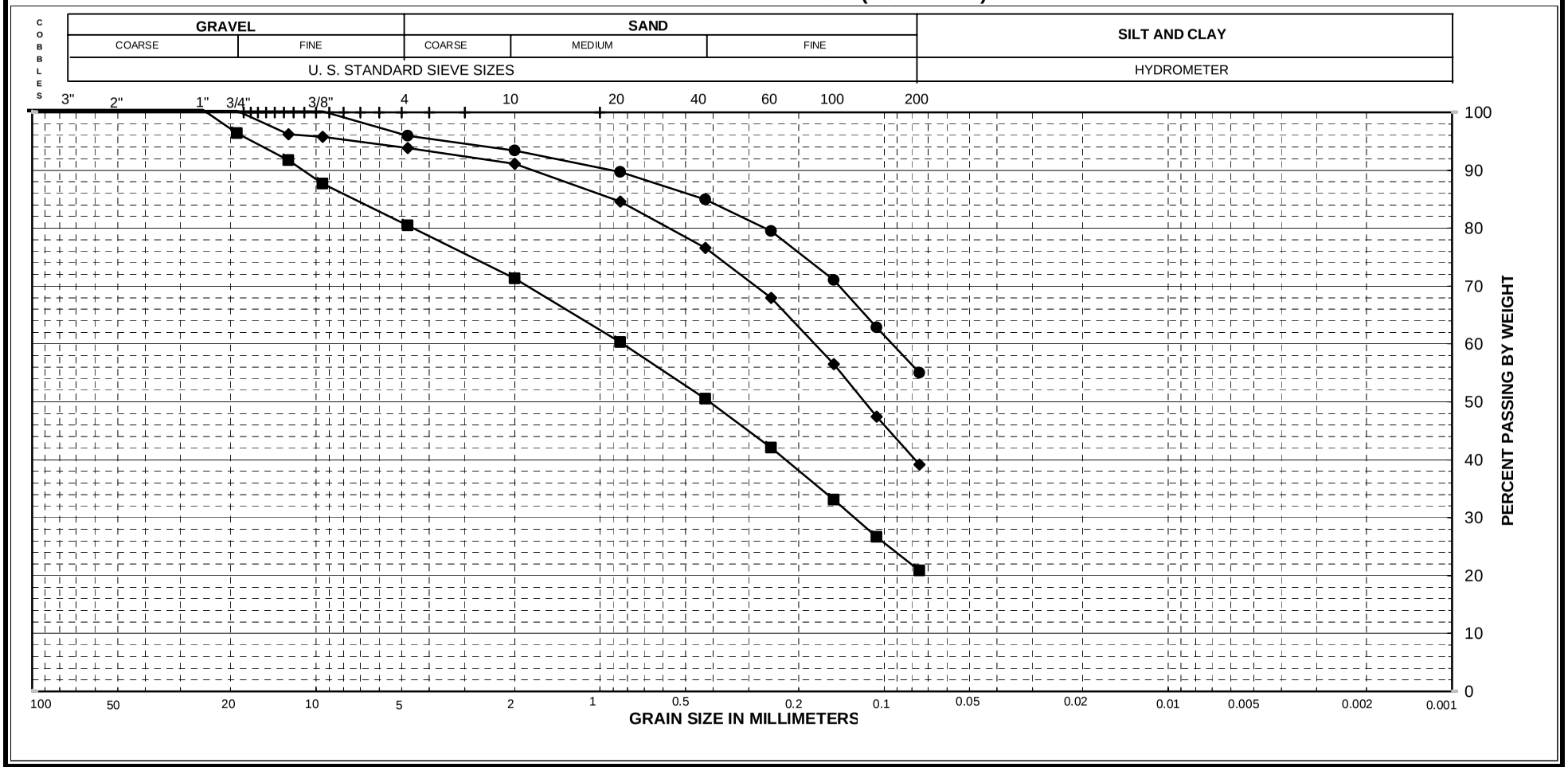
Rammer Type: Mechanical Manual



Respectfully Submitted,
Professional Service Industries, Inc.

Md Shaheed, P.E.
Geotechnical Services Dept. Manager

PARTICLE-SIZE ANALYSIS (ASTM D422)



Location	Sample No.	Depth	SYMBOL	Wn* (%)	LL**	PI**	%Cobbles	% Gravel	% Sand	% Fines	Unified Soil Classification (ASTM D2487)	D_{max}	D_{60}	D_{30}	D_{10}	C_u	C_c
B-2		2.5'-4.0'	●	12.9			0.0	4.2	41.0	55.0	**Sandy Lean Clay (CL)**						
B-12		2.5'-4.0'	◆	8.0			0.0	6.4	54.7	39.2	**Silty, Clayey Sand (SC-SM)**						
B-12		7.5'-9'	■	7.1			0.0	19.9	59.6	20.9	**Silty Sand with Gravel (SM)**						

PROJECT NAME: **Proposed Orange Grove Power Plant**

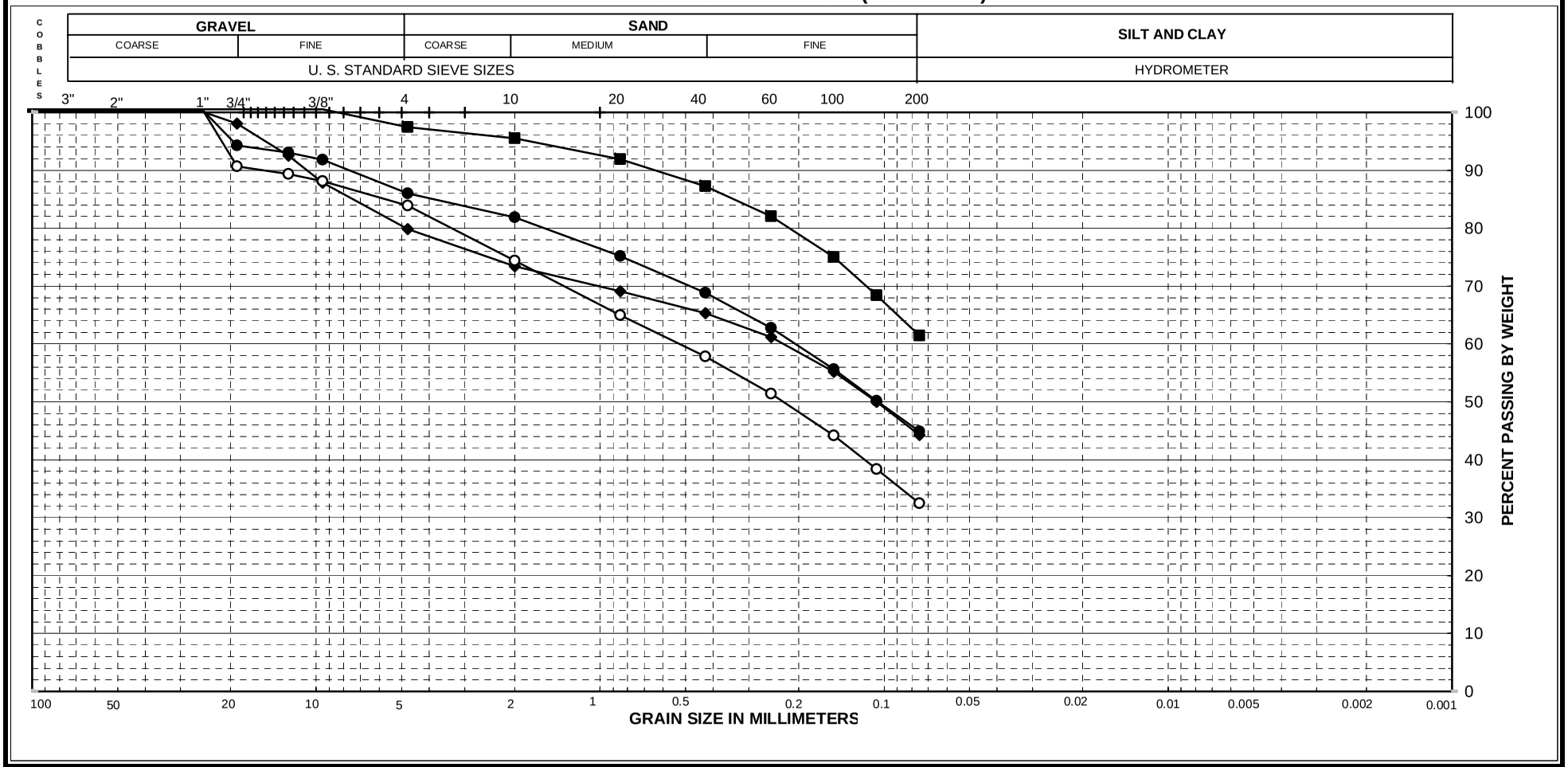
PROJECT NUMBER: **070-75051**

PARTICLE-SIZE DISTRIBUTION CURVES

*Water (moisture) content of sample determined in general accordance with ASTM D2216

** Liquid Limit (LL) and Plasticity Index (PI) determined in general accordance with ASTM D 4318

PARTICLE-SIZE ANALYSIS (ASTM D422)



Location	Sample No.	Depth	SYMBOL	Wn* (%)	LL**	PI**	%Cobbles	% Gravel	% Sand	% Fines	Unified Soil Classification (ASTM D2487)	D_{max}	D_{60}	D_{30}	D_{10}	C_u	C_c
B-4		2.5'-3.5'	●	12.7			0.0	14.4	41.0	44.9	**Sandy Silty Clay (CL-ML)**						
B-7		1.0'-5.0'	◆	3.2			0.0	20.3	35.5	44.3	**Sandy Silty Clay with Gravel (CL-ML)**						
B-7		5.0'-6.5'	■	15.2			0.0	3.0	36.1	61.4	**Sandy Lean Clay (CL)**						
B-7		10'-11'	❍	9.1			0.0	16.5	51.4	32.5	**Clayey Sand with Gravel (SC)**						

PROJECT NAME: **Proposed Orange Grove Power Plant**

PROJECT NUMBER: **070-75051**

PARTICLE-SIZE DISTRIBUTION CURVES

*Water (moisture) content of sample determined in general accordance with ASTM D2216

** Liquid Limit (LL) and Plasticity Index (PI) determined in general accordance with ASTM D 4318

APPENDIX D

STANDARD GUIDELINES FOR GRADING PROJECTS

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GENERAL

The guidelines contained herein and the standard details attached hereto represent this firm's standard recommendation for grading and other associated operations on construction projects. These guidelines should be considered a portion of the project specifications.

All plates attached hereto shall be considered as part of these guidelines.

The Contractor should not vary from these guidelines without prior recommendation by the Geotechnical Consultant and the approval of the Client or his authorized representative. Recommendation by the Geotechnical Consultant and/or Client should not be considered to preclude requirements for the approval by the controlling agency prior to the execution of any changes.

These Standard Grading Guidelines and Standard Details may be modified and/or superseded by recommendations contained in the text of the preliminary Geotechnical Report and/or subsequent reports.

If disputes arise out of the interpretation of these grading guidelines or standard details, the Geotechnical Consultant shall provide the governing interpretation.

DEFINITION OF TERMS

ALLUVIUM – Unconsolidated soil deposits resulting from flow of water, including sediments deposited in river beds, canyons, flood plains, lakes, fans and estuaries.

AS-GRADED (AS-BUILT) – The surface and subsurface conditions at completion of grading.

BACKCUT – A temporary construction slope at the rear of earth retaining structures such as buttresses, shear keys, stabilization fills or retaining walls.

BACKDRAIN – Generally a pipe and gravel or similar drainage system placed behind earth retaining structures such buttresses, stabilization fills, and retaining walls.

BEDROCK – Relatively undisturbed formational rock, more or less solid, either at the surface or beneath superficial deposits of soil.

BENCH – A relatively level step and near vertical rise excavated into sloping ground on which fill is to be placed.

BORROW (Import) – Any fill material hauled to the project site from off-site areas.

BUTTRESS FILL – A fill mass, the configuration of which is designed by engineering calculations to retain slope conditions containing adverse geologic features. A buttress is generally specified by minimum key width and depth and by maximum backcut angle. A buttress normally contains a back-drainage system.

CIVIL ENGINEER – The Registered Civil Engineer or consulting firm responsible for preparation of the grading plans, surveying and verifying as-graded topographic conditions.

CLIENT – The Developer or his authorized representative who is chiefly in charge of the project. He shall have the responsibility of reviewing the findings and recommendations made by the Geotechnical Consultant and shall authorize the Contractor and/or other consultants to perform work and/or provide services.

COLLUVIUM – Generally loose deposits usually found near the base of slopes and brought there chiefly by gravity through slow continuous downhill creep (also see Slope Wash).

COMPACTION – Densification of man-placed fill by mechanical means.

CONTRACTOR – A person or company under contract or otherwise retained by the Client to perform demolition, grading and other site improvements.

DEBRIS – All products of clearing, grubbing, demolition, and contaminated soil materials unsuitable for reuse as compacted fill, and/or any other material so designated by the Geotechnical Consultant.

ENGINEERING GEOLOGIST – A Geologist holding a valid certificate of registration in the specialty of Engineering Geology.

ENGINEERED FILL – A fill of which the Geotechnical Consultant or his representative, during grading, has made sufficient tests to enable him to conclude that the fill has been placed in substantial compliance with the recommendations of the Geotechnical Consultant and the governing agency requirements.

EROSION - The wearing away of ground surface as a result of the movement of wind, water, and/or ice.

EXCAVATION – The mechanical removal of earth materials.

EXISTING GRADE – The ground surface configuration prior to grading.

FILL – Any deposits of soil, rock, soil-rock blends or other similar materials placed by man.

FINISH GRADE – The ground surface configuration at which time the surface elevations conform to the approved plan.

GEOFABRIC – Any engineering textile utilized in geotechnical applications including subgrade stabilization and filtering.

GEOLOGIST – A representative of the Geotechnical Consultant educated and trained in the field of geology.

GEOTECHNICAL CONSULTANT – The Geotechnical Engineering and Engineering Geology consulting firm retained to provide technical services for the project. For the purpose of these specifications, observations by the Geotechnical Consultant include observations by the Soil Engineer, Geotechnical Engineer, Engineering Geologist and those performed by persons employed by and responsible to the Geotechnical Consultants.

GEOTECHNICAL ENGINEER – A licensed Geotechnical Engineer or Civil Engineer who applies scientific methods, engineering principles and professional experience to the acquisition, interpretation and use of knowledge of materials of the earth's crust for the evaluation of engineering problems. Geotechnical Engineering encompasses many of the engineering aspects of soil mechanics, rock mechanics, geology, geophysics, hydrology and related sciences.

GRADING – Any operation consisting of excavation, filling or combinations thereof and associated operations.

LANDSIDE DEBRIS – Material, generally porous and of low density, produced from instability of natural or man-made slopes.

MAXIMUM DENSITY – Standard laboratory test for maximum dry unit weight. Unless otherwise specified, the maximum dry unity weight shall be determined in accordance with ASTM Method of Test D 1557-91.

OPTIMUM MOISTURE – Soil moisture content at the test maximum density.

RELATIVE COMPACTION – The degree of compaction (expressed as a percentage) of dry unit weight of a material as compared to the maximum dry unit weight of the material.

ROUGH GRADE – The ground surface configuration at which time the surface elevations approximately conform to the approved plan.

SITE - The particular parcel of land where grading is being performed.

SHEAR KEY – Similar to buttress, however, it is generally constructed by excavating a slot within a natural slope, in order to stabilize the upper portion of the slope without grading encroaching into the lower portion of the slope.

SLOPE – An inclined ground surface, the steepness of which is generally specified as a ration of horizontal:vertical (e.g., 2:1)

SLOPE WASH – Soil and/or rock material that has been transported down a slope by action of gravity assisted by runoff water not confined by channels (also see Colluvium).

SOIL – Naturally occurring deposits of sand, silt, clay, etc., or combinations thereof.

SOIL ENGINEER – Licensed Geotechnical Engineer or Civil Engineer experienced in soil mechanics (also see Geotechnical Engineer).

STABILIZATION FILL – A fill mass, the configuration of which is typically related to slope height and specified by the standards of practice for enhancing the stability of locally adverse conditions. A stabilization fill is normally specified by minimum key width and depth and by maximum backcut angle. A stabilization fill may or may not have a backdrainage system specified.

SUBDRAIN – Generally a pipe and gravel or similar drainage system placed beneath a fill in the alignment of canyons or formed drainage channels.

SLOUGH – Loose, non-compacted fill material generated during grading operations.

TAILINGS – Non-engineered fill which accumulates on or adjacent to equipment haul-roads.

TERRACE – Relatively level step constructed in the face of a graded slope surface for drainage control and maintenance purposes.

TOPSOIL – The presumable fertile upper zone of soil, which is usually darker in color and loose.

WINDROW – A string of large rocks buried within engineered fill in accordance with guidelines set forth by the Geotechnical Consultant.

OBLIGATIONS OF PARTIES

The Geotechnical Consultant should provide observation and testing services and should make evaluations in order to advise the Client on Geotechnical matters. The Geotechnical Consultant should report his findings and recommendations to the Client or his authorized representative.

The client should be chiefly responsible for all aspects of the project. He or his authorized representative has the responsibility of reviewing the findings and recommendations of the Geotechnical Consultant. He shall authorize or cause to have authorized the Contractor and/or other consultants to perform work and/or provide services. During grading the Client or his authorized representative should remain on-site or should remain reasonably accessible to all concerned parties in order to make decisions necessary to maintain the flow of the project.

The Contractor should be responsible for the safety of the project and satisfactory completion of all grading and other associated operations on construction projects, including but not limited to, earthwork in accordance with the project plans, specifications and controlling agency requirements. During grading, the Contractor or his authorized representative should remain on-site. Overnight and on days off, the Contractor should remain accessible.

SITE PREPARATION

The Client, prior to any site preparation or grading, should arrange and attend a meeting among the Grading Contractor, the Design Engineer, the Geotechnical Consultant, representatives of the appropriate governing authorities as well as any other concerned parties. All parties should be given at least 48 hours notice.

Clearing and grubbing should consist of the removal of vegetation such as brush, grass, woods, stumps, trees, roots of trees and otherwise deleterious natural materials from the areas to be graded. Clearing and grubbing should extend to the outside of all proposed excavation and fill areas.

Demolition should include removal of buildings, structures, foundations, reservoirs, utilities (including underground pipelines, septic tanks, leach fields, seepage pits, cisterns, mining shafts, tunnels, etc.) and man-made surface and subsurface improvements from the areas to be graded. Demolition of utilities should include proper capping and/or re-routing pipelines at the project perimeter and cutoff and capping of wells in accordance with the requirements of the governing authorities and the recommendations of the Geotechnical Consultant at the time of the demolition.

Trees, plants or man-made improvements not planned to be removed or demolished should be protected by the Contractor from damage or injury.

Debris generated during clearing, grubbing and/or demolition operations should be wasted from areas to be graded and disposed off-site. Clearing, grubbing and demolition operations should be performed under the observation of the Geotechnical Consultant.

The Client or Contractor should obtain the required approvals for the controlling authorities for the project prior, during and/or after demolition, site preparation and removals, etc. The appropriate approvals should be obtained prior to proceeding with grading operations.

SITE PROTECTION

Protection of the site during the period of grading should be the responsibility of the Contractor. Unless other provisions are made in writing and agreed upon among the concerned parties, completion of a portion of the project should not be considered to preclude that portion or adjacent areas from the requirements for site protection until such time as the entire project is complete as identified by the Geotechnical Consultant, the Client and the regulating agencies.

The Contractor should be responsible for the stability of all temporary excavations. Recommendations by the Geotechnical Consultant pertaining to temporary excavations (e.g., backcuts) are made in consideration of stability of the completed project and therefore, should not be considered to preclude the responsibilities of the Contractor. Recommendations by the Geotechnical Consultant should not be considered to preclude more restrictive requirements by the regulating agencies.

Precautions should be taken during the performance of site clearing, excavations and grading to protect the work site from flooding, ponding, or inundation by poor or improper surface drainage. Temporary provisions should be made during the rainy season to adequately direct surface drainage away from and off the work site. Where low areas can not be avoided, pumps should be kept on hand to continually remove water during periods of rainfall.

During periods of rainfall, plastic sheeting should be kept reasonably accessible to prevent unprotected slopes from becoming saturated. Where necessary during periods of rainfall, the Contractor should install check-dams de-silting basins, rip-rap, sandbags or other devices or methods necessary to control erosion and provide safe conditions.

During periods of rainfall, the Geotechnical Consultant should be kept informed by the Contractor as to the nature of remedial or preventative work being performed (e.g., pumping, placement of sandbags or plastic sheeting, other labor, dozing, etc.).

Following periods of rainfall, the Contractor should contact the Geotechnical Consultant and arrange a walk-over of the site in order to visually assess rain related damage. The Geotechnical Consultant may also recommend excavations and testing in order to aid in his assessments. At the request of the Geotechnical Consultant, the Contractor shall make excavations in order to evaluate the extent of rain related damage.

Rain-related damage should be considered to include, but may not be limited to, erosion, silting, saturation, swelling, structural distress and other adverse conditions identified by the Geotechnical Consultant. Soil adversely affected should be classified as Unsuitable Materials and should be subject to overexcavation and replaced with compacted fill or other remedial grading as recommended by the Geotechnical Consultant.

Relatively level areas, where saturated soils and/or erosion gullies exist to depths greater then 1 foot, should be overexcavated to unaffected, competent material. Where less than 1 foot in depth, unsuitable materials may be processed in-place to achieve near optimum moisture conditions, then thoroughly recompacted in accordance with the applicable specifications. If the desired results are not achieved, the affected materials should be overexcavated then replaced in accordance with the applicable specifications.

In slope areas, where saturated soil and/or erosion gullies exist to depths of greater than 1 foot, should be over-excavated to unaffected, competent material. Where affected materials exist to depths of 1 foot or less below proposed finished grade, remedial grading by moisture conditioning in-place, followed by thorough recompaction in accordance with the applicable grading guidelines herein may be attempted. If the desired results are not achieved, all affected materials should be overexcavated and replaced as compacted fill in accordance with the slope repair recommendations herein. As field conditions dictate, other slope repair procedures may be recommended by the Geotechnical Consultant.

EXCAVATIONS

Unsuitable Materials

Materials which are unsuitable should be excavated under observation and recommendations of the Geotechnical Consultant. Unsuitable materials include, but may not be limited to dry, loose, soft, wet, organic compressible natural soils and fractured, weathered, soft, bedrock and nonengineered or otherwise deleterious fill materials.

Materials identified by the Geotechnical Consultant as unsatisfactory due to its moisture conditions should be overexcavated, watered or dried, as needed, and thoroughly blended to uniform near optimum moisture condition (per Moisture guidelines presented herein) prior to placement as compacted fill.

Cut Slopes

Unless otherwise recommended by the Geotechnical Consultant and approved by the regulating agencies, permanent cut slopes should not be steeper than 2:1 (horizontal:vertical).

If excavations for cut slopes expose loose, cohesionless, significantly fractured or otherwise suitable material, overexcavation and replacement of the unsuitable materials

with a compacted stabilization fill should be accomplished as recommended by the Geotechnical Consultant. Unless otherwise specified by the Geotechnical Consultant, stabilization fill construction should conform to the requirements of the Standard Details.

The Geotechnical Consultant should review cut slopes during excavation. The Geotechnical Consultant should be notified by the contractor prior to beginning slope excavations.

If during the course of grading, adverse or potentially adverse geotechnical conditions are encountered which were not anticipated in the preliminary report, the Geotechnical Consultant should explore, analyze and make recommendations to treat these problems.

When cuts slopes are made in the direction of the prevailing drainage, a non-erodible diversion swale (brow ditch) should be provided at the top-of-cut.

Pad Areas

All lot pad areas, including side yard terraces, above stabilization fills or buttresses should be over-excavated to provide for a minimum of 3-feet (refer to Standard Details) of compacted fill over the entire pad area. Pad areas with both fill and cut materials exposed and pad areas containing both very shallow (less than 3-feet) and deeper fill should be over- thickness (refer to Standard Details). Cut areas exposing significantly varying material types should also be overexcavated to provide for at least a 3-foot thick compacted fill blanket. Geotechnical conditions may require greater depth of overexcavation. The actual depth should be delineated by the Geotechnical Consultant during grading.

For pad areas created above cut or natural slopes, positive drainage should be established away from the top-of-slope. This may be accomplished utilizing a berm and/or an appropriate pad gradient. A gradient in soil areas away from the top-of-slope of 2 percent or greater is recommended.

COMPACTED FILL

All fill materials should be compacted as specified below or by other methods specifically recommended by the Geotechnical Consultant. Unless otherwise specified, the minimum degree of compaction (relative compaction) should be 90 percent of the laboratory maximum density.

Placement

Prior to placement of compacted fill, the Contractor should request a review by the Geotechnical Consultant of the exposed ground surface. Unless otherwise recommended, the exposed ground surface should then be scarified (6-inches minimum), watered or dried as needed, thoroughly blended to achieve near optimum moisture

conditions, then thoroughly compacted to a minimum of 90 percent of the maximum density. The review by the Geotechnical Consultants should not be considered to preclude requirements of inspection and approval by the governing agency.

Compacted fill should be placed in thin horizontal lifts not exceeding 8-inches in loose thickness prior to compaction. Each lift should be watered or dried as needed, thoroughly blended to achieve near optimum moisture conditions then thoroughly compacted by mechanical methods to a minimum of 90 percent of laboratory maximum dry density. Each lift should be treated in a like manner until the desired finished grades are achieved.

The Contractor should have suitable and sufficient mechanical compaction equipment and watering apparatus on the job site to handle the amount of fill being placed in consideration of moisture retention properties of the materials. If necessary, excavation equipment should be "shut down" temporarily in order to permit proper compaction of fills. Earth moving equipment should only be considered a supplement and not substituted for conventional compaction equipment.

When placing fill in horizontal lifts adjacent to areas sloping steeper than 5:1 (horizontal:vertical), horizontal keys and vertical benches should be excavated into the adjacent slope area. Keying and benching should be sufficient to provide at least 6-foot wide benches and minimum of 4-feet of vertical bench height within the firm natural ground, firm bedrock or engineered compacted fill. No compacted fill should be placed in an area subsequent to keying and benching until the area has been reviewed by the Geotechnical Consultant. Material generated by the benching operation should be moved sufficiently away from the bench area to allow for the recommended review of the horizontal bench prior to placement of fill. Typical keying and benching details have been included within the accompanying Standard Details.

Within a single fill area where grading procedures dictate two or more separate fills, temporary slopes (false slopes) may be created. When placing fill adjacent to a false slope, benching should be conducted in the same manner as above described. At least a 3-foot vertical bench should be established within the firm core of adjacent approved compacted fill prior to placement of additional fill. Benching should proceed in at least 3-foot vertical increments until the desired finished grades are achieved.

Fill should be tested for compliance with the recommended relative compaction and moisture conditions. Field density testing should conform to ASTM Method of Testing D 1556-64, D 2922-78 and/or D2937-71. Tests should be provided for about every 2 vertical feet or 1,000 cubic yards of fill placed. Actual test intervals may vary as field conditions dictate. Fill found not to be in conformance with the grading recommendations should be removed or otherwise handled as recommended by the Geotechnical Consultant.

The Contractor should assist the Geotechnical Consultant and/or his representative by digging test pits for removal determinations and/or for testing compacted fill.

As recommended by the Geotechnical Consultant, the Contractor should "shutdown" or remove any grading equipment from an area being tested.

The Geotechnical Consultant should maintain a plan with estimated locations of field tests. Unless the client provides for actual surveying of test locations, by the Geotechnical Consultant should only be considered rough estimates and should not be utilized for the purpose of preparing cross sections showing test locations or in any case for the purpose of after-the-fact evaluating of the sequence of fill placement.

Moisture

For field testing purposes, "near optimum" moisture will vary with material type and other factors including compaction procedures. "Near optimum" may be specifically recommended in Preliminary Investigation Reports and/or may be evaluated during grading.

Prior to placement of additional compacted fill following an overnight or other grading delay, the exposed surface of previously compacted fill should be processed by scarification, watered or dried as needed, thoroughly blended to near-optimum moisture conditions, then recompacted to a minimum of 90 percent of laboratory maximum dry density. Where wet or other dry or other unsuitable materials exist to depths of greater than one foot, the unsuitable materials should be overexcavated.

Following a period of flooding, rainfall or overwatering by other means, no additional fill should be placed until damage assessments have been made and remedial grading performed as described herein.

Fill Material

Excavated on-site materials which are acceptable to the Geotechnical Consultant may be utilized as compacted fill, provided trash, vegetation and other deleterious materials are removed prior to placement.

Where import materials are required for use on-site, the Geotechnical Consultant should be notified at least 72 hours in advance of importing, in order to sample and test materials from proposed borrow sites. No import materials should be delivered for use on-site without prior sampling and testing by Geotechnical Consultant.

Where oversized rock or similar irreducible material is generated during grading, it is recommended, where practical, to waste such material off-site or on-site in areas designated as "nonstructural rock disposal areas". Rock placed in disposal areas should be placed with sufficient fines to fill voids. The rock should be compacted in lifts to an

unyielding condition. The disposal area should be covered with at least 3-feet of compacted fill, which is free of oversized material. The upper 3-feet should be placed in accordance with the guidelines for compacted fill herein.

Rocks 12 inches in maximum dimension and smaller may be utilized within the compacted fill, provided they are placed in such a manner that nesting of the rock in avoided. Fill should be placed and thoroughly compacted over and around all rock. The amount of rock should not exceed 40 percent by dry weight passing the ¾-inch sieve size. The 12-inch and 40 percent recommendations herein may vary as field conditions dictate.

During the course of grading operations, rocks or similar irreducible materials greater than 12-inch maximum dimension (oversized material) may be generated. These rocks should not be placed within the compacted fill unless placed as recommended by the Geotechnical Consultant.

Where rocks or similar irreducible materials of greater that 12-inches but less than 4-feet of maximum dimension are generated during grading, or otherwise desired to be placed within an engineered fill, special handling in accordance with the accompanying Standard Details is recommended. Rocks greater than 4 feet should be broken down or disposed off-sire. Rocks up to 4-feet maximum dimension should be placed below the upper 10-feet of any fill and should not be closer than 20-feet to any slope face. These recommendations could vary as locations of improvements dictate. Where practical, oversized material should not be placed below areas where structures of deep utilities are proposes.

Oversized material should be placed in windrows on a clean, overexcavated or unyielding compacted fill or firm natural ground surface. Select native or imported granular soil (S.E. 30 or higher) should be placed and thoroughly flooded over and around all windrowed rock, such that voids are filled. Windrows of oversized material should be staggered so that successive strata of oversized material are not in the same vertical plane.

It may be possible to dispose of individual larger rock as field conditions dictate and as recommended by the Geotechnical Consultant at time of placement.

Material that is considered unsuitable by the Geotechnical Consultant should not be utilized in the compacted fill.

During grading operations, placing and mixing the materials from the cut and/or borrow areas may result in soil mixtures which possess unique physical properties. Testing may be required of samples obtained directly from the fill areas in order to verify conformance with the specifications. Processing of these additional samples may take two or more working days. The Contractor may elect to move the operation to other areas within the project, or may continue placing compacted fill pending laboratory and field test results. Should he elect the second alternative, fill placed is done so at the Contractor’s risk.

Any fill placed in areas not previously reviewed and evaluated by the Geotechnical Consultant, and/or in other areas, without prior notification to the Geotechnical Consultant may require removal and recompaction at the Contractor's expense. Determination of overexcavations should be made upon review of field conditions by the Geotechnical Consultant.

Fill Slopes

Unless otherwise recommended by the Geotechnical Consultant and approved by the regulating agencies, permanent fill slopes should not be steeper than 2:1 (horizontal to vertical).

Except as specifically recommended otherwise or as otherwise provided for in these grading guidelines (Reference Fill Materials), compacted fill slopes should be overbuilt and cut back to grade, exposing the firm, compacted fill inner core. The actual amount of overbuilding may vary as field conditions dictate. If the desired results are not achieved, the existing slopes should be overexcavated and reconstructed under the guidelines of the Geotechnical Consultant. The degree of overbuilding shall be increased until the desired compacted slope surface condition is achieved. Care should be taken by the Contractor to provide thorough mechanical compaction to the outer edge of the overbuilt slope surface.

Although no construction procedure produces a slope free from risk of future movement, overfilling and cutting back of slope to a compacted inner core is, given no other constraints, the most desirable procedure. Other constraints, however, must often be considered. These constraints may include property line situations, access, the critical nature of the development, and cost. Where such constraints are identified, slope face compaction may be attempted by conventional construction procedures including backrolling techniques upon specific recommendations by the Geotechnical Consultant.

As a second best alternative for slopes of 2:1 (horizontal to vertical) or flatter, slope construction may be attempted as outlined herein. Fill placement should proceed in thin lifts, (i.e., 6 to 8 inch loose thickness). Each lift should be moisture conditioned and thoroughly compacted. The desired moisture condition should be maintained and/or reestablished, where necessary, during the period between successive lifts. Selected lifts should be tested to ascertain that desired compaction is being achieved. Care should be taken to extend compactive effort to the outer edge of the slope. Each lift should extend horizontally to the desired finished slope surface or more as needed to ultimately establish desired grades. Grade during construction should not be allowed to roll off at the edge of the slope. It may be helpful to elevate slightly the outer edge of the slope. Slough resulting from the placement of individual lifts should not be allowed to drift down over previous lifts. At intervals not exceeding 4-feet in vertical slope height or the capability of available equipment, whichever is less, fill slopes should be thoroughly backrolled utilizing a conventional sheepsfoot-type roller. Care should be taken to maintain the desired moisture conditions and/or reestablishing same as needed prior to backrolling. Upon achieving final grade, the slopes should again be moisture conditioned

and thoroughly backrolled. The use of a side-boom roller will probably be necessary and vibratory methods are strongly recommended. Without delay, so as to avoid (if possible) further moisture conditioning, the slopes should then be grid-rolled to achieve a relatively smooth surface and uniformly compact condition.

In order to monitor slope construction procedures, moisture and density tests will be taken at regular intervals. Failure to achieve the desired results will likely result in a recommendation by the Geotechnical Consultant to overexcavate the slope surfaces followed by reconstruction of the slopes utilizing overfilling and cutting back procedures and/or further attempt at the conventional backrolling approach. Other recommendations may also be provided which would be commensurate with field conditions.

Where placement of fill above a natural slope or above a cut slope is proposed, the fill slope configuration as presented in the accompanying standard Details should be adopted.

For pad areas above fill slopes, positive drainage should be established away from the top-of-slope. This may be accomplished utilizing a berm and pad gradients of at least 2-percent in soil area.

Off-Site Fill

Off-site fill should be treated in the same manner as recommended in these specifications for site preparation, excavation, drains, compaction, etc.

Off-site canyon fill should be placed in preparation for future additional fill, as shown in the accompanying Standard Details.

Off-site fill subdrains temporarily terminated (up canyon) should be surveyed for future relocation and connection.

DRAINAGE

Canyon sub-drain systems specified by the Geotechnical Consultant should be installed in accordance with the Standard Details.

Typical sub-drains for compacted fill buttresses, slope stabilization or sidehill masses, should be installed in accordance with the specifications of the accompanying Standard Details.

Roof, pad and slope drainage should be directed away from slopes and areas of structures to suitable disposal areas via non-erodible devices (i.e., gutters, downspouts, concrete swales).

For drainage over soil areas immediately away from structures (i.e., within 4-feet), a minimum of 4 percent gradient should be maintained. Pad drainage of at least 2 percent should be maintained over soil areas. Pad drainage may be reduced to at least 1

percent for projects where no slopes exist, either natural or man-made, or greater than 10-feet in height and where no slopes are planned, either natural or man-made, steeper than 2:1 (horizontal to vertical slope ratio).

Drainage patterns established at the time of fine grading should be maintained throughout the life of the project. Property owners should be made aware that altering drainage patterns can be detrimental to slope stability and foundation performance.

STAKING

In all fill areas, the fill should be compacted prior to the placement of the stakes. This particularly is important on fill slopes. Slope stakes should not be placed until the slope is thoroughly compacted (backrolled). If stakes must be placed prior to the completion of compaction procedures, it must be recognized that they will be removed and/or demolished at such time as compaction procedures resume.

In order to allow for remedial grading operations, which could include overexcavations or slope stabilization, appropriate staking offsets should be provided. For finished slope and stabilization backcut areas, we recommend at least 10-feet setback from proposed toes and tops-of-cut.

SLOPE MAINTENANCE

Landscape Plants

In order to enhance superficial slope stability, slope planting should be accomplished at the completion of grading. Slope planting should consist of deep-rooting vegetation requiring little watering. Plants native to the Southern California area and plants relative to native plants are generally desirable. Plants native to other semi-arid and arid areas may also be appropriate. A Landscape Architect would be the best party to consult regarding actual types of plants and planting configuration.

Irrigation

Irrigation pipes should be anchored to slope faces, not placed in trenches excavated into slope faces.

Slope irrigation should be minimized. If automatic timing devices are utilized on irrigation systems, provisions should be made for interrupting normal irrigation during periods of rainfall.

Though not a requirement, consideration should be give to the installation of near-surface moisture monitoring control devices. Such devices can aid in the maintenance of relatively uniform and reasonably constant moisture conditions.

Property owners should be made aware that overwatering of slopes is detrimental to slope stability.

Maintenance

Periodic inspections of landscaped slope areas should be planned and appropriate measures should be taken to control weeds and enhance growth of the landscape plants. Some areas may require occasional replanting and/or reseeding.

Terrace drains and downdrains should be periodically inspected and maintained free of debris. Damage to drainage improvements should be repaired immediately.

Property owners should be made aware that burrowing animals can be detrimental to slope stability. A preventative program should be established to control burrowing animals.

As a precautionary measure, plastic sheeting should be readily available, or kept on hand, to protect all slope areas from saturation by periods of heavy or prolonged rainfall. This measure is strongly recommended, beginning with the period of time prior to landscape planting.

Repairs

If slope failures occur, the Geotechnical Consultant should be contacted for a field review of site conditions and development of recommendations for evaluation and repair.

If slope failure occurs as a result of exposure to periods of heavy rainfall, the failure areas and currently unaffected areas should be covered with plastic sheeting to protect against additional saturation.

In the accompanying Standard Details, appropriate repair procedures are illustrated for superficial slope failures (i.e., occurring typically within the outer 1 foot to 3 feet of a slope face).

TRENCH BACKFILL

Utility trench backfill should, unless otherwise recommended, be compacted by mechanical means. Unless otherwise recommended, the degree of compaction should be a minimum of 90 percent of the laboratory maximum density.

As an alternative, granular material (sand equivalent greater than 30) may be thoroughly jetted in-place. Jetting should only be considered to apply to trenches no greater than 2-feet in width and 4-feet in depth. Following jetting operations, trench backfill should be thoroughly mechanically compacted and/or wheel-rolled from the surface.

Backfill of exterior and interior trenches extending below a 1:1 projection from the outer edge of foundations should be mechanically compacted to a minimum of 90 percent of the laboratory maximum density.

Within slab areas, but outside the influence of foundations, trenches up to 1 foot wide and 2 feet deep may be backfilled with sand and consolidated by jetting, flooding or by mechanical means. If on-site materials are utilized, they should be wheel-rolled, tamped or otherwise compacted to a firm condition. For minor interior trenches, density testing may be deleted or spot testing may be elected if deemed necessary, based on review of back-fill operations during construction.

If utility contractors indicate that it is undesirable to use compaction equipment in close proximity to a buried conduit, the Contractor may elect the utilization of light weight compaction equipment and/or shading of the conduit with clean, granular material, which should be thoroughly jetted in-place above the conduit, prior to initiating mechanical compaction procedures. Other methods of utility trench compaction may also be appropriate, upon review by the Geotechnical Consultant at the time of construction.

In cases where clean granular materials are proposed for use in lieu of native materials or where flooding or jetting is proposed, the procedures should be considered subject to review by the Geotechnical Consultant.

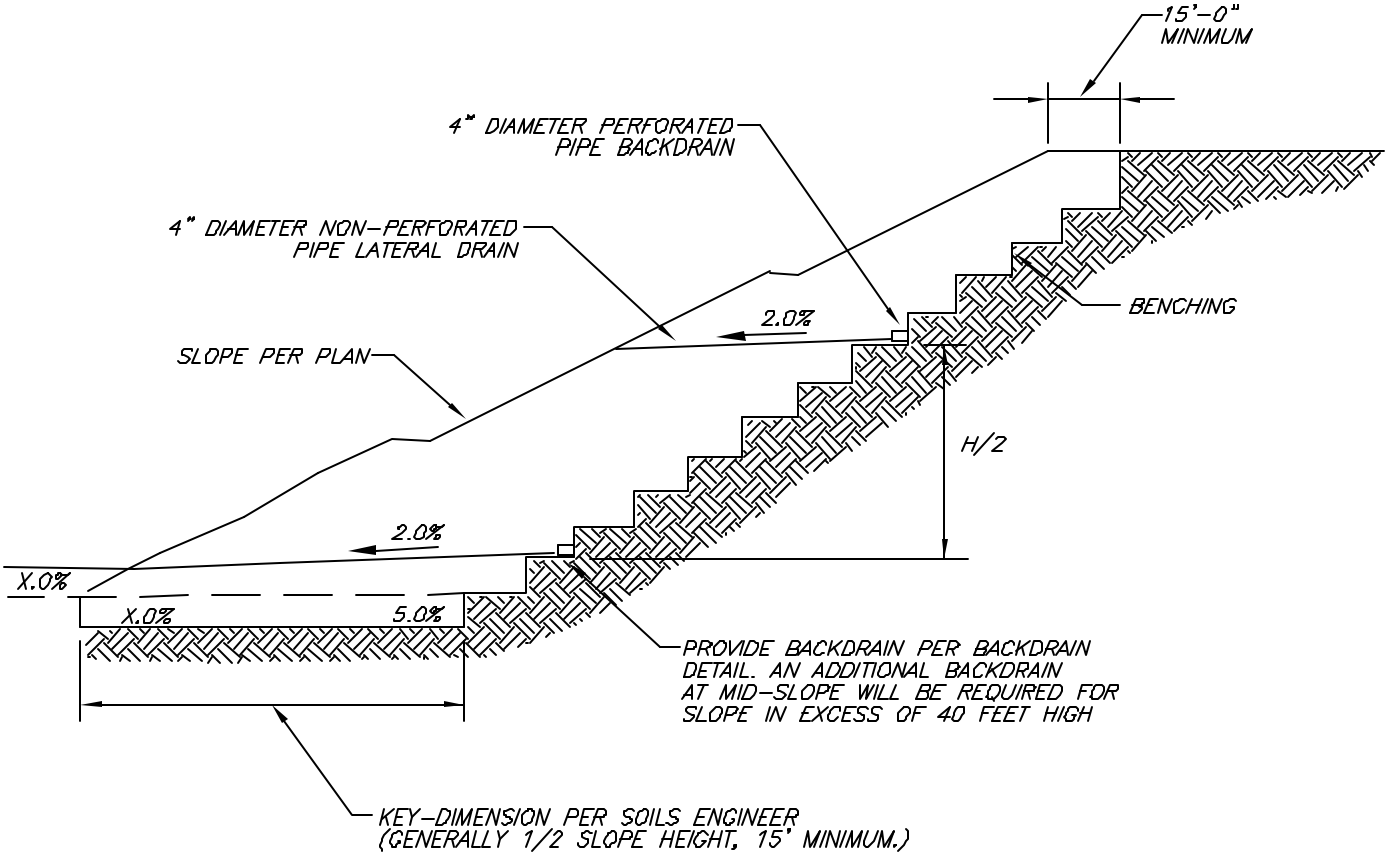
Clean Granular backfill and/or bedding are not recommended in slope areas unless provisions are made for a drainage system to mitigate the potential build-up of seepage forces.

STATUS OF GR ADING

Prior to proceeding with any grading operation, the Geotechnical Consultant should be notified at least two working days in advance in order to schedule the necessary observation and testing services.

Prior to any significant expansion of cut back in the grading operation, the Geotechnical Consultant should be provided with adequate notice (i.e., two days) in order to make appropriate adjustments in observation and testing services.

Following completion of grading operations and/or between phases of a grading operation, the Geotechnical Consultant should be provided with at least two working days notice in advance of commencement of additional grading operations.



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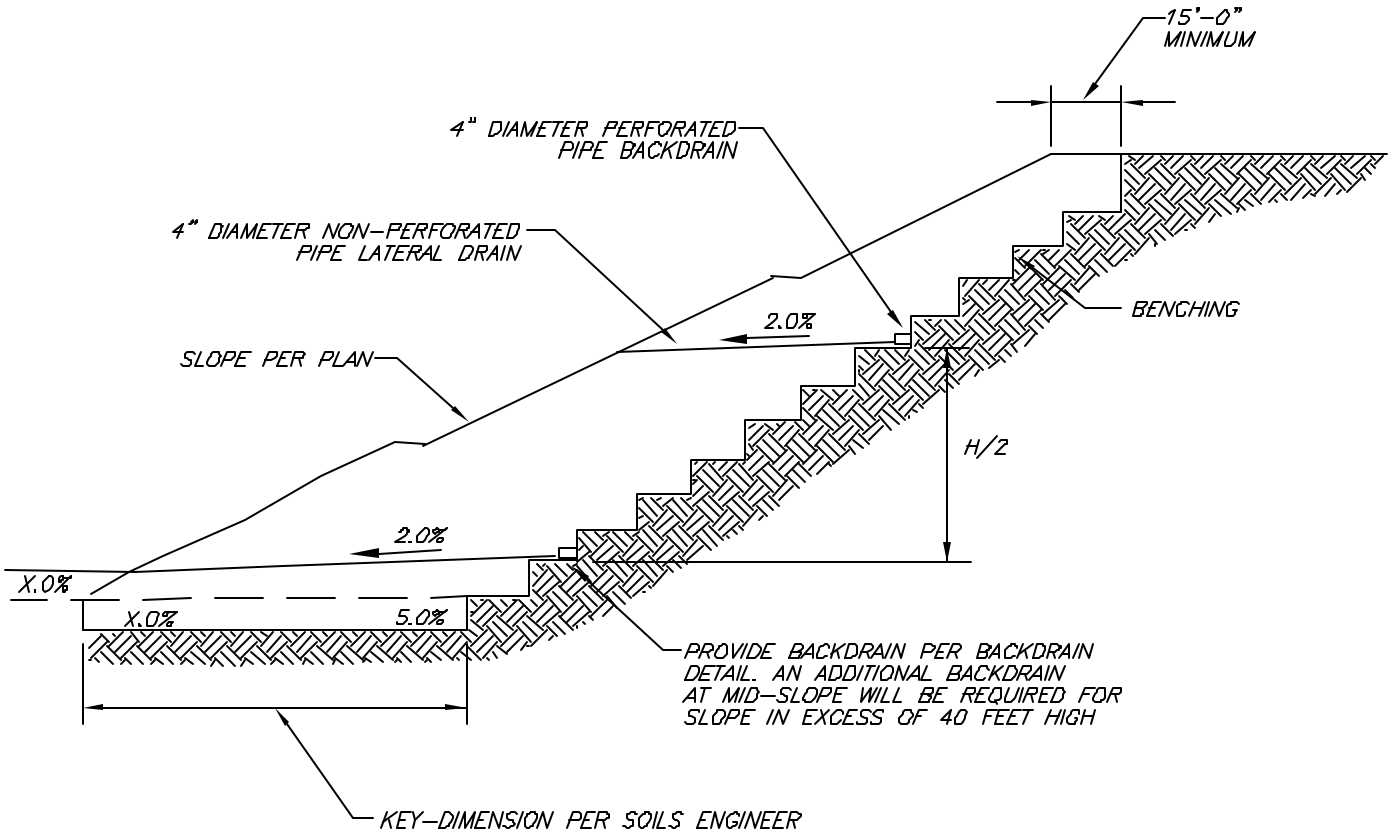
TYPICAL STABILIZATION FILL DETAIL

GEOTECHNICAL SERVICES
3960 Gilman Street
Long Beach, California 90815
(562) 597-3977



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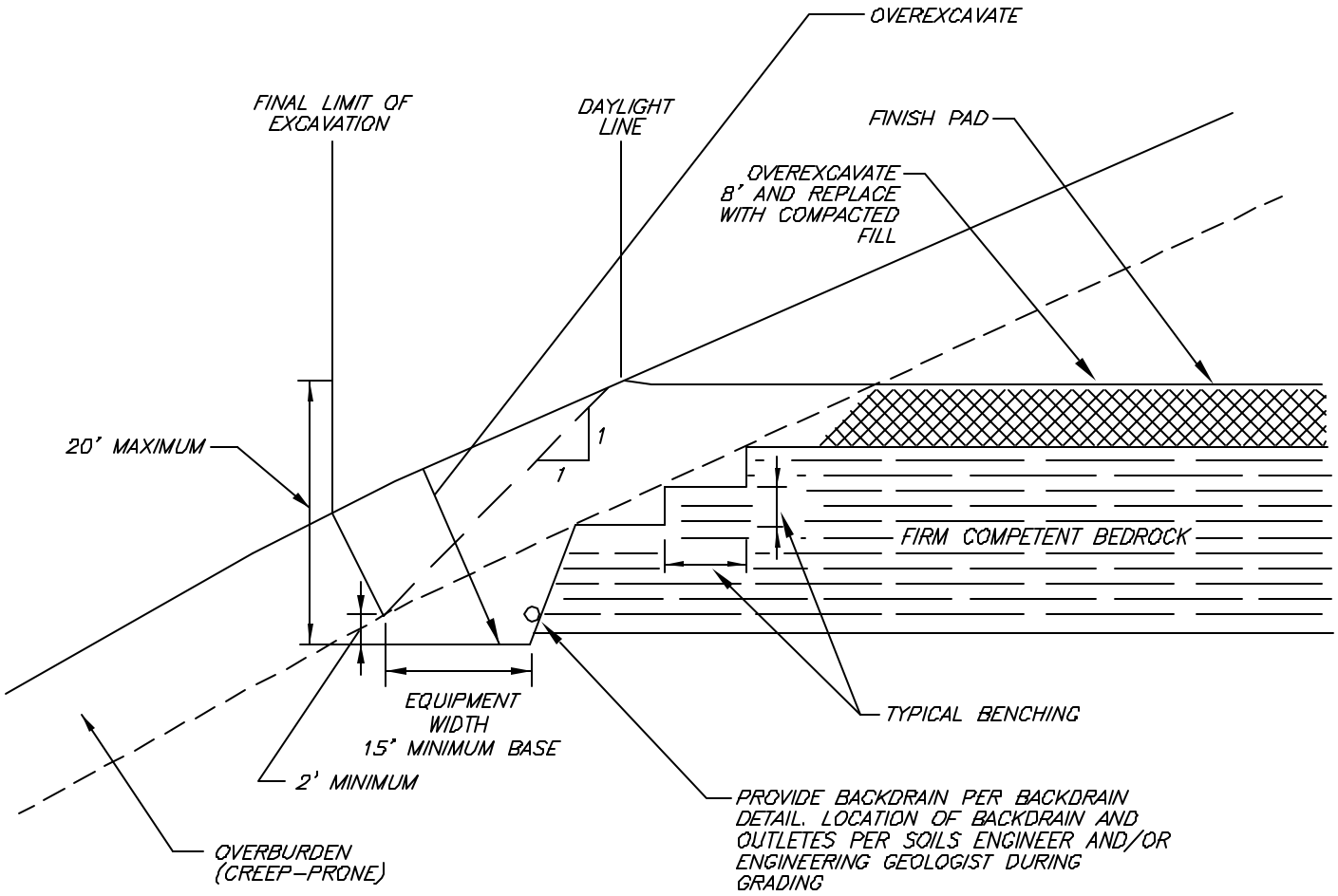
TYPICAL BUTTRESS FILL DETAIL

GEOTECHNICAL SERVICES
3960 Gilman Street
Long Beach, California 90815
(562) 597-3977



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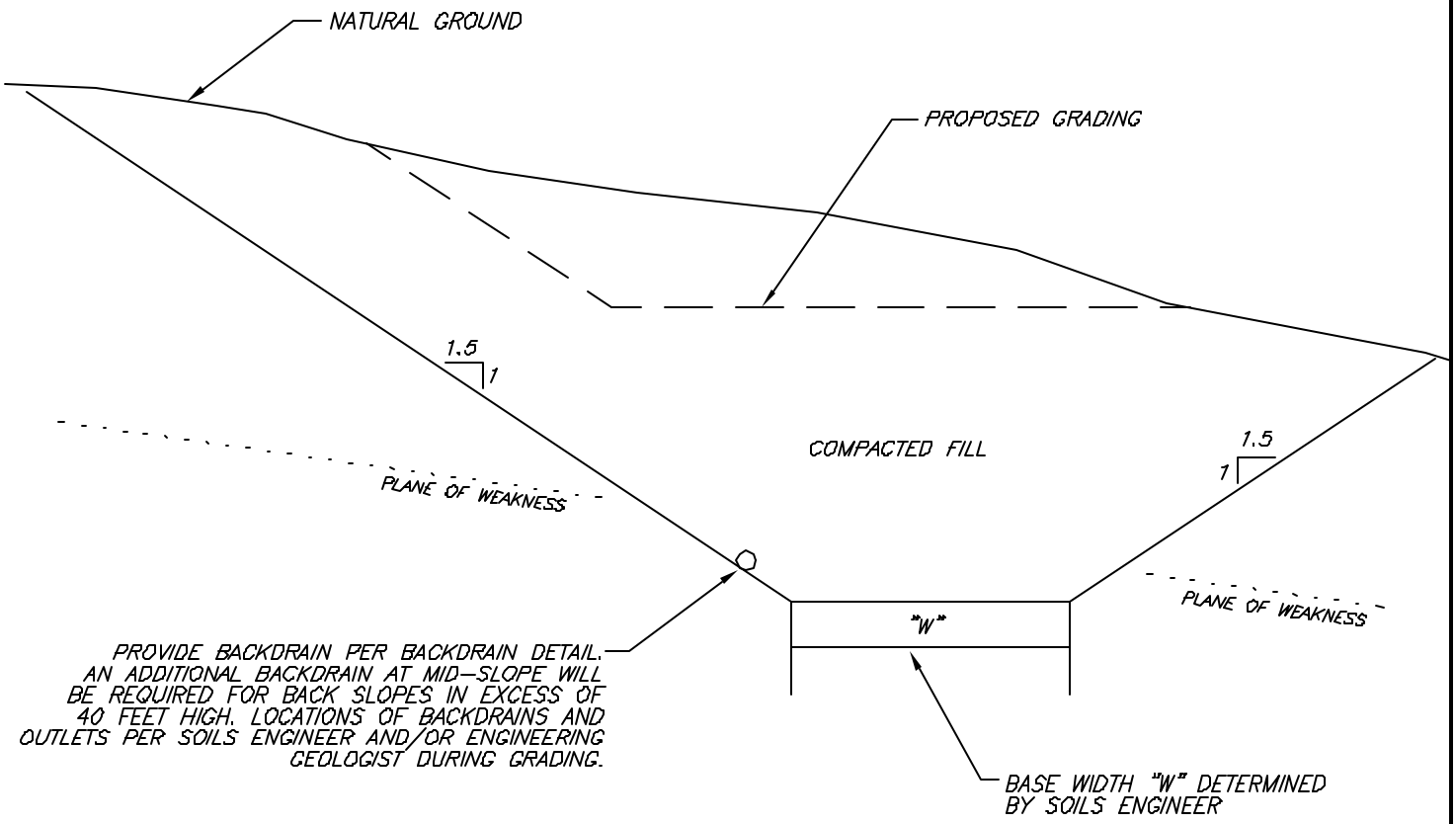
DAYLIGHT SHEAR KEY DETAIL

GEOTECHNICAL SERVICES
3960 Gilman Street
Long Beach, California 90815
(562) 597-3877



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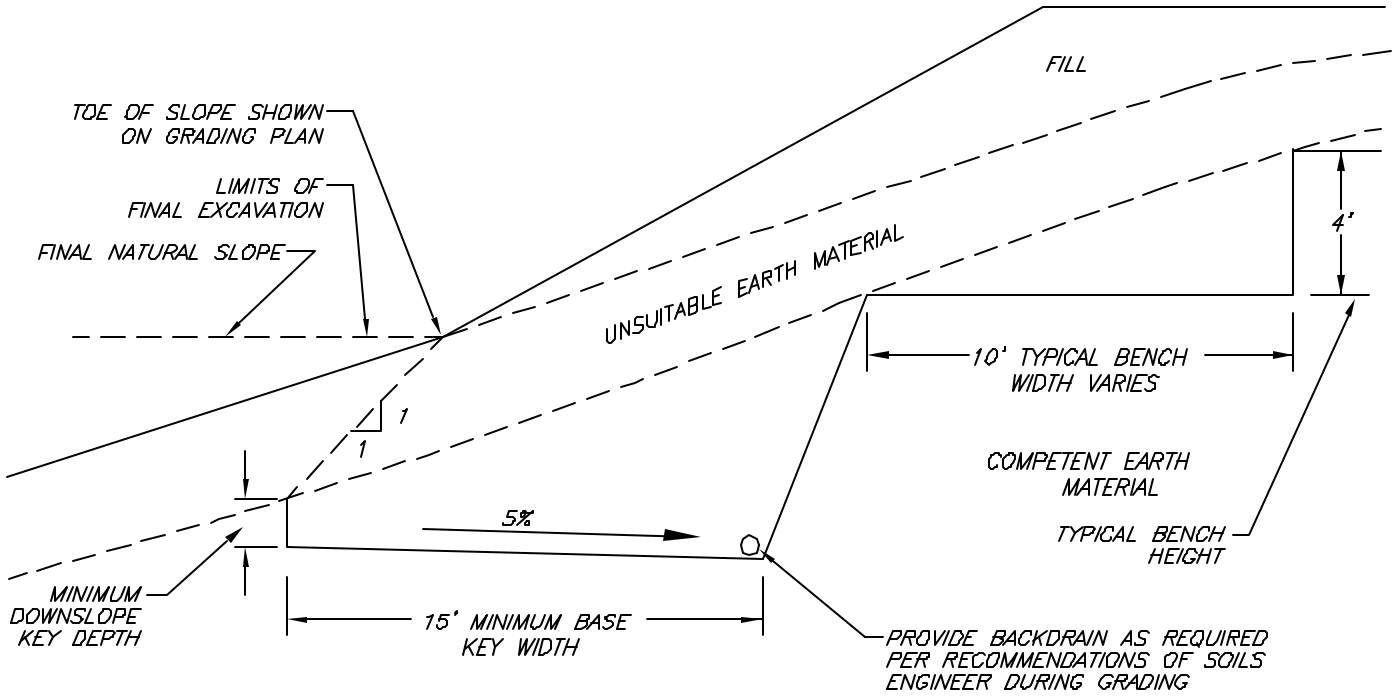

WHERE NATURAL SLOPE IS 5:1 OR LESS, BENCHING IS NOT NECESSARY, HOWEVER, FILL IS NOT TO BE PLACED ON COMPRESSIBLE OR UNSUITABLE MATERIAL.

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FILL SLOPE ABOVE NATURAL GROUND DETAIL

GEOTECHNICAL SERVICES
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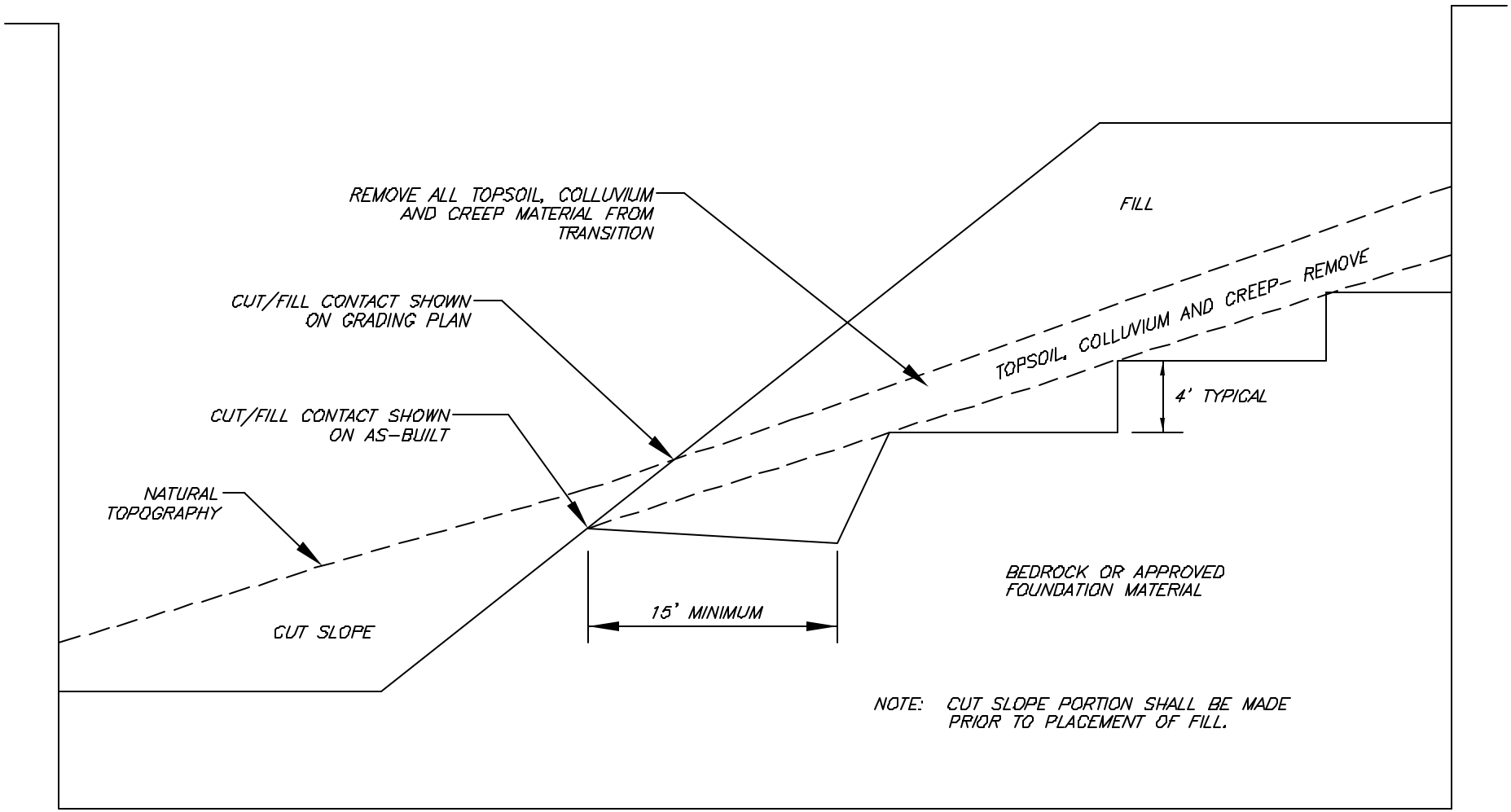
(562) 597-3977



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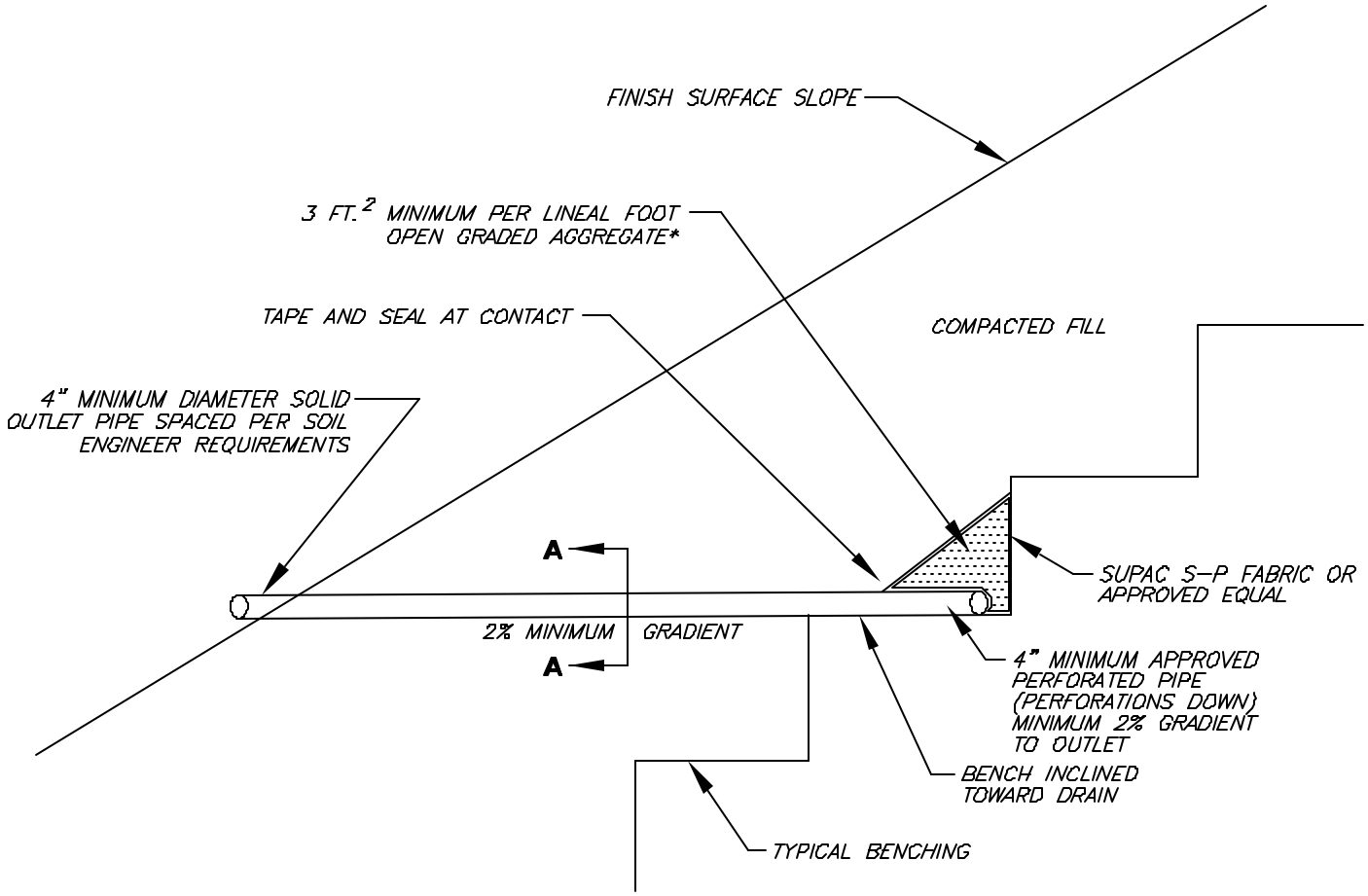
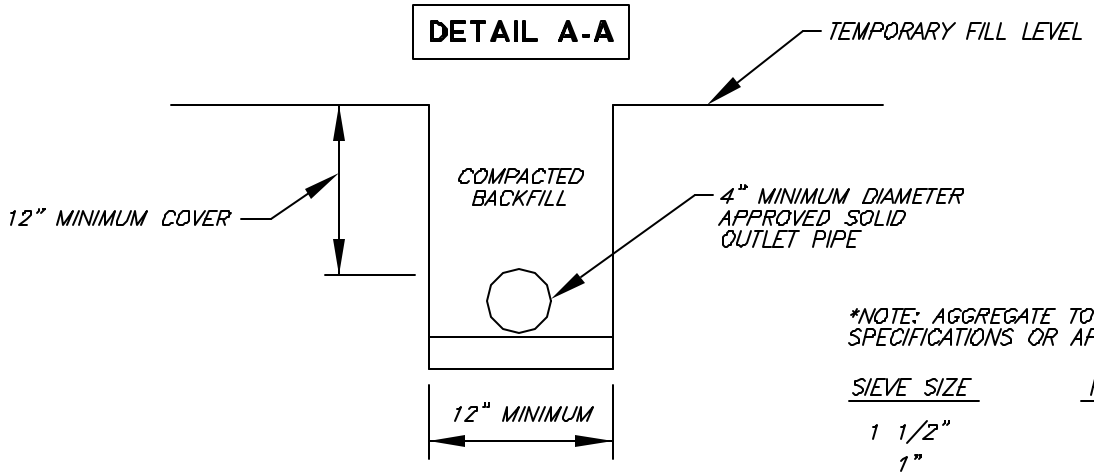
FILL SLOPE ABOVE CUT SLOPE DETAIL

GEOTECHNICAL SERVICES
3850 Gilman Street
Long Beach, California 90815
(562) 597-3977



DETAIL A-A



*NOTE: AGGREGATE TO MEET FOLLOWING SPECIFICATIONS OR APPROVED EQUAL:

SIEVE SIZE	PERCENTAGE PASSING
1 1/2"	100
1"	5–40
3/4"	0–17
3/8"	0–7
NO. 200	0–3

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BACKDRAIN DETAIL (GEOFABRIC)

GEOTECHNICAL SERVICES
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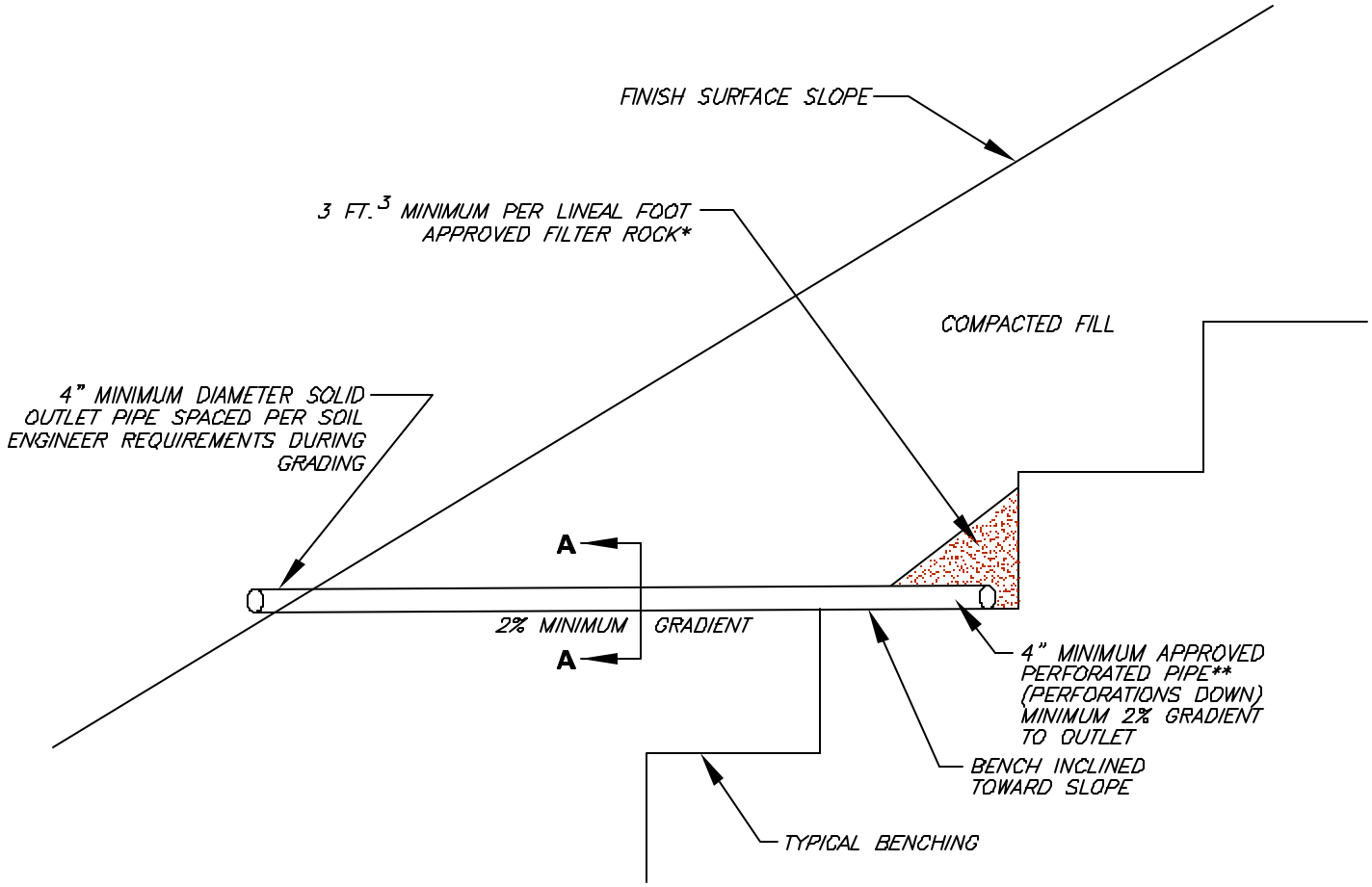
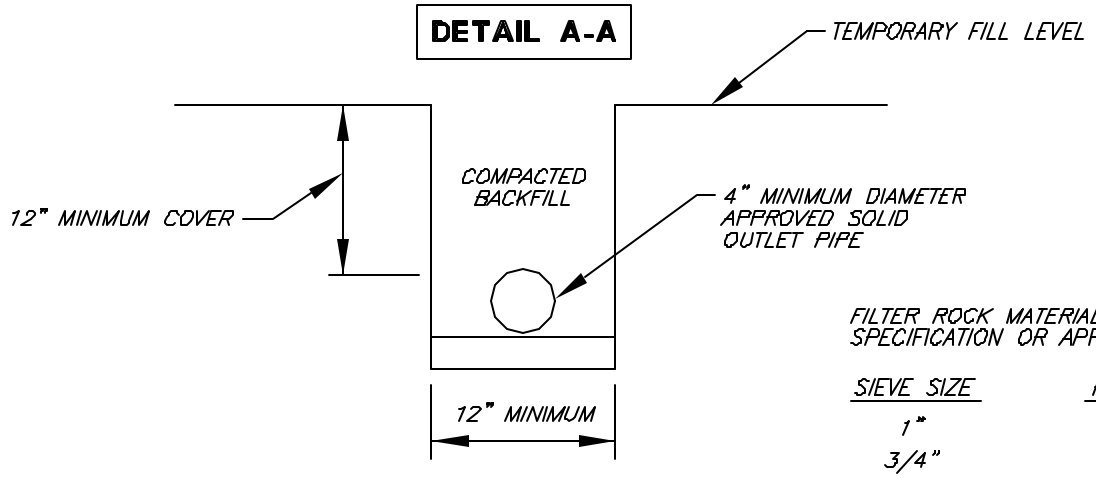
(562) 597-3977



DETAIL A-A



FILTER ROCK MATERIAL TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUAL:

SIEVE SIZE	PERCENTAGE
1"	100
3/4"	90–100
3/8"	40–100
NO. 4	25–40
NO. 30	5–15
NO. 50	0–7
NO. 200	0–3

**APPROVED PIPE TYPE:

SCHEDULE 40 POLYVINYL CHLORIDE (P.V.C.) OR APPROVED EQUAL. MINIMUM CRUSH STRENGTH 1000 PSI.

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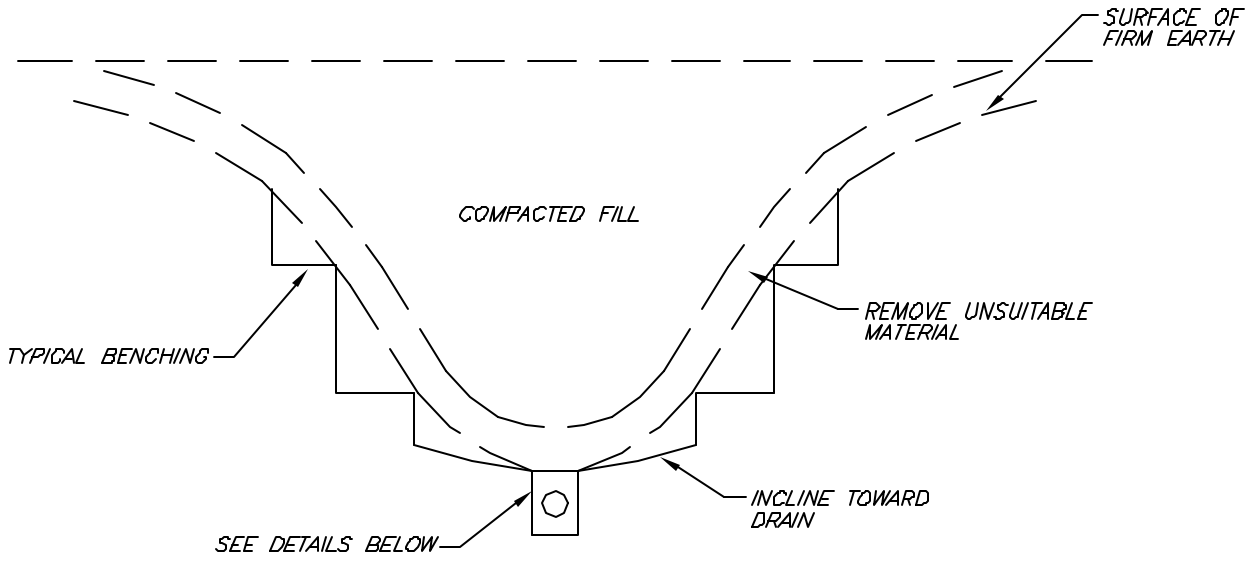
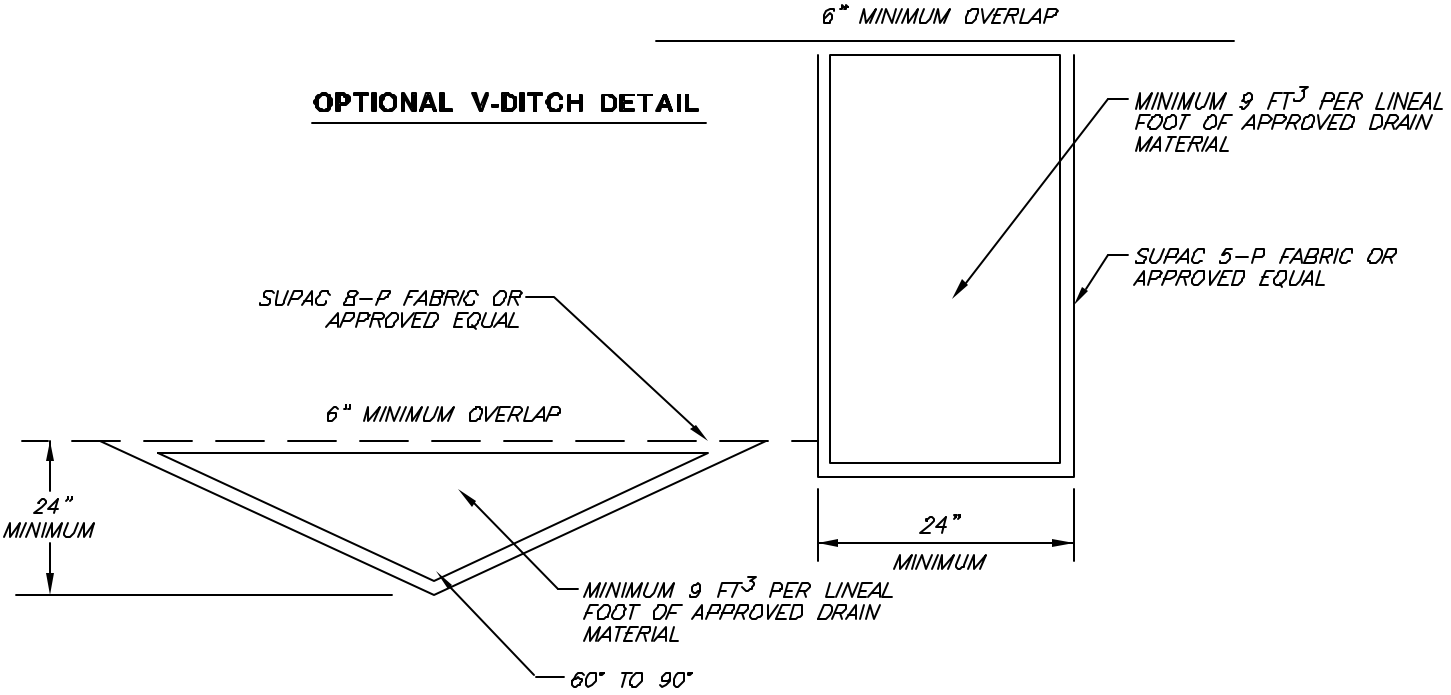
TYPICAL BACKDRAIN DETAIL

GEOTECHNICAL SERVICES
3950 Gilman Street
Long Beach, California 90815
(562) 597-3977



TRENCH DETAIL

OPTIONAL V-DITCH DETAIL



DRAIN MATERIAL TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUAL:

SIEVE SIZE	PERCENTAGE PASSING
1-1/2"	88-100
1"	5-40
3/4"	0-17
3/8"	0-7
NO.:200	0-3

ADD MINIMUM 4" DIAMETER APPROVED PERFORATED PIPE WHEN GRADIENT IS LESS THAN 2%

APPROVED PIPE TO BE SCHEDULE 40 POLY-VINYL-CHLORIDE (P.V.C.) OR APPROVED EQUAL. MINIMUM CRUSH STRENGTH 1000 psi.

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GEOFABRIC SUBDRAIN DETAIL

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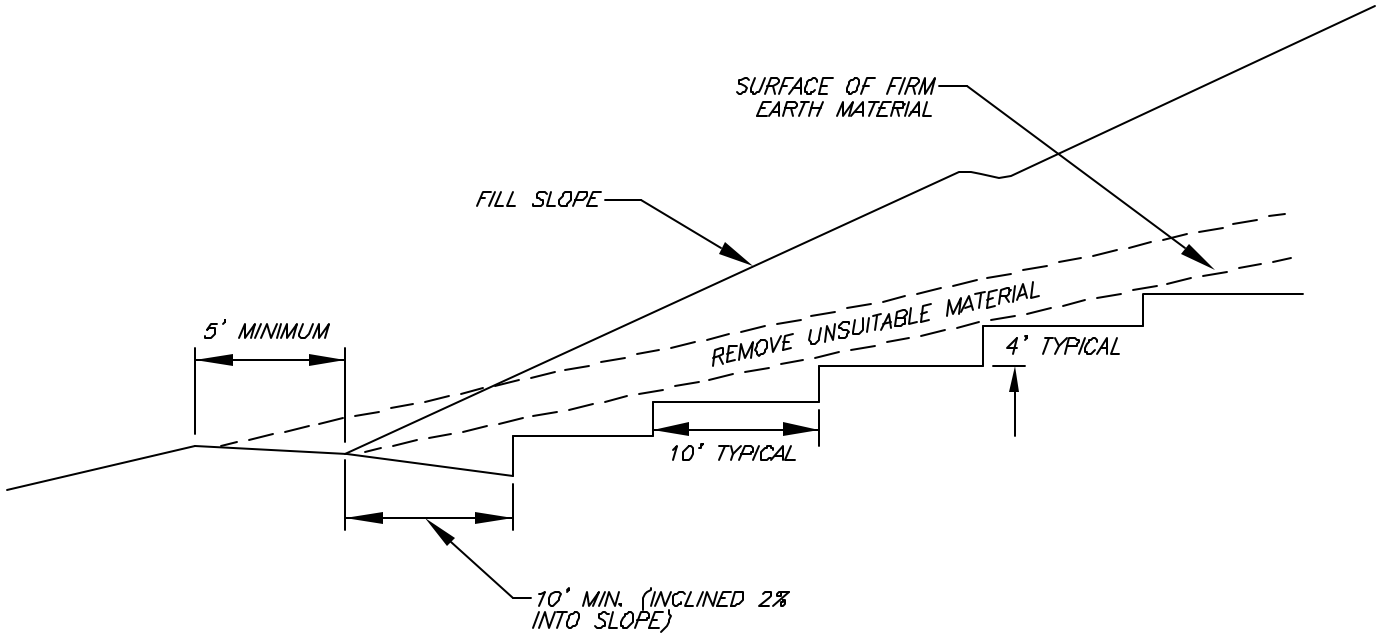
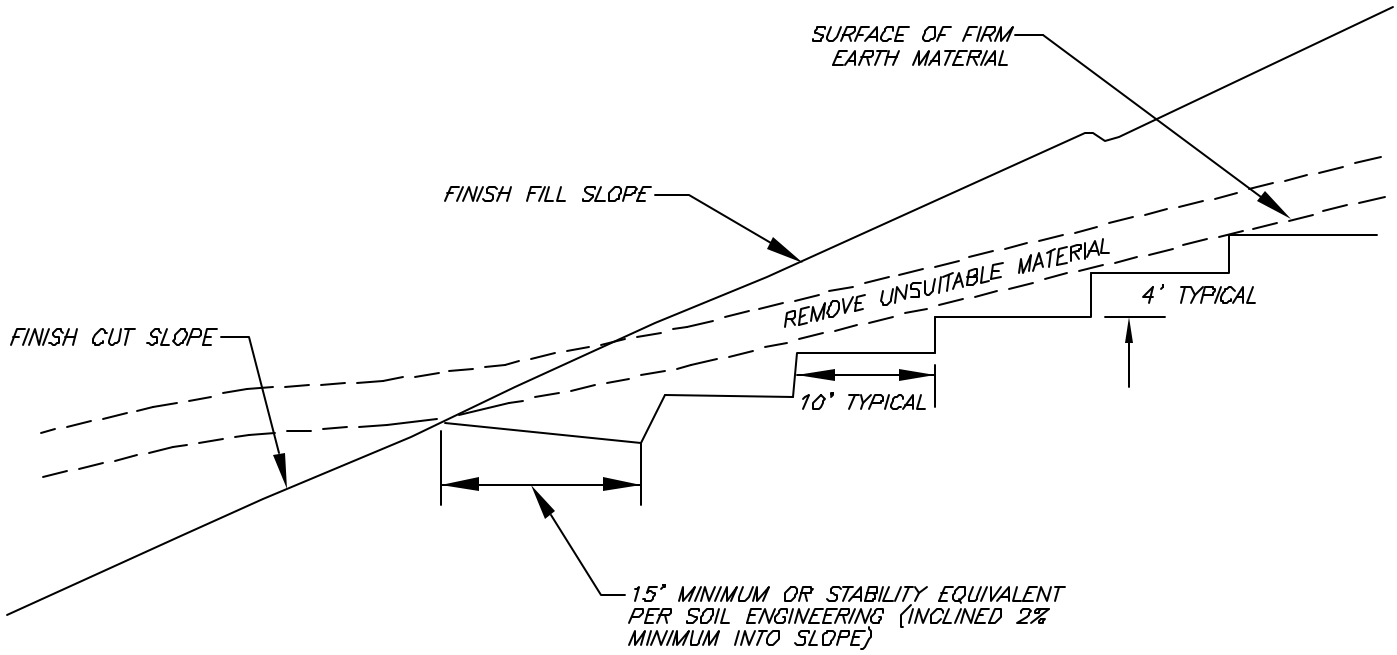
Long Beach, California 90815
(562) 597-3977

BENCHING FILL OVER NATURAL



BENCHING FILL OVER CUT



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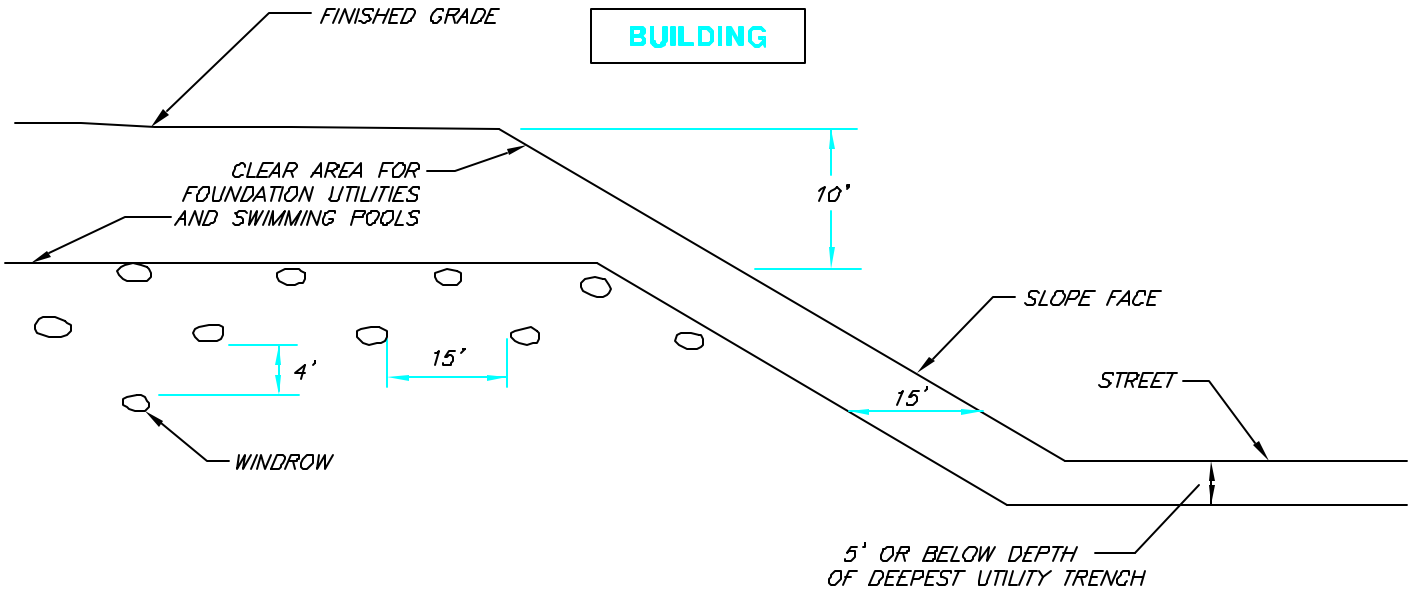
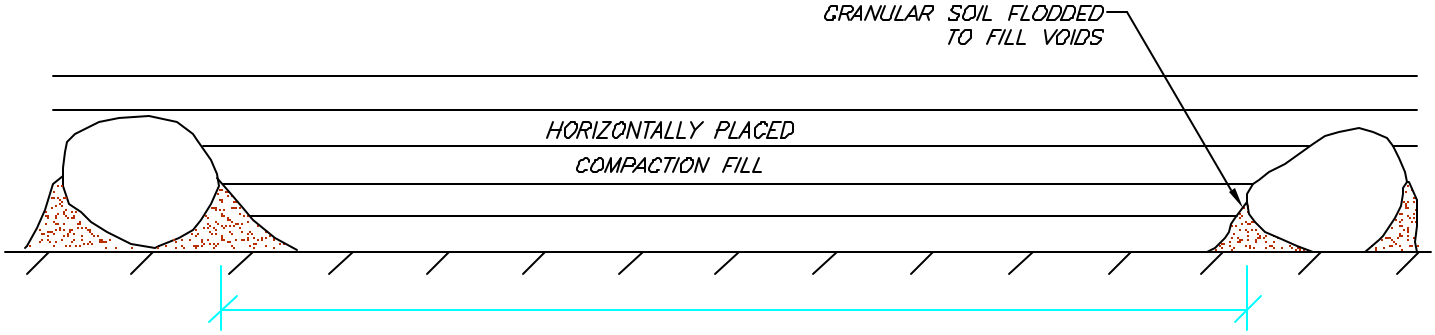
BENCHING FOR COMPACTED FILL DETAIL

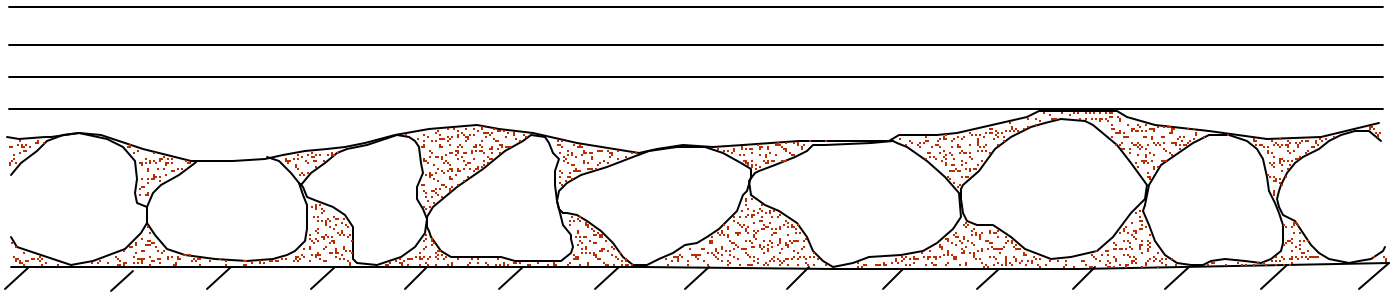
GEOTECHNICAL SERVICES
3960 Gilman Street
Long Beach, California 90813
(562) 597-3977



TYPICAL WINDROW DETAIL (EDGE VIEW)



PROFILE VIEW



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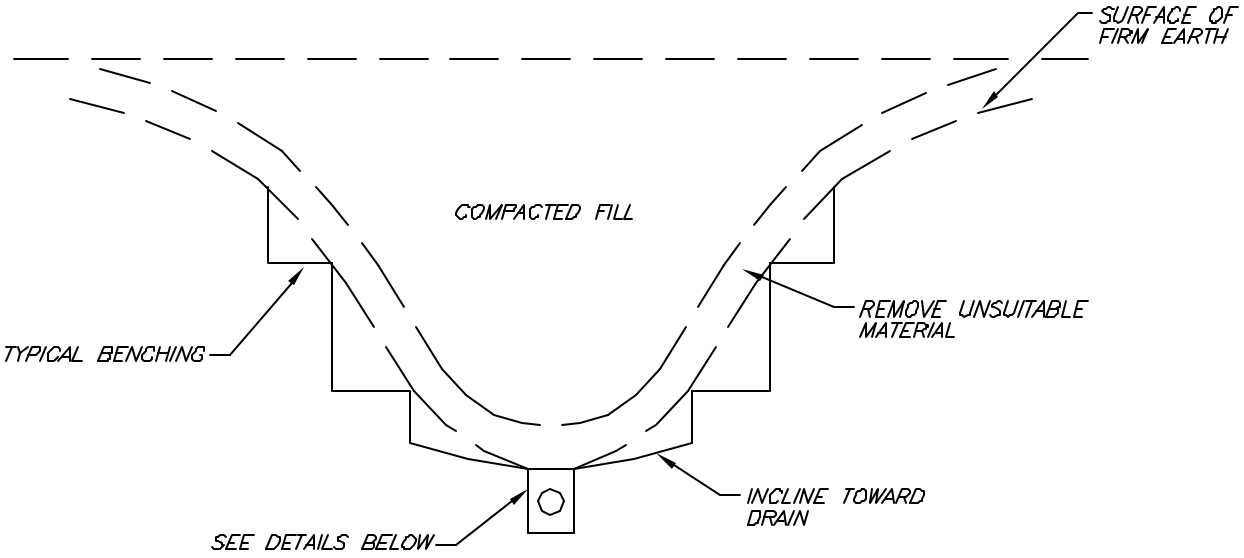
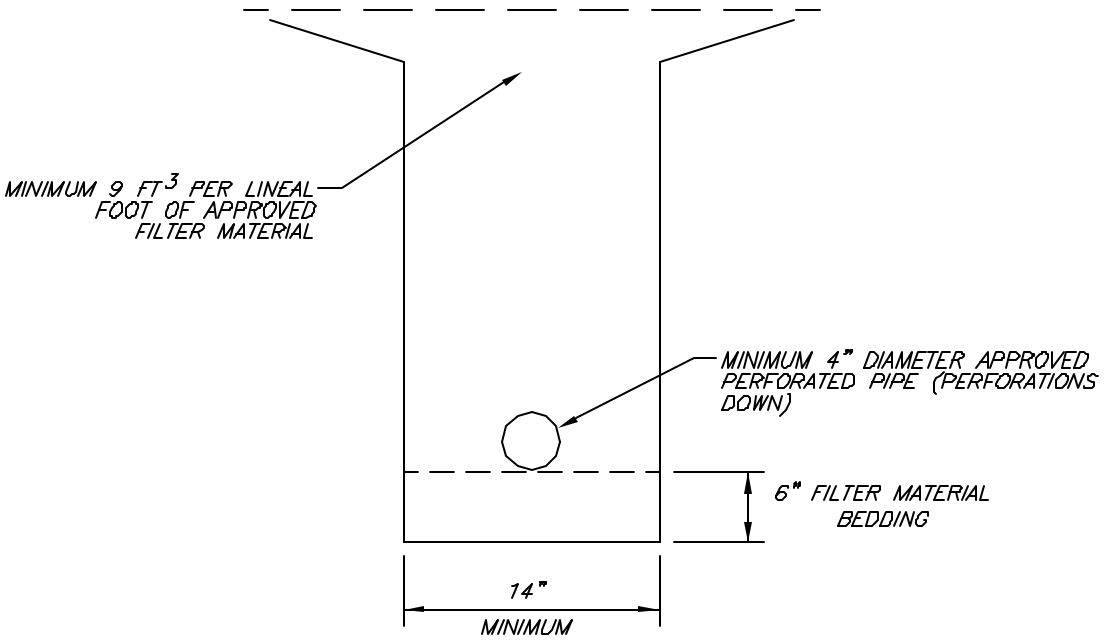
ROCK DISPOSAL DETAIL

GEOTECHNICAL SERVICES
3960 Gilman Street
Long Beach, California 90815
(562) 597-3977



TRENCH DETAIL



FILTER MATERIAL TO MEET FOLLOWING SPECIFICATION OR APPROVED EQUAL:

SIEVE SIZE	PERCENTAGE
1"	100
3/4"	90–100
3/8"	40–100
NO. 4	25–40
NO. 30	5–15
NO. 50	0–7
NO. 200	0–3

APPROVED PIPE TO BE SCHEDULE 40 POLY-VINYL-CHLORIDE (P.V.C.) OR APPROVED EQUAL. MINIMUM CRUSH STRENGTH 1000 psi.

PIPE DIAMETER TO MEET THE FOLLOWING CRITERIA. SUBJECT TO FIELD REVIEW BASED ON ACTUAL GEOTECHNICAL CONDITIONS ENCOUNTERED DURING GRADING.

LENGTH OF RUN	PIPE DIAMETER
UPPER 500'	4"
NEXT 1000'	6"
> 1500'	8"

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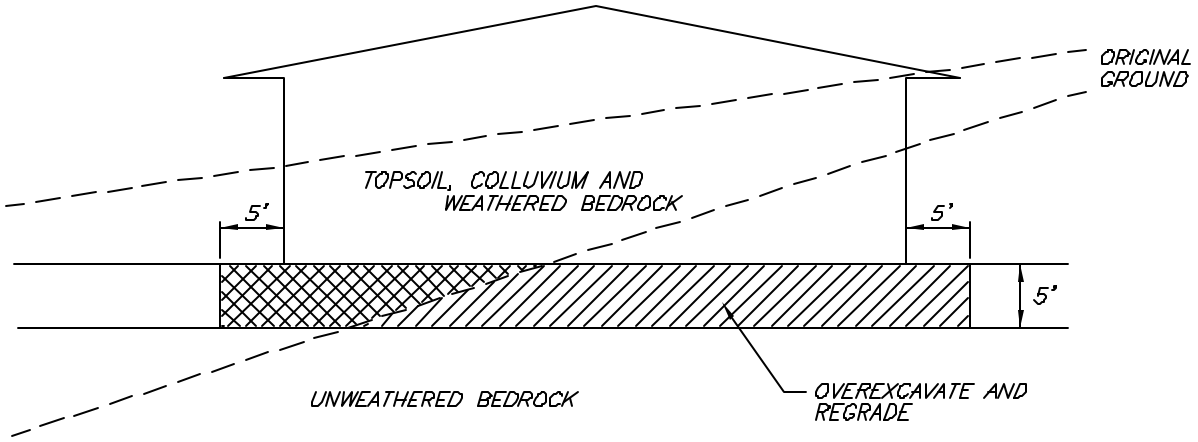
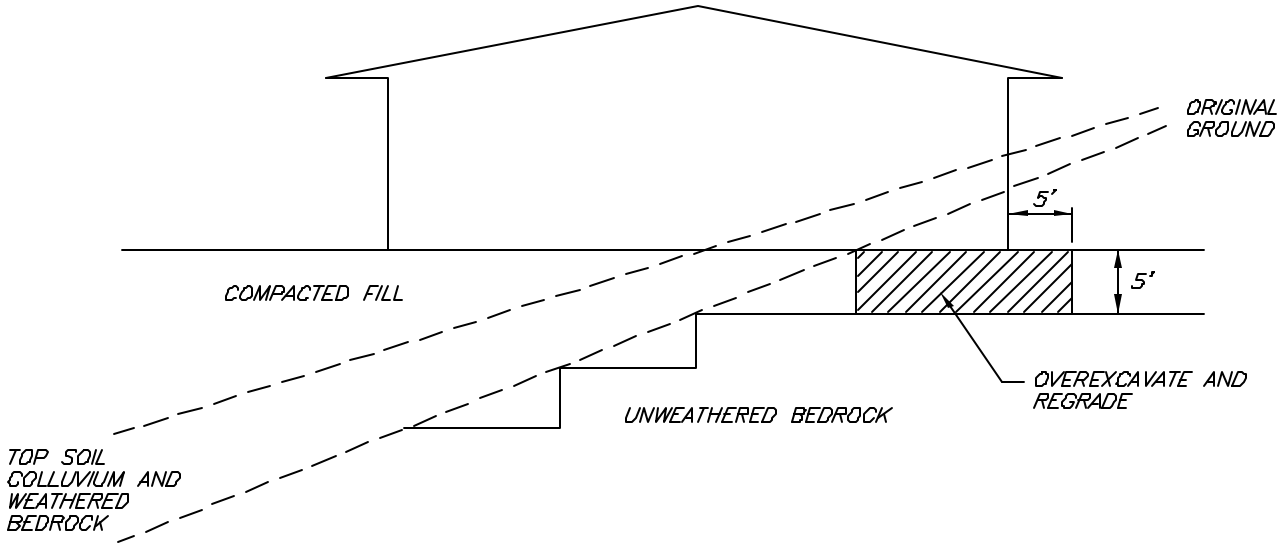
TYPICAL CANYON SUBDRAIN DETAIL

GEOTECHNICAL SERVICES
3980 Gilman Street
Long Beach, California 90815
(562) 597-3977

CUT LOT



CUT/FILL LOT (TRANSITION)



APPENDIX E

REMI TEST RESULTS

Figure 1

Line Location
Orange Grove Power Plant
Pala, California

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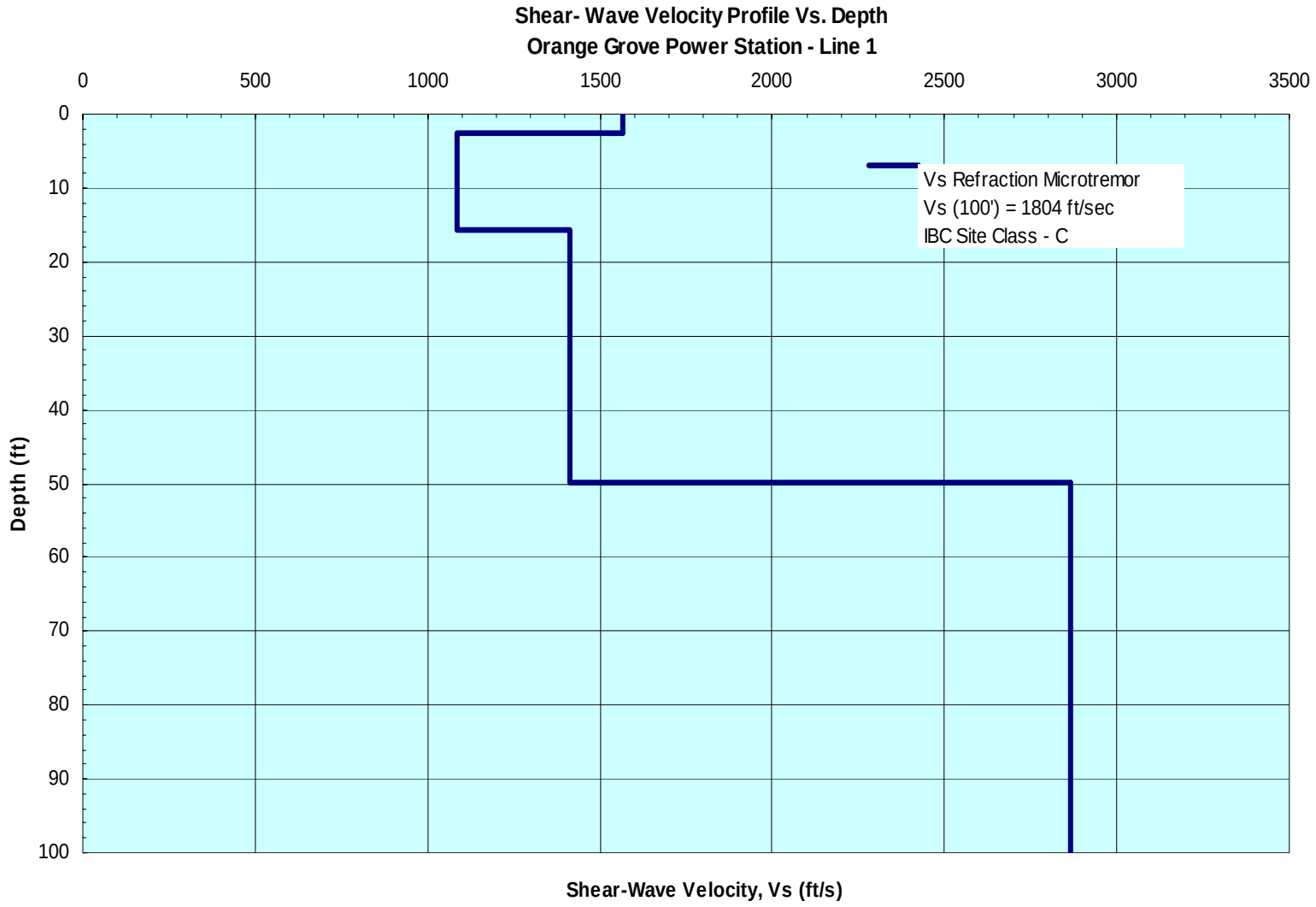

Figure 2	Shear Wave Velocity Profile Line 1 Orange Grove Power Plant Pala, California	psi Information To Build On Engineering • Consulting • Testing

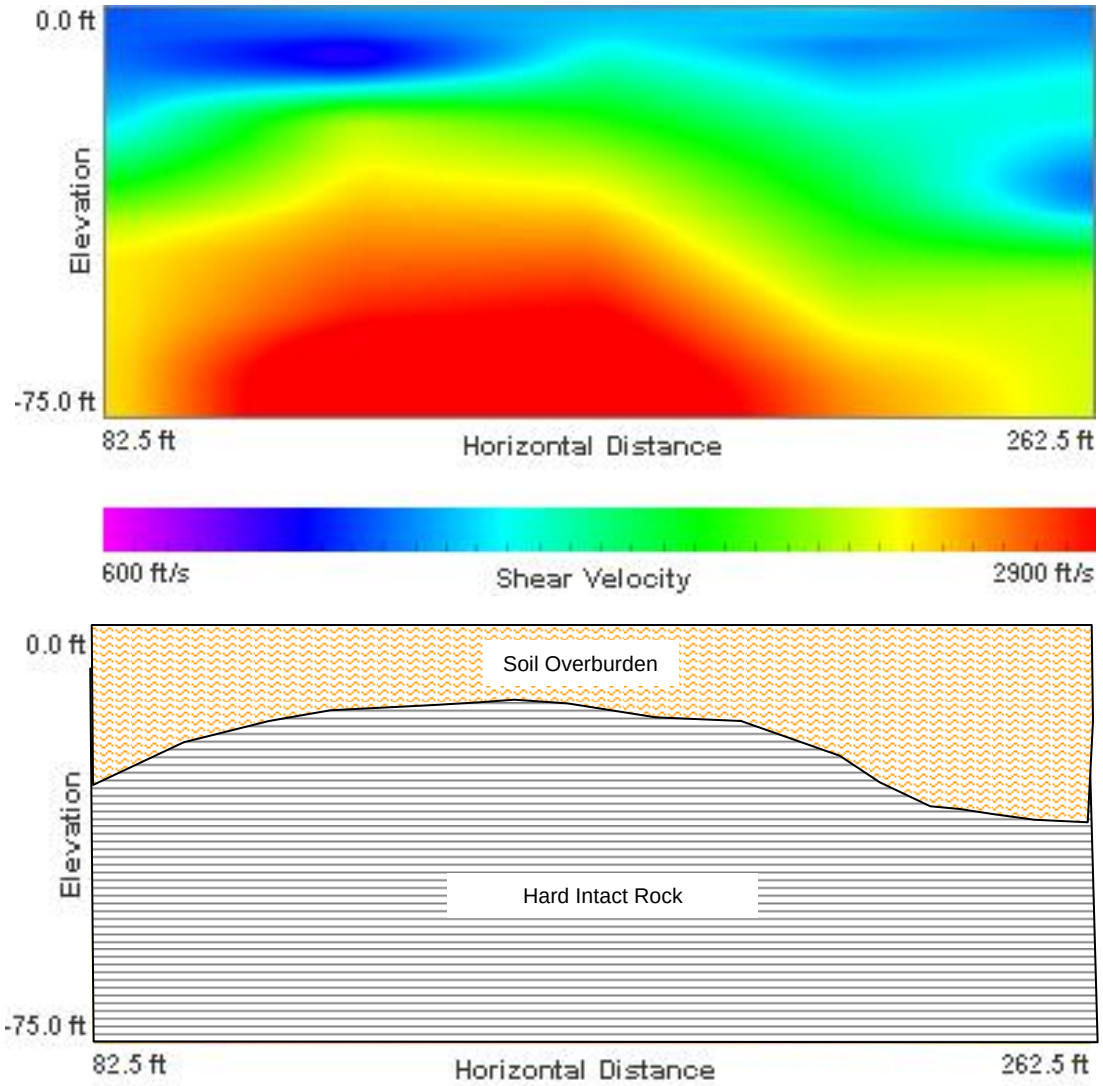

Figure 3

ReMi Profile Line 1
Orange Grove Power Plant
Pala, California

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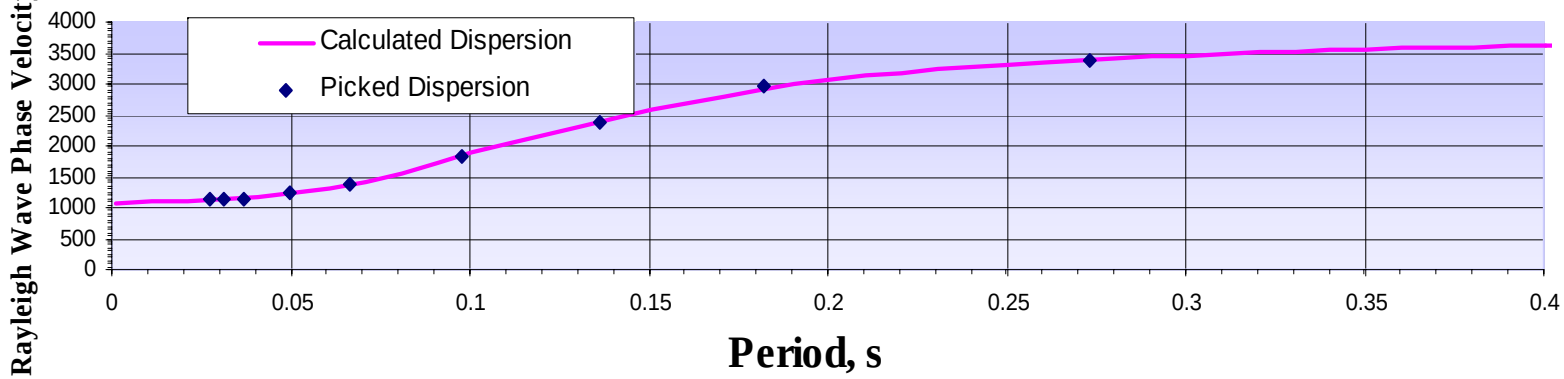
Orange Grove Power Station Line 1: Supportive Illustration

Dispersion Curve Showing Picks and Fit



p-f Image with Dispersion Modeling Picks

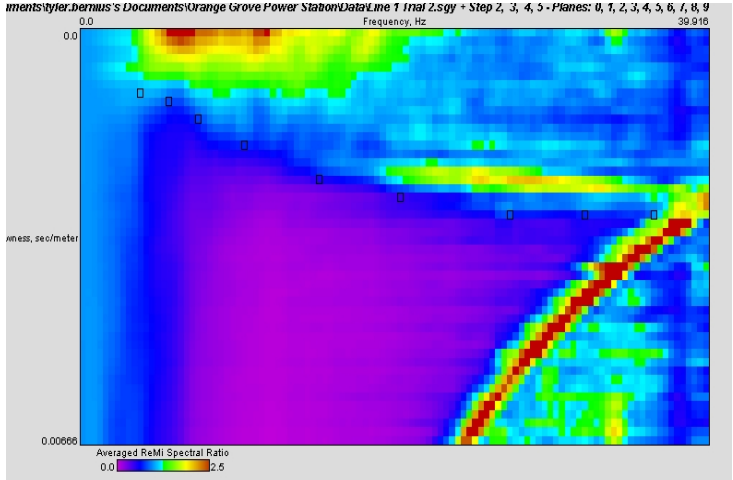


Figure 4	ReMi Supportive Illustration Line 1 Orange Grove Power Plant Pala, California	psi Information To Build On Engineering • Consulting • Testing

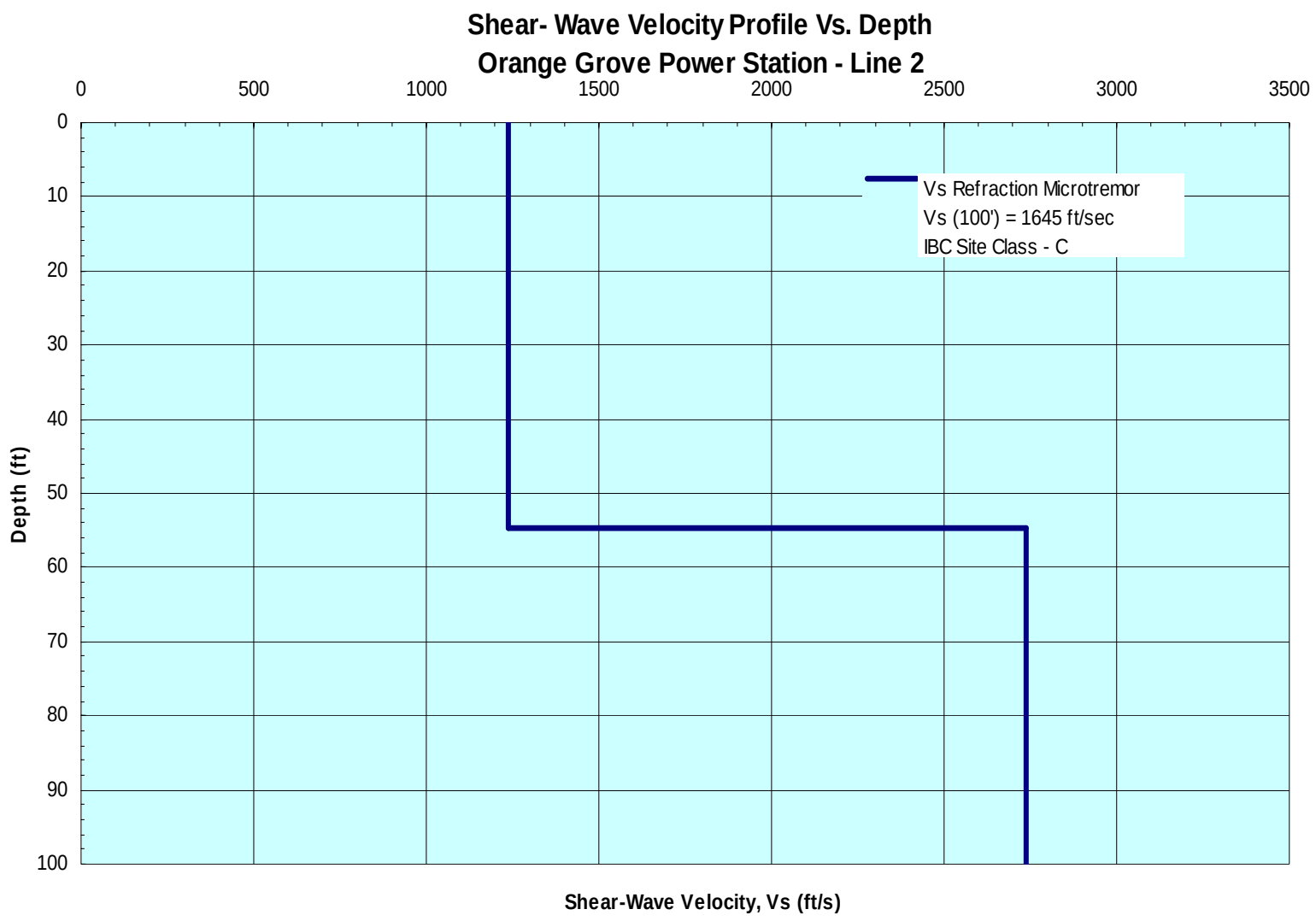


Figure 5

Shear Wave Velocity Profile Line 2
Orange Grove Power Plant
Pala, California

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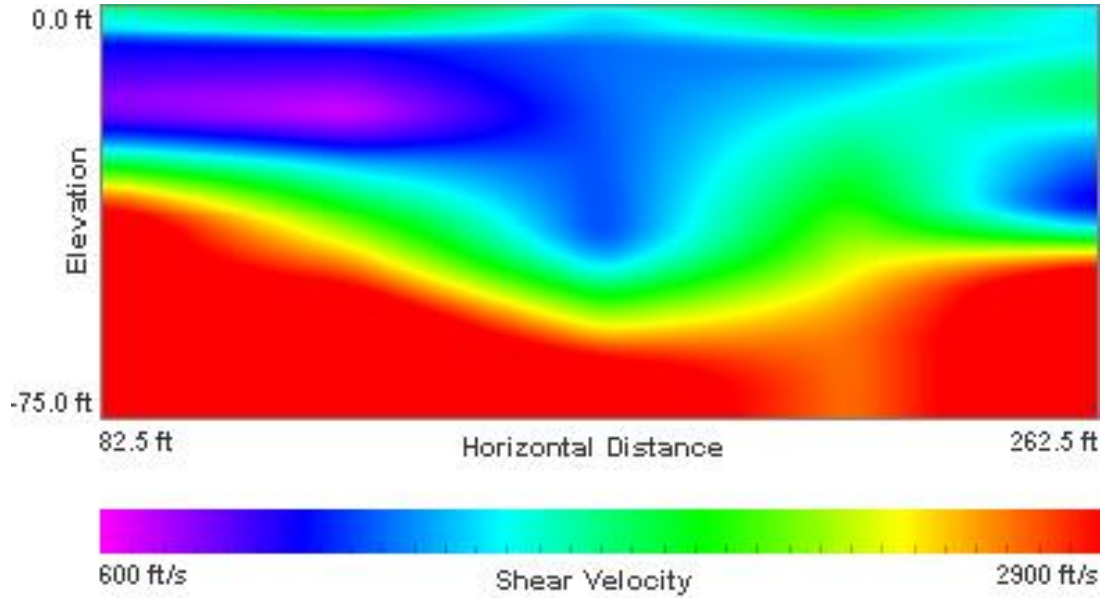

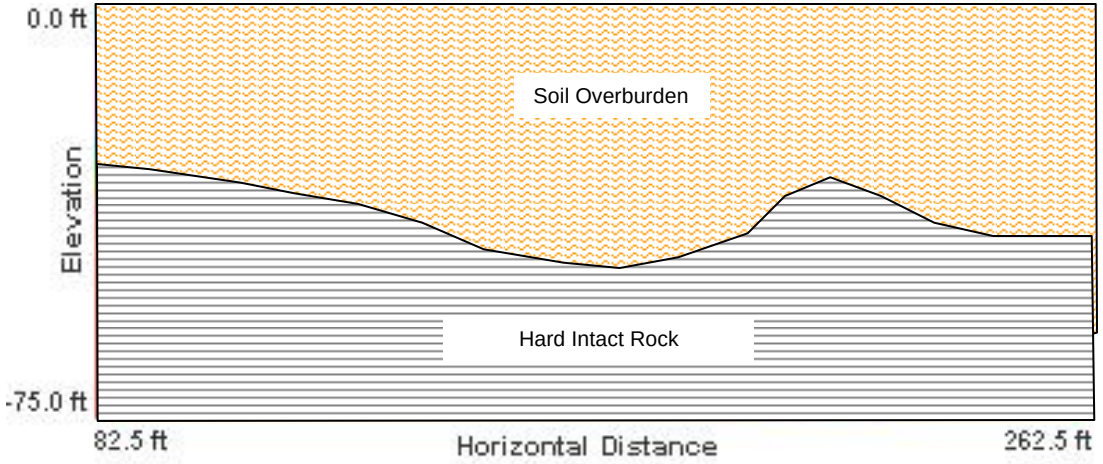

Figure 6

ReMi Profile Line 2
Orange Grove Power Plant
Pala, California

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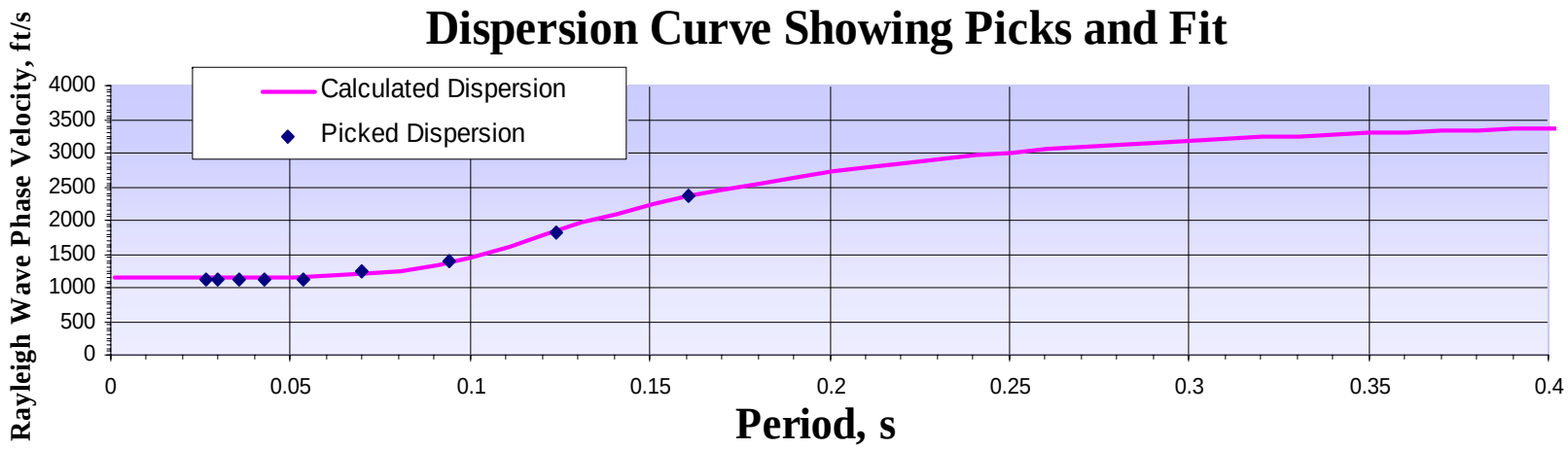
Orange Grove Power Station Line 2: Supportive Illustration



p-f Image with Dispersion Modeling Picks

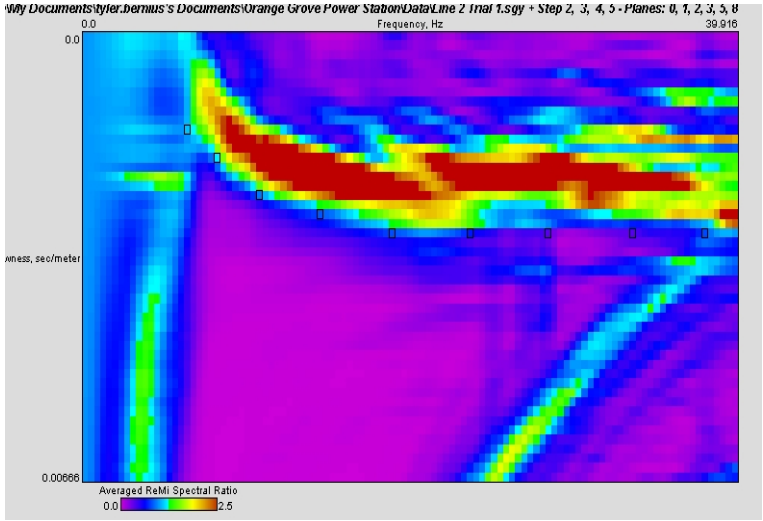


Figure 7	ReMi Supportive Illustration Line 2 Orange Grove Power Plant Pala, California	psi Information To Build On Engineering • Consulting • Testing