Appendix "D"

Updated Preliminary Geotechnical Report

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UPDATED PRELIMINARY GEOTECHNICAL INVESTIGATION
TTM 37217
GREENTREE RANCH PROJECT
COUTY OF RIVERSIDE, CA

Prepared for:
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May 25, 2018
Report No. 1507-05-B-10
P/W 1507-05

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May 25, 2018
P/W 1507-05
Report No 1507-05-B-10

Attention: **Mr. Satish Lion**

Subject: **Updated Preliminary Geotechnical Investigation of 100-Scale Tentative Map, Greentree Ranch Project, Tentative Tract No. 37217, County of Riverside, California**

References: See Appendix

Gentlemen:

Pursuant to your request, Advanced Geotechnical Solutions, Inc. (AGS) presents herein our geotechnical review of the updated 100-scale Tentative Tract Map 37217 for the Greentree Ranch project located north of El Sobrante Road and east of McAllister Road, County of Riverside, California. This review has utilized geotechnical and geologic data and the geotechnical information presented in the referenced reports and supplemented with additional data from our recent study.

Advanced Geotechnical Solutions, Inc., appreciates the opportunity to provide you with geotechnical consulting services and professional opinions. If you have any questions, please contact the undersigned at (619) 867-0487.

Respectfully Submitted,
Advanced Geotechnical Solutions, Inc.

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UPDATED PRELIMINARY GEOTECHNICAL INVESTIGATION
TENTATIVE TRACT MAP 37217
COUNTY OF RIVERSIDE, CALIFORNIA

1.0 INTRODUCTION

The purpose of this report is to provide a Preliminary Geotechnical Investigation for Tentative Tract Map (TTM) 37217, Greentree Ranch project, County of Riverside, California (site). This updated report addresses the current 100-scale TTM plans prepared by Adkan Engineers dated April 25, 2018. This report has been prepared in a manner consistent with County of Riverside geotechnical report guidelines and the current standard of practice. Geotechnical conclusions and recommendations presented in this report address the following items: 1) engineering and excavation characteristics of earth materials; 2) unsuitable soils removals; 3) recommendations for pad and street undercuts to facilitate improvement construction; 4) subsurface drainage; 5) grading recommendations; 6) slope stability; and 7) preliminary foundation design recommendations.

1.1. <u>Scope of Work</u>

This study is aimed at providing geotechnical/geologic conclusions and recommendations for development of the site for residential uses, attendant streets, parks, and open space areas. The scope of this study included the following tasks:

- Review of maps, literature and aerial photographs.
- Excavation logging and sampling of 32 backhoe test pits, 19 excavator test pits and 16 air-track borings.
- Seismic refraction survey of 10 seismic lines.
- Compilation of subsurface data by AGS and previous investigations at the site (Appendix B).
- Preparation of geologic maps and exploration location plans (Plates 1 through 4) based on 100-scale TTM plans (Sheets 2 to 5 of 8) which depict geologic contacts in accordance with subsurface exploration data by AGS and previous investigations at the site.
- Preparation of geologic cross sections (Plate 5).
- Compilation of laboratory test data by AGS and previous investigations at the site (Appendix C).
- Slope stability analyses of both highest cut and fill slopes (Appendix D).
- Analysis of the current tentative tract map as it relates to the existing geotechnical conditions and proposed development.
- Analysis of the excavation characteristics (i.e. rippability) of onsite bedrock materials.
- Discussion of pertinent geologic and geotechnical topics.
- Formulation of grading, remedial grading and earthwork recommendations.
- Determination of engineering parameters for use in preliminary design of structures and retaining walls.
- Preparation of this report and accompanying exhibits.

1.2. Geotechnical Study Limitations

The conclusions and recommendations in this report are professional opinions based on the data developed during this and previous investigations. The conclusions presented herein are based upon the current design as reflected on the current TTM plans. Changes to the plans would necessitate further review.

The materials immediately adjacent to or beneath those observed and sampled may have different characteristics than those observed and sampled. No representations are made as to the quality or extent of materials not observed nor subjected to laboratory testing. Any evaluation regarding the presence or absence of hazardous material is beyond the scope of this firm's services.

2.0 SITE LOCATION AND DESCRIPTION

The subject site is located north of El Sobrante Road and east of McAllister Road, in the County of Riverside, California (Figure 1). The site encompasses approximately 325.4 acres and is bounded to the west and north by existing or proposed residential developments, and to the east and south by existing citrus orchards and/or undeveloped properties. In the center of the property is a Western Municipal Water District Irrigation Pond supplied by a pipeline located along an existing dirt access road which ultimately ties into McAllister Road. The irregularly shaped site consists of rolling hills with a northwesterly flowing steeply incised drainage.

3.0 PROPOSED DEVELOPMENT

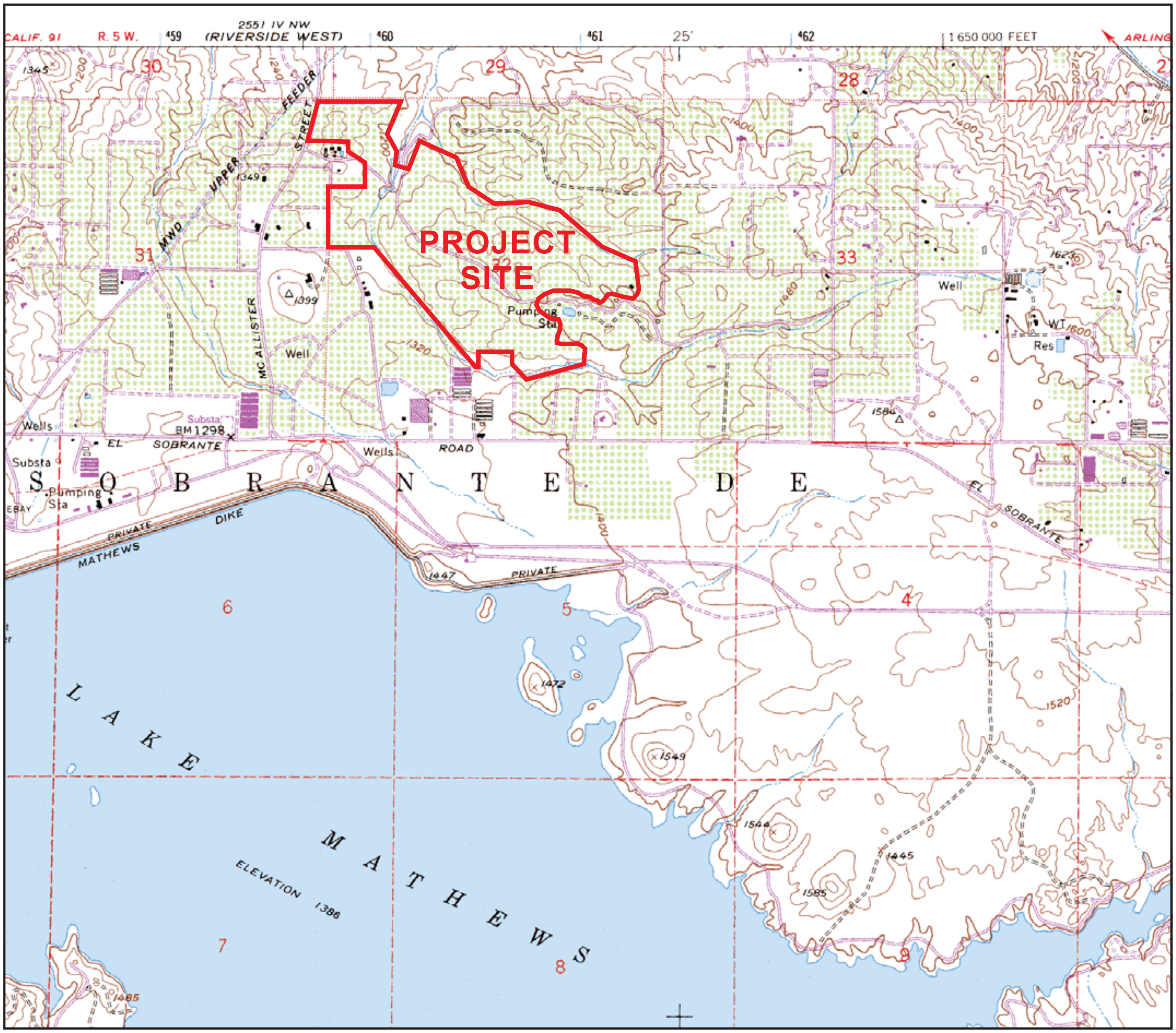
Current 100-scale TTM plans (Plates 1 through 4) prepared by Adkan (2018) call for the site to be developed to support approximately 513 single-family residential lots, associated streets and improvements, park and recreation sites, nine water quality basins, and associated open spaces as depicted in. It is anticipated that the proposed residential structures will be 1- to 2-stories in height, wood-framed, supported by conventional or post-tensioned slab-on-grade foundation systems.

Cut and fill grading techniques are planned to configure the site in general conformance with the design depicted on the TTM plans. Designed cuts are proposed to be as deep as 41 feet below natural ground (Lot 292, eastern area). Designed fills are proposed up to 48 feet (Lot 79, central area). Current design indicates that cut and fill slopes are designed at 2:1 ratios. The highest proposed cut slope is 45 feet below Lot 292. The highest proposed fill slope is 44 feet at Lot 72 (central area). Variable ratio slopes have also been proposed on the current design prepared by Adkan Engineers.

4.0 FIELD AND LABORATORY INVESTIGATION

4.1. Previous Onsite Field Investigation

Leighton Associates (Leighton, 2005) conducted a preliminary investigation within the westerly portion of the site. In addition, Albus-Keefe, Inc. (Albus-Keefe) performed an investigation within the subject site during the same general time frame. Albus-Keefe's study consisted of 83 test pits excavated using a rubber tire backhoe on December 21 through December 27, 2004, however their report was not available for review by AGS. Of the 83 test pits, 65 test pits were observed and logged jointly by Leighton and Albus-Keefe. The log data for test pits T-47 thru T-64 was not included in the Leighton (2005) report. Therefore, only the logs for test pits T-1 through T-46 and



SITE LOCATION MAP
VICTORIA HEIGHTS
RIVERSIDE, CALIFORNIA

P/W 1507-05

FIGURE 1

SOURCE MAP - TOPOGRAPHIC MAP OF THE
LAKE MATTHEWS 7.5 MINUTE QUADRANGLE,
RIVERSIDE COUNTY, CALIFORNIA

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T-65 through T-83 were available for our review and are included herein. The abbreviated logs of these test pits are presented on Plates 1 through 4. With the logs presented in Appendix B.

On January 24, 2005, Leighton logged and sampled six (6) hollow-stem auger soil borings (LB-1 through LB-6) at the site to a maximum depth of approximately 26 feet below ground surface (bgs). The approximate locations of the borings are depicted on the Plates 1 through 4, and the boring logs are included in Appendix B. Laboratory results from samples obtained from the test pits and borings conducted by Leighton are included herewith in Appendix C.

Additionally, air percussion borings were performed by Albus-Keefe during the same general time period. The air percussion boring logs were not available for our review, however the estimated depth to blasting was presented in Leighton's report. Accordingly, AGS has included this data on our Plates 1 through 4. It is assumed by AGS that the estimated depth to blasting is based upon an air-track drilling rate greater than 18 to 20 seconds/foot.

Pertinent information from the previous studies have been compiled herewith to provide an evaluation of the subject property and to supplement fieldwork collected by AGS during this investigation. A collection of the logs available for this project is provided in Appendix B. The associated laboratory test results are presented in Appendix C.

4.2. Current Investigation

On August 27 and 28, 2016, AGS conducted subsurface exploration for this study which included the advancement, logging, and sampling of 32 backhoe test pits (TP-1 through TP-32) and 19 excavator test pits (EX-1 through EX-19). On April 13, 2018 an AGS geologist monitored seismic refraction surveys performed along various slopes and ridges by our subcontractor Southwest Geophysics (SGI) which included lines SL-1 through SL-10 onsite. Based on the results of previous exploration, on April 18, 2018, AGS logged sixteen air percussion borings (AP-1 through AP-16) advanced with an Ingersoll-Rand ECM-370 air/hydraulic drill to further evaluate rock rippability at the site.

Due to the reduced development area shown in the current TTM plans, several of AGS previous and recent excavations (EX-1, EX-12 and EX-13) and test pits (TP-1 through TP-18) are no longer within the project area and were removed from this report. Logs of the excavations and the results of the seismic survey are presented in Appendix B. The approximate locations of exploratory trenches, air track boreholes and the seismic refraction lines are shown on Plates 1 through 4.

AGS also conducted preliminary infiltration testing within the water quality basins proposed for the site. Nine backhoe pits (BP-A through BP-F) were excavated and five percolation tests were performed as part of the infiltration study at the site. The findings were presented in a separate report dated November 6, 2016 (AGS, 2016). Several of the previous water quality basin locations were modified in the current TTM plan.

5.0 ENGINEERING GEOLOGY

5.1. Geologic Analysis

5.1.1. Literature Review

AGS has reviewed the referenced geologic documents in preparing this study. Where deemed appropriate, this information has been included with this document.

5.1.2. Aerial Photograph Review

AGS has reviewed current and historical aerial photographs and satellite imagery available through sources on the internet.

5.1.3. Field Mapping

The site geology was mapped during our subsurface exploration by a Registered Engineering Geologist. This mapping is presented in the attached geologic maps (Plates 1 through 4) included herewith.

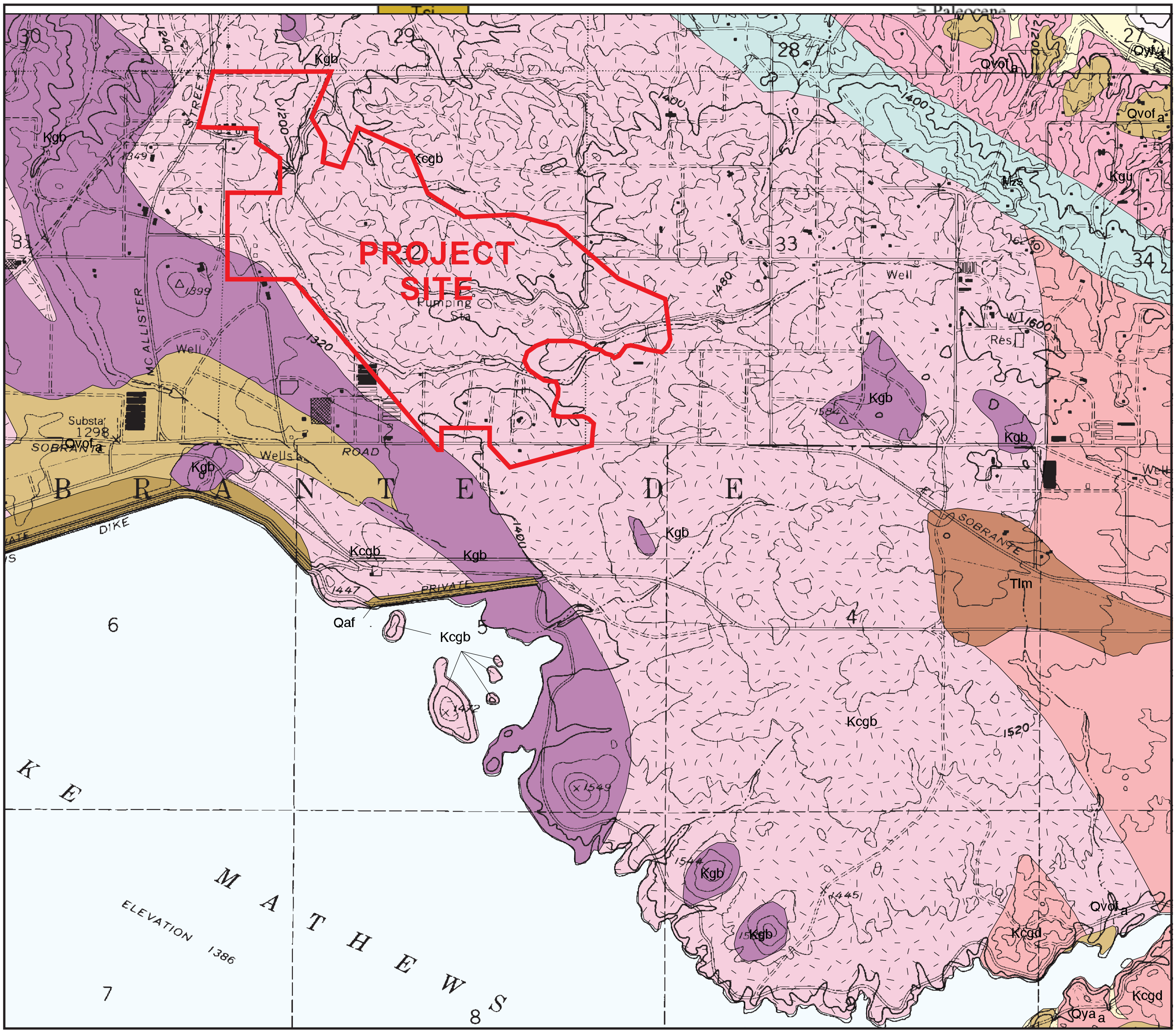
5.2. Geologic and Geomorphic Setting

The project occupies part of the western edge of the Perris Block within the Peninsular Ranges Geomorphic Province. Cretaceous age crystalline rock associated with the southern California Batholith, and specifically the Cajalco Pluton, underlie the site (Morton and Webber 2001). This bedrock has been mapped as undifferentiated Granodiorite and Gabbro (Figure 2). Generally thin, non-marine, Pleistocene age deposits lay uncomfortably on the bedrock. These deposits are remnants of ancient stream bed deposits and alluvial fan deposits. Holocene-age (recent) alluvium is found within the current drainage courses at the site.

Drainage across the site is by sheet flow. The site may experience high-flow volumes during periods of prolonged rainfall, but otherwise the site remains dry throughout most of the year.

5.3. Stratigraphy

Mapping and nomenclature following Morton and Weber (2001) place the site within the Cretaceous age Cajalco Pluton which is composed of crystalline plutonic rock that varies in the site vicinity from predominantly Granodiorite to more mafic rocks such as Gabbro. Remnants of Pleistocene age older alluvial deposits lay unconformably upon the bedrock at the site. This unit is essentially flat-lying and is found within some of the lower elevations at the site. In addition, paleosols have developed on the many of the flatter slopes and ridges at the site where erosion has not been as active. Recent (Holocene) alluvium exists within the well-established drainages on site. Undocumented fill exists in areas where the land surface has been modified in order to support agriculture, access roads, water pipelines, a water reservoir, and a residential pad. A more detailed description of these geologic units is presented below in order of oldest to youngest. Approximate geologic contacts are shown on Plates 1 through 4.



SITE GEOLOGIC MAP
VICTORIA HEIGHTS
RIVERSIDE, CALIFORNIA

N

Qoa	Old axial channel deposits (late to middle Pleistocene)
Qvof	Very old alluvial fan deposits (early Pleistocene)
Kcgb	Granodiorite and gabbro, undifferentiated
Kgr	Gabbro (Cretaceous)

P/W 1507-05

FIGURE 2

SOURCE MAP - MORTON & WEBER, 2001, GEOLOGIC MAP OF THE LAKE MATTHEWS 7.5 MINUTE QUADRANGLE, RIVERSIDE COUNTY, CALIFORNIA

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5.3.1. Undocumented Artificial Fill (afu)

Undocumented fills associated with access roads, past citrus orchards, waterlines, and a reservoir exist at the site. The fills were observed by AGS to be composed mainly of light yellowish brown, brown, and grayish brown, clayey, fine- to medium-grained sand, that is dry and loose. Portions of the undocumented fill could contain trash and debris. Artificial fill was encountered to a maximum depth of two and a half (2.5) feet (test pit TP-21). Thicker layers of undocumented fill may be encountered in localized areas.

5.3.2. Topsoil (No Map Symbol)

A thin veneer of topsoil was encountered in many of the subsurface excavations across the site. Topsoil was observed to consist primarily of light brown to reddish brown, clayey to silty, fine- to medium-grained sand, in a dry and loose condition. The thickness of this material was found to be up to two (2.0) feet thick during our investigation.

5.3.3. Alluvium (Map Symbol Qal)

Holocene-age (recent) alluvial deposits are present in the well-developed modern drainages at the site, which appear to mainly be outside the limits of the proposed grading. The alluvium was found to be composed of reddish brown to yellowish brown clayey fine to medium grained sand, dry, loose to medium dense, with visible porosity. The alluvium is anticipated to range from a few feet to depths of greater than 13 feet (boring LB-4).

5.3.4. Colluvium (Map Symbol Qcol)

Holocene-age (recent) colluvial deposits are present on the flatter areas at the base of slopes, at the site. Colluvium was reported to be up to ten (10) feet thick in T-79 (Leighton, 2015). Colluvium has been mapped on Plates 1 through 4 where significant amounts (3 feet or more) are thought to be present. This material is composed of reddish brown to light brown, clayey, fine- to medium-grained sand, moist to dry, medium dense, visibly porous and locally root-filled. These sediments are derived from adjacent topographic highs which were transported mainly by gravity.

5.3.5. Older Alluvium (Map Symbol Qoa)

Pleistocene-age older alluvium deposits were observed to consist of reddish to yellowish brown, silty sand and clayey sand that is dry, loose, visibly porous, and highly weathered within the upper three (3) to six (6) feet. At depths in excess of three (3) to six (6) feet the older alluvium becomes moist and medium dense.

Leighton (2005) also encountered older alluvium at the site which was designated using map symbol Qalo. For mapping purposes, and to use symbols and nomenclature generally following Morton (2001), map symbol Qoa is used herein to designate older alluvium. For consistency the abbreviated logs on Plates 1 through 4 show Leighton's map symbols as reported (Leighton, 2005).

5.3.6. Very Old Alluvial Fan Deposits (Map Symbol Qvof)

Very old alluvial fan deposits were encountered within excavator test pit TP-32. This unit was encountered below older alluvium at a depth of seven (7) feet, where refusal was reached at eight (8) feet. This unit was observed to be composed of a dark yellowish brown silty, fine-grained sandstone, slightly moist to moist, very dense, which exhibits cementation and was observed to have abundant carbonate stringers. The upper six (6) to twelve (12) inches can be highly weathered.

5.3.7. Granodiorite and Gabbro - Undifferentiated (Map Symbol Kcgb)

Cretaceous-age Granodiorite, Gabbro, and Quartz Latite were encountered during our subsurface investigation. For mapping purposes, these plutonic rocks were combined into one unit (Granodiorite and Gabbro - undifferentiated) as described by Morton, 2001. Leighton designated the plutonic rock that they encountered as “granitic rock”, which has been combined into the same unit Granodiorite and Gabbro - undifferentiated herein. Some differentiation of the plutonic rock types was made within the logs by AGS as well as Leighton when it was obvious that the mineralogy of the rock fit into a certain category. However, the majority of the rock encountered during our investigation appeared to have a mineralogy that was somewhere in-between that of a Gabbro and a Granodiorite, and therefore no distinction was made in the logs.

The Granodiorite to Gabbro plutonic rock encountered during our investigation was found to be yellowish brown to reddish brown, slightly moist, moderately hard to hard and moderately to highly weathered within the upper few feet below ground surface. However, weathering to depths of 21 feet or more was observed within the excavator test pits.

5.4. Geologic Structure and Tectonic Setting

5.4.1. Tectonic Setting

Structurally, the project site is located near the western edge of the Perris Block within the Peninsular Ranges geomorphic province, which extends south into Baja California and terminates in the north against the Transverse Ranges province. The tectonically active Elsinore and San Jacinto Faults reside on the respective west and east margins of the Perris Block.

5.4.2. Regional Faulting

The Greentree project lies in close proximity to the boundary between the North American and Pacific Plates. This regime dominates the regional tectonic setting in southern California. This fault systems consist of a series of en echelon, northwest-striking right-lateral strike-slip faults. The plate boundary is essentially defined by the San Andreas Fault Zone system and its major secondary faults systems, including the Elsinore and the San Jacinto Fault Zones. Portions of the Elsinore, Chino, and the San Jacinto Faults offset Holocene-age sediment and are therefore considered active.

5.4.2.1. *Elsinore Fault Zone*

The active Elsinore Fault Zone is a northwest trending right-lateral, strike-slip zone with at least local thrust- and normal-slip components that can be further subdivided into at least eight (8) known segments. Recent geological studies have shown that this fault has had historic activity.

5.4.2.2. *Chino Fault*

The active Chino Fault is a north trending strike-slip fault that detaches from the Elsinore Fault in the south Corona area, and trends north toward Chino Hills, where it apparently dies-out. The slip rate on various portions of the fault varies, but an average rate of 1 mm/yr. has been reported. The Chino Fault is divided into two separate segments.

5.4.2.3. *San Jacinto Fault Zone*

The active San Jacinto Fault Zone is a complex zone of stepping, bending, splaying and overlapping strike-slip fault segments. Slip rates for segments of this fault are estimated to be 7-15 mm/yr.

5.4.2.4. *Other Active Faults*

A list of the known active faults within 100 km of the site include:

TABLE 5.4.2.4
SITE DISTANCE FROM ACTIVE FAULTS

Fault Name	Distance from Site (km)	Maximum Magnitude
Elsinore	8.8	7.29
Chino	9.4	6.50
San Jacinto	27.8	7.62
Cucamonga	33.5	6.70
San Jose	33.8	6.70
San Joaquin Hills	34.1	7.10
Puente Hills	36.4	6.90
Sierra Madre	37.6	7.20
San Andreas	38.9	7.98
Cleghorn	47.4	6.80
Newport-Inglewood	49.5	7.50
North Frontal (west)	53.7	7.20
Clamshell-Sawpit	53.8	6.70
Raymond	57.8	6.80
Elysian Park	61.9	6.70
Verdugo	69.2	6.90
Palos Verdes	69.4	7.70
Pinto Mountain	73.0	7.30
Hollywood	75.1	6.70

TABLE 5.4.2.4 (continued)		
Fault Name	**Distance from Site (km)**	**Maximum Magnitude**
Coronado Bank	76.7	7.40
Santa Monica	79.4	7.40
Helendale-So Lockhart	79.5	7.40
North Frontal (East)	81.5	7.00
Rose Canyon	82.5	6.90
San Gabriel	89.6	7.30
Lenwood-Old Woman	93.8	7.50
Northridge	96.7	6.90

Source: USGS, 2008, Ellsworth Model.

5.4.3. Geologic Structure

The Quaternary deposits at the site are essentially flat-lying. Structure within the underlying plutonic rock of the Cajalco Pluton is relatively massive and is characterized by the predominantly steeply dipping joint sets within it. Joint sets observed within this unit were mapped from outcrops and within test pits. No faults have been mapped within the site or site vicinity.

5.5. Groundwater

Groundwater was not encountered in the exploratory borings or excavations within the subject site. No depth to groundwater information was readily available, however due to the crystalline bedrock beneath the site, groundwater is considered to be over 100 feet deep.

It should be assumed that surface water will be present within the major drainages at the property in winter months. Nuisance seepage from cut and fill slopes in a post-graded environment is likely to occur due to the expected use of landscaping and irrigation water. This condition may require toe drains or other measures and is discussed in further detail in Section 7.3.

5.6. Non-seismic Geologic Hazards

5.6.1. Mass Wasting

No evidence of mass wasting was observed onsite nor was any noted on the reviewed maps. Land sliding at the site is not considered to be an issue, due to the hard and relatively massive nature of the underlying granitic bedrock at the site. No evidence of mass wasting was observed during our investigation.

5.6.2. Flooding

Based on our review of the relevant FEMA (2008) flood map, the site is within Area X corresponding to areas outside the 0.2% annual chance (500-year) flood plain.

5.6.3. Subsidence and Ground Fissuring

Due to the presence of the hard underlying bedrock at the site, and the limited thickness of sediments below the site, the potential for subsidence and ground fissuring due to settlement is very unlikely.

5.7. Seismic Hazards

The subject site is located in southern California, which is a tectonically active area. The type and magnitude of seismic hazards affecting a site are dependent upon the distance to the causative fault and the intensity and magnitude of the seismic event. The seismic hazard may be primary, such as surface rupture and/or ground shaking, or secondary, such as liquefaction and/or ground lurching. The State of California has mandated by the Alquist-Priolo (A-P) Earthquake Fault Zoning Act to delineate Fault-Rupture Hazard Zones in California and by the Urban Seismic Hazards Mapping Act (USHMA) to delineate zones identified as being potentially susceptible to the secondary seismic hazards of liquefaction and earthquake induced landsliding. The Greentree Ranch project is not located in either of these special studies zones.

The type or severity of seismic hazards affecting the site is chiefly dependent upon the distance to and direction from causative faults, the intensity and duration of the seismic events, and the onsite soil characteristics. The seismic hazard may be primary, such as surface rupture and/or ground shaking, or secondary, such as liquefaction or landsliding. The following is a brief seismic hazards assessment for the project

5.7.1. Surface Fault Rupture

Surface rupture is a break in the ground surface during, or as a consequence of, seismic activity. Fault rupture occurs most often along pre-existing fault traces. No faults have been mapped onsite, nor in the immediate site vicinity. Accordingly, the potential for surface rupture is low.

5.7.2. Seismicity

As noted, the site is within the tectonically active southern California area, and is approximately 8.8 km (5.5 miles) from the active Elsinore fault zone. The potential exists for strong ground motion that may affect future improvements.

At this point in time, non-critical structures (commercial, residential, and industrial) are usually designed according to the California Building Code (2016) and that of the controlling local agency. However, liquefaction/seismic slope stability analyses, critical structures, water tanks and unusual structural designs will likely require site specific ground motion input.

5.7.3. Seiches, Tsunamis & Dam Inundation

A seiche is a free-standing wave oscillation on the surface of water in an enclosed or semi-enclosed basin. The wave can be initiated by an earthquake and can vary in height from several centimeters to a few meters.

The site is near a large body of water (Lake Mathews), however flooding at the site due to a seiche is considered to be very low, due to the fact that the County of Riverside General Plan lists only two water bodies in Riverside County with the potential for a seismically induced seiche (Lake Elsinore and Perris Reservoir).

The Inundation area from a failure of the Lake Mathews reservoir is presented in Amendment 960 to the County of Riverside General Plan. The area of inundation does not enter the site and is restricted to the southwest of the project.

5.7.4. Historical Earthquakes

Earthquakes that have historically impacted the area include the 1857 Fort Tejon Earthquake, the 1858 San Bernardino Earthquake, the 1899 Cajon Pass earthquake, the 6.8 magnitude 1918 San Jacinto earthquake near Hemet, the 6.3 magnitude 1923 North San Jacinto earthquake near Highgrove, the 1981 Sylmar Earthquake, the 5.9 magnitude 1987 Whittier Narrows Earthquake, the 6.4 magnitude Big Bear earthquake, 6.7 magnitude 1994 Northridge Earthquake, and 5.4 magnitude 1990 Upland earthquake.

FIGURE 3 - MAP OF HISTORIC EARTHQUAKES (1910-PRESENT)

5.7.5. Seismic Design Parameters

It is anticipated that after implementation of the grading recommendations provided in this report, some lots will be underlain by less than 10 feet of compacted fill on plutonic rock and other lots will be underlain by more than 10 feet of compacted fill. It is recommended that lots underlain by less than 10 feet of fill be classified as Seismic Site Class B consisting of a rock profile with average shear wave velocity greater than 5,000 ft/sec. Lots underlain by more than 10 feet of fill may be classified as Seismic Site Class D consisting of stiff soil profile with average SPT (N) values between 15 and 50 bpf. Tables 5.7.5.1 and 5.7.5.2 present seismic design parameters in accordance with 2016 CBC and mapped spectral acceleration parameters (United States Geological Survey, 2018) for seismic site classes B and D, respectively. A site location of Latitude 33.865°N and Longitude 117.427°W was utilized. Determination of the applicable seismic site class to individual lots will be provided after site grading is completed.

TABLE 5.7.5.1
2016 CALIFORNIA BUILDING CODE DESIGN PARAMETERS

Seismic Site Class	B
Mapped Spectral Acceleration Parameter at Period of 0.2-Second, S_s	1.500g
Mapped Spectral Acceleration Parameter at Period 1-Second, S_1	0.600g
Site Coefficient, F_a	1.000
Site Coefficient, F_v	1.000
Adjusted MCE_R[1] Spectral Response Acceleration Parameter at Short Period, S_{MS}	1.500g
1-Second Period Adjusted MCE_R[1] Spectral Response Acceleration Parameter, S_{M1}	0.600g
Short Period Design Spectral Response Acceleration Parameter, S_{DS}	1.000g
1-Second Period Design Spectral Response Acceleration Parameter, S_{D1}	0.400g
Peak Ground Acceleration, PGA_M[2]	0.507g
Seismic Design Category	D

Notes: [1] Risk-Targeted Maximum Considered Earthquake
[2] Peak Ground Acceleration adjusted for site effects

TABLE 5.7.5.2
2016 CALIFORNIA BUILDING CODE DESIGN PARAMETERS

Seismic Site Class	D
Mapped Spectral Acceleration Parameter at Period of 0.2-Second, S_s	1.500g
Mapped Spectral Acceleration Parameter at Period 1-Second, S_1	0.600g
Site Coefficient, F_a	1.000
Site Coefficient, F_v	1.500
Adjusted MCE_R[1] Spectral Response Acceleration Parameter at Short Period, S_{MS}	1.500g
1-Second Period Adjusted MCE_R[1] Spectral Response Acceleration Parameter, S_{M1}	0.900g
Short Period Design Spectral Response Acceleration Parameter, S_{DS}	1.000g
1-Second Period Design Spectral Response Acceleration Parameter, S_{D1}	0.600g
Peak Ground Acceleration, PGA_M[2]	0.507g
Seismic Design Category	D

Notes: [1] Risk-Targeted Maximum Considered Earthquake
[2] Peak Ground Acceleration adjusted for site effects

5.7.6. Liquefaction/Dynamic Settlement

Liquefaction is the phenomenon where seismic agitation of loose, saturated sands and silty sands can result in a buildup of pore pressures that, if sufficient to overcome overburden stresses, can produce a temporary quick condition known as liquefaction. Localized, loose lenses/layers of sandy soils may be subject to liquefaction when a large, prolonged, seismic event affects the site. As the excess pore water pressure dissipates, the liquefied zones/lenses can consolidate causing settlement. Post liquefaction effects at a site can manifest in several ways and may include: 1) ground deformations; 2) loss of shear strength; 3) lateral spread; 4) dynamic settlement; and 5) flow failure.

In general, the more recent a sediment has been deposited, the more likely it is to be susceptible to liquefaction. Further, liquefaction potential is greatest in loose, poorly graded sands and silty sands with mean grain size in the range of 0.1 to 0.2 mm. Other factors that must be considered are groundwater, confining stresses, relative density, intensity and duration of ground shaking. It is generally held that soils possessing a clay content (particle size < 0.005mm) greater than fifteen (15) to twenty (20) percent may be considered non-liquefiable (Southern California Earthquake Center, 1999).

Due to the dense nature of the granitic rock; the relatively thin veneer of granular soils; the lack of shallow groundwater; and the proposed remedial grading as outlined herein; the subject site is not considered to be susceptible to liquefaction.

5.7.7. Lateral Spreading

Liquefaction-induced lateral spreading is defined as the finite, lateral displacement of gently sloping ground as a result of pore pressure build-up or liquefaction in a shallow underlying deposit during an earthquake. Due to the lack of shallow ground water and the proposed remedial grading recommended herein, the potential for lateral spreading is remote.

5.7.8. Seismically Induced Landsliding

Owing to the hard granitic rock below the site, and given the proposed post-grading environment, the potential of seismically induced landsliding is considered to be “very low” at the site.

6.0 GEOTECHNICAL ENGINEERING

Presented herein is a discussion of the geotechnical properties of the various soil types and earth materials that have been encountered during our site-specific analyses, and how it relates to the design as shown on Plates 1 through 4.

6.1. Material Properties

6.1.1. Excavation Characteristics

It is anticipated that excavations within the undocumented artificial fill, topsoil, alluvium, older alluvium, and very old alluvial fan deposits, as well as the highly to moderately weathered portions of the Granodiorite-Gabbro, can be accomplished with conventional equipment. It is likely that oversized "float" will be encountered in surface outcrops of the Granodiorite-Gabbro and will require special handling. The slightly weathered Granodiorite-Gabbro found within the deeper cuts will require heavy ripping and possibly blasting to excavate.

As a means to help determine the rippability of the bedrock AGS observed track hoe excavator pits and air track borings at the site. Logs of the excavator pits and air track borings are presented in Appendix B. Locations of the air track borings with estimated depths to non-rippable rock as determined by AGS and Albus-Keefe are presented on Plates 1 through 4. It is assumed by AGS that the estimated depth to non-rippable rock by Albus-Keefe was based on an air-track drilling rates greater than 18 to 20 seconds/foot.

To further evaluate rippability, Southwest Geophysics, Inc. (SGI, 2018) performed ten (10) seismic refraction survey lines (SL-1 thru SL-10) within slopes and ridges onsite. The report by SGI is presented in Appendix B. The approximate locations of the survey lines are shown on Plates 1 through 4. Table 6.1.1 below summarizes the approximate depths at which the interface between rippable (wave velocity <5,500 ft/s) and marginally rippable to non-rippable materials (>5,500 ft/s) is anticipated based upon the seismic refraction lines.

TABLE 6.1.1
SEISMIC REFRACTION SURVEY DATA

Survey Line	Approximate Depth of Rippable/ Non-rippable Interface (ft)
SL-1	55
SL-2	23
SL-3	16
SL-4	9
SL-5	0
SL-6	7
SL-7	16
SL-8	30
SL-9	24
SL -10	25

Generally, it has been AGS's experience that when wave velocities are higher than 5,500 feet/sec, blasting will be required for efficient excavation utilizing a D-9 bulldozer equipped with a single-shank ripper. Although it is possible that in certain instances velocities approaching 5,500 ft/s can be ripped, production rates are typically too low, and drilling and shooting is typically preferred in order to increase production. Velocities greater than 4,000 to 5,000 ft/s may require localized blasting for efficiency during grading and will probably contain common boulders that will require special handling. It should be anticipated that oversized materials will be generated from cuts in the bedrock. These oversized materials should be handled as discussed in Section 7.5.8. Recommended undercuts to remove hard rock from the near pad grade and within utility alignments are presented in Section 7.1.

Based on the drilling and excavator test pits, the rippability of the rock is expected to be variable. This is due to varying degrees of fracturing, weathering, and quartz content. Irregular rippable/non-rippable horizons can also be expected. The determination of rippable/non-rippable quantities should be evaluated by the contractor. It has been AGS's experience that the following factors and combinations thereof, determine production rates and therefore dictate the need for blasting. These factors include: 1) fracture pattern; 2) frequency of quartz rich zones; 3) equipment type and condition; and 4) skill of equipment operators. It is AGS's opinion that isolated areas of hard rock may be encountered in these upper rippable zones requiring the use of blasting or hoe-rams (i.e., secondary breaking) as a means to efficiently excavate and place these materials. Additional rippability studies could be undertaken after detailed 40-scale plans become available.

6.1.2. Compressibility

Onsite materials that are significantly compressible include undocumented fill, topsoil, alluvium, weathered portions of older alluvium as well as the highly weathered portions of the crystalline bedrock. These materials will require complete removal prior to placement of fill, where exposed at design grade and possibly where exposed in cut slopes. Recommended removal depths are presented in Section 7.1 and earthwork adjustment shrink/bulk estimates are presented in Section 6.1.6.

6.1.3. Expansion Potential

Based upon our observations and preliminary testing, the expansion potential of the onsite materials will range from "very low" to "low" when classified in accordance with ASTM D4829. Although not anticipated, we have also provided design recommendations for soils in the "medium" expansion potential range.

6.1.4. Shear Strength

The average shear strength parameters used by AGS for design and analysis are presented in Table 6.1.4. Specific shear strength testing is presented in Appendix C.

TABLE 6.1.4 SHEAR STRENGTH PARAMETERS USED FOR DESIGN (ULTIMATE)			
Material	**Cohesion (psf)**	**Friction Angle (degrees)**	**Moist Density (pcf)**
Compacted Fill	150	31	120
Older Alluvium, Very Old Fan (Qoa, Qvof)	150	32	125
Granodiorite/Gabbro (Kcbg)	500	35	130

6.1.5. Chemical and Resistivity Test Results

The results of preliminary chemical/resistivity testing are presented in Appendix C. Consultation with a corrosion engineer is recommended. Final determination of actual chemical/resistivity design parameters for the foundation will be determined at the conclusion of the grading and will be presented in the grading report.

6.1.6. Earthwork Adjustments

In consideration of the proposed mass grading to develop the project as currently proposed on the Tentative Tract Maps, the following average earthwork adjustment factors presented in Table 6.1.6. have been formulated for use in the earthwork design of the project.

TABLE 6.1.6 EARTHWORK ADJUSTMENTS		
Geologic Unit		**Approximate Range**
Undocumented Artificial Fill, Topsoil, Alluvium, and Colluvium (afu, Topsoil, Qal/Qcol):		10% - 12% Shrink
Older Alluvium, Very Old Alluvial Fan Deposits (Qoa, Ovof):		0% - 5% Shrink
Granodiorite and Gabbro (Kcgb):	*Heavy Ripping*	15% - 18% Bulk
	Blasting	18% - 25% Bulk

These values may be used in an effort to balance the earthwork quantities. As is the case with every project, contingencies should be made to adjust the earthwork balance when grading is in progress and actual conditions are better defined.

6.1.7. Pavement Support Characteristics

Compacted fill derived from onsite soils is expected to possess “moderate” to “good” pavement support characteristics. Testing should be completed once subgrade elevations are reached for the onsite roadways. For preliminary pavement design we have used an assumed R-Value of 30 for the subgrade soil onsite.

6.1.8. Infiltration Rates

Preliminary infiltration testing was conducted as part of our overall review of the recent infiltration design recommendation report prepared by AGS (AGS report no. 1507-05-B-5). As part of our testing five (5) infiltration test areas were analyzed for their infiltration rates. Table 6.1.8 summarizes the as-tested infiltration rates and the recommended design rates utilizing a factor of safety (FS) of 2.0.

TABLE 6.1.8
SUMMARY OF INFILTRATION TEST RESULTS

Test Hole No.	Depth of Test Hole (inch)	Approximate Test Elevation (feet, msl)	Geologic Unit	Description	Test Infiltration Rate (inch/hour)	Recommended* Infiltration Rate (inch/hour)
P-1	60	1399.5	Qoa	Clayey Sand	0.43	0.22
P-2	48	1399.0	Qoa	Clayey Sand	0.72	0.36
P-3	60	1302.9	Qoa	Clayey Sand	0.41	0.20
P-4	54	1302.0	Qoa	Clayey Sand	0.52	0.26
P-5	42	1208.0	Kcgb	Granitic Bedrock	0.07	0.04

* Factor of Safety 2.0

6.2. Analytical Methods

6.2.1. Slope Stability Analysis

Slope stability analyses were performed using the Simplified Janbu Method for circular failure surfaces. Stability calculations were compiled using STEDwin in conjunction with GSTABL7 computer code.

6.2.2. Pavement Design

Asphalt concrete pavement sections have been designed using the recommendations and methods presented in the Caltrans Highway Design Manual.

7.0 EARTHWORK CONCLUSIONS AND RECOMMENDATIONS

Development of the subject property is considered feasible, from a geotechnical standpoint, provided that the conclusions and recommendations presented herein are incorporated into the design and construction of the project. Presented below are specific issues identified by this study as possibly affecting site development. Recommendations to mitigate these issues are presented in the text of this report.

7.1. Site Preparation and Removals/Overexcavation

Grading should be accomplished under the observation and testing of the project geotechnical engineer and engineering geologist or their authorized representative in accordance with the recommendations contained herein, the current grading ordinance of the County of Riverside and AGS's Earthwork Specifications (Appendix E). Existing vegetation, trash, debris, and other deleterious materials should be removed and wasted from the site prior to commencing removal of unsuitable soils and placement of compacted fill materials. Additionally, all pre-existing foundations elements, standpipes, irrigation lines, and utility conduits should be removed and wasted off-site. Concrete can be placed in the fill provided it is broken down into pieces smaller than 12 inches (largest dimension). Cesspools and septic systems should be properly removed and/or backfilled in accordance with the local governing agency.

Soil, undocumented fills, alluvium and weathered portions of the older alluvium, and bedrock should be removed in areas planned to receive compacted fill intended to support settlement-sensitive structures such as buildings, roads and underground improvements. The resulting undercuts should be replaced with engineered fill. Estimated depths of removals based upon the geologic unit are presented in Table 7.1. It should be noted that local variations can be expected requiring an increase in the depth of removal for unsuitable and weathered deposits. The extent of removals can best be determined in the field during grading when observation and evaluation can be performed by the soil engineer and/or engineering geologist. Removal bottoms should finally expose saturated (S>85%) alluvium, very old alluvial fan deposit and/or bedrock. The removal bottom should be observed and mapped by the engineering geologist prior to fill placement. Although unlikely, if removals are completed to saturated alluvium or older alluvium will require monitoring of time-dependent settlement.

In general, soils removed during remedial grading will be suitable for reuse in compacted fills provided they are properly moisture conditioned and do not contain deleterious materials.

TABLE 7.1
ESTIMATED DEPTH OF REMOVALS

Geologic Unit (map symbol)	Estimated Removal Depth (feet)
Topsoil (No Map Symbol)	1 - 2
Artificial Fill – undocumented (afu)	1 - 10
Alluvium (Qal)	1 - 13
Colluvium (Qcol)	1 - 10
Older Alluvium (Qoa)	3 - 6
Very Old Alluvial Fan Deposits (Qvof)	0.5 - 1
Granodiorite and Gabbro (Kcgb)	1 - 2

7.1.1. Stripping and Deleterious Material Removal

Existing vegetation, trash, debris, and other deleterious materials should be removed and wasted from the site prior to commencing removal of unsuitable soils and placement of compacted fill materials. Additionally, all pre-existing foundations elements, standpipes, irrigation lines, and utility conduits should be removed and wasted off-site. Concrete can be placed in the fill provided it is broken down into pieces smaller than 12 inches (largest dimension). Cesspools and septic systems should be properly removed and/or backfilled in accordance with the local governing agency.

7.1.2. Overexcavation of Building Pads and Streets

7.1.2.1. *Cut/Fill Transition Lots*

Where design grades and/or remedial grading activities create a cut/fill transition, the cut and shallow fill portions of the building pad should be overexcavated a minimum depth of three (3) feet and replaced to design grade with compacted fill. Lots anticipated to require replacement fills due to cut/fill transitions are indicated with a © on the enclosed plans. All undercuts should be graded such that a gradient of at least one (1) percent is maintained toward deeper fill areas or the front of the pad. The entire pad area of these lots should be undercut. Replacement fills should be compacted to project specifications as discussed in Section 7.5.

7.1.2.2. *Cut Lots Underlain by Hard Rock*

In order to facilitate foundation trenching and future homeowner improvements, it is recommended that all cut lots be overexcavated at least three (3) feet and capped with "select" material. Deeper undercuts are recommended in front yard areas in order to facilitate service utility construction. Lots anticipated to require replacement fills due to hard rock conditions are indicated with an ® on the enclosed plans. This undercut should have a minimum one (1) percent gradient toward the front of the lots to allow for potential subsurface drainage. "Select" replacement material should be eight- (8) inch minus and be compacted to project specifications as discussed in Section 7.5.

7.1.2.3. *Steep Cut and Cut/Fill Transitions*

In order to reduce the differential settlement potential on lots with steep fill or cut/fill transitions, or highly variable fill thickness, the cut or shallow fill portion of steep transitions shall be overexcavated to a depth equal to one-third (1/3) the deepest fill section within the lot to a maximum thickness of seventeen (17) feet. As an alternative to overexcavation on steep cut and cut/fill transition lots founded in hard rock, foundation design combined with increased compaction criteria can be considered. By increasing the compaction of the fill, differential settlement can be reduced.

7.1.2.4. *Overexcavation of Streets*

It is suggested that the street areas with design cut or shallow fill located in the hard bedrock areas be overexcavated a minimum of one (1) feet below the deepest utility and replaced with compacted, eight- (8) inch minus, select soils. This will facilitate the use of conventional trenching equipment for utility construction.

7.1.2.5. *Selective Grading of Backbone Streets*

Where cast-in-place pipe (CIPP) is proposed, selective grading will be required. Besides a maximum rock size of 3-inches, select soils consisting of soil types SC and SM soil types are generally recommended for the "pipe zone" area where CIPP will be used. Selective grading in these areas should be anticipated.

7.1.3. Removals Along Grading Limits and Property Lines

Removals of unsuitable soils will be required prior to fill placement along the grading limit. Where possible, a 1:1 (H:V) projection from toe of slope or grading limit outward to competent materials should be established. Where removals are not possible due to grading limits, property line or easement restrictions, removals should be initiated at the grading boundary (property line, easement, grading limit or outside the improvement) at a 1:1 ratio inward to competent materials. This reduced removal criteria should not be implemented prior to review by the Geotechnical Consultant and approval by the Owner. Where this reduced removal criteria is implemented, special maintenance zones may be necessary. These areas, if present, will need to be identified during grading. Alternatively, grading limits can be initiated offsite.

7.2. Slope Stability and Remediation

Close geologic inspection should be conducted during grading to observe if soil and geologic conditions differ significantly from those anticipated. Should field conditions dictate, modifications to the recommendations presented herein may be necessary and should be based upon conditions exposed in the field during grading.

7.2.1. Cut Slopes

Proposed cut slopes have been designed at slope ratios of 2:1 (horizontal to vertical). The highest proposed cut slope is approximately 45 feet. It is anticipated that slopes excavated in hard rock will be stable to the proposed heights. Stability calculations supporting this conclusion are presented on Plates D-1 through D-3 (Appendix D).

Rockfall issues can develop when large cut slopes are designed. However, unattached rounded boulders are not found frequently within the site and site vicinity. Possible mitigations for any adverse rock fall conditions could include dedicated impact zones at the toe of slope, catchment fencing, and other restraints. All cut slopes should be observed by the engineering geologist during grading. Modifications to the recommendations presented herein may be necessary and should be based upon conditions exposed in the field at the time of grading.

If conditions exposed during grading determine the need for stabilization fills, then the backcuts for stabilization fills should be made no steeper than 1:1 (H:V). Shallower backcuts may be required if conditions dictate. Final determination should be made in the field by the project geologist. All stabilization fills will require backdrain systems as shown on Detail 3 (Appendix E). Additional backdrains could be required in backcuts where geologic contacts daylight in the backcut. Terrace drains and benches should be constructed on cut slopes in accordance with the County of Riverside Grading Ordinance.

7.2.2. Fill Slopes

Fill slopes are designed at ratios of 2:1 (horizontal to vertical) or flatter. The highest design fill slopes are approximately 44 feet. Fill slopes, when properly constructed with onsite materials, are expected to be grossly and surficially stable as designed. Stability calculations are presented on Plates D-4 through D-6 (Appendix D).

Fill slopes constructed at 2:1 ratios or flatter can be expected to perform satisfactorily when properly constructed with onsite materials and maintained as described in Appendix E. Marginal surficial stability may exist if slopes are not properly maintained or are subjected to inappropriate irrigation practices. Slope protection and appropriate landscaping will improve surficial stability and should be considered.

Keyways should be constructed at the toe of all fill slopes toeing on existing or cut grade. Fill keys should have a minimum width equal to fifteen (15) feet or one-half (1/2) the height of ascending slope, whichever is greater. Where possible, unsuitable soil removals below the toe of proposed fill slopes should extend outward from the catch point of the design toe at a minimum 1:1 (H:V) projection to an approved cleanout as shown on Detail 5 (Appendix E). Backcuts should be cut no steeper than 1:1 (H:V) ratio or as recommended by the geotechnical engineer. Terrace drains and benches should be constructed on fill slopes in accordance with the County of Riverside Grading Ordinance.

7.2.3. Natural Slopes and Skin Fills

Where possible, skin fills or thin fill sections against natural slopes should be avoided. If skin fill conditions are identified in the field or are created by remedial grading, it is recommended that a backcut and keyway be established such that a minimum fill thickness equal to one-half (1/2) the remaining slope height but not less than fifteen (15) feet is provided for all skin fill conditions. This criterion should be implemented for the entire slope height. Drains are required at the heel of keyways and will be designed based upon exposed conditions.

7.2.4. Fill over Cut Slopes

Several fill over cut slopes are proposed for this project. For fill over cut slopes, the fill portion should not be constructed until the cut portion of the slope has been cut to finish grade. The materials and geologic structure exposed along the cut slope will be evaluated for: 1) suitability as a foundation medium; 2) suitability for receiving compacted fill; and 3) surficial and gross stability. Once the cut portion of the slope has been evaluated, it will be released for construction of the fill key or recommendations for further remedial grading will be provided. If it is determined that the exposed materials require remediation, the slope would then become a stabilization fill and should be constructed as discussed in Section 7.2.1.

7.2.5. Surficial Stability

The surficial stability of 2:1 fill and cut slopes have been analyzed, and the analysis presented in Appendix D indicates a factor-of-safety in excess of code minimums. When fill and cut slopes are properly constructed and maintained, satisfactory performance can be anticipated although slopes will be subject to erosion, particularly before landscaping is fully established.

7.2.6. Temporary Backcut Stability

Temporary backcuts should be laid back at gradients no steeper than 1:1 to heights of up to 10 feet, and 1½:1 (horizontal:vertical) for heights greater than 10 feet. Flatter backcuts may be necessary where geologic conditions dictate and where minimum width dimensions are to be maintained.

Care should be taken during remedial grading operations in order to minimize risk of failure. Should failure occur, complete removal of the disturbed material will be required. In consideration of the inherent instability created by temporary construction of backcuts, it is imperative that grading schedules be coordinated to minimize the unsupported exposure time of these excavations. Once started the excavations and subsequent fill operations should be maintained to completion without intervening delays imposed by avoidable circumstances. In cases where five-day workweeks comprise a normal schedule, grading should be planned to avoid exposing at-grade or near-grade excavations through a non-work weekend. Where improvements may be affected by temporary instability, either on or offsite, further restrictions such as slot cutting, extending work days, implementing weekend schedules, and/or other requirements considered critical to serving specific circumstances may be imposed.

7.2.7. Geologic Observation During Grading

All temporary slope excavations, including front, side and backcuts, and all cut slopes should be mapped to verify the geologic conditions that were modeled prior to grading are consistent with the exposures during the grading. It is likely that slope stability analyses and designed keyways may have to be modified based on conditions exposed during grading.

7.3. <u>Subsurface Drainage</u>

7.3.1. Canyon Drains

Six- (6) and eight- (8) inch diameter canyon subdrains are recommended along the deeper canyons on the project. The drains are to be placed along the lowest alignment of canyon removals to intercept, transport and dispose of infiltrating water. The diameter and approximate locations of proposed subdrains are shown on Plates 1 through 4. Final determination of drain locations will be made in the field, based on exposed conditions. Drains should be constructed in accordance with the details shown on Details 1 and 2 (Appendix E).

7.3.2. Heel Drains

Heel drains will be required for all stabilization fill keyways and fill-over-cut keyways. Heel drains should be constructed in accordance with the details shown on Detail 3 (Appendix E).

7.3.3. Cut Slope Toe Drains and Subdrains

Due to the fractured nature of the bedrock, it is common for post-grading irrigation runoff to surface on cut slopes. Consideration should be given to placing a toe drain on all major cut slopes in order to provide drainage for possible future nuisance water on the cut slopes.

Subdrains on the cut slope face may be required if nuisance water surfaces on the slope face during grading. These drains may be tied into the toe drain if it is installed, or if no toe drains are installed, it will need to be tied to adjacent canyon subdrains or the storm drain system.

7.4. Seepage

Seepage, when encountered during grading, should be evaluated by the Geotechnical Consultant. In general, seepage is not anticipated to adversely affect grading. If seepage is excessive, remedial measures such as horizontal drains or under drains may need to be installed. No groundwater or seepage was encountered during the investigation; therefore, seepage is not expected.

7.5. Earthwork Considerations

7.5.1. Compaction Standards

Fill and processed natural ground shall be compacted to a minimum relative compaction of 90 percent as determined by ASTM Test Method D1557. All fill to be placed below fifty (50) feet from ultimate grade and/or below subdrains should be compacted to at least 93 percent of maximum dry density. Care should be taken that the ultimate grade be considered when determining the compaction requirements for disposal fill and "super pad" areas. Compaction shall be achieved at slightly above the optimum moisture content, and as generally discussed in the attached Earthwork Specifications (Appendix E).

7.5.2. Documentation of Removals and Drains

Removal bottoms, canyon subdrains, fill keys, backcuts, backdrains and their outlets should be observed by the engineering geologist and/or geotechnical engineer and documented by the civil engineer prior to fill placement.

7.5.3. Treatment of Removal Bottoms

At the completion of removals, the exposed bottom should be scarified to a depth of approximately 8 to 12 inches, moisture conditioned to above optimum moisture content, and compacted in-place to the standards set forth in this report.

7.5.4. Fill Placement

After removals, scarification, and compaction of in-place materials are completed, additional fill may be placed. Fill should be placed in thin lifts [eight- (8) inch bulk], moisture conditioned to slightly above the optimum moisture content, mixed, compacted, and tested as grading progresses until final grades are attained.

7.5.5. Benching

Where the natural slope is steeper than 5-horizontal to 1-vertical and where determined by the Geotechnical Consultant, compacted fill material shall be keyed and benched into competent materials.

7.5.6. Mixing and Moisture Control

In order to provide thorough moisture conditioning and proper compaction, processing (mixing) of materials is necessary. Mixing should be accomplished prior to, and as part of the compaction of each fill lift.

7.5.7. Fill Slope Construction

Fill slopes may be constructed by preferably overbuilding and cutting back to the compacted core or by back-rolling and compacting the slope face. The following recommendations should be incorporated into construction of the proposed fill slopes.

Care should be taken to avoid spillage of loose materials down the face of any slopes during grading. Spill fill will require complete removal before compaction, shaping and grid rolling.

Seeding and planting of the slopes should follow as soon as practical to inhibit erosion and deterioration of the slope surfaces. Proper moisture control will enhance the long-term stability of the finish slope surface.

7.5.7.1. *Overbuilding Fill Slopes*

Fill slopes should be overfilled to an extent determined by the contractor, but not less than 2 feet measured perpendicular to the slope face, so that when trimmed back to the compacted core, the compaction of the slope face meets the minimum project requirements for compaction.

Compaction of each lift should extend out to the temporary slope face. The slope should be back-rolled at fill intervals not exceeding 4 feet in height unless a more extensive overfilling is undertaken.

7.5.7.2. *Compacting the Slope Face*

As an alternative to overbuilding the fill slopes, the slope faces may be back-rolled with a heavy-duty loaded sheepsfoot or vibratory roller at maximum 4-foot fill height intervals. Back-rolling at more frequent intervals may be required. Compaction of each fill should extend to the face of the slope. Upon completion, the slopes should be watered, shaped, and track-walked with a D-8 bulldozer or similar equipment until the compaction of the slope face meets the minimum project requirements. Multiple passes may be required.

7.5.8. Oversized Materials

Oversized rock material [i.e., rock fragments greater than eight (8) inches] will be produced during the excavation of the design cuts and undercuts. Provided that the procedure is acceptable to the developer and governing agency, this rock may be incorporated into the compacted fill section to within three (3) feet of finish grade within residential areas and to two (2) foot below the deepest utility in street and house utility connection areas. Maximum rock size in the upper portion of the hold-down zone is restricted to eight (8) inches. Disclosure of the above rock hold-down zone should be made to prospective homebuyers explaining that excavations to accommodate swimming pools, spas, and other appurtenances will likely encounter oversize rock [i.e., rocks greater than eight (8) inches] below three (3) feet. Rock disposal details are presented on Detail 10 (Appendix E). Rocks in excess of eight (8) inches in maximum dimension may be placed within the deeper fills, provided rock fills are handled in a manner described below. In order to separate oversized materials from the rock hold-down zones, the use of a rock rake may be necessary.

7.5.8.1. *Rock Blankets*

Rock blankets consisting of a mixture of gravel, sand and rock to a maximum dimension of two (2) feet may be constructed. The rocks should be placed on prepared grade, mixed with sand and gravel, watered and worked forward with bulldozers and pneumatic compaction equipment such that the resulting fill is comprised of a mixture of the various particle sizes, contains no significant voids, and forms a dense, compact, fill matrix.

Rock blankets may be extended to the slope face provided the following additional conditions are met:

1) no rocks greater than twelve (12) inches in diameter are allowed within six (6) horizontal feet of the slope face;
2) 50 percent (by volume) of the material is three-quarter- (3/4) inch minus; and,
3) bankrolling of the slope face is conducted at four- (4) foot vertical intervals and satisfies project compaction specifications.

7.5.8.2. *Rock Windrows*

Rocks to maximum dimension of four (4) feet may be placed in windrows in deeper fill areas in accordance with the details on Detail 10 (Appendix E). The base of the windrow should be excavated an equipment-width into the compacted fill core with rocks placed in single file within the excavation. Sands and gravels should be added and thoroughly flooded and tracked until voids are filled. Windrows should be separated horizontally by at least fifteen (15) feet of compacted fill, be staggered vertically, and separated by at least four (4) vertical feet of compacted fill. Windrows should not be placed within ten (10) feet of finish grade, within two (2) vertical feet of the lowest buried utility conduit in structural fills, or within fifteen (15) feet of the finish slope surface unless specifically approved by the developer, geotechnical consultant, and governing agency.

7.5.8.3. *Individual Rock Burial*

Rocks in excess of four (4) feet, but no greater than eight (8) feet may be buried in the compacted fill mass on an individual basis. Rocks of this size may be buried separately within the compacted fill by excavating a trench and covering the rock with sand/gravel, and compacting the fines surrounding the rock. Distances from slope face, utilities, and building pad areas (i.e., hold-down depth) should be the same as windrows.

7.5.8.4. *Rock Disposal Logistics*

The grading contractor should consider the amount of available rock disposal volume afforded by the design when excavation techniques and grading logistics are formulated. Rock disposal techniques should be discussed and approved by the geotechnical consultant and developer prior to implementation

7.5.9. Haul Roads

Haul roads, ramp fills, and tailing areas should be removed prior to placement of fill.

7.5.10. Import Materials

Import materials, if required, should have similar engineering characteristics as the onsite soils and should be approved by the soil engineer at the source prior to importation to the site.

7.5.11. Utility Trench Excavation and Backfill

All utility trenches should be shored or laid back in accordance with applicable OSHA standards. Excavations in bedrock areas should be made in consideration of underlying geologic structure. The project geotechnical consultant should be consulted on these issues during construction.

Mainline and lateral utility trench backfill should be compacted to at least 90 percent of maximum dry density as determined by ASTM D1557. Onsite soils will not be suitable for use as bedding material but will be suitable for use in backfill, provided oversized materials are removed. No surcharge loads should be imposed above excavations. This includes spoil piles, lumber, concrete trucks, or other construction materials and equipment. Drainage above excavations should be directed away from the banks. Care should be taken to avoid saturation of the soils.

Compaction should be accomplished by mechanical means. Jetting of native soils will not be acceptable. Under-slab trenches should also be compacted to project specifications. If native soils are used, mechanical compaction is recommended. If select granular backfill (SE> 30) is used, compaction by flooding will be acceptable. The soil engineer should be notified for inspection prior to placement of the membrane and slab reinforcement.

8.0 DESIGN RECOMMENDATIONS

From a geotechnical perspective, the proposed development is feasible provided the following recommendations are incorporated into the design and construction. Preliminary design recommendations presented herein are based on the general soils conditions encountered during the referenced geotechnical investigations. As such, recommendations provided herein are considered preliminary and subject to change based on the results of additional observation and testing that will occur during grading operations. Final design recommendations should be provided in a final rough/precise grading report.

8.1. Structural Design Recommendations

Precise building products, loading conditions, and locations are not currently available. It is expected that for typical one- to three-story residential products and loading conditions (1 to 3 ksf for spread and continuous footings), conventional shallow slab-on-grade foundations will be utilized in areas with low expansive and shallow fill areas (<50 feet).

Upon the completion of rough grading, finish grade samples should be collected and tested to develop specific recommendations as they relate to final foundation design recommendations for individual lots. These test results and corresponding design recommendations should be presented in a Final Rough Grading Report.

It is anticipated that the as-graded near-surface soils could vary from "very low" to "medium" in expansion potential with the majority of the lots consisting of "very low" to "low" when tested in accordance with ASTM D4829 procedures.

8.2. Preliminary Foundation Design Recommendations

It is anticipated that wood-frame residential structures with shallow foundations will be constructed for this project. Detailed structural plans, loading conditions and structural sittings are not currently available; however, it can be expected that residential structures can be supported on conventional shallow foundations with slab-on-grade or post-tensioned slab/foundation systems. The design of foundation systems should be based on as-graded conditions as determined after grading completion. The following values may be used in preliminary foundation design:

Allowable Bearing:	2,000 lbs./sq.ft. (assuming a minimum embedment depth of 12 inches and a minimum width of 12 inches).
Lateral Bearing:	350 lbs./sq.ft. per foot of depth to a maximum of 2,000 lbs./sq.ft. (based on level conditions at the toe)
	150 lbs./sq.ft. per foot of depth to a maximum of 1,500 lbs./sq.ft. (based on descending 2:1 slope at the toe)
Sliding Coefficient:	0.35

The above values may be increased as allowed by Code to resist transient loads such as wind or seismic. Building code and structural design considerations may govern. Depth and reinforcement requirements should be provided by the structural engineer.

8.2.1. Conventional Foundation Design Recommendations

Based upon the observed soil conditions, the expansion potential categories for the building pads are anticipated to range from “Very Low” to “Low”. Conventional foundation systems should be designed in accordance with 2016 CBC guidelines and recommendations provided in the following table.

TABLE 8.2.1
CONVENTIONAL SLAB-ON-GRADE FOUNDATION DESIGN RECOMMENDATIONS

Expansion Potential	Very Low to Low (Cat. I)	Medium (Cat. II)
Footing Depth Below Lowest Adjacent Finish Grade		
One-Story	12 inches	18 inches
Two-Story	18 inches	18 inches
Footing Width		
One-Story	12 inches	12 inches
Two-Story	15 inches	15 inches
Footing Reinforcement		
One-Story	No. 4 rebar, one (1) on top and one (1) on bottom	No. 4 rebar, two (2) on top and two (2) on bottom or No. 5 rebar one (1) on top and one (1) on bottom
Two-Story	No. 4 rebar, one (1) on top and one (1) on bottom	No. 4 rebar, two (2) on top and two (2) on bottom or No. 5 rebar one (1) on top and one (1) on bottom
Slab Thickness	4 inches (actual)	4 inches (actual)
Slab Reinforcement	No. 3 rebar spaced 18 inches on center, each way	No. 3 rebar spaced 15 inches on center, each way
Slab Subgrade Moisture	Minimum of optimum moisture prior to placing concrete.	Minimum of 120% of optimum moisture 24 hours prior to placing concrete.
<u>Footing Embedment Next to Swales and Slopes</u> If exterior footings adjacent to drainage swales are to exist within five (5) feet horizontally of the swale, the footing should be embedded sufficiently to assure embedment below the swale bottom is maintained. Footings adjacent to slopes should be embedded such that a least seven (7) feet are provided horizontally from edge of the footing to the face of the slope.		
<u>Garages</u> A grade beam reinforced continuously with the garage footings shall be constructed across the garage entrance, tying together the ends of the perimeter footings and between individual spread footings. This grade beam should be embedded at the same depth as the adjacent perimeter footings. A thickened slab, separated by a cold joint from the garage beam, should be provided at the garage entrance. Minimum dimensions of the thickened edge shall be six (6) inches deep. Footing depth, width and reinforcement should be the same as the structure. Slab thickness, reinforcement and underslab treatment should be the same as the structure.		
<u>Isolated Spread Footings</u> Isolated spread footings should be embedded a minimum of 18 inches below lowest adjacent finish grade and should at least 24 inches wide. A grade beam should also be constructed for interior and exterior spread footings and should be tied into the structure in two orthogonal directions, footing dimensions and reinforcement should be similar to the aforementioned continuous footing recommendations. Final depth, width and reinforcement should be determined by the structural engineer		

8.2.2. Post Tensioned Slab/Foundation Design

Post-tensioned foundations may be designed using the values provided in the following table. For preliminary estimating purposes, post-tensioned foundations may be designed assuming “Low” expansion potential. However, final post-tensioned foundations design recommendations should be based on as-graded conditions.

TABLE 8.2.2
POST-TENSIONED FOUNDATION DESIGN PARAMETERS

Soil Category	Expansion Index	Lot Nos.	Edge Beam Embedment (inches)	Edge Lift [1]		Center Lift [1]	
				Em (ft.)	Ym (in.)	Em (ft.)	Ym (in.)
I	Low	TBD [2]	12	5.4	0.54	9.0	0.23
II	Medium	TBD [2]	18	4.6	0.90	9.0	0.38

Moisture Barrier	An approved moisture and vapor barrier should be placed below all slabs-on-grade within living and moisture sensitive areas as discussed in Section 8.2.8.	
Slab Subgrade Moisture	Soil Category I	Minimum of 110 percent of optimum moisture to a depth of 12 inches prior to placing concrete.
	Soil Category II	Minimum of 130 percent of optimum moisture to a depth of 12 inches prior to placing concrete.
Foundation Embedment	Depth of embedment should be measured below lowest adjacent finish grade. **Foundations Adjacent to Swales and Slopes:** If exterior footings adjacent to drainage swales are to exist within 5 feet horizontally of the swale, the footing should be embedded sufficiently to assure embedment below the swale bottom is maintained. Footings adjacent to slopes should be embedded such that at least 5 feet is provided horizontally from edge of the footing to the face of the slope.	

Notes: [1] The values of predicted lift are based on the procedures outlined in the *Design of Post-Tensioned Slabs-on-Ground*, Third Edition and related addendums. No corrections for vertical barriers at the edge of the slab or other corrections (e.g. horizontal barriers, tree roots, adjacent planters) are assumed. The values assume Post-Equilibrium conditions exist (as defined by the Post Tensioning Institute), and these conditions created during construction should be maintained throughout the life of the structure. Please refer to the appended Homeowner Maintenance Guidelines for a summary of recommended practices to maintain the conditions created during construction.

[2] Final design parameters should be provided in a final grading report and should be based on as-graded soil conditions.

Design and construction of post-tensioned foundations should be undertaken by firms experienced in this field. It is the responsibility of the foundation design engineer to select the design methodology and properly design the foundation system for site-specific soils conditions. The slab designer should provide deflection potential to the project architect/structural engineer for incorporation into the design of the structure.

8.2.3. Total and Differential Settlement

In addition to the potential effects of expansive soils, the proposed residential structures in shallow fills (fill depth less than 50 feet) should be designed for a total settlement of 3/4-inch and differential settlement 3/8 inch in twenty (20) feet. Residential structures on deep fills (fill depth greater than 50 feet) should be designed for a total settlement of 1-inch and differential settlement ½ inch in twenty (20) feet.

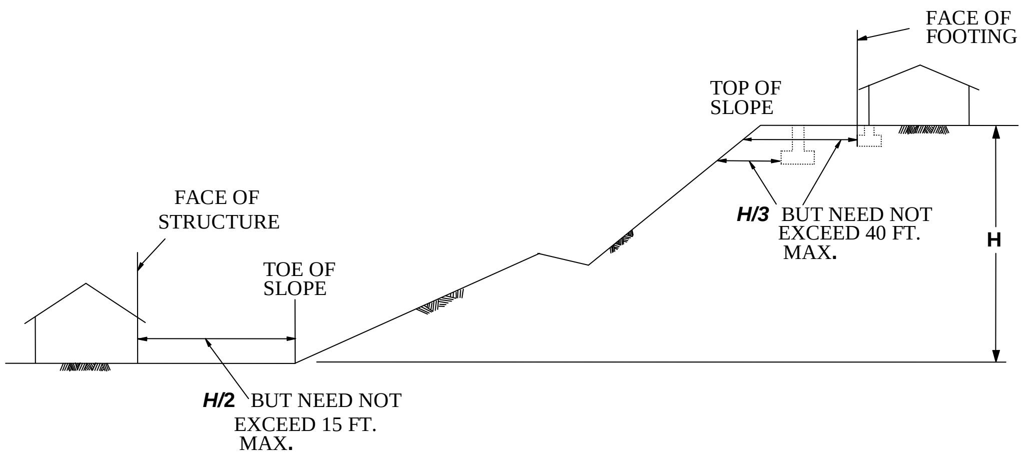
8.2.4. Isolated Footings

Isolated footings outside the structure footprint should be tied with grade beams to the structure in two orthogonal directions.

8.2.5. Deepened Footings and Setbacks

It is generally recognized that improvements constructed in proximity to natural slopes or properly-constructed slopes can, over a period of time, be affected by natural processes including gravity forces, weathering of surficial soils, and long-term (secondary) settlement. In accordance with 2016 CBC guidelines, where foundations for residential structures are to exist in proximity to slopes, the footings should be embedded to satisfy the requirements presented in following figure.

FIGURE 4 – SLOPE SETBACK DIMENSIONS (2016 CBC)



8.2.6. Footing Excavations

Footing excavations should be observed by the geotechnical consultant. Spoils from the footing excavations should not be placed on slab-on-grade areas unless the soils are properly compacted. The footing excavations should not be allowed to dry back and should be kept moist until concrete is poured. The excavations should be free of all loose and sloughed materials, be neatly trimmed, and moisture conditioned at the time of concrete placement.

8.2.7. Garage Entrances

A grade beam reinforced continuously with the garage footings should be constructed across the garage entrance, tying together the ends of the perimeter footings and between individual spread footings. This grade beam should be embedded at the same depth as the adjacent perimeter footings. A thickened slab, separated by a cold joint from the garage beam, should be provided at the garage entrance. The thickened edge should be a minimum of 6 inches deep.

8.2.8. Moisture and Vapor Barrier

A moisture and vapor retarding system should be placed below the slab-on-grade in portions of the structure considered to be moisture sensitive. The retarder should be of suitable composition, thickness, strength and low permeance to effectively prevent the migration of water and reduce the transmission of water vapor to acceptable levels.

Historically, a 10-mil plastic membrane, such as *Visqueen*, placed between one to four inches of clean sand, has been used for this purpose. More recently 15-mil Stego® Wrap or similar underlayments have been used to lower permeance to effectively prevent the migration of water and reduce the transmission of water vapor to acceptable levels. The use of this system or other systems, materials or techniques can be considered, at the discretion of the designer, provided the system reduces the vapor transmission rates to acceptable levels.

8.3. Retaining Wall Design

Retaining wall foundations should be supported on compacted fill and may be designed in accordance with the recommendations provided in Section 8.2. When calculating lateral resistance, the upper 12 inches of soil cover should be ignored in areas that are not covered with hardscape. Retaining wall footings should be designed to resist the lateral forces by passive soil resistance and/or base friction as recommended for foundation lateral resistance.

Retaining walls should be designed to resist earth pressures presented in the following table. These values assume that the retaining walls will be backfilled non-expansive free draining materials (Sand Equivalent of 20 or better and an Expansion Index of 20 or less). Most of the materials onsite are considered free-draining and will be suitable for placement behind these walls. If non-free draining materials are utilized, revised values will need to be provided to design the retaining walls. Retaining walls should be designed to resist additional loads such as construction loads, temporary loads, and other surcharges as evaluated by the structural engineer.

TABLE 8.1.3
RETAINING WALL EARTH PRESSURES

“Native” Backfill Materials (γ=125 pcf, EI<20)				
	Level Backfill		2:1 Backfill	
	Rankine Coefficients	Equivalent Fluid Pressure (psf / lineal foot)	Rankine Coefficients	Equivalent Fluid Pressure (psf / lineal foot)
Active Pressure	$K_a = 0.32$	40	$K_a = 0.50$	63
Passive Pressure	$K_p = 3.12$	390	$K_p = 1.18$	148
At Rest Pressure	$K_o = 0.48$	60	$K_o = 0.88$	110

In addition to the above static pressures, retaining walls supporting more than 6 feet of backfill height should be designed to resist seismic loading as required by the 2016 CBC. The seismic load can be modeled as a thrust load applied at a point 0.6H above the base of the wall, where H is equal to the height of the wall. This seismic load (in pounds per lineal foot of wall) is represented by the following equation:

$$Pe = \tfrac{3}{8} * \gamma * H^2 * k_h$$

Where:

Where:	Pe	=	Seismic thrust load
	H	=	Height of the wall (feet)
	γ	=	soil density = 130 pounds per cubic foot (pcf)
	k_h	=	seismic pseudostatic coefficient = 0.5 * PGA_M

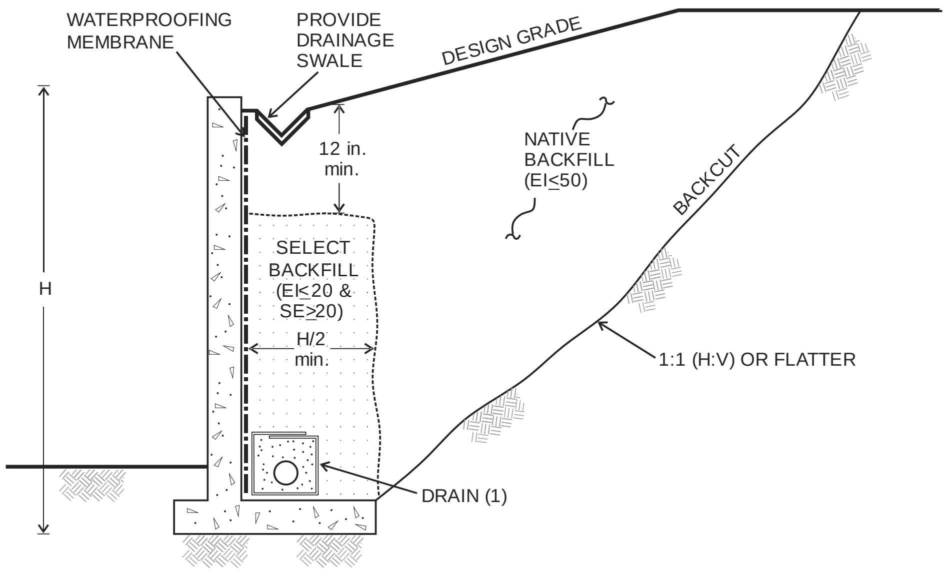
The site-specific peak horizontal ground acceleration (PGA_M) is provided in Section 5.7.5. Walls should be designed to resist the combined effects of static pressures and the above seismic thrust load.

The foundations for retaining walls of appurtenant structures structurally separated from the building structure may bear on properly compacted fill. Retaining wall footings should be designed to resist the lateral forces by passive soil resistance and/or base friction as recommended for foundation lateral resistance. To relieve the potential for hydrostatic pressure wall backfill should consist of a free draining backfill (sand equivalent "SE" >20) and a heel drain should be constructed. The heel drain should be placed at the heel of the wall and should consist of a 4-inch diameter perforated pipe (SDR35 or SCHD 40) surrounded by 4 cubic feet of crushed rock (3/4-inch) per lineal foot, wrapped in filter fabric (Mirafi® 140N or equivalent) as shown in Figure 5.

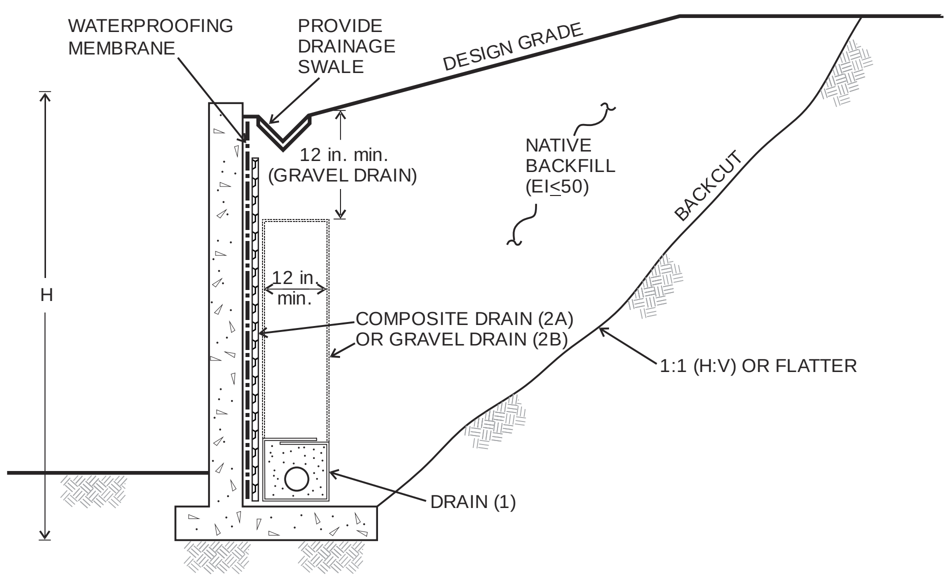
Proper drainage devices should be installed along the top of the wall backfill, which should be properly sloped to prevent surface water ponding adjacent to the wall. In addition to the wall drainage system, for building perimeter walls extending below the finished grade, the wall should be waterproofed and/or damp-proofed to effectively seal the wall from moisture infiltration through the wall section to the interior wall face.

The wall should be backfilled with granular soils placed in loose lifts no greater than 8-inches thick, at or near optimum moisture content, and mechanically compacted to a minimum 90 percent relative compaction as determined by ASTM Test Method D1557. Flooding or jetting of backfill materials generally do not result in the required degree and uniformity of compaction and, therefore, is not recommended. The soils engineer or his representative should observe the retaining wall footings, backdrain installation and be present during placement of the wall backfill to confirm that the walls are properly backfilled and compacted.

FIGURE 5 - RETAINING WALL BACKFILL AND DRAINAGE DETAILS



Detail RTW-A



Detail RTW-B

NOTES: (1) DRAIN: 4-INCH PERFORATED ABS OR PVC PIPE OR APPROVED EQUIVALENT SUBSTITUTE PLACED PERFORATIONS DOWN AND SURROUNDED BY A MINIMUM OF 1 CUBIC FEET OF 3/4 INCH ROCK OR APPROVED EQUIVALENT SUBSTITUTE AND WRAPPED IN MIRAFI 140 FILTER FABRIC OR APPROVED EQUIVALENT SUBSTITUTE

(2A) COMPOSITE DRAIN SYSTEM: MIRAFI G200N, DELTA DRAIN 2000/6000/6200 OR APPROVED EQUIVALENT SUBSTITUTE CONNECTED TO DRAIN (1)

(2B) GRAVEL DRAIN: MINIMUM 12-INCH WIDE 3/4-INCH GRAVEL BLANKET WRAPPED IN MIRAFI FILTER FABRIC (140 OR APPROVED EQUIVALENT SUBSTITUTE)

8.4. Civil Design Recommendations

8.4.1. Site Drainage

Final site grading should assure positive drainage away from structures. Planter areas should be provided with area drains to transmit irrigation and rain water away from structures. The use of gutters and down spouts to carry roof drainage well away from structures is recommended. Raised planters should be provided with a positive means to remove water through the face of the containment wall.

8.4.2. Rear and Side Yard Walls and Fences

Block wall footings should be founded a minimum of 24-inches below the lowest adjacent grade. To reduce the potential for uncontrolled, unsightly cracks, it is recommended that a construction joint be incorporated at regular intervals. Spacing of the joints should be between 10 and 20 feet.

8.4.3. Concrete Flatwork and Lot Improvements

- In an effort to minimize shrinkage cracking, concrete flatwork should be constructed of uniformly cured, low-slump concrete and should contain sufficient control/contraction joints (typically spaced at 8 to 10 feet, maximum).
- Additional provisions need to be incorporated into the design and construction of all improvements exterior to the proposed structures (pools, spas, walls, patios, walkways, planters, etc.) to account for the hillside nature of the project, as well as being designed to account for potential expansive soil conditions. Design considerations on any given lot may need to include provisions for differential bearing materials (bedrock vs. compacted fill), ascending/descending slope conditions, bedrock structure, perched (irrigation) water, special surcharge loading conditions, potential expansive soil pressure, and differential settlement/heave.
- All exterior improvements should be designed and constructed by qualified professionals using appropriate design methodologies that account for the onsite soils and geologic conditions. The aforementioned considerations should be used when designing, constructing, and evaluating long-term performance of the exterior improvements on the lots.
- The homeowners should be advised of their maintenance responsibilities as well as geotechnical issues that could affect design and construction of future homeowner improvements. The information presented in Appendix F should be considered for inclusion in homeowner packages in order to inform the homeowner of issues relative to drainage, expansive soils, landscaping, irrigation, sulfate exposure, and slope maintenance.

8.4.4. Preliminary Pavement Design

Preliminary pavement recommendations for streets and driveways are provided below. The performance of pavement is highly dependent on providing positive surface drainage away from the edge of pavement. Ponding of water on or adjacent to the pavement will likely result in pavement distress and subgrade failure. Drainage from landscaped areas should be directed towards controlled drainage structures and not towards pavement areas. Landscaped areas adjacent to pavement areas are not recommended due the potential for surface or irrigation water infiltrating into the aggregate base and pavement subgrade. If landscaped areas are placed adjacent to pavement areas, consideration should be given to implementing measures that will reduce the potential for water to be introduced into the aggregate base. Such measures may include installing impermeable vertical barriers between the landscaped area and pavement areas including deepened curbs or 10 mil thick plastic liners. Such barriers should extend a minimum of 6 inches below the bottom of the aggregate base.

8.4.4.1. *Asphalt Concrete Pavement*

Presented below are preliminary pavement sections for a range of traffic indices and an assumed R-Value of 30 for the subgrade soils. Testing of the subgrade soils should be performed during precise grading operations to verify the actual R-Value. The project Civil Engineer or Traffic Engineer should select traffic indices that are appropriate for the anticipated pavement usage and level of maintenance desired through the pavement life. Final pavement structural sections will be dependent on the R-value of the subgrade materials and the traffic index for the specific street or area being addressed. The pavement sections are subject to the review and approval of the County of Riverside.

TABLE 8.4.4.1
PRELIMINARY ASPHALT PAVEMENT SECTIONS

Traffic Index (T.I.)	Design R-Value	Asphaltic Concrete (in.)	Class 2 Aggregate Base (in.)
5.0	30	3.0	4.0
6.0	30	3.0	9.0

Pavement subgrade soils should be at or near optimum moisture content and should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D1557. Aggregate base should be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D1557 and should conform with the specifications listed in Section 26 of the *Standard Specifications for the State of California Department of Transportation* (Caltrans) or Section 200-2 of the *Standard Specifications for Public Works Construction* (Green Book). The asphalt concrete should conform to Section 26 of the Caltrans *Standard Specifications* or Section 203-6 of the Green Book.

8.4.4.2. *Portland Cement Concrete Pavement*

We suggest that consideration be given to using Portland cement concrete (PCC) pavements in areas where dumpsters will be stored and where buses and garbage trucks will stop and load. We recommend for these areas a 6-inch thick PCC pavement section placed over 6 inches of aggregate base compacted to 95 percent relative compaction.

Concrete with minimum 28-day Modulus of Rupture (M-R) of 550 psi and compressive strength of 3,000 psi is recommended. Transverse contraction joints should not be spaced more than 15 feet and should be cut to a depth of ¼ the thickness of the slab. Longitudinal joints should not be spaced more than 15 feet apart, however, are not necessary in the pavement adjacent to the curb and gutter section.

8.5. Soil Corrosivity

Laboratory testing was performed on a representative sample of on-site soils to evaluate pH and electrical resistivity, as well as chloride and sulfate contents. The pH value of the tested sample was 7.2. The electrical resistivity value was 980 ohm-centimeters. Chloride content was 507 parts per million (ppm). Sulfate content was 1,074 ppm (i.e. 0.107%). Previous testing by Leighton (2005) indicated pH values of 7.35 and 7.96, chloride contents of 127 and 264 ppm, sulfate contents of 0.03% and 0.015%, and electrical resistivity values of 2,698 and 2,563 ohm-centimeters. Additional details and laboratory test results are presented in Appendix C. Based on Caltrans (2018) corrosion criteria, the site is not considered corrosive which corresponds to the following conditions: chloride concentration above 500 ppm, sulfate concentration above 2,000 ppm, or the pH is 5.5 or less.

8.5.1. Concrete

Concrete in contact with soil or water that contains high concentrations of soluble sulfates can be subject to chemical deterioration. Laboratory testing by AGS indicated a sulfate content of 1,074 ppm (i.e. 0.107%). According to American Concrete Institute (ACI) 318-11, the potential for sulfate attack is Class S1 – Moderate for water-soluble sulfate content in soil between 0.10 percent and 0.20 percent by weight (i.e., 1,000 ppm to 2,000 ppm). Therefore, the site earth materials may be considered to have moderate potential for sulfate attack. According to ACI 318 guidelines, we recommend using Type V cement for concrete structures in contact with soil and water-cement ratio of no more than 0.50.

8.5.2. Metals in Contact with Soil

A factor for evaluating corrosivity to buried metal is electrical resistivity. The electrical resistivity of a soil is a measure of resistance to electrical current. Corrosion of buried metal is directly proportional to the flow of electrical current from the metal into the soil. As resistivity of the soil decreases, the corrosivity generally increases. The sample tested resulted in electrical resistivity value of 980 ohm-centimeters.

Correlations between resistivity and corrosion potential (NACE, 1984) indicate that the soils have corrosive potential to buried metals. As such, corrosion protection for metal in contact with site soils should be considered. Corrosion protection may include the use of epoxy or asphalt coatings. We recommend that a corrosion engineer be consulted regarding corrosion protection recommendations for the project.

9.0 SLOPE AND LOT MAINTENANCE

Maintenance of improvements is essential to the long-term performance of structures and slopes. Although the design and construction during mass grading created slopes that are considered both grossly and surficially stable, certain factors are beyond the control of the soil engineer and geologist. The homeowners must implement certain maintenance procedures.

In addition to the appended Homeowners Maintenance Guidelines, the following recommendations should be implemented.

9.1. Slope Planting

Slope planting should consist of ground cover, shrubs and trees that possess deep, dense root structures and require a minimum of irrigation. The resident should be advised of their responsibility to maintain such planting.

9.2. Lot Drainage

Roof, pad and lot drainage should be collected and directed away from structures and slopes and toward approved disposal areas. Design fine-grade elevations should be maintained through the life of the structure, or if design fine grade elevations are altered, adequate area drains should be installed in order to provide rapid discharge of water away from structures and slopes. Residents should be made aware that they are responsible for maintenance and cleaning of all drainage terraces, down drains, and other devices that have been installed to promote structure and slope stability.

9.3. Slope Irrigation

The resident, homeowner and Homeowner Association should be advised of their responsibility to maintain irrigation systems. Leaks should be repaired immediately. Sprinklers should be adjusted to provide maximum uniform coverage with a minimum of water usage and overlap. Overwatering with consequent wasteful run-off and ground saturation should be avoided. If automatic sprinkler systems are installed, their use must be adjusted to account for natural rainfall conditions.

9.4. Burrowing Animals

Residents or homeowners should undertake a program for the elimination of burrowing animals. This should be an ongoing program in order to maintain slope stability.

10.0 FUTURE STUDY NEEDS

10.1. In-Grading Observation

Geologic exposures afforded during remedial and rough grading operations provide the best opportunity to evaluate the anticipated site geologic structure. Continuous geologic and geotechnical observations, testing, and mapping should be provided throughout site development. Additional near-surface samples should be collected by the geotechnical consultant during grading and subjected to laboratory testing. Final design recommendations should be provided in a grading report based on the observation and test results collected during grading.

11.0 CLOSURE

11.1. Geotechnical Review

As is the case in any grading project, multiple working hypotheses are established utilizing the available data, and the most probable model is used for the analysis. Information collected during the grading and construction operations is intended to evaluate the hypotheses, and some of the assumptions summarized herein may need to be changed as more information becomes available. Some modification of the grading and construction recommendations may become necessary, should the conditions encountered in the field differ significantly than those hypothesized to exist.

AGS should review the pertinent plans and sections of the project specifications, to evaluate conformance with the intent of the recommendations contained in this report.

If the project description or final design varies from that described in this report, AGS must be consulted regarding the applicability of, and the necessity for, any revisions to the recommendations presented herein. AGS accepts no liability for any use of its recommendations if the project description or final design varies and AGS is not consulted regarding the changes.

11.2. Limitations

This report is based on the project as described and the information obtained from referenced reports and the exploratory excavations at the locations indicated on the plans. The findings are based on the review of the field and laboratory data combined with an interpolation and extrapolation of conditions between and beyond the exploratory excavations. The results reflect an interpretation of the direct evidence obtained. Services performed by AGS have been conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. No other representation, either expressed or implied, and no warranty or guarantee is included or intended.

The recommendations presented in this report are based on the assumption that an appropriate level of field review will be provided by geotechnical engineers and engineering geologists who are familiar with the design and site geologic conditions. That field review shall be sufficient to confirm that geotechnical and geologic conditions exposed during grading are consistent with the geologic representations and corresponding recommendations presented in this report. AGS should be notified of any pertinent changes in the project plans or if subsurface conditions are found to vary from those described herein. Such changes or variations may require a re-evaluation of the recommendations contained in this report.

The data, opinions, and recommendations of this report are applicable to the specific design of this project as discussed in this report. They have no applicability to any other project or to any other location, and any and all subsequent users accept any and all liability resulting from any use or reuse of the data, opinions, and recommendations without the prior written consent of AGS.

AGS has no responsibility for construction means, methods, techniques, sequences, or procedures, or for safety precautions or programs in connection with the construction, for the acts or omissions of the CONTRACTOR, or any other person performing any of the construction, or for the failure of any of them to carry out the construction in accordance with the final design drawings and specifications.

APPENDIX A

REFERENCES

REFERENCES

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APPENDIX B1

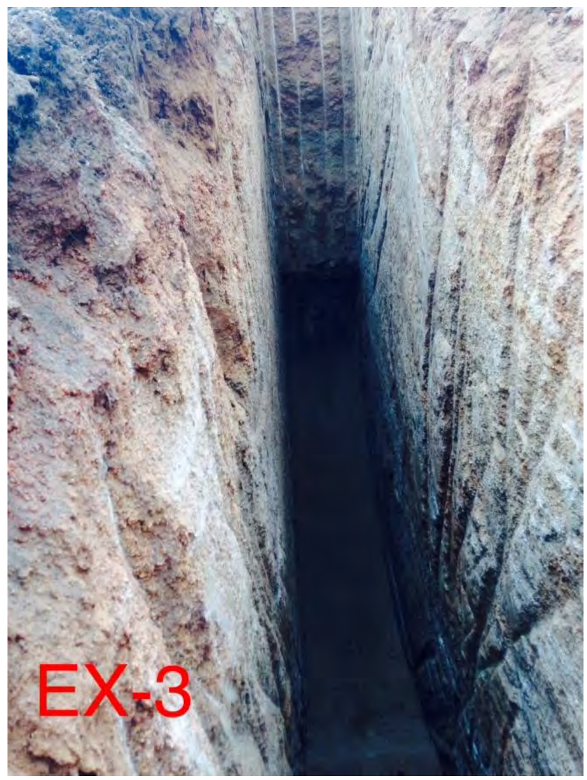
SUBSURFACE LOGS (AGS)

Project Victoria Heights
Date Excavated 8/27/2015
Logged by FE
Equipment Kobelco 82,000 lb. Excavator with 30 inch bucket and Tiger teeth

LOG OF TEST PITS

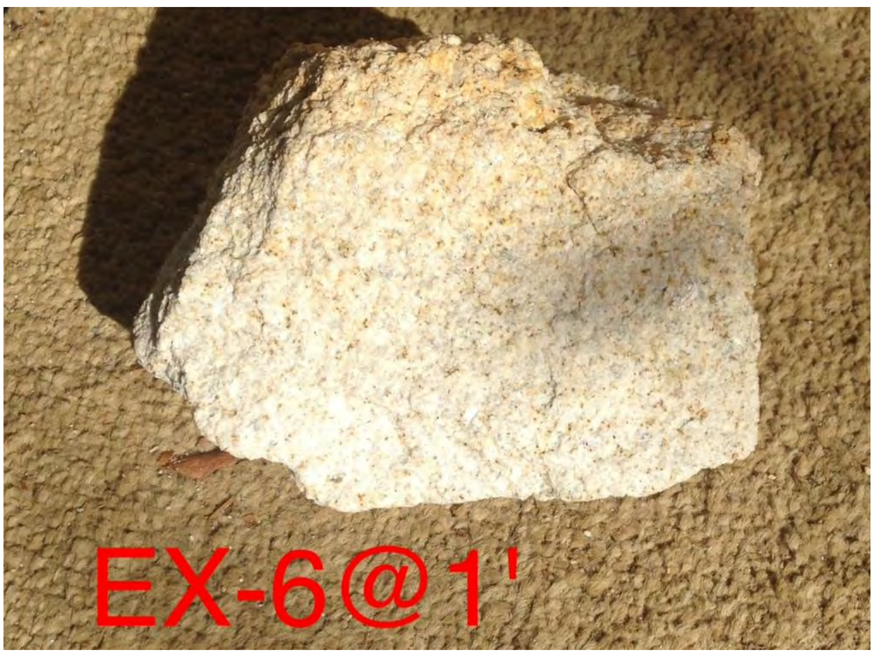
Test Pit No.	Depth (ft.)	USCS	Description
EX-2	0.0 – 1.0	SC	**Topsoil:** CLAYEY SAND; reddish brown, dry, loose, fine to medium grained.
	1.0 – 21.0		**Granodiorite/Gabbro - undifferentiated (Kcgb):** Reddish yellow, slightly moist, soft, fine to medium grained, highly weathered, abundant secondary clays. @ 7 ft. light olive to light yellowish brown, large crystal size (Biotite hornblende Granodiorite), moderately soft, breaks into sand with some silt and clay. @ 8 ft. N-S, 60 E – Joint @ 15 ft. light gray @ 18 ft. moderately hard, some fine flat-lying fractures with iron oxide. @ 19 ft. hard @ 20.5 ft. still rippable
			TOTAL DEPTH 21 FT./MAXIMUM REACH NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
EX-3	0.0 – 0.5	SC	**Topsoil:** CLAYEY SAND; reddish brown, dry, loose, fine to medium grained.
	0.5 – 21.0		**Granodiorite/Gabbro - undifferentiated (Kcgb):** Red, dry, soft, fine to medium grained, highly weathered, abundant secondary clays. Breaks into sand with some silt and clay. @ 3.5 ft. reddish yellow and olive, some fine flat-lying fractures with iron oxide. @ 15 ft. light gray. @ 19 ft. hard. @ 18 ft. olive, moderately hard. @ 21 ft. still rippable TOTAL DEPTH 21 FT./MAXIMUM REACH NO WATER, NO CAVING



Test Pit No.	Depth (ft.)	USCS	Description
EX-4	0.0 – 1.0	SC	**Topsoil:** CLAYEY SAND; reddish brown, dry, loose, fine to medium grained.
	1.0 – 16.5		**Granodiorite/Gabbro - undifferentiated (Kcgb):** Yellowish red, dry, soft, fine to medium grained, highly weathered, abundant secondary clays. @ 3 ft. light olive with horizontal iron oxide staining along fine fractures, moderately soft, breaks into sand with some silt and clay. @ 15 ft. light olive, hard
			TOTAL DEPTH 16.5 FT./PRACTICAL REFUSAL NO WATER, NO CAVING
EX-5	0.0 – 0.5	SM	**Topsoil:** SILTY SAND, grayish brown, dry, loose, fine to medium grained.
	0.5 – 4.0		**Granodiorite/Gabbro - undifferentiated (Kcgb):** Yellowish brown and reddish brown, dry, moderately hard, fine to medium grained, moderately weathered. @ 2.5 ft. light gray to gray, fine grained, hard. @ 3.0 ft. very hard @ 3.0 ft. N 45 E, 85 SE – Joint @ 3.0 ft. N 35 E, 70 NE – Joint
			TOTAL DEPTH 4 FT./REFUSAL NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
EX-6	0.0 – 1.0	SC	**Topsoil:** CLAYEY SAND; reddish brown, slightly moist, loose, fine to medium grained.
	1.0 – 2.5		**Granodiorite/Gabbro - undifferentiated (Kcgb):** Quartz Latite; yellowish brown, slightly moist, moderately hard, moderately weathered, fine grained, soft. @1.5 ft. white, dry, very hard, slightly weathered.
			TOTAL DEPTH 2.5 FT./REFUSAL NO WATER, NO CAVING




EX-6

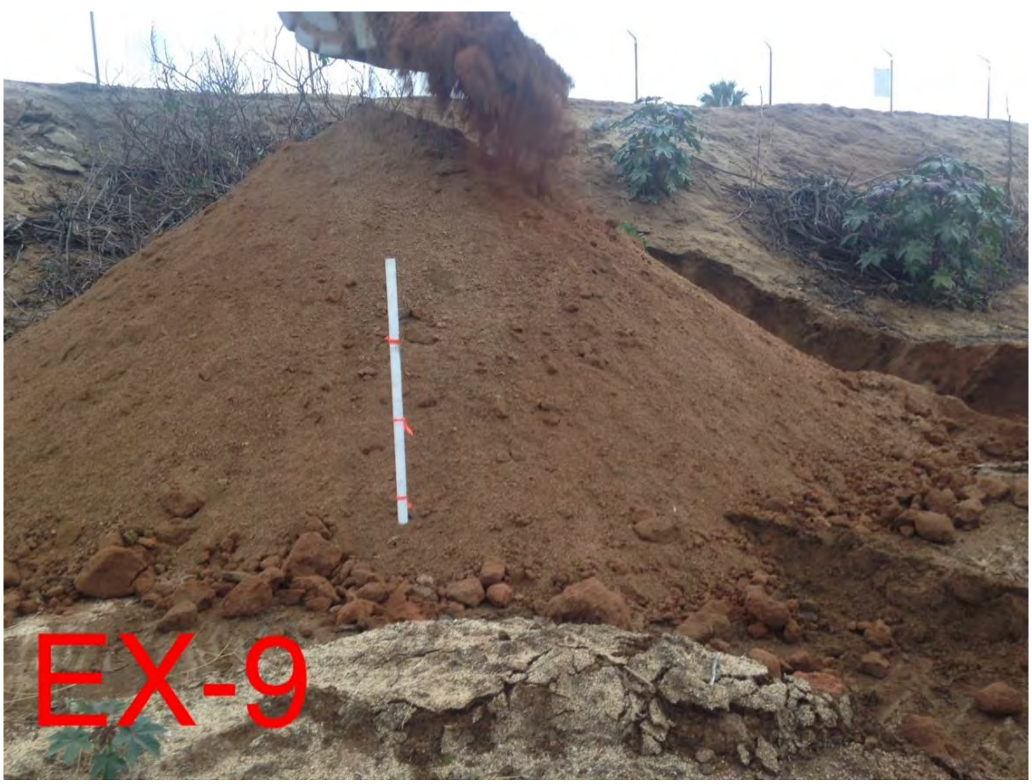

EX-6

Test Pit No.	Depth (ft.)	USCS	Description
EX-7	0.0 – 7.0	SC	**Artificial Fill - undocumented:** CLAYEY SAND; yellowish brown and grayish brown, moist, loose, fine to medium grained. @ 6 ft. 4-inch clay pipe.
	7.0 – 8.0		**Granodiorite/Gabbro - undifferentiated (Kcgb):** Light olive, slightly moist, moderately hard, coarse grained/large crystal size.
			TOTAL DEPTH 8 FT. / REFUSAL NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
EX-8	0.0 – 18.5		**<u>Granodiorite/Gabbro - undifferentiated (Kcgb):</u>** Brownish red, dry, soft, fine to medium grained, highly weathered, abundant secondary clays. @ 2 ft. yellowish brown, moderately soft, breaks into sand with some silt and clay. @ 6 ft. moderately hard, slow digging. @ 16 ft. light gray, hard, still rippable. TOTAL DEPTH 18.5 FT./PRACTICAL REFUSAL NO WATER, NO CAVING

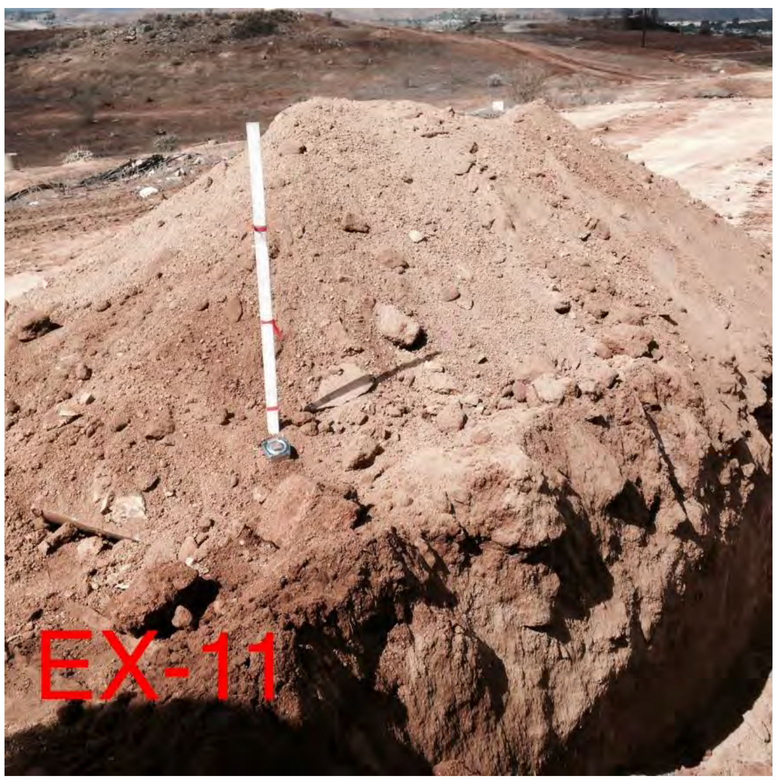
Date Excavated 8/28/2015

Test Pit No.	Depth (ft.)	USCS	Description
EX-9	0.0 – 2.0	SM	**Artificial Fill - undocumented:** SILTY SAND; brown, moist, loose, fine to coarse grained.
	2.0 – 20.0		**Granodiorite/Gabbro undifferentiated (Kcgb):** Red, dry, soft, fine to medium grained, highly weathered to clayey sand, abundant secondary clays. @ 4 ft. brownish gray, moderately soft, breaks into clayey sand. @ 6 ft. breaks into fine to coarse grained sand, some silt and clay. @ 7 ft. Some ½ inch thick pegmatite dikes. @ 11 ft. gray, large crystal size/coarse grained. @ 15 ft. moderately hard. @ 16 ft. light gray, breaks into fine to coarse grained sand, (SE 30+) @ 20 ft. still rippable.
			TOTAL DEPTH 20 FT. NO WATER, NO CAVING



Test Pit No.	Depth (ft.)	USCS	Description
EX-10	0.0 – 2.0	SM	**Artificial Fill - undocumented:** SILTY SAND; reddish brown and brown, slightly moist, loose, fine to coarse grained.
	2.0 – 20.5		**Granodiorite/Gabbro undifferentiated (Kcgb):** Yellowish brown and gray, dry, moderately hard, coarse grained, moderately weathered, breaks into fine to coarse grained sand with some silt and clay. Steeply dipping clay-lined joints, approximately 8-inch spacing. @ 7 ft. N32E, 82SE - Joint @ 7 ft. N33W, 85N - Joint @ 10 ft. moderately hard. @ 16 ft. gray with trace of iron oxide, moderately hard to hard. @ 19 ft. bluish gray, hard, very slow digging. @ 20.5 ft. still rippable. TOTAL DEPTH 20.5 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
EX-11	0.0 – 1.0	SM	**Topsoil:** SILTY SAND; reddish brown, dry, loose, fine to coarse grained, some angular granitic gravel.
	1.0 – 20.0		**Granodiorite/Gabbro undifferentiated (Kcgb):** Red, dry, soft, fine to medium grained, highly weathered, densely fractured, abundant secondary clays. @ 2.5 ft. gray to dark gray (Gabbro), hard, some flat-lying to shallowly dipping fine fractures with iron oxide. @ 5 ft. N20W, 55NE – parallel joints. @ 18 ft. very slow digging. @ 20 ft. still rippable. TOTAL DEPTH 20 FT. NO WATER, NO CAVING



Test Pit No.	Depth (ft.)	USCS	Description
EX-14	0.0 – 16.5		**Granodiorite/Gabbro - undifferentiated (Kcgb):** Brownish red, slightly moist, moderately soft, fine to coarse grained, highly to moderately weathered. @4 ft. light yellowish brown, moderately hard, breaks-up to fine to coarse grained sand. @ 5 ft. gray, hard, slow digging. @ 6 ft. N60E, Vertical - Joint @ 6 ft. N40W, 80NE - Joint @ 12 ft. gray, very slow digging. @ 16.5 ft. Practical Refusal. TOTAL DEPTH 16.5 FT NO WATER, NO CAVING


EX-14@15'

Test Pit No.	Depth (ft.)	USCS	Description
EX-15	0.0 – 3.5		**Granodiorite/Gabbro - undifferentiated (Kcgb):** Reddish brown, slightly moist, moderately soft, fine to medium grained, moderately weathered, densely fractured. @ 2.5 ft. gray to light gray (Gabbro), breaks into sand with angular clasts to 8-inch diameter. @ 2.5 ft. N30W, 60NE
			TOTAL DEPTH 3.5 FT./REFUSAL NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
EX-16	0.0 – 1.0	SM	**Artificial Fill - undocumented:** SILTY SAND; reddish brown, slightly moist, loose, fine to coarse grained.
	1.0 – 3.5		**Granodiorite/Gabbro undifferentiated (Kcgb):** Yellowish brown and gray, dry, moderately hard, very fine grained, moderately weathered, thinly foliated along mica minerals (Phyllite). @ 3 ft. gray, hard
			TOTAL DEPTH 3.5 FT./REFUSAL NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
EX-17	0.0 – 0.5	SC	**Topsoil:** CLAYEY SAND; reddish brown, dry, loose, fine grained.
	0.5 – 19.0		**Granodiorite/Gabbro undifferentiated (Kcgb):** Reddish brown, dry, soft, fine to medium grained, highly weathered, abundant secondary clays. @ 2.5 ft. yellowish brown, slightly moist, fine to coarse grained. @ 16 ft. olive with iron oxide staining, slow digging. @ 18 ft. very hard. TOTAL DEPTH 19 FT./PRACTICAL REFUSAL NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
EX-18	0.0 – 1.5	SC	**Older Alluvium (Qoa):** CLAYEY SAND, yellowish brown, dry, medium dense, fine to medium grained, highly weathered, some clay, some visible porosity. Sharp contact with underlying Kcgb.
	1.5 – 17.5		**Granodiorite/Gabbro - undifferentiated (Kcgb):** Gray with iron oxide along fine fractures, dry, moderately soft, fine grained, moderately weathered. @ 7.0 ft. moderately hard, moderately weathered. @ 11 ft. hard, some clay lined steeply dipping joints. @ 11 ft. N5E, 70SW – Joint
			TOTAL DEPTH 17.5 FT./ PRACTICAL REFUSAL NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
EX-19	0.0 –2.0	SC	**Artificial Fill-undocumented:** CLAYEY SAND, grayish brown and gray, dry, loose, fine to medium grained.
	2.0 – 16.0		**Granodiorite/Gabbro - undifferentiated (Kcgb):** Red, dry, soft, coarse grained, large Biotite crystals, highly weathered. @ 4.0 ft. light gray and yellowish brown, moderately hard, moderately weathered. @ 12.0 ft. hard, slow digging. @ 15.0 ft. Blueish gray, very hard, very slow digging. TOTAL DEPTH 16.0 FT./PRACTICAL REFUSAL NO WATER, NO CAVING

Project Victoria Heights
Date Excavated 8/27/2015
Logged by FE
Equipment JD 460

LOG OF TEST PITS

Test Pit No.	Depth (ft.)	USCS	Description
TP-19	0.0 –2.0	SC	**Older Alluvium (Qoa):** CLAYEY SAND, yellowish brown and gray, dry, loose, fine to medium grained, highly weathered, some clay, some visible porosity. @ 5.0 ft. grayish brown, slightly moist, medium dense, abundant white carbonates.
	2.0 – 3.5		**Granodiorite and Gabbro - undifferentiated (Kcgb):** Granodiorite, light gray, dry, moderately hard, medium grained, moderately weathered. @ 3.0 ft. hard, slightly weathered @ 3.5 ft. Refusal
			TOTAL DEPTH 3.5 FT. NO WATER, NO CAVING

Date Excavated 8/28/2015

LOG OF TEST PITS

Test Pit No.	Depth (ft.)	USCS	Description
TP-20	0.0 – 8.5	SC	**Older Alluvium (Qoa):** Clayey SAND; light yellowish brown, dry, loose, fine grained, weathered, visible porosity. @ 2.5 ft. reddish brown and light yellowish brown, slightly moist, medium dense, some trans-located clays, clay cemented, some visible porosity. @ 4 ft. dense, no visible porosity.
	8.5 – 9.0		**Granodiorite and Gabbro - undifferentiated (Kcgb):** Grayish brown, moderately weathered moderately hard, feldspar minerals are weathered to clay, dry, moderately hard, moderately weathered, clay cemented. @ 9.0 ft. Practical Refusal on Cemented Granitic Paleosol. TOTAL DEPTH 9.0 FT. NO WATER, NO CAVING
TP-21	0.0 – 2.5	SC	**Artificial Fill - undocumented (afu):** CLAYEY SAND; light yellowish brown, dry, loose, fine to medium grained, layered, some roots to 1/2-inch diameter.
	2.5 – 9.0	SC	**Older Alluvium – (Qoa):** CLAYEY SAND; reddish brown dry, dense, clay cemented, some pin-hole porosity, slow digging. @ 6.0 ft. slightly moist, very dense, no visible porosity. @ 7.0 ft. abundant Irion oxide along fine fractures. @ 8.5 ft. grayish brown and reddish yellow. TOTAL DEPTH 9.0 FT. NO WATER, NO CAVING

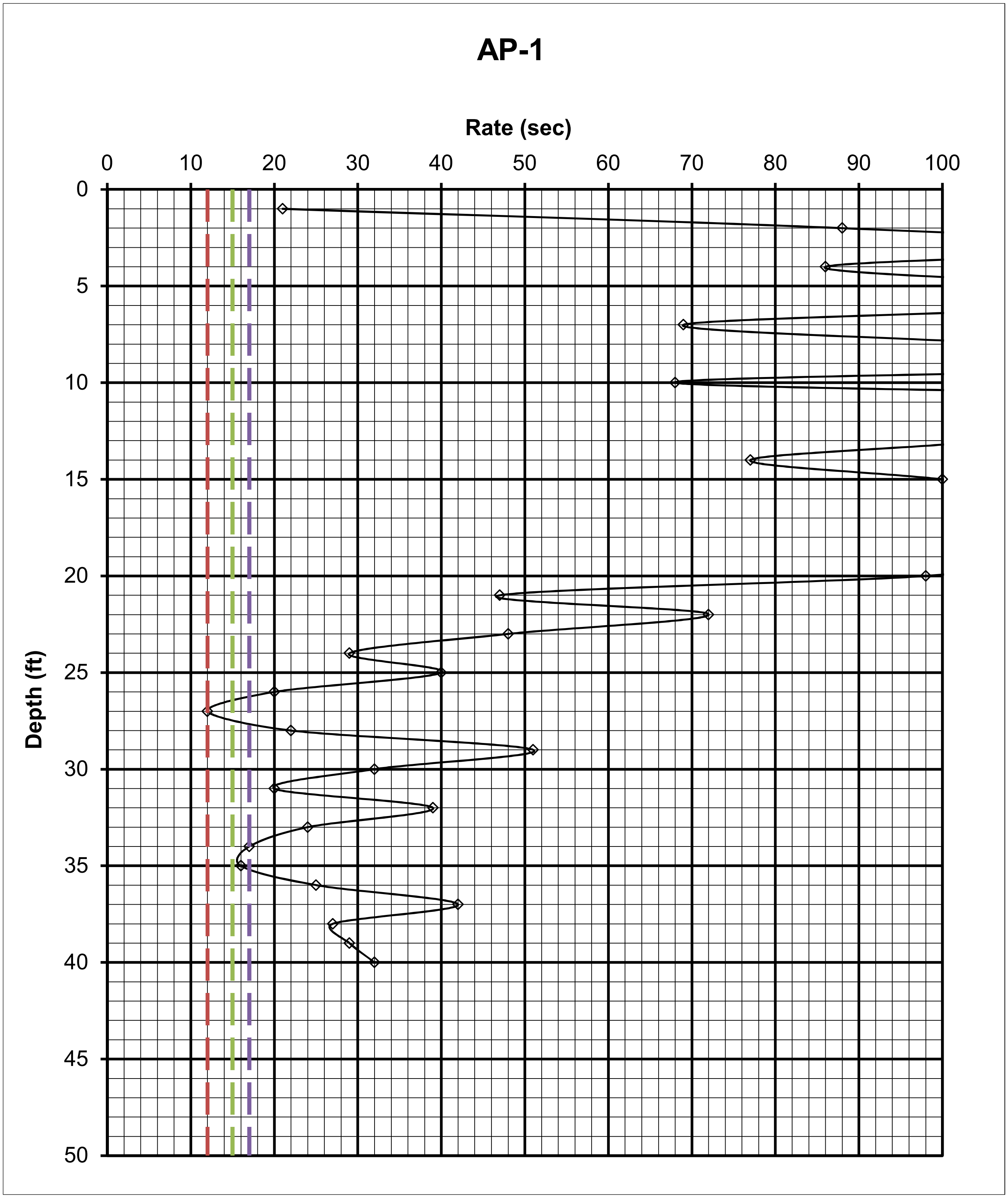
Test Pit No.	Depth (ft.)	USCS	Description
TP-22	0.0 – 1.5	SC	**Topsoil:** CLAYEY SAND; light yellowish brown, dry, loose, fine grained.
	1.5 – 14	SM	**Older Alluvium – (Qoa):** SILTY SAND; brownish gray and yellowish brown, moist, dense, fine to medium grained, some clay, some white carbonates, roots to 9 ft. @ 14 ft. some sub-rounded granitic clasts to 21/2-inch diameter with dark red iron oxide and black manganese oxide coatings (Old Pleistocene surface?).
	14 – 15		**Granodiorite and Gabbro - undifferentiated (Kcgb):** Reddish brown. dry, moderately hard, fine grained, moderately weathered, @ 7.0 ft. reddish brown, slightly moist, moderately hard, moderately weathered. TOTAL DEPTH 15 FT. NO WATER, NO CAVING
TP-23	0.0 – 0.5	SC	**Topsoil:** CLAYEY SAND; light gray and yellowish brown, dry, loose, fine to medium grained.
	0.5 – 2.5	SC	**Older Alluvium – (Qoa):** CLAYEY SAND; reddish brown slightly moist to moist, highly weathered, medium dense, visible porosity. @ 2.5 ft. dense.
	2.5 – 3.5		**Granodiorite and Gabbro - undifferentiated (Kcgb):** Yellowish brown. dry, soft, fine grained, moderately weathered. @ 3.5 ft. gray, hard, slightly weathered. @ 3.5 ft. Refusal TOTAL DEPTH 3.5 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
TP-24	0.0 – 1.0	SP	**Alluvium (Qal):** SAND; gray and yellowish brown, dry, loose, fine to medium grained, some silt.
	1.0 – 6.0	SC	**Older Alluvium – (Qoa):** CLAYEY SAND; reddish brown and yellowish brown, dry, medium dense, fine to medium grained, some visible porosity. @ 3.0 ft. slightly moist, dense, no visible porosity.
	6.0 – 6.5		**Granodiorite and Gabbro - undifferentiated (Kcgb):** Gray, slightly moist, moderately hard, fine grained, moderately weathered.
			TOTAL DEPTH 6.5 FT. NO WATER, NO CAVING
TP-25	0.0 – 1.0	SM	**Topsoil:** SILTY SAND; yellowish brown, dry, loose, fine to medium grained.
	1.0 – 3.0		**Granodiorite and Gabbro - undifferentiated (Kcgb):** Yellowish brown, dry, soft, fine to coarse grained, highly weathered. @ 2.5 ft. gray, moderately hard, moderately weathered.
			TOTAL DEPTH 3.0 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
TP-26	0.0 – 1.0	SM	**Artificial Fill - undocumented:** SILTY SAND; gray and light yellowish brown, dry, medium dense, fine to medium grained, some visible porosity.
	1.0 – 2.5		**Older Alluvium – (Qoa):** SILTY SAND; yellowish brown slightly moist, medium dense, highly weathered, medium dense, visible porosity.
	2.5 – 3.0		**Granodiorite and Gabbro - undifferentiated (Kcgb):** Gray, dry, moderately hard, fine to medium grained, moderately hard, moderately weathered. @ 2.5 ft. moderately weathered, hard, slow digging. @ 3.0 ft. Practical Refusal TOTAL DEPTH 3.0 FT. NO WATER, NO CAVING
TP-27	0.0 – 1.5	SC	**Artificial Fill - undocumented:** CLAYEY SAND; yellowish brown, dry, loose, fine grained, some granitic angular clasts to 4-inch diameter.
	1.5– 3.0		**Granodiorite and Gabbro - undifferentiated (Kcgb):** Reddish brown, dry, soft, fine grained, highly weathered. @ 2.0 ft. grayish brown and reddish brown, moderately weathered, moderately hard. TOTAL DEPTH 3.0 FT. NO WATER, NO CAVING
TP-28	0.0 – 2.5		**Granodiorite and Gabbro - undifferentiated (Kcgb):** Red, slightly moist, soft, fine grained, highly weathered. @ 2.5 ft. reddish brown and grayish brown, hard, moderately weathered. TOTAL DEPTH 2.5 FT. NO WATER, NO CAVING

Test Pit No.	Depth (ft.)	USCS	Description
TP-29	0.0 – 1.5	SC	**Artificial Fill - undocumented:** CLAYEY SAND; light yellowish brown, dry, loose, fine grained.
	1.5 – 2.0		**Granodiorite and Gabbro - undifferentiated (Kcgb):** Quartz Diorite, pale yellow, dry, hard, fine grained, slightly weathered, appears to have a higher silica/quartz content than the typical Granodiorite at the site. @ 2.0 ft. Refusal on hard rock, outcrops in the vicinity.
			TOTAL DEPTH 2.0 FT. NO WATER, NO CAVING
TP-30	0.0 – 1.0	SM	**Artificial Fill - undocumented:** SILTY SAND; gray and light yellowish brown, dry, medium dense, fine to medium grained, some visible porosity.
	1.0 – 4.0	SC	**Older Alluvium – (Qoa):** CLAYEY SAND; yellowish brown dry, medium dense, visible porosity.
	4.0 – 5.0		**Granodiorite and Gabbro - undifferentiated (Kcgb):** Reddish brown, dry, soft, fine to medium grained, moderately hard, moderately weathered. @ 5 ft. moderately hard
			TOTAL DEPTH 5.0 FT. NO WATER, NO CAVING

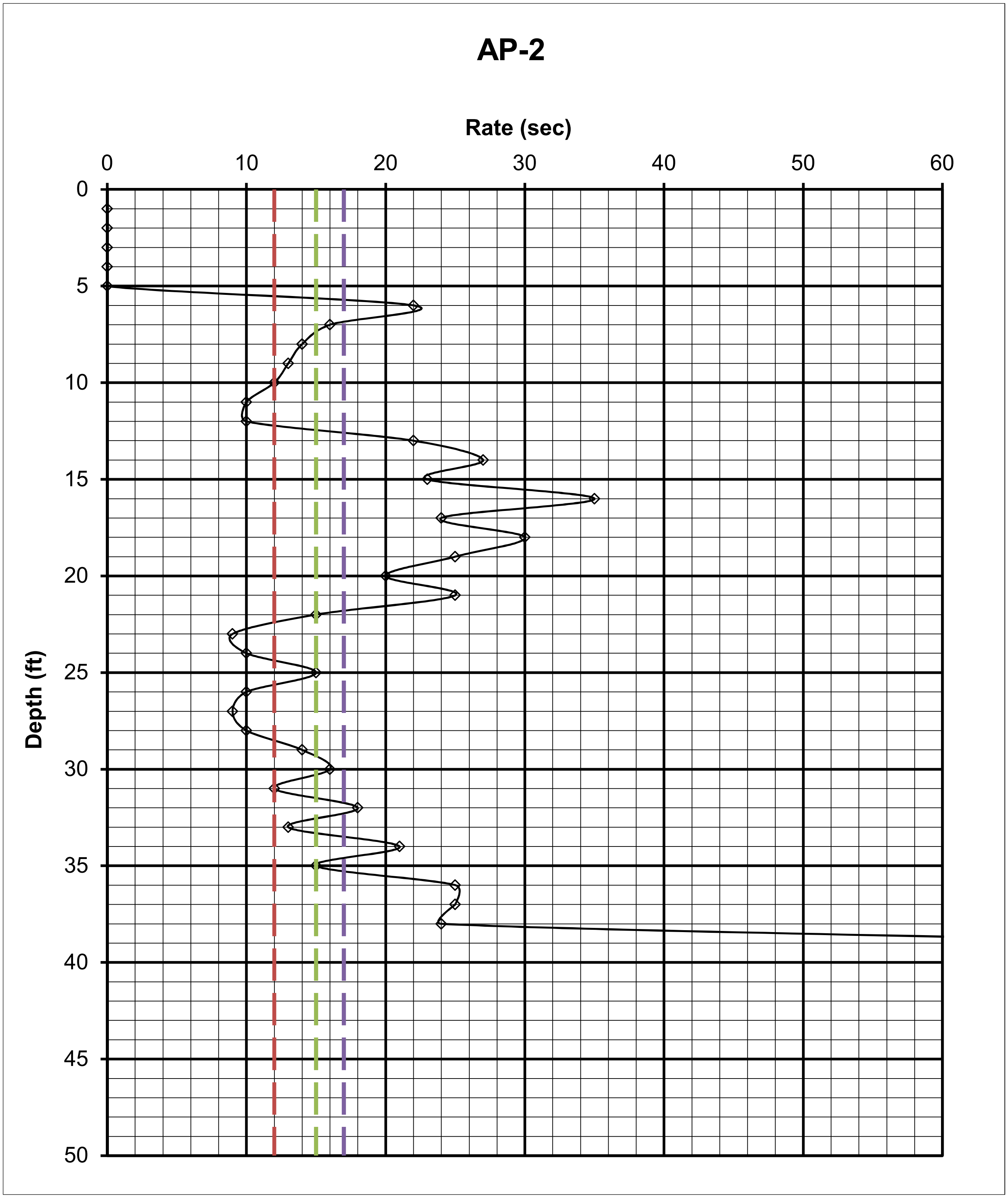
Test Pit No.	Depth (ft.)	USCS	Description
TP-31	0.0 – 1.0	SM	**Artificial Fill - undocumented:** SILTY SAND; gray and light yellowish brown, dry, medium dense, fine to medium grained, some visible porosity.
	1.0 – 4.0	SC	**Older Alluvium – (Qoa):** CLAYEY SAND; yellowish brown dry, medium dense, visible porosity.
	4.0 – 5.0		**Granodiorite and Gabbro - undifferentiated (Kcgb):** Reddish brown, dry, soft, fine to medium grained, moderately hard, moderately weathered. @ 5 ft. moderately hard TOTAL DEPTH 5.0 FT. NO WATER, NO CAVING
TP-32	0.0 – 1.0	SM	**Artificial Fill - undocumented:** SILTY SAND; gray and light yellowish brown, dry, medium dense, fine to medium grained.
	1.0 – 7.0	SM	**Older Alluvium – (Qoa):** SILTY SAND; light yellowish brown dry, loose, highly weathered, medium dense, visible porosity. @ 2.5 ft. yellowish brown, slightly moist, medium dense, fine grained, no visible porosity.
	7.0 – 8.0		**Very Old Alluvium (Qvoa):** Dark yellowish brown, dry, very dense, fine grained, some carbonate stringers, cemented, very slow digging. @ 8.0 ft. Practical Refusal TOTAL DEPTH 8.0 FT. NO WATER, NO CAVING



Equipment
Ingersoll-Rand ECM-370
Excavated April 18, 2018
PW 1507-05

<12 Rippable
12-15 Marginally Rippable
15-17 Heavy Ripping
>17 Drill & Shoot

AGS



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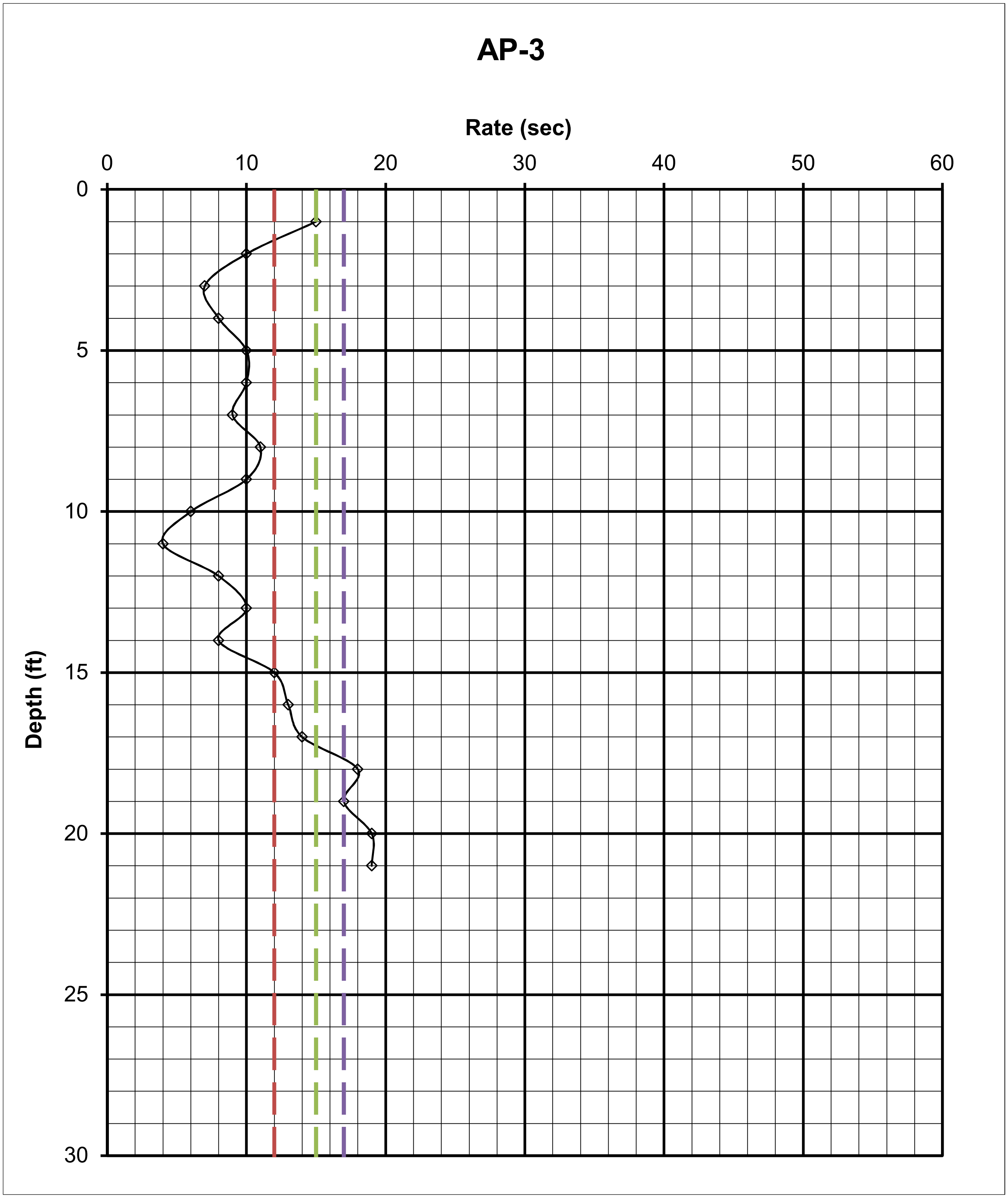

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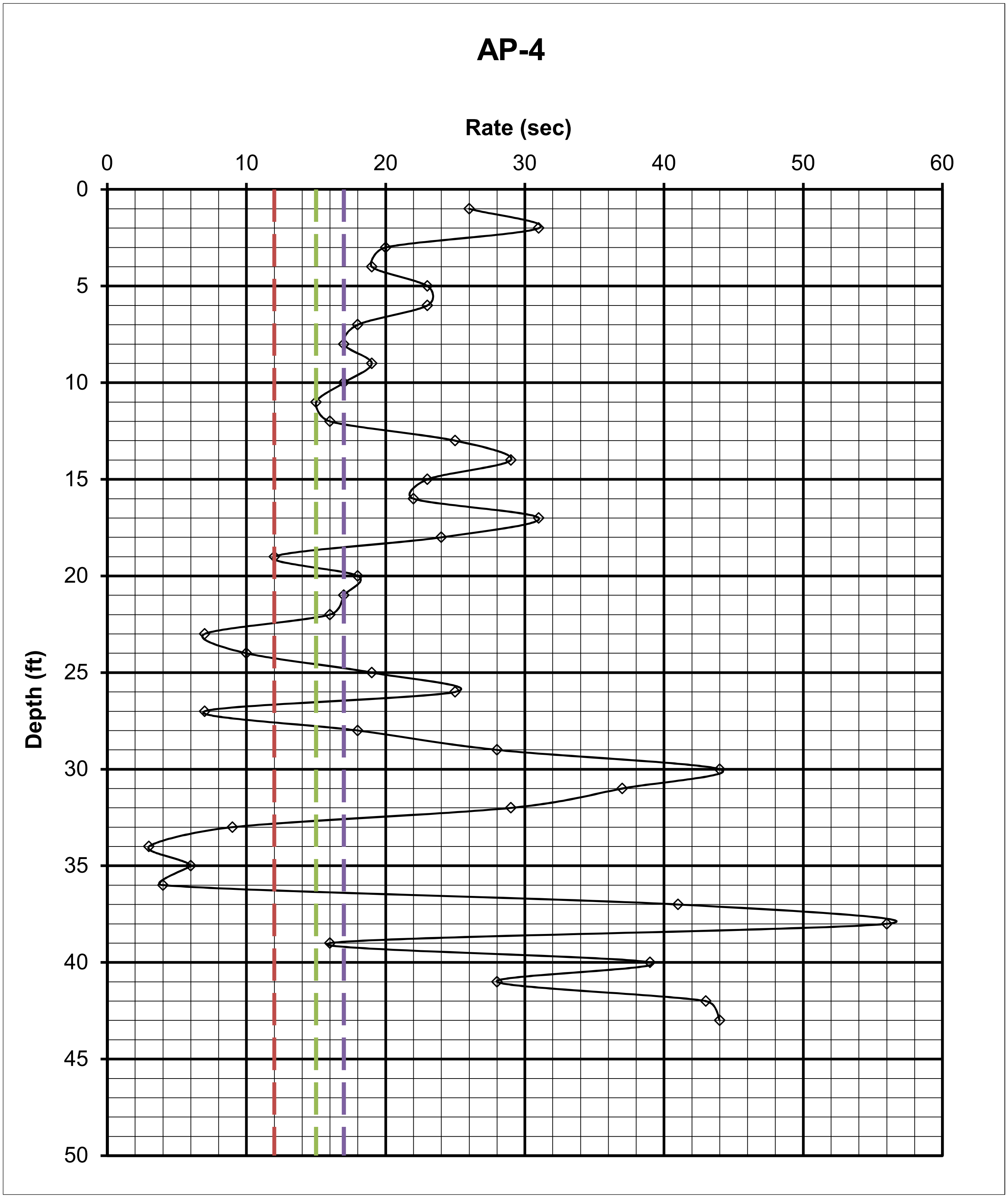

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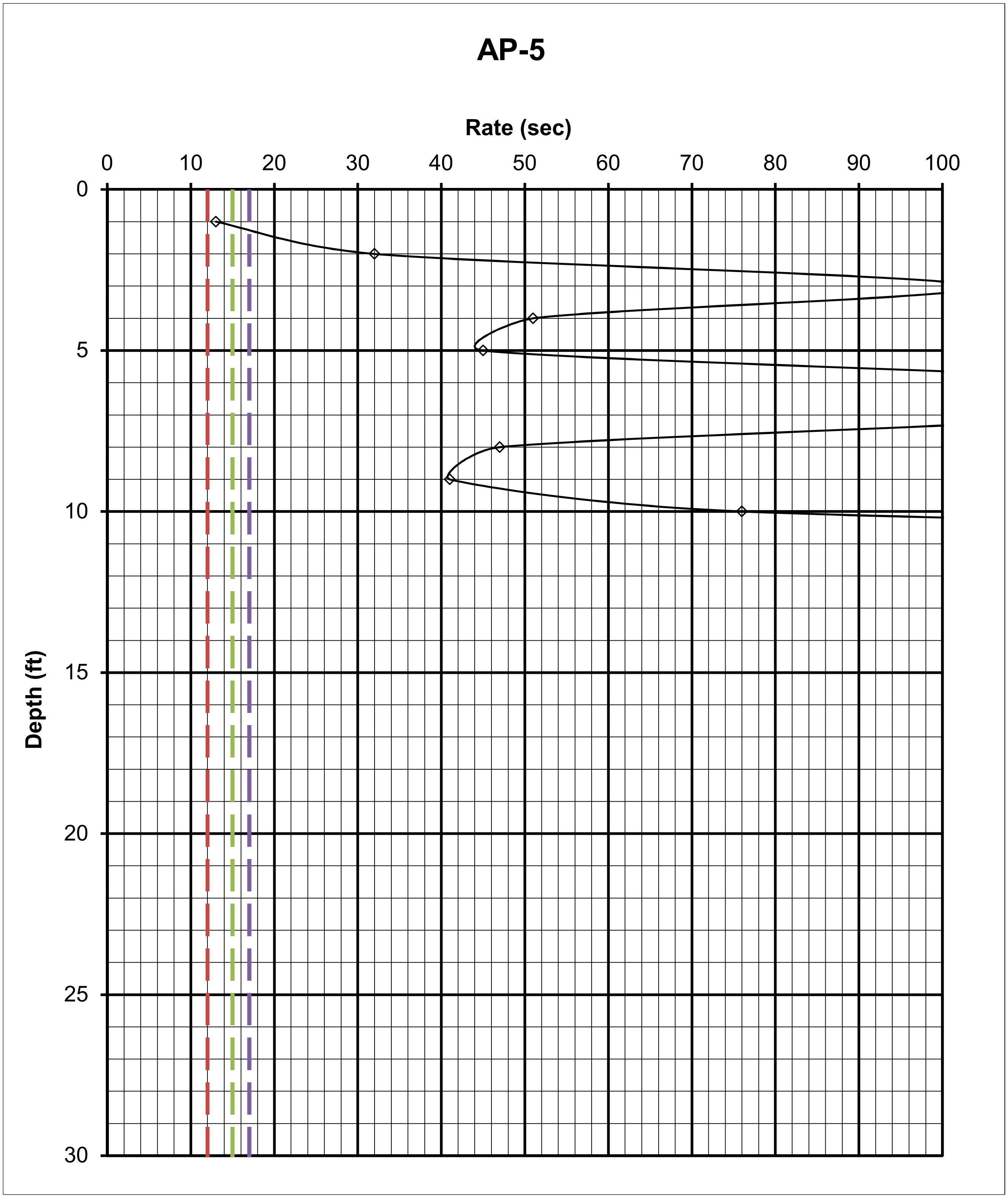

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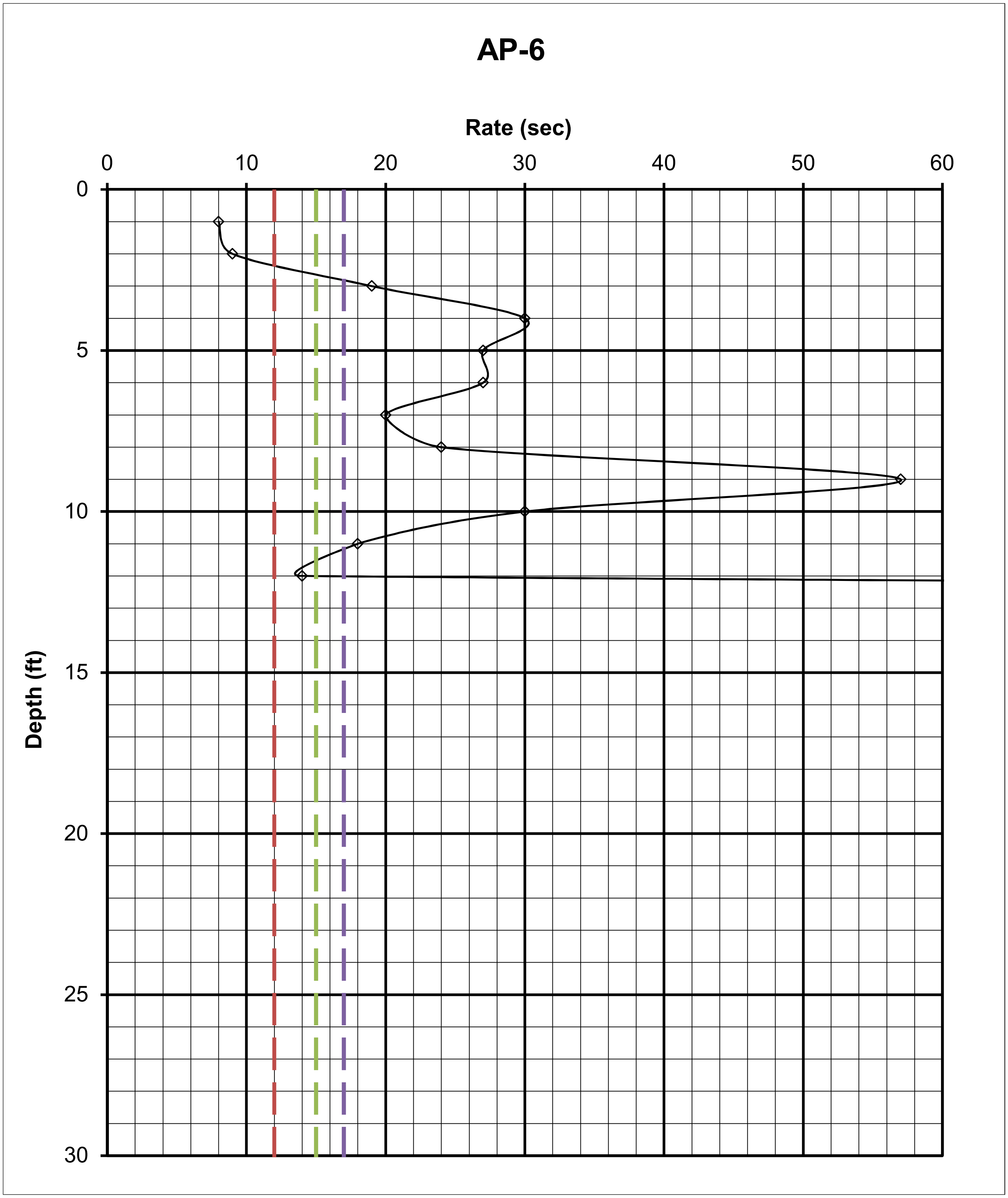

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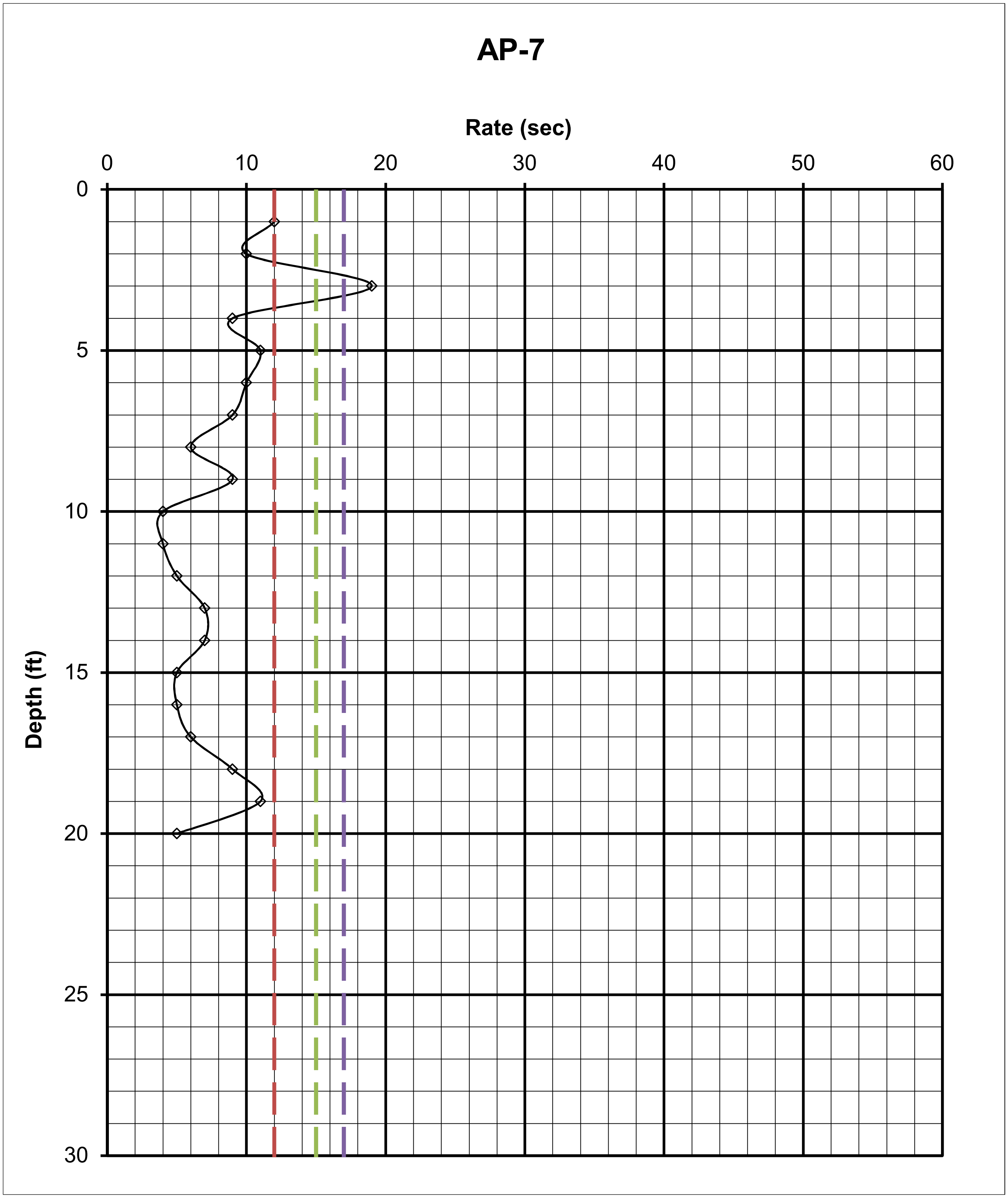

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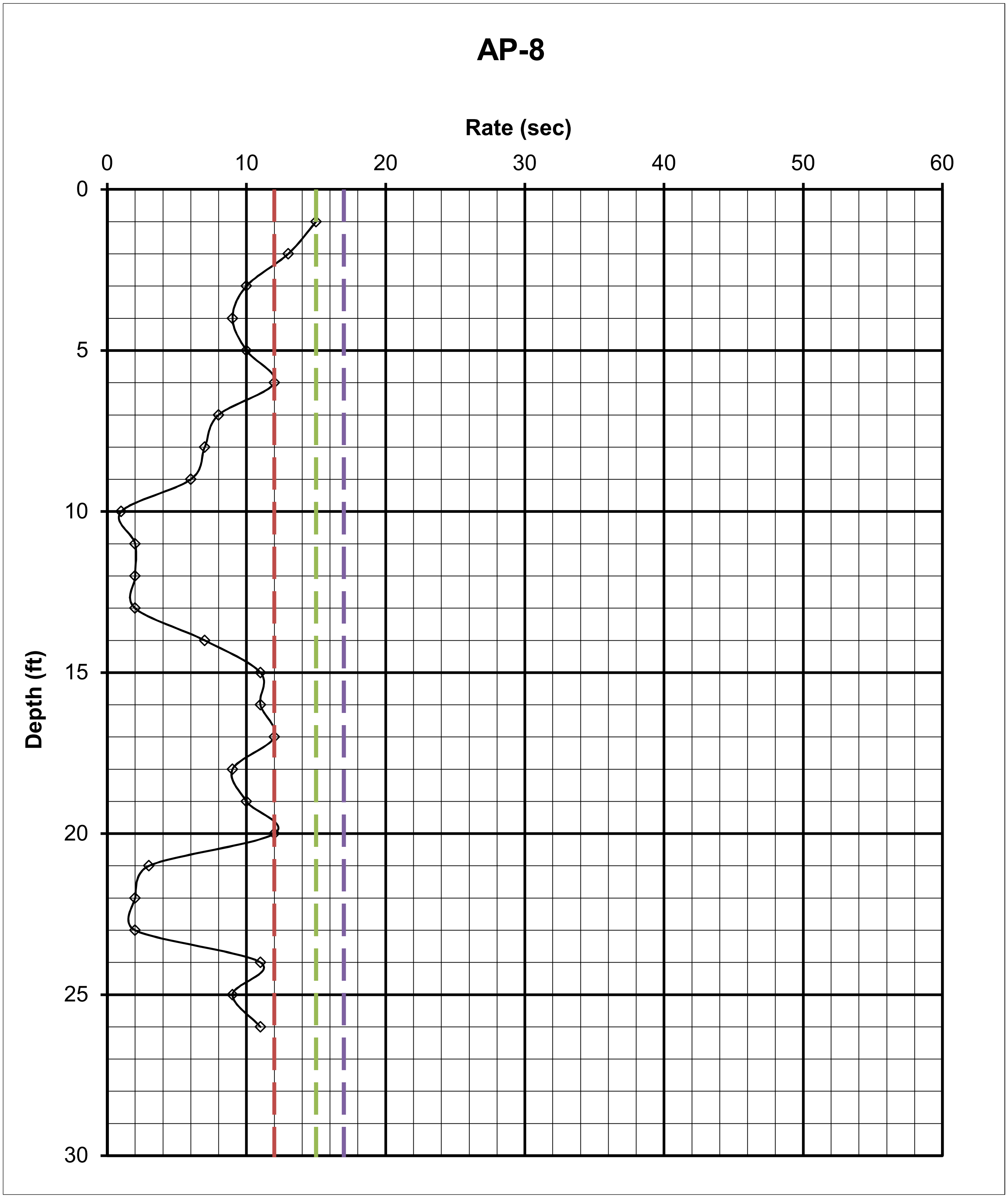

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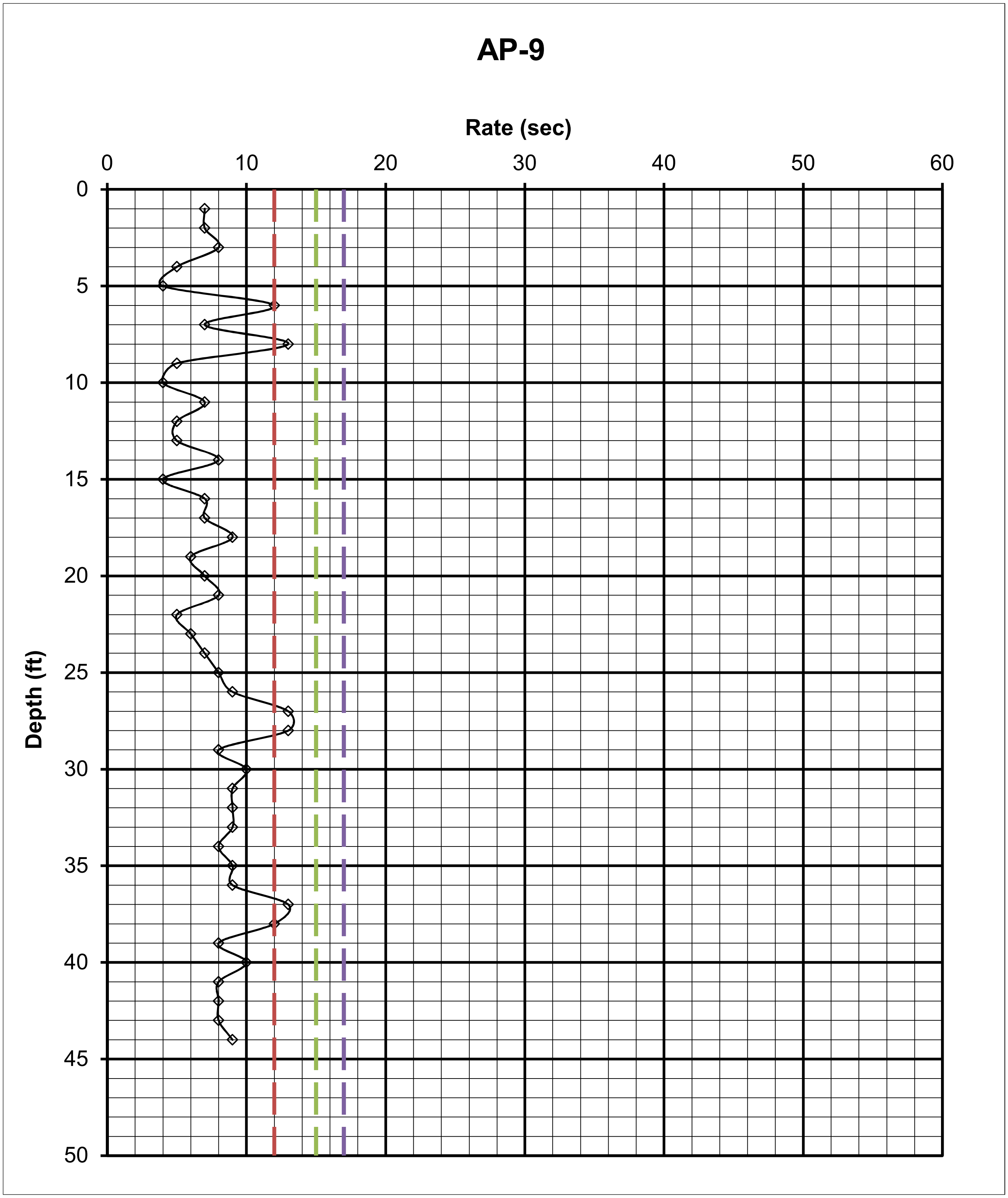

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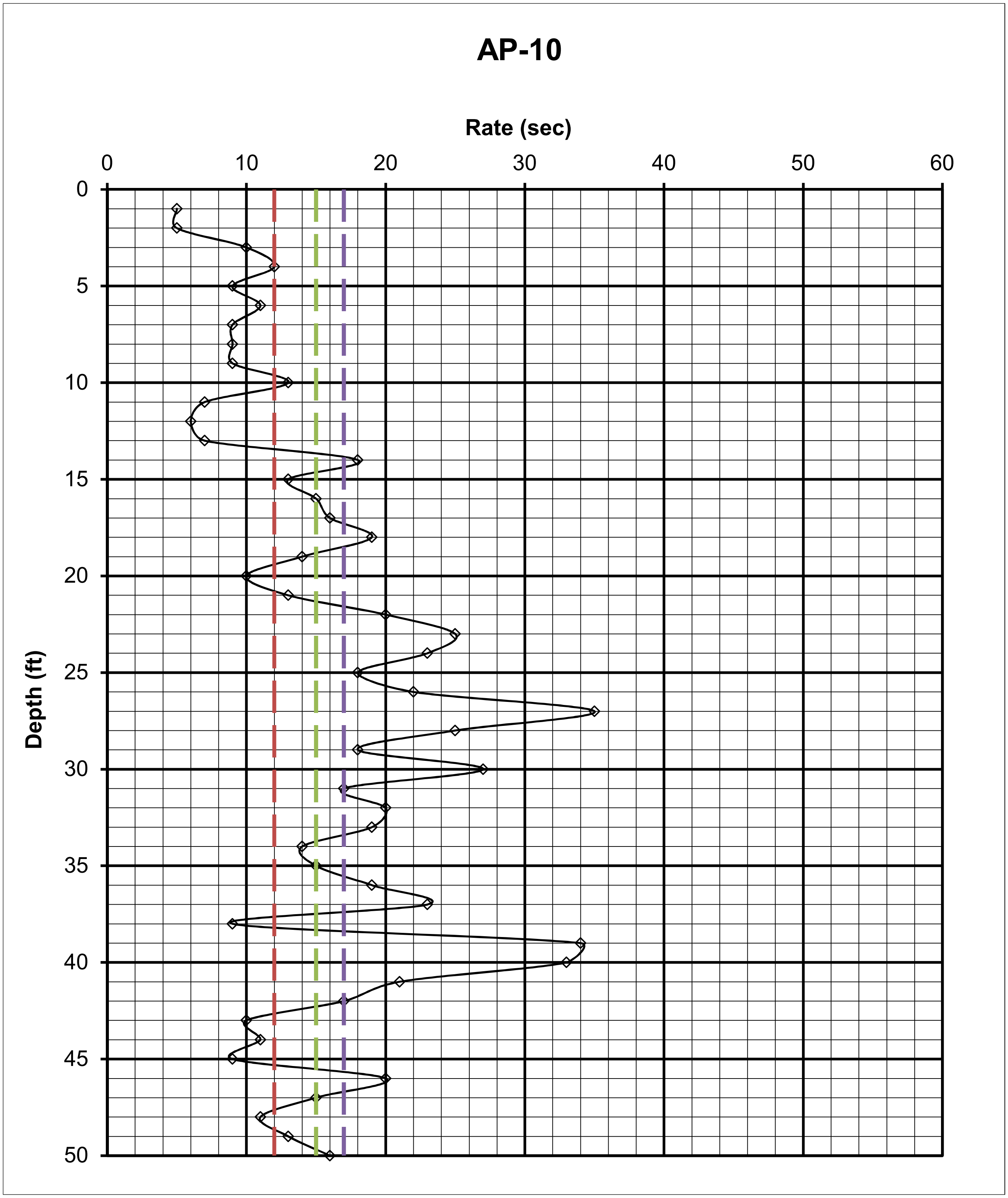

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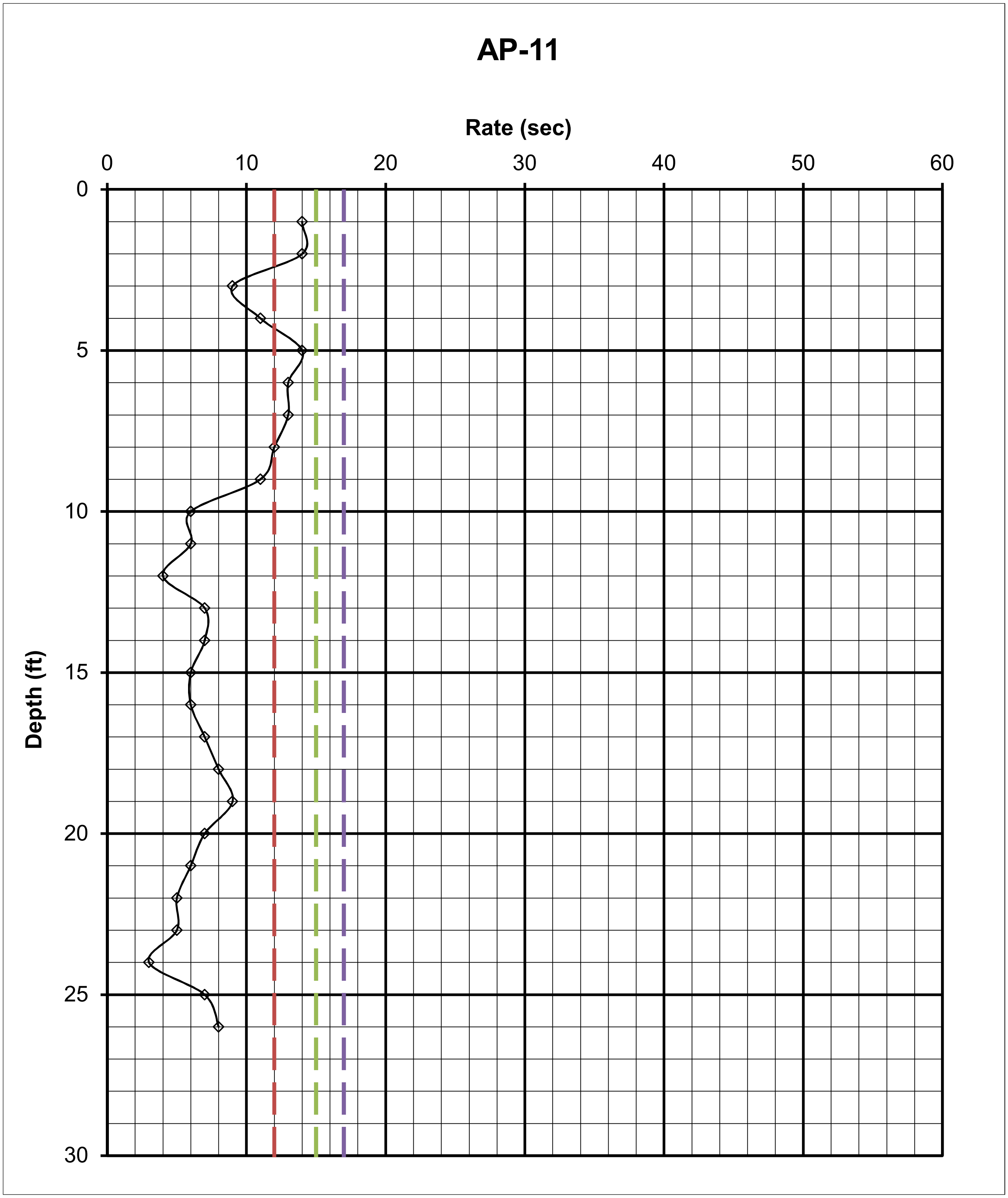

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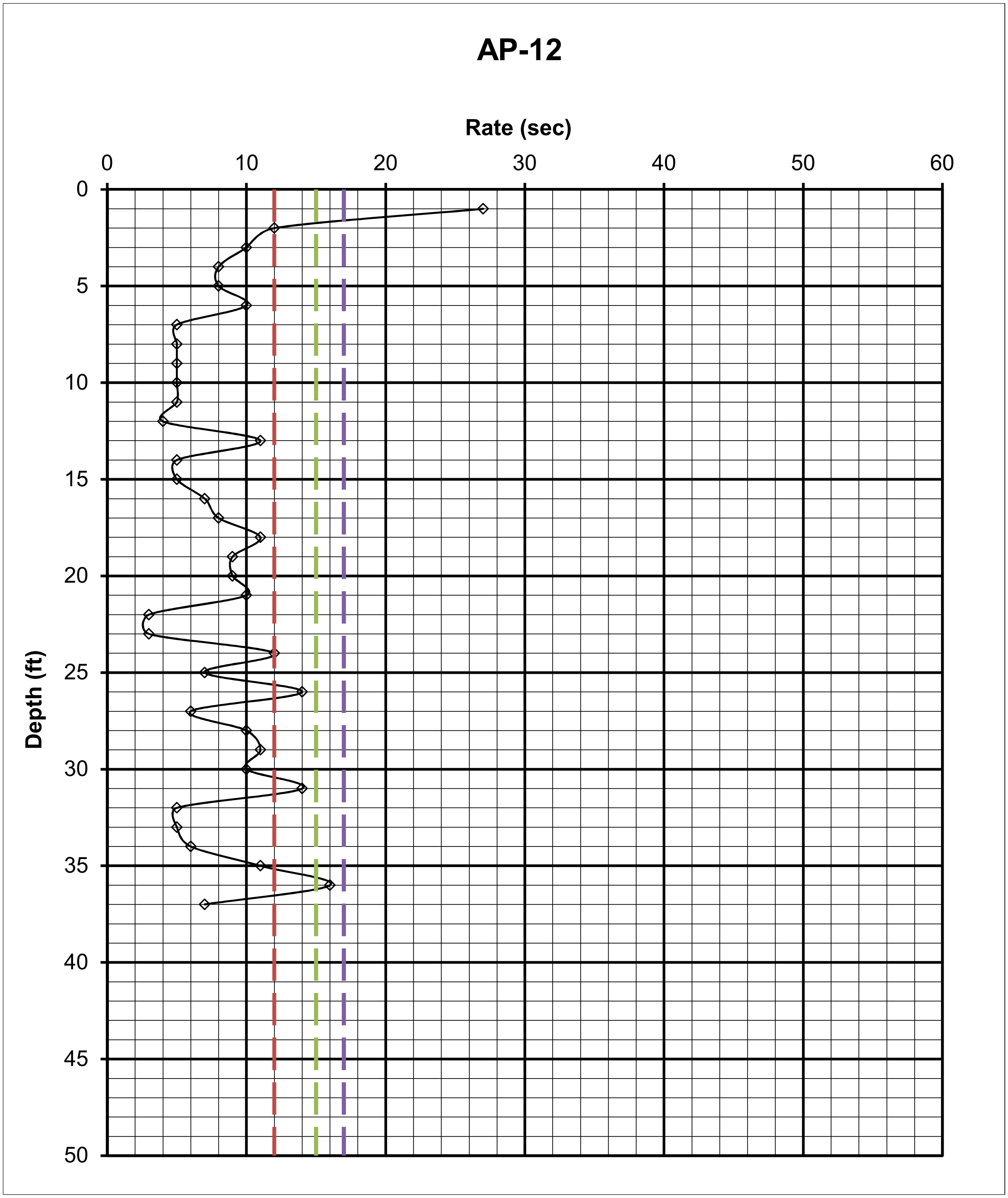

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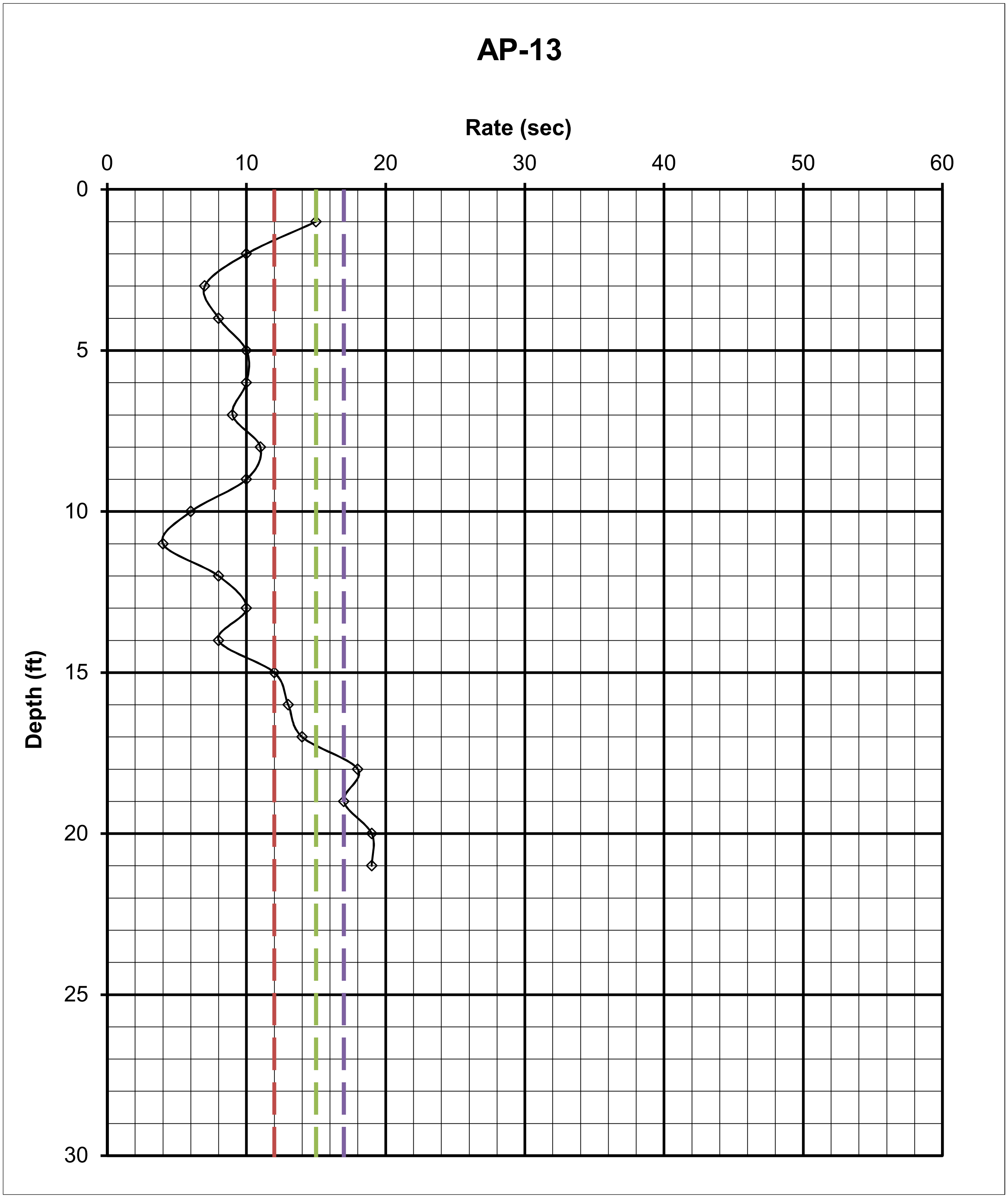

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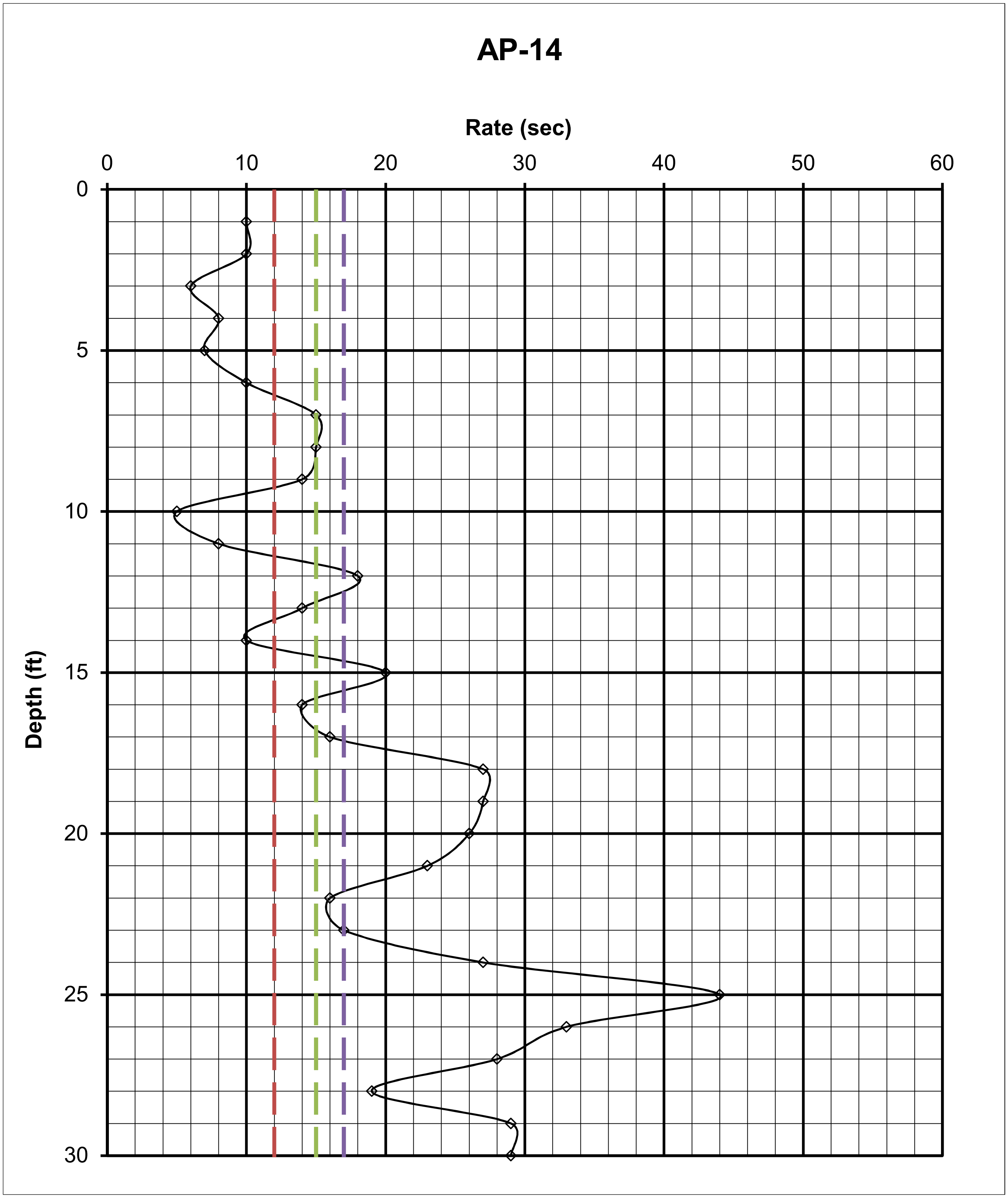
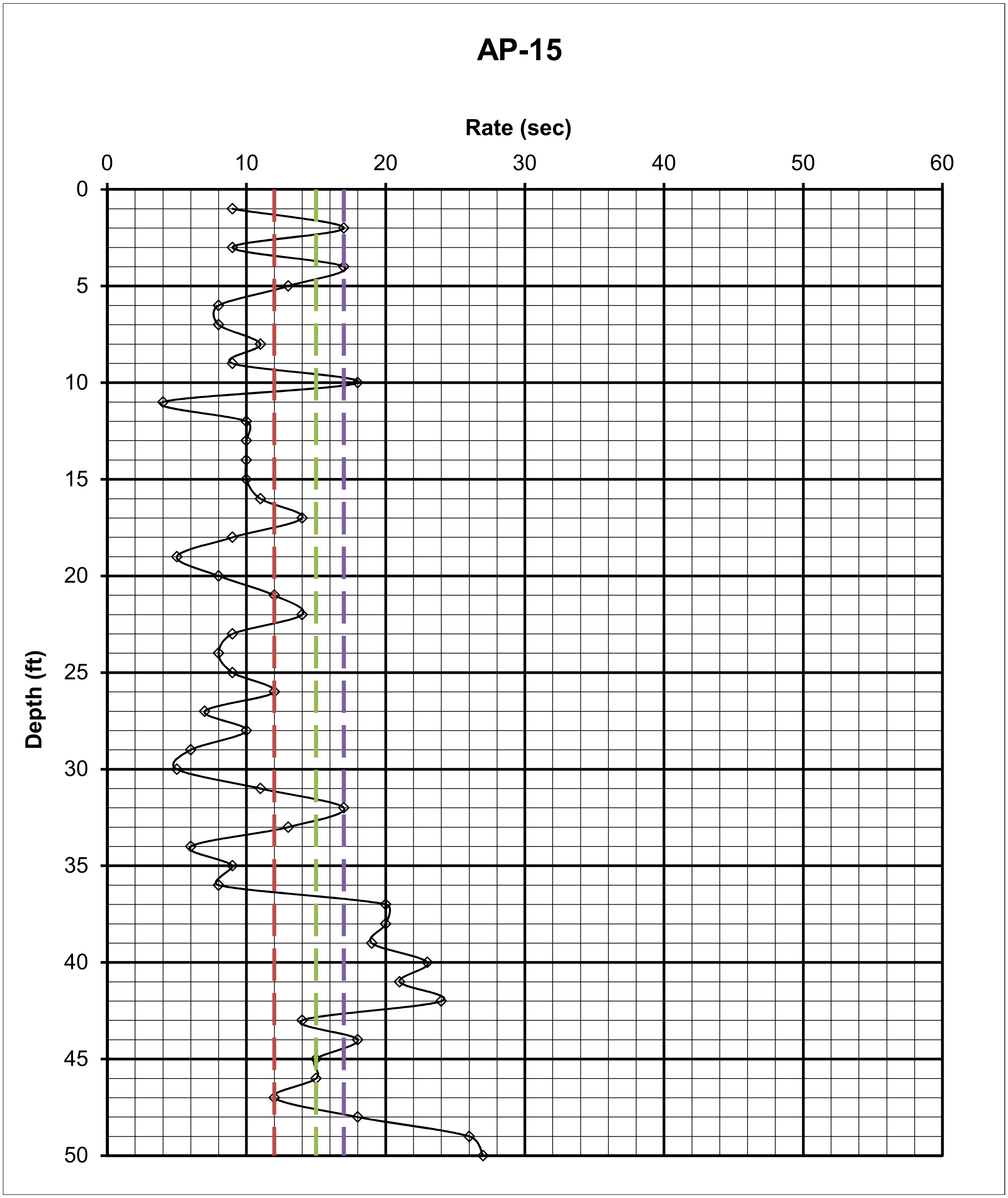
Ingersoll-Rand ECM-370
Excavated April 18, 2018
PW 1507-05

<12 Rippable
12-15 Marginally Rippable
15-17 Heavy Ripping
>17 Drill & Shoot



Equipment
Ingersoll-Rand ECM-370
Excavated April 18, 2018
PW 1507-05

<12 Rippable
12-15 Marginally Rippable
15-17 Heavy Ripping
>17 Drill & Shoot



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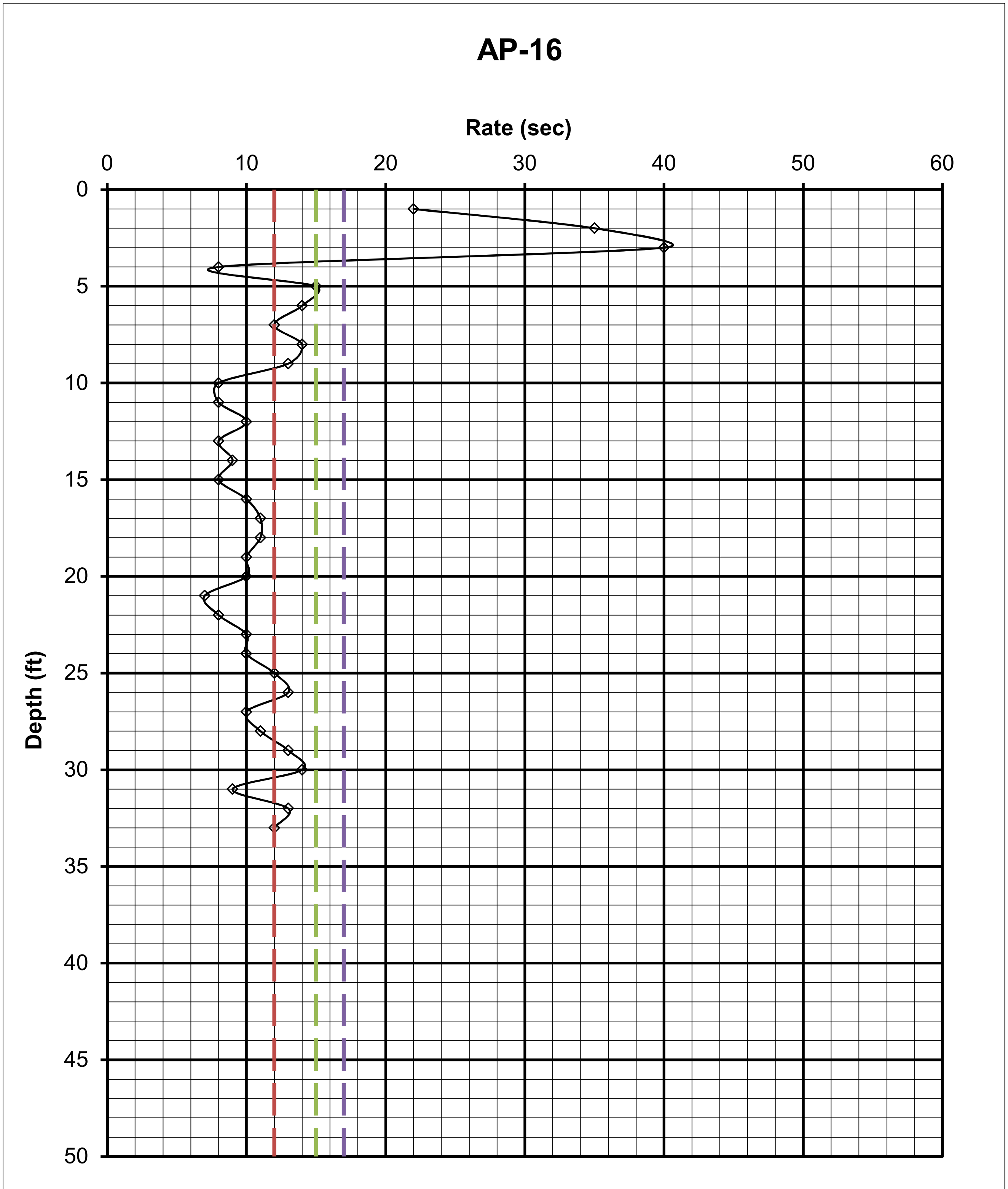


Equipment
Ingersoll-Rand ECM-370
Excavated April 18, 2018
PW 1507-05

<12 Rippable
12-15 Marginally Rippable
15-17 Heavy Ripping
>17 Drill & Shoot

AGS

SEISMIC REFRACTION SURVEY
GREEN TREE RANCH
RIVERSIDE, CALIFORNIA

PREPARED FOR:

Advanced Geotechnical Solutions. Inc.
485 Corporate Drive, Suite B
Escondido, CA 92029

PREPARED BY:

Southwest Geophysics, Inc.
8057 Raytheon Road, Suite 9
San Diego, CA 92111

April 13, 2018
Project No. 118142

SOUTHWEST GEOPHYSICS, INC.
YOUR SUBSURFACE SOLUTION

April 13, 2018
Project No. 118142

Mr. Daniel Linsley
Advanced Geotechnical Solutions, Inc.
485 Corporate Drive, Suite B
Escondido, CA 92029

Subject: Seismic Refraction Survey
Green Tree Ranch
Riverside, California

Dear Mr. Linsley:

In accordance with your authorization, we have performed a seismic refraction survey pertaining to the Green Tree Ranch project located in Riverside, California. Specifically, our survey consisted of performing 10 seismic P-wave refraction traverses at the project site. The purpose of our study was to develop subsurface velocity profiles of the areas surveyed and to assess the apparent rippability of the subsurface materials. This data report presents our survey methodology, equipment used, analysis, and results.

We appreciate the opportunity to be of service on this project. Should you have any questions please contact the undersigned at your convenience.

Sincerely,
SOUTHWEST GEOPHYSICS, INC.

Aaron Puente
Project Geologist/Geophysicist

Hans van de Vrugt, C.E.G., P.Gp.
Principal Geologist/Geophysicist

REGISTERED GEOPHYSICIST
Hans van de Vrugt
No 1012
Exp. 2/29/20
STATE OF CALIFORNIA

AMB/ATP/hv

Distribution: Addressee (electronic)

TABLE OF CONTENTS

1. INTRODUCTION

In accordance with your authorization, we have performed a seismic refraction survey pertaining to the Green Tree Ranch project located in Riverside, California (Figure 1). Specifically, our survey consisted of performing ten seismic P-wave refraction traverses at the project site. The purpose of our study was to develop subsurface velocity profiles of the areas surveyed and to assess the apparent rippability of the subsurface materials. This data report presents our survey methodology, equipment used, analysis, and results.

2. SCOPE OF SERVICES

Our scope of services included:

- Performance of ten seismic P-wave refraction lines at the project site.
- Compilation and analysis of the data collected.
- Preparation of this data report presenting our results and conclusions.

3. SITE DESCRIPTION

The project site is located approximately 1 mile north of Lake Mathews and 7 miles east of Interstate Highway 15 in Riverside, California (Figure 1). Access to the site is by way of dirt roads north of El Sobrante Road and west of Vista Del Lago Drive. The project area is an undeveloped lot with hills, ridges and associated drainages. The seismic lines were conducted along the slopes and ridges. Vegetation in the area consists of annual grass and brush. Several outcrops of granitic rock are also present in and near the site. Figures 2 and 3 depict the general site conditions in the areas of the seismic traverses.

4. SURVEY METHODOLOGY

As previously indicated, the primary purpose of our services was to characterize the subsurface conditions at pre-selected locations through the collection of seismic data. The seismic refraction method uses first-arrival times of refracted seismic waves to estimate the thicknesses and seismic velocities of subsurface layers. Seismic P-waves (compression waves) generated at the surface are refracted at boundaries separating materials of contrasting velocities. These refracted seismic waves are then detected by a series of surface vertical component 14-Hz geophones and recorded with a 24-channel Geometrics Geode seismograph. The travel times of the seismic P-waves are used in conjunction with the shot-to-geophone distances to obtain thickness and velocity information on the subsurface materials. In general, the effective depth of evaluation for a seismic refraction traverse is approximately one-third to one-fifth the length of the traverse.

Ten seismic profiles (SL-1 through SL-10) were conducted at the site and multiple shot points (signal generator locations) were conducted along the lines at the ends, midpoint, and intermediate points between the ends and the midpoint. The P-wave signal (shot) was generated using a 20-pound hammer and an aluminum plate. The locations of the profiles, which were selected by your office, are depicted on Figure 2.

The refraction method requires that subsurface velocities increase with depth. A layer having a velocity lower than that of the layer above will not generally be detectable by the seismic refraction method and, therefore, could lead to errors in the depth calculations of subsequent layers. In addition, lateral variations in velocity, such as those caused by buried boulders, fractures, dikes, etc. can result in the misinterpretation of the subsurface conditions.

In general, the seismic P-wave velocity of a material can be correlated to rippability (see Table 1 below), or to some degree "hardness." Table 1 is based on published information from the Caterpillar Performance Handbook (Caterpillar, 2011) as well as our experience with similar materials, and assumes that a Caterpillar D-9 dozer ripping with a single shank is used. We emphasize the cutoffs in this classification scheme are approximate and rock characteristics, such as fracture spacing and orientation, play a significant role in determining rock quality or rippability. The rippability of a mass is also dependent on the excavation equipment used and the skill and experience of the equipment operator.

For trenching operations, the rippability values should be scaled downward. For example, velocities as low as 3,500 feet/second may indicate difficult ripping during trenching operations. In addition, the presence of boulders, which can be troublesome in narrow trenching operations, should be anticipated.

Table 1 – Rippability Classification	
Seismic P-wave Velocity	**Rippability**
0 to 2,000 feet/second	Easy
2,000 to 4,000 feet/second	Moderate
4,000 to 5,500 feet/second	Difficult, Possible Blasting
5,500 to 7,000 feet/second	Very Difficult, Probable Blasting
Greater than 7,000 feet/second	Blasting Generally Required

It should be noted that the rippability cutoffs presented in Table 1 are slightly more conservative than those published in the Caterpillar Performance Handbook. Accordingly, the above classification scheme should be used with discretion, and contractors should not be relieved of making their own independent evaluation of the rippability of the on-site materials prior to submitting their bids.

5. DATA ANALYSIS

The collected data were processed using SIPwin (Rimrock Geophysics, 2003), a seismic interpretation program, and analyzed using SeisOpt Pro (Optim, 2008). SeisOpt Pro uses first arrival picks and elevation data to produce subsurface velocity models through a nonlinear optimization technique called adaptive simulated annealing. The resulting velocity model provides a tomography image of the estimated geologic conditions. Both vertical and lateral velocity information is contained in the tomography model. Changes in layer velocity are revealed as gradients rather than discrete contacts, which typically are more representative of actual conditions.

6. RESULTS AND CONCLUSIONS

As previously indicated, 10 seismic traverses were conducted as part of our study. Figures 4a through 4j present the velocity models generated from our analysis. Based on the results it appears the study areas are underlain by low velocity materials (e.g., colluvium and topsoil) in the near surface and higher velocity bedrock material at depth. Distinct vertical and lateral velocity variations are evident in the models. Moreover, the degree of bedrock weathering and the depth to bedrock appears to be highly variable across the study area.

Based on the refraction results, variability in the excitability (including depth of rippability) of the subsurface materials should be expected across the project area. Furthermore, blasting may be required depending on the excavation depth, location, equipment used, and desired rate of production. In addition, oversized materials should be expected. A contractor with excavation experience in similar difficult conditions should be consulted for expert advice on excavation methodology, equipment and production rate.

7. LIMITATIONS

The field evaluation and geophysical analyses presented in this report have been conducted in general accordance with current practice and the standard of care exercised by consultants performing similar tasks in the project area. No warranty, express or implied, is made regarding the conclusions, recommendations, and opinions presented in this report. There is no evaluation detailed enough to reveal every subsurface condition. Variations may exist and conditions not observed or described in this report may be present. Uncertainties relative to subsurface conditions can be reduced through additional subsurface exploration. Additional subsurface surveying will be performed upon request.

This document is intended to be used only in its entirety. No portion of the document, by itself, is designed to completely represent any aspect of the project described herein. Southwest Geophysics, Inc. should be contacted if the reader requires additional information or has questions regarding the content, interpretations presented, or completeness of this document. This report is intended exclusively for use by the client. Any use or reuse of the findings, conclusions, and/or recommendations of this report by parties other than the client is undertaken at said parties' sole risk.

8. SELECTED REFERENCES

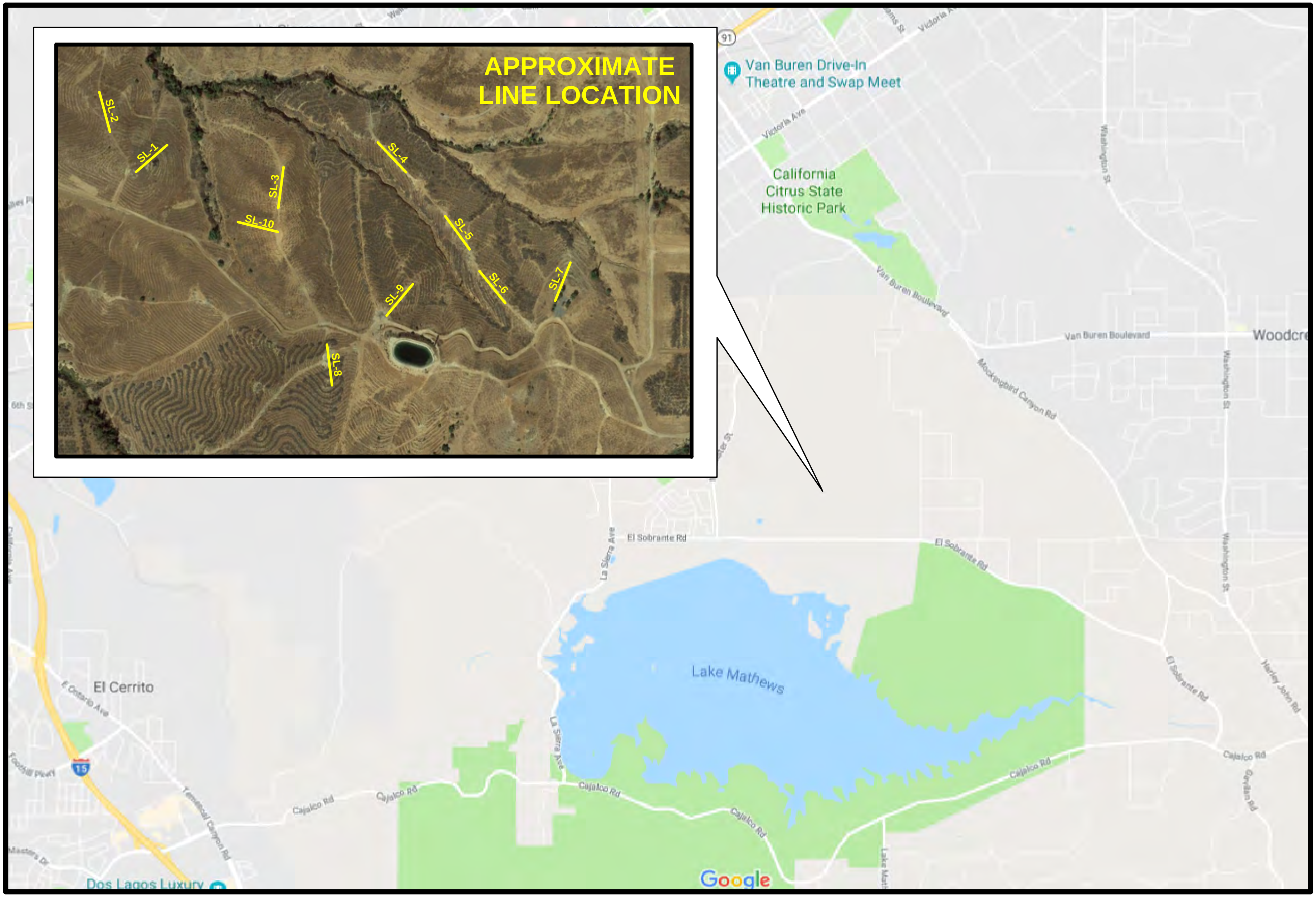
Caterpillar, Inc., 2011, Caterpillar Performance Handbook, Edition 41, Caterpillar, Inc., Peoria, Illinois.

Mooney, H.M., 1976, Handbook of Engineering Geophysics, dated February.

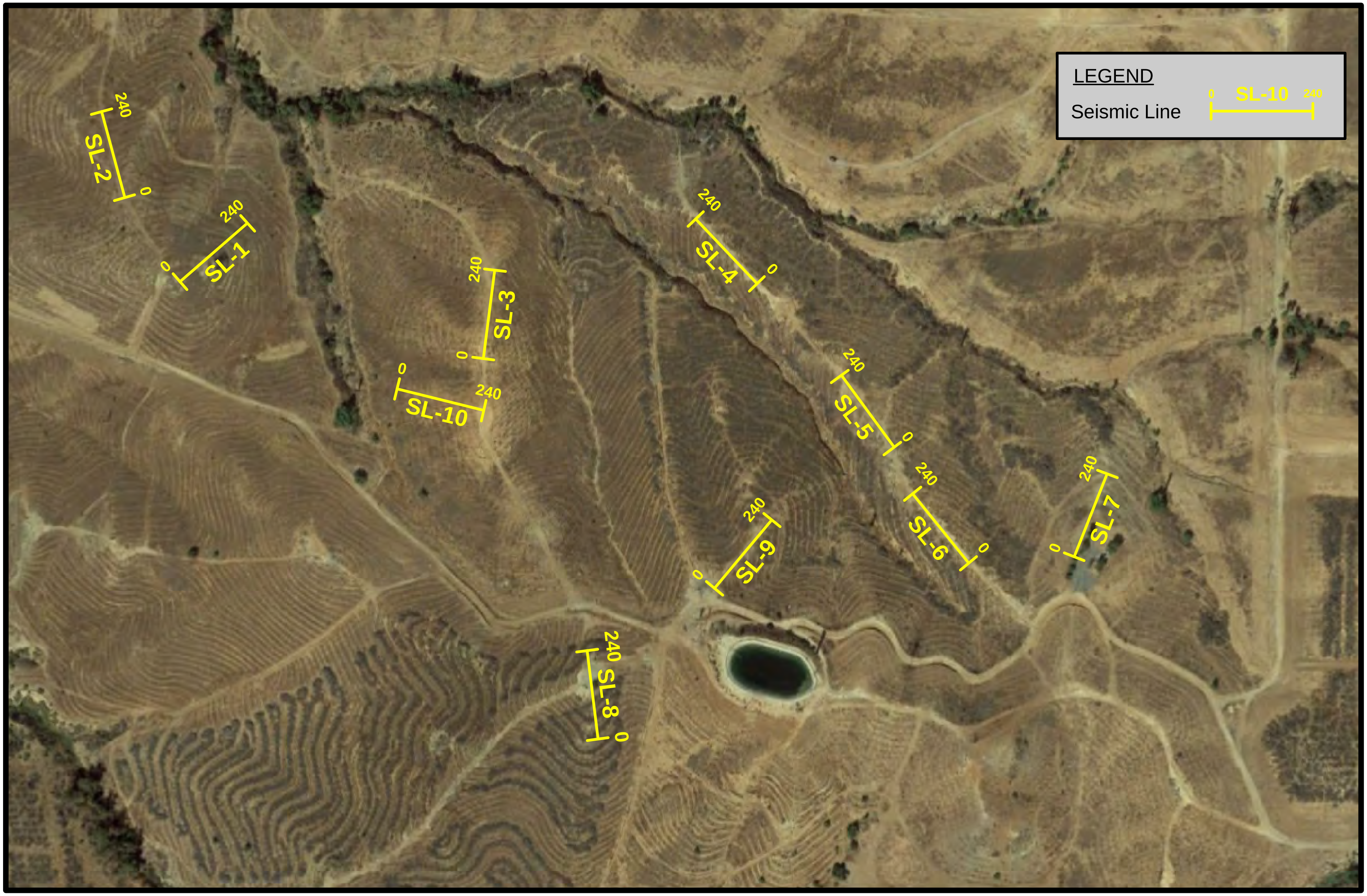
Optim, Inc., 2008, SeisOpt Pro, V-5.0.

Rimrock Geophysics, 2003, Seismic Refraction Interpretation Program (SIPwin), V-2.76.

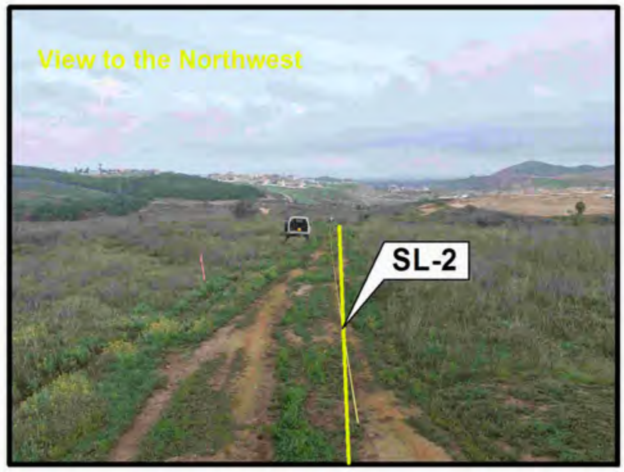
Telford, W.M., Geldart, L.P., Sheriff, R.E., and Keys, D.A., 1976, Applied Geophysics, Cambridge University Press.

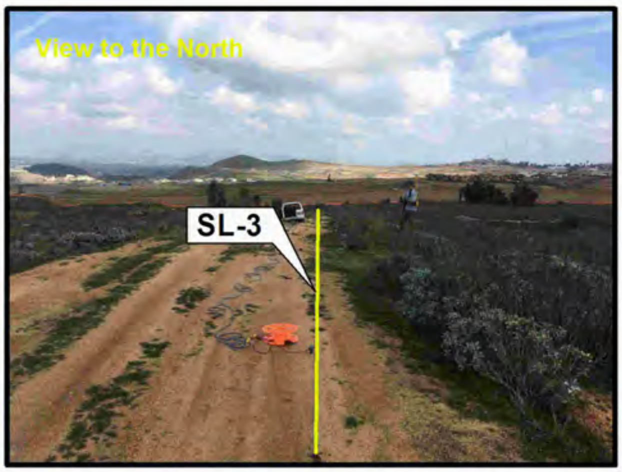


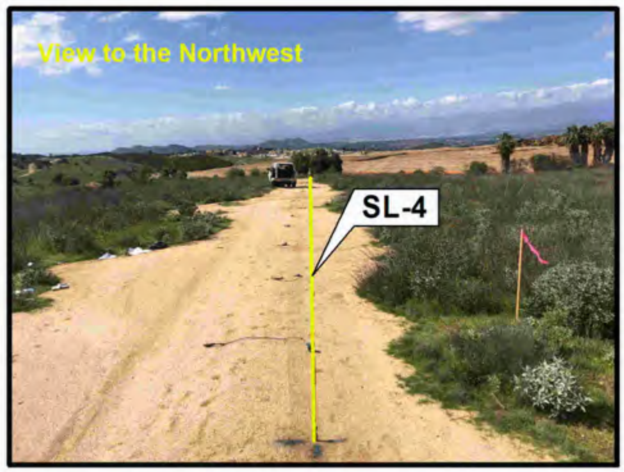
SITE LOCATION MAP	N	Green Tree Ranch, Riverside, California		SOUTHWEST GEOPHYSICS INC. Figure 1
		Project No.: 118142	Date: 04/18	

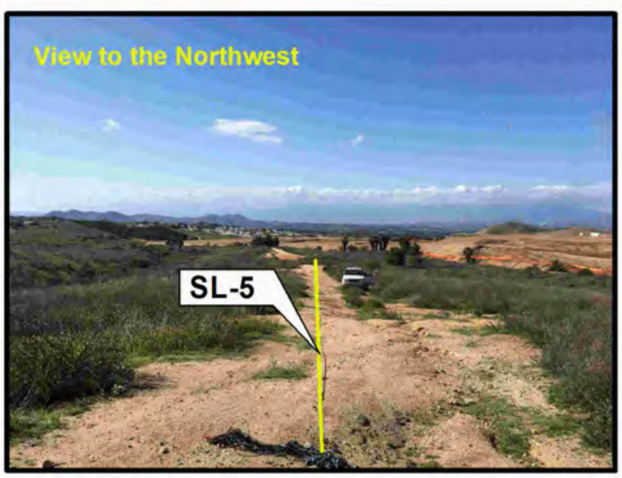


LINE LOCATION MAP	Green Tree Ranch Riverside, California	SOUTHWEST GEOPHYSICS INC. Figure 2
	Project No.: 118142	Date: 04/18

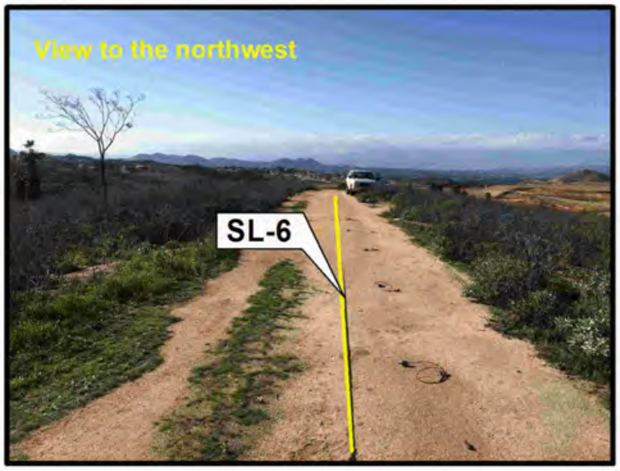


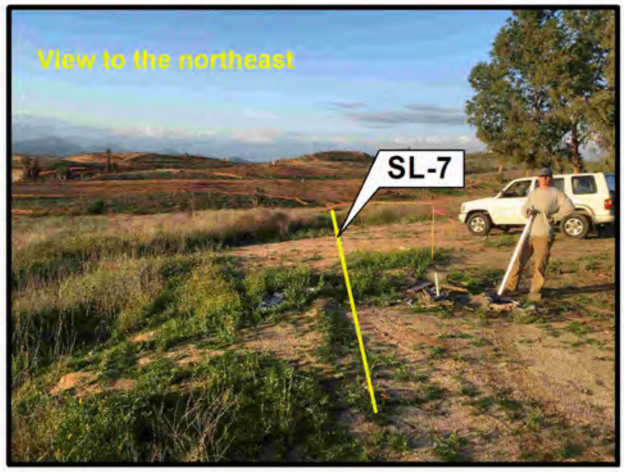


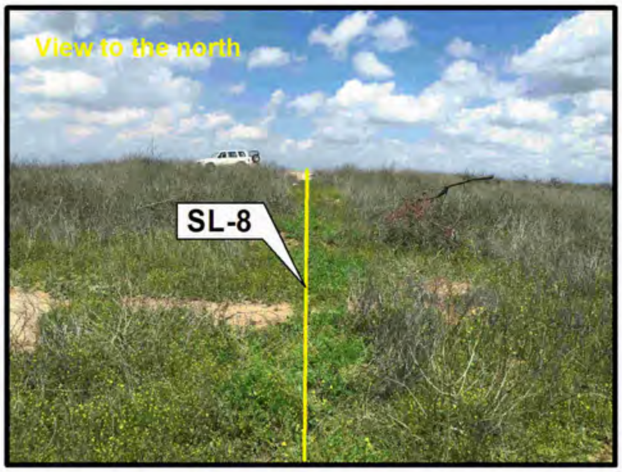


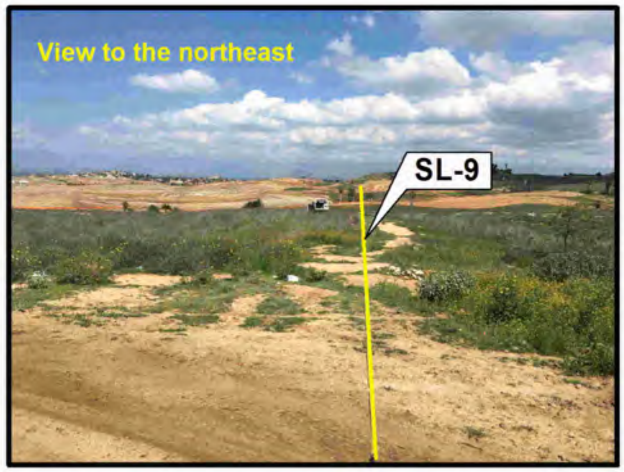


SITE PHOTOGRAPHS	Green Tree Ranch Riverside, California	SOUTHWEST GEOPHYSICS INC. Figure 3a
	Project No.: 118142 / Date: 4/18	



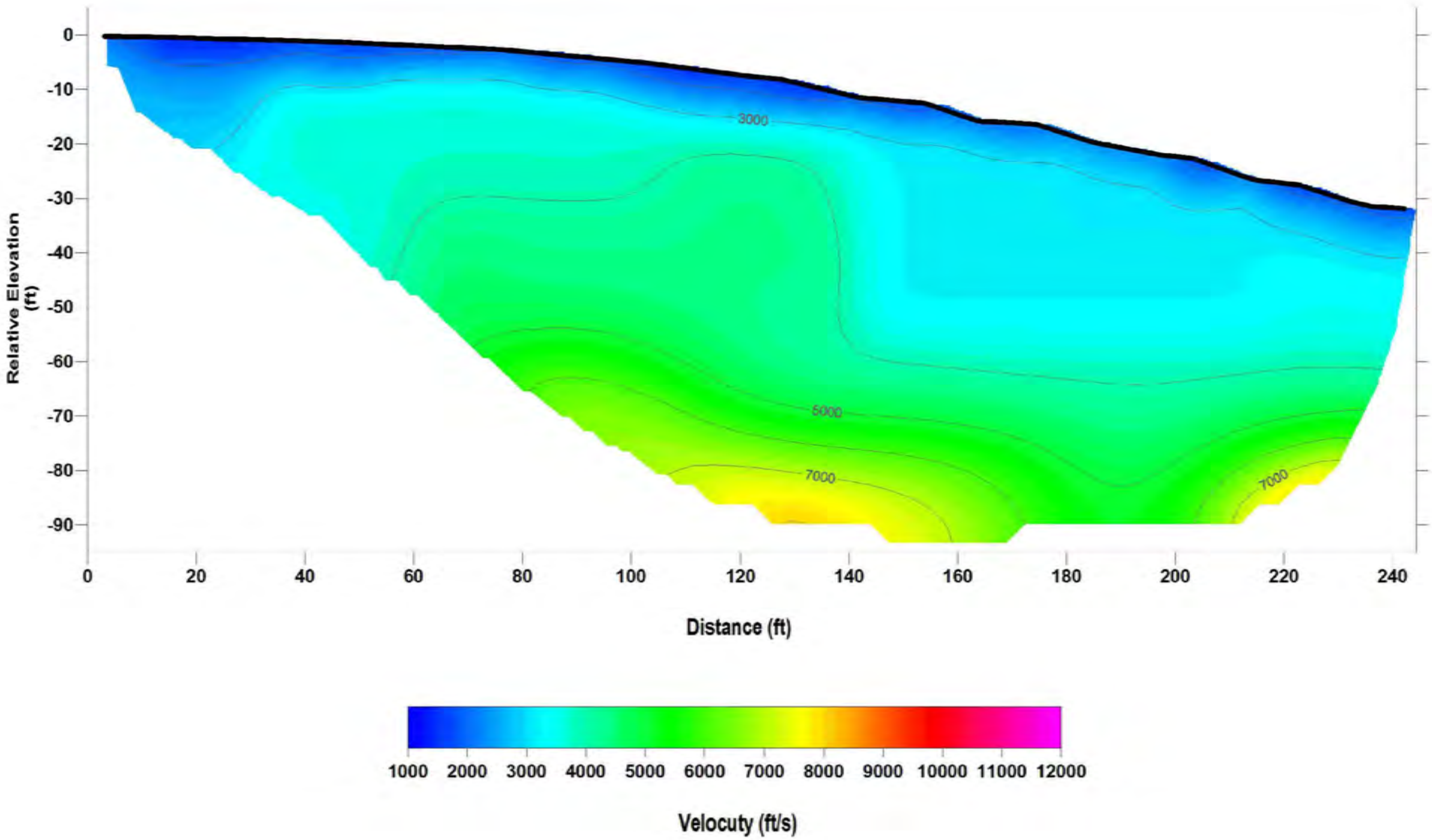






SITE PHOTOGRAPHS	Green Tree Ranch Riverside, California	SOUTHWEST GEOPHYSICS INC.
	Project No.: 118142 / Date: 4/18	Figure 3b

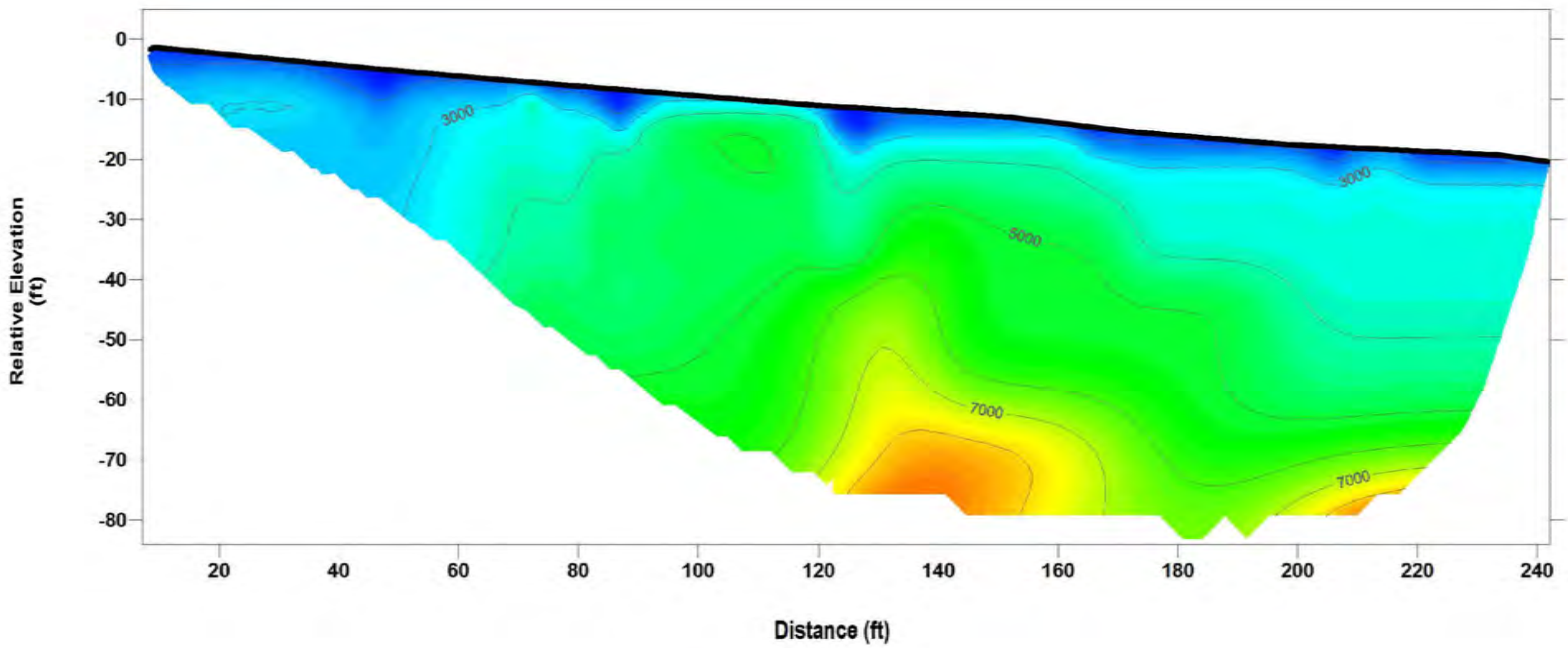
TOMOGRAPHY MODEL

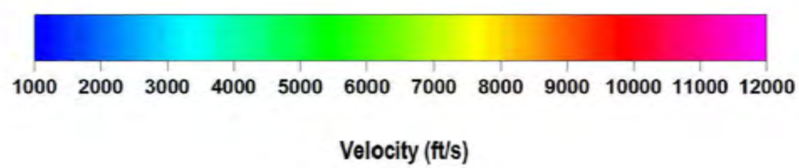


P-WAVE PROFILE SL-1	Green Tree Ranch Riverside, California Project No.: 118142 — Date: 04/18	SOUTHWEST GEOPHYSICS INC. Figure 4a

Note: Contour Interval = 1,000 feet per second

TOMOGRAPHY MODEL





P-WAVE PROFILE SL-2	Green Tree Ranch Riverside, California Project No.: 118142 Date: 04/18	SOUTHWEST GEOPHYSICS INC. Figure 4b

Note: Contour Interval = 1,000 feet per second

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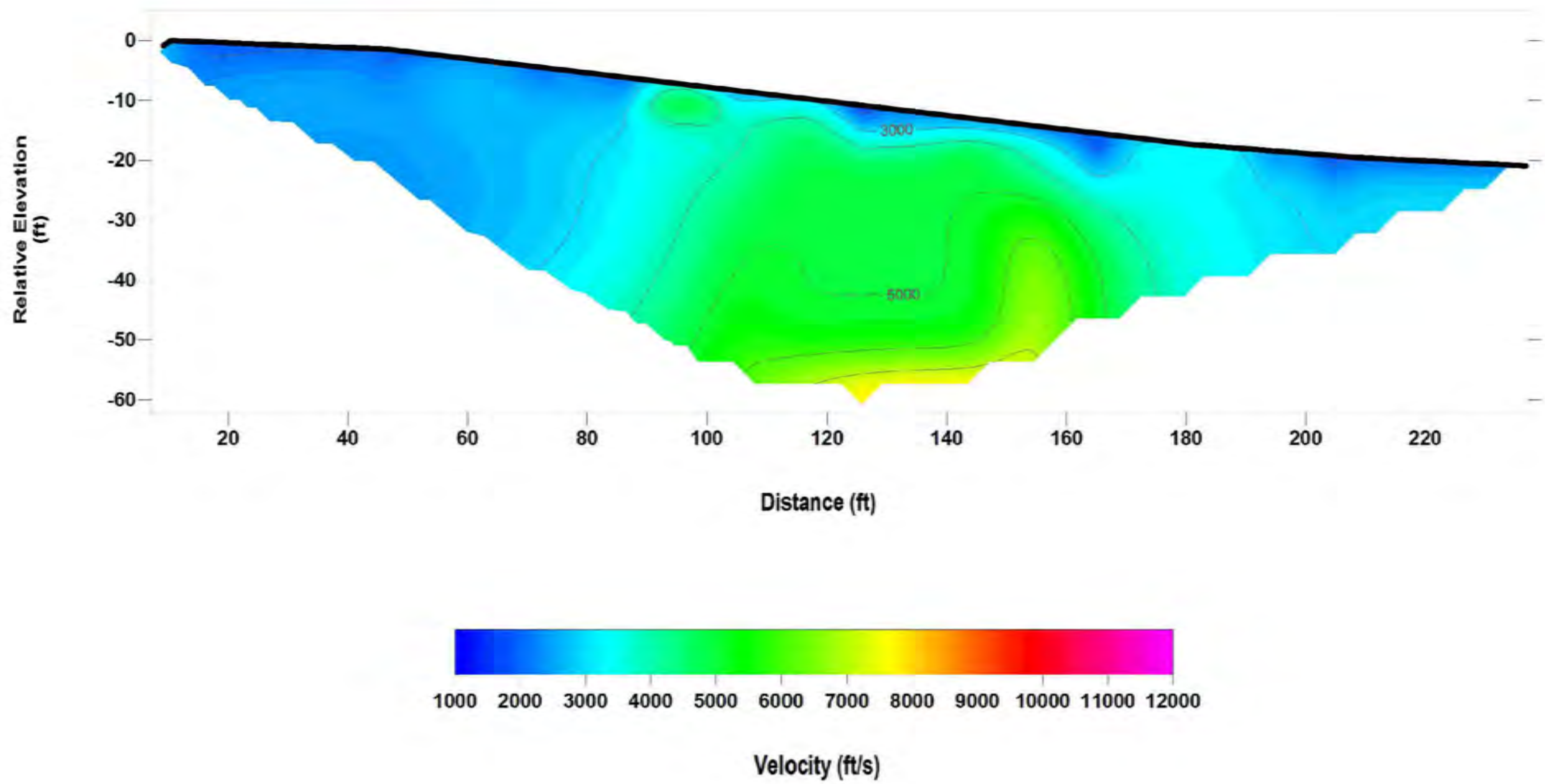

P-WAVE PROFILE **SL-3**	Green Tree Ranch Riverside, California Project No.: 118142 — Date: 04/18	SOUTHWEST GEOPHYSICS INC. Figure 4c	**Note: Contour Interval = 1,000 feet per second**

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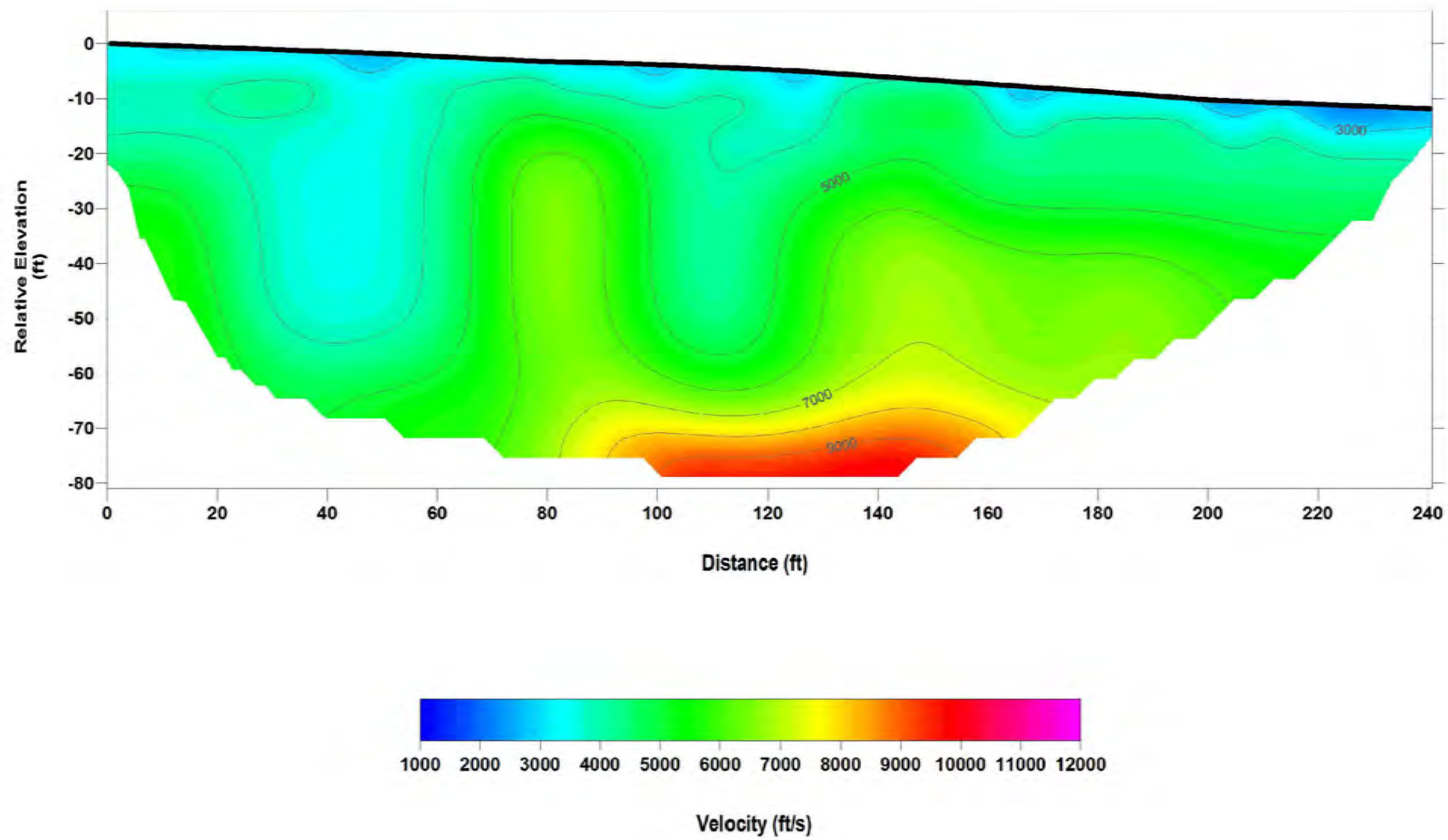

P-WAVE PROFILE SL-4	Green Tree Ranch Riverside, California Project No.: 118142 / Date: 04/18	SOUTHWEST GEOPHYSICS INC. Figure 4d	**Note: Contour Interval = 1,000 feet per second**

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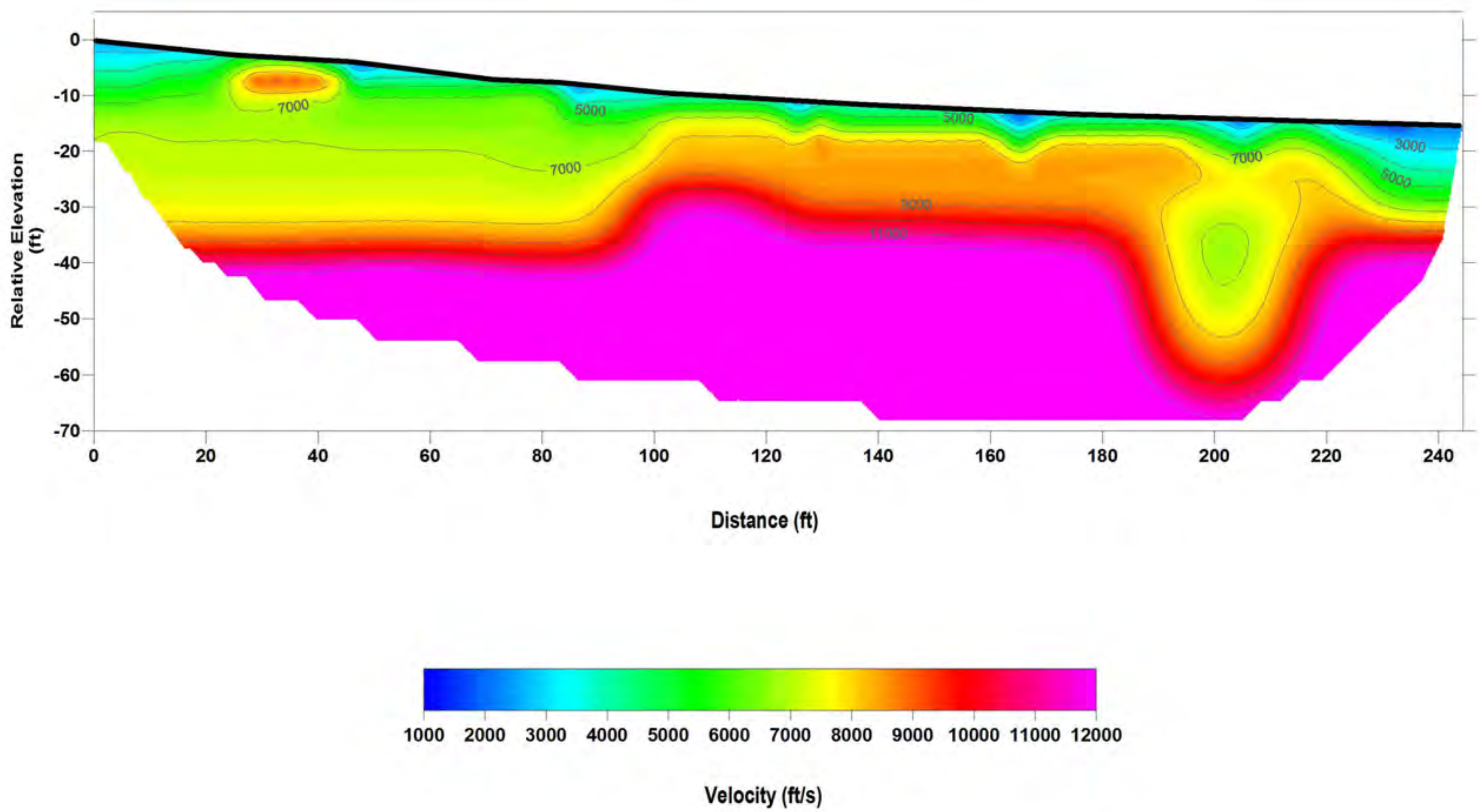
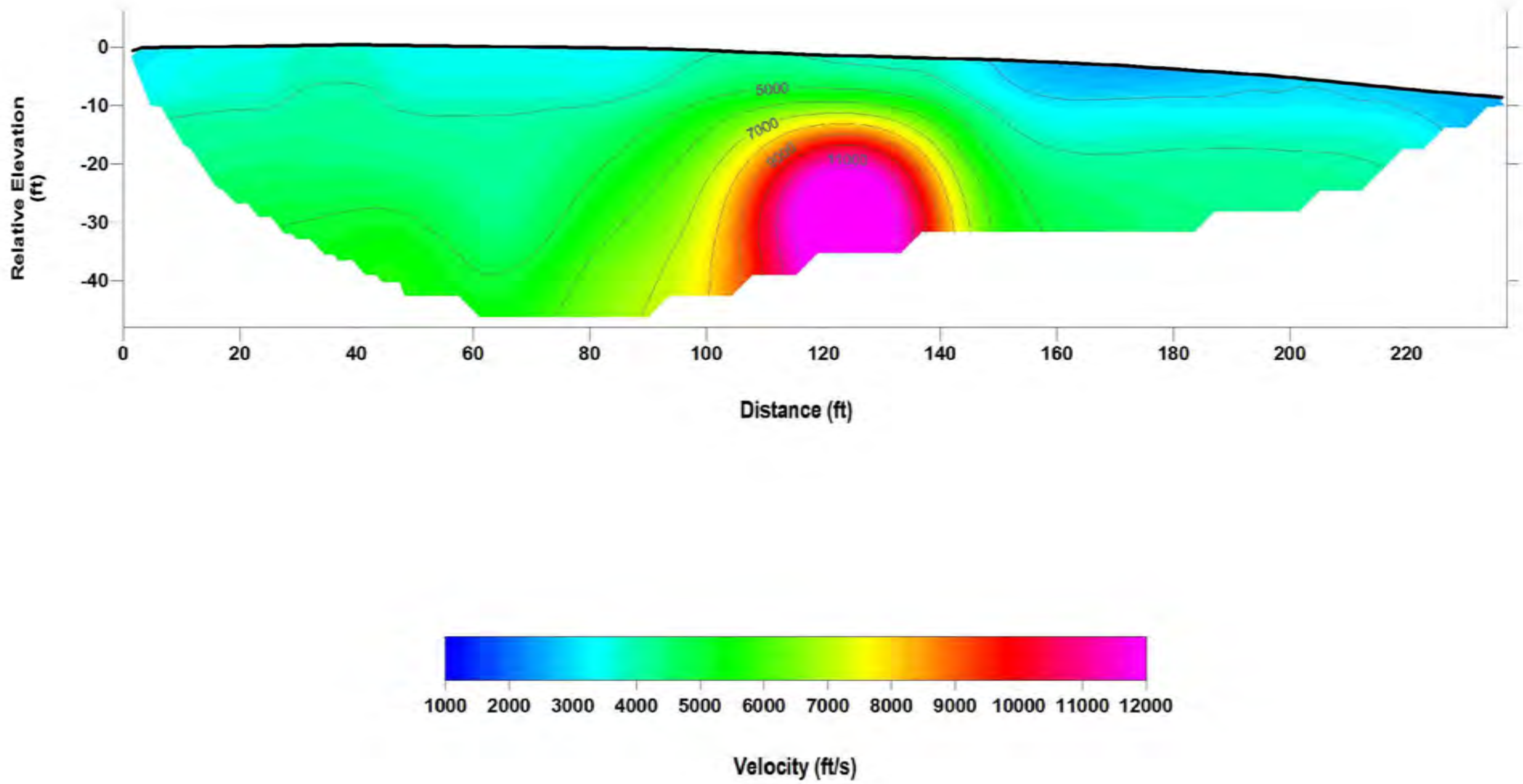


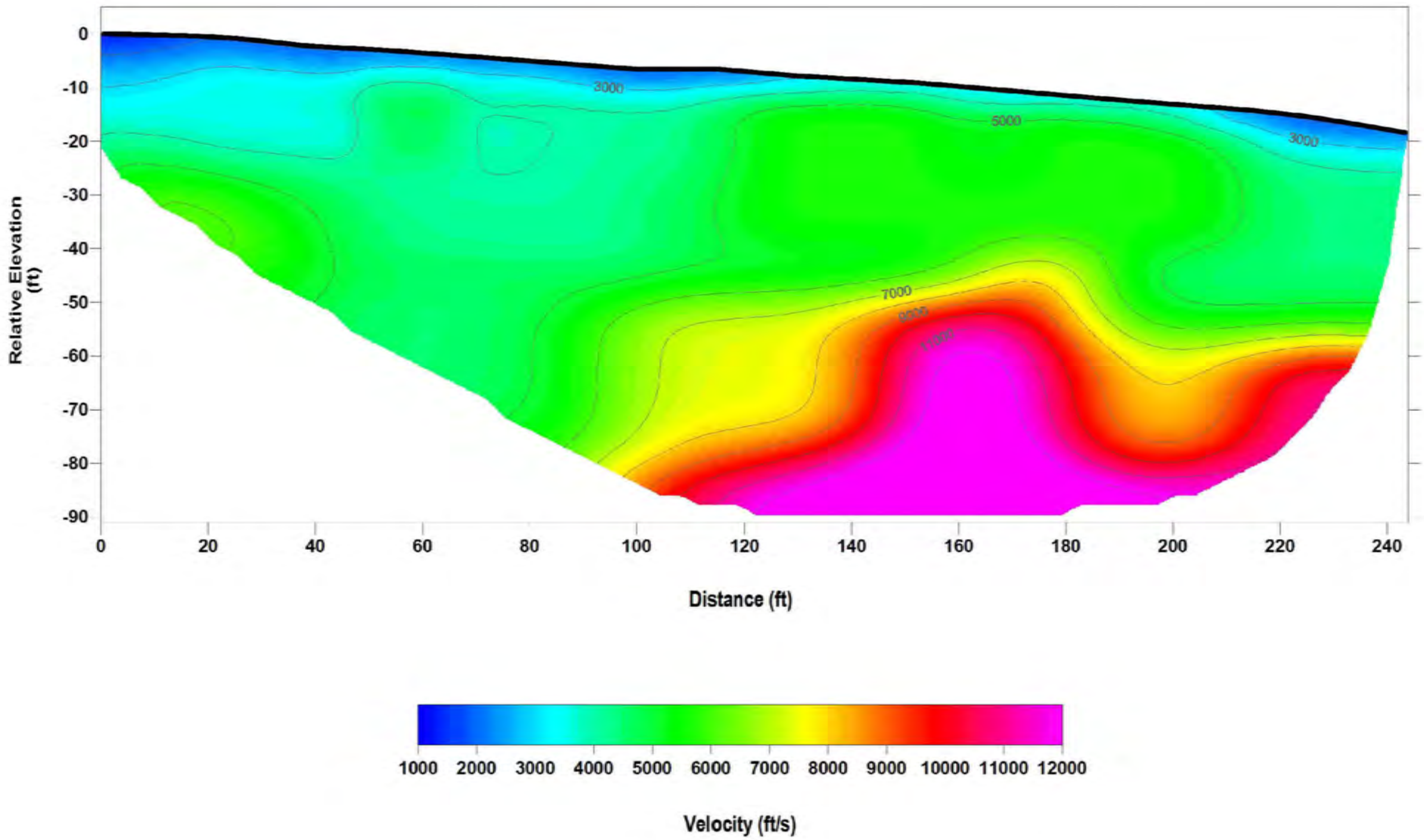
P-WAVE PROFILE SL-5	Green Tree Ranch Riverside, California		SOUTHWEST GEOPHYSICS INC. Figure 4e	**Note: Contour Interval = 1,000 feet per second**
	Project No.: 118142	Date: 04/18		

TOMOGRAPHY MODEL



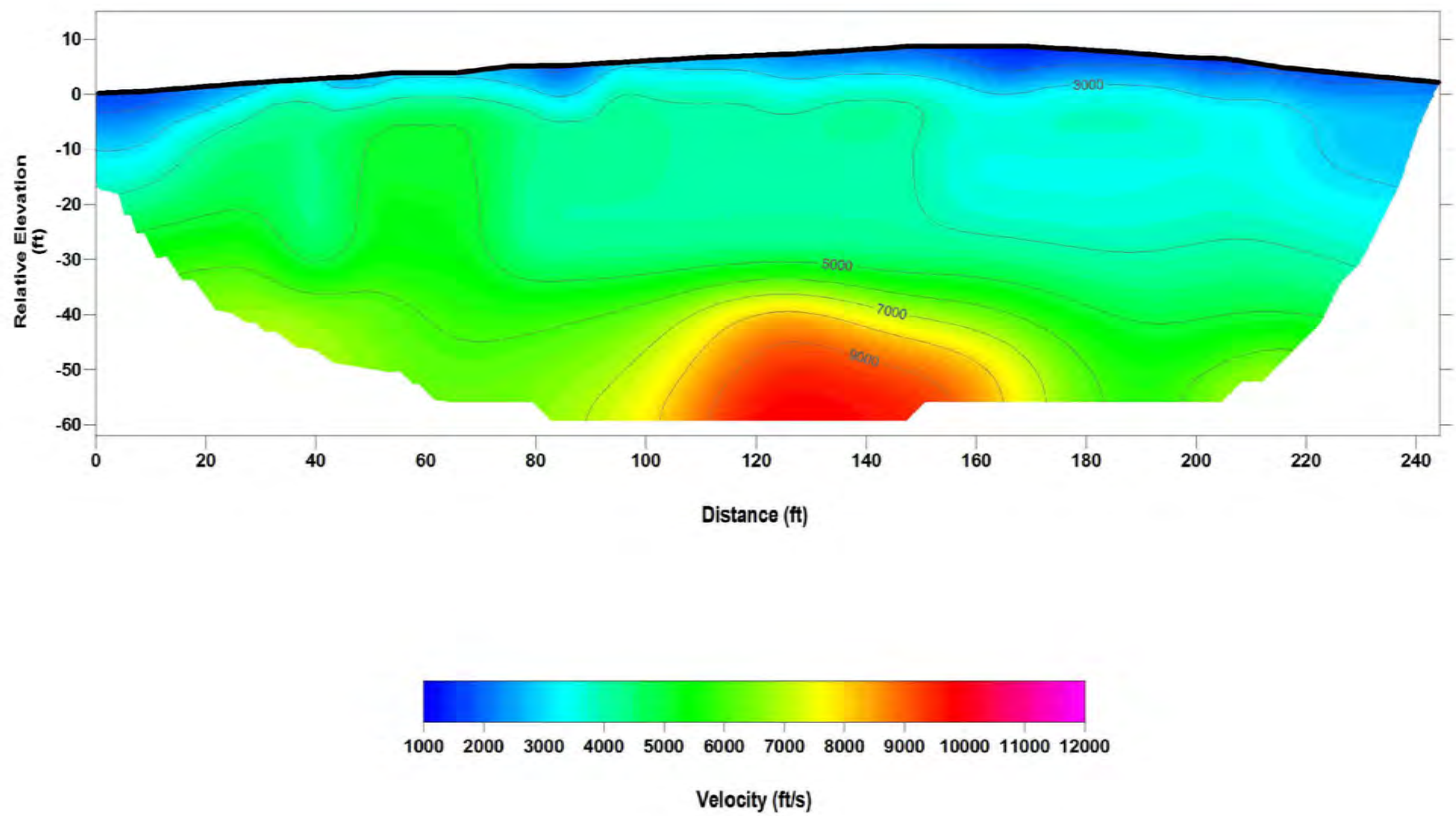
P-WAVE PROFILE SL-6	Green Tree Ranch Riverside, California	SOUTHWEST GEOPHYSICS INC. Figure 4f	**Note: Contour Interval = 1,000 feet per second**
	Project No.: 118142 — Date: 04/18		

TOMOGRAPHY MODEL



P-WAVE PROFILE SL-7	Green Tree Ranch Riverside, California		SOUTHWEST GEOPHYSICS INC. Figure 4g	**Note: Contour Interval = 1,000 feet per second**
	Project No.: 118142	Date: 04/18		

TOMOGRAPHY MODEL



P-WAVE PROFILE SL-8	Green Tree Ranch Riverside, California Project No.: 118142 Date: 04/18	SOUTHWEST GEOPHYSICS INC. Figure 4h

Note: Contour Interval = 1,000 feet per second

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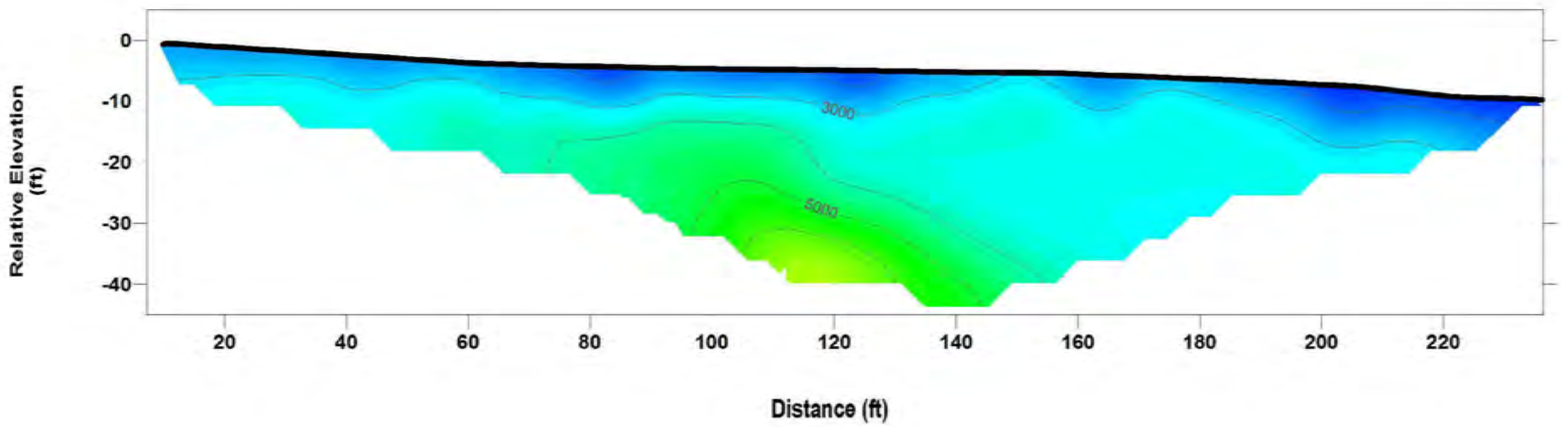

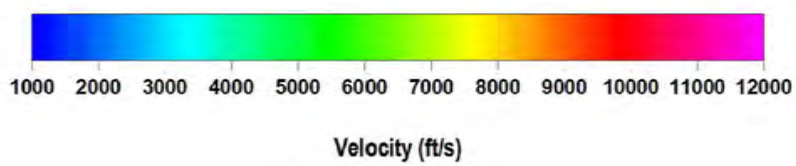

P-WAVE PROFILE SL-9	Green Tree Ranch Riverside, California	SOUTHWEST GEOPHYSICS INC. Figure 4i	**Note: Contour Interval = 1,000 feet per second**
	Project No.: 118142	Date: 04/18	

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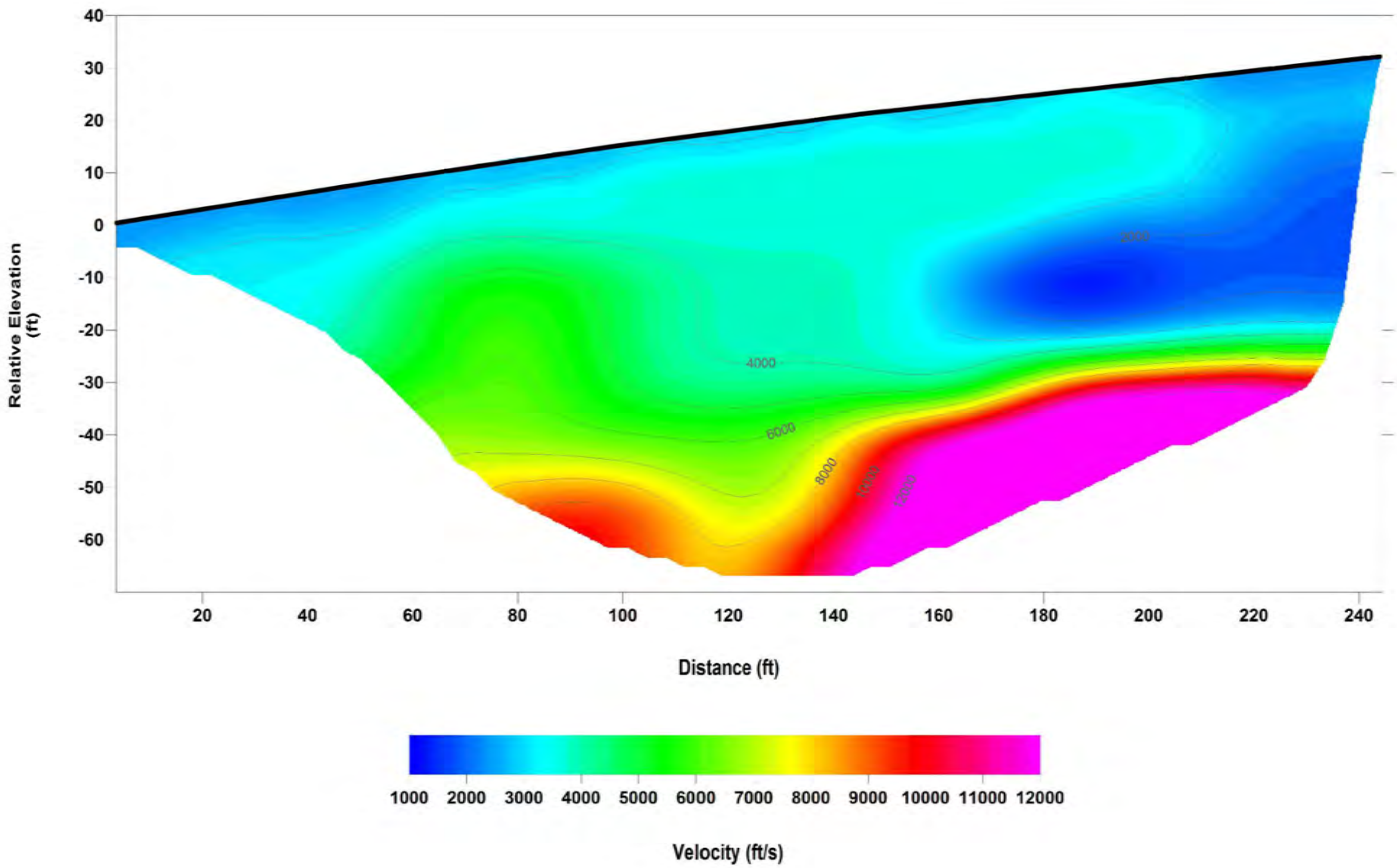

P-WAVE PROFILE SL-10	Green Tree Ranch Riverside, California Project No.: 118142 · Date: 04/18	SOUTHWEST GEOPHYSICS INC. Figure 4j

Note: Contour Interval = 1,000 feet per second

APPENDIX B2

SUBSURFACE LOGS

(LEIGHTON AND ASSOCIATES 2005)

GEOTECHNICAL BORING LOG LB-1

Date 1-24-05 **Sheet** 1 **of** 1
Project Victoria Grove East **Project No.** 111446-001
Drilling Co. Layne Christiansen **Type of Rig**
Hole Diameter 8" **Drive Weight** 140 lbs **Drop** 30"
Elevation Top of Hole +/- 1221' **Location** See Map

Logged By PC
Sampled By PC

Elevation Feet	Depth Feet	Graphic Log (N S)	Notes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0								TOPSOIL	
1220									QUATERNARY ALLUVIUM (Qal)	
				R1	7	103.5	14.7	SM	@ 2.5': Dark brown, moist, loose, silty, fine SAND; pinhole pore common, rootlets common, vugs common	
									QUATERNARY ALLUVIUM OLDER (Qalo)	
	5			R2	26	113.0	9.3	SM	@ 5': Red-brown, moist, medium dense, silty, fine SAND; pinhole pores common, blocky	
1215									CRETACEOUS AGED GRANITIC BEDROCK (Kgr)	
				R3	89/11"	134.5	5.9		@ 7.5': Medium brown, damp to moist, very dense, weathered BEDROCK; very friable	
	10									
1210										
									Total Depth 8.9' No Groundwater Encountered Backfilled with Spoils 1/24/05	
	15									
1205										
	20									
1200										
	25									
1195										
	30									

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

TYPE OF TESTS:
SU SULFATE
DS DIRECT SHEAR
MD MAXIMUM DENSITY
CN CONSOLIDATION
CR CORROSION
HCO HYDROCOLLAPSE
HD HYDROMETER
SA SIEVE ANALYSIS
AL ATTERBERG LIMITS
EI EXPANSION INDEX
RV R-VALUE
CS CORROSION SUITE
MC MOISTURE CONTENT
SE SAND EQUIVALENT
-200 200 WASH
RDS Remolded DS

LEIGHTON

GEOTECHNICAL BORING LOG LB-2

Date 1-24-05
Sheet 1 of 1
Project Victoria Grove East
Project No. 111446-001
Drilling Co. Layne Christiansen
Type of Rig
Hole Diameter 8"
Drive Weight 140 lbs
Drop 30"
Elevation Top of Hole +/- 1290'
Location See Map

Logged By PC
Sampled By PC

Elevation Feet	Depth Feet	Graphic Log (N S)	Notes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
1290	0								TOPSOIL QUATERNARY ALLUVIUM OLDER (Qalo)	
				R1	73	111.2	14.9	ML	@ 2.5': Light to medium brown, moist, very stiff, sandy SILT; pinhole pores, rootlets common, blocky texture	RDS
1285	5			R2	46	111.4	4.4		@ 5': Medium brown, damp to moist, very stiff, sandy SILT; pinhole pores common, calcium carbonate stringers common, blocky texture	HCO, -200, EI
				R3	34			SM	@ 7.5': Light to medium brown, damp to moist, medium dense, silty, fine SAND; pinhole to 2mm diameter hole pores common, calcium carbonate stringers common, blocky texture	
1280	10			R4	63	117.1	8.0		@ 10': Medium to red-brown, damp to moist, dense, silty, fine SAND; pinhole pores common, calcium carbonate stringers very common, blocky texture	HCO, EI
				R5	81	132.9	7.8		@ 12.5': Dark red-brown, moist, dense, silty, fine to medium SAND; few rock fragments, micaceous	HCO, -200, EI
1275	15			R6	19				@ 15': Dark red-brown, moist, medium dense, silty, fine to medium SAND; few rock fragments, micaceous	
				R7	24	112.9	17.2		@ 17.5': Red-brown, damp to moist, medium dense, silty, fine to medium SAND; calcium carbonate stringers very common, micaceous	-200
1270	20			R8	20				@ 20': Red-brown, damp to moist, medium dense, silty, fine to medium SAND; pebbles common, very micaceous	
				R9	63	123.8	2.5		CRETACEOUS AGED GRANITIC BEDROCK (Kgr) @ 22.5': Red-brown, damp to moist, dense, weathered BEDROCK; friable, breaks into coarse sand and gravel, very micaceous	
1265	25			S10	50/5"				@ 25': Gray-brown, damp, very dense, weathered BEDROCK; friable, breaks into coarse sand and gravel	
1260	30								Total Depth 25.9' No Groundwater Encountered Backfilled with Spoils 1/24/05	

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

TYPE OF TESTS:
SU SULFATE
DS DIRECT SHEAR
MD MAXIMUM DENSITY
CN CONSOLIDATION
CR CORROSION
HCO HYDROCOLLAPSE
HD HYDROMETER
SA SIEVE ANALYSIS
AL ATTERBERG LIMITS
EI EXPANSION INDEX
RV R-VALUE
CS CORROSION SUITE
MC MOISTURE CONTENT
SE SAND EQUIVALENT
-200 200 WASH
RDS Remolded DS

LEIGHTON

GEOTECHNICAL BORING LOG LB-3

Date 1-24-05 **Sheet** 1 **of** 1
Project Victoria Grove East **Project No.** 111446-001
Drilling Co. Layne Christiansen **Type of Rig**
Hole Diameter 8" **Drive Weight** 140 lbs **Drop** 30"
Elevation Top of Hole +/- 1182' **Location** See Map

Logged By PC
Sampled By PC

Elevation Feet	Depth Feet	Graphic Log (N S)	Notes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0								TOPSOIL	
1180										
									CRETACEOUS AGED GRANITIC BEDROCK (Kgr)	
	5			R1	23	128.2	2.9		@ 5': Red-brown, damp, medium dense, weathered BEDROCK; friable, breaks into coarse sand and gravel	
1175										
				R2	50/5"	120.7	2.8		@ 7.5': Red-brown, damp, very dense, weathered BEDROCK; friable, breaks into coarse sand and gravel	
	10									
1170									Total Depth 8.4' No Groundwater Encountered Backfilled with Spoils 1/24/05	
	15									
1165										
	20									
1160										
	25									
1155										
	30									

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

TYPE OF TESTS:
SU SULFATE
DS DIRECT SHEAR
MD MAXIMUM DENSITY
CN CONSOLIDATION
CR CORROSION
HCO HYDROCOLLAPSE
HD HYDROMETER
SA SIEVE ANALYSIS
AL ATTERBERG LIMITS
EI EXPANSION INDEX
RV R-VALUE
CS CORROSION SUITE
MC MOISTURE CONTENT
SE SAND EQUIVALENT
-200 200 WASH
RDS Remolded DS

LEIGHTON

GEOTECHNICAL BORING LOG LB-4

Date 1-24-05 | Sheet 1 of 1
Project Victoria Grove East | Project No. 111446-001
Drilling Co. Layne Christiansen | Type of Rig
Hole Diameter 8" | Drive Weight 140 lbs | Drop 30"
Elevation Top of Hole +/- 1228' | Location See Map

Logged By PC
Sampled By PC

Elevation Feet	Depth Feet	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0								TOPSOIL	
									QUATERNARY ALLUVIUM OLDER (Qalo)	
1225				R1	17	109.8	15.5	SM	@ 2.5': Dark red-brown, moist, medium dense, silty, fine SAND; calcium carbonate stringers common, pinhole pores common, rootlets common, semi-blocky texture	HCO, EI
	5			R2	11				@ 5': Dark red-brown, moist, loose to medium dense, silty, fine SAND; calcium carbonate stringers common, pinhole pores common, rootlets common	
1220				R3	19	114.0	11.2		@ 7.5': Dark red-brown, moist, medium dense, silty, fine to coarse SAND; pebbles common, micaceous	HCO, EI
	10			R4	35				@ 10': Dark red-brown, very moist, medium dense, silty, fine to coarse SAND; pebbles common, micaceous	
1215				R5	50/5"	122.3	8.8		@ 12.5': Dark red-brown, very moist, very dense, silty, fine to coarse SAND; micaceous, pebbles common	
									CRETACEOUS AGED GRANITIC BEDROCK (Kgr)	
	15			R6	50/5"	112.1	6.4		@ 15': Red-brown, moist, very dense, weathered BEDROCK; friable, breaks into coarse sand and gravel	
1210										
	20								Total Depth 15.4' No Groundwater Encountered Backfilled with Spoils 1/24/05	
1205										
	25									
1200										
	30									

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

TYPE OF TESTS:
SU SULFATE
DS DIRECT SHEAR
MD MAXIMUM DENSITY
CN CONSOLIDATION
CR CORROSION
HCO HYDROCOLLAPSE
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EI EXPANSION INDEX
RV R-VALUE
CS CORROSION SUITE
MC MOISTURE CONTENT
SE SAND EQUIVALENT
-200 200 WASH
RDS Remolded DS

LEIGHTON

GEOTECHNICAL BORING LOG LB-5

Date 1-24-05 **Sheet** 1 **of** 1
Project Victoria Grove East **Project No.** 111446-001
Drilling Co. Layne Christiansen **Type of Rig**
Hole Diameter 8" **Drive Weight** 140 lbs **Drop** 30"
Elevation Top of Hole +/- 1240' **Location** See Map

Logged By: PC
Sampled By: PC

Elevation Feet	Depth Feet	Graphic Log	Notes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
1240	0								TOPSOIL QUATERNARY ALLUVIUM OLDER (Qalo)	
				R1	20	104.4	19.3	SM	@ 2.5': Red-brown, moist, medium dense, silty, fine SAND; rootlets common, pinhole pores common, calcium carbonate stringers common, blocky textures	
1235	5			R2	28	110.8	15.1		@ 5': Medium brown, moist, medium dense, silty, fine to medium SAND; few rootlets, calcium carbonate stringers common, pinhole pores common, few pebbles	
				R3	35			SP-SM	@ 7.5': Gray-brown, moist, medium dense, silty, fine to coarse SAND; pebbles common, micaceous	
1230	10			R4	22	114.9	16.9	SC-SM	@ 10': Gray-brown, moist, medium dense, clayey, silty, fine SAND; few coarse grains	
				R5	92				CRETACEOUS AGED GRANITIC BEDROCK (Kgr) @ 12.5': Gray-brown, moist, medium dense, heavily weathered BEDROCK; friable, breaks into coarse sand	
1225	15			R6	72	125.3	11.6		@ 15': Medium gray, moist, dense, weathered BEDROCK; friable, breaks into medium to coarse sand, veined	
1220	20								Total Depth 16.5' No Groundwater Encountered Backfilled with Spoils 1/24/05	
1215	25									
1210	30									

SAMPLE TYPES:
- S SPT
- R RING SAMPLE
- B BULK SAMPLE
- T TUBE SAMPLE
- G GRAB SAMPLE
- C CORE SAMPLE

TYPE OF TESTS:
- SU SULFATE
- DS DIRECT SHEAR
- MD MAXIMUM DENSITY
- CN CONSOLIDATION
- CR CORROSION
- HCO HYDROCOLLAPSE
- HD HYDROMETER
- SA SIEVE ANALYSIS
- AL ATTERBERG LIMITS
- EI EXPANSION INDEX
- RV R-VALUE
- CS CORROSION SUITE
- MC MOISTURE CONTENT
- SE SAND EQUIVALENT
- -200 200 WASH
- RDS Remolded DS

LEIGHTON

GEOTECHNICAL BORING LOG LB-6

Date 1-24-05 **Sheet** 1 **of** 1
Project Victoria Grove East **Project No.** 111446-001
Drilling Co. Layne Christiansen **Type of Rig**
Hole Diameter 8" **Drive Weight** 140 lbs **Drop** 30"
Elevation Top of Hole +/- 1255' **Location** See Map

Logged By PC
Sampled By PC

Elevation Feet	Depth Feet	Graphic Log (N S)	Notes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
1255	0								TOPSOIL	
									CRETACEOUS AGED GRANITIC BEDROCK (Kgr)	
				R1	50/5"	130.9	2.2		@ 2.5': Red-brown, damp, very dense, weathered BEDROCK; friable, breaks into coarse sand and gravel	
1250	5									
1245	10								Total Depth 5' No Groundwater Encountered Backfilled with Spoils 1/24/05	
1240	15									
1235	20									
1230	25									
1225	30									

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

TYPE OF TESTS:
SU SULFATE
DS DIRECT SHEAR
MD MAXIMUM DENSITY
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-200 200 WASH
RDS Remolded DS

LEIGHTON

LOG OF TEST PITS

Project No. 111446-001
CLIENT: Victoria Grove

LOGGED BY: PC
DATE: 12/21/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-1	0-2				SM	**Quaternary Colluvium (Qcol) –** Red-brown, very moist, loose to medium dense, silty, fine to coarse SAND; rootlets throughout
	2-5					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Red-brown, moist, medium dense to very dense, weathered BEDROCK; iron oxide staining, silts between grains, very friable, breaks into silty, fine to coarse sand
						Total Depth 5', No Groundwater, No Caving, Backfilled 12/21/04
T-2	0-2.5				SM	**Quaternary Colluvium (Qcol) –** Red-brown, very moist, loose to medium dense, silty, fine to medium SAND; rootlets extend throughout, medium micaceous flakes
	2.5-4					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Pale brown, damp, medium dense to dense, weathered BEDROCK; ivery friable, breaks into silty, fine to coarse sand
						Total Depth 4', No Groundwater, No Caving, Backfilled 12/21/04
T-3	0-2				SM	**Quaternary Colluvium (Qcol) –** Red-brown, very moist, loose to medium dense, silty, fine to coarse SAND; rootlets throughout
	2-5					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Red-brown, moist, medium dense to very dense, weathered BEDROCK; iron oxide staining, silts between grains, very friable, breaks into silty, fine to coarse sand
						Total Depth 5', No Groundwater, No Caving, Backfilled 12/21/04

LOG OF TEST PITS

Project No. 111446-001
CLIENT: Victoria Grove

LOGGED BY: PC
DATE: 12/21/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-4	0-2.5				SM	**Quaternary Colluvium (Qcol) –** Red-brown, very moist, loose to medium dense, silty, fine to coarse SAND; rootlets throughout, large subangular cobbles <8"
	2.5-4.5					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Red-brown, moist, medium dense to very dense, weathered BEDROCK; iron oxide staining, silts between grains, very friable, breaks into silty, fine to coarse sand
						Total Depth 4.5', No Groundwater, No Caving, Backfilled 12/21/04
T-5	0-2.5				SM	**Quaternary Colluvium (Qcol) –** Brown, very moist, loose to medium dense, silty, fine to medium SAND; rootlets throughout
	2.5-4.5					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Red-brown, moist, medium dense to dense, weathered BEDROCK; silts and clay between grains, very friable, breaks into silty, fine to very coarse sand
						Total Depth 4.5', No Groundwater, No Caving, Backfilled 12/21/04
T-6	0-7	Chunk 1 @ 0-6.5 Bulk 2 @ 0-6.5	92.0	5.5	ML	**Quaternary Colluvium (Qcol) –** Red-brown, very moist, soft to medium stiff, silty, fine to coarse SAND; rootlets throughout
	7-7.5					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Gray-brown, damp, medium dense to dense, weathered BEDROCK
						Total Depth 7.5', No Groundwater, No Caving, Backfilled 12/21/04

LOG OF TEST PITS

Project No. 111446-001
CLIENT: Victoria Grove

LOGGED BY: PC
DATE: 12/21/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-7	0-2.5				SM	**Quaternary Colluvium (Qcol) –** Red-brown, damp to moist, loose to medium dense, silty, fine to medium SAND; rootlets throughout
	2.5-3				SM	Red-brown, damp, very dense, silty, fine to medium SAND; hardpan layer, calcium carbonate stringers, pinhole pores throughout
	3-8.5	Bulk 3 @ 3-8'			SM	**Quaternary Alluvium Older (Qalo) –** Red-brown, damp, medium dense to dense, silty, fine to medium SAND; calcium carbonate stringers throughout, pinhole pores throughout
						Total Depth 8.5', No Groundwater, No Caving, Backfilled 12/21/04
T-8	0-3				SM	**Quaternary Colluvium (Qcol) –** Red-brown, damp to moist, loose to medium dense, silty, fine to medium SAND; rootlets throughout, thicker root system upper 1.5 feet
	3-6.5				SM	**Quaternary Alluvium Older (Qalo) –** Red-brown, damp, medium dense to dense, silty, fine to medium SAND; calcium carbonate stringers throughout, pinhole pores throughout
	6.5-8.5	Bulk 4 @ 6.5-8.5'				**Cretaceous-Aged Granitic Bedrock (Kgr) –** Gray-brown, damp, dense to very dense, weathered BEDROCK; mafic, friable, breaks into medium to coarse sand
						Total Depth 8.5', No Groundwater, No Caving, Backfilled 12/21/04

LOG OF TEST PITS

Project No. 111446-001
CLIENT: Victoria Grove

LOGGED BY: PC
DATE: 12/21/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-9	0-8				SM	**Quaternary Colluvium (Qcol) –** Red-brown, moist to very moist, loose to medium dense, silty, fine SAND; few pebbles, pinhole pores throughout, rootlets to 3′ in depth
	3-11				SM	**Quaternary Alluvium Older (Qalo) –** Dark red-brown, moist to wet, medium dense, silty, fine to medium SAND; pinhole pores, calcium carbonate stringers
	11-12					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Green-gray, wet, loose, heavily weathered BEDROCK; very spongy
						Total Depth 12′, No Groundwater, No Caving, Backfilled 12/21/04
T-10	0-0.5				SM	**Quaternary Colluvium (Qcol) –** Dark red-brown, moist, loose to medium dense, silty, fine to medium SAND; rootlets throughout
	0.5-11				SM	**Quaternary Alluvium Older (Qalo) –** Dark red-brown, moist, loose to medium dense, silty, fine to medium SAND; pinhole pores throughout, calcium carbonate stringers, few rootlets, infilled burrows
	11-12				SM	Dark red-brown, moist, dense, silty, fine to medium SAND; calcium carbonate stringers, calcium carbonate infilled burrows, few rootlets, pinhole pores
						Total Depth 12′, No Groundwater, No Caving, Backfilled 12/21/04
T-11	0-0.5				SM	**Quaternary Colluvium (Qcol) –** Red-brown, moist, loose to medium dense, silty, fine to medium SAND; rootlets throughout
	0.5-9					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Red-brown, damp, dense, severely weathered BEDROCK; well decomposed to silty, fine to coarse sand with weathered granitic cobbles up to 6 inches in diameter
						Total Depth 9′, No Groundwater, No Caving, Backfilled 12/21/04

LOG OF TEST PITS

Project No. 111446-001
CLIENT: Victoria Grove

LOGGED BY: PC
DATE: 12/21/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-12	0-0.5				SM	**Topsoil** – Red-brown, moist, loose, silty, fine SAND;, rootlet system throughout
	0.5-4.5					**Cretaceous-Aged Granitic Bedrock (Kgr)** – Red-brown, damp, dense, weathered BEDROCK; friable, breaks into medium to very coarse sand and gravel, some silts between grains
						Total Depth 4.5', No Groundwater, No Caving, Backfilled 12/21/04
T-13	0-5.5				SM	**Quaternary Alluvium Older (Qalo)** – Red-brown, moist, loose to medium dense, silty, fine SAND; rootlet system to 2½' , calcium carbonate stringers
	5.5-9				SM	Light-brown, damp, medium dense, silty, fine to medium SAND; calcium carbonate rich, few pebbles, granitic cobbles surrounded by sand matrix, weathered
	9-12					**Cretaceous-Aged Granitic Bedrock (Kgr)** – Olive-light brown, moist, loose to medium dense, severely weathered BEDROCK; well decomposed to silty fine to medium sand around heavily weathered granitic cobbles
						Total Depth 12', No Groundwater, No Caving, Backfilled 12/21/04
T-14	0-4.5				SM	**Quaternary Colluvium (Qcol)** – Red-brown, moist, medium dense, silty, fine to coarse SAND and GRAVEL; pebbles < 4mm in diameter, rootlets
	4.5-6					**Cretaceous-Aged Granitic Bedrock (Kgr)** – Red-brown, damp to moist, dense, weathered BEDROCK; friable, breaks into medium to very coarse sand
						Total Depth 6', No Groundwater, No Caving, Backfilled 12/21/04

LOG OF TEST PITS

Project No. 111446-001
CLIENT: Victoria Grove

LOGGED BY: PC
DATE: 12/21/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-15	0-5				SM/GW	**Quaternary Colluvium (Qcol) –** Red-brown, moist, medium dense, silty, fine to coarse SAND and GRAVEL; pebbles < 4mm in diameter, rootlets
	5-6					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Red-brown, damp to moist, dense, weathered BEDROCK; friable, breaks into medium to very coarse sand Total Depth 6', No Groundwater, No Caving, Backfilled 12/21/04
T-16	0-3				SM	**Quaternary Alluvium Older (Qalo)** – Red-brown, damp, medium dense, silty, fine to medium SAND and GRAVEL; pebbles range between 2mm and 2 inches in diameter
	3-5					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Red-brown, damp, dense, weathered BEDROCK; friable, breaks into fine to coarse sand Total Depth 5', No Groundwater, No Caving, Backfilled 12/21/04
T-17	0-7.5				SM	**Quaternary Alluvium Older (Qalo) –** Red-brown, damp to slightly moist, loose, silty, fine to coarse SAND; few pebbles, few rootlets, same calcium carbonate stringers Total Depth 7.5', No Groundwater, No Caving, Backfilled 12/21/04
T-18	0-4				SM	**Quaternary Alluvium Older (Qalo) –** Dark red-brown, moist, loose to medium dense, silty, fine to medium SAND; rootlets throughout
	4-7					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Light brown, damp, dense to very dense, weathered BEDROCK; slope contact with unit above (possibly a large boulder) latite dike near vertical Total Depth 7', No Groundwater, No Caving, Backfilled 12/21/04

LOG OF TEST PITS

Project No. 111446-001
CLIENT: Victoria Grove

LOGGED BY: PC
DATE: 12/21/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-19	0-9				SM	**Quaternary Alluvium Older (Qalo) –** Red-brown, damp to moist, medium dense to dense, silty, fine to coarse SAND; rootlets upper 2 feet, pinhole pores throughout, some calcium carbonate stringers Total Depth 9', No Groundwater, No Caving, Backfilled 12/21/04
T-20	0-2.5 2.5-5.5				SM	**Quaternary Colluvium (Qcol) –** Red-brown, moist, medium dense, silty, fine to medium SAND; rootlets throughout, few burrows <½ inch in diameter, few pinhole pores **Cretaceous-Aged Granitic Bedrock (Kgr) –** Red-brown, damp, dense, weathered BEDROCK; very friable, breaks into medium to coarse sand Total Depth 5.5', No Groundwater, No Caving, Backfilled 12/21/04
T-21	0-4 4-7				SM	**Quaternary Colluvium (Qcol) –** Red-brown, damp to slightly moist, medium dense, silty, fine to medium SAND; root system upper 2 feet, few pinhole pores **Cretaceous-Aged Granitic Bedrock (Kgr) –** Red-brown, damp to slightly moist, dense to very dense, weathered BEDROCK; friable, breaks into medium to very coarse sand Total Depth 7', No Groundwater, No Caving, Backfilled 12/21/04
T-22	0-0.5 0.5-2.5				SM	**Topsoil –** Brown, moist, loose, silty, fine to coarse SAND;, rootlet system throughout **Cretaceous-Aged Granitic Bedrock (Kgr) –** Red-brown, moist, medium dense to dense, weathered BEDROCK; friable, breaks into medium to coarse sand Total Depth 2.5', No Groundwater, No Caving, Backfilled 12/21/04

LOG OF TEST PITS

Project No. 111446-001
CLIENT: Victoria Grove

LOGGED BY: PC
DATE: 12/21-22/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-23	0-0.5				SM	**Topsoil –** Red-brown, moist, loose, silty, fine to medium SAND;, root system throughout
	0.5-4				SM	**Quaternary Alluvium Older (Qalo) –** Red-brown, moist, medium dense, silty, fine to medium SAND; calcium carbonate stringers, pinhole pores, few angular cobbles towards lower 2 feet
	4-6					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Red-brown, moist, medium dense to dense, weathered BEDROCK; friable, breaks into medium to coarse sand
						Total Depth 6', No Groundwater, No Caving, Backfilled 12/21/04
T-24	0-0.5				SM	**Topsoil –** Red-brown, moist, loose, silty, fine to medium SAND;, root system throughout
	0.5-3				SM	**Quaternary Alluvium Older (Qalo) –** Red-brown, moist, medium dense, silty, fine to medium SAND; calcium carbonate stringers, pinhole pores, few angular cobbles towards lower 2 feet
	3-5					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Red-brown, moist, medium dense to dense, weathered BEDROCK; friable, breaks into medium to coarse sand
						Total Depth 5', No Groundwater, No Caving, Backfilled 12/22/04
T-25	0-7				SM	**Quaternary Colluvium (Qcol) –** Red-brown, damp to slightly moist, loose to medium dense, silty, fine SAND; rootlets throughout, no gradation change in grain size
						Total Depth 7', No Groundwater, No Caving, Backfilled 12/22/04

LOG OF TEST PITS

Project No. 111446-001
CLIENT: Victoria Grove

LOGGED BY: PC
DATE: 12/27/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-26	0-3.5	B-5 @ 1-3'			SM	**Quaternary Colluvium (Qcol) –** Red-brown, damp to slightly moist, loose to medium dense, silty, fine SAND; rootlets throughout, no gradation change in grain size
	3.5-5	B-6 @ 3.5-5'				**Cretaceous-Aged Granitic Bedrock (Kgr) –** Red-brown, moist, medium dense to dense, weathered BEDROCK; friable, breaks into medium to coarse sand
						Total Depth 5', No Groundwater, No Caving, Backfilled 12/22/04
T-27	0-10				SM	**Quaternary Alluvium Older (Qalo) –** Red-brown, damp to moist, medium dense to dense, silty, fine to medium SAND;, rootlets throughout, pinhole pores, calcium carbonate stringers throughout
						Total Depth 10', No Groundwater, No Caving, Backfilled 12/22/04
T-28	0-0.5				SM	**Topsoil –** Red-brown, moist, loose, silty, fine SAND;, root system
	0.5-3				SM	**Quaternary Alluvium Older (Qalo) –** Dark brown, moist, medium dense, silty, fine SAND; active root system throughout, pinhole pores throughout, blocky
	3-7				SM	Red-brown, damp to moist, medium dense, silty, fine to medium SAND; few rootlets, pinhole pores throughout, some calcium carbonate stringers, blocky
	7-7.5					Calcium Carbonate Layer – Pale brown, damp, loose, calcium carbonate stringers, porous, flaky
	7.5-9				SM	Red-brown, damp to slightly moist, medium dense, silty, fine SAND
	9-9.5					Boulder – Gray, damp, very dense BOULDER; diorite boulder, fresh
	9.5-10				SM	Red-brown, damp, medium dense, silty, fine SAND; pinhole pores
						Total Depth 10', No Groundwater, No Caving, Backfilled 12/22/04

LOG OF TEST PITS

Project No. 111446-001
CLIENT: Victoria Grove

LOGGED BY: PC
DATE: 12/27/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-29	0-7				SM	**Quaternary Alluvium Older (Qalo) –** Red-brown, damp to moist, medium dense, silty, fine to medium SAND; pinhole pores throughout, rootlets throughout, blocky
						Total Depth 7', No Groundwater, No Caving, Backfilled 12/22/04
T-30	0-5				SM	**Quaternary Alluvium Older (Qalo) –** Red-brown, damp to moist, loose to medium dense, silty, fine SAND; pinhole pores, throughout, rootlets in upper 2 feet, calcium carbonate stringers
	5-5.5					Calcium carbonate layer – Pale brown, damp to moist, loose to medium dense, calcium carbonate layer, porous
	5.5-6.5				SM	Dark brown, damp to moist, medium dense to dense, silty, fine SAND; pinhole pores throughout, calcium carbonate stringers, blocky
						Total Depth 6.5', No Groundwater, No Caving, Backfilled 12/22/04
T-31	0-8				SM	**Quaternary Alluvium Older (Qalo) –** Red-brown, moist, loose to medium dense, silty, medium to coarse SAND; grains comprised of displaced Kgr, sand and gravel
	3.5-5					Calcium carbonate layer; 2-3' thick
	8-9	B-7 @ 8-9'				**Cretaceous-Aged Granitic Bedrock (Kgr) –** Dark gray, damp to moist, dense to very dense, weathered BEDROCK; friable, breaks into medium to coarse sand
						Total Depth 9', No Groundwater, No Caving, Backfilled 12/22/04

LOG OF TEST PITS

Project No. 111446-001
CLIENT: Victoria Grove

LOGGED BY: PC
DATE: 12/27/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-32	0-2				SM	**Topsoil –** Brown, damp, loose to medium dense, silty, fine SAND; rootlets throughout, few pinhole pores
	2-9				SM	**Quaternary Alluvium Older (Qalo) –** Dark red-brown, damp to slightly moist, medium dense to dense, silty, fine SAND; few rootlets, pinhole pores, calcium carbonate stringers, blocky, few pebbles <6 mm in diameter
						Total Depth 9', No Groundwater, No Caving, Backfilled 12/22/04
T-33	0-8				SM	**Quaternary Alluvium Older (Qalo) –** Red-brown, damp, dense to very dense, silty SAND; very well cemented, subangular pebbles <8 mm in diameter, calcium carbonate stringers, blocky
						Total Depth 8', No Groundwater, No Caving, Backfilled 12/22/04
T-34	0-4				SM	**Artificial Fill Undocumented (Afu) –** Red-brown, damp to moist, medium dense, silty, fine to coarse SAND; asphalt blocks, rootlets throughout
	4-6				SM	**Quaternary Alluvium Older (Qalo) –** Red-brown, damp to moist, medium dense, silty, fine SAND with gravels; pebbles <4 mm in diameter, pinhole pores, calcium carbonate stringers
	6-7					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Red-brown, damp, dense to very dense, weathered BEDROCK; friable, breaks down to medium to coarse sand
						Total Depth 7', No Groundwater, No Caving, Backfilled 12/22/04

LOG OF TEST PITS

Project No. 111446-001
CLIENT: Victoria Grove

LOGGED BY: PC
DATE: 12/27/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-35	0-2				SM	**Quaternary Colluvium (Qcol) –** Red-brown, damp to moist, loose to medium dense, silty, fine SAND; active root system throughout, porous, some pebbles <10 mm in diameter
	2-4.5					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Red-brown, damp, medium dense, weathered BEDROCK; very friable, breaks into medium to coarse sand
						Total Depth 4.5', No Groundwater, No Caving, Backfilled 12/22/04
T-36	0-2				SM	**Quaternary Colluvium (Qcol) –** Red-brown, moist, loose, silty, fine SAND; few pebbles <4 mm in diameter, rootlets throughout
	2-4.5					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Red-brown, damp to moist, medium dense to dense, weathered BEDROCK; very friable, breaks into medium to coarse sand, few pockets of silty sand
						Total Depth 4.5', No Groundwater, No Caving, Backfilled 12/22/04
T-37	0-7	B-8 @ 0-5'			ML	**Quaternary Alluvium Older (Qalo) –** Light brown, damp, medium stiff, clayey, sandy SILT; rootlets, calcium carbonate stringers throughout, pinhole pores
						Total Depth 7', No Groundwater, No Caving, Backfilled 12/22/04
T-38	0-5				SM	**Artificial Fill Undocumented (Afu) –** Red-brown, damp to moist, medium dense, silty, fine SAND; scattered pebbles <5 mm in diameter, rootlets throughout
	5-8.5				SM	**Quaternary Alluvium Older (Qalo) –** Light brown, damp, medium dense, silty, fine SAND; scattered pebbles <5 mm in diameter
	8.5-9.5				SM	Dark gray, damp, medium dense to dense, silty, fine SAND and GRAVEL; pebbles <8 mm in diameter, heavily weathered, calcium carbonate stringers
						Total Depth 9.5', No Groundwater, No Caving, Backfilled 12/22/04

LOG OF TEST PITS

Project No. 111446-001
CLIENT: Victoria Grove

LOGGED BY: PC
DATE: 12/27/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-39	0-1				SM	**Topsoil** – Red-brown, damp, loose to medium dense, silty, fine SAND; active root system
	1-7				SM	**Quaternary Alluvium Older (Qalo)** – Dark red-brown, damp, medium dense to dense, silty, fine SAND and GRAVEL; pebbles <5 mm in diameter, cobbles @ 5' <8 inches
	7					**Cretaceous-Aged Granitic Bedrock (Kgr)** – Red-brown, damp, dense to very dense, weathered BEDROCK; friable, breaks into medium to coarse sand
						Total Depth 7', No Groundwater, No Caving, Backfilled 12/22/04
T-40	0-3				SM	**Topsoil** – Red-brown, damp, loose to medium dense, silty, fine SAND; active root system throughout, some calcium carbonate stringers
	3-6.5				SM	**Quaternary Alluvium Older (Qalo)** – Dark red-brown, damp, medium dense to dense, silty, fine SAND and GRAVEL; calcium carbonate stringers throughout, rounded to angular pebbles <3 mm in diameter throughout, rootlets
	6.5-7					**Cretaceous-Aged Granitic Bedrock (Kgr)** – Gray, damp, very dense, weathered BEDROCK; friable, breaks into medium to coarse sand
						Total Depth 7', No Groundwater, No Caving, Backfilled 12/22/04
T-41	0-5				SM	**Topsoil/Quaternary Colluvium (Qcol)** – Red-brown, damp to slightly moist, loose to medium dense, silty, fine SAND; pinhole pores throughout, active root system throughout
	5-6					**Cretaceous-Aged Granitic Bedrock (Kgr)** – Red-brown, damp, very dense, weathered BEDROCK; friable, breaks into medium to coarse sand
						Total Depth 6', No Groundwater, No Caving, Backfilled 12/22/04

LOG OF TEST PITS

Project No. 111446-001
CLIENT: Victoria Grove

LOGGED BY: PC
DATE: 12/27/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-42	0-2				SM	**Topsoil –** Red-brown, moist, loose to medium dense, silty, fine SAND; trace roots throughout
	2-4				SM	**Quaternary Colluvium (Qcol) –** Red-brown, damp to moist, medium dense, silty, fine SAND and GRAVEL; rounded to angular pebbles <3 mm in diameter, rootlets throughout
	4-6					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Red-brown, damp, dense to very dense, weathered BEDROCK; friable, rips to medium to coarse sand
						Total Depth 6', No Groundwater, No Caving, Backfilled 12/22/04
T-43	0-0.5				SM	**Topsoil –** Red-brown, moist, medium dense, silty, fine SAND and GRAVEL; scattered pebbles <3 mm in diameter, rootlets throughout, porous
	0.5-3					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Red-brown, damp, dense to very dense, weathered BEDROCK; friable, breaks to medium to coarse sand
						Total Depth 3', No Groundwater, No Caving, Backfilled 12/22/04
T-44	0-5				SM	**Quaternary Colluvium (Qcol) –** Red-brown, moist, medium dense, silty, fine SAND and GRAVEL; scattered pebbles <3 mm in diameter, rootlets throughout, porous
	5-6					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Red-brown, damp, dense to very dense, weathered BEDROCK; friable, breaks to medium to coarse sand
						Total Depth 6', No Groundwater, No Caving, Backfilled 12/22/04
T-45	0-3.5				SM	**Quaternary Colluvium (Qcol) –** Red-brown, moist, medium dense, silty, fine SAND and GRAVEL; scattered pebbles <3 mm in diameter, rootlets throughout, porous
	3.5-5					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Red-brown, damp, dense to very dense, weathered BEDROCK; friable, breaks to medium to coarse sand
						Total Depth 5', No Groundwater, No Caving, Backfilled 12/22/04

LOG OF TEST PITS

Project No. 111446-001
CLIENT: Victoria Grove

LOGGED BY: PC
DATE: 12/27/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-46	0-5				SM	**Quaternary Colluvium (Qcol) –** Red-brown, moist, medium dense, silty, fine SAND and GRAVEL; scattered pebbles <3 mm in diameter, rootlets, porous
	5-6				SM	Red-brown, damp, medium dense to dense, silty, fine SAND; scattered pebbles <3 mm in diameter, micaceous
	6-7					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Red-brown, damp, dense to very dense, weathered BEDROCK; friable, breaks to medium to coarse sand
						Total Depth 7', No Groundwater, No Caving, Backfilled 12/22/04
T-65	0-2				SM	**Topsoil-** Red-brown, damp to moist, loose, silty, fine SAND; scattered pebbles <3mm in diameter, dense root system throughout, pinhole pores very common
	2-6				SM	**Quaternary Colluvium (Qcol) –** Red-brown, damp to moist, medium dense, silty, fine SAND and GRAVEL; subrounded pebbles between 2mm and 20 mm in diameter, rootlets throughout, pinhole pores very common
	6-7					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Red-brown, damp, dense, weathered BEDROCK; friable, breaks into medium to coarse sand
						Total Depth 7', No Groundwater, No Caving, Backfilled 12/27/04
T-66	0-4				SM	**Quaternary Colluvium (Qcol) –** Red-brown, damp to moist, loose to medium dense, silty, fine SAND; scattered pebbles <3mm in diameter, rootlets
	4-7.5				SM	Red-brown, damp to moist, medium dense, silty, fine SAND and GRAVEL; subrounded pebbles between 2mm and 20 mm in diameter, rootlets throughout, pinhole pores very common
	7.5-8					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Red-brown, damp, dense, weathered BEDROCK; friable, breaks into medium to coarse sand
						Total Depth 8', No Groundwater, No Caving, Backfilled 12/27/04

LOG OF TEST PITS

Project No. 111446-001
CLIENT: Victoria Grove

LOGGED BY: PC
DATE: 12/27/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-67	0-1				SM	**Quaternary Colluvium (Qcol) –** Red-brown, damp to moist, loose to medium dense, silty, fine SAND; scattered pebbles <3mm in diameter, rootlets throughout
	1-2.5					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Red-brown, damp to moist, dense, weathered BEDROCK; friable, breaks into medium to coarse sand, mafic 80%, felsic 20%
						Total Depth 2.5', No Groundwater, No Caving, Backfilled 12/27/04
T-68	0-3				SM	**Undocumented Artificial Fill (Afu) –** Red-brown, damp to moist, loose to medium dense, silty, fine SAND; scattered rootlets, few large roots
	2-3				SM	**Quaternary Colluvium (Qcol) –** Red-brown, damp to moist, medium dense, silty, fine SAND and GRAVEL; subrounded pebbles between 2mm and 20 mm in diameter, rootlets throughout, pinhole pores very common
	3-3.5					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Red-brown, damp, dense to very dense, weathered BEDROCK; friable, breaks into medium to coarse sand
						Total Depth 3.5', No Groundwater, No Caving, Backfilled 12/27/04
T-69	0-5				SM	**Undocumented Artificial Fill (Afu) –** Yellow-red-brown, damp to moist, loose to medium dense, silty, fine to coarse SAND and GRAVEL; scattered pebbles <3mm in diameter
	5-6.5				SM	**Quaternary Colluvium (Qcol) –** Dark red-brown, damp to slightly moist, medium dense to dense, silty, fine SAND and GRAVEL; subrounded to subangular pebbles between <20 mm in diameter
	6.5-7.5					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Dark red-brown, damp, very dense, weathered BEDROCK; friable, breaks into medium to coarse sand
						Total Depth 7.5', No Groundwater, No Caving, Backfilled 12/27/04

LOG OF TEST PITS

Project No. 111446-001
CLIENT: Victoria Grove

LOGGED BY: PC
DATE: 12/27/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-70	0-3				SM	**Topsoil –** Red-brown, moist, loose to medium dense, silty, fine SAND; few low-laying boulders, rootlets throughout, pinhole pores very common
	3-5				SM	**Quaternary Colluvium (Qcol) –** Red-brown, moist, medium dense, silty, fine SAND; scattered pebbles and granitic boulders, pinhole pores common
	5-5.5					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Dark red-brown, damp, very dense, weathered BEDROCK; friable, breaks into medium to coarse sand
						Total Depth 5.5', No Groundwater, No Caving, Backfilled 12/27/04
T-71	0-3				SM	**Topsoil –** Red-brown, damp to moist, loose, silty, fine SAND; scattered pebbles <20mm in diameter, rootlets throughout, slightly clayey at bottom
	3-4					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Blue-gray, damp to moist, dense, weathered BEDROCK; friable, breaks into medium to coarse sand and gravel
						Total Depth 4', No Groundwater, No Caving, Backfilled 12/27/04
T-72	0-2.5				SM	**Topsoil –** Red-brown, damp, loose to medium dense, silty, fine SAND; scattered pebbles <5mm in diameter, rootlets throughout, pinhole pores common
	2.5-4.5				SM	**Quaternary Alluvium Older (Qalo) –** Dark red-brown, damp, dense to very dense, silty, fine SAND; Manganese deposits very common, pinhole pores common, rootlets throughout
	4.5-7.5				SM	Red-brown, damp, dense, silty, fine to coarse SAND; manganese deposits common, calcium carbonate stringers common, pinhole pores common, blocky texture
						Total Depth 7.5', No Groundwater, No Caving, Backfilled 12/27/04

LOG OF TEST PITS

Project No. 111446-001
CLIENT: Victoria Grove

LOGGED BY: PC
DATE: 12/27/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-73	0-0.5				SM	**Topsoil** – Red-brown, moist, loose to medium dense, silty, fine SAND; scattered pebbles <3mm in diameter, rootlets throughout, pinhole pores common
	0.5-1.5					**Cretaceous-Aged Granitic Bedrock (Kgr)** – Red-brown, damp, dense, weathered BEDROCK; friable, breaks into medium to coarse sand
	1.5-2.5					Blue-gray, damp, dense, weathered BEDROCK; friable, breaks into medium to coarse sand and gravel
						Total Depth 2.5', No Groundwater, No Caving, Backfilled 12/27/04
T-74	0-2.5				SM	**Topsoil** – Red-brown, moist, loose, silty, fine SAND; rootlets throughout, pinhole pores common
	2.5-3.5				SP	**Quaternary Colluvium (Qcol)** – Red-brown, damp to moist, medium dense to dense, silty, fine SAND and GRAVEL; cobble sized gravel
	3.5-4				SP	**Quaternary Alluvium Older (Qalo)** – Red-brown, damp to moist, dense, silty, sandy, GRAVEL; calcium carbonate stringers common, blocky texture
						Total Depth 4', No Groundwater, No Caving, Backfilled 12/27/04
T-75	0-1.5				SM	**Topsoil** – Red-brown, moist, loose, clayey, silty, fine SAND; scattered pebbles <3mm in diameter, rootlets throughout, pinhole pores common
	1.5-2					**Cretaceous-Aged Granitic Bedrock (Kgr)** – Red-brown, damp to moist, dense, heavily weathered BEDROCK; friable, breaks into medium to coarse sand
	2-4					Blue-gray, damp, very dense, weathered BEDROCK; friable, breaks into medium to coarse sand
						Total Depth 4', No Groundwater, No Caving, Backfilled 12/27/04

LOG OF TEST PITS

Project No. 111446-001
CLIENT: Victoria Grove

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DATE: 12/27/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-76	0-1.5				SM	**Topsoil** – Red-brown, moist, medium dense, clayey, fine SAND; scattered pebbles, rootlets throughout, pinhole pores common
	1.5-5.5					**Cretaceous-Aged Granitic Bedrock (Kgr)** – Red-brown, damp, dense, weathered BEDROCK; friable, breaks into medium to coarse sand
						Total Depth 5.5', No Groundwater, No Caving, Backfilled 12/27/04
T-77	0-3				SM	**Quaternary Colluvium (Qcol)** – Red-brown, damp to moist, medium dense, silty, fine SAND; scattered pebbles <3mm in diameter, pinhole pores common, rootlets throughout, cobbles at 2.5' and pinch out towards the SE
	3-6				SM/ SP	**Quaternary Alluvium Older (Qalo)** – Dark red-brown, damp, dense, silty, fine SAND; scattered pebbles <3mm in diameter, pinhole pores common, calcium carbonate stringers common, blocky texture
						Total Depth 6', No Groundwater, No Caving, Backfilled 12/27/04
T-78	0-2.5				SM	**Topsoil** – Red-brown, damp, loose to medium dense, silty, fine SAND; scattered pebbles <5mm in diameter, pinhole pores common, rootlets throughout
	2.5-4				SM/ SP	**Quaternary Colluvium (Qcol)** – Blue-gray, damp to moist, dense, silty GRAVEL; silts tightly packed between granitic pebbles
	4					**Cretaceous-Aged Granitic Bedrock (Kgr)** – Blue-gray, damp, very dense, weathered BEDROCK; friable, breaks into medium to coarse sand and gravel
						Total Depth 4', No Groundwater, No Caving, Backfilled 12/27/04

LOG OF TEST PITS

Project No. 111446-001
CLIENT: Victoria Grove

LOGGED BY: PC
DATE: 12/27/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-79	0-10				SM	**Quaternary Colluvium (Qcol) –** Light brown, damp, medium dense, silty, fine SAND; scattered pebbles <3mm in diameter, rootlets throughout, pinhole pores very common, calcium carbonate stringers common, sand fines upwards Total Depth 10', No Groundwater, No Caving, Backfilled 12/27/04
T-80	0-4.5 4.5-6				SM	**Quaternary Colluvium (Qcol) –** Red-brown, damp to moist, medium dense, silty, fine to coarse SAND; scattered pebbles <4mm in diameter, very porous, rootlets throughout **Cretaceous-Aged Granitic Bedrock (Kgr) –** Blue-brown, damp, very dense, weathered BEDROCK; slightly friable, breaks into medium to coarse sand and gravel Total Depth 6', No Groundwater, No Caving, Backfilled 12/27/04
T-81	0-3 3-8				SM SM	**Topsoil –** Red-brown, moist, loose, silty, fine SAND; scattered pebbles, porous, rootlets common **Quaternary Alluvium Older (Qalo) –** Dark red-brown, damp, dense, silty, fine SAND; scattered pebbles, porous, calcium carbonate stringers common Total Depth 8', No Groundwater, No Caving, Backfilled 12/27/04
T-82	0-3.5 3.5-4				SM	**Topsoil –** Red-brown, damp to moist, medium dense, silty, fine SAND; scattered pebbles <3mm in diameter, porous, rootlets common **Cretaceous-Aged Granitic Bedrock (Kgr) –** Red-brown, damp, very dense, weathered BEDROCK; friable, breaks into medium to coarse sand Total Depth 4', No Groundwater, No Caving, Backfilled 12/27/04

Project No. 111446-001
CLIENT: Victoria Grove

LOG OF TEST PITS

LOGGED BY: PC
DATE: 12/27/04

TEST PIT#	DEPTH (FT)	SAMPLE TYPE C, B & DEPTH	DRY DENSITY (PCF)	MOIST (%)	USCS	DESCRIPTION
T-83	0-1				SM	**Undocumented Artificial Fill (Afu) —** Red-brown, damp, loose, silty, fine to coarse SAND and GRAVEL
	1-3				SM	**Quaternary Alluvium Older (Qalo) –** Dark red-brown, damp, medium dense, silty, fine SAND; scattered pebbles <5mm in diameter, porous, calcium carbonate stringers common, rootlets common
	3-7				SM/ SP	Dark red-brown, damp, dense, silty, fine to coarse SAND; cobbles at 6'
	7-8					**Cretaceous-Aged Granitic Bedrock (Kgr) –** Dark green-gray, damp, very dense, weathered BEDROCK; friable, breaks into medium to coarse sand
						Total Depth 8', No Groundwater, No Caving, Backfilled 12/27/04

APPENDIX C1

LABORATORY TESTING

(AGS)

ANAHEIM TEST LAB, INC

3008 ORANGE AVENUE
SANTA ANA, CALIFORNIA 92707
PHONE (714) 549-7267

Advanced Geotechnical Solutions
2842 Walnut Avenue, Suite C-1
Tustin, CA 92780

DATE: 09/30/15

P.O. NO.: Chain of Custody

LAB NO.: B-8710-2

SPECIFICATION: CA 301

MATERIAL: Brown, D.G.

Project #: 1507-05
Victoria Heights
Date sampled: 09/15/15

ANALYTICAL REPORT

"R" VALUE

	BY EXUDATION	BY EXPANSION
EX-14 @ 6'	72	75

RESPECTFULLY SUBMITTED

WES BRIDGER CHEMIST

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

MAXIMUM DENSITY - ASTM D1557

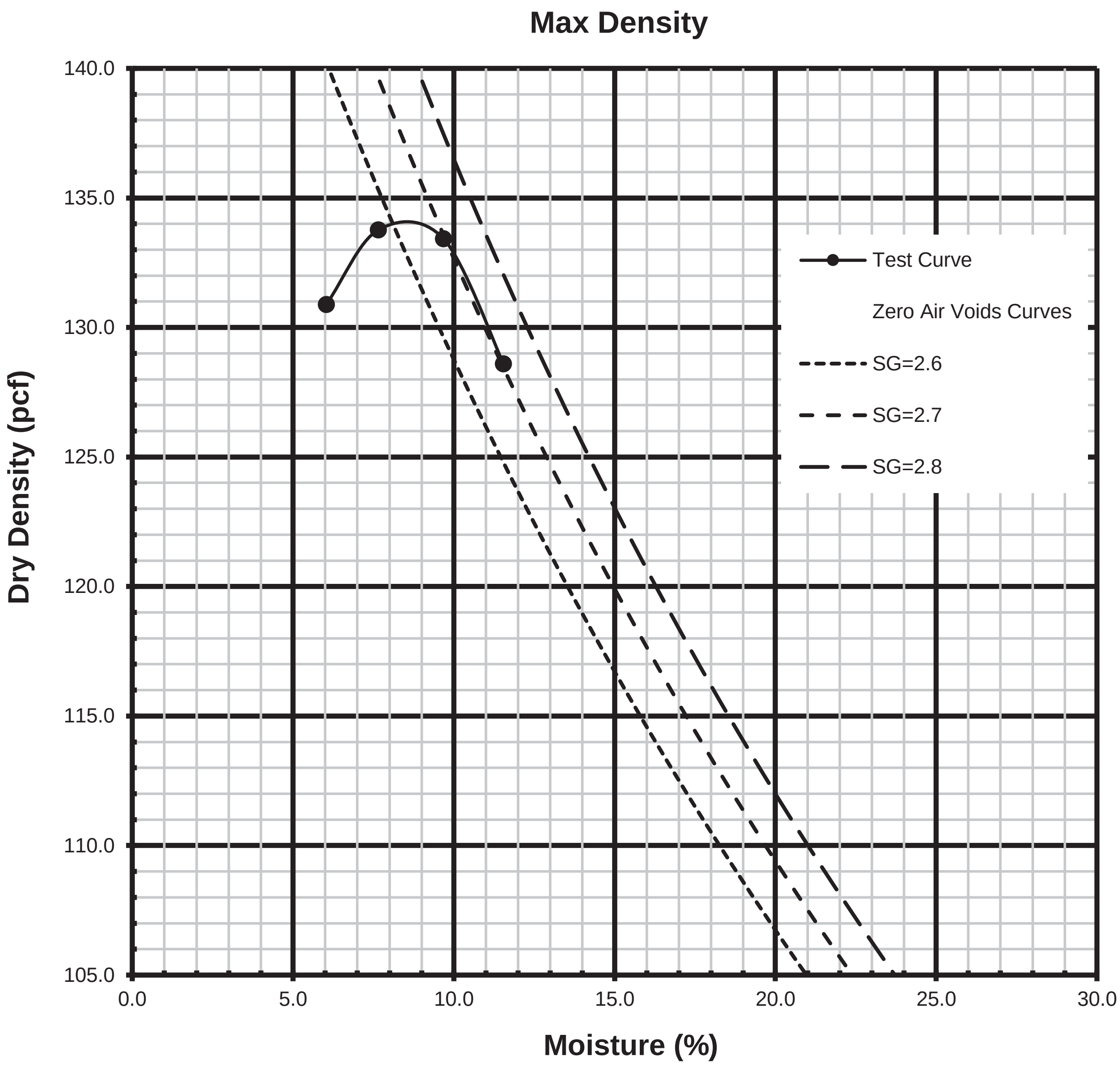
Project Name: Greentree Ranch
Location:
Project No.: 1507-05
Date: 9/23/2015

Excavation: EX-19
Depth: 1 '
Description:

By: H-M

Method A

Test Number	1	2	3	4
Dry Density (pcf)	130.9	133.8	133.4	128.6
Moisture Content (%)	6.0	7.7	9.7	11.5



Maximum Density **134.0** pcf

Optimum Moisture **8.5** %

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

MAXIMUM DENSITY - ASTM D1557

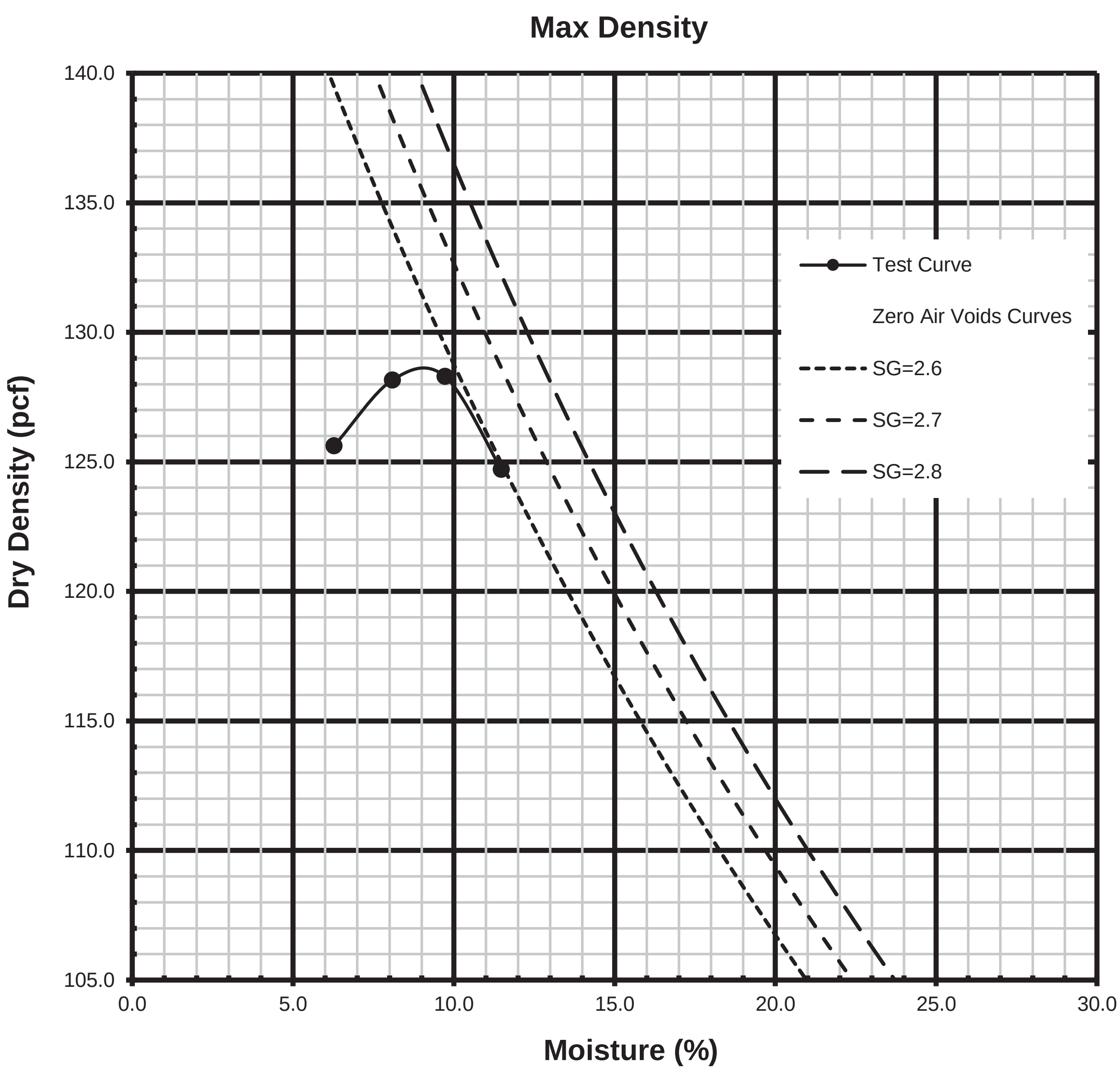
Project Name: Greentree Ranch
Location:
Project No.: 1507-05
Date: 9/23/2015

Excavation: EX-9
Depth: 12 '
Description:

By: H-M

Method A

Test Number	1	2	3	4
Dry Density (pcf)	125.6	128.2	128.3	124.7
Moisture Content (%)	6.3	8.1	9.7	11.5



Maximum Density **128.5** pcf

Optimum Moisture **9.0** %

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

EXPANSION INDEX - ASTM D4829

Project Name:	Greentree Ranch	Excavation:	EX-19
Location:		Depth:	1 '
File No:	1507-05	Description:	Silty Sand
Date:	9/24/15	By:	

Expansion Index - ASTM D4829	
Initial Dry Density (pcf):	120.1
Initial Moisture Content (%):	7.5
Initial Saturation (%):	50.3
Final Dry Density (pcf):	113.5
Final Moisture Content (%):	14.8
Final Saturation (%):	99.1
Expansion Index:	8
Potential Expansion:	Very Low

ASTM D4829 - Table 5.3	
Expansion Index	Potential Expansion
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
>130	Very High

ADVANCED GEOTECHNICAL SOLUTIONS, INC.

DIRECT SHEAR - ASTM D3080

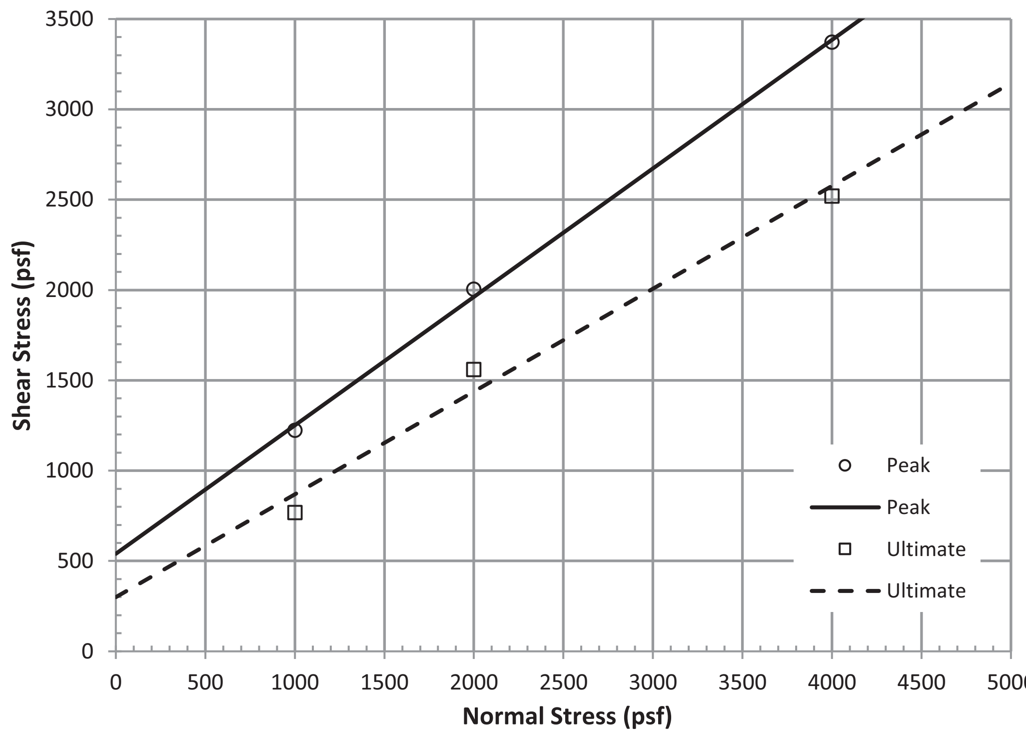
Project Name: Greentree Ranch
Location:
Project No.: 1507-05
Date: 9/25/15

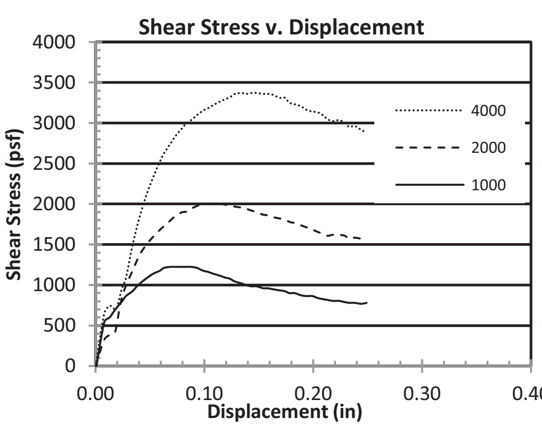
Excavation: EX-9
Depth: 12
Sample Type: Remold 90%
By: 0

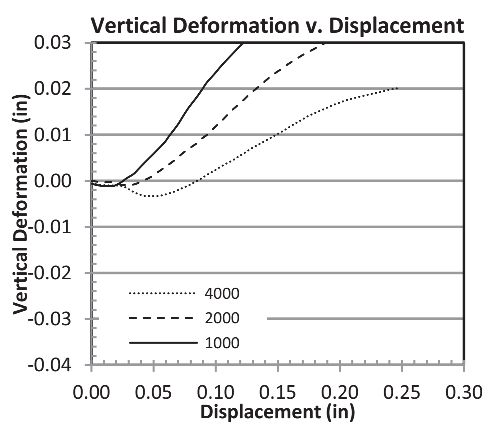
Samples Tested	1	2	3
Normal Stress (psf)	1000	2000	4000
Maximum Shear Stress (psf)	1224	2004	3372
Ultimate Shear Stress (psf)	768	1560	2520
Initial Moisture Content (%)	9.0	9.0	9.0
Initial Dry Density (pcf)	115.7	115.7	115.7

Method: Drained
Consolidation: Yes
Saturation: Yes
Shearing Rate (in/min): 0.04

	Peak	Ultimate
Friction Angle, phi (deg)	35	30
Cohesion (psf)	540	300







ADVANCED GEOTECHNICAL SOLUTIONS, INC.

DIRECT SHEAR - ASTM D3080

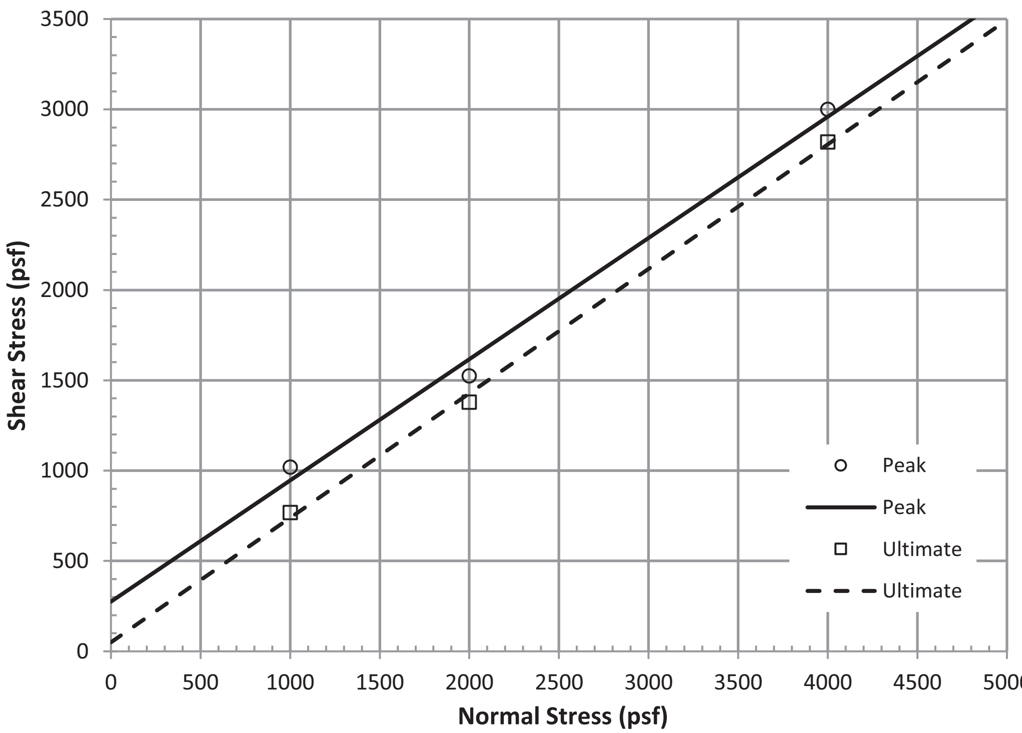
Project Name: Greentree
Location:
Project No.: 1507-05
Date: 9/26/15

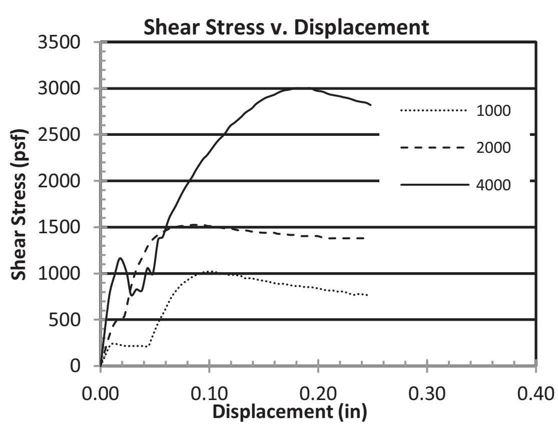
Excavation: EX-19
Depth: 1
Sample Type: Remold 90%
By: 0

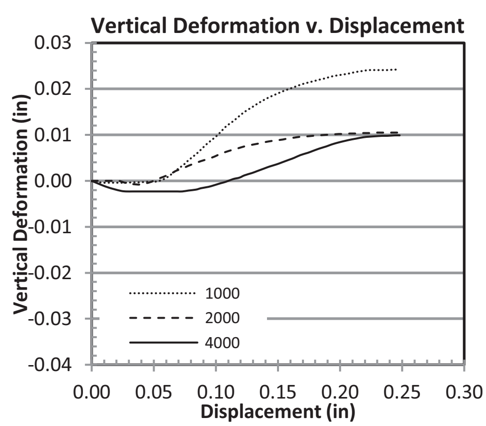
Samples Tested	1	2	3
Normal Stress (psf)	4000	2000	1000
Maximum Shear Stress (psf)	3000	1524	1020
Ultimate Shear Stress (psf)	2820	1380	768
Initial Moisture Content (%)	120.6	120.6	120.6
Initial Dry Density (pcf)	8.5	8.5	8.5

Method: Drained
Consolidation: Yes
Saturation: Yes
Shearing Rate (in/min): 0.04

	Peak	Ultimate
Friction Angle, phi (deg)	34	35
Cohesion (psf)	275	50







ADVANCED GEOTECHNICAL SOLUTIONS, INC.

DIRECT SHEAR - ASTM D3080

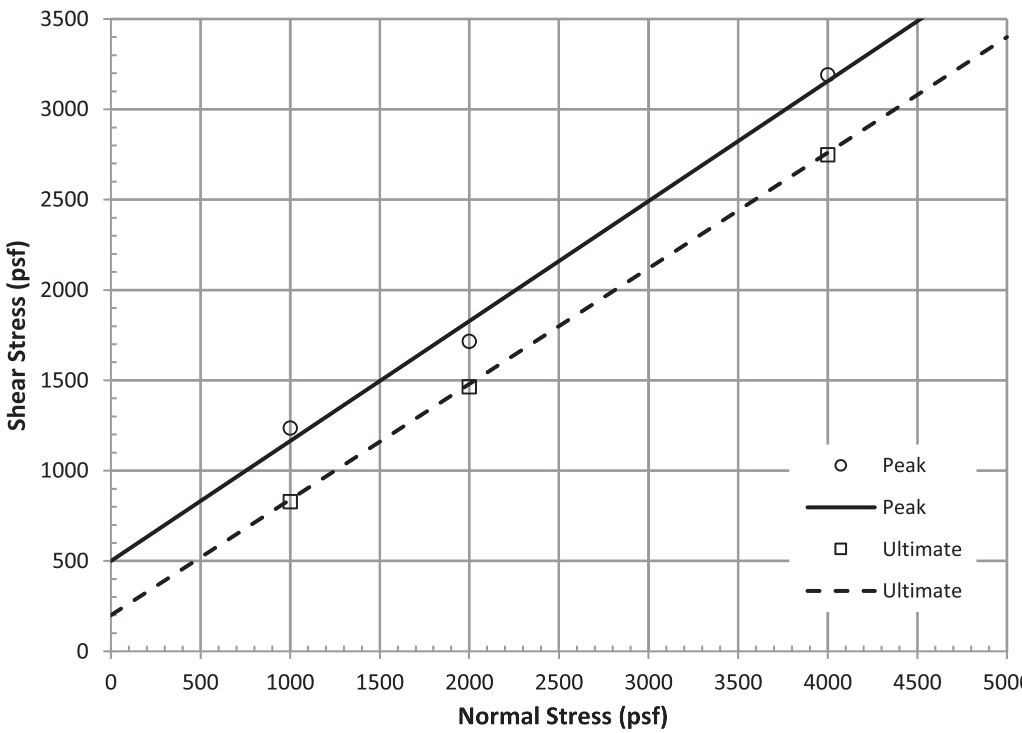
Project Name: Greentree Ranch
Location:
Project No.: 1507-05
Date: 9/5/15

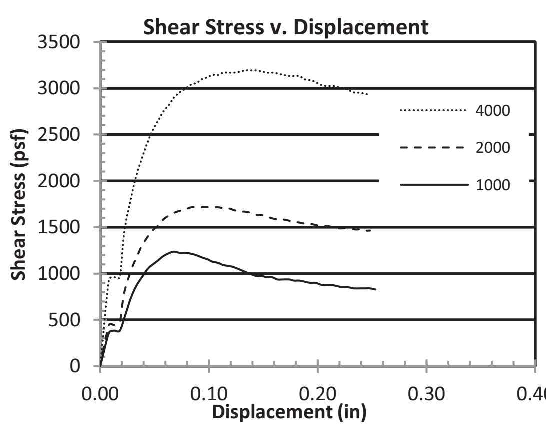
Excavation: T-2
Depth: 4-5
Sample Type: Remold 90%
By: 0

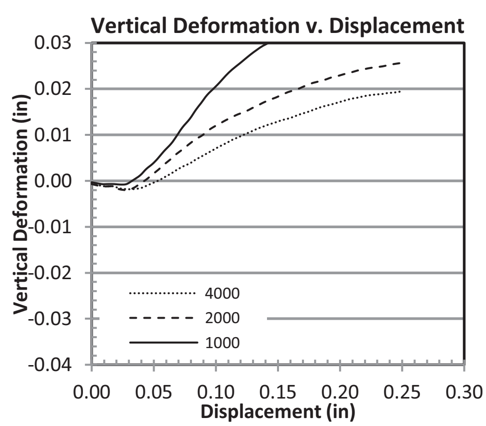
Samples Tested	1	2	3
Normal Stress (psf)	1000	2000	4000
Maximum Shear Stress (psf)	1236	1716	3192
Ultimate Shear Stress (psf)	828	1464	2748
Initial Moisture Content (%)	8.5	8.5	8.5
Initial Dry Density (pcf)	118.8	118.8	118.8

Method: Drained
Consolidation: Yes
Saturation: Yes
Shearing Rate (in/min): 0.04

	Peak	Ultimate
Friction Angle, phi (deg)	34	33
Cohesion (psf)	500	200







ADVANCED GEOTECHNICAL SOLUTIONS, INC.

DIRECT SHEAR - ASTM D3080

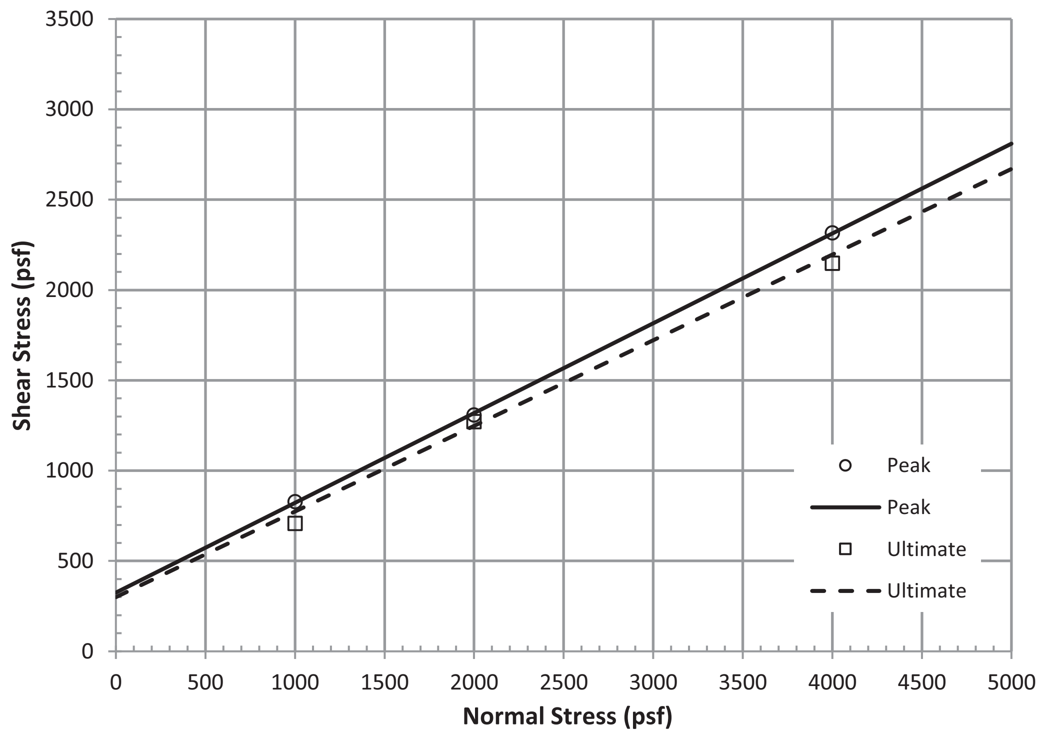
Project Name: Greentree Ranch
Location:
Project No.: 1507-05
Date: 9/6/15

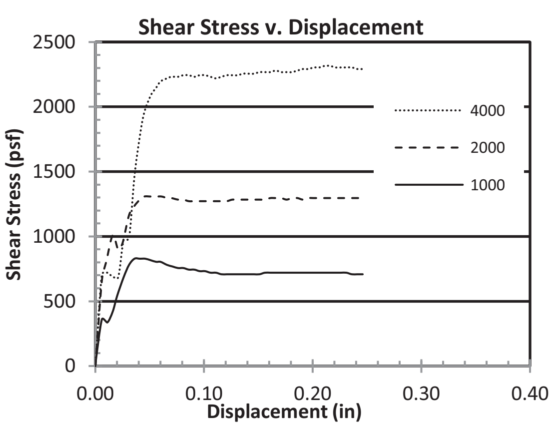
Excavation: T-1
Depth: 2-3
Sample Type: Remold 90%
By: 0

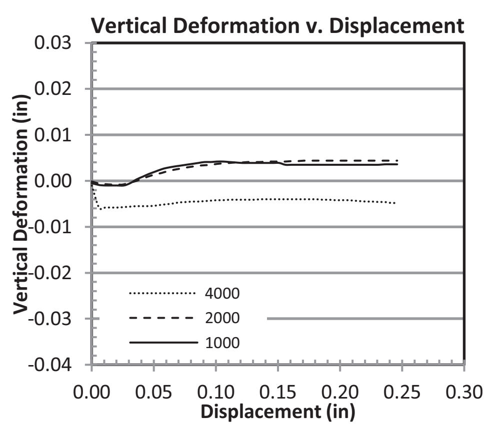
Samples Tested	1	2	3
Normal Stress (psf)	1000	2000	4000
Maximum Shear Stress (psf)	828	1308	2316
Ultimate Shear Stress (psf)	708	1272	2148
Initial Moisture Content (%)	11.0	11.0	11.0
Initial Dry Density (pcf)	113.4	113.4	113.4

Method: Drained
Consolidation: Yes
Saturation: Yes
Shearing Rate (in/min): 0.04

	Peak	Ultimate
Friction Angle, phi (deg)	26	25
Cohesion (psf)	325	300







ANAHEIM TEST LAB, INC

3008 ORANGE AVENUE
SANTA ANA, CALIFORNIA 92707
PHONE (714) 549-7267

DATE: 09/25/15

Advanced Geotechnical Solutions, Inc
2842 Walnut Avenue, Suite C-1
Tustin, CA 92780

P.O. NO.: Chain of Custody

LAB NO.: B-8710-1

SPECIFICATION: CA-417/422/643

Attn: Sean Donovan

MATERIAL: Soil

J.N.: 1507-05
Date sampled: 09/15/15
Project: Victoria Heights
Sample ID: EX-7 @ 2'-3'

ANALYTICAL REPORT

CORROSION SERIES
SUMMARY OF DATA

PH	SOLUBLE SULFATES per CA. 417 ppm	SOLUBLE CHLORIDES per CA. 422 ppm	MIN. RESISTIVITY per CA. 643 ohm-cm
7.2	1,074	507	980

RESPECTFULLY SUBMITTED

WES BRIDGER CHEMIST

APPENDIX C2

LABORATORY TESTING

(LEIGHTON AND ASSOCIATES 2005)

Boring No.	LB-1	LB-1	LB-1	LB-2	LB-2	LB-2	LB-2	LB-2
Sample No.	R-1	R-2	R-3	R-1	R-2	R-4	R-5	R-7
Depth (ft.)	2.5	5	7.5	2.5	5	10	12.5	17.5
Sample Type	RING	RING	RING	RING	RING	RING	RING	RING
Visual Soil Classification	SM	SM	SM	SM	SM	SM	SM	SM
Pocket Penetrometer								
Weight Soil + Rings / Tube (gm.)	1124.0	965.7	1079.5	991.1	922.4	1180.1	1301.8	1222.6
Weight of Rings / Tube (gm.)	267.0	222.5	222.5	222.5	222.5	267.0	267.0	267.0
Average Length (in.)	6.0	5.0	5.0	5.0	5.0	6.0	6.0	6.0
Average Diameter (in.)	2.416	2.416	2.416	2.416	2.416	2.416	2.416	2.416
Wet. Wt. of Soil + Cont. (gm.)	183.8	190.0	201.7	184.7	165.4	156.4	226.3	194.5
Dry Wt. of Soil + Cont. (gm.)	166.7	178.1	193.3	167.4	160.5	148.5	213.6	173.3
Weight of Container (gm)	50.0	50.4	50.7	51.1	50.2	50.2	50.9	49.9
Container No.:	I	9	H	3	T	A	2	M
Wet Density	118.7	123.5	142.4	127.7	116.3	126.5	143.3	132.3
Moisture Content (%)	**14.7**	**9.3**	**5.9**	**14.9**	**4.4**	**8.0**	**7.8**	**17.2**
Dry Density (pcf)	**103.5**	**113.0**	**134.5**	**111.2**	**111.4**	**117.1**	**132.9**	**112.9**
Degree of Saturation (%)	63	51	63	78	23	49	79	94

MOISTURE & DENSITY of SOILS
ASTM D 2937

Leighton and Associates, Inc.

Rev. 08-04

Project Name: VICTORIA GROVE
Project No.: 111446-001
Client Name:
Tested By: AJP   Date: 01/26/05

xM & D 1

Boring No.	LB-2	LB-3	LB-3	LB-6	LB-4	LB-4	LB-4	LB-4
Sample No.	R-9	R-1	R-2	R-1	R-1	R-3	R-5	R-6
Depth (ft.)	22.5	5	7.5	2.5	2.5	7.5	12.5	15
Sample Type	RING	RING	RING	RING	RING	RING	RING	RING
Visual Soil Classification	SM	SM/SW	SM	SM	ML	SM	SM	SM/ML
Pocket Penetrometer								0.75
Weight Soil + Rings / Tube (gm.)	985.7	609.8	387.7	821.7	788.3	1182.5	818.5	752.4
Weight of Rings / Tube (gm.)	222.5	133.5	89.0	178.0	178.0	267.0	178.0	178.0
Average Length (in.)	5.0	3.0	2.0	4.0	4.0	6.0	4.0	4.0
Average Diameter (in.)	2.416	2.416	2.416	2.416	2.416	2.416	2.416	2.416
Wet. Wt. of Soil + Cont. (gm.)	184.0	175.2	161.2	186.4	227.5	207.1	194.9	164.5
Dry Wt. of Soil + Cont. (gm.)	180.8	171.7	158.2	183.5	203.7	191.3	183.2	157.6
Weight of Container (gm)	50.2	50.3	51.0	49.6	50.2	50.0	50.3	50.3
Container No.:	P	L	R	V	K	X	O	5
Wet Density	126.8	131.9	124.1	133.7	126.8	126.8	133.1	119.3
Moisture Content (%)	**2.5**	**2.9**	**2.8**	**2.2**	**15.5**	**11.2**	**8.8**	**6.4**
Dry Density (pcf)	**123.8**	**128.2**	**120.7**	**130.9**	**109.8**	**114.0**	**122.3**	**112.1**
Degree of Saturation (%)	18	25	19	20	78	63	63	34

MOISTURE & DENSITY of SOILS
ASTM D 2937

Leighton and Associates, Inc.

Rev. 08-04

Project Name:	VICTORIA GROVE
Project No.:	111446-001
Client Name:	
Tested By:	AJP
Date:	01/26/05

xM & D 2

Boring No.	LB-5	LB-5	LB-5	LB-5				
Sample No.	R-1	R-2	R-4	R-6				
Depth (ft.)	2.5	5	10	15				
Sample Type	RING	RING	RING	RING				
Visual Soil Classification	ML	SM	ML	SM				
Pocket Penetrometer			4.50					
Weight Soil + Rings / Tube (gm.)	971.6	791.7	1236.7	1276.9				
Weight of Rings / Tube (gm.)	222.5	178.0	267.0	267.0				
Average Length (in.)	5.0	4.0	6.0	6.0				
Average Diameter (in.)	2.416	2.416	2.416	2.416				
Wet. Wt. of Soil + Cont. (gm.)	168.7	182.8	208.9	213.9				
Dry Wt. of Soil + Cont. (gm.)	149.6	165.3	185.9	196.9				
Weight of Container (gm)	50.4	49.5	49.6	50.4				
Container No.:	7	8	Y	Z				
Wet Density	124.5	127.5	134.3	139.9				
Moisture Content (%)	**19.3**	**15.1**	**16.9**	**11.6**				
Dry Density (pcf)	**104.4**	**110.8**	**114.9**	**125.3**				
Degree of Saturation (%)	85	78	98	91				

MOISTURE & DENSITY of SOILS
ASTM D 2937

Leighton and Associates, Inc.

Rev. 08-04

Project Name: VICTORIA GROVE

Project No.: 111446-001

Client Name:

Tested By: AJP Date: 01/26/05

xM & D 3

Boring No.	T-6								
Sample No.	B-1								
Depth (ft.)	0-6.5								
Sample Type	CHUNK								
Visual Soil Classification	SM								
Pocket Penetrometer									
Weight Soil + Rings / Tube (gm.)	161.3								
Weight of Rings / Tube (gm.)	44.5								
Average Length (in.)	1.0								
Average Diameter (in.)	2.416								
Wet. Wt. of Soil + Cont. (gm.)	195.6								
Dry Wt. of Soil + Cont. (gm.)	188.0								
Weight of Container (gm)	50.3								
Container No.:	6								
Wet Density	97.1								
Moisture Content (%)	**5.5**								
Dry Density (pcf)	**92.0**								
Degree of Saturation (%)	18								

MOISTURE & DENSITY of SOILS
ASTM D 2937

Leighton and Associates, Inc.

Rev. 08-04

Project Name: VICTORIA GROVE
Project No.: 111446-001
Client Name:
Tested By: JMD Date: 01/03/05

M & D T-6, B-1

Leighton and Associates, Inc.

PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name:	VICTORIA GROVE EAST	Tested By:	RGO	Date:	01/21/05
Project No.:	111446-001	Checked By:	PRC	Date:	01/21/05
Boring No.:		Depth (ft.):			
Sample No.:	SA-1				

Visual Sample Description: SM, DARK BROWN SILTY SAND

		Moisture Content of Total Air - Dry Soil	
Container No.:	A	Wt. of Air-Dry Soil + Cont. (gm.)	299.8
Wt. of Air Dry Soil+Cont.(gm.)	299.8	Wt. of Dry Soil + Cont. (gm.)	273.9
Wt. of Container (gm.)	0.0	Wt. of Container No. A (gm.)	84.6
Dry Wt. of Soil (gm.)	263.7	Moisture Content (%)	13.7

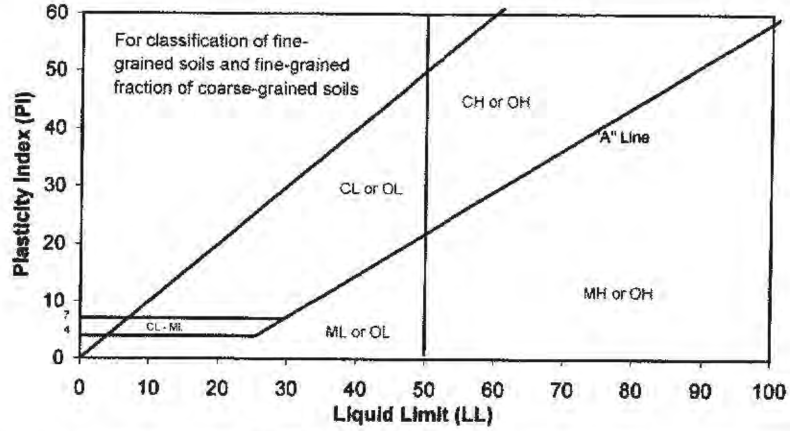
After Wet Sieve	Container No.	A
	Wt. of Dry Soil + Container (gm.)	126.5
	Wt. of Container (gm.)	84.6
	Dry Wt. of Soil Retained on # 200 Sieve (gm.)	41.9

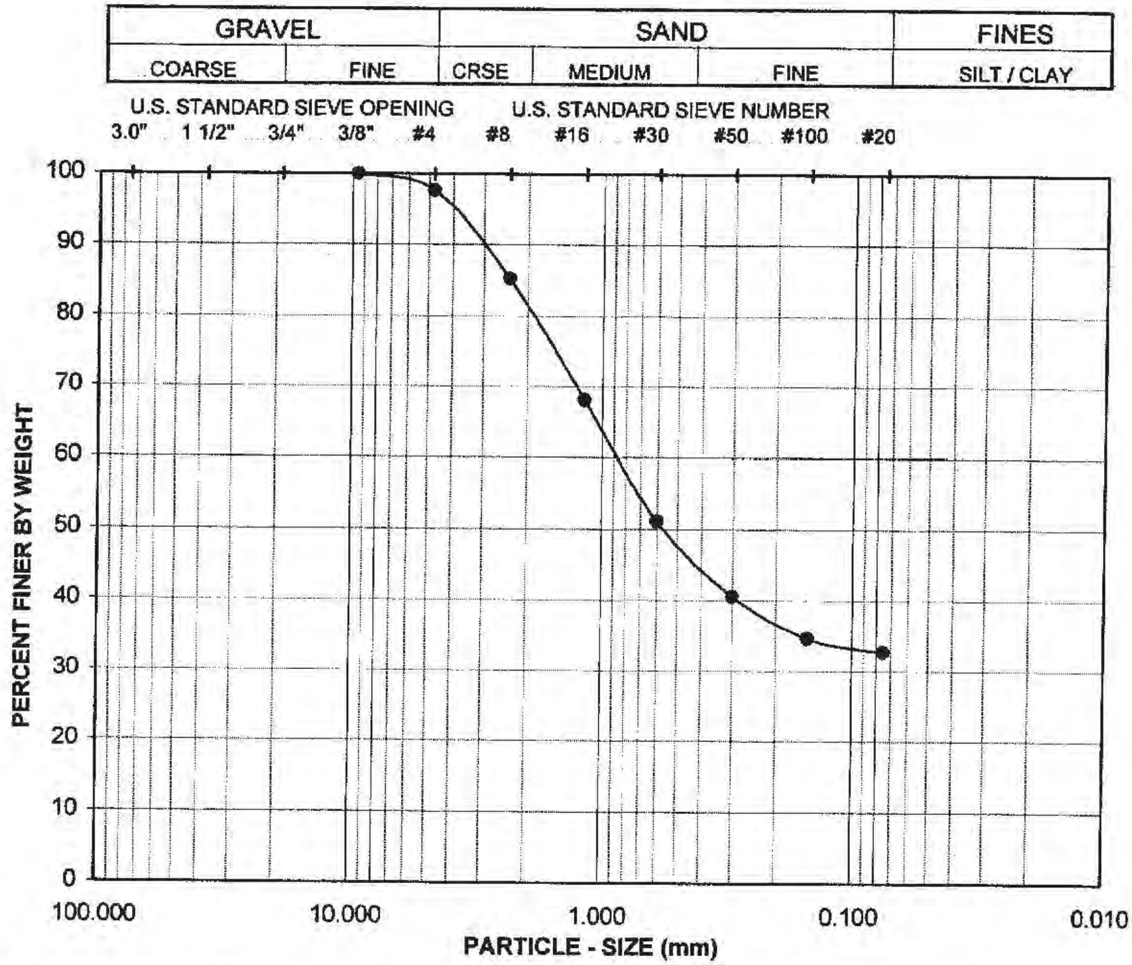
U. S. Sieve Size		Cumulative Weight	Percent Passing
(in.)	(mm.)	Dry Soil Retained (gm.)	(%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000		
3/8"	9.500	0.0	100.0
#4	4.750	6.0	97.7
#8	2.360	39.0	85.2
#16	1.180	84.0	68.1
#30	0.600	129.1	51.0
#50	0.300	157.0	40.5
#100	0.150	172.4	34.6
#200	0.075	177.4	32.7
PAN			

GRAVEL:	2 %	Liquid Limit:	
SAND:	65 %	Plastic Limit	
FINES:	33 %	Plasticity Index:	N/A
GRP. SYMBOL:	SM	Cu = D60/D10 =	
		Cc = $(D30)^2/(D60*D10)$ =	

Remarks:

Rev. 08-04





Boring No.:	Sample No.:	Depth (ft.):	Soil Type	GR:SA:FI	LL,PL,PI
	SA-1		SM	2 : 65 : 33	N/A

Visual Sample Description:
SM, DARK BROWN SILTY SAND

Leighton and Associates, Inc.

Project No.: 111446-001

VICTORIA GROVE EAST

ATTERBERG LIMITS, PARTICLE - SIZE CURVE

ASTM D 4318, D 422

Rev. 08-04

xSieve SA-1

Leighton and Associates, Inc.

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name:	VICTORIA GROVE	Tested By :	AJP/RGO	Date:	01/07/05
Project No. :	111446-001	Data Input By:	JMD	Date:	01/10/05
Boring No.:	T-37	Checked By:	PRC	Date:	01/10/05
Sample No.:	B-8	Depth (ft.) :	0-5		

Visual Sample Description: ML, GREY SANDY SILT

				Moisture Content of Total Air-Dry Soils	Moisture Content of Air-Dry Soils Passing # 10	After Hydrometer & wet sieve ret. on #200 sieve
Liquid Limit:		LL,PL,PI:	N/A			
Plastic Limit:		GR:SA:FI:	0:21:79			
Plasticity Index:	N/A	Grp. Symbol:	ML			
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(gm.)		132.1	132.2	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (gm.)			128.6	93.4
Wt.of Air-Dry Soil + Cont. (gm.)	102.7	Wt. of Container No.___ (gm.)		83.5	83.5	83.5
Wt. of Container	0.0	Moisture Content (%)			8.0	
Dry Wt. of Soil (gm.)	102.70	Wt. of Dry Soil (gm.)				9.9

Coarse Sieve

U.S. Sieve Size	Cumulative Wt.of Dry Soil Retained(gm)	% Passing
3"		
1½"		
3/4"		
3/8"		
No. 4	0.0	100.0
No. 10	0.5	100.6
Pan		

Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. of Dry Soil Retained (gm)	% Passing	% Total Sample
No. 10	0.0	100.0	100.6
No. 20	1.1	97.6	98.2
No. 40	2.4	94.7	95.3
No. 60	4.1	90.9	91.4
No. 100	6.1	86.5	87.0
No. 200	9.9	78.0	78.5
Pan			

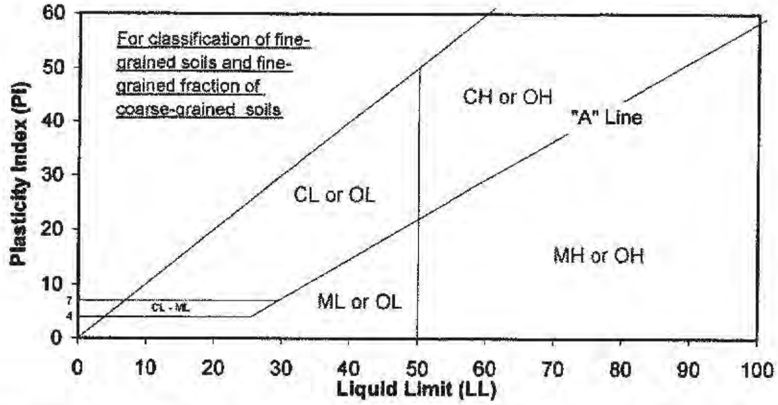
Hydrometer Wt. of Air-Dry Soil (gm) 48.7 Wt. of Dry Soil (gm) 45.1

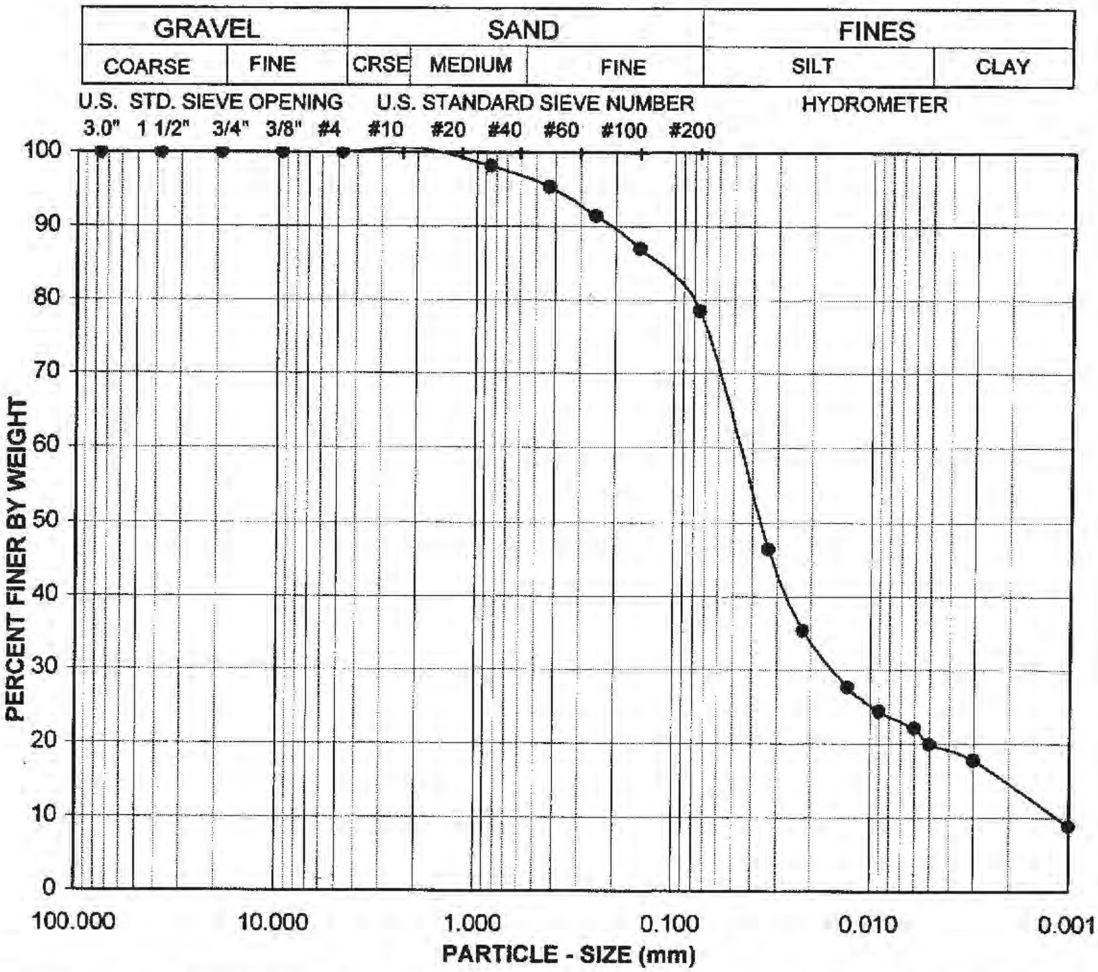
Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°c)	Composite Correction 152 H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
1/7/05	7:32	0	20	5.0			
	7:34	2	20	5.0	26.0	46.4	0.033
	7:37	5	20	5.0	21.0	35.3	0.022
	7:47	15	20	5.0	17.5	27.6	0.013
	8:02	30	20	5.0	16.0	24.3	0.009
	8:32	60	20	5.0	15.0	22.1	0.006
	9:32	120	18	5.0	14.0	19.9	0.005
	11:42	250	18	5.0	13.0	17.7	0.003
1/8/05	7:32	1440	20	5.0	9.0	8.8	0.001

Rev. 08-04

xSieve & Hydrometer T-37,B-8





Boring No.	Sample No.	Depth (ft.)	Soil Type	GR:SA:FI (%)	LL,PL,PI
T-37	B-8	0-5	ML	0:21:79	N/A

Sample Description:
ML, GREY SANDY SILT

Leighton and Associates, Inc.

Project No.: 111446-001

VICTORIA GROVE

ATTERBERG LIMITS, PARTICLE - SIZE CURVE

ASTM D 4318, D 422

Rev. 08-04

Leighton and Associates, Inc.

PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: VICTORIA GROVE — Tested By: JMD — Date: 01/03/05
Project No.: 111446-001 — Checked By: PRC — Date: 01/05/05
Boring No.: T-6 — Depth (ft.): 0-6.5
Sample No.: B-2
Visual Sample Description: ML, BROWN SANDY SILT

		Moisture Content of Total Air - Dry Soil	
Container No.:	A	Wt. of Air-Dry Soil + Cont. (gm.)	282.5
Wt. of Air Dry Soil+Cont.(gm.)	17266.4	Wt. of Dry Soil + Cont. (gm.)	270.7
Wt. of Container (gm.)	0.0	Wt. of Container No. A (gm.)	83.2
Dry Wt. of Soil (gm.)	17266.4	Moisture Content (%)	6.3

After Wet Sieve	Container No.	A
	Wt. of Dry Soil + Container (gm.)	145.5
	Wt. of Container (gm.)	83.2
	Dry Wt. of Soil Retained on # 200 Sieve (gm.)	62.3

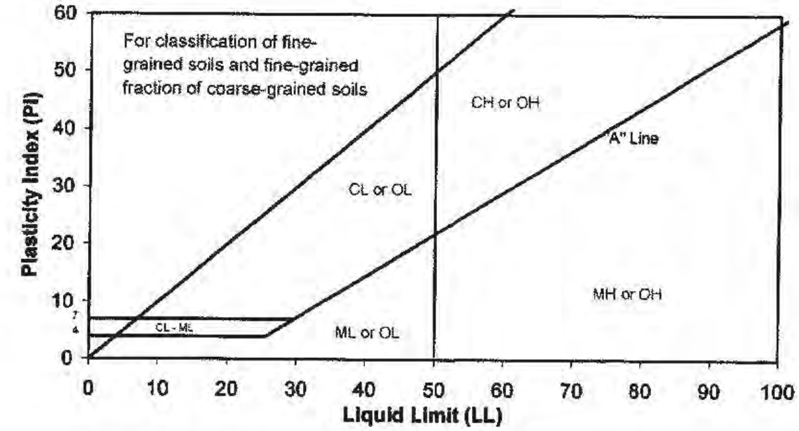
U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (gm.)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000		
3/8"	9.500		
#4	4.750	0.0	100.0
#8	2.360	0.5	99.7
#16	1.180	3.2	98.3
#30	0.600	11.3	94.0
#50	0.300	23.1	87.7
#100	0.150	39.3	79.0
#200	0.075	61.0	67.5
PAN			

GRAVEL: **0 %**
SAND: **32 %**
FINES: **68 %**
GRP. SYMBOL: **ML**

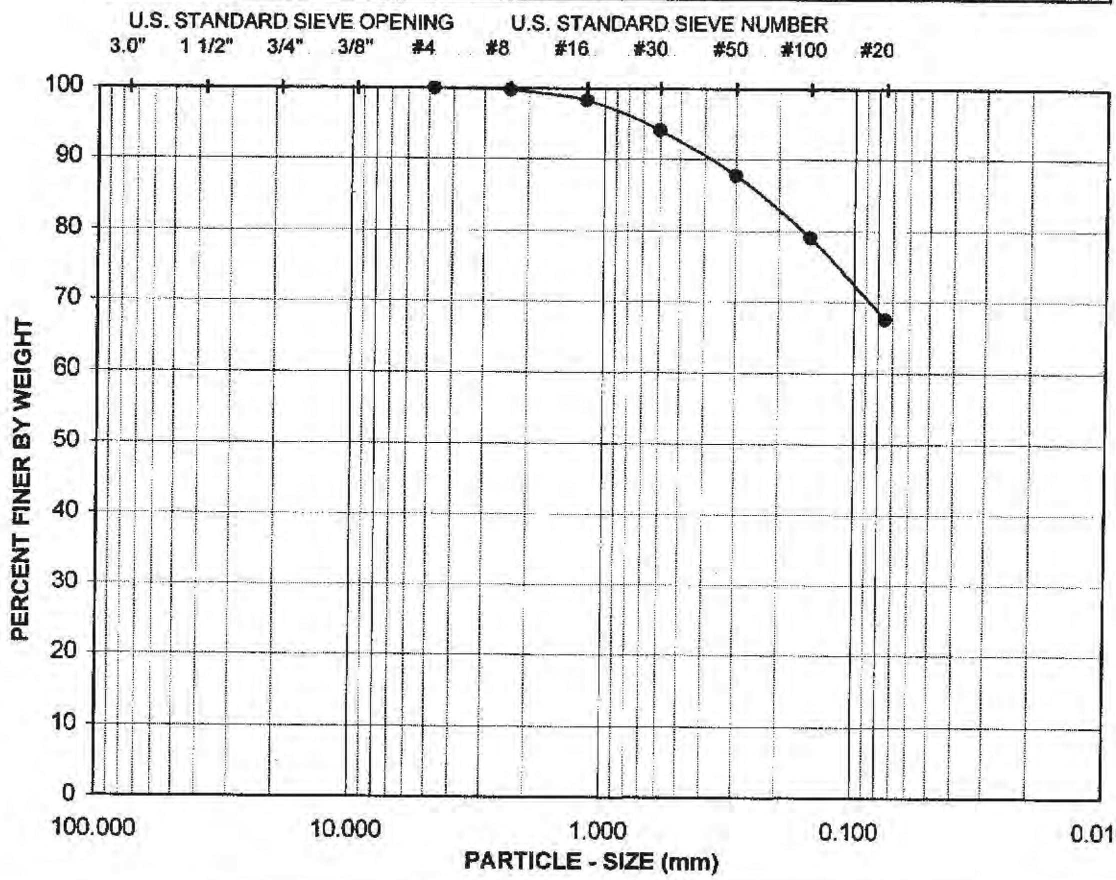
Liquid Limit:
Plastic Limit
Plasticity Index: **N/A**
$Cu = D60/D10 =$
$Cc = (D30)^2/(D60*D10) =$

Remarks:

Rev. 08-04



GRAVEL		SAND			FINES
COARSE	FINE	CRSE	MEDIUM	FINE	SILT / CLAY



Boring No.:	Sample No.:	Depth (ft.):	Soil Type	GR:SA:FI	LL,PL,PI
T-6	B-2	0-6.5	ML	0 : 32 : 68	N/A

Visual Sample Description:
ML, BROWN SANDY SILT

Leighton and Associates, Inc.

Project No.: 111446-001

VICTORIA GROVE

ATTERBERG LIMITS, PARTICLE - SIZE CURVE
ASTM D 4318, D 422

Rev. 08-04

xSieve T-6,B-2

Leighton and Associates, Inc.

COMPACTION TEST

ASTM D 1557

Project Name:	VICTORIA GROVE	Tested By :	AJP	Date:	1/3/05
Project No.:	111446-001	Calculated By :	PRC	Date:	1/5/05
Boring No.:	T-6	Depth (ft.):	0-6.5		
Sample No. :	B-2				

Sample Description ML, BROWN SANDY SILT

Preparation Method: [ ] **Moist** [X] **Dry** [X] **Mechanical Ram** [ ] **Manual Ram**

Mold Volume (ft³) 0.03344 *Ram Weight 10 LBS Drop 18 inches*

Moisture Added	100	50	150	0		
TEST NO.	1	2	3	4		
Wt. Comp. Soil + Mold (gm.)	5782	5695	5754	5584		
Wt. of Mold (gm.)	3639	3639	3639	3639		AS
Net Wt. of Soil (gm.)	2143	2056	2115	1945		REC'D
Wet Wt. of Soil + Cont. (gm.)	139.0	127.1	138.8	138.1		138.1
Dry Wt. of Soil + Cont. (gm.)	128.2	119.3	126.1	131.9		131.9
Wt. of Container (gm.)	12.6	12.6	12.6	12.6		12.6
Moisture Content (%)	9.3	7.3	11.2	5.2		5.2
Wet Density (pcf)	141.3	135.5	139.4	128.2		
Dry Density (pcf)	129.2	126.3	125.4	121.9		

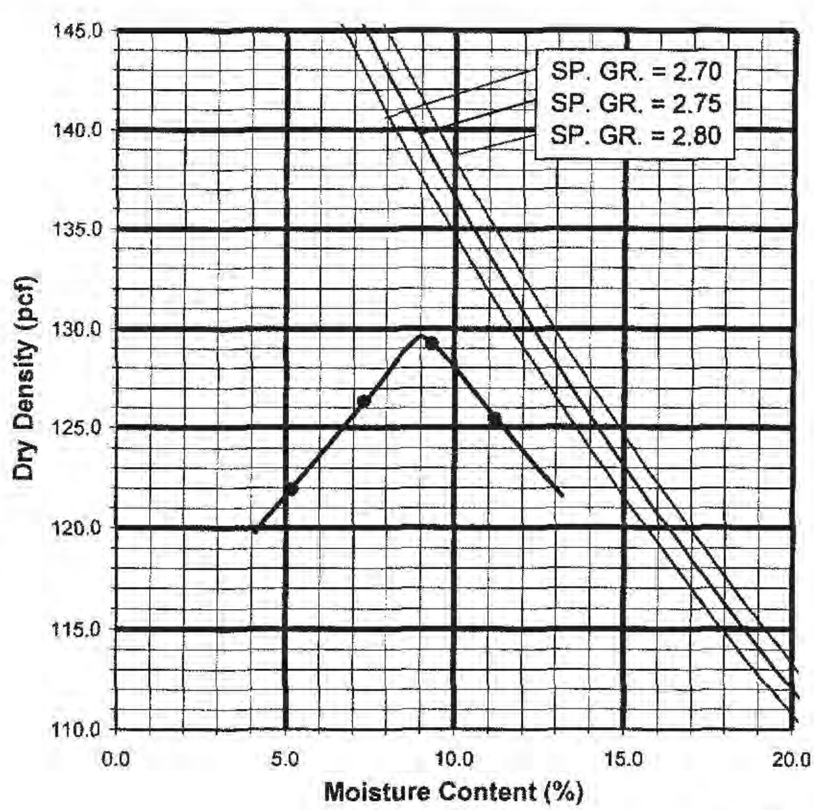
Maximum Dry Density (pcf) 129.5 **Optimum Moisture Content (%)** 9.0

PROCEDURE USED

[X] **Procedure A**
Soil Passing No. 4 (4.75 mm) Siev
Mold: 4 in. (101.6 mm) diamete
Layers: 5 (Five)
Blows per layer: 25 (twenty-five
May be used if No. 4 retained <20%

[ ] **Procedure B**
Soil Passing 3/8 in. (9.5 mm) Siev
Mold: 4 in. (101.6 mm) diamete
Layers: 5 (Five)
Blows per layer: 25 (twenty-five
Use if + No. 4 >20% and +3/8 in. <20%

[ ] **Procedure C**
Soil Passing 3/4 in. (19.0 mm) Siev
Mold: 6 in. (152.4 mm) diamete
Layers: 5 (Five)
Blows per layer: 56 (fifty-six
Use if +3/8 in. >20% and +¾ in. <30%



Particle-Size Distribution:

GR:SA:FI

Atterberg Limits:

LL,PL,PI

Rev. 08-04

xCompaction T-6,B-2

Leighton and Associates, Inc.

COMPACTION TEST

ASTM D 1557

Project Name:	VICTORIA GROVE	Tested By :	AJP	Date:	1/3/05
Project No.:	111446-001	Calculated By :	PRC	Date:	1/5/05
Boring No.:	T-8	Depth (ft.):	6.5-8.5		
Sample No. :	B-4				
Sample Description	SM, BROWN SILTY SAND				

Preparation Method: [ ] Moist [X] Dry — [X] Mechanical Ram [ ] Manual Ram

Mold Volume (ft³) 0.03344 *Ram Weight 10 LBS Drop 18 inches*

Moisture Added	50	0	100	150		
TEST NO.	1	2	3	4		
Wt. Comp. Soil + Mold (gm.)	5607	5525	5695	5705		
Wt. of Mold (gm.)	3639	3639	3639	3639		AS
Net Wt. of Soil (gm.)	1968	1886	2056	2066		REC'D
Wet Wt. of Soil + Cont. (gm.)	141.3	151.5	121.7	140.4		151.5
Dry Wt. of Soil + Cont. (gm.)	128.7	140.2	109.4	124.0		141.4
Wt. of Container (gm.)	12.6	12.6	12.6	12.6		12.6
Moisture Content (%)	10.9	8.9	12.7	14.7		7.8
Wet Density (pcf)	129.7	124.3	135.5	136.2		
Dry Density (pcf)	117.0	114.2	120.3	118.7		

Maximum Dry Density (pcf) 121.0 **Optimum Moisture Content (%)** 13.5

PROCEDURE USED

[X] **Procedure A**
Soil Passing No. 4 (4.75 mm) Sieve
Mold: 4 in. (101.6 mm) diamete
Layers: 5 (Five)
Blows per layer: 25 (twenty-five
May be used if No. 4 retained <20%

[ ] **Procedure B**
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold: 4 in. (101.6 mm) diamete
Layers: 5 (Five)
Blows per layer: 25 (twenty-five
Use if + No. 4 >20% and +3/8 in. <20%

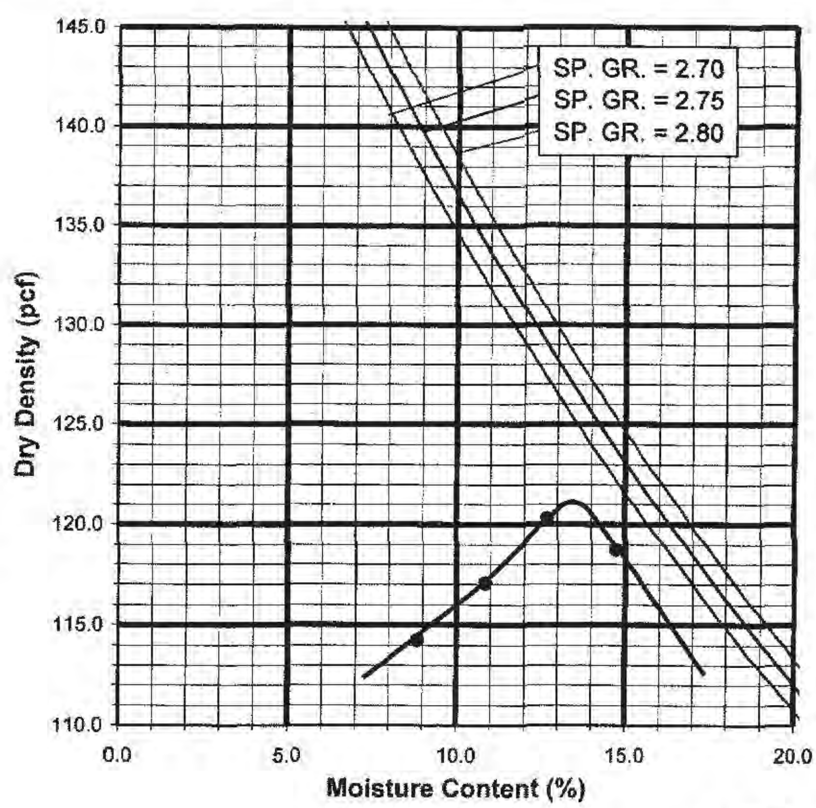
[ ] **Procedure C**
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold: 6 in. (152.4 mm) diamete
Layers: 5 (Five)
Blows per layer: 56 (fifty-six
Use if +3/8 in. >20% and +¾ in. <30%

Particle-Size Distribution:

GR:SA:FI

Atterberg Limits:

LL,PL,PI



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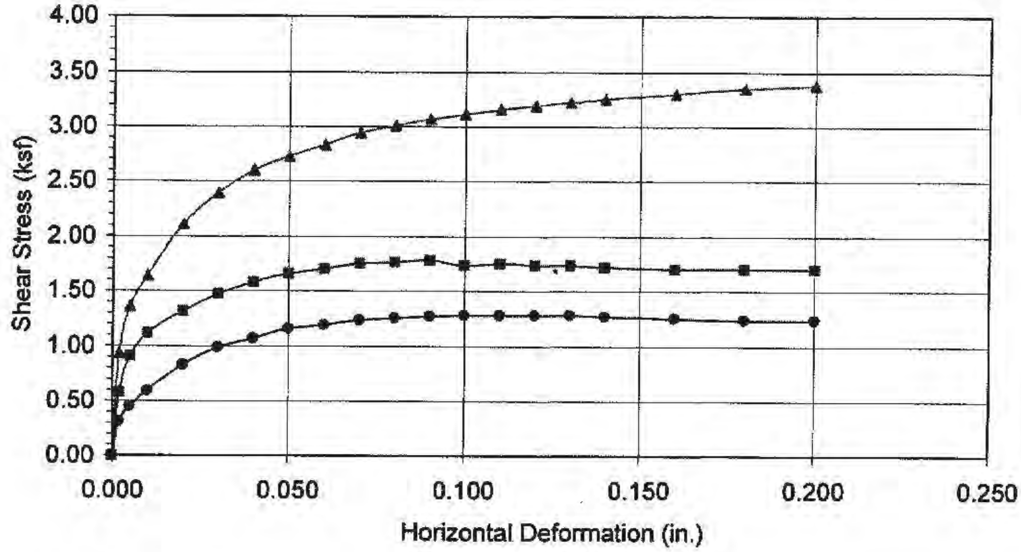

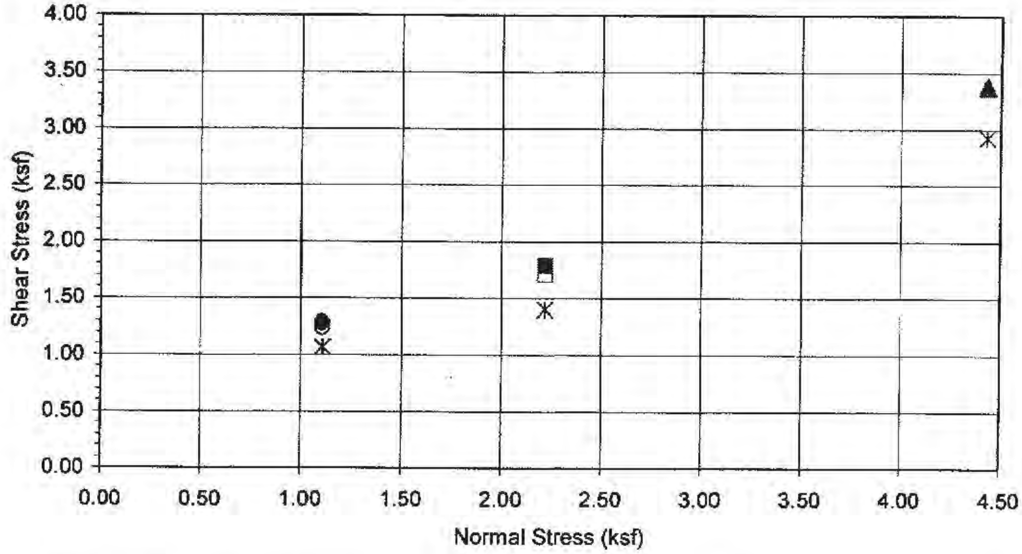

Normal Stress (kip/ft²)	1.108	2.216	4.432
Peak Shear Stress (kip/ft²)	● 1.283	■ 1.784	▲ 3.380
Shear Stress @ End of Test (ksf)	○ 1.236	□ 1.706	△ 3.380
Relaxed Value (ksf)	X 1.064	X 1.393	X 2.927
Deformation Rate (in./min.)	0.010	0.010	0.010
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.416	2.416	2.416
Initial Moisture Content (%)	9.0	9.0	9.0
Dry Density (pcf)	119.1	119.1	119.1
Saturation (%)	58.5	58.5	58.5
Soil Height Before Shearing (in.)	N/A	N/A	N/A
Final Moisture Content (%)	21.6	19.7	20.8

DIRECT SHEAR TEST RESULTS

Consolidated Drained - ASTM D 3080

Sample Remolded to 92% Relative Compaction

Leighton and Associates, Inc.

Boring No.:	LB-2
Sample No.:	R-1
Depth (ft)	2.5
Soil Description:	ML, BROWN SANDY SILT

Project No.: 111446-001

VICTORIA GROVE

Rev. 08-04

xDirect Shear LB-2,R-1

Leighton and Associates, Inc.

EXPANSION INDEX of SOILS
ASTM D 4829

Project Name:	VICTORIA GROVE	Tested By:	AJP	Date:	1/3/05
Project No. :	111446-001	Checked By:	PRC	Date:	1/5/05
Boring No.:	T-26	Depth (ft.)	3.5-5		
Sample No. :	B-6	Location:			
Sample Description:	SM, BROWN SILTY SAND				

Dry Wt. of Soil + Cont. (gm.)	2000.0
Wt. of Container No. (gm.)	0.0
Dry Wt. of Soil (gm.)	2000.0
Weight Soil Retained on #4 Sieve	0.0
Percent Passing # 4	100.0

MOLDED SPECIMEN	Before Test	After Test
Specimen Diameter (in.)	4.01	4.01
Specimen Height (in.)	1.0000	1.0142
Wt. Comp. Soil + Mold (gm.)	588.1	622.7
Wt. of Mold (gm.)	199.6	199.6
Specific Gravity (Assumed)	2.70	2.70
Container No.	E-7	E-7
Wet Wt. of Soil + Cont. (gm.)	312.6	622.7
Dry Wt. of Soil + Cont. (gm.)	287.8	356.4
Wt. of Container (gm.)	12.6	199.6
Moisture Content (%)	9.0	18.7
Wet Density (pcf)	117.2	127.5
Dry Density (pcf)	107.5	107.4
Void Ratio	0.568	0.590
Total Porosity	0.362	0.371
Pore Volume (cc)	75.0	77.9
Degree of Saturation (%) [S meas]	**42.8**	**85.6**

SPECIMEN INUNDATION in distilled water for the period of 24 h or expansion rate < 0.0002 in./h.

Date	Time	Pressure (psi)	Elapsed Time (min.)	Dial Readings (in.)
1/3/05	14:20	1.0	0	0.5000
1/3/05	14:30	1.0	10	0.4995
	Add Distilled Water to the Specimen			
1/4/05	7:20	1.0	1010	0.5142
1/4/05	8:20	1.0	1070	0.5142

Expansion Index (EI meas) = ((Final Rdg - Initial Rdg) / Initial Thick.) x 1000	14.7
Expansion Index (EI)$_{50}$ = EI meas - (50 -S meas)x((65+EI meas) / (220-S meas))	**11**

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Leighton and Associates, Inc.

EXPANSION INDEX of SOILS
ASTM D 4829

Project Name:	VICTORIA GROVE	Tested By: AJP	Date: 1/3/05
Project No. :	111446-001	Checked By: PRC	Date: 1/5/05
Boring No.:	T-7	Depth (ft.) 3-8	
Sample No. :	B-3	Location:	
Sample Description:	SM, BROWN SILTY SAND		

Dry Wt. of Soil + Cont. (gm.)	2000.0
Wt. of Container No. (gm.)	0.0
Dry Wt. of Soil (gm.)	2000.0
Weight Soil Retained on #4 Sieve	0.0
Percent Passing # 4	100.0

MOLDED SPECIMEN	Before Test	After Test
Specimen Diameter (in.)	4.01	4.01
Specimen Height (in.)	1.0000	1.0063
Wt. Comp. Soil + Mold (gm.)	639.7	659.2
Wt. of Mold (gm.)	209.7	209.7
Specific Gravity (Assumed)	2.70	2.70
Container No.	E-5	E-5
Wet Wt. of Soil + Cont. (gm.)	312.6	659.2
Dry Wt. of Soil + Cont. (gm.)	289.1	396.3
Wt. of Container (gm.)	12.6	209.7
Moisture Content (%)	8.5	13.4
Wet Density (pcf)	129.7	135.4
Dry Density (pcf)	119.5	119.4
Void Ratio	0.410	0.419
Total Porosity	0.291	0.295
Pore Volume (cc)	60.2	61.5
Degree of Saturation (%) [S meas]	**55.9**	**86.5**

SPECIMEN INUNDATION in distilled water for the period of 24 h or expansion rate < 0.0002 in./h.

Date	Time	Pressure (psi)	Elapsed Time (min.)	Dial Readings (in.)
1/3/05	13:50	1.0	0	0.5000
1/3/05	14:00	1.0	10	0.4991
	Add Distilled Water to the Specimen			
1/4/05	7:20	1.0	1040	0.5063
1/4/05	8:20	1.0	1100	0.5063

Expansion Index (EI meas)	= ((Final Rdg - Initial Rdg) / Initial Thick.) x 1000	7.2
Expansion Index (EI)$_{50}$	= EI meas - (50 -S meas)x((65+EI meas) / (220-S meas))	**10**

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Leighton and Associates, Inc.

EXPANSION INDEX of SOILS
ASTM D 4829

Project Name:	VICTORIA GROVE	Tested By:	AJP	Date:	1/3/05
Project No. :	111446-001	Checked By:	PRC	Date:	1/5/05
Boring No.:	T-26	Depth (ft.)	1-3		
Sample No. :	B-5	Location:			
Sample Description:	SM, BROWN SILTY SAND				

Dry Wt. of Soil + Cont. (gm.)	2000.0
Wt. of Container No. (gm.)	0.0
Dry Wt. of Soil (gm.)	2000.0
Weight Soil Retained on #4 Sieve	0.0
Percent Passing # 4	100.0

MOLDED SPECIMEN	Before Test	After Test
Specimen Diameter (in.)	4.01	4.01
Specimen Height (in.)	1.0000	1.0186
Wt. Comp. Soil + Mold (gm.)	588.9	631.4
Wt. of Mold (gm.)	202.0	202.0
Specific Gravity (Assumed)	2.70	2.70
Container No.	E-6	E-6
Wet Wt. of Soil + Cont. (gm.)	312.6	631.4
Dry Wt. of Soil + Cont. (gm.)	289.1	356.6
Wt. of Container (gm.)	12.6	202.0
Moisture Content (%)	8.5	20.4
Wet Density (pcf)	116.7	129.4
Dry Density (pcf)	107.6	107.4
Void Ratio	0.567	0.596
Total Porosity	0.362	0.374
Pore Volume (cc)	74.9	78.8
Degree of Saturation (%) [S meas]	**40.5**	**92.4**

SPECIMEN INUNDATION in distilled water for the period of 24 h or expansion rate < 0.0002 in./h.

Date	Time	Pressure (psi)	Elapsed Time (min.)	Dial Readings (in.)
1/3/05	14:00	1.0	0	0.5000
1/3/05	14:10	1.0	10	0.4978
	Add Distilled Water to the Specimen			
1/4/05	7:20	1.0	1030	0.5186
1/4/05	8:20	1.0	1090	0.5186

Expansion Index (EI meas) =	((Final Rdg - Initial Rdg) / Initial Thick.) x 1000	20.8
Expansion Index (EI)$_{50}$ =	EI meas - (50 -S meas)x((65+EI meas) / (220-S meas))	**16**

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One-Dimensional Swell or Settlement Potential of Cohesive Soils
(ASTM D 4546)

Project Name: VICTORIA GROVE		Tested By: JMD	Date: 2/7/05
Project No.: 111446-001		Checked By: PRC	Date: 2/7/05
Boring No.: LB-4		Sample Type: IN SITU	
Sample No.: R-1		Depth (ft.) 2.5	

Sample Description: SM, BROWN SILTY SAND

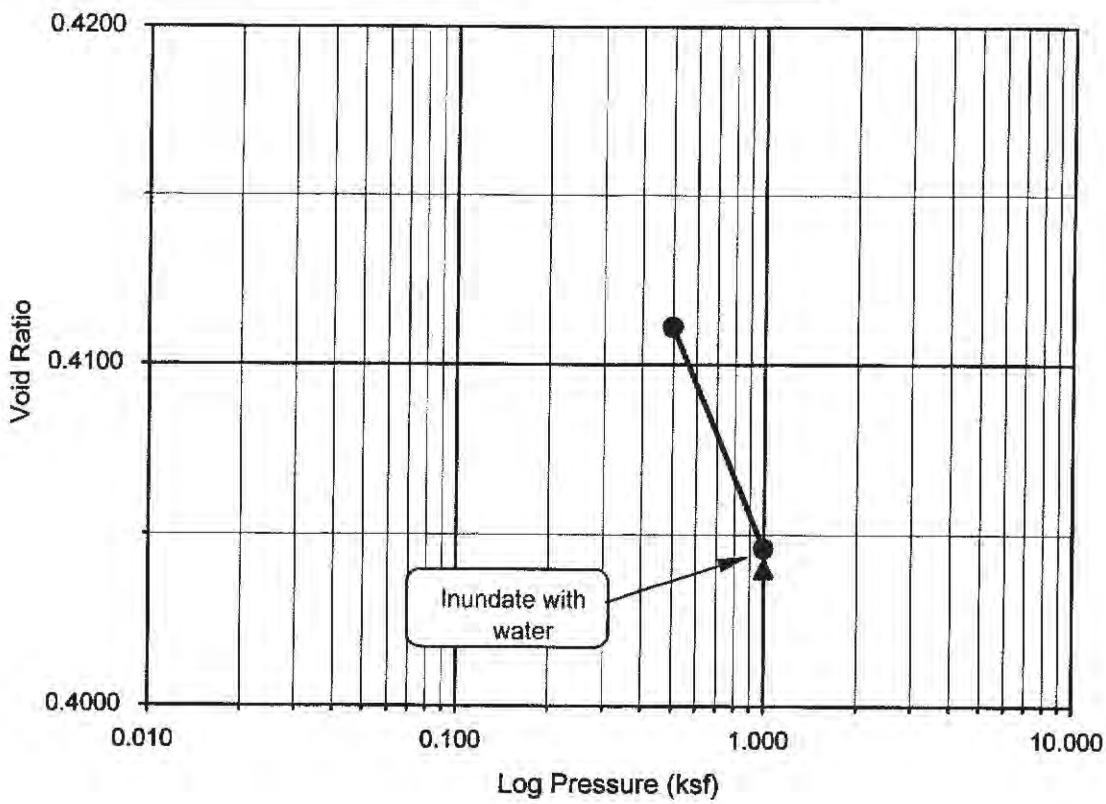
Initial Dry Density (pcf):	118.9
Initial Moisture (%):	14.4
Initial Length (in.):	1.0000
Initial Dial Reading:	0.0500
Diameter(in):	2.416

Final Dry Density (pcf):	120.1
Final Moisture (%) :	14.7
Initial Void ratio:	0.4175
Specific Gravity(assumed):	2.70
Initial Saturation (%)	93.1

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.500	0.0545	0.9955	0.00	-0.45	0.4111	-0.45
1.000	0.0591	0.9909	0.00	-0.91	0.4046	-0.91
H2O	0.0595	0.9905	0.00	-0.95	0.4040	-0.95

Percent Swell / Settlement After Inundation = -0.04

Void Ratio - Log Pressure Curve



Rev. 08-04

xCollapse-Swell LB-4,R-1

Leighton and Associates, Inc.

One-Dimensional Swell or Settlement Potential of Cohesive Soils
(ASTM D 4546)

Project Name: VICTORIA GROVE
Project No.: 111446-001
Boring No.: LB-4
Sample No.: R-3
Sample Description: SM, BROWN SILTY SAND

Tested By: JMD   Date: 2/3/05
Checked By: PRC   Date: 2/7/05
Sample Type: IN SITU
Depth (ft.) 7.5

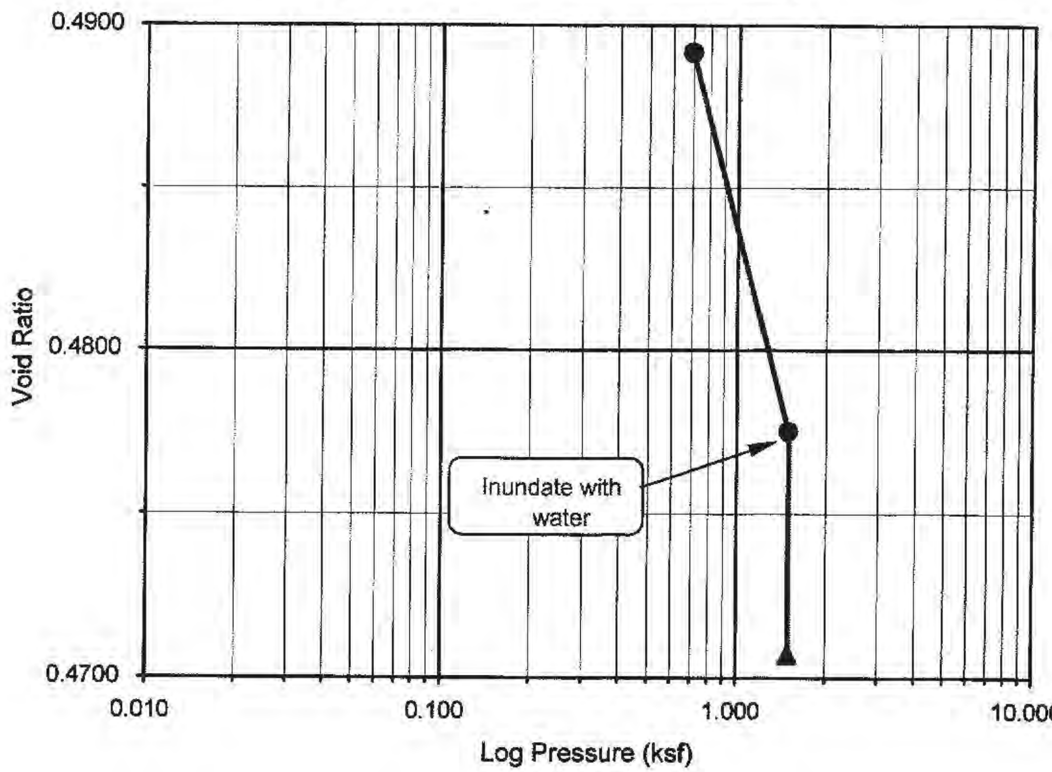
Initial Dry Density (pcf):	112.7
Initial Moisture (%):	10.8
Initial Length (in.):	1.0000
Initial Dial Reading:	0.0500
Diameter(in):	2.416

Final Dry Density (pcf):	114.6
Final Moisture (%) :	15.9
Initial Void ratio:	0.4959
Specific Gravity(assumed):	2.70
Initial Saturation (%)	59.0

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.700	0.0545	0.9955	0.00	-0.45	0.4891	-0.45
1.500	0.0623	0.9877	0.00	-1.23	0.4775	-1.23
H2O	0.0668	0.9832	0.00	-1.68	0.4707	-1.68

Percent Swell / Settlement After Inundation = -0.46

Void Ratio - Log Pressure Curve



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xCollapse-Swell LB-4.R-3

Leighton and Associates, Inc.

One-Dimensional Swell or Settlement Potential of Cohesive Soils
(ASTM D 4546)

Project Name: VICTORIA GROVE
Project No.: 111446-001
Boring No.: T-6
Sample No.: C-1
Sample Description: ML, BROWN SANDY SILT

Tested By: JMD Date: 1/5/05
Checked By: PRC Date: 1/5/05
Sample Type: IN SITU
Depth (ft.) 0-6.5

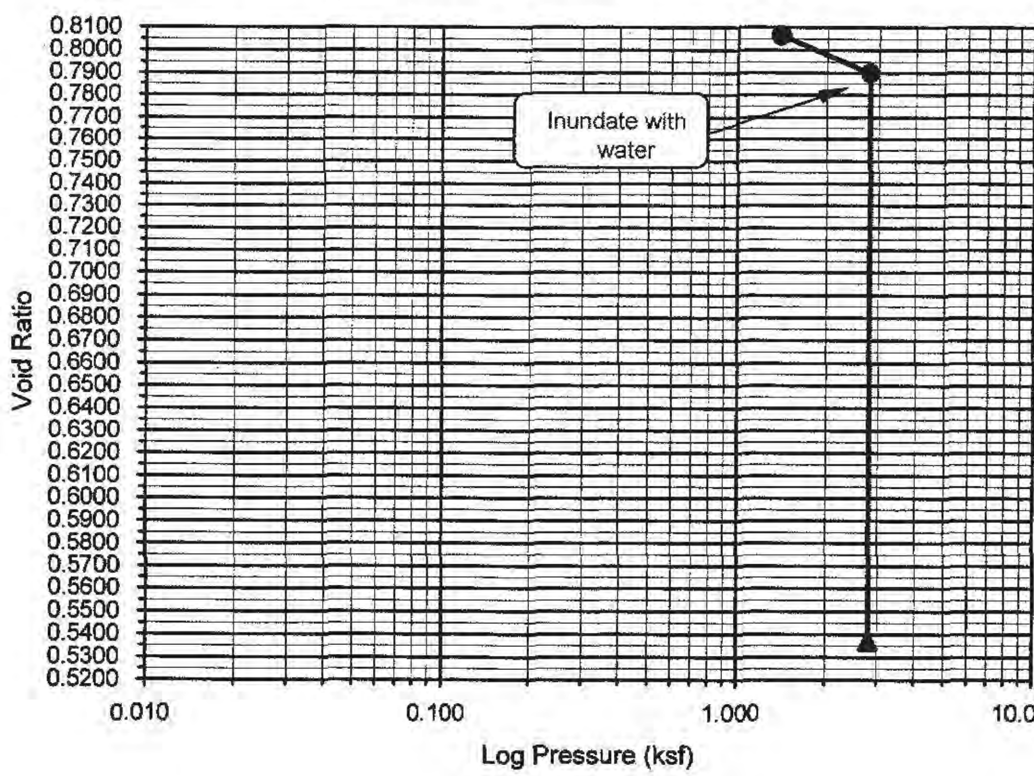
Initial Dry Density (pcf):	91.9
Initial Moisture (%):	7.1
Initial Length (in.):	1.0000
Initial Dial Reading:	0.0500
Diameter(in):	2.416

Final Dry Density (pcf):	109.6
Final Moisture (%) :	19.3
Initial Void ratio:	0.8340
Specific Gravity(assumed):	2.70
Initial Saturation (%)	22.8

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
1.400	0.0651	0.9849	0.00	-1.51	0.8063	-1.51
2.800	0.0742	0.9758	0.00	-2.42	0.7896	-2.42
H2O	0.2117	0.8383	0.00	-16.17	0.5374	-16.17

Percent Swell / Settlement After Inundation = -14.09

Void Ratio - Log Pressure Curve



Rev. 08-04

xCollapse T-6,B-1

Leighton and Associates, Inc.

TESTS for SULFATE CONTENT CHLORIDE CONTENT and pH of SOILS

Project Name: VICTORIA GROVE | Tested By : AJP | Date: 1/4/05

Project No. : 111446-001 | Data Input By: AJP | Date: 1/4/05

Boring No.	T-6	T-26			
Sample No.	B-2	B-6			
Sample Depth (ft)	0-6.5	3.5-5			
Visual Soil Classification	ML	SM			
Wet Weight of Soil + Container (g)	138.1	312.6			
Dry Weight of Soil + Container (g)	131.9	287.8			
Weight of Container (g)	12.6	12.6			
Moisture Content (%)	5.2	9.0			
Weight of Soaked Soil (g)	100.0	100.0			

SULFATE CONTENT, DOT California Test 417, Hach Kit Method

Dilution : 1	3	3			
Water Fraction (ml)	25	25			
Tube Reading	100	50			
PPM Sulfate	300	150			
% Sulfate	0.0300	0.0150			

CHLORIDE CONTENT, DOT California Test 422

ml of Chloride Soln. For Titration (B	30	30			
ml of AgNO3 Soln. Used in Titration (C	1.4	2.6			
PPM of Chloride (C -0.2) * 100 * 30 / E	120	240			
PPM of Chloride, Dry Wt. Basis	**127**	**264**			

pH TEST, DOT California Test 532/643

Container No.	A	A			
pH Value	**7.35**	**7.96**			

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Leighton and Associates, Inc.

SOIL RESISTIVITY TEST
DOT CA TEST 532 / 643

Project Name: VICTORIA GROVE
Project No. : 111446-001
Boring No.: T-26
Sample No. : B-6
Visual Soil Identification: SM

Tested By : AJP Date: 1/4/05
Data Input By AJP Date: 1/4/05
Checked By: PRC Date: 1/5/05
Depth (ft.) : 3.5-5

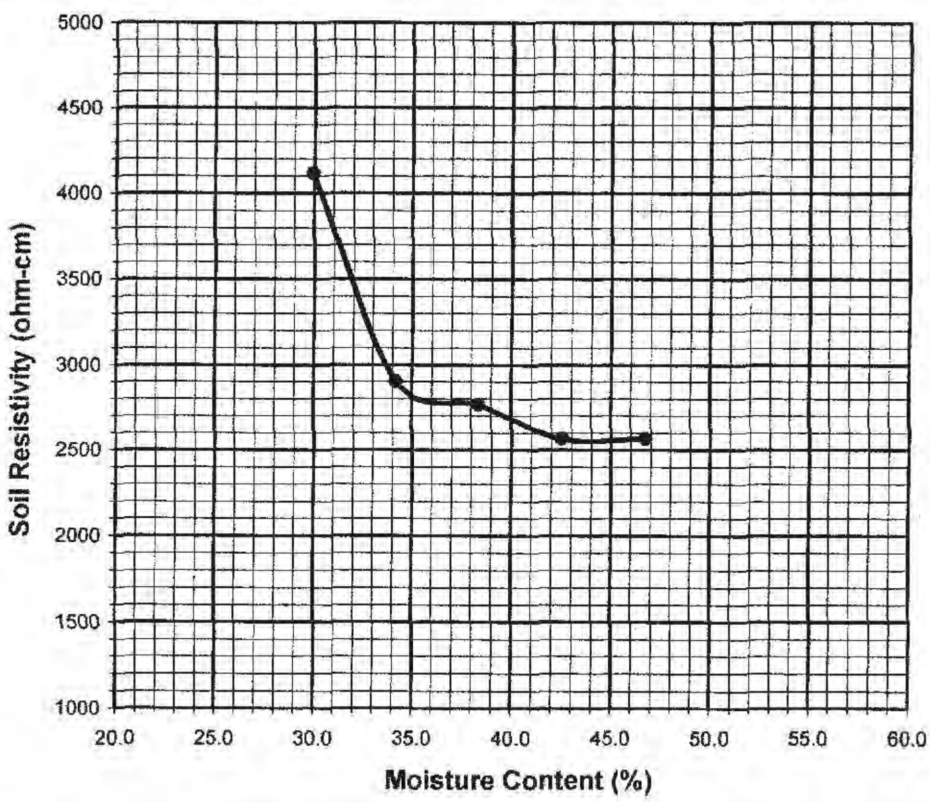
Initial Moisture Content (%)

Wet Wt. of Soil + Cont. (gm.)	312.6
Dry Wt. of Soil + Cont. (gm.)	287.8
Wt. of Container (gm.)	12.6
Moisture Content (%) (MCi)	9.0

Initial Soil Weight (gm)(Wt)	1300.0
Box Constant:	6.75

MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100

Remolded Specimen	Moisture Adjustments				
Water Added (ml) (Wa)	250	300	350	400	450
Adj. Moisture Content (%) (MC)	29.98	34.17	38.36	42.55	46.75
Resistance Rdg. (ohm)	610	430	410	380	380
Soil Resistivity (ohm-cm)	4115	2901	2766	2563	2563



Minimum Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH
DOT CA Test 532 / 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 532/643
2563	42.6	150	264	7.96

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Leighton and Associates, Inc.

SOIL RESISTIVITY TEST
DOT CA TEST 532 / 643

Project Name:	VICTORIA GROVE	Tested By :	AJP	Date:	1/4/05
Project No. :	111446-001	Data Input By:	AJP	Date:	1/4/05
Boring No.:	T-6	Checked By:	PRC	Date:	1/5/05
Sample No. :	B-2	Depth (ft.) :	0-6.5		

Visual Soil Identification: ML

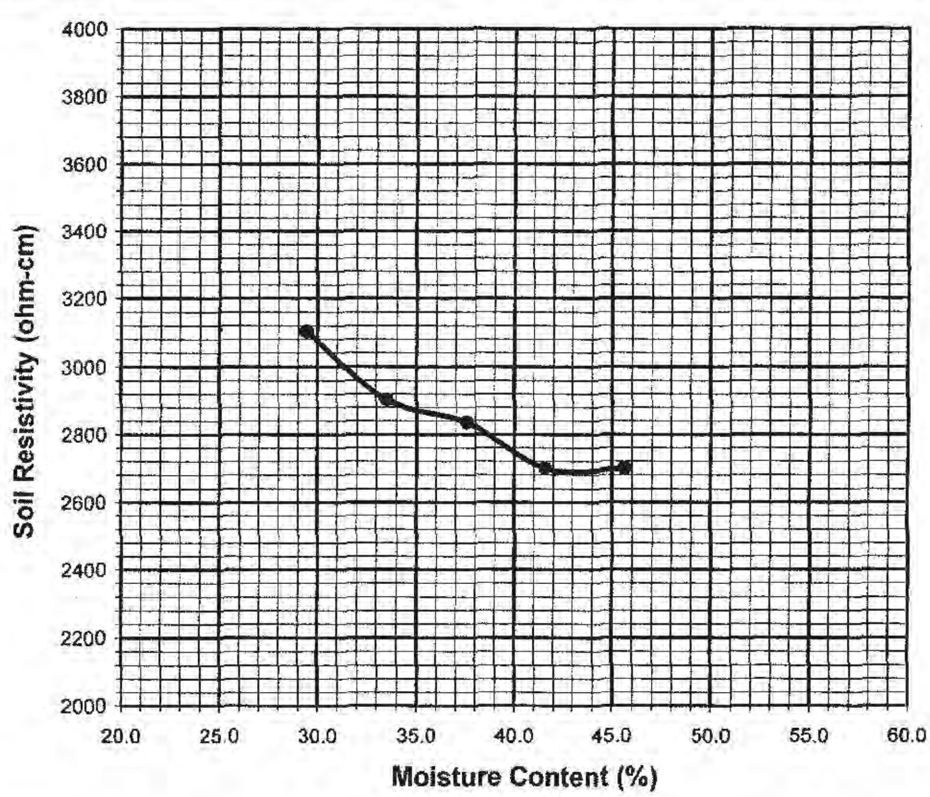
Initial Moisture Content (%)

Wet Wt. of Soil + Cont. (g)	138.10
Dry Wt. of Soil + Cont. (g)	131.90
Wt. of Container (g)	12.60
Moisture Content (%) (MCi)	5.20

Initial Soil Weight (gm)(Wt)	1300.0
Box Constant:	6.75

MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100

Remolded Specimen	Moisture Adjustments				
Water Added (ml) (Wa)	300	350	400	450	500
Adj. Moisture Content (%) (MC)	29.47	33.52	37.57	41.61	45.66
Resistance Rdg. (ohm)	460	430	420	400	400
Soil Resistivity (ohm-cm)	3103	2901	2833	2698	2698



Minimum Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH
DOT CA Test 532 / 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 532/643
2698	41.6	300	127	7.35

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APPENDIX D

SLOPE STABILITY ANALYSIS

1507-05 Green Tree (41 ft Kcgb Cut 2:1 Slope) Static Condition

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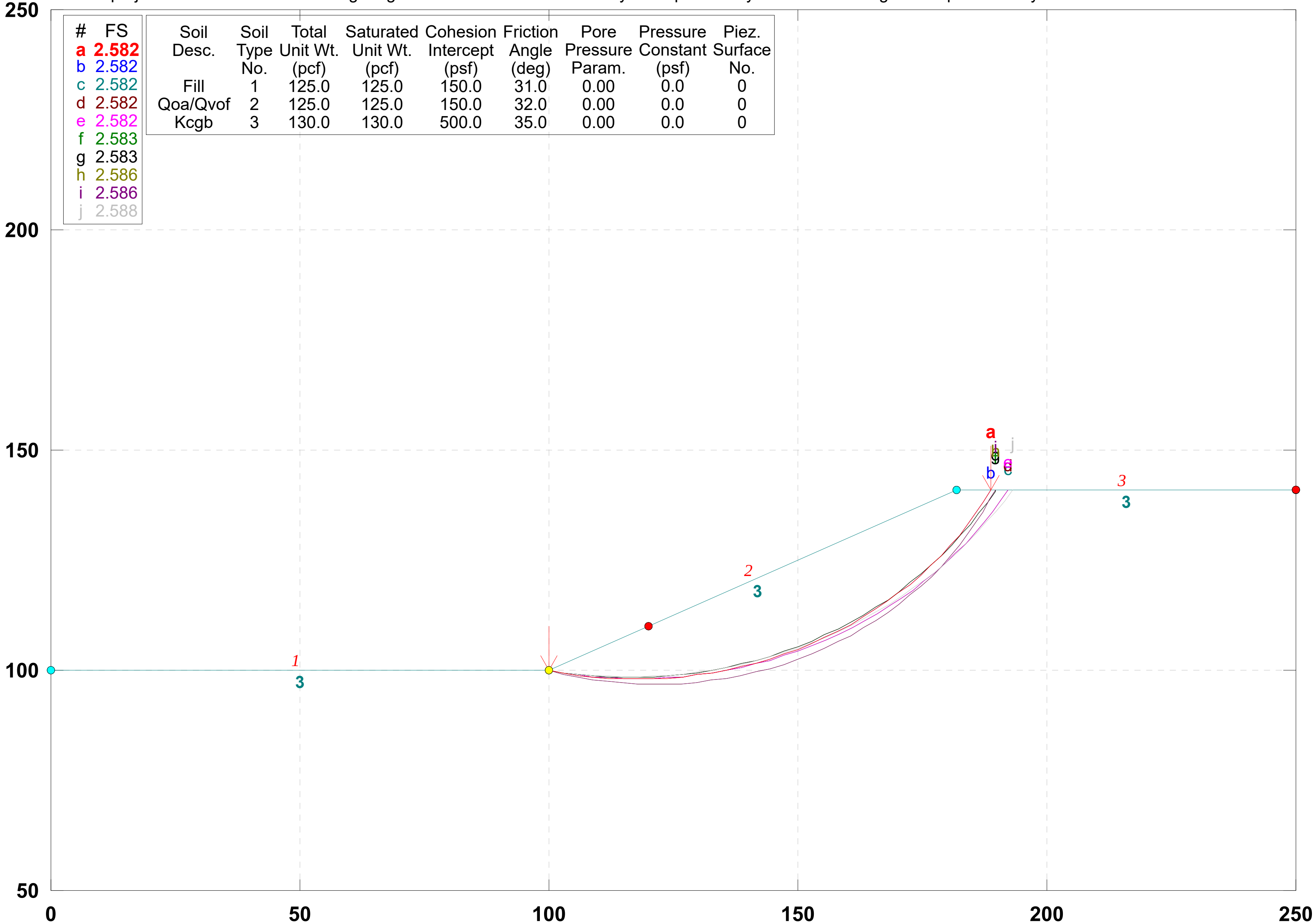


Soil Desc.	Soil Type No.	Total Unit Wt. (pcf)	Saturated Unit Wt. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Param.	Pressure Constant (psf)	Piez. Surface No.
Fill	1	125.0	125.0	150.0	31.0	0.00	0.0	0
Qoa/Qvof	2	125.0	125.0	150.0	32.0	0.00	0.0	0
Kcgb	3	130.0	130.0	500.0	35.0	0.00	0.0	0

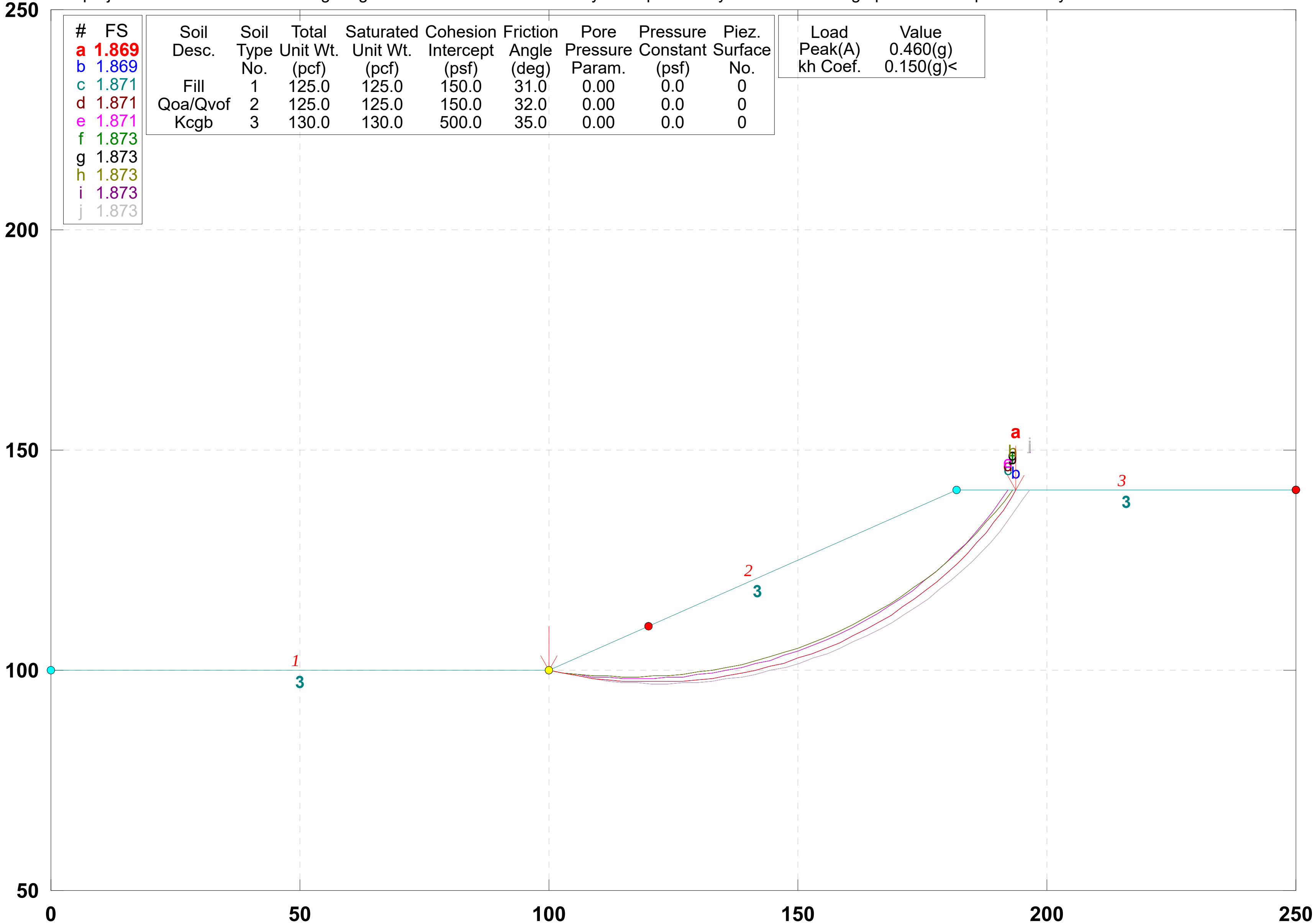
GSTABL7 v.2 FSmin=2.582

Safety Factors Are Calculated By The Simplified Janbu Method for the case of c & phi both > 0

PLATE D-1

1507-05 Green Tree (41 ft Kcgb Cut 2:1 Slope) Pseudostatic Condition

k:\project files\1507-05 victoria heights-greentree ranch\calcs and analysis\slope stability\41 ft 2 to 1 cut kgb pseudostatic.pl2 Run By: AGS 5/10/2018 01:45PM



#	FS
a	1.869
b	1.869
c	1.871
d	1.871
e	1.871
f	1.873
g	1.873
h	1.873
i	1.873
j	1.873

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	150.0	31.0	0.00	0.0	0
Qoa/Qvof	2	125.0	125.0	150.0	32.0	0.00	0.0	0
Kcgb	3	130.0	130.0	500.0	35.0	0.00	0.0	0

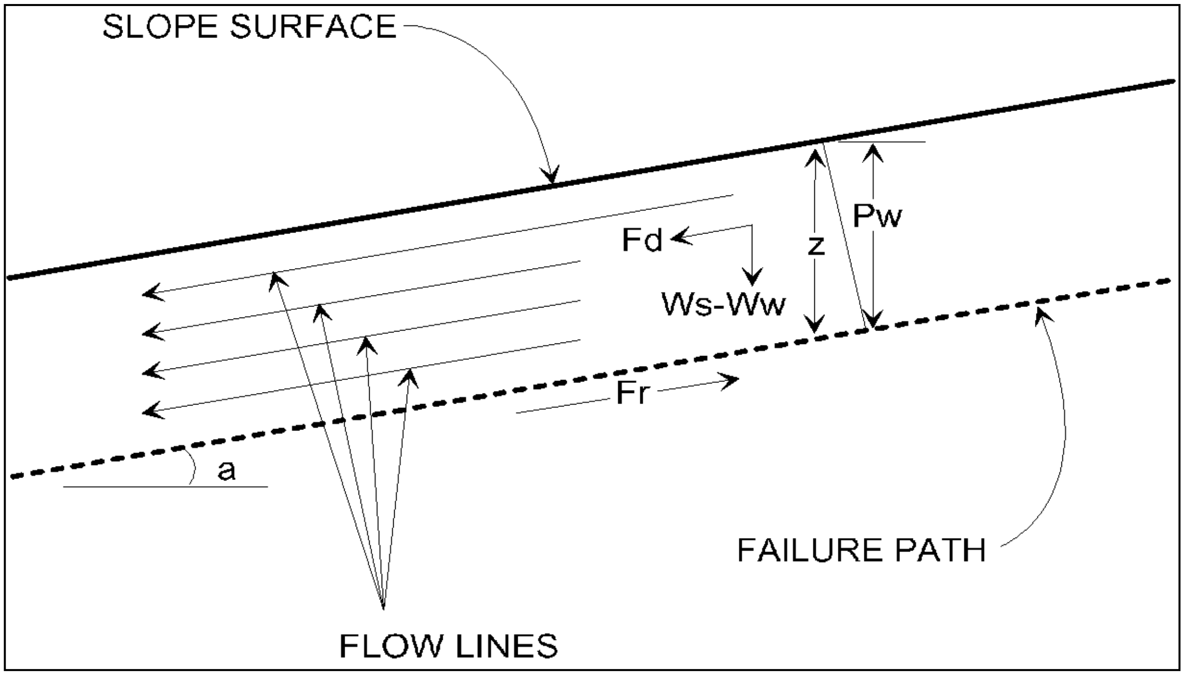
Load	Value
Peak(A)	0.460(g)
kh Coef.	0.150(g)<

GSTABL7 v.2 FSmin=1.869

Safety Factors Are Calculated By The Simplified Janbu Method for the case of c & phi both > 0

PLATE D-2

SURFICIAL SLOPE STABILITY



Assume: (1) Saturation To Slope Surface
(2) Sufficient Permeability To Establish Water Flow

Pw = Water Pressure Head=(z)(cos^2(a))
Ws = Saturated Soil Unit Weight
Ww = Unit Weight of Water (62.4 lb/cu.ft.)
u = Pore Water Pressure=(Ww)(z)(cos^2(a))
z = Layer Thickness
a = Angle of Slope (2:1 H:V) a = 26.5651 degrees
phi = Angle of Friction
c = Cohesion
Fd = (0.5)(z)(Ws)(sin(2a))
Fr = (z)(Ws-Ww)(cos^2(a))(tan(phi)) + c
Factor of Safety (FS) = Fr/Fd

2:1 CUT SLOPE - Qoa

Given:

Ws	z	a		phi		c
(pcf)	(ft)	(degrees)	(radians)	(degrees)	(radians)	(psf)
125	2	26.5651	0.4636	32.0	0.5585	150

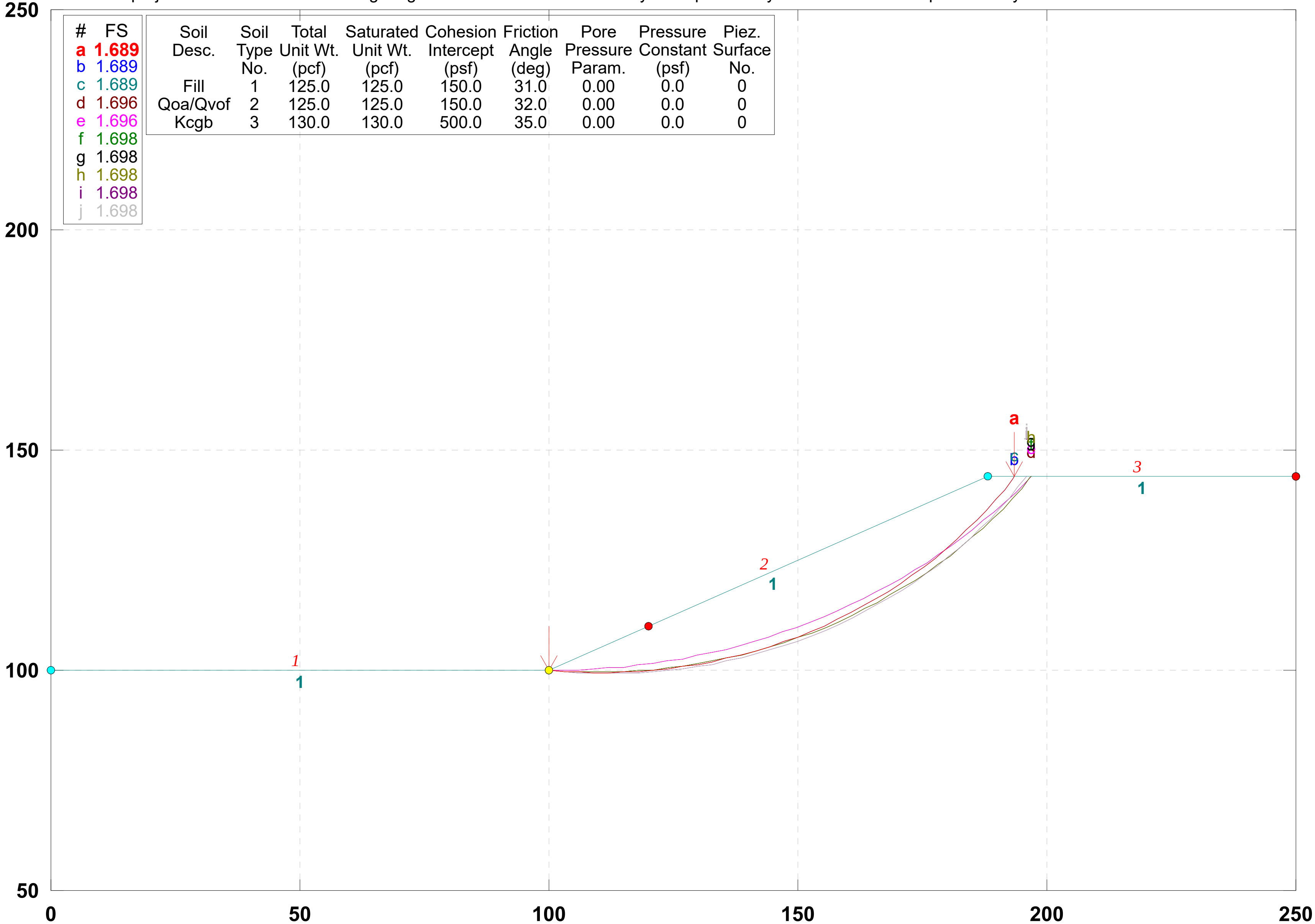
Calculations:

Pw	u	Fd	Fr	**FS**
1.60	99.84	100.00	212.59	**2.13**

PLATE D-3

1507-05 Green Tree (44 ft Fill 2:1 Slope) Static Condition

k:\project files\1507-05 victoria heights-greentree ranch\calcs and analysis\slope stability\44 ft 2 to 1 fill static.pl2   Run By: AGS   5/25/2018   11:11AM



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	150.0	31.0	0.00	0.0	0
Qoa/Qvof	2	125.0	125.0	150.0	32.0	0.00	0.0	0
Kcgb	3	130.0	130.0	500.0	35.0	0.00	0.0	0

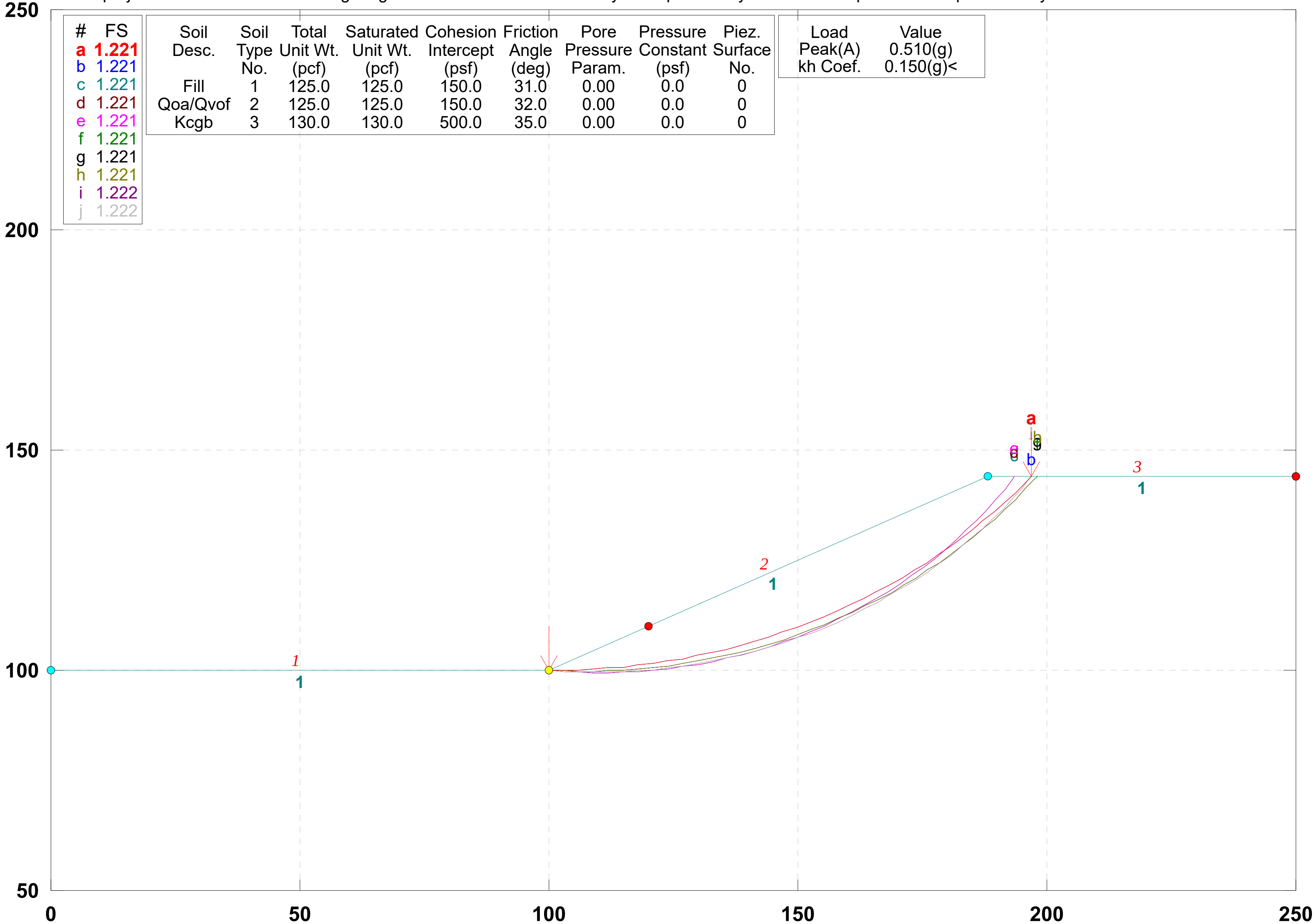
GSTABL7 v.2 FSmin=1.689

Safety Factors Are Calculated By The Simplified Janbu Method for the case of c & phi both > 0

PLATE D-4

1507-05 Green Tree (44 ft Fill 2:1 Slope) Pseudo Static Condition

k:\project files\1507-05 victoria heights-greentree ranch\calcs and analysis\slope stability\44 ft 2 to 1 fill pseudostatic.pl2 Run By: AGS 5/25/2018 11:13AM

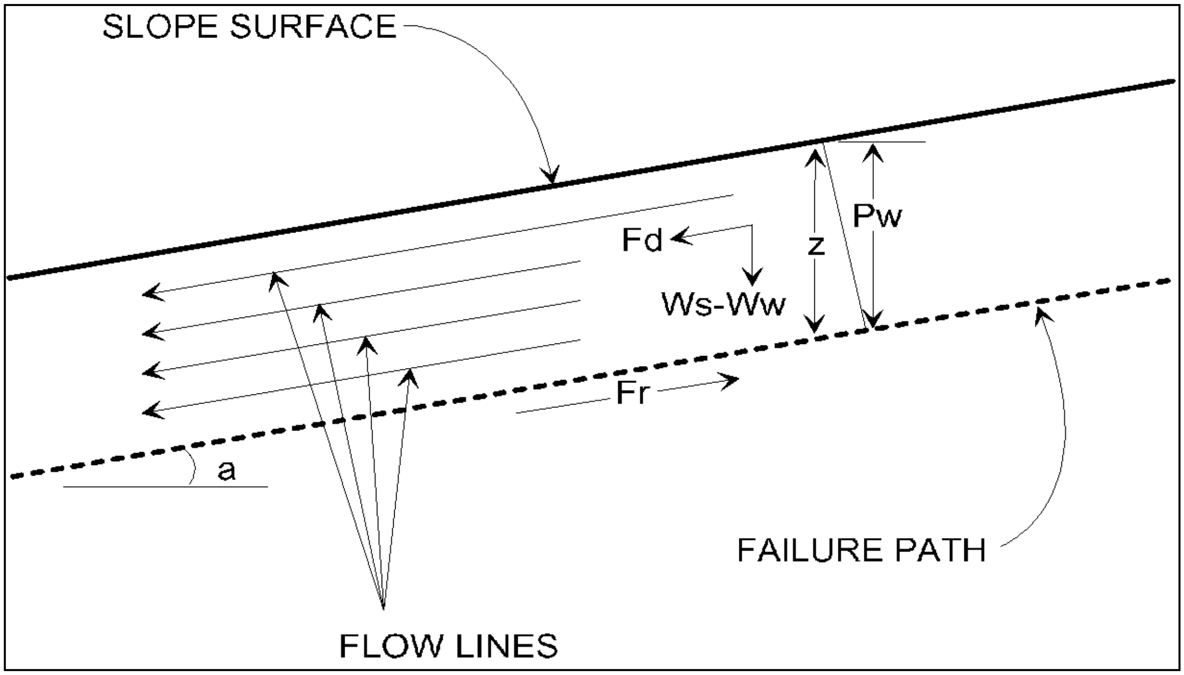


GSTABL7 v.2 FSmin=1.221

Safety Factors Are Calculated By The Simplified Janbu Method for the case of c & phi both > 0

PLATE D-5

SURFICIAL SLOPE STABILITY



Assume: (1) Saturation To Slope Surface
(2) Sufficient Permeability To Establish Water Flow

Pw = Water Pressure Head=(z)(cos^2(a))
Ws = Saturated Soil Unit Weight
Ww = Unit Weight of Water (62.4 lb/cu.ft.)
u = Pore Water Pressure=(Ww)(z)(cos^2(a))
z = Layer Thickness
a = Angle of Slope (2:1 H:V) a = 26.5651 degrees
phi = Angle of Friction
c = Cohesion
Fd = (0.5)(z)(Ws)(sin(2a))
Fr = (z)(Ws-Ww)(cos^2(a))(tan(phi)) + c
Factor of Safety (FS) = Fr/Fd

2:1 FILL SLOPE

Given:

Ws	z	a		phi		c
(pcf)	(ft)	(degrees)	(radians)	(degrees)	(radians)	(psf)
125	2	26.5651	0.4636	31.0	0.5411	150

Calculations:

Pw	u	Fd	Fr	**FS**
1.60	99.84	100.00	210.18	**2.10**

PLATE D-6

APPENDIX E

EARTHWORK SPECIFICATIONS AND GRADING DETAILS

GENERAL EARTHWORK SPECIFICATIONS

I. General

A. General procedures and requirements for earthwork and grading are presented herein. The earthwork and grading recommendations provided in the geotechnical report are considered part of these specifications, and where the general specifications provided herein conflict with those provided in the geotechnical report, the recommendations in the geotechnical report shall govern. Recommendations provided herein and in the geotechnical report may need to be modified depending on the conditions encountered during grading.

B. The contractor is responsible for the satisfactory completion of all earthwork in accordance with the project plans, specifications, applicable building codes, and local governing agency requirements. Where these requirements conflict, the stricter requirements shall govern.

C. It is the contractor's responsibility to read and understand the guidelines presented herein and in the geotechnical report as well as the project plans and specifications. Information presented in the geotechnical report is subject to verification during grading. The information presented on the exploration logs depict conditions at the particular time of excavation and at the location of the excavation. Subsurface conditions present at other locations may differ, and the passage of time may result in different subsurface conditions being encountered at the locations of the exploratory excavations. The contractor shall perform an independent investigation and evaluate the nature of the surface and subsurface conditions to be encountered and the procedures and equipment to be used in performing his work.

D. The contractor shall have the responsibility to provide adequate equipment and procedures to accomplish the earthwork in accordance with applicable requirements. When the quality of work is less than that required, the Geotechnical Consultant may reject the work and may recommend that the operations be suspended until the conditions are corrected.

E. Prior to the start of grading, a qualified Geotechnical Consultant should be employed to observe grading procedures and provide testing of the fills for conformance with the project specifications, approved grading plan, and guidelines presented herein. All clearing and grubbing, remedial removals, clean-outs, removal bottoms, keyways, and subdrain installations should be observed and documented by the Geotechnical Consultant prior to placing fill. It is the contractor's responsibility to apprise the Geotechnical Consultant of their schedules and notify the Geotechnical Consultant when those areas are ready for observation.

F. The contractor is responsible for providing a safe environment for the Geotechnical Consultant to observe grading and conduct tests.

II. Site Preparation

A. Clearing and Grubbing: Excessive vegetation and other deleterious material shall be sufficiently removed as required by the Geotechnical Consultant, and such materials shall be properly disposed of offsite in a method acceptable to the owner and governing agencies. Where applicable, the contractor may obtain permission from the Geotechnical Consultant, owner, and governing agencies to dispose of vegetation and other deleterious materials in designated areas onsite.

B. Unsuitable Soils Removals: Earth materials that are deemed unsuitable for the support of fill shall be removed as necessary to the satisfaction of the Geotechnical Consultant.

C. Any underground structures such as cesspoles, cisterns, mining shafts, tunnels, septic tanks, wells, pipelines, other utilities, or other structures located within the limits of grading shall be removed and/or abandoned in accordance with the requirements of the governing agency and to the satisfaction of the Geotechnical Consultant. Environmental evaluation of existing conditions is not the responsibility of the Geotechnical Consultant.

D. Preparation of Areas to Receive Fill: After removals are completed, the exposed surfaces shall be processed or scarified to a depth of approximately 8 inches, watered or dried, as needed, to achieve a generally uniform moisture content that is at or near optimum moisture content. The scarified materials shall then be compacted to the project requirements and tested as specified.

E. All areas receiving fill shall be observed and approved by the Geotechnical Consultant prior to the placement of fill. A licensed surveyor shall provide survey control for determining elevations of processed areas and keyways.

III. Placement of Fill

A. Suitability of fill materials: Any materials, derived onsite or imported, may be utilized as fill provided that the materials have been determined to be suitable by the Geotechnical Consultant. Such materials shall be essentially free of organic matter and other deleterious materials, and be of a gradation, expansion potential, and/or strength that is acceptable to the Geotechnical Consultant. Fill materials shall be tested in a laboratory approved by the Geotechnical Consultant, and import materials shall be tested and approved prior to being imported.

B. Generally, different fill materials shall be thoroughly mixed to provide a relatively uniform blend of materials and prevent abrupt changes in material type. Fill materials derived from benching should be dispersed throughout the fill area instead of placing the materials within only an equipment-width from the cut/fill contact.

C. Oversize Materials: Rocks greater than 12 inches in largest dimension shall be disposed of offsite or be placed in accordance with the recommendations by the Geotechnical Consultant in the areas that are designated as suitable for oversize rock placement. Rocks that are smaller than 8 inches in largest dimension may be utilized in the fill provided that they are not nested and are their quantity and distribution are acceptable to the Geotechnical Consultant and do not inhibit the ability to properly compact fill materials.

D. The fill materials shall be placed in thin, horizontal layers such that, when compacted, shall not exceed 6 inches. Each layer shall be spread evenly and shall be thoroughly mixed to obtain a near uniform moisture content and uniform blend of materials.

E. Moisture Content: Fill materials shall be placed at or above the optimum moisture content or as recommended by the geotechnical report. Where the moisture content of the engineered fill is less than recommended, water shall be added, and the fill materials shall be blended so that a near uniform moisture content is achieved. If the moisture content is above the limits specified by the Geotechnical Consultant, the fill materials shall be aerated by discing, blading, or other methods until the moisture content is acceptable.

F. Each layer of fill shall be compacted to the project standards in accordance to the project specifications and recommendations of the Geotechnical Consultant. Unless otherwise specified by the Geotechnical Consultant, the fill shall be compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM Test Method: D1557.

G. Benching: Where placing fill on a slope exceeding a ratio of 5 to 1 (horizontal to vertical), the ground should be keyed or benched. The keyways and benches shall extend through all unsuitable materials into suitable materials such as firm materials or sound bedrock or as recommended by the Geotechnical Consultant. The minimum keyway width shall be 15 feet and extend into suitable materials, or as recommended by the geotechnical report and approved by the Geotechnical Consultant. The minimum keyway width for fill over cut slopes is also 15 feet, or as recommended by the geotechnical report and approved by the Geotechnical Consultant. As a general rule, unless otherwise recommended by the Geotechnical Consultant, the minimum width of the keyway shall be equal to ½ the height of the fill slope.

H. Slope Face: The specified minimum relative compaction shall be maintained out to the finish face of fill and stabilization fill slopes. Generally, this may be achieved by overbuilding the slope and cutting back to the compacted core. The actual amount of overbuilding may vary as field conditions dictate. Alternately, this may be achieved by backrolling the slope face with suitable equipment or other methods that produce the designated result. Loose soil should not be allowed to build up on the slope face. If present, loose soils shall be trimmed to expose the compacted slope face.

I. Slope Ratio: Unless otherwise approved by the Geotechnical Consultant and governing agencies, permanent fill slopes shall be designed and constructed no steeper than 2 to 1 (horizontal to vertical).

J. Natural Ground and Cut Areas: Design grades that are in natural ground or in cuts should be evaluated by the Geotechnical Consultant to determine whether scarification and processing of the ground and/or overexcavation is needed.

K. Fill materials shall not be placed, spread, or compacted during unfavorable weather conditions. When grading is interrupted by rain, filing operations shall not resume until the Geotechnical Consultant approves the moisture and density of the previously placed compacted fill.

IV. Cut Slopes

A. The Geotechnical Consultant shall observe all cut slopes, including fill over cut slopes, and shall be notified by the contractor when cut slopes are started.

B. If adverse or potentially adverse conditions are encountered during grading, the Geotechnical Consultant shall investigate, evaluate, and make recommendations to mitigate the adverse conditions.

C. Unless otherwise stated in the geotechnical report, cut slopes shall not be excavated higher or steeper than the requirements of the local governing agencies. Short-term stability of the cut slopes and other excavations is the contractor's responsibility.

V. Drainage

A. Backdrains and Subdrains: Backdrains and subdrains shall be provided in fill as recommended by the Geotechnical Consultant and shall be constructed in accordance with the governing agency and/or recommendations of the Geotechnical Consultant. The location of subdrains, especially outlets, shall be surveyed and recorded by the Civil Engineer.

B. Top-of-slope Drainage: Positive drainage shall be established away from the top of slope. Site drainage shall not be permitted to flow over the tops of slopes.

C. Drainage terraces shall be constructed in compliance with the governing agency requirements and/or in accordance with the recommendations of the Civil Engineer.

D. Non-erodible interceptor swales shall be placed at the top of cut slopes that face the same direction as the prevailing drainage.

VI. Erosion Control

A. All finish cut and fill slopes shall be protected from erosion and/or planted in accordance with the project specifications and/or landscape architect's recommendations. Such measures to protect the slope face shall be undertaken as soon as practical after completion of grading.

B. During construction, the contractor shall maintain proper drainage and prevent the ponding of water. The contractor shall take remedial measures to prevent the erosion of graded areas until permanent drainage and erosion control measures have been installed.

VII. Trench Excavation and Backfill

A. Safety: The contractor shall follow all OSHA requirements for safety of trench excavations. Knowing and following these requirements is the contractor's responsibility. All trench excavations or open cuts in excess of 5 feet in depth shall be shored or laid back. Trench excavations and open cuts exposing adverse geologic conditions may require further evaluation by the Geotechnical Consultant. If a contractor fails to provide safe access for compaction testing, backfill not tested due to safety concerns may be subject to removal.

B. Bedding: Bedding materials shall be non-expansive and have a Sand Equivalent greater than 30. Where permitted by the Geotechnical Consultant, the bedding materials can be densified by jetting.

C. Backfill: Jetting of backfill materials to achieve compaction is generally not acceptable. Where permitted by the Geotechnical Consultant, the bedding materials can be densified by jetting provided the backfill materials are granular, free-draining and have a Sand Equivalent greater than 30.

VIII. Geotechnical Observation and Testing During Grading

A. Compaction Testing: Fill will be tested and evaluated by the Geotechnical Consultant for evaluation of general compliance with the recommended compaction and moisture conditions. The tests shall be taken in the compacted soils beneath the surface if the surficial materials are disturbed. The contractor shall assist the Geotechnical Consultant by excavating suitable test pits for testing of compacted fill.

B. Where tests indicate that the density of a layer of fill is less than required, or the moisture content is not within specifications, the Geotechnical Consultant shall notify the contractor of the unsatisfactory conditions of the fill. The portions of the fill that are not within specifications shall be reworked until the required density and/or moisture content has been attained. No additional fill shall be placed until the last lift of fill is tested and found to meet the project specifications and approved by the Geotechnical Consultant.

C. If, in the opinion of the Geotechnical Consultant, unsatisfactory conditions, such as adverse weather, excessive rock or deleterious materials being placed in the fill, insufficient equipment, excessive rate of fill placement, results in a quality of work that is unacceptable, the consultant shall notify the contractor, and the contractor shall rectify the conditions, and if necessary, stop work until conditions are satisfactory.

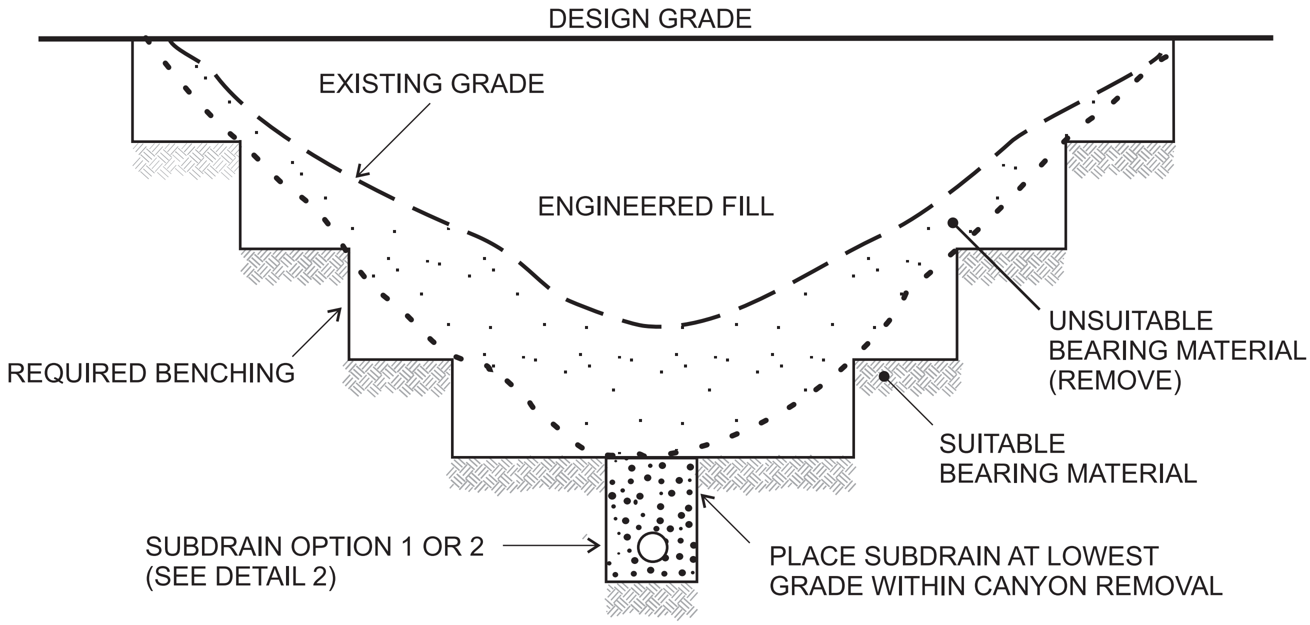
D. Frequency of Compaction Testing: The location and frequency of tests shall be at the Geotechnical Consultant's discretion. Generally, compaction tests shall be taken at intervals approximately two feet in fill height.

E. Compaction Test Locations: The Geotechnical Consultant shall document the approximate elevation and horizontal coordinates of the compaction test locations. The contractor shall coordinate with the surveyor to assure that sufficient grade stakes are established so that the Geotechnical Consultant can determine the test locations. Alternately, the test locations can be surveyed and the results provided to the Geotechnical Consultant.

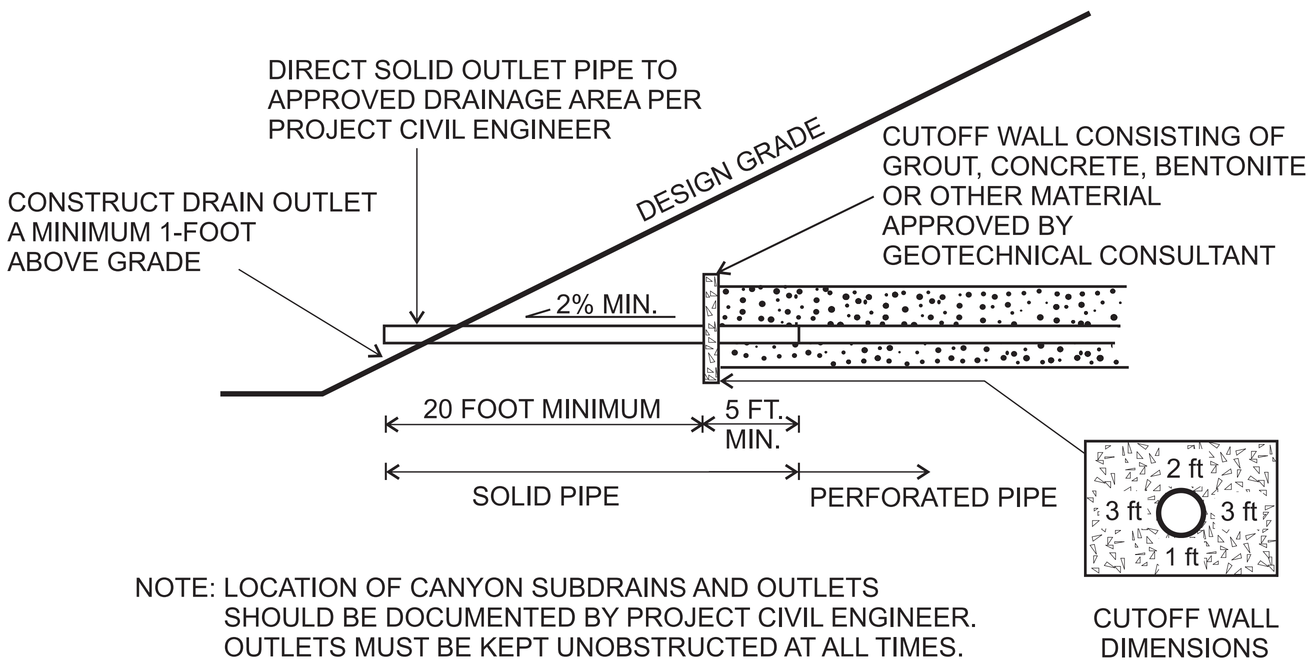
F. Areas of fill that have not been observed or tested by the Geotechnical Consultant may have to be removed and recompacted at the contractor's expense. The depth and extent of removals will be determined by the Geotechnical Consultant.

G. Observation and testing by the Geotechnical Consultant shall be conducted during grading in order for the Geotechnical Consultant to state that, in his opinion, grading has been completed in accordance with the approved geotechnical report and project specifications.

H. Reporting of Test Results: After completion of grading operations, the Geotechnical Consultant shall submit reports documenting their observations during construction and test results. These reports may be subject to review by the local governing agencies.



CANYON SUBDRAIN PROFILE

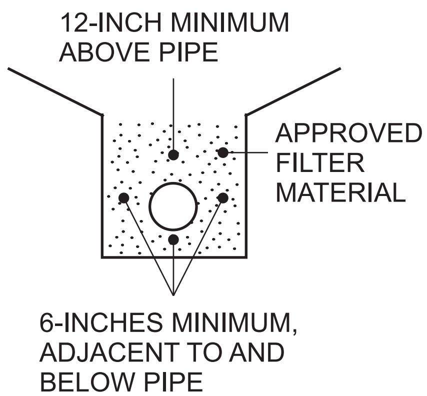


NOTE: LOCATION OF CANYON SUBDRAINS AND OUTLETS SHOULD BE DOCUMENTED BY PROJECT CIVIL ENGINEER. OUTLETS MUST BE KEPT UNOBSTRUCTED AT ALL TIMES.

CANYON SUBDRAIN TERMINUS

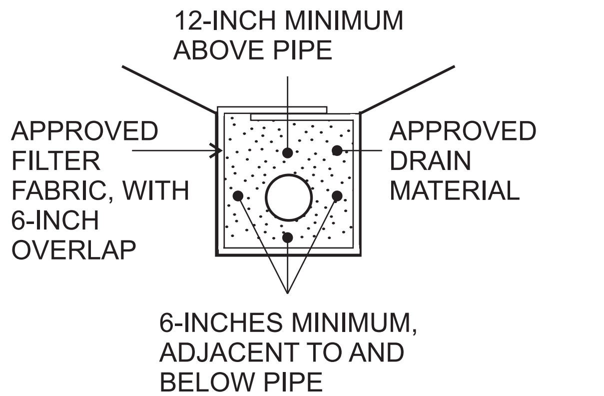
VER 1.0 NTS

AGS ADVANCED GEOTECHNICAL SOLUTIONS	CANYON SUBDRAIN	DETAIL 1



OPTION 1

FILTER MATERIAL: MINIMUM VOLUME OF 9 CUBIC FEET PER LINEAL FOOT OF CALTRANS CLASS 2 PERMEABLE MATERIAL



OPTION 2

DRAIN MATERIAL: MINIMUM VOLUME OF 9 CUBIC FEET PER LINEAL FOOT OF 3/4-INCH MAX ROCK OR APPROVED EQUIVALENT SUBSTITUTE

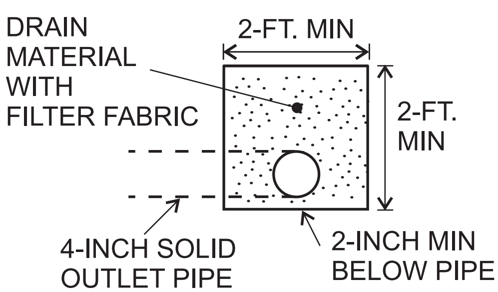
FILTER FABRIC: MIRAFI 140 FILTER FABRIC OR APPROVED EQUIVALENT SUBSTITUTE

PIPE: 6 OR 8-INCH ABS OR PVC PIPE OR APPROVED SUBSTITUTE WITH A MINIMUM OF 8 PERFORATIONS (1/4-INCH DIAMETER) PER LINEAL FOOT IN BOTTOM HALF OF PIPE

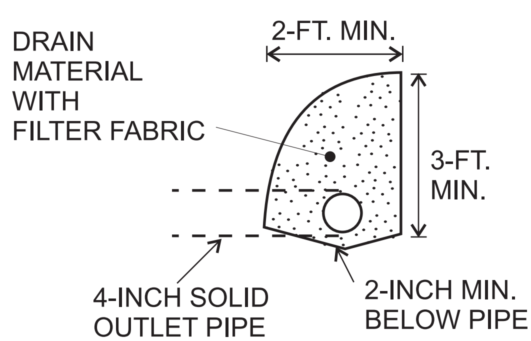
(ASTM D2751, SDR-35 OR ASTM D3034, SDR-35
ASTM D1527, SCHD. 40 OR ASTM D1785, SCHD. 40)

NOTE: CONTINUOUS RUN IN EXCESS OF 5OO FEET REQUIRES 8-INCH DIAMETER PIPE (ASTM D3034, SDR-35, OR ASTM D1785, SCHD. 40)

CANYON SUBDRAIN



OPTION 1



OPTION 2

DRAIN MATERIAL: GRAVEL TRENCH TO BE FILLED WITH 3/4-INCH MAX ROCK OR APPROVED EQUIVALENT SUBSTITUTE

FILTER FABRIC: MIRAFI 140 FILTER FABRIC OR EQUIVALENT SUBSTITUTE WITH A MINIMUM 6-INCH OVERLAP

PIPE: 4-INCH ABS OR PVC PIPE OR APPROVED EQUIVALENT SUBSTITUTE WITH A MINIMUM OF 8 PERFORATIONS (1/4-INCH DIAMETER) PER LINEAL FOOT IN BOTTOM HALF OF PIPE

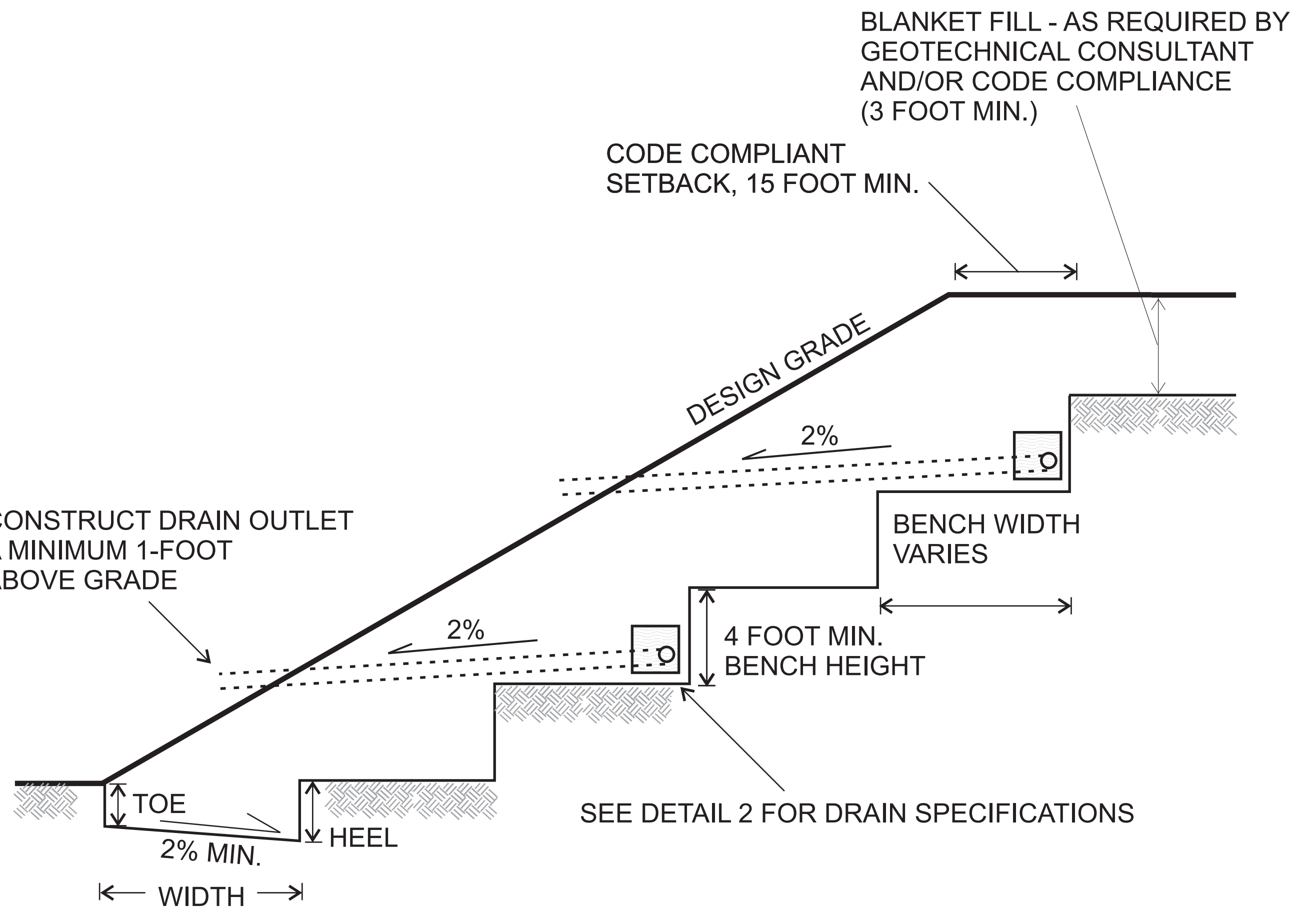
(ASTM D2751, SDR-35 OR ASTM D3034, SDR-35
ASTM D1527, SCHD. 40 OR ASTM D1785, SCHD. 40)

BUTTRESS/STABILIZATION DRAIN

VER 1.0

NTS

AGS ADVANCED GEOTECHNICAL SOLUTIONS	DRAIN SPECIFICATIONS	DETAIL 2



CODE COMPLIANT KEYWAY
WITH MINIMUM DIMENSIONS:

TOE 2 FOOT MIN.
HEEL 3 FOOT MIN.
WIDTH 15 FOOT MIN.

NOTES:

1. DRAIN OUTLETS TO BE PROVIDED EVERY 100 FEET CONNECT TO PERFORATED DRAIN PIPE BY “L” OR “T” AT A MINIMUM 2% GRADIENT.

2. THE NECESSITY AND LOCATION OF ADDITIONAL DRAINS SHALL BE DETERMINED IN THE FIELD BY THE GEOTECHNICAL CONSULTANT. UPPER STAGE OUTLETS SHOULD BE EMPTIED ONTO CONCRETE TERRACE DRAINS.

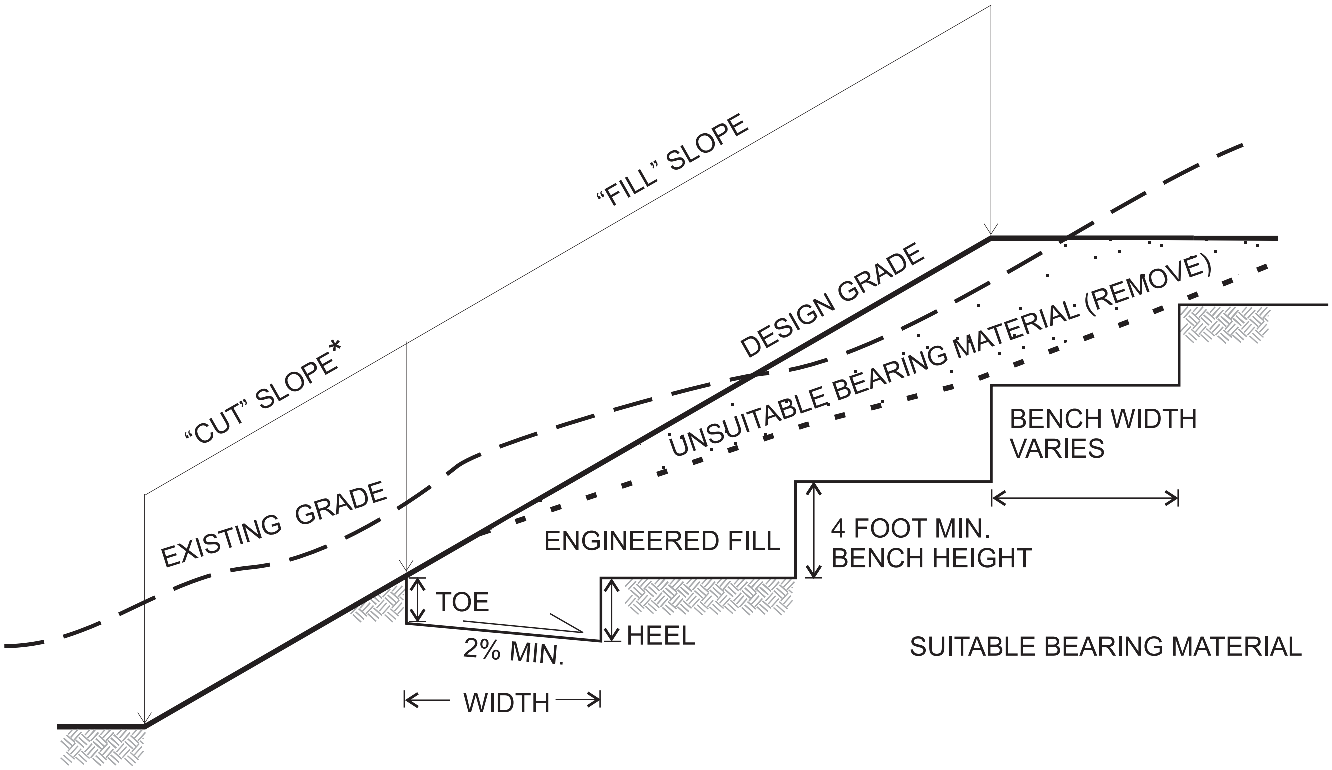
3. DRAIN PIPE TO EXTEND FULL LENGTH OF STABILIZATION/BUTTRESS WITH A MINIMUM GRADIENT OF 2% TO SOLID OUTLET PIPES.

4. LOCATION OF DRAINS AND OUTLETS SHOULD BE DOCUMENTED BY PROJECT CIVIL ENGINEER. OUTLETS MUST BE KEPT UNOBSTRUCTED AT ALL TIMES.

VER 1.0 NTS

AGS ADVANCED GEOTECHNICAL SOLUTIONS	STABILIZATION/BUTTRESS FILL	DETAIL 3

* THE “CUT” PORTION OF THE SLOPE SHALL BE EXCAVATED AND EVALUATED BY THE GEOTECHNICAL CONSULTANT PRIOR TO CONSTRUCTING THE “FILL” PORTION



SUITABLE
BEARING MATERIAL

CODE COMPLIANT KEYWAY
WITH MINIMUM DIMENSIONS:

TOE: 2 FOOT MIN.
HEEL: 3 FOOT MIN.
WIDTH: 15 FOOT MIN.

NOTES:

1. THE NECESSITY AND LOCATION OF DRAINS SHALL BE DETERMINED IN THE FIELD BY THE GEOTECHNICAL CONSULTANT

2. SEE DETAIL 2 FOR DRAIN SPECIFICATIONS

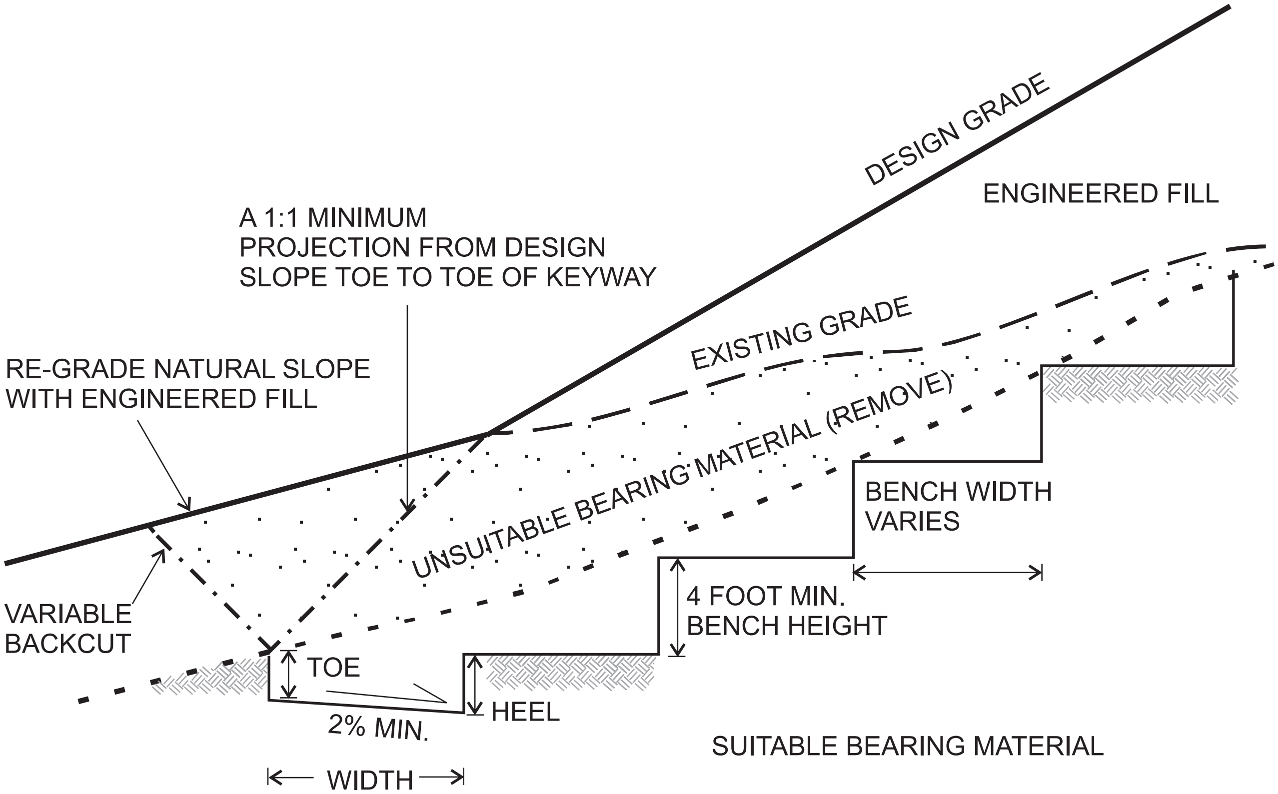
VER 1.0

NTS

AGS
ADVANCED GEOTECHNICAL SOLUTIONS

FILL OVER CUT SLOPE

DETAIL 4



CODE COMPLIANT KEYWAY
WITH MINIMUM DIMENSIONS:

TOE: 2 FOOT MIN.
HEEL: 3 FOOT MIN.
WIDTH: 15 FOOT MIN.

NOTES:

1. WHEN THE NATURAL SLOPE APPROACHES OR EXCEEDS THE DESIGN GRADE SLOPE RATIO, SPECIAL RECOMMENDATIONS ARE NECESSARY BY THE GEOTECHNICAL CONSULTANT

2. THE GEOTECHNICAL CONSULTANT WILL DETERMINE THE REQUIREMENT FOR AND LOCATION OF SUBSURFACE DRAINAGE SYSTEMS.

3. MAINTAIN MINIMUM 15 FOOT HORIZONTAL WIDTH FROM FACE OF SLOPE TO BENCH/BACKCUT

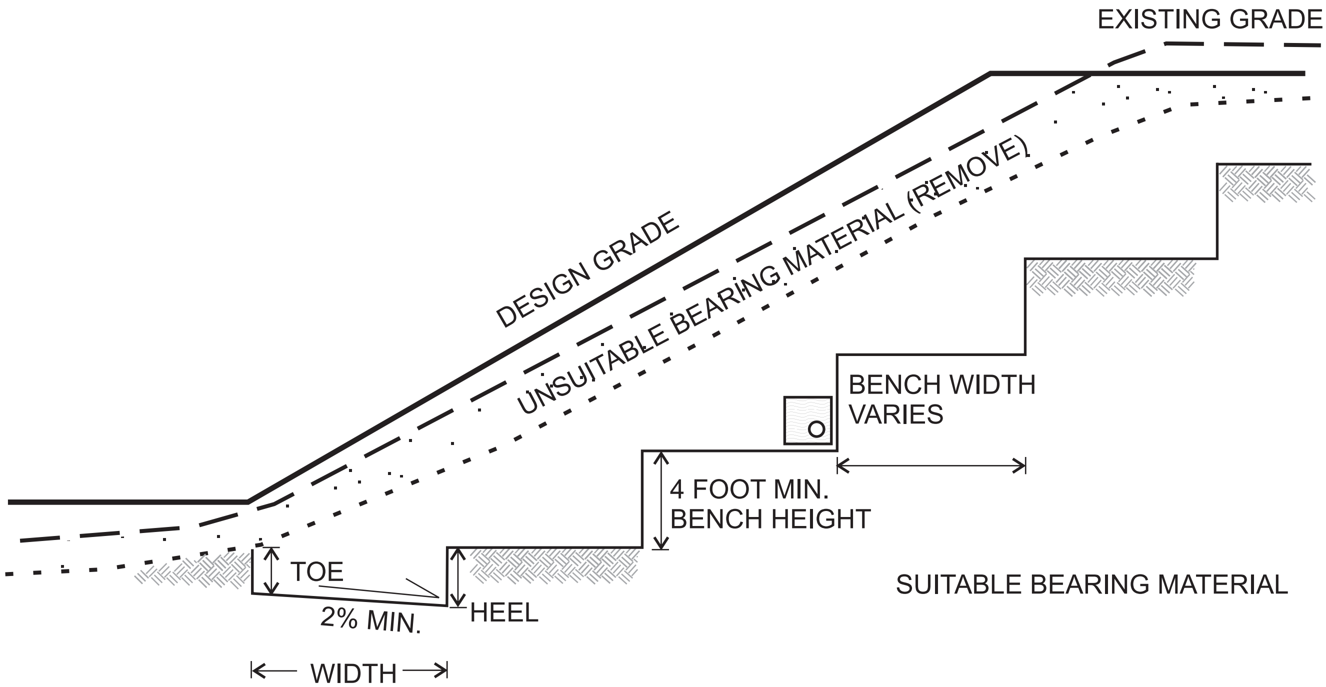
VER 1.0

NTS

AGS
ADVANCED GEOTECHNICAL SOLUTIONS

FILL OVER NATURAL SLOPE

DETAIL 5



CODE COMPLIANT KEYWAY
WITH MINIMUM DIMENSIONS:

TOE: 2 FOOT MIN.
HEEL: 3 FOOT MIN.
WIDTH: 15 FOOT MIN.

NOTES:

1. MAINTAIN MINIMUM 15 FOOT HORIZONTAL WIDTH FROM FACE OF SLOPE TO BENCH/BACKCUT

2. SEE DETAIL 2 FOR DRAIN SPECIFICATIONS

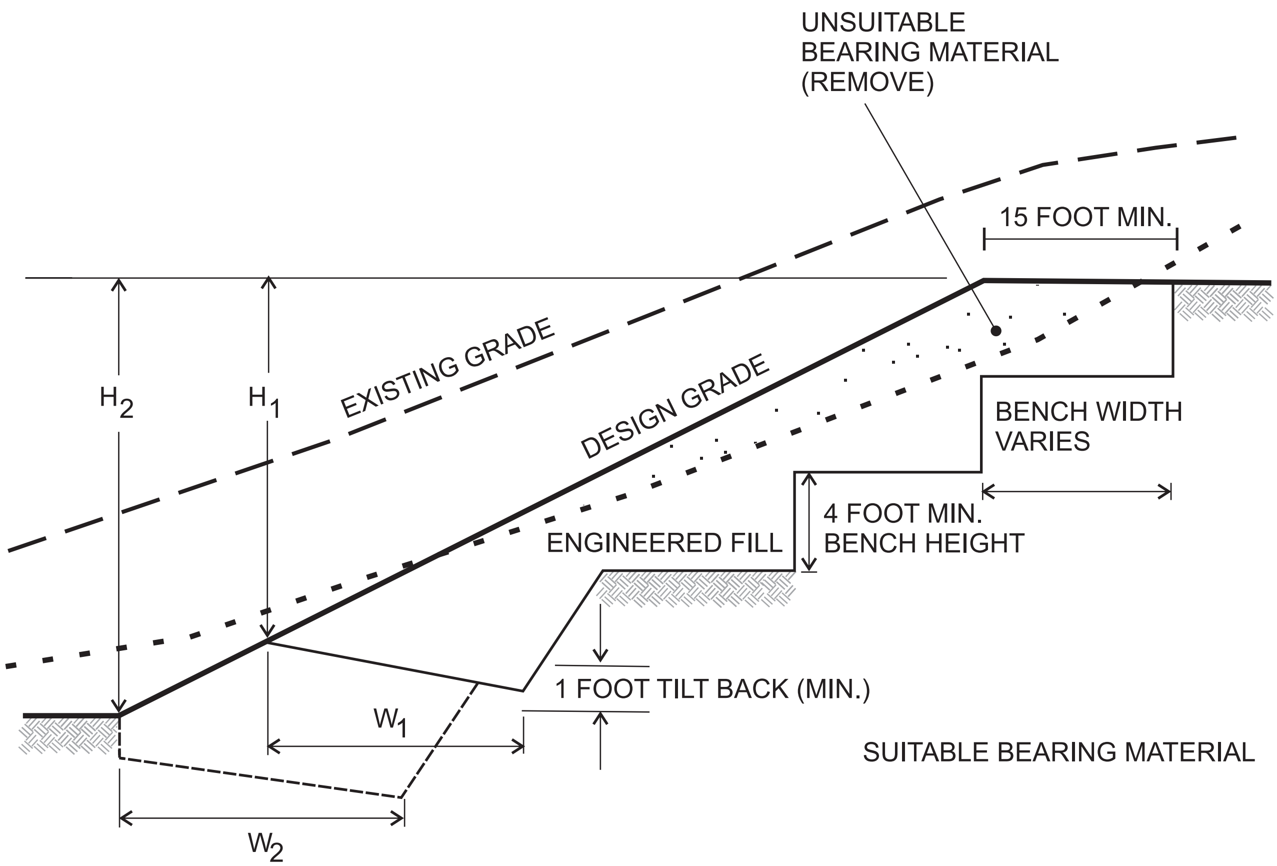
VER 1.0

NTS

AGS
ADVANCED GEOTECHNICAL SOLUTIONS

SKIN FILL CONDITION

DETAIL 6



NOTES:

1. IF RECOMMENDED BY THE GEOTECHNICAL CONSULTANT, THE REMAINING CUT PORTION OF THE SLOPE MAY REQUIRE REMOVAL AND REPLACEMENT WITH AN ENGINEERED FILL

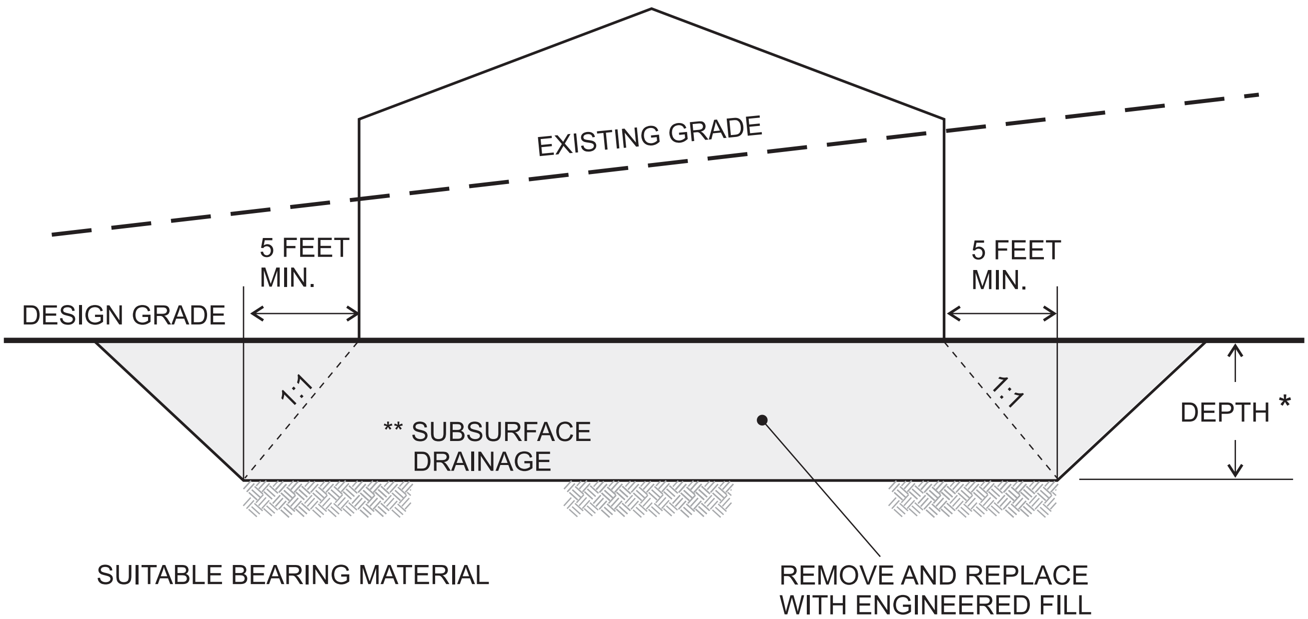
2. “W” SHALL BE EQUIPMENT WIDTH (15 FEET) FOR SLOPE HEIGHT LESS THAN 25 FEET. FOR SLOPES GREATER THAN 25 FEET, “W” SHALL BE DETERMINED BY THE GEOTECHNICAL CONSULTANT. AT NO TIME SHALL “W” BE LESS THAN H/2

3. DRAINS WILL BE REQUIRED (SEE DETAIL 2)

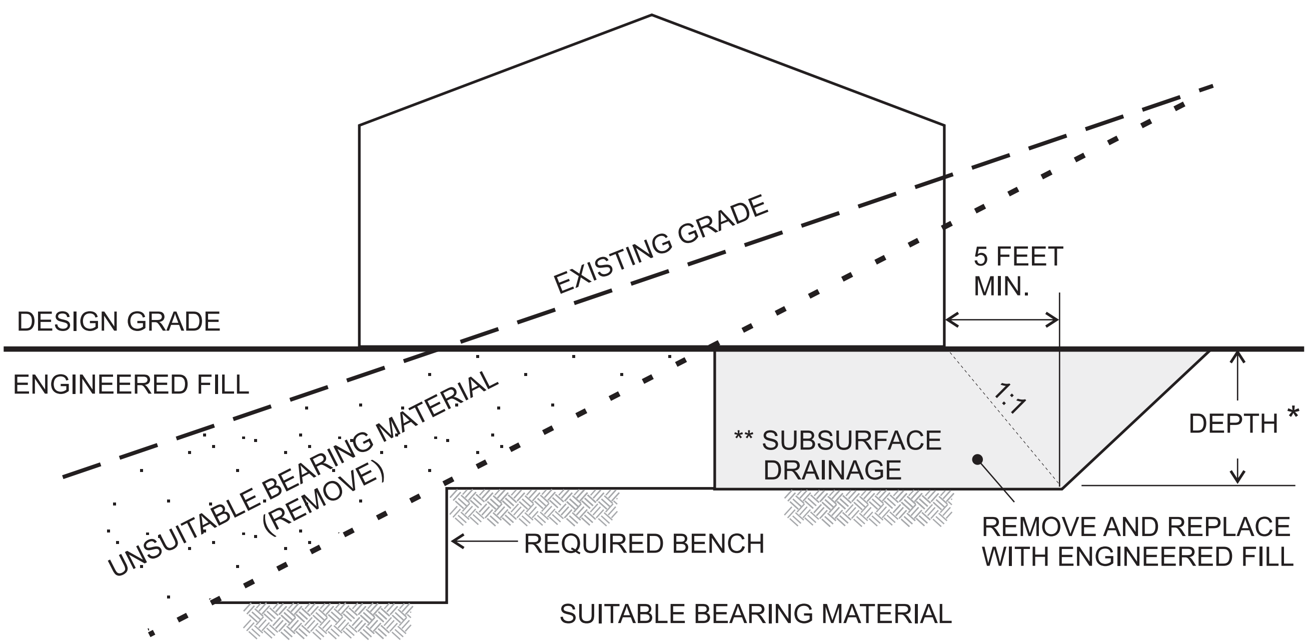
VER 1.0

NTS

AGS ADVANCED GEOTECHNICAL SOLUTIONS	PARTIAL CUT SLOPE STABILIZATION	DETAIL 7



CUT LOT OVEREXCAVATION



CUT-FILL LOT OVEREXCAVATION

NOTES:

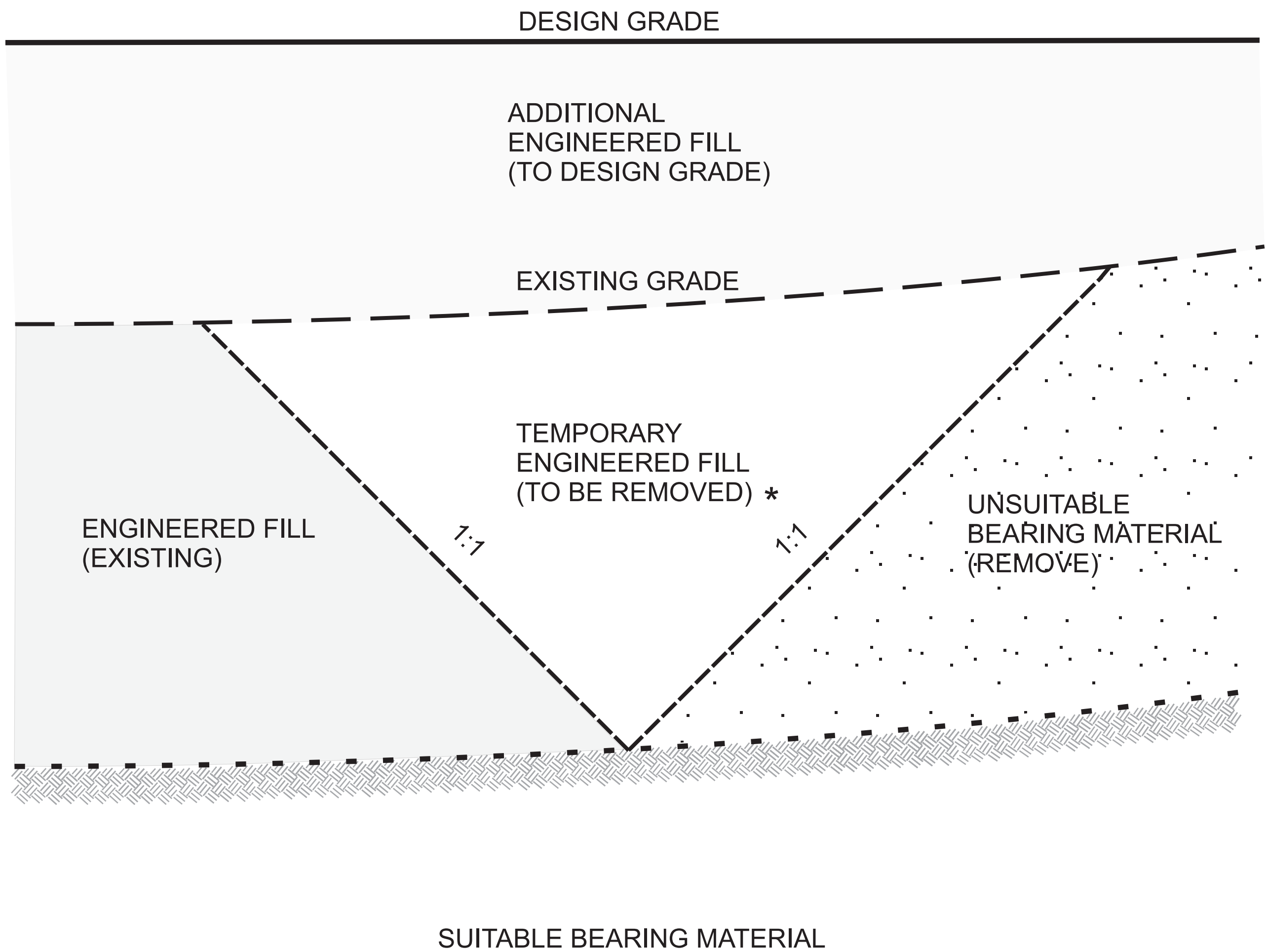
* SEE REPORT FOR RECOMMENDED DEPTHS, DEEPER OVEREXCAVATION MAY BE REQUIRED BY THE GEOTECHNICAL CONSULTANT BASED ON EXPOSED FIELD CONDITIONS

** CONSTRUCT EXCAVATION TO PROVIDE FOR POSITIVE DRAINAGE TOWARDS STREETS, DEEPER FILL AREAS OR APPROVED DRAINAGE DEVICES BASED ON FIELD CONDITIONS

VER 1.0

NTS

AGS ADVANCED GEOTECHNICAL SOLUTIONS	CUT & CUT-FILL LOT OVEREXCAVATION	DETAIL 8



* REMOVE BEFORE PLACING ADDITIONAL ENGINEERED FILL

TYPICAL UP-CANYON PROFILE

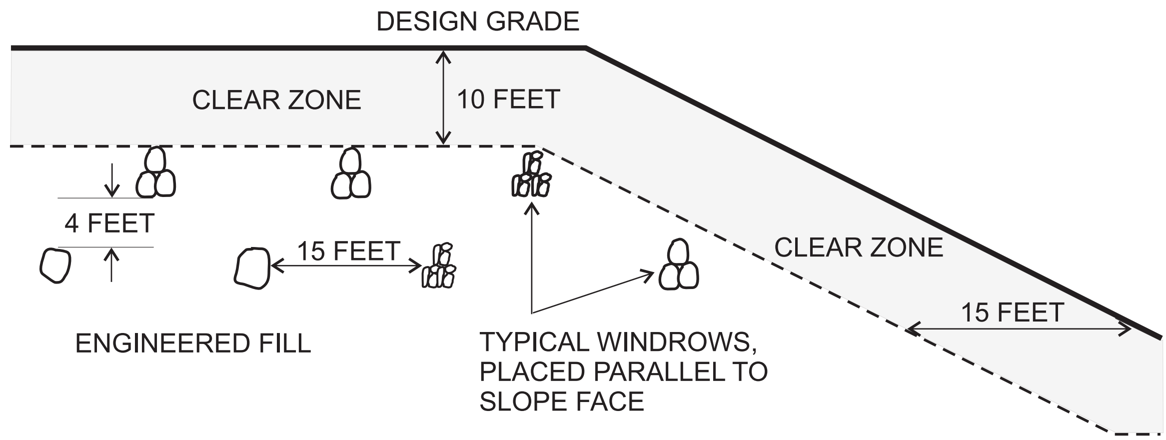
VER 1.0

NTS

AGS
ADVANCED GEOTECHNICAL SOLUTIONS

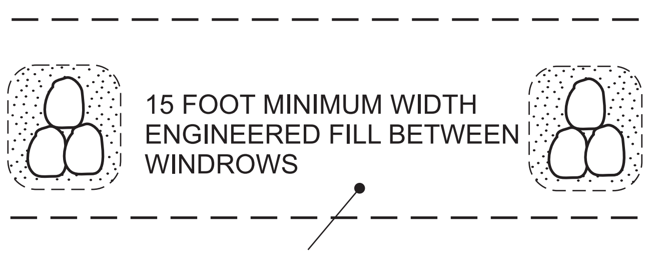
REMOVAL ADJACENT TO EXISTING FILL

DETAIL 9



CLEAR ZONE DIMENSIONS FOR REFERENCE ONLY, ACTUAL DEPTH, WIDTH, WINDROW LENGTH, ETC. TO BE BASED ON ELEVATIONS OF FOUNDATIONS, UTILITIES OR OTHER STRUCTURES PER THE GEOTECHNICAL CONSULTANT OR GOVERNING AGENCY APPROVAL

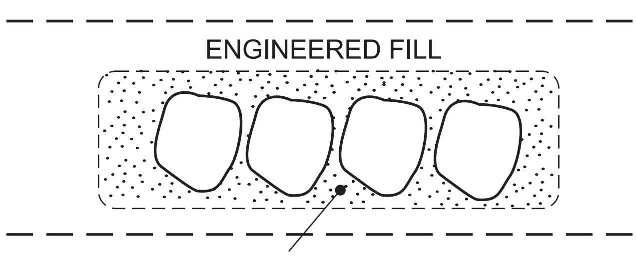
OVERSIZED MATERIAL DISPOSAL PROFILE



HORIZONTALLY PLACED ENGINEERED FILL, FREE OF OVERSIZED MATERIALS AND COMPACTED TO MINIMUM PROJECT STANDARDS

COMPACT ENGINEERED FILL ABOVE OVERSIZED MATERIALS TO FACILITATE “TRENCH” CONDITION PRIOR TO FLOODING GRANULAR MATERIALS

WINDROW CROSS-SECTION



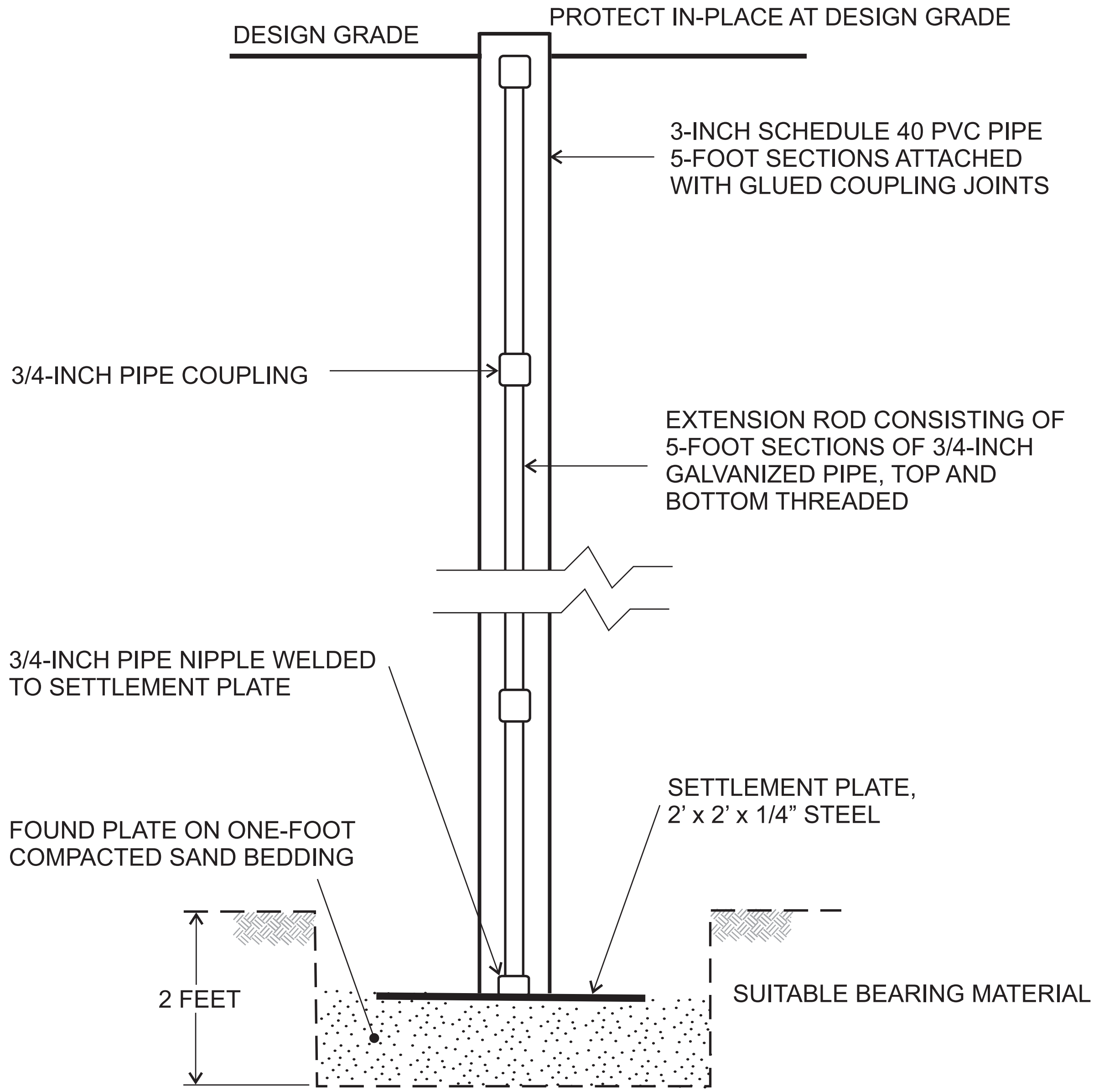
GRANULAR MATERIAL APPROVED BY THE GEOTECHNICAL CONSULTANT AND CONSOLIDATED IN-PLACE BY FLOODING

WINDROW PROFILE

VER 1.0

NTS

AGS ADVANCED GEOTECHNICAL SOLUTIONS	OVERSIZED MATERIAL DISPOSAL CRITERIA	DETAIL 10



NOTES:

1. SETTLEMENT PLATE LOCATIONS SHALL BE SUFFICIENTLY IDENTIFIED BY THE CONTRACTOR AND BE READILY VISIBLE TO EQUIPMENT OPERATORS.

2. CONTRACTOR SHALL MAINTAIN ADEQUATE HORIZONTAL CLEARANCE FOR EQUIPMENT OPERATION AND SHALL BE RESPONSIBLE FOR REPAIRING ANY DAMAGE TO SETTLEMENT PLATE DURING SITE CONSTRUCTION.

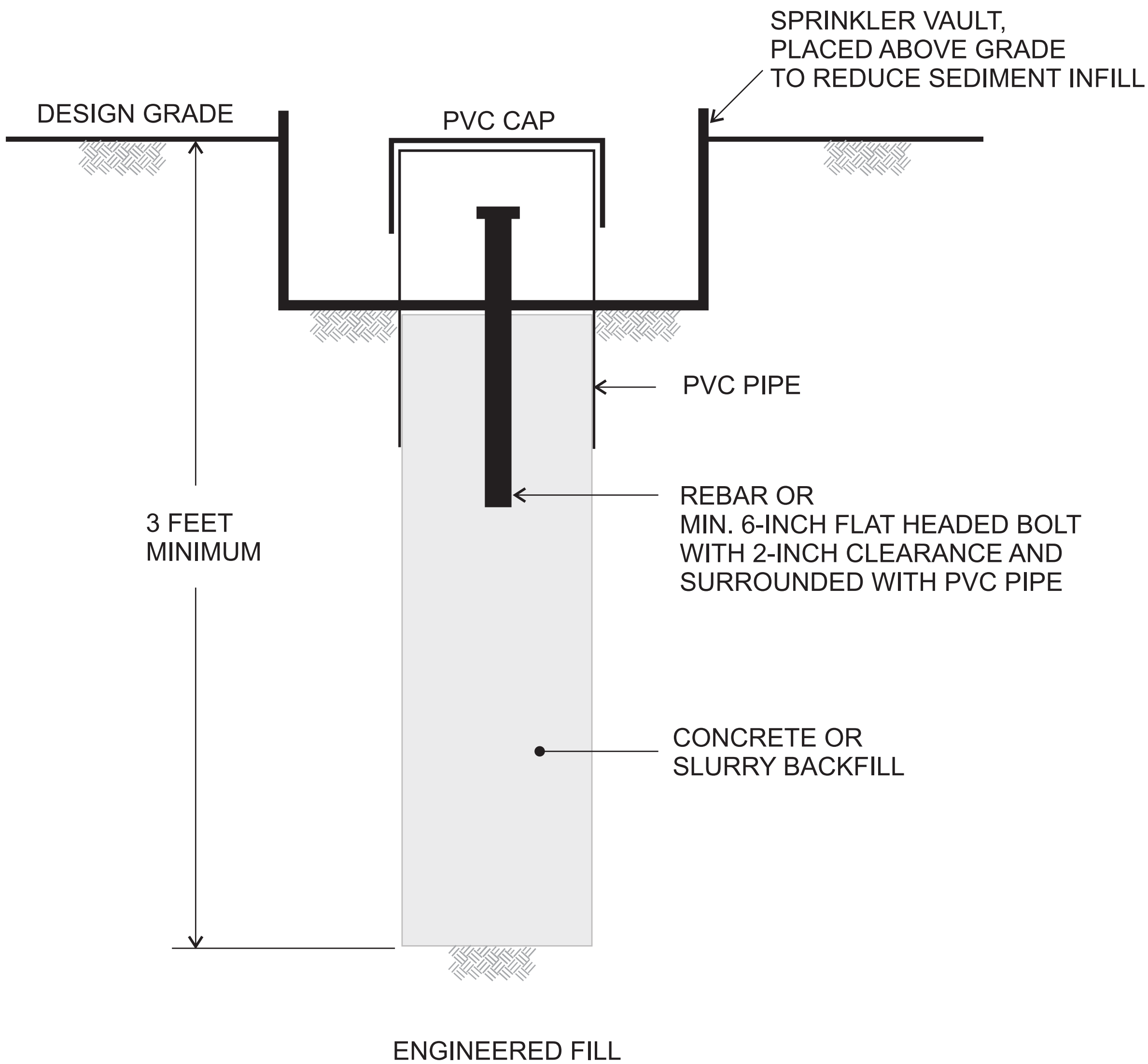
3. A MINIMUM 5-FOOT ZONE ADJACENT TO SETTLEMENT PLATE/EXTENSION RODS SHALL BE ESTABLISHED FOR HAND-HELD MECHANICAL COMPACTION OF ENGINEERED FILL. ENGINEERED FILL SHALL BE COMPACTED TO MINIMUM PROJECT STANDARD.

4. ELEVATIONS OF SETTLEMENT PLATE AND ALL EXTENSION ROD PLACEMENT SHALL BE DOCUMENTED BY PROJECT CIVIL ENGINEER OR SURVEYOR.

VER 1.0

NTS

AGS ADVANCED GEOTECHNICAL SOLUTIONS	SETTLEMENT PLATE	DETAIL 11



NOTES:

1. SETTLEMENT MONUMENT LOCATIONS SHALL BE SUFFICIENTLY IDENTIFIED AND BE READILY VISIBLE TO EQUIPMENT OPERATORS.

2. ELEVATIONS OF SURFACE MONUMENTS SHALL BE DOCUMENTED BY PROJECT CIVIL ENGINEER OR SURVEYOR.

VER 1.0

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ADVANCED GEOTECHNICAL SOLUTIONS

SETTLEMENT MONUMENT

DETAIL 12

APPENDIX F

HOMEOWNERS MAINTENANCE GUIDELINES

HOMEOWNERS MAINTENANCE GUIDELINES

Homeowners are accustomed to maintaining their homes. They expect to paint their houses periodically, replace wiring, clean out clogged plumbing, and repair roofs. Maintenance of the home site, particularly on hillsides, should be considered on the same basis, or even on a more serious basis because neglect can result in serious consequences. In most cases, lot and site maintenance can be taken care of along with landscaping, and can be carried out more economically than repair after neglect.

Most slope and hillside lot problems are associated with water. Uncontrolled water from a broken pipe, cesspool, or wet weather causes most damage. Wet weather is the largest cause of slope problems, particularly in California where rain is intermittent, but may be torrential. Therefore, drainage and erosion control are the most important aspects of home site stability; these provisions must not be altered without competent professional advice. Further, maintenance must be carried out to assure their continued operation.

As geotechnical engineers concerned with the problems of building sites in hillside developments, we offer the following list of recommended home protection measures as a guide to homeowners.

Expansive Soils

Some of the earth materials on site have been identified as being expansive in nature. As such, these materials are susceptible to volume changes with variations in their moisture content. These soils will swell upon the introduction of water and shrink upon drying. The forces associated with these volume changes can have significant negative impacts (in the form of differential movement) on foundations, walkways, patios, and other lot improvements. In recognition of this, the project developer has constructed homes on these lots on post-tensioned or mat slabs with pier and grade beam foundation systems, intended to help reduce the potential adverse effects of these expansive materials on the residential structures within the project. Such foundation systems are not intended to offset the forces (and associated movement) related to expansive soil, but are intended to help soften their effects on the structures constructed thereon.

Homeowners purchasing property and living in an area containing expansive soils must assume a certain degree of responsibility for homeowner improvements as well as for maintaining conditions around their home. Provisions should be incorporated into the design and construction of homeowner improvements to account for the expansive nature of the onsite soils material. Lot maintenance and landscaping should also be conducted in consideration of the expansive soil characteristics. Of primary importance is minimizing the moisture variation below all lot improvements. Such design, construction and homeowner maintenance provisions should include:

- Employing contractors for homeowner improvements who design and build in recognition of local building code and site specific soils conditions.
- Establishing and maintaining positive drainage away from all foundations, walkways, driveways, patios, and other hardscape improvements.

- ❖ Avoiding the construction of planters adjacent to structural improvements. Alternatively, planter sides/bottoms can be sealed with an impermeable membrane and drained away from the improvements via subdrains into approved disposal areas.
- ❖ Sealing and maintaining construction/control joints within concrete slabs and walkways to reduce the potential for moisture infiltration into the subgrade soils.
- ❖ Utilizing landscaping schemes with vegetation that requires minimal watering. Alternatively, watering should be done in a uniform manner as equally as possible on all sides of the foundation, keeping the soil "moist" but not allowing the soil to become saturated.
- ❖ Maintaining positive drainage away from structures and providing roof gutters on all structures with downspouts installed to carry roof runoff directly into area drains or discharged well away from the structures.
- ❖ Avoiding the placement of trees closer to the proposed structures than a distance of one-half the mature height of the tree.
- ❖ Observation of the soil conditions around the perimeter of the structure during extremely hot/dry or unusually wet weather conditions so that modifications can be made in irrigation programs to maintain relatively constant moisture conditions.

Sulfates

On site soils were tested for the presence of soluble sulfates. Based on the results of that testing, the soluble sulfate exposure level was determined to be “negligible” to “severe” when classified in accordance with the ACI 318-05 Table 4.3.1 (per 2010 CBC). Concrete mixes should be designed based on Code standards.

Homeowners should be cautioned against the import and use of certain fertilizers, soil amendments, and/or other soils from offsite sources in the absence of specific information relating to their chemical composition. Some fertilizers have been known to leach sulfate compounds into soils otherwise containing “negligible” sulfate concentrations and increase the sulfate concentrations in near-surface soils to “moderate” or “severe” levels. In some cases, concrete improvements constructed in soils containing high levels of soluble sulfates may be affected by deterioration and loss of strength.

Water - Natural and Man Induced

Water in concert with the reaction of various natural and man-made elements, can cause detrimental effects to your structure and surrounding property. Rain water and flowing water erodes and saturates the ground and changes the engineering characteristics of the underlying earth materials upon saturation. Excessive irrigation in concert with a rainy period is commonly associated with shallow slope failures and deep seated landslides, saturation of near structure soils, local ponding of water, and transportation of water soluble substances that are deleterious to building materials including concrete, steel, wood, and stucco.

Water interacting with the near surface and subsurface soils can initiate several other potentially detrimental phenomena other then slope stability issues. These may include expansion/contraction cycles, liquefaction potential increase, hydro-collapse of soils, ground surface settlement, earth material consolidation, and introduction of deleterious substances.

The homeowners should be made aware of the potential problems which may develop when drainage is altered through construction of retaining walls, swimming pools, paved walkways and patios. Ponded water, drainage over the slope face, leaking irrigation systems, over-watering or other conditions which could lead to ground saturation must be avoided.

- ❖ Before the rainy season arrives, check and clear roof drains, gutters and down spouts of all accumulated debris. Roof gutters are an important element in your arsenal against rain damage. If you do not have roof gutters and down spouts, you may elect to install them. Roofs, with their, wide, flat area can shed tremendous quantities of water. Without gutters or other adequate drainage, water falling from the eaves collects against foundation and basement walls.
- ❖ Make sure to clear surface and terrace drainage ditches, and check them frequently during the rainy season. This task is a community responsibility.
- ❖ Test all drainage ditches for functioning outlet drains. This should be tested with a hose and done before the rainy season. All blockages should be removed.
- ❖ Check all drains at top of slopes to be sure they are clear and that water will not overflow the slope itself, causing erosion.
- ❖ Keep subsurface drain openings (weep-holes) clear of debris and other material which could block them in a storm.
- ❖ Check for loose fill above and below your property if you live on a slope or terrace.
- ❖ Monitor hoses and sprinklers. During the rainy season, little, if any, irrigation is required. Oversaturation of the ground is unnecessary, increases watering costs, and can cause subsurface drainage.
- ❖ Watch for water backup of drains inside the house and toilets during the rainy season, as this may indicate drain or sewer blockage.
- ❖ Never block terrace drains and brow ditches on slopes or at the tops of cut or fill slopes. These are designed to carry away runoff to a place where it can be safely distributed.
- ❖ Maintain the ground surface upslope of lined ditches to ensure that surface water is collected in the ditch and is not permitted to be trapped behind or under the lining.
- ❖ Do not permit water to collect or pond on your home site. Water gathering here will tend to either seep into the ground (loosening or expanding fill or natural ground), or will overflow into the slope and begin erosion. Once erosion is started, it is difficult to control and severe damage may result rather quickly.
- ❖ Never connect roof drains, gutters, or down spouts to subsurface drains. Rather, arrange them so that water either flows off your property in a specially designed pipe or flows out into a paved driveway or street. The water then may be dissipated over a wide surface or, preferably, may be carried away in a paved gutter or storm drain. Subdrains are constructed to take care of ordinary subsurface water and cannot handle the overload from roofs during a heavy rain.

- ❖ Never permit water to spill over slopes, even where this may seem to be a good way to prevent ponding. This tends to cause erosion and, in the case of fill slopes, can eat away carefully designed and constructed sites.
- ❖ Do not cast loose soil or debris over slopes. Loose soil soaks up water more readily than compacted fill. It is not compacted to the same strength as the slope itself and will tend to slide when laden with water; this may even affect the soil beneath the loose soil. The sliding may clog terrace drains below or may cause additional damage in weakening the slope. If you live below a slope, try to be sure that loose fill is not dumped above your property.
- ❖ Never discharge water into subsurface blanket drains close to slopes. Trench drains are sometimes used to get rid of excess water when other means of disposing of water are not readily available. Overloading these drains saturates the ground and, if located close to slopes, may cause slope failure in their vicinity.
- ❖ Do not discharge surface water into septic tanks or leaching fields. Not only are septic tanks constructed for a different purpose, but they will tend, because of their construction, to naturally accumulate additional water from the ground during a heavy rain. Overloading them artificially during the rainy season is bad for the same reason as subsurface subdrains, and is doubly dangerous since their overflow can pose a serious health hazard. In many areas, the use of septic tanks should be discontinued as soon as sewers are made available.
- ❖ Practice responsible irrigation practices and do not over-irrigate slopes. Naturally, ground cover of ice plant and other vegetation will require some moisture during the hot summer months, but during the wet season, irrigation can cause ice plant and other heavy ground cover to pull loose. This not only destroys the cover, but also starts serious erosion. In some areas, ice plant and other heavy cover can cause surface sloughing when saturated due to the increase in weight and weakening of the near-surface soil. Planted slopes should be planned where possible to acquire sufficient moisture when it rains.
- ❖ Do not let water gather against foundations, retaining walls, and basement walls. These walls are built to withstand the ordinary moisture in the ground and are, where necessary, accompanied by subdrains to carry off the excess. If water is permitted to pond against them, it may seep through the wall, causing dampness and leakage inside the basement. Further, it may cause the foundation to swell up, or the water pressure could cause structural damage to walls.
- ❖ Do not try to compact soil behind walls or in trenches by flooding with water. Not only is flooding the least efficient way of compacting fine-grained soil, but it could damage the wall foundation or saturate the subsoil.
- ❖ Never leave a hose and sprinkler running on or near a slope, particularly during the rainy season. This will enhance ground saturation which may cause damage.
- ❖ Never block ditches which have been graded around your house or the lot pad. These shallow ditches have been put there for the purpose of quickly removing water toward the driveway, street or other positive outlet. By all means, do not let water become ponded above slopes by blocked ditches.

- ❖ Seeding and planting of the slopes should be planned to achieve, as rapidly as possible, a well-established and deep-rooted vegetal cover requiring minimal watering.
- ❖ It should be the responsibility of the landscape architect to provide such plants initially and of the residents to maintain such planting. Alteration of such a planting scheme is at the resident's risk.
- ❖ The resident is responsible for proper irrigation and for maintenance and repair of properly installed irrigation systems. Leaks should be fixed immediately. Residents must undertake a program to eliminate burrowing animals. This must be an ongoing program in order to promote slope stability. The burrowing animal control program should be conducted by a licensed exterminator and/or landscape professional with expertise in hill side maintenance.

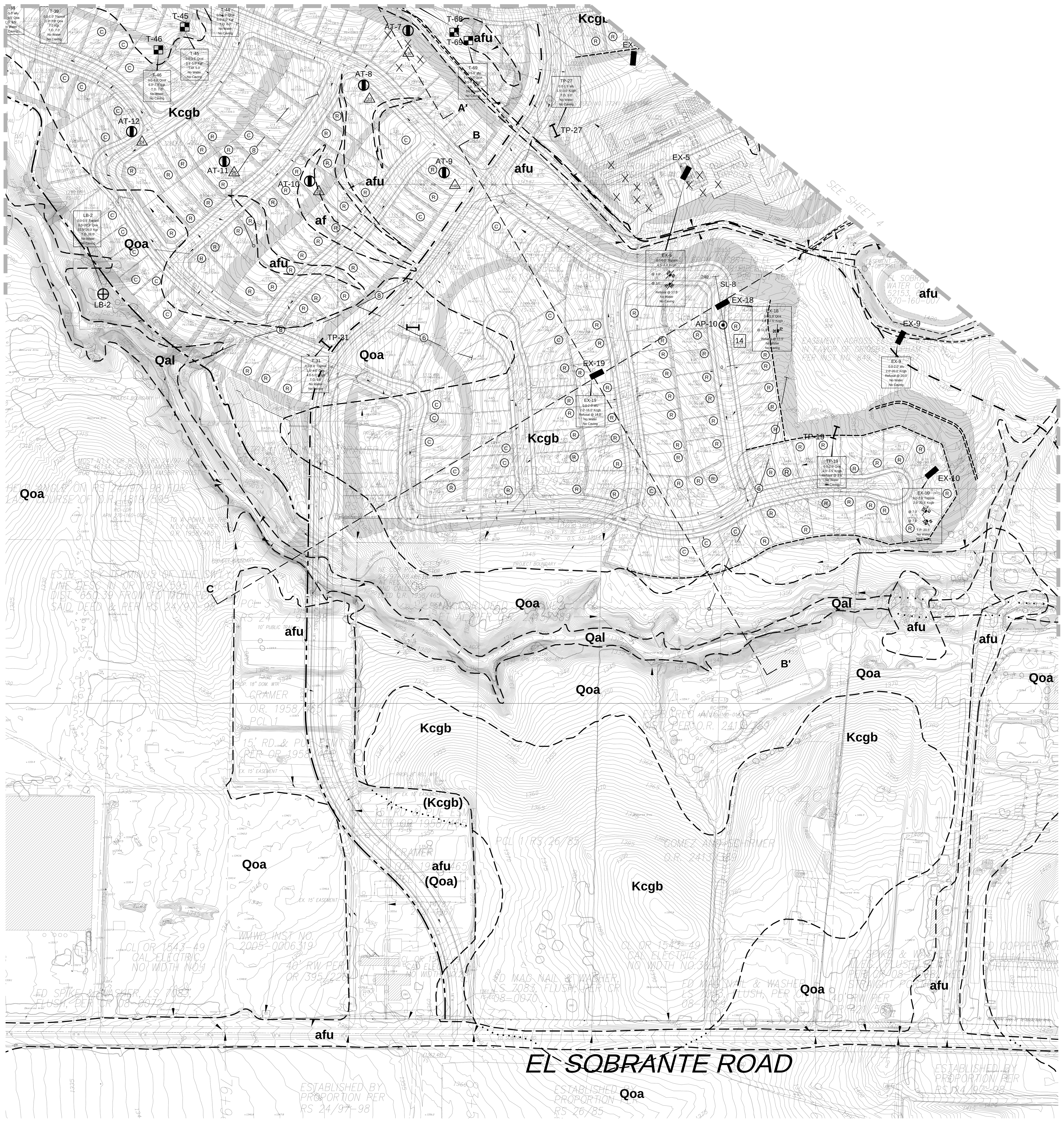
Geotechnical Review

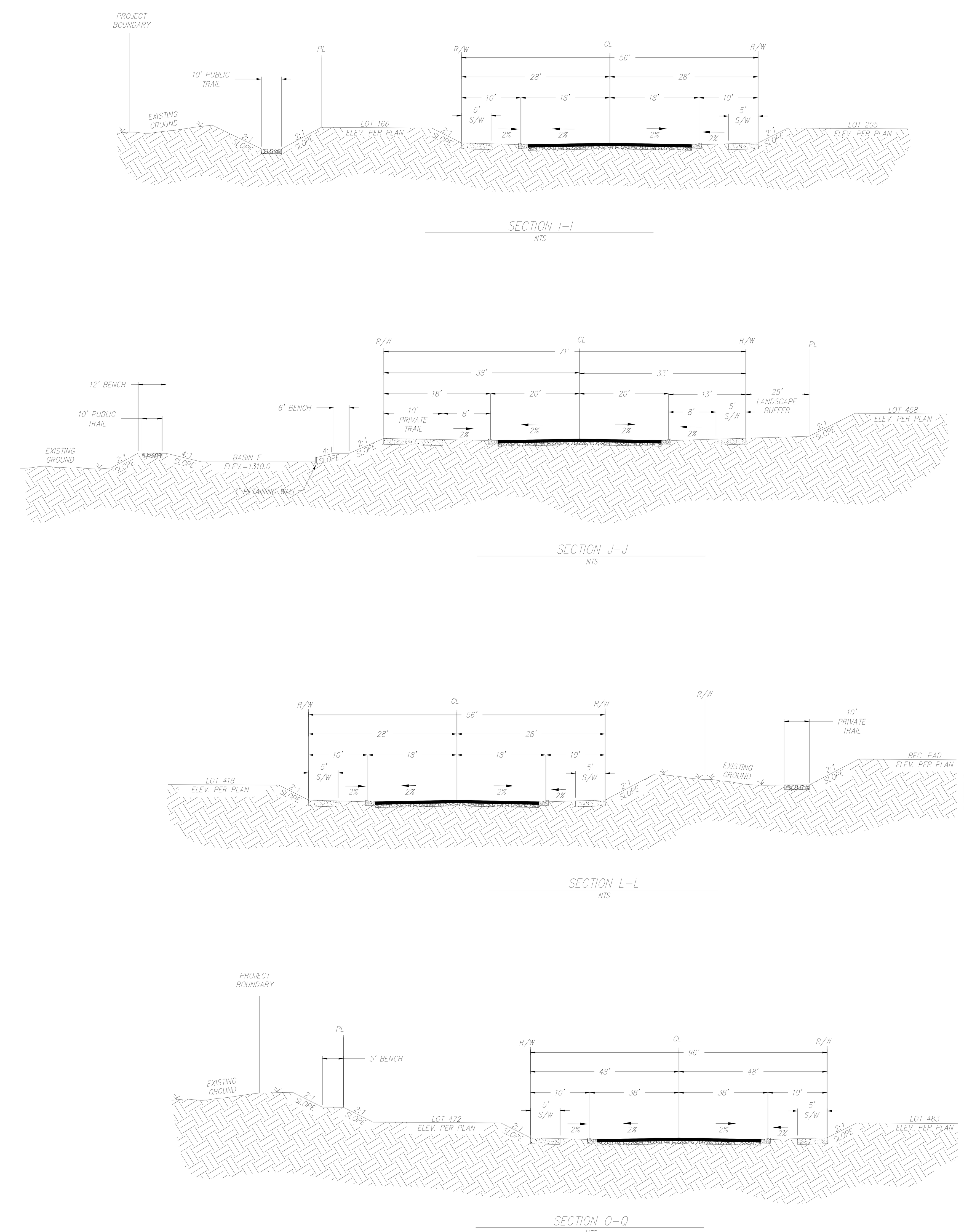
Due to the presence of expansive soils on site and the fact that soil types may vary with depth, it is recommended that plans for the construction of rear yard improvements (swimming pools, spas, barbecue pits, patios, etc.), be reviewed by a geotechnical engineer who is familiar with local conditions and the current standard of practice in the vicinity of your home.

In conclusion, your neighbor's slope, above or below your property, is as important to you as the slope that is within your property lines. For this reason, it is desirable to develop a cooperative attitude regarding hillside maintenance, and we recommend developing a "good neighbor" policy. Should conditions develop off your property, which are undesirable from indications given above, necessary action should be taken by you to insure that prompt remedial measures are taken. Landscaping of your property is important to enhance slope and foundation stability and to prevent erosion of the near surface soils. In addition, landscape improvements should provide for efficient drainage to a controlled discharge location downhill of residential improvements and soil slopes.

Additionally, recommendations contained in the Geotechnical Engineering Study report apply to all future residential site improvements, and we advise that you include consultation with a qualified professional in planning, design, and construction of any improvements. Such improvements include patios, swimming pools, decks, etc., as well as building structures and all changes in the site configuration requiring earth cut or fill construction.

LEGEND
afu ARTIFICIAL FILL – UNDOCUMENTED
Qal ALLUVIUM
Qoa OLDER ALLUVIUM
Qvof VERY OLD ALLUVIAL FAN DEPOSITS
Kcgb GRANODIORITE AND GABBRO – UNDIFFERENTIATED
BRACKETED WHERE BURIED
GEOLOGIC CONTACT – DOTTED WHERE BURIED QUERIED WHERE UNKNOWN
AP-16 AIR TRACK BORING (THIS REPORT) WITH ESTIMATED DEPTH TO NON–RIPPABLE ROCK IN FEET
SL-10 SEISMIC REFRACTION LINE (THIS REPORT)
TP-32 BACKHOE TEST PIT (AGS, 2017)
EX-1 EXCAVATOR TEST PIT (AGS, 2017)
AT-13 AIR TRACK BORING (ALBUS KEEFE, 2005) WITH ESTIMATED DEPTH TO NON–RIPPABLE ROCK IN FEET
LB-1 HOLLOW STEM BORING (LEIGHTON, 2006)
T-83 BACKHOE TEST PIT (LEIGHTON, 2005)
HARD ROCK OUTCROPS
PROPOSED SUBDRAIN PIPE WITH DIAMETER IN INCHES
CUT/FILL TRANSITION
HARD ROCK LOT
NOTE: ALL LOCATIONS, DIRECTIONS, AND DIMENSIONS ARE APPROXIMATE
SECTION A–A
SECTION R–R
SECTION B–B
SECTION C–C
SECTION D–D
SECTION G–G
SECTION E–E (TYPICAL PAD TO PAD SECTION) (WITH RETAINING WALL)
SECTION E–E (TYPICAL PAD TO PAD SECTION) (WITHOUT RETAINING WALL)
SECTION F–F
SEE SHEET 3
SEE SHEET 4
PLATE 1
ADVANCED GEOTECHNICAL SOLUTIONS, INC.
485 Corporate Drive, Suite B
Escondido, California 92029
Telephone: (714) 786-5661 Fax: (714) 409-3287
Project# P/W 1507–05
Report# 1507–05–B–10
Date: MAY 2018
REVISIONS
DESCRIPTION
APPR.
DATE
MAP PREPARED BY:
adkan ENGINEERS
Civil Engineering · Surveying · Planning
6879 Airport Drive, Riverside, CA 92504
Tel:(951) 688–0241 · Fax:(951) 688–0599
Email: Bryan Ingersoll– bingersoll@adkan.com
TENTATIVE TRACT 37217
PREPARATION DATE : MAY 2018
SCALE: 1" = 100'
SHEET 2 OF 8





SEE PLATE 1 FOR LEGEND PLATE 2

AGS ADVANCED GEOTECHNICAL SOLUTIONS, INC.

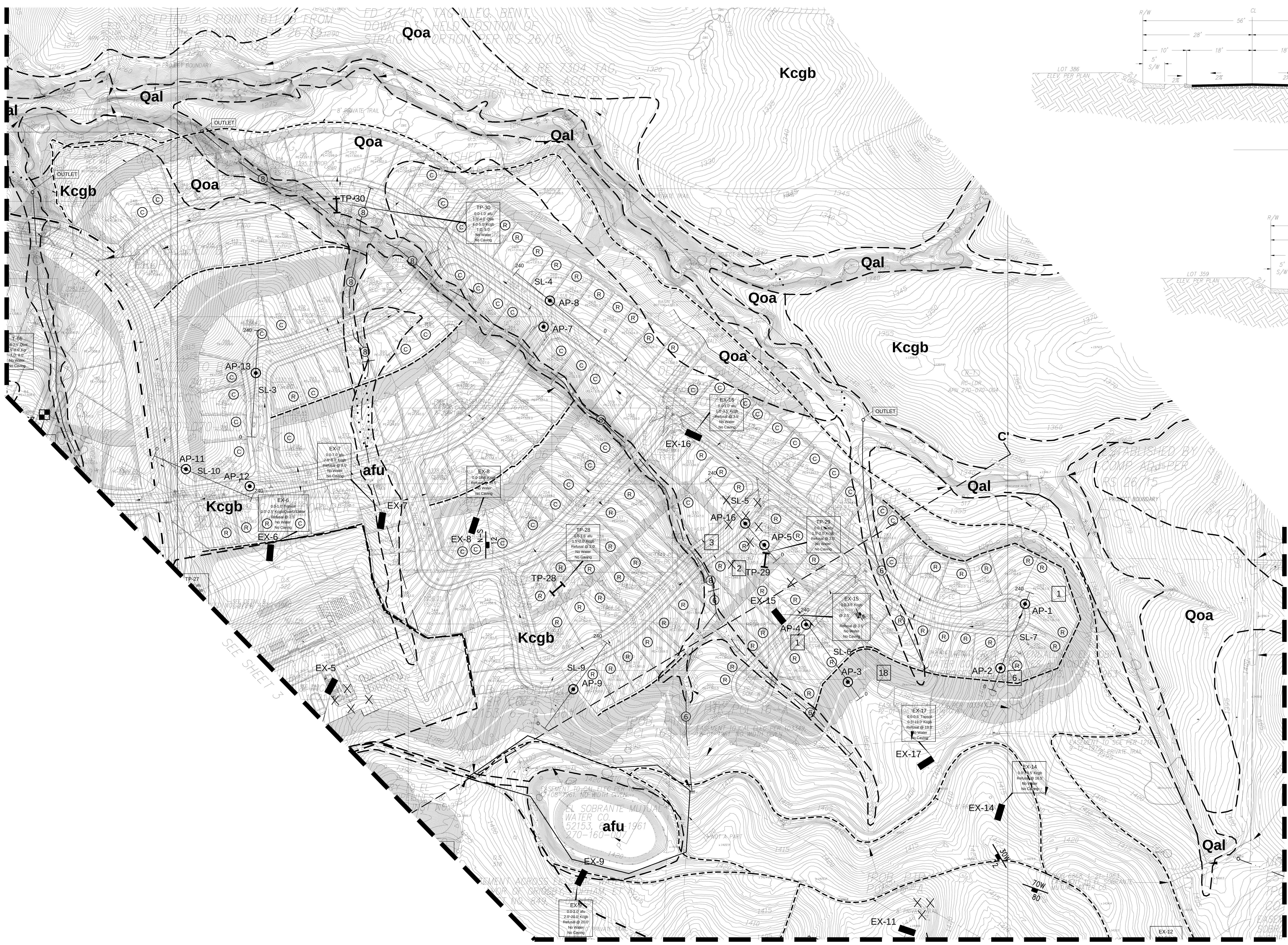
Project#	Report#	Date:
P/W 1507-05	1507-05-B-10	MAY 2018

LEGEND

TENTATIVE TRACT 37217

PREPARATION DATE: MAY 2018

SHEET 3 OF 8



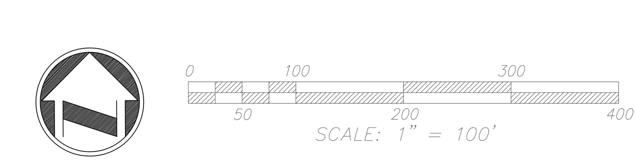
SEE PLATE 1 FOR LEGEND PLATE 3

ADVANCED GEOTECHNICAL SOLUTIONS, INC.
485 Corporate Drive, Suite B
Escondido, California 92029
Telephone: (714) 786-5661 Fax: (714) 409-3287

Project#	Report#	Date:
P/W 1507-05	1507-05-B-10	MAY 2018

LEGEND

8' PRIVATE TRAIL
10' PUBLIC TRAIL
10' PRIVATE TRAIL



REVISIONS			
INT.	DESCRIPTION	APPR.	DATE

TENTATIVE TRACT 37217
PREPARATION DATE : MAY 2018

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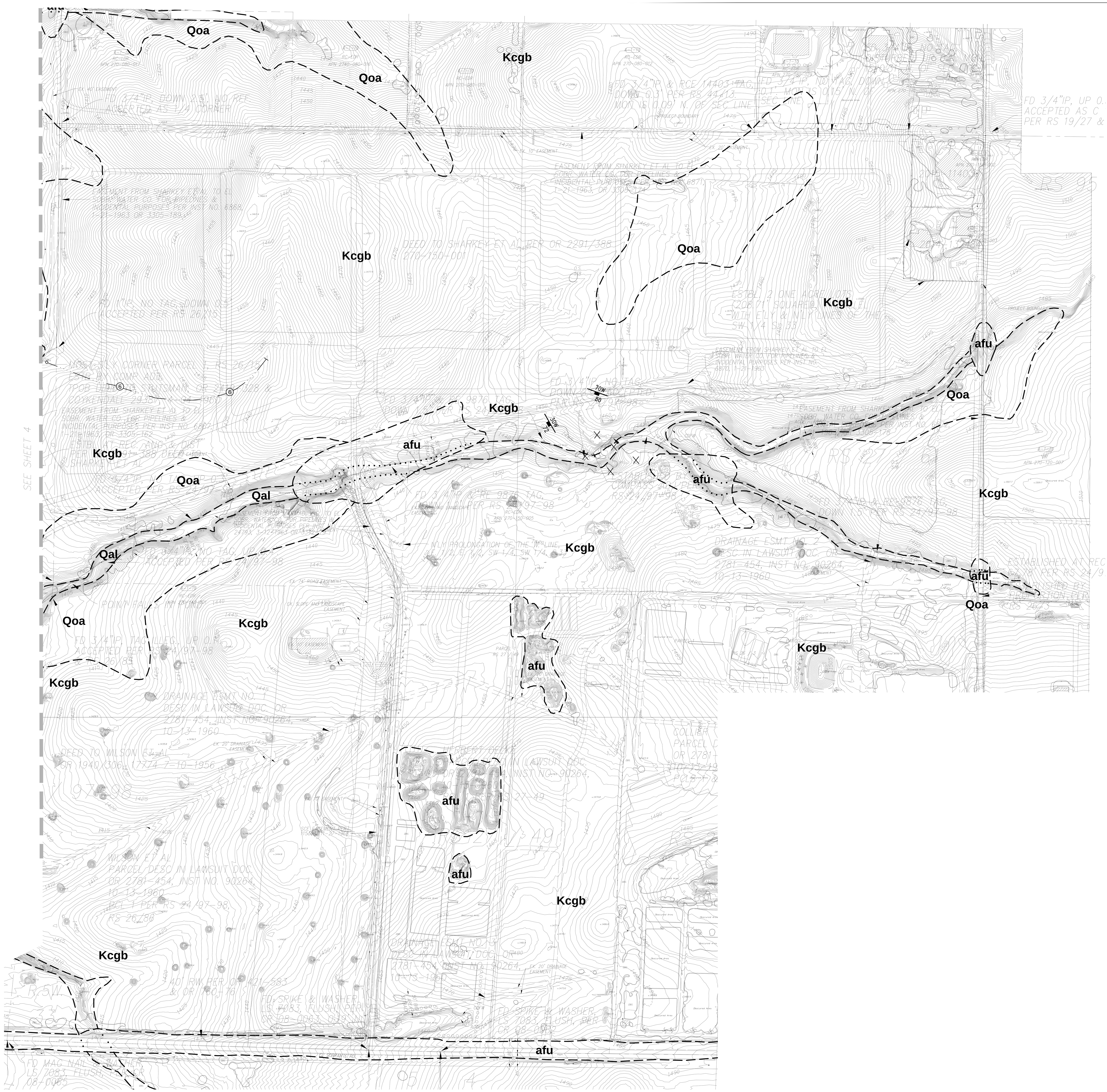
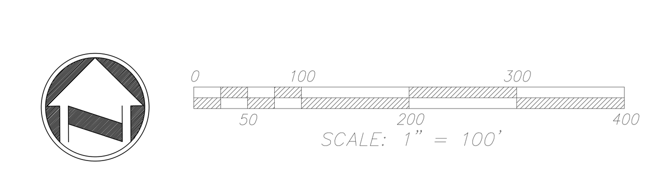
SHEET 4 OF 8





SEE PLATE 1 FOR LEGEND PLATE 4

ADVANCED GEOTECHNICAL SOLUTIONS, INC.
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Project#	Report#	Date:
P/W 1507-05	1507-05-B-10	MAY 2018

REVISIONS

INT.	DESCRIPTION	APPR.	DATE

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TENTATIVE TRACT 37217
PREPARATION DATE : MAY 2018

SHEET 5 OF 8

CROSS-SECTIONS A–A, B–B, AND C–C'
SCALE: 1"=100'

SEE PLATE 1 FOR LEGEND PLATE 5

AGS
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Project#	Report#	Date:
P/W 1507-05	1507-05-B-10	MAY 2018