Appendix E-3

2014 Preliminary Geotechnical Investigation

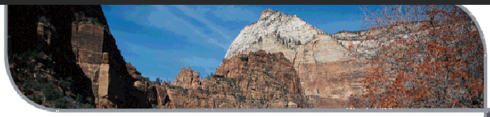
PRELIMINARY GEOTECHNICAL INVESTIGATION
PHASE 1 OF THE MESA VERDE PROJECT
CITY OF CALIMESA, COUNTY OF RIVERSIDE, CALIFORNIA

BTEK CORPORATION

NOVEMBER 18, 2014
J.N. 13-546

PETRA GEOTECHNICAL, INC.
DESERT REGION

42-240 Green Way, Suite E
Palm Desert, CA 92211
T: 760.340.5303 F: 760.340.5096



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November 18, 2014
J.N. 13-546

Mr. Paul Kim
BTEK CORPORATION
2 Park Plaza, Suite 1250
Irvine, California 92614

Subject: **Preliminary Geotechnical Investigation, Phase 1 of the Mesa Verde Project, City of Calimesa, Riverside County, California**

Dear Mr. Kim:

Petra Geotechnical, Inc. (Petra) is pleased to present this preliminary geotechnical investigation report for Phase 1 of the Mesa Verde Project located in the city of Calimesa, California. This work was performed in accordance with the scope of work outlined in our Proposal No. 13-546P dated October 9, 2013. This report presents the results of our field investigation, laboratory testing, and our engineering judgment, opinions, conclusions and recommendations pertaining to the geotechnical design aspects of the proposed development.

It has been a pleasure to be of service to you on this project. Should you have any questions regarding the contents of this report, or should you require additional information, please contact us at (760) 340-5303.

Respectfully submitted,

PETRA GEOTECHNICAL, INC.

Alan Pace, CEG
Vice President

CORPORATE
3198 Airport Loop Drive, Suite A2
Costa Mesa, California 92626
Tel: 714-549-8921

ORANGE COUNTY
3190 Airport Loop Drive, Suite J-1
Costa Mesa, California 92626
Tel: 714-549-8921

RIVERSIDE COUNTY
40880 County Center Drive, Suite R
Temecula, California 92591
Tel: 951-600-9271

LOS ANGELES COUNTY
25050 Avenue Kearny, Suite 110A
Valencia, California 91355
Tel: 661-255-5790

DESERT REGION
42-240 Green Way, Suite E
Palm Desert, CA 92211
Tel: 760-340-5303

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PRELIMINARY GEOTECHNICAL INVESTIGATION
PHASE 1 OF THE MESA VERDE PROJECT
CITY OF CALIMESA, COUNTY OF RIVERSIDE, CALIFORNIA

INTRODUCTION

Project Description

This report presents the results of a preliminary geotechnical investigation performed by **Petra Geotechnical, Inc. (Petra)** for development of Phase 1 of the Mesa Verde Project (formerly, the Oak Valley Project) located in the city of Calimesa, California. Phase 1 comprises approximately 267 acres of the 1,492-acre Mesa Verde Project (MVP). The planned development of Phase 1 consists of 1,046 single-family homes, a school site, three park sites, a recreation site, a storm water retention basin, open space, and associated infrastructure. The 1,492-acre MVP lies west of the I-10 freeway, south of the San Bernardino/Riverside County line, and about one mile north of San Timoteo Road. Access to the area comprising Phase 1 is primarily from County Line Road located to the north and Sandalwood Drive located to the east. Numerous dirt roads also provide access to interior portions of the site.

Scope of Work

The scope of work associated with this geotechnical investigation consisted of the following:

- Collection and review of various published and unpublished geotechnical maps and literature pertaining to regional and local geologic conditions including previous work performed by Petra and other geotechnical consultants.
- Review of a 100-scale mass grading plan for Phase 1 prepared by VA Consulting.
- Obtaining and reviewing historical aerial photographs to better define surface features within and adjacent to the site.
- Drilling of 9 exploratory hollow-stem auger borings to depths ranging from 30 feet to a maximum of approximately 60 feet to evaluate subsurface soil, geologic, and groundwater conditions.
- Excavation of 34 exploratory backhoe test pits to depths ranging from approximately 5 feet to a maximum of 20.5 feet to further evaluate subsurface soil, geologic, and groundwater conditions.
- Logging and classifying soil and bedrock materials encountered in each boring and test pit.
- Collecting representative bulk and relatively undisturbed samples of the onsite soils and bedrock materials for laboratory analysis.
- Performing appropriate laboratory analyses on selected soil and bedrock samples.
- Preparation of the enclosed 100-scale geotechnical maps, Plates 1 and 2.

- Preparation of 3 geotechnical cross sections, Figures 1 and 2.
- Performing geologic and engineering analyses on all data collected.
- Preparation of this report providing geotechnical recommendations with respect to site clearing and grading, and preliminary recommendations for design and construction of building foundations and other site improvements as influenced by anticipated as-graded soil and geologic conditions.

LOCATION AND SITE DESCRIPTION

The area comprising Phase 1 is generally characterized by a series of east-west and north-south trending ridges transected by northerly, westerly, and southwesterly draining valleys and narrow canyons. The elevations along the ridges are all about the same and range from about 2,280 feet to 2,330 feet above mean sea level (msl).

The valleys and narrow canyons in the northern part of the property drain toward the north and are tributaries of Yucaipa Creek. The valleys and narrow canyons in the southern part of the site drain primarily westerly and southwesterly and are tributaries of Burns Canyon and ultimately San Timoteo Creek. Burns Canyon is the major valley which traverses the southeast corner of the site. Maximum topographic relief between drainages and the adjacent ridge tops is on the order of about 100 feet.

Valley and canyon profiles range from sharp and V-shaped in the smaller canyon to somewhat broad and U-shaped across the larger valleys. Although commonly steep, the valley walls are mostly covered with slopewash (colluvium) which provides soil that supports vegetation well. The slopewash and the vegetation obscure the nature of the underlying bedrock material.

The flat floors of the larger valleys are incised in some places by narrow second-order ravines or arroyos with nearly vertical walls. In this report, the term arroyo is reserved for these recent, vertically sided, narrow incisions into the valley bottoms. In the largest canyons, these arroyos are up to about 40 or 50 feet deep, cutting through the valley alluvium and into the San Timoteo Formation providing some of the better views of the bedrock character.

Some of the smaller canyons also have these second-order arroyos but these are mostly on the order of 10 feet deep (± 5 feet), but also commonly expose San Timoteo bedrock in the bottom.

PROPOSED MASS GRADING

The mass grading plan prepared by VA Consulting (undated) indicates the site will initially be mass graded to create large super pads and access streets. Proposed maximum vertical depths of cut and fill are both on the order of approximately 50 feet. However, alluvial removals in canyon areas will locally increase the maximum fill depths to about 80-85 feet. The super pads will be re-graded at a later date to create individual building sites for construction of residential homes, a school and park amenities. A storm water retention basin is also proposed in the south-central portion of Phase 1. Many areas within Phase 1 are designated as Open Space and will remain ungraded. The Open Space areas are typically located in areas that exhibit a relatively steep terrain. The super pads will be graded to a sheet flow configuration with drainage generally directed to the southwest and northeast at gradients of 2 to 4 percent. Proposed cut and fill slopes are planned at a slope ratio of 2:1 (horizontal:vertical [h:v]) and to maximum heights of approximately 45 and 95 feet, respectively. The highest cut slope is proposed in the south-central portion of the site near the southerly boundary of Phase 1. This cut slope will descend to the proposed storm water retention basin. The highest fill slope is proposed near the southwesterly corner of the site. Daylight cuts along ridge lines adjacent to areas designated as open space will result in many of the super pads being bordered by steeply inclined natural slopes.

PRELIMINARY GEOTECHNICAL INVESTIGATION – PHASE 1

This preliminary investigation for the Phase 1 area included a review of available published and unpublished literature from previous investigations, a review of aerial photographs, a reconnaissance level site visit and mapping, subsurface exploration, laboratory testing, engineering and geologic analyses of the site and preparation of this report. Brief descriptions of our activities are provided below.

Review of Previous Investigations

Geological investigations in the region have been performed since the 1920s (e.g., Frick, 1921); these studies are summarized in the EIR (MBA, 1988). There is little published information available on the specific project area. The EIR is a principal source of background information for this geotechnical investigation and in-depth review of the previous work was not conducted unless it was considered germane to this investigation. Of particular importance were the investigations by Dames & Moore (1987) and of Rasmussen Associates (1984, 1988) both of which conducted fault trenching investigations. Also important is research conducted since the EIR was prepared; specifically the work of Albright (1999) and Kendrick et al (2002).

In June 2004, Petra and Hushmand Associates prepared a limited geotechnical investigation report for the Oak Valley at Calimesa development (Petra/HAI, 2004). Pertinent data obtained from the above investigations were utilized in our evaluation of Phase 1.

Review of Aerial Photographs

Stereographic aerial photographs were previously analyzed to characterize the geologic setting of the site. Several vintages of photos taken between 1979 and 1995 were reviewed. These were at a scale of about 1:24,000.

Site Reconnaissance and Mapping

Reconnaissance level geological/geotechnical mapping of the MVP was initially conducted in April 2004 by a senior, California-licensed, Engineering Geologist with Petra, aided by previous maps (e.g., Dames & Moore, 1987; Rasmussen Associates, 1984, 1988) and the aerial photographs. The mapping for Phase 1 was field checked in October 2013 during excavation of the exploratory borings and test pits. The refined Geotechnical Maps are presented as Plates 1 and 2 of this report.

Subsurface Exploration

Subsurface exploration within Phase 1 was conducted in October 2013 and consisted of refining the geologic mapping and the drilling of 9 borings, advanced to depths ranging from approximately 30 to 60 feet. These borings were drilled utilizing a truck-mounted, hollow-stem auger drill rig. A California-licensed, Engineering Geologist with Petra logged the borings. Soil and bedrock materials encountered within the borings were visually classified and logged in general accordance with the Unified Soil Classification System (ASTM D2488) and the Engineering Geology Field Manual by the U.S. Department of the Interior, Bureau of Reclamation, respectively. Approximate locations of the exploratory borings are shown on the Geotechnical Maps, Plates 1 and 2, and descriptive logs for the borings are presented in Appendix A.

Associated with the subsurface exploration was the collection of bulk samples and relatively undisturbed samples for laboratory testing. Bulk samples consisted of selected soil materials obtained at various depth intervals from the exploratory borings. Undisturbed samples were obtained from the borings using a 3-inch outside diameter (OD) modified California split-spoon soil sampler lined with brass rings. The soil sampler was driven mechanically to a depth of 18 inches with successive 30-inch drops of a 140-pound automatic trip hammer. Blow counts were recorded for each 6-inch driving increment. The total of the blow counts for the last 12 inches are reported on the boring logs. The central portions of the driven core samples were placed in sealed containers and transported to our laboratory for testing.

Standard Penetration (SPT) tests were also performed at selected depth intervals in accordance with ASTM D 1586. This method consisted of driving an unlined, 2.5-inch outside diameter **(OD)** standard split-barrel sampler 18 inches into the soil with successive 30-inch drops of the 140-pound automatic trip hammer. Blow counts for each 6-inch driving increment were recorded on the exploration logs. The number of blows required to drive the standard split-spoon sampler for the last 12 of the 18 inches was identified as the uncorrected standard penetration resistance (N). Disturbed soil samples from the unlined standard split-spoon samplers were placed in sealed plastic bags and transported to our laboratory for testing.

In addition to the exploratory borings, 34 test pits were excavated by backhoe to evaluate near-surface geologic conditions, primarily along existing natural slopes and drainages, or where graded slopes are proposed. Bulk samples of representative soil and bedrock materials were also obtained and transported to Petra's laboratory for testing. Approximate locations of the exploratory test pits are shown on the Geotechnical Maps, Plates 1 and 2. The test pits were logged by Petra's engineering geologist and the logs are included in Appendix A.

Laboratory Testing

Soil samples collected during field investigation were delivered to Petra's laboratory in sealed containers to be examined and tested. Selected soil samples were tested to evaluate their physical characteristics including in-situ conditions and engineering properties. The tests were performed in accordance with the following testing procedures:

- In-place moisture and dry density (ASTM D2937),
- Maximum dry density and optimum moisture content (ASTM D1557),
- Expansion potential (ASTM D4829),
- Atterberg limits (ASTM D4318),
- Shear strength (ASTM D3080),
- Collapse potential (ASTM D5333),
- Grain size analysis (ASTM C136), and
- Corrosion potential (including soluble sulfates, soluble chlorides, pH and minimum resistivity tests, in accordance with California Test Methods Nos. 417, 422 and 643).

A description of laboratory test criteria and summaries of the test data are presented in Appendix B. An evaluation of the test data is reflected throughout the "Conclusions and Recommendations" section of this report.

FINDINGS

Regional Physiography

The site area is located in the northeast part of the Peninsular Ranges geologic/physiographic province. The Peninsular Ranges province comprises a series of northwest-southeast trending mountains and valleys extending from the Los Angeles-San Gabriel-Upper Santa Ana River (San Bernardino) valleys at the southern margin of the Transverse Ranges geologic/physiographic province. The Peninsular Ranges province consists of three major blocks separated by major northwest-southeast trending faults such as the Whittier-Elsinore and San Jacinto fault systems. The eastern margin of the Peninsular Ranges is along the San Andreas fault and the Salton Trough geologic/physiographic province.

The site area is within the eastern block of the Peninsular Ranges province between the San Jacinto and San Andreas faults. This area comprises an elevated upland terrain transected by a complex arrangement of geologic faults which create an area of diverse physiographic elements. The principal elements are the San Timoteo Badlands, Crafton Hills, Yucaipa Valley, Beaumont Plain, and San Gorgonio Pass. These elements are bounded by the San Jacinto Mountains and Salton Trough on the south, the San Bernardino Mountains on the northeast, the San Bernardino Valley on the northwest and the Perris Uplands block on the west.

These upland areas are dissected primarily by southwest-flowing creeks which are tributaries to the San Timoteo Creek which flows northwesterly into the San Ana River. The major creek in the site region is Yucaipa Creek which flows west-southwesterly just north of the site area. The site area is dissected and incised by local creeks forming a system of flat-lying ridges and mesas bordered by shallow to deep, steep-sided canyons. The site area is within the northwest part of the Beaumont Plain adjacent to the San Timoteo Badlands. Although the site area has been referred to as being within the San Timoteo Badlands, badlands topography is not as well-developed within the project area as in the area to the west between San Timoteo Canyon and the San Jacinto Valley.

Elevations in the site region and nearby Beaumont Plain to the east and southeast are generally in the 2,000 to 2,500 foot range. These elevations rise dramatically to above 11,500 feet at San Gorgonio Peak in the San Bernardino Mountains to the northeast (Figure 3), and to Mount San Jacinto at more than 10,800 feet to the southeast. The Crafton Hills to the north of the site rise to about 3500 feet at Zanja Peak. Maximum elevations in the San Timoteo Badlands are around 2,000 feet (± a few hundred feet). San Timoteo Canyon rises from about 1,000-1,500 feet near the southern margin of the Upper Santa Ana

River Valley on the north, to about 2,200 feet in the southeast. Just west of the site area, the canyon is about 1,600 to 1,700 feet elevation.

Regional Stratigraphy

The region is characterized by late Tertiary and Quaternary-aged sediments and sedimentary rocks overlying ancient crystalline basement rocks. The basement rocks consist of Mesozoic plutonic rocks (e.g., granites, diorites) and Paleozoic/Precambrian-aged metamorphic rocks (e.g. gneiss). Two distinct basement complexes are present in the project region; to the north are the San Bernardino and San Gabriel mountains where the crystalline basement contains plutonic igneous rocks of late-Mesozoic age and older metamorphic rocks. The basement rocks in the San Jacinto Mountains, and underlying the Perris block, are part of the southern California batholith and also of late-Mesozoic age, as well as pre Mesozoic metamorphic sedimentary and volcanic rocks.

Sedimentary rocks in the site vicinity consist of Miocene- to Pleistocene-age conglomerate, sandstone, siltstone, and shale of nonmarine fluvial (river) origin and local clay beds of possible lacustrine (lake) origin (Dibblee, 1981). In the San Timoteo Badlands, the oldest sedimentary rocks are the late Miocene-Pliocene age Mount Eden Formation which is overlain by the Pliocene-Pleistocene San Timoteo Formation (Shuler, 1953; Dibblee, 1981; Albright, 1999). Both of these units were deposited in a basin which extended north from what is now the San Jacinto Valley and San Timoteo Badlands into the Upper Santa Ana River Valley and eastward into the Beaumont Plain-San Gorgonio Pass region.

These sedimentary rocks are overlain within most valleys by Quaternary-age alluvium and alluvial-fan deposits. Quaternary deposits may have also covered much of the Miocene-Pliocene strata but most of these have been largely removed and reduced by erosion. The Quaternary deposits are divided into old alluvium and young alluvium. The valleys in the region are filled with late-Quaternary-age young alluvium consisting of valley alluvium, stream-channel, stream-terrace, colluvium, and alluvial-fan deposits.

Regional Structure

The geological structure along the project is quite complex. This region lies between the San Andreas fault on the northeast and the San Jacinto fault on the southwest. These two major faults are highly active and converge northwesterly. As they become closer, several faults cross between them. The region where all of these faults intersect has been referred to as a tectonic knot. Matti et al (1992b) believe the structural complexity in the region is a result of transferring strain across a right step between the San Jacinto and the San Andreas faults.

The older structural history of the region is evident in the crystalline basement rocks. Geological relationships show igneous rocks to be intruded into ancient rocks (Paleozoic and Precambrian age) in Mesozoic time (approximately 100 million years ago). Sometime later, probably relatively recently in geologic time, both groups of rocks were brought to the surface by geological forces.

Most major faults in the region are strike-slip faults (e.g., San Jacinto, San Andreas, Banning) but reverse faults such as the San Gorgonio Pass fault and normal faults also occur. The Redlands, Reservoir Canyon, and the Yucaipa Valley faults to the north of the project area are normal faults within the Crafton Hills horst and graben fault system (Matti et al, 1992b). The Redlands and Reservoir Canyon faults dip northwesterly and displace Quaternary-age sediment downward on the northwest. The Yucaipa Valley fault system forms a graben with sediments on the north side of the valley displaced down to the southeast and sediments on the south side of the valley displaced down to the northwest, forming Yucaipa Valley in between. The normal faulting may be related to arching over northerly dipping thrust faults. Although late Holocene-age surface displacements are rare, segments of the normal fault systems displace essentially all of the stratigraphic units in the region and are testimony to the ongoing active nature of tectonics in the region.

The southern edge of the tectonic knot is marked by the San Gorgonio Pass fault and the Banning fault. The Banning fault is a major branch of the strike-slip San Andreas fault that projects to just northeast of the site in close association with the San Gorgonio Pass fault which is a northerly dipping oblique-reverse fault. The Banning fault is not believed to be active west of Banning (Rasmussen, 1982).

The San Gorgonio Pass fault or a similar fault called the Cherry Valley fault extends onto the site from the east. The fault is recognized by tilted and folded beds, offset early to middle Quaternary strata, and geomorphic scarps, and therefore is potentially active; this fault is described in more detail below in Section 3.3

The Beaumont Plain fault consists of two generally north-northwest trending faults in older alluvium. These faults are part of a series of faults which displace late Pleistocene-age alluvial deposits in the vicinity of Beaumont. Matti et al (1985) indicate these faults have normal, dip-slip separation. The faults have strong geomorphic expression including 7- to 16-foot-high, east-facing scarps aligned with linear drainages and benches (Dames & Moore, 1987). There is no surficial expression of faulting in younger alluvium which overlies the fault traces. Based on these relationships, the Beaumont Plain fault zone is considered to be potentially active.

Smaller local faults, the Shadybrook, Singleton Ranch, and the Haskell Ranch lineament faults have been mapped south of the site area. Field investigations by Rasmussen and Associates (1978, 1983) and Dames and Moore (1987) could not preclude these faults and suggested that they may be potentially active. These faults do not impact the site.

SITE GEOLOGY

Site Physiography

The Mesa Verde Project area is along the western edge of the Beaumont Plain and near the eastern edge of a region referred to as the San Timoteo Badlands. The site is generally a well-vegetated grassland and somewhat more similar to a savanna or wooded savanna than to true badlands which are characterized by little vegetation. The locally rugged relief in parts of the site is probably mainly a result of the area being capped by a hard, erosion-resistant, impermeable, ancient soil with a well-developed carbonate horizon. This hard surface protects the area from erosion, but once the cap is breached, the underlying uncemented materials are susceptible to erosion and formation of steep-sided canyons.

Site Stratigraphy

The geologic units at the site consist of three basic units. The distribution of these units is shown on Plates 1 and 2. The predominant unit is the San Timoteo Formation (map symbol QTs) which underlies the entire site and can be considered the bedrock unit. The crystalline basement rocks described under the Regional Stratigraphy section are not exposed on the site and are too deep beneath the site (possibly as much as 5000 feet) to be significant for any of the facilities associated with this project. The San Timoteo Formation is overlain by young Quaternary alluvium (Qya) in the canyons and gullies. These deposits consist primarily of local erosional and weathering byproducts of QTs which have washed into the valleys from the surrounding slopes and mesas. The third unit (Qrp) is not really a stratigraphic deposit but rather a soil formed by long-term, deep weathering of the San Timoteo Formation. These units are described further below.

San Timoteo Formation

The San Timoteo Formation (map symbol QTs on Plates1 and 2) is Pliocene (4-5 million years) to Pleistocene (0.5 to 0.8 million years) in age and commonly contains vertebrate fossils (Reynolds and Reeder, 1981; Smith 1983; Albright 1999). No fossils were found onsite during this investigation and none are reported in the previous investigations. The formation is divided into three members (Shuler, 1953). The formation onsite represents the upper member. The middle and lower members are present in the deep subsurface, and the entire formation along with probable older sediments reach a total thickness of over 5,000 feet beneath parts of the Oak Valley development. An oil well drilled in 1922 on the Shutt Ranch just west of the site reached a total depth of 5,358 feet in sedimentary rock, and a well drilled in 1933 on the Haskell Ranch south of the site reached 3,180 feet in sedimentary rocks (Dames & Moore, 1987).

The San Timoteo Formation is chiefly of fluvial (river) origin with local lacustrine (lake) deposits and is composed of beds of siltstone, sandstone, silty sandstone, claystone, and poorly sorted gravelly to bouldery sandstone and conglomerate. Gravels in the unit are composed of quartz, plutonic (e.g., granite, diorite), metasedimentary, metaigneous, and metavolcanic rock types. The rock fragments are subangular to subrounded indicating short transport distance. These deposits were principally derived from rocks to the north and northeast in the San Gabriel and San Bernardino Mountains (Albright, 1999). The sediments in outcrop are generally friable to moderately indurated, and easily to moderately erodible. Bedding is generally poorly developed, gradational, and lenticular.

Alluvium

The canyons and valleys within the site contain young alluvium of probable Holocene age. This alluvium appears to be primarily locally derived and is mapped as Qya on Plates 1 and 2. The material is generally composed of dark reddish-brown and dark brown, nonindurated, sand to silty sand with minor amounts of gravelly and bouldery sands. The alluvium is poorly bedded.

The young alluvium is generally relatively thin in small tributary canyons and thicker in the larger drainages and at the canyon mouths. The arroyos in the narrower parts of smaller valleys indicate thicknesses of only about 5 feet to as much as 20 feet. Two borings drilled in the middle parts of two of the larger canyons indicated about 40 feet of alluvium, but the relationships were not clear because the alluvium is derived from the San Timoteo Formation (QTs), and therefore is very similar. When the alluvium overlies weathered QTs, it is difficult to distinguish between them, especially in small-diameter borehole samples.

Parts of some of the most-recently incised arroyos have thin, loose, stream-channel sand and gravel alluvium in the very bottom of the channel. These deposits are the youngest deposits and are generally of historical or modem age. However, these are so thin and so widely scattered that they were not individually mapped and are included with the Qya map unit on Plates 1 and 2.

Relict Soil

The mesas and ridges throughout much of the site are underlain by red clayey and white carbonate-rich soils. This material is primarily a product of long-term weathering of the San Timoteo Formation, although locally there may be some remnants of old alluvial deposits that once covered the Qrp surface and which underwent similar weathering and soil formation. Areas occupied by this Qrp unit have been mapped as old alluvial deposits (Qoa) by several previous investigators but close scrutiny reveals that the material is conformable with and generally grades imperceptibly into the underlying San Timoteo Formation. Some additional Holocene-latest Pleistocene weathering and soil formation has overprinted some of the older relict soils but the younger soils are relatively thin (1-2 feet).

The relatively flat surface of the tops of the ridges and mesas occupied by the Qrp unit are remnants of an ancient geomorphic surface which was stable for a long period of time, undergoing very little deposition or erosion. After lying stable for several tens of thousands to a few hundred thousand years, the area underwent uplift which led to erosion, downcutting, and some minor tectonic deformation.

The uppermost part of the Qrp unit is characterized by dark red (2.5YR and 5YR hues I) silty and sandy clays with scattered pebbles. This red zone represents an argillic B soil horizon. The dark red color gradually gives way with depth to yellowish-brown or strong-brown (7.5YR and 10YR hues) silts, silty sands, and gravelly sands which represent less-weathered but strongly oxidized San Timoteo Formation. The lowest part of the Qrp unit and the uppermost part of the San Timoteo Formation consist of white to very-pale-brown (10YR) calcareous silts, sands, and gravelly sands. This lower zone represents a pedogenic carbonate soil horizon or K Horizon. This carbonate horizon occupies much of the ground surface in the eastern and northeastern part of the site where it commonly is characterized by nearly horizontal, hard, impermeable layers. These carbonate soils represent a Stage III or Stage IV plugged K Horizon.

All together the Qrp unit ranges from a few inches thick to several feet thick (locally up to about 20 feet thick). Much of the site area, primarily the northeastern part is characterized by the white surface cap consisting of the calcareous zone. The calcareous materials were probably overlain by an A soil horizon and the dark red B soil horizon at one time, but these have been stripped away by erosion as the region underwent uplift and the resulting incision that led to the present valley-and-ridge topography. The high degree and great thickness of mature soil development within this unit indicates great age, perhaps on the order of a few hundred thousand years. This unit is similar to the Qvoa and Q3 unit of Matti et al (1992a), Kendrick et al (2003), and Albright (1999) who estimate an age on the order of about 300,000 to 500,000 years.

The geotechnical properties of the Qrp unit vary depending upon which of the zones is present. In general the unit is very firm and hard and will provide good foundation support. The red clayey upper zone exhibits a polygonal cracking indicative of a high clay content which may have an expansive character. The light-colored calcareous zone may be corrosive to some materials.

Artificial Fill

Artificial fill deposits exist within a few local areas within Phase 1. Generally these are small berms or dams built to retain water for livestock and fills associated with construction of portions of Sandalwood Drive where it crosses the northeasterly corner of Phase 1. These are widely scattered throughout the site (Plate 1); some of the larger ones are identified on Plates 1 and 2 but many are too small to be adequately shown at the scale of Plates 1 and 2. The only area with significant fill is the valley just south of the trailer park in the eastern part of the site near 7th Street. This area presently serves as an equipment storage area and has been a borrow area. These activities have resulted in dirt, brush, and trash having been disturbed and pushed into the arroyo. Several other areas along the creeks also have local accumulations of trash; like many rural areas, it appears to have been a common practice to dump trash into small canyons and creek beds. These areas are small and not shown on Plates1 and 2, and generally not significant to the project.

Site Structure

The Mesa Verde Project is located on the east limb of a regional asymmetric, northwest-trending anticline in the San Timoteo Formation. The axis of this fold is located west and southwest of the project boundaries and parallels the San Jacinto fault. Bedding in the San Timoteo Formation on the west limb of the fold dips 15 to 50 degrees southwest. On the east limb, including the area beneath Oak Valley, bedding typically strikes northwesterly to northeasterly and generally has gentle dips ranging from nearly horizontal to about 5 degrees to the north with local increases in dip to about 15 degrees. Steeper dips occur only in association with deformation along the north side of the Cherry Valley fault in the eastern part of the area.

The only fault known in the site area is the Cherry Valley fault. This fault extends into the southeast corner of the site area (Figure 2 and Plate 1) from offsite to the east (Matti et al, 1985, 1992; Dames and Moore, 1987; Rasmussen and Associates, 1984, 1988). There is uncertainty and has been some discussion in previous reports as to whether the fault should be called the Cherry Valley fault or the western extension of the San Gorgonio Pass fault. Rasmussen Associates (1988) believe it is the Cherry Valley fault or a branch of the Cherry Valley fault.

Field investigations of the Cherry Valley fault by Dames & Moore (1987) were inconclusive regarding the recent activity; they considered it to be potentially active based on the work of Matti et al (1985) that indicated that the San Gorgonio fault displaces Holocene deposits east of the site, and recommended a restricted-building zone or setback zone. Subsequent work onsite by Rasmussen Associates (1988) suggested that the fault is overlain by the unfaulted mature soil (Qrp) and, therefore they concluded that the fault should not be considered active.

Our investigation revealed that the fault can be recognized by an eroded and degraded geomorphic scarp associated with folding and displaced San Timoteo Formation strata. In the southeast corner of the site, the scarp is 70 to 80 feet high. Westerly, the scarp height steadily diminishes to 20-30 feet high and disappears east of the Qrp mesa just east of Covington Canyon. In Covington Canyon, two faults are present in the arroyo walls. These have similar low- to moderate-angle dips (28 and 42 degrees), and are in direct alignment with the scarp to the east. The faults in the arroyo extend upward to young alluvium but do not appear to offset the alluvium, albeit exposures are somewhat obscured near the Qya/QTs contact.

The QTs strata in proximity to the faulting in the arroyo are folded and indicate post QTs (i.e., late Quaternary-age) tectonic deformation. The faults in the arroyo are relatively simple, sharp fractures without much evidence of strong shearing, and thus do not appear to represent a major regional fault. The amount of displacement could not be determined, but it appears to be greater than the depth of the arroyo which is more than about 20-30 feet at that locality.

Reevaluation of the Rasmussen Associates (1988) work indicates that they based their conclusions on the interpretation that the fault is overlain by the Qrp surface which is several hundred thousand years old. However, their main trench did not conclusively identify any major fault but that several minor fractures and folded QTs strata were not directly overlain by the Qrp. It seems evident that the scarp and folding occurred after formation of the Qrp surface, and that uplift along the fault or even fault displacement led to removal of the Qrp along the fault zone. These relationships suggest that the faulting occurred in late-Quaternary time after formation of the Qrp soil/surface, i.e., less than the 300,000-500,000 years ago. This would result in classifying the fault as a late-Quaternary-age, or potentially active, feature. Whether the fault has been active in early Holocene time, and therefore would be active, can not be established based on the present data.

SEISMOLOGY

Historical Seismicity

The site is in seismically active southern California and is subject to shaking from both local and distant earthquakes. The seismicity map shows only the larger (M>4) events in historical time. The site is along the boundary between the North American and Pacific plates which comprise major faults. The San Andreas Fault, the major fault of the plate boundary system, has not had substantial earthquake activity along this segment in historical time. In spite of the paucity of recent earthquakes on the San Andreas Fault, geologic evidence indicates numerous Holocene displacements. In contrast, historical seismic activity has been abundant on the San Jacinto fault to the west of the site, and it is one of the most seismically active faults in the world. The San Jacinto system (which includes the Imperial fault) has generated about a dozen moderate- to large-magnitude (M>6) earthquakes in historical time. Small earthquakes are quite common in the area between the San Andreas and San Jacinto faults, i.e., in proximity to the Banning, San Gorgonio Pass, and Crafton Hills fault systems.

The largest historical earthquakes in the area were the 1923 event on the San Jacinto fault (Ms = 6.3), the 1948 event near Desert Hot Springs (Ms = 6.5), and the 1986 North Palm Springs earthquake (ML = 5.9). The earlier events are poorly located so the sources are uncertain, whereas the 1986 event probably occurred on the Banning fault.

Microseismicity in the Yucaipa Valley area may suggest normal faulting but alternate interpretations support reverse faulting as well (Matti et al, 1992). A small earthquake (M= 4.5) occurred just northwest of the project area in 1998. This event is notable because it yielded a normal-fault focal mechanism, and it may have been associated with the Crafton Hills fault system where it intersects the San Jacinto fault.

Faults

Table 1 lists the nearest active faults and their estimated maximum earthquakes. The California Geological Survey has not designated any Earthquake Fault Zones (formerly known as Alquist-Priolo Special Studies zones) within the site area that requires special considerations such as restricted building or setback zones (MBA, 1988). However, setback zones may be prudent on the Cherry Valley fault. The largest earthquakes (Upperbound Earthquakes) estimated for the major faults in the region are listed on Table 1.

Table 1

Maximum Earthquakes

Fault Name	Type of Slip(1)	Maximum Earthquake	Distance From Site (km)
San Andreas	ST	8.0	10
San Jacinto - Claremont Segment	ST	7.5	5
San Gorgonio Pass	RO	7.0	12
Beaumont Plain	N	6.75	6
Crafton Hills - Yucaipa Valley Segment	N	6.5	1.4
Cherry Valley	RE	6.25	0

Notes: I) ST = Strike Slip; RE = reverse; RO = reverse oblique; N = normal

GEOLOGICAL HAZARDS

Surface Faulting

There is one fault known within the site. The Cherry Valley fault extends into the southeast corner of the site and crosses the site to at least Covington Canyon (Plate 1). The age of latest displacement on this fault is uncertain. It appears to have been very active in late-Quaternary time but whether that activity continued into the early Holocene time has not been established. The fault is not known to displace latest Holocene young Alluvium (Qya) but it is not overlain by Qya in many places.

The degree of scarp degradation indicates that the fault is not highly active. However, the possibility of early Holocene displacement cannot be ruled out based on the present data. In view of the uncertainty and its projection through two proposed school sites, we recommend 100 foot setback zones on each side of the fault. Before habitable structures, including schools, can be built within this zone, additional fault studies (preferably trenching) should be conducted.

Erosion

The steep-sided canyons and the mesa/valley-type topography of the site vicinity indicate that the geologic formations in the area, specifically the San Timoteo Formation (QTs), are susceptible to erosion. Although the San Timoteo Formation materials are quite dense and hard compared to the Qya deposits, they are not cemented and are friable. Consequently, when they are subjected to flowing water they are erodible.

Landslides

There are few landslides within the site region. Although there is a potential for landsliding within the site, the hazard in general does not appear to be great. Bedding in the predominant geologic formation, the San Timoteo Formation, is poorly developed and the formation is not highly fractured so there are few planes of weakness that would promote widespread landsliding. Furthermore, the orientation of the bedding is generally horizontal to very low angle (less than 5 degrees) which is not prone to substantial landsliding.

A few small slides are observed along the major stream channels where erosion and undercutting occasionally destabilize the adjacent slopes. Undoubtedly, there are more small slides and earth flows that are not shown on the map. Slopes throughout the site are commonly steep; the EIR (MBA, 1987) provides maps showing areas with slope gradients greater than 15 percent and 25 percent which includes most of the slopes along the sides of the canyons and valleys. Any building planned for the areas above or below these slopes should account for the landsliding hazard by setting structures back from the tops of the slopes and away from the bottom of the slopes in accordance with applicable building codes (see Geotechnical Engineering Recommendations).

Many of the slides appear to be shallow earth flows or debris flows. These are generally shallow (less than about 10 feet thick). These features appear to be relatively random and not structurally controlled; rather they appear to be related to downshope flow of thicker accumulations of slope wash within small side slope gullies and swales. During intense periods of rainfall they become saturated. Although these are generally not devastating events, the larger ones can damage buildings and facilities that lie in their path. These types of features also commonly fail during strong seismic events. Rasmussen Associates (1984) reports evidence for deep-seated and large translational and/or rotational landslides. Some of the deep-seated landslides were interpreted to represent ancient landslides with now have little geomorphic expression. Some of the older, larger and deep-seated landslides identified by Rasmussen Associates exhibit little geomorphic expression and therefore other similar subtle landslides may exist on the site. Reactivation of older landsides on-site is a potential hazard and could be aggravated in some situations by grading.

If structures for human occupancy are to be placed adjacent to the known or suspected landslides or next to the steep slopes, subsurface borings or test pits will be necessary to determine the extent and subsurface geometry of the landslides. If any development, including roadways, is planned in the immediate vicinity of the landslides or the steep slopes, mitigating measures such as buttressing of the slopes or reducing slope gradients, should be implemented.

Liquefaction

State of California Seismic Hazard Zones Maps have not been issued for the quadrangles where the subject site is located. Previous investigations (e.g., EIR) indicated that all of the valleys had a high liquefaction potential. However, based on our field investigation, liquefaction and dynamic settlement resulting from the effects of strong ground shaking are not expected to be widespread at the site due to the great depth to groundwater and the relative density of the underlying soils. Many of the smaller valleys identified in previous reports as having a liquefaction potential are underlain by firm bedrock (QTs) at shallow depths (e.g. 5 feet) and therefore might easily be developed providing that the recommendations given in the Geotechnical Engineering Recommendations section of this report are followed.

HYDROLOGY

Surface Water

There are no major perennial streams passing through the site. The site is crossed by several ephemeral streams that may flow during times of heavy precipitation such as the winter rainy season or during the occasional summer monsoonal thunder showers. Drainage within these local channels in the northern part of the site is toward the north whereas drainage in the rest of the site is toward the southwest. The two largest valleys are Covington Valley in the central part of the site and Burns Valley in the southeastern part of Phase 1.

There are no lakes within the site but there are several small dams and water-retaining berms that have been used for stock watering. At the time of this investigation, these were nearly all dry and many were dysfunctional.

Severe erosion that led to the arroyo cutting within some existing canyons (e.g. Covington Canyon) indicate that substantial volumes of runoff occasionally occur at the site during prolonged and intense precipitation. However, the flow appears to have been completely contained within the existing valleys so the flooding hazard for sites built on high ground appears minimal.

Groundwater

Water wells south of the site produce water from deep within the San Timoteo Formation (Rasmussen Associates, 1984). Water levels in three wells are currently from greater than 100 feet below the ground surface. Data from the South Mesa No. 5 well near the northern property line indicates the water table in June 1984 was approximately 270 feet below the surface. A regional hydrogeologic study by Bloyd (1971) suggests that the water table beneath the site slopes to the west at a gradient of approximately 150 feet per mile. Integration of the well data with water gradient interpretations by Bloyd (1971) suggests that water levels could be approximately 140 feet below the lowest ground surface in the easternmost portion of the site. There has been no analysis of the possible affect of faults on the ground water, and data are of insufficient quantity to determine any such effects. The presence of thick caliche zones near the reverse/thrust fault suggests that this fault has been a ground-water barrier in the past.

Areas of artesian groundwater conditions have occurred both north and south of the site area during the early 1900s (Mendenhall, 1905). Yucaipa Valley was an artesian groundwater basin a few decades ago but over-pumping has severely reduced groundwater levels in the valley. Artesian conditions also occurred in San Timoteo Canyon

No groundwater was encountered in borings drilled for this investigation which extended to a maximum depth of about 60 feet. No springs or evidence for an existing shallow ground-water body was observed during this investigation. The fine-grained units of the San Timoteo Formation exposed in the very bottom of several local canyons were moist where protected from direct sunlight, perhaps as a result of rains within the past couple months. Ground water may become perched following prolonged periods of high precipitation. Such perching is expected to be local because of the poor lateral continuity of strata.

CONCLUSIONS AND RECOMMENDATIONS

Based on our review of available literature, subsurface investigation and geotechnical engineering and engineering geologic analyses, development of the site is considered feasible from a geotechnical point of view. It is our opinion that the building sites will be free of hazard from landslide, settlement and slippage provided that the following general recommendations are incorporated into the design criteria and project specifications. However, the project is still in the conceptual stage and specific grading plans and development plans have not been developed. More-specific recommendations will require additional more-extensive geotechnical investigations.

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 County of Riverside. Grading should also be performed in accordance with applicable provisions of the attached "Standard Grading Specifications" in Appendix C, unless specifically revised or amended herein.

Site 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 limited exploratory borings, surficial deposits of man-made fill, colluvium, alluvium, and older alluvium are expected to be readily excavatable with conventional heavy-duty earthmoving equipment.

The ridges are underlain primarily by the San Timoteo Formation consisting of sandstone, siltstone, and conglomerate. Light to heavy ripping can be expected in this formation. The formation contains abundant cobbles and some boulders which may produce significant numbers of oversized rock. Cuts made into the San Timoteo Formation can be expected to generate a significant amount of cobbles greater than 6 inches in diameter, and some boulders to about 2 feet and possibly 3 feet in diameter with the total percentage of oversized rock being on the order of 5 percent or less.

Any rock exceeding 12 inches in maximum dimension should either be disposed of offsite or buried in the deeper fills in accordance with Plate SG-4, Appendix C (Standard Grading Specifications). The "Disposal of Oversize Rock" is discussed in a subsequent section.

Removal of Existing Fill Deposits

All existing deposits of artificial fill should be removed to competent underlying native soils or bedrock. The actual limits and depths of removal of existing unsuitable fill materials will have to be determined during grading. The excavated fill materials may be replaced as properly compacted fill within the site provided that they are first cleared of any trash, construction debris or oversize rock.

Removals and Canyon Cleanouts

All existing low-density surficial soils in areas to receive compacted fill should be removed to underlying competent bedrock or competent native soils approved by the project geotechnical consultant. In general, low-density surficial soils include any artificial fill deposits, alluvium, colluvium, and highly weathered surficial bedrock formation. Throughout the majority of the site, recommended depths of remedial removal will extend into competent bedrock or competent native soils. Competent materials are defined as undisturbed, relatively unweathered and non-porous 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 surficial soil deposits or highly weathered bedrock are not removed in their entirety. Based on our boring and laboratory data, depths of removal are expected to vary from approximately 5 to in excess of 30 feet as indicated on Plates 1 and 2 at each boring and test pit location. However, the 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, minor amounts of perched groundwater overlying dense bedrock or fine-grained materials 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 installation of canyon subdrains and 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 tributaries 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. A preliminary layout of the recommended canyon subdrain system is shown on Plates 1 and 2; however, actual subdrain locations should be determined in the field during grading based on exposed geologic conditions.

Fill Placement

Following removal of unsuitable surficial materials, exposed bottom surfaces in areas approved for placement of fill should first be scarified to a depth of 6 inches, watered or air dried as necessary to achieve near optimum moisture conditions, and compacted to a minimum relative compaction of either 90 or 92 percent depending on the total thickness of fill to be placed (see below).

All fills should be placed in 6- to 8-inch-thick maximum lifts watered or air dried as necessary to achieve a moisture content that is equal to or slightly above optimum moisture content, and compacted to the minimum relative compactions noted below.

Fill materials placed at depths of less than 40 feet below the proposed finish grades should be compacted to a minimum relative compaction of 90 percent. Fill materials that will be placed at depths in excess of 40 feet below the proposed finish grades should be compacted to a minimum relative compaction of 92 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.

Settlement Monitoring of Deep Fills

Ultimate fill depths will range from a few feet to a maximum estimated at approximately 80-85 feet. Settlement monitoring will be required in selected deep fill areas (greater than 40 feet of fill) in order to evaluate the amount of time for primary consolidation to take place and the magnitude of any remaining long term secondary consolidation. The locations of recommended near-surface settlement monuments should be determined by the project geotechnical consultant during and upon completion of rough grading. At least two settlement monuments should be constructed in bedrock to serve as control points. A monitoring period of at least 3 to 6 months will likely be required prior to the commencement of residential construction.

Benching

Fills placed against canyon walls, on natural slope surfaces inclining at 5:1, horizontal to vertical, 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 or competent native soil materials. 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 wind rows, 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 the building areas or street areas where they may interfere with footing and utility trenches, or in areas where they may interfere with the future construction of swimming pools and/or spas. Based on this investigation and prior studies, oversize rock quantities should be less than 5 percent of total excavated materials.

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.

Cut/Fill Transitions

To mitigate distress to building structures related to the potential adverse effects of excessive differential settlement, cut/fill transitions should be eliminated from all building sites where the depth of fill placed within the "fill" portion exceeds proposed footing depths (e.g., 12 inches and 18 inches for one-story and two-story structures, respectively). This should be accomplished by overexcavating the "cut" portions and replacing the excavated materials as properly compacted fill. Recommended depths of overexcavation will depend on maximum depths of compacted fill placed on the "fill" portions, but will generally follow the guidelines provided below. Horizontal limits of overexcavation should extend beyond the perimeter building lines to a distance of 5 feet or to a distance equal to the required depth of overexcavation, whichever is greater. It is anticipated that finalized building locations will be unknown at the time the initial mass grading is performed to create the super pads. Therefore, elimination of cut/fill transitions will likely have to be performed when final grading operations are performed to develop individual building sites. If this is the case, cut/fill transition lines should be accurately shown on the as-built mass grading plans.

Recommended Depths of Overexcavation

Depth of Fill	Depth of Overexcavation
Up to 3 feet	Equal Depth
3 to 6 feet	3 feet
Greater then 6 feet	One-half of greatest fill depth placed on the "fill" portion; to 15 feet maximum

Additional building sites may require overexcavation due to cut/fill transitions created during grading such as unsuitable material removal, incised haul road areas through cut areas, construction of stabilization fills, etc. The required depths of overexcavation should be based on actual conditions encountered during grading using the guidelines presented above.

Deep Fill/Shallow Fill Transitions

To mitigate the detrimental effects of excessive differential settlement, deep fill/ shallow fill transitions should also be eliminated from all building areas. This should be accomplished by overexcavating the "shallow" fill portions of each building area and replacing the excavated materials as properly compacted fill. Generally, the depths of overexcavation should equal one-half the thickness of the maximum depth of fill underlying the building area to a maximum depth of 15 feet.

Over-Steepened Natural Slopes and Temporary Slopes

Following removal of unsuitable surficial soils, alluvium and weathered bedrock materials to competent native soils or bedrock during grading, over-steepened natural slopes and temporary excavated slopes (created during canyon cleanouts, etc.) will likely underlie some cut/fill transition areas and some fill areas within the subject site. To mitigate the detrimental effects of excessive differential settlement, over-steepened natural slopes or temporary excavated backcut slopes created in areas that will receive compacted fill should be laid back in accordance with the following criteria:

1. Natural and temporary excavated slope surfaces located within 25 vertical feet of finish grade should be laid back at a slope ratio no steeper than 2:1, horizontal to vertical.
2. Natural and temporary excavated slope surfaces located within 25 to 50 vertical feet of finish grade should be laid back at a slope ratio no steeper than 1.5:1, horizontal to vertical.
3. Natural and temporary excavated slope surfaces located greater than 50 vertical feet below finish grade do not need to be laid back at any specific slope ratio. However, temporary excavated slopes should be graded at inclinations that provide adequate temporary stability for worker safety, protection of existing offsite improvements, etc.

Haul Roads

Haul roads should be selected to avoid disturbing terrain which is to remain in a natural state. Also, haul roads traversing compacted fill areas should be coordinated and planned to avoid or minimize generation of loose spill fills thereon. When this condition is unavoidable, close coordination with the project soils engineer and his representative will be required to eliminate intermingling of engineered and non-engineered fill.

During grading, special care should be exercised to avoid spilling and depositing of loose soil or debris onto slope areas and into areas programmed to remain in a natural state. Any loose slough, debris or other deleterious materials deposited or accumulated on natural areas will have to be removed by the contractor upon completion of grading.

Volumetric Changes

Volumetric changes in earth quantities will occur when excavated on-site soil and bedrock materials are replaced as properly compacted fill. Following is typical values of shrinkage and bulking factors anticipated for the various geologic units present on the site. These typical values are based on in-place densities of the various materials and on the estimated degree of relative compaction that will be achieved during grading.

Topsoil and artificial fill (af)	Shrinkage of 12% to 15%
Alluvium/Colluvium (Qya)	Shrinkage of 12% to 15%
San Timoteo Formation (QTs)	Bulking of 0% to 3%

The above estimated shrinkage and bulking factors are exclusive of oversize rock materials that are removed from the site if not placed properly within designated rock disposal areas. Furthermore, the actual shrinkage or bulking that will occur during grading will depend on the average degree of relative compaction achieved.

A subsidence estimated at 0.10 to 0.15 feet may be anticipated as a result of the scarification and recompaction of the exposed ground surfaces within alluvial areas and 0.05 to 0.10 feet within bedrock areas.

The above estimates of shrinkage, bulking and subsidence are intended for use by project planners in determining earthwork quantities and should not be considered absolute values. Contingencies should be made for balancing earthwork quantities based on actual shrinkage and subsidence that will occur during grading. Due to uncertainties in the anticipated amounts of shrinkage or bulking of the various earth materials within the site, and due to uncertainties that will occur due to the removal and disposal of oversize rock materials, it is recommended that several earthwork balance test plots be performed during the initial stages of grading. These test plots can be performed to determine the initial volume of soil excavated within the test plot area and the final volume of soil placed and compacted in the fill area in order to determine the actual as-graded shrinkage or bulking amounts of the onsite earth materials.

Geotechnical Observations and Testing During Grading

Observations of the clearing operations, removal of low density surficial soils, keyway excavations, observation of cut slopes, 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.

Cut Slopes

Gross Stability of Cut Slopes

Recommended remedial removal of unsuitable surficial soils is anticipated to essentially eliminate any cut slopes exposing alluvial, or colluvial materials and is expected to result in these slopes being constructed as fill slopes. Therefore, the majority of the major cut slopes within the site will expose San Timoteo Formation sedimentary bedrock materials. In general, these cut slopes are planned at a slope ratio of 2:1, horizontal to vertical, and to a maximum vertical height of approximately 45 feet. The slope stability calculations presented in Appendix D for the highest proposed cut slope indicate cut slopes exposing favorable geologic conditions will be grossly stable under both static and pseudo-static (earthquake) loading conditions. However, in-grading observation of individual cut slopes will be required by the project engineering geologist to confirm the geologic structure of the exposed bedrock. For conditions where cut slopes exhibit adverse geologic conditions, such as out-of-slope bedding, they will require removal and replacement with buttress fills or stabilization fills. Buttress fills and stabilization fills should be constructed in accordance with the typical detail shown on Plate SG-2, Appendix C. The bottoms of the buttress and stabilization fill keys should be tilted back at a minimum of 2 percent towards the heel of the key. As fill placement proceeds up slope, a minimum fill width of 15 feet should be maintained to allow proper compaction of the fill layers. Internal backdrains should also be installed in each buttress fill or 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.

Stability of Temporary Backcut Slopes

The stability of temporary backcut slopes associated with buttress fill and stabilization fill construction is dependent on many factors, which include slope angle, height, geologic structure of unsupported bedrock, shear strength along planes of weakness, groundwater conditions, nuisance water, and the length of time temporary cuts remain unsupported. Consequently, there may be a risk for a backcut failure during excavation of basal fill keys for buttress fills and stabilization fills. In order to maintain temporary stability, the backcuts should be analyzed by the project geotechnical engineer and, if needed, should be laid back at a relatively flat slope ratio. In order to minimize the potential for backcut failures, the following techniques should also be considered:

- All basal fill keys 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.
- Provisions should be made for preventing nuisance water and rainwater from collecting and ponding in keyway excavations.
- Grading equipment and other construction traffic should never be allowed to traverse along the tops of temporary backcut slopes.
- In addition to the above, all OSHA requirements should be followed with respect to excavation safety.

Fill Slopes

Fill Slope Construction

Fill slopes are planned at a slope ratio of 2:1, horizontal to vertical, and to a maximum vertical height of approximately 95 feet. The slope stability calculations presented in Appendix D indicate fill slopes constructed with on-site soil and bedrock materials will be grossly stable. Fill slopes should be constructed as recommended below. The surface compaction recommendations provided below for fill slopes should also be applied to buttress and stabilization slopes.

Fill Keys

Fill keys excavated into competent bedrock or competent bearing soils will be required at the base of all proposed 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 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.

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.

Fill-Over-Cut Slopes

Where fill-over-cut slopes are proposed, a keyway excavated into competent bedrock or dense native soils should be provided at the contact. The keyway should be at least 15 feet wide and tilted back into the slope at a minimum gradient of 2 percent. Where fill-over-cut transition contacts vary from about vertical to a few degrees from vertical, benching of the fill portion into the cut portion will be difficult and may create a potential slip surface due to inadequate benching. Therefore, overexcavation of the cut portion and reconstruction of the entire slope with compacted fill is recommended.

Surficial Stability of Fill Slopes

Fill slopes are proposed to be constructed at a maximum slope ratio of 2:1, horizontal to vertical. The surfaces of the fill slopes within the site will be comprised of fill materials that consist of reconstituted native bedrock materials and (to a much lesser extent), colluvium and alluvium. Therefore, surficial slope stability calculations should be performed using strength properties of fill slope materials and for a depth of saturation of 4 feet below the slope face and assuming an infinite slope with seepage parallel to the slope face.

Natural Slopes

Gross Stability

The gross stability of natural slopes to remain ungraded was determined for the slope configuration shown on Cross Section C-C’, Figure 2. The stability calculations, Appendix D, indicate that the natural slopes bordering the proposed mass graded super pads will be grossly stable. However, the stability of all natural slopes should be analyzed when specific plans for such slopes are available.

Post-Grading Considerations

Utility Trenches

All applicable requirements of the California Construction and General Industry Safety Orders, the Occupational Safety and Health Act of 1970, and the Construction Safety Act should be followed with respect to excavation of trenches for subsurface utilities. In general, the majority of the on-site soils are classified as Type C soil in accordance with CAL/OSHA regulations. Accordingly, the sidewalls of open trenches should be sloped back at a ratio of 1.5:1 (h:v) or flatter. Trench shields should also be considered as added protection for workers entering the trenches.

All utility trench backfill should be compacted to a minimum relative compaction of 90 percent. Where on-site soils 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 2-foot-thick maximum lifts, moisture conditioned to establish optimum or slightly above optimum moisture content, 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.

For shallow trenches where pipe may be damaged by mechanical compaction equipment, such as under building floor slabs, clean on-site sands having a sand equivalent (SE) value of 30 or greater should be utilized for backfill that is jetted or flooded into place, and then tamped 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, clean sand bedding should be placed at least l-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.

Where utility trenches are proposed parallel to any building footing (interior and/or exterior trenches), the bottom of the trench should not extend below a 1:1 plane projected downward from the outside bottom edge of the adjacent footing.

Pad Drainage

Positive surface drainage systems consisting of a combination of sloped concrete flatwork, sheet flow gradients and earth swales, and surface area drains (where needed) should be provided around each building and within yard areas to collect and direct all surface waters to the adjacent streets. Sheet-flow-graded ground surfaces should be inclined at a minimum gradient of 2 percent away from building foundations and similar structures. Surface waters should not be allowed to collect or pond against building foundations and within the level areas of the lots, or to flow onto adjacent slopes. Roof gutters with downspouts should be used on the sides of houses where there is insufficient area to construct effective yard drainage devices and/or where roof drainage is directed onto adjacent slopes.

For unimproved graded lots to remain idle for a long period of time, pad drainage should be designed for a minimum gradient of 1 percent toward the adjacent streets.

Slope Landscaping and Maintenance

Proper slope and pad drainage are essential in the design of grading for the subject property. The overall stability of the graded slopes should not be adversely affected provided all 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 County of Riverside grading codes. 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 Design Recommendations

General

For planning purposes, we provide the following preliminary foundation design recommendations based on anticipated conditions at the completion of rough grading. Final design recommendations should be provided by the project geotechnical consultant based on final as-graded soil conditions existing within the building sites.

2013 California Building Code

Previous preliminary foundation design recommendations prepared by Petra were based on the outmoded 2010 California Building Code (CBC). Therefore, since the current 2013 CBC was adopted by Building Officials in early 2014, the following seismic design coefficients and preliminary foundation design recommendations have been updated to comply with the current 2013 CBC.

2013 CBC Seismic Design Coefficients

Earthquake loads on earthen structures and buildings are a function of ground acceleration which may be determined from the site-specific acceleration response spectrum. To provide the design team with the parameters necessary to construct the site-specific acceleration response spectrum for this project, we used two computer applications that are available on the United States Geological Survey (USGS) website, http://geohazards.usgs.gov/.

Specifically, the Design Maps website http://geohazards.usgs.gov/designmaps/us/application.php was used to calculate the ground motion parameters. And, the 2008 PSHA Interactive Deaggregation website http://geohazards.usgs.gov/deaggint/2008/ was used to determine the appropriate earthquake magnitude.

To run the above computer applications, site latitude, longitude, risk category and knowledge of “Site Class” are required. The site class definition depends on the average shear wave velocity, Vs_{30}, within the upper 30 meters (approximately 100 feet) of site soils. A shear wave velocity of 300 meters per second for the upper 100 feet was used for the site based on Petra’s engineering experience and judgment.

The following table, Table A, provides parameters required to construct the site-specific acceleration response spectrum based 2013 CBC guidelines.

Table A

SEISMIC DESIGN PARAMETERS

Ground Motion Parameters	Reference	Parameter Value	Unit
Latitude (North)	-	33.99796	°
Longitude (West)	-	-117.07597	°
Site Class Definition	Table 20.3-1, ASCE 7-10	**D**	-
Assumed Risk Category	Table 1604.5, CBC 2013	II	-
M_w - Earthquake Magnitude	Section 1803.5.12.2, CBC 2013	7.5	-
S_s - Mapped Spectral Response Acceleration	Figure 1613.3.1(1), CBC 2013	1.512	g
S_1 - Mapped Spectral Response Acceleration	Figure 1613.3.1(2), CBC 2013	0.699	g
F_a - Site Coefficient	Table 1613.3.3(1), CBC 2013	1.0	-
F_v - Site Coefficient	Table 1613.3.3(2), CBC 2013	1.5	-
S_{MS} - Adjusted Maximum Considered Earthquake Spectral Response Acceleration	Equation 16-37, CBC 2013	1.512	g
S_{M1} - Adjusted Maximum Considered Earthquake Spectral Response Acceleration	Equation 16-38, CBC 2013	1.049	g
S_{DS} - Design Spectral Response Acceleration	Equation 16-39, CBC 2013	1.008	g
S_{D1} - Design Spectral Response Acceleration	Equation 16-40, CBC 2013	0.699	g
T_o - ($0.2\ S_{D1}/\ S_{DS}$)	Section 11.3, ASCE 7-10	0.139	s
T_s - ($S_{D1}/\ S_{DS}$)	Section 11.3, ASCE 7-10	0.693	s
T_L - Long Period Transition Period	Figure 22-12, ASCE 7-10	8	s
F_{PGA} - Site Coefficient	Figure 22-7, ASCE 7-10	1.000	-
PGA_M - Peak Ground Acceleration at MCE [1]	Equation 11.8-1, ASCE 7-10	0.608	g
PGA – Design Level – (0.4 S_{DS} [2])	Equation 11.4-5, ASCE 7-10	0.403	g
C_{RS} - Short Period Risk Coefficient	Figure 22-17, ASCE 7-10	1.038	-
C_{R1} - Long Period Risk Coefficient	Figure 22-18, ASCE 7-10	1.001	-
Seismic Design Category [3]	Section 1613.3.5, CBC 2013	D	-

[1] PGA Calculated at the MCE return period of 2475 years (2 percent chance of exceedance in 50 years).

[2] PGA Calculated at the Design Level of 2/3 of MCE which is approximately equivalent to a return period of 475 years (10 percent chance of exceedance in 50 years).

[3] Seismic Design Category may be calculated by the structural engineer in accordance with the alternate design procedures of Section 1613.3.5.1 based on structural characteristics in addition to the ground motion parameters, this may supersede the category listed herein.

References: USGS Seismic Design Web Application – http://geohazards.usgs.gov/designmaps/us/application.php
USGS 2008 Interactive Deaggregation Tool - https://geohazards.usgs.gov/deaggint/2008/

Building Clearances From Ascending Slopes

To conform to Section 1808.7.1 and Figure 1808.7.1 of the 2013 CBC, minimum clearances of H/2 (one-half of the total slope height) to a maximum of 15 feet should be maintained between buildings and the toe of any adjacent ascending slope. Retaining walls may be constructed at the base of the slopes to achieve the required building clearances.

Footing Setbacks from Descending Slopes

To conform with Section 1808.7.2 and Figure 1808.7.1 of the 2013 CBC, building footings to be constructed on or near descending slopes should be deepened, as necessary, to provide a minimum footing setback of H/3 (one-third of the total slope height). The footing setbacks should be 5 feet minimum where the slope height is 15 feet or less, and vary up to 40 feet maximum where slope heights exceed 15 feet. The footing setbacks should be measured along a horizontal line projected from the lower outside bottom edges of the footings to the face of the adjacent descending slope.

Allowable Soil Bearing Capacities

Provided that site grading is performed in accordance with the "Earthwork" recommendations presented in this report, an allowable bearing value of 1,500 pounds per square foot is recommended for preliminary design of 24-inch-square pad footings and 12-inch-wide continuous footings founded at a minimum depth of 12 inches below the lowest adjacent final grade. This value may be increased by 20 percent for each additional one foot of width and/or depth, to a maximum value of 3,000 pounds per square foot. Recommended allowable bearing values include both dead and live loads, and may be increased by one-third when designing for short duration wind and seismic forces.

Footing Settlements

On-site native soil and bedrock materials are not subject to hydro-consolidation (collapse), consolidation under anticipated maximum overburden pressures, or earthquake-induced dynamic settlement. Therefore, foundation settlements are expected to be limited to compression of the near-surface foundation soils due to building loads. Under the recommended maximum allowable bearing capacity, the maximum total footing settlement due to building loads is estimated at ½ of an inch, and maximum differential settlement is estimated at ¼ inch over a span of 40 feet. The majority of this estimated footing settlement will occur during building construction or shortly thereafter as the loads are applied.

Lateral Resistance

Provided that site grading is performed in accordance with our "Earthwork" recommendations, a passive earth pressure increasing at a rate of 250 pounds per square foot per foot of depth, to a maximum value of 2,500 pounds per square foot, may be used to determine lateral bearing resistance for building foundations. In addition, a coefficient of friction of 0.35 times the dead load forces may be used between concrete and the supporting soil to determine lateral sliding resistance. An increase of one-third of the above values may also be used when designing for short duration wind and seismic forces.

The above values are based on footings placed directly against compacted fill or competent native soil or bedrock. In the case where footing sides are formed, all backfill placed against the footings should be compacted to at a minimum relative compaction of 90 percent of maximum dry density.

Preliminary Design Recommendations for Conventional Footings and Floor Slabs

Results of the laboratory expansion index tests performed in accordance with ASTM D 4829 indicate a majority of the on-site soil and bedrock materials exhibit Very Low and Low expansion potentials. Based on the distribution of the various geologic units within the site and the anticipated grading, it is expected that upon the completion of rough grading that the majority of the soils underlying the building sites will exhibit a Very Low or Low expansion potential. However, it is also anticipated that the foundation soils underlying some building sites may exhibit a Medium expansion potential.

Section 1808.6.2 of the 2013 CBC specifies that slab-on-ground foundations (floor slabs) resting on expansive soils should be designed in accordance with Wire Reinforcement Institute (WRI) publication "Design of Slab-on Ground Foundation," that was last updated in 1996. The design procedures outlined in the WRI publication are based on the expansion potential and the weighted plasticity index of the different soil layers existing within the upper 15 feet of each building site. Therefore, since the individual lots will be underlain by soil and bedrock materials with variable expansion potentials, final foundation design recommendations should be provided by the project geotechnical consultant on a lot-by-lot basis and should be based on the actual expansion potentials and weighted plasticity indices of the soil and bedrock materials underlying each individual lot. However, the following recommendations are provided for preliminary design purposes.

Very Low Expansion Potential (EI of 20 or Less)

For foundation soils that exhibit expansion potentials that are within the Very Low range (Expansion Index of 20 or less), the design of slabs-on-grade is considered to be exempt from the procedures outlined in Sections 1803.5.3 and 1808.6.2 of the 2013 CBC and may be performed using any method deemed rational and appropriate by the project structural engineer. However, the following minimum recommendations are presented herein for conditions where the project design team may require geotechnical engineering guidelines for design and construction of footings and slabs on-grade.

The design and construction recommendations that follow are based on the above non-expansive soil conditions and may be considered for reducing the effects of variability in composition and behavior within the site soils and long-term differential settlement. These recommendations have been developed on the basis of the previous experience of this firm on projects with similar soil conditions. Although construction performed in accordance with these recommendations has been found to reduce post-construction movement and/or distress, they generally do not positively eliminate all potential effects of variability in soils characteristics and future settlement.

It should also be noted that the recommendations for reinforcement provided herein are performance-based and intended only as guidelines to achieve adequate performance under the anticipated soil conditions. The project structural engineer, architect and/or civil engineer should make appropriate adjustments to reinforcement type, size and spacing to account for internal concrete forces (e.g., thermal, shrinkage and expansion) as well as external forces (e.g., applied loads) as deemed necessary. Consideration should also be given to minimum design criteria as dictated by local building code requirements.

Conventional Slab-on-Grade (Very Low EI)

For foundation soils exhibiting a very low expansion potential, we recommend that footings and floor slabs be designed and constructed in accordance with the following minimum criteria.

Footings

1. Exterior continuous footings supporting one- and two-story structures should be founded at minimum depths of 12 and 18 inches below the lowest adjacent final grade, respectively. Interior continuous footings may be founded at a minimum depth of 10 inches below the tops of the adjacent finish floor slabs.

2. All continuous footings should have minimum widths of 12 and 15 inches for one- and two-story construction, respectively. All continuous footings should be reinforced with a minimum of two No. 4 bars, one top and one bottom.

3. A minimum 12-inch-wide grade beam founded at the same depth as adjacent footings should be provided across garage entrances. The grade beam should be reinforced with a similar manner as provided above.

4. Interior isolated pad footings, if required, should be a minimum of 24 inches square and founded at a minimum depth of 12 inches below the bottoms of the adjacent floor slabs. Pad footings should be reinforced with No. 4 bars spaced a maximum of 18 inches on centers, both ways, placed near the bottoms of the footings.

5. Exterior isolated pad footings intended for support of roof overhangs such as second-story decks, patio covers and similar construction should be a minimum of 24 inches square and founded at a minimum depth of 18 inches below the lowest adjacent final grade. The pad footings should be

reinforced with No. 4 bars spaced a maximum of 18 inches on centers, both ways, placed near the bottoms of the footings. Exterior isolated pad footings may need to be connected to adjacent pad and/or continuous footings via tie beams at the discretion of the project structural engineer.

6. The minimum footing dimensions and reinforcement recommended herein may be modified (increased or decreased) by the structural engineer responsible for foundation design based on his/her calculations, engineering experience and judgment.

Building Floor Slabs

1. Concrete floor slabs should be a minimum 4 inches thick and reinforced with No. 3 bars spaced a maximum of 24 inches on centers, both ways. Alternatively, the structural engineer may recommend the use of prefabricated welded wire mesh for slab reinforcement. For this condition, the welded wire mesh should be of sheet type (not rolled) and should consist of 6x6/W2.9xW2.9 (per the Wire Reinforcement Institute [WRI] designation) or stronger. All slab reinforcement should be supported on concrete chairs or brick to ensure the desired placement near mid-depth. Care should be exercised to prevent warping of the welded wire mesh between the chairs in order to ensure its placement at the desired mid-slab position.

2. Living area concrete floor slabs should be underlain with a moisture vapor retarder consisting of a minimum 10-mil-thick polyethylene or polyolefin membrane that meets the minimum requirements of ASTM E96 and ASTM E1745 for vapor retarders (such as Husky Orange Guard®, Stego® Wrap, or equivalent). All laps within the membrane should be sealed, and at least 2 inches of clean sand should be placed over the membrane to promote uniform curing of the concrete. To reduce the potential for punctures, the membrane should be placed on a pad surface that has been graded smooth without any sharp protrusions. If a smooth surface cannot be achieved by grading, consideration should be given to lowering the pad finished grade an additional inch and then placing a 1-inch-thick leveling course of sand across the pad surface prior to the placement of the membrane.

   At the present time, some slab designers, geotechnical professionals and concrete experts view the sand layer below the slab (blotting sand) as a place for entrapment of excess moisture that could adversely impact moisture-sensitive floor coverings. As a preventive measure, the potential for moisture intrusion into the concrete slab could be reduced if the concrete is placed directly on the vapor retarder. However, if this sand layer is omitted, appropriate curing methods must be implemented to ensure that the concrete slab cures uniformly. A qualified materials engineer with experience in slab design and construction should provide recommendations for alternative methods of curing and supervise the construction process to ensure uniform slab curing. Additional steps would also need to be taken to prevent puncturing of the vapor retarder during concrete placement.

3. Garage floor slabs should be a minimum 4 inches thick and reinforced in a similar manner as living area floor slabs. Garage slabs should also be poured separately from adjacent wall footings with a positive separation maintained using ¾-inch-minimum felt expansion joint material. To control the propagation of shrinkage cracks, garage floor slabs should be quartered with weakened plane joints.

4. Presaturation of the subgrade soils below floor slabs will not be required; however, prior to placing concrete, the subgrade soils below living area and garage floor slabs should be prewatered to promote uniform curing of the concrete and reduce the potential for development of shrinkage cracks.

5. The minimum dimensions and reinforcement recommended herein for building floor slabs may be modified (increased or decreased) by the structural engineer responsible for foundation design based on his/her calculations, engineering experience and judgment.

Low Expansion Potential (EI of 21` to 50)

Where foundation soils exhibit expansion potentials that are within the Low range (Expansion Index from 21 to 50), the site soils are classified as "expansive" as defined in Section 1803.5.3 of the 2013 CBC. The design of foundations and slabs-on-ground should therefore be performed in accordance with the procedures outlined in Sections 1808.6.1 and 1808.6.2 of the 2013 CBC, respectively.

General

Briefly, Section 1808.6.1 of the 2013 CBC requires that foundations placed on or within the active zone of expansive soils shall be designed to resist differential volume changes and to prevent structural damage to the supported structure. Section 1808.6.2 of the 2013 CBC requires that non-prestressed slabs-on-grade or mat foundations constructed on expansive soils be designed in accordance with *WRI/CRSI Design of Slab-on-Ground Foundations.*

> *The design and construction recommendations that follow are based on the above soil conditions (Low Expansion Potential) and may be considered for reducing the effects of variability in composition and behavior within the site soils and long-term differential settlement. These recommendations have been developed on the basis of the previous experience of this firm on projects with similar soil conditions. Although construction performed in accordance with these recommendations has been found to reduce post-construction movement and/or distress, they generally do not positively eliminate all potential effects of variability in soils characteristics and future settlement.*
>
> *It should also be noted that the recommendations for reinforcement provided herein are performance-based and intended only as guidelines to achieve adequate performance under the anticipated soil conditions. The project structural engineer, architect and/or civil engineer should make appropriate adjustments to reinforcement type, size and spacing to account for internal concrete forces (e.g., thermal, shrinkage and expansion) as well as external forces (e.g., applied loads) as deemed necessary. Consideration should also be given to minimum design criteria as dictated by local building code requirements.*

Conventional Slab-on-Grade System (Low EI)

Foundation soils exhibiting a Low expansion potential are considered expansive per Section 1803.5.3 of the 2013 CBC. Section 1808.6.2 of the 2013 CBC specifies that non-prestressed slab-on-grade foundations (floor slabs) constructed on expansive materials should be designed in accordance with the latest edition of the Wire Reinforcement Institute (WRI) publication "Design of Slab-on-Ground Foundations". The design procedures outlined in the WRI publication are based on the weighted plasticity index of the various soil layers existing within the upper 15 feet of the building site.

Based on limited laboratory testing by our firm, a weighted plasticity index of 20 can be assumed for the subject site. The WRI publication states that the weighted plasticity index of each building site should be modified (multiplied) by correction factors that compensate for the effects of sloping ground and the unconfined compressive strength of the supporting soil or bedrock materials. Since the building(s) will be constructed on level building pads, and in consideration of the estimated unconfined compressive strength of the onsite soils, it is recommended that the weighted plasticity index, as provided herein be multiplied by a factor of 1.2 in order to determine the value of the effective plasticity index (per Figure 9 of the WRI publication). In summary, it is recommended that an effective plasticity index of 24 be utilized by the project structural engineer to design slabs-on-ground with an interior grade beam system in accordance with the WRI publication.

Footings

1. Exterior continuous footings supporting one- and two-story structures should be founded at a minimum depth of 12 and 18 inches below the lowest adjacent final grade, respectively. Interior continuous footings may be founded at a minimum depth of 12 inches below the tops of the adjacent finish floor slabs.

2. All continuous footings should have minimum widths of 12 and 15 inches for one-story and two-story construction, respectively. All continuous footings should be reinforced with a minimum of two No. 4 bars, one top and one bottom.

3. A minimum 12-inch-wide grade beam founded at the same depth as adjacent footings should be provided across the garage entrances or similar openings (such as large doors or bay windows). The grade beam should be reinforced in a similar manner as provided above.

4. Interior isolated pad footings, if required, should be a minimum of 24 inches square and founded at a minimum depth of 12 inches below the bottoms of the adjacent floor slabs. Pad footings should be reinforced with No. 4 bars spaced a maximum of 18 inches on centers, both ways, placed near the bottoms of the footings.

5. Exterior isolated pad footings intended for support of roof overhangs such as second-story decks, patio covers and similar construction should be a minimum of 24 inches square, and founded at a

minimum depth of 18 inches below the lowest adjacent final grade. The pad footings should be reinforced with No. 4 bars spaced a maximum of 18 inches on centers, both ways, placed near the bottoms of the footings. Exterior isolated pad footings may need to be connected to adjacent pad and/or continuous footings via tie beams at the discretion of the project structural engineer.

6. The spacing and layout of the interior concrete grade beam system required below floor slabs should be determined by the project architect or structural engineer in accordance with the WRI publication using the effective plasticity index value provided previously.

7. The minimum footing dimensions and reinforcement recommended herein may be modified (increased or decreased subject to the constraints of Chapter 18 of the 2010 CBC) by the structural engineer responsible for foundation design based on his/her calculations and engineering experience and judgment.

Building Floor Slabs

1. Concrete floor slabs should be a minimum 4 inches thick and reinforced with No. 3 bars spaced a maximum of 18 inches on centers, both ways. Alternatively, the structural engineer may recommend the use of prefabricated welded wire mesh for slab reinforcement. For this condition, the welded wire mesh should be of sheet type (not rolled) and should consist of 6x6/W2.9xW2.9 (per the Wire Reinforcement Institute [WRI] designation) or stronger. All slab reinforcement should be supported on concrete chairs or brick to ensure the desired placement near mid-depth. Care should be exercised to prevent warping of the welded wire mesh between the chairs in order to ensure its placement at the desired mid-slab position.

2. Living area concrete floor slabs should be underlain with a moisture vapor retarder consisting of a minimum 10-mil-thick polyethylene or polyolefin membrane that meets the minimum requirements of ASTM E96 and ASTM E1745 for vapor retarders (such as Husky Orange Guard®, Stego® Wrap, or equivalent). All laps within the membrane should be sealed, and at least 2 inches of clean sand should be placed over the membrane to promote uniform curing of the concrete. To reduce the potential for punctures, the membrane should be placed on a pad surface that has been graded smooth without any sharp protrusions. If a smooth surface cannot be achieved by grading, consideration should be given to lowering the pad finished grade an additional inch and then placing a 1-inch-thick leveling course of sand across the pad surface prior to the placement of the membrane.

   At the present time, some slab designers, geotechnical professionals and concrete experts view the sand layer below the slab (blotting sand) as a place for entrapment of excess moisture that could adversely impact moisture-sensitive floor coverings. As a preventive measure, the potential for moisture intrusion into the concrete slab could be reduced if the concrete is placed directly on the vapor retarder. However, if this sand layer is omitted, appropriate curing methods must be implemented to ensure that the concrete slab cures uniformly. A qualified materials engineer with experience in slab design and construction should provide recommendations for alternative methods of curing and supervise the construction process to ensure uniform slab curing. Additional steps would also need to be taken to prevent puncturing of the vapor retarder during concrete placement.

3. Garage floor slabs should be a minimum 4 inches thick and reinforced in a similar manner as living area floor slabs. Garage slabs should also be poured separately from adjacent wall footings with a positive separation maintained using ¾-inch-minimum felt expansion joint materials. To control the propagation of shrinkage cracks, garage floor slabs should be quartered with weakened plane joints.

4. Prior to placing concrete, the subgrade soils below living area floor slabs should be prewatered to achieve a moisture content that is at least 1.2 times the optimum moisture content. This moisture should penetrate to a depth of approximately 12 inches into the subgrade.

5. The minimum dimensions and reinforcement recommended herein for building floor slabs may be modified (increased or decreased subject to the constraints of Chapter 18 of the 2010 CBC) by the structural engineer responsible for foundation design based on his/her calculations and engineering experience and judgment.

Medium Expansion Potential (EI 51 to 90)

Foundation soils exhibiting expansion potentials that are within the Medium range (EI from 51 to 90) are classified as "expansive" as defined in Section 1803.5.3 of the 2013 CBC. The design of foundations and slabs-on-ground should therefore be performed in accordance with the procedures outlined in Sections 1808.6.1 and 1808.6.2 of the 201 CBC, respectively.

General

Briefly, Section 1808.6.1 of the 2013 CBC requires that foundations placed on or within the active zone of expansive soils shall be designed to resist differential volume changes and to prevent structural damage to the supported structure. Section 1808.6.2 of the 201 CBC requires that non-prestressed slabs-on-grade or mat foundations constructed on expansive soils be designed in accordance with *WRI/CRSI Design of Slab-on-Ground Foundations.*

> *The design and construction recommendations that follow are based on the above soil conditions (Medium Expansion Potential) and may be considered for reducing the effects of variability in composition and behavior within the site soils and long-term differential settlement. These recommendations have been developed on the basis of the previous experience of this firm on projects with similar soil conditions. Although construction performed in accordance with these recommendations has been found to reduce post-construction movement and/or distress, they generally do not positively eliminate all potential effects of variability in soils characteristics and future settlement.*
>
> *It should also be noted that the recommendations for reinforcement provided herein are performance-based and intended only as guidelines to achieve adequate performance under the*

anticipated soil conditions. The project structural engineer, architect and/or civil engineer should make appropriate adjustments to reinforcement type, size and spacing to account for internal concrete forces (e.g., thermal, shrinkage and expansion) as well as external forces (e.g., applied loads) as deemed necessary. Consideration should also be given to minimum design criteria as dictated by local building code requirements.

Conventional Slab-on-Grade System (Medium EI)

Section 1808.6.2 of the 2013 CBC specifies that nonprestressed slab-on-grade foundations (floor slabs) constructed on expansive materials should be designed in accordance with the latest edition of the Wire Reinforcement Institute (WRI) publication "Design of Slab-on-Ground Foundations". The design procedures outlined in the WRI publication are based on the weighted plasticity index of the various soil layers existing within the upper 15 feet of the building site.

Based on our experience and limited laboratory testing by our firm, a weighted plasticity index of 25 can be assumed for the subject site. The WRI publication states that the weighted plasticity index of each building site should be modified (multiplied) by correction factors that compensate for the effects of sloping ground and the unconfined compressive strength of the supporting soil or bedrock materials. Since the buildings will be constructed on level building pads, and in consideration of the estimated unconfined compressive strength of the on-site soils, it is recommended that the weighted plasticity index (25) be multiplied by a factor of 1.2 in order to determine the value of the effective plasticity index (per Figure 9 of the WRI publication). In summary, it is recommended that an effective plasticity index of 30 be utilized by the project structural engineer to design slabs-on-ground with an interior grade beam system in accordance with the WRI publication.

Footings

1. Exterior continuous footings supporting one- and two-story structures should be founded at a minimum depth of 18 inches below the lowest adjacent final grade. Interior continuous footings may be founded at a minimum depth of 12 inches below the tops of the adjacent finish floor slabs.

2. All continuous footings should have minimum widths of 12 and 15 inches for one-story and two-story construction, respectively. All continuous footings should be reinforced with a minimum of four No. 4 bars, two top and two bottom.

3. A minimum 12-inch-wide grade beam founded at the same depth as adjacent footings should be provided across garage entrances. The grade beam should be reinforced in a similar manner as provided above.

4. Interior isolated pad footings, if required, should be a minimum of 24 inches square and founded at a minimum depth of 12 inches below the bottoms of the adjacent floor slabs. Pad footings should be reinforced with a minimum of No. 4 bars spaced a maximum of 18 inches on centers, both ways, placed near the bottoms of the footings.

5. Exterior isolated pad footings intended for support of roof overhangs such as second-story decks, patio covers and similar construction should be a minimum of 24 inches square, and founded at a minimum depth of 18 inches below the lowest adjacent final grade. The pad footings should be reinforced with No. 4 bars spaced a maximum of 18 inches on centers, both ways, placed near the bottoms of the footings. Exterior isolated pad footings may need to connect to adjacent pad and/or continuous footings via tie beams at the discretion of the project structural engineer.

6. The spacing and layout of the interior concrete grade beam system required below floor slabs should be determined by the project architect or structural engineer in accordance with the WRI publication using the effective plasticity index value provided previously.

7. The minimum footing dimensions and reinforcement recommended herein may be modified (increased or decreased) by the structural engineer responsible for foundation design based on his/her calculations and engineering experience and judgment.

Building Floor Slabs

1. Concrete floor slabs should be a minimum 4 inches thick and reinforced with a minimum No. 3 bars spaced a maximum of 18 inches on centers for subgrade soils with an effective plasticity index (PI) of less than 20 and 15 inches on centers for subgrade soils with an effective plasticity index (PI) of 30 or greater, both ways. As an alternate, for conditions where the effective plasticity index of subgrade soils is less than 30, the structural engineer may recommend the use of prefabricated welded wire mesh for slab reinforcement. For this condition, the welded wire mesh should be of sheet type (not rolled) and should consist of 6x6/W2.9xW2.9 (per the Wire Reinforcement Institute [WRI] designation) or stronger. The use of prefabricated welded wire mesh is not recommended for conditions where subgrade soils effective plasticity index (PI) is equal or greater than 30. All slab reinforcement should be supported on concrete chairs or brick to ensure the desired placement near mid-depth. Care should be exercised to prevent warping of the welded wire mesh between the chairs in order to ensure its placement at the desired mid-slab position.

2. Living area concrete floor slabs should be underlain with a moisture vapor retarder consisting of a minimum 10-mil-thick polyethylene or polyolefin membrane that meets the minimum requirements of ASTM E96 and ASTM E1745 for vapor retarders (such as Husky Orange Guard®, Stego® Wrap, or equivalent). All laps within the membrane should be sealed, and at least 2 inches of clean sand should be placed over the membrane to promote uniform curing of the concrete. To reduce the potential for punctures, the membrane should be placed on a pad surface that has been graded smooth without any sharp protrusions. If a smooth surface cannot be achieved by grading, consideration should be given to lowering the pad finished grade an additional inch and then placing a 1-inch-thick leveling course of sand across the pad surface prior to the placement of the membrane.

At the present time, some slab designers, geotechnical professionals and concrete experts view the sand layer below the slab (blotting sand) as a place for entrapment of excess moisture that could adversely impact moisture-sensitive floor coverings. As a preventive measure, the potential for moisture intrusion into the concrete slab could be reduced if the concrete is placed directly on the vapor retarder. However, if this sand layer is omitted, appropriate curing methods must be implemented to ensure that the concrete slab cures uniformly. A qualified materials engineer with experience in slab design and construction should provide recommendations for alternative methods of curing and supervise the construction process to ensure uniform slab curing. Additional steps would also need to be taken to prevent puncturing of the vapor retarder during concrete placement.

3. Garage floor slabs should be a minimum 4 inches thick and reinforced in a similar manner as living area floor slabs. Garage slabs should also be poured separately from adjacent wall footings with a positive separation maintained using ¾-inch-minimum felt expansion joint materials. To control the propagation of shrinkage cracks, garage floor slabs should be quartered with weakened plane joints.

4. Prior to placing concrete, the subgrade soils below living area floor slabs should be prewatered to achieve a moisture content that is at least 1.3 times the optimum moisture content. This moisture should penetrate to a depth of approximately 18 inches into the subgrade.

5. The minimum dimensions and reinforcement recommended herein for building floor slabs may be modified (increased or decreased) by the structural engineer responsible for foundation design based on his/her calculations, engineering experience and judgment.

Preliminary Retaining Wall Design Recommendations

Allowable Bearing Values and Lateral Resistance

Retaining wall footings may be designed using the allowable soil bearing and lateral resistance values recommended previously for design of building footings. However, when calculating passive resistance, the upper 6 inches of the soils should be ignored in areas where the footings will not covered with concrete flatwork.

On-Site Soils Used for Backfill

On-site soils consisting predominately of clean sands or silty sands exhibiting a very low expansion potential and a sand equivalent (SE) value exceeding 30 are recommended for use as backfill behind retaining walls. These soil materials are considered well-suited for use as backfill behind retaining walls provided they are cleared of cobbles exceeding a maximum dimension of 3 inches. Active earth pressures equivalent to fluids having densities of 35 and 51 pounds per cubic foot may be used for design of cantilevered walls retaining a level backfill and ascending 2:1 backfill, respectively. For walls that are restrained at the top, at-rest earth pressures of 53 and 78 pounds per cubic foot (equivalent fluid pressures) should be used. The above values are for retaining walls that have been supplied with a proper subdrain system. All walls should be designed to support any adjacent structural surcharge loads imposed by other nearby walls or footings in addition to the above-recommended active and at-rest earth pressures.

Drainage and Waterproofing

Perforated pipe and gravel subdrains should be installed behind all retaining walls to prevent entrapment of water in the backfill. Perforated pipe should consist of 4-inch-minimum diameter PVC Schedule 40, or ABS SDR-35, with the perforations lain down. The pipe should be encased in a 1-foot-wide column of 3/4-inch to 1½-inch open-graded gravel. If on-site sandy soils are used as backfill, the open-graded gravel should extend above the wall footings to a minimum height of 1-foot above the footing. The open-graded gravel should be completely wrapped in filter fabric consisting of Mirafi 140N, or equivalent. Solid outlet pipes should be connected to the subdrains and then routed to a suitable area for discharge of accumulated water. The portions of retaining walls supporting backfill should be coated with an approved waterproofing compound or covered with a similar material to inhibit infiltration of moisture through the walls.

Wall Backfill

Where on-site soils used for backfill, they should be placed in approximately 6- to 8-inch-thick maximum lifts, watered as necessary to achieve near optimum moisture conditions, and then mechanically compacted in place to a minimum relative compaction of 90 percent. Flooding or jetting of the backfill materials should be avoided. A representative of the project geotechnical consultant should observe the backfill procedures and test the wall backfill to verify adequate compaction.

Preliminary Recommendations for Masonry Block Walls

Construction Near the Tops of Descending Slopes

Continuous footings for masonry screen walls proposed on or within 5 feet from the top of a descending slope should be deepened such that a horizontal clearance of 5 feet or more is maintained between the outside bottom edge of the footings and the slope face. The footings should be reinforced with two No. 4 bars, one top and one bottom, or as recommended by the structural engineer..

Construction on Level Ground

Where masonry screen walls are proposed on level ground and 5 or more feet from the tops of descending slopes, the footings for these walls may be founded at a depth of 12 inches or more below the lowest adjacent final grade. These footings should also be reinforced with two No. 4 bars, one top and one bottom, or as recommended by the structural engineer.

Construction Joints

In order to mitigate the potential for unsightly cracking related to the effects of differential settlement, positive separations (construction joints) should be provided in the walls at horizontal intervals of approximately 25 feet and at each corner. The separations should be provided in the blocks only and not extend though the footings. The footings should be placed monolithically with continuous rebars to serve as effective grade beams along the full lengths of the walls.

Preliminary Recommendations for Exterior Concrete Flatwork

General

It is expected that a majority of the as-graded building pads will be underlain with subgrade soils exhibiting a very low or low expansion potential and some being underlain with subgrade soils exhibiting a medium low expansion potential. The following preliminary design recommendations are provided for concrete flatwork depending on the expansion potential of the subgrade soils.

Thickness and Joint Spacing

1. Very Low and Low Expansion Potentials

   To reduce the potential of unsightly cracking, concrete walkways, patio-type slabs, large decorative slabs and concrete subslabs to be covered with decorative pavers should be at least 4 inches thick and provided with construction joints or expansion joints every 6 feet or less. Private driveways that will be designed for the use of passenger cars for access to private garages should also be at least 4 inches thick and provided with construction joints or expansion joints every 10 feet or less. Concrete pavement that will be designed based on an unlimited number of applications of an 18-kip single-axle load in public access areas, segments of roads that will be paved with concrete (such as bus stops and cross-walks) or access roads that will be subject to heavy truck loadings should have a minimum thickness of 5 inches and be provided with control joints spaced at maximum 10-foot intervals. A modulus of subgrade reaction of 125 pounds per cubic foot may be used for design of the public and access roads.

2. Medium Expansion Potential

   Concrete walkways, patio-type slabs, large decorative slabs and concrete subslabs to be covered with decorative pavers should be at least 4 inches thick and provided with construction joints or expansion joints every 6 feet or less. Private driveways that will be designed for the use of passenger cars for access to private garages should also be at least 5 inches thick and provided with construction joints or expansion joints every 10 feet or less. Concrete pavement that will be designed based on an unlimited number of applications of an 18-kip single-axle load in public access areas or access roads that will be subject to heavy truck loadings should have a minimum thickness of 6 inches and be provided with control joints spaced at maximum 10-foot intervals. A modulus of subgrade reaction of 100 pounds per cubic foot may be used for design of the public and access roads.

Reinforcement

1. Very Low and Low Expansion Potentials

   All concrete flatwork having their largest plan-view panel dimension exceeding 10 feet should be reinforced with a minimum of No. 3 bars spaced 24 inches on centers, both ways. Alternatively, the slab reinforcement may consist of welded wire mesh of the sheet type (not rolled) with 6x6/W1.4xW1.4 designation in accordance with the Wire Reinforcement Institute (WRI). The reinforcement should be properly positioned near the middle of the slabs.

2. Medium Expansion Potential

   All concrete walkways, patio-type slabs, large decorative slabs, concrete subslabs to be covered with decorative pavers and private driveways that will be designed for the use of passenger cars for access to private garages should be reinforced with a minimum of No. 3 bars spaced 18 inches on centers, both ways. Alternatively, the slab reinforcement may consist of welded wire mesh of the sheet type with 6x6/W2.9xW2.9 designation in accordance with the Wire Reinforcement Institute (WRI). Concrete pavement that will be designed based on an unlimited number of applications of an 18-kip single-axle load in public access areas, segments of road that will be paved with concrete (such as bus stops and cross-walks) or access roads that will be subject to heavy truck loadings should be reinforced with a minimum of No. 3 bars spaced 18 inches on centers, both ways. Alternatively, the slab reinforcement may consist of welded wire mesh of the sheet type with 6x6/W2.9xW2.9 designation in accordance with the Wire Reinforcement Institute (WRI). The reinforcement should be properly positioned near the middle of the slabs. All reinforcements should continue through the joints.

Subgrade Preparation

1. Compaction

   To reduce the potential for distress to concrete flatwork, the subgrade soils below concrete flatwork areas to a minimum depth of 12 inches (or deeper, as either prescribed elsewhere in this report or determined in the field) should be moisture conditioned to at least equal to, or slightly greater than, the optimum moisture content and then compacted to a minimum relative compaction of 90 percent. Where concrete public roads, concrete segments of roads and/or concrete access driveways are proposed, the upper 6 inches of subgrade soil should be compacted to a minimum 95 percent relative compaction.

2. Pre-Moistening

   As a further measure to reduce the potential for concrete flatwork cracking, subgrade soils should be thoroughly moistened prior to placing concrete. The moisture content of the soils should be at least 1.2 times the optimum moisture content and penetrate to a minimum depth of 12 inches into the subgrade. Flooding or ponding of the subgrade is not considered feasible to achieve the above moisture conditions since this method would likely require construction of numerous earth berms to contain the water. Therefore, moisture conditioning should be achieved with sprinklers or a light spray applied to the subgrade over a period of few to several days just prior to pouring concrete. Pre-watering of the soils is intended to promote uniform curing of the concrete, reduce the development of shrinkage cracks and reduce the potential for differential expansion pressure on freshly poured flatwork. A representative of the project geotechnical consultant should observe and verify the density and moisture content of the soils, and the depth of moisture penetration prior to pouring concrete.

Corrosivity Screening

As a screening level study, limited chemical and electrical tests were performed on representative samples of onsite soils to identify potential corrosive characteristics of these soils. The following sections present the test results and an interpretation of current codes and guidelines that are commonly used in our industry as they relate to the adverse impact of chemical contents of the site soils and their associated moisture on various components of the proposed structures in contact with site soils.

A variety of test methods are available to quantify corrosive potential of soils for various elements of construction materials. Depending on the test procedures adopted, characteristics of the leachate that is used to extract the target chemicals from the soils and the test equipment; the results can vary appreciably for different test methods in addition to those caused by variability in soil composition. The testing procedures referred to herein are considered to be typical for our industry and have been adopted and/or approved by many public or private agencies. In drawing conclusions from the results of our chemical and electrical laboratory testing and providing mitigation guidelines to reduce the detrimental impact of corrosive site soils on various components of the structure in contact with site soils, heavy references were made to 2013 CBC and American Concrete Institute, 2011 Structural Concrete Building Code (ACI 318-11). Where relevant information was not available in these codes, references were made to guidelines developed by California Department of Transportation (Caltrans), mainly because their risk tolerance for highway bridges are considered comparable to those for residential or commercial structures and that Post Tensioning Institute (PTI), in part, accepts and uses Caltrans' relevant corrosivity criteria for post-tensioned slabs on-grade.

It should be noted that Petra does not practice corrosion engineering; therefore, the test results, opinion and engineering judgment provided herein should be considered as general guidelines only. Additional analyses would be warranted, especially, for cases where buried metallic building materials (such as copper and cast or ductile iron) in contact with site soils are planned for the project. In many cases, the project geotechnical engineer is not informed of these choices. Therefore, for conditions where such elements are considered, we recommend that the project design professionals (i.e., the architect and/or structural engineer) consider recommending a qualified corrosion engineer to conduct additional sampling and testing of near-surface soils during the final stages of site grading to provide a complete assessment of soil corrosivity. Recommendations to mitigate the detrimental effects of corrosive soils on buried metallic and other building materials that may be exposed to corrosive soils should be provided by the corrosion engineer as deemed appropriate.

Concrete in Contact with Site Soils

Soils containing soluble sulfates beyond certain threshold levels as well as acidic soils are considered to be detrimental to long-term integrity of concrete placed in contact with such soils. For the purpose of this study, soluble sulfates (SO_4) concentration in soils determined in accordance with California Test Method No. 417. The soil soluble sulfate severity rating is adopted from ACI 318 publication. Soil acidity, as indicated by hydrogen-ion concentration (pH), was determined in accordance with California Test Method No. 643. The soil acid severity rating is adopted from The United States Department of Agriculture, Natural Resources Conservation Service classification.

The results of our limited in-house laboratory tests indicate that on-site soils contain a water-soluble sulfate content of less than 0.10 percent by weight Based on Article 1904.1 of Section 1904 of the 2013 CBC, concrete that will be exposed to sulfates in site soil should be assigned exposure classes in accordance with the durability requirements of ACI 318.

Based on the test results and in reference to Table 4.2.1 of ACI 318-11, an exposure class of **S0** is appropriate for onsite soils. Accordingly, a severity level of **Not Applicable** for exposure to sulfate may be expected for concrete placed in contact with the onsite soil materials. As such, Table 4.3.1 of ACI 318-11 provides that no restriction for cement type or maximum water-cement ratio for the fresh concrete would be required. However, this table indicates that the concrete minimum unconfined compressive strength should not be less than 2,500 psi.

Further, the results of limited in-house testing of representative samples indicate that soils within the subject site are neutral with respect to pH (pH of 7.0 and 7.2). Based on this finding and according to Section 8.22.2 of Caltrans' 2003 Bridge Design Specifications (2003 BDS) requirements (which consider the combined effects of soluble sulfates and soil pH), a commercially available Type II Modified cement may be used.

The guidelines provided herein should be evaluated and confirmed, or modified, in its entirety by the project structural engineer and the contractor responsible for concrete placement for concrete used in exterior and interior footings, interior slabs on-ground, garage slabs, walls foundation and concrete exposed to weather such as driveways, patios, porches, walkways, ramps, steps, curbs, etc.

Metals Encased in Concrete

Soils containing a soluble chloride concentration beyond a certain threshold level are considered corrosive to metallic elements such as reinforcement bars, tendons, cables, bolts, etc. that are encased in concrete that, in turn, is in contact with such soils. For the purpose of this study, soluble chlorides (Cl) in soils were determined in accordance with California Test Method No. 422.

Based on Article 1904.1 of Section 1904 of the 2013 CBC, concrete that will be exposed to chlorides from "*deicing chemicals, salt, saltwater, brackish water, seawater or spray from these sources, where concrete has steel reinforcement*" should be assigned exposure classes in accordance with the durability requirements of ACI 318. According to Table 4.2.1 of ACI 318-11, an exposure class of **C0** with a severity designation of **Not Applicable** is appropriate for reinforced concrete that remains dry or protected from moisture. Similarly, an exposure class of **C1** with a severity designation of **Moderate** is appropriate for reinforced concrete that is exposed to moisture but not to external sources of chlorides. And, lastly, an exposure class of **C2** with a severity designation of **Severe** is appropriate for reinforced concrete that is exposed to moisture and external sources of chlorides as enumerated above.

Based on our understanding of the project, it is our professional opinion that an exposure class of **C1** with a severity designation of **Moderate** is appropriate for a majority of reinforced concrete, to be placed at the site, that are in contact with site soils. It should be noted, however, that an exposure class of **C2** with a severity designation of **Severe** is more appropriate for reinforced concrete that is planned for pool walls and decking, should such features be considered for the project.

The results of limited screening tests performed indicate that onsite soil and bedrock materials contain water-soluble chloride concentrations of 73 to 85 parts per million (ppm). Article 1904.2 of Section 1904 of the 2013 CBC requires that concrete mixtures conform to the most restrictive maximum water-cementitious material ratios, maximum cementitious admixture, minimum air-entrainment and minimum specified concrete compressive strength requirements of ACI 318 based on the exposure classes assigned in Article 1904.1. No maximum water/cement ratio for the fresh concrete is prescribed by ACI 318 for class **C1** (or **Moderate** severity) exposure condition. However, Table 4.3.1 of ACI 318-11indicates that concrete minimum unconfined compressive strength, f'c, should not be less than 2,500 psi. For class **C2** (or **Severe**) exposure condition, Table 4.3.1 of ACI 318-11requires that the maximum water/cement ratio of the fresh concrete should not exceed 0.40 and concrete minimum unconfined compressive strength, f'c, should not be less than 5,000 psi.

The guidelines provided herein should be evaluated and confirmed, or modified, in its entirety by the project structural engineer for reinforced concrete placement for concrete used in exterior and interior footings, interior slabs on-ground, garage slabs walls foundation and concrete exposed to weather such as driveways, patios, porches, walkways, ramps, steps, curbs, etc.

Metallic Elements in Contact with Site Soils

Elevated concentrations of soluble salts in soils tend to induce low level electrical currents in metallic objects in contact with such soils. This process promotes metal corrosion and can lead to distress to building components that are in contact with site soils. The minimum electrical resistivity indicates the relative concentration of soluble salts in the soil and, therefore, can be used to estimate soil corrosivity with regard to metals. For the purpose of this investigation, the minimum resistivity in soils is measured in accordance with California Test Method No. 643.

The minimum electrical resistivity for onsite soil and bedrock materials was found to range from 1,900 to 2,000 ohm-cm based on limited testing. This result indicates that onsite soil and bedrock materials are **Highly Corrosive** to ferrous metals and copper. As such, any ferrous metal or copper components of the subject buildings (such as cast iron or ductile iron piping, copper tubing, etc.) that are expected to be placed in direct contact with site soils should be protected against detrimental effects of corrosive soils.

Storm Water Retention Basin

Boring HS-9 drilled in the area of the proposed storm water infiltration basin encountered approximately 20 feet of native alluvial soils overlying bedrock of the Sam Timoteo formation. Grain size analyses tests indicate the native soils and bedrock materials within the area of the proposed storm water retention basin may generally be classified as silty sand and clean sand, respectively. Based on their granular nature, average infiltration rates of the native soils and bedrock materials are estimated at approximately 0.5 and 5.0 inches/hour, respectively. However, infiltration testing is recommended to determine accurate infiltration rates for basin design.

REPORT LIMITATIONS

This report is based on the proposed project and geotechnical data as described herein. The materials encountered on the project site, described in other literature, and utilized in our laboratory investigation are believed representative of the total project area, and the conclusions and recommendations contained in this report are presented on that basis. However, soils can vary in characteristics between points of exploration, both laterally and vertically, and those variations could affect the conclusions and recommendations contained herein. As such, observation and testing by a geotechnical consultant during the construction phase of the project are essential to confirming the basis of this report. To provide the greatest degree of continuity between the design and construction phases, consideration should be given to retaining Petra for construction services.

This report has been prepared consistent with the level of care being provided by other professionals providing similar services at the same locale and in the same time period. This report provides our professional opinions and as such, they are not to be considered a guaranty or warranty. This report should be reviewed and updated after a period of one year or if the site conditions, ownership or project concept changes from that described herein. This report has not been prepared for use by parties or projects other than those named or described herein and may not contain sufficient information for other parties or other purposes.

This report is subject to review by the controlling authorities for this project. Should you have any questions, please do not hesitate to call.

Respectfully submitted,

PETRA GEOTECHNICAL, INC.

11/19/14

Alan Pace
Senior Associate Geologist
CEG 1952

Siamak Jafroudi, PhD
Senior Principal Engineer
GE 2024

SIAMAK JAFROUDI
No. GE002024

AP/SJ/CB/lm

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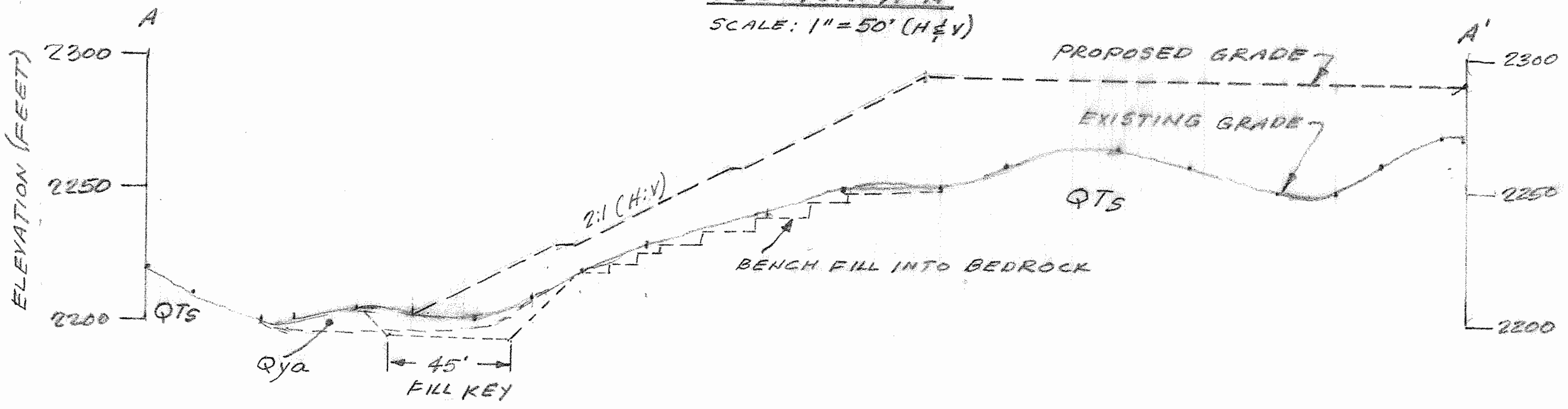
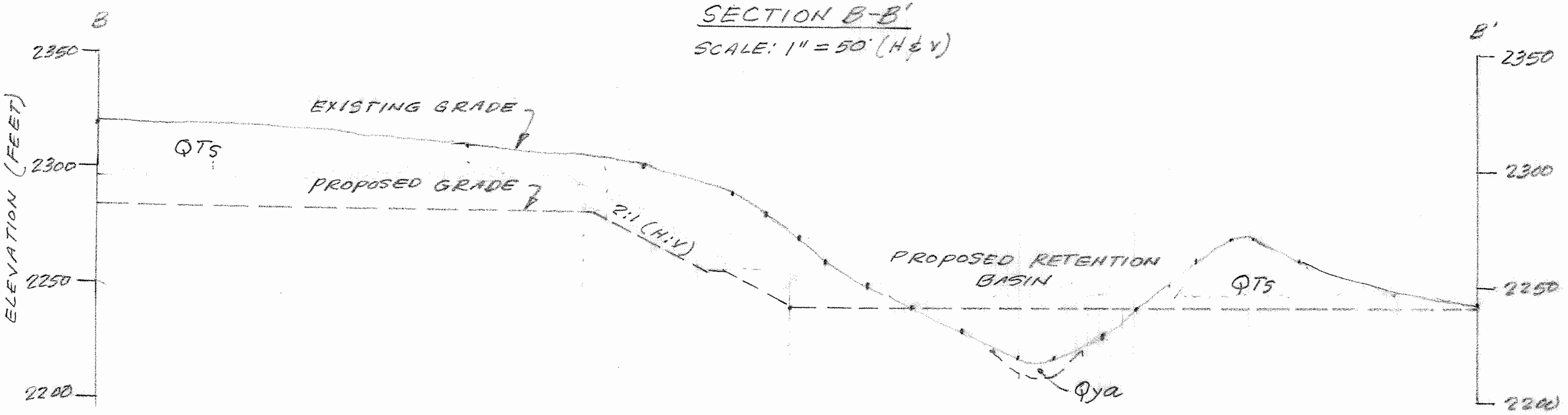
SECTION A-A'

SCALE: 1" = 50' (H & V)



SECTION B-B'

SCALE: 1" = 50' (H & V)



PETRA GEOTECHNICAL, INC.

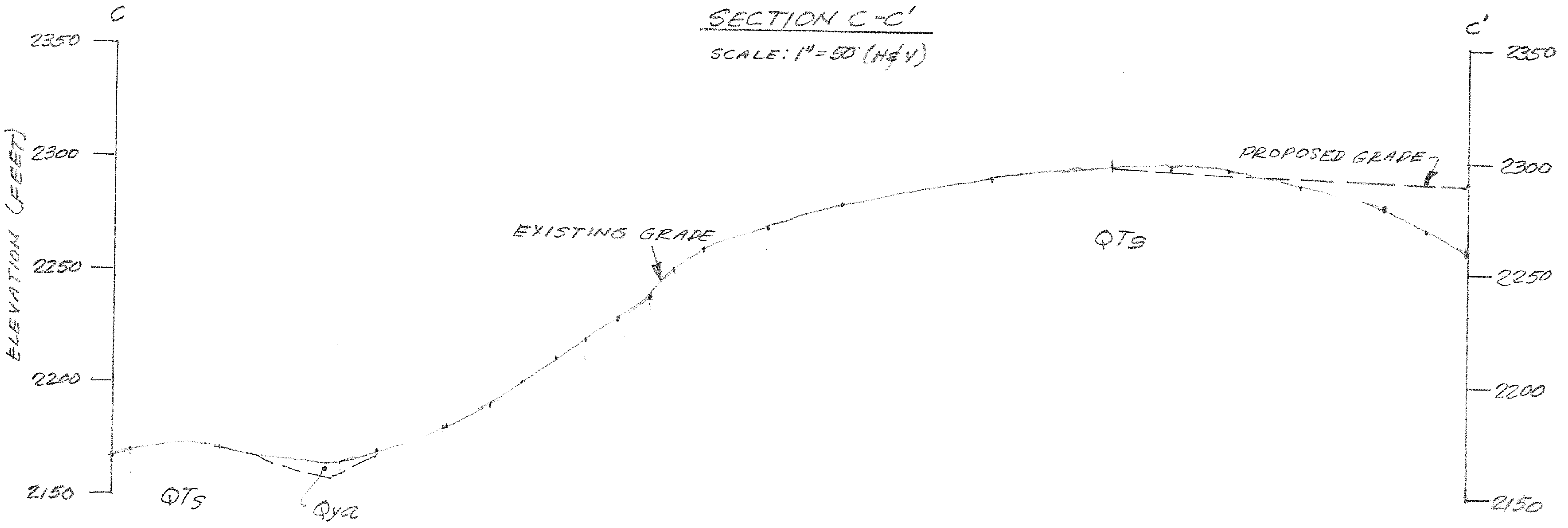
GEOLOGIC CROSS SECTIONS

J.N. 13-5466 NOV. , 2014

FIGURE 1

SECTION C-C'

SCALE: 1" = 50' (H&V)



PETRA GEOTECHNICAL, INC.
GEOLOGIC CROSS SECTION
J.N. 13-546 NOV., 2014
FIGURE 2

APPENDIX A

EXPLORATORY BORING AND TEST PIT LOGS

EXPLORATION LOG

Project: **Mesa Verde**		Boring No.:	**TP- 1**
Location: **Calimesa Blvd and I-10, Calimesa**		Elevation:	**+/- 2279**
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date:	**10/16/13**
Drill Method: **Backhoe**	Driving Weight:	Logged By:	**SKM**

Depth (Feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		YOUNGER ALLUVIUM (Qya) Sandy Silt (ML): Light reddish-brown; dry; soft; fine-grained sand; with few fine-grained gravel and some 1/8" voids.							
		@ 2': becomes slightly moist; firm to stiff.							
		@ 3': becomes moist.							
5		@ 5': with some 1/8-1/4" roots.							
10		@ 10': with larger roots 1".							
		@ 11': becomes stiff to very stiff; no roots.							
		Total Depth = 12' No Groundwater Encountered Test Pit Backfilled with Cuttings..							
15									
20									

PLATE A-1

EXPLORATION LOG

Project: **Mesa Verde**		Boring No.: **TP- 2**
Location: **Calimesa Blvd and I-10, Calimesa**		Elevation: **+/- 2271**
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date: **10/16/13**
Drill Method: **Backhoe**	Driving Weight:	Logged By: **SKM**

Depth (Feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		YOUNGER ALLUVIUM (Qva) Sandy Silt (ML): Light reddish-brown; dry; soft; fine-grained sand; with few fine-grained gravel and some 1/8" voids.							
		Silty Sand (SM): Light reddish-brown; dry; loose; fine-grained sand.							
5		**BEDROCK - San Timeteo (QTs)** Sandy Siltstone and Silty Sandstone: Light brown; slightly moist; moderately hard to hard; fine- and coarse-grained sand; massive; slightly fractured; moderately weathered; with some carbonate staining on fractures. @ 4': becomes slightly weathered.							
		Total Depth = 6.5 Feet No Groundwater Encountered Test Pit Backfilled with Cuttings..							
10									
15									
20									

EXPLORATION LOG

Project: **Mesa Verde**
Boring No.: **TP- 3**
Location: **Calimesa Blvd and I-10, Calimesa**
Elevation: **+/- 2265**
Job No.: **13-546**
Client: **BTEK Corporation/Paul Kim**
Date: **10/16/13**
Drill Method: **Backhoe**
Driving Weight:
Logged By: **SKM**

Depth (Feet)	Lithology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		YOUNGER ALLUVIUM (Qya) Sandy Silt (ML): Light brown; dry; soft; fine-grained sand; massive; with few fine-grained gravel and some 1/8" voids.							
		@ 2': becomes slightly moist and soft to firm.				▨			
		@ 3': becomes moist.				▨			
5						▨			
10		@ 10': with numerous cobbles (cobble lense) of weathered granitics..							
		BEDROCK - San Timeteo (QTs) Silty Sandstone: Light brown; moist; moderately hard; fine-grained sand; massive; slightly fractured; moderately weathered.							
		Total Depth = 11.5 Feet No Groundwater Encountered Boring Backfilled with Cuttings..							
15									
20									

EXPLORATION LOG

Project: **Mesa Verde**		Boring No.: **TP- 4**	
Location: **Calimesa Blvd and I-10, Calimesa**		Elevation: **+/- 2252**	
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date: **10/16/13**	
Drill Method: **Backhoe**	Driving Weight:	Logged By: **SKM**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		YOUNGER ALLUVIUM (Qva) Sandy Silt (ML): Medium brown; dry; soft; fine-grained sand; massive; with few fine-grained gravel and some 1/8" voids.							
		@1': becomes slightly moist with some root voids 1/8".							
		@ 3': becomes moist and firm.							
5									
		@ 6': with roots 1/2".							
		@7': becomes stiff.							
10									
		BEDROCK - San Timeteo (QTs) Cobble Conglomerate: Grayish-white; slightly moist; moderately hard; fine- to coarse-grained sand; massive; highly weathered.							
		moderately weathered.							
		Total Depth = 14 Feet No Groundwater Encountered Boring Backfilled with Cuttings..							
15									
20									

EXPLORATION LOG

Project: **Mesa Verde**		Boring No.:	**TP- 5**
Location: **Calimesa Blvd and I-10, Calimesa**		Elevation:	**+/- 2266**
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date:	**10/16/13**
Drill Method: **Backhoe**	Driving Weight:	Logged By:	**SKM**

Depth (Feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		YOUNGER ALLUVIUM (Qva) Sandy Silt (ML): Light brown to medium brown; dry; very soft; fine-grained sand; massive; with few fine-grained gravel. @ 2': becomes slightly moist to moist.							
5									
		BEDROCK - San Timeteo (QTs) Sandy Siltsone and silty pebbly sandstone: Light brown; slightly moist to moist; moderately hard; fine- and coarse-grained sand; massive; slightly fractured; moderately weathered; Sandstone has some pebbles , is friable and has some iron oxide staining..							
		Total Depth = 7 Feet No Groundwater Encountered Test Pit Backfilled with Cuttings..							
10									
15									
20									

EXPLORATION LOG

Project: **Mesa Verde**		Boring No.: **TP- 6**
Location: **Calimesa Blvd and I-10, Calimesa**		Elevation: **+/- 2233**
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date: **10/16/13**
Drill Method: **Backhoe**	Driving Weight:	Logged By: **SKM**

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		YOUNGER ALLUVIUM (Qva) Sandy Silt (ML): Medium brown; dry; very soft; fine-grained sand; massive; with some fine-grained gravel. @ 2': becomes moist.							
5									
10		**BEDROCK - San Timeteo (QTs)** Sandy Siltstone: Light brown; moist to very moist; moderately hard; fine- and coarse-grained sand; massive; moderately fractured; highly weathered. @ 10': becomes pebble conglomerate to pebbly sandstone; light grayish-brown, moderately hard; massive; moderately fractured; moderately weathered; friable with some cobbles. Total Depth = 11 Feet No Groundwater Encountered Test Pit Backfilled with Cuttings..							
15									
20									

Petra Geotechnical

EXPLORATION LOG

Project: **Mesa Verde**		Boring No.: **TP- 7**
Location: **Calimesa Blvd and I-10, Calimesa**		Elevation: **+/- 2265**
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date: **10/16/13**
Drill Method: **Backhoe**	Driving Weight:	Logged By: **SKM**

Depth (Feet)	Lith- ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		YOUNGER ALLUVIUM (Qya) Sandy Silt (ML): Medium brown; dry; very soft; fine-grained sand; massive; with some fine-grained gravel. @ 2': becomes moist.							
5									
		BEDROCK - San Timeteo (QTs) Sandy Siltstone and pebble conglomerate: Light brown; moist to very moist; moderately hard; fine- and coarse-grained sand; massive; moderately fractured; moderately weathered. @ 9': becomes slighlty weathered.				▨			
10									
		Total Depth = 10.5 Feet No Groundwater Encountered Test Pit Backfilled with Cuttings..							
15									
20									

EXPLORATION LOG

Project: **Mesa Verde**		Boring No.:	**TP- 8**
Location: **Calimesa Blvd and I-10, Calimesa**		Elevation:	**+/- 2330**
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date:	**10/16/13**
Drill Method: **Backhoe**	Driving Weight:	Logged By:	**SKM**

Depth (Feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		Residual Soil Silt (ML): Light brown; dry; very soft; massive.							
		BEDROCK - Relic Paleosol (Qrp) Carbonate K-Horizon Siltstone: Medium brown; slightly moist; soft to moderately hard; massive; highly weathered; has abundant carbonate.							
5		**BEDROCK - San Timeteo (QTs)** Sandy Siltstone: Light olive-brown; slightly moist; moderately hard to hard; massive; moderately fractured; slightly weathered; has some carbonate on fractures.							
		Total Depth = 6.5 Feet No Groundwater Encountered Test Pit Backfilled with Cuttings.							
10									
15									
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EXPLORATION LOG

Project: **Mesa Verde**		Boring No.:	**TP- 9**
Location: **Calimesa Blvd and I-10, Calimesa**		Elevation:	**+/- 2260**
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date:	**10/16/13**
Drill Method: **Backhoe**	Driving Weight:	Logged By:	**SKM**

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
	▨	**BEDROCK - Relic Paleosol (Qrp) Argillic B-Horizon** Sandy Silty Claystone: Dark brown; slightly moist; soft; massive; highly weathered; has dessicated into blocky structure. @ .5': becomes moderately weathered; moist; and moderately hard.				▒			
5	☰	**BEDROCK - San Timeteo (QTs)** Sandy Siltstone: Light olive-brown; moist; soft to moderately hard; massive; moderately fractured; highly weathered; has carbonate staining on fractures and a gradational contact with Qrp. @ 4.5': becomes moderately hard to hard; slightly fractured; and slighly weathered.							
		Total Depth = 5.5 Feet No Groundwater Encountered Test Pit Backfilled with Cuttings.							
10									
15									
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EXPLORATION LOG

Project: **Mesa Verde**		Boring No.:	**TP-10**
Location: **Calimesa Blvd and I-10, Calimesa**		Elevation:	**+/- 2255**
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date:	**10/16/13**
Drill Method: **Backhoe**	Driving Weight:	Logged By:	**SKM**

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
	▤	**BEDROCK - Relic Paleosol (Qrp) Carbonate K-Horizon** Sandy Siltstone and Silty Sandstone: Light grayish-brown; dry; soft to moderately hard; massive; highly weathered; has abundant 1-1.5" horizontal layers of carbonate deposits, generally massive but has sub-horizontal laminations in thin siltstone layer.							
	▤	**BEDROCK - San Timeteo (QTs)** Sandy Siltstone and Silty Sandstone: Light grayish-brown; dry; moderately hard to hard; massive; slightly fractured; slightly weathered.							
5		Total Depth = 5 Feet No Groundwater Encountered Test Pit Backfilled with Cuttings.							
10									
15									
20									

PLATE A-10

EXPLORATION LOG

Project:	**Mesa Verde**	Boring No.:	**TP-11**
Location:	**Calimesa Blvd and I-10, Calimesa**	Elevation:	**+/- 2270**
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date:	**10/16/13**
Drill Method: **Backhoe**	Driving Weight:	Logged By:	**SKM**

Depth (Feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
	▨	**BEDROCK - Relic Paleosol (Qrp) Argillic B-Horizon** Sandy Claystone: Dark brown; slightly moist; moderately hard; massive; highly weathered; has gradational contact with QTs.							
5	▤	**BEDROCK - San Timeteo (QTs)** Sandy Siltstone: Light grayish-brown; dry to slightly moist; moderately hard to hard; massive; slightly fractured; slightly weathered; has abundant carbonate deposits and trace igneous pebbles. @ 3.5': becomes hard and no carbonate. @ 6': becomes slightly moist.							
10		Total Depth = 9 Feet No Groundwater Encountered Test Pit Backfilled with Cuttings.							
15									
20									

PLATE A-11

EXPLORATION LOG

Project: **Mesa Verde**		Boring No.:	**TP-12**
Location: **Calimesa Blvd and I-10, Calimesa**		Elevation:	**+/- 2236**
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date:	**10/16/13**
Drill Method: **Backhoe**	Driving Weight:	Logged By:	**SKM**

Depth (Feet)	Lith- ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		YOUNGER ALLUVIUM (Qva) Sandy Silt (ML): Medium brown; dry to slightly moist; soft; fine-grained sand; massive. @ .5': becomes soft to stiff.							
5		@ 5': becomes stiff.							
10		**BEDROCK - San Timeteo (QTs)** Sandy Siltstone: Light grayish-brown; slightly moist; moderately hard to hard; massive; slightly fractured; highly weathered; has abundant carbonate deposits. @ 10.5': becomes moderately to slightly weathered.							
		Total Depth = 12 Feet No Groundwater Encountered Test Pit Backfilled with Cuttings..							
15									
20									

EXPLORATION LOG

Project: **Mesa Verde**		Boring No.:	**TP-13**
Location: **Calimesa Blvd and I-10, Calimesa**		Elevation:	**+/- 2265**
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date:	**10/16/13**
Drill Method: **Backhoe**	Driving Weight:	Logged By:	**SKM**

Depth (Feet)	Lith-ology	Material Description	Water	Samples Blows Per Foot	Core	Bulk	Laboratory Tests Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
	▥	**YOUNGER ALLUVIUM (Qya)** Sandy Silt (ML): Medium reddish-brown; dry to slightly moist; soft to firm; fine-grained sand; massive. @ 1': becomes slightly moist; stiff;and has roots 1/4 - 1/2".							
5	▥	@ 5': has no roots.							
10	▨	**BEDROCK - San Timeteo (QTs)** Pebbly Sandstone: Light reddish-brown; slightly moist to moist; moderately hard; massive; moderately weathered. @ 11': becomes a pebble conglomerate; light brown; and slightly weathered.				▨			
		Total Depth = 13 Feet No Groundwater Encountered Test Pit Backfilled with Cuttings..							
15									
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EXPLORATION LOG

Project: **Mesa Verde**
Boring No.: **TP-14**
Location: **Calimesa Blvd and I-10, Calimesa**
Elevation: **+/- 2285**
Job No.: **13-546**
Client: **BTEK Corporation/Paul Kim**
Date: **10/16/13**
Drill Method: **Backhoe**
Driving Weight:
Logged By: **SKM**

Depth (Feet)	Lith-ology	Material Description	Water	Samples Blows Per Foot	Core	Bulk	Laboratory Tests Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		TOPSOIL Sandy Silt (ML): Medium brown; dry; soft; fine-grained sand; massive; has some coarse grained sand/bedrock fragments.				▨			
		BEDROCK - Relic Paleosol (Qrp) Carbonate K-Horizon with scattered pebbles: Black; dry; moderately hard; massive; moderately fractured; highly weathered; has abundant carbonate deposits, upper 2.5' exhibits downhill creep fractures.. @ 3': becomes moderately weathered.				▨			
5		**BEDROCK - San Timeteo (QTs)** Sandy Siltstone and Pebbly Sandstone: Light greenish-brown; dry; moderately hard to hard; massive; slightly fractured; moderately weathered; pebbly sandstone is friable. Qrp/QTs contact is gradational..							
		Total Depth = 5.5 Feet No Groundwater Encountered Test Pit Backfilled with Cuttings..							
10									
15									
20									

EXPLORATION LOG

Project:	**Mesa Verde**	Boring No.:	**TP-15**
Location:	**Calimesa Blvd and I-10, Calimesa**	Elevation:	**+/- 2300**
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date:	**10/16/13**
Drill Method: **Backhoe**	Driving Weight:	Logged By:	**SKM**

Depth (Feet)	Lith-ology	Material Description	Water	Samples Blows Per Foot	Core	Bulk	Laboratory Tests Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		TOPSOIL Sandy Silt (ML): Medium brown; dry; soft; fine-grained sand; massive; has some coarse grained sand/bedrock fragments.							
		BEDROCK - Relic Paleosol (Qrp) Carbonate K-Horizon with scattered pebbles: Black; dry; moderately hard; massive; moderately fractured; highly weathered; has abundant carbonate deposits, upper 3.5' exhibits downhill creep fractures.. @ 3': becomes moderately weathered.							
5		**BEDROCK - San Timeteo (QTs)** Sandy Siltstone and Pebbly Sandstone: Light greenish-brown; dry; moderately hard to hard; massive; slightly fractured; moderately weathered; pebbly sandstone is friable. Qrp/QTs contact is gradational. Appx. B: N 70 E, 17 NW on erosional contact..							
		Total Depth = 6.5 Feet No Groundwater Encountered Test Pit Backfilled with Cuttings..							
10									
15									
20									

EXPLORATION LOG

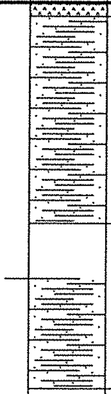
Project: **Mesa Verde**		Boring No.: **TP-16**	
Location: **Calimesa Blvd and I-10, Calimesa**		Elevation: **+/- 2265**	
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date: **10/16/13**	
Drill Method: **Backhoe**	Driving Weight:	Logged By: **SKM**	

Depth (Feet)	Lith- ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
	▨	**TOPSOIL** Sandy Clayey Silt (ML): Light reddish-brown to medium brown; dry to slightly moist; soft; fine-grained sand; massive; Has few coarse grained sand.							
5	▤	**BEDROCK - Relic Paleosol (Qrp) Argillic B-Horizon** Sandy Siltstone with Silty Sandstone lenses: Reddish-brown; dry to slightly moist; moderately hard to hard; massive; moderately weathered; Lenticular sandstones are friable.							
10	▤	**BEDROCK - San Timeteo (QTs)** Sandy Siltstone: Light brown; dry to slightly moist; moderately hard to hard; massive; slightly weathered. @ 11 ft becomes a pebble conglomerate (friable) with few cobbles..							
15 20		Total Depth = 12.5 Feet No Groundwater Encountered Test Pit Backfilled with Cuttings..							

PLATE A-16

EXPLORATION LOG

Project: **Mesa Verde**		Boring No.:	**TP-17**
Location: **Calimesa Blvd and I-10, Calimesa**		Elevation:	**+/- 2296**
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date:	**10/16/13**
Drill Method: **Backhoe**	Driving Weight:	Logged By:	**SKM**



Depth (Feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		TOPSOIL Sandy Silt (ML): Medium brown; dry; soft; fine-grained sand; massive; has some coarse grained sand/bedrock fragments.							
		BEDROCK - Relic Paleosol (Qrp) Carbonate K-Horizon Sandy Siltstone: White; dry; moderately hard; massive; moderately fractured; highly weathered; has abundant carbonate deposits, upper 2.5' exhibits downhill creep fractures.. @ 3': becomes moderately weathered.							
5		**BEDROCK - San Timeteo (QTs)** Sandy Siltstone and Pebbly Sandstone: Light greenish-brown; dry; moderately hard to hard; massive; slightly fractured; moderately weathered; pebbly sandstone is friable. Qrp/QTs contact is gradational..							
		Total Depth = 7 Feet No Groundwater Encountered Test Pit Backfilled with Cuttings..							
10									
15									
20									

EXPLORATION LOG

Project: **Mesa Verde**		Boring No.: **TP-18**
Location: **Calimesa Blvd and I-10, Calimesa**		Elevation: **+/- 2299**
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date: **10/16/13**
Drill Method: **Backhoe**	Driving Weight:	Logged By: **SKM**

Depth (Feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
	▨	**TOPSOIL** Sandy Clayey Silt (ML): Light reddish-brown; dry to slightly moist; soft; fine-grained sand; massive.							
	▤	**BEDROCK - Relic Paleosol (Qrp) Argillic B-Horizon** Sandy Clayey Siltstone: Light reddish-brown t medium brown; slightly moist; moderately hard to hard; massive; slightly weathered.							
5	▤	@ 6 ft. scattered pebbles and few cobbles.							
	▤	**BEDROCK - San Timeteo (QTs)** Sandy Siltstone: Light brown to tan; slightly moist; moderately hard to hard; massive; slightly weathered.							
10		Total Depth = 10 Feet No Groundwater Encountered Test Pit Backfilled with Cuttings..							
15									
20									

EXPLORATION LOG

Project: **Mesa Verde**		Boring No.: **TP-19**	
Location: **Calimesa Blvd and I-10, Calimesa**		Elevation: **+/- 2285**	
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date: **10/16/13**	
Drill Method: **Backhoe**	Driving Weight:	Logged By: **SKM**	

Depth (Feet)	Lithology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		TOPSOIL Sandy Clayey Silt (ML): Light reddish-brown; dry to slightly moist; soft; fine-grained sand; massive.							
		BEDROCK - Relic Paleosol (Qrp) Argillic B-Horizon Sandy Clayey Siltstone: Medium reddish-brown; dry to slightly moist; moderately hard; massive; moderately weathered.							
5		@ 5 ft. becomes moderately hard to hard and slightly weathered..							
10									
		BEDROCK - San Timeteo (QTs) Sandy Siltstone: Light brown; slightly moist to moist; moderately hard to hard; massive; slightly weathered.				▨			
		Total Depth = 13 Feet No Groundwater Encountered Test Pit Backfilled with Cuttings..							
15									
20									

EXPLORATION LOG

Project: **Mesa Verde**		Boring No.: **TP-20**	
Location: **Calimesa Blvd and I-10, Calimesa**		Elevation: **+/- 2252**	
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date: **10/16/13**	
Drill Method: **Backhoe**	Driving Weight:	Logged By: **SKM**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		YOUNGER ALLUVIUM (Qya) Sandy Silt (ML): Medium brown; dry; soft; fine- to coarse-grained sand; massive; with some fine-grained gravel lenses and some 1/8" voids.. @ 2': becomes slightly moist.							
5									
		@ 8': has no voids , becomes moist and soft to firm..							
10									
		@ 14 becomes firm to stiff..							
15									
		BEDROCK ? San Timeteo (QTs?) Sandy Siltstone with pebbles: Light brown; moist; moderately hard; massive; @ 18' probable top of weathered bedrock, has few cobbles..							
20		**BEDROCK - San Timeteo (QTs)** Pebble Conglomerate: Grayish-white; slightly moist; moderately hard to hard; massive; slightly weathered; conglomerate is cemented.. Total Depth = 20.5 Feet No Groundwater Encountered Boring Backfilled with Cuttings..							

EXPLORATION LOG

Project:	**Mesa Verde**	Boring No.:	**TP-21**
Location:	**Calimesa Blvd and I-10, Calimesa**	Elevation:	**+/- 2238**
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date:	**10/16/13**
Drill Method: **Backhoe**	Driving Weight:	Logged By:	**SKM**

Depth (Feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		YOUNGER ALLUVIUM (Qya) Sandy Silt (ML): Medium brown; dry; soft; fine to coarse gravel; massive with some horizontal gravel lenses; has 10-15% fine gravel lenses (horizontal layers).							
		@ 2' becomes moist and firm.				▨			
5						▨			
10						▨			
		@ 11.5' has a 1-1.5 ft thick cobble layer.							
15									
		BEDROCK - San Timeteo (QTs) Sandy Siltstone: Light olive brown; moist; moderately hard; massive; moderately weathered.							
		Total Depth = 16.5 Feet No Groundwater Encountered Boring Backfilled with Cuttings..							
20									

EXPLORATION LOG

Project: **Mesa Verde**
Boring No.: **TP-22**
Location: **Calimesa Blvd and I-10, Calimesa**
Elevation: **+/- 2227**
Job No.: **13-546**
Client: **BTEK Corporation/Paul Kim**
Date: **10/16/13**
Drill Method: **Backhoe**
Driving Weight:
Logged By: **SKM**

Depth (Feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		YOUNGER ALLUVIUM (Qva) Sandy Silt (ML): Light reddish-brown; dry; soft; fine-grained sand; massive; has 1/8" voids.. @ 2': becomes slightly moist. @ 4': has no voids , becomes slightly moist to moist and soft to firm..							
5									
10									
		@ 9' has a coarse gravel layer about 1 foot thick.							
15									
		@ 18' becomes coarse gravel with a few cobbles.							
20		Total Depth = 20 Feet No Groundwater Encountered Boring Backfilled with Cuttings..							

EXPLORATION LOG

Project:	**Mesa Verde**	Boring No.:	**TP-23**
Location:	**Calimesa Blvd and I-10, Calimesa**	Elevation:	**+/- 2254**
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date:	**10/16/13**
Drill Method: **Backhoe**	Driving Weight:	Logged By:	**SKM**

Depth (Feet)	Lith- ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		YOUNGER ALLUVIUM (Qva) Sandy Silt (ML): Light reddish-brown; dry; soft; fine-grained sand; massive; has 1/8" voids.. @ 2': becomes slightly moist.							
5		@ 4': has no voids , becomes slightly moist to moist and soft to firm..							
10									
15		**BEDROCK - San Timeteo (QTs)** Siltstone: Light brown; slightly moist; moderately hard; massive; moderately weathered. Total Depth = 15.5 Feet No Groundwater Encountered Boring Backfilled with Cuttings..							
20									

PLATE A-23

Petra Geotechnical

EXPLORATION LOG

Project:	**Mesa Verde**	Boring No.:	**TP-24**
Location:	**Calimesa Blvd and I-10, Calimesa**	Elevation:	**+/- 2266**
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date:	**10/16/13**
Drill Method: **Backhoe**	Driving Weight:	Logged By:	**SKM**

Depth (Feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		YOUNGER ALLUVIUM (Qya) Sandy Silt (ML): Light reddish-brown; dry; soft; fine-grained sand; massive; has 1/8" voids..							
5		**BEDROCK - San Timeteo (QTs)** pebbly Sandstone: Light brown; dry to slightly moist; moderately hard to hard; moderately weathered; pebbly sandstone is fiable..							
		Total Depth = 6 Feet No Groundwater Encountered Boring Backfilled with Cuttings..							
10									
15									
20									

EXPLORATION LOG - V2 13-546.GPJ PETRA.GDT 1/8/14

EXPLORATION LOG

Project: **Mesa Verde**		Boring No.:	**TP-25**
Location: **Calimesa Blvd and I-10, Calimesa**		Elevation:	**+/- 2250**
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date:	**10/16/13**
Drill Method: **Backhoe**	Driving Weight:	Logged By:	**SKM**

Depth (Feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		TOPSOIL Sandy Silt (ML): Light to medium brown; dry; soft; fine-grained sand; massive.							
		BEDROCK - San Timeteo (QTs) Siltstone and Pebbly Sandtone: Light brown and light grayish-white respectively; dry; soft to moderately hard; massive with horizontal lenses of friable pebbly sandstone; highly weathered. @ 3' becomes moderately hard to hard and moderately weathered..							
5									
		Total Depth = 6 Feet No Groundwater Encountered Boring Backfilled with Cuttings..							
10									
15									
20									

EXPLORATION LOG

Project: **Mesa Verde**		Boring No.:	**TP-26**
Location: **Calimesa Blvd and I-10, Calimesa**		Elevation:	**+/- 2228**
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date:	**10/16/13**
Drill Method: **Backhoe**	Driving Weight:	Logged By:	**SKM**

Depth (Feet)	Lith- ology	Material Description	Water	Samples Blows Per Foot	Samples Core	Samples Bulk	Laboratory Tests Moisture Content (%)	Laboratory Tests Dry Density (pcf)	Laboratory Tests Other Lab Tests
		YOUNGER ALLUVIUM (Qva) Sandy Silt (ML): Light brown; dry; fine- to coarse-grained sand; massive.							
5		@ 5' becomes slightly moist and has some cobbles.							
10		@ 10' becomes firm to stiff.							
		BEDROCK - San Timeteo (QTs) Pebble Conglomerate: Light grayish white; dry to slightly moist; moderately hard; highly weathered.							
15		@ 15' becomes moderately hard to hard and moderately weathered.							
		Total Depth = 16 Feet No Groundwater Encountered Boring Backfilled with Cuttings..							
20									

PLATE A-26

EXPLORATION LOG

Project:	**Mesa Verde**	Boring No.:	**TP-27**
Location:	**Calimesa Blvd and I-10, Calimesa**	Elevation:	**+/- 2258**
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date:	**10/16/13**
Drill Method: **Backhoe**	Driving Weight:	Logged By:	**SKM**

Depth (Feet)	Lith-ology	Material Description	Water	Samples Blows Per Foot	Samples Core	Samples Bulk	Laboratory Tests Moisture Content (%)	Laboratory Tests Dry Density (pcf)	Laboratory Tests Other Lab Tests
		YOUNGER ALLUVIUM (Qya) Sandy Silt (ML): Light reddish-brown; dry; soft; fine-grained sand; massive; has 1/8" voids.. @ 2': becomes slightly moist.							
5									
		@ 8': has no voids , becomes slightly moist to moist and soft to firm..							
10		@ 10' has a coarse gravel layer about 1 foot thick.							
15									
		BEDROCK? San Timeteo (QTs?) Sandy Siltstone: Light brown; slightly moist; soft to moderately hard; highly weathered; @ 18' probable top of weathered bedrock.							
20		Total Depth = 19 Feet No Groundwater Encountered Boring Backfilled with Cuttings..							

EXPLORATION LOG

Project:	**Mesa Verde**	Boring No.:	**TP-28**
Location:	**Calimesa Blvd and I-10, Calimesa**	Elevation:	**+/- 2244**
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date:	**10/16/13**
Drill Method: **Backhoe**	Driving Weight:	Logged By:	**SKM**

Depth (Feet)	Lith-ology	Material Description	Water	Samples Blows Per Foot	Core	Bulk	Laboratory Tests Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		YOUNGER ALLUVIUM (Qva) Sandy Silt (ML): Light brown; dry; soft; coarse-grained sand to fine gravel; massive; has 1/8" voids.. @ 2': becomes slightly moist.							
5									
		@ 7': has no voids , becomes slightly moist to moist and soft to firm..							
10									
		BEDROCK - San Timeteo (QTs) Pebbly Sandstone: Light brown; slightly moist; moderately hard; moderately weathered.							
15		Total Depth = 15 Feet No Groundwater Encountered Boring Backfilled with Cuttings..							
20									

EXPLORATION LOG

Project: **Mesa Verde**		Boring No.:	**TP-29**
Location: **Calimesa Blvd and I-10, Calimesa**		Elevation:	**+/- 2200**
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date:	**10/16/13**
Drill Method: **Backhoe**	Driving Weight:	Logged By:	**SKM**

Depth (Feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		SLOPEWASH (Qsw) Sandy Silt (ML): 1.5: Medium brown; dry; soft; fine- to coarse-grained sand; massive; slopewash has animal burrows.							
		BEDROCK - San Timeteo (QTs) Silty Sandstone: Light greenish-brown; slightly moist; soft to moderately hard; massive with horizontal lenses of friable pebbly sandstone; highly weathered; has some carbonate staining. 3.5 becomes moderately hard and moderately weathered.							
5									
		Total Depth = 6 Feet No Groundwater Encountered Boring Backfilled with Cuttings..							
10									
15									
20									

PLATE A-29

EXPLORATION LOG

Project:	**Mesa Verde**	Boring No.:	**TP-30**
Location:	**Calimesa Blvd and I-10, Calimesa**	Elevation:	**+/- 2278**
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date:	**10/16/13**
Drill Method: **Backhoe**	Driving Weight:	Logged By:	**SKM**

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		YOUNGER ALLUVIUM (Qya) Sandy Silt (ML): Medium brown; dry; soft; fine- to medium-grained sand; massive; has some 1/16 to 1/8" voids..							
		@ 2': becomes slightly moist and soft to firm.							
		@ 4': has no voids , becomes slightly moist to moist and firm..							
5									
		@ 9' becomes stiff to very stiff.							
10									
15		**BEDROCK - San Timeteo (QTs)** Sandy Siltstone to Silty Sandstone: Light brown; slightly moist; moderately hard; moderately weathered.							
		Total Depth = 16 Feet No Groundwater Encountered Boring Backfilled with Cuttings..							
20									

EXPLORATION LOG

Project:	**Mesa Verde**	Boring No.:	**TP-31**
Location:	**Calimesa Blvd and I-10, Calimesa**	Elevation:	**+/- 2310**
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date:	**10/16/13**
Drill Method: **Backhoe**	Driving Weight:	Logged By:	**SKM**

Depth (Feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
	▨	**BEDROCK - Relic Paleosol (Qrp) Argillic B-Horizon** Sandy Clayey Siltstone: Medium to dark brown; dry; soft; highly weathered.							
	▤	**BEDROCK - Relic Paleosol (Qrp) Carbonate K-Horizon** Sandy Siltstone and Silty Sandstone: Light brown; dry to slightly moist; moderately hard to hard; massive; highly weathered; has some carbonate staining, gradational contact with "argillic horizon".. @ 2' becomes moderately weathered.				▨			
5		Total Depth = 5 Feet No Groundwater Encountered Boring Backfilled with Cuttings..							
10									
15									
20									

EXPLORATION LOG

Project: **Mesa Verde**		Boring No.: **TP-32**	
Location: **Calimesa Blvd and I-10, Calimesa**		Elevation: **+/- 2203**	
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date: **10/16/13**	
Drill Method: **Backhoe**	Driving Weight:	Logged By: **SKM**	

Depth (Feet)	Lith- ology	Material Description	Water	Samples Blows Per Foot	Core	Bulk	Laboratory Tests Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		YOUNGER ALLUVIUM (Qya) Sandy Silt (ML): Light brown to medium brown; dry; soft; fine- to medium-grained sand; massive; has 1/8" voids..							
5									
		@ 6': has a 6 inch thick sandy lense.							
		@ 7': has no voids ,.							
		@ 9' has a coarse gravel layer about 1 foot thick.							
10									
		@ 10.5' becomes firm.							
		@ 13' has some cobbles.							
		@ 14' becomes slightly moist and firm to stiff.							
15									
		Total Depth = 18 Feet No Groundwater Encountered Boring Backfilled with Cuttings..							
20									

EXPLORATION LOG

Project: **Mesa Verde**
Boring No.: **TP-33**
Location: **Calimesa Blvd and I-10, Calimesa**
Elevation: **+/- 2240**
Job No.: **13-546**
Client: **BTEK Corporation/Paul Kim**
Date: **10/16/13**
Drill Method: **Backhoe**
Driving Weight:
Logged By: **SKM**

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		ARTIFICIAL FILL (af) Sandy Silt (ML): Light brown; dry; stiff; fine- to coarse-grained sand; Artificial fill associated with Sandlewood Drive grading..							
5		**YOUNGER ALLUVIUM (Qya)** Sandy Clayey Silt (ML): Medium to dark brown; slightly moist; soft; coarse-grained sand; massive; has 1/16' voids.							
		@ 9' no voids.							
10									
		@ 14' becomes firm to stiff..							
15		Total Depth = 6 Feet No Groundwater Encountered Boring Backfilled with Cuttings..							
20									

EXPLORATION LOG

Project:	**Mesa Verde**	Boring No.:	**TP-34**
Location:	**Calimesa Blvd and I-10, Calimesa**	Elevation:	**+/- 2287**
Job No.: **13-546**	Client: **BTEK Corporation/Paul Kim**	Date:	**10/16/13**
Drill Method: **Backhoe**	Driving Weight:	Logged By:	**SKM**

Depth (Feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		Residual Soil Breccia (ML): Light brown; dry; soft; fine-grained sand; massive.							
		YOUNGER ALLUVIUM (Qya) Sandy Silt (ML): Medium brown; dry; soft; fine- to coarse-grained sand; massive.							
5		**BEDROCK - San Timeteo (QTs)** Sandy Siltstone to Pebbly Sandstone: Light brown; slightly moist; moderately hard; massive; moderately weathered.							
		Total Depth = 5.5 Feet No Groundwater Encountered Boring Backfilled with Cuttings..							
10									
15									
20									

EXPLORATION LOG

Project:	**Mesa Verde Phase I**	Boring No.:	**HS-1**
Location:	**Calimesa**	Elevation:	**2330**
Job No.: **13-546**	Client: **BTEK Corporation**	Date:	**10/22/13**
Drill Method: **Hollow-Stem Auger**	Driving Weight: **140 lbs / 30 in**	Logged By:	**AGW**

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
	▨	**Older Alluvial Fan Deposits (Qoa):** Clayey SAND; yellowish white, dry, dense, fine sand, abundant caliche.		36	■	▨	15.9	97.1	
5	▨	very dense.		57	■		10.0	102.0	
		San Timeteo Formation (Tst) Silty SANDSTONE; medium brown, dry, very dense, fine sand, $CaCO_3$ concentrations.		42 50/4"	■		15.6	101.7	
		Sandy SILTSTONE; olive gray, moist, hard, fine sand, $CaCO_3$ concentrations.		94	■		10.5	112.8	
10		Sandy CLAYSTONE; olive gray, moist, hard, fine sand, $CaCO_3$ nodules.		58	■		10.9	113.9	
		Clayey SANDSTONE; olive gray, moist, very dense, fine to coarse sand, abundant caliche.							
15				36 50/5"	■	▨	14.0	119.3	
		Sandy SILTSTONE; yellowish brown, moist, hard, fine sand.				▨			
20				54	■		16.6	108.2	
25		medium brown.		63	■		19.5	109.2	
		Clayey SANDSTONE; reddish brown, moist, very dense, fine to coarse sand.							

EXPLORATION LOG

Project: **Mesa Verde Phase I**		Boring No.:	**HS-1**
Location: **Calimesa**		Elevation:	**2330**
Job No.: **13-546**	Client: **BTEK Corporation**	Date:	**10/22/13**
Drill Method: **Hollow-Stem Auger**	Driving Weight: **140 lbs / 30 in**	Logged By:	**AGW**

Depth (Feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
	▨			45 50/4"	■		10.9	124.7	
		Total Depth = 31.3 feet No groundwater, no caving.							

EXPLORATION LOG

Project: **Mesa Verde Phase I**
Boring No.: **HS-2**
Location: **Calimesa**
Elevation: **2290**
Job No.: **13-546**
Client: **BTEK Corporation**
Date: **10/22/13**
Drill Method: **Hollow-Stem Auger**
Driving Weight: **140 lbs / 30 in**
Logged By: **AGW**

Depth (Feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		Younger Alluvium (Qa): Clayey SAND, medium brown, slightly moist, medium dense, fine to medium sand.							
				19	■	▨	9.6	104.3	
5				14	■	▨	10.5	105.9	
				14	■		10.7	108.4	
		Silty SAND; medium brown, moist, medium dense, fine to medium sand.							
		loose.		9	■		16.3	96.2	
10		medium dense, trace clay.		14	■		13.6	105.1	
15		**San Timeteo Formation (Tst):** Poorly-graded SANDSTONE; dark yellowish brown, dry, very dense, fine to coarse sand.		63	■	▨	4.4	109.2	
20				50/3"	■	▨	2.9	108.5	
		Silty SANDSTONE; medium brown, slightly moist, very dense, fine to coarse sand, fine gravel.							
25				46 50/4"	■		13.0	119.2	

EXPLORATION LOG

Project: **Mesa Verde Phase I**
Boring No.: **HS-2**
Location: **Calimesa**
Elevation: **2290**
Job No.: **13-546**
Client: **BTEK Corporation**
Date: **10/22/13**
Drill Method: **Hollow-Stem Auger**
Driving Weight: **140 lbs / 30 in**
Logged By: **AGW**

Depth (Feet)	Lith- ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
	▨	dark brown, fine to coarse sand.		84	■		12.1	119.2	
		Total Depth = 31 feet No groundwater, no caving.							

PLATE A-38

Petra Geotechnical

EXPLORATION LOG

Project: **Mesa Verde Phase I**		Boring No.: **HS-3**	
Location: **Calimesa**		Elevation: **2225**	
Job No.: **13-546**	Client: **BTEK Corporation**	Date: **10/18/13**	
Drill Method: **Hollow-Stem Auger**	Driving Weight: **140 lbs / 30 in**	Logged By: **TAG**	

Depth (Feet)	Lith- ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
	⁞	**Older Alluvial Fan Deposits (Qoa):** Silty SAND; light brown, dry, loose, fine to coarse sand.							
	⁞	reddish brown, slightly moist, medium dense, fine sand, porous.		20	■		5.1	112.8	
5	⁞								
	⁞	trace coarse sand.		14	■		11.6	107.4	
	▨	Clayey SAND; reddish brown, slightly moist, medium dense, fine to coarse sand, trace fine gravel, slightly porous.							
10	▨			16	■	▒	8.9	118.1	
	⁞	Silty SAND; reddish brown, slightly moist, medium dense, fine to coarse sand, fine gravel.				▒			
15	⁞			29	■		6.8	120.0	
20	⁞	fine to coarse sand.		30	■		10.2	119.5	
25	⁞	trace fine gravel.		19	■		3.0	123.2	
	▨	Clayey SAND; dark reddish yellow, moist, medium dense.							

EXPLORATION LOG

Project: **Mesa Verde Phase I**		Boring No.: **HS-3**	
Location: **Calimesa**		Elevation: **2225**	
Job No.: **13-546**	Client: **BTEK Corporation**	Date: **10/18/13**	
Drill Method: **Hollow-Stem Auger**	Driving Weight: **140 lbs / 30 in**	Logged By: **TAG**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
	▨			14	▨		10.3		
35	▤	**San Timeteo Formation (Tst):** Clayey SANDSTONE; dark reddish brown, moist, loose, very hard.		29 50/4"	■		16.2	114.9	
40	▤	reddish yellow, fine sand.		51	▨		14.8		
	▤	Sandy SILTSTONE; yellowish to reddish brown, moist, hard, fine to coarse sand.							
45	▤			30 50/4"	■				
		Total Depth = 45.8 feet No groundwater, no caving.							

EXPLORATION LOG

Project: **Mesa Verde Phase I**		Boring No.: **HS-4**	
Location: **Calimesa**		Elevation: **2230**	
Job No.: **13-546**	Client: **BTEK Corporation**	Date: **10/18/13**	
Drill Method: **Hollow-Stem Auger**	Driving Weight: **140 lbs / 30 in**	Logged By: **TAG**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples Blows Per Foot	Core	Bulk	Laboratory Tests Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		Younger Alluvium (Qa): Clayey SAND; reddish brown, slightly moist, loose.							
		brown, dry, medium dense, fine to coarse sand.		13	■		6.8	91.8	
5									
		dark reddish brown, slightly moist, loose, porous.		10	■		9.1	104.0	
10		medium dense, fine sand.		17	■		6.3	109.2	
		Silty SAND; dark reddish brown, slightly moist, medium dense, fine to coarse sand.							
15				20	■		8.7	113.3	
20		dry, fine sand.		29	▨		13.2		
		San Timeteo Formation (Tst): Clayey SANDSTONE; dark reddish brown, moist, very dense, fine to coarse sand, slightly indurated.							
25				49 50/4"	■		13.1	123.0	

EXPLORATION LOG

Project: **Mesa Verde Phase I**
Boring No.: **HS-4**
Location: **Calimesa**
Elevation: **2230**
Job No.: **13-546**
Client: **BTEK Corporation**
Date: **10/18/13**
Drill Method: **Hollow-Stem Auger**
Driving Weight: **140 lbs / 30 in**
Logged By: **TAG**

Depth (Feet)	Lith- ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
	▨			34 50/4"	■		12.0	114.7	
		Total Depth = 30.8 feet No groundwater, no caving.							

PLATE A-42

Petra Geotechnical

EXPLORATION LOG

Project:	**Mesa Verde Phase I**	Boring No.:	**HS-5**
Location:	**Calimesa**	Elevation:	**2300**
Job No.: **13-546**	Client: **BTEK Corporation**	Date:	**10/18/13**
Drill Method: **Hollow-Stem Auger**	Driving Weight: **140 lbs / 30 in**	Logged By:	**TAG**

Depth (Feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		Older Alluvial Fan Deposits (Qoa): Clayey SAND; dark brown, slightly moist, loose, porous, roots and rootlets.							
		San Timeteo Formation (Tst) SILTSTONE; pale reddish brown, dry to slightly moist, hard, carbonate stringers.		28 50/5"	■		7.9	91.0	
5		SANDSTONE; pale yellowish brown, dry, very dense, fine sand.		66	■	▨	5.5	104.5	
		Sandy SILTSTONE; reddish brown, slightly moist, hard, fine sand.		33 50/3"	■	▨	15.4	95.5	
		Clayey SANDSTONE; dark reddish brown, dry, very dense, fine to coarse sand, trace fine gravel, carbonate stringers.		39 50/3"	■	▨	9.8	111.3	
10		SANDSTONE; reddish brown, dry, very dense, fine to coarse sand, trace gravel.		38 50/3"	■		9.0	116.6	
15		Clayey SANDSTONE; dark reddish brown, slightly moist, very dense.		39 50/4"	■		11.8	114.0	
20		Sandy SILTSTONE; yellowish brown, slightly moist, hard, fine to coarse sand.		34 50/4"	■	▨	15.8	113.2	
25		SANDSTONE; light gray to pale yellowish brown, slightly moist, very dense, interbedded with SILTSTONE.							

EXPLORATION LOG

Project:	**Mesa Verde Phase I**	Boring No.:	**HS-5**
Location:	**Calimesa**	Elevation:	**2300**
Job No.: **13-546**	Client: **BTEK Corporation**	Date:	**10/18/13**
Drill Method: **Hollow-Stem Auger**	Driving Weight: **140 lbs / 30 in**	Logged By:	**TAG**

Depth (Feet)	Lith-ology	Material Description	Water	Samples Blows Per Foot	Core	Bulk	Laboratory Tests Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
				93	■		2.8	114.6	DSU
35									
		Silty SANDSTONE; pale reddish yellow, slightly moist, very dense, slightly indurated.							
40				39 50/4"	■		11.2	105.6	
45		grayish brown, dry to slightly moist, fine to coarse sand, trace fine gravel.		50/5"	■		4.4	119.0	
50		No recovery.		50/3" 50/3"	▨				
		Total Depth = 50.5 feet No groundwater, no caving.							

PLATE A-44

Petra Geotechnical

EXPLORATION LOG

Project: **Mesa Verde Phase I**		Boring No.: **HS-6**
Location: **Calimesa**		Elevation: **2205**
Job No.: **13-546**	Client: **BTEK Corporation**	Date: **10/18/13**
Drill Method: **Hollow-Stem Auger**	Driving Weight: **140 lbs / 30 in**	Logged By: **TAG**

Depth (Feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		Older Alluvial Fan Deposits (Qoa): Silty SAND; light brown, dry, loose, fine to coarse sand.				▨			
5		pale reddish brown.		12	■		7.4	112.8	
10		reddish brown, slightly moist, medium dense.		14	■		7.6	106.8	
15		pale reddish brown, dry, medium dense, fine to coarse sand.		24	■		3.8	108.7	
20		reddish brown, slightly moist, trace fine gravel.		32	■		3.7	110.0	
25		pale reddish brown, moist, very dense.		70	■		10.3	120.4	
		San Timeteo Formation (Tst)							

PLATE A-45

Petra Geotechnical

EXPLORATION LOG

Project:	**Mesa Verde Phase I**	Boring No.:	**HS-6**
Location:	**Calimesa**	Elevation:	**2205**
Job No.: **13-546**	Client: **BTEK Corporation**	Date:	**10/18/13**
Drill Method: **Hollow-Stem Auger**	Driving Weight: **140 lbs / 30 in**	Logged By:	**TAG**

Depth (Feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		SANDSTONE; pale reddish yellow, moist, very dense, fine sand.		46 50/4"	■		13.4	109.4	
35		pale yellowish brown, dry, fine to coarse sand, trace gravel, interfingered with SILTSTONE.		50/5"	■		8.8	105.7	
		Sandy SILTSTONE; reddish yellow, moist, hard.							
40				43 50/4"	■		23.0	101.0	
		Total Depth = 40.8 feet No groundwater, no caving.							

EXPLORATION LOG

Project: **Mesa Verde Phase I**
Boring No.: **HS-7**
Location: **Calimesa**
Elevation: **2175**
Job No.: **13-546**
Client: **BTEK Corporation**
Date: **10/21/13**
Drill Method: **Hollow-Stem Auger**
Driving Weight: **140 lbs / 30 in**
Logged By: **AGW**

Depth (Feet)	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
	Younger Alluvium (Qa): Silty SAND; olive gray, slightly moist, loose, fine to medium sand, moderate porosity.				▨			
			10	■	▨	8.5	102.1	
5			28	■	▨	13.9	116.4	
	fine to coarse sand, trace clay.		46	■		14.5	117.2	
	Sandy SILT; olive brown, moist, very stiff.		30	■		22.9	100.9	
10	**San Timeteo Formation (Tst):** Clayey SANDSTONE; dark reddish brown, moist, loose, very hard.		36 50/3"	■	▨	17.2	109.5	
15	reddish brown to olive gray.		41 50/4"	■		12.1	118.3	
	Poorly-graded SANDSTONE; yellowish brown, dry, very dense, fine to coarse sand.							
20			50/3"	■		5.1	104.6	
25	fine to coarse sand, fine to coarse gravel.		50/3"	■		5.0	126.3	
	Sandy SILTSTONE; olive brown, moist, hard, fine sand.							

EXPLORATION LOG

Project:	**Mesa Verde Phase I**	Boring No.:	**HS-7**
Location:	**Calimesa**	Elevation:	**2175**
Job No.: **13-546**	Client: **BTEK Corporation**	Date:	**10/21/13**
Drill Method: **Hollow-Stem Auger**	Driving Weight: **140 lbs / 30 in**	Logged By:	**AGW**

Depth (Feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
				34 50/3"	■		16.9	111.1	
		Silty SANDSTONE; olive gray, moist, very dense, fine to medium sand.							
35				18 50/5"	■				
		Total Depth = 35.9 feet No groundwater, no caving.							

EXPLORATION LOG

Project:	**Mesa Verde Phase I**	Boring No.:	**HS-8**
Location:	**Calimesa**	Elevation:	**2325**
Job No.: **13-546**	Client: **BTEK Corporation**	Date:	**10/21/13**
Drill Method: **Hollow-Stem Auger**	Driving Weight: **140 lbs / 30 in**	Logged By:	**AGW**

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Older Alluvial Fan Deposits (Qoa): Clayey SAND; light yellowish brown, dry, dense, fine to medium sand, abundant caliche.				▨			
					■	▨	3.6	100.1	
5		**San Timeteo Formation (Tst)** Silty SANDSTONE; yellowish brown, dry, very dense, fine to medium sand, trace clay.			■		13.1	100.2	
		fine to coarse sand, CaCo3 nodules.			■		9.2	98.5	
		Clayey SANDSTONE; yellowish brown, dry, very dense, fine to medium sand, trace clay.			■		19.4	97.4	
10		Sandy SILTSTONE; yellowish brown, moist, hard, fine sand, caliche stringers.			■		17.0	101.3	
		Silty SANDSTONE; yellowish brown, slightly moist, very dense, fine to medium sand, abundant caliche.							
15					■		17.3	104.3	
		Sandy SILTSTONE; yellowish brown, moist, hard, fine to medium sand, caliche stringers.							
20					■		13.8	110.3	
		Silty SANDSTONE; yellowish brown, slightly moist, very dense, fine to coarse sand.							
25		Sandy SILTSTONE; olive brown, moist, hard, fine to medium sand.			■	▨	3.8	114.1	
		Poorly-graded SANDSTONE; yellowish brown, dry, very dense, fine to coarse sand.				▨			

EXPLORATION LOG

Project:	**Mesa Verde Phase I**	Boring No.:	**HS-8**
Location:	**Calimesa**	Elevation:	**2325**
Job No.: **13-546**	Client: **BTEK Corporation**	Date:	**10/21/13**
Drill Method: **Hollow-Stem Auger**	Driving Weight: **140 lbs / 30 in**	Logged By:	**AGW**

Depth (Feet)	Lith-ology	Material Description	Water	Samples Blows Per Foot	Core	Bulk	Laboratory Tests Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
					■		7.9	114.5	
		Silty SANDSTONE; yellowish brown, slightly moist, very dense, fine to medium sand.							
		Sandy SILTSTONE; yellowish brown, moist, hard, fine sand.							
35					■		23.9	101.4	
		Sandy CLAYSTONE; olive gray, dry, hard, fine to medium sand, abundant caliche.							
		Silty SANDSTONE; yellowish brown, slightly moist, very dense, fine to medium sand.							
40					■		15.0	114.3	
45									
50		dry, fine to coarse sand.			■		7.4	90.0	
55		slightly moist, fine to medium sand.			■				

EXPLORATION LOG

Project: **Mesa Verde Phase I**		Boring No.: **HS-8**
Location: **Calimesa**		Elevation: **2325**
Job No.: **13-546**	Client: **BTEK Corporation**	Date: **10/21/13**
Drill Method: **Hollow-Stem Auger**	Driving Weight: **140 lbs / 30 in**	Logged By: **AGW**

Depth (Feet)	Lith- ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
		Total Depth = 60.3 feet No groundwater, no caving.			■				

EXPLORATION LOG

Project: **Mesa Verde Phase I**		Boring No.: **HS-9**	
Location: **Calimesa**		Elevation: **2230**	
Job No.: **13-546**	Client: **BTEK Corporation**	Date: **10/21/13**	
Drill Method: **Hollow-Stem Auger**	Driving Weight: **140 lbs / 30 in**	Logged By: **AGW**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples: Blows Per Foot	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
		Younger Alluvium (Qa): Silty SAND; medium brown, dry, medium dense, fine to coarse sand, moderate porosity.		21	■		3.9	107.1	
5		dense, fine to coarse sand, fine gravel.		34	■	▨	4.5	108.1	
		medium dense.		29	■	▨	4.5	106.8	Sieve
		very dense.		54	■	▨	3.7	118.9	
10		dense.		40	■		4.0	108.8	
15				46	■		3.6	114.4	
20		**San Timeteo Formation (Tst)** Silty SANDSTONE; olive gray, dry, very dense, fine to coarse sand, fine to coarse gravel.		50/4"	■		2.5	118.1	Sieve
25		Poorly-graded SANDSTONE with silt; olive gray, dry, very dense, fine to coarse sand, fine to coarse gravel.		50/3"	■		2.3	125.3	

EXPLORATION LOG

Project: **Mesa Verde Phase I**		Boring No.: **HS-9**	
Location: **Calimesa**		Elevation: **2230**	
Job No.: **13-546**	Client: **BTEK Corporation**	Date: **10/21/13**	
Drill Method: **Hollow-Stem Auger**	Driving Weight: **140 lbs / 30 in**	Logged By: **AGW**	

Depth (Feet)	Lith-ology	Material Description	Water	Samples			Laboratory Tests		
				Blows Per Foot	Core	Bulk	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
				50/3"	■				
		Total Depth = 31.25 feet No groundwater, no caving.							

HAI Hushmand Associates, Inc. / PETRA

BORING NUMBER B6

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CLIENT FIESTA DEVELOPMENT CO.

PROJECT NAME OAK VALLEY

PROJECT NUMBER 04-0419

PROJECT LOCATION CALIMESA, RIVERSIDE COUNTY, CALIFORNIA

DATE STARTED 4/19/04 COMPLETED 4/19/04

GROUND ELEVATION N/A HOLE SIZE 8"

DRILLING CONTRACTOR CAL-PAC Drilling

GROUND WATER LEVELS:

DRILLING METHOD HSA

AT TIME OF DRILLING None

LOGGED BY BS CHECKED BY BH

AT END OF DRILLING None

NOTES ---

AFTER DRILLING None

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	CORE SAMPLE	BULK SAMPLE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	OTHER LABORATORY TESTS
		SANDY CLAY: Brown, dry, hard, abundent roots and grass.							
		SILTY SAND with GRAVEL: Dark red (2.5YR3/6) to dark reddish brown (5YR4/4), dry, hard. 10% fine Gravel to 1/2", 40% Silt, 45% Sand. Igneous and Metamorphic Rocks. Root filaments. Mature Argillic B Soil Horizon.	⧗		MC 1	38-22-30 (52)	117.6	7.1	
5		SAND and GRAVEL in SANDY CLAY matrix: Yellowish brown (5YR5/6) with lighter specks (rocks). Slightly moist to dry, hard. This is lower part of mature Argillic B Horizon. Well-graded to rocks 1" size.	⧗		MC 2	12-28-28 (56)	115	4.9	
10		SANDY CLAY: Reddish yellow (7.5YR6/6), slightly moist, dense/stiff, 10-20% Sand. SANDY CLAY: White to very pale brown, slightly moist, stiff to hard, Calcareous K horizon.	⧗		MC 3	20-39-50/2"	97.6	22.2	
		SILTY CLAY: Light brown (7.5YR6/4), moist, very stiff to hard, with black specks, low plasticity.							
15		SILTY CLAY: Light yellowish brown (10YR6/4) with black specks and yellowish brown streaks (oxidation), moist, stiff to hard.	⧗		MC 4	22-30-50/3"	109.8	13.4	
20		Same with tr. medium Sand grains in upper rings.	⧗		MC 5	19-50/2"	115.1	14.5	
		SILTY SAND (at the bottom): Yellowish brown (10YR5/4), moist, dense, fine to medium Sand, 20% Silt.							
		Borehole terminated at 20.67 feet.							

HAI Hushmand Associates, Inc. / PETRA

BORING NUMBER B7

PAGE 1 OF 1

CLIENT FIESTA DEVELOPMENT CO.
PROJECT NAME OAK VALLEY
PROJECT NUMBER 04-0419
PROJECT LOCATION CALIMESA, RIVERSIDE COUNTY, CALIFORNIA
DATE STARTED 4/19/04
COMPLETED 4/19/04
GROUND ELEVATION N/A
HOLE SIZE 8"
DRILLING CONTRACTOR CAL-PAC Drilling
GROUND WATER LEVELS:
DRILLING METHOD HSA
AT TIME OF DRILLING None
LOGGED BY BS
CHECKED BY BH
AT END OF DRILLING None
NOTES ---
AFTER DRILLING None

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	CORE SAMPLE	BULK SAMPLE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	OTHER LABORATORY TESTS
		SILTY CLAY with SAND: Red (2.5YR4/6), dry to slightly moist, very stiff, 30% Silt, 2-3% fine Sand, tr. medium Sand.							
		same: Dark reddish brown (2.5YR3/4) to yellowish red (5YR5/6), dry, hard. This is mature Argillic B Soil Horizon, 5% medium to coarse Sand. Low plasticity.	⧗		MC 1	18-14-21 (35)	112.7	6.9	
5		Color change near 5'. SANDY CLAY: White to very pale brown (10YR7/3), dry to slightly moist, hard. This is K soil horizon-caliche (Carbonate), 5-10% fine Sand, tr. fine Gravel (1/4-inch).	⧗		MC 2	50/5"	102.3	11	
		White cuttings.							
10		Same: GRAVEL to 2" size.	⧗		MC 3	23-50/5"	116.4	10.4	
15		SILT with Calcareous Nodules and SILTY SAND: Light olive brown (2.5YR5/4) mottled, slightly moist, stiff/dense, micaceous. Silt 20%, fine to medium Sand 60-70%, 10% Coarse, 5% fine Gravel.	⧗		MC 4	24-50/5"	108.5	9.1	
		Reddish brown cuttings.							
20		SAND and GRAVEL: Yellowish brown (10YR5/6), moist, dense, well-graded from Silt to Gravel (max. 2-1/2" size). Gravel is igneous and metamorphic rocks, subrounded to subangular, hard to crumbly rocks. (SAN TIMOTEO FORMATION)	⧗		MC 5	30-50/4"	109.4	4.9	

Borehole terminated at 20.83 feet.

Hushmand Associates, Inc. / PETRA

BORING NUMBER B8

PAGE 1 OF 1

CLIENT FIESTA DEVELOPMENT CO.
PROJECT NAME OAK VALLEY
PROJECT NUMBER 04-0419
PROJECT LOCATION CALIMESA, RIVERSIDE COUNTY, CALIFORNIA
DATE STARTED 4/19/04
COMPLETED 4/19/04
GROUND ELEVATION N/A
HOLE SIZE 8"
DRILLING CONTRACTOR CAL-PAC Drilling
GROUND WATER LEVELS:
DRILLING METHOD HSA
AT TIME OF DRILLING None
LOGGED BY BS
CHECKED BY BH
AT END OF DRILLING None
NOTES ---
AFTER DRILLING None

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	CORE SAMPLE	BULK SAMPLE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	OTHER LABORATORY TESTS
	▥	CLAYEY SILT/SILTY CLAY: White, dry, stiff, Calcareous K horizon.			AU SK1			13	
	▥	same: slightly moist, low plasticity.	☒		MC 1	12-18-27 (45)	91.1	14.4	
5	▥	same: mottled white to yellow (10YR7/6), slightly moist, stiff with hard calcareous nodules and carbonate disseminated throughout sample with filaments common.	☒		MC 2	21-41-46 (87)	104.1	11.9	
10	▥	same, color predominantly light yellowish brown (10YR6/4) but white zones and veins common, slightly moist, stiff with hard calcareous zones, low plasticity. White layers commonly horizontal.	☒		MC 3	13-26-45 (71)	106.9	17.2	
15	▨	SILTY CLAY/CLAYEY SILT with SAND: Yellowish brown (10YR5/6) to strong brown (7.5YR5/6), 5-10% medium to coarse Sand, tr. small pebbles (1/4") and tr. Calcareous nodules and streaks. Slightly moist, stiff to hard, low plasticity.	☒		MC 4	15-26-33 (59)	112.1	15.1	
20	▨	SILTY CLAY: Brown (7.5YR5/4) and yellowish brown (10YR5/8) with few white veins, moist, stiff, micaceous, low plasticity.	☒		MC 5	10-21-30 (51)	105.8	15.8	
		Borehole terminated at 21.5 feet.							

HAI *Hushmand Associates, Inc.* / **PETRA**

BORING NUMBER B9

PAGE 1 OF 2

CLIENT FIESTA DEVELOPMENT CO.
PROJECT NAME OAK VALLEY
PROJECT NUMBER 04-0419
PROJECT LOCATION CALIMESA, RIVERSIDE COUNTY, CALIFORNIA
DATE STARTED 4/19/04 **COMPLETED** 4/19/04
GROUND ELEVATION N/A **HOLE SIZE** 8"
DRILLING CONTRACTOR CAL-PAC Drilling
GROUND WATER LEVELS:
DRILLING METHOD HSA
AT TIME OF DRILLING None
LOGGED BY BS **CHECKED BY** BH
AT END OF DRILLING None
NOTES ---
AFTER DRILLING None

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	CORE SAMPLE	BULK SAMPLE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	OTHER LABORATORY TESTS
		SANDY SILT: with scattered pebbles, dry to slightly moist, medium stiff. Grass and roots common. (VALLEY ALLUVIUM)							
5		SANDY SILT: Dark yellowish brown (10YR4/4), slightly moist, medium stiff, 10-20% fine Sand. Massive (unbedded). (ALLUVIUM)	⧗		MC 1	5-6-10 (16)	102.8	7.6	COLL
10		same but with tr. Gravel several pieces 1/4" and one 2" size.	⧗		MC 2	5-7-13 (20)	111.5	7.1	
15		SILTY SAND: Reddish yellow (7.5YR6/6) with few small darker mottles. Predominantly fine Sand with 5% coarse Sand and trace of small pebbles (1/4"). Pebbles subrounded and composed of igneous and metamorphic rocks.	⧗		MC 3	7-9-10 (19)	117.4	6.8	COLL
20		same.	⧗		MC 4	8-9-14 (23)	120.2	9.2	
25		Cuttings all dark brown with occassional pebbles.							

(Continued Next Page)

Hushmand Associates, Inc. / PETRA

BORING NUMBER B9

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CLIENT FIESTA DEVELOPMENT CO.

PROJECT NAME OAK VALLEY

PROJECT NUMBER 04-0419

PROJECT LOCATION CALIMESA, RIVERSIDE COUNTY, CALIFORNIA

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	CORE SAMPLE	BULK SAMPLE	SAMPLE NUMBER	BLOW COUNTS (N VALUE)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	OTHER LABORATORY TESTS
30		SILTY SAND with CLAY and GRAVEL: Dark yellowish brown (10YR4/6) with a few faint lighter filaments, moist, dense. Predominantly fine Sand with 5% Clay, 10-30% Silt, and 5% gravel ranging from 1/4" to 1/2" size. Hard subangular igneous and metamorphic rocks. Some cohesion, low plasticity. (ALLUVIUM)	⧗		MC 5	7-2-4 (6)	115.7	12.1	
35		Cuttings all dark brown with occasional pebbles.							
40		SAND and GRAVEL: Yellowish brown (10YR5/4) with white specks (rocks), slightly moist, dense. Well-graded from fine sand to gravel > 2-1/2" diameter. Predominantly igneous rocks. Very much different than brown materials above. (SAN TIMOTEO FORMATION)	⧗		MC 6	28-22-30 (52)	117.1	3.4	
45		Added water to help drilling.							
50		SILTY CLAY: Strong brown (7.5YR4/6), moist, very stiff to hard, finely micaceous modulus of plasticity.	⧗		MC 7	14-28-50/4"	117.5	16.6	
		Borehole terminated at 51.33 feet.							

APPENDIX B

LABORATORY TEST PROCEDURES

LABORATORY DATA SUMMARY

PETRA

LABORATORY TEST PROCEDURES

Soil Classification

Soils encountered within the property were classified and described using the visual-manual procedures of the Unified Soil Classification System in general accordance with Test Method ASTM D 2488. The assigned group symbols are presented in the Exploration and Test Pit Logs, Appendix A.

In Situ Moisture and Density

Moisture content and unit dry density of in-place soil and bedrock materials were determined in representative strata. Test data are summarized in the Exploration and Test Pit Logs, Appendix A.

Laboratory Maximum Dry Density/Optimum Moisture

The maximum dry density and optimum moisture content of the on-site soils were determined for selected samples of the onsite soil and bedrock materials in accordance with ASTM D 1557. The results of these tests are presented on Plate B-1.

Expansion Potential

Expansion index tests were performed on selected samples of the onsite soil and bedrock materials in accordance with ASTM 4829. The results of this test are presented on Plate B-1.

Soluble Sulfates and Chlorides

Chemical analyses were performed on selected samples of the onsite soil and bedrock materials to determine soluble sulfate and chloride contents in accordance with California Test Method Nos. 417 and 422, respectively. Test results are presented on Plate B-1.

pH and Minimum Resistivity

pH and minimum resistivity tests were performed on selected samples of the onsite soil and bedrock materials to provide a preliminary evaluation of their corrosive potential to concrete and metal construction materials. These tests were performed in accordance with California Test Method No. 643. The results of these tests are included in Plate B-1.

Grain Size Analysis

Grain size analyses were performed on selected samples in accordance with ASTM C136. The test results are graphically presented on Plates B-2 and B-3.

Direct Shear

The Coulomb shear strength parameters (angle of internal friction and cohesion) were determined for a selected undisturbed sample of the in situ bedrock and selected sample of soil remolded to 90 percent of maximum dry density. These tests were performed in general accordance with ASTM D 3080. Three specimens were prepared for each test. The test specimens were artificially saturated, and then sheared under varying normal loads at a maximum constant rate of strain of 0.05 inches per minute. The test results are graphically presented on Plates B-4 and B-5.

Hydro-Collapse Potential (Consolidation)

Hydro-collapse potential (consolidation) tests were performed on selected samples of the in situ alluvial soils in general accordance with ASTM D 5333. The test samples surcharged to a loading approximately equal to the proposed total overburden pressures and then inundated to evaluate the effects of a sudden increase in moisture content (hydro-consolidation potential). Results of these tests are graphically presented on Plates B-6 through B-11.

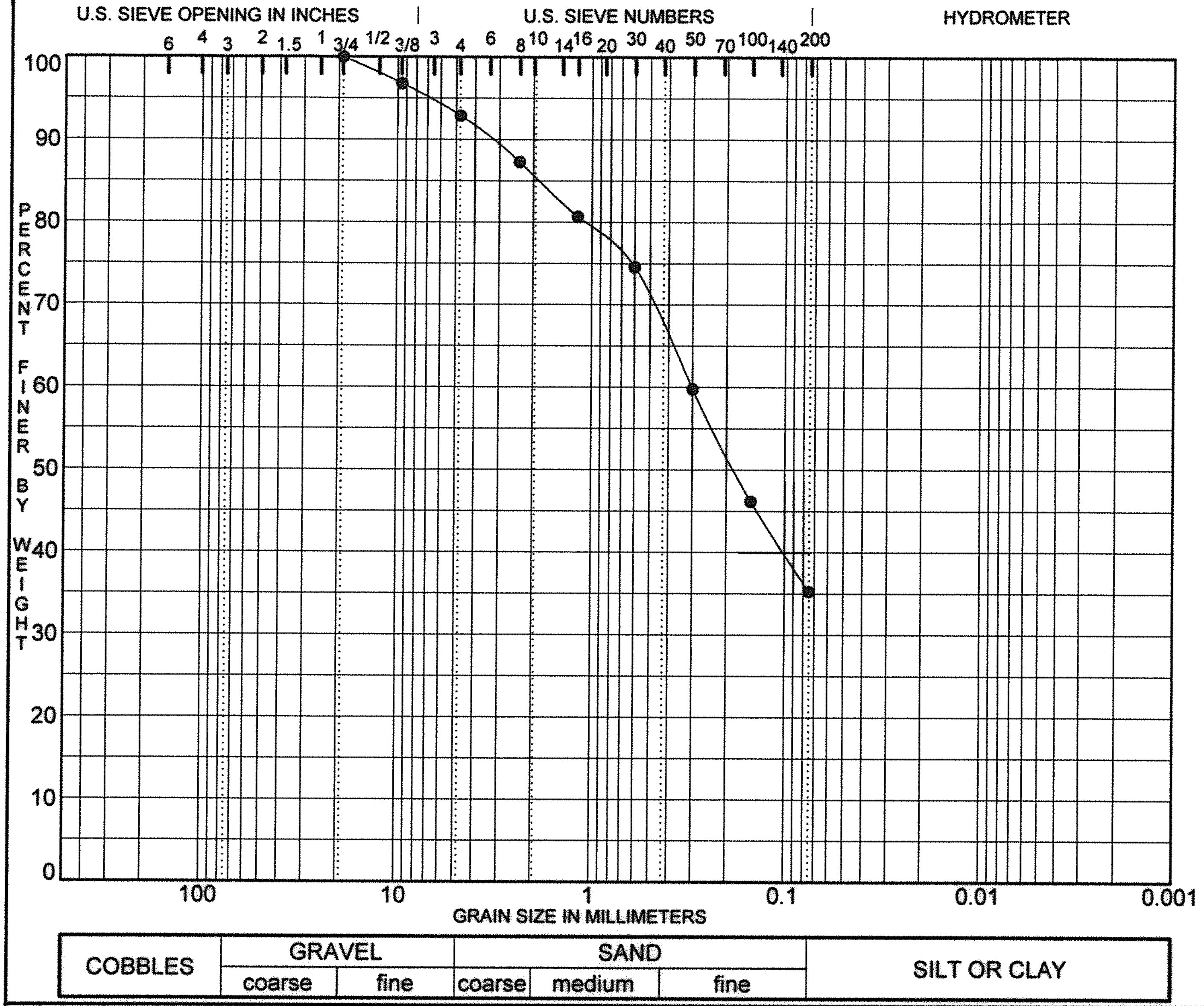
LABORATORY DATA SUMMARY

Test Pit/Boring Number	Sample Depth (ft)	Soil Description	Max. Dry Density[1] (pcf)	Optimum Moisture[1] (%)	Expansion Index[2]	Expansion Potential[2]	Atterberg Limits[3]			Sulfate Content[4] (%)	Chloride Content[5] (ppm)	pH[6]	Minimum Resistivity[6] (Ohm-cm)
							LL	PL	PI				
TP-3	2-7	Sandy SILT (ML)	124.5	12.0	39	Low	31	17	14	0.03	73	7.2	1900
TP-13	9.5-11.0	Sandstone	127.0	11.0									
TP-19	10.5-13	Sandy Siltstone	121.0	14.0	17	Very Low				0.06	85	7.0	2000

Test Procedures:

[1] Per ASTM Test Method D 1557
[2] Per ASTM Test Method D 4829
[3] Per ASTM Test Method D 4318
[4] Per Caltrans Test Method 417
[5] Per Caltrans Test Method 422
[6] Per Caltrans Test Method 643

PLATE B-1



Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
● HS-9	7.0	SILTY SAND (SM)						

Specimen Identification		D100	D60	D30	D50	%Gravel	%Sand	%Silt	%Clay
● HS-9	7.0	19.00	0.30		0.1821	7.1	57.6	35.3	

GRAIN SIZE - V1 13-546.GPJ PETRA.GDT 12/20/13

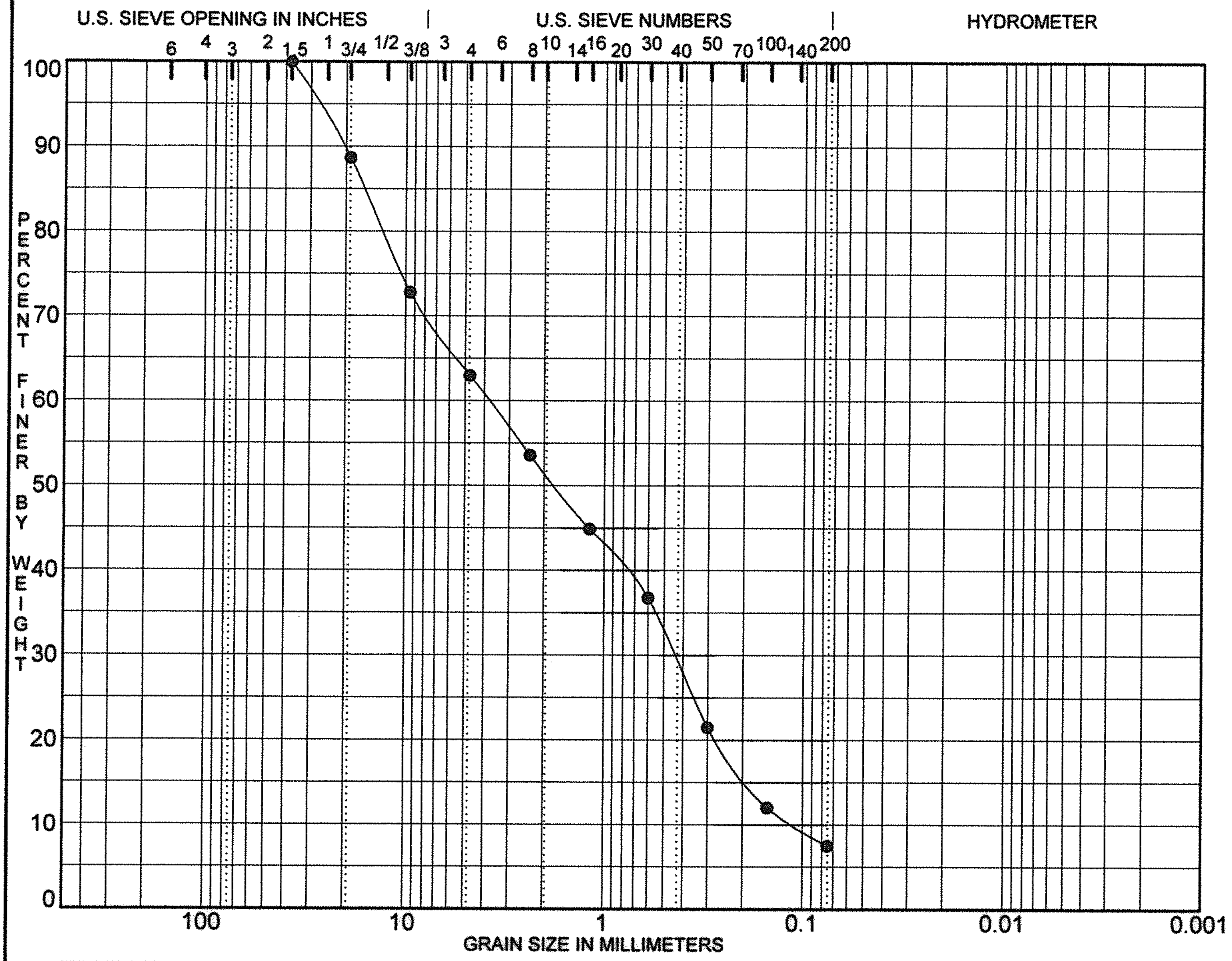
J.N. 13-546

PETRA GEOTECHNICAL, INC.

GRAIN SIZE ANALYSIS

December, 2013

PLATE B-2



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	HS-9	20.0	POORLY-GRADED SAND WITH SILT & GRAVEL					0.46	34.5

	Specimen Identification		D100	D60	D30	D50	%Gravel	%Sand	%Silt	%Clay
●	HS-9	20.0	37.50	3.80	0.441	1.7715	37.0	55.5	7.5	

GRAIN SIZE - V1 13-546.GPJ PETRA.GDT 12/20/13

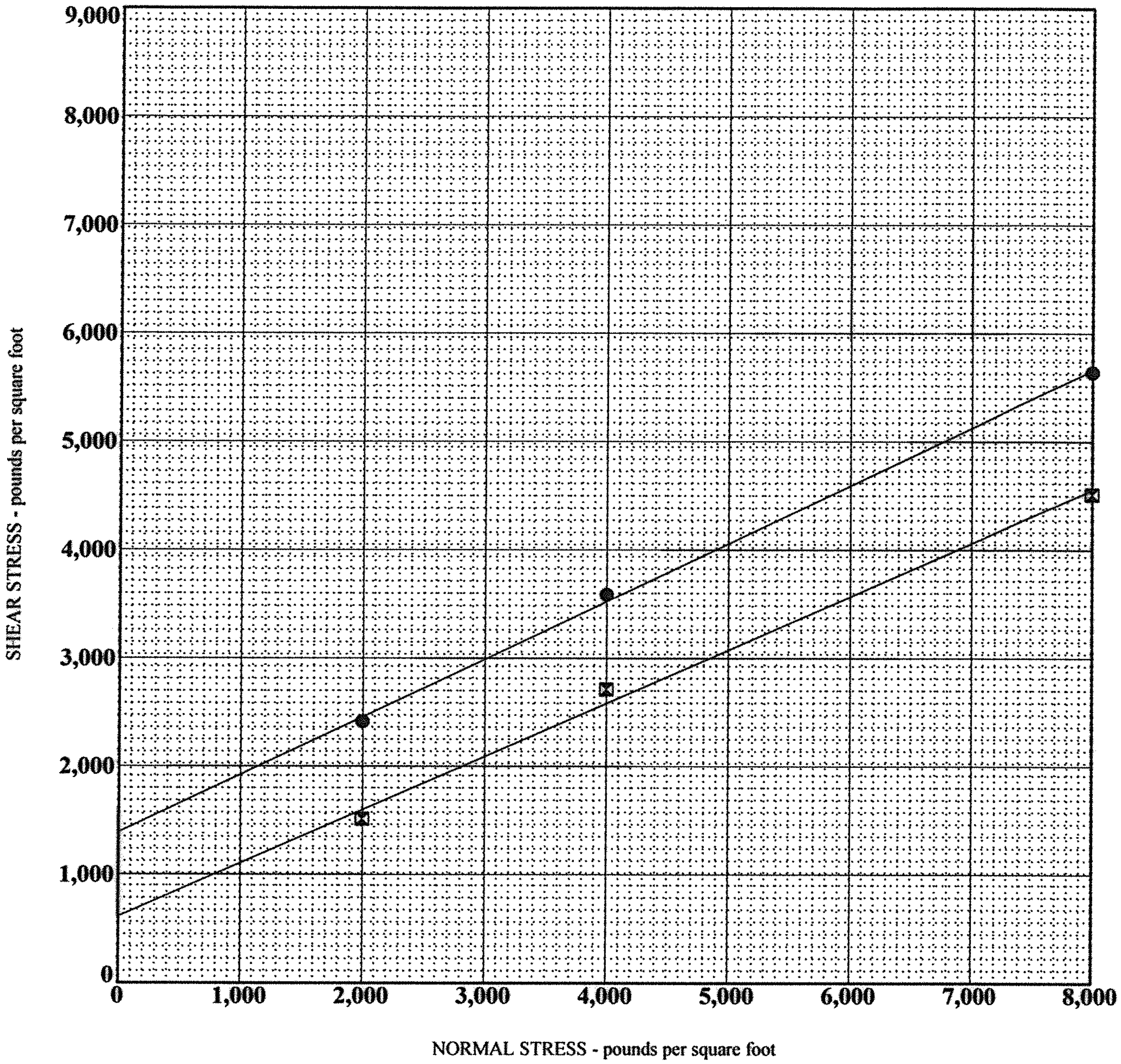
J.N. **13-546**

PETRA GEOTECHNICAL, INC.

GRAIN SIZE ANALYSIS

December, 2013

PLATE B-3

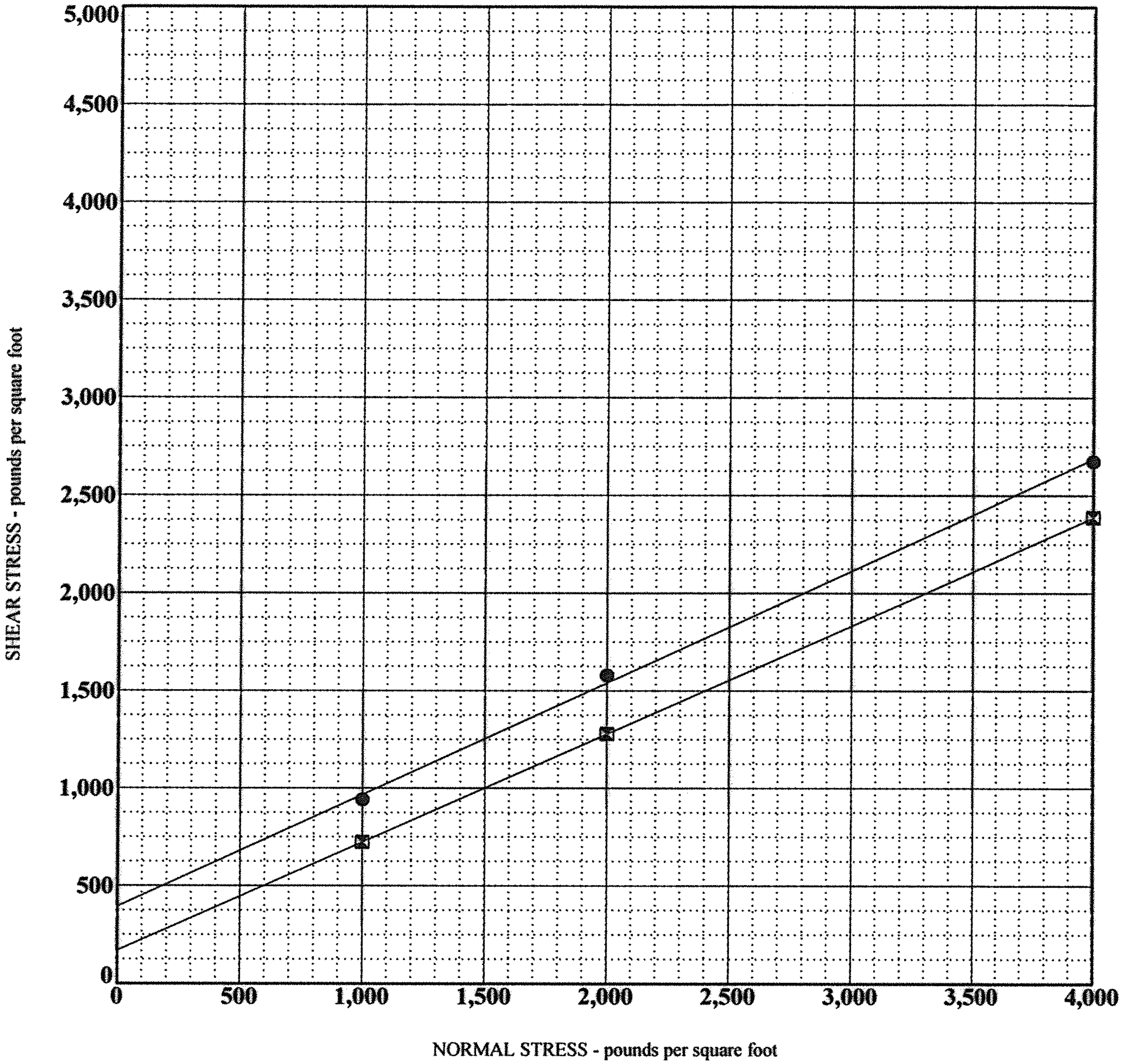


SAMPLE LOCATION	DESCRIPTION	FRICTION ANGLE (°)	COHESION (PSF)
● HS-5 @ 40.0	Silty Sandstone & Siltstone - Peak	28	1390
☒ HS-5 @ 40.0	Silty Sandstone & Siltstone @ 0.25"	26	610

NOTES:

Undisturbed Test Samples
All Samples Were Presoaked Prior to Shearing

J.N. 13-546	**DIRECT SHEAR TEST DATA**	**December, 2013**
PETRA GEOTECHNICAL, INC.		**PLATE B-4**



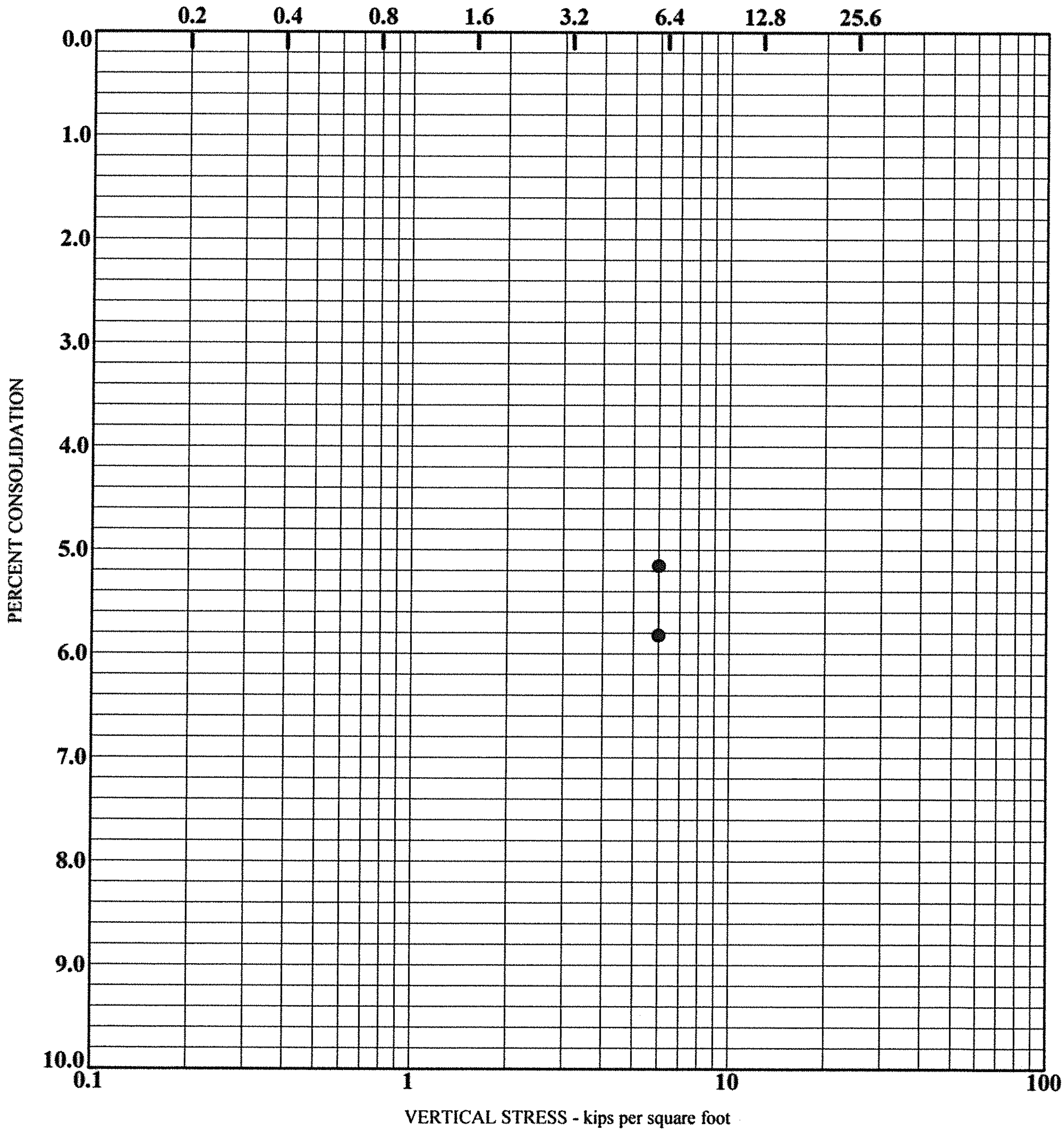
SAMPLE LOCATION	DESCRIPTION	FRICTION ANGLE (°)	COHESION (PSF)
● TP-19 @ 10.5	Sandy Siltstone - Peak	30	395
☒ TP-19 @ 10.5	Sandy Siltsone @ 0.25" Displ.	29	170

NOTES:

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

J.N. 13-546	DIRECT SHEAR TEST DATA	December, 2013
PETRA GEOTECHNICAL, INC.		PLATE B-5

SAMPLE LOCATION	MATERIAL DESCRIPTION	INITIAL			INUNDATED
		DENSITY (pcf)	MOISTURE (%)	SATURATION (%)	LOAD (ksf)
● HS-3 @ 20.0	Silty Sand (SM)				



J.N. **13-546**

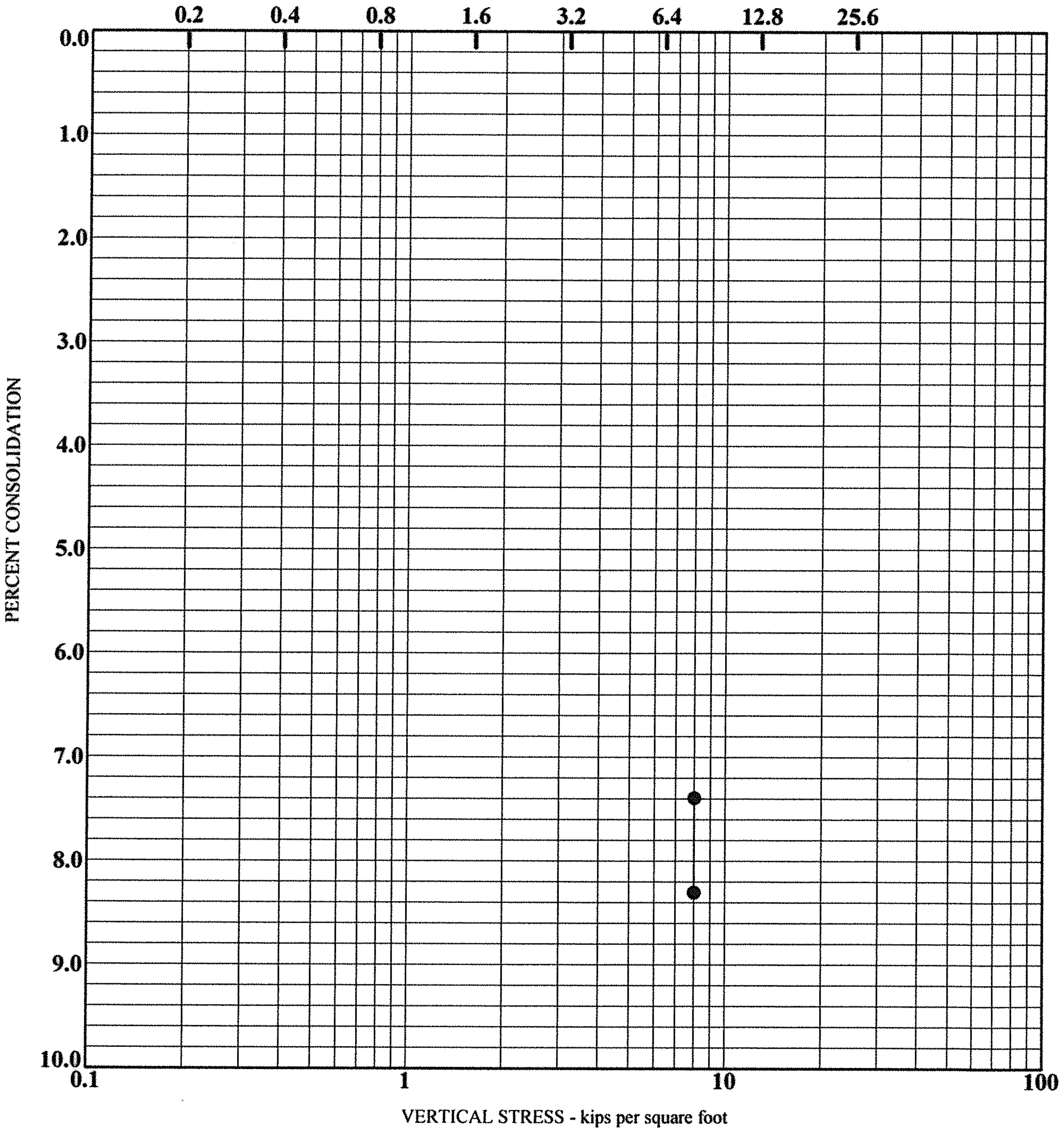
PETRA GEOTECHNICAL, INC.

CONSOLIDATION TEST RESULTS

December, 2013

PLATE B-6

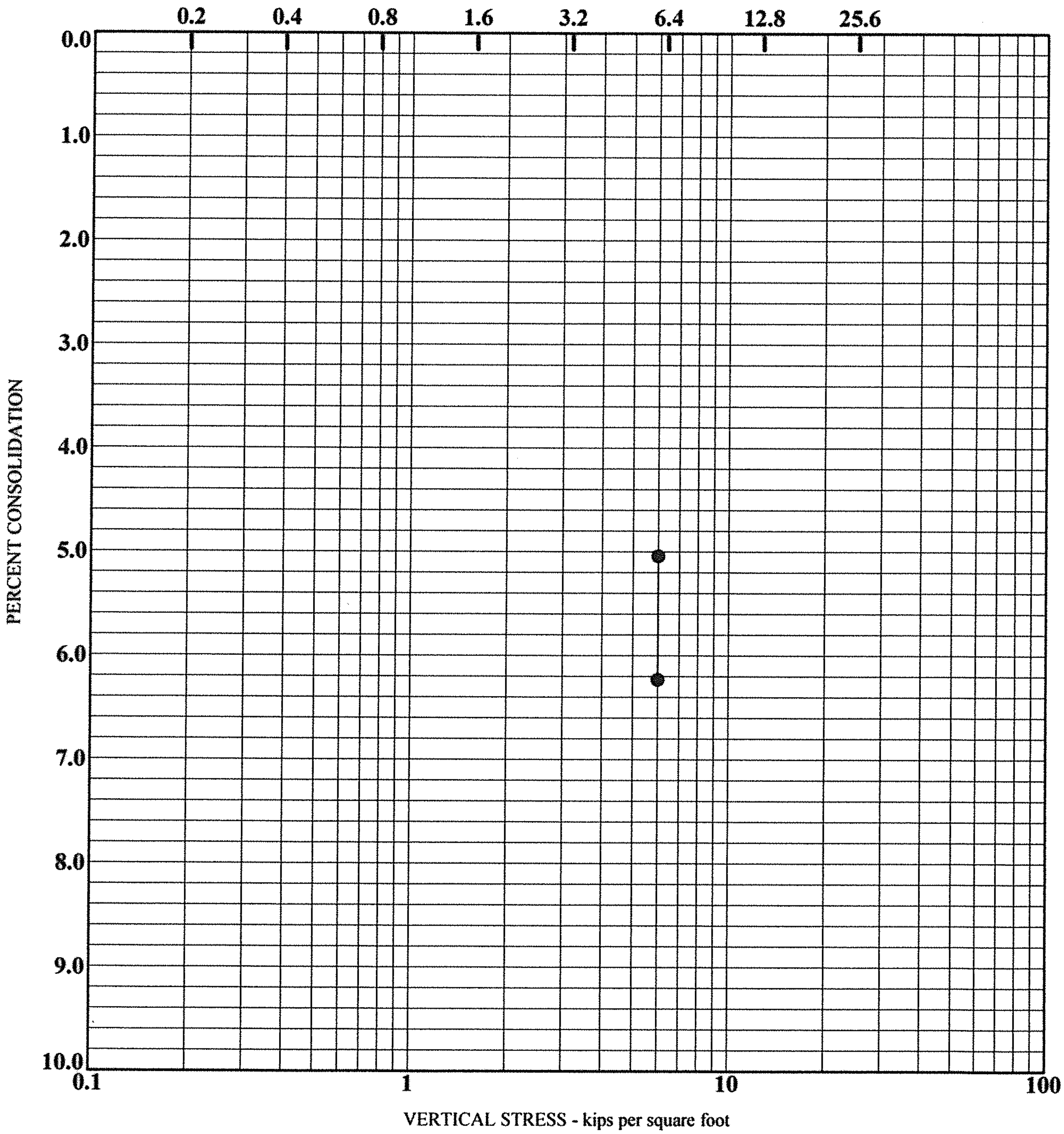
SAMPLE LOCATION	MATERIAL DESCRIPTION	INITIAL			INUNDATED
		DENSITY (pcf)	MOISTURE (%)	SATURATION (%)	LOAD (ksf)
● HS-3 @ 25.0	Silty Sand (SM)				



CONSOLIDATION - STRAIN 13-546.GPJ PETRA.GDT 12/20/13

J.N. 13-546	**CONSOLIDATION TEST RESULTS**	**December, 2013**
PETRA GEOTECHNICAL, INC.		**PLATE B-7**

SAMPLE LOCATION	MATERIAL DESCRIPTION	INITIAL			INUNDATED
		DENSITY (pcf)	MOISTURE (%)	SATURATION (%)	LOAD (ksf)
● HS-4 @ 10.0	Clayey Sand (SC)				



J.N. **13-546**

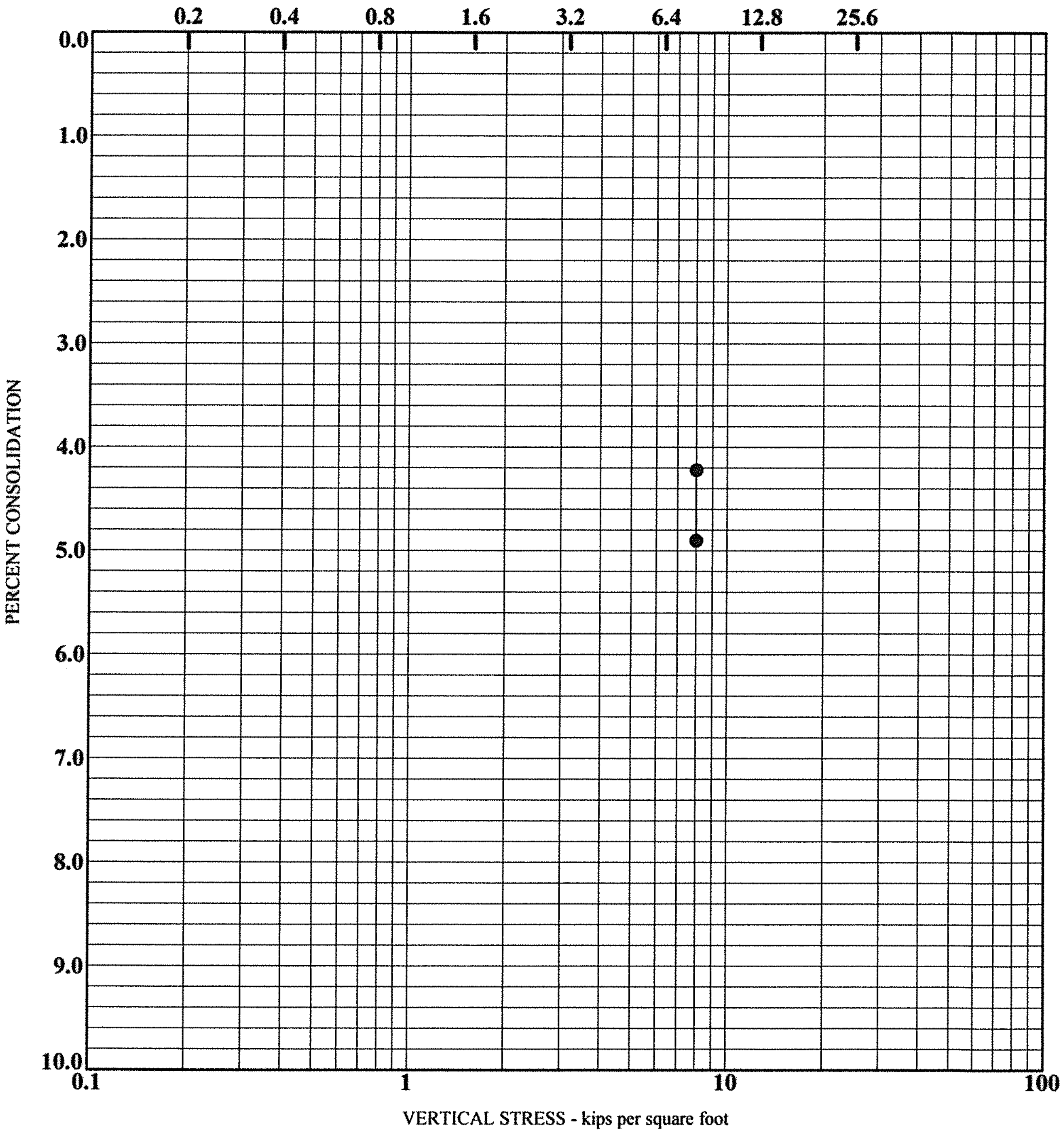
PETRA GEOTECHNICAL, INC.

CONSOLIDATION TEST RESULTS

December, 2013

PLATE B-8

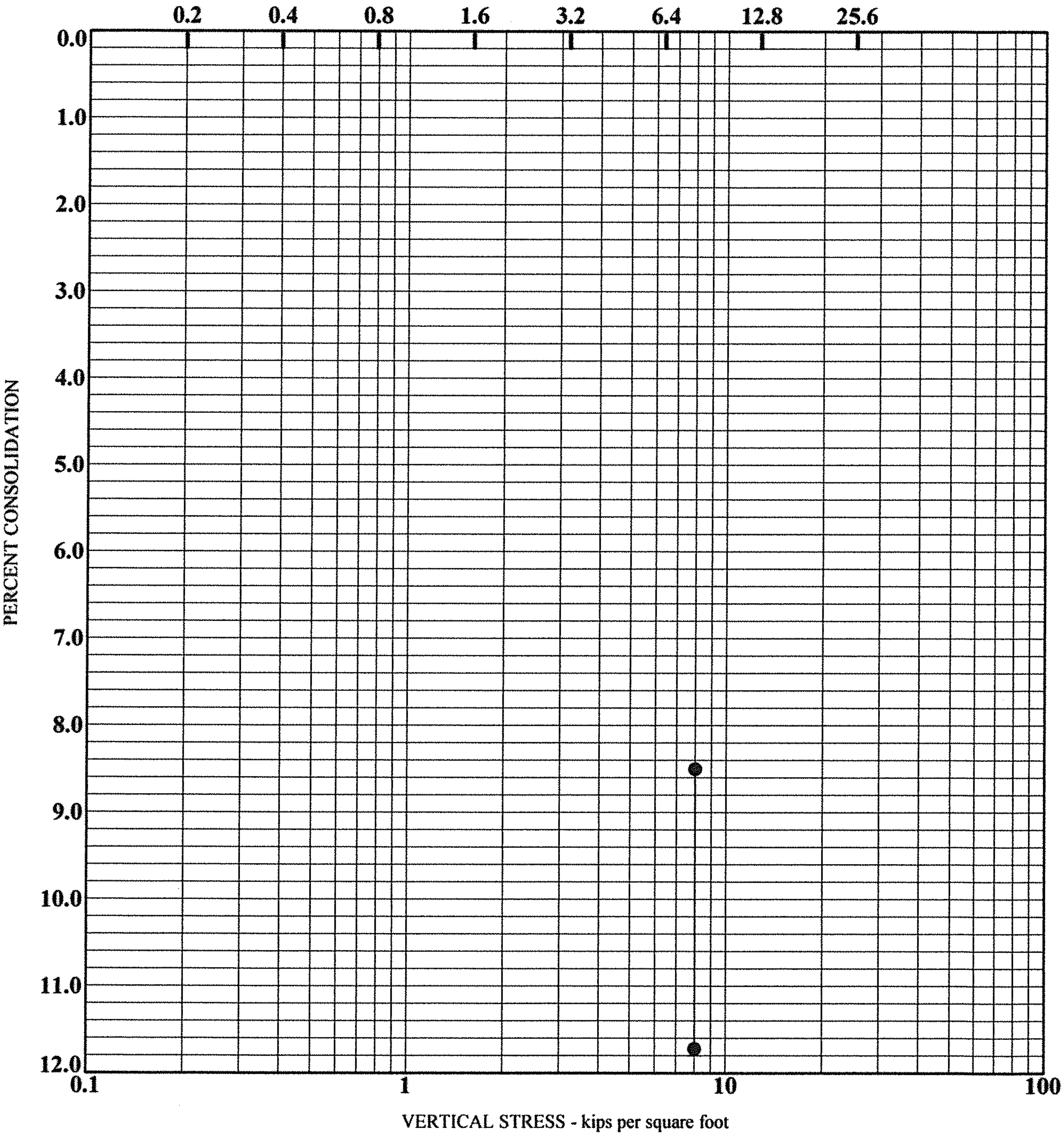
SAMPLE LOCATION	MATERIAL DESCRIPTION	INITIAL			INUNDATED
		DENSITY (pcf)	MOISTURE (%)	SATURATION (%)	LOAD (ksf)
● HS-4 @ 15.0	Silty Sand (SM)				



CONSOLIDATION - STRAIN 13-546.GPJ PETRA.GDT 12/20/13

J.N. 13-546	CONSOLIDATION TEST RESULTS	December, 2013
PETRA GEOTECHNICAL, INC.		PLATE B-9

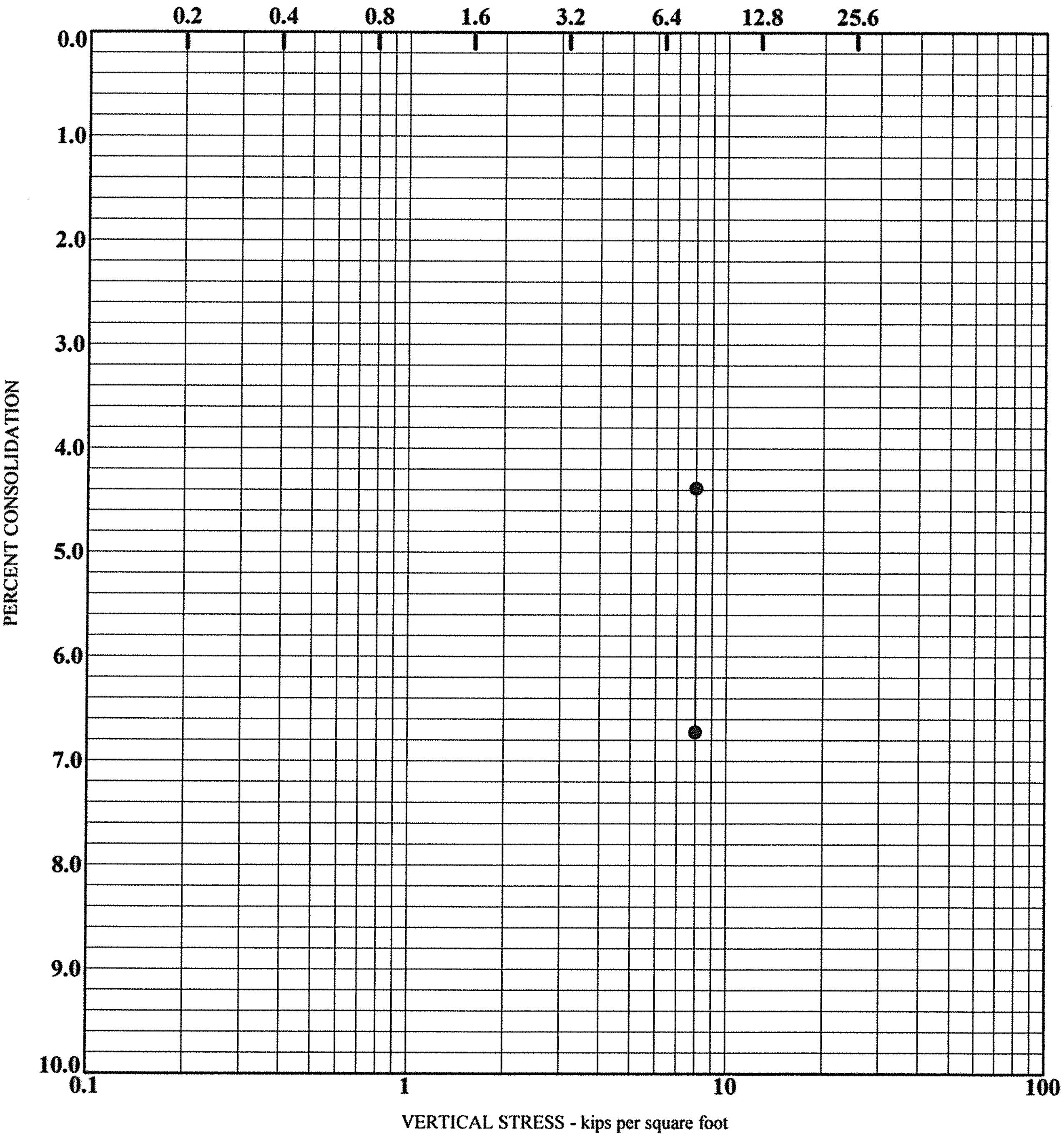
SAMPLE LOCATION	MATERIAL DESCRIPTION	INITIAL			INUNDATED
		DENSITY (pcf)	MOISTURE (%)	SATURATION (%)	LOAD (ksf)
● HS-6 @ 10.0	Silty Sand (SM)				



CONSOLIDATION - STRAIN 13-546.GPJ PETRA.GDT 12/20/13

J.N. 13-546	CONSOLIDATION TEST RESULTS	December, 2013
PETRA GEOTECHNICAL, INC.		PLATE B-10

SAMPLE LOCATION	MATERIAL DESCRIPTION	INITIAL			INUNDATED
		DENSITY (pcf)	MOISTURE (%)	SATURATION (%)	LOAD (ksf)
● HS-6 @ 20.0	Silty Sand (SM)				



CONSOLIDATION - STRAIN 13-546.GPJ PETRA.GDT 12/20/13

J.N. 13-546	**CONSOLIDATION TEST RESULTS**	**December, 2013**
PETRA GEOTECHNICAL, INC.		**PLATE B-11**

APPENDIX C

STANDARD GRADING SPECIFICATIONS

PETRA

STANDARD GRADING SPECIFICATIONS

These specifications present the usual and minimum requirements for projects on which Petra Geotechnical, Inc. is the geotechnical consultant. 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 of record (Geotechnical Consultant).

I. GENERAL

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

B. The contractor should prepare and submit to the Owner and Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of "spreads" and the estimated quantities of daily earthwork to be performed prior to the commencement of grading. This work plan should be reviewed by the Geotechnical Consultant to schedule personnel to perform the appropriate level of observation, mapping, and compaction testing as necessary.

C. All clearing, site preparation, or earthwork performed on the project shall be conducted by the Contractor in accordance with the recommendations presented in the geotechnical report and under the observation of the Geotechnical Consultant.

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

E. It is 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 to project specifications. Sufficient watering apparatus will also be provided by the Contractor, with due consideration for the fill material, rate of placement, and time of year.

F. After completion of grading a report will be submitted by the Geotechnical Consultant.

II. SITE PREPARATION

A. Clearing and Grubbing

1. All vegetation such as trees, brush, grass, roots, and deleterious material shall be disposed of offsite. This removal shall be concluded prior to placing fill.

2. Any underground structures such as cesspools, cisterns, mining shafts, tunnels, septic tanks, wells, pipe lines, etc., are to be removed or treated in a manner prescribed by the Geotechnical Consultant.

III. FILL AREA PREPARATION

A. Remedial Removals/Overexcavations

1. Remedial removals, as well as overexcavation for remedial purposes, shall be evaluated by the Geotechnical Consultant. Remedial removal depths presented in the geotechnical report and shown on the geotechnical plans are estimates only. The actual extent of removal should be determined by the Geotechnical Consultant based on the conditions exposed during grading. All soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be overexcavated to competent ground as determined by the Geotechnical Consultant.

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

3. Should potentially hazardous materials be encountered, the Contractor should stop work in the affected area. An environmental consultant specializing in hazardous materials should be notified immediately for evaluation and handling of these materials prior to continuing work in the affected area.

B. Evaluation/Acceptance of Fill Areas

All areas to receive fill, including removal and processed areas, key bottoms, and benches, shall be observed, mapped, elevations recorded, and/or tested prior to being accepted by the Geotechnical Consultant as suitable to receive fill. The contractor shall obtain a written acceptance from the Geotechnical Consultant prior to fill placement. A licensed surveyor shall provide sufficient survey control for determining locations and elevations of processed areas, keys, and benches.

C. Processing

After the ground surface to receive fill has been declared satisfactory for support of fill by the Geotechnical Consultant, it shall be scarified to a minimum depth of 6 inches and until the ground surface 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 to a minimum relative compaction of 90 percent.

D. Subdrains

Subdrainage devices shall be constructed in compliance with the ordinances of the controlling governmental agency, and/or with the recommendations of the Geotechnical Consultant. (Typical Canyon Subdrain details are given on Plate SG-1).

E. Cut/Fill & Deep Fill/Shallow Fill Transitions

In order to provide uniform bearing conditions in cut/fill and deep fill/shallow fill transition lots, the cut and shallow fill portions of the lot should be overexcavated to the depths and the horizontal limits discussed in the approved geotechnical report and replaced with compacted fill. (Typical details are given on Plate SG-7.)

IV. COMPACTED FILL MATERIAL

A. General

Materials excavated on the property may be utilized in the fill, provided each material has been determined to be suitable by the Geotechnical Consultant. Material to be used for fill shall be essentially free of organic material and other deleterious substances. Roots, tree branches, and other matter missed during clearing shall be removed from the fill as recommended by the Geotechnical Consultant. Material that is spongy, subject to decay, or otherwise considered unsuitable shall not be used in the compacted fill.

Soils of poor quality, such as those with unacceptable gradation, high expansion potential, or low strength shall be placed in areas acceptable to the Geotechnical Consultant or mixed with other soils to achieve satisfactory fill material.

B. Oversize Materials

Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 12 inches in diameter, shall be taken offsite or placed in accordance with the recommendations of the Geotechnical Consultant in areas designated as suitable for rock disposal (Typical details for Rock Disposal are given on Plate SG-4).

Rock fragments less than 12 inches in diameter may be utilized in the fill provided, they are not nested or placed in concentrated pockets; they are surrounded by compacted fine grained soil material and the distribution of rocks is approved by the Geotechnical Consultant.

C. Laboratory Testing

Representative samples of materials to be utilized as compacted fill shall be analyzed by the laboratory of the Geotechnical Consultant 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 Geotechnical Consultant as soon as possible.

D. Import

If importing of fill material is required for grading, proposed import material should meet the requirements of the previous section. The import source shall be given to the Geotechnical Consultant at least 2 working days prior to importing so that appropriate tests can be performed and its suitability determined.

V. FILL PLACEMENT AND COMPACTION

A. Fill Layers

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 Geotechnical Consultant.

B. Moisture Conditioning

Fill soils shall be watered, dried back, blended, and/or mixed, as necessary to attain a relatively uniform moisture content at or slightly above optimum moisture content.

C. Compaction

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 1557-02, 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.

D. Failing Areas

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

E. Benching

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 Geotechnical Consultant.

VI. SLOPES

A. Fill Slopes

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 that produces the required compaction.

B. Side Hill Fills

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-5.)

C. Fill-Over-Cut Slopes

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-6).

D. Landscaping

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

E. Cut Slopes

1. The Geotechnical Consultant should observe all cut slopes at vertical intervals not exceeding 10 feet.

2. 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 evaluated by the Geotechnical Consultant, 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-2 and SG-3.).

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

4. 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.

5. Drainage terraces shall be constructed in compliance with the ordinances of controlling governmental agencies, or with the recommendations of the Geotechnical Consultant.

VII. GRADING OBSERVATION

A. General

All cleanouts, processed ground to receive fill, key excavations, subdrains, and rock disposals must be observed and approved by the Geotechnical Consultant prior to placing any fill. It shall be the Contractor's responsibility to notify the Geotechnical Consultant when such areas are ready.

B. Compaction Testing

Observation of the fill placement shall be provided by the Geotechnical Consultant during the progress of grading. Location and frequency of tests shall be at the Consultants discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations may be selected to verify adequacy of compaction levels in areas that are judged to be susceptible to inadequate compaction.

C. Frequency of Compaction Testing

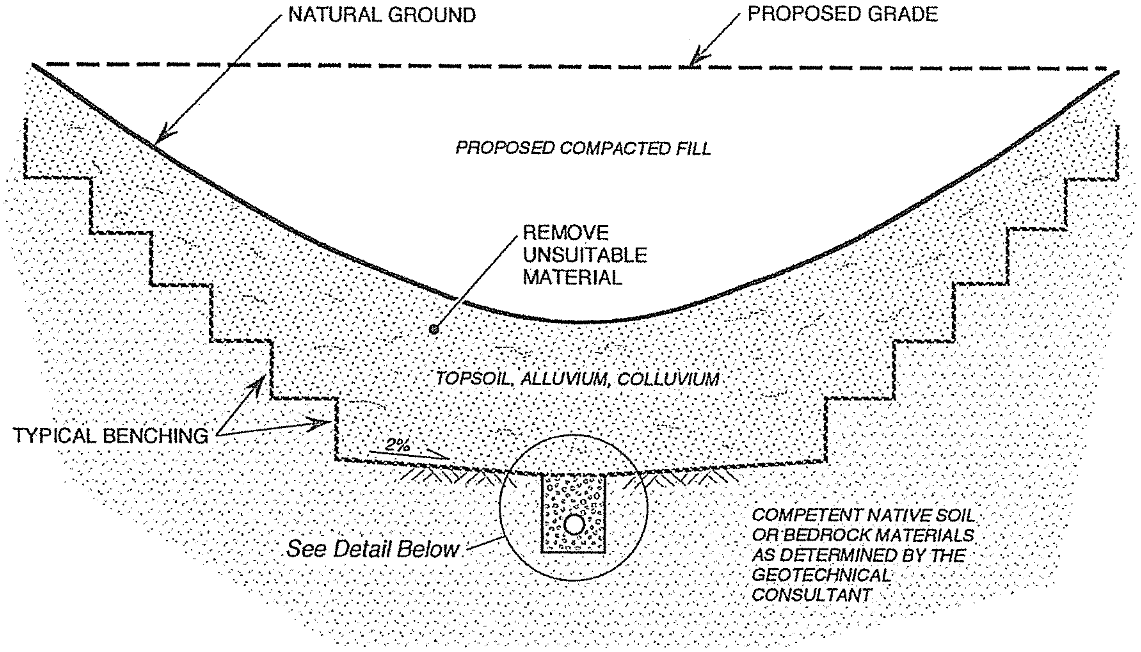
In general, density tests should be made at intervals not exceeding 2 feet of fill height or every 1000 cubic yards of fill placed. This criteria will vary depending on soil conditions and the size of the job. In any event, an adequate number of field density tests shall be made to verify that the required compaction is being achieved.

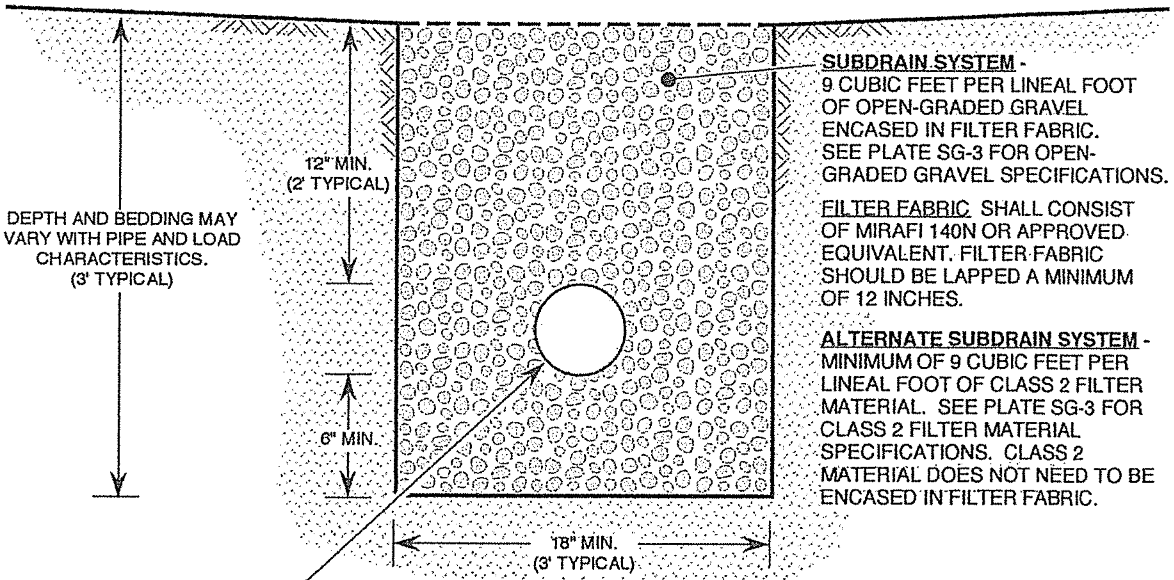
VIII. CONSTRUCTION CONSIDERATIONS

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 observations by the Geotechnical Consultant, 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 Geotechnical Consultant.

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.





DEPTH AND BEDDING MAY VARY WITH PIPE AND LOAD CHARACTERISTICS. (3' TYPICAL)

SUBDRAIN SYSTEM - 9 CUBIC FEET PER LINEAL FOOT OF OPEN-GRADED GRAVEL ENCASED IN FILTER FABRIC. SEE PLATE SG-3 FOR OPEN-GRADED GRAVEL SPECIFICATIONS.

FILTER FABRIC SHALL CONSIST OF MIRAFI 140N OR APPROVED EQUIVALENT. FILTER FABRIC SHOULD BE LAPPED A MINIMUM OF 12 INCHES.

ALTERNATE SUBDRAIN SYSTEM - MINIMUM OF 9 CUBIC FEET PER LINEAL FOOT OF CLASS 2 FILTER MATERIAL. SEE PLATE SG-3 FOR CLASS 2 FILTER MATERIAL SPECIFICATIONS. CLASS 2 MATERIAL DOES NOT NEED TO BE ENCASED IN FILTER FABRIC.

MINIMUM 6-INCH DIAMETER PVC SCHEDULE 40, OR ABS SDR-35 WITH A MINIMUM OF EIGHT 1/4-INCH DIAMETER PERFORATIONS PER LINEAL FOOT IN BOTTOM HALF OF PIPE. PIPE TO BE LAID WITH PERFORATIONS FACING DOWN.

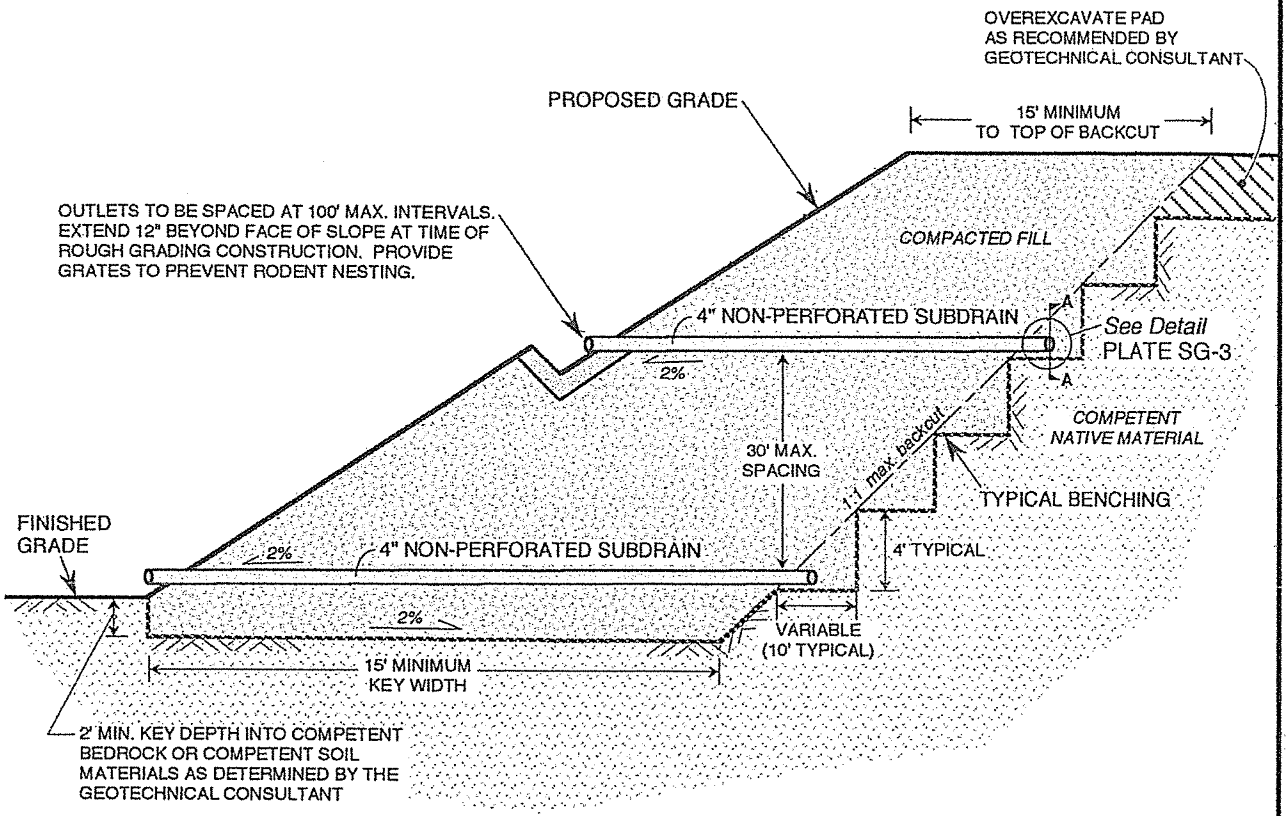
NOTES:

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

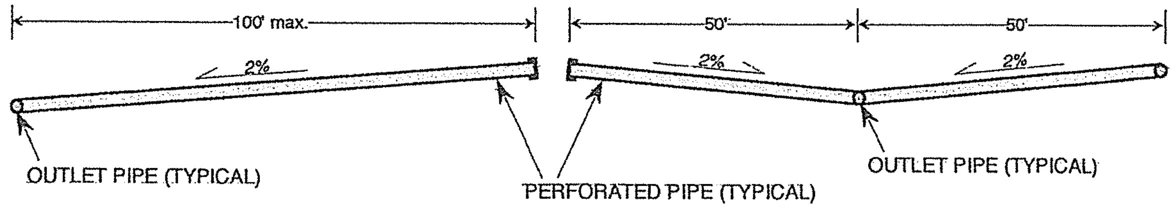
PLATE SG-1



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.

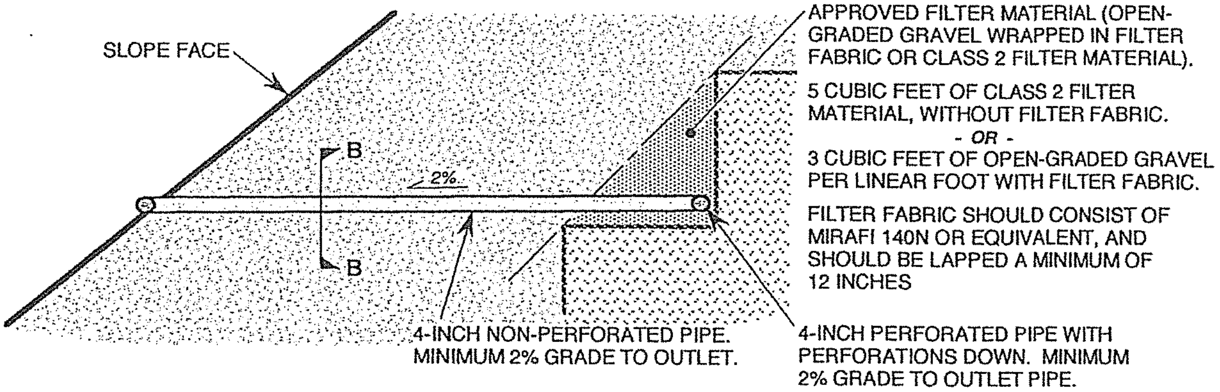
SECTION A-A (PERFORATED PIPE PROFILE)

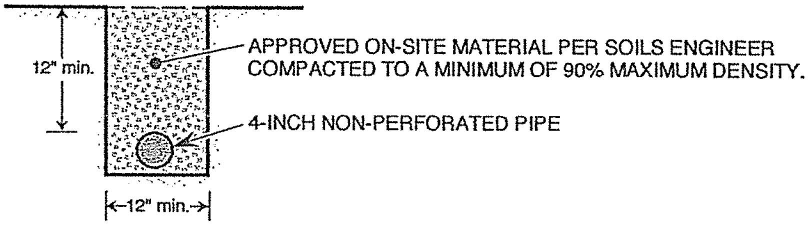


PETRA

BUTTRESS OR STABILIZATION FILL DETAIL

PLATE SG-2





SECTION B-B (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 GRAVEL

SIEVE 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.

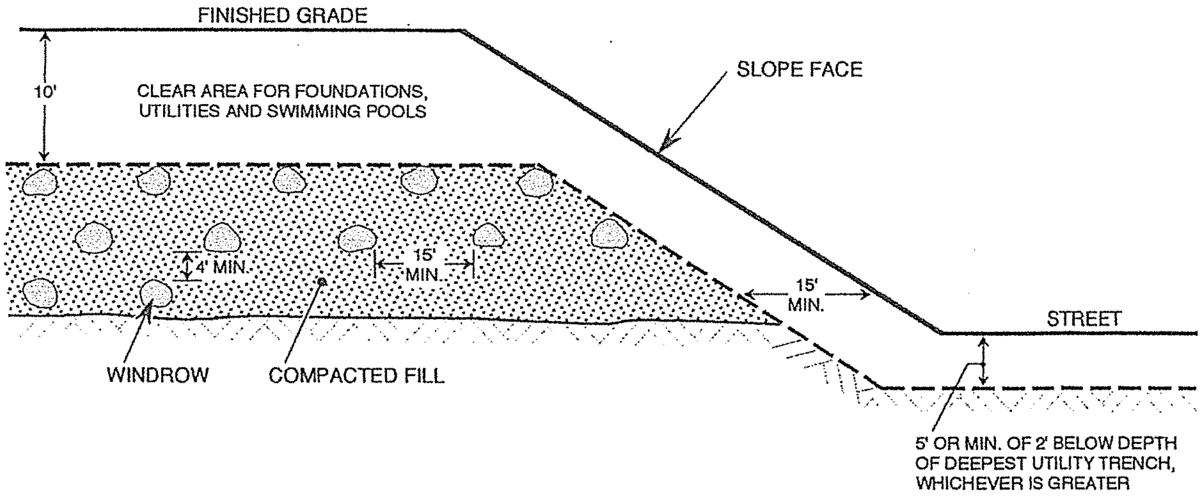
CLASS 2 FILTER MATERIAL

SIEVE 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

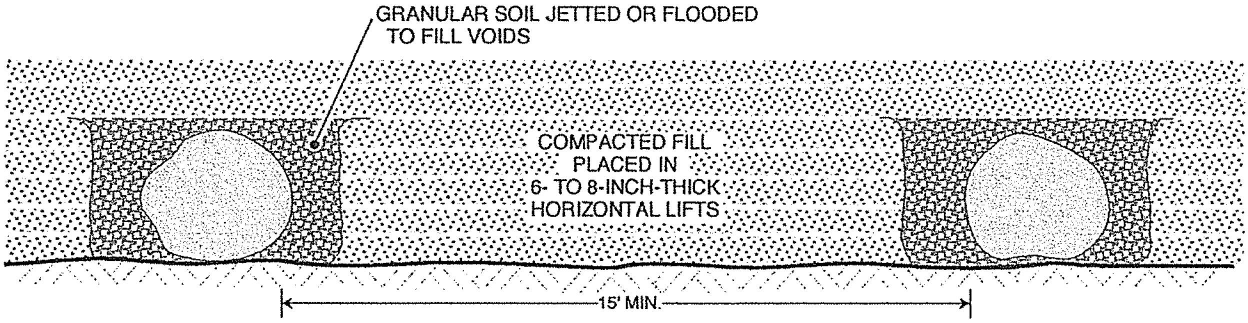
PETRA

BUTTRESS OR STABILIZATION FILL SUBDRAIN

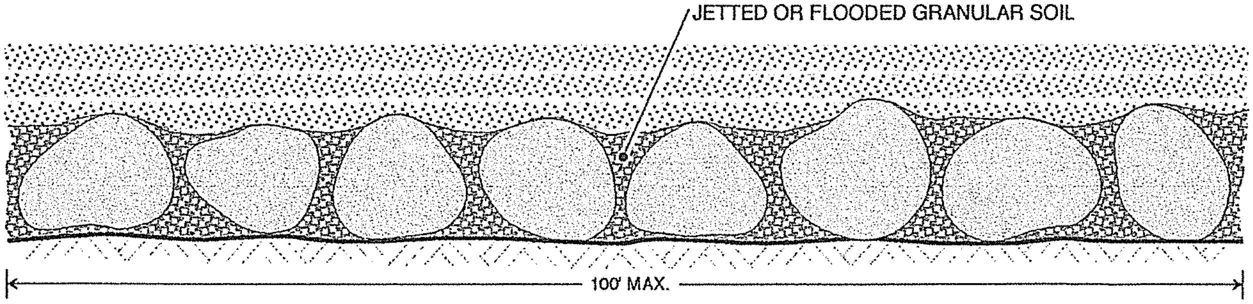
PLATE SG-3



TYPICAL WINDROW DETAIL (END VIEW)

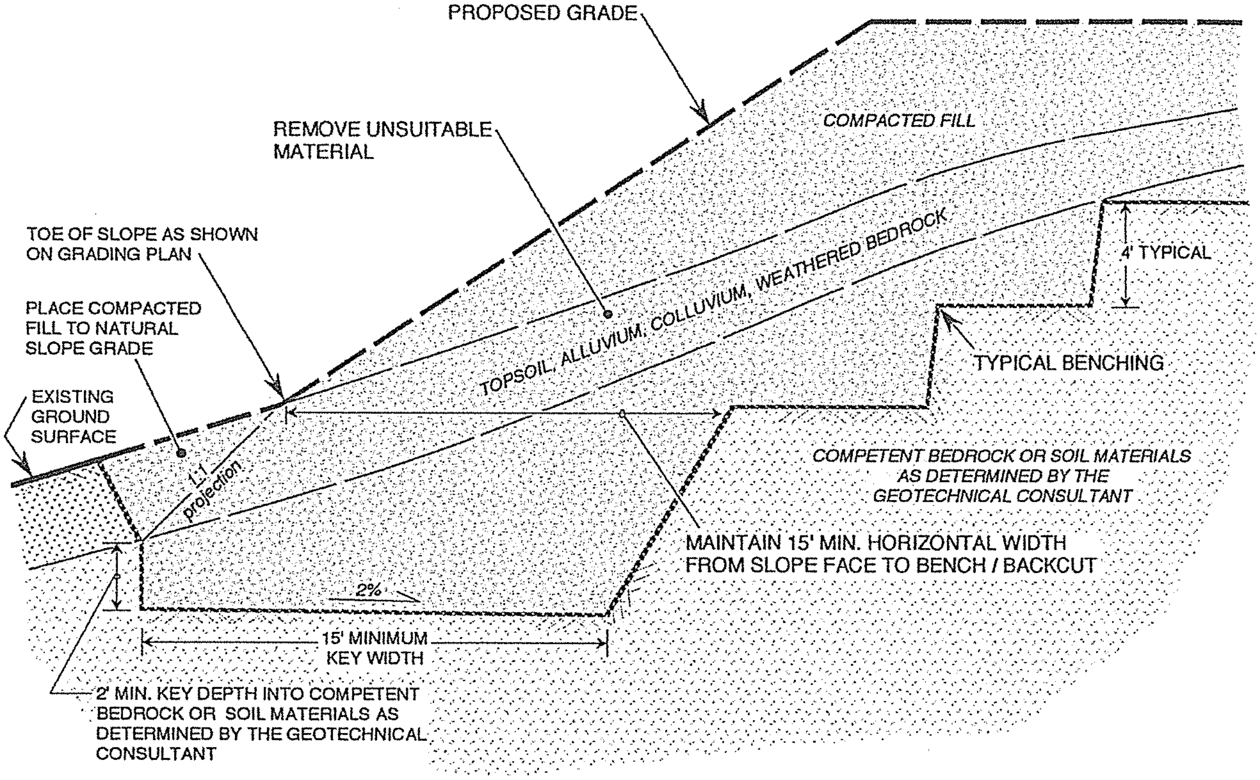


TYPICAL WINDROW DETAIL (PROFILE VIEW)



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

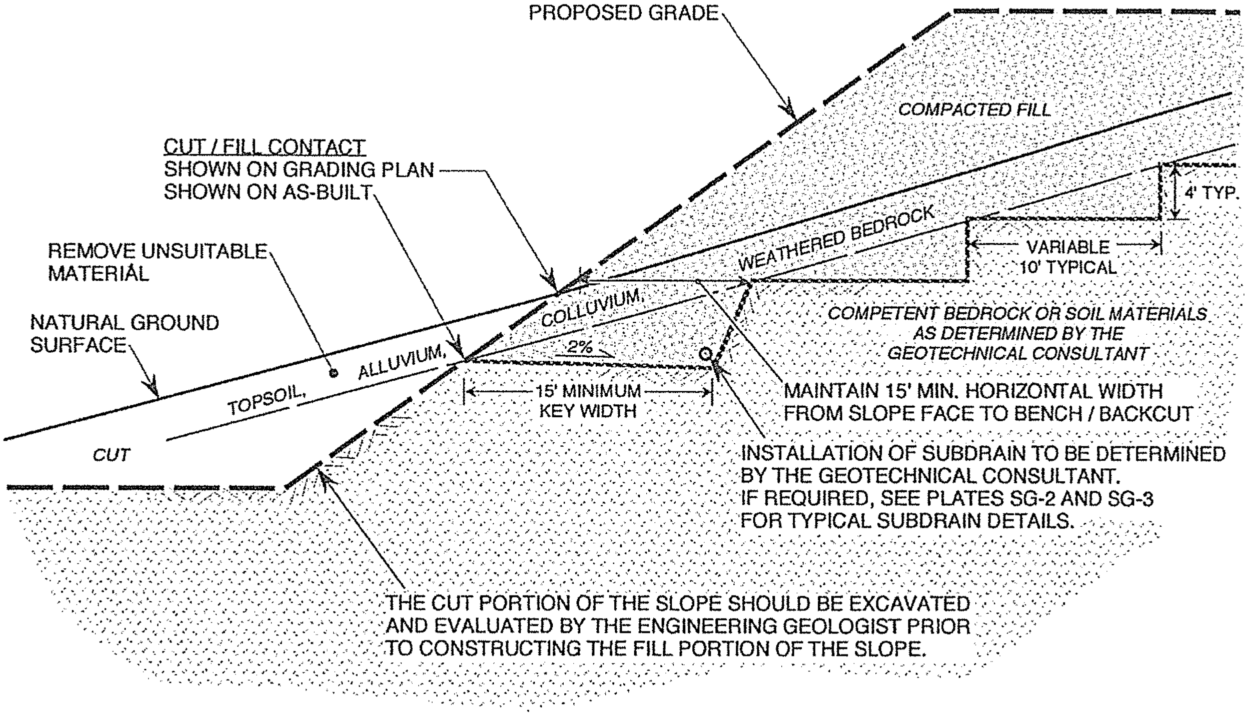
PETRA	TYPICAL ROCK DISPOSAL DETAIL	PLATE SG-4



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.

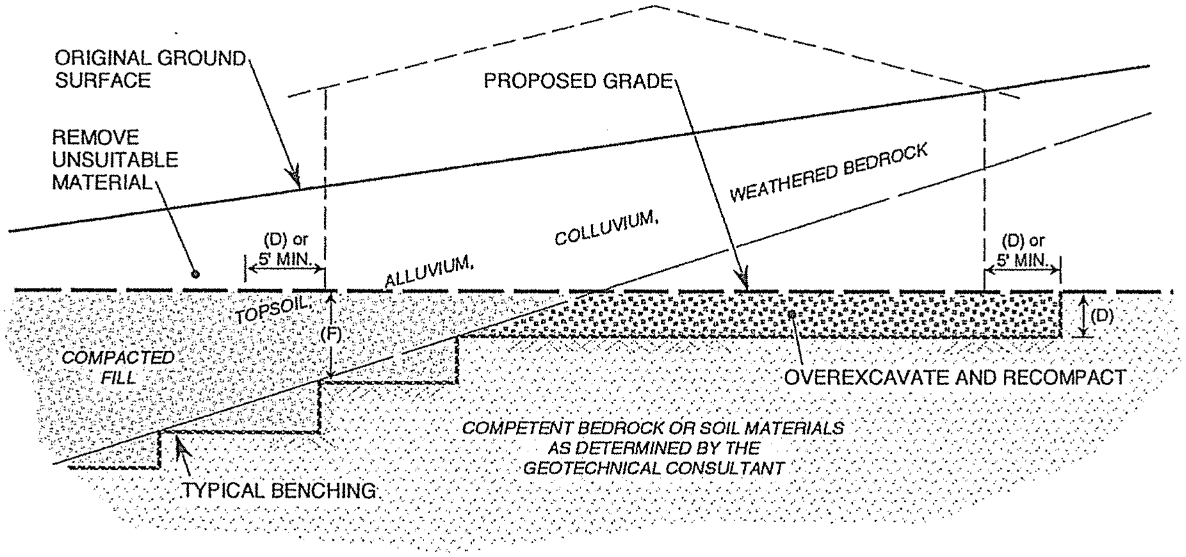
PETRA	FILL SLOPE ABOVE NATURAL SLOPE	PLATE SG-5



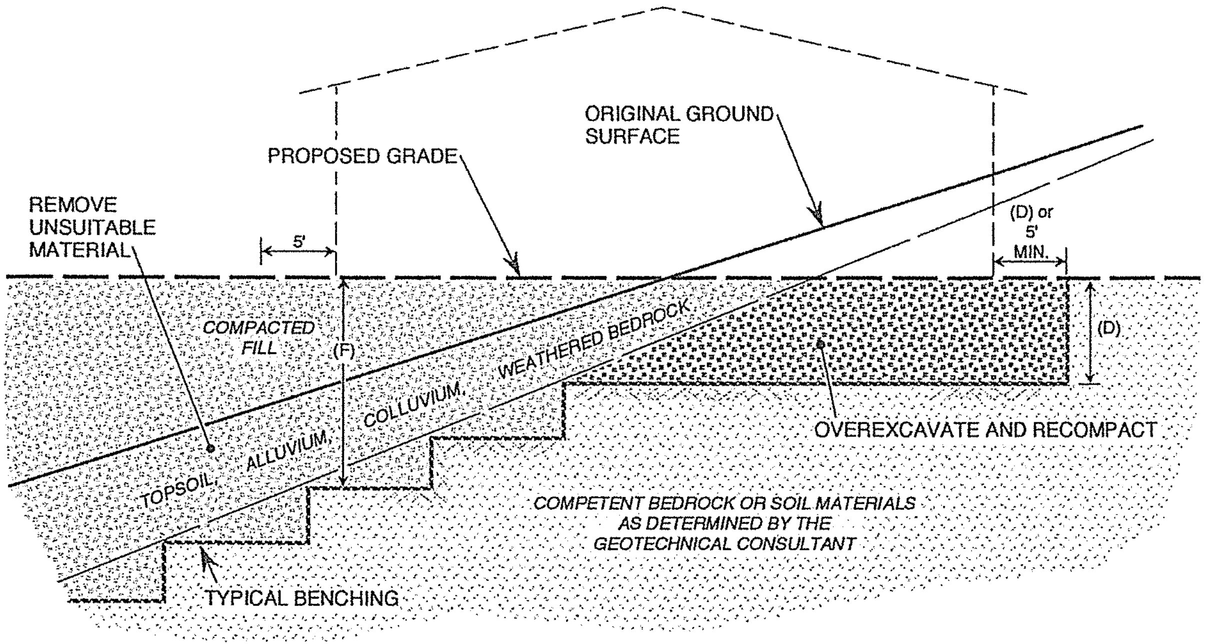
PETRA	FILL SLOPE ABOVE CUT SLOPE	PLATE SG-6

CUT LOT

UNSUITABLE MATERIAL EXPOSED IN PORTION OF CUT PAD



CUT-FILL TRANSITION LOT

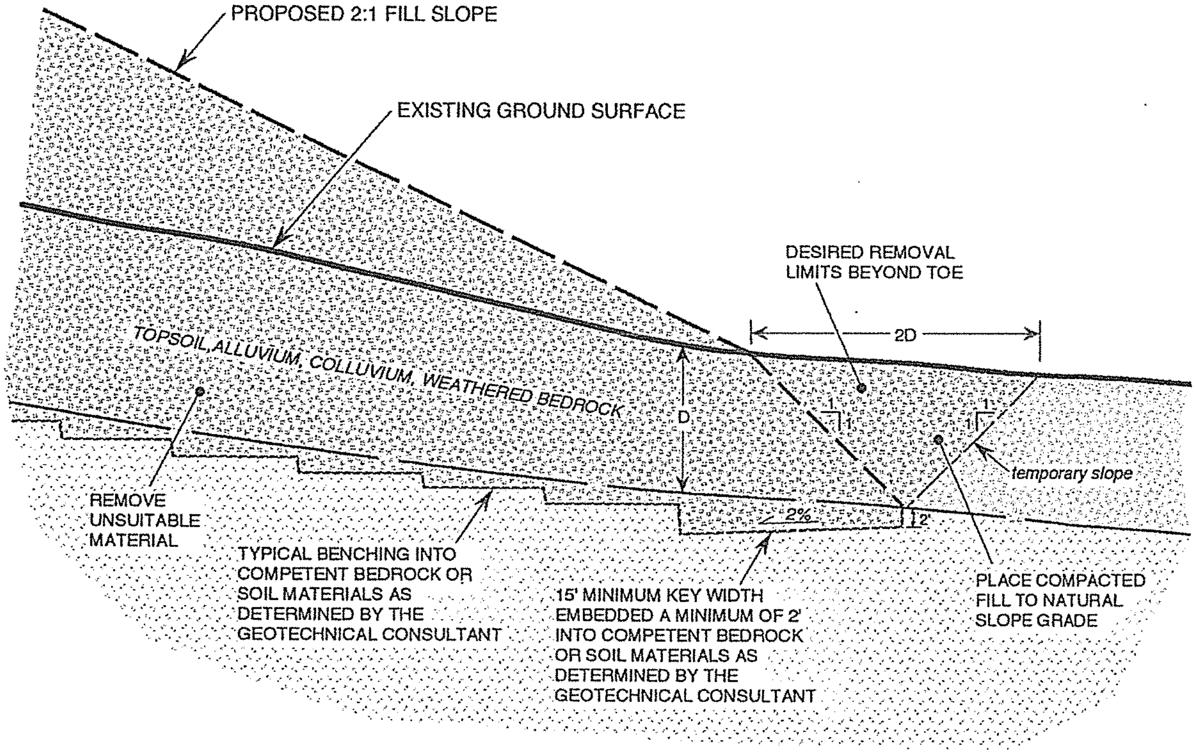


MAXIMUM FILL THICKNESS (F)	DEPTH OF OVEREXCAVATION (D)
FOOTING DEPTH TO 3 FEET	EQUAL DEPTH
3 TO 6 FEET	3 FEET
GREATER THAN 6 FEET	1/2 THE THICKNESS OF DEEPEST FILL PLACED WITHIN THE "FILL" PORTION (F) TO 15 FEET MAXIMUM

PETRA

CUT LOTS AND CUT-FILL TRANSITION LOTS

PLATE SG-7

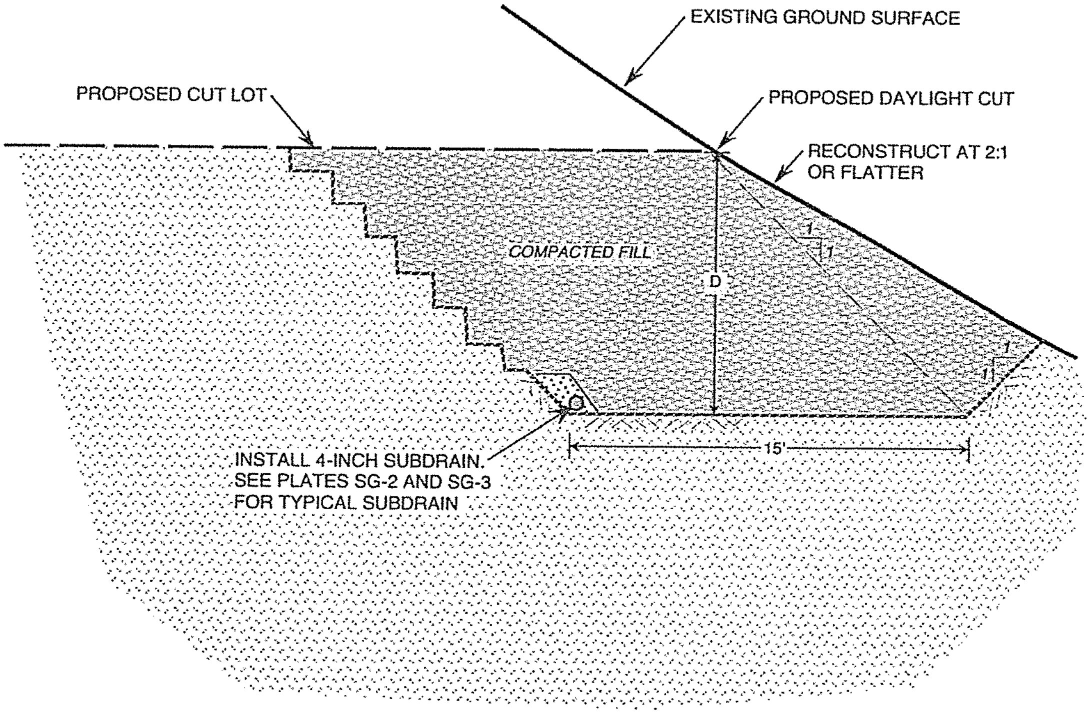


D = RECOMMENDED DEPTH OF REMOVAL
PER GEOTECHNICAL REPORT

PETRA

TYPICAL REMOVALS BEYOND TOE OF PROPOSED FILL SLOPE

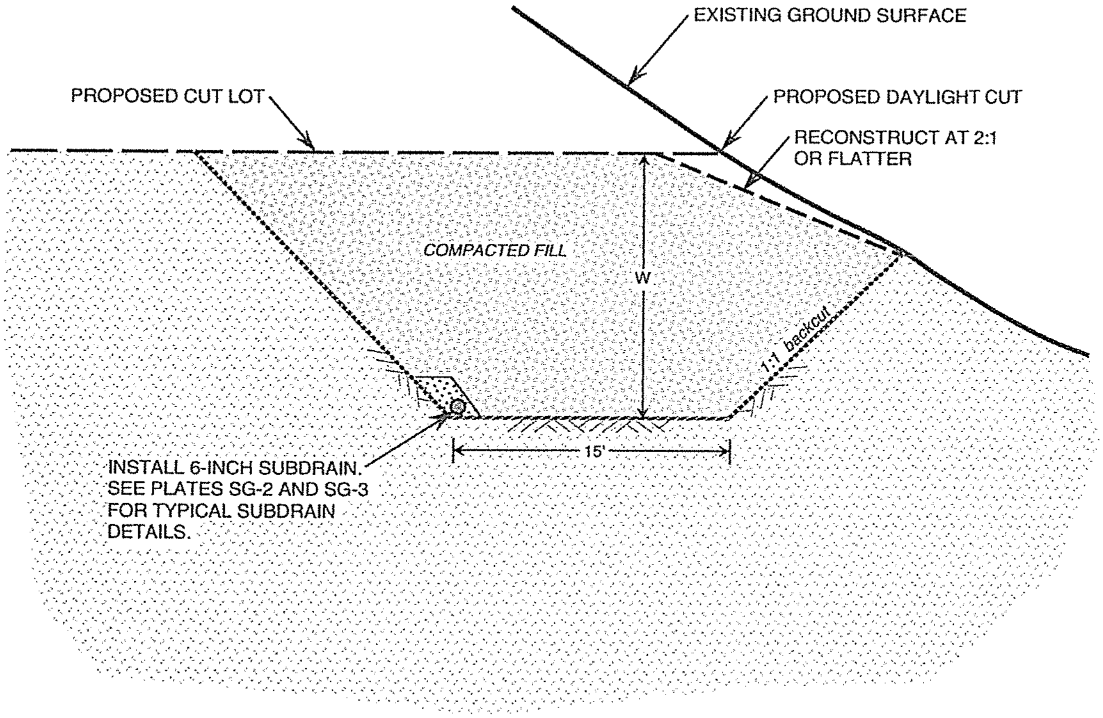
PLATE SG-8



<u>NOTE</u>:

1. "D" SHALL BE 10 FEET MINIMUM OR AS DETERMINED BY SOILS ENGINEER.

PETRA	SHEAR KEY ON DAYLIGHT CUT LOTS	PLATE SG-9



NOTE:

1. "W" SHALL BE 10 FEET MINIMUM OR AS DETERMINED BY SOILS ENGINEER.

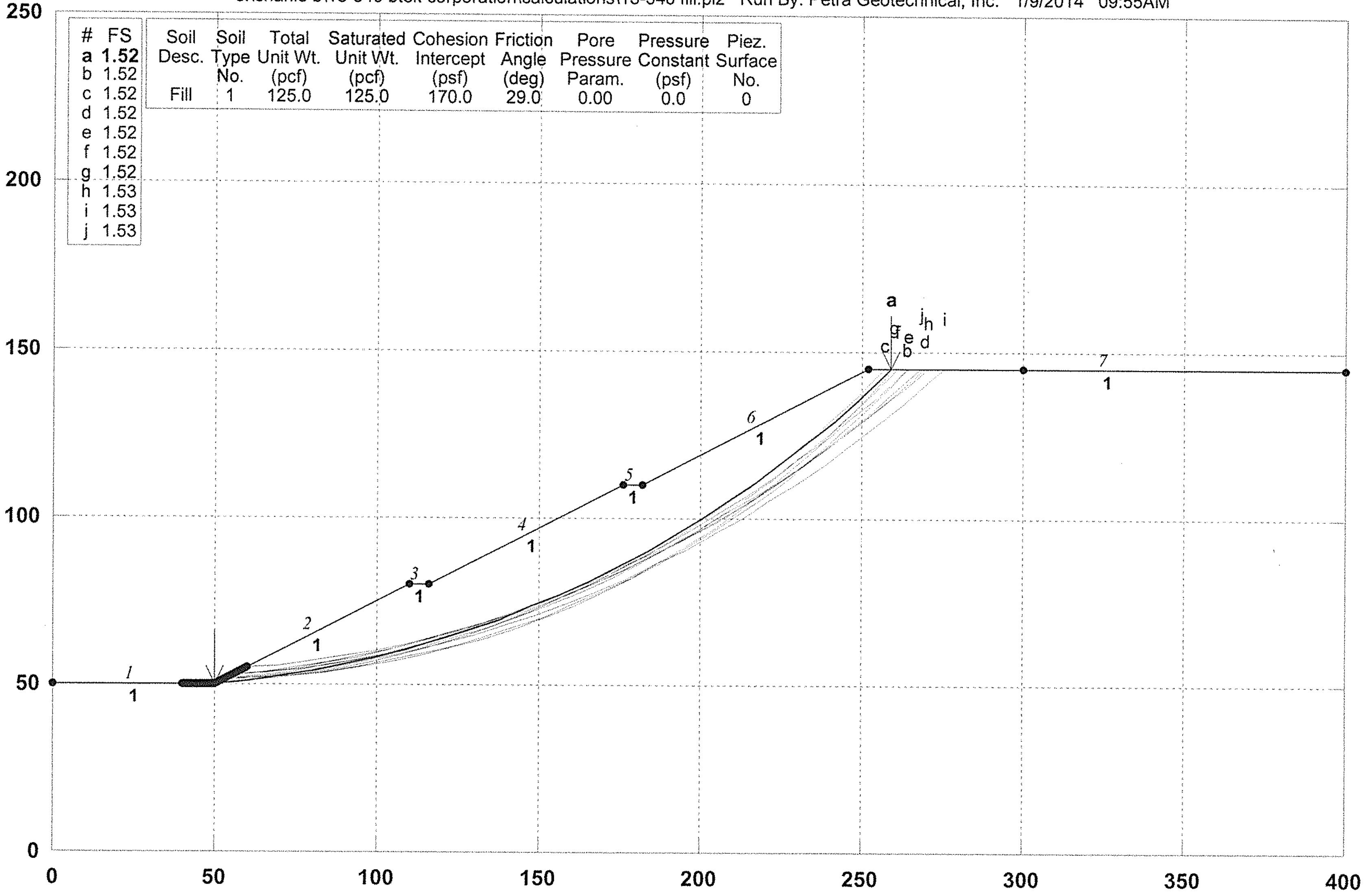
PETRA	**SHEAR KEY ON DAYLIGHT CUT LOTS**	**PLATE SG-9**

APPENDIX D

SLOPE STABILITY CALCULATIONS

Mesa Verde Phase 1 - 2:1 Fill Slope (H =95 ft.) - Static Analysis

s:\charlie b\13-546 btek corporation\calculations\13-546 fill.pl2 Run By: Petra Geotechnical, Inc. 1/9/2014 09:55AM



#	FS
a	**1.52**
b	1.52
c	1.52
d	1.52
e	1.52
f	1.52
g	1.52
h	1.53
i	1.53
j	1.53

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.
Fill	1	125.0	125.0	170.0	29.0	0.00	0.0	0

GSTABL7 v.2 FSmin=1.52

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:          1/9/2014
    Time of Run:                09:55AM
    Run By:                     Petra Geotechnical, Inc.
    Input Data Filename:        S:\CHARLIE B\13-546 BTEK Corporation\Calculations\13-546
Fill.in
    Output Filename:            S:\CHARLIE B\13-546 BTEK Corporation\Calculations\13-546
Fill.OUT
    Unit System:                English
    Plotted Output Filename:    S:\CHARLIE B\13-546 BTEK Corporation\Calculations\13-546
Fill.PLT
    PROBLEM DESCRIPTION:    Mesa Verde Phase 1 - 2:1 Fill Slope (H =
                            95 ft.) - Static Analysis
    BOUNDARY COORDINATES
        7 Top   Boundaries
        7 Total Boundaries
    Boundary     X-Left     Y-Left    X-Right     Y-Right     Soil Type
       No.        (ft)       (ft)       (ft)       (ft)       Below Bnd
        1          0.00      50.00      50.00      50.00         1
        2         50.00      50.00     110.00      80.00         1
        3        110.00      80.00     116.00      80.00         1
        4        116.00      80.00     176.00     110.00         1
        5        176.00     110.00     182.00     110.00         1
        6        182.00     110.00     252.00     145.00         1
        7        252.00     145.00     400.00     145.00         1
    Default Y-Origin = 0.00(ft)
    Default X-Plus Value = 0.00(ft)
    Default Y-Plus Value = 0.00(ft)
   ISOTROPIC SOIL PARAMETERS
     1 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   125.0    125.0     170.0     29.0    0.00      0.0      0
    A Critical Failure Surface Searching Method, Using A Random
    Technique For Generating Circular Surfaces, Has Been Specified.
    1000 Trial Surfaces Have Been Generated.
      20 Surface(s) Initiate(s) From Each Of    50 Points Equally Spaced
    Along The Ground Surface Between  X =  40.00(ft)
                                 and  X =  60.00(ft)
    Each Surface Terminates Between   X = 252.00(ft)
                                 and   X = 300.00(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 =  1000
          Number of Trial Surfaces With Valid FS = 1000
          Statistical Data On All Valid FS Values:
             FS Max =   2.754   FS Min =   1.518   FS Ave =   2.127
             Standard Deviation =    0.386   Coefficient of Variation =   18.16 %
          Failure Surface Specified By 25 Coordinate Points
```

```
                Point       X-Surf       Y-Surf
                 No.         (ft)         (ft)
                  1          50.204       50.102
                  2          60.148       51.160
                  3          70.058       52.501
                  4          79.925       54.125
                  5          89.742       56.031
                  6          99.500       58.217
                  7         109.191       60.681
                  8         118.809       63.422
                  9         128.344       66.436
                 10         137.788       69.721
                 11         147.135       73.276
                 12         156.377       77.096
                 13         165.505       81.179
                 14         174.513       85.521
                 15         183.393       90.120
                 16         192.138       94.970
                 17         200.741      100.069
                 18         209.194      105.411
                 19         217.491      110.993
                 20         225.625      116.810
                 21         233.590      122.857
                 22         241.378      129.130
                 23         248.983      135.623
                 24         256.400      142.330
                 25         259.188      145.000
             Circle Center At X =     18.207 ; Y =   398.251 ; and Radius =   349.616
                    Factor of Safety
                   ***    1.518   ***
                  Individual data on the    29  slices
                               Water  Water      Tie     Tie     Earthquake
                               Force  Force     Force   Force       Force   Surcharge
 Slice  Width    Weight         Top    Bot      Norm     Tan      Hor     Ver     Load
  No.    (ft)    (lbs)         (lbs)  (lbs)     (lbs)   (lbs)    (lbs)   (lbs)   (lbs)
   1      9.9     2432.8        0.0    0.0        0.       0.      0.0     0.0     0.0
   2      9.9     7086.7        0.0    0.0        0.       0.      0.0     0.0     0.0
   3      9.9    11325.5        0.0    0.0        0.       0.      0.0     0.0     0.0
   4      9.8    15140.0        0.0    0.0        0.       0.      0.0     0.0     0.0
   5      9.8    18523.5        0.0    0.0        0.       0.      0.0     0.0     0.0
   6      9.7    21471.3        0.0    0.0        0.       0.      0.0     0.0     0.0
   7      0.8     1920.6        0.0    0.0        0.       0.      0.0     0.0     0.0
   8      6.0    13675.2        0.0    0.0        0.       0.      0.0     0.0     0.0
   9      2.8     6207.3        0.0    0.0        0.       0.      0.0     0.0     0.0
  10      9.5    22477.9        0.0    0.0        0.       0.      0.0     0.0     0.0
  11      9.4    24148.6        0.0    0.0        0.       0.      0.0     0.0     0.0
  12      9.3    25391.6        0.0    0.0        0.       0.      0.0     0.0     0.0
  13      9.2    26213.8        0.0    0.0        0.       0.      0.0     0.0     0.0
  14      9.1    26624.4        0.0    0.0        0.       0.      0.0     0.0     0.0
  15      9.0    26634.8        0.0    0.0        0.       0.      0.0     0.0     0.0
  16      1.5     4408.4        0.0    0.0        0.       0.      0.0     0.0     0.0
  17      6.0    16616.5        0.0    0.0        0.       0.      0.0     0.0     0.0
  18      1.4     3586.1        0.0    0.0        0.       0.      0.0     0.0     0.0
  19      8.7    22231.9        0.0    0.0        0.       0.      0.0     0.0     0.0
  20      8.6    21184.6        0.0    0.0        0.       0.      0.0     0.0     0.0
  21      8.5    19806.2        0.0    0.0        0.       0.      0.0     0.0     0.0
  22      8.3    18118.2        0.0    0.0        0.       0.      0.0     0.0     0.0
  23      8.1    16143.7        0.0    0.0        0.       0.      0.0     0.0     0.0
  24      8.0    13907.9        0.0    0.0        0.       0.      0.0     0.0     0.0
  25      7.8    11437.2        0.0    0.0        0.       0.      0.0     0.0     0.0
  26      7.6     8759.8        0.0    0.0        0.       0.      0.0     0.0     0.0
  27      3.0     2737.3        0.0    0.0        0.       0.      0.0     0.0     0.0
  28      4.4     2562.8        0.0    0.0        0.       0.      0.0     0.0     0.0
  29      2.8      465.2        0.0    0.0        0.       0.      0.0     0.0     0.0
            Failure Surface Specified By 25 Coordinate Points
              Point       X-Surf       Y-Surf
               No.         (ft)         (ft)
```

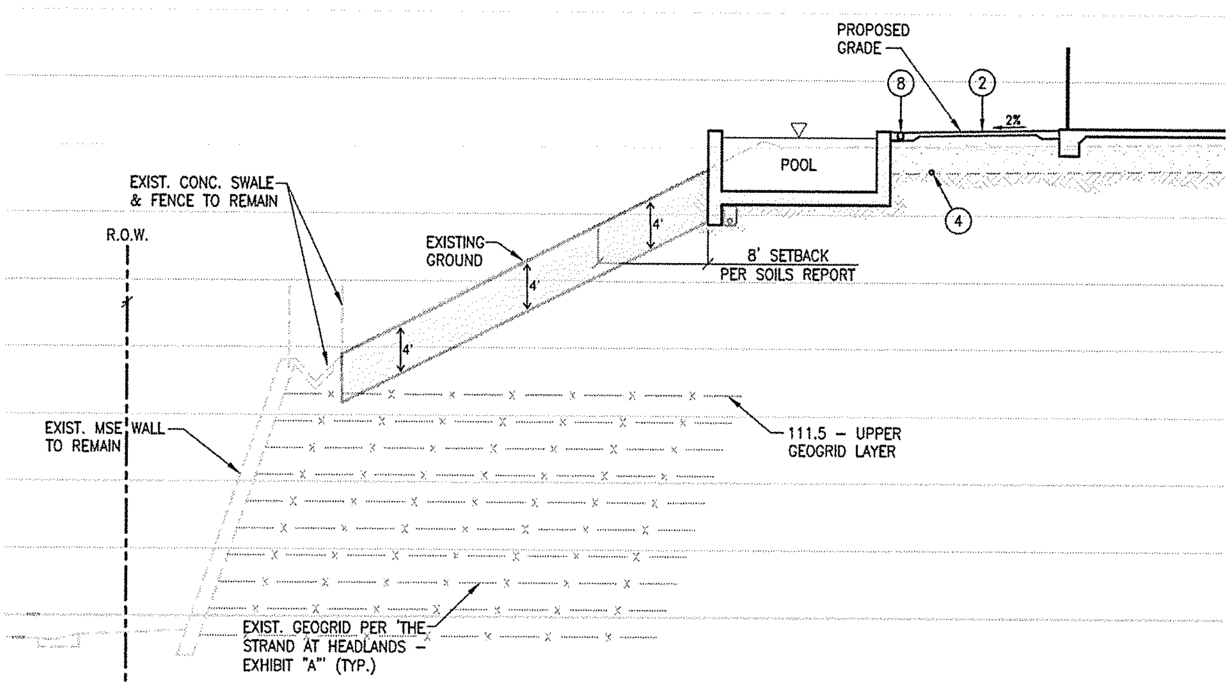
```
      1          53.061        51.531
      2          63.054        51.922
      3          73.027        52.646
      4          82.971        53.702
      5          92.875        55.088
      6         102.727        56.803
      7         112.516        58.844
      8         122.232        61.211
      9         131.864        63.899
     10         141.401        66.907
     11         150.833        70.230
     12         160.149        73.865
     13         169.338        77.808
     14         178.392        82.055
     15         187.299        86.601
     16         196.049        91.441
     17         204.634        96.570
     18         213.044       101.981
     19         221.268       107.669
     20         229.299       113.628
     21         237.127       119.850
     22         244.744       126.330
     23         252.140       133.060
     24         259.309       140.032
     25         264.088       145.000
 Circle Center At X =    46.292 ; Y =   351.881 ; and Radius =   300.427
        Factor of Safety
       ***    1.518   ***
 Failure Surface Specified By 25 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
      1          50.204        50.102
      2          60.173        50.894
      3          70.111        52.001
      4          80.010        53.420
      5          89.859        55.150
      6          99.649        57.190
      7         109.370        59.537
      8         119.011        62.189
      9         128.565        65.145
     10         138.020        68.399
     11         147.369        71.951
     12         156.600        75.795
     13         165.706        79.928
     14         174.677        84.346
     15         183.504        89.045
     16         192.179        94.019
     17         200.693        99.265
     18         209.037       104.776
     19         217.204       110.548
     20         225.184       116.574
     21         232.970       122.849
     22         240.555       129.366
     23         247.931       136.118
     24         255.090       143.100
     25         256.919       145.000
 Circle Center At X =    30.055 ; Y =   366.685 ; and Radius =   317.224
        Factor of Safety
       ***    1.518   ***
 Failure Surface Specified By 26 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
      1          52.653        51.327
      2          62.596        52.392
      3          72.508        53.717
      4          82.382        55.301
      5          92.211        57.143
```

```
      6        101.988       59.241
      7        111.707       61.594
      8        121.362       64.200
      9        130.945       67.057
     10        140.450       70.165
     11        149.870       73.519
     12        159.200       77.119
     13        168.432       80.962
     14        177.561       85.045
     15        186.580       89.364
     16        195.482       93.919
     17        204.263       98.704
     18        212.915      103.718
     19        221.434      108.956
     20        229.812      114.414
     21        238.045      120.090
     22        246.127      125.980
     23        254.052      132.079
     24        261.815      138.382
     25        269.411      144.887
     26        269.536      145.000
 Circle Center At X =    16.881 ; Y =   432.062 ; and Radius =   382.412
        Factor of Safety
       ***    1.521   ***
 Failure Surface Specified By 25 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
      1         54.694       52.347
      2         64.638       53.401
      3         74.549       54.731
      4         84.420       56.337
      5         94.242       58.215
      6        104.008       60.366
      7        113.710       62.788
      8        123.341       65.478
      9        132.894       68.435
     10        142.361       71.656
     11        151.735       75.139
     12        161.008       78.881
     13        170.174       82.880
     14        179.225       87.131
     15        188.155       91.633
     16        196.956       96.381
     17        205.622      101.371
     18        214.145      106.601
     19        222.520      112.065
     20        230.740      117.760
     21        238.799      123.681
     22        246.689      129.824
     23        254.406      136.184
     24        261.944      142.756
     25        264.378      145.000
 Circle Center At X =    21.736 ; Y =   410.648 ; and Radius =   359.814
        Factor of Safety
       ***    1.521   ***
 Failure Surface Specified By 25 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
      1         55.918       52.959
      2         65.897       53.615
      3         75.849       54.594
      4         85.764       55.894
      5         95.632       57.514
      6        105.442       59.452
      7        115.185       61.706
      8        124.849       64.275
      9        134.426       67.154
```

```
     10          143.904        70.342
     11          153.275        73.834
     12          162.527        77.628
     13          171.652        81.719
     14          180.640        86.103
     15          189.481        90.775
     16          198.167        95.731
     17          206.688       100.965
     18          215.035       106.472
     19          223.200       112.245
     20          231.173       118.280
     21          238.948       124.570
     22          246.515       131.108
     23          253.866       137.887
     24          260.995       144.900
     25          261.090       145.000
Circle Center At X =     40.620 ; Y =   361.768 ; and Radius =   309.187
       Factor of Safety
      ***    1.521   ***
Failure Surface Specified By 25 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
     1          53.469        51.735
     2          63.467        51.948
     3          73.451        52.523
     4          83.407        53.457
     5          93.323        54.751
     6         103.186        56.401
     7         112.983        58.407
     8         122.701        60.765
     9         132.327        63.472
    10         141.850        66.525
    11         151.256        69.920
    12         160.533        73.653
    13         169.670        77.718
    14         178.653        82.110
    15         187.473        86.823
    16         196.116        91.852
    17         204.572        97.190
    18         212.830       102.830
    19         220.879       108.764
    20         228.709       114.985
    21         236.309       121.484
    22         243.669       128.254
    23         250.780       135.285
    24         257.632       142.568
    25         259.760       145.000
Circle Center At X =     52.554 ; Y =   328.653 ; and Radius =   276.919
       Factor of Safety
      ***    1.522   ***
Failure Surface Specified By 25 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
     1          54.694        52.347
     2          64.624        53.530
     3          74.521        54.962
     4          84.379        56.642
     5          94.191        58.569
     6         103.952        60.742
     7         113.656        63.159
     8         123.295        65.819
     9         132.865        68.721
    10         142.359        71.862
    11         151.771        75.240
    12         161.095        78.853
    13         170.326        82.700
    14         179.457        86.777
```

```
     15         188.483        91.082
     16         197.398        95.613
     17         206.196       100.366
     18         214.872       105.338
     19         223.421       110.527
     20         231.837       115.928
     21         240.114       121.539
     22         248.248       127.357
     23         256.233       133.377
     24         264.064       139.595
     25         270.531       145.000
Circle Center At X =     12.557 ; Y =   448.301 ; and Radius =   398.190
       Factor of Safety
      ***    1.528   ***
Failure Surface Specified By 26 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
     1          51.837        50.918
     2          61.801        51.760
     3          71.740        52.865
     4          81.646        54.233
     5          91.512        55.864
     6         101.332        57.756
     7         111.097        59.908
     8         120.803        62.318
     9         130.441        64.984
    10         140.004        67.905
    11         149.487        71.079
    12         158.883        74.503
    13         168.184        78.176
    14         177.385        82.093
    15         186.478        86.254
    16         195.458        90.654
    17         204.318        95.291
    18         213.052       100.161
    19         221.654       105.261
    20         230.117       110.587
    21         238.436       116.136
    22         246.605       121.904
    23         254.618       127.887
    24         262.470       134.079
    25         270.155       140.478
    26         275.301       145.000
Circle Center At X =     25.170 ; Y =   426.686 ; and Radius =   376.713
       Factor of Safety
      ***    1.528   ***
Failure Surface Specified By 25 Coordinate Points
  Point       X-Surf       Y-Surf
   No.         (ft)         (ft)
     1          59.592        54.796
     2          69.550        55.711
     3          79.478        56.909
     4          89.368        58.390
     5          99.211        60.153
     6         109.000        62.196
     7         118.727        64.518
     8         128.384        67.116
     9         137.962        69.988
    10         147.455        73.133
    11         156.854        76.547
    12         166.152        80.228
    13         175.341        84.173
    14         184.414        88.378
    15         193.363        92.840
    16         202.181        97.556
    17         210.861       102.522
    18         219.396       107.733
```

```
        19          227.778         113.186
        20          236.002         118.876
        21          244.060         124.798
        22          251.945         130.947
        23          259.652         137.319
        24          267.175         143.908
        25          268.351         145.000
 Circle Center At X =     32.518 ; Y =    404.196 ; and Radius =    350.447
        Factor of Safety
       ***    1.530   ***
           **** END OF GSTABL7 OUTPUT ****
```



EXPLANATION

▨ Creep Zone

PETRA GEOTECHNICAL, INC.
3190 Airport Loop, Suite J-1
Costa Mesa, California 92626
PHONE: (714) 549-8921
COSTA MESA TEMECULA VALENCIA PALM DESERT CORONA

GEOTECHNICAL CROSS SECTION

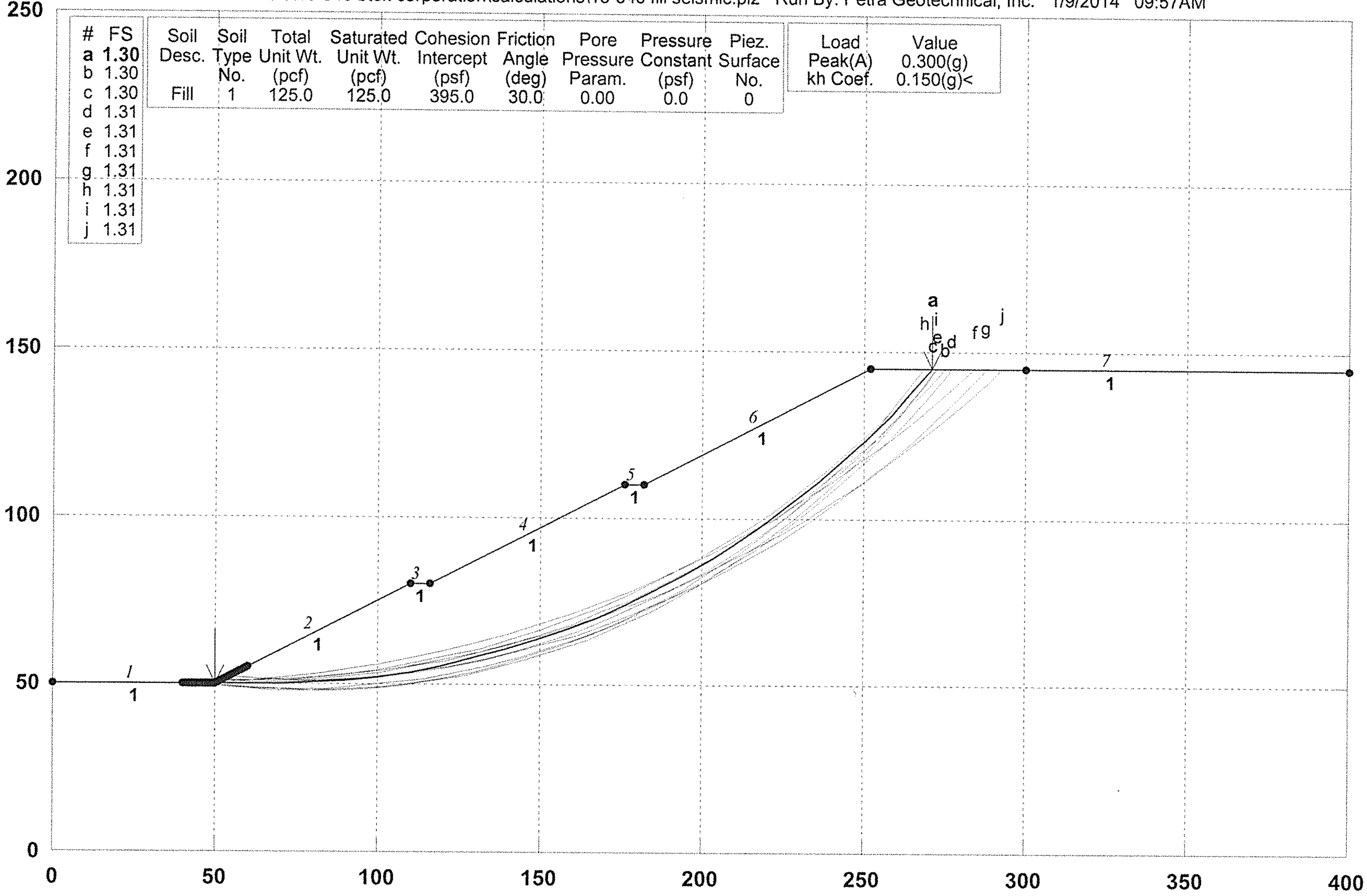
3 Oceanfront Lane (Lot 7, Tract 16331)
Dana Point, California

PETRA GEOTECHNICAL™
DATE: January, 2014
J.N.: 13-452
Figure 2

Base Map Reference: TOTAL ENGINEERING, INC. 139 AVENIDA NAVARRO, SAN CLEMENTE, CA 92672, Sheet C3, Scale: N/A, Project No. 15071, dated September 30, 2013.

Mesa Verde Phase 1 - 2:1 Fill Slope (H =95 ft.) - Seismic Analysis

s:\charlie b\13-546 btek corporation\calculations\13-546 fill seismic.pl2 Run By: Petra Geotechnical, Inc. 1/9/2014 09:57AM



#	FS
a	**1.30**
b	1.30
c	1.30
d	1.31
e	1.31
f	1.31
g	1.31
h	1.31
i	1.31
j	1.31

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.
Fill	1	125.0	125.0	395.0	30.0	0.00	0.0	0

Load	Value
Peak(A)	0.300(g)
kh Coef.	0.150(g)<

GSTABL7 v.2 FSmin=1.30

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

```
                         ***  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:          1/9/2014
    Time of Run:                09:57AM
    Run By:                     Petra Geotechnical, Inc.
    Input Data Filename:        S:\CHARLIE B\13-546 BTEK Corporation\Calculations\13-546 Fill
Seismic.in
    Output Filename:            S:\CHARLIE B\13-546 BTEK Corporation\Calculations\13-546 Fill
Seismic.OUT
    Unit System:                English
    Plotted Output Filename:    S:\CHARLIE B\13-546 BTEK Corporation\Calculations\13-546 Fill
Seismic.PLT
    PROBLEM DESCRIPTION:  Mesa Verde Phase 1 - 2:1 Fill Slope (H =
                          95 ft.) - Seismic Analysis
    BOUNDARY COORDINATES
        7 Top   Boundaries
        7 Total Boundaries
    Boundary     X-Left     Y-Left     X-Right     Y-Right     Soil Type
       No.        (ft)       (ft)        (ft)        (ft)      Below Bnd
        1          0.00      50.00       50.00       50.00         1
        2         50.00      50.00      110.00       80.00         1
        3        110.00      80.00      116.00       80.00         1
        4        116.00      80.00      176.00      110.00         1
        5        176.00     110.00      182.00      110.00         1
        6        182.00     110.00      252.00      145.00         1
        7        252.00     145.00      400.00      145.00         1
    Default Y-Origin = 0.00(ft)
    Default X-Plus Value = 0.00(ft)
    Default Y-Plus Value = 0.00(ft)
   ISOTROPIC SOIL PARAMETERS
     1 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   125.0    125.0     395.0     30.0     0.00      0.0      0
    Specified Peak Ground Acceleration Coefficient (A) =   0.300(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.
    1000 Trial Surfaces Have Been Generated.
      20 Surface(s) Initiate(s) From Each Of    50 Points Equally Spaced
    Along The Ground Surface Between  X =  40.00(ft)
                                 and  X =  60.00(ft)
    Each Surface Terminates Between   X = 252.00(ft)
                                and   X = 300.00(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 =  1000
          Number of Trial Surfaces With Valid FS = 1000
```

```
          Statistical Data On All Valid FS Values:
             FS Max =    2.737   FS Min =    1.300   FS Ave =    1.717
             Standard Deviation =    0.282   Coefficient of Variation =   16.44 %
          Failure Surface Specified By 26 Coordinate Points
            Point      X-Surf      Y-Surf
             No.        (ft)        (ft)
              1        50.204      50.102
              2        60.199      49.788
              3        70.199      49.840
              4        80.190      50.258
              5        90.160      51.042
              6       100.093      52.191
              7       109.979      53.702
              8       119.802      55.574
              9       129.550      57.805
             10       139.210      60.391
             11       148.768      63.329
             12       158.213      66.615
             13       167.531      70.244
             14       176.710      74.213
             15       185.737      78.514
             16       194.601      83.144
             17       203.290      88.095
             18       211.791      93.360
             19       220.094      98.934
             20       228.187     104.808
             21       236.060     110.974
             22       243.701     117.424
             23       251.102     124.150
             24       258.251     131.142
             25       265.139     138.391
             26       270.974     145.000
         Circle Center At X =    63.791 ; Y =   322.741 ; and Radius =   272.977
                Factor of Safety
               ***    1.300   ***
              Individual data on the    30  slices
                           Water  Water     Tie     Tie     Earthquake
                           Force  Force    Force   Force       Force   Surcharge
 Slice  Width   Weight     Top    Bot      Norm    Tan      Hor     Ver    Load
  No.   (ft)    (lbs)     (lbs)  (lbs)    (lbs)   (lbs)    (lbs)   (lbs)  (lbs)
   1    10.0    3318.1     0.0    0.0        0.      0.    497.7    0.0     0.0
   2    10.0    9731.7     0.0    0.0        0.      0.   1459.8    0.0     0.0
   3    10.0   15671.3     0.0    0.0        0.      0.   2350.7    0.0     0.0
   4    10.0   21106.3     0.0    0.0        0.      0.   3165.9    0.0     0.0
   5     9.9   26010.3     0.0    0.0        0.      0.   3901.6    0.0     0.0
   6     9.9   30362.0     0.0    0.0        0.      0.   4554.3    0.0     0.0
   7     0.0      70.5     0.0    0.0        0.      0.     10.6    0.0     0.0
   8     6.0   19291.7     0.0    0.0        0.      0.   2893.8    0.0     0.0
   9     3.8   12231.4     0.0    0.0        0.      0.   1834.7    0.0     0.0
  10     9.7   33689.9     0.0    0.0        0.      0.   5053.5    0.0     0.0
  11     9.7   36335.7     0.0    0.0        0.      0.   5450.4    0.0     0.0
  12     9.6   38395.8     0.0    0.0        0.      0.   5759.4    0.0     0.0
  13     9.4   39872.7     0.0    0.0        0.      0.   5980.9    0.0     0.0
  14     9.3   40774.0     0.0    0.0        0.      0.   6116.1    0.0     0.0
  15     8.5   37907.0     0.0    0.0        0.      0.   5686.0    0.0     0.0
  16     0.7    3189.3     0.0    0.0        0.      0.    478.4    0.0     0.0
  17     5.3   22831.4     0.0    0.0        0.      0.   3424.7    0.0     0.0
  18     3.7   15561.5     0.0    0.0        0.      0.   2334.2    0.0     0.0
  19     8.9   36846.6     0.0    0.0        0.      0.   5527.0    0.0     0.0
  20     8.7   35680.6     0.0    0.0        0.      0.   5352.1    0.0     0.0
  21     8.5   34050.5     0.0    0.0        0.      0.   5107.6    0.0     0.0
  22     8.3   31990.8     0.0    0.0        0.      0.   4798.6    0.0     0.0
  23     8.1   29539.6     0.0    0.0        0.      0.   4430.9    0.0     0.0
  24     7.9   26738.7     0.0    0.0        0.      0.   4010.8    0.0     0.0
  25     7.6   23633.2     0.0    0.0        0.      0.   3545.0    0.0     0.0
  26     7.4   20271.4     0.0    0.0        0.      0.   3040.7    0.0     0.0
  27     0.9    2266.8     0.0    0.0        0.      0.    340.0    0.0     0.0
```

```
  28       6.3   13216.5      0.0      0.0        0.       0.  1982.5      0.0       0.0
  29       6.9    8811.6      0.0      0.0        0.       0.  1321.7      0.0       0.0
  30       5.8    2410.1      0.0      0.0        0.       0.   361.5      0.0       0.0
           Failure Surface Specified By 26 Coordinate Points
             Point      X-Surf      Y-Surf
              No.        (ft)        (ft)
               1        51.837      50.918
               2        61.836      50.788
               3        71.834      51.002
               4        81.818      51.559
               5        91.778      52.459
               6       101.700      53.700
               7       111.574      55.282
               8       121.388      57.202
               9       131.130      59.458
              10       140.789      62.048
              11       150.353      64.968
              12       159.811      68.216
              13       169.152      71.786
              14       178.365      75.675
              15       187.439      79.879
              16       196.362      84.391
              17       205.126      89.208
              18       213.719      94.324
              19       222.130      99.731
              20       230.352     105.424
              21       238.372     111.397
              22       246.183     117.641
              23       253.774     124.151
              24       261.137     130.917
              25       268.263     137.933
              26       274.965     145.000
          Circle Center At X =    60.627 ; Y =   341.703 ; and Radius =   290.918
                 Factor of Safety
               ***    1.302   ***
          Failure Surface Specified By 26 Coordinate Points
            Point      X-Surf      Y-Surf
             No.        (ft)        (ft)
              1        52.245      51.122
              2        62.245      51.122
              3        72.239      51.466
              4        82.215      52.154
              5        92.162      53.185
              6       102.067      54.558
              7       111.920      56.271
              8       121.707      58.322
              9       131.418      60.709
             10       141.041      63.428
             11       150.565      66.478
             12       159.978      69.853
             13       169.269      73.550
             14       178.428      77.565
             15       187.443      81.893
             16       196.304      86.529
             17       204.999      91.467
             18       213.520      96.701
             19       221.855     102.226
             20       229.996     108.034
             21       237.931     114.119
             22       245.653     120.473
             23       253.151     127.090
             24       260.417     133.960
             25       267.442     141.077
             26       271.056     145.000
          Circle Center At X =    57.294 ; Y =   341.296 ; and Radius =   290.218
                 Factor of Safety
               ***    1.304   ***
```

```
 Failure Surface Specified By 28 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
     1         44.490       50.000
     2         54.449       49.100
     3         64.436       48.579
     4         74.435       48.436
     5         84.432       48.673
     6         94.413       49.288
     7        104.364       50.280
     8        114.269       51.649
     9        124.116       53.393
    10        133.890       55.508
    11        143.576       57.992
    12        153.162       60.842
    13        162.632       64.052
    14        171.975       67.620
    15        181.175       71.538
    16        190.220       75.803
    17        199.097       80.407
    18        207.793       85.344
    19        216.296       90.607
    20        224.593       96.189
    21        232.673      102.081
    22        240.524      108.275
    23        248.134      114.762
    24        255.493      121.533
    25        262.591      128.578
    26        269.416      135.886
    27        275.959      143.448
    28        277.203      145.000
Circle Center At X =    73.217 ; Y =   312.157 ; and Radius =   263.726
       Factor of Safety
      ***    1.309   ***
Failure Surface Specified By 26 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
     1         53.878       51.939
     2         63.856       51.279
     3         73.852       51.013
     4         83.851       51.141
     5         93.838       51.663
     6        103.796       52.577
     7        113.710       53.884
     8        123.565       55.580
     9        133.346       57.663
    10        143.037       60.130
    11        152.623       62.977
    12        162.090       66.200
    13        171.422       69.793
    14        180.605       73.751
    15        189.626       78.067
    16        198.469       82.736
    17        207.121       87.750
    18        215.569       93.100
    19        223.800       98.780
    20        231.801      104.779
    21        239.559      111.089
    22        247.062      117.699
    23        254.299      124.600
    24        261.258      131.781
    25        267.929      139.231
    26        272.700      145.000
Circle Center At X =    75.631 ; Y =   304.587 ; and Radius =   253.583
       Factor of Safety
      ***    1.310   ***
Failure Surface Specified By 27 Coordinate Points
```

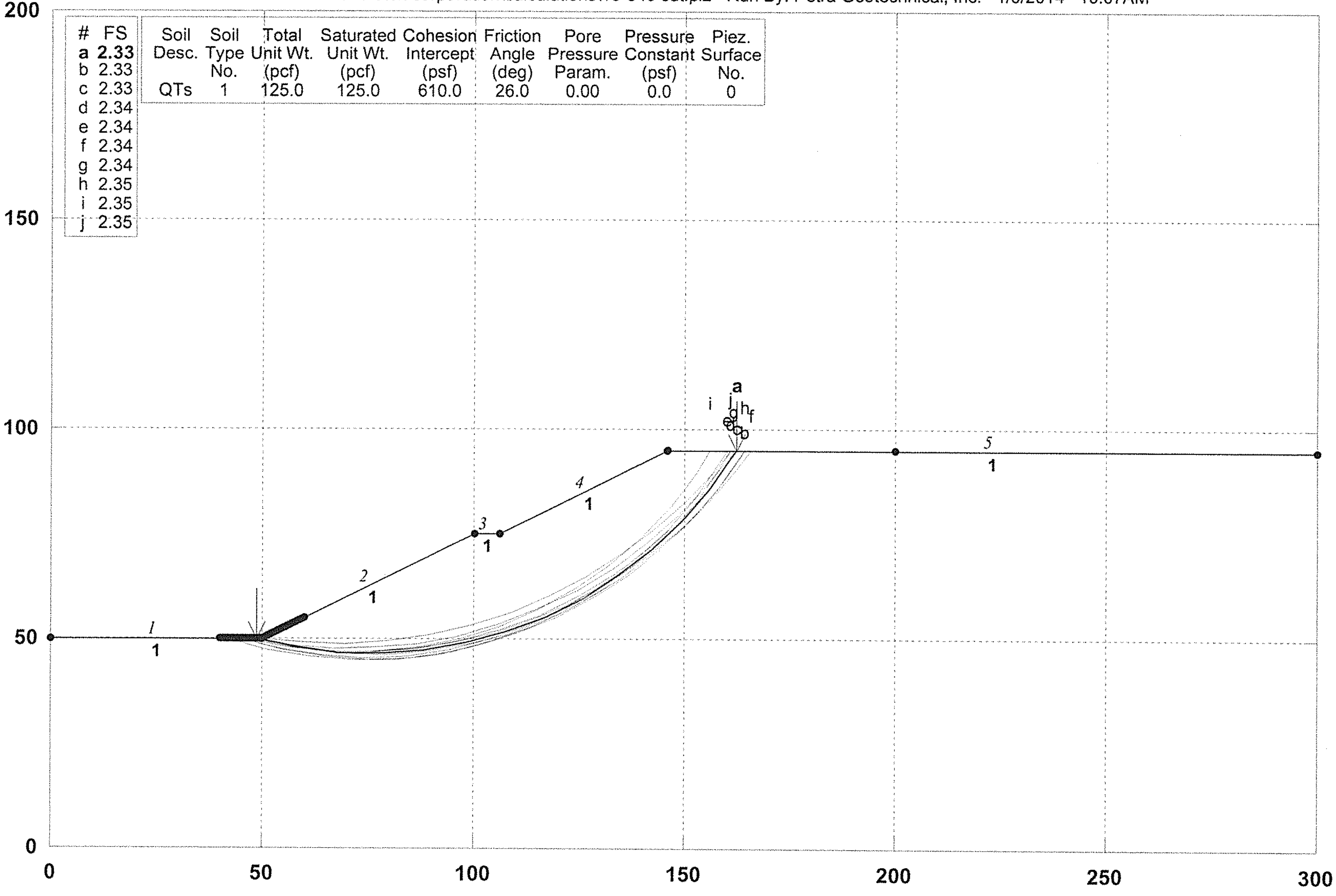
```
    Point       X-Surf       Y-Surf
     No.         (ft)         (ft)
      1          51.429       50.714
      2          61.416       51.216
      3          71.386       51.989
      4          81.331       53.033
      5          91.245       54.347
      6         101.119       55.930
      7         110.946       57.781
      8         120.719       59.899
      9         130.431       62.281
     10         140.075       64.927
     11         149.643       67.833
     12         159.129       70.999
     13         168.525       74.422
     14         177.824       78.099
     15         187.021       82.027
     16         196.106       86.204
     17         205.075       90.626
     18         213.921       95.290
     19         222.636      100.194
     20         231.215      105.332
     21         239.651      110.702
     22         247.938      116.299
     23         256.070      122.119
     24         264.040      128.159
     25         271.843      134.412
     26         279.474      140.876
     27         284.082      145.000
 Circle Center At X =     37.967 ; Y =   418.238 ; and Radius =   367.770
        Factor of Safety
       ***    1.310   ***
 Failure Surface Specified By 28 Coordinate Points
   Point       X-Surf       Y-Surf
    No.         (ft)         (ft)
     1          52.245       51.122
     2          62.236       50.690
     3          72.235       50.594
     4          82.232       50.833
     5          92.216       51.408
     6         102.174       52.317
     7         112.097       53.559
     8         121.972       55.135
     9         131.789       57.040
    10         141.536       59.274
    11         151.203       61.834
    12         160.778       64.716
    13         170.252       67.919
    14         179.612       71.437
    15         188.850       75.268
    16         197.953       79.406
    17         206.913       83.848
    18         215.718       88.587
    19         224.359       93.620
    20         232.827       98.940
    21         241.111      104.540
    22         249.203      110.416
    23         257.093      116.560
    24         264.773      122.965
    25         272.233      129.624
    26         279.465      136.530
    27         286.462      143.675
    28         287.675      145.000
 Circle Center At X =     70.131 ; Y =   348.418 ; and Radius =   297.833
        Factor of Safety
       ***    1.312   ***
 Failure Surface Specified By 27 Coordinate Points
```

```
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1         49.388      50.000
    2         59.335      48.970
    3         69.316      48.364
    4         79.315      48.186
    5         89.312      48.433
    6         99.289      49.107
    7        109.228      50.206
    8        119.112      51.728
    9        128.921      53.670
   10        138.639      56.029
   11        148.248      58.800
   12        157.729      61.979
   13        167.066      65.559
   14        176.242      69.534
   15        185.240      73.897
   16        194.044      78.639
   17        202.638      83.753
   18        211.005      89.229
   19        219.132      95.057
   20        227.002     101.226
   21        234.602     107.725
   22        241.918     114.542
   23        248.937     121.665
   24        255.645     129.082
   25        262.031     136.777
   26        268.082     144.738
   27        268.264     145.000
Circle Center At X =    78.506 ; Y =   282.571 ; and Radius =   234.386
       Factor of Safety
      ***    1.313   ***
Failure Surface Specified By 27 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1         46.939      50.000
    2         56.875      48.876
    3         66.850      48.165
    4         76.846      47.868
    5         86.845      47.987
    6         96.831      48.521
    7        106.786      49.469
    8        116.693      50.829
    9        126.535      52.600
   10        136.295      54.777
   11        145.956      57.358
   12        155.502      60.337
   13        164.916      63.711
   14        174.181      67.472
   15        183.283      71.614
   16        192.205      76.131
   17        200.932      81.014
   18        209.448      86.256
   19        217.739      91.846
   20        225.792      97.776
   21        233.591     104.035
   22        241.123     110.612
   23        248.377     117.496
   24        255.338     124.675
   25        261.995     132.137
   26        268.336     139.869
   27        272.199     145.000
Circle Center At X =    78.983 ; Y =   288.704 ; and Radius =   240.845
       Factor of Safety
      ***    1.313   ***
Failure Surface Specified By 28 Coordinate Points
  Point      X-Surf      Y-Surf
```

```
      No.         (ft)         (ft)
       1         51.429        50.714
       2         61.428        50.817
       3         71.421        51.204
       4         81.398        51.874
       5         91.353        52.828
       6        101.276        54.064
       7        111.160        55.581
       8        120.997        57.379
       9        130.779        59.455
      10        140.499        61.808
      11        150.147        64.436
      12        159.717        67.337
      13        169.201        70.509
      14        178.590        73.949
      15        187.879        77.654
      16        197.058        81.622
      17        206.121        85.848
      18        215.060        90.331
      19        223.868        95.065
      20        232.538       100.048
      21        241.063       105.275
      22        249.437       110.742
      23        257.651       116.444
      24        265.701       122.378
      25        273.578       128.538
      26        281.278       134.919
      27        288.793       141.516
      28        292.541       145.000
 Circle Center At X =    52.854 ; Y =   402.504 ; and Radius =   351.792
        Factor of Safety
       ***    1.313   ***
          **** END OF GSTABL7 OUTPUT ****
```

Mesa Verde Phase 1 - 2:1 Cut Slope (H = 45 ft.) - Static Analysis

s:\charlie b\13-546 btek corporation\calculations\13-546 cut.pl2 Run By: Petra Geotechnical, Inc. 1/9/2014 10:07AM



#	FS
a	**2.33**
b	2.33
c	2.33
d	2.34
e	2.34
f	2.34
g	2.34
h	2.35
i	2.35
j	2.35

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.
QTs	1	125.0	125.0	610.0	26.0	0.00	0.0	0

GSTABL7 v.2 FSmin=2.33

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

```
                              ***  GSTABL7  ***
                    ** GSTABL7 by Garry H. Gregory, P.E. **
      ** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
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    *********************************************************************************
                         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:          1/9/2014
     Time of Run:                10:07AM
     Run By:                     Petra Geotechnical, Inc.
     Input Data Filename:        S:\CHARLIE B\13-546 BTEK Corporation\Calculations\13-546 cut.in
     Output Filename:            S:\CHARLIE B\13-546 BTEK Corporation\Calculations\13-546
 cut.OUT
     Unit System:                English
     Plotted Output Filename:    S:\CHARLIE B\13-546 BTEK Corporation\Calculations\13-546
 cut.PLT
     PROBLEM DESCRIPTION:    Mesa Verde Phase 1 - 2:1 Cut Slope (H =
                             45 ft.) - Static Analysis
    BOUNDARY COORDINATES
        5 Top   Boundaries
        5 Total Boundaries
    Boundary     X-Left     Y-Left     X-Right    Y-Right    Soil Type
       No.        (ft)       (ft)        (ft)       (ft)     Below Bnd
        1          0.00      50.00       50.00      50.00        1
        2         50.00      50.00      100.00      75.00        1
        3        100.00      75.00      106.00      75.00        1
        4        106.00      75.00      146.00      95.00        1
        5        146.00      95.00      300.00      95.00        1
    Default Y-Origin = 0.00(ft)
    Default X-Plus Value = 0.00(ft)
    Default Y-Plus Value = 0.00(ft)
   ISOTROPIC SOIL PARAMETERS
     1 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   125.0    125.0     610.0     26.0     0.00       0.0       0
    A Critical Failure Surface Searching Method, Using A Random
    Technique For Generating Circular Surfaces, Has Been Specified.
    1000 Trial Surfaces Have Been Generated.
      20 Surface(s) Initiate(s) From Each Of    50 Points Equally Spaced
    Along The Ground Surface Between  X =  40.00(ft)
                                 and  X =  60.00(ft)
    Each Surface Terminates Between   X = 146.00(ft)
                                and   X = 200.00(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 =  1000
          Number of Trial Surfaces With Valid FS = 1000
          Statistical Data On All Valid FS Values:
             FS Max =   8.632   FS Min =   2.330   FS Ave =   2.980
             Standard Deviation =    0.537   Coefficient of Variation =   18.01 %
          Failure Surface Specified By 15 Coordinate Points
            Point      X-Surf      Y-Surf
             No.        (ft)        (ft)
              1        48.571      50.000
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                2         58.336        47.844
                3         68.265        46.653
                4         78.263        46.440
                5         88.233        47.207
                6         98.081        48.946
                7        107.711        51.640
                8        117.031        55.264
                9        125.952        59.783
               10        134.388        65.153
               11        142.258        71.323
               12        149.486        78.234
               13        156.003        85.819
               14        161.746        94.005
               15        162.307        95.000
         Circle Center At X =    75.433 ; Y =   148.451 ; and Radius =   102.050
                Factor of Safety
              ***    2.330   ***
              Individual data on the    18  slices
                           Water  Water     Tie      Tie     Earthquake
                           Force  Force     Force    Force      Force   Surcharge
 Slice  Width    Weight     Top    Bot      Norm     Tan      Hor     Ver     Load
  No.    (ft)    (lbs)    (lbs)  (lbs)     (lbs)    (lbs)    (lbs)   (lbs)   (lbs)
   1      1.4      28.2     0.0    0.0        0.       0.      0.0     0.0      0.0
   2      8.3    3459.5     0.0    0.0        0.       0.      0.0     0.0      0.0
   3      9.9   11668.8     0.0    0.0        0.       0.      0.0     0.0      0.0
   4     10.0   18852.1     0.0    0.0        0.       0.      0.0     0.0      0.0
   5     10.0   24677.5     0.0    0.0        0.       0.      0.0     0.0      0.0
   6      9.8   28930.1     0.0    0.0        0.       0.      0.0     0.0      0.0
   7      1.9    6070.1     0.0    0.0        0.       0.      0.0     0.0      0.0
   8      6.0   18508.4     0.0    0.0        0.       0.      0.0     0.0      0.0
   9      1.7    5139.5     0.0    0.0        0.       0.      0.0     0.0      0.0
  10      9.3   28815.2     0.0    0.0        0.       0.      0.0     0.0      0.0
  11      8.9   28125.5     0.0    0.0        0.       0.      0.0     0.0      0.0
  12      8.4   25957.9     0.0    0.0        0.       0.      0.0     0.0      0.0
  13      7.9   22549.8     0.0    0.0        0.       0.      0.0     0.0      0.0
  14      3.7    9801.3     0.0    0.0        0.       0.      0.0     0.0      0.0
  15      3.5    8031.2     0.0    0.0        0.       0.      0.0     0.0      0.0
  16      6.5   10568.7     0.0    0.0        0.       0.      0.0     0.0      0.0
  17      5.7    3652.9     0.0    0.0        0.       0.      0.0     0.0      0.0
  18      0.6      34.9     0.0    0.0        0.       0.      0.0     0.0      0.0
         Failure Surface Specified By 15 Coordinate Points
           Point       X-Surf       Y-Surf
            No.         (ft)         (ft)
             1         48.980        50.000
             2         58.735        47.802
             3         68.657        46.555
             4         78.653        46.272
             5         88.630        46.955
             6         98.494        48.597
             7        108.154        51.184
             8        117.518        54.690
             9        126.501        59.085
            10        135.018        64.325
            11        142.989        70.363
            12        150.341        77.143
            13        157.003        84.600
            14        162.916        92.665
            15        164.302        95.000
         Circle Center At X =    76.583 ; Y =   149.750 ; and Radius =   103.499
                Factor of Safety
              ***    2.332   ***
         Failure Surface Specified By 15 Coordinate Points
           Point       X-Surf       Y-Surf
            No.         (ft)         (ft)
             1         46.939        50.000
             2         56.747        48.050
             3         66.693        47.018
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     4          76.693        46.914
     5          86.659        47.737
     6          96.506        49.481
     7         106.148        52.131
     8         115.503        55.664
     9         124.491        60.049
    10         133.032        65.249
    11         141.055        71.219
    12         148.489        77.907
    13         155.271        85.256
    14         161.342        93.202
    15         162.468        95.000
 Circle Center At X =     72.820 ; Y =   154.541 ; and Radius =   107.697
          Factor of Safety
        ***    2.333   ***
 Failure Surface Specified By 15 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
     1          45.306        50.000
     2          54.953        47.368
     3          64.819        45.735
     4          74.800        45.119
     5          84.792        45.527
     6          94.690        46.953
     7         104.390        49.384
     8         113.791        52.793
     9         122.794        57.145
    10         131.306        62.394
    11         139.236        68.486
    12         146.503        75.356
    13         153.029        82.933
    14         158.747        91.137
    15         160.889        95.000
 Circle Center At X =     75.819 ; Y =   142.838 ; and Radius =    97.724
          Factor of Safety
        ***    2.340   ***
 Failure Surface Specified By 15 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
     1          44.490        50.000
     2          54.168        47.485
     3          64.051        45.957
     4          74.037        45.433
     5          84.026        45.917
     6          93.914        47.405
     7         103.603        49.882
     8         112.993        53.321
     9         121.988        57.689
    10         130.498        62.941
    11         138.436        69.023
    12         145.720        75.874
    13         152.278        83.424
    14         158.042        91.596
    15         159.961        95.000
 Circle Center At X =     74.236 ; Y =   144.587 ; and Radius =    99.154
          Factor of Safety
        ***    2.340   ***
 Failure Surface Specified By 15 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
     1          45.714        50.000
     2          55.530        48.090
     3          65.475        47.044
     4          75.474        46.871
     5          85.449        47.570
     6          95.326        49.138
     7         105.027        51.562
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    8        114.481       54.824
    9        123.613       58.898
   10        132.355       63.754
   11        140.640       69.354
   12        148.404       75.656
   13        155.588       82.612
   14        162.138       90.169
   15        165.637       95.000
 Circle Center At X =    72.460 ; Y =   161.284 ; and Radius =   114.453
       Factor of Safety
      ***    2.341   ***
 Failure Surface Specified By 15 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
    1          46.939       50.000
    2          56.808       48.391
    3          66.782       47.664
    4          76.781       47.825
    5          86.726       48.872
    6          96.539       50.798
    7         106.142       53.587
    8         115.460       57.217
    9         124.418       61.660
   10         132.948       66.880
   11         140.980       72.837
   12         148.453       79.482
   13         155.306       86.765
   14         161.485       94.627
   15         161.729       95.000
 Circle Center At X =    69.972 ; Y =   160.201 ; and Radius =   112.582
       Factor of Safety
      ***    2.342   ***
 Failure Surface Specified By 16 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
    1          41.633       50.000
    2          51.290       47.405
    3          61.148       45.727
    4          71.121       44.982
    5          81.119       45.177
    6          91.054       46.308
    7         100.840       48.367
    8         110.389       51.336
    9         119.618       55.187
   10         128.444       59.888
   11         136.790       65.396
   12         144.583       71.663
   13         151.753       78.634
   14         158.237       86.247
   15         163.978       94.435
   16         164.300       95.000
 Circle Center At X =    74.056 ; Y =   151.308 ; and Radius =   106.370
       Factor of Safety
      ***    2.346   ***
 Failure Surface Specified By 14 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
    1          46.939       50.000
    2          56.731       47.971
    3          66.678       46.947
    4          76.678       46.941
    5          86.627       47.951
    6          96.422       49.967
    7         105.961       52.969
    8         115.145       56.925
    9         123.879       61.794
   10         132.073       67.526
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    11         139.642       74.061
    12         146.508       81.332
    13         152.598       89.264
    14         156.139       95.000
Circle Center At X =    71.758 ; Y =   144.769 ; and Radius =    97.965
       Factor of Safety
      ***    2.348   ***
Failure Surface Specified By 14 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1          49.796       50.000
    2          59.743       48.969
    3          69.741       48.779
    4          79.720       49.432
    5          89.608       50.923
    6          99.335       53.241
    7         108.833       56.370
    8         118.034       60.287
    9         126.872       64.966
   10         135.285       70.372
   11         143.213       76.467
   12         150.599       83.208
   13         157.391       90.547
   14         160.865       95.000
Circle Center At X =    67.031 ; Y =   167.029 ; and Radius =   118.291
       Factor of Safety
      ***    2.349   ***
          **** END OF GSTABL7 OUTPUT ****
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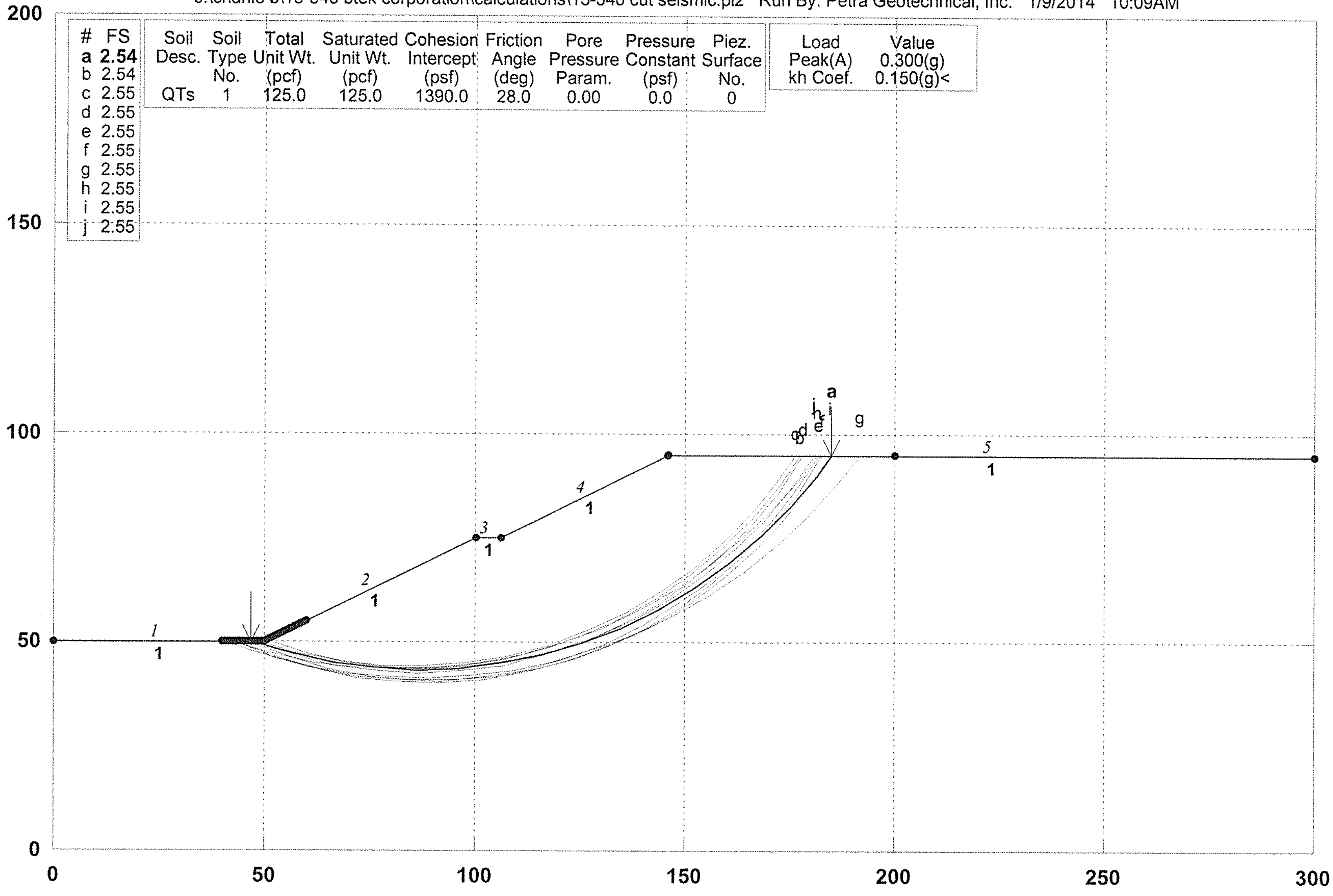
Mesa Verde Phase 1 - 2:1 Cut Slope (H = 45 ft.) - Seismic Analysis

s:\charlie b\13-546 btek corporation\calculations\13-546 cut seismic.pl2 Run By: Petra Geotechnical, Inc. 1/9/2014 10:09AM



#	FS
a	**2.54**
b	2.54
c	2.55
d	2.55
e	2.55
f	2.55
g	2.55
h	2.55
i	2.55
j	2.55

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.
QTs	1	125.0	125.0	1390.0	28.0	0.00	0.0	0

Load	Value
Peak(A)	0.300(g)
kh Coef.	0.150(g)<

GSTABL7 v.2 FSmin=2.54

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

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    ** Original Version 1.0, January 1996; Current Version 2.004, June 2003 **
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  *********************************************************************************
                         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:          1/9/2014
    Time of Run:                10:09AM
    Run By:                     Petra Geotechnical, Inc.
    Input Data Filename:        S:\CHARLIE B\13-546 BTEK Corporation\Calculations\13-546 cut
seismic.in
    Output Filename:            S:\CHARLIE B\13-546 BTEK Corporation\Calculations\13-546 cut
seismic.OUT
    Unit System:                English
    Plotted Output Filename:    S:\CHARLIE B\13-546 BTEK Corporation\Calculations\13-546 cut
seismic.PLT
    PROBLEM DESCRIPTION:  Mesa Verde Phase 1 - 2:1 Cut Slope (H =
                          45 ft.) - Seismic Analysis
    BOUNDARY COORDINATES
        5 Top   Boundaries
        5 Total Boundaries
    Boundary     X-Left     Y-Left    X-Right     Y-Right     Soil Type
       No.        (ft)       (ft)       (ft)       (ft)       Below Bnd
        1          0.00      50.00      50.00      50.00          1
        2         50.00      50.00     100.00      75.00          1
        3        100.00      75.00     106.00      75.00          1
        4        106.00      75.00     146.00      95.00          1
        5        146.00      95.00     300.00      95.00          1
    Default Y-Origin = 0.00(ft)
    Default X-Plus Value = 0.00(ft)
    Default Y-Plus Value = 0.00(ft)
   ISOTROPIC SOIL PARAMETERS
     1 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   125.0    125.0    1390.0     28.0    0.00       0.0      0
    Specified Peak Ground Acceleration Coefficient (A) =   0.300(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.
    1000 Trial Surfaces Have Been Generated.
      20 Surface(s) Initiate(s) From Each Of    50 Points Equally Spaced
    Along The Ground Surface Between  X =  40.00(ft)
                                and  X =  60.00(ft)
    Each Surface Terminates Between   X = 146.00(ft)
                                and   X = 200.00(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 =  1000
          Number of Trial Surfaces With Valid FS = 1000
          Statistical Data On All Valid FS Values:
             FS Max =  13.727   FS Min =   2.544   FS Ave =   3.058
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                 Standard Deviation =    0.859   Coefficient of Variation =   28.10 %
              Failure Surface Specified By 17 Coordinate Points
                Point      X-Surf      Y-Surf
                 No.        (ft)        (ft)
                  1        46.939      50.000
                  2        56.506      47.089
                  3        66.283      44.988
                  4        76.201      43.710
                  5        86.191      43.265
                  6        96.183      43.656
                  7       106.108      44.879
                  8       115.896      46.928
                  9       125.479      49.786
                 10       134.789      53.435
                 11       143.763      57.848
                 12       152.336      62.995
                 13       160.450      68.841
                 14       168.047      75.343
                 15       175.075      82.457
                 16       181.484      90.134
                 17       184.900      95.000
              Circle Center At X =    86.517 ; Y =   162.911 ; and Radius =   119.647
                     Factor of Safety
                    ***    2.544   ***
                   Individual data on the    20  slices
                                 Water  Water     Tie     Tie     Earthquake
                                 Force  Force    Force   Force      Force   Surcharge
      Slice  Width   Weight       Top    Bot     Norm     Tan     Hor     Ver    Load
       No.    (ft)    (lbs)     (lbs)  (lbs)    (lbs)   (lbs)   (lbs)   (lbs)   (lbs)
        1     3.1     178.2      0.0    0.0       0.      0.     26.7    0.0      0.0
        2     6.5    2884.9      0.0    0.0       0.      0.    432.7    0.0      0.0
        3     9.8   11803.5      0.0    0.0       0.      0.   1770.5    0.0      0.0
        4     9.9   20173.1      0.0    0.0       0.      0.   3026.0    0.0      0.0
        5    10.0   27610.6      0.0    0.0       0.      0.   4141.6    0.0      0.0
        6    10.0   33890.6      0.0    0.0       0.      0.   5083.6    0.0      0.0
        7     3.8   14387.7      0.0    0.0       0.      0.   2158.2    0.0      0.0
        8     6.0   22878.0      0.0    0.0       0.      0.   3431.7    0.0      0.0
        9     0.1     406.5      0.0    0.0       0.      0.     61.0    0.0      0.0
       10     9.8   38659.5      0.0    0.0       0.      0.   5798.9    0.0      0.0
       11     9.6   40711.0      0.0    0.0       0.      0.   6106.6    0.0      0.0
       12     9.3   41265.3      0.0    0.0       0.      0.   6189.8    0.0      0.0
       13     9.0   40376.3      0.0    0.0       0.      0.   6056.5    0.0      0.0
       14     2.2   10046.4      0.0    0.0       0.      0.   1507.0    0.0      0.0
       15     6.3   26854.1      0.0    0.0       0.      0.   4028.1    0.0      0.0
       16     8.1   29495.3      0.0    0.0       0.      0.   4424.3    0.0      0.0
       17     7.6   21754.7      0.0    0.0       0.      0.   3263.2    0.0      0.0
       18     7.0   14143.0      0.0    0.0       0.      0.   2121.5    0.0      0.0
       19     6.4    6973.5      0.0    0.0       0.      0.   1046.0    0.0      0.0
       20     3.4    1039.1      0.0    0.0       0.      0.    155.9    0.0      0.0
              Failure Surface Specified By 16 Coordinate Points
                Point      X-Surf      Y-Surf
                 No.        (ft)        (ft)
                  1        47.755      50.000
                  2        57.312      47.057
                  3        67.098      44.999
                  4        77.031      43.846
                  5        87.029      43.605
                  6        97.006      44.279
                  7       106.880      45.863
                  8       116.567      48.343
                  9       125.988      51.698
                 10       135.062      55.901
                 11       143.713      60.916
                 12       151.870      66.700
                 13       159.464      73.207
                 14       166.431      80.380
                 15       172.714      88.160
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     16        177.270       95.000
 Circle Center At X =    84.654 ; Y =   152.681 ; and Radius =   109.110
        Factor of Safety
       ***    2.544   ***
 Failure Surface Specified By 16 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
     1         48.571       50.000
     2         58.162       47.169
     3         67.973       45.230
     4         77.919       44.198
     5         87.919       44.083
     6         97.886       44.886
     7        107.738       46.599
     8        117.392       49.209
     9        126.765       52.693
    10        135.780       57.022
    11        144.359       62.160
    12        152.431       68.062
    13        159.928       74.680
    14        166.786       81.958
    15        172.947       89.834
    16        176.273       95.000
 Circle Center At X =    84.167 ; Y =   152.685 ; and Radius =   108.679
        Factor of Safety
       ***    2.545   ***
 Failure Surface Specified By 17 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
     1         47.347       50.000
     2         56.810       46.766
     3         66.534       44.435
     4         76.435       43.028
     5         86.424       42.556
     6         96.413       43.025
     7        106.314       44.429
     8        116.039       46.757
     9        125.503       49.988
    10        134.621       54.093
    11        143.314       59.036
    12        151.504       64.774
    13        159.119       71.255
    14        166.093       78.423
    15        172.362       86.214
    16        177.872       94.559
    17        178.107       95.000
 Circle Center At X =    86.440 ; Y =   148.936 ; and Radius =   106.380
        Factor of Safety
       ***    2.545   ***
 Failure Surface Specified By 17 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
     1         43.265       50.000
     2         52.576       46.353
     3         62.183       43.576
     4         72.004       41.692
     5         81.957       40.719
     6         91.956       40.663
     7        101.919       41.526
     8        111.761       43.300
     9        121.398       45.970
    10        130.749       49.514
    11        139.735       53.901
    12        148.280       59.095
    13        156.312       65.052
    14        163.764       71.721
    15        170.572       79.046
```
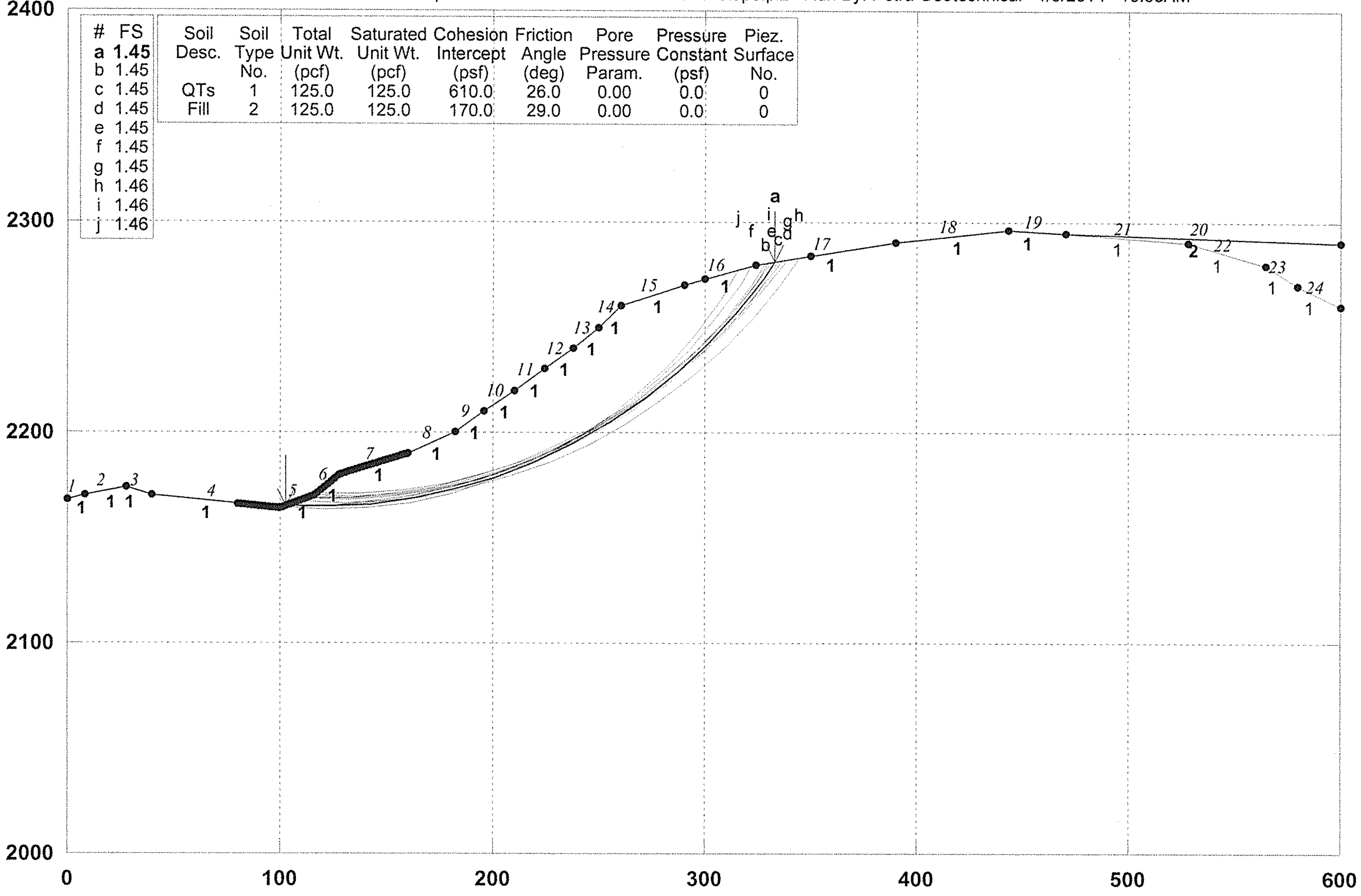

```
   16        176.678       86.965
   17        181.770       95.000
 Circle Center At X =    87.560 ; Y =   149.368 ; and Radius =   108.793
       Factor of Safety
      ***    2.547   ***
 Failure Surface Specified By 18 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
     1         43.265      50.000
     2         52.537      46.253
     3         62.115      43.378
     4         71.917      41.398
     5         81.860      40.331
     6         91.858      40.185
     7        101.828      40.961
     8        111.684      42.654
     9        121.341      45.249
    10        130.718      48.724
    11        139.735      53.048
    12        148.314      58.185
    13        156.384      64.092
    14        163.873      70.718
    15        170.720      78.006
    16        176.866      85.895
    17        182.258      94.317
    18        182.611      95.000
 Circle Center At X =    88.434 ; Y =   148.378 ; and Radius =   108.252
       Factor of Safety
      ***    2.550   ***
 Failure Surface Specified By 18 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
     1         40.408      50.000
     2         49.868      46.758
     3         59.551      44.261
     4         69.399      42.521
     5         79.352      41.552
     6         89.350      41.357
     7         99.333      41.938
     8        109.241      43.292
     9        119.014      45.410
    10        128.593      48.281
    11        137.921      51.886
    12        146.941      56.203
    13        155.598      61.207
    14        163.842      66.868
    15        171.621      73.151
    16        178.890      80.019
    17        185.604      87.430
    18        191.460      95.000
 Circle Center At X =    86.857 ; Y =   170.101 ; and Radius =   128.771
       Factor of Safety
      ***    2.552   ***
 Failure Surface Specified By 17 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
     1         42.041      50.000
     2         51.631      47.166
     3         61.420      45.123
     4         71.343      43.884
     5         81.334      43.457
     6         91.326      43.845
     7        101.254      45.045
     8        111.051      47.051
     9        120.652      49.847
    10        129.993      53.416
    11        139.013      57.734
```

```
    12       147.651       62.772
    13       155.850       68.497
    14       163.556       74.870
    15       170.717       81.850
    16       177.286       89.390
    17       181.420       95.000
 Circle Center At X =    81.573 ; Y =   166.142 ; and Radius =   122.686
        Factor of Safety
       ***    2.553   ***
 Failure Surface Specified By 17 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
     1        46.122       50.000
     2        55.446       46.384
     3        65.061       43.638
     4        74.888       41.783
     5        84.843       40.836
     6        94.843       40.805
     7       104.804       41.689
     8       114.642       43.482
     9       124.274       46.168
    10       133.620       49.725
    11       142.601       54.123
    12       151.142       59.324
    13       159.170       65.286
    14       166.619       71.959
    15       173.425       79.285
    16       179.532       87.203
    17       184.478       95.000
 Circle Center At X =    90.186 ; Y =   149.795 ; and Radius =   109.090
        Factor of Safety
       ***    2.553   ***
 Failure Surface Specified By 16 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
     1        50.612       50.306
     2        60.146       47.289
     3        69.916       45.157
     4        79.841       43.928
     5        89.836       43.613
     6        99.817       44.214
     7       109.702       45.727
     8       119.407       48.138
     9       128.851       51.427
    10       137.954       55.567
    11       146.640       60.523
    12       154.835       66.253
    13       162.472       72.709
    14       169.485       79.837
    15       175.817       87.577
    16       180.830       95.000
 Circle Center At X =    88.269 ; Y =   152.634 ; and Radius =   109.037
        Factor of Safety
       ***    2.553   ***
           **** END OF GSTABL7 OUTPUT ****
```

Mesa Verde Phase 1 - Section C-C' - Natural Slope - Static Analysis

s:\charlie b\13-546 btek corporation\calculations\13-546 natural slope.pl2 Run By: Petra Geotechnical 1/9/2014 10:53AM



#	FS
a	**1.45**
b	1.45
c	1.45
d	1.45
e	1.45
f	1.45
g	1.45
h	1.46
i	1.46
j	1.46

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.
QTs	1	125.0	125.0	610.0	26.0	0.00	0.0	0
Fill	2	125.0	125.0	170.0	29.0	0.00	0.0	0

GSTABL7 v.2 FSmin=1.45
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:        1/9/2014
     Time of Run:              10:53AM
     Run By:                   Petra Geotechnical
     Input Data Filename:      S:\CHARLIE B\13-546 BTEK Corporation\Calculations\13-546
natural slope.in
     Output Filename:          S:\CHARLIE B\13-546 BTEK Corporation\Calculations\13-546
natural slope.OUT
     Unit System:              English
     Plotted Output Filename:  S:\CHARLIE B\13-546 BTEK Corporation\Calculations\13-546
natural slope.PLT
     PROBLEM DESCRIPTION:  Mesa Verde Phase 1 - Section C-C' - Natu
                           ral Slope - Static Analysis
     BOUNDARY COORDINATES
        20 Top   Boundaries
        24 Total Boundaries
     Boundary     X-Left     Y-Left    X-Right    Y-Right    Soil Type
        No.        (ft)       (ft)       (ft)       (ft)     Below Bnd
         1          0.00    2168.00       8.00    2170.00        1
         2          8.00    2170.00      28.00    2174.00        1
         3         28.00    2174.00      40.00    2170.00        1
         4         40.00    2170.00     100.00    2164.00        1
         5        100.00    2164.00     116.00    2170.00        1
         6        116.00    2170.00     128.00    2180.00        1
         7        128.00    2180.00     160.00    2190.00        1
         8        160.00    2190.00     182.00    2200.00        1
         9        182.00    2200.00     196.00    2210.00        1
        10        196.00    2210.00     210.00    2220.00        1
        11        210.00    2220.00     224.00    2230.00        1
        12        224.00    2230.00     238.00    2240.00        1
        13        238.00    2240.00     250.00    2250.00        1
        14        250.00    2250.00     260.00    2260.00        1
        15        260.00    2260.00     290.00    2270.00        1
        16        290.00    2270.00     324.00    2280.00        1
        17        324.00    2280.00     390.00    2290.00        1
        18        390.00    2290.00     443.00    2296.00        1
        19        443.00    2296.00     470.00    2295.00        1
        20        470.00    2295.00     600.00    2290.00        2
        21        470.00    2295.00     528.00    2290.00        1
        22        528.00    2290.00     565.00    2280.00        1
        23        565.00    2280.00     580.00    2270.00        1
        24        580.00    2270.00     600.00    2260.00        1
    User Specified Y-Origin =      2000.00(ft)
    Default X-Plus Value = 0.00(ft)
    Default Y-Plus Value = 0.00(ft)
   ISOTROPIC SOIL PARAMETERS
     2 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   125.0    125.0     610.0     26.0    0.00       0.0       0
      2   125.0    125.0     170.0     29.0    0.00       0.0       0
    A Critical Failure Surface Searching Method, Using A Random
    Technique For Generating Circular Surfaces, Has Been Specified.
    1000 Trial Surfaces Have Been Generated.
```

```
   20 Surface(s) Initiate(s) From Each Of    50 Points Equally Spaced
  Along The Ground Surface Between  X =  80.00(ft)
                               and  X = 160.00(ft)
  Each Surface Terminates Between   X = 300.00(ft)
                              and   X = 350.00(ft)
  Unless Further Limitations Were Imposed, The Minimum Elevation
  At Which A Surface Extends Is  Y =   2000.00(ft)
  20.00(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 =  1000
        Number of Trial Surfaces With Valid FS = 1000
        Statistical Data On All Valid FS Values:
           FS Max =   2.214   FS Min =   1.447   FS Ave =   1.675
           Standard Deviation =    0.153   Coefficient of Variation =    9.15 %
        Failure Surface Specified By 15 Coordinate Points
          Point      X-Surf      Y-Surf
           No.        (ft)        (ft)
            1        102.857     2165.072
            2        122.855     2164.756
            3        142.817     2165.987
            4        162.624     2168.756
            5        182.158     2173.048
            6        201.302     2178.836
            7        219.942     2186.086
            8        237.966     2194.755
            9        255.266     2204.790
           10        271.738     2216.132
           11        287.285     2228.714
           12        301.814     2242.458
           13        315.237     2257.285
           14        327.474     2273.104
           15        332.887     2281.346
        Circle Center At X =   116.933 ; Y =  2423.328 ; and Radius =   258.640
               Factor of Safety
              ***    1.447   ***
             Individual data on the    26  slices
                       Water  Water     Tie      Tie     Earthquake
                       Force  Force     Force    Force      Force    Surcharge
 Slice  Width   Weight   Top    Bot      Norm     Tan      Hor      Ver     Load
  No.    (ft)   (lbs)  (lbs)  (lbs)     (lbs)    (lbs)    (lbs)    (lbs)   (lbs)
   1     13.1    4218.6   0.0    0.0        0.       0.      0.0      0.0      0.0
   2      6.9    6894.2   0.0    0.0        0.       0.      0.0      0.0      0.0
   3      5.1    8323.5   0.0    0.0        0.       0.      0.0      0.0      0.0
   4     14.8   31087.7   0.0    0.0        0.       0.      0.0      0.0      0.0
   5     17.2   43231.4   0.0    0.0        0.       0.      0.0      0.0      0.0
   6      2.6    7224.0   0.0    0.0        0.       0.      0.0      0.0      0.0
   7     19.4   59852.0   0.0    0.0        0.       0.      0.0      0.0      0.0
   8      0.2     534.4   0.0    0.0        0.       0.      0.0      0.0      0.0
   9     13.8   51761.9   0.0    0.0        0.       0.      0.0      0.0      0.0
  10      5.3   22441.7   0.0    0.0        0.       0.      0.0      0.0      0.0
  11      8.7   39538.1   0.0    0.0        0.       0.      0.0      0.0      0.0
  12      9.9   48962.0   0.0    0.0        0.       0.      0.0      0.0      0.0
  13      4.1   21045.8   0.0    0.0        0.       0.      0.0      0.0      0.0
  14     14.0   76097.6   0.0    0.0        0.       0.      0.0      0.0      0.0
  15      0.0     194.6   0.0    0.0        0.       0.      0.0      0.0      0.0
  16     12.0   70117.3   0.0    0.0        0.       0.      0.0      0.0      0.0
  17      5.3   32494.8   0.0    0.0        0.       0.      0.0      0.0      0.0
  18      4.7   30308.2   0.0    0.0        0.       0.      0.0      0.0      0.0
  19     11.7   73166.7   0.0    0.0        0.       0.      0.0      0.0      0.0
  20     15.5   85666.7   0.0    0.0        0.       0.      0.0      0.0      0.0
  21      2.7   13420.1   0.0    0.0        0.       0.      0.0      0.0      0.0
  22     11.8   51489.8   0.0    0.0        0.       0.      0.0      0.0      0.0
  23     13.4   42915.2   0.0    0.0        0.       0.      0.0      0.0      0.0
  24      8.8   17266.0   0.0    0.0        0.       0.      0.0      0.0      0.0
```

```
 25      3.5    4084.1     0.0      0.0        0.       0.     0.0      0.0       0.0
 26      5.4    2510.9     0.0      0.0        0.       0.     0.0      0.0       0.0
         Failure Surface Specified By 14 Coordinate Points
           Point      X-Surf      Y-Surf
            No.        (ft)        (ft)
             1        115.918     2169.969
             2        135.917     2169.706
             3        155.865     2171.144
             4        175.619     2174.272
             5        195.035     2179.068
             6        213.973     2185.498
             7        232.297     2193.514
             8        249.872     2203.058
             9        266.573     2214.063
            10        282.277     2226.447
            11        296.872     2240.121
            12        310.252     2254.987
            13        322.319     2270.936
            14        328.461     2280.676
         Circle Center At X =   129.156 ; Y =  2403.935 ; and Radius =   234.340
               Factor of Safety
              ***    1.451   ***
         Failure Surface Specified By 14 Coordinate Points
           Point      X-Surf      Y-Surf
            No.        (ft)        (ft)
             1        114.286     2169.357
             2        134.282     2168.982
             3        154.242     2170.243
             4        174.033     2173.132
             5        193.520     2177.629
             6        212.575     2183.705
             7        231.069     2191.318
             8        248.879     2200.418
             9        265.885     2210.944
            10        281.974     2222.825
            11        297.037     2235.982
            12        310.974     2250.326
            13        323.691     2265.762
            14        334.712     2281.623
         Circle Center At X =   128.884 ; Y =  2413.224 ; and Radius =   244.303
               Factor of Safety
              ***    1.451   ***
         Failure Surface Specified By 15 Coordinate Points
           Point      X-Surf      Y-Surf
            No.        (ft)        (ft)
             1        102.857     2165.072
             2        122.856     2165.284
             3        142.788     2166.930
             4        162.551     2170.000
             5        182.043     2174.480
             6        201.164     2180.345
             7        219.815     2187.565
             8        237.900     2196.104
             9        255.327     2205.918
            10        272.005     2216.956
            11        287.850     2229.161
            12        302.778     2242.470
            13        316.714     2256.815
            14        329.586     2272.123
            15        336.694     2281.923
         Circle Center At X =   109.893 ; Y =  2443.796 ; and Radius =   278.813
               Factor of Safety
              ***    1.451   ***
         Failure Surface Specified By 14 Coordinate Points
           Point      X-Surf      Y-Surf
            No.        (ft)        (ft)
             1        112.653     2168.745
```

```
       2        132.652     2168.961
       3        152.572     2170.742
       4        172.292     2174.077
       5        191.691     2178.945
       6        210.649     2185.317
       7        229.049     2193.154
       8        246.780     2202.407
       9        263.732     2213.020
      10        279.801     2224.927
      11        294.889     2238.056
      12        308.903     2252.325
      13        321.756     2267.648
      14        331.363     2281.116
 Circle Center At X =   119.987 ; Y =  2423.496 ; and Radius =   254.857
          Factor of Safety
        ***    1.452   ***
 Failure Surface Specified By 14 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
     1        112.653     2168.745
     2        132.644     2168.144
     3        152.608     2169.340
     4        172.385     2172.322
     5        191.814     2177.066
     6        210.739     2183.535
     7        229.007     2191.675
     8        246.471     2201.422
     9        262.991     2212.697
    10        278.432     2225.408
    11        292.670     2239.453
    12        305.590     2254.719
    13        317.089     2271.083
    14        321.864     2279.372
 Circle Center At X =   129.471 ; Y =  2390.078 ; and Radius =   221.971
          Factor of Safety
        ***    1.452   ***
 Failure Surface Specified By 15 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
     1        101.224     2164.459
     2        121.221     2164.805
     3        141.146     2166.536
     4        160.904     2169.642
     5        180.399     2174.109
     6        199.537     2179.915
     7        218.228     2187.033
     8        236.380     2195.429
     9        253.908     2205.062
    10        270.726     2215.885
    11        286.754     2227.847
    12        301.915     2240.891
    13        316.137     2254.953
    14        329.350     2269.967
    15        338.719     2282.230
 Circle Center At X =   106.232 ; Y =  2453.010 ; and Radius =   288.594
          Factor of Safety
        ***    1.453   ***
 Failure Surface Specified By 15 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
     1        109.388     2167.521
     2        129.373     2166.745
     3        149.357     2167.524
     4        169.221     2169.853
     5        188.844     2173.719
     6        208.108     2179.097
     7        226.895     2185.955
```

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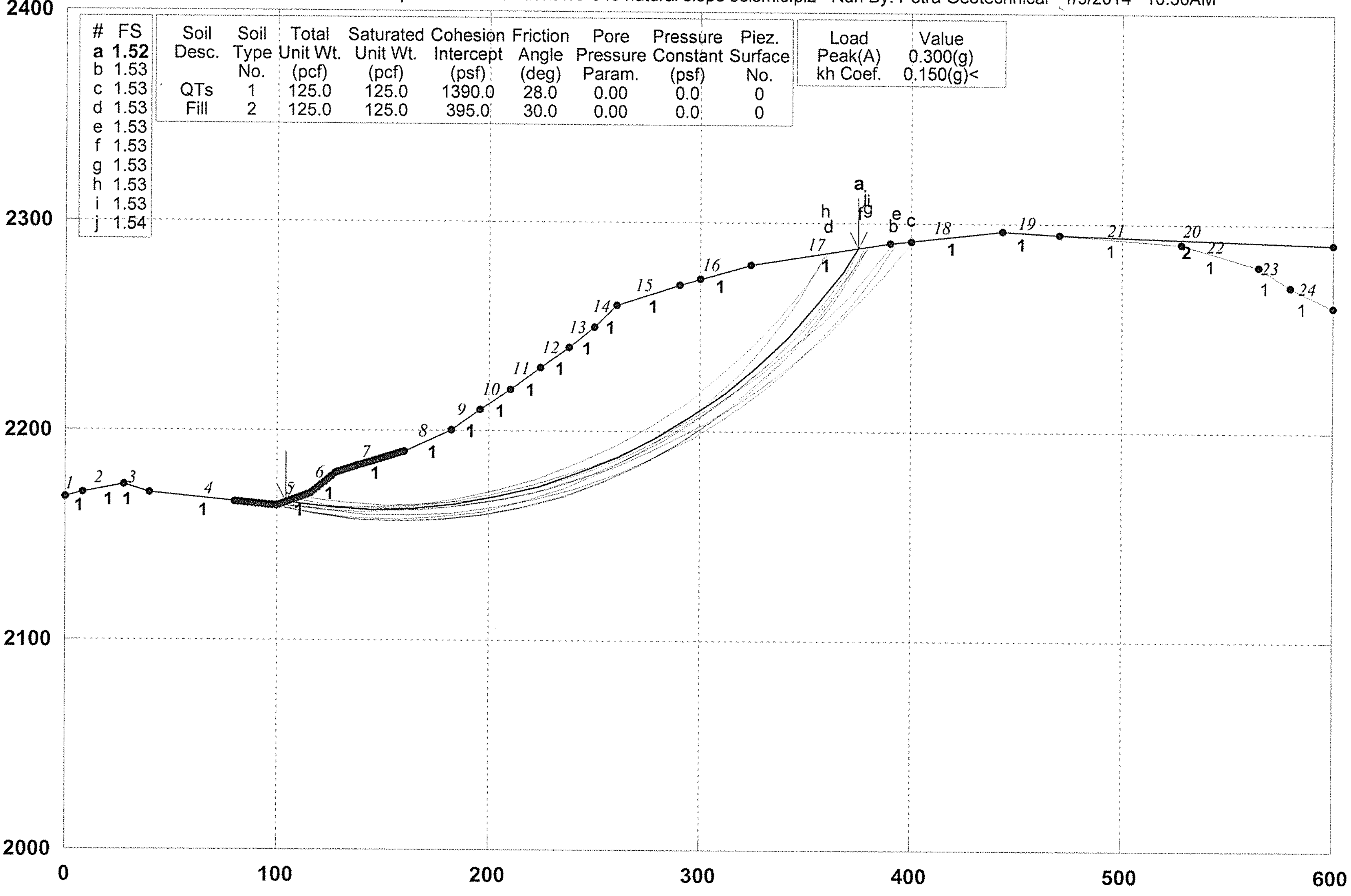
      8        245.092     2194.253
      9        262.590     2203.939
     10        279.283     2214.955
     11        295.069     2227.235
     12        309.854     2240.704
     13        323.548     2255.281
     14        336.067     2270.877
     15        344.398     2283.091
 Circle Center At X =    129.352 ; Y =  2423.988 ; and Radius =   257.243
        Factor of Safety
       ***    1.455   ***
 Failure Surface Specified By 14 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
     1        117.551     2171.292
     2        137.550     2171.059
     3        157.497     2172.510
     4        177.251     2175.638
     5        196.671     2180.418
     6        215.620     2186.818
     7        233.961     2194.792
     8        251.566     2204.282
     9        268.309     2215.223
    10        284.070     2227.534
    11        298.738     2241.130
    12        312.208     2255.914
    13        324.385     2271.780
    14        330.266     2280.949
 Circle Center At X =    130.471 ; Y =  2407.372 ; and Radius =   236.433
        Factor of Safety
       ***    1.455   ***
 Failure Surface Specified By 14 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
     1        101.224     2164.459
     2        121.200     2163.462
     3        141.183     2164.269
     4        161.013     2166.874
     5        180.527     2171.256
     6        199.567     2177.379
     7        217.977     2185.193
     8        235.608     2194.635
     9        252.316     2205.628
    10        267.965     2218.082
    11        282.428     2231.896
    12        295.586     2246.958
    13        307.334     2263.144
    14        315.974     2277.639
 Circle Center At X =    122.319 ; Y =  2384.759 ; and Radius =   221.308
        Factor of Safety
       ***    1.455   ***
           **** END OF GSTABL7 OUTPUT ****
```

Mesa Verde Phase 1 - Section C-C' - Natural Slope - Seismic Analysis

s:\charlie b\13-546 btek corporation\calculations\13-546 natural slope seismic.pl2 Run By: Petra Geotechnical 1/9/2014 10:56AM



#	FS
a	**1.52**
b	1.53
c	1.53
d	1.53
e	1.53
f	1.53
g	1.53
h	1.53
i	1.53
j	1.54

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.
QTs	1	125.0	125.0	1390.0	28.0	0.00	0.0	0
Fill	2	125.0	125.0	395.0	30.0	0.00	0.0	0

Load	Value
Peak(A)	0.300(g)
kh Coef.	0.150(g)<

GSTABL7 v.2 FSmin=1.52

Safety Factors Are Calculated By The Modified Bishop Method

GSTABL7

```
                                ***  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:         1/9/2014
    Time of Run:               10:56AM
    Run By:                    Petra Geotechnical
    Input Data Filename:       S:\CHARLIE B\13-546 BTEK Corporation\Calculations\13-546
natural slope seismic.in
    Output Filename:           S:\CHARLIE B\13-546 BTEK Corporation\Calculations\13-546
natural slope seismic.OUT
    Unit System:               English
    Plotted Output Filename:   S:\CHARLIE B\13-546 BTEK Corporation\Calculations\13-546
natural slope seismic.PLT
    PROBLEM DESCRIPTION:  Mesa Verde Phase 1 - Section C-C' - Natu
                          ral Slope - Seismic Analysis
    BOUNDARY COORDINATES
       20 Top   Boundaries
       24 Total Boundaries
    Boundary     X-Left     Y-Left     X-Right     Y-Right     Soil Type
       No.        (ft)       (ft)        (ft)        (ft)      Below Bnd
        1          0.00    2168.00        8.00     2170.00         1
        2          8.00    2170.00       28.00     2174.00         1
        3         28.00    2174.00       40.00     2170.00         1
        4         40.00    2170.00      100.00     2164.00         1
        5        100.00    2164.00      116.00     2170.00         1
        6        116.00    2170.00      128.00     2180.00         1
        7        128.00    2180.00      160.00     2190.00         1
        8        160.00    2190.00      182.00     2200.00         1
        9        182.00    2200.00      196.00     2210.00         1
       10        196.00    2210.00      210.00     2220.00         1
       11        210.00    2220.00      224.00     2230.00         1
       12        224.00    2230.00      238.00     2240.00         1
       13        238.00    2240.00      250.00     2250.00         1
       14        250.00    2250.00      260.00     2260.00         1
       15        260.00    2260.00      290.00     2270.00         1
       16        290.00    2270.00      324.00     2280.00         1
       17        324.00    2280.00      390.00     2290.00         1
       18        390.00    2290.00      443.00     2296.00         1
       19        443.00    2296.00      470.00     2295.00         1
       20        470.00    2295.00      600.00     2290.00         2
       21        470.00    2295.00      528.00     2290.00         1
       22        528.00    2290.00      565.00     2280.00         1
       23        565.00    2280.00      580.00     2270.00         1
       24        580.00    2270.00      600.00     2260.00         1
   User Specified Y-Origin =      2000.00(ft)
   Default X-Plus Value = 0.00(ft)
   Default Y-Plus Value = 0.00(ft)
  ISOTROPIC SOIL PARAMETERS
    2 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   125.0    125.0     1390.0     28.0    0.00       0.0      0
     2   125.0    125.0      395.0     30.0    0.00       0.0      0
   Specified Peak Ground Acceleration Coefficient (A) =   0.300(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.
    1000 Trial Surfaces Have Been Generated.
      20 Surface(s) Initiate(s) From Each Of    50 Points Equally Spaced
    Along The Ground Surface Between  X =  80.00(ft)
                                 and  X = 160.00(ft)
    Each Surface Terminates Between   X = 300.00(ft)
                                and   X = 400.00(ft)
    Unless Further Limitations Were Imposed, The Minimum Elevation
    At Which A Surface Extends Is  Y =   2000.00(ft)
    20.00(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 =  1000
          Number of Trial Surfaces With Valid FS = 1000
          Statistical Data On All Valid FS Values:
             FS Max =   3.034   FS Min =   1.524   FS Ave =   1.803
             Standard Deviation =    0.181   Coefficient of Variation =   10.06 %
          Failure Surface Specified By 17 Coordinate Points
            Point      X-Surf      Y-Surf
             No.        (ft)        (ft)
              1        104.490     2165.684
              2        124.345     2163.279
              3        144.323     2162.347
              4        164.316     2162.893
              5        184.213     2164.915
              6        203.907     2168.400
              7        223.290     2173.331
              8        242.255     2179.679
              9        260.700     2187.411
             10        278.524     2196.485
             11        295.628     2206.849
             12        311.921     2218.449
             13        327.312     2231.221
             14        341.718     2245.094
             15        355.060     2259.993
             16        367.265     2275.838
             17        375.107     2287.743
         Circle Center At X =   146.932 ; Y =  2432.941 ; and Radius =   270.606
                 Factor of Safety
                ***   1.524   ***
               Individual data on the    28  slices
                          Water  Water     Tie      Tie     Earthquake
                          Force  Force     Force    Force      Force   Surcharge
Slice  Width    Weight     Top    Bot      Norm     Tan      Hor      Ver    Load
 No.    (ft)    (lbs)     (lbs)  (lbs)     (lbs)    (lbs)    (lbs)   (lbs)   (lbs)
  1     11.5     4108.0     0.0    0.0        0.       0.    616.2     0.0     0.0
  2      8.3    10110.5     0.0    0.0        0.       0.   1516.6     0.0     0.0
  3      3.7     6983.2     0.0    0.0        0.       0.   1047.5     0.0     0.0
  4     16.3    40446.3     0.0    0.0        0.       0.   6066.9     0.0     0.0
  5     15.7    48970.2     0.0    0.0        0.       0.   7345.5     0.0     0.0
  6      4.3    15183.3     0.0    0.0        0.       0.   2277.5     0.0     0.0
  7     17.7    71155.7     0.0    0.0        0.       0. 10673.4     0.0     0.0
  8      2.2     9955.5     0.0    0.0        0.       0.   1493.3     0.0     0.0
  9     11.8    58687.8     0.0    0.0        0.       0.   8803.2     0.0     0.0
 10      7.9    44598.9     0.0    0.0        0.       0.   6689.8     0.0     0.0
 11      6.1    37051.9     0.0    0.0        0.       0.   5557.8     0.0     0.0
 12     13.3    88220.2     0.0    0.0        0.       0. 13233.0     0.0     0.0
 13      0.7     4998.1     0.0    0.0        0.       0.    749.7     0.0     0.0
 14     14.0   103404.2     0.0    0.0        0.       0. 15510.6     0.0     0.0
 15      4.3    33407.8     0.0    0.0        0.       0.   5011.2     0.0     0.0
 16      7.7    63380.2     0.0    0.0        0.       0.   9507.0     0.0     0.0
 17     10.0    87472.5     0.0    0.0        0.       0. 13120.9     0.0     0.0
 18      0.7     6377.4     0.0    0.0        0.       0.    956.6     0.0     0.0
```

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  19      17.8  158754.0      0.0      0.0       0.       0. 23813.1      0.0       0.0
  20      11.5   97728.0      0.0      0.0       0.       0. 14659.2      0.0       0.0
  21       5.6   46212.3      0.0      0.0       0.       0.  6931.9      0.0       0.0
  22      16.3  125048.3      0.0      0.0       0.       0. 18757.3      0.0       0.0
  23      12.1   82685.7      0.0      0.0       0.       0. 12402.9      0.0       0.0
  24       3.3   20868.3      0.0      0.0       0.       0.  3130.2      0.0       0.0
  25      14.4   78216.8      0.0      0.0       0.       0. 11732.5      0.0       0.0
  26      13.3   51952.7      0.0      0.0       0.       0.  7792.9      0.0       0.0
  27      12.2   27026.6      0.0      0.0       0.       0.  4054.0      0.0       0.0
  28       7.8    5253.1      0.0      0.0       0.       0.   788.0      0.0       0.0
          Failure Surface Specified By 18 Coordinate Points
            Point      X-Surf      Y-Surf
             No.        (ft)        (ft)
              1        101.224     2164.459
              2        121.170     2162.979
              3        141.168     2162.740
              4        161.143     2163.743
              5        181.017     2165.984
              6        200.714     2169.454
              7        220.157     2174.140
              8        239.272     2180.024
              9        257.985     2187.083
             10        276.224     2195.290
             11        293.918     2204.613
             12        310.999     2215.016
             13        327.402     2226.459
             14        343.062     2238.899
             15        357.921     2252.287
             16        371.919     2266.571
             17        385.005     2281.696
             18        391.457     2290.165
          Circle Center At X =    135.100 ; Y =  2484.147 ; and Radius =   321.478
                 Factor of Safety
               ***    1.526   ***
          Failure Surface Specified By 19 Coordinate Points
            Point      X-Surf      Y-Surf
             No.        (ft)        (ft)
              1        101.224     2164.459
              2        121.109     2162.312
              3        141.089     2161.430
              4        161.086     2161.817
              5        181.017     2163.471
              6        200.804     2166.386
              7        220.365     2170.550
              8        239.623     2175.946
              9        258.501     2182.553
             10        276.921     2190.344
             11        294.810     2199.287
             12        312.096     2209.347
             13        328.709     2220.483
             14        344.582     2232.650
             15        359.652     2245.799
             16        373.858     2259.877
             17        387.142     2274.828
             18        399.451     2290.592
             19        399.805     2291.110
          Circle Center At X =    144.993 ; Y =  2476.601 ; and Radius =   315.196
                 Factor of Safety
               ***    1.527   ***
          Failure Surface Specified By 16 Coordinate Points
            Point      X-Surf      Y-Surf
             No.        (ft)        (ft)
              1        104.490     2165.684
              2        124.400     2163.791
              3        144.397     2163.423
              4        164.363     2164.582
              5        184.183     2167.262
```

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     6         203.740     2171.447
     7         222.921     2177.112
     8         241.613     2184.225
     9         259.708     2192.744
    10         277.100     2202.619
    11         293.688     2213.792
    12         309.375     2226.199
    13         324.068     2239.767
    14         337.684     2254.417
    15         350.141     2270.064
    16         360.647     2285.553
Circle Center At X =    139.231 ; Y =  2425.079 ; and Radius =   261.711
       Factor of Safety
      ***    1.529   ***
Failure Surface Specified By 18 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1         102.857     2165.072
    2         122.596     2161.850
    3         142.515     2160.056
    4         162.512     2159.700
    5         182.483     2160.782
    6         202.324     2163.299
    7         221.933     2167.236
    8         241.207     2172.573
    9         260.048     2179.282
   10         278.358     2187.329
   11         296.042     2196.672
   12         313.007     2207.263
   13         329.168     2219.046
   14         344.438     2231.961
   15         358.741     2245.941
   16         372.001     2260.914
   17         384.149     2276.801
   18         393.038     2290.344
Circle Center At X =    157.491 ; Y =  2437.242 ; and Radius =   277.600
       Factor of Safety
      ***    1.531   ***
Failure Surface Specified By 17 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1         107.755     2166.908
    2         127.514     2163.810
    3         147.455     2162.275
    4         167.455     2162.313
    5         187.390     2163.924
    6         207.136     2167.097
    7         226.572     2171.814
    8         245.577     2178.045
    9         264.032     2185.751
   10         281.825     2194.885
   11         298.844     2205.390
   12         314.984     2217.201
   13         330.145     2230.245
   14         344.234     2244.440
   15         357.162     2259.700
   16         368.850     2275.929
   17         376.112     2287.896
Circle Center At X =    156.971 ; Y =  2416.200 ; and Radius =   254.104
       Factor of Safety
      ***    1.532   ***
Failure Surface Specified By 18 Coordinate Points
  Point      X-Surf      Y-Surf
   No.        (ft)        (ft)
    1          97.959     2164.204
    2         117.545     2160.153
    3         137.390     2157.672
```

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      4        157.370     2156.778
      5        177.358     2157.475
      6        197.227     2159.759
      7        216.852     2163.616
      8        236.107     2169.022
      9        254.872     2175.942
     10        273.027     2184.332
     11        290.457     2194.140
     12        307.053     2205.302
     13        322.708     2217.749
     14        337.323     2231.401
     15        350.807     2246.172
     16        363.073     2261.969
     17        374.044     2278.691
     18        379.354     2288.387
 Circle Center At X =   158.648 ; Y =  2407.594 ; and Radius =   250.842
        Factor of Safety
       ***    1.533   ***
 Failure Surface Specified By 17 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
      1         97.959     2164.204
      2        117.561     2160.232
      3        137.433     2157.976
      4        157.426     2157.454
      5        177.389     2158.670
      6        197.171     2161.615
      7        216.623     2166.266
      8        235.597     2172.588
      9        253.951     2180.534
     10        271.546     2190.043
     11        288.249     2201.044
     12        303.933     2213.454
     13        318.481     2227.178
     14        331.782     2242.114
     15        343.737     2258.148
     16        354.254     2275.160
     17        359.395     2285.363
 Circle Center At X =   153.428 ; Y =  2387.561 ; and Radius =   230.141
        Factor of Safety
       ***    1.533   ***
 Failure Surface Specified By 17 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
      1        111.020     2168.133
      2        130.844     2165.479
      3        150.811     2164.336
      4        170.807     2164.711
      5        190.718     2166.602
      6        210.427     2169.998
      7        229.822     2174.879
      8        248.791     2181.218
      9        267.225     2188.977
     10        285.017     2198.113
     11        302.064     2208.571
     12        318.269     2220.293
     13        333.538     2233.210
     14        347.783     2247.249
     15        360.922     2262.327
     16        372.880     2278.359
     17        379.223     2288.367
 Circle Center At X =   155.870 ; Y =  2427.743 ; and Radius =   263.456
        Factor of Safety
       ***    1.534   ***
 Failure Surface Specified By 18 Coordinate Points
   Point      X-Surf      Y-Surf
    No.        (ft)        (ft)
```
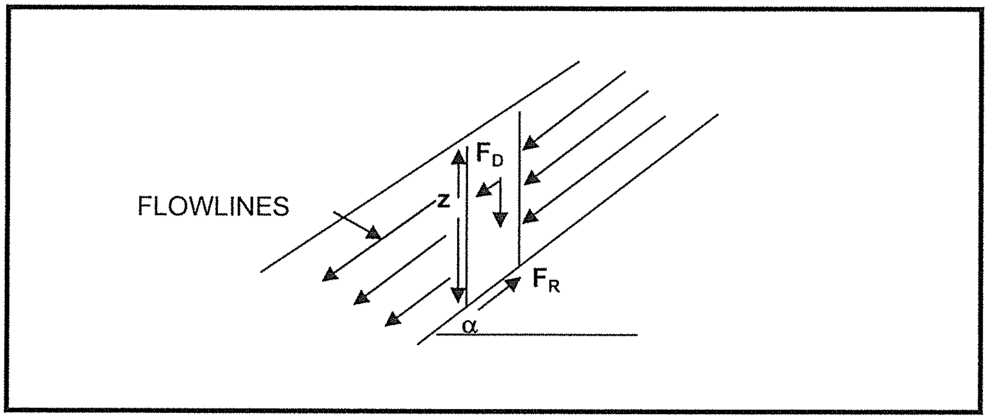

```
     1          96.327     2164.367
     2         115.889     2160.207
     3         135.722     2157.625
     4         155.697     2156.638
     5         175.688     2157.253
     6         195.565     2159.465
     7         215.202     2163.261
     8         234.471     2168.615
     9         253.251     2175.495
    10         271.420     2183.855
    11         288.862     2193.642
    12         305.464     2204.793
    13         321.121     2217.238
    14         335.733     2230.895
    15         349.204     2245.677
    16         361.450     2261.490
    17         372.391     2278.231
    18         377.793     2288.150
Circle Center At X =   158.056 ; Y =  2405.904 ; and Radius =   249.300
       Factor of Safety
      ***    1.535   ***
          **** END OF GSTABL7 OUTPUT ****
```



Problem Description: 2:1 Fill Slope

Parameters

Depth of Saturation (ft), Z = **4**
Buoyant Unit Weight of Soil (pcf), γ_b = ***62.6***
Total Unit Weight of Soil (pcf), γ_t = **125**
Slope Angle, α = **26.6**
Angle of Internal Friction, ϕ = **29**
Cohesion (psf), c = **170**

Force Tending To Cause Movement

$F_D = (1/2)\ Z\gamma_t \sin 2\alpha$ = **200.18** lb/ft

Force Tending To Resist Movement

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

= **280.97** lb/ft

Factor of Safety, F.S.

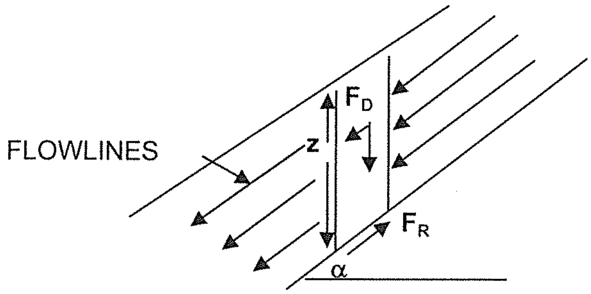
$$\text{F.S.} = \frac{2Z\gamma_b \cos^2\alpha\ \tan\phi + 2c}{Z\gamma_t \sin 2\alpha}$$

= **1.40**

SURFICIAL SLOPE STABILITY ANALYSIS

PETRA GEOTECHNICAL, INC.

Job Name: Mesa Verde Phase 1
Job No: 13-536
Designed/Checked: CB



Problem Description: 2:1 Cut Slope

Parameters

Depth of Saturation (ft), Z	=	**4**
Buoyant Unit Weight of Soil (pcf), γ_b	=	***62.6***
Total Unit Weight of Soil (pcf), γ_t	=	**125**
Slope Angle, α	=	**26.6**
Angle of Internal Friction, ϕ	=	**26**
Cohesion (psf), c	=	**610**

Force Tending To Cause Movement

$F_D = (1/2)\ Z\gamma_t \sin 2\alpha$ = **200.18** lb/ft

Force Tending To Resist Movement

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

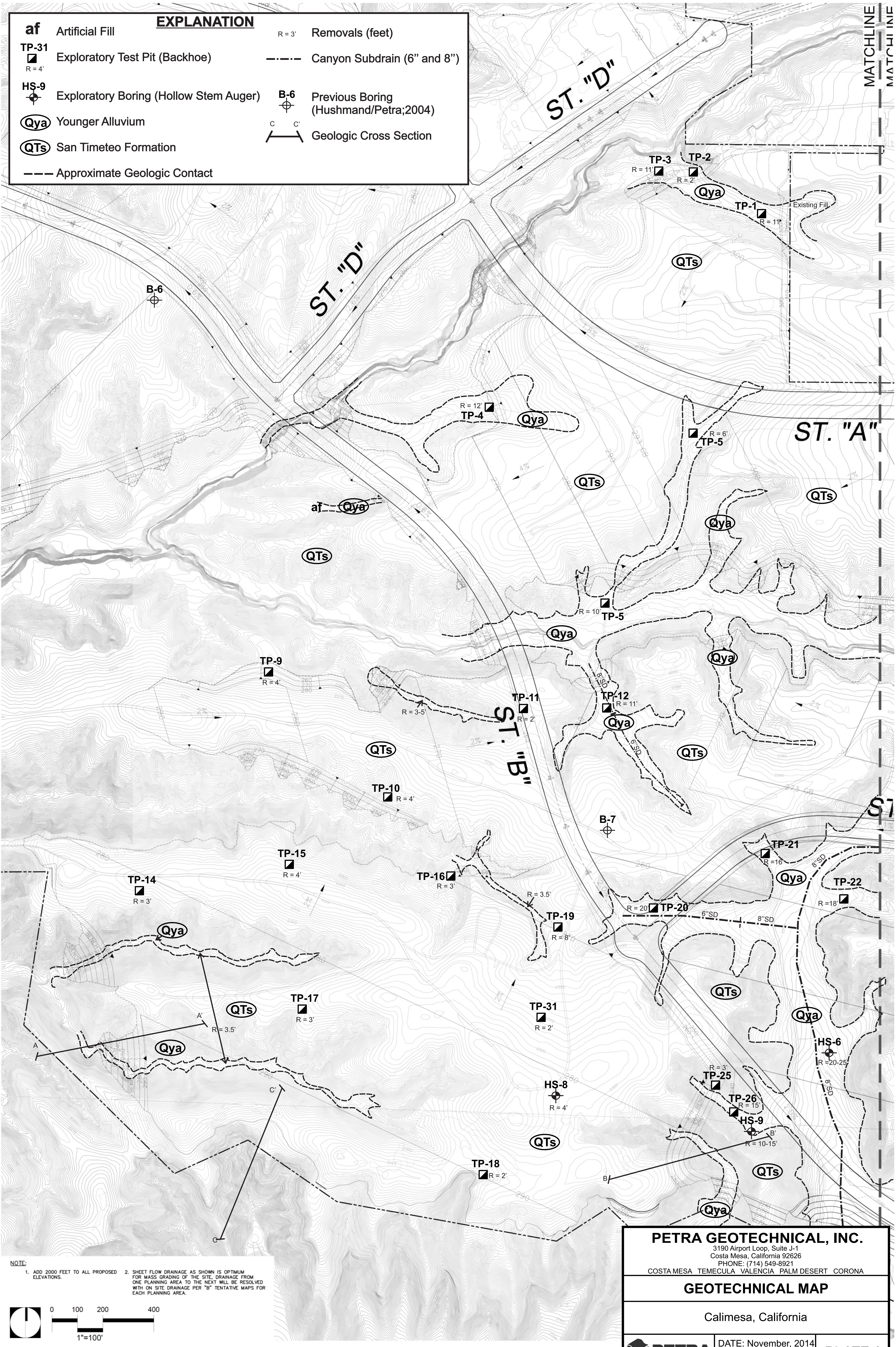
= **707.64** lb/ft

Factor of Safety, F.S.

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

= **3.53**

SURFICIAL SLOPE STABILITY ANALYSIS	**PETRA GEOTECHNICAL, INC.**
	Job Name: Mesa Verde Phase 1
	Job No: 13-536
	Designed/Checked: CB



EXPLANATION

af	Artificial Fill
TP-31 ◪ R = 4'	Exploratory Test Pit (Backhoe)
HS-9 ⊕	Exploratory Boring (Hollow Stem Auger)
Qya	Younger Alluvium
QTs	San Timeteo Formation
– – –	Approximate Geologic Contact
R = 3'	Removals (feet)
–·–·–	Canyon Subdrain (6" and 8")
B-6 ⊕	Previous Boring (Hushmand/Petra;2004)
C C'	Geologic Cross Section

NOTE:

1. ADD 2000 FEET TO ALL PROPOSED ELEVATIONS.
2. SHEET FLOW DRAINAGE AS SHOWN IS OPTIMUM FOR MASS GRADING OF THE SITE, DRAINAGE FROM ONE PLANNING AREA TO THE NEXT WILL BE RESOLVED WITH ON SITE DRAINAGE PER "B" TENTATIVE MAPS FOR EACH PLANNING AREA.

0 100 200 400

1"=100'

PETRA GEOTECHNICAL, INC.
3190 Airport Loop, Suite J-1
Costa Mesa, California 92626
PHONE: (714) 549-8921
COSTA MESA TEMECULA VALENCIA PALM DESERT CORONA

GEOTECHNICAL MAP

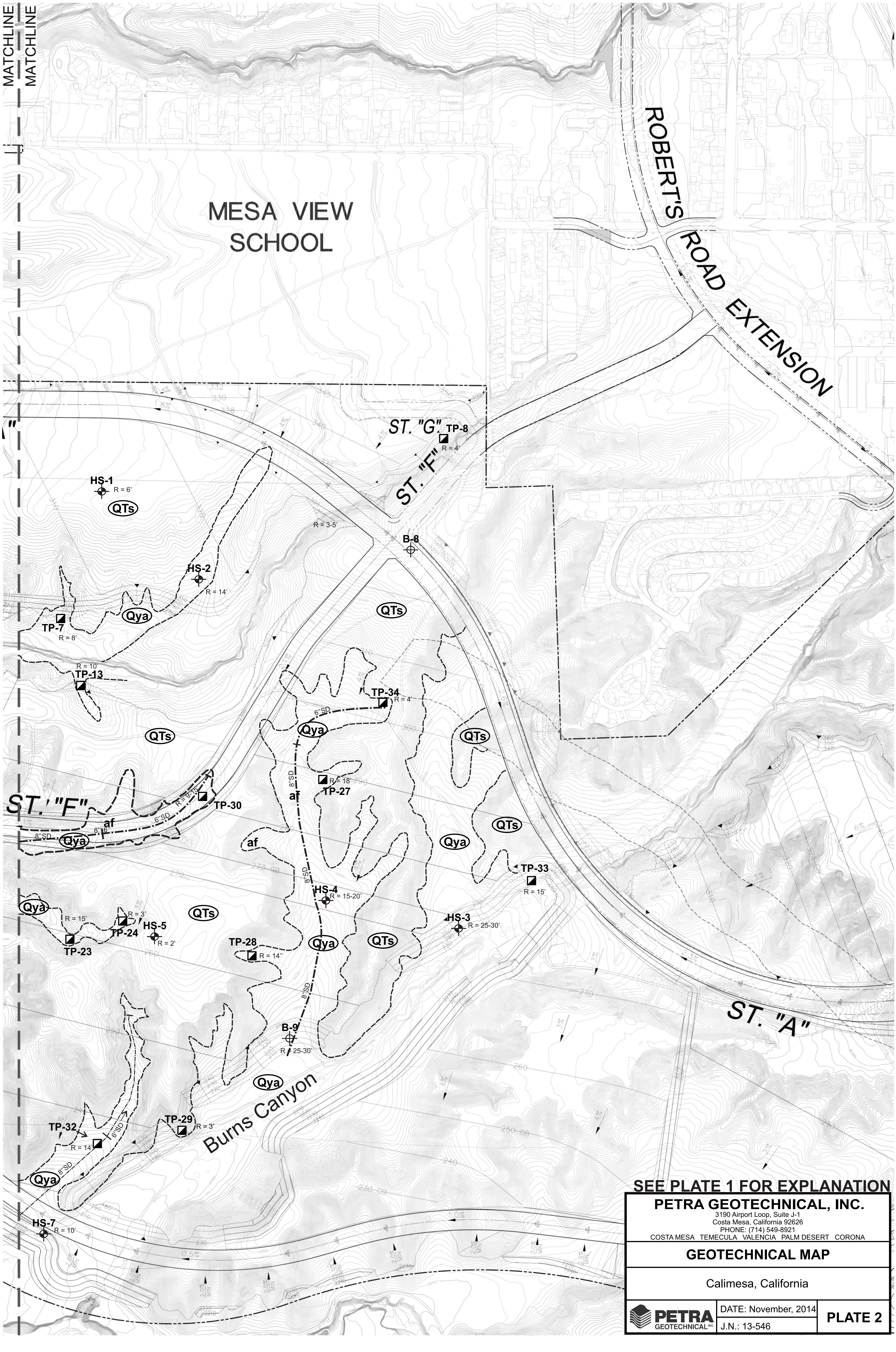
Calimesa, California

PETRA GEOTECHNICAL INC.

DATE: November, 2014

J.N.: 13-546

PLATE 1



SEE PLATE 1 FOR EXPLANATION

PETRA GEOTECHNICAL, INC.
3190 Airport Loop, Suite J-1
Costa Mesa, California 92626
PHONE: (714) 549-8921
COSTA MESA TEMECULA VALENCIA PALM DESERT CORONA

GEOTECHNICAL MAP

Calimesa, California

PETRA GEOTECHNICAL INC.
DATE: November, 2014
J.N.: 13-546

PLATE 2