APPENDIX K

GEOTECHNICAL REPORT

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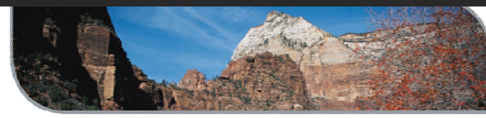

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July 22, 2011
J.N. 247-11

Mr. Mark Chaffee
COGENTRIX ENERGY, LLC.
9405 Arrowpoint Blvd.
Charlotte, NC 28273

Subject: Preliminary Geologic/Geotechnical Investigation, Proposed Peaker Plant, APN# 366-081-2500, *Quail Brush Project,* City of San Diego, San Diego County, California

Dear Mr. Chaffee:

Petra Geotechnical, Inc. (Petra) is pleased to submit herewith our preliminary geologic/geotechnical investigation report for the proposed Peaker Plant (*Quail Brush Project*), in the City of San Diego, San Diego County, California. This work was performed in accordance with the scope of work outlined in our Proposal No. 1193-11 dated May 27, 2011. The purpose of this preliminary geologic/geotechnical investigation was to provide preliminary recommendations for slope design, earthwork, building and equipment foundations and concrete flatwork for the proposed Peaker Plant. Please note that a final design investigation will be required following formalization of the development plans. This report presents the results of our field exploration and our engineering judgment, opinions, conclusions and recommendations pertaining to geotechnical design aspects for the proposed Peaker Plant.

It has been a pleasure to be of service to you on this project. Should you have questions regarding the contents of this report or should you require additional information, please contact this office.

Respectfully submitted,

PETRA GEOTECHNICAL, INC.

Grayson R. Walker, GE
Principal Engineer

JC/GRW/kms/jma

Distribution: (4) Addressee

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PRELIMINARY GEOLOGIC/GEOTECHNICAL INVESTIGATION
PROPOSED PEAKER PLANT, APN3 366-081-2500 (*QUAIL BRUSH PROJECT*), CITY OF SAN DIEGO
SAN DIEGO COUNTY, CALIFORNIA

SUMMARY

The following section summarizes key elements of this report. It is intended to provide a general briefing, only, and shall not be utilized outside of the context of the details of our findings, conclusions and recommendations presented herein.

- The project site is deemed to be suitable for the proposed development, provided the recommendations presented herein are implemented.
- The site lies outside of designated Fault Hazard Zones. No evidence of faults was observed during the field exploration.
- Shallow groundwater was not encountered during our field exploration. Groundwater is not anticipated to impact the proposed development.
- Clayey siltstone and claystone bedrock of the Friars Formation underlies the entire site and is exposed in the western and southern portions of the site. The Friars Formation is capped by sandstone and cobble conglomerate of the Stadium Conglomerate Formation on the predominant ridges in the central, northern and eastern portions of the site.
- Proposed cut slopes along the northern and eastern project boundaries will likely expose Friars Formation bedrock in the lower portions of the slopes and Stadium Conglomerate Formation in the upper portions of the slopes. The Friars Formation materials do not perform well with respect to long-term surficial stability. Consequently, cut slope construction should anticipate the need for the remedial construction of a stabilization fill slope in the zones of Friars Formation exposure. The Stadium Conglomerate Formation generally performs well as a cut slope, although minor surficial raveling of cobble exposures should be anticipated. Accordingly provisions should be made to protect from isolated rockfall, such as a debris fence, berm or setback. Both cut and fill slopes may be constructed at an inclination of 2:1 (horizontal:vertical).
- Grading of the proposed building pad will require substantial cuts and fills. Maximum fill depths may be on the order of 80 to 90 feet in the canyons, while maximum cuts are expected to be on the order of 50 feet. Compaction standards will be increased from 90 percent to 93 percent relative compaction for all fills placed deeper than 40 feet from design grade. Canyon cleanouts prior to fill placement may be as deep as 15 to 20 feet due to the presence of collivium deposits and sidehill slumps in the Friars Formation along the canyon walls. Subdrains will be required beneath all canyon fills.

- The Friars Formation bedrock materials are highly expansive and should be restricted from the upper 5 feet of the building pad. The pad should be selectively constructed of materials derived from the Stadium Conglomerate, although some screening to rid the fill material of plus-3-inch cobbles may be required.

- Provided site grading is performed in accordance with the recommendations of this report, the use of conventional shallow foundations, rigid mat or structural slab foundations or combinations thereof are considered feasible for support of the various structural elements of the facility.

- Both the Friars Formation and the Stadium Conglomerate materials exhibit low sulfate and chloride contents and generally neutral pH. Therefore, special cement and reinforcement corrosion prevention measures for concrete are not required. The resistivity testing, however, yielded very low resistivity results, indicative of severely corrosive soils to exposed metals. A more detailed corrosivity study by a corrosion specialist is recommended.

INTRODUCTION

This report presents the results of Petra Geotechnical, Inc.'s (Petra's) preliminary geologic/geotechnical investigation of the proposed Peaker Plant site. The purposes of this investigation were to determine the nature of surface and subsurface-soil and bedrock conditions, evaluate their in-place characteristics and provide preliminary geotechnical recommendations with respect to slope design, earthwork, and building and equipment foundations.

Purpose and Scope of Services

The purposes of this study were to obtain information on the surface and subsurface conditions within the project area, evaluate field and laboratory data and provide conclusions and recommendations with regard to the proposed development of the site as influenced by the subsurface conditions.

The scope of our evaluation consisted of the following.

- Review of overall site plans made available to us at the time of our investigation.
- Review of available published and unpublished data, maps and geotechnical reports concerning geologic and soil conditions within and adjacent to the site which could have an impact on the proposed improvements.

- Review and interpretation of stereo-aerial photographs dating from 1972 to 1998.

- Perform geologic mapping of the site.

- Excavation of thirteen exploratory trenches, utilizing a four-wheel-drive backhoe, to evaluate the stratigraphy of the subsurface soils and collect representative undisturbed and bulk samples for laboratory testing.

- Logged and visually classify soil materials encountered in our exploratory trenches in accordance with the Unified Soil Classification System.

- Laboratory testing and analysis of representative samples (bulk and undisturbed) obtained from the exploratory trenches to determine their engineering properties, including in-situ density and moisture content, as well as undisturbed and remolded shear strength.

- Prepared geotechnical cross sections.

- Preformed slope stability calculations utilizing the cross sections and laboratory test data.

- Preformed engineering and geologic analysis of the data collected.

- Preparation of a geotechnical map showing the location of the trenches.

- Preparation of this report presenting the results of our supplemental investigation and recommendations.

Please note that evaluation of hazardous materials, should they exist on the site, was not within our scope of services.

Location and Site Description

The subject property comprises approximately 21.57 acres of vacant land adjacent to Sycamore Landfill Road and is located approximately 0.35 miles northwest of the intersection of Sycamore Landfill Road and Mast Boulevard in the City of San Diego, San Diego County, California. The location of the site is shown on Figure 1. The property is bounded by vacant land to the north with the Sycamore Landfill beyond; vacant land to the east; vacant land and the Sycamore Landfill Road to the south and the Sycamore Landfill Road to the west with a major south-trending drainage canyon beyond.

Topography within the site consists of southwest-trending ridgelines and tributary canyons. On site elevations range from a high of approximately 555(±) feet above mean sea level (msl) within the northeastern portion of the site to a low of approximately 375(±) feet msl within the southwestern portion of the site. The site is overgrown with thick, low to medium height weeds, native grasses and brush and occasional small trees.

Proposed Construction

The property will be developed as a power generation facility, utilizing eleven gas-powered reciprocating engines to drive generators. The proposed development includes grading of the site utilizing cuts and fills to create a large level building pad or possibly terraced pads, for the proposed power plant and switchyard. Along with the level building pad(s) are proposed 2:1 to 3:1 horizontal:vertical (h:v) cut and fill slopes. Conceptual grading plans were not available for review at the time of this proposal.

Background Information

Petra researched and reviewed available published and unpublished geologic data pertaining to the site and surrounding area. These documents are identified in the References section of this report.

SITE INVESTIGATION

Stereo Aerial Photograph Analysis

Sequential stereo aerial photographs covering the site area were reviewed and analyzed by this firm for the years 1972, 1993, and 1998 (Reference)

Geologic Mapping

Surficial geologic mapping of the site was accomplished utilizing a 60-scale Land Title Survey Map provided by RBF Consulting. The mapping was performed by a Petra geologist during field exploration operations in June 2011.

Subsurface Exploration

Subsurface exploration was performed by Petra on June 6 and 7, 2011 utilizing a four-wheel-drive backhoe. The exploration involved the excavation of thirteen exploratory trenches to depths of approximately 6 to 12 feet (T-1 through T-13). Earth materials encountered within the exploratory trenches were classified and logged by an engineering geologist in accordance with the visual-manual procedures of the Unified Soil Classification System. The approximate locations of the exploratory trenches are shown on Plate 1 located in the pocket at the back of the report.

Disturbed bulk samples and relatively undisturbed ring samples of soil materials were collected for classification, laboratory testing and engineering analyses. Undisturbed samples were obtained using a 3-inch outside diameter modified California split-spoon soil sampler lined with brass rings. The soil sampler was driven with successive 30-inch drops of a free-fall, 140-pound hammer. The central portions of the driven-core samples were placed in sealed containers and transported to our laboratory for testing. The number of blows required to drive the split-spoon sampler 12 inches into the soil were recorded for each 6-inch driving increment.

Laboratory Testing

Laboratory tests included in-situ dry density and moisture content, maximum dry density and optimum moisture content, expansion index, soluble sulfate and chloride content, general soil corrosivity (pH and resistivity) and direct shear tests performed on both undisturbed and remolded samples of formational materials. A description of laboratory test methods and summary of the laboratory test data are presented in Appendix B.

FINDINGS

Regional Geologic Setting

Geologically, San Diego County lies within the Peninsular Ranges Geomorphic Province. The Peninsular Range region is underlain primarily of plutonic rock of the Southern California Batholith. These rocks formed from the cooling of molten magma deep within the earth's crust. Intense heat associated with these plutonic magma metamorphosed the ancient sedimentary rock into which the plutons intruded.

More specifically, the subject site lies within the San Diego Embayment graben, which is a downdropped structural block, encompassing the western portion of San Diego County from south of Carlsbad, east to Rancho Bernardo and south into the northern portion of the Republic of Mexico.

Local Geology and Subsurface Soil Conditions

Several geologic units were encountered during our preliminary investigation of the site.

The earth materials encountered within our exploratory trenches consist of colluvial deposits, relatively young alluvial deposits, and Tertiary age bedrock of the Stadium Conglomerate and Friars Formation. These units, from younger to older, are described further below.

Colluvium (Not Mapped): Colluvial soils represent thin deposits that were deposited by slope wash and/or creep processes. They generally mantle the lower portions of the hillsides throughout the site where they overlie or are interbedded with alluvial soils within the canyons. These materials consisted of silty clay, clay and fine to medium clayey sands and sandy clays which were various hues of grayish brown, brownish gray and gray, dry to moist and firm/loose to medium dense. The majority of the colluvial soils contained subrounded to rounded gravel and cobble.

Alluvium (Qal): The canyons contain young alluvium of Holocene age. This alluvium is primarily locally derived from upstream outcrops of the Stadium Conglomerate and Friars Formations. This material consists of silty clays that were olive gray and brown, moist and soft to firm with subrounded to rounded gravel and cobble.

Stadium Conglomerate (Tst): The Stadium Conglomerate forms the cap rock of the extensive Poway and Linda Vista marine terraces. This formation consists of a massive cobble conglomerate with a yellowish brown, fine to coarse grained matrix. Dispersed lenses of sandstone are contained within this formation and were observed along the top of the ridge lines within the subject site. The sandstone observed was silty and clayey sandstone which has various hues of yellowish brown, orange brown and olive gray, slightly moist to moist and moderately hard to hard.

Friars Formation (Tf): The Friars Formation is nonmarine and lagoonal bedrock. This formation is the upper most unit of the La Jolla Group which is conformably overlain by the Stadium Conglomerate. The Friars Formation, as encountered within our exploratory trenches on the subject site, consisted of clayey siltstone, sandy siltstone and silty claystone which were various hues of olive gray and olive brown, slightly moist to moist and soft to hard. The upper portion of the Friars is moderately to highly weathered, blocky and hackly fractured, with shears and slickensides.

Groundwater

Groundwater was not encountered in our exploratory trenches to the maximum depth explored. Groundwater levels, however, can vary due to seasonal changes, irrigation practices and other factors.

Faulting

The geologic structure of the southern California area is dominated mainly by northwest-trending faults associated with the San Andreas Fault system. Based on our review of published and unpublished geotechnical maps and literature pertaining to the site and regional geology, the site does not lie within the boundaries of an Earthquake Fault zone as defined by the State of California Alquist-Priolo Earthquake Fault Zoning Act. The closest active faults to the site are the Rose Canyon fault located approximately 17.8 kilometers (11.1 miles) to the west, the Coronado Bank fault located approximately 38.9 kilometers (24.2 miles) to the southwest and the Elsinore-Julian fault located approximately 47.8 kilometers (29.7 miles) to the northeast.

Seismic Hazard Analysis

A probabilistic seismic hazard analysis (PSHA) was performed for the site in order to determine the ground-motions for the Design-Basis earthquakes. The Design-Basis Earthquake (DBE) ground motion is determined by probabilistic methods and defined as having a 10 percent chance of excedence in 50 years. A probabilistic analysis incorporates uncertainties in time, recurrence intervals, size, and location (along faults) of hypothetical earthquakes. This method therefore accounts for the likelihood (rather than certainty) of occurrence and provides levels of ground acceleration that might be more reasonably hypothesized for a finite exposure period. The DBE ground-motion with a recurrence interval of about 475 years is used.

We have developed a recommended pairing of the maximum credible magnitude of the Rose Canyon fault and the estimated peak ground acceleration at the site, based on a 10 percent probability of being exceeded in 50 years (DBE – Design Based Earthquake). Our recommendation is based on three sources, the California Geological Survey website and the USGS NSHMP online Java Application version 5.1a, and the online USGS deaggregation tools, our recommendation is shown in Table 1 below. The online USGS NSHMP Java Application gives both the values based on the use of Sds over 2.5 per the building code section 1803.5.12.2 of the 2010 CBC, and a base motion input value for site class B rock for different probabilities of occurance. The online USGS deaggregation tools use the 2008 fault database from USGS in comparison to the 2002 fault database utilized by the other tools from USGS, and CGS. The earthquake magnitudes used in the CGS and USGS 2002 fault database are based on fault models developed by the California Geological Survey (formally known as the California Division of Mines and Geology) and the U.S. Geological Survey (USGS). These models are described in Peterson et al (1996) and Cao, et al. (2003). The deaggregation for the site shows a pga (peak ground acceleration) of 0.25 for a 10 percent chance of exceedance in 50 years, and the magnitude with the highest contribution is a 8.18. The magnitude chosen for our Maximum Credible Magnitude was one standard deviation above the mean magnitude. The magnitude and acceleration were scaled within the liquefaction analysis programs to appropriate weighting equal to a scale magnitude of 7.5.

Table 1.

Maximum Credible Magnitude	Peak Horizontal Ground Acceleration
7.2	0.25 g

Shear Strength Data

Petra conducted direct shear strength testing on both undisturbed and remolded samples of formational materials to evaluate the strength properties of cohesion, c, and angle of internal friction, Φ. Results are presented in the following table.

Sample Location	Material Description	Peak		Ultimate	
		Cohesion (psf)	Friction Angle (deg)	Cohesion (psf)	Friction Angle (deg)
T-3 at 5 ft.	Friars FM - Clayey Siltstone (undisturbed)	400	47°	590	35°
T-3 at 8 ft.	Friars FM - Clayey Siltstone (remolded)	500	31°	210	31°
T-3 at 8 ft.	Friars FM - Clayey Siltstone (undisturbed)	610	43°	260	40°
T-8 at 5 ft.	Stadium Conglomerate – Clayey Sandstone (undisturbed)	940	37°	220	30°
T-8 at 8 ft.	Stadium Conglomerate – Clayey Sandstone (remolded)	400	32°	80	29°
T-10 at 4 ft.	Friars FM - Claystone (undisturbed)	320	27°	160	28°

Preliminary Global Slope Stability Analyses

Grading plans have not been prepared for the site. However, preliminary information as provided by the client indicates that cut-and-fill grading will be performed to create a large level building pad or possibly terraced building pads to accommodate construction of the proposed generator plant and switchyard. On the basis of this preliminary information, and for the purpose of performing a preliminary assessment of slope stability, it has been assumed that a large single building pad will be created at a finish pad elevation of 460 feet msl and perimeter cut and fill slopes will be constructed at a ratio of 2:1 (h:v). This grading concept will require the construction of cut slopes ascending above the building on the north and east, and construction of fill slopes descending below the building pad on the south and west. This grading concept is illustrated on the enclosed Geologic Cross Sections A-A' and B-B.'

The three cut and fill slope configurations shown on Cross Sections A-A' and B-B' were analyzed for global stability using the computer program GSTABL7 by Garry H. Gregory, P.E. The analyses included both static and pseudo-static (seismic) loading configurations. The pseudo-static condition included a lateral load of 0.15g. The results of our preliminary analyses for the three slope conditions are discussed below and printouts of the stability calculations are presented in Appendix D.

Fill Slope - Cross Section A-A': The west-facing 2:1 (h:v) fill slope depicted on Cross Section A-A' reaches a height of approximately 80 feet. The analysis of the fill slope was first undertaken using shear strength parameters of 80 psf cohesion and 29° angle of internal friction, which represent the weakest strength parameters determined for a remolded sample of Stadium Conglomerate. The initial analysis, however, yielded an unsatisfactory static factor of safety of 1.33. As a result, it will be necessary to utilize compacted fill material with a higher cohesion component to achieve a suitable factor of safety. Iterative analyses were conducted where the cohesion factor was varied so as to attain a minimum satisfactory factor of safety. A cohesion of 200 psf and 30° angle of internal friction were found to yield a satisfactory static factor of safety of 1.55 and a pseudo-static factor of safety of 1.13.

Cut Slope - Cross Section A-A': The west-facing 2:1 (h:v) cut slope depicted on Cross Section A-A' reaches a height of approximately 60 feet. It is expected that this cut slope, for its full height, will expose competent bedrock materials of the Stadium Conglomerate. The stability analyses for this slope yielded a satisfactory static factor of safety of 1.64 and a pseudo-static factor of safety of 1.20 utilizing the weakest strength parameters determined for undisturbed samples of the Stadium Conglomerate.

Cut Slope - Cross Section B-B': The south-facing 2:1 (h:v) cut slope depicted on Cross Section A-A' reaches a height of approximately 65 feet. It is expected that the lower-half of this cut slope will expose unstable bedrock materials of the Friars Formation whereas the upper half will expose competent bedrock materials of the Stadium Conglomerate. The Friars Formation is prone to landsliding and/or surficial failures, especially at the contact with Stadium Conglomerate. Therefore, the cut slope will require overexcavation and replacement with a stabilization fill. The stabilization fill will require a base keyway having a minimum width of 20 feet and depth of 5 feet. As with the fill slope shown on Cross Section A-A', an initial analysis yielded an unsatisfactory static factor of safety of 1.43 utilizing strength parameters of 80 psf cohesion and 29° angle of internal friction, which represent the weakest strength parameters determined for a remolded sample of Stadium Conglomerate. However, a repeat of the analyses utilizing a cohesion of 200 psf and 30° angle of internal friction were found to yield a satisfactory static factor of safety of 1.89 and a pseudo-static factor of safety of 1.38.

Surficial Slope Stability Analyses

Generalized cut and fill slopes were analyzed for surficial stability using the infinite-slope method. This static analysis is based on 4-foot deep zone of saturation of the slope face where both sliding and basal seepage are taken as acting parallel to the slope face. Using the same slope angle and shear strength parameters as the global analyses, the analysis of the cut fill slopes yielded a factor of safety of 1.64. The analysis of the fill slope yielded a factor of safety of 1.56. The surficial slope stability analyses are included in Appendix D.

CONCLUSIONS AND RECOMMENDATIONS

General

Based on our preliminary subsurface investigation and analyses, development of the site as proposed is considered feasible from a geotechnical point of view. It is our opinion that the site will be free of hazard from landslide, settlement and slippage provided the following conclusions and recommendations are incorporated into the design criteria and project specifications. It is also our opinion that proposed grading and construction will not adversely affect the geologic stability of adjoining properties provided grading and construction are performed in accordance with the recommendations presented in this report.

Earthwork Recommendations

General Earthwork and Grading Specifications

All earthwork and grading should be performed in accordance with the recommendations of this report and all applicable requirements of the Grading Code of the City of San Diego, California.

Clearing

All weeds, grasses, brush, shrubs, trees and similar vegetation existing within areas to be graded should be stripped and removed from the site. Clearing operations should include the removal of all trash and debris. Trees and large shrubs, when removed, should be grubbed out so as to include their stumps and major root systems, and these organic materials removed from the site. During site grading, laborers should clear from fill soils any roots, tree branches, and other deleterious materials missed during initial clearing and grubbing operations.

The project geotechnical consultant should be notified at the appropriate times to provide observation and testing services during clearing operations to verify compliance with the above recommendations. In addition, should any buried structures or unusual or adverse soil conditions be encountered during grading that are not described or anticipated herein, these conditions should be brought to the immediate attention of the project geotechnical consultant for corrective recommendations.

Excavation Characteristics and Potential for Generation of Oversize Rock

Based on our exploratory trenches, on site surficial soil deposits (alluvium, colluviums, surficial slide materials) and bedrock materials of the Friars Formation and Stadium Conglomerate are expected to be excavatable with conventional earthmoving equipment

Oversize rock will be generated from the Stadium Conglomerate. Any rock exceeding 12 inches in maximum dimension should either be disposed of offsite or buried in the deeper fills planned within the site in accordance with the typical details shown on Plate SG-4, Appendix C (Standard Grading Specifications). The "Disposal of Oversize Rock" is discussed in a subsequent section.

Recompaction of Exploratory Trench Backfills

Following sampling and logging of the exploratory trenches, each trench was immediately backfilled; however, little to no compactive effort was applied to the backfills other than track-rolling the tops of the trenches. Consequently, the backfill materials are subject to significant settlement, particularly upon introduction and accumulation of water derived from irrigation and rainfall. Therefore, it is recommended that the exploratory trenches be re-excavated to their original depth and the backfill soils then replaced in lifts using mechanical compaction equipment.

The re-excavated soils should first be watered to achieve near optimum moisture conditions, replaced in approximately 3-foot-thick maximum lifts, and then mechanically compacted in place with a hydra-hammer, backhoe-mounted vibratory plate, or similar equipment that can achieve a minimum relative compaction of 90 percent. In cut areas or in remedial removal areas where the previous exploratory trench excavations are removed in their entirety, no additional removals will be required.

Remedial Removals and Canyon Cleanouts

All existing low-density surficial soils in areas to receive compacted fill should be removed to underlying competent bedrock approved by the project geotechnical consultant. In general, low-density surface deposits soils include alluvium, colluvium, localized shallow slumps (slide materials) and highly weathered bedrock. Competent materials are defined as, relatively unweathered and nonporous bedrock materials and dense native soils possessing an in-place relative compaction of at least 85 percent and a degree of saturation of at least 70 percent; however, where these materials exhibit a relative compaction of 90 percent or greater, no specific degree of saturation is necessary.

Similar removals should also be performed in areas of shallow cut where low-density surface soil deposits or highly weathered bedrock and landslide materials are not removed in their entirety. Based on our exploratory trench data, depths of removal are expected to vary from approximately 2 to 15 feet. Actual depths and horizontal limits of removals will have to be determined during grading.

Groundwater

Static groundwater is not expected to be encountered during grading; however, perched groundwater overlying dense bedrock may be encountered during canyon cleanouts, especially if grading is performed during the winter months. Temporary diversion and control of locally perched groundwater may be necessary during initial placement of compacted fill, particularly in the lower portions of the canyon drainages. If encountered, drying of wet or saturated soils excavated from canyon bottom areas may be necessary to obtain near-optimum moisture content in order to achieve proper compaction.

Canyon Subdrains

To mitigate the potential build-up of hydrostatic pressures below compacted fills due to infiltration of surface waters, subdrains should be installed along the axes of all major canyons and drainages to be filled where the depth of fill exceeds approximately 15 feet. Subdrains should be constructed in accordance with Plate SG-1, Appendix C. Those portions of the ends of the subdrains that are underlain by compacted fill materials rather than suitable native materials should be constructed with solid pipe rather than perforated pipe. Actual subdrain locations should be determined in the field during grading based on exposed geologic conditions; however, the project geotechnical consultant should generally designate the location of the subdrain systems on the approved grading plans.

Fill Placement

Following completion of remedial removals, exposed bottom surfaces in areas approved for placement of fill should first be scarified to a minimum depth of 6 inches, watered or air dried as necessary to achieve near optimum moisture conditions, and then compacted in place to a minimum relative compaction of 90 percent. All fills should be placed in 6- to 8-inch-thick maximum lifts, watered or air dried as necessary to achieve near optimum moisture conditions, and then compacted to a minimum relative compaction of 90 percent. Fill materials placed at depths of 40 feet or more below design finish grade should be compacted to a minimum relative compaction of 93 percent. The laboratory maximum dry density and optimum moisture content for each change in soil type should be determined in accordance with Test Method ASTM D 1557.

Benching

Fills placed against canyon walls, on natural slope surfaces inclining at 5:1 (h:v) or steeper, and against temporary backcut slopes associated with construction of stabilization fills should be placed on a series of level benches excavated into competent bedrock. These benches should be provided at vertical intervals of approximately 3 to 5 feet. Typical benching details are shown on Plates SG-5 through SG-8, Appendix C.

Disposal of Oversize Rock

As noted previously, oversize rock is expected to be encountered during grading operations. Oversize rock is defined as hard boulders or irreducible cemented bedrock fragments exceeding 12 inches in maximum dimension. Oversize rock generated during grading operations should be removed from the site or placed in the lower portions of the deeper fills utilizing the typical detail shown on Plate SG-4, Appendix C. Any oversize materials buried on site should be placed individually or in windows, and in a manner to avoid nesting, and then completely covered with finer-grained on-site earth materials. The finer-grained materials should be thoroughly watered and rolled to ensure closure of all voids. Oversize rock should not be placed within the upper 10 feet of finish grade within areas where structures are planned or other areas where they may interfere with footing and utility trench excavations. Furthermore, rock greater than 3 inches in maximum size should not be placed within the upper 5 feet of finish grade where structures are planned.

Processing of Cut Areas

In shallow cut areas where unsuitable surficial materials are not removed in their entirety, these materials should be overexcavated to underlying competent materials and then brought back to grade with properly compacted fill. In deep cut areas where competent materials are exposed at grade, no special remedial work such as scarification or recompaction will be required unless a transition from cut to fill exists beneath a proposed structure.

Building Pad Fill Cap

Friars Formation materials, both undisturbed and used as fill, are highly expansive and are not deemed suitable as building pad subgrade. Consequently, the building pad shall be capped with a 5-foot layer of engineered fill derived from the Stadium Conglomerate. The fill materials should be screened of rock in excess of 3 inches.

Expansive Soils:

Bedrock materials of the Stadium Conglomerate exhibit very low to low expansion potentials and the bedock materials of the Friars Formation exhibit a high expansion potential. Due to the potential for distress to building foundations due to the adverse effects of expansion and contraction, it is recommended that all building pads be underlain by soil or bedrock materials that exhibit very low to low expansion potentials. Therefore, the highly expansive Friars Formation bedrock materials should not be placed within 5 feet of proposed finish grade within building pad areas. In addition, building pads that are cut down to grade and expose highly expansive earth materials should be over-excavated to a depth of at least 5 feet below pad grade and replaced with fill materials exhibiting very low to low expansion potentials.

Volumetric Changes

Volumetric changes in earth quantities (shrinkage and bulking) will occur when excavated onsite soil and bedrock materials are replaced as properly compacted fill. It is estimated that a shrinkage factor of approximately 15 percent will occur for surficial soil deposits consisting of alluvium, colluviums and shallow slump (slide) materials when excavated and replaced as compacted fill. A bulking factor of 0 to 3 percent is estimated for bedrock materials when excavated and replaced as compacted fill. In addition, a subsidence of approximately 0.1 feet may result due to scarification and recompaction of the exposed ground surfaces within the removal areas.

The above estimates of shrinkage, bulking and subsidence are intended for use by project planners in determining earthwork quantities but should not be considered absolute values. Contingencies should be made for balancing earthwork quantities based on actual shrinkage, bulking and subsidence that occur during grading.

Cut Slopes

Cut Slope Construction

Based on our preliminary assessment of cut slope stability, cut slopes may be constructed at a ratio of 2:1 (h:v). Bedrock materials associated with the Stadium Conglomerate are hard to very hard, massive and do not exhibit any potential planes of weakness. Therefore, cut slopes exposing Stadium Conglomerate are expected to be grossly stable and no remedial grading will be required. Conversely, bedrock materials associated with the Friars Formation are prone to surficial slumping as evidenced in localized areas within the site and surrounding areas. Therefore, cut slopes exposing bedrock materials of the Friars Formation will require replacement with a stabilization fill.

Stabilization Fills

The lower half of the south-facing cut slope depicted on Cross Section B-B' will expose bedrock materials of the Friars Formation and will require overexcavation and replacement with a stabilization fill. Based on our preliminary stability calculations, the stabilization fill should be founded on a basal keyway having a minimum width of 20 feet and a depth of 5 feet below finish grade at the toe of the finished slope. In addition, fill materials utilized for construction should consist of a mixture of soil and/or bedrock materials that will possess a shear strength cohesion component of 200 psf and a friction angle of 30 degrees, to be confirmed during grading. The bottom of the stabilization fill keyway should be tilted back at a minimum gradient of 2 percent towards the heel of the key. The top of the temporary backcut slope that will extend above the keyway should daylight at a minimum horizontal distance of 15 feet from the top of the finished slope. As fill placement progresses upslope, the fill materials should be keyed and benched into the temporary backcut. Internal backdrains should also be installed in the stabilization fill to mitigate a potential buildup of excessive hydrostatic pressures. Backdrains should be constructed in accordance with the details shown on Plates SG-2 and SG-3, Appendix C. Backdrain locations should be determined during grading based on local topography and the most feasible exit points for outlet pipe. Additional stabilization fills may be required if other cut slopes expose bedrock materials of the Friars Formation.

Stability of Temporary Backcut Slope

The temporay backcut slope associated with construction of the above stabilization fill will be excavated at an approximate ratio of 2:1 (h:v). At this configuration, the backcut is expected to remain stable during construction of the stabilization fill. However, the stability of the temporary backcut slope will be dependent on the length of time the temporary cut remains unsupported. In order to minimize the potential for a backcut failure, the following techniques should be considered:

1. The basal fill keyway should be excavated, observed by the project geologist, and then filled in the shortest practical period of time. Keyway excavations should never be allowed to stand open for prolonged periods of time.
2. Provisions should be made for preventing nuisance water and rainwater from collecting and ponding in the keyway excavation.
3. Grading equipment and other construction traffic should never be allowed to traverse along the top of temporary backcut slope.
4. In addition to the above, all OSHA requirements should be followed with respect to excavation safety.

Fill Slopes

Fill Slope Construction

Fill slopes may be constructed at a slope ratio of 2:1 (h:v). Based on our preliminary assessment of fill slope stability, fill materials utilized for construction should consist of a mixture of soil and/or bedrock materials that will possess a shear strength cohesion component of 200 psf and a friction angle of 30 degrees, to be confirmed during grading. Fill slopes should be constructed as recommended below. The surface compaction recommendations provided below for fill slopes should also be applied to stabilization fill slopes.

1. Fill Keys

   Fill keys excavated into competent bedrock will be required at the base of all fill slopes to be constructed on slope surfaces inclining at 5:1 (h:v) or steeper. The fill keys should be excavated to a minimum depth of 2 feet into competent materials and have a minimum width equal to one-half of the slope height, or 15 feet, whichever is greater. The bottoms of the fill keys should be tilted back at a minimum gradient of 2 percent towards the heel of the key. Internal backdrains will be required in the keyways to prevent entrapment of irrigation water and rainwater in the key bottoms. Typical details for construction of the backdrains are shown on plates SG-2 and SG-3, Appendix C.

2. Surface Compaction

The finish surfaces of all fill slopes should be compacted to a minimum relative compaction of 90 percent. Final surface compaction should be achieved by overfilling the slopes during construction, backrolling the overfilled slope surfaces at vertical intervals not exceeding 4 to 5 feet, and then trimming the slopes back to the compacted inner core. Where this procedure may not be practical, surface compaction should be obtained by backrolling during construction to achieve at least 90 percent relative compaction within 6 to 8 inches of the finish surfaces. This initial back-rolling should be performed at vertical intervals not exceeding 4 to 5 feet. Final surface compaction should then be achieved by rolling the slope surface with a cable-lowered sheepsfoot and then re-rolling with a grid roller. During final surface compaction, it is critical that the moisture content of the surface soils be maintained at near optimum moisture content or slightly higher.

Slope Drainage

Applicable grading codes indicate that cut and fill slopes will require 6-foot wide (minimum) terrace drains at 30-foot vertical intervals to control surface drainage and debris. It is noted that the required 6-foot wide (minimum) terrace drains are not depicted on the slopes shown on Cross Sections A-A1 and B-B1. Although the stability calculations are based on a straight slope configuration without terrace drains, inclusion of terrace drains in the slope geometry would result in slightly higher factors of safety.

Geotechnical Observations

Observations of the clearing operations, removal of low density surficial soils, keyway excavations, and general grading procedures should be performed by a representative of the project geotechnical consultant. It should be the grading contractor's responsibility to notify the project geotechnical consultant when fill areas and fill keys are ready for observation. A representative of the project geotechnical consultant should be present on site during all major grading operations to verify proper placement and adequate compaction of all fills, as well as to verify compliance with the other recommendations presented herein.

Post-Grading Considerations

Utility Trenches

All utility trench backfill should be compacted to a minimum relative compaction of at least 90 percent. Where on-site soils and excavated bedrock materials are utilized as backfill, mechanical compaction will be required. Density testing, along with probing, should be performed by a representative of the project geotechnical consultant to verify proper compaction.

For deep trenches with vertical walls, backfill should be placed in approximately 3-foot-thick maximum lifts, and then mechanically compacted with a hydra-hammer, pneumatic tampers, or similar equipment that can achieve the desired compaction. For deep trenches with sloped walls, backfill materials should be placed in approximately 8- to 12-inch-thick maximum lifts, and then compacted by rolling with a sheepsfoot tamper or similar equipment.

As an alternate for shallow trenches where pipe may be damaged by mechanical compaction equipment, such as under building floor slabs, imported clean sand having a Sand Equivalent value of 30 or greater may be utilized and jetted or flooded into place. No specific relative compaction will be required; however, observation, probing, and if deemed necessary, testing should be performed by the project geotechnical consultant to verify that an adequate degree of compaction is achieved. To avoid point loads and subsequent distress to asbestos, clay, cement, or plastic pipe, imported sand bedding should be placed at least 1 foot above all pipe in areas where excavated trench materials contain oversize rock. Sand bedding materials should be thoroughly jetted prior to placement of backfill.

Slope Landscaping and Maintenance

The overall stability of the graded slopes should not be adversely affected provided drainage provisions are properly constructed and maintained thereafter, and provided all engineered slopes are landscaped with a deep-rooted, drought-resistant, and relatively maintenance-free plant species. Additional comments and recommendations are presented below with respect to slope drainage, landscaping and irrigation.

1. Proper drainage provisions for engineered slopes should consist of concrete terrace drains, downdrains and energy dissipaters (where required) constructed in accordance with the City of San

Diego grading code. Provisions should also be made for construction of compacted earth berms along the tops of all engineered slopes.

2. All engineered slopes should be landscaped as soon as practical at the completion of grading. As noted, the landscaping should consist of a deep-rooted, drought-resistant, and maintenance-free plant species. If landscaping cannot be provided within a reasonable period of time, jute matting or equivalent, or a spray-on product designed to seal slope surfaces should be considered as a temporary measure to inhibit surface erosion.

3. Irrigation systems should be installed on the engineered slopes and a watering program then implemented which maintains a uniform, near optimum moisture condition in the soils. Overwatering and subsequent saturation of the slope soils should be avoided. On the other hand, allowing the soils to dry out is also detrimental to slope performance.

4. Irrigation systems should be constructed at the surface only. Construction of sprinkler lines in trenches should not be allowed without prior approval from the soils engineer and engineering geologist.

5. During construction of terrace drains and downdrains, care must be taken to avoid placement of loose soil on the slope surfaces.

6. A permanent slope maintenance program should be initiated. Proper slope maintenance must include the care of drainage and erosion control provisions, rodent control, and repair of leaking irrigation systems.

7. Provided the above recommendations are followed with respect to slope drainage, maintenance and landscaping, the potential for deep saturation of slope soils is considered very low.

PRELIMINARY FOUNDATION RECOMMENDATIONS

Earthquake Loads

Structures within the site should be designed and constructed to resist the effects of seismic ground motions as provided in Section 1613 of the 2010 California Building Code (CBC). The method of design is dependent on the seismic zoning, site characteristics, occupancy category, building configuration, type of structural system and on the building height.

For structural design in accordance with the 2010 CBC, a computer program, Earthquake Ground Motion Parameters Version 5.1.0, developed by the United States Geological Survey (USGS, 2007) was utilized to provide ground motion parameters for the subject site. The program includes hazard curves, uniform hazard response spectra and design parameters for sites in the 50 United States, Puerto Rico and the United States Virgin Islands. Based on the latitude, longitude and site classification, seismic design parameters and spectral response for both short periods and 1-second periods are calculated including Mapped Spectral Response Acceleration Parameter, Site Coefficient, Adjusted Maximum Considered Earthquake Spectral Response Acceleration Parameter and Design Spectral Response Acceleration Parameter. The program is based on USGS research and publications in cooperation with the California Geological Survey for evaluation of California faulting and seismicity (USGS, 1996a; 1996b; 2002; 2007).

As stated previously, the Rose Canyon Fault (approximately 11.1 miles or 17.8 kilometers to the southwest of the site) should be considered to be the causative fault for the subject site and is expected to generate the most severe site ground motions with an anticipated maximum moment magnitude (Mw) of 7.2 and an anticipated slip rate of 1.5 mm/year (CGS, 2002).

The following 2010 CBC seismic design coefficients should be used for the proposed structures. These criteria are based on the site class as determined by existing subsurface geologic conditions, on the proximity of the site to the nearby fault and on the maximum moment magnitude and slip rate of the nearby fault.

2010 CBC Section 1613, Earthquake Loads	
Mapped Spectral Response Acceleration Parameter, S_s (Figure 1613.5(3) for 0.2 second)	0.999
Mapped Spectral Response Acceleration Parameter, S_1 (Figure 1613.5(4) for 1.0 second)	0.357
Site Class Definition (Table 1613.5.2)	D
Site Coefficient, F_a (Table 1613.5.3 (1) short period)	1.1
Site Coefficient, F_v (Table 1613.5.3 (2) 1-second period)	1.686
Adjusted Maximum Considered Earthquake Spectral Response Acceleration Parameter, S_{MS} (Eq. 16-36)	1.099
Adjusted Maximum Considered Earthquake Spectral Response Acceleration Parameter, S_{M1} (Eq. 16-37)	0.602
Design Spectral Response Acceleration Parameter, S_{DS} (Eq. 16-38)	0.733
Design Spectral Response Acceleration Parameter, S_{D1} (Eq. 16-39)	0.401

Foundation System

Provided site grading is performed in accordance with the recommendations of this report, the use of conventional shallow foundations, rigid mat or structural slab foundations or combinations thereof are considered feasible for support of the various structural elements of the facility. Preliminary foundation design recommendations are provided herein based on anticipated as-graded soil conditions pursuant to recommendations presented in this report. For purposes of analysis, continuous footing loads of 10 kips/foot and column loads of 150 kips have been assumed. Once details of the specific foundation requirements are known, more detailed design recommendations can be provided as needed.

Allowable Bearing Capacity

For preliminary design purposes, conventional shallow foundations may be sized utilizing the following allowable bearing capacities:

- Continuous: $q_{all} = 800 + 750D + 500B$
- Isolated Pad: $q_{all} = 400 + 975D + 400B$

Note: Maximum allowable bearing capacity is 4,000 psf

where: q_{all} = allowable bearing capacity, psf
D = footing embedment, ft
B = footing width, ft

The recommended allowable bearing values include both dead and live loads and may be increased by one-third when considering short-duration wind and seismic forces.

Settlement

Preliminary settlement calculations were performed for both a continuous footing and an isolated column pad footing utilizing the assumed loads of 10 kips/ft and 150 kips, respectively. Based on the general settlement characteristics of compacted fills comprised of granular soils, as would exist in the building pad, and the underlying bedrock materials, as well as the anticipated loading, it is estimated that the total settlement of a continuous footing would be 0.40 inches and an isolated column pad footing would be 0.47 inches. It is anticipated that the majority of the settlement would occur during construction or shortly thereafter as building loads are applied.

Lateral Resistance

A passive earth pressure of 250 psf per foot of depth up to a value of 2,500 psf may be used to determine lateral bearing resistance for footings. In addition, a coefficient of friction of 0.35 times the dead-load forces may be used between concrete and the supporting soils to determine lateral sliding resistance. The above values may be increased by one-third when considering short-duration wind and seismic forces. The above values are based on footings placed directly against compacted fill. In the case where footing sides are formed, backfill placed against the footings should be compacted to a relative compaction of 90 percent or more of maximum dry density, with reference to ASTM D1557.

Modulus of Subgrade Reaction

Structural slab-on-ground foundations or other appropriate foundation elements may be designed using a modulus of subgrade reaction, k_s, of 200 pounds per cubic inch (pci).

Expansive Soil Conditions

The building pad is recommended to be constructed of granular soils derived from the sandstone and conglomerate bedrock materials. These materials generally exhibit Very Low expansion potential. Based on the granular, sandy nature of onsite soils a Very Low expansion potential is deemed appropriate for preliminary design purposes. Be advised that the soils derived from the underlying Friars Formation bedrock, comprised of clayey siltstone and claystone, exhibit a High expansion potential and placement of these materials within the building pad will warrant special foundation design provisions.

LIMITATIONS

This report is based on the project, as described and the geotechnical data obtained from the field tests performed. The materials encountered on the project site and utilized in our laboratory evaluation are believed representative of the total area. However, soil materials can vary in characteristics between excavations, both laterally and vertically.

The conclusions and opinions contained in this report are based on the results of the described geotechnical evaluations and represent our professional judgment. The findings, conclusions and opinions contained in this report are to be considered tentative only and subject to confirmation by the undersigned during the construction process. Without this confirmation, this report is to be considered incomplete and Petra or the undersigned professionals assume no responsibility for its use. In addition, this report should be reviewed and updated after a period of 1 year or if the site ownership or project concept changes from that described herein.

The professional opinions contained herein have been derived in accordance with current standards of practice and no warranty is expressed or implied.

Respectfully submitted,

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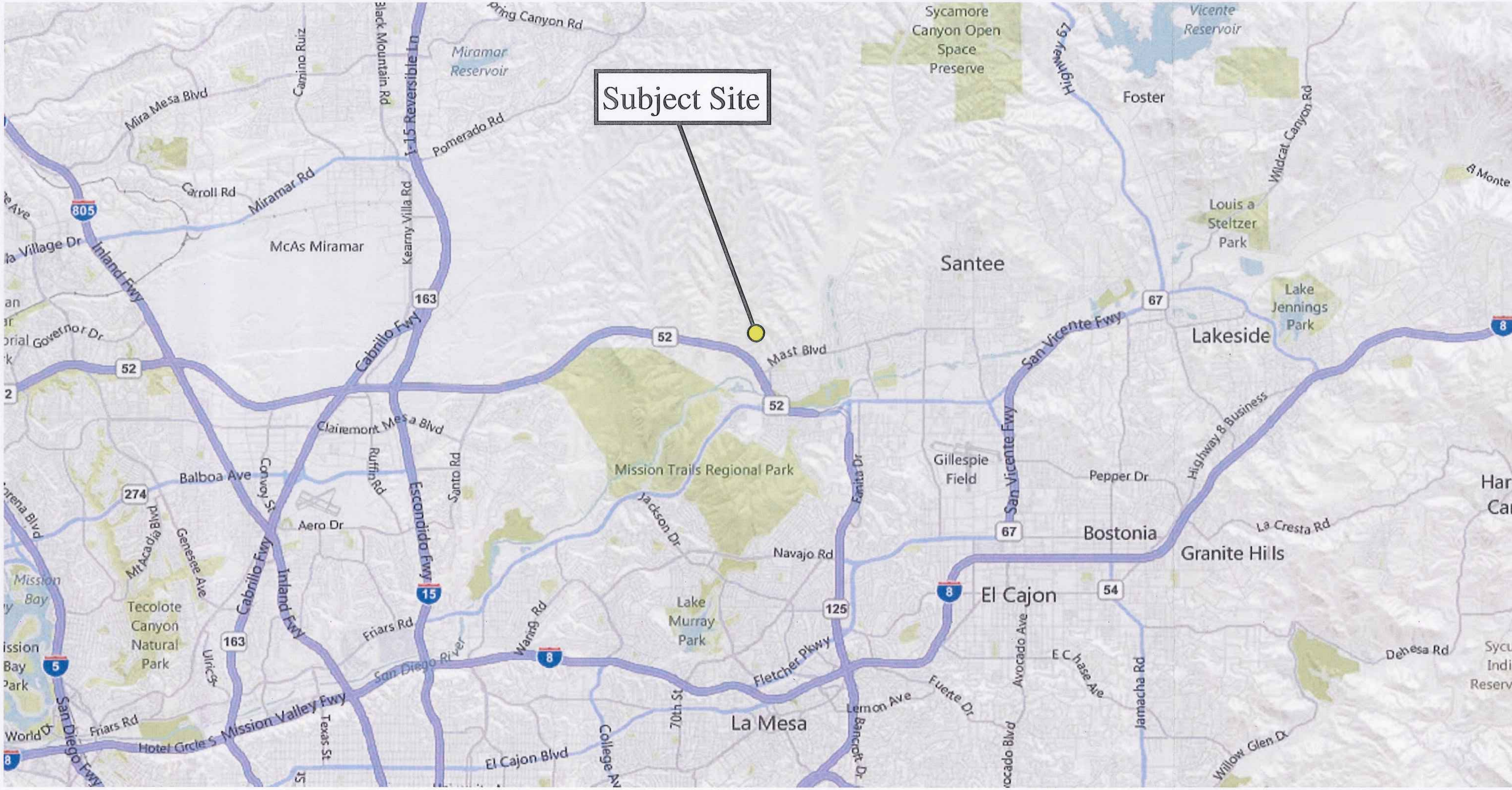
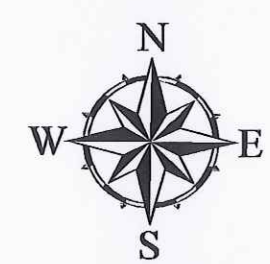
Aerial-Photographs Reviewed

Date	Photo/Number	Scale 1 inch = --- feet
04/16/72	107-3 -11-12	No scale
01/14/88	SD-7-18	No scale
10/21/93	C97-10-103-104	2,000
07/10/98	C121-11-111-110	2,000
07/10/98	C121-10-46-47	2,000





Reference: Bing Maps

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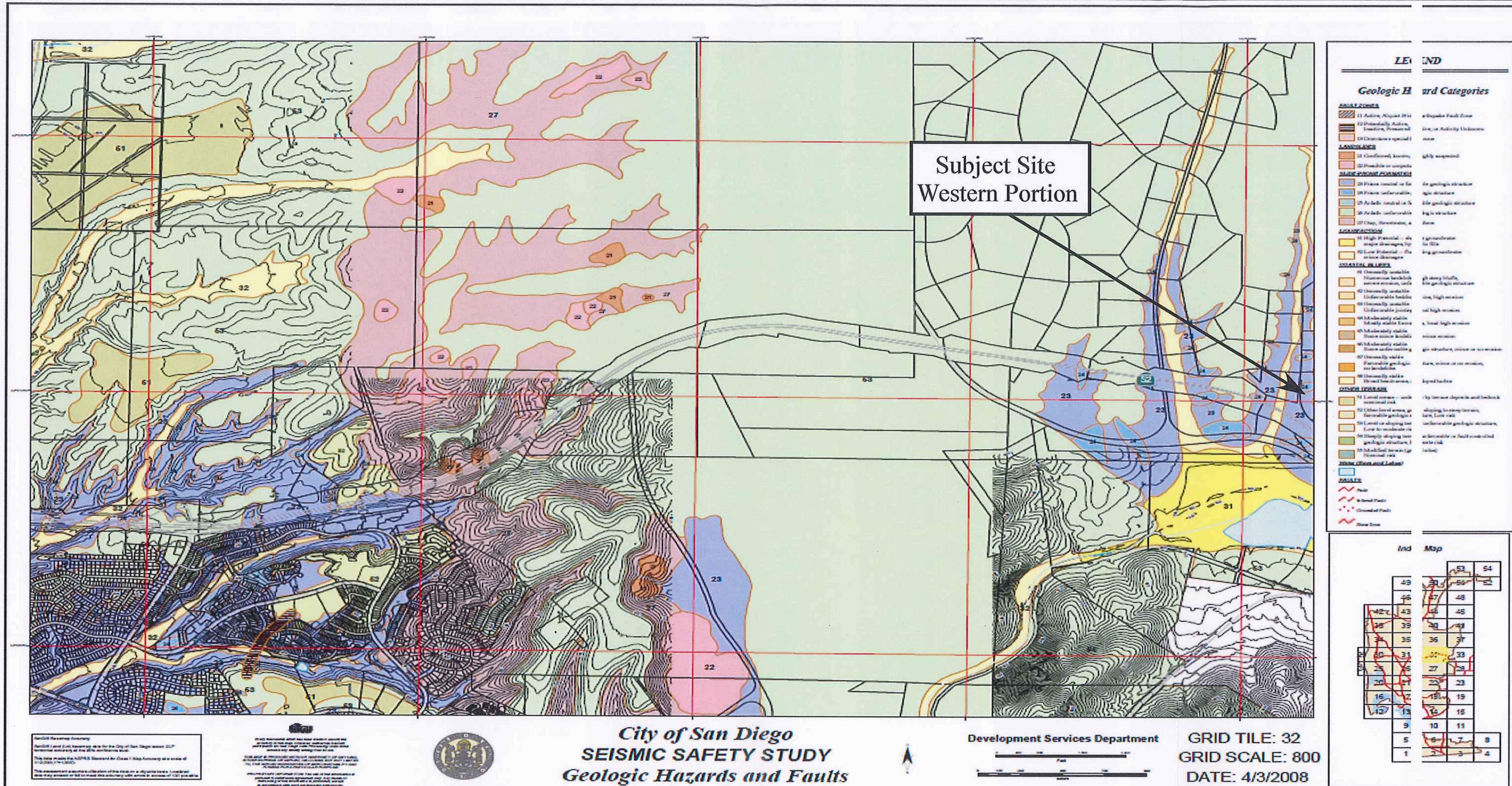
SITE LOCATION MAP

Cogentrix Energy, LLC.
Peaker Plant Project
City of San Diego, California

DATE: July 2011	J.N.: 247-11	**Figure 1**
DWG BY: JC	SCALE: N/A	



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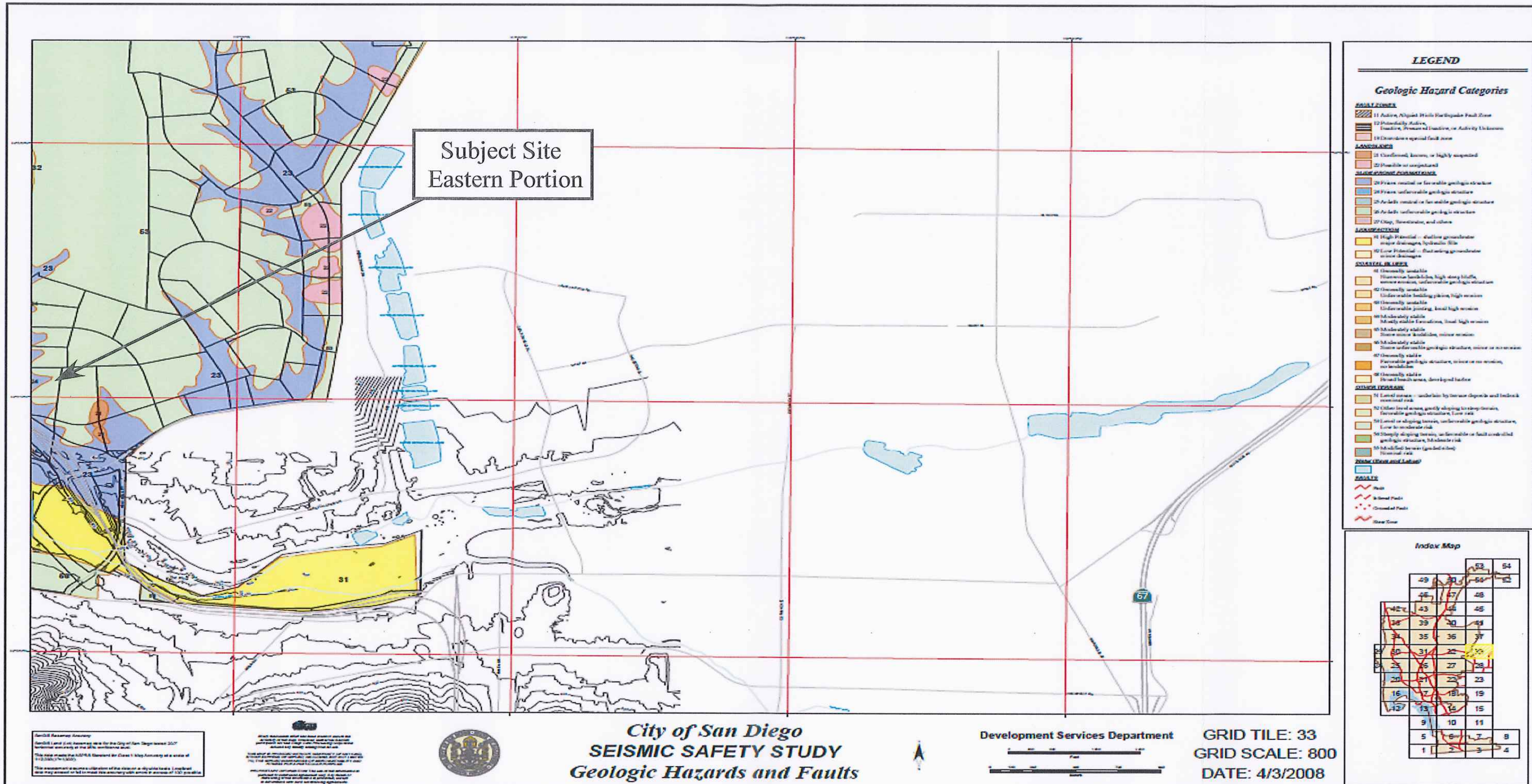
HAZARD MAP

Cogentrix Energy, LLC.
Peaker Plant Project
City of San Diego, California

DATE: July 2011	J.N.: 247-11	Figure 2
DWG BY: JC	SCALE: N/A	



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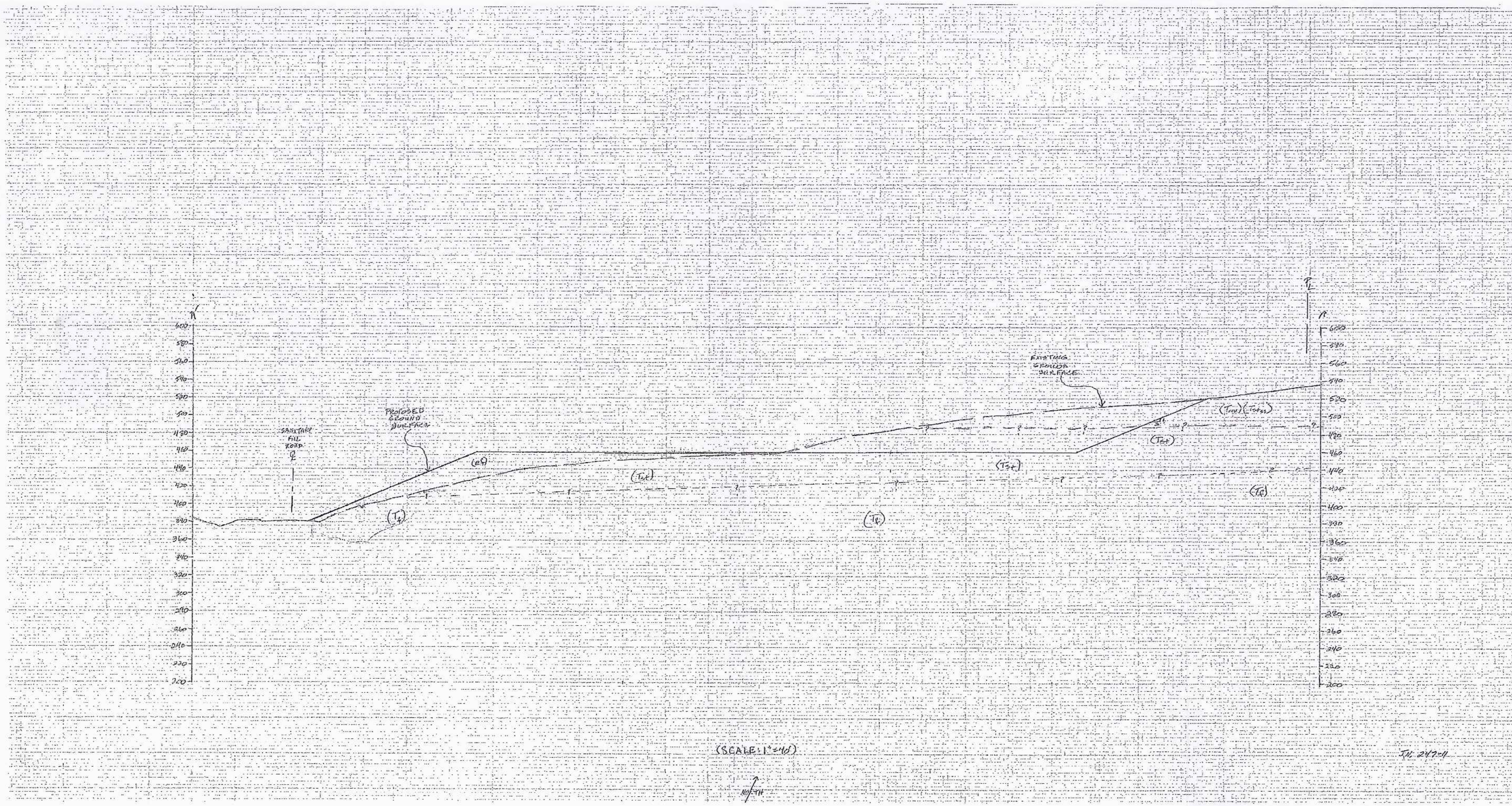
HAZARD MAP

Cogentrix Energy, LLC.
Peaker Plant Project
City of San Diego, California

DATE: July 2011	J.N.: 247-11	Figure 2A
DWG BY: JC	SCALE: N/A	



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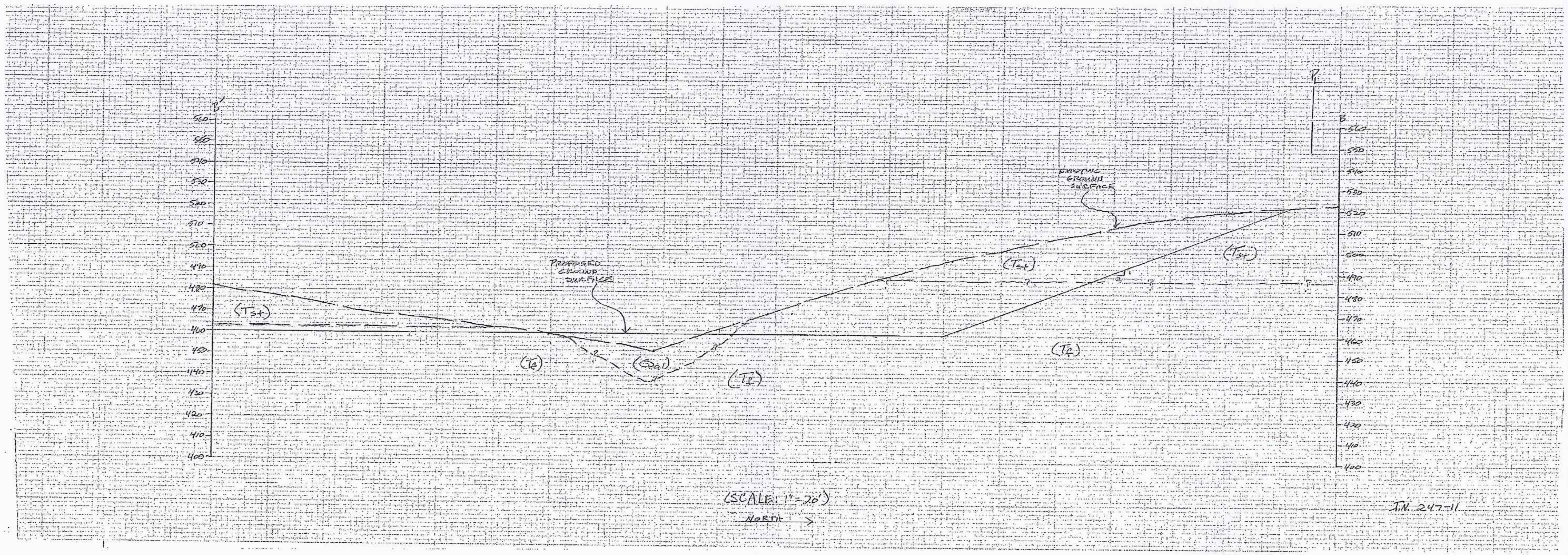
CROSS SECTION A - A'

Cogentrix Energy, LLC.
Peaker Plant Project
City of San Diego, California

DATE: July 2011	J.N.: 247-11	Figure 3
DWG BY: JC	SCALE: N/A	



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CROSS SECTION B - B'

Cogentrix Energy, LLC.
Peaker Plant Project
City of San Diego, California

DATE: July 2011	J.N.: 247-11	**Figure 4**
DWG BY: JC	SCALE: N/A	

APPENDIX A

LOGS OF TEST PITS

PETRA

LOGS OF TEST PITS

TEST PIT NUMBER	DEPTH (ft)	DESCRIPTION
TP-1	0.0 – 3.0	**COLLUVIUM (Qcol):** Silty CLAY (CL/CH): grayish brown, moist, firm; roots in upper 8", few cobble
	3.0 – 6.0	**STADIUM CONGLOMERATE (Tst_{ss}):** Silty SANDSTONE: yellowish brown and olive gray, slightly moist, moderately hard; fine to medium grained, slightly micaceous
		Total Depth = 6 Feet No Groundwater Encountered Trench Backfilled
TP-2	0.0 – 4.0	**COLLUVIUM (Qcol):** Silty CLAY (CL/CH): grayish brown, moist, firm; few gravel
	4.0 - 9.5	**Friars Formation (Tf):** SILTSTONE: olive gray and olive brown, slightly moist, soft to moderately hard; highly weathered, shears, slickensides @7 ½ feet: large pockets of caliche
	9.5 - 11	Sandy SILTSTONE: olive gray, slightly moist, hard; blocky fracturing, manganese staining along fractures
		Total Depth = 11 Feet No Groundwater Encountered Trench Backfilled
TP-3	0.0 – 3.5	**COLLUVIUM (Qcol):** Silty Clay (CL/CH): dark grayish brown, moist, firm; some fine to medium sand, roots in upper 8".
	3.5 – 7.0	**FRIARS FORMATION (Tf):** Clayey SILTSTONE: olive gray and olive brown, moist, soft to moderately hard; highly weathered, fractured, oxidation staining, some fine to medium sand
	7.0 – 9.0	Clayey SILTSTONE: olive gray, slightly moist, moderately hard to hard; blocky fracturing, iron oxidation staining and manganese staining along fractures
		Total Depth = 9 Feet No Groundwater Encountered Trench Backfilled

LOGS OF TEST PITS

TEST PIT NUMBER	DEPTH (ft)	DESCRIPTION
TP-4	0.0 – 2.5	**COLLUVIUM (Qcol):** Clayey SAND/ sandy CLAY (SC/CL): dark brownish gray, slightly moist, loose to medium dense/ firm; fine to medium, rootlets.
	2.5 – 8.0	**FRIARS FORMATION (Tf):** Clayey SILTSTONE: olive brown, moist, soft to moderately hard: highly weathered, highly fractured, blocky fracturing, iron oxidation staining along fractures
		Total Depth = 8 Feet No Groundwater Encountered Trench Backfilled
TP-5	0.0 – 1.5	**COLLUVIUM (Qcol):** Clayey SAND (SC): brownish gray, dry to slightly moist, loose; fine to medium, numerous cobbles
	1.5 – 2.5	CLAY (CL/CH): brown, moist, firm.
	2.5 – 4.5	**STADIUM CONGLOMERATE (Tst_{ss}):** Clayey SANDSTONE: brown to light brown, moist, moderately hard; fine to medium grained, highly weathered
	4.5 – 10.0	**STADIUM CONGLOMERATE (Tst):** CONGLOMERATE: clayey sandstone matrix, light to dark yellowish brown, slightly moist, moderately hard; fine to coarse grained, subrounded to rounded gravel and cobble
		Total Depth = 10 Feet No Groundwater Encountered Trench Backfilled

LOGS OF TEST PITS

TEST PIT NUMBER	DEPTH (ft)	DESCRIPTION
TP-6	0.0 – 1.0	COLLUVIUM (Qcol): Clayey SAND (SC): brownish gray, dry, loose; fine to medium, roots
	1.0 – 2.5	Clay (CL/CH): brown, moist, firm; some fine to medium sand
	2.5 – 8.5	STADIUM CONGLOMERATE (Tst) CONGLOMERATE: clayey sandstone matrix, light to dark yellowish brown, slightly moist, moderately hard; fine to coarse grained, subrounded to rounded gravel and cobble
		Total Depth = 8.5 Feet No Groundwater Encountered Trench Backfilled
TP-7	0.0 – 2.5	COLLUVIUM (Qcol): Silty CLAY (CL/CH): dark brownish gray, slightly moist to moist, firm; some subrounded to rounded gravel
	2.5 – 9.0	STADIUM CONGLOMERATE (Tst) CONGLOMERATE: clayey sandstone matrix, slightly moist, yellowish brown and gray, moderately hard; fine to coarse grained, subrounded to rounded gravel and cobble, minor iron oxidation staining to 4.5 feet
		Total Depth = 9 Feet No Groundwater Encountered Trench Backfilled
TP-8	0.0 – 1.0	COLLUVIUM (Qcol): Clayey SAND (SC): grayish black, dry, medium dense; fine to medium, roots, few subrounded gravel
	1.0 – 2.0	Clay (CL/CH): brown, moist, firm; some fine sand
	2.5 – 8.5	STADIUM CONGLOMERATE (Tst_{ss}): Clayey SANDSTONE: light yellowish brown and gray, moist, moderately hard to hard, fine to medium, oxidation staining to 4.5 feet
		Total Depth = 8.5 Feet No Groundwater Encountered Trench Backfilled

LOGS OF TEST PITS

TEST PIT NUMBER	DEPTH (ft)	DESCRIPTION
TP-9	0.0 – 2.0	COLLUVIUM (Qcol): Clayey SAND (CL): very dark gray, dry to slightly moist, soft; fine to medium with numerous subrounded to rounded gravel and cobble, roots
	2 - 4	Clay (CL/CH): brown, moist, firm; minor fine sand
	4.0 – 5.5	STADIUM CONGLOMERATE (Tst): CONGLOMERATE: clayey sandstone matrix, light to dark yellowish brown, slightly moist, moderately hard; fine to coarse grained, subrounded to rounded gravel and cobble Undulating contact
	5.5 – 7.0	FRIARS FORMATION (Tf): Clayey SILTSTONE: olive gray and olive brown, moist, soft to moderately hard: highly weathered, highly fractured, blocky fracturing, iron oxidation staining along fractures
		Total Depth = 7 Feet No Groundwater Encountered Trench Backfilled
TP-10	0.0 – 3.0	COLLUVIUM (Qcol): Sandy CLAY/Clayey SAND (CL/SC): very dark gray, dry to slightly moist, loose; with gravel and cobble, roots, desiccation cracks, upper 8”
	3.0 – 10.0	FRIARS FORMATION (Tf): CLAYSTONE: olive gray, slightly moist, moderately hard to hard; highly weathered, blocky fracturing, iron oxidation staining and manganese staining along fractures, shears, slickensides Moderately weathered below 7 feet
		Total Depth = 10 Feet No Groundwater Encountered Trench Backfilled
TP-11	0.0 – 3.5	COLLUVIUM (Qcol): Sandy CLAY/Clayey SAND (CL/SC): very dark gray, dry to slightly moist, loose; fine to medium, numerous subrounded gravel and cobble, roots and dessication cracks in upper 1 foot Undulating contract dipping 10 degrees NW
	3.5 – 11.0	STADIUM CONGLOMERATE (Tst): CONGLOMERATE: clayey sandstone matrix, light yellowish brown and orange brown, slightly moist, moderately hard; fine to coarse grained, subrounded to rounded gravel and cobble
		Total Depth = 11 Feet No Groundwater Encountered Trench Backfilled

LOGS OF TEST PITS

TEST PIT NUMBER	DEPTH (ft)	DESCRIPTION
TP-12	0.0 – 4.0	**ALLUVIUM (Qal):** Clayey SAND (SC): very dark gray, slightly moist, loose to medium dense; numerous subrounded to rounded gravel and cobble
	4.0 – 7.0	Silty CLAY (CL/CH): olive gray, moist, soft to firm
	7.0 – 9.5	Silty CLAY (CL/CH): brown, moist, firm; subrounded to rounded gravel and cobble
	9.5 – 11.5	**FRIARS FORMATION (Tf):** Silty CLAYSTONE: dark olive gray, moist, moderately hard; highly weathered, highly fractured, sheared, striations, manganese straining
		Total Depth = 11.5 Feet No Groundwater Encountered Trench Backfilled
TP-13	0.0 – 4.5	**ALLUVIUM (Qoal):** Clayey SAND/Sandy CLAY (SC/CL): very dark gray, slightly moist, loose/soft; fine to medium, numerous subrounded gravel and cobble
	4.5 – 6.5	Silty CLAY (CL/CH): brown, moist, firm; numerous subrounded to rounded gravel to cobble, minor roots;
	6.5 – 10.0	**Friars Formation (Tf):** Silty CLAYSTONE: dark olive , moist, soft to moderately hard; highly weathered, highly sheared, manganese staining, slickensides, striations
	10.0 – 12.0	Slightly to moderately weathered, blocky and hackly fractured, manganese staining along fractures
		Total Depth = 12.0 Feet No Groundwater Encountered Trench Backfilled

APPENDIX B

LABORATORY TEST CRITERIA/LABORATORY TEST DATA

PETRA

APPENDIX B

Laboratory Test Criteria

Soil Classification

Soils encountered within the exploratory trenches were initially classified in the field in general accordance with the visual-manual procedures of the Unified Soil Classification System (ASTM D 2488). The samples retrieved from the exploratory trenches were re-examined in the laboratory and the classifications reviewed and then revised where appropriate. The assigned group symbols are presented in the exploratory trench logs (Appendix A).

In Situ Moisture and Density

Moisture content and unit dry density of the in-place soil and bedrock materials were determined in representative strata. Test data are summarized on Plate B-1.

Laboratory Maximum Dry Density

Maximum dry density and optimum moisture content were determined for selected samples of onsite earth materials in accordance with ASTM D 1557. Pertinent test values are summarized on Plate B-1.

Expansion Index

Expansion index tests were performed on selected samples in accordance with ASTM D4829. The test results are presented on Plate B-1.

Corrosion Tests

Chemical analyses were performed on selected samples of the onsite earth materials to determine concentrations of soluble sulfate and chloride, as well as pH and resistivity. These tests were performed in accordance with California Test Method Nos. 417 (sulfate), 422 (chloride) and 643 (pH and resistivity). Test results are included on Plate B-1.

Direct Shear

The Coulomb shear strength parameters, angle of internal friction and cohesion, were determined for selected undisturbed samples retrieved from the exploratory trenches borings and for disturbed (bulk)

APPENDIX B

samples remolded to approximately 90 percent of maximum dry density. These tests were performed in general accordance with ASTM D3080. Three specimens were prepared for each test. The test specimens were artificially saturated, and then sheared under varied normal loads at a maximum constant rate of strain of 0.05 inches per minute. Test results are graphically presented on Plates B-2 through B-7.

Consolidation

Consolidation tests were performed on selected undisturbed samples retrieved from the exploratory trenches. The tests were performed in general accordance with ASTM D2435. Axial loads were applied in several increments to a laterally restrained 1-inch-high sample. Loads were applied in a geometric progression by doubling the previous load, and the resulting deformations were recorded at selected time intervals. The test samples were inundated at a surcharge loading approximately equal to the existing or anticipated overburden pressure in order to evaluate the effects of a sudden increase in moisture content (e.g., hydrocollapse potential). Results of these tests are graphically presented on Plates B-8 and B-9

Grain-Size Analysis

A full grain-size analysis that included a hydrometer analysis was performed on a selected sample in accordance with ASTM D422. The test result is graphically presented on Plate B-10.

IN-SITU MOISTURE AND DENSITY

Trench No. and Depth (feet)	Soil Description	Moisture (%)	Dry Density (pcf)
T-1 @ 3.0	Silty Sandstone (Tmv)	12.7	112.4
T-2 @ 6.0	Siltstone (Tf)	27.2	91.5
T-3 @ 5.0	Clayey Siltstone (Tf)	21.8	98.2
T-3 @ 8.0	Clayey Siltstone (Tf)	20.0	100.5
T-4 @ 7.0	Clayey Siltstone (Tf)	19.3	103.5
T-8 @ 1.0	Clay (CL-CH) – Colluvium	16.0	104.2
T-8 @ 5.0	Clayey Sandstone (Tmv/Tst)	12.8	111.8
T-10 @ 4.0	Claystone (Tf)	13.9	101.3
T-10 @ 9.0	Claystone (Tf)	19.8	105.0

LABORATORY MAXIMUM DRY DENSITY

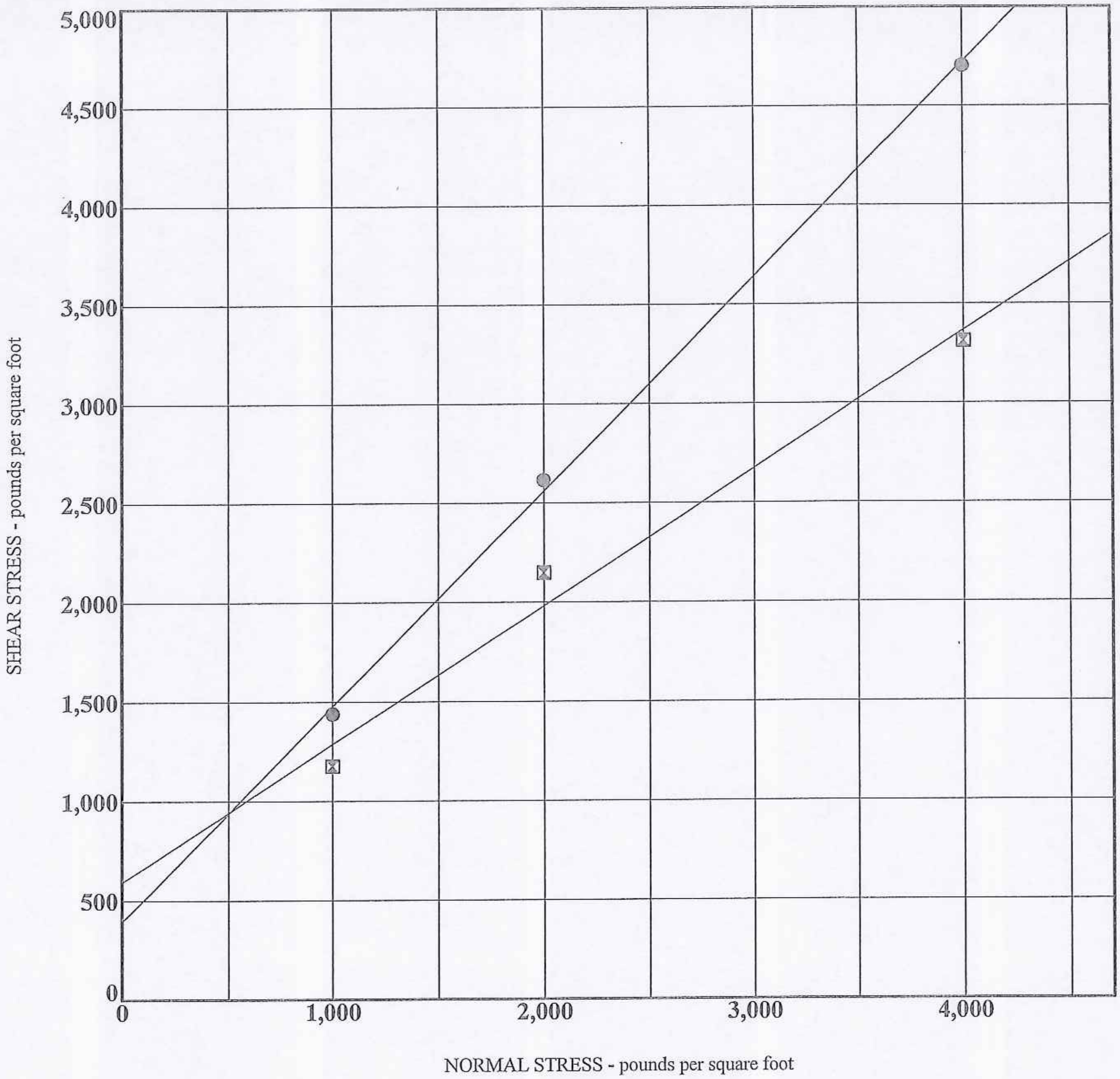
Trench No. and Depth (feet)	Soil Description	Optimum Moisture (%)	Maximum Dry Density (pcf)
T-1 @ 3.0	Silty Sandstone (Tmv)	14.5	116.0
T-3 @ 8.0	Clayey Siltstone (Tf)	22.0	106.0
T-8 @ 5.0	Clayey Sandstone (Tmv/Tst)	13.0	119.0
T-12 @ 11.9	Silty Claystone (Tf)	21.5	107.0

EXPANSION INDEX

Trench No. and Depth (feet)	Soil Description	Expansion Index	Expansion Potential
T-1 @ 3.0	Silty Sandstone (Tmv)	11	Very Low
T-3 @ 8.0	Clayey Siltstone (Tf)	26	Low
T-12 @ 11.9	Silty Claystone (Tf)	103	High

CORROSION TESTS

Trench No. and Depth (feet)	Sulfate (%)	Chloride (ppm)	pH	Resistivity (ohm-cm)	Corrosivity Potential
T-1 @ 3.0	0.0162	140	6.6	360	concrete: negligible steel: non-corrosive
T-3 @ 8.0	0.0122	130	7.0	240	concrete: negligible steel: non-corrosive
T-12 @ 11.0	0.0486	--	--	--	concrete: negligible



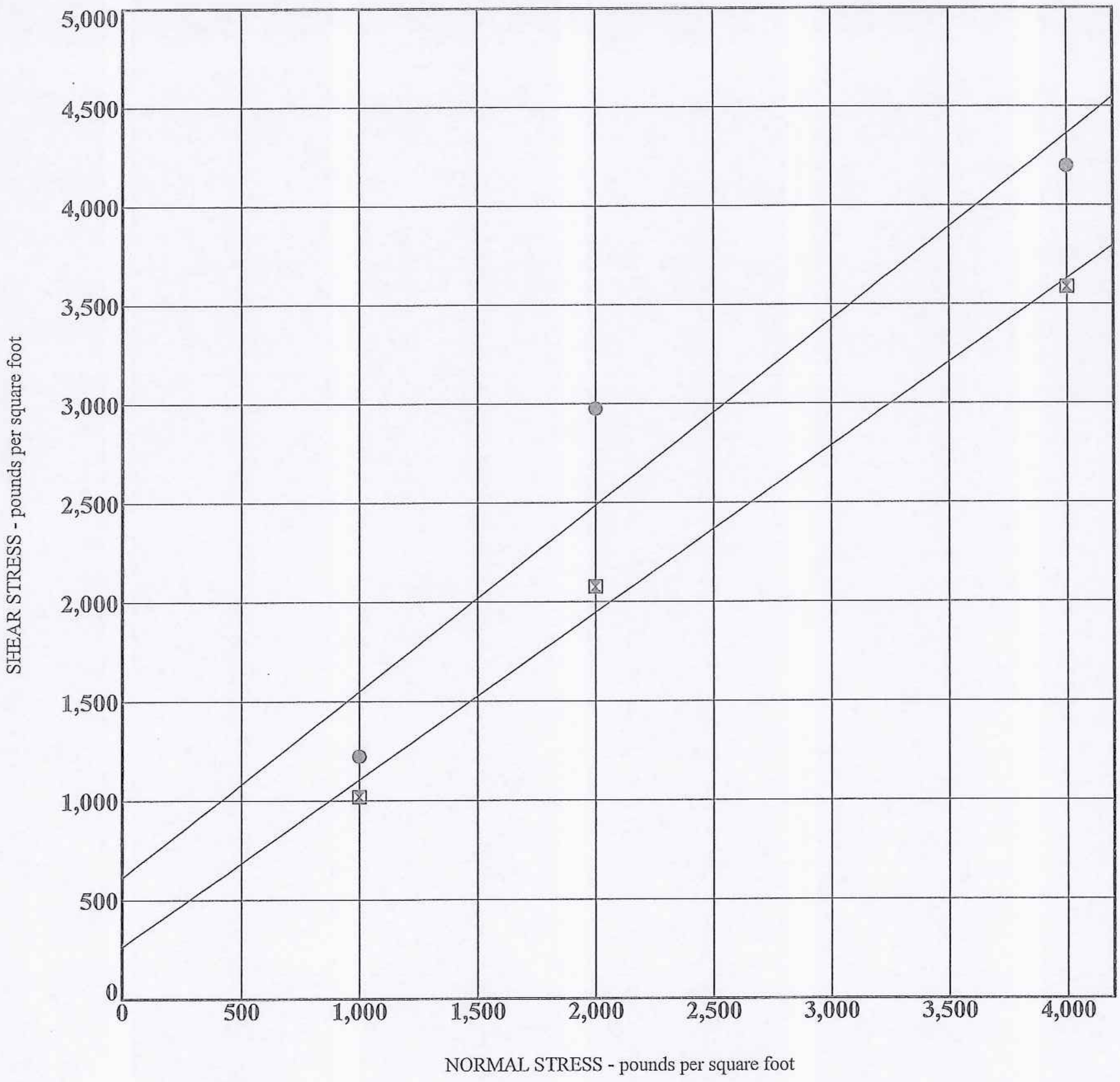
SAMPLE LOCATION	DESCRIPTION	FRICTION ANGLE (°)	COHESION (PSF)
● T-3 @ 5.0	Clayey SILTSTONE - peak	47	400
☒ T-3 @ 5.0	Clayey SILTSTONE - ultimate	35	590

NOTES:

Undisturbed Test Samples
All Samples Were Inundated Prior to Shearing

J.N. 247-11	DIRECT SHEAR TEST DATA	July, 2011
PETRA GEOTECHNICAL, INC.	UNDISTURBED TEST SAMPLES	PLATE B-2

DIRECT SHEAR 247-11.GPJ PETRA.GDT 7/8/11



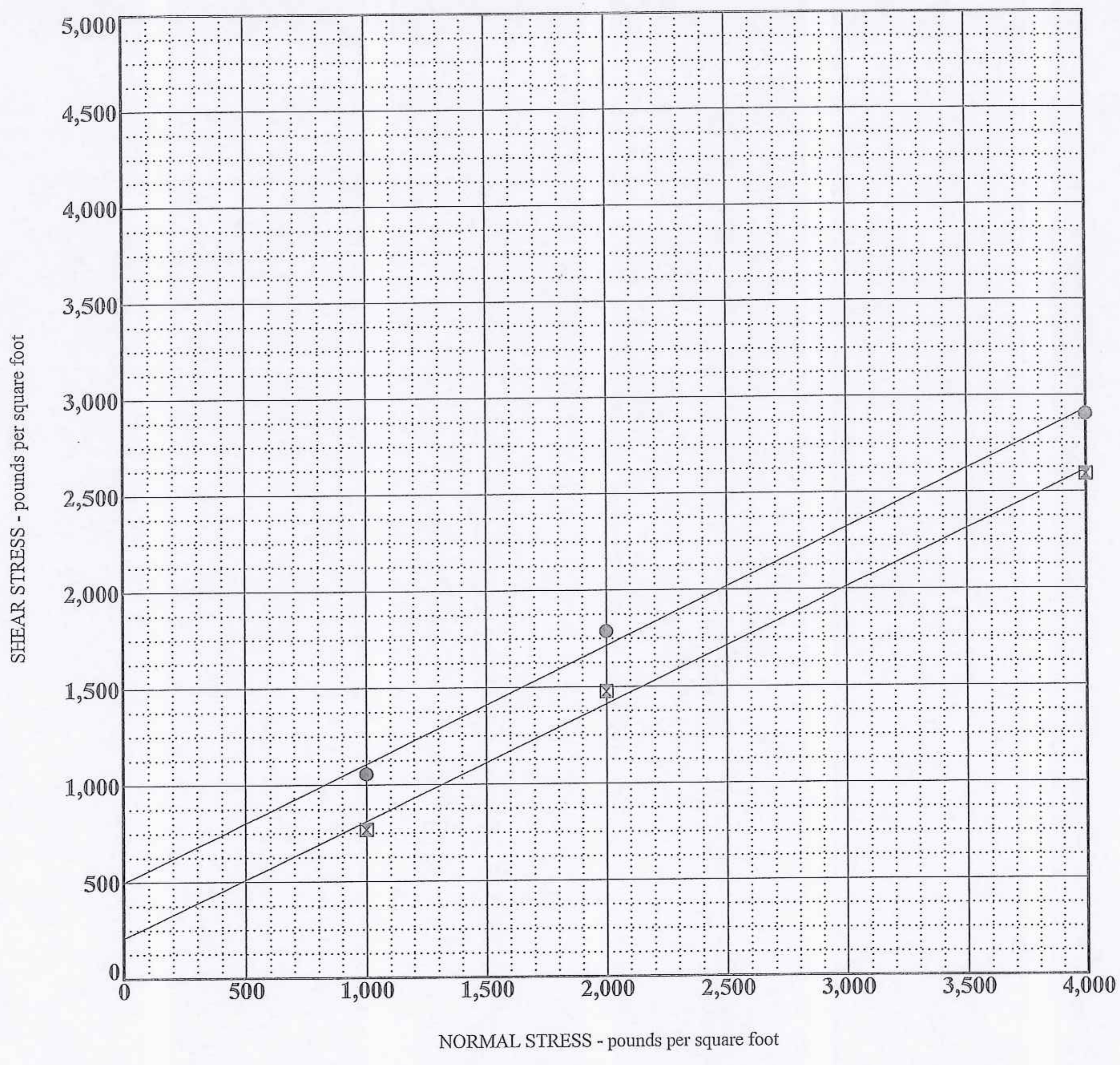
SAMPLE LOCATION	DESCRIPTION	FRICTION ANGLE (°)	COHESION (PSF)
● T-3 @ 8.0	Clayey SILTSTONE - peak	43	610
⊠ T-3 @ 8.0	Clayey SILTSTONE - ultimate	40	260

NOTES:

Undisturbed Test Samples
All Samples Were Inundated Prior to Shearing

J.N. 247-11	DIRECT SHEAR TEST DATA	July, 2011
PETRA GEOTECHNICAL, INC.	UNDISTURBED TEST SAMPLES	PLATE B-3

DIRECT SHEAR 247-11.GPJ PETRA.GDT 7/8/11

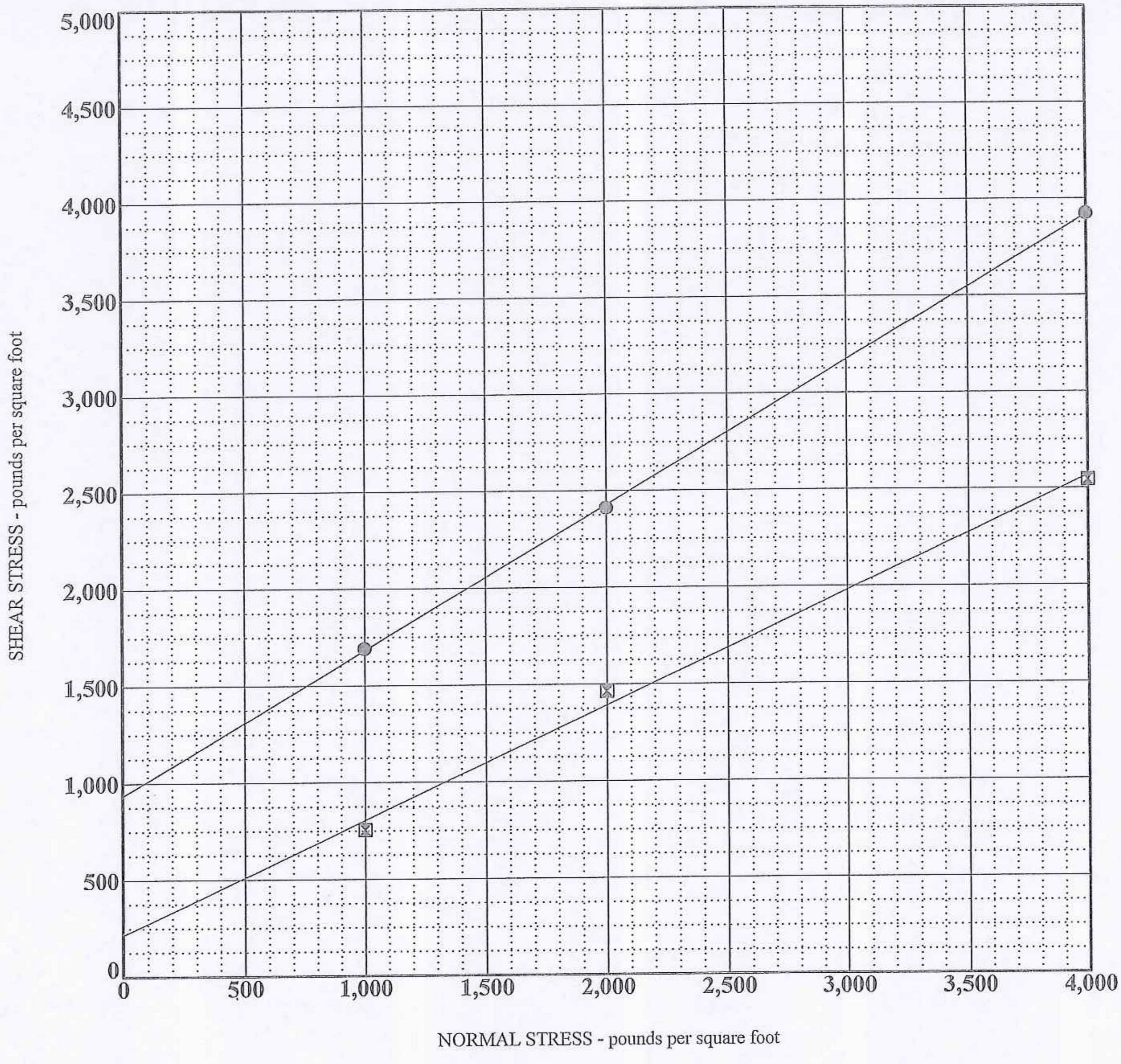


SAMPLE LOCATION	DESCRIPTION	FRICTION ANGLE (°)	COHESION (PSF)
● T-3 @ 8.1	Clayey SILTSTONE - peak	31	500
⊠ T-3 @ 8.1	Clayey SILTSTONE - ultimate	31	210

NOTES:

Samples Remolded to 90% of Maximum Dry Density
All Samples Were Inundated Prior to Shearing

J.N. 247-11	DIRECT SHEAR TEST DATA	July, 2011
PETRA GEOTECHNICAL, INC.	REMOLDED TEST SAMPLES	PLATE B-4



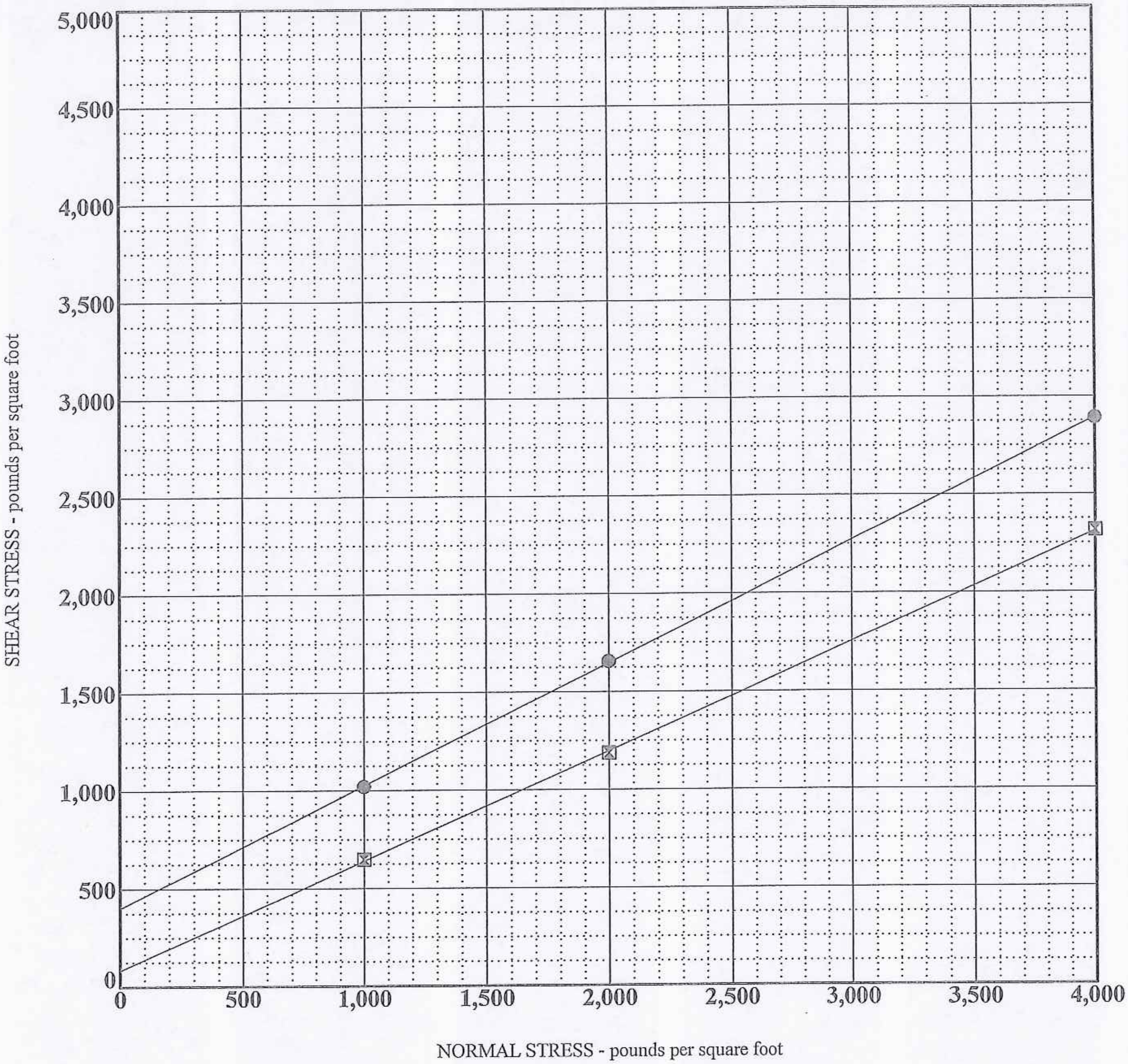
SAMPLE LOCATION	DESCRIPTION	FRICTION ANGLE (°)	COHESION (PSF)
● T-8 @ 5.0	Clayey SANDSTONE -peak	37	940
⊠ T-8 @ 5.0	Clayey SANDSTONE - ultimate	30	220

NOTES:

Undisturbed Test Samples
All Samples Were Inundated Prior to Shearing

J.N. 247-11	DIRECT SHEAR TEST DATA	July, 2011
PETRA GEOTECHNICAL, INC.	UNDISTURBED TEST SAMPLES	PLATE B-5

DIRECT SHEAR 247-11.GPJ PETRA.GDT 7/8/11



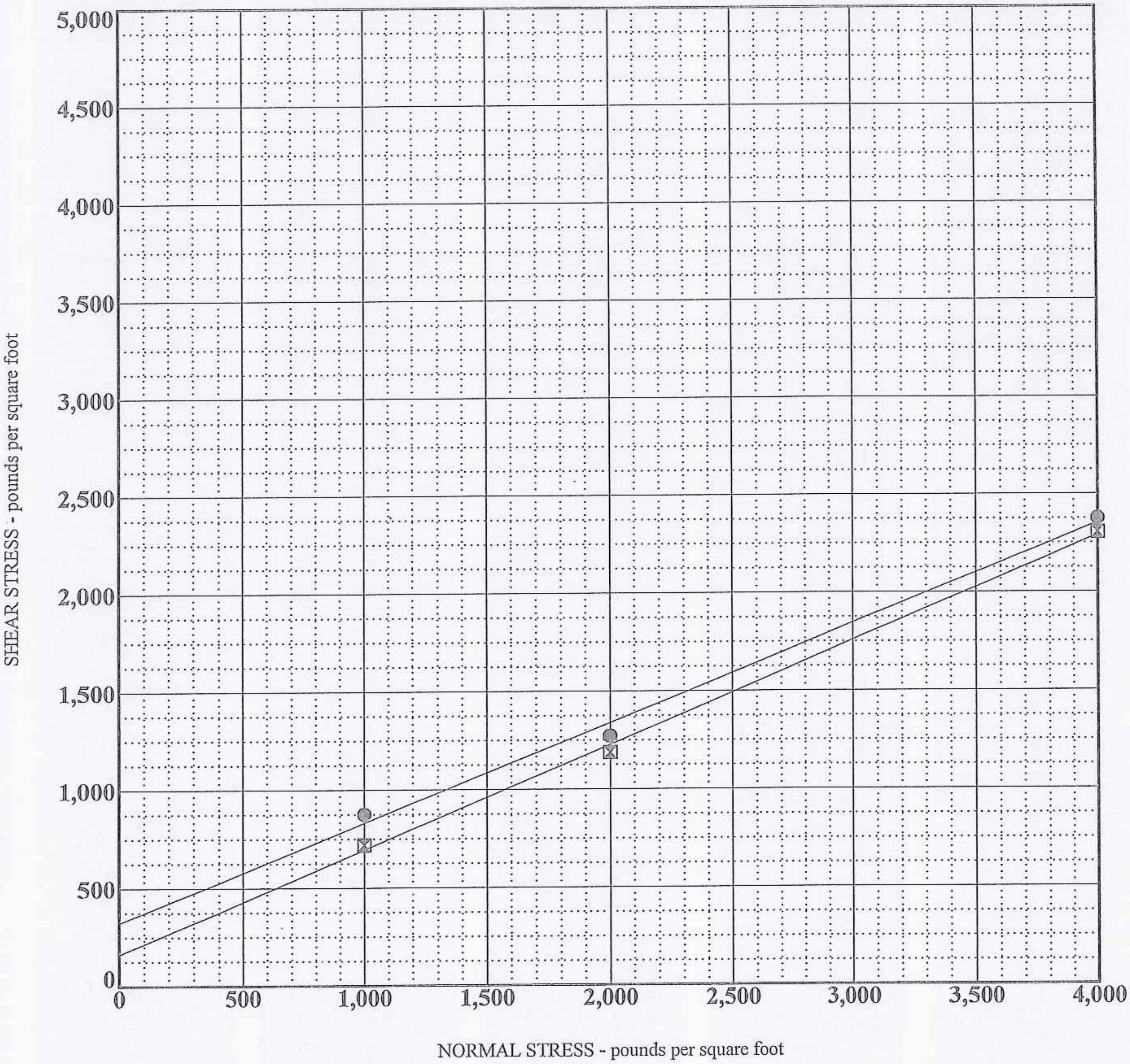
SAMPLE LOCATION	DESCRIPTION	FRICTION ANGLE (°)	COHESION (PSF)
● T-8 @ 8.0	Clayey SANDSTONE -peak	32	400
⊠ T-8 @ 8.0	Clayey SANDSTONE - ultimate	29	80

NOTES:

Samples Remolded to 90% of Maximum Dry Density
All Samples Were Inundated Prior to Shearing

J.N. 247-11	DIRECT SHEAR TEST DATA	July, 2011
PETRA GEOTECHNICAL, INC.	REMOLDED TEST SAMPLES	PLATE B-6

DIRECT SHEAR 247-11.GPJ PETRA.GDT 7/8/11



SAMPLE LOCATION	DESCRIPTION	FRICTION ANGLE (°)	COHESION (PSF)
● T-10 @ 4.0	CLAYSTONE - peak	27	320
⊠ T-10 @ 4.0	CLAYSTONE - ultimate	28	160

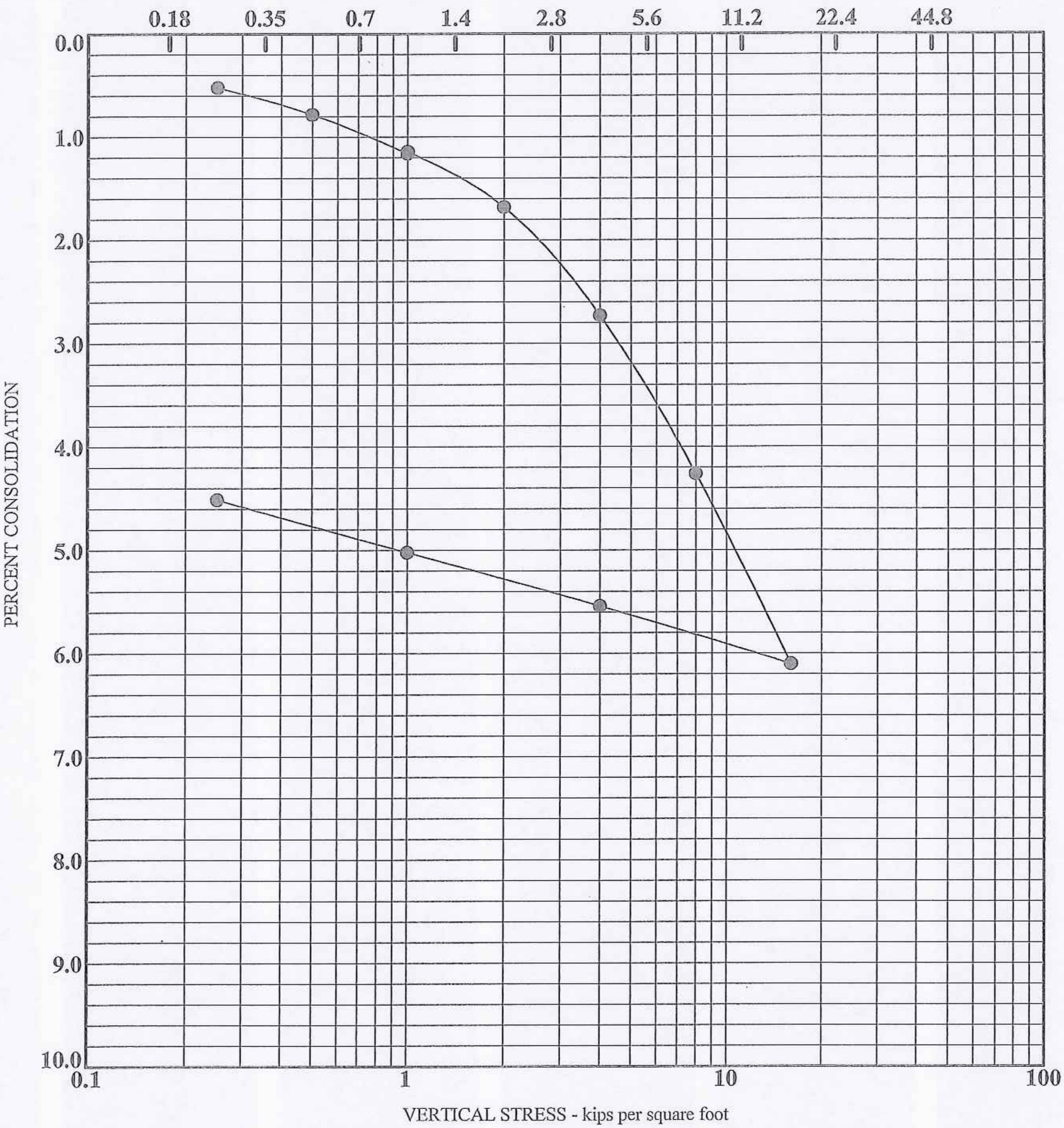
NOTES:

Undisturbed Test Samples
All Samples Were Inundated Prior to Shearing

J.N. 247-11	DIRECT SHEAR TEST DATA	July, 2011
PETRA GEOTECHNICAL, INC.	UNDISTURBED TEST SAMPLES	PLATE B-7

DIRECT SHEAR 247-11.GPJ PETRA.GDT 7/8/11

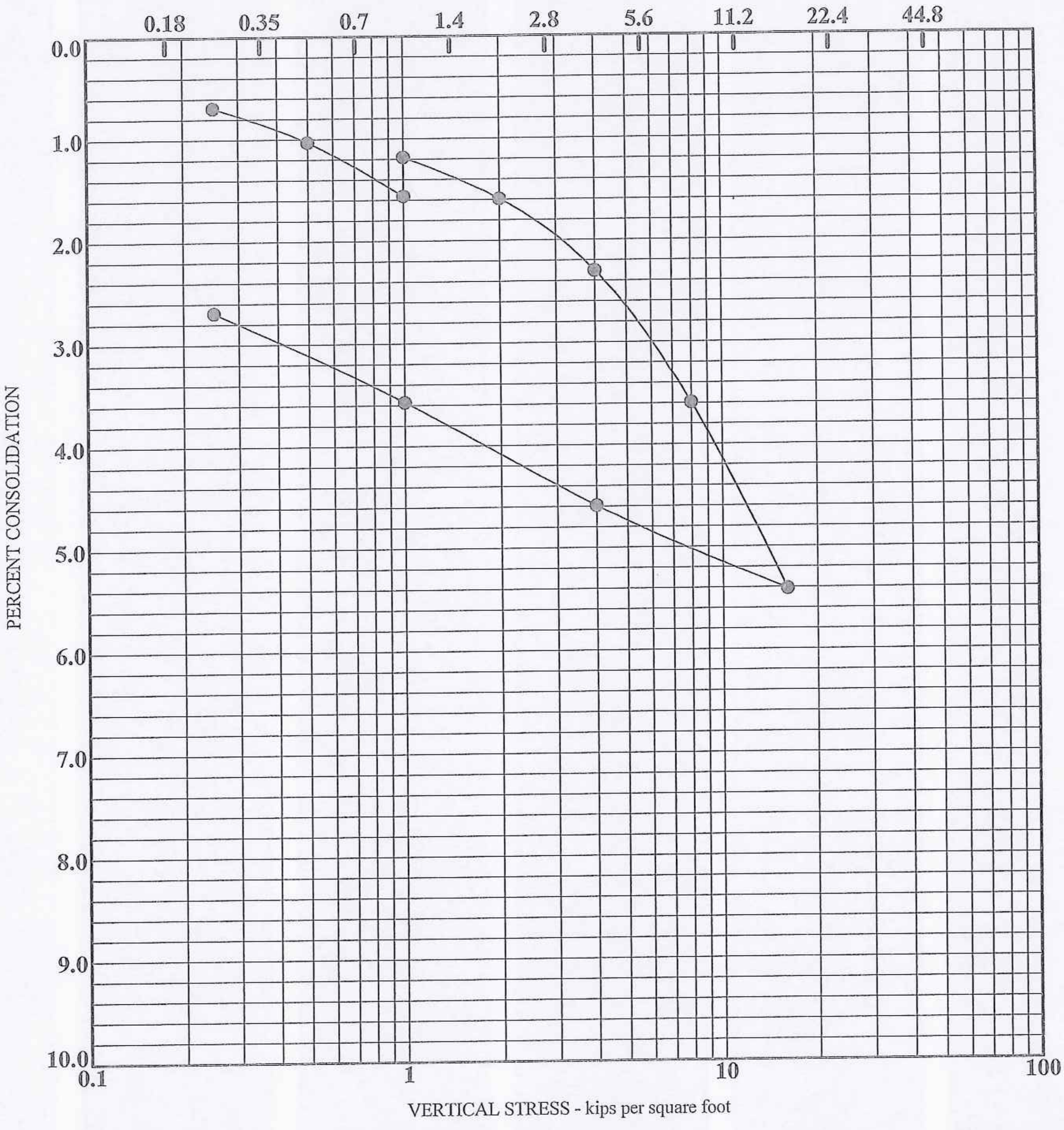
SAMPLE LOCATION	MATERIAL DESCRIPTION	INITIAL			INUNDATED
		DENSITY (pcf)	MOISTURE (%)	SATURATION (%)	LOAD (ksf)
● T-3 @ 8.0	Clayey SILTSTONE	94.6	21.1	73	



CONSOLIDATION - STRAIN 247-11.GPJ PETRA.GDT 7/8/11

J.N. 247-11	CONSOLIDATION TEST RESULTS	July, 2011
PETRA GEOTECHNICAL, INC.		PLATE B-8

SAMPLE LOCATION	MATERIAL DESCRIPTION	INITIAL			INUNDATED
		DENSITY (pcf)	MOISTURE (%)	SATURATION (%)	LOAD (ksf)
● T-10 @ 9.0	CLAYSTONE	99.8	21.2	83	



CONSOLIDATION - STRAIN 247-11.GPJ PETRA.GDT 7/8/11

J.N. 247-11	CONSOLIDATION TEST RESULTS	July, 2011
PETRA GEOTECHNICAL, INC.		PLATE B-9

APPENDIX C

STANDARD GRADING SPECIFICATIONS

PETRA

STANDARD GRADING SPECIFICATIONS

These specifications present the usual and minimum requirements for grading operations performed under the control of Petra Geotechnical, Inc.

No deviation from these specifications will be allowed, except where specifically superseded in the preliminary geology and soils report, or in other written communication signed by the Soils Engineer and Engineering Geologist.

I. GENERAL

A. The Soils Engineer and Engineering Geologist are the Owner's or Builder's representative on the project. For the purpose of these specifications, supervision by the Soils Engineer includes that inspection performed by any person or persons employed by, and responsible to, the licensed Civil Engineer signing the soils report.

B. All clearing, site preparation, or earthwork performed on the project shall be conducted by the Contractor under the supervision of the Soils Engineer.

C. It is the Contractor's responsibility to prepare the ground surface to receive the fills to the satisfaction of the Soils Engineer and to place, spread, mix, water, and compact the fill in accordance with the specifications of the Soils Engineer. The Contractor shall also remove all material considered unsatisfactory by the Soils Engineer.

D. It is also the Contractor's responsibility to have suitable and sufficient compaction equipment on the job site to handle the amount of fill being placed. If necessary, excavation equipment will be shut down to permit completion of compaction. Sufficient watering apparatus will also be provided by the Contractor, with due consideration for the fill material, rate of placement, and time of year.

E. A final report shall be issued by the Soils Engineer and Engineering Geologist attesting to the Contractor's conformance with these specifications.

II. SITE PREPARATION

A. All vegetation and deleterious material such as rubbish shall be disposed of offsite. This removal shall be concluded prior to placing fill.

B. Soil, alluvium, or bedrock materials determined by the Soils Engineer as being unsuitable for placement in compacted fills shall be removed and wasted from the site. Any material incorporated as a part of a compacted fill must be approved by the Soils Engineer.

C. After the ground surface to receive fill has been cleared, it shall be scarified, disced, or bladed by the Contractor until it is uniform and free from ruts, hollows, hummocks, or other uneven features which may prevent uniform compaction.

The scarified ground surface shall then be brought to optimum moisture, mixed as required, and compacted as specified. If the scarified zone is greater than 12 inches in depth, the excess shall be removed and placed in lifts restricted to 6 inches.

Prior to placing fill, the ground surface to receive fill shall be inspected, tested, and approved by the Soils Engineer.

D. Any underground structures such as cesspools, cisterns, mining shafts, tunnels, septic tanks, wells, pipe lines, or others are to be removed or treated in a manner prescribed by the Soils Engineer.

E. In order to provide uniform bearing conditions in cut/fill transition lots and where cut lots are partially in soil, colluvium, or unweathered bedrock materials, the bedrock portion of the lot extending a minimum of 3 feet outside of building lines shall be overexcavated a minimum of 3 feet and replaced with compacted fill. (Typical details are given on Plate SG-1.)

III. COMPACTED FILLS

A. Any material imported or excavated on the property may be utilized in the fill, provided each material has been determined to be suitable by the Soils Engineer. Roots, tree branches, and other matter missed during clearing shall be removed from the fill as directed by the Soils Engineer.

B. Rock fragments less than 6 inches in diameter may be utilized in the fill provided:

1. They are not placed in concentrated pockets.
2. There is a sufficient percentage of fine grained material to surround the rocks.
3. The distribution of rocks is supervised by the Soils Engineer.

C. Rocks greater than 6 inches in diameter shall be taken offsite or placed in accordance with the recommendations of the Soils Engineer in areas designated as suitable for rock disposal. (A typical detail for Rock Disposal is given in Plate SG-2.)

D. Material that is spongy, subject to decay, or otherwise considered unsuitable shall not be used in the compacted fill.

E. Representative samples of materials to be utilized as compacted fill shall be analyzed by the laboratory of the Soils Engineer to determine their physical properties. If any material other than that previously tested is encountered during grading, the appropriate analysis of this material shall be conducted by the Soils Engineer as soon as possible.

F. Material used in the compacting process shall be evenly spread, watered, processed, and compacted in thin lifts not to exceed 6 inches in thickness to obtain a uniformly dense layer. The fill shall be placed and compacted on a horizontal plane, unless otherwise approved by the Soils Engineer.

G. If the moisture content or relative density varies from that required by the Soils Engineer, the Contractor shall rework the fill until it is approved by the Soils Engineer.

H. Each layer shall be compacted to 90 percent of the maximum density in compliance with the testing method specified by the controlling governmental agency. (In general, ASTM D 1557-78, the five-layer method, will be used.)

If compaction to a lesser percentage is authorized by the controlling governmental agency because of a specific land use or expansive soils condition, the area to received fill compacted to less than 90 percent shall either be delineated on the grading plan or appropriate reference made to the area in the soils report.

I. All fills shall be keyed and benched through all topsoil, colluvium, alluvium or creep material, into sound bedrock or firm material where the slope receiving fill exceeds a ratio of 5 horizontal to 1 vertical, in accordance with the recommendations of the Soils Engineer.

J. The key for side hill fills shall be a minimum of 15 feet within bedrock or firm materials, unless otherwise specified in the soils report. (See detail on Plate SG-3.)

K. Subdrainage devices shall be constructed in compliance with the ordinances of the controlling governmental agency, or with the recommendationsof the Soils Engineer or Engineering Geologist. (Typical Canyon Subdrain details are given in Plate SG-4.)

L. The contractor will be required to obtain a minimum relative compaction of 90 percent out to the finish slope face of fill slopes, buttresses, and stabilization fills. This may be achieved by either overbuilding the slope and cutting back to the compacted core, or by direct compaction of the slope face with suitable equipment, or by any other procedure which produces the required compaction.

M. All fill slopes should be planted or protected from erosion by other methods specified in the soils report.

N. Fill-over-cut slopes shall be properly keyed through topsoil, colluvium or creep material into rock or firm materials, and the transition shall be stripped of all soils prior to placing fill. (See detail on Plate SG-7.)

IV. CUT SLOPES

A. The Engineering Geologist shall inspect all cut slopes at vertical intervals not exceeding 10 feet.

B. If any conditions not anticipated in the preliminary report such as perched water, seepage, lenticular or confined strata of a potentially adverse nature, unfavorably inclined bedding, joints or fault planes are encountered during grading, these conditions shall be analyzed by the Engineering Geologist and Soils Engineer, and recommendations shall be made to treat these problems. (Typical details for stabilization of a portion of a cut slope are given in Plates SG-5 and SG-8.)

C. Cut slopes that face in the same direction as the prevailing drainage shall be protected from slope wash by a nonerodible interceptor swale placed at the top of the slope.

D. Unless otherwise specified in the soils and geological report, no cut slopes shall be excavated higher or steeper than that allowed by the ordinances of controlling governmental agencies.

E. Drainage terraces shall be constructed in compliance with the ordinances of controlling governmental agencies, or with the recommendations of the Soils Engineer or Engineering Geologist.

V. GRADING CONTROL

A. Inspection of the fill placement shall be provided by the Soils Engineer during the progress of grading.

B. In general, density tests should be made at intervals not exceeding 2 feet of fill height or every 500 cubic yards of fill placed. This criteria will vary depending on soil conditions and the size of the job. In any event, an adequate number of field density tests shall be made to verify that the required compaction is being achieved.

C. Density tests should also be made on the surface material to receive fill as required by the Soils Engineer.

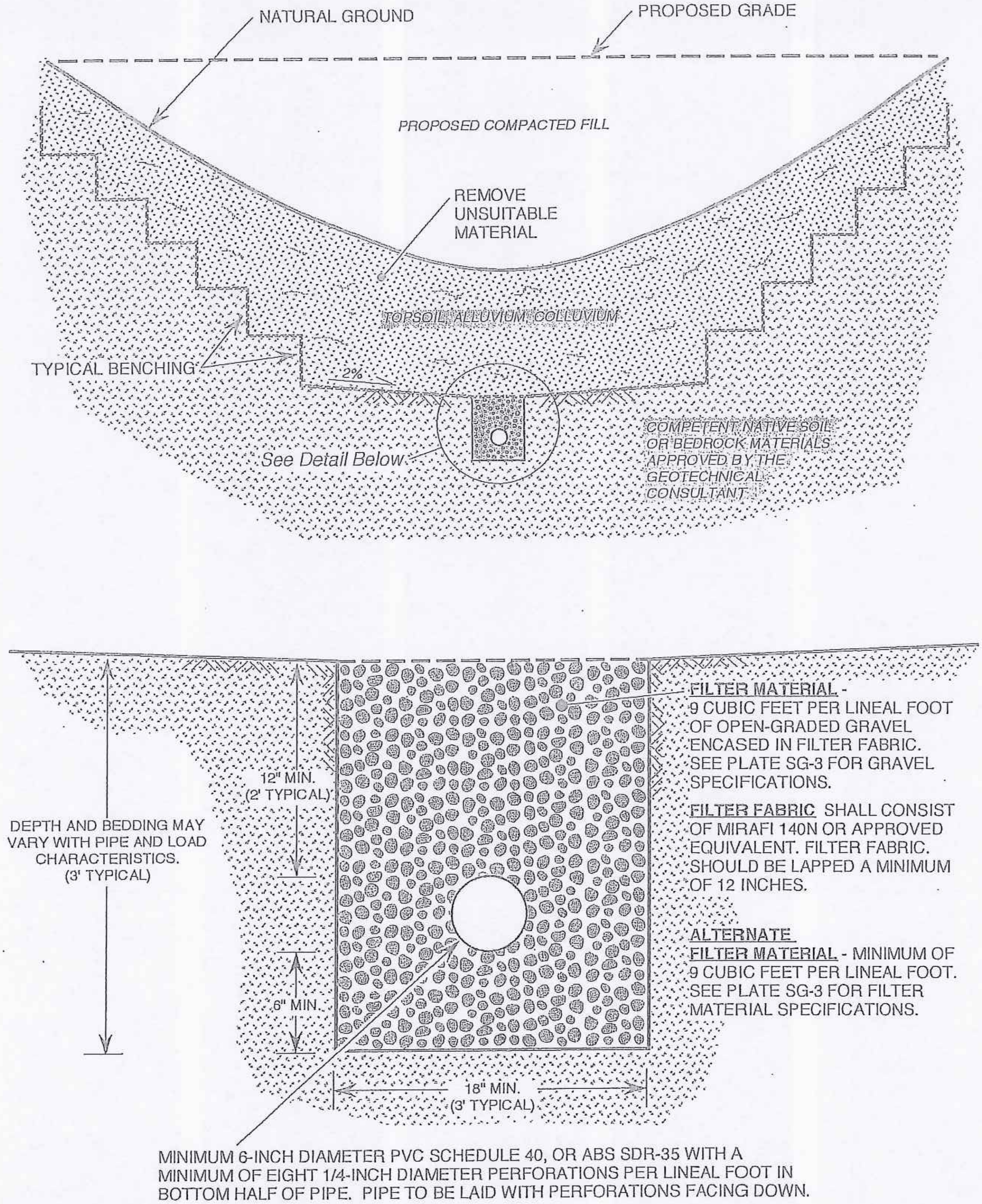
D. All cleanouts, processed ground to receive fill, key excavations, subdrains, and rock disposals must be inspected and approved by the Soils Engineer or Engineering Geologist prior to placing any fill. It shall be the Contractor's responsibility to notify the Soils Engineer when such areas are ready for inspection.

VI. CONSTRUCTION CONSIDERATIONS

A. Erosion control measures, when necessary, shall be provided by the Contractor during grading and prior to the completion and construction of permanent drainage controls.

B. Upon completion of grading and termination of inspections by the Soils Engineer, no further filling or excavating, including that necessary for footings, foundations, large tree wells, retaining walls, or other features shall be performed without the approval of the Soils Engineer or Engineering Geologist.

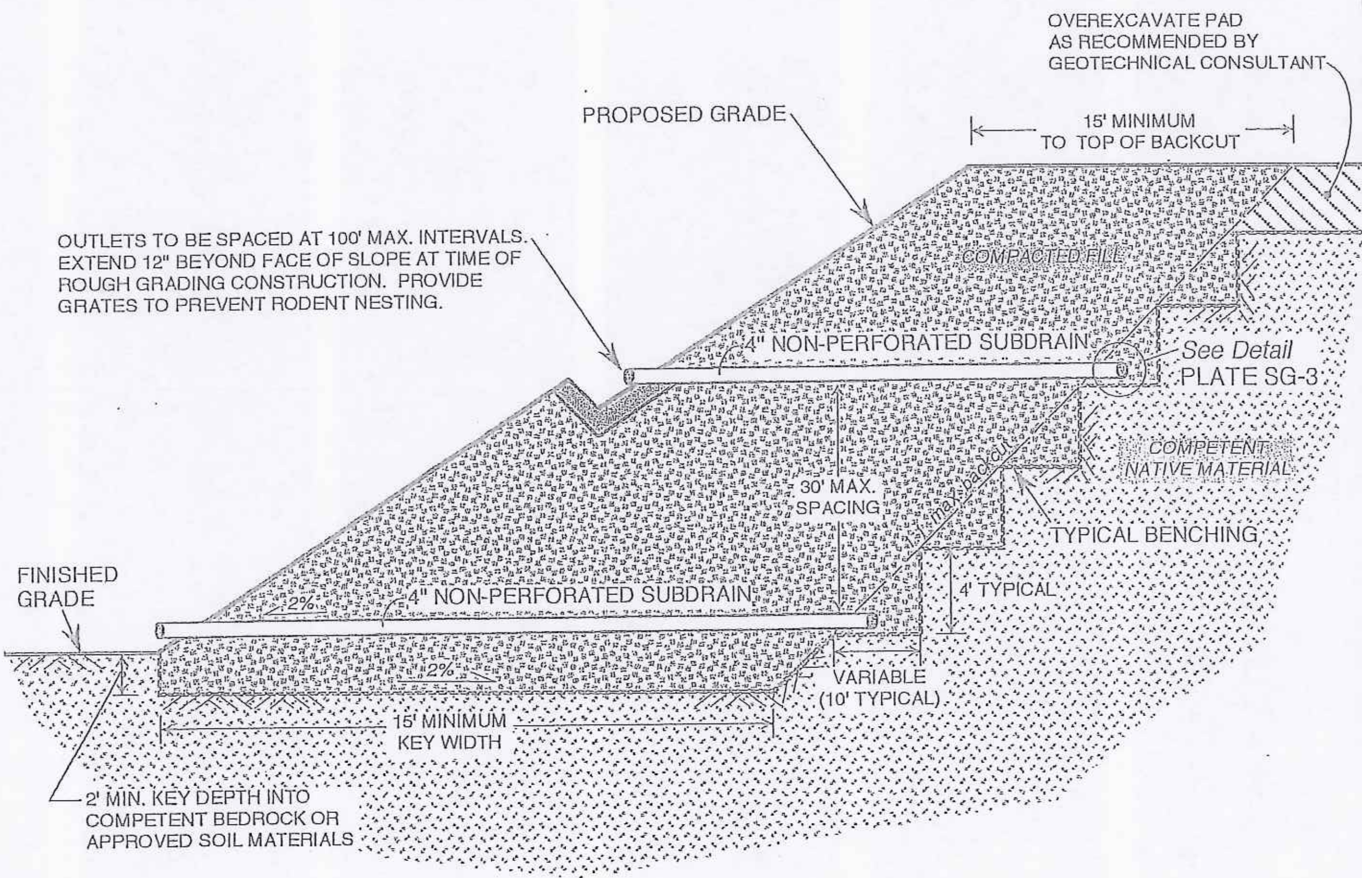
C. Care shall be taken by the Contractor during final grading to preserve any berms, drainage terraces, interceptor swales, or other devices of permanent nature on or adjacent to the property.



NOTES:

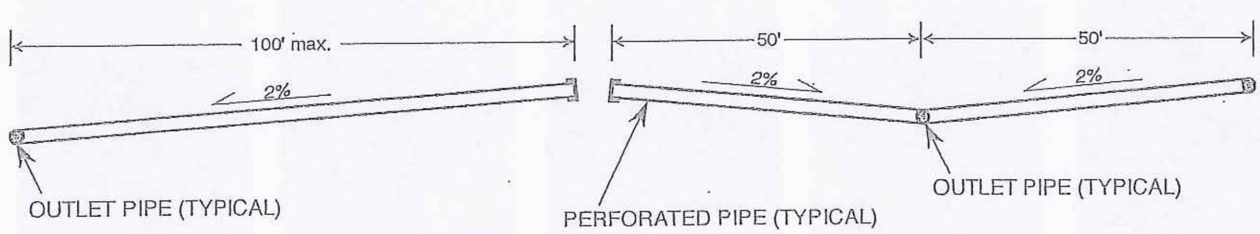
1. FOR CONTINUOUS RUNS IN EXCESS OF 500 FEET USE 8-INCH DIAMETER PIPE.
2. FINAL 20 FEET OF PIPE AT OUTLET SHALL BE NON-PERFORATED AND BACKFILLED WITH FINE-GRAINED MATERIAL.

PETRA	CANYON SUBDRAIN DETAIL	PLATE SG-1



NOTES:

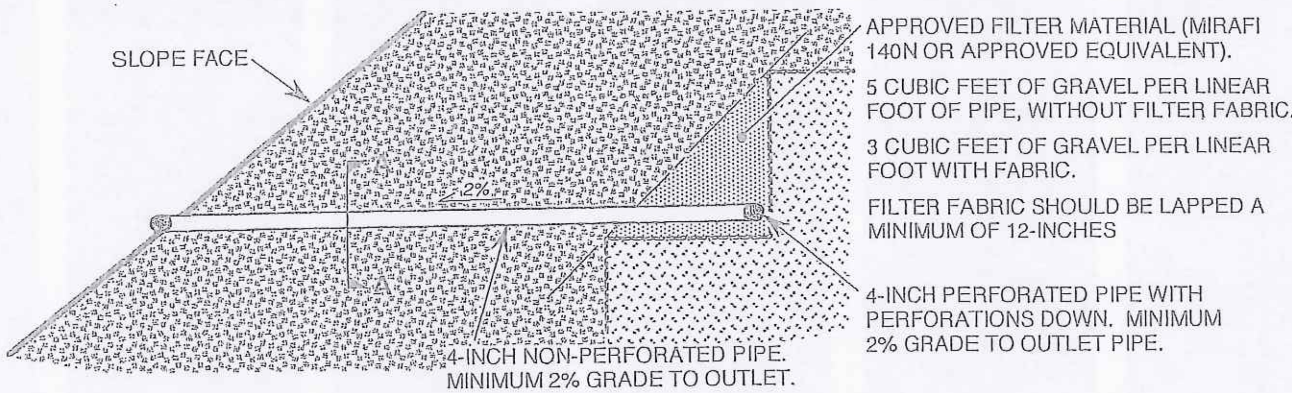
1. 30' MAXIMUM VERTICAL SPACING BETWEEN SUBDRAIN SYSTEMS.
2. 100' MAXIMUM HORIZONTAL DISTANCE BETWEEN NON-PERFORATED OUTLET PIPES. *(See Below)*
3. MINIMUM GRADIENT OF 2% FOR ALL PERFORATED AND NON-PERFORATED PIPE.

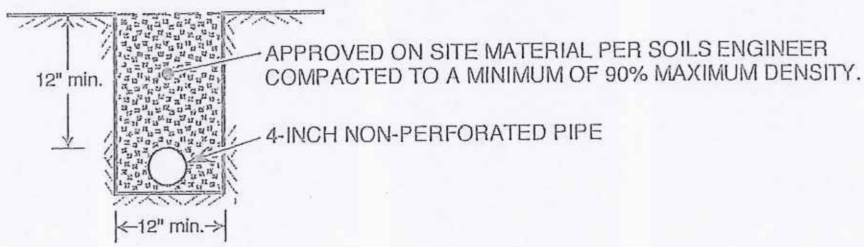


PETRA

BUTTRESS OR STABILIZATION
FILL DETAIL

PLATE SG-2





SECTION A - A (OUTLET PIPE)

PIPE SPECIFICATIONS:

1. 4-INCH MINIMUM DIAMETER, PVC SCHEDULE 40, OR ABS SDR-35.
2. FOR PERFORATED PIPE, MINIMUM 8 PERFORATIONS PER FOOT ON BOTTOM HALF OF PIPE.

FILTER MATERIAL/FABRIC SPECIFICATIONS:

OPEN GRADED GRAVEL ENCASED IN FILTER FABRIC.
(MIRAFI 140N OR EQUIVALENT)

OPEN GRADED

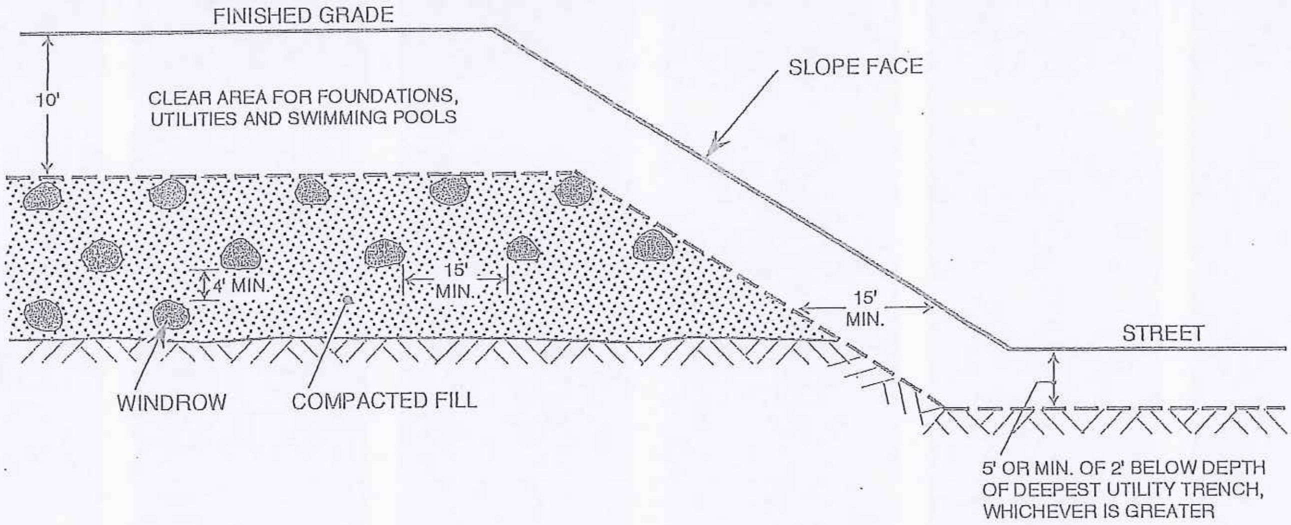
SEIVE SIZE	PERCENT PASSING
1 1/2-INCH	88 - 100
1-INCH	5 - 40
3/4-INCH	0 - 17
3/8-INCH	0 - 7
No. 200	0 - 3

ALTERNATE:

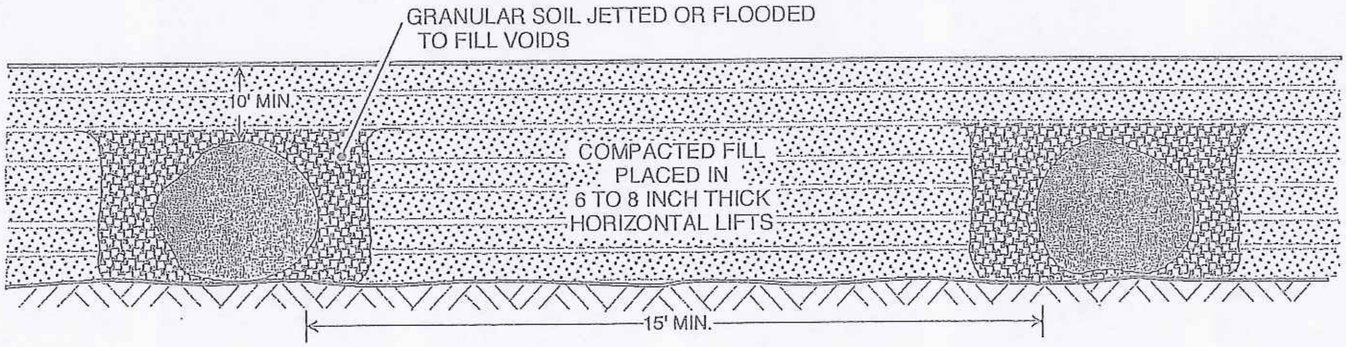
CLASS 2 PERMEABLE FILTER MATERIAL PER CALTRANS STANDARD SPECIFICATION 68-1.025.

CLASS 2

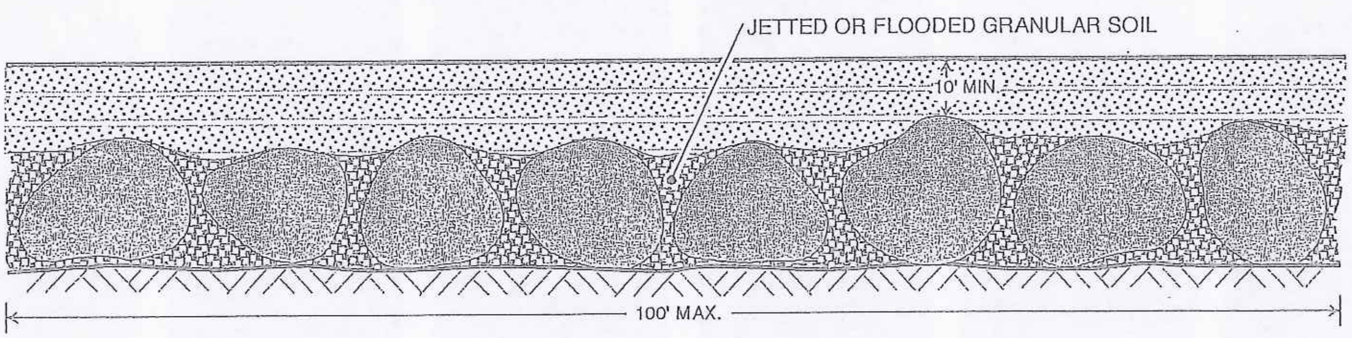
SEIVE SIZE	PERCENT PASSING
1-INCH	100
3/4-INCH	90 - 100
3/8-INCH	40 - 100
No. 4	25 - 40
No. 8	18 - 33
No. -30	5 - 15
No. -50	0 - 7
No. 200	0 - 3



TYPICAL WINDROW DETAIL (END VIEW)

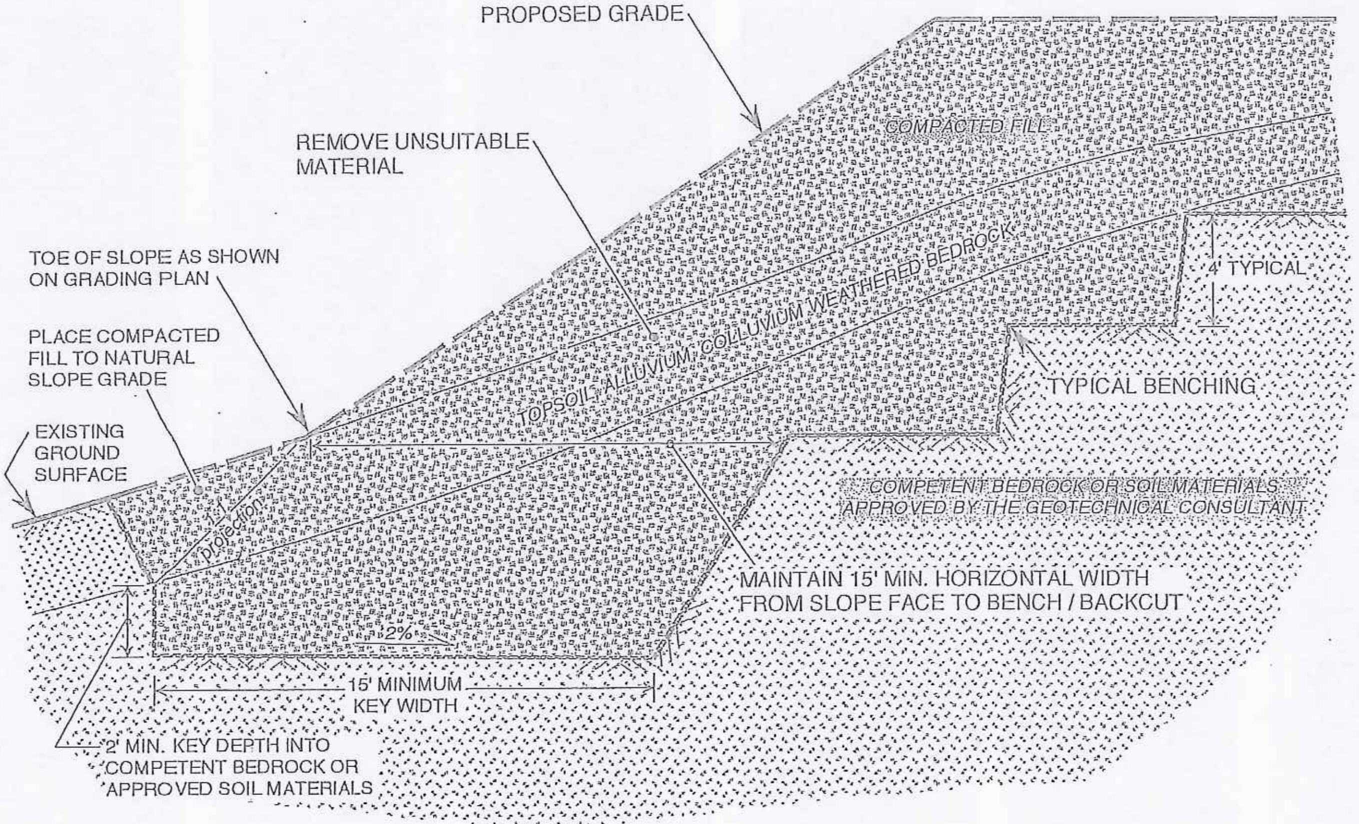


TYPICAL WINDROW DETAIL (PROFILE VIEW)



NOTE: OVERSIZE ROCK IS DEFINED AS CLASTS HAVING A MAXIMUM DIMENSION OF 12" OR LARGER

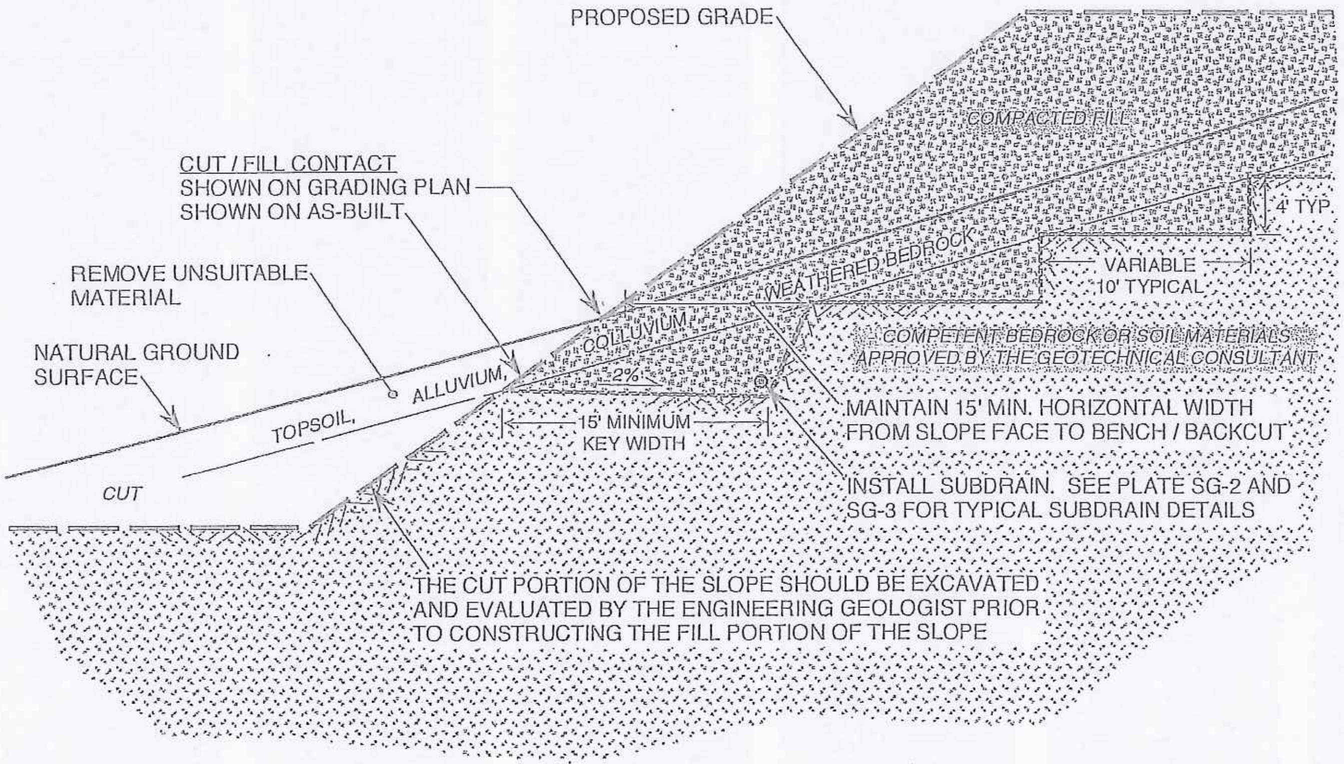
PETRA	TYPICAL ROCK DISPOSAL DETAIL	PLATE SG-4



NOTES:

1. WHERE NATURAL SLOPE GRADIENT IS 5:1 OR LESS, BENCHING IS NOT NECESSARY; HOWEVER, FILL IS NOT TO BE PLACED ON COMPRESSIBLE OR UNSUITABLE MATERIAL.
2. SOILS ENGINEER TO DETERMINE IF SUBDRAIN IS REQUIRED.

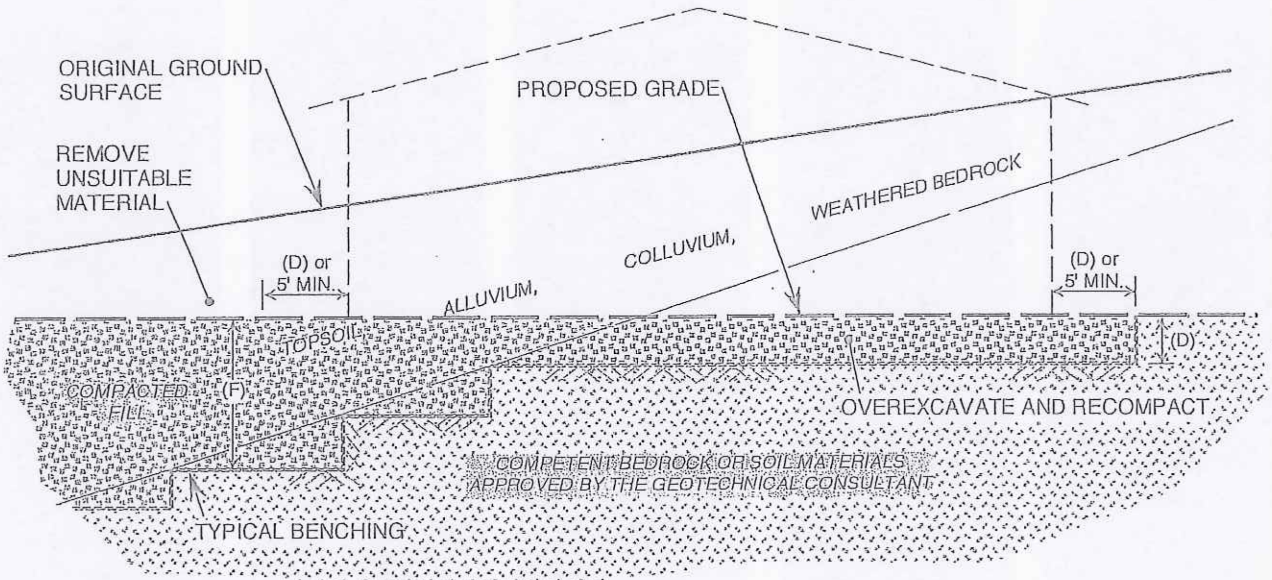
PETRA | FILL SLOPE ABOVE NATURAL SLOPE | PLATE SG-5



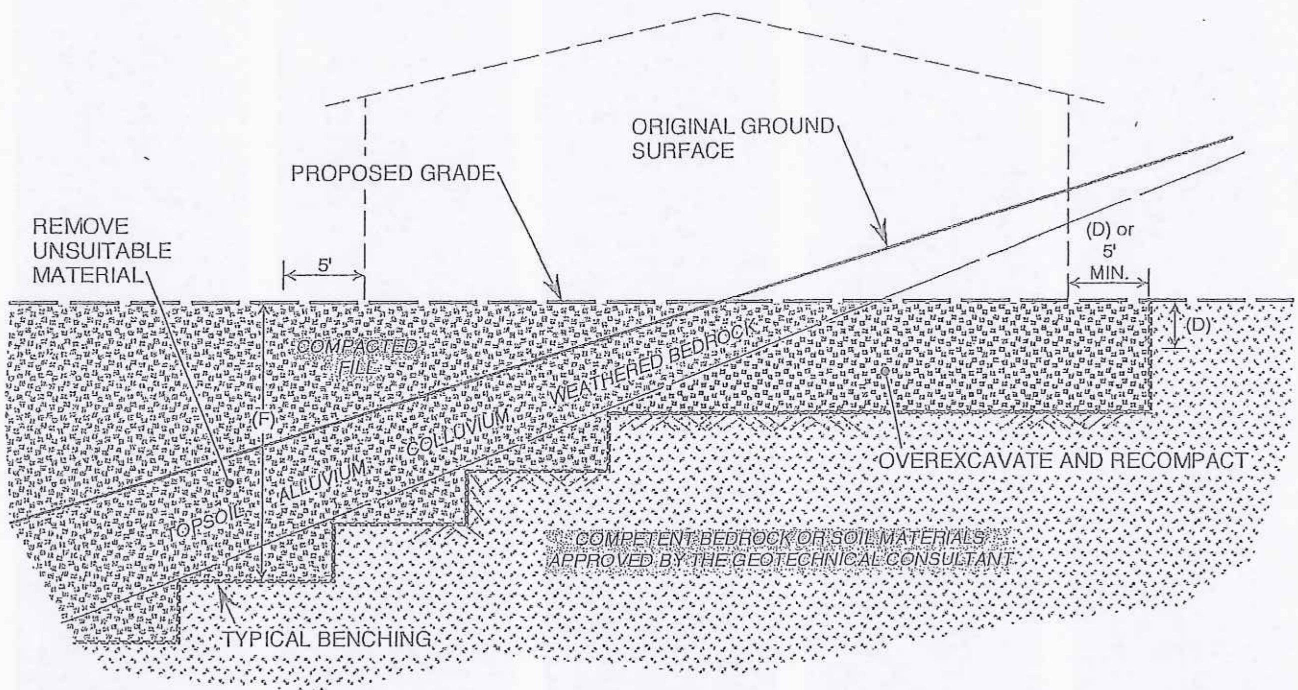
PETRA	FILL SLOPE ABOVE CUT SLOPE	PLATE SG-6

CUT LOT

UNSUITABLE MATERIAL EXPOSED IN PORTION OF CUT PAD



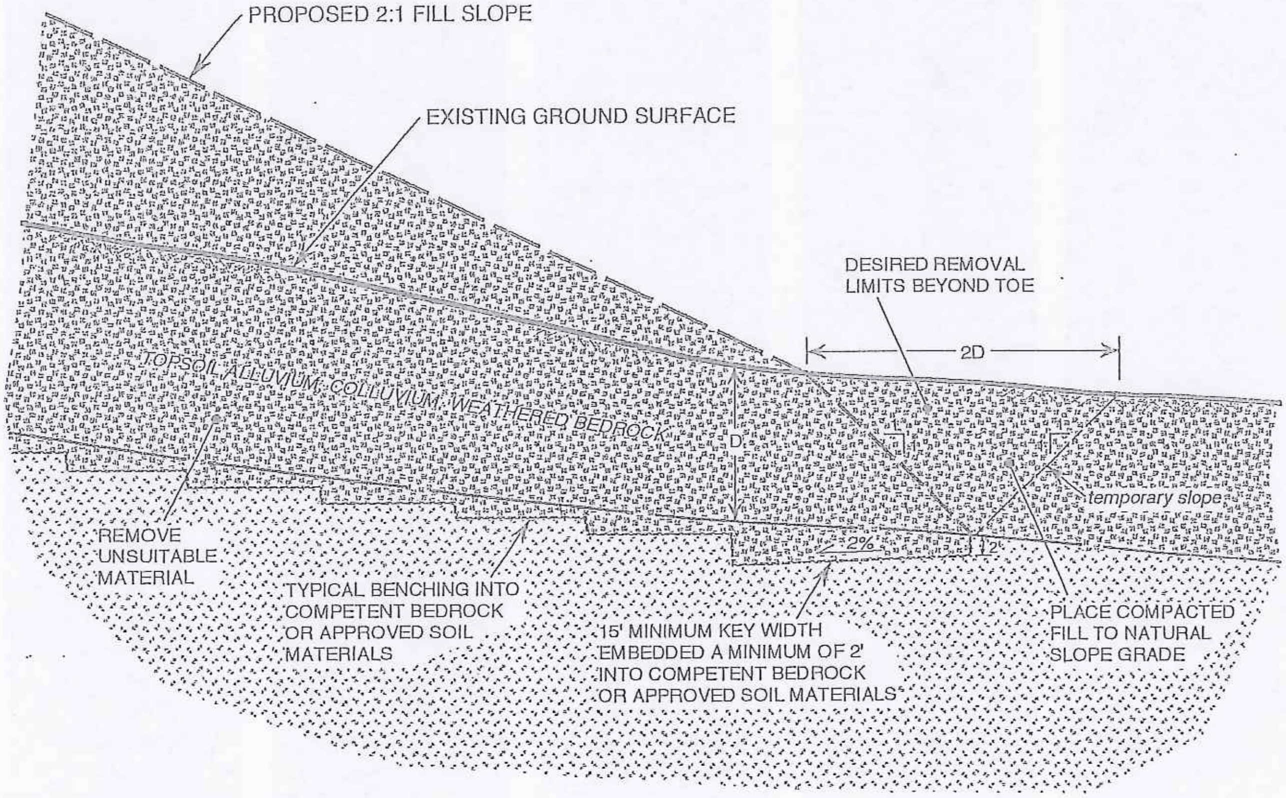
CUT-FILL TRANSITION LOT



MAXIMUM DEPTH OF FILL (F)	DEPTH OF OVEREXCAVATION (D)
FOOTING DEPTH TO 3 FEET	EQUAL DEPTH
3 TO 6 FEET	3 FEET
GREATER THAN 6 FEET	1/2 THE THICKNESS OF FILL PLACED ON THE "FILL" PORTION (F) TO 15 FEET MAXIMUM

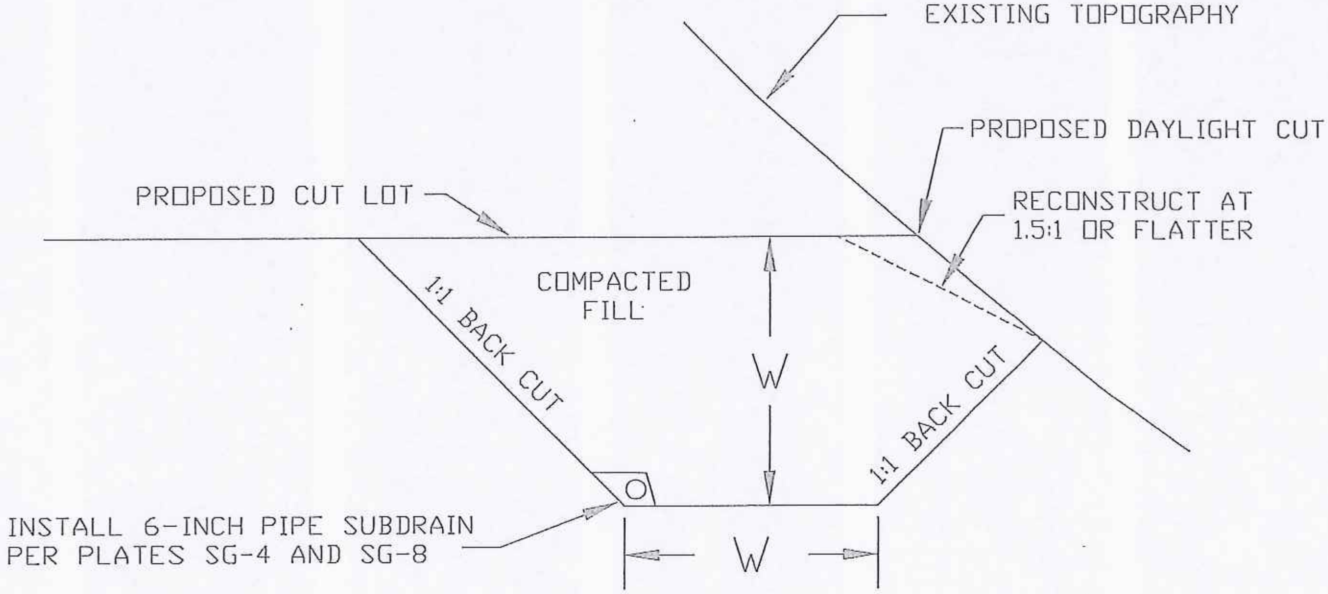
PETRA	CUT LOTS AND CUT-FILL TRANSITION LOTS	PLATE SG-7

TYPICAL REMOVAL OF UNSUITABLE SURFICIAL SOILS BEYOND PROPOSED TOE OF FILL SLOPE



D = RECOMMENDED DEPTH OF REMOVAL
PER GEOTECHNICAL REPORT

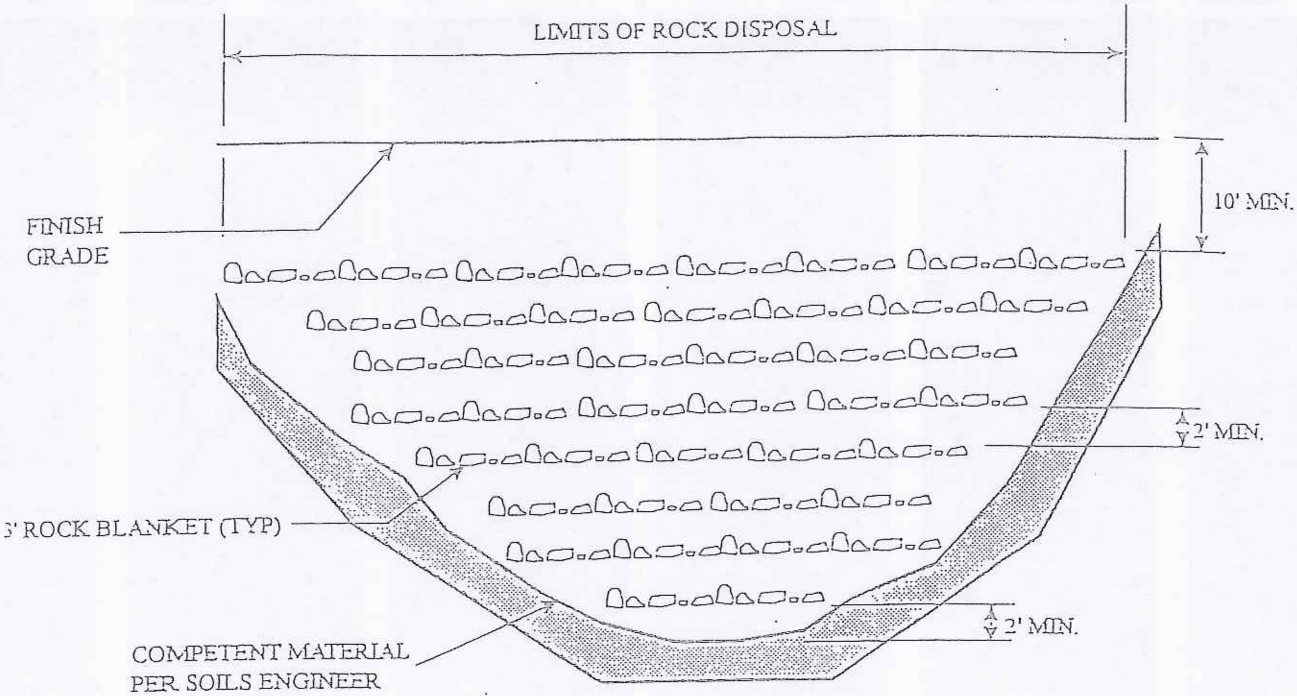
SHEAR KEY ON DAYLIGHT CUT LOTS



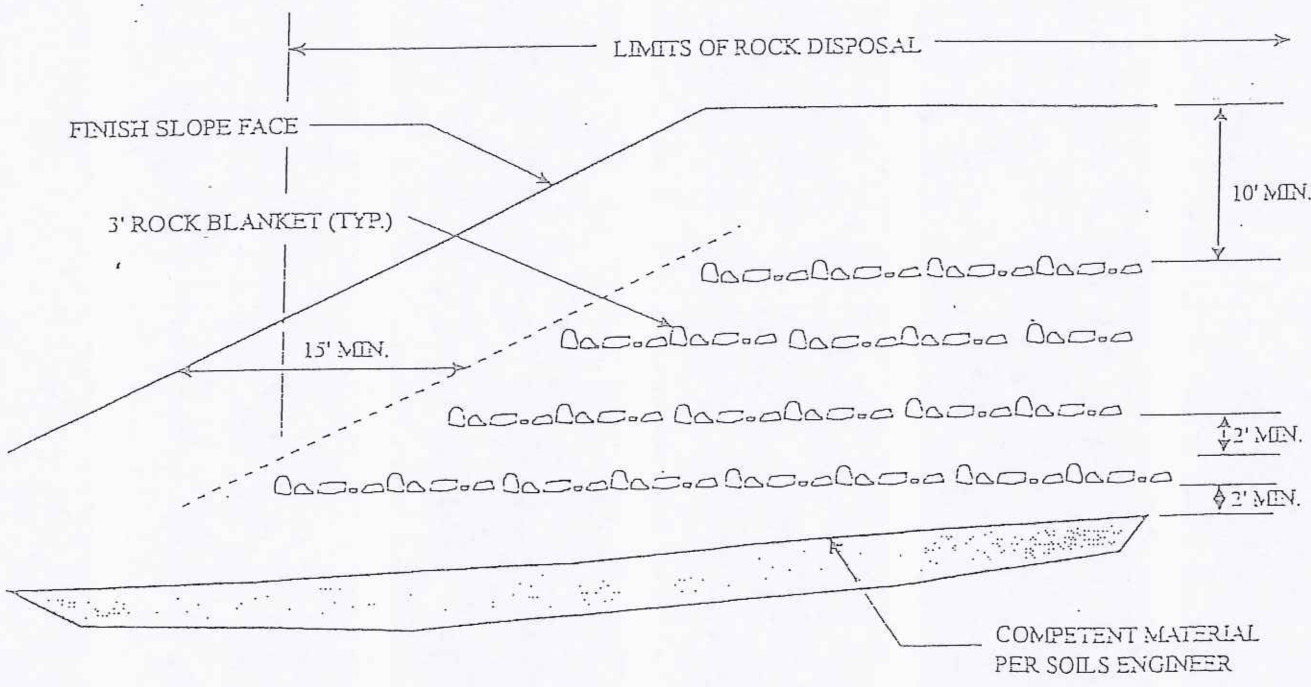
NOTE: "W" SHALL BE 10 FEET OR AS DETERMINED BY THE PROJECT SOILS ENGINEER

PETRA GEOTECHNICAL, INC.

PLATE SG-9



SECTION A-A'



SECTION B-B'

PETRA GEOTECHNICAL, INC.

PLATE SG-10

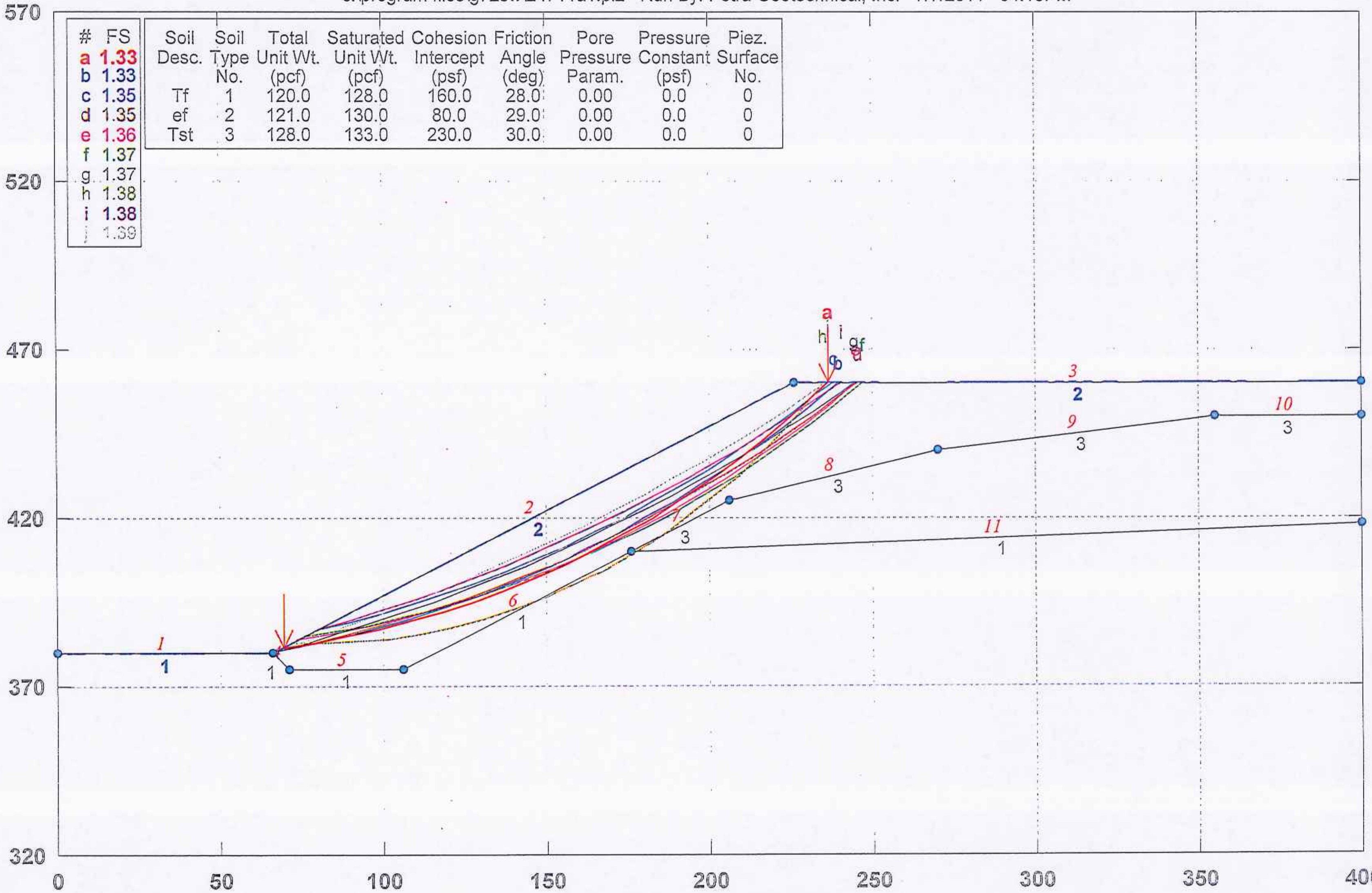
APPENDIX D

SLOPE STABILITY CALCULATIONS

PETRA

Section A-A' - 2:1 Fill Slope - Static Analysis

c:\program files\g72sw\24711a1.pl2 Run By: Petra Geotechnical, Inc. 7/7/2011 04:13PM



#	FS
a	1.33
b	1.33
c	1.35
d	1.35
e	1.36
f	1.37
g	1.37
h	1.38
i	1.38
j	1.39

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Tf	1	120.0	128.0	160.0	28.0	0.00	0.0	0
ef	2	121.0	130.0	80.0	29.0	0.00	0.0	0
Tst	3	128.0	133.0	230.0	30.0	0.00	0.0	0

GSTABL7 v.2 FSmin=1.33

Safety Factors Are Calculated By The Modified Bishop Method

```
*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
(All Rights Reserved-Unauthorized Use Prohibited)
*********************************************************************************
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*********************************************************************************
Analysis Run Date:         7/7/2011
Time of Run:               04:13PM
Run By:                    Petra Geotechnical, Inc.
Input Data Filename:       c:\program files\g72sw\24711a1.in
Output Filename:           c:\program files\g72sw\24711a1.OUT
Unit System:               English
Plotted Output Filename:   c:\program files\g72sw\24711a1.PLT
PROBLEM DESCRIPTION:  Section A-A' -  2:1 Fill Slope -
                      Static Analysis
BOUNDARY COORDINATES
    3 Top   Boundaries
   11 Total Boundaries
```

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	380.00	66.00	380.00	1
2	66.00	380.00	226.00	460.00	2
3	226.00	460.00	400.00	460.00	2
4	66.00	380.00	71.00	375.00	1
5	71.00	375.00	106.00	375.00	1
6	106.00	375.00	176.00	410.00	1
7	176.00	410.00	206.00	425.00	3
8	206.00	425.00	270.00	440.00	3
9	270.00	440.00	355.00	450.00	3
10	355.00	450.00	400.00	450.00	3
11	176.00	410.00	400.00	418.00	1

```
User Specified Y-Origin =        320.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
  3 Type(s) of Soil
```

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	128.0	160.0	28.0	0.00	0.0	0
2	121.0	130.0	80.0	29.0	0.00	0.0	0
3	128.0	133.0	230.0	30.0	0.00	0.0	0

```
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
 500 Trial Surfaces Have Been Generated.
  25 Surface(s) Initiate(s) From Each Of    20 Points Equally Spaced
Along The Ground Surface Between  X =  40.00(ft)
                             and  X =  80.00(ft)
Each Surface Terminates Between   X = 230.00(ft)
                             and  X = 275.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is  Y =      0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
      Failure Surfaces Evaluated. They Are
      Ordered - Most Critical First.
      * * Safety Factors Are Calculated By The Modified Bishop Method * *
      Total Number of Trial Surfaces Attempted =   500
      Number of Trial Surfaces With Valid FS =  500
      Statistical Data On All Valid FS Values:
```

FS Max = 2.647 FS Min = 1.328 FS Ave = 1.997
Standard Deviation = 0.354 Coefficient of Variation = 17.71 %

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	69.474	381.737
2	79.376	383.133
3	89.226	384.860
4	99.012	386.916
5	108.724	389.298
6	118.351	392.004
7	127.882	395.032
8	137.306	398.376
9	146.612	402.035
10	155.791	406.003
11	164.832	410.277
12	173.725	414.850
13	182.459	419.719
14	191.026	424.878
15	199.415	430.321
16	207.617	436.042
17	215.623	442.034
18	223.423	448.291
19	231.010	454.806
20	236.663	460.000

Circle Center At X = 32.835 ; Y = 677.718 ; and Radius = 298.240

Factor of Safety
*** 1.328 ***

Individual data on the 20 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.9	2129.7	0.0	0.0	0.	0.	0.0	0.0	0.0
2	9.8	6142.6	0.0	0.0	0.	0.	0.0	0.0	0.0
3	9.8	9676.5	0.0	0.0	0.	0.	0.0	0.0	0.0
4	9.7	12723.6	0.0	0.0	0.	0.	0.0	0.0	0.0
5	9.6	15279.8	0.0	0.0	0.	0.	0.0	0.0	0.0
6	9.5	17344.6	0.0	0.0	0.	0.	0.0	0.0	0.0
7	9.4	18920.8	0.0	0.0	0.	0.	0.0	0.0	0.0
8	9.3	20015.3	0.0	0.0	0.	0.	0.0	0.0	0.0
9	9.2	20638.0	0.0	0.0	0.	0.	0.0	0.0	0.0
10	9.0	20802.5	0.0	0.0	0.	0.	0.0	0.0	0.0
11	8.9	20525.9	0.0	0.0	0.	0.	0.0	0.0	0.0
12	8.7	19828.3	0.0	0.0	0.	0.	0.0	0.0	0.0
13	8.6	18733.1	0.0	0.0	0.	0.	0.0	0.0	0.0
14	8.4	17266.7	0.0	0.0	0.	0.	0.0	0.0	0.0
15	8.2	15458.6	0.0	0.0	0.	0.	0.0	0.0	0.0
16	8.0	13340.6	0.0	0.0	0.	0.	0.0	0.0	0.0
17	7.8	10947.6	0.0	0.0	0.	0.	0.0	0.0	0.0
18	2.6	3104.7	0.0	0.0	0.	0.	0.0	0.0	0.0
19	5.0	4452.4	0.0	0.0	0.	0.	0.0	0.0	0.0
20	5.7	1776.5	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	67.368	380.684
2	77.197	382.527
3	86.972	384.635
4	96.687	387.007
5	106.334	389.640
6	115.906	392.533
7	125.397	395.684
8	134.799	399.090
9	144.106	402.749
10	153.310	406.659
11	162.405	410.815

12	171.385	415.216
13	180.242	419.858
14	188.970	424.738
15	197.564	429.852
16	206.016	435.196
17	214.321	440.767
18	222.471	446.561
19	230.463	452.572
20	238.289	458.797
21	239.720	460.000

Circle Center At X = 4.106 ; Y = 745.163 ; and Radius = 369.929

Factor of Safety

*** 1.334 ***

Failure Surface Specified By 19 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	80.000	387.000
2	89.745	389.244
3	99.431	391.731
4	109.051	394.459
5	118.601	397.428
6	128.072	400.635
7	137.461	404.078
8	146.761	407.754
9	155.965	411.663
10	165.069	415.801
11	174.066	420.165
12	182.952	424.753
13	191.719	429.562
14	200.364	434.589
15	208.880	439.831
16	217.262	445.285
17	225.505	450.946
18	233.604	456.812
19	237.780	460.000

Circle Center At X = -4.742 ; Y = 777.341 ; and Radius = 399.433

Factor of Safety

*** 1.354 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	67.368	380.684
2	77.172	382.657
3	86.926	384.861
4	96.625	387.295
5	106.264	389.957
6	115.838	392.847
7	125.341	395.961
8	134.767	399.299
9	144.112	402.859
10	153.370	406.638
11	162.537	410.635
12	171.606	414.848
13	180.574	419.273
14	189.434	423.909
15	198.183	428.753
16	206.814	433.802
17	215.324	439.054
18	223.708	444.505
19	231.960	450.153
20	240.077	455.994
21	245.375	460.000

Circle Center At X = -11.259 ; Y = 796.694 ; and Radius = 423.375

Factor of Safety

*** 1.354 ***

Failure Surface Specified By 21 Coordinate Points

Point X-Surf Y-Surf

No.	(ft)	(ft)
1	73.684	383.842
2	83.557	385.434
3	93.379	387.309
4	103.144	389.464
5	112.844	391.898
6	122.469	394.610
7	132.013	397.596
8	141.467	400.854
9	150.824	404.381
10	160.076	408.176
11	169.216	412.234
12	178.236	416.552
13	187.128	421.127
14	195.885	425.955
15	204.500	431.032
16	212.967	436.354
17	221.277	441.916
18	229.425	447.714
19	237.403	453.743
20	245.205	459.998
21	245.207	460.000

Circle Center At X = 23.067 ; Y = 729.075 ; and Radius = 348.924

Factor of Safety

*** 1.358 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	75.789	384.895
2	85.673	386.419
3	95.507	388.230
4	105.285	390.326
5	114.998	392.705
6	124.638	395.365
7	134.196	398.303
8	143.665	401.518
9	153.037	405.007
10	162.304	408.766
11	171.457	412.793
12	180.490	417.083
13	189.394	421.635
14	198.163	426.443
15	206.788	431.503
16	215.262	436.812
17	223.579	442.365
18	231.731	448.156
19	239.711	454.182
20	246.967	460.000

Circle Center At X = 28.270 ; Y = 725.823 ; and Radius = 344.224

Factor of Safety

*** 1.369 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	67.368	380.684
2	77.045	383.208
3	86.675	385.904
4	96.254	388.772
5	105.782	391.810
6	115.253	395.019
7	124.665	398.397
8	134.015	401.942
9	143.301	405.655
10	152.518	409.532
11	161.665	413.574
12	170.738	417.779
13	179.734	422.146

```
    14         188.651       426.673
    15         197.485       431.358
    16         206.234       436.201
    17         214.895       441.200
    18         223.466       446.353
    19         231.942       451.658
    20         240.323       457.114
    21         244.587       460.000
Circle Center At X =    -68.841 ; Y =    922.820 ; and Radius =    558.985
          Factor of Safety
         ***    1.369    ***
Failure Surface Specified By 20 Coordinate Points
   Point        X-Surf        Y-Surf
    No.          (ft)          (ft)
     1          71.579       382.789
     2          81.579       382.775
     3          91.567       383.260
     4         101.519       384.242
     5         111.409       385.719
     6         121.214       387.687
     7         130.907       390.142
     8         140.467       393.078
     9         149.868       396.486
    10         159.088       400.359
    11         168.102       404.688
    12         176.890       409.460
    13         185.429       414.664
    14         193.698       420.289
    15         201.675       426.318
    16         209.343       432.738
    17         216.680       439.532
    18         223.670       446.684
    19         230.294       454.175
    20         234.948       460.000
Circle Center At X =     76.908 ; Y =    582.955 ; and Radius =    200.237
          Factor of Safety
         ***    1.380    ***
Failure Surface Specified By 19 Coordinate Points
   Point        X-Surf        Y-Surf
    No.          (ft)          (ft)
     1          80.000       387.000
     2          89.640       389.658
     3          99.229       392.497
     4         108.762       395.516
     5         118.237       398.713
     6         127.651       402.088
     7         136.999       405.640
     8         146.278       409.366
     9         155.487       413.266
    10         164.620       417.339
    11         173.675       421.582
    12         182.648       425.996
    13         191.537       430.576
    14         200.339       435.324
    15         209.049       440.236
    16         217.666       445.310
    17         226.186       450.546
    18         234.605       455.941
    19         240.685       460.000
Circle Center At X =    -56.577 ; Y =    901.110 ; and Radius =    531.942
          Factor of Safety
         ***    1.383    ***
Failure Surface Specified By 20 Coordinate Points
   Point        X-Surf        Y-Surf
    No.          (ft)          (ft)
     1          69.474       381.737
     2          79.011       384.743
```

3	88.502	387.894
4	97.943	391.189
5	107.334	394.627
6	116.670	398.208
7	125.952	401.931
8	135.175	405.794
9	144.339	409.798
10	153.441	413.940
11	162.478	418.221
12	171.449	422.638
13	180.352	427.192
14	189.185	431.881
15	197.946	436.703
16	206.631	441.658
17	215.241	446.745
18	223.772	451.963
19	232.223	457.309
20	236.335	460.000

Circle Center At X = -122.901 ; Y = 1008.902 ; and Radius = 656.007

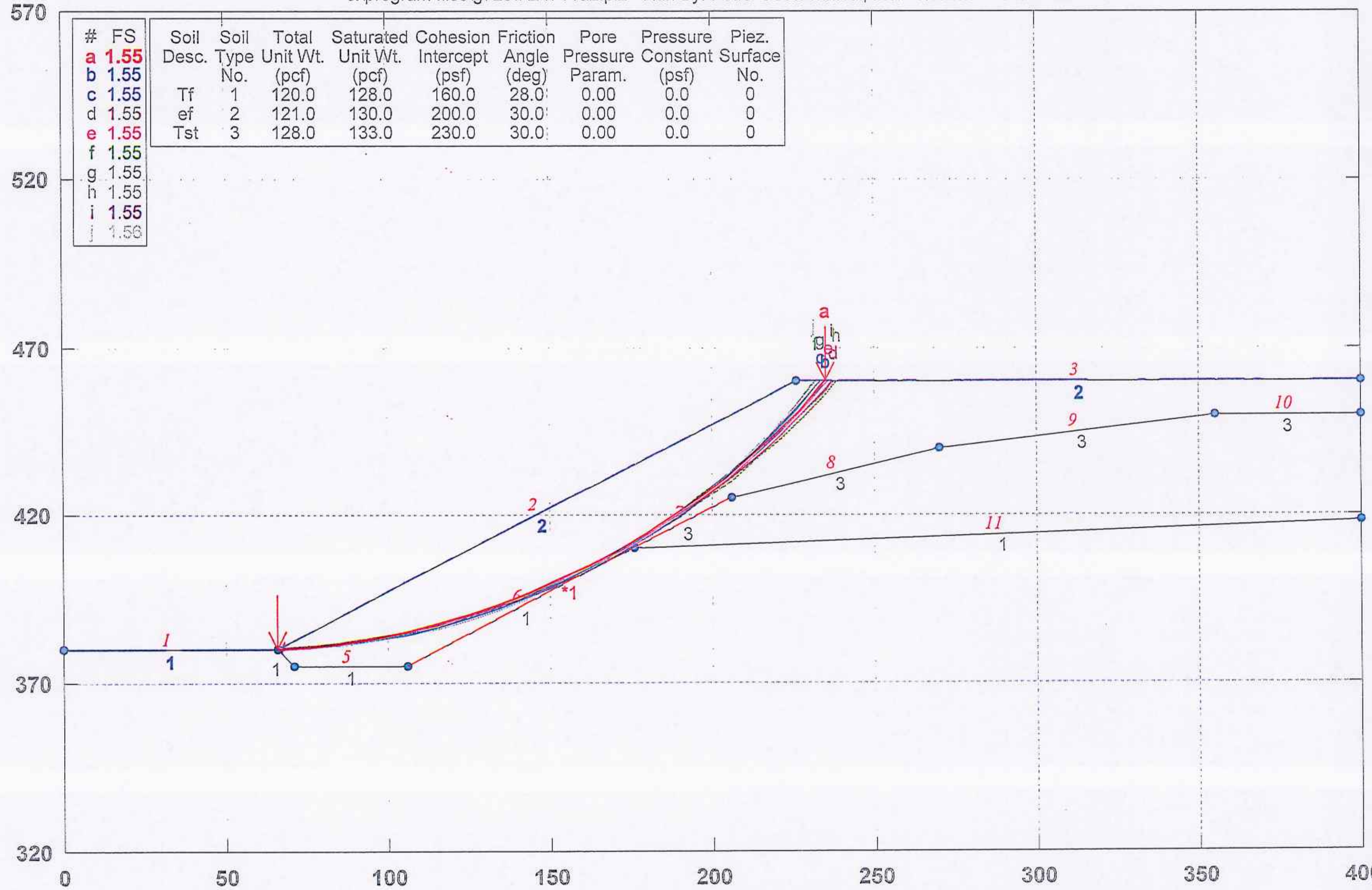
Factor of Safety

*** 1.390 ***

**** END OF GSTABL7 OUTPUT ****

Section A-A' - 2:1 Fill Slope - Increase Cohesion to 200 for Fiil - Static

c:\program files\g72sw\24711a2.pl2 Run By: Petra Geotechnical, Inc. 7/7/2011 04:21PM



GSTABL7 v.2 FSmin=1.55

Safety Factors Are Calculated By The Modified Bishop Method

```
                 *** GSTABL7 ***
         ** GSTABL7 by Garry H. Gregory, P.E. **
  ** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
         (All Rights Reserved-Unauthorized Use Prohibited)
*********************************************************************************
              SLOPE STABILITY ANALYSIS SYSTEM
      Modified Bishop, Simplified Janbu, or GLE Method of Slices.
      (Includes Spencer & Morgenstern-Price Type Analysis)
      Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
      Nonlinear Undrained Shear Strength, Curved Phi Envelope,
      Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
      Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*********************************************************************************
Analysis Run Date:         7/7/2011
Time of Run:               04:21PM
Run By:                    Petra Geotechnical, Inc.
Input Data Filename:       c:\program files\g72sw\24711a2.in
Output Filename:           c:\program files\g72sw\24711a2.OUT
Unit System:               English
Plotted Output Filename:   c:\program files\g72sw\24711a2.PLT
PROBLEM DESCRIPTION:  Section A-A' -  2:1 Fill Slope - Increas
                      e Cohesion to 200 for Fill -  Static
BOUNDARY COORDINATES
     3 Top   Boundaries
    11 Total Boundaries
Boundary     X-Left     Y-Left     X-Right    Y-Right    Soil Type
   No.        (ft)       (ft)        (ft)       (ft)     Below Bnd
    1          0.00     380.00       66.00     380.00        1
    2         66.00     380.00      226.00     460.00        2
    3        226.00     460.00      400.00     460.00        2
    4         66.00     380.00       71.00     375.00        1
    5         71.00     375.00      106.00     375.00        1
    6        106.00     375.00      176.00     410.00        1
    7        176.00     410.00      206.00     425.00        3
    8        206.00     425.00      270.00     440.00        3
    9        270.00     440.00      355.00     450.00        3
   10        355.00     450.00      400.00     450.00        3
   11        176.00     410.00      400.00     418.00        1
User Specified Y-Origin =        320.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
  3 Type(s) of Soil
Soil  Total  Saturated  Cohesion Friction   Pore    Pressure   Piez.
Type Unit Wt. Unit Wt. Intercept  Angle   Pressure  Constant  Surface
 No.  (pcf)    (pcf)     (psf)    (deg)    Param.    (psf)      No.
  1   120.0    128.0     160.0    28.0     0.00       0.0       0
  2   121.0    130.0     200.0    30.0     0.00       0.0       0
  3   128.0    133.0     230.0    30.0     0.00       0.0       0
Searching Routine Will Be Limited To An Area Defined By  1 Boundaries
 Of Which The First  1 Boundaries Will Deflect Surfaces Upward
Boundary      X-Left     Y-Left     X-Right    Y-Right
   No.         (ft)       (ft)        (ft)       (ft)
    1         106.00     375.00     206.00     425.00
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
 500 Trial Surfaces Have Been Generated.
  25 Surface(s) Initiate(s) From Each Of    20 Points Equally Spaced
Along The Ground Surface Between  X =  66.00(ft)
                             and  X =  80.00(ft)
Each Surface Terminates Between   X = 230.00(ft)
                             and  X = 250.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is  Y =      0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
      Failure Surfaces Evaluated. They Are
```

```
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted =   500
Number of Trial Surfaces With Valid FS =  500
Statistical Data On All Valid FS Values:
   FS Max =    2.312   FS Min =    1.551   FS Ave =    1.664
   Standard Deviation =     0.148   Coefficient of Variation =     8.87 %
Failure Surface Specified By 21 Coordinate Points
```

Point No.	X-Surf (ft)	Y-Surf (ft)
1	66.000	380.000
2	75.980	380.628
3	85.926	381.671
4	95.819	383.127
5	105.644	384.993
6	115.382	387.266
7	125.017	389.943
8	134.532	393.018
9	143.912	396.486
10	153.139	400.341
11	162.197	404.577
12	171.072	409.186
13	179.747	414.161
14	188.207	419.492
15	196.439	425.170
16	204.427	431.186
17	212.158	437.529
18	219.618	444.188
19	226.795	451.152
20	233.675	458.408
21	235.064	460.000

```
Circle Center At X =     55.897 ; Y =    620.096 ; and Radius =    240.309
        Factor of Safety
       ***    1.551    ***
       Individual data on the     21  slices
```

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	10.0	2633.7	0.0	0.0	0.	0.	0.0	0.0	0.0
2	9.9	7613.7	0.0	0.0	0.	0.	0.0	0.0	0.0
3	9.9	12015.7	0.0	0.0	0.	0.	0.0	0.0	0.0
4	9.8	15817.2	0.0	0.0	0.	0.	0.0	0.0	0.0
5	9.7	19002.5	0.0	0.0	0.	0.	0.0	0.0	0.0
6	9.6	21562.8	0.0	0.0	0.	0.	0.0	0.0	0.0
7	9.5	23496.4	0.0	0.0	0.	0.	0.0	0.0	0.0
8	9.4	24808.1	0.0	0.0	0.	0.	0.0	0.0	0.0
9	9.2	25510.1	0.0	0.0	0.	0.	0.0	0.0	0.0
10	9.1	25620.8	0.0	0.0	0.	0.	0.0	0.0	0.0
11	8.9	25165.3	0.0	0.0	0.	0.	0.0	0.0	0.0
12	8.7	24175.3	0.0	0.0	0.	0.	0.0	0.0	0.0
13	8.5	22688.2	0.0	0.0	0.	0.	0.0	0.0	0.0
14	8.2	20747.5	0.0	0.0	0.	0.	0.0	0.0	0.0
15	8.0	18401.8	0.0	0.0	0.	0.	0.0	0.0	0.0
16	7.7	15704.8	0.0	0.0	0.	0.	0.0	0.0	0.0
17	7.5	12714.9	0.0	0.0	0.	0.	0.0	0.0	0.0
18	6.4	8587.5	0.0	0.0	0.	0.	0.0	0.0	0.0
19	0.8	887.7	0.0	0.0	0.	0.	0.0	0.0	0.0
20	6.9	4346.2	0.0	0.0	0.	0.	0.0	0.0	0.0
21	1.4	133.7	0.0	0.0	0.	0.	0.0	0.0	0.0

```
Failure Surface Specified By 21 Coordinate Points
```

Point No.	X-Surf (ft)	Y-Surf (ft)
1	66.000	380.000
2	75.992	380.393
3	85.958	381.225
4	95.877	382.495

5	105.730	384.199
6	115.499	386.336
7	125.165	388.899
8	134.709	391.886
9	144.112	395.289
10	153.356	399.103
11	162.424	403.319
12	171.297	407.930
13	179.959	412.927
14	188.393	418.300
15	196.583	424.038
16	204.512	430.132
17	212.166	436.568
18	219.529	443.334
19	226.587	450.418
20	233.327	457.805
21	235.160	460.000

Circle Center At X = 62.063 ; Y = 607.297 ; and Radius = 227.331

Factor of Safety

*** 1.551 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	66.000	380.000
2	75.990	380.458
3	85.949	381.356
4	95.860	382.692
5	105.701	384.463
6	115.456	386.666
7	125.103	389.297
8	134.626	392.351
9	144.004	395.822
10	153.220	399.702
11	162.257	403.985
12	171.096	408.662
13	179.720	413.724
14	188.112	419.161
15	196.257	424.963
16	204.138	431.118
17	211.741	437.615
18	219.049	444.440
19	226.050	451.581
20	232.729	459.024
21	233.531	460.000

Circle Center At X = 60.610 ; Y = 606.772 ; and Radius = 226.836

Factor of Safety

*** 1.552 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	66.000	380.000
2	75.976	380.691
3	85.917	381.778
4	95.806	383.261
5	105.629	385.136
6	115.369	387.400
7	125.011	390.051
8	134.541	393.084
9	143.941	396.493
10	153.199	400.274
11	162.299	404.421
12	171.226	408.927
13	179.967	413.784
14	188.508	418.986
15	196.834	424.524
16	204.934	430.389
17	212.793	436.571

```
   18        220.401      443.062
   19        227.743      449.851
   20        234.810      456.926
   21        237.645      460.000
Circle Center At X =     53.645 ; Y =    630.798 ; and Radius =    251.102
      Factor of Safety
     ***    1.552    ***
Failure Surface Specified By 21 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1         66.737      380.368
    2         76.723      380.898
    3         86.677      381.850
    4         96.582      383.225
    5        106.420      385.018
    6        116.173      387.228
    7        125.823      389.850
    8        135.353      392.879
    9        144.746      396.310
   10        153.985      400.137
   11        163.053      404.352
   12        171.934      408.949
   13        180.612      413.918
   14        189.071      419.251
   15        197.296      424.939
   16        205.272      430.971
   17        212.985      437.336
   18        220.421      444.022
   19        227.566      451.018
   20        234.408      458.312
   21        235.862      460.000
Circle Center At X =     59.269 ; Y =    615.751 ; and Radius =    235.501
      Factor of Safety
     ***    1.552    ***
Failure Surface Specified By 21 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1         66.000      380.000
    2         75.989      380.458
    3         85.948      381.363
    4         95.857      382.712
    5        105.695      384.502
    6        115.444      386.731
    7        125.083      389.393
    8        134.594      392.483
    9        143.957      395.996
   10        153.153      399.923
   11        162.165      404.258
   12        170.974      408.991
   13        179.562      414.113
   14        187.913      419.614
   15        196.010      425.483
   16        203.836      431.708
   17        211.377      438.276
   18        218.616      445.175
   19        225.539      452.391
   20        232.133      459.909
   21        232.206      460.000
Circle Center At X =     60.743 ; Y =    603.581 ; and Radius =    223.643
      Factor of Safety
     ***    1.553    ***
Failure Surface Specified By 20 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1         66.737      380.368
    2         76.723      380.894
    3         86.677      381.856
```

4	96.579	383.252
5	106.410	385.079
6	116.153	387.334
7	125.787	390.013
8	135.296	393.110
9	144.659	396.620
10	153.861	400.536
11	162.882	404.851
12	171.706	409.555
13	180.316	414.641
14	188.696	420.098
15	196.829	425.916
16	204.700	432.085
17	212.294	438.591
18	219.597	445.423
19	226.593	452.567
20	233.261	460.000

Circle Center At X = 59.709 ; Y = 608.998 ; and Radius = 228.737

Factor of Safety

*** 1.553 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	66.737	380.368
2	76.718	380.983
3	86.666	381.999
4	96.565	383.416
5	106.399	385.230
6	116.152	387.440
7	125.808	390.041
8	135.351	393.030
9	144.766	396.401
10	154.037	400.148
11	163.149	404.267
12	172.088	408.749
13	180.839	413.589
14	189.388	418.777
15	197.721	424.306
16	205.824	430.166
17	213.684	436.348
18	221.288	442.843
19	228.624	449.638
20	235.680	456.724
21	238.690	460.000

Circle Center At X = 56.498 ; Y = 628.102 ; and Radius = 247.945

Factor of Safety

*** 1.554 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	67.474	380.737
2	77.463	381.195
3	87.424	382.081
4	97.337	383.394
5	107.185	385.131
6	116.950	387.289
7	126.612	389.864
8	136.156	392.852
9	145.562	396.247
10	154.814	400.042
11	163.894	404.230
12	172.786	408.805
13	181.474	413.757
14	189.941	419.077
15	198.173	424.756
16	206.152	430.783
17	213.866	437.147

18	221.300	443.836
19	228.439	450.838
20	235.272	458.139
21	236.868	460.000

Circle Center At X = 61.806 ; Y = 613.606 ; and Radius = 232.938

Factor of Safety

*** 1.554 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	66.000	380.000
2	75.996	380.286
3	85.968	381.039
4	95.893	382.257
5	105.751	383.938
6	115.519	386.078
7	125.177	388.672
8	134.702	391.715
9	144.076	395.200
10	153.275	399.120
11	162.282	403.465
12	171.076	408.227
13	179.637	413.394
14	187.947	418.956
15	195.988	424.901
16	203.743	431.215
17	211.194	437.885
18	218.325	444.896
19	225.120	452.232
20	231.565	459.878
21	231.658	460.000

Circle Center At X = 64.887 ; Y = 593.830 ; and Radius = 213.833

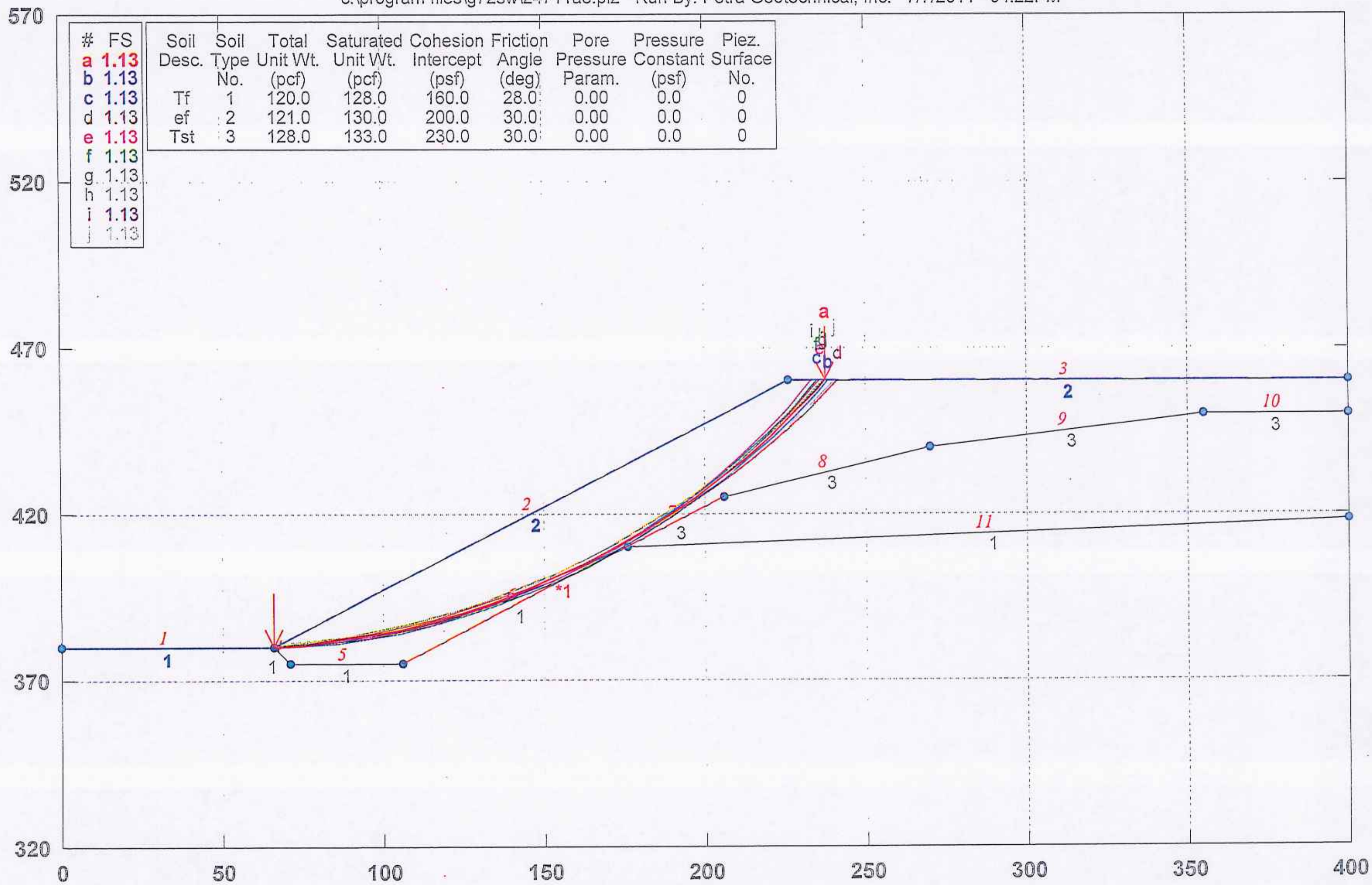
Factor of Safety

*** 1.555 ***

**** END OF GSTABL7 OUTPUT ****

Section A-A' - 2:1 Fill Slope - Increase Cohesion to 200 for Fill - Seismic

c:\program files\g72sw\24711a3.pl2 Run By: Petra Geotechnical, Inc. 7/7/2011 04:22PM



GSTABL7 v.2 FSmin=1.13

Safety Factors Are Calculated By The Modified Bishop Method

*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **

****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
****

Analysis Run Date: 7/7/2011
Time of Run: 04:22PM
Run By: Petra Geotechnical, Inc.
Input Data Filename: c:\program files\g72sw\24711a3.in
Output Filename: c:\program files\g72sw\24711a3.OUT
Unit System: English
Plotted Output Filename: c:\program files\g72sw\24711a3.PLT
PROBLEM DESCRIPTION: Section A-A' - 2:1 Fill Slope - Increas
e Cohesion to 200 for Fiil - Seismic

BOUNDARY COORDINATES
3 Top Boundaries
11 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	380.00	66.00	380.00	1
2	66.00	380.00	226.00	460.00	2
3	226.00	460.00	400.00	460.00	2
4	66.00	380.00	71.00	375.00	1
5	71.00	375.00	106.00	375.00	1
6	106.00	375.00	176.00	410.00	1
7	176.00	410.00	206.00	425.00	3
8	206.00	425.00	270.00	440.00	3
9	270.00	440.00	355.00	450.00	3
10	355.00	450.00	400.00	450.00	3
11	176.00	410.00	400.00	418.00	1

User Specified Y-Origin = 320.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	128.0	160.0	28.0	0.00	0.0	0
2	121.0	130.0	200.0	30.0	0.00	0.0	0
3	128.0	133.0	230.0	30.0	0.00	0.0	0

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	106.00	375.00	206.00	425.00

Specified Peak Ground Acceleration Coefficient (A) = 0.400(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.150(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
500 Trial Surfaces Have Been Generated.
25 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 66.00(ft)
and X = 80.00(ft)
Each Surface Terminates Between X = 230.00(ft)
and X = 250.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation

At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 500
Number of Trial Surfaces With Valid FS = 500
Statistical Data On All Valid FS Values:
FS Max = 1.715 FS Min = 1.125 FS Ave = 1.206
Standard Deviation = 0.112 Coefficient of Variation = 9.29 %
Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	66.000	380.000
2	75.976	380.691
3	85.917	381.778
4	95.806	383.261
5	105.629	385.136
6	115.369	387.400
7	125.011	390.051
8	134.541	393.084
9	143.941	396.493
10	153.199	400.274
11	162.299	404.421
12	171.226	408.927
13	179.967	413.784
14	188.508	418.986
15	196.834	424.524
16	204.934	430.389
17	212.793	436.571
18	220.401	443.062
19	227.743	449.851
20	234.810	456.926
21	237.645	460.000

Circle Center At X = 53.645 ; Y = 630.798 ; and Radius = 251.102
Factor of Safety
*** 1.125 ***
Individual data on the 21 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	10.0	2593.6	0.0	0.0	0.	0.	389.0	0.0	0.0
2	9.9	7504.0	0.0	0.0	0.	0.	1125.6	0.0	0.0
3	9.9	11860.1	0.0	0.0	0.	0.	1779.0	0.0	0.0
4	9.8	15641.9	0.0	0.0	0.	0.	2346.3	0.0	0.0
5	9.7	18835.1	0.0	0.0	0.	0.	2825.3	0.0	0.0
6	9.6	21431.9	0.0	0.0	0.	0.	3214.8	0.0	0.0
7	9.5	23430.2	0.0	0.0	0.	0.	3514.5	0.0	0.0
8	9.4	24834.1	0.0	0.0	0.	0.	3725.1	0.0	0.0
9	9.3	25653.6	0.0	0.0	0.	0.	3848.0	0.0	0.0
10	9.1	25904.7	0.0	0.0	0.	0.	3885.7	0.0	0.0
11	8.9	25609.2	0.0	0.0	0.	0.	3841.4	0.0	0.0
12	8.7	24794.3	0.0	0.0	0.	0.	3719.2	0.0	0.0
13	8.5	23493.0	0.0	0.0	0.	0.	3523.9	0.0	0.0
14	8.3	21743.0	0.0	0.0	0.	0.	3261.4	0.0	0.0
15	8.1	19587.0	0.0	0.0	0.	0.	2938.1	0.0	0.0
16	7.9	17072.4	0.0	0.0	0.	0.	2560.9	0.0	0.0
17	7.6	14250.5	0.0	0.0	0.	0.	2137.6	0.0	0.0
18	5.6	8773.6	0.0	0.0	0.	0.	1316.0	0.0	0.0
19	1.7	2311.1	0.0	0.0	0.	0.	346.7	0.0	0.0
20	7.1	5653.3	0.0	0.0	0.	0.	848.0	0.0	0.0
21	2.8	527.1	0.0	0.0	0.	0.	79.1	0.0	0.0

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)

1	66.737	380.368
2	76.718	380.983
3	86.666	381.999
4	96.565	383.416
5	106.399	385.230
6	116.152	387.440
7	125.808	390.041
8	135.351	393.030
9	144.766	396.401
10	154.037	400.148
11	163.149	404.267
12	172.088	408.749
13	180.839	413.589
14	189.388	418.777
15	197.721	424.306
16	205.824	430.166
17	213.684	436.348
18	221.288	442.843
19	228.624	449.638
20	235.680	456.724
21	238.690	460.000

Circle Center At X = 56.498 ; Y = 628.102 ; and Radius = 247.945

Factor of Safety

*** 1.126 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	66.000	380.000
2	75.980	380.628
3	85.926	381.671
4	95.819	383.127
5	105.644	384.993
6	115.382	387.266
7	125.017	389.943
8	134.532	393.018
9	143.912	396.486
10	153.139	400.341
11	162.197	404.577
12	171.072	409.186
13	179.747	414.161
14	188.207	419.492
15	196.439	425.170
16	204.427	431.186
17	212.158	437.529
18	219.618	444.188
19	226.795	451.152
20	233.675	458.408
21	235.064	460.000

Circle Center At X = 55.897 ; Y = 620.096 ; and Radius = 240.309

Factor of Safety

*** 1.127 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	66.737	380.368
2	76.702	381.201
3	86.630	382.401
4	96.507	383.966
5	106.319	385.896
6	116.053	388.186
7	125.696	390.834
8	135.235	393.836
9	144.656	397.189
10	153.947	400.887
11	163.095	404.926
12	172.088	409.299
13	180.913	414.002

14	189.559	419.028
15	198.013	424.369
16	206.264	430.019
17	214.301	435.969
18	222.112	442.212
19	229.688	448.740
20	237.018	455.543
21	241.478	460.000

Circle Center At X = 49.181 ; Y = 650.577 ; and Radius = 270.779

Factor of Safety

*** 1.127 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	66.737	380.368
2	76.723	380.898
3	86.677	381.850
4	96.582	383.225
5	106.420	385.018
6	116.173	387.228
7	125.823	389.850
8	135.353	392.879
9	144.746	396.310
10	153.985	400.137
11	163.053	404.352
12	171.934	408.949
13	180.612	413.918
14	189.071	419.251
15	197.296	424.939
16	205.272	430.971
17	212.985	437.336
18	220.421	444.022
19	227.566	451.018
20	234.408	458.312
21	235.862	460.000

Circle Center At X = 59.269 ; Y = 615.751 ; and Radius = 235.501

Factor of Safety

*** 1.127 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	66.000	380.000
2	75.992	380.393
3	85.958	381.225
4	95.877	382.495
5	105.730	384.199
6	115.499	386.336
7	125.165	388.899
8	134.709	391.886
9	144.112	395.289
10	153.356	399.103
11	162.424	403.319
12	171.297	407.930
13	179.959	412.927
14	188.393	418.300
15	196.583	424.038
16	204.512	430.132
17	212.166	436.568
18	219.529	443.334
19	226.587	450.418
20	233.327	457.805
21	235.160	460.000

Circle Center At X = 62.063 ; Y = 607.297 ; and Radius = 227.331

Factor of Safety

*** 1.127 ***

Failure Surface Specified By 21 Coordinate Points

Point X-Surf Y-Surf

No.	(ft)	(ft)
1	67.474	380.737
2	77.463	381.195
3	87.424	382.081
4	97.337	383.394
5	107.185	385.131
6	116.950	387.289
7	126.612	389.864
8	136.156	392.852
9	145.562	396.247
10	154.814	400.042
11	163.894	404.230
12	172.786	408.805
13	181.474	413.757
14	189.941	419.077
15	198.173	424.756
16	206.152	430.783
17	213.866	437.147
18	221.300	443.836
19	228.439	450.838
20	235.272	458.139
21	236.868	460.000

Circle Center At X = 61.806 ; Y = 613.606 ; and Radius = 232.938

Factor of Safety

*** 1.128 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	67.474	380.737
2	77.435	381.612
3	87.356	382.869
4	97.221	384.507
5	107.016	386.523
6	116.726	388.914
7	126.337	391.676
8	135.834	394.806
9	145.204	398.298
10	154.434	402.148
11	163.508	406.351
12	172.414	410.898
13	181.139	415.785
14	189.669	421.004
15	197.992	426.546
16	206.097	432.405
17	213.970	438.570
18	221.600	445.034
19	228.976	451.786
20	236.087	458.817
21	237.195	460.000

Circle Center At X = 49.698 ; Y = 640.223 ; and Radius = 260.094

Factor of Safety

*** 1.128 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	66.000	380.000
2	75.990	380.458
3	85.949	381.356
4	95.860	382.692
5	105.701	384.463
6	115.456	386.666
7	125.103	389.297
8	134.626	392.351
9	144.004	395.822
10	153.220	399.702
11	162.257	403.985
12	171.096	408.662

13	179.720	413.724
14	188.112	419.161
15	196.257	424.963
16	204.138	431.118
17	211.741	437.615
18	219.049	444.440
19	226.050	451.581
20	232.729	459.024
21	233.531	460.000

Circle Center At X = 60.610 ; Y = 606.772 ; and Radius = 226.836

Factor of Safety

*** 1.128 ***

Failure Surface Specified By 21 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	68.211	381.105
2	78.174	381.963
3	88.098	383.194
4	97.968	384.796
5	107.772	386.767
6	117.496	389.103
7	127.124	391.802
8	136.645	394.861
9	146.045	398.273
10	155.310	402.036
11	164.428	406.143
12	173.385	410.589
13	182.170	415.367
14	190.769	420.471
15	199.171	425.894
16	207.364	431.628
17	215.336	437.665
18	223.076	443.996
19	230.574	450.613
20	237.819	457.506
21	240.250	460.000

Circle Center At X = 50.299 ; Y = 647.332 ; and Radius = 266.829

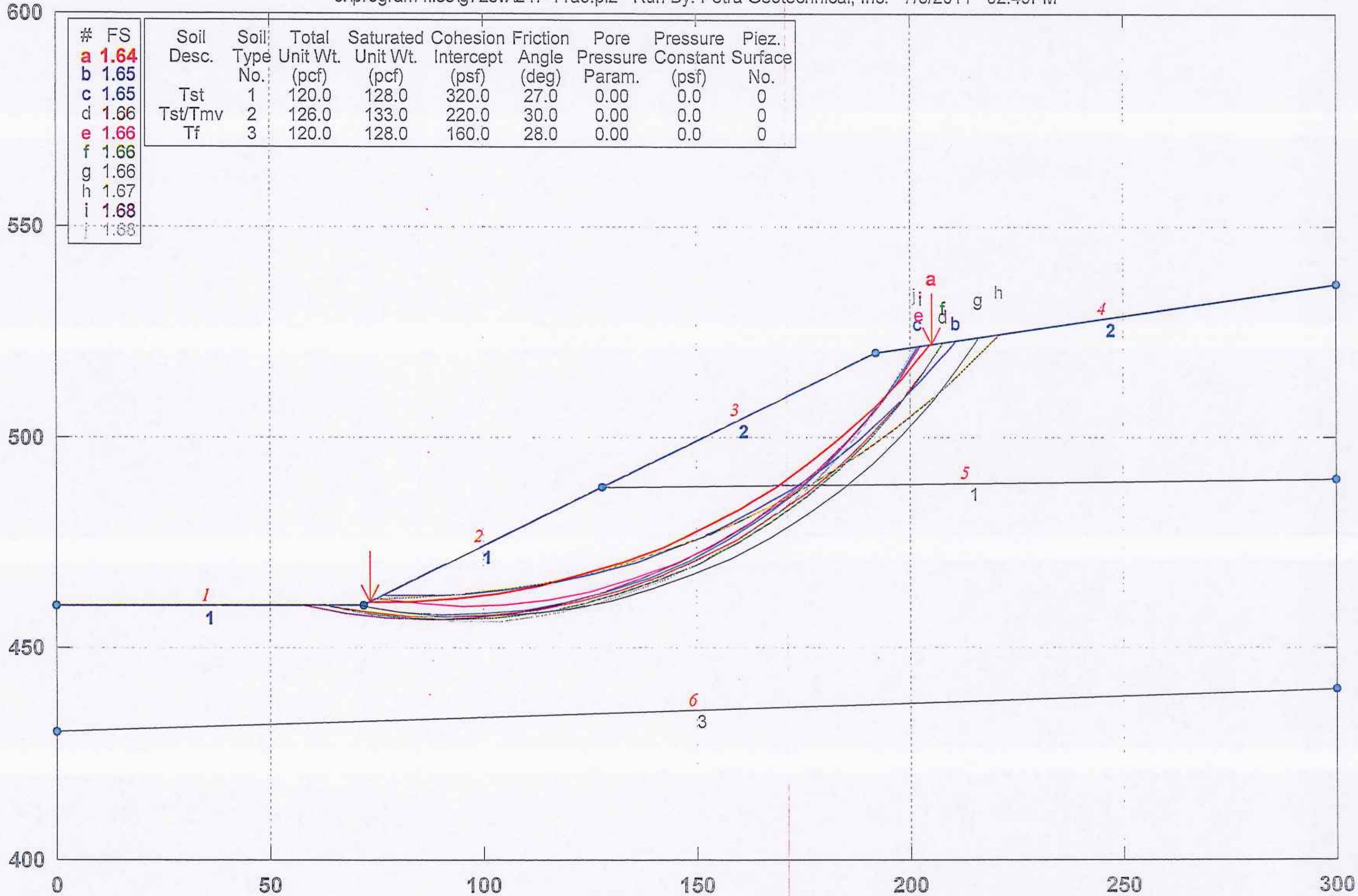
Factor of Safety

*** 1.129 ***

**** END OF GSTABL7 OUTPUT ****

Section A-A' - Cut Slope - Static Analysis

c:\program files\g72sw\247-11a3.pl2 Run By: Petra Geotechnical, Inc. 7/6/2011 02:49PM



GSTABL7 v.2 FSmin=1.64

Safety Factors Are Calculated By The Modified Bishop Method

```
*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
(All Rights Reserved-Unauthorized Use Prohibited)
*****************************************************************************
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*****************************************************************************
Analysis Run Date:          7/6/2011
Time of Run:                02:49PM
Run By:                     Petra Geotechnical, Inc.
Input Data Filename:        c:\program files\g72sw\247-11A3.in
Output Filename:            c:\program files\g72sw\247-11A3.OUT
Unit System:                English
Plotted Output Filename:    c:\program files\g72sw\247-11A3.PLT
PROBLEM DESCRIPTION:  Section A-A' - Cut Slope -
                      Static Analysis
BOUNDARY COORDINATES
    4 Top   Boundaries
    6 Total Boundaries
Boundary    X-Left     Y-Left    X-Right    Y-Right    Soil Type
   No.       (ft)       (ft)      (ft)       (ft)      Below Bnd
    1         0.00     460.00     72.00     460.00        1
    2        72.00     460.00    128.00     488.00        1
    3       128.00     488.00    192.00     520.00        2
    4       192.00     520.00    300.00     536.00        2
    5       128.00     488.00    300.00     490.00        1
    6         0.00     430.00    300.00     440.00        3
User Specified Y-Origin =        400.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
  3 Type(s) of Soil
Soil  Total  Saturated  Cohesion Friction   Pore    Pressure   Piez.
Type Unit Wt. Unit Wt.  Intercept  Angle  Pressure Constant  Surface
 No.  (pcf)    (pcf)     (psf)    (deg)    Param.   (psf)      No.
  1   120.0    128.0     320.0     27.0     0.00     0.0        0
  2   126.0    133.0     220.0     30.0     0.00     0.0        0
  3   120.0    128.0     160.0     28.0     0.00     0.0        0
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
 500 Trial Surfaces Have Been Generated.
  25 Surface(s) Initiate(s) From Each Of    20 Points Equally Spaced
Along The Ground Surface Between  X =  50.00(ft)
                             and  X =  80.00(ft)
Each Surface Terminates Between   X = 200.00(ft)
                             and  X = 250.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is  Y =      0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
      Failure Surfaces Evaluated. They Are
      Ordered - Most Critical First.
      * * Safety Factors Are Calculated By The Modified Bishop Method * *
      Total Number of Trial Surfaces Attempted =   500
      Number of Trial Surfaces With Valid FS =  500
      Statistical Data On All Valid FS Values:
         FS Max =   2.760   FS Min =   1.641   FS Ave =   2.110
         Standard Deviation =    0.302   Coefficient of Variation =    14.32 %
      Failure Surface Specified By 17 Coordinate Points
        Point      X-Surf      Y-Surf
         No.        (ft)        (ft)
```

1	73.684	460.842
2	83.684	460.828
3	93.666	461.436
4	103.590	462.664
5	113.419	464.507
6	123.114	466.958
7	132.637	470.008
8	141.953	473.645
9	151.024	477.854
10	159.815	482.619
11	168.293	487.922
12	176.424	493.743
13	184.178	500.058
14	191.524	506.844
15	198.433	514.073
16	204.878	521.719
17	205.036	521.931

Circle Center At X = 78.913 ; Y = 621.378 ; and Radius = 160.621

Factor of Safety

*** 1.641 ***

Individual data on the 19 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	10.0	3008.6	0.0	0.0	0.	0.	0.0	0.0	0.0
2	10.0	8630.8	0.0	0.0	0.	0.	0.0	0.0	0.0
3	9.9	13414.6	0.0	0.0	0.	0.	0.0	0.0	0.0
4	9.8	17298.5	0.0	0.0	0.	0.	0.0	0.0	0.0
5	9.7	20243.5	0.0	0.0	0.	0.	0.0	0.0	0.0
6	4.9	11163.1	0.0	0.0	0.	0.	0.0	0.0	0.0
7	4.6	11101.7	0.0	0.0	0.	0.	0.0	0.0	0.0
8	9.3	23528.5	0.0	0.0	0.	0.	0.0	0.0	0.0
9	9.1	23889.2	0.0	0.0	0.	0.	0.0	0.0	0.0
10	8.8	23360.2	0.0	0.0	0.	0.	0.0	0.0	0.0
11	8.5	22012.1	0.0	0.0	0.	0.	0.0	0.0	0.0
12	0.8	1966.9	0.0	0.0	0.	0.	0.0	0.0	0.0
13	7.4	17853.8	0.0	0.0	0.	0.	0.0	0.0	0.0
14	7.8	16852.3	0.0	0.0	0.	0.	0.0	0.0	0.0
15	7.3	13396.5	0.0	0.0	0.	0.	0.0	0.0	0.0
16	0.5	767.7	0.0	0.0	0.	0.	0.0	0.0	0.0
17	6.4	7917.5	0.0	0.0	0.	0.	0.0	0.0	0.0
18	6.4	2870.5	0.0	0.0	0.	0.	0.0	0.0	0.0
19	0.2	1.9	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	76.842	462.421
2	86.839	462.176
3	96.832	462.557
4	106.781	463.564
5	116.648	465.193
6	126.393	467.436
7	135.978	470.286
8	145.366	473.730
9	154.520	477.757
10	163.403	482.348
11	171.981	487.488
12	180.221	493.155
13	188.089	499.327
14	195.555	505.980
15	202.589	513.087
16	209.164	520.622
17	210.828	522.789

Circle Center At X = 85.752 ; Y = 621.684 ; and Radius = 159.512

Factor of Safety

*** 1.651 ***

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	70.526	460.000
2	80.416	458.516
3	90.393	457.838
4	100.392	457.971
5	110.347	458.912
6	120.194	460.657
7	129.867	463.194
8	139.303	466.506
9	148.439	470.571
10	157.216	475.362
11	165.577	480.849
12	173.465	486.995
13	180.830	493.759
14	187.623	501.098
15	193.799	508.963
16	199.318	517.302
17	201.587	521.420

Circle Center At X = 93.761 ; Y = 581.165 ; and Radius = 123.373

Factor of Safety

*** 1.653 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	62.632	460.000
2	72.495	458.353
3	82.452	457.421
4	92.449	457.211
5	102.436	457.722
6	112.360	458.953
7	122.170	460.897
8	131.813	463.543
9	141.241	466.878
10	150.403	470.885
11	159.252	475.542
12	167.742	480.826
13	175.829	486.708
14	183.470	493.159
15	190.626	500.144
16	197.260	507.627
17	203.336	515.569
18	207.778	522.338

Circle Center At X = 90.377 ; Y = 595.545 ; and Radius = 138.356

Factor of Safety

*** 1.659 ***

Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	75.263	461.632
2	85.172	460.284
3	95.158	459.758
4	105.154	460.057
5	115.090	461.179
6	124.901	463.116
7	134.518	465.856
8	143.877	469.380
9	152.913	473.663
10	161.566	478.677
11	169.775	484.387
12	177.486	490.754
13	184.645	497.736
14	191.205	505.284
15	197.120	513.347
16	202.122	521.500

Circle Center At X = 96.541 ; Y = 580.884 ; and Radius = 121.136

Factor of Safety
*** 1.660 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	62.632	460.000
2	72.457	458.140
3	82.394	457.018
4	92.387	456.640
5	102.380	457.010
6	112.318	458.124
7	122.145	459.977
8	131.806	462.558
9	141.247	465.852
10	150.417	469.842
11	159.263	474.505
12	167.737	479.816
13	175.790	485.744
14	183.379	492.256
15	190.461	499.316
16	196.996	506.886
17	202.947	514.922
18	207.610	522.313

Circle Center At X = 92.447 ; Y = 590.443 ; and Radius = 133.807

Factor of Safety
*** 1.664 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	70.526	460.000
2	80.401	458.425
3	90.364	457.562
4	100.363	457.415
5	110.347	457.986
6	120.264	459.271
7	130.063	461.264
8	139.695	463.954
9	149.108	467.328
10	158.256	471.368
11	167.090	476.054
12	175.566	481.361
13	183.639	487.262
14	191.268	493.727
15	198.414	500.722
16	205.041	508.212
17	211.113	516.157
18	215.965	523.550

Circle Center At X = 97.414 ; Y = 596.663 ; and Radius = 139.283

Factor of Safety
*** 1.664 ***

Failure Surface Specified By 18 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	75.263	461.632
2	85.262	461.792
3	95.240	462.460
4	105.170	463.635
5	115.029	465.313
6	124.789	467.490
7	134.426	470.160
8	143.914	473.317
9	153.230	476.952
10	162.349	481.056
11	171.248	485.618
12	179.903	490.627
13	188.292	496.069
14	196.394	501.931

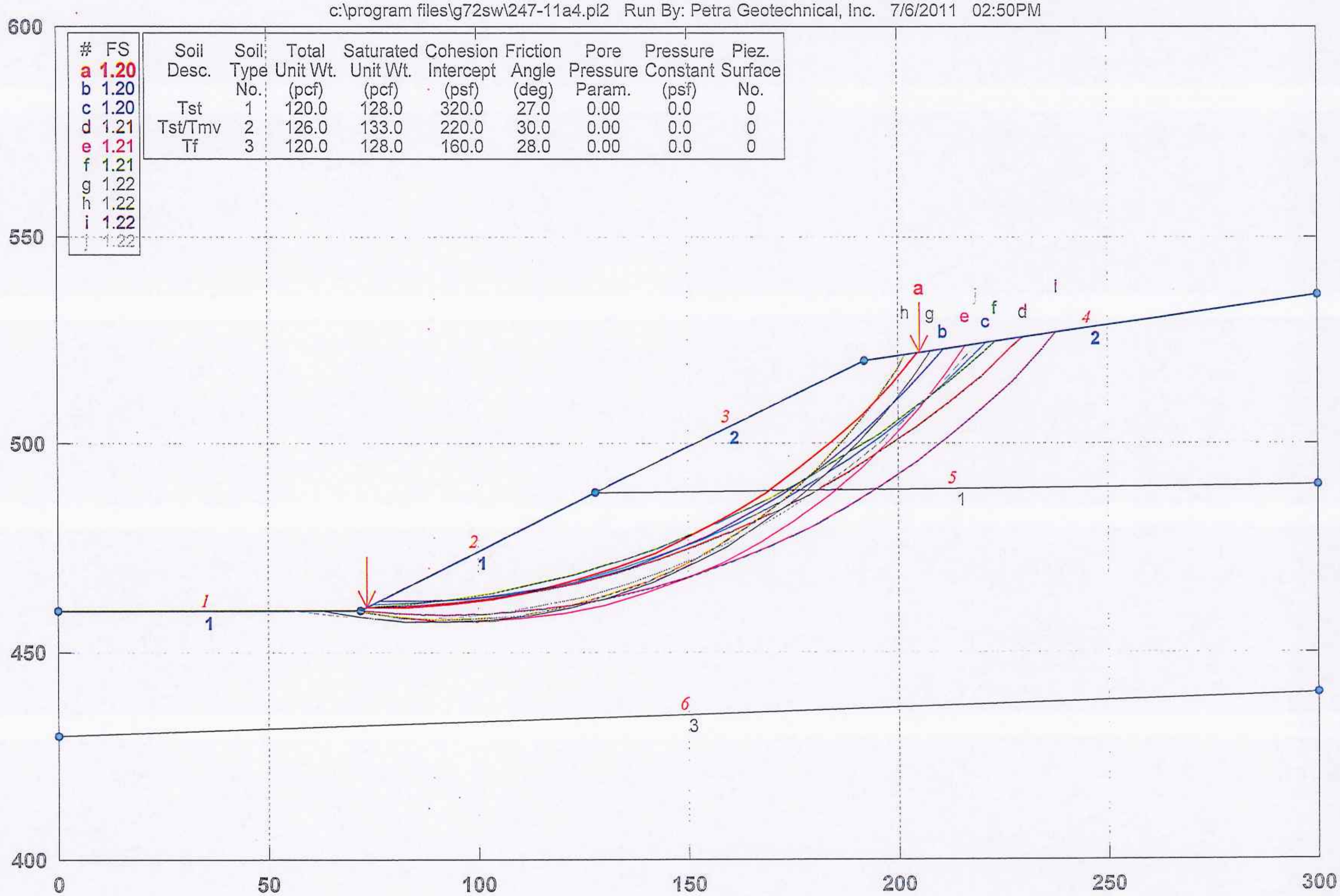
```
  15        204.188       508.197
  16        211.652       514.851
  17        218.769       521.876
  18        220.981       524.294
Circle Center At X =    77.176 ; Y =   657.946 ; and Radius =    196.324
       Factor of Safety
      ***    1.669   ***
Failure Surface Specified By 18 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
   1          57.895       460.000
   2          67.721       458.143
   3          77.658       457.024
   4          87.651       456.649
   5          97.644       457.020
   6         107.582       458.136
   7         117.408       459.990
   8         127.069       462.572
   9         136.511       465.867
  10         145.680       469.857
  11         154.526       474.520
  12         163.000       479.830
  13         171.054       485.757
  14         178.644       492.269
  15         185.726       499.328
  16         192.263       506.896
  17         198.217       514.931
  18         202.388       521.539
Circle Center At X =    87.686 ; Y =   590.455 ; and Radius =    133.814
       Factor of Safety
      ***    1.675   ***
Failure Surface Specified By 18 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
   1          64.211       460.000
   2          73.980       457.865
   3          83.894       456.553
   4          93.882       456.075
   5         103.876       456.433
   6         113.804       457.625
   7         123.599       459.642
   8         133.190       462.471
   9         142.512       466.092
  10         151.498       470.479
  11         160.086       475.602
  12         168.216       481.425
  13         175.831       487.906
  14         182.878       495.002
  15         189.307       502.661
  16         195.073       510.831
  17         200.137       519.455
  18         201.041       521.339
Circle Center At X =    94.615 ; Y =   575.461 ; and Radius =    119.397
       Factor of Safety
      ***    1.677   ***
          **** END OF GSTABL7 OUTPUT ****
```

Section A-A' - Cut Slope - Seismic Analysis

c:\program files\g72sw\247-11a4.pl2 Run By: Petra Geotechnical, Inc. 7/6/2011 02:50PM

#	FS
a	1.20
b	1.20
c	1.20
d	1.21
e	1.21
f	1.21
g	1.22
h	1.22
i	1.22
j	1.22

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Tst	1	120.0	128.0	320.0	27.0	0.00	0.0	0
Tst/Tmv	2	126.0	133.0	220.0	30.0	0.00	0.0	0
Tf	3	120.0	128.0	160.0	28.0	0.00	0.0	0



GSTABL7 v.2 FSmin=1.20
Safety Factors Are Calculated By The Modified Bishop Method

*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **

****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
****

Analysis Run Date: 7/6/2011
Time of Run: 02:50PM
Run By: Petra Geotechnical, Inc.
Input Data Filename: c:\program files\g72sw\247-11A4.in
Output Filename: c:\program files\g72sw\247-11A4.OUT
Unit System: English
Plotted Output Filename: c:\program files\g72sw\247-11A4.PLT
PROBLEM DESCRIPTION: Section A-A' - Cut Slope -
Seismic Analysis

BOUNDARY COORDINATES
4 Top Boundaries
6 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	460.00	72.00	460.00	1
2	72.00	460.00	128.00	488.00	1
3	128.00	488.00	192.00	520.00	2
4	192.00	520.00	300.00	536.00	2
5	128.00	488.00	300.00	490.00	1
6	0.00	430.00	300.00	440.00	3

User Specified Y-Origin = 400.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	128.0	320.0	27.0	0.00	0.0	0
2	126.0	133.0	220.0	30.0	0.00	0.0	0
3	120.0	128.0	160.0	28.0	0.00	0.0	0

Specified Peak Ground Acceleration Coefficient (A) = 0.400(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.150(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
500 Trial Surfaces Have Been Generated.
25 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 50.00(ft)
and X = 80.00(ft)
Each Surface Terminates Between X = 200.00(ft)
and X = 250.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 500
Number of Trial Surfaces With Valid FS = 500
Statistical Data On All Valid FS Values:
FS Max = 2.009 FS Min = 1.201 FS Ave = 1.531

Standard Deviation = 0.224 Coefficient of Variation = 14.66 %

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	73.684	460.842
2	83.684	460.828
3	93.666	461.436
4	103.590	462.664
5	113.419	464.507
6	123.114	466.958
7	132.637	470.008
8	141.953	473.645
9	151.024	477.854
10	159.815	482.619
11	168.293	487.922
12	176.424	493.743
13	184.178	500.058
14	191.524	506.844
15	198.433	514.073
16	204.878	521.719
17	205.036	521.931

Circle Center At X = 78.913 ; Y = 621.378 ; and Radius = 160.621

Factor of Safety

*** 1.201 ***

Individual data on the 19 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	10.0	3008.6	0.0	0.0	0.	0.	451.3	0.0	0.0
2	10.0	8630.8	0.0	0.0	0.	0.	1294.6	0.0	0.0
3	9.9	13414.6	0.0	0.0	0.	0.	2012.2	0.0	0.0
4	9.8	17298.5	0.0	0.0	0.	0.	2594.8	0.0	0.0
5	9.7	20243.5	0.0	0.0	0.	0.	3036.5	0.0	0.0
6	4.9	11163.1	0.0	0.0	0.	0.	1674.5	0.0	0.0
7	4.6	11101.7	0.0	0.0	0.	0.	1665.3	0.0	0.0
8	9.3	23528.5	0.0	0.0	0.	0.	3529.3	0.0	0.0
9	9.1	23889.2	0.0	0.0	0.	0.	3583.4	0.0	0.0
10	8.8	23360.2	0.0	0.0	0.	0.	3504.0	0.0	0.0
11	8.5	22012.1	0.0	0.0	0.	0.	3301.8	0.0	0.0
12	0.8	1966.9	0.0	0.0	0.	0.	295.0	0.0	0.0
13	7.4	17853.8	0.0	0.0	0.	0.	2678.1	0.0	0.0
14	7.8	16852.3	0.0	0.0	0.	0.	2527.8	0.0	0.0
15	7.3	13396.5	0.0	0.0	0.	0.	2009.5	0.0	0.0
16	0.5	767.7	0.0	0.0	0.	0.	115.2	0.0	0.0
17	6.4	7917.5	0.0	0.0	0.	0.	1187.6	0.0	0.0
18	6.4	2870.5	0.0	0.0	0.	0.	430.6	0.0	0.0
19	0.2	1.9	0.0	0.0	0.	0.	0.3	0.0	0.0

Failure Surface Specified By 17 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	76.842	462.421
2	86.839	462.176
3	96.832	462.557
4	106.781	463.564
5	116.648	465.193
6	126.393	467.436
7	135.978	470.286
8	145.366	473.730
9	154.520	477.757
10	163.403	482.348
11	171.981	487.488
12	180.221	493.155
13	188.089	499.327
14	195.555	505.980
15	202.589	513.087
16	209.164	520.622

```
   17        210.828       522.789
Circle Center At X =    85.752 ; Y =    621.684 ; and Radius =    159.512
       Factor of Safety
     ***    1.203   ***
Failure Surface Specified By 18 Coordinate Points
  Point        X-Surf        Y-Surf
   No.          (ft)          (ft)
    1          75.263       461.632
    2          85.262       461.792
    3          95.240       462.460
    4         105.170       463.635
    5         115.029       465.313
    6         124.789       467.490
    7         134.426       470.160
    8         143.914       473.317
    9         153.230       476.952
   10         162.349       481.056
   11         171.248       485.618
   12         179.903       490.627
   13         188.292       496.069
   14         196.394       501.931
   15         204.188       508.197
   16         211.652       514.851
   17         218.769       521.876
   18         220.981       524.294
Circle Center At X =    77.176 ; Y =    657.946 ; and Radius =    196.324
       Factor of Safety
     ***    1.204   ***
Failure Surface Specified By 19 Coordinate Points
  Point        X-Surf        Y-Surf
   No.          (ft)          (ft)
    1          73.684       460.842
    2          83.681       461.086
    3          93.657       461.781
    4         103.591       462.926
    5         113.464       464.517
    6         123.255       466.552
    7         132.944       469.027
    8         142.511       471.936
    9         151.937       475.275
   10         161.204       479.034
   11         170.291       483.208
   12         179.180       487.788
   13         187.854       492.765
   14         196.295       498.127
   15         204.485       503.865
   16         212.408       509.966
   17         220.048       516.419
   18         227.388       523.210
   19         229.740       525.591
Circle Center At X =    73.271 ; Y =    682.446 ; and Radius =    221.604
       Factor of Safety
     ***    1.209   ***
Failure Surface Specified By 18 Coordinate Points
  Point        X-Surf        Y-Surf
   No.          (ft)          (ft)
    1          70.526       460.000
    2          80.401       458.425
    3          90.364       457.562
    4         100.363       457.415
    5         110.347       457.986
    6         120.264       459.271
    7         130.063       461.264
    8         139.695       463.954
    9         149.108       467.328
   10         158.256       471.368
   11         167.090       476.054
```

```
     12         175.566       481.361
     13         183.639       487.262
     14         191.268       493.727
     15         198.414       500.722
     16         205.041       508.212
     17         211.113       516.157
     18         215.965       523.550
Circle Center At X =     97.414 ; Y =    596.663 ; and Radius =    139.283
       Factor of Safety
      ***     1.214    ***
Failure Surface Specified By 18 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1          73.684       460.842
    2          83.657       461.575
    3          93.591       462.729
    4         103.466       464.302
    5         113.266       466.291
    6         122.974       468.692
    7         132.571       471.501
    8         142.041       474.714
    9         151.367       478.323
   10         160.532       482.324
   11         169.519       486.708
   12         178.313       491.469
   13         186.899       496.597
   14         195.259       502.083
   15         203.381       507.917
   16         211.248       514.090
   17         218.848       520.590
   18         223.175       524.618
Circle Center At X =     61.422 ; Y =    696.673 ; and Radius =    236.149
       Factor of Safety
      ***     1.214    ***
Failure Surface Specified By 18 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1          62.632       460.000
    2          72.495       458.353
    3          82.452       457.421
    4          92.449       457.211
    5         102.436       457.722
    6         112.360       458.953
    7         122.170       460.897
    8         131.813       463.543
    9         141.241       466.878
   10         150.403       470.885
   11         159.252       475.542
   12         167.742       480.826
   13         175.829       486.708
   14         183.470       493.159
   15         190.626       500.144
   16         197.260       507.627
   17         203.336       515.569
   18         207.778       522.338
Circle Center At X =     90.377 ; Y =    595.545 ; and Radius =    138.356
       Factor of Safety
      ***     1.217    ***
Failure Surface Specified By 17 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1          70.526       460.000
    2          80.416       458.516
    3          90.393       457.838
    4         100.392       457.971
    5         110.347       458.912
    6         120.194       460.657
```

7	129.867	463.194
8	139.303	466.506
9	148.439	470.571
10	157.216	475.362
11	165.577	480.849
12	173.465	486.995
13	180.830	493.759
14	187.623	501.098
15	193.799	508.963
16	199.318	517.302
17	201.587	521.420

Circle Center At X = 93.761 ; Y = 581.165 ; and Radius = 123.373

Factor of Safety

*** 1.217 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	72.105	460.053
2	82.072	459.233
3	92.067	458.940
4	102.065	459.174
5	112.036	459.936
6	121.953	461.222
7	131.788	463.029
8	141.514	465.353
9	151.104	468.186
10	160.532	471.521
11	169.770	475.348
12	178.794	479.658
13	187.578	484.437
14	196.098	489.673
15	204.330	495.350
16	212.251	501.455
17	219.839	507.968
18	227.073	514.872
19	233.932	522.148
20	237.872	526.796

Circle Center At X = 92.657 ; Y = 648.236 ; and Radius = 189.302

Factor of Safety

*** 1.218 ***

Failure Surface Specified By 20 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	56.316	460.000
2	66.242	458.786
3	76.221	458.145
4	86.221	458.079
5	96.208	458.588
6	106.149	459.671
7	116.012	461.323
8	125.763	463.540
9	135.371	466.314
10	144.803	469.636
11	154.028	473.495
12	163.016	477.878
13	171.738	482.771
14	180.163	488.157
15	188.265	494.019
16	196.016	500.337
17	203.392	507.090
18	210.366	514.256
19	216.917	521.812
20	218.553	523.934

Circle Center At X = 82.392 ; Y = 631.642 ; and Radius = 173.611

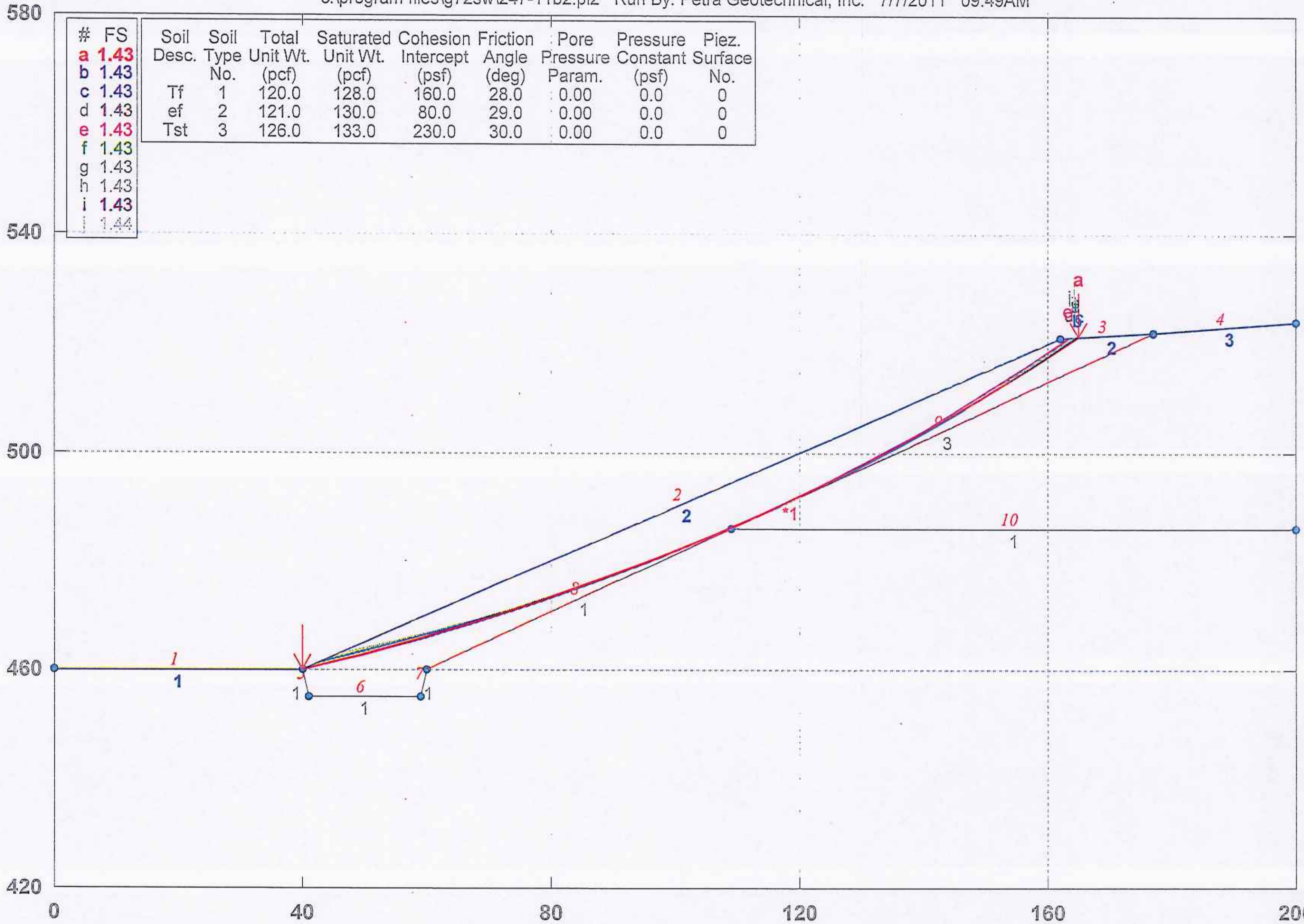
Factor of Safety

*** 1.218 ***

**** END OF GSTABL7 OUTPUT ****

Section B-B' - Stabilization Fill Slope - Failure Through 90% Fill - Static

c:\program files\g72sw\247-11b2.pl2 Run By: Petra Geotechnical, Inc. 7/7/2011 09:49AM



#	FS
a	1.43
b	1.43
c	1.43
d	1.43
e	1.43
f	1.43
g	1.43
h	1.43
i	1.43
j	1.44

Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Tf	1	120.0	128.0	160.0	28.0	0.00	0.0	0
ef	2	121.0	130.0	80.0	29.0	0.00	0.0	0
Tst	3	126.0	133.0	230.0	30.0	0.00	0.0	0

GSTABL7 v.2 FSmin=1.43

Safety Factors Are Calculated By The Modified Bishop Method

```
                    ***  GSTABL7  ***
           ** GSTABL7 by Garry H. Gregory, P.E. **
 ** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
          (All Rights Reserved-Unauthorized Use Prohibited)
*********************************************************************************
               SLOPE STABILITY ANALYSIS SYSTEM
      Modified Bishop, Simplified Janbu, or GLE Method of Slices.
      (Includes Spencer & Morgenstern-Price Type Analysis)
      Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
      Nonlinear Undrained Shear Strength, Curved Phi Envelope,
      Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
      Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*********************************************************************************
Analysis Run Date:        7/7/2011
Time of Run:              09:49AM
Run By:                   Petra Geotechnical, Inc.
Input Data Filename:      c:\program files\g72sw\247-11b2.in
Output Filename:          c:\program files\g72sw\247-11b2.OUT
Unit System:              English
Plotted Output Filename:  c:\program files\g72sw\247-11b2.PLT
PROBLEM DESCRIPTION:  Section B-B' - Stabilization Fill Slope
                      - Failure Through 90% Fill  - Static
BOUNDARY COORDINATES
    4 Top   Boundaries
   10 Total Boundaries
Boundary      X-Left      Y-Left     X-Right     Y-Right     Soil Type
   No.         (ft)        (ft)        (ft)        (ft)      Below Bnd
    1          0.00      460.00       40.00      460.00          1
    2         40.00      460.00      162.00      521.00          2
    3        162.00      521.00      177.00      522.00          2
    4        177.00      522.00      200.00      524.00          3
    5         40.00      460.00       41.00      455.00          1
    6         41.00      455.00       59.00      455.00          1
    7         59.00      455.00       60.00      460.00          1
    8         60.00      460.00      109.00      486.00          1
    9        109.00      486.00      177.00      522.00          3
   10        109.00      486.00      200.00      486.00          1
User Specified Y-Origin =       420.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
  3 Type(s) of Soil
Soil  Total  Saturated  Cohesion Friction   Pore   Pressure   Piez.
Type Unit Wt. Unit Wt. Intercept  Angle   Pressure Constant Surface
 No.  (pcf)    (pcf)     (psf)    (deg)    Param.    (psf)     No.
  1   120.0    128.0     160.0    28.0     0.00       0.0      0
  2   121.0    130.0      80.0    29.0     0.00       0.0      0
  3   126.0    133.0     230.0    30.0     0.00       0.0      0
Searching Routine Will Be Limited To An Area Defined By  1 Boundaries
 Of Which The First  1 Boundaries Will Deflect Surfaces Upward
Boundary      X-Left      Y-Left     X-Right     Y-Right
   No.         (ft)        (ft)        (ft)        (ft)
    1         60.00      460.00      177.00      522.00
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
 500 Trial Surfaces Have Been Generated.
  25 Surface(s) Initiate(s) From Each Of    20 Points Equally Spaced
Along The Ground Surface Between  X =  40.00(ft)
                             and  X =  60.00(ft)
Each Surface Terminates Between   X = 162.00(ft)
                            and   X = 177.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is  Y =      0.00(ft)
10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
      Failure Surfaces Evaluated. They Are
      Ordered - Most Critical First.
```

* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 500
Number of Trial Surfaces With Valid FS = 500
Statistical Data On All Valid FS Values:
FS Max = 1.769 FS Min = 1.431 FS Ave = 1.498
Standard Deviation = 0.063 Coefficient of Variation = 4.21 %
Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	40.000	460.000
2	49.628	462.701
3	59.178	465.669
4	68.640	468.903
5	78.009	472.400
6	87.276	476.157
7	96.435	480.171
8	105.478	484.440
9	114.399	488.960
10	123.190	493.726
11	131.844	498.737
12	140.355	503.987
13	148.716	509.472
14	156.921	515.189
15	164.962	521.133
16	165.052	521.203

Circle Center At X = -51.873 ; Y = 806.074 ; and Radius = 358.062
Factor of Safety
*** 1.431 ***
Individual data on the 16 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.6	1231.2	0.0	0.0	0.	0.	0.0	0.0	0.0
2	9.5	3485.6	0.0	0.0	0.	0.	0.0	0.0	0.0
3	9.5	5345.3	0.0	0.0	0.	0.	0.0	0.0	0.0
4	9.4	6813.9	0.0	0.0	0.	0.	0.0	0.0	0.0
5	9.3	7897.5	0.0	0.0	0.	0.	0.0	0.0	0.0
6	9.2	8603.8	0.0	0.0	0.	0.	0.0	0.0	0.0
7	9.0	8942.7	0.0	0.0	0.	0.	0.0	0.0	0.0
8	8.9	8925.9	0.0	0.0	0.	0.	0.0	0.0	0.0
9	8.8	8567.2	0.0	0.0	0.	0.	0.0	0.0	0.0
10	8.7	7882.0	0.0	0.0	0.	0.	0.0	0.0	0.0
11	8.5	6887.6	0.0	0.0	0.	0.	0.0	0.0	0.0
12	8.4	5603.0	0.0	0.0	0.	0.	0.0	0.0	0.0
13	8.2	4048.9	0.0	0.0	0.	0.	0.0	0.0	0.0
14	5.1	1637.2	0.0	0.0	0.	0.	0.0	0.0	0.0
15	3.0	380.1	0.0	0.0	0.	0.	0.0	0.0	0.0
16	0.1	0.4	0.0	0.0	0.	0.	0.0	0.0	0.0

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	43.158	461.579
2	52.806	464.207
3	62.372	467.124
4	71.845	470.327
5	81.217	473.814
6	90.480	477.581
7	99.626	481.625
8	108.646	485.943
9	117.532	490.529
10	126.276	495.381
11	134.870	500.494
12	143.307	505.863
13	151.578	511.483
14	159.677	517.349
15	164.637	521.176

Circle Center At X = -39.367 ; Y = 783.598 ; and Radius = 332.425
Factor of Safety
*** 1.432 ***
Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	43.158	461.579
2	52.801	464.225
3	62.363	467.155
4	71.833	470.366
5	81.204	473.855
6	90.469	477.621
7	99.617	481.658
8	108.643	485.964
9	117.537	490.535
10	126.292	495.366
11	134.901	500.455
12	143.355	505.795
13	151.648	511.384
14	159.772	517.214
15	164.992	521.199

Circle Center At X = -41.520 ; Y = 789.102 ; and Radius = 338.292
Factor of Safety
*** 1.432 ***
Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	42.105	461.053
2	51.763	463.646
3	61.336	466.538
4	70.814	469.725
5	80.189	473.206
6	89.451	476.976
7	98.591	481.032
8	107.601	485.370
9	116.472	489.986
10	125.196	494.875
11	133.763	500.033
12	142.166	505.455
13	150.396	511.134
14	158.446	517.067
15	163.584	521.106

Circle Center At X = -36.525 ; Y = 773.193 ; and Radius = 321.892
Factor of Safety
*** 1.432 ***
Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	40.000	460.000
2	49.651	462.620
3	59.217	465.532
4	68.692	468.732
5	78.064	472.217
6	87.327	475.985
7	96.472	480.032
8	105.490	484.353
9	114.373	488.946
10	123.113	493.806
11	131.701	498.928
12	140.130	504.309
13	148.393	509.942
14	156.481	515.822
15	163.277	521.085

Circle Center At X = -41.666 ; Y = 779.846 ; and Radius = 330.107
Factor of Safety
*** 1.433 ***
Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	44.211	462.105
2	53.862	464.722
3	63.429	467.634
4	72.902	470.836
5	82.273	474.327
6	91.532	478.104
7	100.672	482.162
8	109.683	486.498
9	118.557	491.107
10	127.286	495.986
11	135.862	501.130
12	144.276	506.534
13	152.521	512.193
14	160.589	518.102
15	164.517	521.168

Circle Center At X = -36.449 ; Y = 778.674 ; and Radius = 326.683

Factor of Safety

*** 1.433 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	40.000	460.000
2	49.630	462.696
3	59.179	465.664
4	68.641	468.900
5	78.008	472.402
6	87.272	476.168
7	96.425	480.194
8	105.462	484.477
9	114.373	489.014
10	123.153	493.801
11	131.794	498.833
12	140.290	504.109
13	148.633	509.622
14	156.817	515.369
15	164.606	521.174

Circle Center At X = -50.576 ; Y = 802.013 ; and Radius = 353.803

Factor of Safety

*** 1.433 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	42.105	461.053
2	51.753	463.684
3	61.316	466.606
4	70.787	469.816
5	80.157	473.311
6	89.416	477.087
7	98.557	481.142
8	107.572	485.470
9	116.451	490.070
10	125.188	494.935
11	133.773	500.063
12	142.200	505.447
13	150.460	511.084
14	158.546	516.968
15	163.913	521.128

Circle Center At X = -40.122 ; Y = 781.483 ; and Radius = 330.812

Factor of Safety

*** 1.434 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	40.000	460.000
2	49.646	462.638

3	59.208	465.564
4	68.679	468.774
5	78.049	472.267
6	87.311	476.039
7	96.455	480.086
8	105.474	484.405
9	114.360	488.993
10	123.104	493.844
11	131.699	498.955
12	140.138	504.321
13	148.412	509.937
14	156.514	515.799
15	163.388	521.093

Circle Center At X = -43.265 ; Y = 783.411 ; and Radius = 333.957

Factor of Safety

*** 1.434 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	45.263	462.632
2	54.921	465.227
3	64.492	468.124
4	73.967	471.321
5	83.337	474.814
6	92.593	478.599
7	101.725	482.674
8	110.725	487.034
9	119.583	491.674
10	128.291	496.590
11	136.840	501.778
12	145.222	507.232
13	153.428	512.946
14	161.451	518.916
15	164.266	521.151

Circle Center At X = -32.464 ; Y = 771.150 ; and Radius = 318.159

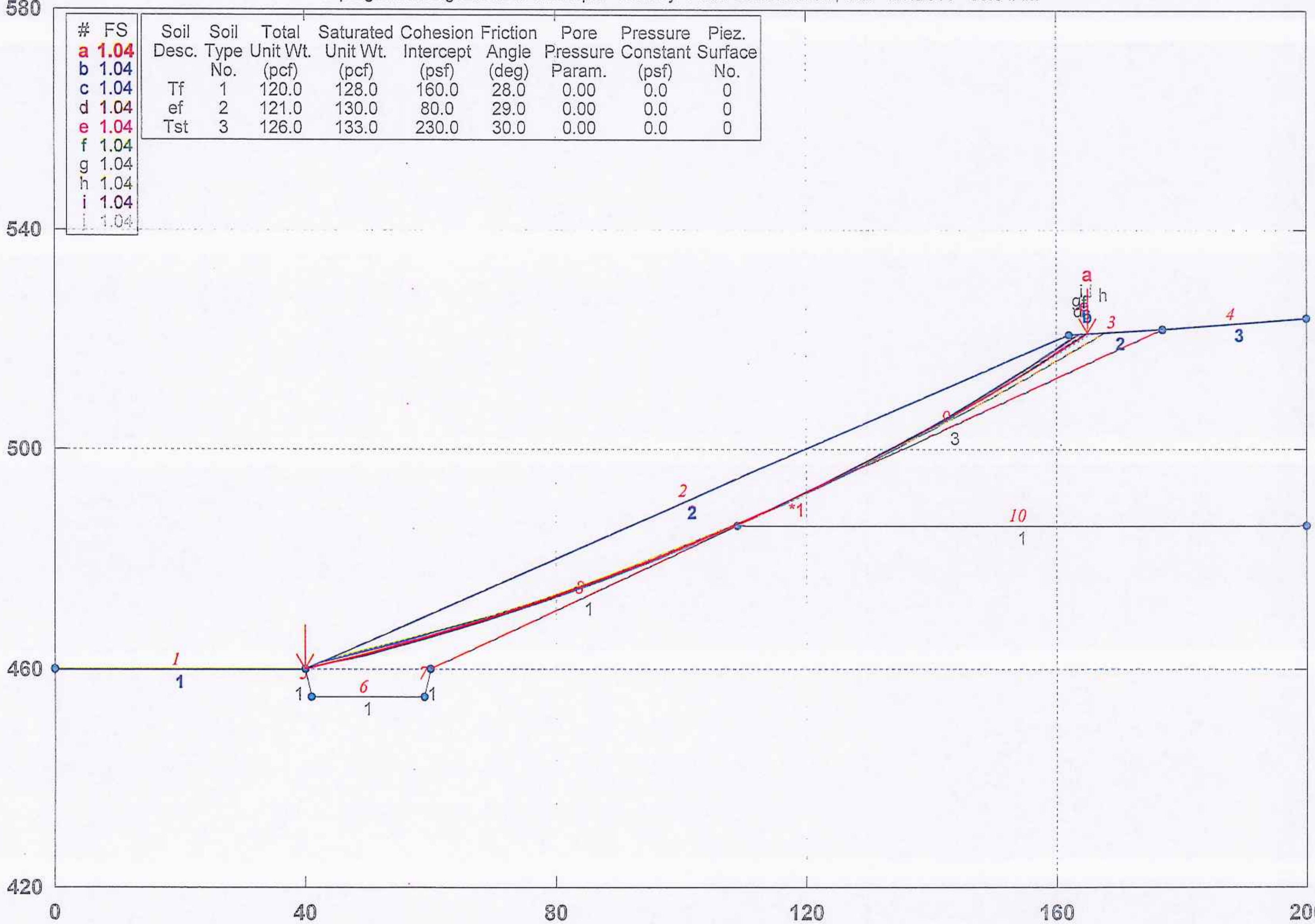
Factor of Safety

*** 1.435 ***

**** END OF GSTABL7 OUTPUT ****

Section B-B' - Stabilization Fill Slope - Failure Through 90% Fill - Seismic

c:\program files\g72sw\24711b2s.pl2 Run By: Petra Geotechnical, Inc. 7/7/2011 09:54AM



GSTABL7 v.2 FSmin=1.04

Safety Factors Are Calculated By The Modified Bishop Method

*** GSTABL7 ***
** GSTABL7 by Garry H. Gregory, P.E. **
** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **

****
SLOPE STABILITY ANALYSIS SYSTEM
Modified Bishop, Simplified Janbu, or GLE Method of Slices.
(Includes Spencer & Morgenstern-Price Type Analysis)
Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
Nonlinear Undrained Shear Strength, Curved Phi Envelope,
Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
****

Analysis Run Date: 7/7/2011
Time of Run: 09:54AM
Run By: Petra Geotechnical, Inc.
Input Data Filename: c:\program files\g72sw\24711b2s.in
Output Filename: c:\program files\g72sw\24711b2s.OUT
Unit System: English
Plotted Output Filename: c:\program files\g72sw\24711b2s.PLT
PROBLEM DESCRIPTION: Section B-B' - Stabilization Fill Slope
- Failure Through 90% Fill - Seismic

BOUNDARY COORDINATES
4 Top Boundaries
10 Total Boundaries

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)	Soil Type Below Bnd
1	0.00	460.00	40.00	460.00	1
2	40.00	460.00	162.00	521.00	2
3	162.00	521.00	177.00	522.00	2
4	177.00	522.00	200.00	524.00	3
5	40.00	460.00	41.00	455.00	1
6	41.00	455.00	59.00	455.00	1
7	59.00	455.00	60.00	460.00	1
8	60.00	460.00	109.00	486.00	1
9	109.00	486.00	177.00	522.00	3
10	109.00	486.00	200.00	486.00	1

User Specified Y-Origin = 420.00(ft)
Default X-Plus Value = 0.00(ft)
Default Y-Plus Value = 0.00(ft)

ISOTROPIC SOIL PARAMETERS
3 Type(s) of Soil

Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
1	120.0	128.0	160.0	28.0	0.00	0.0	0
2	121.0	130.0	80.0	29.0	0.00	0.0	0
3	126.0	133.0	230.0	30.0	0.00	0.0	0

Searching Routine Will Be Limited To An Area Defined By 1 Boundaries
Of Which The First 1 Boundaries Will Deflect Surfaces Upward

Boundary No.	X-Left (ft)	Y-Left (ft)	X-Right (ft)	Y-Right (ft)
1	60.00	460.00	177.00	522.00

Specified Peak Ground Acceleration Coefficient (A) = 0.400(g)
Specified Horizontal Earthquake Coefficient (kh) = 0.150(g)
Specified Vertical Earthquake Coefficient (kv) = 0.000(g)
Specified Seismic Pore-Pressure Factor = 0.000
A Critical Failure Surface Searching Method, Using A Random
Technique For Generating Circular Surfaces, Has Been Specified.
500 Trial Surfaces Have Been Generated.
25 Surface(s) Initiate(s) From Each Of 20 Points Equally Spaced
Along The Ground Surface Between X = 40.00(ft)
and X = 60.00(ft)
Each Surface Terminates Between X = 162.00(ft)
and X = 177.00(ft)
Unless Further Limitations Were Imposed, The Minimum Elevation
At Which A Surface Extends Is Y = 0.00(ft)

10.00(ft) Line Segments Define Each Trial Failure Surface.
Following Are Displayed The Ten Most Critical Of The Trial
Failure Surfaces Evaluated. They Are
Ordered - Most Critical First.
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted = 500
Number of Trial Surfaces With Valid FS = 500
Statistical Data On All Valid FS Values:
FS Max = 1.298 FS Min = 1.037 FS Ave = 1.086
Standard Deviation = 0.046 Coefficient of Variation = 4.21 %
Failure Surface Specified By 16 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	40.000	460.000
2	49.628	462.701
3	59.178	465.669
4	68.640	468.903
5	78.009	472.400
6	87.276	476.157
7	96.435	480.171
8	105.478	484.440
9	114.399	488.960
10	123.190	493.726
11	131.844	498.737
12	140.355	503.987
13	148.716	509.472
14	156.921	515.189
15	164.962	521.133
16	165.052	521.203

Circle Center At X = -51.873 ; Y = 806.074 ; and Radius = 358.062
Factor of Safety
*** 1.037 ***
Individual data on the 16 slices

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.6	1231.2	0.0	0.0	0.	0.	184.7	0.0	0.0
2	9.5	3485.6	0.0	0.0	0.	0.	522.8	0.0	0.0
3	9.5	5345.3	0.0	0.0	0.	0.	801.8	0.0	0.0
4	9.4	6813.9	0.0	0.0	0.	0.	1022.1	0.0	0.0
5	9.3	7897.5	0.0	0.0	0.	0.	1184.6	0.0	0.0
6	9.2	8603.8	0.0	0.0	0.	0.	1290.6	0.0	0.0
7	9.0	8942.7	0.0	0.0	0.	0.	1341.4	0.0	0.0
8	8.9	8925.9	0.0	0.0	0.	0.	1338.9	0.0	0.0
9	8.8	8567.2	0.0	0.0	0.	0.	1285.1	0.0	0.0
10	8.7	7882.0	0.0	0.0	0.	0.	1182.3	0.0	0.0
11	8.5	6887.6	0.0	0.0	0.	0.	1033.1	0.0	0.0
12	8.4	5603.0	0.0	0.0	0.	0.	840.5	0.0	0.0
13	8.2	4048.9	0.0	0.0	0.	0.	607.3	0.0	0.0
14	5.1	1637.2	0.0	0.0	0.	0.	245.6	0.0	0.0
15	3.0	380.1	0.0	0.0	0.	0.	57.0	0.0	0.0
16	0.1	0.4	0.0	0.0	0.	0.	0.1	0.0	0.0

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	43.158	461.579
2	52.801	464.225
3	62.363	467.155
4	71.833	470.366
5	81.204	473.855
6	90.469	477.621
7	99.617	481.658
8	108.643	485.964
9	117.537	490.535
10	126.292	495.366
11	134.901	500.455

```
Circle Center At X =    -50.576 ; Y =    802.013 ; and Radius =    353.803
       Factor of Safety
      ***    1.039    ***
Failure Surface Specified By 15 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1         44.211      462.105
    2         53.862      464.722
    3         63.429      467.634
    4         72.902      470.836
    5         82.273      474.327
    6         91.532      478.104
    7        100.672      482.162
    8        109.683      486.498
    9        118.557      491.107
   10        127.286      495.986
   11        135.862      501.130
   12        144.276      506.534
   13        152.521      512.193
   14        160.589      518.102
   15        164.517      521.168
Circle Center At X =    -36.449 ; Y =    778.674 ; and Radius =    326.683
       Factor of Safety
      ***    1.039    ***
Failure Surface Specified By 15 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1         40.000      460.000
    2         49.651      462.620
    3         59.217      465.532
    4         68.692      468.732
    5         78.064      472.217
    6         87.327      475.985
    7         96.472      480.032
    8        105.490      484.353
    9        114.373      488.946
   10        123.113      493.806
   11        131.701      498.928
   12        140.130      504.309
   13        148.393      509.942
   14        156.481      515.822
   15        163.277      521.085
Circle Center At X =    -41.666 ; Y =    779.846 ; and Radius =    330.107
       Factor of Safety
      ***    1.039    ***
Failure Surface Specified By 16 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1         40.000      460.000
    2         49.591      462.831
    3         59.110      465.895
    4         68.551      469.190
    5         77.909      472.715
    6         87.179      476.468
    7         96.353      480.446
    8        105.428      484.647
    9        114.398      489.069
   10        123.256      493.708
   11        131.999      498.562
   12        140.621      503.628
   13        149.116      508.904
   14        157.480      514.385
   15        165.707      520.069
   16        167.489      521.366
Circle Center At X =    -70.819 ; Y =    853.343 ; and Radius =    408.656
       Factor of Safety
      ***    1.040    ***
```

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	42.105	461.053
2	51.753	463.684
3	61.316	466.606
4	70.787	469.816
5	80.157	473.311
6	89.416	477.087
7	98.557	481.142
8	107.572	485.470
9	116.451	490.070
10	125.188	494.935
11	133.773	500.063
12	142.200	505.447
13	150.460	511.084
14	158.546	516.968
15	163.913	521.128

Circle Center At X = -40.122 ; Y = 781.483 ; and Radius = 330.812

Factor of Safety

*** 1.040 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	41.053	460.526
2	50.670	463.266
3	60.209	466.267
4	69.663	469.525
5	79.025	473.040
6	88.288	476.808
7	97.445	480.827
8	106.489	485.093
9	115.414	489.604
10	124.213	494.356
11	132.880	499.345
12	141.407	504.568
13	149.789	510.022
14	158.020	515.701
15	165.598	521.240

Circle Center At X = -54.844 ; Y = 815.392 ; and Radius = 367.595

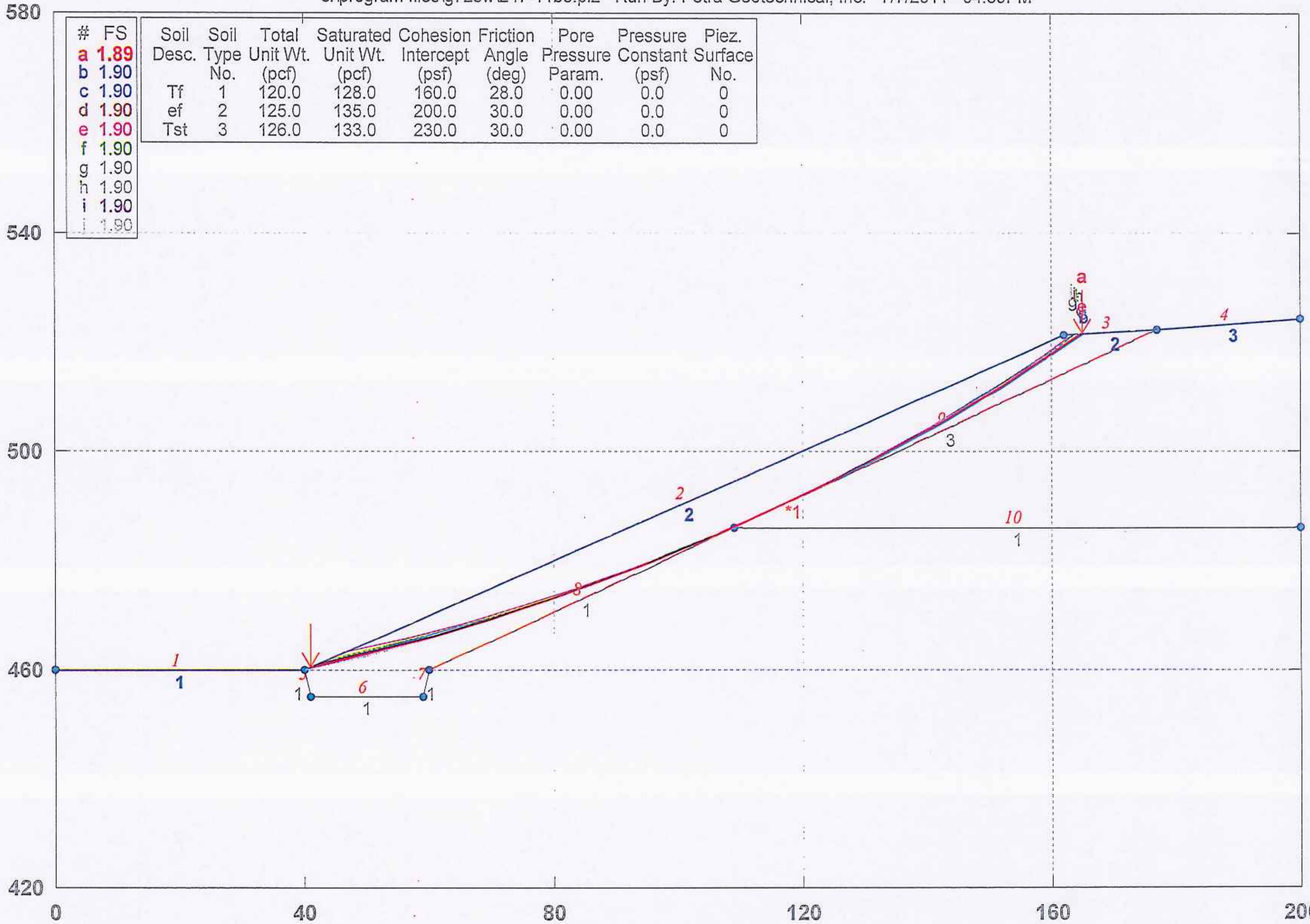
Factor of Safety

*** 1.040 ***

**** END OF GSTABL7 OUTPUT ****

Section B-B' - Stabilization Fill Slope Increase Fill Cohesion to 200 - Static

c:\program files\g72sw\247-11b3.pl2 Run By: Petra Geotechnical, Inc. 7/7/2011 04:39PM



GSTABL7 v.2 FSmin=1.89

Safety Factors Are Calculated By The Modified Bishop Method

```
                         ***  GSTABL7  ***
                ** GSTABL7 by Garry H. Gregory, P.E. **
    ** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
             (All Rights Reserved-Unauthorized Use Prohibited)
*********************************************************************************
                      SLOPE STABILITY ANALYSIS SYSTEM
       Modified Bishop, Simplified Janbu, or GLE Method of Slices.
       (Includes Spencer & Morgenstern-Price Type Analysis)
       Including Pier/Pile, Reinforcement, Soil Nail, Tieback,
       Nonlinear Undrained Shear Strength, Curved Phi Envelope,
       Anisotropic Soil, Fiber-Reinforced Soil, Boundary Loads, Water
       Surfaces, Pseudo-Static & Newmark Earthquake, and Applied Forces.
*********************************************************************************
 Analysis Run Date:          7/7/2011
 Time of Run:                04:39PM
 Run By:                     Petra Geotechnical, Inc.
 Input Data Filename:        c:\program files\g72sw\247-11b3.in
 Output Filename:            c:\program files\g72sw\247-11b3.OUT
 Unit System:                English
 Plotted Output Filename:    c:\program files\g72sw\247-11b3.PLT
 PROBLEM DESCRIPTION:  Section B-B' - Stabilization Fill Slope
                        Increase Fill Cohesion to 200 -  Static
 BOUNDARY COORDINATES
     4 Top   Boundaries
    10 Total Boundaries
 Boundary     X-Left      Y-Left     X-Right     Y-Right     Soil Type
    No.        (ft)        (ft)        (ft)        (ft)      Below Bnd
     1         0.00      460.00       40.00      460.00          1
     2        40.00      460.00      162.00      521.00          2
     3       162.00      521.00      177.00      522.00          2
     4       177.00      522.00      200.00      524.00          3
     5        40.00      460.00       41.00      455.00          1
     6        41.00      455.00       59.00      455.00          1
     7        59.00      455.00       60.00      460.00          1
     8        60.00      460.00      109.00      486.00          1
     9       109.00      486.00      177.00      522.00          3
    10       109.00      486.00      200.00      486.00          1
 User Specified Y-Origin =        420.00(ft)
 Default X-Plus Value = 0.00(ft)
 Default Y-Plus Value = 0.00(ft)
ISOTROPIC SOIL PARAMETERS
  3 Type(s) of Soil
 Soil  Total  Saturated  Cohesion Friction   Pore    Pressure   Piez.
 Type Unit Wt. Unit Wt. Intercept   Angle  Pressure Constant Surface
  No.  (pcf)    (pcf)     (psf)     (deg)   Param.    (psf)     No.
   1   120.0    128.0     160.0     28.0    0.00       0.0       0
   2   125.0    135.0     200.0     30.0    0.00       0.0       0
   3   126.0    133.0     230.0     30.0    0.00       0.0       0
Searching Routine Will Be Limited To An Area Defined By  1 Boundaries
 Of Which The First  1 Boundaries Will Deflect Surfaces Upward
 Boundary     X-Left      Y-Left     X-Right     Y-Right
    No.        (ft)        (ft)        (ft)        (ft)
     1        60.00      460.00      177.00      522.00
 A Critical Failure Surface Searching Method, Using A Random
 Technique For Generating Circular Surfaces, Has Been Specified.
  500 Trial Surfaces Have Been Generated.
   25 Surface(s) Initiate(s) From Each Of     20 Points Equally Spaced
 Along The Ground Surface Between  X =  40.00(ft)
                                and  X =  60.00(ft)
 Each Surface Terminates Between    X = 162.00(ft)
                              and    X = 177.00(ft)
 Unless Further Limitations Were Imposed, The Minimum Elevation
 At Which A Surface Extends Is  Y =       0.00(ft)
 10.00(ft) Line Segments Define Each Trial Failure Surface.
 Following Are Displayed The Ten Most Critical Of The Trial
       Failure Surfaces Evaluated. They Are
       Ordered - Most Critical First.
```

```
* * Safety Factors Are Calculated By The Modified Bishop Method * *
Total Number of Trial Surfaces Attempted =   500
Number of Trial Surfaces With Valid FS =  500
Statistical Data On All Valid FS Values:
   FS Max =   2.744   FS Min =   1.892   FS Ave =   2.046
   Standard Deviation =    0.148   Coefficient of Variation =    7.26 %
Failure Surface Specified By 15 Coordinate Points
```

Point No.	X-Surf (ft)	Y-Surf (ft)
1	41.053	460.526
2	50.693	463.184
3	60.253	466.119
4	69.723	469.329
5	79.097	472.813
6	88.366	476.566
7	97.522	480.586
8	106.559	484.869
9	115.467	489.412
10	124.241	494.211
11	132.871	499.261
12	141.352	504.560
13	149.676	510.101
14	157.837	515.882
15	164.892	521.193

```
Circle Center At X =   -45.923 ; Y =   794.888 ; and Radius =   345.489
       Factor of Safety
      ***   1.892   ***
     Individual data on the    17  slices
```

Slice No.	Width (ft)	Weight (lbs)	Water Force Top (lbs)	Water Force Bot (lbs)	Tie Force Norm (lbs)	Tie Force Tan (lbs)	Earthquake Force Hor (lbs)	Earthquake Force Ver (lbs)	Surcharge Load (lbs)
1	9.6	1303.3	0.0	0.0	0.	0.	0.0	0.0	0.0
2	9.6	3686.8	0.0	0.0	0.	0.	0.0	0.0	0.0
3	9.5	5646.8	0.0	0.0	0.	0.	0.0	0.0	0.0
4	9.4	7187.4	0.0	0.0	0.	0.	0.0	0.0	0.0
5	9.3	8314.8	0.0	0.0	0.	0.	0.0	0.0	0.0
6	9.2	9037.8	0.0	0.0	0.	0.	0.0	0.0	0.0
7	9.0	9367.2	0.0	0.0	0.	0.	0.0	0.0	0.0
8	8.3	8672.5	0.0	0.0	0.	0.	0.0	0.0	0.0
9	0.6	643.7	0.0	0.0	0.	0.	0.0	0.0	0.0
10	0.7	711.5	0.0	0.0	0.	0.	0.0	0.0	0.0
11	8.1	8188.8	0.0	0.0	0.	0.	0.0	0.0	0.0
12	8.6	8136.6	0.0	0.0	0.	0.	0.0	0.0	0.0
13	8.5	7044.9	0.0	0.0	0.	0.	0.0	0.0	0.0
14	8.3	5646.4	0.0	0.0	0.	0.	0.0	0.0	0.0
15	8.2	3964.6	0.0	0.0	0.	0.	0.0	0.0	0.0
16	4.2	1306.6	0.0	0.0	0.	0.	0.0	0.0	0.0
17	2.9	358.8	0.0	0.0	0.	0.	0.0	0.0	0.0

```
Failure Surface Specified By 15 Coordinate Points
```

Point No.	X-Surf (ft)	Y-Surf (ft)
1	43.158	461.579
2	52.801	464.225
3	62.363	467.154
4	71.834	470.364
5	81.206	473.851
6	90.472	477.613
7	99.622	481.645
8	108.650	485.946
9	117.548	490.511
10	126.307	495.335
11	134.920	500.416
12	143.380	505.748
13	151.679	511.327
14	159.810	517.148
15	165.144	521.210

```
Circle Center At X =    -41.847 ; Y =    790.247 ; and Radius =    339.482
         Factor of Safety
        ***    1.895   ***
Failure Surface Specified By 15 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1         43.158       461.579
    2         52.801       464.225
    3         62.363       467.155
    4         71.833       470.366
    5         81.204       473.855
    6         90.469       477.621
    7         99.617       481.658
    8        108.643       485.964
    9        117.537       490.535
   10        126.292       495.366
   11        134.901       500.455
   12        143.355       505.795
   13        151.648       511.384
   14        159.772       517.214
   15        164.992       521.199
Circle Center At X =    -41.520 ; Y =    789.102 ; and Radius =    338.292
         Factor of Safety
        ***    1.896   ***
Failure Surface Specified By 15 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1         43.158       461.579
    2         52.806       464.207
    3         62.372       467.124
    4         71.845       470.327
    5         81.217       473.814
    6         90.480       477.581
    7         99.626       481.625
    8        108.646       485.943
    9        117.532       490.529
   10        126.276       495.381
   11        134.870       500.494
   12        143.307       505.863
   13        151.578       511.483
   14        159.677       517.349
   15        164.637       521.176
Circle Center At X =    -39.367 ; Y =    783.598 ; and Radius =    332.425
         Factor of Safety
        ***    1.896   ***
Failure Surface Specified By 16 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
    1         40.000       460.000
    2         49.628       462.701
    3         59.178       465.669
    4         68.640       468.903
    5         78.009       472.400
    6         87.276       476.157
    7         96.435       480.171
    8        105.478       484.440
    9        114.399       488.960
   10        123.190       493.726
   11        131.844       498.737
   12        140.355       503.987
   13        148.716       509.472
   14        156.921       515.189
   15        164.962       521.133
   16        165.052       521.203
Circle Center At X =    -51.873 ; Y =    806.074 ; and Radius =    358.062
         Factor of Safety
        ***    1.897   ***
```

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	43.158	461.579
2	52.817	464.168
3	62.391	467.057
4	71.870	470.241
5	81.246	473.719
6	90.509	477.487
7	99.650	481.540
8	108.662	485.876
9	117.534	490.490
10	126.258	495.377
11	134.826	500.534
12	143.230	505.954
13	151.461	511.632
14	159.512	517.564
15	164.058	521.137

Circle Center At X = -35.291 ; Y = 773.521 ; and Radius = 321.655

Factor of Safety

*** 1.898 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	42.105	461.053
2	51.763	463.646
3	61.336	466.538
4	70.814	469.725
5	80.189	473.206
6	89.451	476.976
7	98.591	481.032
8	107.601	485.370
9	116.472	489.986
10	125.196	494.875
11	133.763	500.033
12	142.166	505.455
13	150.396	511.134
14	158.446	517.067
15	163.584	521.106

Circle Center At X = -36.525 ; Y = 773.193 ; and Radius = 321.892

Factor of Safety

*** 1.898 ***

Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	44.211	462.105
2	53.862	464.722
3	63.429	467.634
4	72.902	470.836
5	82.273	474.327
6	91.532	478.104
7	100.672	482.162
8	109.683	486.498
9	118.557	491.107
10	127.286	495.986
11	135.862	501.130
12	144.276	506.534
13	152.521	512.193
14	160.589	518.102
15	164.517	521.168

Circle Center At X = -36.449 ; Y = 778.674 ; and Radius = 326.683

Factor of Safety

*** 1.900 ***

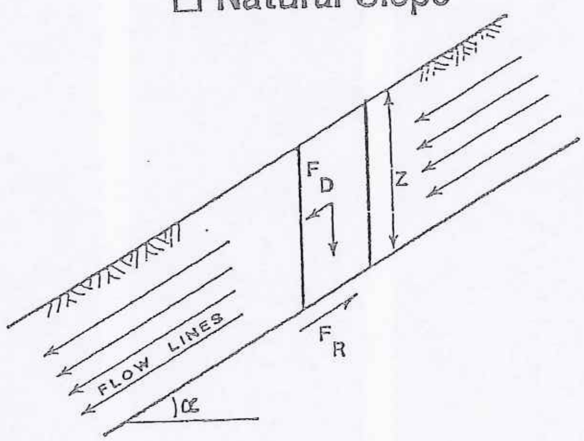
Failure Surface Specified By 15 Coordinate Points

Point No.	X-Surf (ft)	Y-Surf (ft)
1	46.316	463.158

```
   2         55.990       465.690
   3         65.575       468.542
   4         75.060       471.710
   5         84.434       475.192
   6         93.687       478.982
   7        102.810       483.079
   8        111.792       487.475
   9        120.622       492.168
  10        129.292       497.151
  11        137.792       502.420
  12        146.112       507.967
  13        154.243       513.788
  14        162.177       519.876
  15        163.681       521.112
Circle Center At X =    -25.077 ; Y =    755.692 ; and Radius =    301.120
       Factor of Safety
      ***    1.902    ***
Failure Surface Specified By 15 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
   1         40.000       460.000
   2         49.651       462.620
   3         59.217       465.532
   4         68.692       468.732
   5         78.064       472.217
   6         87.327       475.985
   7         96.472       480.032
   8        105.490       484.353
   9        114.373       488.946
  10        123.113       493.806
  11        131.701       498.928
  12        140.130       504.309
  13        148.393       509.942
  14        156.481       515.822
  15        163.277       521.085
Circle Center At X =    -41.666 ; Y =    779.846 ; and Radius =    330.107
       Factor of Safety
      ***    1.902    ***
          **** END OF GSTABL7 OUTPUT ****
```

Surficial Slope Stabilty Analysis

☒ Cut Slope
☐ Fill Slope
☐ Natural Slope



Parameters

Z = Depth of Saturation (feet) = 4.0

γ_b = Buoyant Unit Weight of Soil (pcf) = 70.6

γ_t = Total Unit Weight of Soil (pcf) = 133.0

α = Slope Angle = 26.6° (2:1)

ϕ = Angle of Internal Friction = 30°

c = Cohesion (psf) = 220

Force Tending to Cause Movement

$$F_D = Z\gamma_t \cos\alpha \sin\alpha = \tfrac{1}{2} Z\gamma_t \sin 2\alpha$$

Force Tending to Resist Movement

$$F_R = Z\gamma_b \cos^2\alpha \tan\phi + c$$

Factor of Safety

$$F.S. = \frac{2Z\gamma_b \cos^2\alpha \tan\phi + 2c}{Z\gamma_t \sin 2\alpha} = \frac{700.7}{426.0} = 1.64$$

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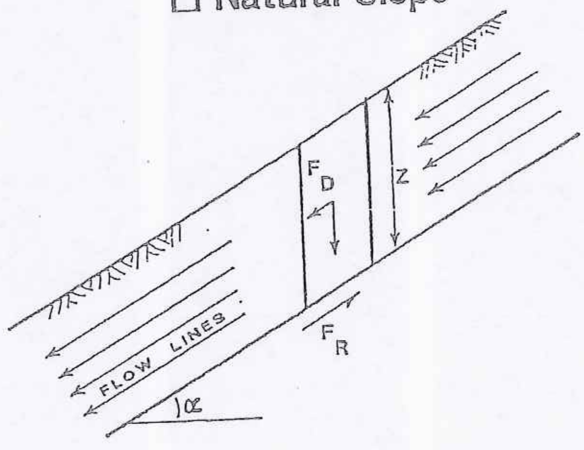
Surficial Slope Stabilty Analysis

☐ Cut Slope
☒ Fill Slope
☐ Natural Slope



Parameters

Z = Depth of Saturation (feet) = 4.0

γ_b = Buoyant Unit Weight of Soil (pcf) = 67.6

γ_t = Total Unit Weight of Soil (pcf) = 130.0

α = Slope Angle = 26.6° (2:1)

ϕ = Angle of Internal Friction = 30°

c = Cohesion (psf) = 200

Force Tending to Cause Movement

$$F_D = Z\gamma_t \cos\alpha \sin\alpha = \tfrac{1}{2} Z\gamma_t \sin 2\alpha$$

Force Tending to Resist Movement

$$F_R = Z\gamma_b \cos^2\alpha \tan\phi + c$$

Factor of Safety

$$F.S. = \frac{2Z\gamma_b \cos^2\alpha \tan\phi + 2c}{Z\gamma_t \sin 2\alpha} = \frac{649.6}{416.4} = 1.56$$

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