Appendix H

Preliminary Geotechnical Evaluation
(May 2023)

PETRA GEOSCIENCES INC.

SOLID AS A ROCK

PRELIMINARY GEOTECHNICAL EVALUATION
PROPOSED MIXED-USE COMMERCIAL/LIGHT INDUSTRIAL DEVELOPMENT
PLANNING AREA 40 AND PORTIONS OF PA-41 AND PA-44 OF THE GREEN VALLEY SPECIFIC PLAN
44.9±-ACRE SITE SOUTHWESTERLY OF WATSON AND CASE ROADS
CITY OF PERRIS, RIVERSIDE COUNTY, CALIFORNIA

RICHLAND COMMUNITIES

May 26, 2023
J.N. 22-367

ENGINEERS + GEOLOGISTS + ENVIRONMENTAL SCIENTISTS

May 26, 2023
J.N. 22-367

RICHLAND COMMUNITIES
3161 Michelson Drive, Suite 425
Irvine, California 92615

Attention: Mr. Derek Barbour

Subject: Preliminary Geotechnical Evaluation, Proposed Mixed-Use Commercial/Light Industrial Development, Planning Area 40 and Portions of PA-41 and PA-44 of the Green Valley Specific Plan, 44.9±-Acre Site Southwesterly of Watson and Case Roads, City of Perris, Riverside County, California

Dear Mr. Barbour:

Petra Geosciences, Inc. (Petra) is submitting herewith our preliminary geotechnical evaluation report for the proposed mixed-use commercial/light industrial development within the southeasterly portion of the Green Valley Specific Plan in the city of Perris, California. This evaluation was performed in accordance with the scope of work outlined in our Proposals dated October 5, 2022, and April 18, 2023. This preliminary report is prepared based on the requirements of both the 2022 California Building Code (2022 CBC) and presents our findings, engineering judgment, opinions, conclusions, and recommendations pertaining to geotechnical design aspects of the proposed development. It should be noted that this geotechnical and geological evaluation does not address soil contamination or other environmental issues, which may affect the property.

It has been a pleasure to be of service to you on this project. Please contact us if you have any questions regarding the contents of this report or require additional information.

Respectfully submitted,

PETRA GEOSCIENCES, INC.

Douglass Johnston, CEG
Senior Associate Geologist

Siamak Jafroudi, PhD, GE
Senior Principal Engineer

TABLE OF CONTENTS

Page

ATTACHMENTS

FIGURE 1 – SITE LOCATION MAP

FIGURES 2 & 3 – EXPLORATION LOCATION MAPS

APPENDIX A – EXPLORATION LOGS (BORINGS AND TEST PITS)

APPENDIX B – LABORATORY TESTING PROCEDURES / LABORATORY DATA SUMMARY

APPENDIX C – STANDARD GRADING SPECIFICATIONS

PRELIMINARY GEOTECHNICAL EVALUATION
PROPOSED MIXED-USE COMMERCIAL/LIGHT INDUSTRIAL DEVELOPMENT
PLANNING AREA 40 AND PORTIONS OF PA-41 AND PA-44 OF THE
GREEN VALLEY SPECIFIC PLAN
44.9±-ACRE SITE SOUTHWESTERLY OF WATSON AND CASE ROADS
CITY OF PERRIS, RIVERSIDE COUNTY, CALIFORNIA

INTRODUCTION

Petra Geosciences, Inc. (Petra) is presenting herein the results of our preliminary geotechnical evaluation for the development of several proposed building structures and appurtenant facilities within the subject property situated southwesterly of Watson and Case Roads and north of Ethanac Road, in the city of Perris, California. The purpose of this study was to obtain preliminary information on the general geologic and geotechnical soil conditions within the project area in order to provide conclusions and recommendations for the feasibility of the proposed project, and preliminary geotechnical recommendations for site grading and assumed improvements. As grading plans, foundation plans, and the various structural building loads are still being developed at this time, geotechnical recommendations for design of the building foundations will be provided under a separate cover at the appropriate time.

SCOPE OF WORK

The scope of our evaluation consisted of the following.

- Review of available published and unpublished reports, maps and data concerning geologic and soil conditions within the site and nearby area that could have an impact on the proposed development (see References).
- Review of readily available satellite imagery of the site and surrounding area.
- Coordinate with Underground Service Alert [USA] to obtain an underground-utility clearance, prior to commencement of the subsurface exploration.
- Geotechnical excavation, logging, and sampling of 9 exploratory test pits utilizing a conventional backhoe and 2 exploratory borings utilizing a hollow-stem auger drill rig. Log and visually classify soil and materials encountered in the borings and test pits in accordance with the Unified Soil Classification System (USCS).
- Conduct preliminary laboratory testing of representative in-situ drive and bulk samples obtained from the borings and test pits and hand to determine their engineering properties.
- Engineering and geologic analysis of the research, field exploration findings and laboratory data with respect to the proposed site development.
- Preparation of this geotechnical report presenting the results of our evaluation and providing recommendations for the proposed site development in general conformance with the requirements of the 2022 California Building Code (2022 CBC), as well as in accordance with applicable state and local jurisdictional requirements.

LOCATION AND SITE DESCRIPTION

The subject property is irregular-shaped consisting of three parcels totaling approximately 44.9 acres in size, situated southwesterly of Watson and Case Roads, north of Ethanac Road and westerly of the "Perris Crossings" commercial plaza. Figure 1 depicts the general site location and surrounding area. PA-40 is the northeasterly parcel, PA-44 is the southernmost parcel and PA-41 is the parcel in the middle of the subject site. Case Road is an unimproved dirt access road along the north and vacant land is located further to the west. Several dirt paths transect the property. An Eastern Municipal Water District (EMWD) water reclamation facility is located north of Case Road. Chain link fencing and a gate are located along Ethanac Road on the south; however, the site is generally open on the north and northeastern boundaries.

Two existing detention basins improved with storm drain inlet and outlet structures and fencing are located within the site, one in the northwesterly corner of PA-40 and the other in the southeast corner of PA-44. We understand an existing large-diameter, subsurface storm drain pipeline is located inside the southerly boundary of PA-40 that extends northward into the northwesterly basin, generally along the dirt pathway alignment. Additionally, a subsurface concrete box culvert structure was recently installed near Ethanac Road to the south of the basin in PA-44. EMWD water line(s) appear to be present on the south side of Case Road, and an EMWD sewer line is located near the southwesterly property boundary. Other utility lines could be present near the property boundaries.

The surface of the property is low gradient, sloping very gently towards the northwest with original grade site elevations ranging from approximately 1,418 feet above mean sea level (msl) in the northwesterly corner to approximately 1,424 feet along the easterly boundary. However, the surface topography has been altered in two notable areas that were previously used first as staging/construction yards, followed by soil stockpiling during construction activities for the commercial development to the east. A large stockpile was placed generally in the south-central portions of PA-40 and a smaller stockpile of soil covers the majority of PA-44. Graded ascending fill slopes are present along the eastern property boundary of PA-41 and 44. The surface of the site currently contains a variable growth of native weeds and small shrubs as well as various piles of random dumped materials and debris as well as scattered trash.

PROPOSED DEVELOPMENT

Based on the conceptual site exhibits prepared by both SB&O, Inc. and Architects Orange, LLP, the currently planned development will consist of an approximately 500,000 square-foot industrial warehouse building, two self-storage buildings, a 4-sotry hotel building, 3 restaurant/retail buildings and an RV parking area. Ancillary site improvements will include driveway and parking pavement, underground utilities (sewer, water, storm drain and dry utilities), loading docks, perimeter masonry walls, sidewalks and landscaping. Conceptual grading plans are not currently available; however, it is expected the site will be raised from current grades by several feet. Notable cut slopes are not anticipated.

Literature and Online Imagery Review

Petra researched and reviewed available published and unpublished geologic data and reports pertaining to regional geology, groundwater, faulting, and geologic hazards that may affect the site including the preliminary geotechnical reports for the adjacent sites prepared by Krazan & Associates, Inc. and Earth Systems Southwest (Krazan, 2004 and ESSW 2015). The results of this review are included within this report and pertinent exploration logs included in Appendix A. Based on readily available historic aerial photos and online imagery, the site appears to have been periodically used for dry farming from at least 1938 to around 2002. Grading and construction of Perris Crossings to the east of PA-41 and 44 began around 2006 and PA-41 was utilized as a construction/staging yard and stockpiling of soils in PA-40 began around 2007. By 2009 the two detention basins had been constructed, the staging yard was abandoned, and soil stockpiling appears to have ceased. Other than surficial dumping and vegetation growth, the site appears to be in a similar condition since the general 2009 timeframe.

Field Exploration and Testing

Subsurface explorations were conducted under the supervision of an engineering geologist from Petra on April 24 and May 2, 2023. Subsurface exploration involved the excavation of 9 exploratory test pits (TP-1 through TP-9), to depths ranging between 4 and 10 feet below existing surface grades utilizing a conventional backhoe and advancing 2 hollow-stem auger borings (B-1 and B-2) utilizing a conventional drill rig equipped with 8-inch diameter augers. The borings were drilled and sampled to depths ranging from 51.5 feet below grades. Earth materials encountered within the exploratory borings and test pits were classified and logged in accordance with the visual-manual procedures of the Unified Soil Classification System (USCS). Following logging and sampling, the test pits were loosely backfilled. The approximate locations of the exploratory borings and test pits are shown on the attached Figures 2 and 3 and descriptive logs of them are presented in Appendix A.

Associated with the subsurface exploration was the collection of bulk and relatively undisturbed samples of the soil materials for laboratory testing. Undisturbed samples were obtained using a 3-inch outside diameter modified California split-spoon soil sampler lined with brass rings. The soil sampler was driven with successive 30-inch drops of a free-fall, 140-pound automatic trip hammer. The central portions of the driven-core samples were placed in sealed containers and transported to our laboratory for testing. The number of blows required to drive the split-spoon sampler 18 inches into the soil were recorded for each 6-inch driving increment; however, the number of blows required to drive the sampler for the final 12 inches was noted in the boring logs as *Blows per Foot*.

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

Laboratory Testing

Laboratory testing for selected samples of onsite soils materials included in-situ dry density and moisture content, expansion index, consolidation potential, plasticity index, No. 200 wash and general soil corrosivity screening potential (sulfate content, chloride content, pH/resistivity). A description of laboratory test methods and laboratory testing are presented in Appendix B and the in-site dry density and moisture content results are presented on the boring logs (Appendix A).

FINDINGS

Regional Geologic Setting

Geologically, the site lies within the northerly portion of the Peninsular Ranges Geomorphic Province (CGS, 2002). The Peninsular Range Province extends from the tip of Baja California north to the Transverse Ranges Geomorphic Province and is characterized by northwest trending mountain ranges separated by subparallel fault zones. The San Bernardino Mountains, located on the north side of the valley, provides the boundary between the Peninsula Range Province and the Transverse Ranges Province. In general, the province is underlain primarily of plutonic rock of the Southern California Batholith. These rocks formed from the cooling of molten magma deep within the earth's crust. Intense heat associated with the plutonic magma metamorphosed the ancient sedimentary rocks into which the plutons intruded. The Peninsular Range Geomorphic Province is generally characterized by alluviated basins and elevated erosional surfaces.

Local Geology and Subsurface Soil Conditions

The subject property is situated within the central portion of a broad alluvial valley known as the Perris Plain in near proximity to the San Jacinto River to the northwest. The general area is underlain predominantly by surficial Holocene-age alluvial valley deposits and older alluvial fan deposits (Morton, 2003). Local alluvial valley soil materials are generally known to consist of interlayered clays, silts, silty sands, clayey sands and occasional sand beds with some gravels. The depth to bedrock in this portion of the valley is currently unknown.

Artificial Fill

A surficial artificial fill horizon was observed at the points of exploration ranging from approximate depth from 1 to 5.5 feet. These materials generally consisted of dry to slightly moist, loose, silty sand and clayey sand with variable amounts of gravel.

Younger Alluvium

Recent or young alluvium was observed beneath the fill horizon generally ranging from 2.5 to 5 feet in thickness. These alluvial soils predominantly consisted of moist, medium dense clayey sand with lesser occurrences of firm to stiff sandy clay and occasional gravels.

Older Alluvium

Older alluvium is present beneath the younger alluvium layer underlying the site at approximate depths between 5 and 7.5 feet below surface grades where explored. These soils predominantly consisted of moist, dense to very dense or very stiff to hard, upper clayey sand and sandy clay with interbedded, sandy silt, clayey silt and silty sand at depth.

Groundwater

Based on groundwater wells along Watson Road just to the northeast and northwest of the site, the depth to groundwater was measured between 47.5 and 67 feet below ground surface (bgs) between 2011 and 2022. Another well a little further to the northwest measured groundwater between 49 and 86 feet bgs between 1995 and 2022. ESSW and Petra did not encounter groundwater to the maximum explored depth of 51.5 feet bgs within or adjacent to the site during 2015 and 2023 respectively.

Groundwater is not expected to be encountered during remedial grading at this time. However, during significant rainy seasons, surface water has been observed to temporarily pond in the local area, therefore, depending on the time of year when the site is graded, there is a possibility of encountering localized nuisance or perched water during grading in rainy seasons.

Faulting

Based on our review of published and unpublished geotechnical maps and literature pertaining to site geology, no active or potentially active faults are known to project through the site and the site does not lie within the bounds of an "Earthquake Fault Zone" as defined by the State of California in the Alquist-Priolo (AP) Earthquake Fault Hazard Zoning Act (Bryant and Hart, 2007) nor a Riverside County fault zone. In addition, we did not observe any features in the field that would indicate active faulting. The closest known active faults are the San Jacinto Fault zone which lies approximately 9.9 miles to the northeast and the Elsinore Fault zone which lies approximately 12.2 miles to the southwest. The potential for active fault rupture at the site is considered to be very low.

Secondary Seismic Effects

Secondary effects of seismic activity normally considered as possible hazards to a site include several types of ground failure and seismically induced flooding. Various general types of ground failures, which might occur as a consequence of severe ground shaking at the site, include landsliding, ground subsidence, ground lurching and lateral spreading. The probability of occurrence of each type of ground failure depends on the severity of the earthquake, distance from faults, topography, subsurface soil and groundwater conditions, in addition to other factors. The subject property proposed for development exhibits nearly level topography that is not subject to landsliding, and the potential for ground lurching and lateral spreading are considered very low. The potential for seismically-induced flooding due to tsunami or seiche (i.e., a wave-like oscillation of the surface of water in an enclosed basin) is considered negligible at this site.

Liquefaction and Seismically Induced Settlement

Liquefaction occurs when strong seismic shaking of saturated sand or silt causes intergranular fluid (pore-water) pressures to increase to levels where grain-to-grain contact is lost, and material temporarily behaves as a viscous fluid. Liquefaction can cause settlement of the ground surface, loss of bearing, settlement and tilting of structures, lateral movement of soil masses, flotation and buoyancy of buried structures and fissuring of the ground surface. A common surface manifestation of liquefaction is the formation of sand boils – short-lived fountains of soil and water that emerge from fissures or vents and leave freshly deposited, usually conical mounds of sand or silt on the ground surface.

For sandy soils above the water table, strong seismic shaking can also result in rearrangement of the granular soil structure leading to densification of sandy soils, ground settlement and settlement and tilting of superstructures.

Assessment of liquefaction or dry sand settlement potential for a particular site requires knowledge of a number of regional as well as site-specific parameters, including the estimated design earthquake magnitude, and the associated probable peak horizontal ground acceleration at the site, subsurface stratigraphy and soil characteristics. Parameters such as estimated probable peak horizontal ground acceleration can readily be determined using published references, or by utilizing a commercially available computer program specifically designed to perform a probabilistic analysis. On the other hand, stratigraphy and soil characteristics can only be accurately determined by means of a site-specific subsurface investigation combined with appropriate laboratory analysis of representative samples of onsite soils.

Propagating earthquake waves induces shearing stresses and strains in soil materials during strong ground shaking. This process rearranges the structure of granular soils such that there is an increase in density, with a corresponding decrease in volume, which results in vertical settlement. Dynamic settlement has been well documented in wet, sandy deposits undergoing liquefaction (see Tokimatsu and Seed, 1987) and in relatively dry sediments as well (Stewart et al, 1996). Specific methods to analyze potential wet and dry dynamic settlement are reported in Tokimatsu and Seed (1987), and specifically dry settlement in Pradel (1998) and Stewart et al. (2001; 2002) respectively. Most of the referenced papers focus on the seismic effects on dry, clean sands of a uniform grain size, though several reports extend the literature to fine-grained soils (Stewart et al., 2001 & 2002). State guidelines for evaluating dynamic settlement are provided in the California Geological Survey Special Publication 117A (CGS, 2008).

Riverside County has identified the subject property area within a low liquefaction potential zone and groundwater is currently deeper than 51.5 feet beneath the site. Based on these factors and the relative dense to very dense nature of the older alluvium underlying the site, the potential for both liquefaction and seismically induced settlement are considered very low.

Collapsible Soils

A notable geotechnical factor affecting the project site is the presence of existing surficial artificial fills and shallow subsurface low-density younger alluvial soils ranging in depth from approximately 5 to 7.5 feet bgs at our points of exploration. Based on the former stockpiling activities, unsuitable soils could be deeper than 7.5 feet in localized areas. These materials in their current state are not considered suitable for support of proposed fills or structural loads. Accordingly, these materials will require removal (over-excavation) to expose the underlying competent older alluvial deposits, to be verified in the field by the geotechnical consultant. The removed soils are considered to be suitable for re-use as engineered fill.

CONCLUSIONS AND RECOMMENDATIONS

Development Feasibility

Based on our field explorations, research and review of pertinent geologic literature, and preliminary laboratory testing and analysis, development of the project site is considered feasible for the proposed mixed-use development from a soils engineering, geologic and geotechnical standpoint. When grading plans and foundation/structural plans for the proposed development are available, a comprehensive plan review should be performed by this firm and additional field exploration may be considered. The following geotechnical factors should be considered during the preliminary design process.

Effect of Proposed Grading on Adjacent Properties

It is our opinion that the proposed grading and construction will not significantly affect the stability of adjoining property improvements provided that the grading and construction are performed in accordance with the earthwork recommendations provided herein as well as Appendix C attached. It should be noted that future grading may encroach onto the existing fills slope along the east boundary of PA-41 and 44 and/or in proximity of the existing detention basins.

Seismic Shaking

The site is located within an active tectonic area of southern California with several significant faults capable of producing moderate to strong earthquakes. The site will likely be subjected to very strong seismically related ground shaking during the anticipated life span of the project and structures within the site should therefore be designed and constructed to resist the effects of strong ground motion in accordance with the most current edition of the 2022 California Building Code.

Soil Settlement and Remedial Grading

The upper site soils consisting of 1 to 5.5 feet of artificial fill and the younger alluvial soils below the fill are porous and inconsistent due to their variable nature and are subject to static settlement due to dead and live loading conditions of fill and structures. Accordingly, remedial grading will be necessary for support of engineered fills for the structure foundation system. In general, in all areas where structures are proposed, all collapsible/compressible alluvial soils will need to be removed (over-excavated) to competent older alluvium, then subsequently placed as properly compacted (engineered) fill.

Earthwork Recommendations

General Recommendations

Earthwork should be performed in accordance with the Grading Code of the City of Perris or the County of Riverside and to the applicable provisions of the 2022 CBC and should also be performed in accordance with the following site-specific recommendations prepared by Petra herein based on the proposed construction.

Geotechnical Observations and Testing

Prior to the start of earthwork, a meeting should be held at the site with the owner, contractor and geotechnical consultant to discuss the work schedule and geotechnical aspects of the grading. Earthwork, which in this instance will generally entail removal and re-compaction of existing unsuitable soils and/or over-excavation, should be accomplished under full-time observation and testing of the geotechnical consultant. A representative of the project geotechnical consultant should be present onsite during all earthwork operations to document proper placement and compaction of fills, as well as to document compliance with the other recommendations presented herein.

Demolition, Clearing and Grubbing

Based on the development concept, we presume the existing storm drain line within PA-40 would be re-alighted from its current locations. As such the existing storm drain pipeline will need to be demolished and removed from the site as well as any other existing utility lines from the proposed grading areas. All existing vegetation throughout the site should be removed from the site, including the root balls for any trees. Additionally, clearing operations should also include the removal of any dumped trash, debris and similar deleterious materials. Any cavities or excavations created upon removal of any unknown subsurface structures should be cleared of loose soil, shaped to provide access for backfilling and compaction equipment and then backfilled with engineered fill. Note that buried deleterious materials could be encountered within the site (i.e., buried debris) due to the past site usage for both agriculture and as a construction yard, that would need to be removed from the fills by hand (i.e., root pickers), during grading operations.

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

Suitability of On-Site Materials for Use as Engineered Fill

Based on our field observations and subsurface soil conditions encountered in our test pits, the onsite soil materials would be suitable for use as engineered fill, provided they are clean of organics, construction debris or other deleterious materials. Soils exposed at or near the surface will likely require moisture-conditioning, i.e. pre-watering, to near optimum moisture for use as engineered fill during the onset of grading.

Excavation Characteristics

The existing site soils consisting of stockpiled fill and native older and younger alluvium are expected to be readily excavated with conventional earthmoving equipment.

Ground Preparation

Geotechnical Observations

A representative of the project geotechnical consultant should also be present on site during all grading operations to document the sufficient remedial removals, proper placement, and adequate compaction of fills has been achieved, as well as to observe compliance with the other recommendations presented herein. Exposed bottom surfaces in remedial removal areas should be observed and approved by a representative of the project geotechnical consultant ***prior to the placement of fill***. It is the grading contractor's responsibility to notify the project geotechnical consultant at least 24 hours prior to requiring observation (including excavation bottom verification).

Unsuitable Soil Removals and Bottom Processing

The existing roughly 5 to 7.5 feet of surface fills and native alluvial soils are considered unsuitable for support of proposed fills, structures, flatwork, pavement or other improvements and should be removed to underlying competent older alluvial materials as approved by the project geotechnical consultant. The estimated depth of remedial removal of soil materials is recommended to be *no less than 4 feet below bottom of the proposed footings for the industrial warehouse building pad*. Soil removals may need to be locally deeper depending in other areas upon the exposed conditions encountered during grading. Remedial removals should extend horizontally at least 10 feet beyond the limits of the building pads. The actual depths and horizontal limits of removals and over-excavations should be evaluated during grading on the basis of observations and testing performed by the project geotechnical consultant.

Remedial soil removals in parking lot, driveways and other non-building pad areas may be reduced to a minimum of 4 feet below existing site grades.

Prior to placing engineered fill or processing, the exposed bottom surfaces in the removal areas should be approved by a representative of project geotechnical consultant first. The exposed bottom(s) should then be scarified to a minimum depth of 12 inches, moisture-conditioned or air-dried to achieve approximately two percent above optimum moisture content and then compacted with a heavy construction equipment prior to placement of fill. The minimum compaction of the upper 12 inches of the removal bottom should meet or exceed 90 percent relative compaction. The laboratory maximum dry density, the standard for determining relative compaction, and optimum moisture content for each change in soil type should be determined in accordance with Test Method ASTM D 1557.

Cut-Fill Transition Areas

Cut/fill transitions should be eliminated from beneath the building pad areas to reduce the detrimental effects of differential settlement. This should be accomplished by over-excavating the cut and shallow fill portions and replacing the excavated materials as properly compacted fill. Horizontal limits of over-excavation should extend across the entire level portion of the lot. Where the recommended depths of remedial over-excavation are less than 4 feet below pad grade, the over-excavation should be extended to at least 4 feet below pad grade, thereby constructing a minimum fill thickness of 4 feet.

Benching

Fills placed on or against sloping surfaces inclining at 5:1 (h:v) or steeper, should be placed on a series of level benches excavated into competent older alluvium. These benches should be provided at vertical intervals of approximately 3 to 4 feet. Typical benching details are shown on Plates SG-2, SG-5, SG-6, SG-7 and SG-8 (Appendix C).

Fill Placement

Fill materials should be placed in approximately 6- to 8-inch thick loose lifts, watered or air-dried as necessary to achieve a moisture content of at least 2 above optimum moisture condition, and then compacted in-place to a minimum relative compaction of 90 percent. The laboratory maximum dry density and optimum moisture content for each change in soil type should be determined in accordance with ASTM D 1557.

Temporary Excavations

Temporary excavations varying up to an estimated maximum depth of up to roughly 7.5 feet below existing grades may be required to accomplish the recommended over-excavation of existing soils. Based on the physical properties of the onsite soils, temporary excavations which are constructed exceeding 5 feet in height should be cut back to an inclination of 1:1 (h:v) or flatter for the duration of the over-excavation of unsuitable soil material and replacement as compacted fill, as well as placement of underground utilities. The 1:1 (h:v) recommendation may possibly be steepened, depending on conditions observed by a representative of the project geotechnical consultant. Other factors which should be considered with respect to the stability of the temporary slopes include construction traffic and/or storage of materials on or near the tops of the slopes, construction scheduling, presence of nearby walls or structures on adjacent properties and weather conditions at the time of construction. Applicable requirements of the California Construction and General Industry Safety Orders, the Occupational Safety and Health act of 1970 and the Construction Safety Act should also be followed.

Import Soils for Grading

If needed, all imported soils should be free of deleterious materials, oversize rock and any hazardous materials. The soil should also be essentially low or non-expansive, and essentially non-corrosive and approved by the project geotechnical consultant *prior* to being brought onsite. The geotechnical consultant should visit the potential borrow site(s) and conduct testing of the soil at least three days before the commencement of import operations.

Volumetric Changes - Shrinkage and Subsidence

Volumetric changes in earth quantities will occur when onsite soils are excavated and replaced as properly compacted fill. Based on our observations of earth materials encountered in the borings, an *estimated* shrinkage factor on the order of 12 to 17 percent may be considered during removal and re-compaction of the surface fill soils and upper native alluvial soils. The actual shrinkage that will occur during grading will depend on the average degree of relative compaction achieved. A subsidence of approximately 0.1 to 0.2 feet may be anticipated as a result of the scarification and re-compaction of the exposed bottom surfaces within the removal areas.

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

Fill Slope Construction

A fill key excavated at a depth of 2 feet or more into competent older alluvium is recommended at the base of all new fill slopes 5 feet in height or higher. The width of the fill key should equal one-half the slope height or 15 feet, whichever is greater. Typical fill-key construction details are shown on Plates SG-2, SG-5, SG-6 and SG-8 (Appendix C). Where a fill slope is to be constructed over deeper underlying engineered fill, a fill key may not be required at the discretion of the geotechnical engineer. To obtain proper compaction to the face of low-height fill slopes should be overfilled during construction and then trimmed-back to the compacted inner core.

The finish surface of the low-height fill slopes are anticipated to be both grossly and surficially stable at an inclination of 2:1 (h:v); however, based on the granular nature of the soil materials, these slopes may be potentially erodible.

Cut Slope Construction

No cut slopes are currently anticipated.

Preliminary Foundation Design Considerations

Seismic Design Parameters

Earthquake loads on earthen structures and buildings are a function of ground acceleration which may be determined from the site-specific ground motion analysis. Alternatively, a design response spectrum can be developed for certain sites based on code guidelines. We used two computer applications to provide the design team with the parameters necessary to construct the design acceleration response spectrum for this project. The first was developed by Structural Engineering Association of California (SEA) and California's Office of Statewide Health Planning and Development (OSHPD). The SEA/OSHPD Seismic Design Maps Tool website, https://seismicmaps.org, is used to calculate ground motion parameters. The second, the United Stated Geological Survey (USGS) Unified Hazard Tool website, https://earthquake.usgs.gov/hazards/interactive/, is used to estimate the earthquake magnitude and the distance to surface projection of the fault.

To run the applications discussed above, the following parameters are required: site latitude and longitude; seismic risk category; and site class. The site class designation depends on the direct measurement and the ASCE 7-16 recommended procedure for calculating average small-strain shear wave velocity, Vs30, within the upper 30 meters (approximately 100 feet) of site soils.

A seismic risk category of II was assigned to the proposed buildings in accordance with 2022 CBC, Table 1604.5. Shear wave velocity measurements were not performed at the site; however, based on the two geotechnical borings, the site exhibits the characteristics of a very dense soil and soft rock condition, therefore, in accordance with ASCE 7-16, Table 20.3-1, a Site Class C designation is assigned. As such, Table 1 below provides parameters required to construct the seismic response coefficient, C_s, curve based on ASCE 7-16, Article 12.8 guidelines.

~Remainder of Page Intentionally Left Blank~

TABLE 1

Seismic Design Parameters

Ground Motion Parameters	Specific Reference	Parameter Value	Unit
Site Latitude (North)	-	33.7470	°
Site Longitude (West)	-	-117.1948	°
Site Class Definition	Section 1613.2.2 (1), Chapter 20 (2)	C (4)	-
Assumed Seismic Risk Category	Table 1604.5 (1)	II	-
M_w - Earthquake Magnitude	USGS Unified Hazard Tool (3)	6.9 (3)	-
R – Distance to Surface Projection of Fault	USGS Unified Hazard Tool (3)	16.1 (3)	km
S_s - Mapped Spectral Response Acceleration Short Period (0.2 second)	Figure 1613.2.1(1) (1)	1.416 (4)	g
S_1 - Mapped Spectral Response Acceleration Long Period (1.0 second)	Figure 1613.2.1(3) (1)	0.524 (4)	g
F_a – Short Period (0.2 second) Site Coefficient	Table 1613.2.3(1) (1)	1.2 (4)	-
F_v – Long Period (1.0 second) Site Coefficient	Table 1613.2.3(2) (1)	1.47 (4)	-
S_{MS} – MCE_R Spectral Response Acceleration Parameter Adjusted for Site Class Effect (0.2 second)	Equation 16-20 (1)	1.699 (4)	g
S_{M1} - MCE_R Spectral Response Acceleration Parameter Adjusted for Site Class Effect (1.0 second)	Equation 16-21 (1)	0.774 (4)	g
S_{DS} - Design Spectral Response Acceleration at 0.2-s	Equation 16-22 (1)	1.133 (4)	g
S_{D1} - Design Spectral Response Acceleration at 1-s	Equation 16-23 (1)	0.516 (4)	g
$T_o = 0.2\ S_{D1}/\ S_{DS}$	Section 11.4.6 (2)	0.091	s
$T_s = S_{D1}/\ S_{DS}$	Section 11.4.6 (2)	0.455	s
T_L - Long Period Transition Period	Figure 22-14 (2)	8 (4)	s
PGA - Peak Ground Acceleration Maximum Considered Earthquake Geometric Mean, MCE_G (*)	Figure 22-9 (2)	0.5	g
F_{PGA} - Site Coefficient Adjusted for Site Class Effect (2)	Table 11.8-1 (2)	1.2 (4)	-
PGA_M –Peak Ground Acceleration (2) Adjusted for Site Class Effect	Equation 11.8-1 (2)	0.6 (4)	g
Design PGA ≈ (⅔ PGA_M) - Slope Stability (†)	Similar to Eqs. 16-22 & 16-23 (2)	0.799	g
Design PGA ≈ (0.4 S_{DS}) – Short Retaining Walls (‡)	Equation 11.4-5 (2)	0.45	g
C_{RS} - Short Period Risk Coefficient	Figure 22-18A (2)	0.937 (4)	-
C_{R1} - Long Period Risk Coefficient	Figure 22-19A (2)	0.92 (4)	-
SDC - Seismic Design Category (§)	Section 1613.2.5 (1)	D (4)	-

References:
(1) California Building Code (CBC), 2022, California Code of Regulations, Title 24, Part 2, Volume I and II.
(2) American Society of Civil Engineers/Structural Engineering Institute (ASCE/SEI), 2016, Minimum Design Loads and Associated Criteria for Buildings and Other Structures, Standards 7-16.
(3) USGS Unified Hazard Tool - https://earthquake.usgs.gov/hazards/interactive/ [Dynamic: Conterminous U.S. 2014 (update) (v4.2.0)]
(4) SEI/OSHPD Seismic Design Map Application – https://seismicmaps.org [Reference: ASCE 7-16]
Related References:
Federal Emergency Management Agency (FEMA), 2015, NEHERP (National Earthquake Hazards Reduction Program) Recommended Seismic Provision for New Building and Other Structures (FEMA P-1050).

Notes:
* PGA Calculated at the MCE return period of 2475 years (2 percent chance of exceedance in 50 years).
† PGA Calculated at the Design Level of ⅔ of MCE; approximately equivalent to a return period of 475 years (10 percent chance of exceedance in 50 years).
‡ PGA Calculated for short, stubby retaining walls with an infinitesimal (zero) fundamental period.
§ The designation provided herein may be superseded by the structural engineer in accordance with Section 1613.2.5.1, if applicable.

Expansive Soil Conditions

Based on our initial laboratory test, near-surface soils encountered in our test pits are low in expansion potential with moderate plasticity, however medium expansive soils are documented in the general area and could be encountered during grading. Additional sampling and testing should be performed during site grading for determining actual expansion potential of the supporting building pad soils.

General Corrosivity Screening

As a screening level study, limited chemical and electrical tests were performed on samples considered representative of the onsite soils to identify potential corrosive characteristics of these soils. The common indicators associated with soil corrosivity include water-soluble sulfate and chloride levels, pH (a measure of acidity), and minimum electrical resistivity.

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

In general, a soil's water-soluble sulfate levels and pH relate to the potential for concrete degradation; water-soluble chlorides in soils impact ferrous metals embedded or encased in concrete, e.g., reinforcing steel; and electrical resistivity is a measure of a soil's corrosion potential to a variety of buried metals used in the building industry, such as copper tubing and cast or ductile iron pipes. Table 2, below, presents the range of each category of individual test results with an interpretation of current code indicators and guidelines that are commonly used in this industry. The table includes the code-related classifications of the soils as they relate to the various tests, as well as a general recommendation for possible mitigation measures in view of the potential adverse impact on various components of the proposed structures in direct contact with site soils. The guidelines provided herein should be evaluated and confirmed, or modified, in their entirety by the project structural engineer, corrosion engineer and/or the contractor responsible for concrete placement for structural concrete used in exterior and interior footings, interior slabs on-ground, garage slabs, wall foundations and concrete exposed to weather such as driveways, patios, porches, walkways, ramps, steps, curbs, etc.

TABLE 2

Soil Corrosivity Screening Results

Test	Test Results	Classification	General Recommendations
Soluble Sulfates (Cal 417)	0.015 percent	S0[(1)]	No special recommendations
pH (Cal 643)	7.3	Neutral	No special recommendations
Soluble Chloride (Cal 422)	323 ppm	C1[(2)]	Type II cement; min. f'c= 2,500 psi; no water/cement ratio restrictions
Resistivity (Cal 643)	540 ohm-cm	Extremely Corrosive[3]	Consult with professional corrosion engineer

Notes:
1. ACI 318-14, Section 19.3
2. ACI 318-14, Section 19.3
3. Pierre R. Roberge, "Handbook of Corrosion Engineering"

Post-Grading Considerations

Utility Trenches

All utility trench backfill should be compacted to a minimum relative compaction of 90 percent. Trench backfill materials should be free of rock greater than 6-inches in diameter and placed in lifts no greater than approximately 12 inches in thickness, watered or air-dried as necessary to achieve near optimum moisture conditions, and then mechanically compacted in place to a minimum relative compaction of 90 percent. A representative of the project geotechnical consultant should probe and test the backfills to verify adequate compaction.

As an alternative for shallow trenches where pipe or utility lines may be damaged by mechanical compaction equipment, such as under building floor slabs, clean sand having a sand equivalent (SE) value of 30 or greater may be utilized. The sand backfill materials should be watered to achieve near optimum moisture conditions and then tamped into place. No specific relative compaction will be required; however, observation, probing, and if deemed necessary, testing should be performed by a representative of the project geotechnical consultant to verify an adequate degree of compaction.

If clean, imported sand is to be used for backfill of exterior utility trenches, it is recommended that the upper 12 inches of trench backfill materials consist of properly compacted onsite soil materials. This is to mitigate infiltration of irrigation and rainwater into granular trench backfill materials.

Where an exterior and/or interior utility trench is proposed in a direction parallel to a building footing, the bottom of the trench should not extend below a 1:1 (horizontal to vertical) plane projected downward from the bottom edge of the adjacent footing. Where this condition occurs, the adjacent footing should be deepened or the utility constructed and the trench backfilled and compacted prior to footing construction. Where utility trenches cross under a building footing, these trenches should be backfilled with on-site soils at the point where the trench crosses under the footing to reduce the potential for water to migrate under the floor slabs.

Site Drainage

Positive surface drainage systems consisting of a combination of sloped concrete flatwork/asphalt pavement, sheet flow gradients, swales and surface area drains (where needed) should be provided around all buildings and planter areas to collect and direct all surface waters to an appropriate drainage facility as determined by the project civil engineer. The ground surfaces of planter and landscape areas that are located within 10 feet of building foundations should be sloped at a minimum gradient of 5 percent away from the foundations and towards the nearest area drains. The ground surface of planter and landscape areas that are located more than 10 feet away from building foundations may be sloped at a minimum gradient of 2 percent away from the foundations and towards the nearest area drains.

Concrete flatwork surfaces that are located within 10 feet of building foundations should be inclined at a minimum gradient of one percent away from the building foundations and towards the nearest area drains. Concrete flatwork surfaces that are located more than 10 feet away from building foundations may be sloped at a minimum gradient of 1 percent towards the nearest area drains. Surface waters should not be allowed to collect or pond against building foundations and within the level areas of the site. All drainage devices should be properly maintained throughout the lifetime of development. Future changes to site improvements, or planting and watering practices, should not be allowed to cause over-saturation of site soils adjacent to the structures.

Preliminary Pavement Design Recommendations

Flexible Pavement

The final pavement section should be designed once rough grading has occurred and the R-Value of the resulting subgrade can be determined. For the purposes of this preliminary evaluation, we assumed an R-value of 15 based on a similar test value in the development immediately to the east (Krazan, 2004) as well as the clayey soil types in the general area. The following pavement sections have been computed in accordance with Caltrans design procedures and presented in the following table, Table 3. Based upon our experience, the thicker pavement section provided below is recommended due to increased performance and life.

TABLE 3

Preliminary Structural Asphalt Pavement Sections

Location	Preliminary Design R-value	Traffic Index	Pavement Section, in
Auto Parking Spaces	15	4.5	3.5 AC / 5.5 AB
Auto Driveways	15	5.0	4.0 AC / 6.0 AB
Truck Driveways/Parking	15	8.0	6.5 AC / 12.0 AB

Note: AC = Asphalt Concrete AB = Aggregate Base

Final pavement design recommendations should be provided based on sampling and testing at the completion of rough grading and the values of traffic indices that should be provided by the project civil engineer. Subgrade soils should be properly compacted, smooth, and non-yielding prior to pavement construction. The subgrade soils should be compacted to at least 95 percent of ASTM D 1557.

Aggregate base materials should be Crushed Aggregate Base, Crushed Miscellaneous Base, or Processed Miscellaneous Base conforming to Section 200-2 of the Standard Specifications for Public Works Construction (Greenbook). The base materials should be brought to uniform moisture near optimum moisture then compacted to at least 95 percent of the applicable maximum density standard as determined per ASTM D 1557. Asphaltic concrete materials and construction should conform to Section 203 of the Greenbook.

Rigid Pavement

Based on the anticipated low R-value of the site soils, we recommend the pavement section to consist of Portland cement concrete (PCC) underlain by compacted aggregate base in accordance with guideline provided in Table 4 below.

TABLE 4

Preliminary Structural Concrete Pavement Sections

Location	Preliminary Design R-value	Traffic Index	Pavement Section, in
Truck Driveways/Parking/Loading Dock	15	8.0	6 PCC / 10 AB

Note: **PCC = Portland Cement Concrete**
AB = Aggregate Base

Similar to flexible pavement, final rigid pavement design recommendations should be provided based on sampling and testing at the completion of rough grading and the values of traffic indices that should be provided by the project civil engineer.

Aggregate base materials should be Crushed Aggregate Base, Crushed Miscellaneous Base, or Processed Miscellaneous Base conforming to Section 200-2 of the Standard Specifications for Public Works Construction (Greenbook). The base materials should be brought to uniform moisture near optimum moisture then compacted to at least 95 percent of the applicable maximum density standard as determined per ASTM D 1557. subgrade should be graded such that it accommodates placement of 7-inch-thick concrete pavement section. Subgrade compaction shall be no less than 95 percent relative compaction with reference to ASTM D 1557. Prior to placing base, the subgrade soils below the pavement area should be pre-watered to achieve a moisture content that is at least optimum moisture content, but not overly wet. The concrete pavement section should be reinforced with No. 4 bars spaced a maximum of 18 inches on centers (both ways). The reinforcement should be properly positioned near the middle of the slabs. Concrete shall exhibit an unconfined compressive strength of no less than 3,250 psi.

Feasibility Level Infiltration Design

The onsite native soils have notable clay content and are expected to have very poor percolation/infiltration characteristics. In addition, the prior geotechnical consultant also indicated the upper clayey soils are not considered suitable for the infiltration of stormwater (ESS, 2015). For reference, Petra has performed an in-situ Dual Ring Infiltrometer test within the undisturbed older alluvial unit at a nearby site to the west with a result 0.4 inches per hour with no factor of safety applied, further indicating the poor infiltration characteristics of the general area. It is Petra's opinion that the onsite soils, especially shallow native deposits, are generally unsuitable for the infiltration of stormwater.

GRADING AND STRUCTURAL PLAN REVIEWS

This report is based on the existing site conditions and the preliminary development concept. We recommend that our firm be retained to review the grading plans and various structural foundation plans once they become available. Additional recommendations and/or modification of the recommendations provided herein will be provided if necessary, depending on the results of the plan reviews and building types and heights.

If additional or alternative improvements are considered in the future, our firm should be notified so that we may provide design recommendations. It is further recommended that we be engaged to review the final design drawings, specifications and grading plan prior to any new construction. If we are not provided the opportunity to review these documents with respect to the geotechnical aspects of new construction and grading, it should not be assumed that the recommendations provided herein are wholly or in part applicable to the proposed construction.

We recommend that Petra be retained to provide soil-engineering services during excavation, grading, construction and foundation phases of the work. This is to observe compliance with the design, specifications or recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to start of construction.

REPORT LIMITATIONS

This report is based on the project site and our preliminary field explorations, limited laboratory testing and geotechnical analysis. The materials encountered on the project site and utilized in our laboratory evaluation are believed representative of the general area; however, soil and moisture conditions can vary in characteristics between excavations, both laterally and vertically, especially when considering the previous undocumented stockpiling within the site and adjacent use.

The conclusions and opinions contained in this report are based on the results of the described geotechnical evaluations and represent our professional judgment. This report has been prepared consistent with that level of care being provided by other professionals providing similar services at the same locale and in the same time period. The contents of this report are professional opinions and as such, are not to be considered a guaranty or warranty. This report has not been prepared for use by parties or projects other than those named or described herein. This report may not contain sufficient information for other parties or other purposes. In addition, this report should be reviewed and updated after a period of 1 year or if the site ownership or project concept changes from that described herein.

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

Respectfully submitted,

PETRA GEOSCIENCES, INC.

Douglass Johnston
Senior Associate Geologist
CEG 2477

5/26/23

Siamak Jafroudi, PhD
Senior Principal Engineer
GE 2024

DJ/SJ/lv

W:\2020-2025\2022\300\22-367\Reports\22-367 110 Preliminary Geotechnical Evalutation.docx

REFERENCES

Architects Orange, LLP, 2023, Conceptual Mixed Use Master Plan, dated February 2.

California Geologic Survey, 2008, Guidelines for Evaluating and Mitigating Seismic Hazards in California: CGS Special Publication 117A.

California Geological Survey, 2018, Earthquake Fault Zones, A Guide for Government Agencies, Property Owners/Developers, and Geoscience Practitioners for Assessing Fault Rupture Hazards in California, Special Publication 42.

California Geologic Survey, 2023, Earthquake Zones of Required Investigation, accessed April, https://maps.conservation.ca.gov/cgs/EQZApp/app/

California Department of Water Resources, 2023, Water Data Library, accessed April. http://www.water.ca.gov/waterdatalibrary/groundwater/

County of Riverside, 2023, Map My County System, version 10.0, accessed April. https://gis.countyofriverside.us/Html5Viewer/?viewer=MMC_Public

Engineering Association of California (SEAOC) and California's Office of Statewide Health Planning and Development (OSHPD), Seismic Design Maps, with ASCE 7-16 Design Code Reference Document, https://seismicmaps.org/

Earth Systems Southwest, 2015, Preliminary Geotechnical Investigation, Proposed Green Valley Project (±250 Acres, Near Ethanac Road and Murrieta Road and Goetz Road, Perris, Riverside County, California, *prepared for Green Valley Recovery Acquisition LLC,* dated July 15.

Google Earth™ 2023, by Google Earth, Inc., http://www.google.com/earth/index.html, accessed April.

International Building Code, 2022 California Building Code, California Code of Regulations, Title 24, Part 2, Volume 2 of 2, California Building Standards Commission.

Krazan & Associates, Inc., 2004, Geotechnical Engineering Investigation, Proposed Perris Passage Shopping Center, NWC I-215 Freeway and Ethanac Road, Perris, California, *prepared for Cahan Properties,* dated December 7.

Morton, D. M., 2003a, Geologic Map of the Romoland 7.5' Quadrangle, Riverside County, California, Version 1.0, U.S.G.S. Open-File Report 03-102.

______, 2003b, Geologic Map of the Perris 7.5' Quadrangle, Riverside County, California, Version 1.0, U.S.G.S. Open-File Report 03-270.

Petra Geosciences, Inc., 2020, Environmental Impact Report (EIR) Geologic and Geotechnical Assessment, Proposed *Green Valley Specific Plan Phase 1B Area (*Planning Areas 3, 10-14, 19-21, 23, 26, 29-39, 45, 46a and 55-57), 505± Acres North of Ethanac Road between Goetz and Case Roads, City of Perris, Riverside County, California, J.N. 18-106, *prepared for Raintree Investment Corporation,* dated August 27.

REFERENCES

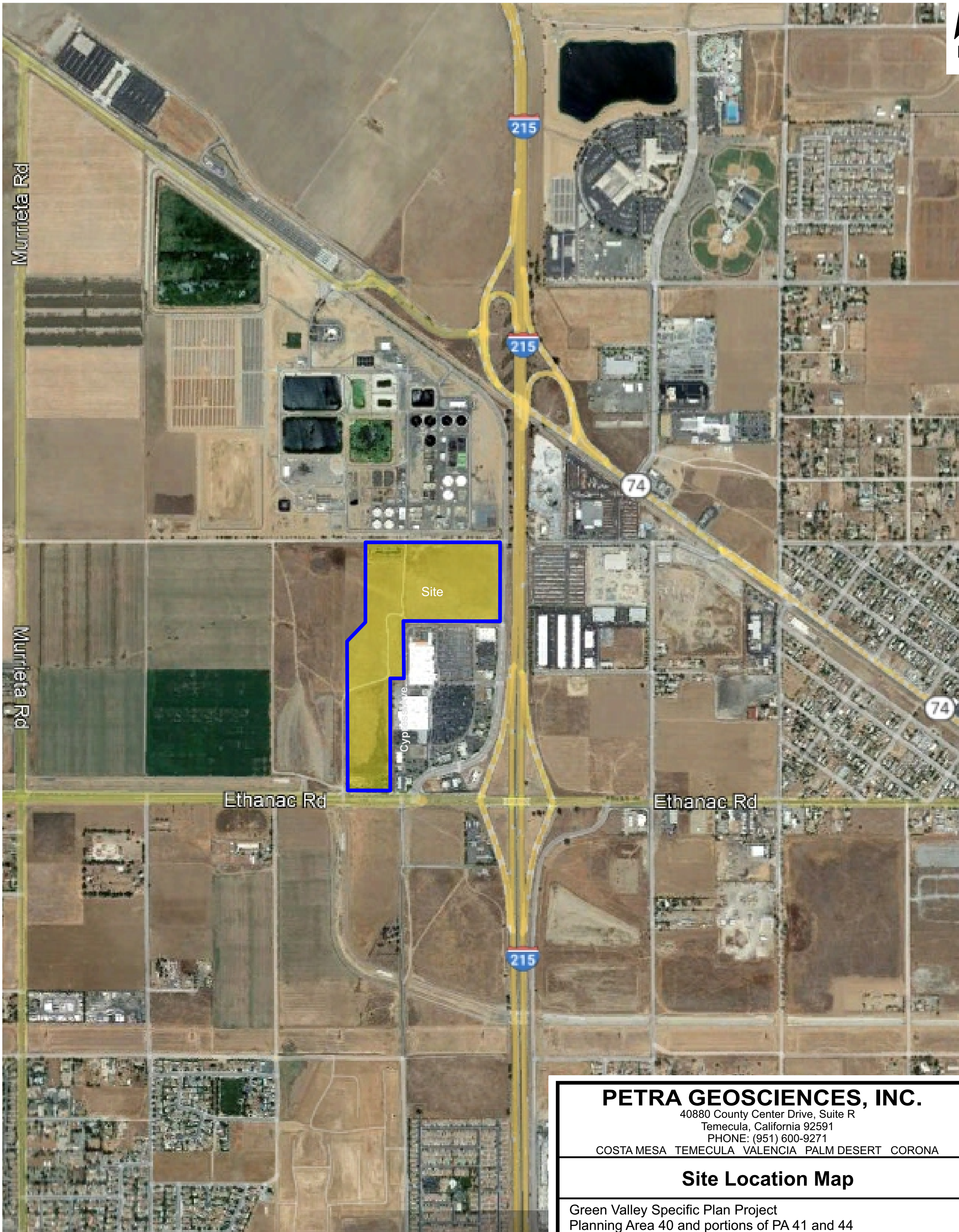
______, 2022, Feasibility/Due-Diligence Desktop Geotechnical Review, *Green Valley Specific Plan Project*, Portions of Planning Areas 40, 41 and 44, Approximately 45-Acres of Vacant Land, Northeast of Ethanac Road at Future Green Valley Parkway, City of Perris, Riverside County, California, J.N. 22-367, *Draft report prepared for Richland Communities,* dated October 23.

SB&O, Inc., 2022, Conceptual Grading Plan, Perris Airport Industrial, 40-scale plans, 3 sheets dated February 6.

Standard Specifications for Public Works Construction (Greenbook), 2021 Edition, BNI Publishers.

UC Santa Barbara Library, 2023, accessed April, http://mil.library.ucsb.edu/ap_indexes/FrameFinder/

FIGURES



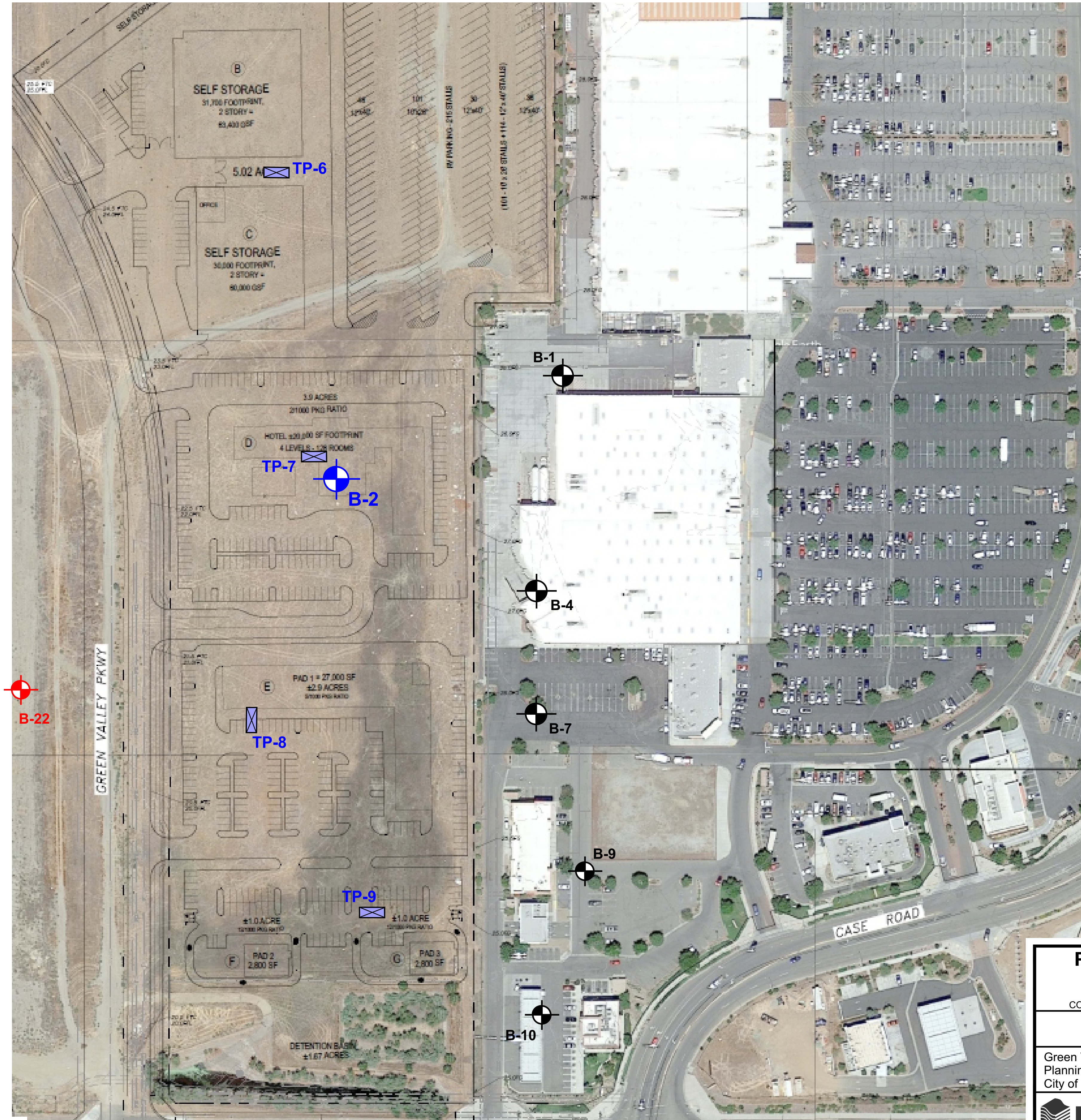
PETRA GEOSCIENCES, INC.
40880 County Center Drive, Suite R
Temecula, California 92591
PHONE: (951) 600-9271
COSTA MESA TEMECULA VALENCIA PALM DESERT CORONA

Site Location Map

Green Valley Specific Plan Project
Planning Area 40 and portions of PA 41 and 44
City of Perris, Riverside County, California

PETRA GEOSCIENCES INC.	DATE: May 2023	Figure 1
	J.N.: 22-367	

Reference: Google Earth, 2021 image



Legend

B-2, TP-9 — Borings/Test Pits by Petra (this study)

B-25 — Borings by Krazan (2004)

B-22 — Explorations by ESSW (2015)

Reference: SB&O, 2023, excerpt from New Base Map

PETRA GEOSCIENCES, INC.
40880 County Center Drive, Suite M
Temecula, California 92591
Phone: (951) 600-9271
COSTA MESA TEMECULA VALENCIA PALM DESERT CORONA

Exploration Location Map

Green Valley Specific Plan Project
Planning Area 40 and portions of PA 41 and 44
City of Perris, Riverside County, California

PETRA GEOSCIENCES INC.

DATE: May 2023

J.N.: 22-367

Figure 2

Reference: SB&O, 2023, excerpt from New Base Map

PETRA GEOSCIENCES, INC.
40880 County Center Drive, Suite M
Temecula, California 92591
Phone: (951) 600-9271
COSTA MESA TEMECULA VALENCIA PALM DESERT CORONA

Exploration Location Map

Green Valley Specific Plan Project
Planning Area 40 and portions of 41 and 44
City of Perris, Riverside County, California

PETRA GEOSCIENCES INC.

DATE: May 2023
J.N.: 22-367

Figure 3

APPENDIX A

EXPLORATION LOGS
(Petra, Krazan and ESSW)

Key to Soil and Bedrock Symbols and Terms

PETRA

Unified Soil Classification System

Major Divisions				Group Symbol	Typical Names
Coarse-grained Soils > 1/2 of materials is larger than #200 sieve	The No. 200 U.S. Standard Sieve is about the smallest particle visible to the naked eye	GRAVELS more than half of coarse fraction is larger than #4 sieve	Clean Gravels (less than 5% fines)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines
				GP	Poorly-graded gravels, gravel-sand mixtures, little or no fines
			Gravels with fines	GM	Silty Gravels, poorly-graded gravel-sand-silt mixtures
				GC	Clayey Gravels, poorly-graded gravel-sand-clay mixtures
		SANDS more than half of coarse fraction is smaller than #4 sieve	Clean Sands (less than 5% fines)	SW	Well-graded sands, gravelly sands, little or no fines
				SP	Poorly-graded sands, gravelly sands, little or no fines
			Sands with fines	SM	Silty Sands, poorly-graded sand-gravel-silt mixtures
				SC	Clayey Sands, poorly-graded sand-gravel-clay mixtures
Fine-grained Soils > 1/2 of materials is smaller than #200 sieve		SILTS & CLAYS Liquid Limit Less Than 50		ML	Inorganic silts & very fine sands, silty or clayey fine sands, clayey silts with slight plasticity
				CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
				OL	Organic silts & clays of low plasticity
		SILTS & CLAYS Liquid Limit Greater Than 50		MH	Inorganic silts, micaceous or diatomaceous fine sand or silt
				CH	Inorganic clays of high plasticity, fat clays
				OH	Organic silts and clays of medium-to-high plasticity
Highly Organic Soils				PT	Peat, humus swamp soils with high organic content

Grain Size

Description		Sieve Size	Grain Size	Approximate Size
Boulders		>12"	>12"	Larger than basketball-sized
Cobbles		3 - 12"	3 - 12"	Fist-sized to basketball-sized
Gravel	coarse	3/4 - 3"	3/4 - 3"	Thumb-sized to fist-sized
	fine	#4 - 3/4"	0.19 - 0.75"	Pea-sized to thumb-sized
Sand	coarse	#10 - #4	0.079 - 0.19"	Rock salt-sized to pea-sized
	medium	#40 - #10	0.017 - 0.079"	Sugar-sized to rock salt-sized
	fine	#200 - #40	0.0029 - 0.017"	Flour-sized to sugar-sized to
Fines		Passing #200	<0.0029"	Flour-sized and smaller

Modifiers

Trace	< 1 %
Few	1 - 5%
Some	5 - 12 %
Numerous	12 - 20 %

Laboratory Test Abbreviations

MAX	Maximum Dry Density	MA	Mechanical (Particle Size) Analysis
EXP	Expansion Potential	AT	Atterberg Limits
SO4	Soluble Sulfate Content	#200	#200 Screen Wash
RES	Resistivity	DSU	Direct Shear (Undisturbed Sample)
pH	Acidity	DSR	Direct Shear (Remolded Sample)
CON	Consolidation	HYD	Hydrometer Analysis
SW	Swell	SE	Sand Equivalent
CL	Chloride Content	OC	Organic Content
RV	R-Value	COMP	Mortar Cylinder Compression

Bedrock Hardness

Soft	Can be crushed and granulated by hand; "soil like" and structureless
Moderately Hard	Can be grooved with fingernails; gouged easily with butter knife; crumbles under light hammer blows
Hard	Cannot break by hand; can be grooved with a sharp knife; breaks with a moderate hammer blow
Very Hard	Sharp knife leaves scratch; chips with repeated hammer blows

Sampler and Symbol Descriptions

Approximate Depth of Groundwater Encountered

Approximate Depth of Standing Groundwater

Modified California Split Spoon Sample

No Recovery in Mod. Calif. Split Spoon Sample

Standard Penetration Test

Shelby Tube Sample

Bulk Sample

No Recovery in SPT Sampler

No Recovery in Shelby Tube

Notes:

Blows Per Foot: Number of blows required to advance sampler 1 foot (unless a lesser distance is specified). Samplers in general were driven into the soil or bedrock at the bottom of the hole with a standard (140 lb.) hammer dropping a standard 30 inches unless noted otherwise in Log Notes. Drive samples collected in bucket auger borings may be obtained by dropping non-standard weight from variable heights. When a SPT sampler is used the blow count conforms to ASTM D-1586

EXPLORATION LOG

Project: **Green Valley**		Boring No.:	**B-1**
Location: **SWC Watson and Case Roads**		Elevation:	**±1421**
Job No.: **22-367**	Client: **Richland**	Date:	**4/24/23**
Drill Method: **8" Hollow Stem Auger**	Driving Weight: **140 lbs / 30 "**	Logged By:	**SS**

Depth (Feet)	Material Description	Blows per 6 in.	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
0	**ARTIFICIAL FILL (af)** Clayey Sand (SC): Brown to light brown, slightly moist, loose, fine- to coarse-grained.	6 7 7			
	Silty Sand (SM): Brown, dry to slightly moist, medium dense, fine- to coarse-grained.				
	ALLUVIUM (Qal) Clayey Sand (SC): Brown, slightly moist, fine- to coarse-grained. medium dense.	5 6 11	15.3	116.1	
5	very dense.	13 18 48	10.2	125.8	CN
	OLDER ALLUVIUM (Qoal) Sandy Clay (CL): Red to brown, dry to slightly moist, hard, fine- to coarse-grained, low plasticity.	15 50/4"	9.3	121.5	
	Red to light brown.	20 31 50/6"	9.7	125.8	
10		18 50/6"	10.4	119.8	
	low to medium plasticity.	15 27 46	16.5	112.3	
15		14 30 34	18.1	106.4	
20	Clayey Sand (SC): Light brown, dry to slightly moist, dense, fine- to coarse-grained.	11 16 20			
25	Silty Clay (CH): Brown to orange, slightly moist, stiff, trace fine to medium sand.	10 10 15			
30	Clayey Silt (ML): Brown to orange, slightly moist, very stiff, trace fine to medium sand.	6 10 18			

PLATE A-1

Petra Geosciences, Inc.

EXPLORATION LOG

Project:	**Green Valley**	Boring No.:	**B-1**
Location:	**SWC Watson and Case Roads**	Elevation:	**±1421**
Job No.: **22-367**	Client: **Richland**	Date:	**4/24/23**
Drill Method: **8" Hollow Stem Auger**	Driving Weight: **140 lbs / 30 "**	Logged By:	**SS**

Depth (Feet)	Lithology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
35		Silty Sand (SM): Light brown to brown, slightly moist, dense, fine- to coarse-grained.		9 12 18					
40		Brown to orange.		8 14 24					
45		Sandy Silt (ML): Brown to orange, slightly moist, very stiff, fine- to medium-grained, some clay.		6 11 15					
50		Silty Sand (SM): Brown to orange, slightly moist, very dense, fine- to coarse-grained.		17 32 38					
		Total Depth = 51.5 No groundwater encountered Boring backfilled with cuttings.							
55									
60									
65									

PLATE A-1

Petra Geosciences, Inc.

EXPLORATION LOG

Project:	**Green Valley**	Boring No.:	**B-2**
Location:	**SWC Watson and Case Roads**	Elevation:	**±1423**
Job No.: **22-367**	Client: **Richland**	Date:	**4/24/23**
Drill Method: **8" Hollow Stem Auger**	Driving Weight: **140 lbs / 30 "**	Logged By:	**SS**

Depth (Feet)	Material Description	Blows per 6 in.	Moisture Content (%)	Dry Density (pcf)	Other Lab Tests
0	**ARTIFICIAL FILL (af)** Silty Sand (SM): Orange to brown, slightly moist, loose, fine- to coarse-grained, trace gravel.				
		4 6 7			
	ALLUVIUM (Qal) Sandy Clay (CL): Light brown to brown, slightly moist, very stiff, fine- to coarse-grained.				
		7 7 26	10.2	126.3	
5	**OLDER ALLUVIUM (Qoal)** Clayey Sand (SC): Brown to dark brown, slightly moist, dense, fine- to coarse-grained, no to low plasticity.	33 50/4"	12.8	118.9	CN
		25 50/6"	10.6	120.5	
10		16 25 40	13.1	117.8	
	Brown to red, dense, trace gravel.	17 15 31	9.9	123.1	
	Brown to light brown, very dense.	12 25 50/5"	8.7	125.4	
15	Sandy Clay (CL): Orange to brown, slightly moist, hard, fine- to coarse-grained, trace gravel.	14 21 38	18.1	99.5	
20	Clayey Silt with Sand (ML): Orange to brown, slightly moist, very stiff.	5 15 21			
25		6 12 20			
	Clayey Sand (SC): Light brown to brown, slightly moist, medium dense, fine- to coarse-grained, trace gravel.				
30	Silty Sand (SM): Light brown to brown, slightly moist, dense, fine- to coarse-grained.	16 21 21			

PLATE A-2

Petra Geosciences, Inc.

EXPLORATION LOG

Project:	Green Valley		Boring No.:	B-2
Location:	SWC Watson and Case Roads		Elevation:	±1423
Job No.:	22-367	Client: Richland	Date:	4/24/23
Drill Method:	8" Hollow Stem Auger	Driving Weight: 140 lbs / 30 "	Logged By:	SS

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
35		Clayey Sand (SC): Light brown to brown, slightly moist, dense, fine- to coarse-grained.		17 17 22					
40		Silty Sand with Clay (SM): Orange to brown, slightly moist, dense, fine- to coarse-grained.		12 17 25					
45		Clayey Sand with Silt (SC): Light brown to orange, slightly moist, very dense, fine- to coarse-grained.		19 18 38					
50		Silty Sand (SM): Brown to orange, slightly moist, very dense, fine- to coarse-grained, trace clay.		13 25 50/6"					
		Total Depth = 51.5 No groundwater encountered Boring backfilled with cuttings.							
55									
60									
65									

PLATE A-2

Petra Geosciences, Inc.

EXPLORATION LOG

Project:	**Green Valley**	Boring No.:	**TP-1**
Location:	**SWC Watson and Case Roads**	Elevation:	**±1423**
Job No.: **22-367**	Client: **Richland**	Date:	**5/2/23**
Drill Method: **Backhoe**	Driving Weight: **N/A**	Logged By:	**SS**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ARTIFICIAL FILL (af)** Silty Sand (SM): Light brown to brown, dry to slightly moist, loose, fine- to coarse-grained, few gravel. Compacted Gravel (GW): very dense.				■	6.1		#200
		ALLUVIUM (Qal) Clayey Sand (SC): Brown to dark brown, slightly moist, medium dense, fine- to coarse-grained, low plasticity.							
5		**OLDER ALLUVIUM (Qoal)** Clayey Sand/Sandy Clay (SC/CL): Dark brown, slightly moist, dense to very stiff, fine- to coarse-grained, low plasticity.							
		Total Depth = 8' No groundwater encountered No caving Trench backfilled with cuttings.							
10									
15									
20									
25									
30									

PLATE A-3

EXPLORATION LOG

Project:	**Green Valley**	Boring No.:	**TP-2**
Location:	**SWC Watson and Case Roads**	Elevation:	**±1423**
Job No.: **22-367**	Client: **Richland**	Date:	**5/2/23**
Drill Method: **Backhoe**	Driving Weight: **N/A**	Logged By:	**SS**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ARTIFICIAL FILL (af)** Silty Sand (SM): Brown to light brown, dry to slightly moist, loose, fine- to coarse-grained, trace gravel.							
		ALLUVIUM (Qal) Clayey Sand (SC): Brown to dark brown, slightly moist, medium dense, fine- to coarse-grained, no to low plasticity. few gravel.							
5									
		OLDER ALLUVIUM (Qoal) Clayey Sand/Sandy Clay (SC/CL): Dark brown, slightly moist, dense to very stiff, fine- to coarse-grained, low plasticity.				■	8.2		#200
		Total Depth = 8' No groundwater encountered No caving Trench backfilled with cuttings.							
10									
15									
20									
25									
30									

PLATE A-4

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Green Valley**			Boring No.: **TP-3**
Location: **SWC Watson and Case Roads**			Elevation: **±1423**
Job No.: **22-367**	Client: **Richland**		Date: **5/2/23**
Drill Method: **Backhoe**	Driving Weight: **N/A**		Logged By: **SS**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ARTIFICIAL FILL (af)** Silty Sand (SM): Light brown to brown, dry to slightly moist, loose, fine- to coarse-grained.							
		Clayey Sand (SC): Light brown to brown, dry to slightly moist, loose, fine- to coarse-grained.							
		ALLUVIUM (Qal) Clayey Sand (SC): Brown, slightly moist, medium dense, fine- to coarse-grained.							
5		Total Depth = 4' No groundwater encountered No caving Trench backfilled with cuttings.							
10									
15									
20									
25									
30									

PLATE A-5

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Green Valley**		Boring No.:	**TP-4**
Location: **SWC Watson and Case Roads**		Elevation:	**±1424**
Job No.: **22-367**	Client: **Richland**	Date:	**5/2/23**
Drill Method: **Backhoe**	Driving Weight: **N/A**	Logged By:	**SS**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ARTIFICIAL FILL (af)** Silty Sand (SM): Light brown to brown, dry to slightly moist, loose, fine- to coarse-grained. Clayey Sand (SC): Brown, dry to slightly moist, medium dense, fine- to coarse-grained, with gravel. slightly moist.							
5		**ALLUVIUM (Qal)** Clayey Sand (SC): Brown to dark brown, slightly moist, medium dense, fine- to coarse-grained, low plasticity.							
		OLDER ALLUVIUM (Qoal) Clayey Sand/Sandy Clay (SC/CL): Dark brown, slightly moist, dense to stiff, fine- to coarse-grained, low plasticity.				■	5.8		#200, EI
10		Total Depth = 8' No groundwater encountered No caving Trench backfilled with cuttings.							
15									
20									
25									
30									

PLATE A-6

EXPLORATION LOG

Project: **Green Valley**			Boring No.: **TP-5**
Location: **SWC Watson and Case Roads**			Elevation: **±1427**
Job No.: **22-367**	Client: **Richland**		Date: **5/2/23**
Drill Method: **Backhoe**	Driving Weight: **N/A**		Logged By: **SS**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ARTIFICIAL FILL (af)** Silty Sand (SM): Light brown to brown, dry, loose, fine- to coarse-grained. Clayey Sand (SC): Brown, dry to slightly moist, medium dense, fine- to coarse-grained, with gravel. Brown to dark brown, slightly moist.							
5		**ALLUVIUM (Qal)** Clayey Sand (SC): Brown to dark brown, slightly moist, medium dense, fine- to coarse-grained.							
		OLDER ALLUVIUM (Qoal) Clayey Sand/Sandy Clay (SC/CL): Dark brown, slightly moist, medium dense, fine- to coarse-grained.							
10		Total Depth = 10' No groundwater encountered No caving Trench backfilled with cuttings.							
15									
20									
25									
30									

PLATE A-7

Petra Geosciences, Inc.

EXPLORATION LOG

Project:	**Green Valley**	Boring No.:	**TP-6**
Location:	**SWC Watson and Case Roads**	Elevation:	**±1421**
Job No.:	**22-367**	Client: **Richland**	Date: **5/2/23**
Drill Method:	**Backhoe**	Driving Weight: **N/A**	Logged By: **SS**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ARTIFICIAL FILL (af)** Silty Sand (SM): Light brown to brown, dry, loose, fine- to coarse-grained.							
		ALLUVIUM (Qal) Clayey Sand (SC): Brown, slightly moist, medium dense, fine- to coarse-grained.							
5		**OLDER ALLUVIUM (Qoal)** Clayey Sand (SC): Dark brown, slightly moist, medium dense, fine- to coarse-grained.				■	7.8		#200
10		Total Depth = 8.5' No groundwater encountered No caving Trench backfilled with cuttings.							
15									
20									
25									
30									

PLATE A-8

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Green Valley**		Boring No.:	**TP-7**
Location: **SWC Watson and Case Roads**		Elevation:	**±1423**
Job No.: **22-367**	Client: **Richland**	Date:	**5/2/23**
Drill Method: **Backhoe**	Driving Weight: **N/A**	Logged By:	**SS**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ARTIFICIAL FILL (af)** Silty Sand (SM): Light brown to brown, dry, loose, fine- to coarse-grained, some gravel.							
		ALLUVIUM (Qal) Sandy Clay (CL): Brown, slightly moist, stiff, fine- to coarse-grained. Brown to red, low plasticity.				■	8.7		#200, EI, Chem, A.L.
5		Total Depth = 4' No groundwater encountered No caving Trench backfilled with cuttings.							
10									
15									
20									
25									
30									

PLATE A-9

Petra Geosciences, Inc.

EXPLORATION LOG

Project:	Green Valley	Boring No.:	TP-8
Location:	SWC Watson and Case Roads	Elevation:	±1424
Job No.:	22-367 Client: Richland	Date:	5/2/23
Drill Method:	Backhoe Driving Weight: N/A	Logged By:	SS

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ARTIFICIAL FILL (Af)** Gravelly Silty Sand (SM): Light brown, dry, loose, fine- to coarse-grained. Light brown to gray, trace gravel to small cobbles.							
		ALLUVIUM (Qal) Clayey Sand (SC): Brown to dark brown, slightly moist, medium dense, fine- to coarse-grained.							
5		**OLDER ALLUVIUM (Qoal)** Clayey Sand (SC): Dark brown to orange, slightly moist, medium dense, fine- to coarse-grained.							
		Total Depth = 8.5' No groundwater encountered No caving Trench backfilled with cuttings.							
10									
15									
20									
25									
30									

PLATE A-10

Petra Geosciences, Inc.

EXPLORATION LOG

Project: **Green Valley**		Boring No.:	**TP-9**
Location: **SWC Watson and Case Roads**		Elevation:	**±1422**
Job No.: **22-367**	Client: **Richland**	Date:	**5/2/23**
Drill Method: **Backhoe**	Driving Weight: **N/A**	Logged By:	**SS**

Depth (Feet)	Lith-ology	Material Description	WATER	Samples: Blows per 6 in.	Samples: Core	Samples: Bulk	Laboratory Tests: Moisture Content (%)	Laboratory Tests: Dry Density (pcf)	Laboratory Tests: Other Lab Tests
0		**ARTIFICIAL FILL (af)** Silty Sand (SM): Brown to light brown, dry, loose, fine- to coarse-grained, trace gravel.							
		ALLUVIUM (Qal) Clayey Sand (SC): Brown to dark brown, slightly moist, very dense, fine- to coarse-grained.							
5		**OLDER ALLUVIUM (Qoal)** Clayey Sand (SC): Dark brown to orange, slightly moist, very dense, fine- to coarse-grained.							
10		Total Depth = 9' No groundwater encountered No caving Trench backfilled with cuttings.							
15									
20									
25									
30									

PLATE A-11

Log of Boring B - 1

Project: Perris Passage Shopping Center **Project No.** 1 1 2 0 4 0 7 0
Client: Cahan Properties
Location NWC Ethanac Road & Case Road **Logged By:** S.K.
Depth of Water> **Initial:** **At Completion:**

SUBSURFACE PROFILE				SAMPLE					
Depth (ft)	Symbol	USCS	GEOTECHNICAL DESCRIPTION	Dry Density (pcf)	Moisture (%)	Type	Recovery	Blows/Foot	Water Level
		SM	SILTY SAND, light brown, moist, very dense, fine to medium grained	124.7	9.6	MCS		73/11"	
5			Same as above, with trace of clay	123.0	10.6	MCS		74/6"	
10		SM/ ML	SILTY SAND/SANDY SILT, light brown, moist, very dense, fine to medium grained	122.7	13.1	MCS		72	
15		ML	SANDY SILT, light brown, moist, hard, fine grained, with clay	104.3	22.8	MCS		50/8"	
20			Total Depth = 20' No groundwater encountered during drilling Hole backfilled with soil cuttings and tamped 11-8-04						
25									

Krazan & Associates, Inc.

Drill Rig: CME 55 Drill Date: 8-Nov-04
Drill Method: Hollow Stem Hole Size: 8"
Driller: Williams Drilling Sheet: 1 of 1

Log of Boring B - 4

Project: Perris Passage Shopping Center — **Project No.** 11204070
Client: Cahan Properties
Location NWC Ethanac Road & Case Road — **Logged By:** S.K.
Depth of Water> — **Initial:** — **At Completion:**

Depth (ft)	USCS	GEOTECHNICAL DESCRIPTION (SUBSURFACE PROFILE)	Dry Density (pcf)	Moisture (%)	Type	Blows/Foot	Water Level
~2.5	SM	SILTY SAND, yellowish brown, moist, very dense, fine to medium grained, with trace of clay	117.2	12.5	MCS	75/11"	
5		Same as above	118.4	9.6	MCS	74/6"	
10	SM ML	SILTY SAND/SANDY SILT, yellowish brown, moist, very dense, fine to medium grained, with clay	115.0	16.1	MCS	100/10"	
15	ML	SANDY SILT, light brown, very moist, hard, with little clay	97.3	25.7	MCS	82/10"	
20		Total Depth = 20' No groundwater encountered during drilling Hole backfilled with soil cuttings and tamped 11-8-04					

Krazan & Associates, Inc.

Drill Rig:	CME 55	Drill Date:	8-Nov-04
Drill Method:	Hollow Stem	Hole Size:	8"
Driller:	Williams Drilling	Sheet:	1 of 1

Log of Boring B - 7

Project: Perris Passage Shopping Center — **Project No.** 1 1 2 0 4 0 7 0
Client: Cahan Properties
Location NWC Ethanac Road & Case Road — **Logged By:** S.K.
Depth of Water> — **Initial:** — **At Completion:**

Depth (ft)	Symbol	USCS	GEOTECHNICAL DESCRIPTION	Dry Density (pcf)	Moisture (%)	Type	Recovery	Blows/Foot	Water Level
		SM	SILTY SAND, reddish brown, moist, very dense, fine to medium grained, with trace of clay	114.4	8.4	MCS		75/10"	
5			Same as above	118.6	8.4	MCS		75/10"	
10			Same as above	117.1	11.0	MCS		81/10"	
15		ML	SANDY SILT, light brown, very moist, hard, with clay	91.9	30.6	MCS		50/9"	
20			Total Depth = 20' No groundwater encountered during drilling Hole backfilled with soil cuttings and tamped 11-8-04						
25									

Krazan & Associates, Inc.

Drill Rig: CME 55 — Drill Date: 8-Nov-04
Drill Method: Hollow Stem — Hole Size: 8"
Driller: Williams Drilling — Sheet: 1 of 1

Log of Boring B - 9

Project:	Perris Passage Shopping Center	**Project No.**	1 1 2 0 4 0 7 0
Client:	Cahan Properties		
Location	NWC Ethanac Road & Case Road	**Logged By:**	S.K.
Depth of Water>	**Initial:**	**At Completion:**	

SUBSURFACE PROFILE				SAMPLE					
Depth (ft)	Symbol	USCS	**GEOTECHNICAL DESCRIPTION**	Dry Density (pcf)	Moisture (%)	Type	Recovery	Blows/Foot	Water Level
0			0-5': Fill?						
		SM	SILTY SAND, mottled brown, damp, loose, fine to medium grained, with rootlets and minor organics, trace clay	104.3	5.8	MCS	■	7	
5			SILTY SAND, mottled brown, moist, medium dense	120.8	10.0	MCS	■	34	
10			Total Depth = 10' No groundwater encountered during drilling Hole backfilled with soil cuttings and tamped 11-8-04						
15									
20									
25									

Krazan & Associates, Inc.

Drill Rig:	CME 55	Drill Date:	8-Nov-04
Drill Method:	Hollow Stem	Hole Size:	8"
Driller:	Williams Drilling	Sheet:	1 of 1

Log of Boring B - 10

Project:	Perris Passage Shopping Center	**Project No.**	1 1 2 0 4 0 7 0
Client:	Cahan Properties		
Location	NWC Ethanac Road & Case Road	**Logged By:**	S.K.
Depth of Water>	**Initial:**	**At Completion:**	

Depth (ft)	Symbol	USCS	GEOTECHNICAL DESCRIPTION	Dry Density (pcf)	Moisture (%)	Type	Recovery	Blows/Foot	Water Level
			0-10': Fill?						
		SM	SILTY SAND, yellowish brown, moist, loose, fine to medium grained, with wood fragments and small roots, trace of clay	102.5	5.0	MCS		5	
5			Same as above	106.7	6.3	MCS		6	
10		SM ML	SILTY SAND/SANDY SILT, yellowish brown, moist, very dense, fine to medium grained, with clay	117.6	13.6	MCS		77/11"	
15		ML	SANDY SILT, reddish brown, moist, hard, with little clay	98.6	21.9	MCS		71/11"	
20			Total Depth = 20' No groundwater encountered during drilling Hole backfilled with soil cuttings and tamped 11-8-04						
25									

Krazan & Associates, Inc.

Drill Rig:	CME 55	Drill Date:	8-Nov-04
Drill Method:	Hollow Stem	Hole Size:	8"
Driller:	Williams Drilling	Sheet:	1 of 1

Log of Boring B - 24

Project: Perris Passage Shopping Center — **Project No.** 1 1 2 0 4 0 7 0
Client: Cahan Properties
Location NWC Ethanac Road & Case Road — **Logged By:** S.K.
Depth of Water> **Initial:** **At Completion:**

Depth (ft)	Symbol	USCS	GEOTECHNICAL DESCRIPTION	Dry Density (pcf)	Moisture (%)	Type	Recovery	Blows/Foot	Water Level
		SM	SILTY SAND, reddish brown, moist, very dense, fine to medium grained, with trace of clay	116.3	14.9	MCS		75/9"	
5			Same as above	124.6	9.6	MCS		91/8"	
10			Same as above, with trace of gravel	106.0	16.1	MCS		73/11"	
15		ML	SANDY SILT, dark brown, moist, hard, fine grained, with trace of clay	104.2	20.8	MCS		50/8"	
20			Total Depth = 20' No groundwater encountered during drilling Hole backfilled with soil cuttings and tamped 11-9-04						
25									

Krazan & Associates, Inc.

Drill Rig: CME 55 — **Drill Date:** 9-Nov-04
Drill Method: Hollow Stem — **Hole Size:** 8"
Driller: Williams Drilling — **Sheet:** 1 of 1

Log of Boring B - 25

Project: Perris Passage Shopping Center — **Project No.** 1 1 2 0 4 0 7 0
Client: Cahan Properties
Location NWC Ethanac Road & Case Road — **Logged By:** S.K.
Depth of Water> **Initial:** **At Completion:**

Depth (ft)	Symbol	USCS	GEOTECHNICAL DESCRIPTION	Dry Density (pcf)	Moisture (%)	Type	Recovery	Blows/Foot	Water Level
		SM	SILTY SAND, reddish brown, moist, very dense, fine to medium grained, with trace of clay	112.4	16.1	MCS		74/9"	
5			Same as above, with less clay	121.5	13.1	MCS		50/8"	
10			Same as above, with more clay	120.8	13.8	MCS		72	
15			Same as above, with less clay, becomes coarse @ 15'	112.9	15.1	MCS		72/9"	
20			Total Depth = 20' No groundwater encountered during drilling Hole backfilled with soil cuttings and tamped 11-9-04						
25									

Krazan & Associates, Inc.

Drill Rig: CME 55 — Drill Date: 9-Nov-04
Drill Method: Hollow Stem — Hole Size: 8"
Driller: Williams Drilling — Sheet: 1 of 1

Earth Systems
Southwest

1680 Illinois Ave., Perris, CA 92571
Phone (951) 928-9799, Fax (951) 928-9948

Boring No: B-19
File Name Green Valley Project
Project Number: 50378-01
Boring Location: See Plate 2

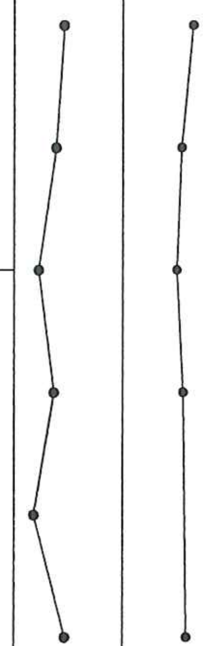
Drilling Date: May 6, 2015
Drilling Method: 8" HSA w/auto hammer
Drill Type: Mobile B-61
Logged By: R. Reed

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Depth (Ft.)	Sample Type (Bulk / SPT / MOD Calif.)	Penetration Resistance (Blows/6")	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0			ML			SANDY SILT: orangish brown, very stiff, moist, fine grained sand
5	MOD Calif.	12,26,43		123	12	near saturated
10	MOD Calif.	18,23,35		116	15	near saturated
15	MOD Calif.	10,17,17	SM	113	4	SILTY SAND: orangish brown, dense, moist, fine to coarse grained sand
20	MOD Calif.	15,20,35		117	9	fine grained sand
25	SPT	8,10,17				fine to medium grained sand, some clay
30	MOD Calif.	16,26,44		119	12	no clay
35						
40						
45						
50						
55						Boring completed at 31-1/2 feet No groundwater encountered Potential perched water conditions Backfilled with native cuttings
60						

Graphic Trend: Blow Count, Dry Density



Earth Systems
Southwest

1680 Illinois Ave., Perris, CA 92571
Phone (951) 928-9799, Fax (951) 928-9948

Boring No: B-22

Project Name Green Valley Project
Project Number: 50378-01
Boring Location: See Plate 2

Drilling Date: May 6, 2015
Drilling Method: 8" HSA w/auto hammer
Drill Type: Mobile B-61
Logged By: R. Reed

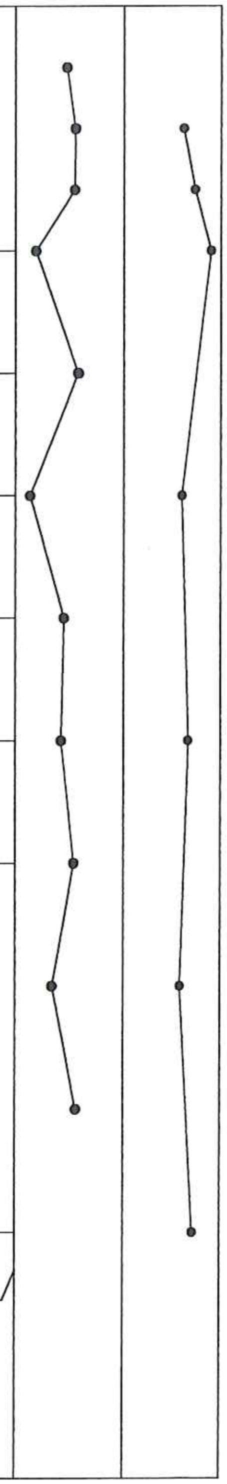
Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Depth (Ft.)	Sample Type (Bulk / SPT / MOD Calif.)	Penetration Resistance (Blows/6")	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units
0	Bulk		SM			SILTY SAND: brown, dense, dry, fine grained sand
2.5	MOD Calif.	8,21,50/6"				
5	MOD Calif.	23,50/4"		117	8	moist
7.5	MOD Calif.	16,23,50		124	8	
10	MOD Calif.	19,38,44	SM	134	2	SILTY SAND: orangish brown, dense, damp, fine grained sand
15	SPT	13,13,15	SM/ML			SILTY SAND TO SANDY SILT: orangish brown, dense, moist, fine grained sand
20	MOD Calif.	17,38,44	SP-SM	116	5	POORLY GRADED SAND WITH SILT: orangish brown, very dense, moist, fine to medium grained sand
25	SPT	9,9,11	SP-SM			POORLY GRADED SAND WITH SILT: orangish brown, medium dense, moist, fine to medium grained sand
30	MOD Calif.	17,50/6"	SC	120	9	CLAYEY SAND: dark brown, very dense, moist, fine to medium grained sand
35	SPT	19,27,36	SP-SM			POORLY GRADED SAND AND SILT: grayish orange, very dense, moist, fine to medium grained sand
40	MOD Calif.	31,50/5"		115	4	
45	SPT	18,23,28				orangish brown, fine to coarse grained sand
50	MOD Calif.	34,50/1"	SC	123	12	CLAYEY SAND: brown, very dense, moist, fine to medium grained sand

Boring completed at 51-1/2 feet
No groundwater encountered
Backfilled with native cuttings

Graphic Trend (Blow Count, Dry Density)



Earth Systems Southwest

1680 Illinois Ave., Perris, CA 92571
Phone (951) 928-9799, Fax (951) 928-9948

Boring No: TP-12	Drilling Date: May 12, 2015
Project Name Proposed Green Valley Project	Drilling Method: Backhoe
Project Number: 50378-01	Drill Type: 24" Bucket
Boring Location: See Plate 2	Logged By: R. Reed

Description of Units

Note: The stratification lines shown represent the approximate boundary between soil and/or rock types and the transition may be gradational.

Depth (Ft.)	Sample Type: Bulk	SPT	MOD Calif.	Penetration Resistance (Blows/6")	Symbol	USCS	Dry Density (pcf)	Moisture Content (%)	Description of Units	Graphic Trend: Blow Count	Dry Density
0						ML			SANDY SILT WITH CLAY: light brown, moist, fine grained sand, upper 4 inches farm till with organics		
							105	13			
5							116	11			
10											
15											
20											
25									Test Pit completed at 5 feet		
									No groundwater encountered		
									Backfilled with native cuttings		
30									Moisture/Density per ASTM D 6938-10		

APPENDIX B

LABORATORY TEST PROCEDURES

LABORATORY DATA SUMMARY

LABORATORY TEST PROCEDURES

Soil Classification

Soils encountered within the exploration borings were initially classified in the field in general accordance with the visual-manual procedures of the Unified Soil Classification System (ASTM D 2488). The samples were re-examined in the laboratory and the classifications revised if appropriate. The assigned group symbols are presented on the exploration logs, Appendix A.

In-Situ Moisture and Density

Moisture content and dry density of the in place soils were determined in representative strata in the borings in accordance with test method ASTM D 2216. Test data are presented in the boring and test pit logs, Appendix A.

Expansion Index

An expansion index test was performed on a selected sample of soil in accordance with ASTM D 4829. The expansion potential classification was determined from 2022 CBC Section 1802.3.2 on the basis of the expansion index value. The test result and expansion potentials are presented on Plate B-1.

Grain-Size Analysis

Grain-size analyses were performed on selected samples to verify visual classifications performed in the field. These tests were performed in accordance with ASTM D 422 or 1140. Test results are presented on Plate B-1.

Atterberg Limits

Atterberg limit tests (Liquid Limit, Plastic Limit and Plasticity Index) were performed on selected samples to verify visual classifications. These tests were performed in accordance with ASTM D 4318. Test results are presented on Plate B-1.

Soil Corrosivity

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

Consolidation

Volume change (settlement or heave) characteristics of select undisturbed soils were determined by one-dimensional consolidation tests. These tests were performed in general accordance with the latest version of the Test Method ASTM D 2435. Additionally, heave or hydro-consolidation tests were performed in general accordance with the latest version of Test Method ASTM D 4546, or ASTM D 5333 respectively. Axial loads were applied in several increments to laterally restrained 1-inch-high samples. The resulting deformations were recorded at selected time intervals. The test samples were inundated at the approximate in-situ and/or anticipated design overburden pressure in order to evaluate the effect of an increase in moisture content, e.g., hydro-consolidation potential or heave. Results of these tests are graphically presented on Plate B-2 and B-3.

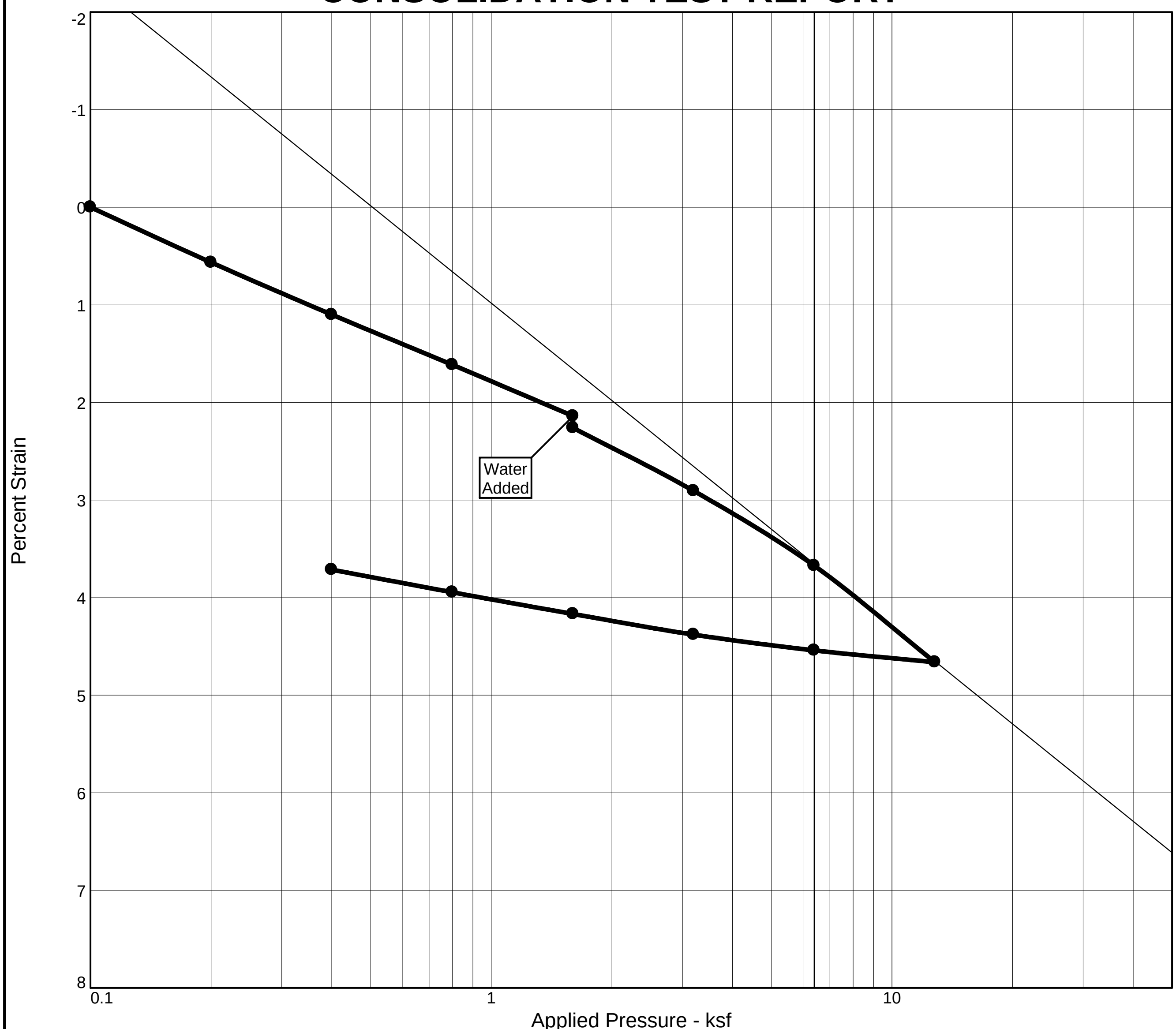
LABORATORY DATA SUMMARY																
Test Pit Number	Sample Depth (ft.)	Soil Description[1]	Compaction[2]		Expansion[3]		Atterberg Limits[4]			Corrosivity Screening				Percent Passing No. 200 Sieve[8]	Percent Fine Clay[8] (%)
			Maximum Dry Unit Weight (pcf)	Optimum Moisture (%)	Index	Potential	LL	PL	PI	Soluble Sulfate Content[5] (%)	Chloride Content[6] (ppm)	pH[7] (Acidity)	Minimum Resistivity[7] (Ohm-cm)		
TP-1	2-3	Clayey Sand	--	--	--	--	--	--	--	--	--	--	--	32.6	--
TP-2	7-8	Clayey Sand/Sandy Clsy	--	--	--	--	--	--	--	--	--	--	--	44.7	--
TP-4	7-8	Clayey Sand/Sandy Clay	--	--	24	Low	--	--	--	--	--	--	--	46.5	--
TP-6	5-6	Clayey Sand	--	--	--	--	--	--	--	--	--	--	--	34.4	--
TP-7	3-4	Sandy Clay	--	--	28	Low	34	20	14	0.015	323	7.3	540	60.3	--

(--) Tests Not Performed

Test Procedures:

[1] Per Test Method ASTM D 2488
[2] Per Test Method ASTM D 1557
[3] Per Test Method ASTM D 4829
[4] Per Test Method ASTM D 4318
[5] Per California Test Method CTM 417
[6] Per California Test Method CTM 422
[7] Per California Test Method CTM 643
[8] Per Test Method ASTM C 117

CONSOLIDATION TEST REPORT



Natural Saturation	Natural Moisture	Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (ksf)	P_c (ksf)	C_c	C_r	Initial Void Ratio
85.9 %	10.2 %	125.9			2.65		6.5	0.04	0.01	0.314

MATERIAL DESCRIPTION	USCS	AASHTO
Brown Silty Fine to Coarse Sand		

Project No. **Client:**

Project:

Source of Sample: 23L089 **Depth:** 5 **Sample Number:** B-1

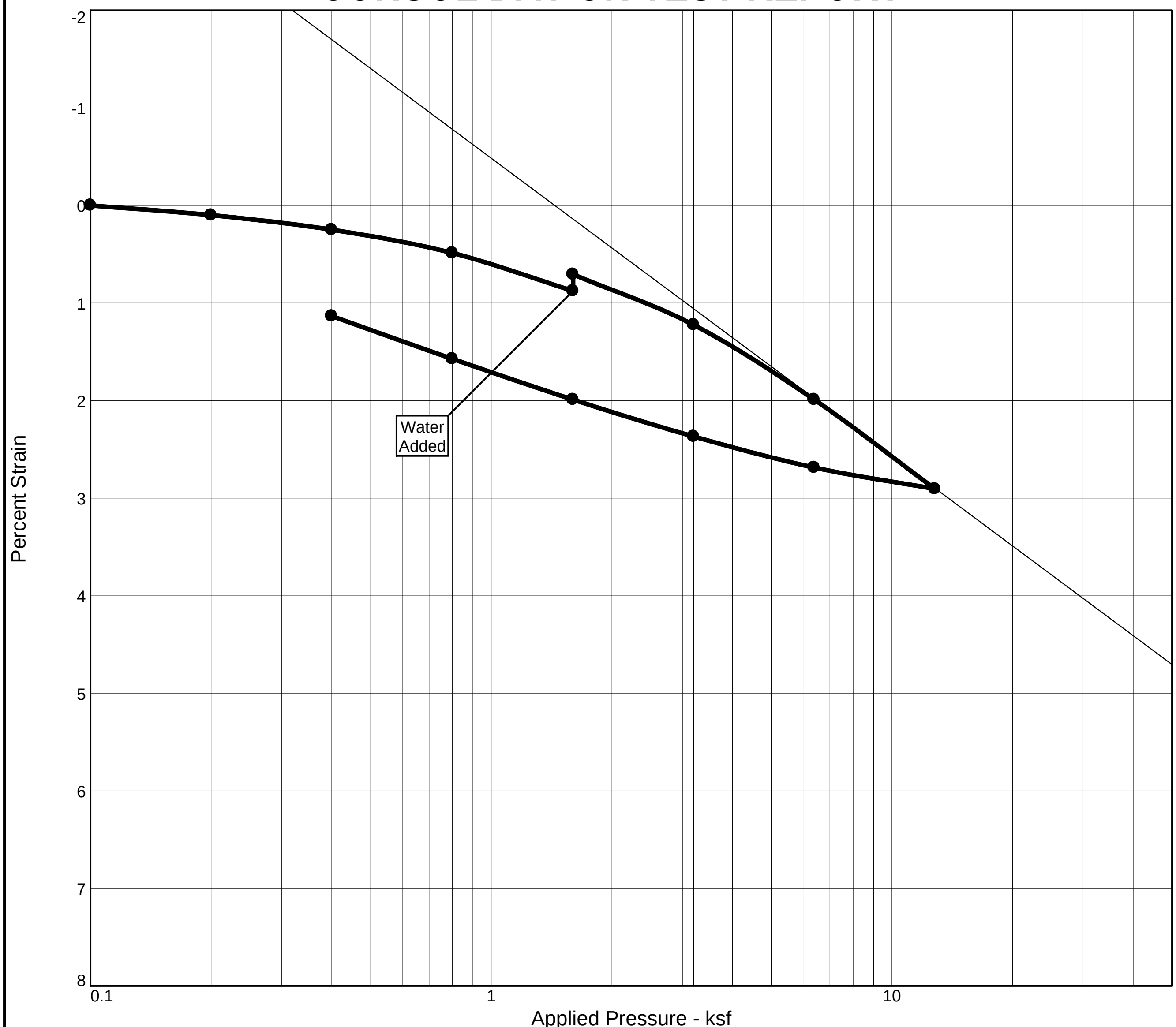
PETRA GEOSCIENCES INC.

Remarks:

Figure B-2

Tested By: DI

CONSOLIDATION TEST REPORT



Natural Saturation	Natural Moisture	Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (ksf)	P_c (ksf)	C_c	C_r	Initial Void Ratio
80.5 %	12.8 %	116.5			2.65		3.9	0.04	0.02	0.420

MATERIAL DESCRIPTION	USCS	AASHTO
Brown Silty Fine to Coarse Sand with Clay		

Project No. **Client:**

Project:

Source of Sample: 23L089 **Depth:** 5 **Sample Number:** B-2

PETRA GEOSCIENCES INC.

Remarks:

Figure B-3

Tested By: DI

APPENDIX C

STANDARD GRADING SPECIFICATIONS

STANDARD GRADING SPECIFICATIONS

These specifications present the usual and minimum requirements for projects on which Petra Geosciences, Inc. (Petra) is the geotechnical consultant. No deviation from these specifications will be allowed, except where specifically superseded in the preliminary geology and soils report, or in other written communication signed by the Soils Engineer and Engineering Geologist of record (Geotechnical Consultant).

I. GENERAL

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

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

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

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

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

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

II. SITE PREPARATION

A. Clearing and Grubbing

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

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

III. FILL AREA PREPARATION

A. Remedial Removals/Overexcavations

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

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

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

B. Evaluation/Acceptance of Fill Areas

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

C. Processing

After the ground surface to receive fill has been declared satisfactory for support of fill by the Geotechnical Consultant, it shall be scarified to a minimum depth of 6 inches and until the ground surface is uniform and free from ruts, hollows, hummocks, or other uneven features which may prevent uniform compaction.

The scarified ground surface shall then be brought to optimum moisture, mixed as required, and compacted to a minimum relative compaction of 90 percent.

D. Subdrains

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

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

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

IV. COMPACTED FILL MATERIAL

A. General

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

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

B. Oversize Materials

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

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

C. Laboratory Testing

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

D. Import

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

V. FILL PLACEMENT AND COMPACTION

A. Fill Layers

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

B. Moisture Conditioning

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

C. Compaction

Each layer shall be compacted to 90 percent of the maximum density in compliance with the testing method specified by the controlling governmental agency. (In general, ASTM D 1557-02, will be used.)

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

D. Failing Areas

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

E. Benching

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

VI. SLOPES

A. Fill Slopes

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

B. Side Hill Fills

The key for side hill fills shall be a minimum of 15 feet within bedrock or firm materials, unless otherwise specified in the soils report. (See detail on Plate SG-5.)

C. Fill-Over-Cut Slopes

Fill-over-cut slopes shall be properly keyed through topsoil, colluvium or creep material into rock or firm materials, and the transition shall be stripped of all soils prior to placing fill. (see detail on Plate SG-6).

D. Landscaping

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

E. Cut Slopes

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

2. If any conditions not anticipated in the preliminary report such as perched water, seepage, lenticular or confined strata of a potentially adverse nature, unfavorably inclined bedding, joints or fault planes are encountered during grading, these conditions shall be evaluated by the Geotechnical Consultant, and recommendations shall be made to treat these problems (Typical details for stabilization of a portion of a cut slope are given in Plates SG-2 and SG-3.).

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

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

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

VII. GRADING OBSERVATION

A. General

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

B. Compaction Testing

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

C. Frequency of Compaction Testing

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

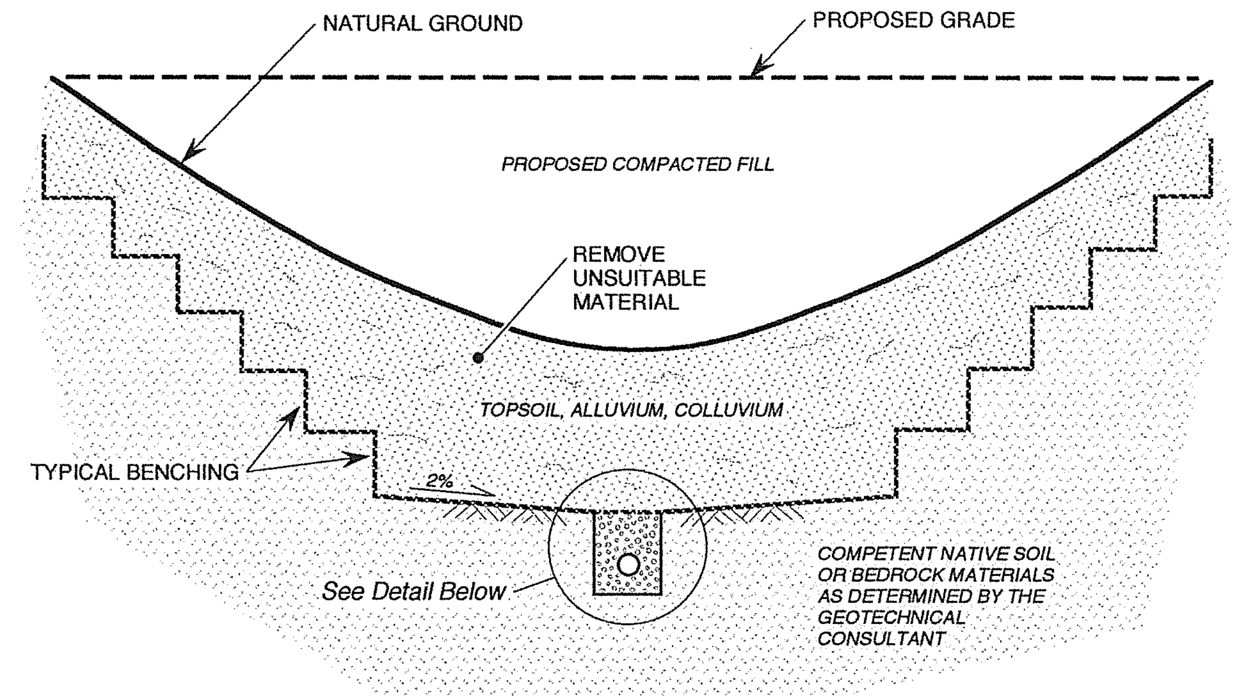
VIII. CONSTRUCTION CONSIDERATIONS

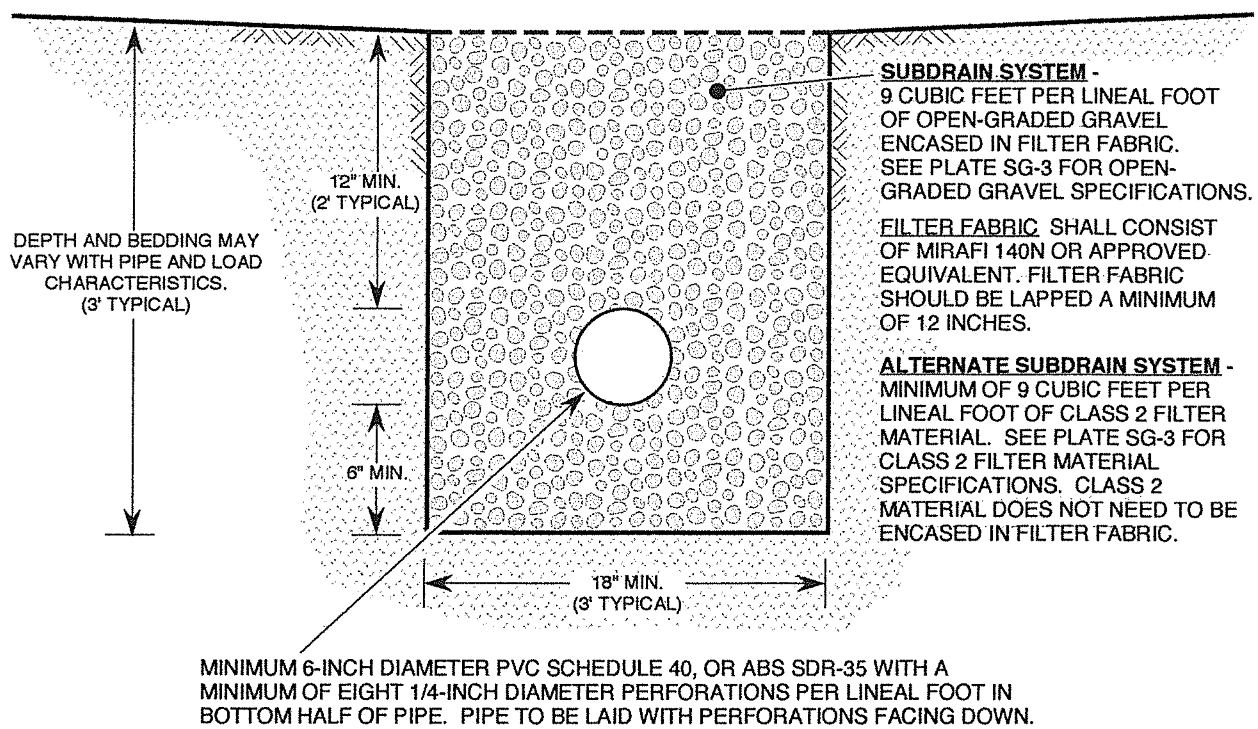
A. Erosion control measures, when necessary, shall be provided by the Contractor during grading and prior to the completion and construction of permanent drainage controls.

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

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

S:\!BOILERS-WORK\REPORT INSERTS\STANDARD GRADING SPECS

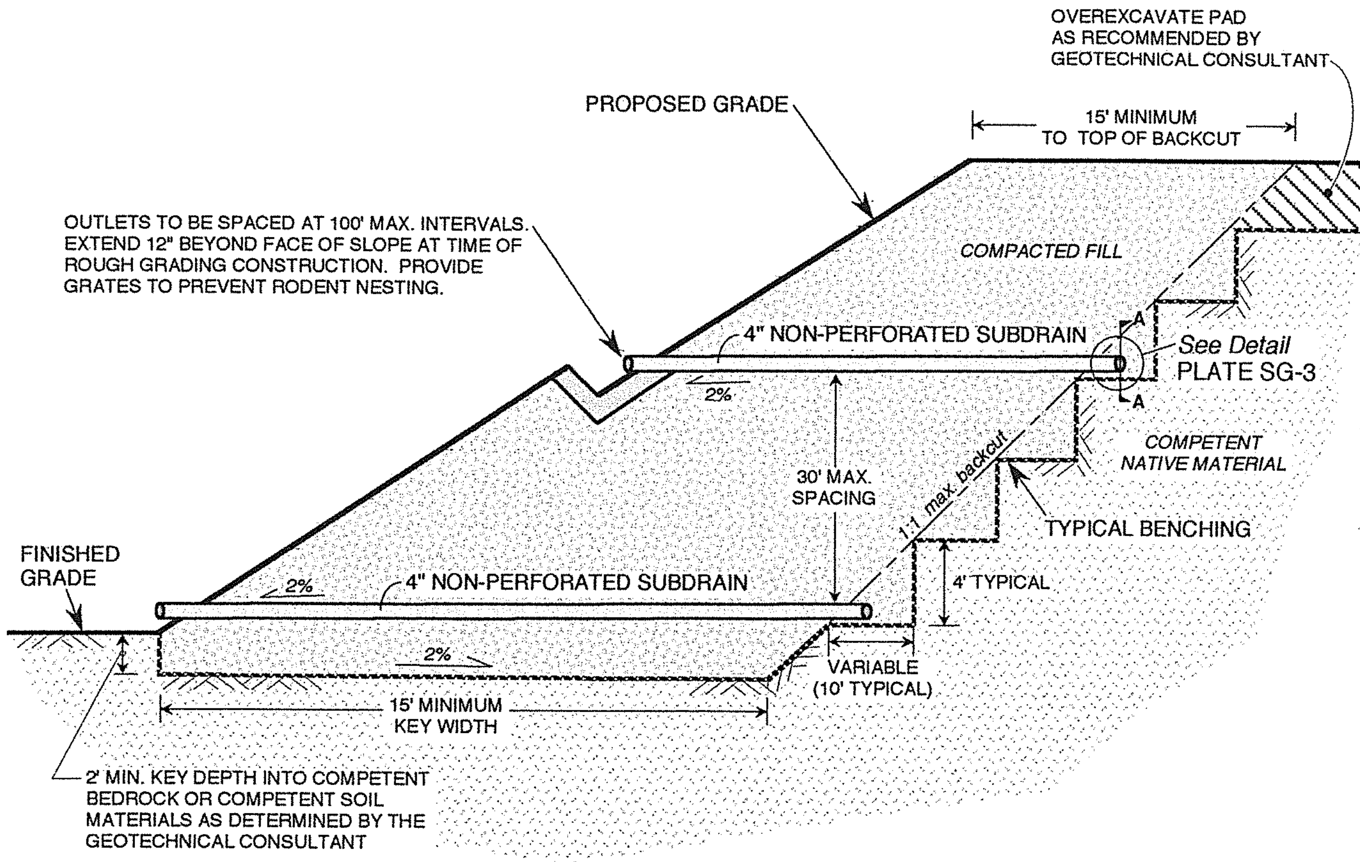




NOTES:

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

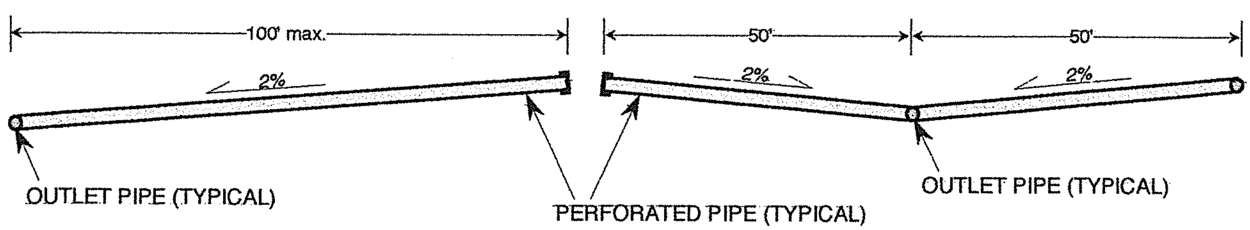
PETRA	CANYON SUBDRAIN DETAIL	PLATE SG-1



NOTES:

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

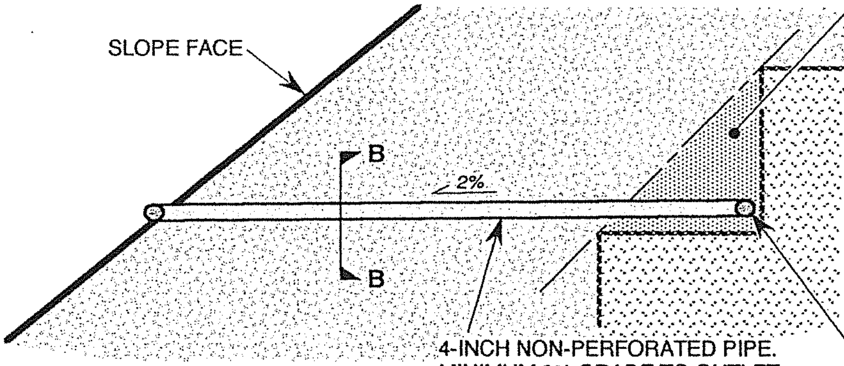
SECTION A-A (PERFORATED PIPE PROFILE)

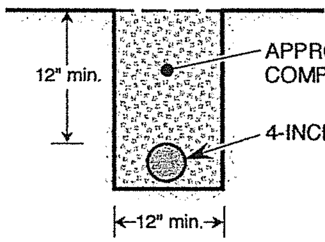


PETRA

BUTTRESS OR STABILIZATION FILL DETAIL

PLATE SG-2





SECTION B-B (OUTLET PIPE)

PIPE SPECIFICATIONS:

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

FILTER MATERIAL/FABRIC SPECIFICATIONS:

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

OPEN-GRADED GRAVEL

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

ALTERNATE:

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

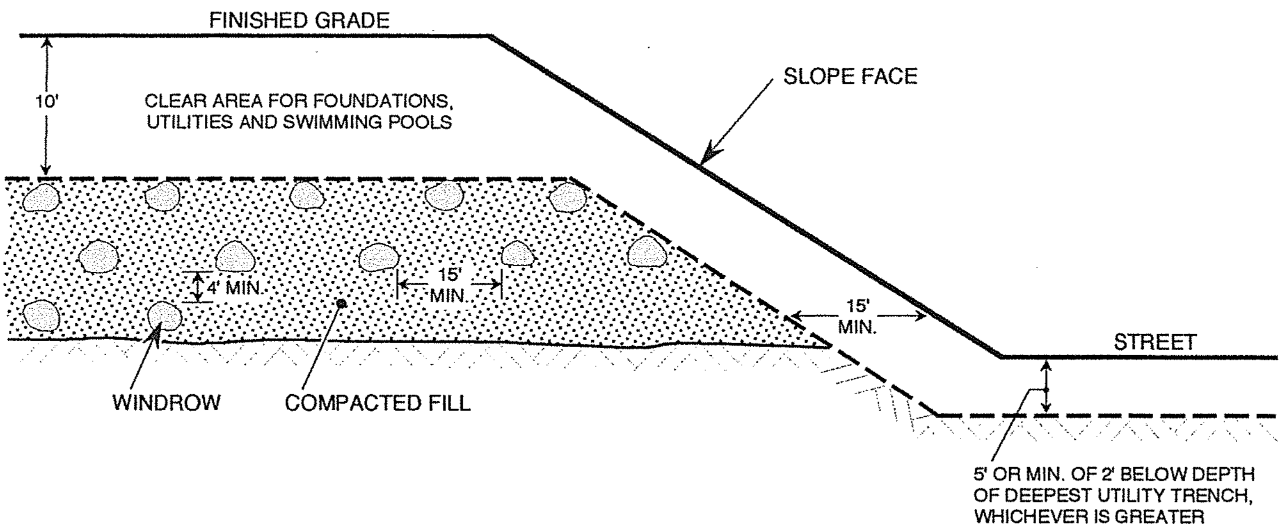
CLASS 2 FILTER MATERIAL

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

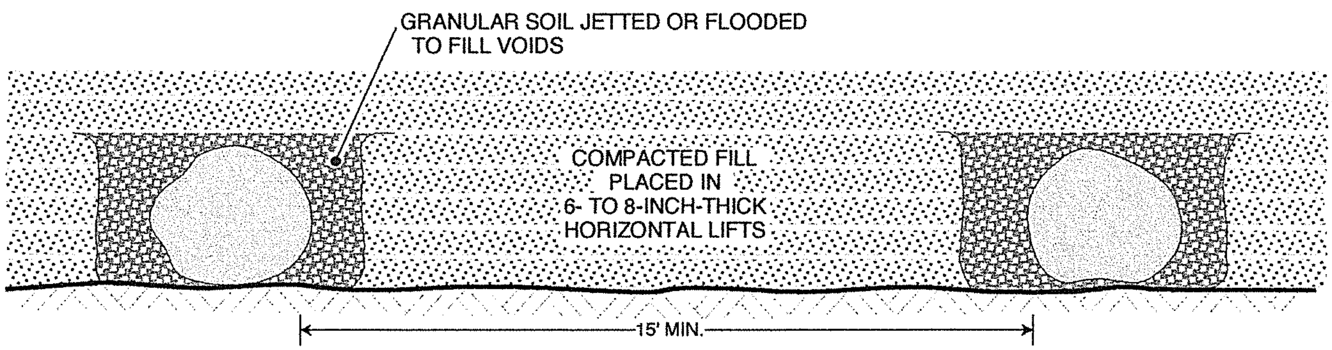
PETRA

BUTTRESS OR STABILIZATION FILL SUBDRAIN

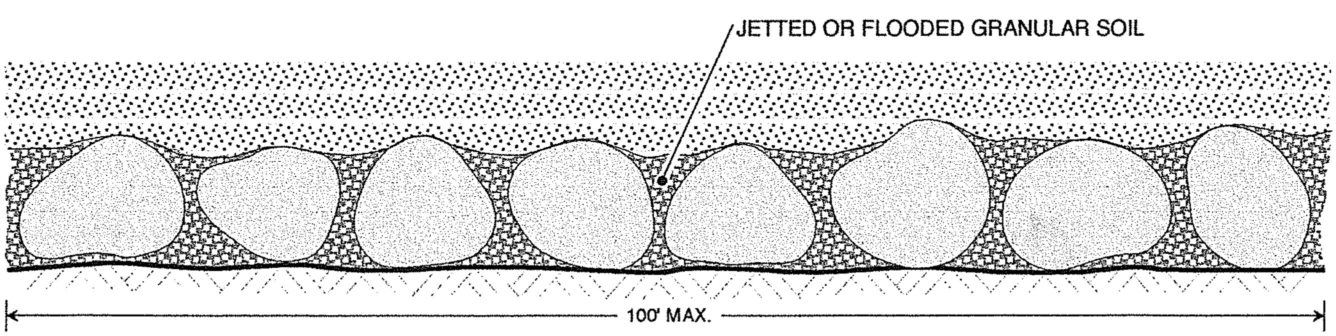
PLATE SG-3



TYPICAL WINDROW DETAIL (END VIEW)

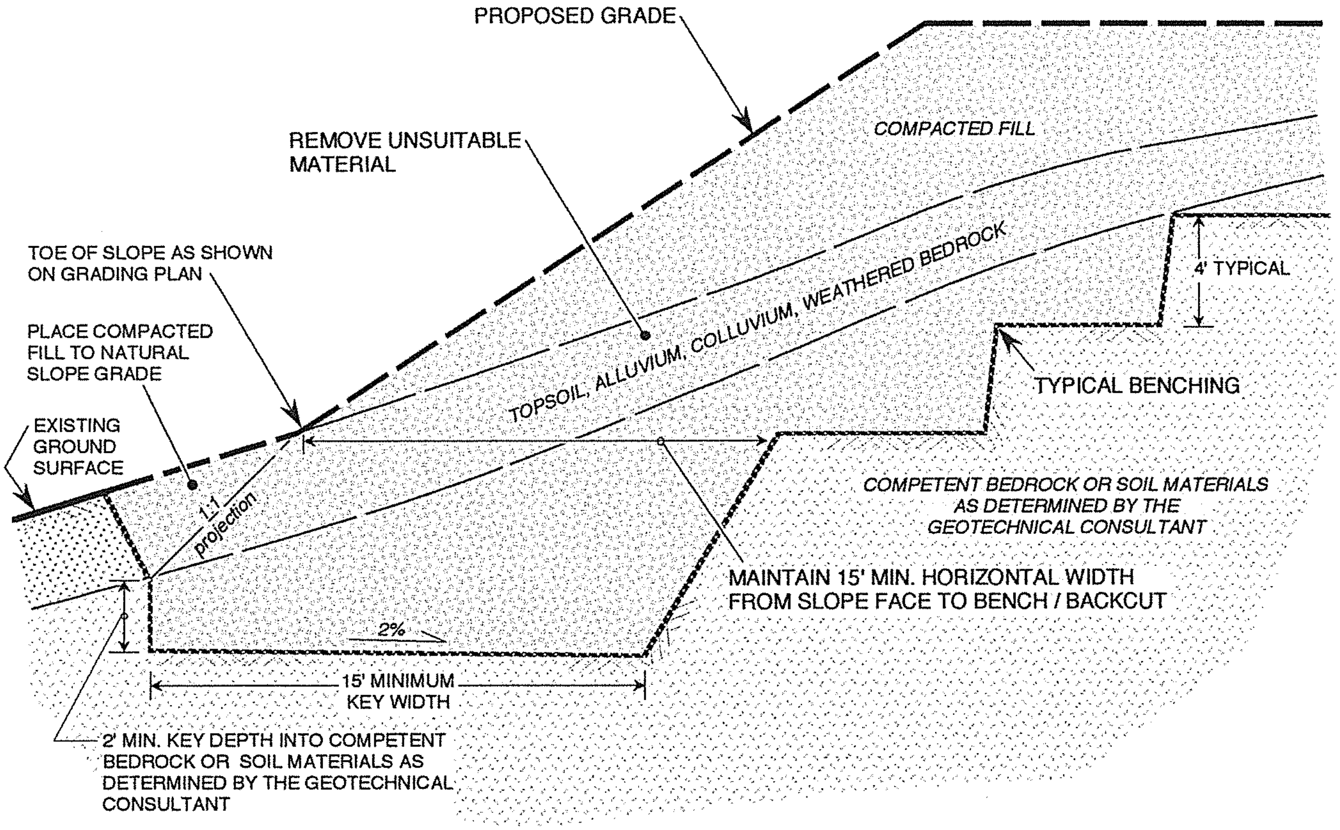


TYPICAL WINDROW DETAIL (PROFILE VIEW)



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

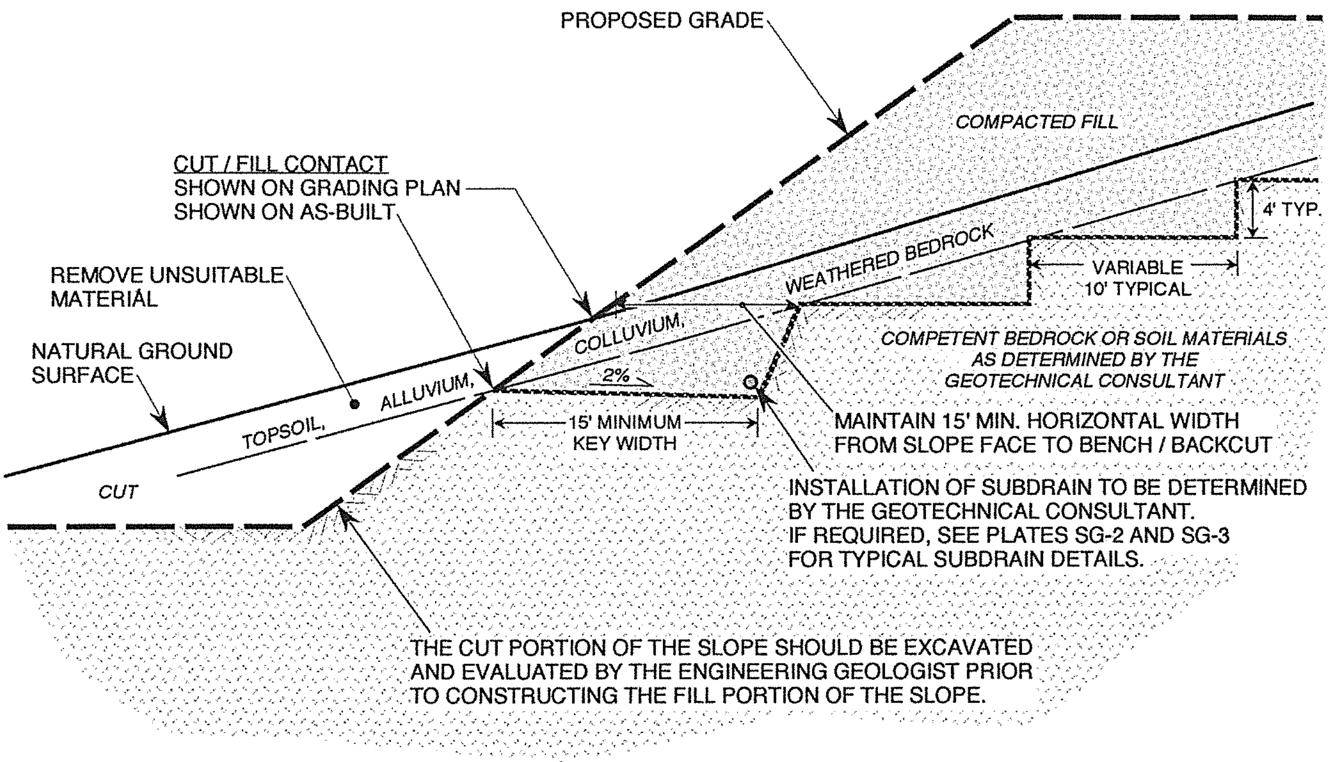
PETRA	TYPICAL ROCK DISPOSAL DETAIL	PLATE SG-4



NOTES:

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

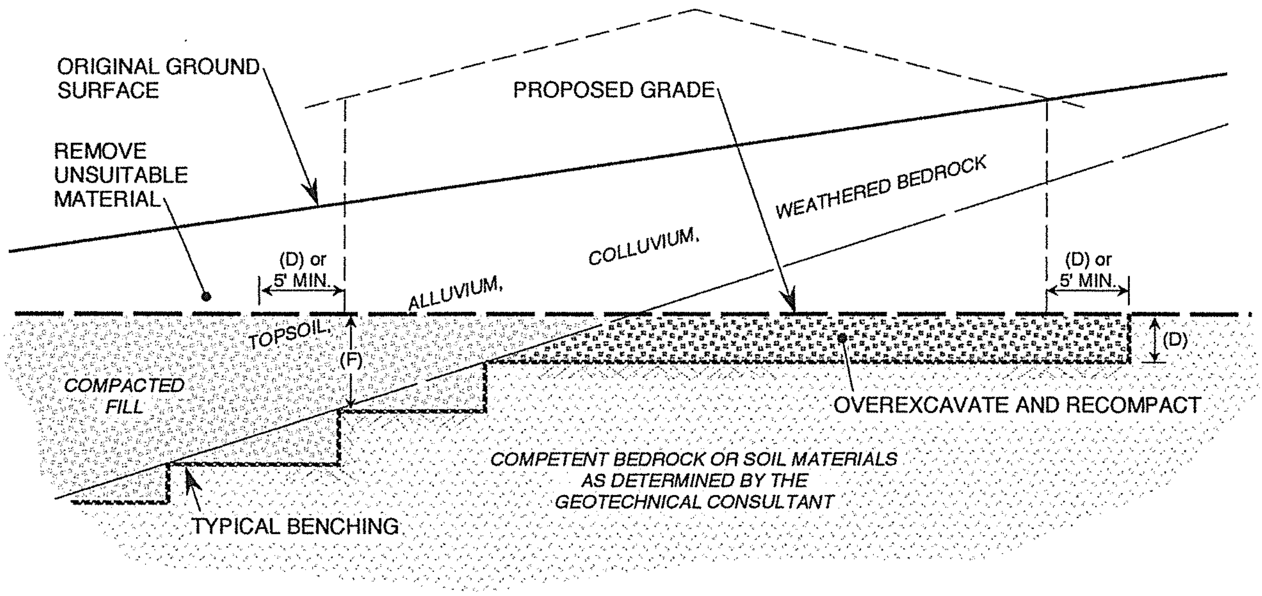
PETRA	FILL SLOPE ABOVE NATURAL SLOPE	PLATE SG-5



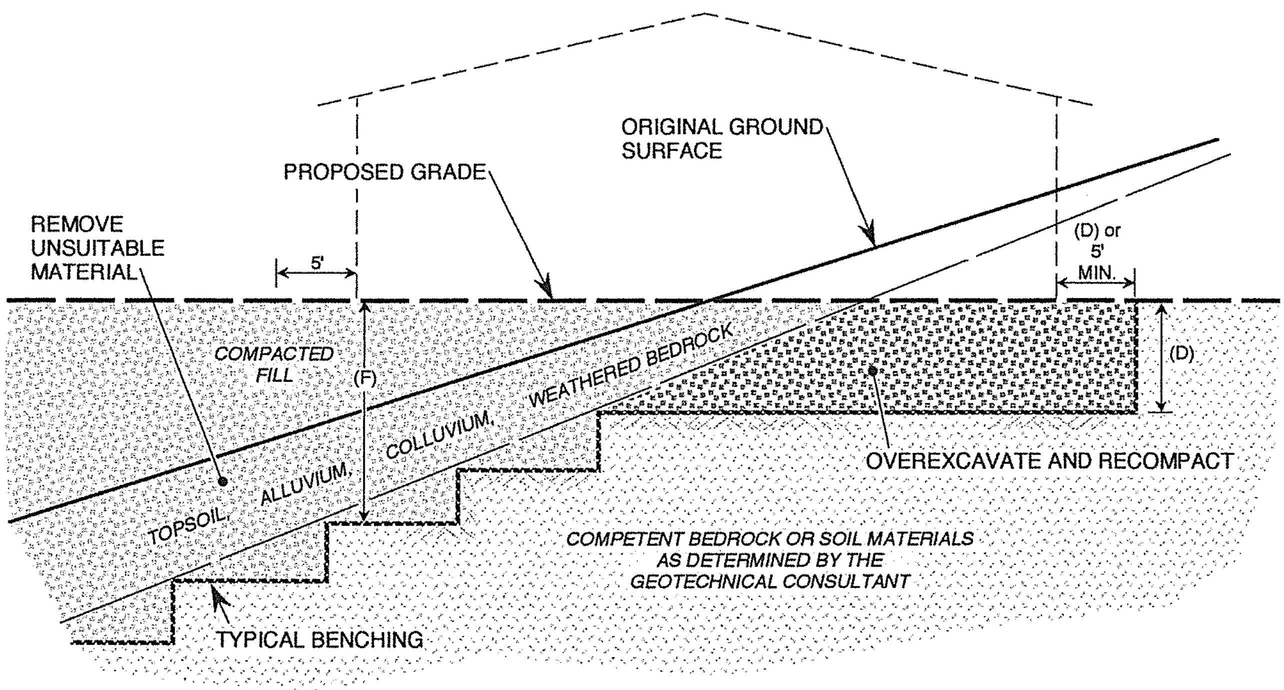
PETRA	FILL SLOPE ABOVE CUT SLOPE	PLATE SG-6

CUT LOT

UNSUITABLE MATERIAL EXPOSED IN PORTION OF CUT PAD

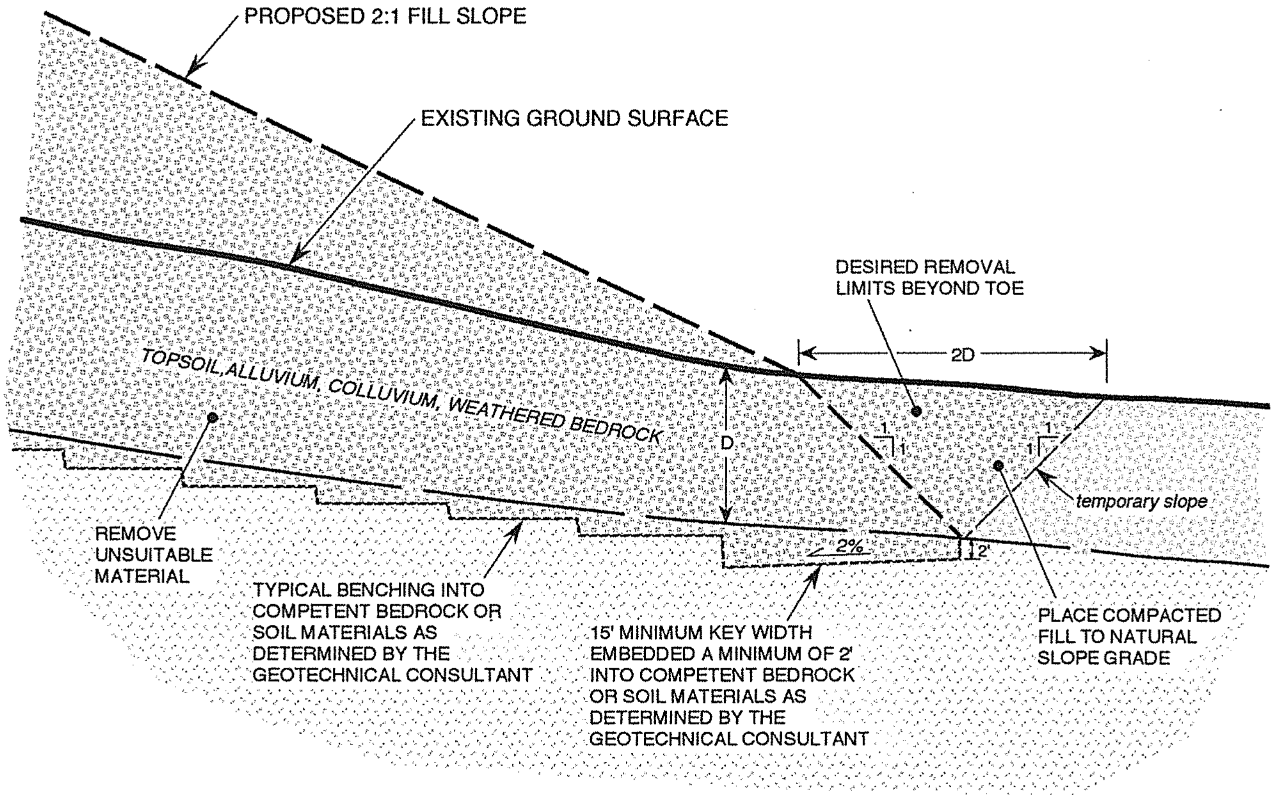


CUT-FILL TRANSITION LOT



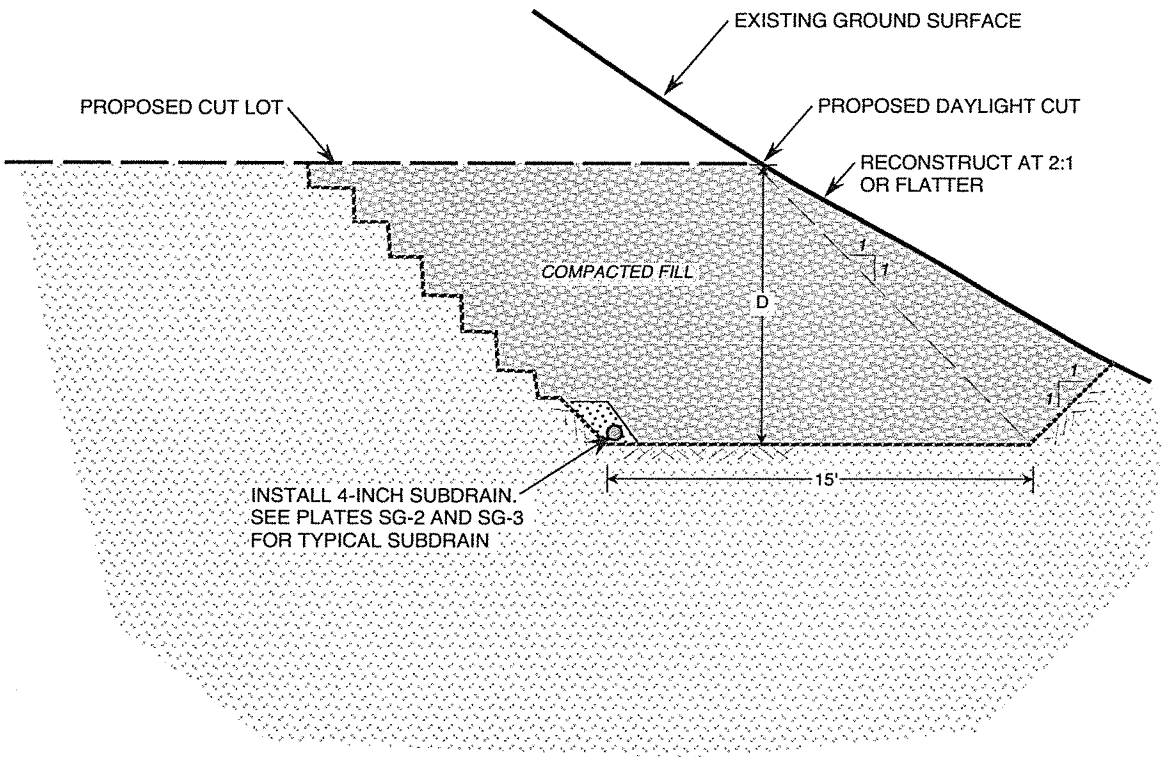
MAXIMUM FILL THICKNESS (F)	DEPTH OF OVEREXCAVATION (D)
FOOTING DEPTH TO 3 FEET	EQUAL DEPTH
3 TO 6 FEET	3 FEET
GREATER THAN 6 FEET	1/2 THE THICKNESS OF DEEPEST FILL PLACED WITHIN THE "FILL" PORTION (F) TO 15 FEET MAXIMUM

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



D = RECOMMENDED DEPTH OF REMOVAL PER GEOTECHNICAL REPORT

PETRA	TYPICAL REMOVALS BEYOND TOE OF PROPOSED FILL SLOPE	PLATE SG-8



NOTE:

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

PETRA	SHEAR KEY ON DAYLIGHT CUT LOTS	PLATE SG-9