Appendix F:
Geology and Soils Supporting Information

THIS PAGE INTENTIONALLY LEFT BLANK

F.1 - Geotechnical Grading Plan Review

THIS PAGE INTENTIONALLY LEFT BLANK

GEOTECHNICAL GRADING PLAN REVIEW PROPOSED RIO VISTA DEVELOPMENT, WEST OF 20TH STREET, SOUTH OF THE COUNTY LINE, CITY OF JURUPA VALLEY, CALIFORNIA

Prepared For **RICHLAND COMMUNITIES, INC.**
3161 Michelson Drive, Suite 425
Irvine, California 92612

Prepared By **LEIGHTON AND ASSOCIATES, INC.**
10532 Acacia Street, Suite B-6
Rancho Cucamonga, California 91730

Project No. 10270.003

December 7, 2021

December 7, 2021

Project No. 10270.003

Richland Communities, Inc.
3161 Michelson Drive, Suite 425
Irvine, California 92612

Attention: Mr. Brian Hardy
Vice President- Land Entitlement

Subject: Grading Plan Review, Proposed Rio Vista Development, West of 20th Street, South of the County Line, City of Jurupa Valley, California

In response to your request and authorization, Leighton and Associates, Inc. (Leighton) has conducted a geotechnical grading plan review for the proposed mixed-use development to be located west of the western terminus of 20th Street and south of the Riverside-San Bernardino County line in the City of Jurupa Valley. The purpose of this study has been to review the general geotechnical conditions of the site based on previous reporting with respect to the proposed development and to provide preliminary geotechnical recommendations for design and construction.

Based on this grading plan review and our previously conducted investigation (Leighton, 2015), construction of the proposed development is feasible from a geotechnical standpoint. The most significant geotechnical issues at the site are those related to the potential for strong seismic shaking, hard bedrock, potentially compressible soils, potential for rock fall, and infeasible infiltration characteristics of planned basin locations where bedrock is either present at the surface or is relatively shallow. Good planning and design of the project can limit the impact of these constraints. This report presents our preliminary findings, conclusions, and geotechnical recommendations for the project.

We appreciate the opportunity to work with you on the development of this project. If you have any questions regarding this report, please call us at your convenience.





Respectfully submitted,

LEIGHTON AND ASSOCIATES, INC.

Steven G. Okubo, CEG 2706
Senior Project Geologist
Ext. 8773, sokubo@leightongroup.com

Jason D. Hertzberg, GE 2711
Principal Engineer
Ext. 8772, jhertzberg@leightongroup.com

JAT/JDH/SGO/rsm

Distribution: (2) Addressee

TABLE OF CONTENTS

Section Page

1.0 INTRODUCTION 1
1.1 Site Location and Description 1
1.2 Proposed Development 2
1.3 Previous Work 2
1.4 Purpose of Review 4
1.5 Scope of Geotechnical Plan Review 4

2.0 FINDINGS 5
2.1 Regional Geologic Conditions 5
2.2 Subsurface Soil Conditions 5
2.2.1 Compressible and Collapsible Soils 6
2.2.2 Expansive Soils 7
2.2.3 Sulfate Content 7
2.2.4 Resistivity, Chloride and pH 8
2.3 Rippability and Oversized Rock 8
2.4 Slope Stability and Rockfall Potential 9
2.5 Surface Water, Groundwater and Subdrains 11
2.6 Infiltration Testing 12
2.7 Faulting and Seismicity 14
2.8 Secondary Seismic Hazards 15
2.8.1 Liquefaction Potential 15
2.8.2 Seismically Induced Settlement 15
2.8.3 Seismically Induced Slope Failures 16

3.0 CONCLUSIONS AND RECOMMENDATIONS 17
3.1 General Earthwork and Grading 17
3.1.1 Site Preparation 17
3.1.2 Removals and Overexcavation 17
3.1.3 Cut/Fill Transitions and Canyon Wall Cleanouts 18
3.1.4 Groundwater and Subdrainage 19
3.1.5 Fill Placement 19
3.1.6 Shrinkage and Bulking 20
3.1.7 Import Fill Soil 20
3.1.8 Rippability and Oversized Material 21
3.2 Shallow Foundation Recommendations 23
3.2.1 Minimum Embedment and Width 24
3.2.2 Allowable Bearing 24
3.2.3 Lateral Load Resistance 24
3.2.4 Increase in Bearing and Friction - Short Duration Loads 24
3.3 Recommendations for Slabs-On-Grade 25

3.4 Seismic Design Parameters 26
3.5 Retaining Walls 27
3.6 Infiltration Basin Design 28
3.7 Pavement Design 30
3.8 Temporary Excavations 31
3.9 Slope Stability 32
3.10 Rock Fall 32
3.11 Trench Backfill 34
3.12 Surface Drainage 35
3.13 Sulfate Attack and Corrosion Protection 35
3.14 Additional Geotechnical Services 36

4.0 LIMITATIONS 37

Important Information About This Geotechnical-Engineering Report

Figures (Rear of Text)

Figure 1 - Site Location Map
Figure 2 - Rock Fall Remedial Options
Figure 3 - Retaining Wall Backfill and Subdrain Detail

Plate 1 - Geotechnical Map

Appendices

Appendix A - References
Appendix B - Geotechnical Boring Logs, Test Pit Logs, and Infiltration Test Results Appendix C - Laboratory Test Results
Appendix D - Summary of Seismic Hazard Analysis
Appendix E - Seismic Refraction Survey
Appendix F - General Earthwork and Grading Specifications

1.0 INTRODUCTION

1.1 Site Location and Description

The Rio Vista development property is irregularly shaped and consists of approximately 820 acres of undeveloped land within the Jurupa Hills west of the western terminus of 20th Street and south of the Riverside-San Bernardino County line in the City of Jurupa Valley, California. The property is generally bounded on the west by residential development and the Riverside-San Bernardino County line is present on the north. State Route 60 freeway, residential development and undeveloped property is present to the south. A concrete plant, storage yards and industrial buildings are present to the east with undeveloped property to the southeast and residential development to the northeast (see Site Location Map, Figure 1).

The majority of the site is currently vacant and undeveloped. Overhead electrical power transmission lines extend from southwest to northeast through the central portion of the property. Along the northeast boundary of the site, the transmission lines turn to the east. Numerous unimproved dirt roads and trails cross the site. Primary access to the site is gained from the western terminus of 20th Street. However, site access can also be attained through the vacant field on the northwest side of the property off of Armstrong Road and along the several residential streets in the northeast portion of the site.

The site generally consists of a north- and northwest-trending ridgeline with associated drainages. Topography across the site is moderate to steep, and elevations vary from a high of about 1,720 feet in the hills on the south side of the property, to a low of about 972 feet on the west, north of the old quarry. Natural hillsides above the development typically slope at inclinations in the range of 2:1 to 3:1 (horizontal to vertical) but locally up to roughly 1.4:1 and locally steeper. The western portion of the property generally drains to the west, and the eastern portion generally drains to the east.

Vegetation onsite consists of an assortment of native grasses and brush, with very heavy vegetation in some areas, as well as a few mature trees occurring in some of the stream valley bottoms of the site.

1.2 Proposed Development

Based on the preliminary site plan prepared by Hunsaker & Associates Irvine, Inc., sent to us on November 29, 2021, development of approximately two thirds of the property is planned. The majority of the development is planned for the gentler sloping areas of the site in the northeast, north, and west. Most of the steeper hillsides of the site are to remain undeveloped. Development is expected to include cut and fill grading to create residential home sites, water detention basins, drainage, utility, landscape, hardscape, street and other associated improvements.

The design includes cut and fill slopes up to about 120 feet in height. The deepest design cut is on the order of 135 feet and the deepest design fill approaches 85 feet.

The project design includes single family residential lots, multi-family development, and superpad areas. The project includes an entrance into the site from Sierra Avenue on the west and from 20th Street on the east.

1.3 Previous Work

The area of proposed development was initially studied by Geolabs in 1988. Although we did not have access to their report, test pit logs and test pit locations by Geolabs were provided in subsequent reports by John R. Byerly, Inc. (Byerly) and Gary S. Rasmussen and Associates (Rasmussen), prepared for Specific Plan 243. The stated purpose of Byerly's 2006 geotechnical investigation report was to provide an evaluation of surface and subsurface conditions of the site with respect to foundation types, slope stability, vertical and lateral bearing values, support of concrete slabs-on-grade, and site preparation. Rassmusen provided a geotechnical feasibility report in 2005, and provided a subsurface investigation focusing on slope stability of the project as designed at that time.

Of significance, several landslides were mapped across the hillside areas of the site in the geologic and geotechnical reports prepared by Rasmussen and Byerly. These landslides were mapped with very little or no subsurface data, and based solely on topographic expression or air photo analysis. Considering the hard nature of the granitic lithology onsite and without significant subsurface data, the

conclusion that so many large landslides were present was questioned by the County. After several review comments and responses to County comments, Byerly ultimately presented slope stability analysis that indicated most of these landslides were stable in their current condition. Nonetheless, stabilization of one of the identified landslides was recommended with the construction of a stability buttress. Further discussion of Byerly's findings and conclusions with respect to landsliding is discussed later in this report.

We have reviewed the Byerly and Rasmussen reports and their field and laboratory data during our study. The locations of their borings and test pits and those of Geolabs are shown on the Geotechnical Map (Plate 1). The logs of the borings and test pits are provided in Appendix B.

In 2015, Leighton performed a preliminary investigation report, which provided geotechnical recommendations for grading and design for the mixed-use development proposed at that time. That investigation included field work to estimate rippability of bedrock onsite, to evaluate the existing conditions and to develop geotechnical conclusions and recommendations for grading and construction. Fieldwork included air percussion drilling, hollow-stem auger soil borings, backhoe test pits, excavator test pits, laboratory testing, a seismic refraction survey, and geotechnical analysis. A total of 10 exploratory, hollow-stem-auger borings (LB-1 through LB-10) were drilled, logged, and sampled to depths ranging from 15.5 to 51.5 feet below the existing ground surface (bgs). 37 backhoe test pits were excavated to depths ranging from approximately 3 to 17 feet bgs and 12 excavator test pits were excavated to depths ranging from 11 to 17.5 feet to observe subsurface conditions and to estimate rippability of the bedrock. 18 air percussion borings were drilled onsite to depths ranging from 25 to 65 feet bgs to evaluate rippability of the bedrock drilled. Four well permeameter tests were conducted at two proposed basins within the development (LB-1 through LB-4) and percolations tests were conducted at 2 locations within the development (TP-1 and TP-4) in general accordance with Riverside County guidelines to estimate infiltration rates.

Acting as our subconsultant, Terra Geoscience conducted a seismic refraction survey on the property in areas of significant planned cuts into granitic bedrock. The purpose of their work was to estimate the shear wave velocity of underlying bedrock materials as an estimate of rock hardness and to estimate the need for heavy ripping and/or blasting of rock to achieve design grades.

The data collected during previous investigations has been incorporated into this report.

1.4 Purpose of Review

The purpose of this review has been to evaluate the geotechnical and geologic conditions at the site based on previous work for the project with respect to the proposed development and to provide planning level geotechnical recommendations for design and construction of the proposed develpoment. Our review is based on data collected by Leighton in the last several years as well as data collected previously by Leighton and other investigators.

1.5 Scope of Geotechnical Plan Review

The scope of our study has included the following tasks:

- Background Review: We reviewed available, relevant geotechnical and geologic maps and reports and aerial photographs available from our in-house library. We also reviewed the reports for the site previously prepared by Byerly and Rasmussen and Leighton (see references).

- Engineering Analysis: Data obtained from our background review, previous field exploration and geotechnical laboratory testing was evaluated and analyzed to develop geotechnical conclusions and provide preliminary recommendations presented in this report.

- Report Preparation: Results of our preliminary geotechnical plan review have been summarized in this report, presenting our findings, conclusions and preliminary geotechnical recommendations for design and construction of the proposed residential development.

2.0 FINDINGS

2.1 Regional Geologic Conditions

The site is located in the northern Peninsular Ranges Geomorphic Province of southern California along the western margin of the San Bernardino Valley. This is a geologically complex area where the relatively northwest-moving Peninsular Range Province meets the relatively southeast-moving Transverse Ranges Province. Strike-slip faults, such as the San Jacinto Fault Zone, dominate the structure of the Peninsular Ranges. The active San Andreas Fault Zone, located approximately 22 kilometers northeast of the site, separates the valley from the rugged San Bernardino Mountains. The active San Jacinto Fault Zone is present about 10 kilometers to the northeast, and the active Cucamonga fault is located about 18 kilometers to the northwest. The San Andreas, San Jacinto, and Cucamonga faults have experienced significant activity in the recent geologic past.

Based on available regional geologic maps, the site and surroundings are underlain by granitic bedrock of the Upper Cretaceous age and locally by metamorphic schist of Paleozic age (USGS, 2006), see Figure 2. The bedrock units are mantled by older and younger alluvium.

2.2 Subsurface Soil Conditions

Based upon our review of pertinent geotechnical literature and our previous subsurface investigation, the site is underlain by surficial units and bedrock. Mapped surficial units include artificial fill, young alluvium and older alluvium.

Artificial Fill (map symbol Afu) was encountered in tests pits excavated in the northwestern and northeastern valley portions of the site. Uncontrolled artificial fill consisting of silty sand was encountered to depths ranging from 1 to 4 feet in Test Pits TP-1, TP-3, TP-15 and TP-19 as labeled on Plate 1. The fill was generally dry and loose and contained plastic bags, metal scraps, cloth, and other debris. Uncontrolled fill and debris were also reported in test pit logs by Geolabs (GTP-15 and 16). Ten feet of fill/trash was report in GTP-15. Uncontrolled fill may be present in other areas of the site, particularly where dirt roads cross drainage areas.

Young or recent alluvium (map symbol Qal) is present in active stream channels in several areas of the site. Young alluvium was generally described as silty sand and sand that was dry and loose. Young alluvium was usually less than about 4 feet thick; however, 12 feet of loose alluvial soil was encountered in TP-17.

Older Alluvium (map symbol Qalo) mantles much of the lower elevations of the site and was generally observed as light brown to reddish brown, silt and sandy silt. The older alluvium encountered was dry to slightly moist, and dense to very dense. As observed in our borings and test pits, the older alluvium varied from a few feet to more than 50 feet thick (Boring LB-7 in the northeast).

The Peninsular Ranges Batholith Tonalite (map symbol Kt) underlies the ridges and elevated knolls of the site and is present at relatively shallow depth below the alluvial soil across much of the site. This granitic bedrock consists of tonalite, and heterogeneous tonalite, typically light brown to gray, and medium- to very coarse-grained. As encountered in our borings and test pits, the bedrock was weathered at the surface becoming very hard at shallow depths.

Exposures of metamorphic schist (Paleozoic Biotite Schist) mixed with tonalite were observed locally on the surface and in some of the excavator test pits (EP-5 and EP-6). These areas are mapped on the Geotechnical Map as KtPz.

The bedrock units have numerous fractures and joints that are typically moderately angled. Regional mapping suggest a moderately steep, east-dipping, joint pattern is present. Outcrops of granitic bedrock are present across the elevated portions of the site. In some areas, the rock has weathered to create spheroidal boulders resting on steep slopes. Evidence of rock fall is present at the base of some slopes, and buried boulders and cobbles may be present within the alluvial soil near the foot of slopes.

2.2.1 Compressible and Collapsible Soils

Soil compressibility refers to a soil's potential for settlement when subjected to increased loads as from a fill surcharge. Based on our investigation, the older alluvial soil is generally considered slightly compressible. Undocumented artificial fill and young alluvial soil is

expected to be moderately compressible. Complete removal of undocumented fill and partial removal of alluvial soil is recommended later in this report to reduce the potential for adverse total and differential settlement of the proposed improvements. The bedrock onsite is not considered compressible.

Collapse potential refers to the potential settlement of a soil under existing stresses upon being wetted. Previous test results (Leighton, 2015) indicate that the alluvial soil within the upper 5 feet onsite has a negligible to moderate collapse potential.

2.2.2 Expansive Soils

Expansive soils contain significant amounts of clay particles that swell considerably when wetted and shrink when dried. Foundations constructed on these soils are subjected to large uplifting forces caused by the swelling. Without proper measures taken, heaving and cracking of both building foundations and slabs-on-grade could result.

The near surface soils consist of primarily of sandy silts and silty sands. Testing conducted by Byerly (2006) yielded expansion index of 0. Based on this result and the nature of the soils observed, the near-surface soil is expected to have a low to very low expansion potential.

2.2.3 Sulfate Content

Water-soluble sulfates in soil can react adversely with concrete. However, concrete in contact with soil containing sulfate concentrations of less than 0.1 percent by weight is considered to have negligible sulfate exposure based on the American Concrete Institute (ACI) provisions, adopted by the 2019 CBC (CBC, 2019, Chapter 19, and ACI, 2014, Chapter 4).

Two near-surface soil samples were tested during our previous investigation (Leighton, 2015), for soluble sulfate content. The results of these tests indicate a sulfate content of approximately 0.01 percent by weight, indicating negligible sulfate exposure.

2.2.4 Resistivity, Chloride and pH

Soil corrosivity to ferrous metals can be estimated by the soil's electrical resistivity, chloride content and pH. In general, soil having a minimum resistivity less than 1,000 ohm-cm is considered severely corrosive. Soil with a chloride content of 500 parts-per-million (ppm) or more is considered corrosive to ferrous metals.

As a screening for potentially corrosive soil, representative soil samples were tested during our previous investigation (Leighton, 2015), to determine minimum resistivity, chloride content, and pH. The tests indicated a minimum resistivity of 4080 to 5790 ohm-cm, chloride content of 21 to 63 ppm, and pH of 7.5 to 7.8. Based on the tests, the onsite soil is considered mildly corrosive to ferrous metals.

2.3 Rippability and Oversized Rock

The granitic bedrock onsite is hard as evidenced by outcrops of rock on the surface and exposures in excavations present around the site. To estimate the density of the rock and the difficulty of excavation, Terra Geoscience conducted a seismic refraction survey onsite. Ten seismic lines were placed in design cut areas underlain by granitic bedrock. The report of their survey is provided in Appendix E. In addition, 18 air percussion drill holes were excavated by ECM, and the rate of advancement was used to estimate rippability. Logs of these borings are included in Appendix B. We also previously excavated 12 test pits with an excavator to qualitatively observe its progress of excavation. These excavations were also observed by a representative of Sukut construction, who commented on the rippability of the material. The logs of the excavator test pits are provided in Appendix B.

In general, based on the areas tested, the upper portion of the bedrock appeared to be rippable to depths on the order of 15 to 20 feet and perhaps as deep as 30 feet. In general, we were able to excavate test pits with the excavator to depths of at least 13 feet and up to 17 feet, and the limitation on depth was typically the reach of the excavator rather than refusal (although the excavation was difficult). Since excavation was completed in a trench condition to depths of 13 to 17 feet with the excavator, we anticipate that the bedrock will generally be rippable in an open excavation with a larger dozer and a single shank ripper to these depths.

The air percussion test results and the seismic refraction survey also suggested that the bedrock may be rippable to depths of 20 to 25 feet. However, very hard bedrock with high seismic velocities was encountered along all seismic lines at depths as shallow as 5 to 10 feet (Line S-3 & S-4). Blasting of the bedrock in cuts deeper than about 20 to 30 feet should be expected. Our preliminary estimates of the depth of rippable material are shown on Plate 1, *Geotechnical Map*.

Although our 2015 data suggested that the bedrock onsite may be rippable to depths on the order of 20 feet, there are many considerations in determining bedrock rippability, including the nature of the rock, the type of equipment used, and the production rate during ripping. Although the rock may be rippable, if rates of progress are very slow, blasting may provide superior results. Likewise, some areas of bedrock may be rippable, but very hard non rippable rock may be adjacent. Due to the variabilities of the bedrock conditions and the equipment being used, it is difficult to accurately predict the depth of rippable material across the site. Areas onsite may also encounter buried core stones or non-rippable rock. Additional discussion of excavation considerations is provided in the seismic refraction survey report in Appendix E.

2.4 Slope Stability and Rockfall Potential

The hard granitic bedrock present in elevated portions of the site is not typically prone to deep-seated slope failures. Geologic maps prepared by Rasmussen and Byerly show numerous large landslides on the property. These were mapped by the geologist based primarily on topographic expression and aerial photograph review, not subsurface data or evidence of displaced units. We had observed no evidence of deep-seated landslides during our 2015 study. Large, deep-seated landslides would be very unusual in this geologic terrain and setting. Based on our observations, the preponderance of evidence is that the landslides mapped by Byerly and Rasmussen are not present.

For example, an ancient landslide was mapped by Rasmussen (2006) in the southwest portion of the site, shown on their Cross-section D-D'. The landslide was reportedly investigated with Trench T-4, and landslide debris and landslide rupture surfaces are shown on the trench log. However, no landslide is shown in the area of Trench T-4 on the geologic map included with the 2006 report, nor is a landslide shown in the area of Trench T-4 on subsequently prepared geologic

maps. A review of aerial photographs in the area where Trench T-4 is located shows an unbroken outcrop of granitic bedrock (dike) extending north-south along the ridge and extending across and well beyond the limits of the mapped landslide, indicating no landslide is present in this area.

Trench T-3 (Rasmussen, 2006) was also reportedly excavated in an ancient landslide shown on Cross-section C-C'. Although landslide material and "ruptures surfaces" are shown on the trench log, no landslide is shown on the included geologic map or subsequent maps. These are two of only four subsurface explorations made into landslides mapped by Byerly and Rasmussen.

We conducted reviews of the landslides mapped by Byerly and Rasmussen and found similar evidence suggesting that the landslides are not present as mapped.

Although Byerly mapped the landslides, Byerly concluded that the majority of the landslides were stable and that they were ancient slides that failed in the Pleistocene when the climate was wetter and groundwater was more shallow. Considering the very hard nature of the bedrock and its poor permeability, it is our opinion that the wetter climate in the Pleistocene would have only a minor impact in the gross stability of the granitic slopes onsite.

Based on their analysis, only one landslide required stabilization for the Specific Plan 243 design. This was a landslide mapped adjacent to Trench 4 and on Cross-section D-D'. However, a dike visible in aerial photographs is unbroken and extends across the mapped limits of this landslide, and there is no evidence for offset of the dike by landslide movement.

It is our opinion that the landslides are not present as mapped by Rasmussen and Byerly. Subsurface evidence for their presence is very limited and contradictory (as noted in the discussion of Trenches T-3 and T-4 above), and strong evidence of continuous bedrock extending across the mapped trace of many of the mapped landslides is readily observed in aerial photographs.

The onsite bedrock is very hard and capable of supporting tall, steep slopes. A near vertical cut of nearly 300 feet in height is exposed in the quarry offsite to the southwest. This suggests the bedrock onsite is capable of supporting the existing and manufactured slopes in the development.

Cut slopes excavated at 2:1 and up to 120 feet in height are planned for the development. When underlain by granitic bedrock, these slopes are expected to be grossly and surficially stable. Natural slopes surrounding the development are also expected to be grossly stable. Design slopes cut into the older alluvial soils are also expected to be grossly and surficially stable when constructed at 2:1.

However, portions of the natural hillsides adjacent to the development are covered with exposed bedrock outcrops and subrounded to rounded boulders. There is a potential for surficial instability and rockfall in these areas. Areas with a potential for rockfall are noted on the Geotechnical Map (Plate 1). Rock fall can present a hazard to improvements at the base of slopes if not mitigated or considered in the project design.

Many of the natural slopes above the development are covered with loose colluvial soils and topsoils that may be prone to soil slumps and debris flow during or immediately following heavy rainfall. Special consideration of these areas will be required during the design and grading of the site. Protection for downslope structures from debris flow should be provided and may include drainage swales, debris walls and berms.

2.5 Surface Water, Groundwater and Subdrains

Surface water was not observed onsite during our investigation in 2015 and no groundwater was encountered within any of the borings or test pits excavated onsite. The granitic bedrock onsite is not generally considered water bearing. The historically highest groundwater level in the near vicinity is approximately 120 feet below the existing ground surface (CDWR, 1970).

Based on our review of regional groundwater data (CDWR, 2021), a well approximately 1.4 miles north of the site with groundwater readings from October 2011 to January 2021, recorded the shallowest groundwater level on the order of 177 feet below the ground surface in 2011. Groundwater is expected to be greater than 100 feet below the ground surface in the lower portions of the site underlain by alluvial soil. Groundwater is not generally expected to be a significant constraint to development of the site.

Following grading, water from irrigation or other sources may accumulate in the subsurface. Subdrains will be required to remove subterranean water from canyon areas and in areas of fill slope.

2.6 Infiltration Testing

Four well permeameter tests at 2 locations (LB-1 through LB-4, two tests at each location) were conducted by us in 2015 to preliminarily evaluate infiltration rates where water quality basins are planned.

Well permeameter tests are useful for field measurements of soil infiltration rates, and are suited for testing when the design depth of the basin or chamber is deeper than current existing grades. It should be noted that this is a clean-water, small-scale test, and that correction factors need to be applied. The test consists of excavating a boring to the depth of the test (or deeper if it is partially backfilled with soil and a bentonite plug with a thin soil covering is placed just below the design test elevation). A layer of clean sand is placed in the boring bottom to support a float valve and temporary perforated well casing pipe. In addition, sand is poured around the outside of the well casing within the test zone to prevent the boring from caving/collapsing or eroding when water is added. The float valve, placed inside the casing, adds water stored in barrels at the top of the hole to the boring as water infiltrates into the soil, while maintaining a relatively constant water head in the boring. The infiltration rate as measured during intervals of the test is defined as the incremental flow rate of water infiltrated, divided by the surface area of the infiltration interface. The test was conducted based on the USBR 7300-89 test method.

LB-1 and LB-2 (Leighton, 2015) were conducted at the planned basin on the eastern side of the property, just north of 20th Street. The design at that time called for a cut on the order of 5 to 20 feet to achieve design grade for the basin. Borings drilled in this area encountered older alluvium to a depth of 21.5 feet (LB-1, design cut to basin bottom of 5 feet), and bedrock at 15 feet (LB-2, design cut to basin bottom of 20 feet).

The infiltration rates of small-scale tests LB-1 through LB-11 (Leighton, 2015) ranged from approximately 3 to 16 inches per hour (prior to applying correction factors or a factor of safety). Design rates, correction factors, and other

infiltration facility recommendations are discussed in Section 3.6. Infiltration test results are provided in Appendix B.

Measured infiltration rates of the small-scale tests at LB-1 (Leighton, 2015) at depths of 7.8 to 15 feet bgs were on the order of 1.9 inches per hour. Measured infiltration rates of the small-scale test at LB-2 at depths of 19.2 to 30 feet bgs were on the order of 0.0 inch per hour.

LB-3 and LB-4 (Leighton, 2015) were conducted at the basin planned at that time in the northeastern portion of the site. That basin design required a cut of roughly 0 to 25 feet to achieve design grade for this basin. In this area, bedrock was encountered at a depth of 45 feet bgs. There was an existing natural drainage channel north of this proposed basin with a bottom elevation lower than the proposed basin bottom. Measured infiltration rates of the small-scale test at LB-3 (design cut to basin bottom of 0 to 5 feet) at depths of 6.2 to 12 feet bgs were on the order of 1.1 inches per hour. Measured infiltration rates of the small-scale test at LB-4 (design cut to basin bottom of 20 to 25 feet) at depths of 20.8 to 30 feet bgs were on the order of 2.4 inches per hour.

Two percolation tests were conducted to estimate infiltration rates at a planned basin on the west side of the project (TP-4) and in possible bioswale area (TP-1) in the northeastern portions of the site (Leighton, 2015). Percolation tests were conducted at depths of approximately 5 to 6.5 feet bgs at these locations. The percolation test consisted of excavating a 20-inch-deep, 7- to 10-inch-diameter boring in the bottom of the test pit, placing a perforated cylinder in the test hole and backfilling with sand and gravel around the test hole. The boring was then repeatedly filled with water and the drop in water level measured over time. The test results give a percolation rate which is then converted to infiltration rate.

Infiltration rates for these small-scale tests ranged from approximately 5 to 8 inches per hour (no correction factor or factor of safety applied). Infiltration testing within TP-1 showed a result of about 5 inches per hour. Infiltration testing within TP-4 showed a result of about 8 inches per hour. These results are considered a feasible rate for reliance on infiltration in these locations.

Design rates, correction factors, and other infiltration facility recommendations are discussed in Section 3.6. Infiltration test results are provided in Appendix B. The test locations are shown on the Geotechnical Map (Plate 1).

Percolation tests were also planned at several other areas of the site in 2015 (TP-2, TP-3, TP-5, TP-6, TP-7, TP-9 TP-10 and TP-11). However, granitic bedrock was encountered in the test pits in these areas, and infiltration at these locations is not considered feasible.

2.7 Faulting and Seismicity

Our review of available in-house literature indicates that there are no known active faults traversing the site. The closest known active or potentially active fault is the San Jacinto Fault, located approximately 6 miles northeast of the site. The principal seismic hazard that could affect the site is ground shaking resulting from an earthquake occurring along several major active or potentially active faults in southern California. The known regional active and potentially active faults that could produce the most significant ground shaking at the site include the San Jacinto-San Bernardino, San Jacinto-San Jacinto Valley, Cucamonga, San Andreas-San Bernardino, San Andreas-Southern, Chino-Central Avenue, San Jose, Cleghorn, Elsinore-Glen Ivy, and Whittier faults.

We have selected Site Class D for seismic analysis of the site. The Mapped MCE Geometric Mean Peak Ground Acceleration (PGA) is 0.83g based on ASCE-7-16 Figure 22-7. Probabilistic magnitude was estimated using hazard deaggregation from using the United States Geological Survey's (USGS) 2008 Interactive Deaggregations utility. The results of this analysis indicate that the predominant modal earthquake has a magnitude of approximately 8.1 (M_W) at a distance on the order of 11 kilometers for the Maximum Considered Earthquake (2% probability of exceedance in 50 years).

Based on ASCE 7-16 Equation 11.8-1, the F_{PGA} is 1.1, the PGA is 0.57g, and the PGA_M is 0.63g.

2.8 Secondary Seismic Hazards

In general, secondary seismic hazards for sites in the region could include soil liquefaction, earthquake-induced settlement, lateral displacement, landsliding, and earthquake-induced flooding. The potential for secondary seismic hazards at the site is discussed below.

2.8.1 Liquefaction Potential

Liquefaction is the loss of soil strength or stiffness due to a buildup of pore-water pressure during severe ground shaking. Liquefaction is associated primarily with loose (low density), saturated, fine-to-medium grained, cohesionless soils. As the shaking action of an earthquake progresses, the soil grains are rearranged and the soil densifies within a short period of time. Rapid densification of the soil results in a buildup of pore-water pressure. When the pore-water pressure approaches the total overburden pressure, the soil reduces greatly in strength and temporarily behaves similarly to a fluid. Effects of liquefaction can include sand boils, settlement, and bearing capacity failures below structural foundations.

The State of California has not prepared liquefaction hazard maps for this area. The County of Riverside has mapped a portion of the site in an area with a moderate liquefaction potential (Riverside County, 2021).

Based on a review of our previous study (Leighton, 2015) the potential for liquefaction across the majority of the site is very low due to the presence of dense soil and bedrock and the absence of shallow groundwater.

2.8.2 Seismically Induced Settlement

During a strong seismic event, seismically induced settlement can occur within loose to moderately dense, dry or saturated granular soil. Settlement caused by ground shaking is often nonuniformly distributed, which can result in differential settlement.

The majority of the site is underlain by granitic bedrock or firm older alluvial soil and seismically induced settlement is expected to be minor (generally less than 1 inch).

Considering our overexcavation/removal recommendations, the potential total settlement resulting from seismic loading is considered low (less than 1 inch) for this site. Differential settlement resulting from seismic loading is generally assumed to be one-half of the total seismically induced settlement over a distance of 40 feet.

2.8.3 Seismically Induced Slope Failures

Based on our analysis, the greatest risk of seismically induced slope failures is rock fall. Loose rocks on steep slopes can become weakened or dislodged during strong seismic shaking resulting in rock fall to the base of the slope.

3.0 CONCLUSIONS AND RECOMMENDATIONS

Based on this investigation, construction of the proposed development is feasible from a geotechnical standpoint. No severe geologic or soils related issues were identified that would preclude development of the site for the proposed improvements. The most significant geotechnical issues at the site are those related to the potential for strong seismic shaking, potentially compressible soils, rock fall hazards and hard granitic bedrock. Good planning and design of the project can limit the impact of these constraints. Remedial recommendations for these and other geotechnical issues are provided in the following sections.

3.1 General Earthwork and Grading

All grading should be performed in accordance with the General Earthwork and Grading Specifications presented in Appendix F, unless specifically revised or amended below or by future recommendations based on final development plans.

3.1.1 Site Preparation

Prior to construction, the site should be cleared of vegetation, trash and debris, which should be disposed of offsite. Any underground obstructions should be removed as should large trees and their root systems. Resulting cavities should be properly backfilled and compacted. Efforts should be made to locate existing utility lines. Those lines should be removed or rerouted if they interfere with the proposed construction, and the resulting cavities should be properly backfilled and compacted. Trees should be removed.

3.1.2 Removals and Overexcavation

The following overexcavation recommendations are based on preliminary data. These recommendations should be reviewed and revised, as necessary, based on our future review of the project site plans, grading plans, and on field conditions encountered during grading.

All uncontrolled fill, younger alluvium and the upper compressible portion of older alluvium and weathered bedrock should be removed to firm material and replaced as compacted fill. The depth of these removals is expected to range from 4 to 15 feet in alluvial areas. The actual depth of removals should be determined in the field based on observations during grading.

For proposed building pads and utility trenches in marginally rippable to non-rippable rock areas, it may be desirable to over-excavate at least 2 feet below the bottom of proposed utility trenches and 4 to 5 feet below pad grade to facilitate future trenching operations.

All removal bottoms should be surveyed by the project civil engineer prior to the placement of compacted fill. The data from that survey will be required for analysis of differential settlement under proposed building areas.

After completion of the overexcavation, and prior to fill placement, the exposed surfaces should be scarified to a minimum depth of 6 inches, moisture-conditioned, and recompacted to a minimum 90 percent relative compaction.

3.1.3 Cut/Fill Transitions and Canyon Wall Cleanouts

Building pads located on or near cut/fill transitions or areas with significant variations in fill thickness should be overexcavated to reduce the potential for differential settlement associated with the transition. Overexcavation should extend a minimum of 3 feet below the bottom of footings.

Additional recommendations may be needed based on the conditions encountered during rough grading, based on the actual subsurface conditions encountered.

Removal operations in canyon areas often result in the creation of steep canyon walls. If canyon cleanouts result in canyon sidewalls that are steeper than 1.5:1 (horizontal to vertical), we recommend that the canyon sidewalls be laid back to an inclination of 1.5:1 or flatter, such that a

steeper cut/fill transition is not created. These areas should be evaluated in the field by Leighton, based on the nature of the canyon removals and based on proposed building locations, if known at that time.

3.1.4 Groundwater and Subdrainage

Canyon subdrains should be placed after completion of compressible soil removals in canyon areas of the site. The approximate locations of recommended canyon drains are shown on the geotechnical map. Canyon subdrains should be constructed with Schedule 40 PVC pipe surrounded by 9 cubic feet per lineal foot of Class II permeable filter material. Subdrains placed along the back cut of stability fills may be constructed with 3 cubic feet per lineal foot of Class II permeable filter material with outlet cannons provided every 100 feet laterally. Local areas of particularly abundant groundwater (if encountered) may require subdrainage. All subdrains should be constructed in accordance with the standard specifications presented in Appendix F. The location of all subdrains should be surveyed by the project civil engineer.

3.1.5 Fill Placement

The onsite soils and bedrock are generally suitable for use as compacted structural fill, provided that they are free of oversized material (rock larger than 12 inches in dimension) organic material, and construction debris. Import soil to be placed as fill should be evaluated by Leighton. Fill soils should be placed in accordance with the General Earthwork and Grading Specifications (Appendix F), except as amended herein.

Prior to compaction, all fill soil should be placed in thin, loose lifts roughly 8 inches in thickness. In areas where the fill depth is less than 30 feet, the fill should be moisture-conditioned (moistened or dried), as necessary, to at least optimum moisture content and compacted to a minimum 90 percent relative compaction, as determined by ASTM Test Method D1557. We recommend fill placed at depths greater than 30 feet below design grade be placed using a minimum standard of 95 percent relative compaction and at least optimum moisture content.

Oversize material will be generated from bedrock areas during grading of the site. Placement of oversize material should be conducted as noted in Section 3.1.8.

3.1.6 Shrinkage and Bulking

The change in volume of excavated materials upon recompaction as fill can vary significantly based on soil type and location. This volume change is represented as a percentage increase (bulking) or decrease (shrinkage) in the volume of fill materials after excavation and recompaction. Subsidence occurs as natural ground is moisture conditioned and densified to receive fill. Subsidence also can refer to settlement of the existing ground upon placement of fill.

We assume that the bedrock onsite will not shrink, but estimate it could bulk slightly (roughly 5 percent) when placed as compacted fill. The uncontrolled fill and alluvial soils onsite are expected to shrink on the order of 10 to 15 percent when placed as compacted fill.

These values can vary significantly depending on the level of fill compaction, variations in the dry density of the existing soil, and other factors that influence the amount of volume change. The preliminary estimates of shrinkage presented here are, by necessity, based on very limited data as compared to the thousands of cubic yards of earth to be moved. Adjustments to earthwork volume should be anticipated during grading of the site, and areas should be established where grades can be adjusted to accommodate variations in earthwork shrinkage or swelling.

3.1.7 Import Fill Soil

Import soil to be placed as fill should be geotechnically accepted by Leighton. Preferably at least 3 working days prior to proposed import to the site, the contractor should provide Leighton pertinent information of the proposed import soil, such as location of the soil, whether stockpiled or native in place, and pertinent geotechnical reports if available. We recommend that a Leighton representative visit the proposed import site to observe the soil conditions and obtain representative soil

samples. Potential issues may include soil that is more expansive than onsite soil, soil that is too wet, soil that is too rocky or too dissimilar to onsite soils, oversize material, organics, debris, etc.

3.1.8 Rippability and Oversized Material

The granitic bedrock onsite is hard, as evidenced by outcrops of rock on the surface and exposures in excavations present around the site. In general, based on our field work, the upper portion of the bedrock appears to be rippable to depths on the order of 15 to 20 feet and perhaps as deep as 30 feet. However, very hard bedrock with high seismic velocities was encountered at depths a shallow as 5 to 10 feet. Blasting of the bedrock in cuts deeper than about 20 to 30 feet should be expected, and blasting will be required at shallower depths in some areas.

For proposed building pads and utility trenches in marginally rippable to non-rippable rock areas, it may be desirable to over-excavate at least 2 feet below the bottom of proposed utility trenches and 5 feet below pad grade to facilitate future trenching operations.

Based on the results of our field work, we anticipate that considerable quantities of rock fragments and oversized rock will be generated during rough grading. Therefore, rock disposal during grading of the site will be needed. Disposing of rock and rock fragments can be performed in the following manner based on the size of the material:

Rock and Rock Fragments 12 Inches in Dimension or Less

Soil should be placed as a fill cap in areas to receive fill. Within this fill cap, rock and rock fragments 12 inches or less in largest dimension may be combined with finer material. These materials should be placed, as a minimum, in the upper 5 feet below finished grade on fill lots and lots overexcavated due to the presence of hard rock or due to cut/fill transitions. The outer 10 feet of slope faces should be constructed with 12-inch minus fill material. In street areas, 12-inch minus fill material should be placed within the entire street right-of-way to the bottom elevation of the lowest utility.

Fill cap material consisting of 12-inch minus rock, rock fragments and finer material should be placed in maximum one-foot-thick lifts, moisture-conditioned, as necessary, to at least optimum moisture content (greater if the soil remains workable) and recompacted to a minimum of 90 percent relative compaction.

Rock and Rock Fragments Greater Than 12 inches and Less Than 36 Inches

We anticipate that a significant quantity of rock and rock fragments greater than 12 inches and less than 36 inches in largest dimension will be generated during rough grading. Rock in this size range should be incorporated into fills with finer material in the form of rock blankets. Rock blankets should have a maximum thickness of 24 to 36 inches. Sufficient quantities of finer material must be incorporated into the rock blankets to prevent nesting and to fill voids.

Rock blankets should be restricted to those areas that are at least one foot below the lowest utility invert within street rights-of-way, 5 feet below finish pad grade on fill lots, and within 10 feet (measured horizontally) from the face of fill slopes.

Rock material should be moisture conditioned in excess of optimum moisture content (within workable limits) and compacted by wheel rolling with scrapers and water trucks, track walking with dozers, and/or with sheepsfoot rollers. Each rock blanket should be completed and its surface compacted prior to beginning another rock blanket, a rock windrow or a 12-inch-minus fill cap.

Rock Greater Than 36 Inches in Dimension

Oversized material greater than 36 inches in largest dimension should be placed in rock windrows. Rocks placed in windrows should be placed such that they are not nested. The void spaces between the rocks should be filled with the more granular material onsite. This material should be flooded into the voids. Horizontal spacing between windrows should be at least an equipment (scraper) width to facilitate working the fine material

into the windrows from the sides and top. A minimum of 3 feet of 12-inch-minus fill material should be placed over windrows prior to initiating another windrow. Windrows should be staggered such that no windrows are directly above another on subsequent lifts. Windrows should be placed perpendicular to the face of slopes and should be terminated 15 feet from the face of fill slopes. Windrows should be placed a minimum of 10 feet below finish grade.

Large rocks can also be buried individually within 12-inch-minus fill (below 10 feet or below the minimum cap thickness) or in native ground. This can be accomplished by excavating a dozer trench to a minimum depth of one foot greater than the largest dimension of the rock. The area around and beneath the rock should be filled with the more granular material onsite and flooded in place to fill all voids. Individually buried rock should be spaced no closer than 15 feet from one another and at least 6 feet of compacted fill must be placed over a buried individual rock prior to placing another rock directly over it. Individual rocks can be buried at closer vertical intervals provided they are staggered in accordance with Leighton's field recommendations.

We recommend that, where possible, large rocks be incorporated into nonstructural fills, placed in open (green belt) areas or incorporated into the finished landscape by the landscape architect. A representative of Leighton and Associates should observe the placement of rock fills, individual rocks, and rock windrows. Observation pits should be excavated into the rock fills periodically to observe for evidence of voids and rock nesting.

If sufficiently deep fill areas are not available, size reduction processing or off-site disposal may be required. Other uses of resistant rock may include onsite riprap or crushing/processing for aggregate base materials.

3.2 Shallow Foundation Recommendations

Overexcavation and recompaction of the footing subgrade soil should be performed as detailed in Section 3.1. The following recommendations are based on the onsite soil conditions and soils with a low expansion potential.

3.2.1 Minimum Embedment and Width

Footings should have a minimum embedment in accordance with the California Building Code (CBC), with a minimum width of 24 and 12 inches for isolated and continuous footings, respectively.

3.2.2 Allowable Bearing

An allowable bearing pressure of 1,800 pounds-per-square-foot (psf) may be used for single family residences based on the minimum embedment depth and width above. This allowable bearing value may be increased by 250 psf per foot increase in depth or width to a maximum allowable bearing pressure of 2,500 psf. If higher bearing pressures are required, this should be reviewed on a case-by-case basis. These allowable bearing pressures are for total dead load and sustained live loads. Footing reinforcement should be designed by the structural engineer.

3.2.3 Lateral Load Resistance

Soil resistance available to withstand lateral loads on a shallow foundation is a function of the frictional resistance along the base of the footing and the passive resistance that may develop as the face of the structure tends to move into the soil. The frictional resistance between the base of the foundation and the subgrade soil may be computed using a coefficient of friction of 0.30. The passive resistance may be computed using an allowable equivalent fluid pressure of 240 pounds per cubic foot (pcf), assuming there is constant contact between the footing and undisturbed soil. The coefficient of friction and passive resistance may be combined without further reduction.

3.2.4 Increase in Bearing and Friction - Short Duration Loads

The allowable bearing pressure and coefficient of friction values may be increased by one-third when considering loads of short duration, such as those imposed by wind and seismic forces.

3.3 Recommendations for Slabs-On-Grade

Concrete slabs-on-grade should be designed by the structural engineer in accordance with the current CBC for a soil with a very low expansion potential. Where conventional light floor loading conditions exist, the following minimum recommendations should be used. More stringent requirements may be required by local agencies, the structural engineer, the architect, or the CBC. Laboratory testing should be conducted at finish grade to evaluate the Expansion Index (EI) of near-surface subgrade soils. Slabs-on-grade should have the following minimum recommended components:

Subgrade Moisture Conditioning: The subgrade soil should be moisture conditioned to at least 2 percent above optimum moisture content to a minimum depth of 18 inches prior to placing steel or concrete.

- Moisture Vapor Retarder: A minimum of a 10-mil vapor retarder should be placed below slabs where moisture-sensitive floor coverings or equipment is planned. Since moisture will otherwise be transmitted up from the soil through the concrete, it is important that an intact vapor retarder be installed. We recommend that the vapor retarder meet the requirements of ASTM E1745 and be installed per ASTM E1643. The structural engineer should specify pertinent concrete design parameters and moisture migration prevention measures, such as vapor retarder selection and whether a sand blotter layer should be placed over the vapor retarder. Gravel or other protruding objects that could puncture the moisture retarder should be removed from the subgrade prior to placing the vapor retarder, or a stronger vapor retarder intended for the specific conditions present can be used.

- Concrete Thickness: Slabs-on-grade should be at least 4 inches thick. Reinforcing steel should be designed by the structural engineer, but as a minimum should be No. 3 rebar placed at 18 inches on center, each direction, mid-depth in the slab.

Minor cracking of the concrete as it cures, due to drying and shrinkage is normal and should be expected. However, cracking is often aggravated by a high water/cement ratio, high concrete temperature at the time of placement, small nominal aggregate size, and rapid moisture loss due to hot, dry, and/or windy

weather conditions during placement and curing. Cracking due to temperature and moisture fluctuations can also be expected. Low slump concrete can reduce the potential for shrinkage cracking. Additionally, our experience indicates that reinforcement in slabs and foundations can generally reduce the potential for concrete cracking. The structural engineer should consider these components in slab design and specifications.

Moisture retarders can reduce, but not eliminate moisture vapor rise from the underlying soils up through the slab. Floor covering manufacturers should be consulted for specific recommendations.

Leighton does not practice in the field of moisture vapor transmission evaluation, since this is not specifically a geotechnical issue. Therefore, we recommend that a qualified person, such as the flooring subcontractor and/or structural engineer, be consulted with to evaluate the general and specific moisture vapor transmission paths and any impact on the proposed construction. That person should provide recommendations for mitigation of potential adverse impact of moisture vapor transmission on various components of the structures as deemed appropriate.

3.4 Seismic Design Parameters

The site will experience strong ground shaking after the proposed project is developed resulting from an earthquake occurring along one or more of the major active or potentially active faults in southern California. Accordingly, the project should be designed in accordance with all applicable current codes and standards utilizing the appropriate seismic design parameters to reduce seismic risk as defined by California Geological Survey (CGS) Chapter 2 of Special Publication 117a (CGS, 2008). Through compliance with these regulatory requirements and the utilization of appropriate seismic design parameters selected by the design professionals, potential effects relating to seismic shaking can be reduced.

The following parameters should be considered for design under the 2019 CBC:

2019 CBC Parameters (CBC or ASCE 7-16 reference)	Value 2019 CBC
Site Latitude and Longitude (degrees):	34.0282, -117.4038
Site Class Definition (1613.2.2, ASCE 7-16 Ch 20)	C
Mapped Spectral Response Acceleration at 0.2s Period (1613.2.1), S_s	1.500 g
Mapped Spectral Response Acceleration at 1s Period (1613.2.1), S_1	0.600 g
Short Period Site Coefficient at 0.2s Period (T1613.2.3(1)), F_a	1.200
Long Period Site Coefficient at 1s Period (T1613.2.3(2)), F_v	1.400
Adjusted Spectral Response Acceleration at 0.2s Period (1613.2.3), S_{MS}	1.800 g
Adjusted Spectral Response Acceleration at 1s Period (1613.2.3), S_{M1}	0.840 g
Design Spectral Response Acceleration at 0.2s Period (1613.2.4), S_{DS}	1.200 g
Design Spectral Response Acceleration at 1s Period (1613.2.4), S_{D1}	0.560 g
Mapped MCE_G peak ground acceleration (11.8.3.2, Fig 22-9 to 13), ***PGA***	0.573 g
Site Coefficient for Mapped MCE_G *PGA* (11.8.3.2), F_{PGA}	1.200
Site-Modified Peak Ground Acceleration (1803.5.12; 11.8.3.2), PGA_M	0.688 g

3.5 Retaining Walls

We recommend that retaining walls be backfilled with very low expansive soil and constructed with a backdrain in accordance with the recommendations provided on Figure 3 (rear of text). Using expansive soil as retaining wall backfill will result in higher lateral earth pressures exerted on the wall. Based on these recommendations, the following parameters may be used for the design of conventional retaining walls:

Static Equivalent Fluid Weight for Sand Backfill (pcf)		
Condition	Level Backfill	2:1 Sloping Backfill
Active	37	60
At-Rest	58	89
Passive	300 (Maximum of 5,400 psf)	170 (2:1 Sloping Front)

The above values do not contain an appreciable factor of safety except the passive pressure, so the structural engineer should apply the applicable factors of safety and/or load factors during design, as specified by the California Building Code.

Cantilever walls that are designed to yield at least 0.001H, where H is equal to the wall height, may be designed using the active condition. Rigid walls and walls braced at the top should be designed using the at-rest condition.

Passive pressure is used to compute soil resistance to lateral structural movement. In addition, for sliding resistance, a frictional resistance coefficient of 0.3 may be used at the concrete and soil interface. The lateral passive resistance should be taken into account only if it is ensured that the soil providing passive resistance, embedded against the foundation elements, will remain intact with time.

In addition to the above lateral forces due to retained earth, surcharge due to improvements, such as an adjacent structure or traffic loading, should be considered in the design of the retaining wall. Loads applied within a 1:1 projection from the surcharging structure on the stem of the wall should be considered in the design.

Walls retaining over 6 feet of soil should be reviewed on a case-by-case basis, and will require a seismic coefficient based on conditions of the walls.

A soil unit weight of 120 pcf may be assumed for calculating the actual weight of the soil over the wall footing.

3.6 Infiltration Basin Design

Small–scale infiltration testing had been previously conducted at several locations onsite (Leighton, 2015). Well permeameter tests were conducted for basins planned in 2015, which were located in the east central portion of the site north of and adjacent to 20th Street (LB-1 and LB-2) and at the basin in the northeast portion of the site at Alicante Avenue (LB-3 and LB-4). Percolation tests were also conducted at a proposed basin in the western portion of the site (TP-4) and in a slope area in the northeast (TP-1).

Infiltration tests were conducted in LB-1 and LB-2 at the planned basin on the eastern side of the property, just west of 20th Street. Based on the data collected, the northern portion of the basin is anticipated to be underlain by granitic bedrock with a measured small-scale infiltration rate of approximately 0 inch per hour. The southern portion of the basin will be underlain by older alluvium with a measured small-scale infiltration rate of 1.9 inches per hour. However, due to shallow bedrock, infiltration into this basin is considered infeasible.

Infiltration tests were previously conducted in LB-3 and LB-4 (Leighton, 2015) at the basin planned at that time in the northeastern portion of the site off of Alicante Avenue. Based on the data collected, this basin will be underlain by older alluvial soil. Measured small-scale infiltration rates range from 1.1 to 2.4 in./hr. We recommended an unfactored infiltration rate of 1.1 in./hr be used for this basin.

For the basin in the western portion of the site (vicinity TP-4) a small-scale infiltration rate of 8 in./hr was measured (Leighton, 2015). However, the geologic conditions in this area are variable with granitic bedrock present at relatively shallow depth. As such, infiltration within this basin is considered infeasible.

At location TP-1 at a depth of 5 feet, a small-scale infiltration rate of about 5 in./hr was measured.

We had recommended that a correction factor/safety factor be applied to all infiltration rates in conformance with the Riverside County Technical Guidance Document for WQMP, since monitoring of actual facility performance has shown that actual infiltration rates are lower than for small-scale tests. The small-scale infiltration rate should be divided by a correction factor of at least 3, but the correction/safety factor may be higher based on project-specific aspects.

Infiltration tests were also planned at several other areas of the site (TP-2, TP-3, TP-5, TP-6, TP-7, TP-9 TP-10 and TP-11). However, granitic bedrock was encountered in the test pits in these areas, and infiltration at these locations is not considered feasible.

These values were for a clean, unsilted infiltration surface in native, sandy alluvial soil. These values may be reduced over time as silting of the basin occurs. Furthermore, if the basin or chamber bottom is allowed to be compacted by heavy equipment, this value is expected to be significantly reduced. Infiltration of water through soil is highly dependent on such factors as grain size distribution of the soil particles, particle shape, clay content, and density. Small changes in soil conditions, including density, can cause large differences in observed infiltration rates.

Based on our infiltration testing in 2015, infiltration is not suitable in compacted fill nor in areas underlain by bedrock at the surface or at shallow depths (10 feet or less). All basins currently proposed for the development are underlain by either bedrock or shallow bedrock and infiltration at these locations are expected to not be feasible.

3.7 Pavement Design

Based on the design procedures outlined in the current Caltrans Highway Design Manual, and using an assumed design R-value of 50, flexible pavement sections may consist of the following for the Traffic Indices indicated. Final pavement design should be based on the Traffic Index determined by the project civil engineer and R-value testing provided near the end of grading.

Asphalt Pavement Section Thickness, Type I Subgrade Soil

Traffic Index	Asphaltic Concrete (AC) Thickness (inches)	Class 2 Aggregate Base Thickness (inches)	Total Pavement Section Thickness (inches)
5 or less	3	4	7
6	3	4.5	7.5
7	4	4.5	8.5

All pavement construction should be performed in accordance with the Standard Specifications for Public Works Construction or Caltrans Specifications. Field observations and periodic testing, as needed during placement of the base course materials, should be undertaken to ensure that the requirements of the standard specifications are fulfilled.

Prior to placement of aggregate base, the subgrade soil should be processed to a minimum depth of 6 inches, moisture-conditioned, as necessary, and recompacted to a minimum of 90 percent relative compaction. Aggregate base should be moisture conditioned, as necessary, and compacted to a minimum of 95 percent relative compaction.

If the pavement is to be constructed prior to construction of the structures, we recommend that the full depth of the pavement section be placed in order to support heavy construction traffic.

3.8 Temporary Excavations

All temporary excavations, including utility trenches, retaining wall excavations and other excavations should be performed in accordance with project plans, specifications and all OSHA requirements.

No surcharge loads should be permitted within a horizontal distance equal to the height of cut or 5 feet, whichever is greater from the top of the slope, unless the cut is shored appropriately. Excavations that extend below an imaginary plane inclined at 45 degrees below the edge of any adjacent existing site foundation should be properly shored to maintain support of the adjacent structures.

Cantilever shoring should be designed based on an active equivalent fluid pressure of 35 pcf. If excavations are braced at the top and at specific design intervals, the active pressure may then be approximated by a rectangular soil pressure distribution with the pressure per foot of width equal to 25H, where H is equal to the depth of the excavation being shored.

During construction, the soil conditions should be regularly evaluated to verify that conditions are as anticipated. The contractor should be responsible for providing the "competent person" required by OSHA, standards to evaluate soil conditions. Close coordination between the competent person and the geotechnical engineer should be maintained to facilitate construction while providing safe excavations.

3.9 Slope Stability

Numerous manufactured cut and fill slopes are planned as part of the development. Cut slopes are planned to a maximum height of about 150 feet excavated at 2:1 or flatter. These slopes excavated into the existing granitic bedrock or older alluvial soils are expected to be grossly and surficially stable as designed. However, the slopes should be mapped in detail during construction to confirm the geologic conditions. Additional review and analysis of the slope conditions should be conducted as the project proceeds.

The surficial stability of slopes to remain natural is dependent on the thickness of weaker surficial soils and slope gradient. Thick accumulations of surficial soils on steep slopes are susceptible to surficial failures, mudflows and downhill creep during periods of heavy rainfall.

Several areas of the development are located immediately below natural slopes that may experience surficial failures. To mitigate the potential damage from debris flows and slumps, we recommend that debris catchment basins be provided where canyons and reentrants descend to the area of the development. In addition, we recommend that debris deflection/impact walls or earthen berms be constructed at the base of natural slopes adjacent to the development. Specific locations for construction of debris protection measures should be established as the project proceeds and more detailed grading plans are developed.

3.10 Rock Fall

Some of the hillsides within the site and adjacent to the development are covered with exposed bedrock outcrops and subrounded to rounded boulders, and there is a potential for surficial instability and rockfall in these areas. In some areas, individual rocks or isolated out crops create a localized hazard of rock fall. In other areas, a significant portion of the slope above the development is covered with rock out crops of loose boulders. Areas with significant rock fall hazards are noted on the geotechnical map and include the natural slope north of 20th Street where it enters the site. Granitic boulders at the base of this and other slopes are evidence of past rock fall. Rock fall can present a hazard to improvements at the base of the slope if not mitigated or considered in the project design.

In areas with isolated rock outcrops or loose rocks, it may be possible to remove or break individual rocks and remove the hazard. However in areas with numerous rocks on steep slopes, mitigation for the area should be provided.

To mitigate the potential for rock fall in these areas, the project design should incorporate walls, berms, setback areas, and/or rock fences to separate the development from the rock fall hazard area. Mitigation options for rock fall hazard include:

- Implementation of a 50- to 75-foot setback from the toe of the natural slope to the future property line of the proposed lots and construction of a conventional block wall or other type of ridged fence that will provide some additional measure of protection from potential rockfall hazard.

- Construction of a debris ditch as shown in Figure 2, drawing 2.1, with an 8-foot-tall, 1-1/2:1 geogrid reinforced manufactured slope. Also construct a 5-foot-tall, top of slope conventional block wall or other type of fence that will provide some additional measure of protection from potential rockfall hazard. The toe of the manufactured slope should be a minimum 15 feet from the toe of the natural slope.

- Construction of a debris ditch as shown in Figure 2, drawing 2.2, with a 5-foot-tall, 2:1 manufactured slope and 5-foot-tall, top of slope impact wall. The wall should be designed using an equivalent fluid pressure of 125 pcf. The toe of the manufactured slope should be a minimum 15 feet from the toe of the natural slope.

- Construction of a debris ditch as shown in Figure 2, drawing 2.3, with a 5-foot-tall retaining wall. The base of the wall should be a minimum of 15 feet from the toe of the natural slope.

In general, impact walls and rock fences are generally more intrusive and aesthetically less appealing than a rock encatchment area or building setback. Building setbacks generally require more land and the loss of more space than rock encatchment areas, however, they can likely be used to accommodate open space, drainage, or greenbelt requirements.

The remedial alternative(s) selected for the project should be designed by the project civil engineer in consultation with Leighton and Associates, taking into consideration the specific rockfall hazards (or perceived hazard) in the area and site drainage characteristics. We assume that an encatchment area would also serve as a drainage course for runoff from the foothills. The actual drainage device should be located nearer to the toe of the natural slope as opposed to adjacent to the rockfall hazard remediation device. The encatchment area can be constructed by elevating the lots adjacent to the hillside or by excavating a wide ditch or trough at the rear of the lots. Alternative designs can also be considered as the project proceeds, and depending on the site conditions it may be possible to construct mitigation such as those noted above, but reduced in scale.

Leighton and Associates should be consulted to identify individual rocks within each of the zones that should be removed or blasted as part of the rockfall hazard mitigation.

Prospective homebuyer perception of the rockfall hazard should be considered when designing the rockfall remedial measures.

3.11 Trench Backfill

Utility-type trenches onsite can be backfilled with onsite material, provided it is free of debris, significant organic material and oversized material (greater than 3 inches for trench backfill within 3 feet of a pipe, and 6 inches for trench backfill above). Prior to backfilling the trench, pipes should be bedded and shaded in a granular material that has a sand equivalent of 30 or greater. We recommend that open-graded crushed rock or similar material not be used as bedding material, unless special provisions are implemented to limit the migration of surrounding soil into the open-graded material, including the use of filter fabric around the open-graded material. The bedding material should extend 12 inches above the top of the pipe. The bedding/shading sand should be densified in-place by mechanical means, or in areas where the trench walls and bottom soil have a minimum sand equivalent of 15, the bedding sand may be jetted. Bedding sand should be placed in accordance with the Standard Specifications for Public Works Construction – Greenbook (Public Works Standard, Inc., 2009), current edition. The native soil fill should be placed in loose layers, moisture

conditioned, as necessary, and mechanically compacted using a minimum standard of 90 percent relative compaction based on ASTM D 1557. The thickness of layers should be based on the compaction equipment used in accordance with the current Greenbook.

3.12 Surface Drainage

Inadequate control of runoff water and/or poorly controlled irrigation can cause the onsite soils to expand and/or shrink, producing heaving and/or settlement of foundations, flatwork, walls, and other improvements. Maintaining adequate surface drainage, proper disposal of runoff water, and control of irrigation should help reduce the potential for future soil moisture problems.

Positive surface drainage should be designed to be directed away from foundations and toward approved drainage devices, such as gutters, paved drainage swales, or watertight area drains and collector pipes.

Surface drainage should be provided to prevent ponding of water adjacent to the structures. In general, the area around the buildings should slope away from the building. We recommend that unpaved landscaped areas adjacent to the buildings be avoided. Roof runoff should be carried to suitable drainage outlets by watertight drain pipes or over paved areas.

3.13 Sulfate Attack and Corrosion Protection

Based on the results of previous laboratory testing (Leighton 2015), concrete structures in contact with the onsite soil will have negligible exposure to water-soluble sulfates in the soil. Type II cement may be used for concrete construction. The concrete should be designed in accordance with Table 4.3.1 of the American Concrete Institute ACI 318-14 provisions (ACI, 2014).

Based on our previous laboratory testing, the onsite soil is considered to be moderately corrosive to ferrous metals. Corrosion information presented in this report should be provided to your underground utility subcontractors. Additional testing and evaluation by a corrosion engineer may be warranted if corrosion protection is considered critical to the project.

3.14 Additional Geotechnical Services

The preliminary geotechnical recommendations presented in this report are based on subsurface conditions as interpreted from limited subsurface explorations and limited laboratory testing. Our preliminary geotechnical recommendations provided in this report are based on information available at the time the report was prepared and may change as plans are developed. Additional geotechnical investigation and analysis will be required based as the project proceeds and grading plans are prepared. Leighton should review the site and grading plans when available and comment further on the geotechnical aspects of the project. Geotechnical observation and testing should be conducted during excavation and all phases of grading operations. Our conclusions and preliminary recommendations should be reviewed and verified by Leighton during construction and revised accordingly if geotechnical conditions encountered vary from our preliminary findings and interpretations. Geotechnical observation and testing should be provided:

- After completion of site clearing.
- During overexcavation of compressible soil.
- During compaction of all fill materials.
- After excavation of all footings and prior to placement of concrete.
- During utility trench backfilling and compaction.
- During pavement subgrade and base preparation.
- When any unusual conditions are encountered.

4.0 LIMITATIONS

This report was based in part on data obtained from a limited number of observations, site visits, soil excavations, samples, and tests. Such information is, by necessity, incomplete. The nature of many sites is such that differing soil or geologic conditions can be present within small distances and under varying climatic conditions. Changes in subsurface conditions can and do occur over time. Therefore, our findings, conclusions, and recommendations presented in this report are based on the assumption that Leighton and Associates, Inc. will conduct additional geotechnical studies and the project proceeds and will provide geotechnical observation and testing during construction.

This report was prepared for the sole use of Richland Communities, Inc. for application to the design of the proposed residential development in accordance with generally accepted geotechnical engineering practices at this time in California.

See the Important Information About This Geotechnical-Engineering Report (from the Geotechnical Business Council) insert on the following page for important information about this geotechnical engineering report.

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled*. No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed*. The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependent

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

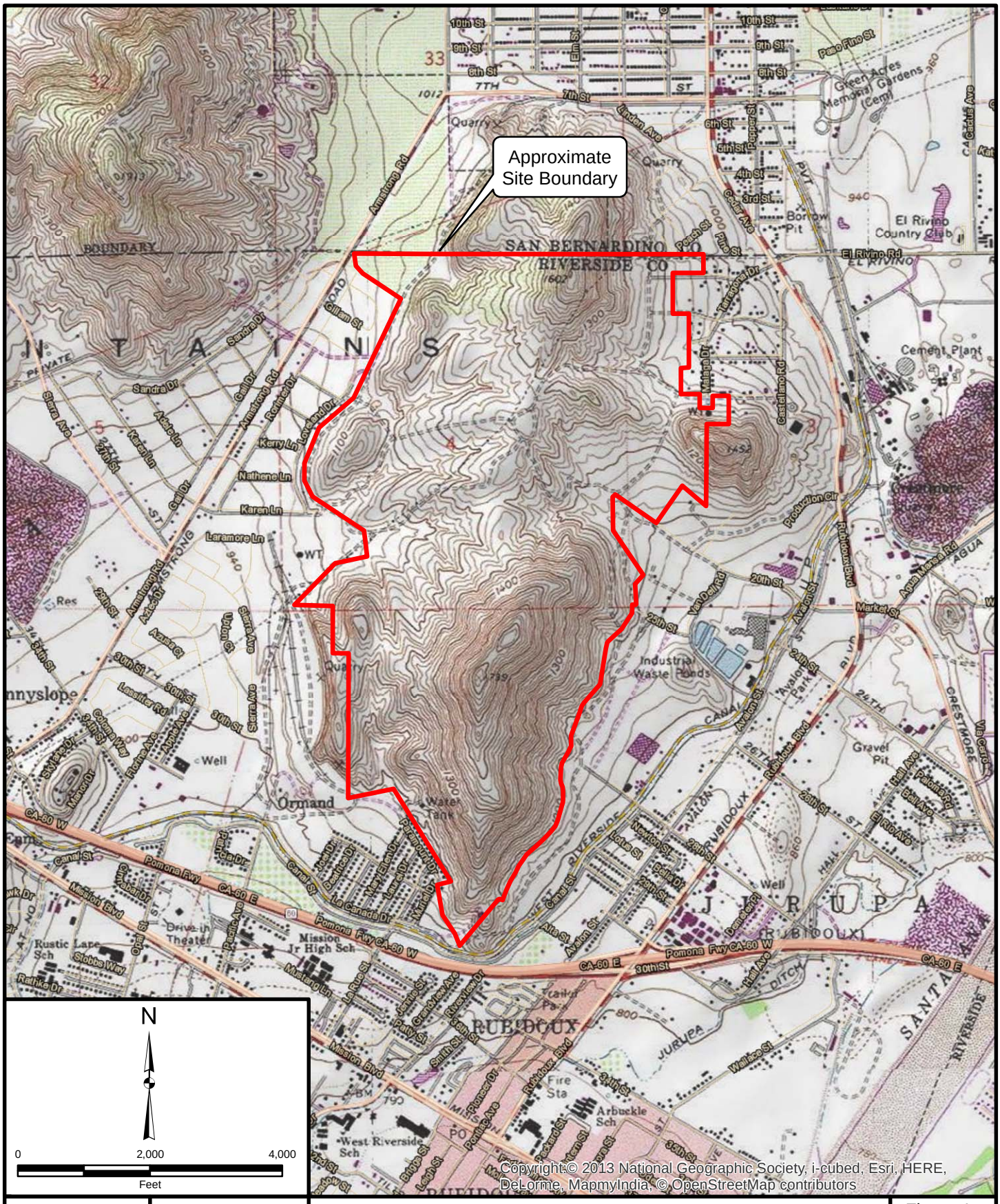
Obtain Professional Assistance to Deal with Moisture Infiltration and Mold

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

GEOPROFESSIONAL BUSINESS ASSOCIATION

Telephone: 301/565-2733
e-mail: info@geoprofessional.org www.geoprofessional.org

Copyright 2016 by Geoprofessional Business Association (GBA). Duplication, reproduction, or copying of this document, in whole or in part, by any means whatsoever, is strictly prohibited, except with GBA's specific written permission. Excerpting, quoting, or otherwise extracting wording from this document is permitted only with the express written permission of GBA, and only for purposes of scholarly research or book review. Only members of GBA may use this document or its wording as a complement to or as an element of a report of any kind. Any other firm, individual, or other entity that so uses this document without being a GBA member could be committing negligent



Project: 10270.003	Eng/Geol: JDH/SGO
Scale:1 " = 2,000 '	Date: December 2021

Base Map: ESRI ArcGIS Online 2015
Thematic Information: Leighton
Author: Leighton Geomatics (btran)

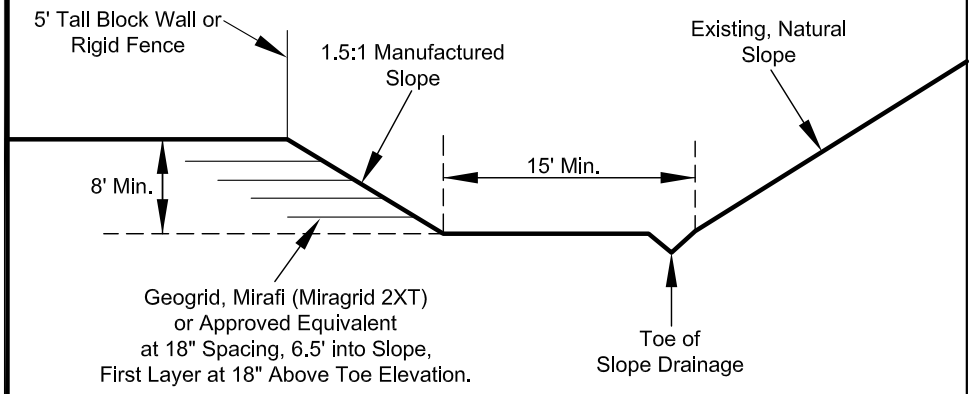
SITE LOCATION MAP

Rio Vista Development
Jurupa Valley, California

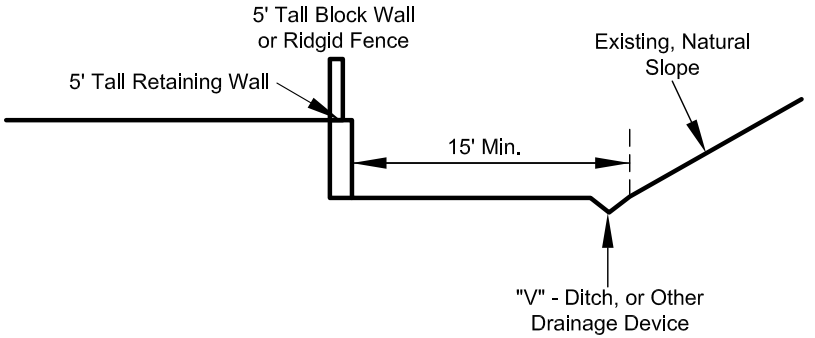
Figure 1

Leighton

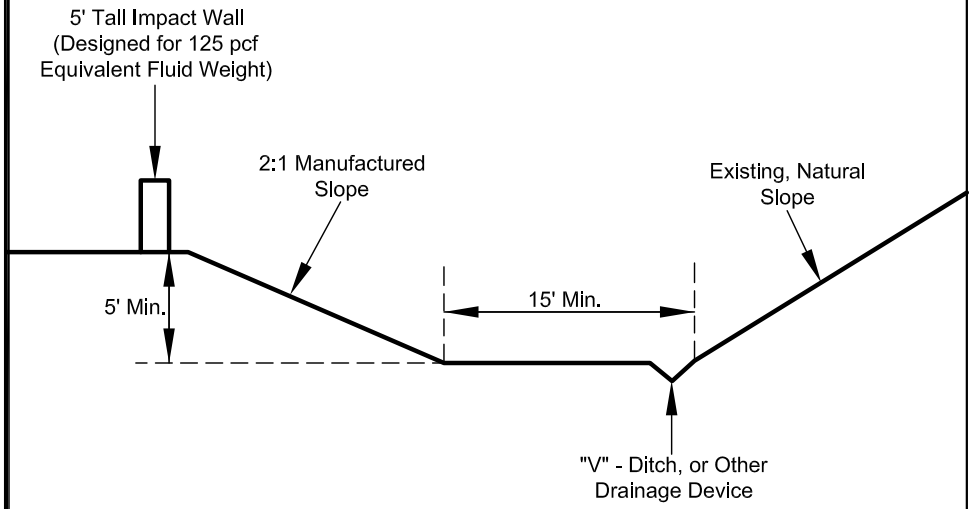
Map Saved as P:\Drafting\10270\002\Maps\10270-002_F01b_SLM_20150924.mxd on 9/24/2015 1:44:18 PM



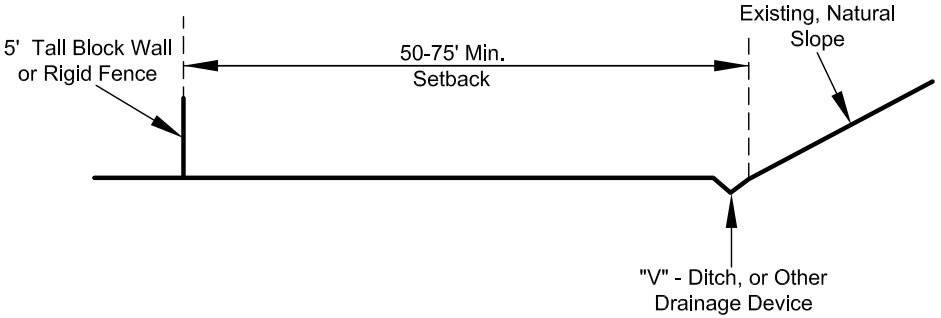
2.1



2.3



2.2



2.4

Proj: 10270.003	Eng/Geol: JDH/SGO
Scale: NTS	Date: Dec. 2021

P:\DRAFTING\10270\002\CAD\OF_2015-08-18\10270-002_F02_RHRO_20150925.DWG (09-25-15 3:28:21PM) Plotted by: btran

ROCKFALL HAZARD REMEDIAL OPTIONS

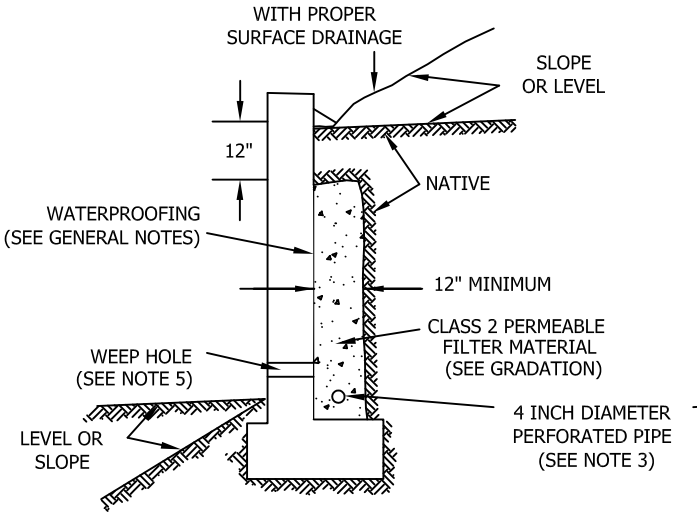
Rio Vista Development
City of Jurupa Valley, California

Figure 2

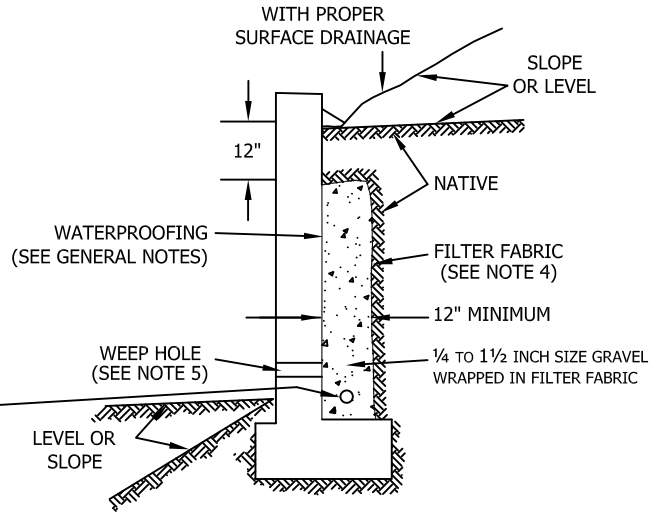
Leighton

SUBDRAIN OPTIONS AND BACKFILL WHEN NATIVE MATERIAL HAS EXPANSION INDEX OF ≤50

OPTION 1: PIPE SURROUNDED WITH CLASS 2 PERMEABLE MATERIAL



OPTION 2: GRAVEL WRAPPED IN FILTER FABRIC



Class 2 Filter Permeable Material Gradation
Per Caltrans Specifications

Sieve Size	Percent Passing
1"	100
3/4"	90-100
3/8"	40-100
No. 4	25-40
No. 8	18-33
No. 30	5-15
No. 50	0-7
No. 200	0-3

GENERAL NOTES:

* Waterproofing should be provided where moisture nuisance problem through the wall is undesirable.
* Water proofing of the walls is not under purview of the geotechnical engineer
* All drains should have a gradient of 1 percent minimum
*Outlet portion of the subdrain should have a 4-inch diameter solid pipe discharged into a suitable disposal area designed by the project engineer. The subdrain pipe should be accessible for maintenance (rodding)
*Other subdrain backfill options are subject to the review by the geotechnical engineer and modification of design parameters.

Notes:
1) Sand should have a sand equivalent of 30 or greater and may be densified by water jetting.
2) 1 Cu. ft. per ft. of 1/4- to 1 1/2-inch size gravel wrapped in filter fabric
3) Pipe type should be ASTM D1527 Acrylonitrile Butadiene Styrene (ABS) SDR35 or ASTM D1785 Polyvinyl Chloride plastic (PVC), Schedule 40, Armco A2000 PVC, or approved equivalent. Pipe should be installed with perforations down. Perforations should be 3/8 inch in diameter placed at the ends of a 120-degree arc in two rows at 3-inch on center (staggered)
4) Filter fabric should be Mirafi 140NC or approved equivalent.
5) Weephole should be 3-inch minimum diameter and provided at 10-foot maximum intervals. If exposure is permitted, weepholes should be located 12 inches above finished grade. If exposure is not permitted such as for a wall adjacent to a sidewalk/curb, a pipe under the sidewalk to be discharged through the curb face or equivalent should be provided. For a basement-type wall, a proper subdrain outlet system should be provided.
6) Retaining wall plans should be reviewed and approved by the geotechnical engineer.
7) Walls over six feet in height are subject to a special review by the geotechnical engineer and modifications to the above requirements.

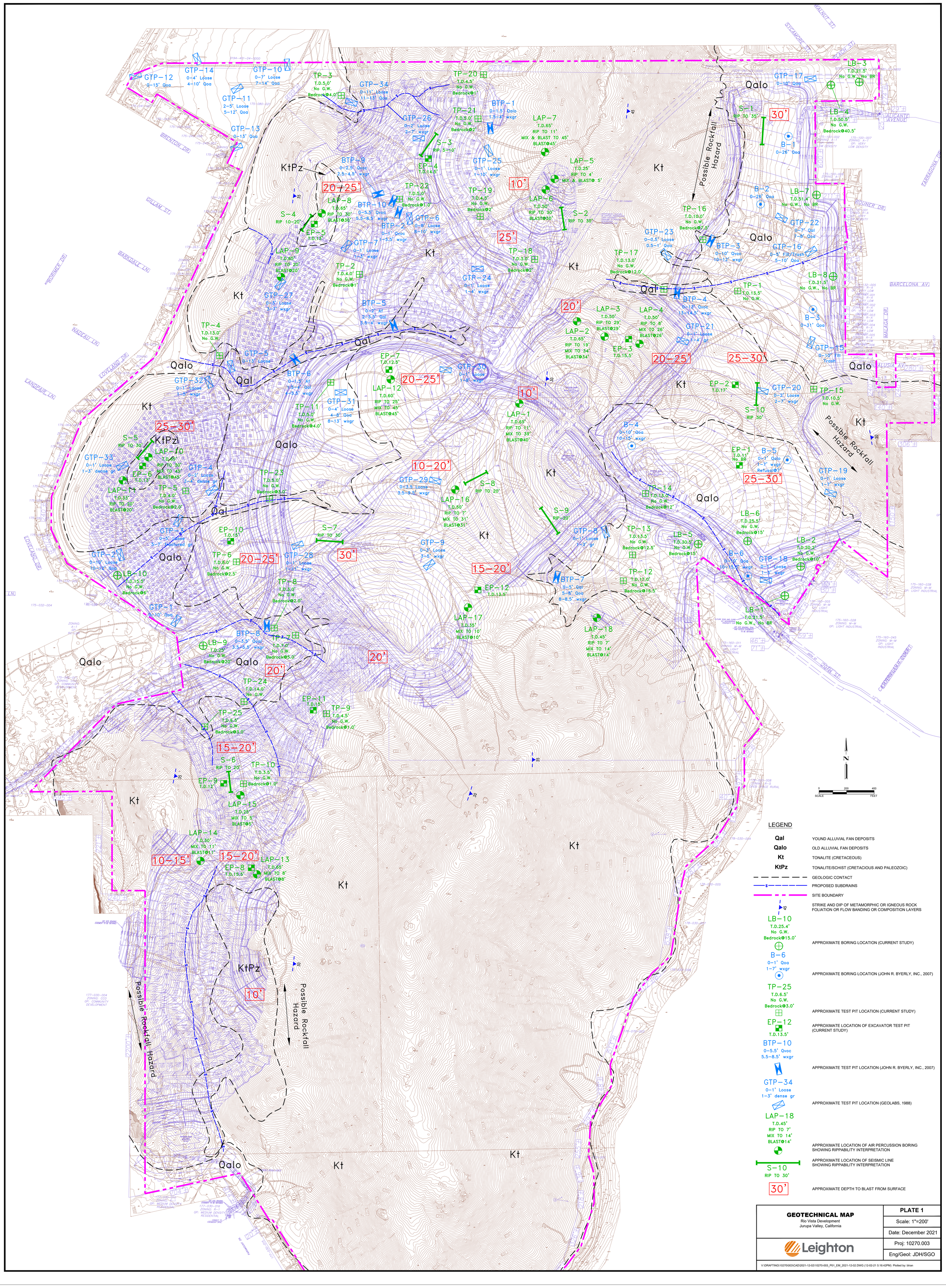
RETAINING WALL BACKFILL AND SUBDRAIN DETAIL FOR WALLS 6 FEET OR LESS IN HEIGHT

WHEN NATIVE MATERIAL HAS EXPANSION INDEX OF ≤50

Leighton

Figure 3

P:\Drafting\templates\details\retain-wall-backfill-and subdrain.dwg (7/00)



LEGEND

Qal	YOUND ALLUVIAL FAN DEPOSITS
Qalo	OLD ALLUVIAL FAN DEPOSITS
Kt	TONALITE (CRETACEOUS)
KtPz	TONALITE/SCHIST (CRETACIOUS AND PALEOZOIC)
	GEOLOGIC CONTACT
—S—	PROPOSED SUBDRAINS
	SITE BOUNDARY
45	STRIKE AND DIP OF METAMORPHIC OR IGNEOUS ROCK FOLIATION OR FLOW BANDING OR COMPOSITION LAYERS
LB-10 T.D.25.4' No G.W. Bedrock@15.0'	APPROXIMATE BORING LOCATION (CURRENT STUDY)
B-6 0-1' Qoa 1-7' wxgr	APPROXIMATE BORING LOCATION (JOHN R. BYERLY, INC., 2007)
TP-25 T.D.6.5' No G.W. Bedrock@3.0'	APPROXIMATE TEST PIT LOCATION (CURRENT STUDY)
EP-12 T.D.13.5'	APPROXIMATE LOCATION OF EXCAVATOR TEST PIT (CURRENT STUDY)
BTP-10 0-5.5' Qvoc 5.5-8.5' wxgr	APPROXIMATE TEST PIT LOCATION (JOHN R. BYERLY, INC., 2007)
GTP-34 0-1' Loose 1-3' dense gr	APPROXIMATE TEST PIT LOCATION (GEOLABS, 1988)
LAP-18 T.D.45' RIP TO 7' MIX TO 14' BLAST@14'	APPROXIMATE LOCATION OF AIR PERCUSSION BORING SHOWING RIPPABILITY INTERPRETATION
S-10 RIP TO 30'	APPROXIMATE LOCATION OF SEISMIC LINE SHOWING RIPPABILITY INTERPRETATION
30'	APPROXIMATE DEPTH TO BLAST FROM SURFACE

GEOTECHNICAL MAP
Rio Vista Development
Jurupa Valley, California

PLATE 1

Scale: 1"=200'

Date: December 2021

Leighton

Proj: 10270.003

Eng/Geol: JDH/SGO

V:\DRAFTING\10270\003\CAD\2021-12-02\10270-003_P01_EM_2021-12-02.DWG (12-02-21 5:16:42PM) Plotted by: btran

APPENDIX A

REFERENCES

APPENDIX A

References

American Concrete Institute (ACI), 2014, Building Code Requirements for Structural Concrete (ACI-318-14) and Commentary (ACI 318-14), and ACI Standard.

(ACI 318R-08), an ACI Standard, 2008.

Byerly, John, R., Inc., 2006, Soils Investigation, Rio Vista Specific Plan 243, West End of 20th Street, Rubidoux Area of Riverside County, Rpt. No. 8552, dated January 25, 2006.

_____, 2009a, Tentative Tract No. 35421, Riverside County GEO 2098, West End of 20th Street, Rubidoux Area of Riverside County, California, Supplemental Response to Geologic and Geotechnical Review, Rpt. No. 5907, dated January 26, 2009.

_____, 2009b, Tentative Tract No. 35419, Riverside County GEO 2098, West End of 20th Street, Rubidoux Area of Riverside County, California, Supplemental Response to Geologic and Geotechnical Review, Rpt. No. 5907, dated October 23, 2009.

_____, 2009c, Tentative Tract No. 35418, West End of 20th Street, Rubidoux Area of Riverside County, California, Response to Geologic/Geotechnical Review Comments #2, Rpt. No. 5524, dated April 28, 2009.

California Building Standards Commission, 2019, 2019 California Building Code, California Code of Regulations, Title 24, Part 2, Volume 2 of 2, Based on 2018 International Building Code, effective January 1, 2020.

California Geological Survey (CGS), 1982, Guidelines for Geologic/Seismic Considerations in Environmental Impact Reports, CDMG Note 46.

California Geologic Survey, 2008, Guidelines for Evaluating and Mitigating Seismic Hazards in California, Special Publication 117A, Revised and Re-Adopted on September 11, 2008, Laguna Beach, California.

California Department of Water Resources (CDWR), 1970, Meeting Water Demands in Chino-Riverside Area, Bulletin No. 104-3, September 1970.

California Department of Water Resources (CDWR) 2021, Sustainable Groundwater Management Act Data Viewer Tool, Website: https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#gwlevels; accessed November 18, 2021.

Chino Basin Watermaster, 2007, Depth to Groundwater Contours – Chino Basin – Fall 2006, dated July 20, 2007.

Civil Tech Corporation, 2011, LIQUEFYPRO Version 5.2, A Computer Program for Liquefaction and Settlement Analysis, Civil Tech Software.

County of Riverside, 2007a, Review Comments, County Geologic Report No. 1779, Soils Investigation, Rio Vista Specific Plan 243, West End of 20th Street, Rubidoux Area of Riverside County, dated March 13, 2007.

County of Riverside, 2007b, Rio Vista Specific Plan 243, Tract 34518, West End of 20th Street, Rubidoux Area of Riverside County, California; Supplemental Response to County of Riverside Geotechnical Report Review; GEO 01894, dated October 15, 2007.

County of Riverside, 2009a, Tentative Tract No. 35418, West End of 22nd Street, Rubidoux Area of Riverside County, California; Response to Geologic/Geotechnical Review Comments #2, dated April 28, 2009.

County of Riverside, 2009b, Tentative Tract No. 35421, West End of 22nd Street, Rubidoux Area of Riverside County, California; Response to Geologic/Geotechnical Review Comments #2, dated April 28, 2009.

County of Riverside, 2009c, Tentative Tract No. 35421, West End of 20th Street, Rubidoux Area of Riverside County, California; Supplemental to Response to Geologic and Geotechnical Review, dated September 18, 2009.

County of Riverside, 2009d, Conditions of Approval, County Geologic Report No. 1933, Soils Investigation, Rio Vista Specific Plan 243, West End of 20th Street, Rubidoux Area of Riverside County, dated September 29, 2009.

County of Riverside, 200e, Conditions of Approval, County Geologic Report No. 2098, Soils Investigation, Rio Vista Specific Plan 243, West End of 20th Street, Rubidoux Area of Riverside County, dated December 14, 2009.

County of Riverside, 2010, Conditions of Approval, County Geologic Report No. 1894, Soils Investigation, Rio Vista Specific Plan 243, West End of 20th Street, Rubidoux Area of Riverside County, dated January 12, 2010.

Gary S. Rasmussen & Associates, Inc., 2005, Engineering Geology Feasibility Investigation, Rio Vista Specific Plan 243, Rubidoux Area, Riverside County, California, Project No. 3560, dated August 16, 2005.

Gary S. Rasmussen & Associates, Inc., 2006, Engineering Geology Investigation of Slope Stability, Rio Vista Specific Plan 243, Rubidoux Area, Riverside County, California, Project No. 3560.1, dated January 23, 2006.

Hart, E.W., 2007, Fault Rupture Hazard Zones in California, Alquist-Priolo Special Studies Zones Act of 1972 with Index to Special Study Zone Maps, Department of Conservation, Division of Mines and Geology, Special Publication 42 Interim Revision.

Leighton and Associates, Inc., 2015, Report of Preliminary Geotechnical Investigation, Proposed Rio Vista Development, West of 20th Street, South of Riverside County/San Berenardino County Boundary, City of Jurupa Valley, California, Project No, 10270.002, dated September 29, 2015.

Martin, G. R., and Lew, M., ed., 1999, “Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction Hazards in California,” Southern California Earthquake Center, dated March 1999.

Office of Statewide Health Planning and Development (OSHPD) and Structural Engineers Association of California (SEAOC), 2021, Seismic Design Maps website: https://seismicmaps.org, accessed November 18, 2021.

Page, A.L., Miller, R. H. and Keeney, D. R., 1989, Methods of Soil Analysis. Part-2, 2nd ed. American Society Agronomy Inc.

Petersen, M. D. and Wesnousky, S. G., 1994, Fault Slip Rates and Earthquake Histories for Active Faults in Southern California: Seismological Society of America Bulletin, Volume 84, No. 5, pp. 1608-1649.

Riverside County, 2021, Map My County – Riverside County, <http://mmc.rivcoit.org/MMC_Public/Custom/disclaimer/Default.htm>

Public Works Standard, Inc., 2018, Greenbook, Standard Specifications for Public Works Construction: 2018 Edition, BNI Building News, Anaheim, California.

United States Geological Survey (USGS), 2006, Geologic Map of the San Bernardino and Santa Ana 30'x60' quadrangles, California, Version 1.0, Open File Report 2006-1217.

_____, 2014, A Web Based Computer Program Published by USGS to calculate Seismic Hazard Curves and Response and Design Parameters based on ASCE 7-10 seismic procedures.

_____, 2015, National Water Information System: Mapper, <http://maps.waterdata.usgs.gov/mapper/index.html>.

United States Geological Survey and California Geologic Survey, 2014, Quaternary fault and fold database for the United States, accessed September 18, 2014 from USGS web site: http//earthquakes.usgs.gov/regional/qfaults/

United States Geologic Survey (USGS), 2021, Earthquake Hazards Program, Unified Hazard Tool, website: https://earthquake.usgs.gov/hazards/interactive, accessed November 18, 2021.

Youd, T.L. and I.M. Idriss (co-chairs), 2001, Liquefaction Resistance of Soils: Summary Report from the 1996 NCEER and 1998 NCEER/NSF Workshops on Evaluation of Liquefaction Resistance of Soils, Journal of Geotechnical and Geoenvironmental Engineering, ASCE, Vol. 127, No. 10, published October 2001.

Aerial Photos Reviewed:

Date	Flight	Frame	Scale	Source
1/17/1958	R11758	11 & 12	1:12,000	RCFCD
1/30/1962	RCFC 62	3-434 & 3-435	1:24,000	RCFCD
4/16/1966	GS-VBNF	I-121B & I-120	1:16,400	
2/07/1970	C-297	16		SBCFC
5/24/1974	RCFC 74	8, 9, & 10	1:24,000	RCFCD
1/7/1976	C-268	70		
1/23/1980	RCFC 80	9, 10, & 11	1:24,000	RCFCD

APPENDIX B

GEOTECHNICAL BORING LOGS, TEST PIT LOGS, AND INFILTRATION TEST RESULTS

GEOTECHNICAL BORING LOG LB- 1

Project No.	10270.002	**Date Drilled**	7-10-15
Project	Richland Rio Vista	**Logged By**	L. Rincon
Drilling Co.	2R Drilling, Inc.	**Hole Diameter**	9"
Drilling Method	HSA - Cal-Mod "Ring" and SPT	**Ground Elevation**	1001'
Location	see Plate 1	**Sampled By**	L. Rincon

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
1000	0			B-0					**ALLUVIUM (Qal)** @ Surface: silty SAND, dry, light brown, non-plastic fines with fine-grained sand, contains organic matter (i.e. dry bush).	
				R-1	50/5"			SM	@ 2.5' - Silty SAND, very dense, dry, light brown, fine-grained sand with non-plastic fines, slightly cemented.	
995	5			R-2	50/4"			ML	@ 5' - SILT, hard, dry, light brown, non-plastic fines, slightly cemented.	
				S-3	6 8 11				@ 7.5' - SILT, stiff, dry, light brown to light reddish brown, non-plastic fines, trace fine- to medium-grained sand.	
990	10			R-4	18 30 33				@ 10' - SILT with sand, dense, slightly moist, light brown to brown, non-plastic fines with fine-grained sand.	
				S-5	9 11 33				@ 12.5' - SILT, hard, dry, light brown, non-plastic fines.	
985	15			R-6	50/4"				@ 15' - SILT with sand, hard, dry, light reddish brown, non-plastic with fine-grained sand	
980	20			S-7	12 20 22				@ 20' - SILT, very stiff, dry, brown, non-plastic fines.	
975	25								Total Drilled Depth = 20 feet Total Sampled Depth = 21.5 feet No groundwater encountered Backfilled w/spoils on 7/22/2015	
	30									

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH



*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB- 2

Project No.	10270.002	**Date Drilled**	7-10-15
Project	Richland Rio Vista	**Logged By**	L. Rincon
Drilling Co.	2R Drilling, Inc.	**Hole Diameter**	9"
Drilling Method	HSA - Cal-Mod "Ring" and SPT	**Ground Elevation**	1016'
Location	see Plate 1	**Sampled By**	L. Rincon

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
1015	0								**ALLUVIUM (Qal)** @ surface: sandy SILT, dry, light brown, non-plastic fines with fine-grained sand.	
				R-1	8 14 22			ML	@ 2.5' - SILT, very stiff, dry, light red brown, non-plastic fines, top of sampler: fine grained SAND with silt, trace medium-grained sand.	
1010	5			R-2	25 50/3"				@ 5' - SILT, hard, dry, brownish red, non-plastic fines, poorly cemented.	
1005	10			R-3	11 35 34			SW	**WEATHERED BEDROCK** @ 10' - SAND with silt, dense, slightly moist, brown, fine- to coarse-grained sand with non-plastic fines.	
1000	15			R-4	50/2"				**BEDROCK (Kt)** @ 15' - Bedrock.	
995	20			R-5	50/2.5				@ 20' - Same as above. Total Drilled Depth = 30 feet Total Sampled Depth = 20.2 feet No groundwater encountered Backfilled with cuttings on 07/22/2015	
990	25									
	30									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB- 3

Project No.	10270.002	**Date Drilled**	7-10-15
Project	Richland Rio Vista	**Logged By**	L. Rincon
Drilling Co.	2R Drilling, Inc.	**Hole Diameter**	9"
Drilling Method	HSA - Cal-Mod "Ring" and SPT	**Ground Elevation**	1053'
Location	see Plate 1	**Sampled By**	L. Rincon

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0								*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
									ALLUVIUM (Qal)	
									@ Surface: sandy SILT, dry, non-plastic fines with fine-grained sand, contains organic matter (i.e. dry bush).	
1050				R-1	5 12 19			ML	@ 2.5' - SILT, very stiff, dry, light brown, non-plastic fines, with trace medium-grained sand.	
	5			R-2	8 14 18				@ 5' - SILT, very stiff, dry, light brown, non-plastic fines, trace medium-grained sand.	
1045				S-3	5 8 14				@ 7.5' - SILT, very stiff, slightly moist, brown, non-plastic fines, poorly cemented, trace rock flour.	
	10			R-4	9 9 17				@ 10' - SILT, stiff, slightly moist, orange brown, non-plastic fines, poorly cemented, trace rock flour, trace medium grained sand.	
1040				S-5	5 7 7				@ 12.5' - Same as above.	
	15			R-6	10 14 25				@ 15' - Sandy SILT, very stiff, slight moist, light brown, non-plastic fines with fine-grained sand, poorly cemented, trace crushed rock.	
1035										
	20			S-7	6 14 20				@ 20' - SILT, hard, slightly moist, light brown, non-plastic fines, slightly cemented.	
1030									Total Drilled Depth = 20 feet Total Sampled Depth = 21.5 feet No groundwater encountered Backfilled with cuttings on 07/22/2015	
	25									
1025										
	30									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		



*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB- 4

Project No.	10270.002	**Date Drilled**	7-10-15
Project	Richland Rio Vista	**Logged By**	L. Rincon
Drilling Co.	2R Drilling, Inc.	**Hole Diameter**	9"
Drilling Method	HSA - Cal-Mod "Ring" and SPT	**Ground Elevation**	1076'
Location	see Plate 1	**Sampled By**	L. Rincon

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
									This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
1075	0			B-0					**ALLUVIUM (Qal)** @ Surface: SILT with sand, dry, non-plastic fines with fine-grained sand, contains organic matter (i.e. dry bush).	
				R-1	4 7 11			ML	@ 2.5' - SILT, stiff, dry, light brown, non-plastic fines, trace medium-grained sand.	
1070	5			R-2	8 9 23				@ 5' - Same as above.	
1065	10			R-3	8 14 25				@ 10' - Same as above, trace fine crushed rock.	
1060	15			R-4	15 25 37				@ 15' - Same as above, higher content of crushed rock.	
1055	20			S-5	8 13 14				@ 20' - Sandy SILT, very stiff, dry, light brown, non-plastic fines with fine- to medium-grained sand, trace crush rock in sample.	
				S-6	8 17 19				@ 22.5' - SILT, hard, dry, brown, non-plastic fines with crushed rock.	
1050	25			S-7	6 9 12			SM	@ 25' - Silty SAND, medium dense, slightly moist, dark brown with black mottling, fine- to medium-grained sand with non-plastic fines.	
				S-8	7 8 11				@ 27.5' - Same as above.	
	30									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB- 4

Project No.	10270.002	**Date Drilled**	7-10-15
Project	Richland Rio Vista	**Logged By**	L. Rincon
Drilling Co.	2R Drilling, Inc.	**Hole Diameter**	9"
Drilling Method	HSA - Cal-Mod "Ring" and SPT	**Ground Elevation**	1076'
Location	see Plate 1	**Sampled By**	L. Rincon

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	30			S-9	8 11 15			ML	@ 30' - Sandy SILT, very stiff, slightly moist, grayish brown, non-plastic fines, trace crushed rock.	
1045										
	35			S-10	14 20 23				@ 35' - SILT, hard, dry, orange brown, non-plastic fines, poorly cemented.	
1040										
	40			S-11	40 50/2"				@ 40' - SILT, hard, slightly moist, brown, non-plastic fines with weathered bedrock. Bottom of the sample is bedrock.	
1035									**BEDROCK (Kt)**	
	45			S-12	48 50/3"				@ 45' - Bedrock.	
1030										
	50			S-13	50/4"				@ 50' - No recovery.	
1025									Total Drilled Depth = 50 feet Total Sampled Depth = 50.5 feet No groundwater encountered Backfilled with cuttings on 07/22/2015	
	55									
1020										
	60									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB- 5

Project No.	10270.002	**Date Drilled**	7-20-15
Project	Richland Rio Vista	**Logged By**	L. Rincon
Drilling Co.	2R Drilling, Inc.	**Hole Diameter**	9"
Drilling Method	HSA - Cal-Mod "Ring" and SPT	**Ground Elevation**	1057'
Location	see Plate 1	**Sampled By**	L. Rincon

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0			B-0				SM	**ALLUVIUM (Qal)** @surface: SILT with sand, dry, non-plastic fines with fine-grained sand, contains organic matter (i.e. dry bush).	
1055										
	5			R-1	28 50/6"			ML	@ 5' - SILT with sand, hard, moist, orange brown, non-plastic fines with fine- to coarse-grained sand, trace rock flour in sample.	
1050										
	10			R-2	20 30 38			SM	@ 10' - Silty SAND with gravel, very dense, moist, light brown, fine- to coarse-grained sand with non-plastic fines, subangular gravel up to 1 inch in diameter, trace crushed rock in sample.	
1045										
	15			R-3	19 24 30			SW	**WEATHERED BEDROCK** @ 15' - SAND with silt, very dense, moist, light brown with black mottling, fine- to coarse-grained sand with non-plastic fines.	
1040										
	20			S-4	25 50/4"				**BEDROCK (Kt)** @ 20' - Bedrock.	
1035										
	25			R-5	50/1"				@ 25' - Same as above.	
1030										
	30									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB- 5

Project No.	10270.002	**Date Drilled**	7-20-15
Project	Richland Rio Vista	**Logged By**	L. Rincon
Drilling Co.	2R Drilling, Inc.	**Hole Diameter**	9"
Drilling Method	HSA - Cal-Mod "Ring" and SPT	**Ground Elevation**	1057'
Location	see Plate 1	**Sampled By**	L. Rincon

Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
		N S							*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
	30			S-6	50/4"				@ 30' - Same as above.	
1025									Total Drilled Depth = 30 feet Total Sampled Depth = 30.5 feet No groundwater encountered Backfilled with cuttings on 07/20/2015	
	35									
1020										
	40									
1015										
	45									
1010										
	50									
1005										
	55									
1000										
	60									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		



*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB- 6

Project No.	10270.002	**Date Drilled**	7-20-15
Project	Richland Rio Vista	**Logged By**	L. Rincon
Drilling Co.	2R Drilling, Inc.	**Hole Diameter**	9"
Drilling Method	HSA - Cal-Mod "Ring" and SPT	**Ground Elevation**	1040'
Location	see Plate 1	**Sampled By**	L. Rincon

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
1040	0			B-0				SW	**ALLUVIUM (Qal)** @surface: SAND with gravel, moist, fine- to coarse-grained sand with subangular gravel up to 2 inches in diameter.	
				R-1	9 14 26			ML	@ 2.5' - Sandy SILT, hard, moist, light brown, non-plastic fines with fine- to medium-grained sand, trace fine subrounded gravel up to 0.25 inches, poorly consolidated.	
1035	5			R-2	50/5"			ML	@ 5' - SILT, hard, moist, light red brown, non-plastic fines, poorly cemented, trace rock flour in sample.	
1030	10			R-3	50/4"			ML	@ 10' - SILT, hard, slightly moist, light brown, non-plastic fines, trace medium-grained sand, trace crushed rock, possible weathered bedrock.	
1025	15			R-4	50/1"			SW	**WEATHERED BEDROCK** @ 15' - Well-graded SAND, very dense, slightly moist, light brown with black mottling, fine- to coarse-grained sand, trace silt.	
1020	20			S-5	50/4"				**BEDROCK (Kt)** @ 20' - Bedrock.	
1015	25			S-6	50/5"				@ 25' - Same as above.	
1010	30								Total Drilled Depth = 25 feet Total Sampled Depth = 25.5 feet No groundwater encountered Backfilled with cuttings on 07/20/2015	

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		



*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB- 7

Project No.	10270.002	**Date Drilled**	7-20-15
Project	Richland Rio Vista	**Logged By**	L. Rincon
Drilling Co.	2R Drilling, Inc.	**Hole Diameter**	9"
Drilling Method	HSA - Cal-Mod "Ring" and SPT	**Ground Elevation**	1083'
Location	see Plate 1	**Sampled By**	L. Rincon

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0			B-0				ML	**ALLUVIUM (Qal)** @surface: sandy SILT, wet, brown, non-plastic fines w/ fine- to coarse-grained sand, contains dry bush and shrubs.	
1080				R-1	13 21 30			ML	@ 2.5' - SILT, hard, dry, light orange brown, non-plastic fines, slightly consolidated.	
	5			R-2	22 40 50/5"			ML	@ 5' - same as above, light brown, top of sample contains trace crushed rock.	
1075										
	10			R-3	24 40 50/5"			ML	@ 10' - same as above, poorly consolidated, trace coarse-grained sand, trace rock flour in sample.	
1070										
	15			S-4	20 24 26			ML	@ 15' - Sandy SILT, hard, moist, light brown, non-plastic fines with fine- to medium-grained sand, trace rock flour in sample.	
1065										
	20			R-5	39 50/6"			ML	@ 20' - Sandy SILT, hard, slightly moist, light brown, non-plastic fines with fine-grained sand, trace medium- to coarse-grained sand.	
1060										
	25			S-6	15 25 30			ML	@ 25' - SILT with sand, hard, slightly moist, light brown, non-plastic fines with fine- to coarse-grained sand.	
1055										
	30									

SOIL DESCRIPTION: This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB- 7

Project No.	10270.002	**Date Drilled**	7-20-15
Project	Richland Rio Vista	**Logged By**	L. Rincon
Drilling Co.	2R Drilling, Inc.	**Hole Diameter**	9"
Drilling Method	HSA - Cal-Mod "Ring" and SPT	**Ground Elevation**	1083'
Location	see Plate 1	**Sampled By**	L. Rincon

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	30			R-7	17 28 41			SM	@ 30' - Silty SAND, dense, slightly moist, light brown, fine- to coarse-grained sand with non-plastic fines.	
1050										
	35			S-8	11 10 12			SW	@ 35' - SAND with silt, brown, fine- to coarse-grained sand with non-plastic fines.	
								ML	@ 36' - Sandy SILT, very stiff, slightly moist, light brown to brown, non-plastic fines with fine-grained sand.	
1045										
	40			R-9	50/5"			ML	@ 40' - Sandy SILT, hard, slightly moist, brown, non-plastic fines with fine-grained sand, trace medium-grained sand.	
									@ 42' - Chatter from drill rig.	
1040										
	45			S-10	30 39 50			ML	@ 45' - Sandy SILT, hard, slightly moist, brown, non-plastic fines with fine- to coarse-grained sand.	
1035										
	50			R-11	32 42 50/5"			SM	@ 50' - Silty SAND or same as above, higher sand content, slightly cemented.	
1030									Total Drilled Depth = 50 feet Total Sampled Depth = 51.5 feet No groundwater encountered Backfilled with cuttings on 07/20/2015	
	55									
1025										
	60									

Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

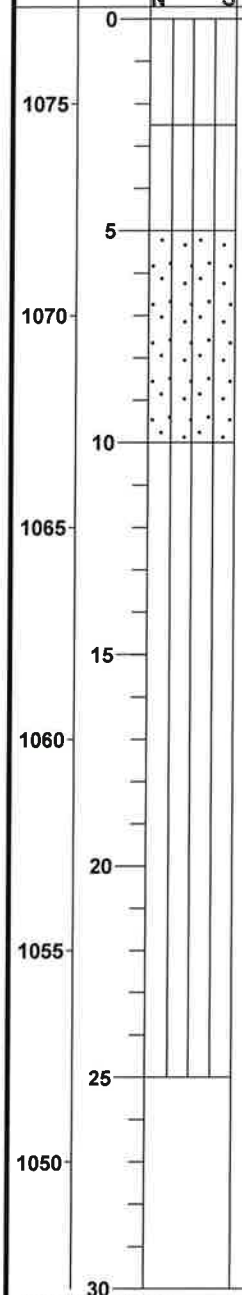
TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB- 8

Project No.	10270.002	**Date Drilled**	7-20-15
Project	Richland Rio Vista	**Logged By**	L. Rincon
Drilling Co.	2R Drilling, Inc.	**Hole Diameter**	9"
Drilling Method	HSA - Cal-Mod "Ring" and SPT	**Ground Elevation**	1077'
Location	see Plate 1	**Sampled By**	L. Rincon



Elevation Feet	Depth Feet	Graphic Log	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
									This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.	
1075	0			B-0				ML	**ALLUVIUM (Qal)** @surface: SILT, dry, brown, non-plastic fines, trace fine- to coarse-grained sand, trace fine gravel.	
				R-1	8 17 29			ML	@ 2.5' - SILT, hard, dry, brown, non-plastic fines, poorly cemented, trace fine gravel.	
1070	5			R-2	30 37 36			SM	@ 5' - Silty SAND, dense, dry, brown, fine- to coarse-grained sand with non-plastic fines.	
1065	10			R-3	19 20 32			ML	@ 10' - SILT with sand, hard, slightly moist, light brown, non-plastic fines, trace medium-grained sand.	
1060	15			R-4	24 50/6"			ML	@ 15' - SILT, hard, slightly moist, pale brown, non-plastic fines, trace medium-grained sand.	
1055	20			S-5	30 23 26			ML	@ 20' - Sandy SILT, hard, slightly moist, pale brown, non-plastic fines with fine-grained sand, trace medium-grained sand.	
1050	25			R-6	28 50/6"			SM	@ 25' - Silty SAND with gravel, dense, slightly moist, pale brown, fine-grained sand with non-plastic fines, trace medium- to coarse-grained sand, trace gravel.	
	30									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB- 8

Project No.	10270.002	**Date Drilled**	7-20-15
Project	Richland Rio Vista	**Logged By**	L. Rincon
Drilling Co.	2R Drilling, Inc.	**Hole Diameter**	9"
Drilling Method	HSA - Cal-Mod "Ring" and SPT	**Ground Elevation**	1077'
Location	see Plate 1	**Sampled By**	L. Rincon

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	30			S-7	14 14 15			SW	@ 30' - SAND with silt, medium dense, dry, brown, fine- to coarse-grained sand with non-plastic fines3	
1045									Total Drilled Depth = 30 feet Total Sampled Depth = 31.5 feet No groundwater encountered Backfilled with cuttings on 07/20/2015	
	35									
1040										
	40									
1035										
	45									
1030										
	50									
1025										
	55									
1020										
	60									

The Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB- 9

Project No.	10270.002	**Date Drilled**	7-20-15
Project	Richland Rio Vista	**Logged By**	L. Rincon
Drilling Co.	2R Drilling, Inc.	**Hole Diameter**	9"
Drilling Method	HSA - Cal-Mod "Ring" and SPT	**Ground Elevation**	1040'
Location	see Plate 1	**Sampled By**	L. Rincon

Elevation Feet	Depth Feet	Graphic Log (N / S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
1040	0			B-0				ML	**ALLUVIUM (Qal)** @surface: SILT, light brown, non-plastic fines, contains shrubbery and dry bush.	
				R-1	4 5 8			ML	@ 2.5' - SILT, slightly moist, stiff, light brown, non-plastic fines.	
1035	5			R-2	5 6 15			ML	@ 5' - same as above, trace fine gravel.	
1030	10			R-3	29 50/6"			ML	@ 10' - same as above, without gravel.	
1025	15			R-4	29 50/6"			SM-SC	@ 15' - SAND with silt and clay to clayey SILT with sand, dense, dry, brown, golden brown, fine-grained sand with non-plastic fines and semi-plastic fines.	
1020	20			S-5	50/5"				**BEDROCK (Kt)** @ 20' - Bedrock.	
1015	25			R-5	50/2"				@ 25' - Bedrock, no recovery Total Drilled Depth = 25 feet Total Sampled Depth = 25 feet No groundwater encountered Backfilled with cuttings on 07/20/2015	
1010	30									

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG LB-10

Project No.	10270.002	**Date Drilled**	7-20-15
Project	Richland Rio Vista	**Logged By**	L. Rincon
Drilling Co.	2R Drilling, Inc.	**Hole Diameter**	9"
Drilling Method	HSA - Cal-Mod "Ring" and SPT	**Ground Elevation**	1016'
Location	see Plate 1	**Sampled By**	L. Rincon

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
1015	0			B-0					**ALLUVIUM (Qal)** @ surface: silty SAND with subangular to subrounded gravel up to 2 inches in diameter.	
				R-1	5 9 20			ML	@ 2.5' - SILT, very stiff, olive brown, dry, non-plastic fines.	
1010	5			R-2	21 30 42			SC	@ 5' - Clayey SAND, dense, moist, brown with white mottling, fine- to coarse-grained sand with semi-plastic fines, Bottom of sample is bedrock. **BEDROCK (Kt)**	
1005	10			R-3	50/4"				@ 10' - Bedrock.	
1000	15			R-4	50/4"				@ 15 ' - Bedrock. Total Drilled Depth = 15 feet Total Sampled Depth = 15.5 feet No groundwater encountered Backfilled with cuttings on 07/20/2015	
995	20									
990	25									
	30									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

Richland Rio Vista **Project No. 10270.002**

Logged By: BER
Sampled By: BER

Test Pit TP-1

Date Excavated: 7/30/2015
Location: (see Geotechnical Map)

Depth Top (ft)	Depth Bottom (ft)	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample number	Depth (ft)	Density, Dry (pcf)	Moisture (%)
			surface: course sand & trash piles	Afu	Bulk-1	2.5		
0.0	3.0	SM	SILTY SAND, 15% fines (field estimate), reddish brown, slightly moist, non plastic					
3.0	4.0		TRASH, plastic bags, metal debris					
4.0	13.5	SM	SILTY SAND, 15% fines (field estimate), reddish brown, slightly moist, non plastic, more dense with depth	Qalo				

Total Depth (ft): 13.5
No ground water encountered.
Test pit backfilled with native soil, tamped with bucket and wheel rolled at surface.
Additional test pit approximately 5 feet away was dug to a depth of 5 feet for percolation testing.
Additional test pit backfilled on 8/11/2015.

Test Pit TP-2

Date Excavated: 7/30/2015
Location: (see Geotechnical Map)

Depth Top (ft)	Depth Bottom (ft)	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample number	Depth (ft)	Density, Dry (pcf)	Moisture (%)
			surface: course sand	Qalo	Bulk-2	3.0		
0.0	1.0	SM	SILTY SAND, 20% fines (field estimate), brown, dry, non plastic					
1.0	4.0		Granitic Bedrock, refusal	Kt				

Total Depth (ft): 4.0
No ground water encountered.
Test pit backfilled with native soil, tamped with bucket and wheel rolled at surface.

Leighton

Richland Rio Vista **Project No. 10270.002**

Logged By: BER
Sampled By: BER

Test Pit TP-3

Date Excavated: 7/30/2015
Location: (see Geotechnical Map)

Depth Top (ft)	Depth Bottom (ft)	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample number	Depth (ft)	Density, Dry (pcf)	Moisture (%)
			surface: course silty sand and scattered debris					
0.0	1.0	SM	SILTY SAND w/buried debris, plastic	Afu				
1.0	4.0	SM	SILTY SAND, 30% fines (field estimate), brown, dry, non plastic	Qalo				
4.0	5.0		BEDROCK, granitics, refusal	Kt				

Total Depth (ft): 5.0
No ground water encountered.
Test pit backfilled with native soil, tamped with bucket and wheel rolled at surface.

Test Pit TP-4

Date Excavated: 7/30/2015
Location: (see Geotechnical Map)

Depth Top (ft)	Depth Bottom (ft)	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample number	Depth (ft)	Density, Dry (pcf)	Moisture (%)
			surface: course silty sand		BULK-3	4.0		
0.0	3.0	SM	SILTY SAND, course grained, 10% fines (field estimate), brown, slightly moist, non plastic, debris present (plasic & cloth)	Afu				
3.0	5.0	SM	SILTY SAND, course grained, 10% fines (field estimate), brown, slightly moist, non plastic	Qalo				
5.0	13.0	SM	Same as above, increasing silt with depth					

Total Depth (ft): 13.0
No ground water encountered.
Test pit backfilled with native soil, tamped with bucket and wheel rolled at surface.
Additional test pit approximately 5 feet away was dug to a depth of 5 feet for percolation testing.
Additional test pit backfilled on 8/11/2015.

Leighton

Richland Rio Vista **Project No. 10270.002**

Logged By: BER
Sampled By: BER

Test Pit TP-5

Date Excavated: 7/30/2015
Location: (see Geotechnical Map)

Depth		Soil	Description	Geologic	Test Results			
Top (ft)	Bottom (ft)	symbol (USCS)		Unit	Sample number	Depth (ft)	Density, Dry (pcf)	Moisture (%)
			surface: silty sand					
0.0	2.0	SM	SILTY SAND, 35% fines (field estimate), reddish brown, slightly moist, non plastic	Qalo				
2.0	4.0		BEDROCK, granitics, refusal	Kt				

Total Depth (ft): 4.0
No ground water encountered.
Test pit backfilled with native soil, tamped with bucket and wheel rolled at surface.

Test Pit TP-6

Date Excavated: 7/30/2015
Location: (see Geotechnical Map)

Depth		Soil	Description	Geologic	Test Results			
Top (ft)	Bottom (ft)	symbol (USCS)		Unit	Sample number	Depth (ft)	Density, Dry (pcf)	Moisture (%)
			surface: silty sand, course grained					
0.0	2.5	SM	SILTY SAND, 25% fines, brown, slightly moist, non plastic	Qalo				
2.5	8.0		BEDROCK, granitics, refusal	Kt				

Total Depth (ft): 8.0
No ground water encountered.
Test pit backfilled with native soil, tamped with bucket and wheel rolled at surface.

Leighton

Richland Rio Vista **Project No. 10270.002**

Logged By: BER
Sampled By: BER

Test Pit TP-7

Date Excavated: 7/30/2015

Location: (see Geotechnical Map)

Depth		Soil	Description	Geologic	Test Results			
Top (ft)	Bottom (ft)	symbol (USCS)		Unit	Sample number	Depth (ft)	Density, Dry (pcf)	Moisture (%)
			surface: course silty sand					
0.0	5.0	SM	SILTY SAND, 20% fines (field estimate), course grained, brown, slightly moist, non plastic	Qalo				
5.0	7.0		BEDROCK, granitics, refusal	Kt				

Total Depth (ft): 7.0
No ground water encountered.
Test pit backfilled with native soil, tamped with bucket and wheel rolled at surface.

Test Pit TP-8

Date Excavated: 7/30/2015

Location: (see Geotechnical Map)

Depth		Soil	Description	Geologic	Test Results			
Top (ft)	Bottom (ft)	symbol (USCS)		Unit	Sample number	Depth (ft)	Density, Dry (pcf)	Moisture (%)
0.0	2.0	SM	SILTY SAND, 20% fines (field estimate), olive brown, slightly moist, non plastic	Qalo				
2.0	3.0		BEDROCK, granitics, refusal	Kt				

Total Depth (ft): 3.0
No ground water encountered.
Test pit backfilled with native soil, tamped with bucket and wheel rolled at surface.

Leighton

Richland Rio Vista **Project No. 10270.002**

Logged By: BER
Sampled By: BER

Test Pit TP-9

Date Excavated: 7/30/2015
Location: (see Geotechnical Map)

Depth		Soil	Description	Geologic	Test Results			
Top (ft)	Bottom (ft)	symbol (USCS)		Unit	Sample number	Depth (ft)	Density, Dry (pcf)	Moisture (%)
			surface: silty sand		BULK-4	4.0		
0.0	1.0	SM	SILTY SAND, 25% fines (field estimate), reddish brown, slightly moist, non plastic	Qalo				
1.0	4.5		BEDROCK, decomposed granitics, refusal	Kt				

Total Depth (ft): 4.5
No ground water encountered.
Test pit backfilled with native soil, tamped with bucket and wheel rolled at surface.

Test Pit TP-10

Date Excavated: 7/30/2015
Location: (see Geotechnical Map)

Depth		Soil	Description	Geologic	Test Results			
Top (ft)	Bottom (ft)	symbol (USCS)		Unit	Sample number	Depth (ft)	Density, Dry (pcf)	Moisture (%)
			surface: course sand					
0.0	1.0	SM	SILTY SAND, 10% fine (field estimate), course grained weathered granitics intermixed	Qalo				
1.0	3.5		BEDROCK, granitics, refusal	Kt				

Total Depth (ft): 3.5
No ground water encountered.
Test pit backfilled with native soil, tamped with bucket and wheel rolled at surface.

Leighton

Richland Rio Vista **Project No. 10270.002**

Logged By: BER
Sampled By: BER

Test Pit TP-11

Date Excavated: 7/30/2015
Location: (see Geotechnical Map)

Depth Top (ft)	Depth Bottom (ft)	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample number	Depth (ft)	Density, Dry (pcf)	Moisture (%)
			surface: course silty sand					
0.0	4.0	SM	SILTY SAND, 35% fines (field estimate), red, slightly moist, non plastic	Qal				
4.0	5.0		BEDROCK, granitics, refusal	Kt				

Total Depth (ft): 5.0
No ground water encountered.
Test pit backfilled with native soil, tamped with bucket and wheel rolled at surface.

Test Pit TP-12

Date Excavated: 8/11/2015
Location: (see Geotechnical Map)

Depth Top (ft)	Depth Bottom (ft)	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample number	Depth (ft)	Density, Dry (pcf)	Moisture (%)
			surface: silty sand		Bulk-1	4'		
0.0	14.5	SM	SILTY SAND, 20% fines (field estimate), brown, slightly moist, non plastic	Qalo				
14.5	16.5	SM	SILTY SAND, 30% fines (field estimate), olive brown, slightly moist, non plastic					
16.5	17.0		BEDROCK, decomposed granitics, maximum extension)	Kt				

Total Depth (ft): 17.0
No ground water encountered.
Test pit backfilled with native soil, tamped with bucket and wheel rolled at surface.

Leighton

Richland Rio Vista **Project No. 10270.002**

Logged By: BER
Sampled By: BER

Test Pit TP-13

Date Excavated: 8/11/2015
Location: (see Geotechnical Map)

Depth Top (ft)	Depth Bottom (ft)	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample number	Depth (ft)	Density, Dry (pcf)	Moisture (%)
			surface: dry brush					
0.0	12.5	SM	SILTY SAND, 10% fines (field estimate), brown, slightly moist, non plastic	Qalo				
12.5	13.5		BEDROCK, decomposed granitics, olive gray, slightly moist, non plastic, refusal	Kt				

Total Depth (ft): 13.5
No ground water encountered.
Test pit backfilled with native soil, tamped with bucket and wheel rolled at surface.

Test Pit TP-14

Date Excavated: 8/11/2015
Location: (see Geotechnical Map)

Depth Top (ft)	Depth Bottom (ft)	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample number	Depth (ft)	Density, Dry (pcf)	Moisture (%)
			surface: dry brush					
0.0	12.0	SM	SILTY SAND, 15% fines (field estimate), brown, slightly moist, non plastic	Qalo				
12.0	13.0		BEDROCK, weathered granitics, slightly moist, non plastic, refusal	Kt				

Total Depth (ft): 13.0
No ground water encountered.
Test pit backfilled with native soil, tamped with bucket and wheel rolled at surface.

Leighton

Richland Rio Vista **Project No. 10270.002**

Logged By: BER
Sampled By: BER

Test Pit TP-15

Date Excavated: 8/11/2015
Location: (see Geotechnical Map)

Depth Top (ft)	Depth Bottom (ft)	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample number	Depth (ft)	Density, Dry (pcf)	Moisture (%)
			surface: dry brush					
0.0	1.0		uncontrolled fill, trash	Afu				
1.0	10.5	SM	SILTY SAND, 20% fines (field estimate), brown, slightly moist, non plastic, fewer fines with depth, denser with depth, too hard to dig at 10.5', refusal	Qalo				

Total Depth (ft): 10.5
No ground water encountered.
Test pit backfilled with native soil, tamped with bucket and wheel rolled at surface.

Test Pit TP-16

Date Excavated: 8/11/2015
Location: (see Geotechnical Map)

Depth Top (ft)	Depth Bottom (ft)	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample number	Depth (ft)	Density, Dry (pcf)	Moisture (%)
			surface: dry brush					
0.0	7.5	SM	SILTY SAND, 10% fines (field estimate), brown, slightly moist, non plastic	Qalo				
7.5	10.0		BEDROCK, weathered granitics, gray, slightly moist, non plastic, refusal	Kt				

Total Depth (ft): 10.0
No ground water encountered.
Test pit backfilled with native soil, tamped with bucket and wheel rolled at surface.

Leighton

Richland Rio Vista **Project No. 10270.002**

Logged By: BER
Sampled By: BER

Test Pit TP-17

Date Excavated: 8/11/2015
Location: (see Geotechnical Map)

Depth		Soil	Description	Geologic	Test Results			
Top (ft)	Bottom (ft)	symbol (USCS)		Unit	Sample number	Depth (ft)	Density, Dry (pcf)	Moisture (%)
			surface: dry brush					
0.0	12.0	SM	SILTY SAND, 10% fines (field estimate), brown, slightly moist, non plastic	Qal				
12.0	13.0		BEDROCK, weathered granitics, course sand, olive gray, slightly moist, non plastic, refusal	Kt				

Total Depth (ft): 13.0
No ground water encountered.
Test pit backfilled with native soil, tamped with bucket and wheel rolled at surface.

Test Pit TP-18

Date Excavated: 8/11/2015
Location: (see Geotechnical Map)

Depth		Soil	Description	Geologic	Test Results			
Top (ft)	Bottom (ft)	symbol (USCS)		Unit	Sample number	Depth (ft)	Density, Dry (pcf)	Moisture (%)
			surface: dry brush					
0.0	2.0	SM	SILTY SAND, 10% fines (field estimate), brown, slightly moist, non plastic	Qalo				
2.0	3.0		BEDROCK, weathered granitics, refusal	Kt				

Total Depth (ft): 3.0
No ground water encountered.
Test pit backfilled with native soil, tamped with bucket and wheel rolled at surface.

Leighton

Richland Rio Vista **Project No. 10270.002**

Logged By: BER
Sampled By: BER

Test Pit TP-19

Date Excavated: 8/11/2015
Location: (see Geotechnical Map)

Depth Top (ft)	Depth Bottom (ft)	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample number	Depth (ft)	Density, Dry (pcf)	Moisture (%)
			surface: dry brush					
0.0	2.0		uncontrolled fill, debris, trash	Afu				
2.0	4.5		BEDROCK, weathered granitics, course sand, gray, slightly moist, non plastic, refusal	Kt				

Total Depth (ft): 4.5
No ground water encountered.
Test pit backfilled with native soil, tamped with bucket and wheel rolled at surface.

Test Pit TP-20

Date Excavated: 8/11/2015
Location: (see Geotechnical Map)

Depth Top (ft)	Depth Bottom (ft)	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample number	Depth (ft)	Density, Dry (pcf)	Moisture (%)
			surface: dry brush					
0.0	1.0	SM	SILTY SAND, 10% fines (field estimate), brown, slightly moist, non plastic	Qalo				
1.0	4.5		BEDROCK, weathered granitics, refusal	Kt				

Total Depth (ft): 4.5
No ground water encountered.
Test pit backfilled with native soil, tamped with bucket and wheel rolled at surface.

Leighton

Richland Rio Vista **Project No. 10270.002**

Logged By: BER
Sampled By: BER

Test Pit TP-21

Date Excavated: 8/11/2015
Location: (see Geotechnical Map)

Depth Top (ft)	Depth Bottom (ft)	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample number	Depth (ft)	Density, Dry (pcf)	Moisture (%)
			surface: dry brush					
0.0	2.0	SM	SILTY SAND, 10% fines (field estimate), brown, slightly moist, non plastic	Qalo				
2.0	5.0		BEDROCK, weathered granitics, refusal	Kt				

Total Depth (ft): 5.0
No ground water encountered.
Test pit backfilled with native soil, tamped with bucket and wheel rolled at surface.

Test Pit TP-22

Date Excavated: 8/11/2015
Location: (see Geotechnical Map)

Depth Top (ft)	Depth Bottom (ft)	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample number	Depth (ft)	Density, Dry (pcf)	Moisture (%)
			surface: dry brush					
0.0	1.0	SM	SILTY SAND, 10% fines (field estimate), brown, slightly moist, non plastic	Qalo				
1.0	5.0		BEDROCK, weathered granitics, refusal	Kt				

Total Depth (ft): 5.0
No ground water encountered.
Test pit backfilled with native soil, tamped with bucket and wheel rolled at surface.

Leighton

Richland Rio Vista **Project No. 10270.002**

Logged By: BER
Sampled By: BER

Test Pit TP-23

Date Excavated: 8/11/2015
Location: (see Geotechnical Map)

Depth Top (ft)	Depth Bottom (ft)	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample number	Depth (ft)	Density, Dry (pcf)	Moisture (%)
			surface: dry brush					
0.0	3.0	SM	SILTY SAND, 10% fines (field estimate), brown, slightly moist, non plastic	Qal				
3.0	5.0		BEDROCK, weathered granitics, olive gray, slightly moist, non plastic, refusal	Kt				

Total Depth (ft): 5.0
No ground water encountered.
Test pit backfilled with native soil, tamped with bucket and wheel rolled at surface.

Test Pit TP-24

Date Excavated: 8/11/2015
Location: (see Geotechnical Map)

Depth Top (ft)	Depth Bottom (ft)	Soil symbol (USCS)	Description	Geologic Unit	Test Results: Sample number	Depth (ft)	Density, Dry (pcf)	Moisture (%)
			surface: dry brush					
0.0	14.0	SM	SILTY SAND, 10% fines (field estimate), brown, slightly moist, non plastic, maximum extension	Qalo				

Total Depth (ft): 14.0
No ground water encountered.
Test pit backfilled with native soil, tamped with bucket and wheel rolled at surface.

Leighton

Richland Rio Vista **Project No. 10270.002**

Logged By: BER
Sampled By: BER

Test Pit TP-25

Date Excavated: 8/11/2015

Location: (see Geotechnical Map)

Depth		Soil	Description	Geologic	Test Results			
Top (ft)	Bottom (ft)	symbol (USCS)		Unit	Sample number	Depth (ft)	Density, Dry (pcf)	Moisture (%)
			surface: dry brush					
0.0	3.0	SM	SILTY SAND, 20% fines (field estimate), brown, slightly moist, non plastic	Qalo				
3.0	6.5		BEDROCK, weathered granitics, refusal	Kt				

Total Depth (ft): 6.5
No ground water encountered.
Test pit backfilled with native soil, tamped with bucket and wheel rolled at surface.

Leighton

GEOTECHNICAL BORING LOG EP- 1

Project No.	10270.001	**Date Drilled**	8-8-13
Project	Richland Rio Vista Jurupa Valley	**Logged By**	Sean Richards
Drilling Co.		**Hole Diameter**	"
Drilling Method	Cat 345 Excavator with rock teeth	**Ground Elevation**	1076'
Location	see Plate 1	**Sampled By**	Sean Richards

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
1075	0								*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
									Quaternary Old Alluvium (Qalo) SILTY SAND (SM), dense, brown to reddish brown, dry to moist, fine to medium sand	
1070	5									
1065	10									
									Total Depth 11 feet below ground surface **No groundwater encountered** **Backfilled with soil cuttings**	
1060	15									
1055	20									
1050	25									
	30									

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH



*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG EP- 2

Project No.	10270.001	**Date Drilled**	8-8-13
Project	Richland Rio Vista Jurupa Valley	**Logged By**	Sean Richards
Drilling Co.		**Hole Diameter**	"
Drilling Method	Cat 345 Excavator with rock teeth	**Ground Elevation**	1203'
Location	see Plate 1	**Sampled By**	Sean Richards

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
1200	0								*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
									Quaternary Old Alluvium (Qalo) SILTY SAND with gravel (SM), loose, light brown, fine to medium sand	
									Weathered Granite (Kt) GRAVEL with sand (GP), light brown to light brownish gray, dry, fine to coarse sand with fine gravel, weathered granite (Kt) material, grusified, soft easy digging.	
1195	5								GRAVEL with sand (GP), medium dense, light brownish gray to light gray, dry, fine to coarse sand with fine gravel, weathered granite (Kt) material, grusified, becomes hard, more difficult to dig, still rippable.	
1190	10								increasing density, within Kt some fractured blocks from sill. GRAVEL with sand (GP), dense, light gray to dark gray, dry to moist, coarse sand to fine gravel, weathered granite, color becomes darker, still blocks 4-inch x 4-inch average from sill. GRAVEL with sand (GP), dense, dark gray to gray, coarse sand to fine gravel	
1185	15								GRAVEL with sand (GP), dense, gray, dry, coarse sand to fine gravel at 16 feet bucket is digging jerky, and scratching for depth, Kt is dense and becoming more tight with depth	
1180	20								**Total Depth 17.2 feet below ground surface** **No groundwater encountered** **Backfilled with soil cuttings**	
1175	25									
	30									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG EP- 3

Project No.	10270.001	**Date Drilled**	8-8-13
Project	Richland Rio Vista Jurupa Valley	**Logged By**	Sean Richards
Drilling Co.		**Hole Diameter**	"
Drilling Method	Cat 345 Excavator with rock teeth	**Ground Elevation**	1300'
Location	see Plate 1	**Sampled By**	Sean Richards

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
1300	0								*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
									Quaternary Old Alluvium (Qalo) SILTY SAND with gravel (SM), brown, dry, fine to medium sand GRAVEL with sand (GP), brown to light brownish gray, dry, fine to medium sand	
									Weathered Granite (Kt) GRAVEL with sand (GP), loose to medium dense, grayish brown, coarse sand to fine gravel	
1295	5									
									GRAVEL with sand (GP), dense, gray to light gray, coarse sand to fine gravel, tighter digging, excavator digging but tight	
1290	10								sill with blocks of 12 inch by 8 inch of quartzite	
									more chunky in cuttings	
1285	15								GRAVEL with sand (GP), very dense, gray, coarse sand to fine gravel, darker gray coloration, not as friable	
									Total Depth 15.5 feet below ground surface **No groundwater encountered** **Backfilled with soil cuttings**	
1280	20									
1275	25									
1270	30									

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG EP- 4

Project No.	10270.001	**Date Drilled**	8-8-13
Project	Richland Rio Vista Jurupa Valley	**Logged By**	Sean Richards
Drilling Co.		**Hole Diameter**	"
Drilling Method	Cat 345 Excavator with rock teeth	**Ground Elevation**	1282'
Location	see Plate 1	**Sampled By**	Sean Richards

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
1280	0								*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
									Quaternary Old Alluvium (Qalo) SILTY SAND (SM), medium dense, brown to reddish brown, dry, fine to medium sand, rippable	
1275	5								Weathered Granite (Kt) GRAVEL with sand (GP), medium dense, light brownish gray to light gray, dry, fine to coarse sand with fine gravel, weathered granite (Kt) material, rippable.	
1270	10								GRAVEL with sand (GP), medium dense, light brownish gray to light gray, dry, fine to coarse sand with fine gravel, weathered granite (Kt) material, becoming tighter, chuncky in spoils, rippable.	
1265	15								GRAVEL with sand (GP), medium dense, light brownish gray to light gray, dry, fine to coarse sand with fine gravel, weathered granite (Kt) material, scratching for depth but rippable.	
									Total Depth 14.5 feet below ground surface **No groundwater encountered** **Backfilled with soil cuttings**	
1260	20									
1255	25									
	30									

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH



*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG EP- 5

Project No.	10270.001	**Date Drilled**	8-8-13
Project	Richland Rio Vista Jurupa Valley	**Logged By**	Sean Richards
Drilling Co.		**Hole Diameter**	"
Drilling Method	Cat 345 Excavator with rock teeth	**Ground Elevation**	1214'
Location	see Plate 1	**Sampled By**	Sean Richards

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0								*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
									Quaternary Old Alluvium (Qalo) SILTY SAND (SM), medium dense, brown to reddish brown, dry, fine to medium sand, rippable	
1210										
	5								**Weathered Granite / Weathered Schist (Kt Pz)** GRAVEL with sand (GP), medium dense, light brownish gray to light yellowish brown, dry, fine to coarse sand with fine gravel, weathered Granite (Kt) and chunky schist (Pz) material, slightly chuncky in spoils, rippable.	
1205										
	10								GRAVEL with sand (GP), medium dense, light brownish gray to light yellowish brown, dry, fine to coarse sand with fine gravel, weathered Granite (Kt) and schist (Pz) material, becoming tighter, chuncky in spoils, rippable.	
									GRAVEL with sand (GP), medium dense, light brownish gray to light yellowish brown, dry, fine to coarse sand with fine gravel, weathered Granite (Kt) and schist (Pz) material, scratching for depth but rippable.	
1200										
	15								**Total Depth 13 feet below ground surface** **No groundwater encountered** **Backfilled with soil cuttings**	
1195										
	20									
1190										
	25									
1185										
	30									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		



*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG EP- 6

Project No.	10270.001	**Date Drilled**	8-8-13
Project	Richland Rio Vista Jurupa Valley	**Logged By**	Sean Richards
Drilling Co.		**Hole Diameter**	"
Drilling Method	Cat 345 Excavator with rock teeth	**Ground Elevation**	1183'
Location	see Plate 1	**Sampled By**	Sean Richards

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
1180	0								**Weathered Granite and Weathered Schist (Kt Pz)** GRAVEL with sand (GP), medium dense, light brownish gray to yellowish brown, dry, fine to coarse sand with fine gravel, weathered granite (Kt) chunks of weathered schist (Pz), blocky, rippable.	
1175	5								GRAVEL with sand (GP), dense, light brownish gray to light yellowish brown, dry, fine to coarse sand with fine gravel, weathered granite (Kt) and weathered schist (Pz), becoming tighter, chuncky in spoils, blocks of schist, rippable.	
1170	10								GRAVEL with sand (GP), dense, light brownish gray to light yellowish brown, dry, fine to coarse sand with fine gravel, weathered granite (Kt) and weathered schist (Pz), chuncky in spoils, blocks of schist, tight, rippable.	
1165	15								**Total Depth 13 feet below ground surface** **No groundwater encountered** **Backfilled with soil cuttings**	
1160	20									
1155	25									
	30									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		



*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG EP- 7

Project No.	10270.001	**Date Drilled**	8-8-13
Project	Richland Rio Vista Jurupa Valley	**Logged By**	Sean Richards
Drilling Co.		**Hole Diameter**	"
Drilling Method	Cat 345 Excavator with rock teeth	**Ground Elevation**	1233'
Location	see Plate 1	**Sampled By**	Sean Richards

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
1230	0								*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
									Quaternary Old Alluvium (Qalo) SILTY SAND (SM), medium dense, brown to light gray, dry, fine to medium sand, with some weathered granite fragments, undulatory contact, rippable	
									Weathered Granite (Kt) GRAVEL with sand (GP), medium dense, light brownish gray to light reddish brown, dry, fine to coarse sand with fine gravel, weathered granite (Kt) material, rippable	
1225	5									
									GRAVEL with sand (GP), medium dense, light brownish gray to light gray, dry, fine to coarse sand with fine gravel, weathered granite (Kt) material, becoming tighter, some small blocks from sill, rippable	
1220	10								GRAVEL with sand (GP), medium dense, light brownish gray to gray, dry, fine to coarse sand with fine gravel, weathered granite (Kt) material, scratching for depth but rippable	
									Total Depth 12.5 feet below ground surface **No groundwater encountered** **Backfilled with soil cuttings**	
1215	15									
1210	20									
1205	25									
	30									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG EP- 8

Project No.	10270.001	**Date Drilled**	8-9-13
Project	Richland Rio Vista Jurupa Valley	**Logged By**	Sean Richards
Drilling Co.		**Hole Diameter**	"
Drilling Method	Cat 345 Excavator with rock teeth	**Ground Elevation**	1201'
Location	see Plate 1	**Sampled By**	Sean Richards

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
1200	0								**Quaternary Old Alluvium (Qalo)** SILTY SAND with gravel (SM), loose, light brown, fine to medium sand	
									Weathered Granite (Kt) GRAVEL with sand (GP), loose, light brown to light brownish gray, dry, fine to coarse sand with fine gravel, weathered granite (Kt) material, grusified, soft easy digging, some blocks of quartzite from sill up to 24 inches.	
1195	5								GRAVEL with sand (GP), medium dense, light brownish gray to light gray, dry, fine to coarse sand with fine gravel, weathered granite (Kt) material, grusified, becomes hard, more difficult to dig, still rippable.	
1190	10								GRAVEL with sand (GP), dense, light gray to dark gray, dry to moist, coarse sand to fine gravel, weathered granite (Kt), massive, scratching then scooping for depth, color becomes slightly darker, some smaller blocks from sill.	
									GRAVEL with sand (GP), dense, dark gray to gray, dry to moist, coarse sand to fine gravel, weathered granite, massive, scratching then scooping for depth, more chunky, friable in hand sample.	
1185	15								GRAVEL with sand (GP), dense, gray, dry, coarse sand to fine gravel, weathered granite, massive, as above, scratching for depth, jerky digging.	
									Total Depth 15.5 feet below ground surface **No groundwater encountered** **Backfilled with soil cuttings**	
1180	20									
1175	25									
	30									

This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG EP- 9

Project No.	10270.001	**Date Drilled**	8-9-13
Project	Richland Rio Vista Jurupa Valley	**Logged By**	Sean Richards
Drilling Co.		**Hole Diameter**	"
Drilling Method	Cat 345 Excavator with rock teeth	**Ground Elevation**	1151'
Location	see Plate 1	**Sampled By**	Sean Richards

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
1150	0								*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
									Quaternary Old Alluvium (Qalo) SILTY SAND with gravel (SM), loose, brown, fine to medium sand	
1145	5								**Weathered Granite (Kt)** GRAVEL with sand (GP), loose, light brown to light brownish gray, dry, fine to coarse sand with fine gravel, weathered granite (Kt) material, grusified, soft easy digging, some blocks of quartzite from sill up to 8-10 inches.	
1140	10								GRAVEL with sand (GP), medium dense, light brownish gray to light gray, dry, fine to coarse sand with fine gravel, weathered granite (Kt) material, grusified, massive, more difficult diging, chunky, still rippable.	
									GRAVEL with sand (GP), dense, gray, dry, coarse sand to fine gravel, weathered granite (Kt), massive, scratching for depth, jerky digging.	
1135	15								**Total Depth 12 feet below ground surface** **No groundwater encountered** **Backfilled with soil cuttings**	
1130	20									
1125	25									
	30									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		



*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG EP-10

Project No.	10270.001	**Date Drilled**	8-9-13
Project	Richland Rio Vista Jurupa Valley	**Logged By**	Sean Richards
Drilling Co.		**Hole Diameter**	"
Drilling Method	Cat 345 Excavator with rock teeth	**Ground Elevation**	1106'
Location	see Plate 1	**Sampled By**	Sean Richards

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
1105	0								*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
									Quaternary Old Alluvium (Qalo) SILTY SAND with gravel (SM), loose, brown, dry, fine to medium sand, with some cobble size blocks.	
1100	5								Weathered Granite (Kt) GRAVEL with sand (GP), loose, light brown to light brownish gray, dry, fine to coarse sand with fine gravel, weathered granite (Kt) material, grusified, soft easy digging, some blocks of quartzite from sill 12 to 24 inches.	
									GRAVEL with sand (GP), medium dense, light brownish gray to light gray, dry, fine to coarse sand with fine gravel, weathered granite (Kt) material, grusified, massive, more difficult diging, chunky, still rippable, in stockpile chunks 2-6 inches.	
1095	10								GRAVEL with sand (GP), dense, gray, dry, coarse sand to fine gravel, weathered granite (Kt), massive, scratching for depth, jerky digging, some hard quartzite blocks from sill angular.	
1090	15								**Total Depth 15 feet below ground surface** **No groundwater encountered** **Backfilled with soil cuttings**	
1085	20									
1080	25									
	30									

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH



*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG EP-11

Project No.	10270.001	**Date Drilled**	8-9-13
Project	Richland Rio Vista Jurupa Valley	**Logged By**	Sean Richards
Drilling Co.		**Hole Diameter**	"
Drilling Method	Cat 345 Excavator with rock teeth	**Ground Elevation**	1142'
Location	see Plate 1	**Sampled By**	Sean Richards

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
1140	0								*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
									Quaternary Old Alluvium (Qalo) SILTY SAND with gravel (SM), loose, brown, dry, fine to medium sand	
1135	5								Weathered Granite (Kt) GRAVEL with sand (GP), loose, light brown to light brownish gray, dry, fine to coarse sand with fine gravel, weathered granite (Kt) material, grusified, soft easy digging.	
1130	10								GRAVEL with sand (GP), medium dense, light brownish gray to light gray, dry, fine to coarse sand with fine gravel, weathered granite (Kt) material, grusified, massive, easy to moderate diging, rippable.	
	15								GRAVEL with sand (GP), medium dense, gray, dry, coarse sand to fine gravel, weathered granite (Kt), massive, moderate digging, becoming chuncky.	
1125									**Total Depth 15 feet below ground surface** **No groundwater encountered** **Backfilled with soil cuttings** ** Turned around and excavator dug on sill. top weathered and easily broke however below 8-10 inches very hard and blocks 12-18 inches thick and 2 to 4 foot long off sill weathered granite portion rippable.	
1120	20									
1115	25									
	30									

SAMPLE TYPES:

B	BULK SAMPLE
C	CORE SAMPLE
G	GRAB SAMPLE
R	RING SAMPLE
S	SPLIT SPOON SAMPLE
T	TUBE SAMPLE

TYPE OF TESTS:

-200	% FINES PASSING	DS	DIRECT SHEAR	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	EI	EXPANSION INDEX	SE	SAND EQUIVALENT
CN	CONSOLIDATION	H	HYDROMETER	SG	SPECIFIC GRAVITY
CO	COLLAPSE	MD	MAXIMUM DENSITY	UC	UNCONFINED COMPRESSIVE STRENGTH
CR	CORROSION	PP	POCKET PENETROMETER		
CU	UNDRAINED TRIAXIAL	RV	R VALUE		

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

GEOTECHNICAL BORING LOG EP-12

Project No.	10270.001	**Date Drilled**	8-9-13
Project	Richland Rio Vista Jurupa Valley	**Logged By**	Sean Richards
Drilling Co.		**Hole Diameter**	"
Drilling Method	Cat 345 Excavator with rock teeth	**Ground Elevation**	1238'
Location	see Plate 1	**Sampled By**	Sean Richards

Elevation Feet	Depth Feet	Graphic Log (N S)	Attitudes	Sample No.	Blows Per 6 Inches	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	SOIL DESCRIPTION	Type of Tests
	0								*This Soil Description applies only to a location of the exploration at the time of sampling. Subsurface conditions may differ at other locations and may change with time. The description is a simplification of the actual conditions encountered. Transitions between soil types may be gradual.*	
									Quaternary Old Alluvium (Qalo) SILTY SAND with gravel (SM), loose, brown, dry, fine to medium sand, with some cobble size blocks	
1235									Weathered Granite (Kt) GRAVEL with sand (GP), loose, light brown to light brownish gray, dry, fine to coarse sand with fine gravel, weathered granite (Kt) material, grusified, rippable.	
	5									
1230									GRAVEL with sand (GP), medium dense, light brownish gray to light gray, dry, fine to coarse sand with fine gravel, weathered granite (Kt) material, grusified, massive, more difficult diging, chunky, still rippable, in stockpile chunks 2-4 inches.	
	10									
1225									GRAVEL with sand (GP), dense, gray, dry, coarse sand to fine gravel, weathered granite (Kt), massive, scratching for depth, jerky digging, rippable.	
	15								**Total Depth 13.5 feet below ground surface** **No groundwater encountered** **Backfilled with soil cuttings**	
1220										
	20									
1215										
	25									
1210										
	30									

SAMPLE TYPES:

- B BULK SAMPLE
- C CORE SAMPLE
- G GRAB SAMPLE
- R RING SAMPLE
- S SPLIT SPOON SAMPLE
- T TUBE SAMPLE

TYPE OF TESTS:

- -200 % FINES PASSING
- AL ATTERBERG LIMITS
- CN CONSOLIDATION
- CO COLLAPSE
- CR CORROSION
- CU UNDRAINED TRIAXIAL
- DS DIRECT SHEAR
- EI EXPANSION INDEX
- H HYDROMETER
- MD MAXIMUM DENSITY
- PP POCKET PENETROMETER
- RV R VALUE
- SA SIEVE ANALYSIS
- SE SAND EQUIVALENT
- SG SPECIFIC GRAVITY
- UC UNCONFINED COMPRESSIVE STRENGTH

*** This log is a part of a report by Leighton and should not be used as a stand-alone document. ***

Earth, Construction, & Mining
CA LIC. No. 651848
NV LIC. NO. 0071919

E C M

11542 Knott Street #10, Garden Grove CA 92841
PH: 714-897-4ECM [4326] · FX: 714-897-2016

INVESTIGATIVE DRILL LOGS

HOLE LOCATION: N 34.02706 W117.40533			
JOB# 4257	HOLE# 1	DRILL CALIBRATIONS	
DATE: 5/8/13		DRILL MAKE/MODEL: INGERSAL RAND ECM 720 CRAWLER DRILL #838	
RIPPABLE/OVERBURDEN:		NEUTRAL NO LOAD: FEED 500 PSI / ROTATION 100 PSI	
MARGINAL:		ROTATION UNDER LOAD: FEED 500 PSI / ROTATION 900 PSI	
PROBABLE BLASTING:		DRILL W/PERCUSION : PERCUSSION 1200 PSI / FEED 800 PSI / ROTATION 1000	

DEPTH	TIME	RQ	NOTES	DEPTH	TIME	RQ	NOTES
1	0			41			
2				42			
3				43			
4				44			
5	11 sec	Soft	COLLAR	45	1m47s	Med Hard	ROTATION
6	0			46	0		
7				47			FLOATERS
8				48			
9				49			
10				50	1m40s	Med Hard	ROTATION
11	1m57s	Medium	ROTATION	51	0		
12	0			52			
13				53			
14				54	1m05s	Med Hard	ROTATION
15	1m24s	Medium	ROTATION	55	0		
16	0			56			
17				57			
18				58	1m43s	Hard	ROTATION
19				59	0		
20	1m31s	Medium	ROTATION	60	45s	Hard	PERCUSSION
21	0			61	0		
22				62			SMALL SOFT SEAMS
23				63			
24				64	1m16s	Hard	ROTATION
25	1m07s	Medium	ROTATION	65			
26	0			66			
27				67			
28				68			
29				69			
30	1m40s	Medium	ROTATION	70			
31	0			71			
32				72			
33				73			
34				74			
35	1m48s	Medium	ROTATION	75			
36	0			76			
37				77			
38				78			
39	35s	Medium	percusion	79			
40	0			80			

The following Data contains estimated Rippable/Marginal and Marginal/Blasting Horizons are based upon experience in Massive Homogeneous Granite Rock Types. Deviations due to changes in geologic formations, bedding planes, joints sets, faulting or hydrological conditions as well as ripper equipment types and conditions can result in wide variances in either direction in the actual rippability limits encountered.

Earth, Construction, & Mining
CA LIC. No. 651848
NV LIC. NO. 0071919

E C M

11542 Knott Street #10, Garden Grove CA 92841
PH: 714-897-4ECM [4326] · FX: 714-897-2016

INVESTIGATIVE DRILL LOGS

HOLE LOCATION: N 34.02866 W 117.40396			
JOB# 4257	HOLE # 2	DRILL CALIBRATIONS	
DATE: 5/8/13		DRILL MAKE/MODEL: INGERSAL RAND ECM 720 CRAWLER DRILL #838	
RIPPABLE/OVERBURDEN:		NEUTRAL NO LOAD: FEED 500 PSI / ROTATION 100 PSI	
MARGINAL:		ROTATION UNDER LOAD: FEED 500 PSI / ROTATION 900 PSI	
PROBABLE BLASTING:		DRILL W/PERCUSION : PERCUSSION 1200 PSI / FEED 800 PSI / ROTATION 1000	

DEPTH	TIME	RQ	NOTES	DEPTH	TIME	RQ	NOTES
1				41			
2				42			GREY
3				43			SEAMS
4			BROWN	44			
5				45	1m33s	Hard	ROTATION
6				46			DARK GREY
7		Soft	COLLAR	47			
8				48			
9				49	1m35s	Hard	PERCUSSION
10				50			
11	1m10s	Soft	ROTATION	51			
12				52			
13			BROWN	53			MASSIVE
14			GREY	54			
15				55	1m30s	Hard	PERCUSSION
16	2m	Soft	ROTATION	56			SEAMS
17				57	1m	Hard	PERCUSSION
18			GREY	58	30s	Hard	SEAMS
19				59			
20	2m	Medium	ROTATION	60	1m53s	Hard	PERCUSSION
21				61			
22				62			
23			GREY	63			
24				64			
25	1m43s	Medium	ROTATION	65	2m55s	Hard	PERCUSSION
26				66			
27			BROWN	67			
28			GREY	68			
29				69			
30	1m39s	Medium	ROTATION	70			
31				71			
32				72			
33				73			
34				74			
35	2m10s	Med Hard	ROTATION	75			
36				76			
37	45s	Med Hard	ROTATION	77			
38				78			
39				79			
40	1m24s	Med Hard	ROTATION	80			

The following Data contains estimated Rippable/Marginal and Marginal/Blasting Horizons are based upon experience in Massive Homogeneous Granite Rock Types. Deviations due to changes in geologic formations, bedding planes, joints sets, faulting or hydrological conditions as well as ripper equipment types and conditions can result in wide variances in either direction in the actual rippability limits encountered.

Earth, Construction, & Mining
CA LIC. No. 651848
NV LIC. NO. 0071919

E C M

11542 Knott Street #10, Garden Grove CA 92841
PH: 714-897-4ECM [4326] · FX: 714-897-2016

INVESTIGATIVE DRILL LOGS

HOLE LOCATION: N 34.02833 W 117.40328				
JOB# 4257	HOLE # 3		DRILL CALIBRATIONS	
DATE: 5/8/13		DRILL MAKE/MODEL : INGERSAL RAND ECM 720 CRAWLER DRILL #838		
RIPPABLE/OVERBURDEN:		NEUTRAL NO LOAD: FEED 500 PSI / ROTATION 100 PSI		
MARGINAL:		ROTATION UNDER LOAD: FEED 500 PSI / ROTATION 900 PSI		
PROBABLE BLASTING		DRILL W/PERCUSSION : PERCUSSION 1200 PSI / FEED 800 PSI / ROTATION 1000		

DEPTH	TIME	RQ	NOTES	DEPTH	TIME	RQ	NOTES
1				41	19s	Soft	ROTATION HIT HARD
2				42			
3				43			BROWN GREY
4				44			DARK GREY
5				45	1m53s	Hard	PERCUSION
6				46			
7			WATER INJECTION	47			
8		Soft	COLLAR	48			
9				49			DARK GREY
10				50	2m01s	Hard	PERCUSSION
11				51			
12	37s	soft	ROTATION	52			
13				53			
14				54			
15	1m10s	med soft	ROTATION	55			
16				56			
17				57			
18			ROTATION	58			
19				59			
20	1m22s	Soft	ROTATION	60			
21				61			
22			BROWN	62			
23				63			
24				64			
25	1m19s	Soft	ROTATION	65			
26				66			
27				67			
28				68			
29	1m09s	Soft	ROTATION	69			
30				70			
31				71			
32		ROCK LAYER/BOULDER (?)		72			
33				73			
34				74			
35	1m24s	Med Hard	PERCUSSION	75			
36			punch thru	76			
37				77			
38				78			
39				79			
40	1m12s	Medium	ROTATION	80			

The following Data contains estimated Rippable/Marginal and Marginal/Blasting Horizons are based upon experience in Massive Homogeneous Granite Rock Types. Deviations due to changes in geologic formations, bedding planes, joints sets, faulting or hydrological conditions as well as ripper equipment types and conditions can result in wide variances in either direction in the actual rippability limits encountered.

Earth, Construction, & Mining
CA LIC. No. 651848
NV LIC. NO. 0071919

E C M

11542 Knott Street #10, Garden Grove CA 92841
PH: 714-897-4ECM [4326] · FX: 714-897-2016

INVESTIGATIVE DRILL LOGS

HOLE LOCATION: N 34.02832 W 117.40272

JOB# 4257	HOLE# 4	DRILL CALIBATION
DATE: 5/8/13		DRILL MAKE/MODEL: INGERSAL RAND ECM 720 CRAWLER DRILL #838
RIPPABLE/OVERBURDEN:		NEUTRAL NO LOAD: FEED 500 PSI / ROTATION 100 PSI
marginal:		ROTATION UNDER LOAD: FEED 500 PSI / ROTATION 900 PSI
PROBABLE BLASTING:		DRILL W/PERCUSION : PERCUSSION 1200 PSI / FEED 800 PSI / ROTATION 1000

DEPTH	TIME	RQ	NOTES	DEPTH	TIME	RQ	NOTES
1				41			DARK GREY
2				42			
3				43			
4				44			
5				45	1m58s	Med Hard	PERCUSSION
6			WATER INJECTION	46			
7	1m30s	Soft	COLLAR	47			WHITE
8	15s	Soft	ROTATION	48			
9				49			
10				50	3m44s	Hard	PERCUSSION
11	42s	Med Hard	PERCUSSION	51			
12				52			
13			DARK GREY	53			
14				54			
15	45s	Med Hard	PERCUSSION	55			
16				56			
17			DARK GREY	57			
18			BROWN	58			
19				59			
20	1m55s	Med Hard	PERCUSSION	60			
21				61			
22			DARK GREY	62			
23				63			
24	1m03s	Med Hard	PERCUSSION	64			
25				65			
26				66			
27			DARK GREY	67			
28				68			
29				69			
30	2m40s	Med Hard	PERCUSSION	70			
31				71			
32				72			
33				73			
34				74			
35	1m52s	Med Hard	PERCUSSION	75			
36				76			
37				77			
38				78			
39				79			
40	2m07s	Med Hard	PERCUSION	80			

The following Data contains estimated Rippable/Marginal and Marginal/Blasting Horizons are based upon experience in Massive Homogeneous Granite Rock Types. Deviations due to changes in geologic formations, bedding planes, joints sets, faulting or hydrological conditions as well as ripper equipment types and conditions can result in wide variances in either direction in the actual rippability limits encountered.

Earth, Construction, & Mining
CA LIC. No. 651848
NV LIC. NO. 0071919

E C M

11542 Knott Street #10, Garden Grove CA 92841
PH: 714-897-4ECM [4326] · FX: 714-897-2016

INVESTIGATIVE DRILL LOGS

HOLE LOCATION: N 34.03148 W 117.40437

JOB# 4257	HOLE # 5	DRILL CALIBRATIONS
DATE: 5/8/13		DRILL MAKE/MODEL: INGERSAL RAND ECM 720 CRAWLER DRILL #838
RIPPABLE/OVERBURDEN:		NEUTRAL NO LOAD: FEED 500 PSI / ROTATION 100 PSI
Marginal:		ROTATION UNDER LOAD: FEED 500 PSI / ROTATION 900 PSI
PROBABLE BLASTING:		DRILL W/PERCUSION : PERCUSSION 1200 PSI / FEED 800 PSI / ROTATION 1000

DEPTH	TIME	RQ	NOTES	DEPTH	TIME	RQ	NOTES
1				41			
2				42			
3				43			
4				44			
5			BROKEN ROCK	45			
6			BROWN	46			
7				47			
8				48			
9				49			
10				50			
11		Hard	WATER INJECTION	51			
12	55s	Broken	COLLAR	52			
13				53			
14				54			
15	1m11s	Hard	PERCUSSION	55			
16				56			
17				57			
18				58			
19				59			
20	1m	Hard	PERCUSSION	60			
21				61			
22				62			
23				63			
24				64			
25	1m08s	Hard	PERCUSSION	65			
26				66			
27	BROKE DRILL			67			
28	HOLE TERMIMATED			68			
29	AT 25 FEET			69			
30				70			
31				71			
32				72			
33				73			
34				74			
35				75			
36				76			
37				77			
38				78			
39				79			
40				80			

The following Data contains estimated Rippable/Marginal and Marginal/Blasting Horizons are based upon experience in Massive Homogeneous Granite Rock Types. Deviations due to changes in geologic formations, bedding planes, joints sets, faulting or hydrological conditions as well as ripper equipment types and conditions can result in wide variances in either direction in the actual rippability limits encountered.

Earth, Construction, & Mining
CA LIC. No. 651848
NV LIC. NO. 0071919

E C M

11542 Knott Street #10, Garden Grove CA 92841
PH: 714-897-4ECM [4326] · FX: 714-897-2016

INVESTIGATIVE DRILL LOGS

		HOLE LOCATION: N 34.03144 W 117.40450
JOB# 4257	HOLE# 6	DRILL CALIBRATIONS
DATE: 5/13/13		DRILL MAKE/MODEL: INGERSAL RAND ECM 720 CRAWLER DRILL #838
RIPPABLE/OVERBURDEN:		NEUTRAL NO LOAD: FEED 500 PSI / ROTATION 100 PSI
Marginal:		ROTATION UNDER LOAD: FEED 500 PSI / ROTATION 900 PSI
PROBABLE BLASTING:		DRILL W/PERCUSION : PERCUSSION 1200 PSI / FEED 800 PSI / ROTATION 1000

DEPTH	TIME	RQ	NOTES	DEPTH	TIME	RQ	NOTES
1				41			
2				42			
3				43			
4				44			
5				45	2m18s	Hard	PERCUSSION
6				46			
7			BROWN	47			
8				48			
9				49			
10				50	2m02s	Hard	PERCUSSION
11				51			
12			COLLAR	52			
13				53			
14				54			
15	1s01m	Soft	ROTATE	55			
16				56			
17				57			
18				58			
19				59			
20	50s	Soft	ROTATE	60			
21				61			
22				62			
23				63			
24				64			
25	1m15s	Soft	ROTATE	65			
26				66			
27				67			
28				68			
29				69			
30	1m33s	Soft	ROTATE	70			
31				71			
32		medium		72			
33				73			
34				74			
35	1m11s	Hard	PERCUSSION	75			
36				76			
37				77			
38				78			
39				79			
40	2m44s	Hard	PERCUSSION	80			

The following Data contains estimated Rippable/Marginal and Marginal/Blasting Horizons are based upon experience in Massive Homogeneous Granite Rock Types. Deviations due to changes in geologic formations, bedding planes, joints sets, faulting or hydrological conditions as well as ripper equipment types and conditions can result in wide variances in either direction in the actual rippability limits encountered.

Earth, Construction, & Mining
CA LIC. No. 651848
NV LIC. NO. 0071919

E C M

11542 Knott Street #10, Garden Grove CA 92841
PH: 714-897-4ECM [4326] · FX: 714-897-2016

INVESTIGATIVE DRILL LOGS

HOLE LOCATION: N34.03197 W 117.40473

JOB# 4257	HOLE #7	DRILL CALIBRATIONS
DATE: 5/13/13		DRILL MAKE/MODEL: INGERSAL RAND ECM 720 CRAWLER DRILL #838
RIPPABLE/OVERBURDEN:		NEUTRAL NO LOAD: FEED 500 PSI / ROTATION 100 PSI
Marginal:		ROTATION UNDER LOAD: FEED 500 PSI / ROTATION 900 PSI
PROBABLE BLASTING:		DRILL W/PERCUSION : PERCUSSION 1200 PSI / FEED 800 PSI / ROTATION 1000

DEPTH	TIME	RQ	NOTES	DEPTH	TIME	RQ	NOTES
1				41			
2				42			
3				43			
4				44			
5				45	1m23s	Medium	PERCUSSION
6				46			
7				47			
8				48			
9				49			
10			WATER INJECTION	50	2m24s	Hard	PERCUSSION
11	1m07s	Soft	COLLAR	51			
12				52			
13				53			
14	1m09s	Hard	ROTATION	54	1m34s	Hard	PERCUSSION
15				55			
16				56			
17				57			
18	40s	Medium	PERCUSSION	58			
19				59			
20	45s	med Hard	ROTATION	60	1m45s	Hard	PERCUSSION
21				61			
22	52s	Hard	ROTATION	62			
23				63			
24				64			
25	1m03s	med Hard	PERCUSSION	65	1m37s	med Hard	PERCUSSION
26				66			
27				67			
28				68			
29				69			
30	1m45s	med Hard	PERCUSSION	70			
31				71			
32			soft	72			
33			spots	73			
34				74			
35	1m09s	Medium	PERCUSSION	75			
36				76			
37				77			
38				78			
39				79			
40	55s	Medium	PERCUSSION	80			

The following Data contains estimated Rippable/Marginal and Marginal/Blasting Horizons are based upon experience in Massive Homogeneous Granite Rock Types. Deviations due to changes in geologic formations, bedding planes, joints sets, faulting or hydrological conditions as well as ripper equipment types and conditions can result in wide variances in either direction in the actual rippability limits encountered.

Earth, Construction, & Mining
CA LIC. No. 651848
NV LIC. NO. 0071919

E C M

11542 Knott Street #10, Garden Grove CA 92841
PH: 714-897-4ECM [4326] · FX: 714-897-2016

INVESTIGATIVE DRILL LOGS

HOLE LOCATION: N 34.03069 W 117.41021

JOB# 4257	HOLE # 8	DRILL CALIBRATIONS	
DATE: 5/13/13		DRILL MAKE/MODEL: INGERSAL RAND ECM 720 CRAWLER DRILL #838	
RIPPABLE/OVERBURDEN:		NEUTRAL NO LOAD: FEED 500 PSI / ROTATION 100 PSI	
Marginal:		ROTATION UNDER LOAD: FEED 500 PSI / ROTATION 900 PSI	
PROBABLE BLASTING:		DRILL W/PERCUSION : PERCUSSION 1200 PSI / FEED 800 PSI / ROTATION 1000	

DEPTH	TIME	RQ	NOTES	DEPTH	TIME	RQ	NOTES
1				41			
2				42			
3				43			GREY
4				44		med hard	
5				45	2m	hard	PERCUSSION
6				46			
7				47			
8				48			DARK GREY
9				49			
10			WATER INJECTION	50	1m33s	hard	PERCUSSION
11		dirt	COLLAR	51			
12				52			
13				53			DARK GREY
14				54	1m23s	hard	PERCUSSION
15	1m09s	medium	PERCUSSION	55			
16				56			
17	19s	medium	PERCUSSION	57			DARK GREY
18	59s	medium	ROTATION	58			
19				59			
20	30s	medium	PERCUSSION	60	3m16s	XTRA hard	PERCUSSION
21				61			
22				62			
23				63			
24				64			
25	1m20s	medium	PERCUSSION	65	1m50s	hard	PERCUSSION
26				66			
27				67			
28				68			
29				69			
30	1m	medium	PERCUSSION	70			
31				71			
32				72			
33				73			
34				74			
35	1m23s	hard	PERCUSSION	75			
36				76			
37				77			
38				78			
39				79			
40	1m23s	med hard	PERCUSSION	80			

The following Data contains estimated Rippable/Marginal and Marginal/Blasting Horizons are based upon experience in Massive Homogeneous Granite Rock Types. Deviations due to changes in geologic formations, bedding planes, joints sets, faulting or hydrological conditions as well as ripper equipment types and conditions can result in wide variances in either direction in the actual rippability limits encountered.

Earth, Construction, & Mining
CA LIC. No. 651848
NV LIC. NO. 0071919

E C M

11542 Knott Street #10, Garden Grove CA 92841
PH: 714-897-4ECM [4326] · FX: 714-897-2016

INVESTIGATIVE DRILL LOGS

HOLE LOCATION: N 34.02942 W 117.41106

JOB# 4257	HOLE # 9	DRILL CALIBRATIONS
DATE: 5/13/13		DRILL MAKE/MODEL: INGERSAL RAND ECM 720 CRAWLER DRILL #838
RIPPABLE/OVERBURDEN:		NEUTRAL NO LOAD: FEED 500 PSI / ROTATION 100 PSI
Marginal:		ROTATION UNDER LOAD: FEED 500 PSI / ROTATION 900 PSI
PROBABLE BLASTING:		DRILL W/PERCUSION : PERCUSSION 1200 PSI / FEED 800 PSI / ROTATION 1000

DEPTH	TIME	RQ	NOTES	DEPTH	TIME	RQ	NOTES
1				41			
2				42			
3				43			GREY BROWN
4				44			
5				45	1m52s	hard	PERCUSSION
6				46			
7				47			
8				48			
9				49			
10				50	1m25s	hard	PERCUSSION
11			WATER INJECTION	51			
12		soft	COLLAR	52			GREY
13				53			
14				54			
15				55	2m32s	hard	PERCUSSION
16	1m25s	medium	ROTATION	56			
17				57			
18				58			
19		medium		59			
20	56s	med hard	PERCUSSION	60	4m26s	XTRA hard	PERCUSSION
21				61			
22				62			
23				63			
24				64			
25	2m07s	hard	PERCUSSION	65			
26				66			
27				67			
28				68			
29				69			
30	2m05s	hard	PERCUSSION	70			
31				71			
32			GREY	72			
33				73			
34				74			
35	2m17s	hard	PERCUSSION	75			
36				76			
37				77			
38				78			
39				79			
40	2m36s	hard	PERCUSSION	80			

The following Data contains estimated Rippable/Marginal and Marginal/Blasting Horizons are based upon experience in Massive Homogeneous Granite Rock Types. Deviations due to changes in geologic formations, bedding planes, joints sets, faulting or hydrological conditions as well as ripper equipment types and conditions can result in wide variances in either direction in the actual rippability limits encountered.

Earth, Construction, & Mining
CA LIC. No. 651848
NV LIC. NO. 0071919

E C M

11542 Knott Street #10, Garden Grove CA 92841
PH: 714-897-4ECM [4326] · FX: 714-897-2016

INVESTIGATIVE DRILL LOGS

HOLE LOCATION: N34.02608 W 117.41393

JOB# 4257	HOLE #10	DRILL CALIBRATIONS
DATE: 5/13/13		DRILL MAKE/MODEL: INGERSAL RAND ECM 720 CRAWLER DRILL #838
RIPPABLE/OVERBURDEN:		NEUTRAL NO LOAD: FEED 500 PSI / ROTATION 100 PSI
Marginal:		ROTATION UNDER LOAD: FEED 500 PSI / ROTATION 900 PSI
PROBABLE BLASTING:		DRILL W/PERCUSION : PERCUSSION 1200 PSI / FEED 800 PSI / ROTATION 1000

DEPTH	TIME	RQ	NOTES	DEPTH	TIME	RQ	NOTES
1				41			
2				42			GREY CHUNKY
3				43			
4				44			
5				45	1m27s	med Hard	ROTATION
6				46			
7				47			
8				48			
9				49			
10				50	1m30s	hard	PERCUSSION
11			WATER INJECTION	51			
12		dirt	COLLAR	52			
13				53			
14				54	1m	hard	PERCUSSION
15	52s	soft	ROTATION	55			
16				56			
17				57			DARK GREY
18				58			
19				59			
20	1m33s	soft	ROTATION	60	1m48s	hard	PERCUSSION
21				61			
22			BROWN	62			
23				63			
24				64			
25	1m06s	soft	ROTATION	65	1m29s	hard	PERCUSSION
26				66			
27				67			
28			BROWN	68			
29				69			
30	54s	soft	ROTATION	70			
31				71			
32				72			
33			GREY	73			
34				74			
35	1m46s	medium	ROTATION	75			
36				76			
37				77			
38				78			
39				79			
40	1m50s	medium	ROTATION	80			

The following Data contains estimated Rippable/Marginal and Marginal/Blasting Horizons are based upon experience in Massive Homogeneous Granite Rock Types. Deviations due to changes in geologic formations, bedding planes, joints sets, faulting or hydrological conditions as well as ripper equipment types and conditions can result in wide variances in either direction in the actual rippability limits encountered.

Earth, Construction, & Mining
CA LIC. No. 651848
NV LIC. NO. 0071919

E C M

11542 Knott Street #10, Garden Grove CA 92841
PH: 714-897-4ECM [4326] · FX: 714-897-2016

INVESTIGATIVE DRILL LOGS

HOLE LOCATION: N34.02585 W 117.41419

JOB# 4257	HOLE# 11		DRILL CALIBATION
DATE: 5/13/13		DRILL MAKE/MODEL: INGERSAL RAND ECM 720 CRAWLER DRILL #838	
RIPPABLE/OVERBURDEN:		NEUTRAL NO LOAD: FEED 500 PSI / ROTATION 100 PSI	
Marginal:		ROTATION UNDER LOAD: FEED 500 PSI / ROTATION 900 PSI	
PROBABLE BLASTING:		DRILL W/PERCUSION : PERCUSSION 1200 PSI / FEED 800 PSI / ROTATION 1000	

DEPTH	TIME	RQ	NOTES	DEPTH	TIME	RQ	NOTES
1				41			
2				42			
3				43			
4		chunky		44			
5				45			
6			WATER INJECTION	46			
7		dirt	COLLAR	47			
8				48			
9	19s	chunky	PERCUSSION	49			
10	49s	medium	ROTATION	50			
11				51			
12	20s	medium	PERCUSSION	52			
13				53			
14				54			
15	20s	soft	PERCUSSION	55			
16				56			
17				57			
18				58			
19				59			
20	1m09s	soft	PERCUSSION	60			
21				61			
22				62			
23				63			
24				64			
25	1m21s	hard	PERCUSSION	65			
26	15s	hard	PERCUSSION	66			
27				67			
28	49s	med hard	PERCUSSION	68			
29				69			
30			SEAMY	70			
31			AND	71			
32			BROKEN	72			
33	1m42s	med hard	PERCUSSION	73			
34				74			
35				75			
36				76			
37				77			
38				78			
39				79			
40				80			

The following Data contains estimated Rippable/Marginal and Marginal/Blasting Horizons are based upon experience in Massive Homogeneous Granite Rock Types. Deviations due to changes in geologic formations, bedding planes, joints sets, faulting or hydrological conditions as well as ripper equipment types and conditions can result in wide variances in either direction in the actual rippability limits encountered.

Earth, Construction, & Mining
CA LIC. No. 651848
NV LIC. NO. 0071919

E C M

11542 Knott Street #10, Garden Grove CA 92841
PH: 714-897-4ECM [4326] · FX: 714-897-2016

INVESTIGATIVE DRILL LOGS

HOLE LOCATION: N34.02734 W 117.40810

JOB# 4257	HOLE #12		DRILL CALIBRATIONS
DATE: 5/13/13		DRILL MAKE/MODEL: INGERSAL RAND ECM 720 CRAWLER DRILL #838	
RIPPABLE/OVERBURDEN:		NEUTRAL NO LOAD: FEED 500 PSI / ROTATION 100 PSI	
Marginal:		ROTATION UNDER LOAD: FEED 500 PSI / ROTATION 900 PSI	
PROBABLE BLASTING:		DRILL W/PERCUSION : PERCUSSION 1200 PSI / FEED 800 PSI / ROTATION 1000	

DEPTH	TIME	RQ	NOTES	DEPTH	TIME	RQ	NOTES
1				41			
2				42			
3				43			
4				44			
5				45	1m17s	medium	PERCUSSION
6				46			
7				47			
8				48			GREY
9				49			
10				50	1m	med hard	PERCUSSION
11			WATERINJECTION	51			
12			COLLAR	52			
13				53			
14				54			
15	42s	medium	PERCUSSION	55	1m	med hard	PERCUSSION
16				56			
17				57			
18			BROWN GREY	58		XTRA hard	DARK GREY
19				59			
20	49s	medium	PERCUSSION	60	1m26s	hard	PERCUSSION
21				61			
22				62			
23				63			
24				64			
25	53s	soft	ROTATION	65			
26				66			
27				67			
28				68			
29				69			
30				70			
31				71			
32	1m03s	medium	PERCUSSION	72			
33				73			
34			GREY	74			
35				75			
36				76			
37				77			
38				78			
39				79			
40	1m07s	medium	PERCUSSION	80			

The following Data contains estimated Rippable/Marginal and Marginal/Blasting Horizons are based upon experience in Massive Homogeneous Granite Rock Types. Deviations due to changes in geologic formations, bedding planes, joints sets, faulting or hydrological conditions as well as ripper equipment types and conditions can result in wide variances in either direction in the actual rippability limits encountered.

Earth, Construction, & Mining
CA LIC. No. 651848
NV LIC. NO. 0071919

E C M

11542 Knott Street #10, Garden Grove CA 92841
PH: 714-897-4ECM [4326] · FX: 714-897-2016

INVESTIGATIVE DRILL LOGS

HOLE LOCATION: N 34.01797 W 117.41135

JOB# 4257	HOLE #13	DRILL CALIBRATIONS
DATE: 5/14/13		DRILL MAKE/MODEL: INGERSAL RAND ECM 720 CRAWLER DRILL #838
RIPPABLE/OVERBURDEN:		NEUTRAL NO LOAD: FEED 500 PSI / ROTATION 100 PSI
Marginal:		ROTATION UNDER LOAD: FEED 500 PSI / ROTATION 900 PSI
PROBABLE BLASTING:		DRILL W/PERCUSION : PERCUSSION 1200 PSI / FEED 800 PSI / ROTATION 1000

DEPTH	TIME	RQ	NOTES	DEPTH	TIME	RQ	NOTES
1				41			
2				42			DARK GREY
3				43			
4			WATER INJECTION	44			
5		medium	COLLAR	45	1m52s	hard	PERCUSSION
6				46			
7		med hard		47			
8				48			
9				49			
10	1m14s	hard	PERCUSSION	50	2m05s	hard	PERCUSSION
11	16s	hard	PERCUSSION	51			
12				52			
13				53			
14				54	2m14s	hard	PERCUSSION
15	1m06s	hard	PERCUSSION	55			
16				56		XTRA hard	
17				57			DARK GREY
18				58			
19				59			
20	1m21s	hard	PERCUSSION	60	3m27s	XTRA hard	PERCUSSION
21				61			
22			GREY	62			
23				63			DARK GREY
24				64			
25	1m12s	hard	PERCUSSION	65	2m45s	XTRA hard	PERCUSSION
26				66			
27		xtra hard	DARK GREY	67			
28				68			
29				69			
30	1m25s	hard	PERCUSSION	70			
31				71			
32			DARK GREY	72			
33				73			
34				74			
35	1m20s	hard	PERCUSSION	75			
36				76			
37			DARK GREY	77			
38				78			
39				79			
40	1m30s	hard	PERCUSSION	80			

The following Data contains estimated Rippable/Marginal and Marginal/Blasting Horizons are based upon experience in Massive Homogeneous Granite Rock Types. Deviations due to changes in geologic formations, bedding planes, joints sets, faulting or hydrological conditions as well as ripper equipment types and conditions can result in wide variances in either direction in the actual rippability limits encountered.

Earth, Construction, & Mining
CA LIC. No. 651848
NV LIC. NO. 0071919

E C M

11542 Knott Street #10, Garden Grove CA 92841
PH: 714-897-4ECM [4326] · FX: 714-897-2016

INVESTIGATIVE DRILL LOGS

HOLE LOCATION: N 34.01797 W 117.41278

JOB# 4257	HOLE #14	DRILL CALIBRATIONS
DATE: 5/14/13		DRILL MAKE/MODEL: INGERSAL RAND ECM 720 CRAWLER DRILL #838
RIPPABLE/OVERBURDEN:		NEUTRAL NO LOAD: FEED 500 PSI / ROTATION 100 PSI
Marginal:		ROTATION UNDER LOAD: FEED 500 PSI / ROTATION 900 PSI
PROBABLE BLASTING:		DRILL W/PERCUSION : PERCUSSION 1200 PSI / FEED 800 PSI / ROTATION 1000

DEPTH	TIME	RQ	NOTES	DEPTH	TIME	RQ	NOTES
1				41			
2				42			
3				43			
4			WATER INJECTION	44			
5		soft med	COLLAR	45			
6				46			
7				47			
8			GREY	48			
9				49			
10	1m37s	med soft	PERCUSSION	50			
11		medium		51			
12		hard		52			
13		XTRA hard		53			
14				54			
15	2m12s	XTRA hard	PERCUSSION	55			
16				56			
17				57			
18			DARK GREY	58			
19				59			
20	2M30S	XTRA hard	PERCUSSION	60			
21				61			
22				62			
23				63			
24				64			
25	2M09S	hard	PERCUSSION	65			
26				66			
27				67			
28				68			
29				69			
30	1M55S	hard	PERCUSSION	70			
31				71			
32				72			
33				73			
34				74			
35				75			
36				76			
37				77			
38				78			
39				79			
40				80			

The following Data contains estimated Rippable/Marginal and Marginal/Blasting Horizons are based upon experience in Massive Homogeneous Granite Rock Types. Deviations due to changes in geologic formations, bedding planes, joints sets, faulting or hydrological conditions as well as ripper equipment types and conditions can result in wide variances in either direction in the actual rippability limits encountered.

Earth, Construction, & Mining
CA LIC. No. 651848
NV LIC. NO. 0071919

E C M

11542 Knott Street #10, Garden Grove CA 92841
PH: 714-897-4ECM [4326] · FX: 714-897-2016

INVESTIGATIVE DRILL LOGS

HOLE #15 LOCATION: N34.01967 W 117.41215			
JOB# 4257	HOLE #15	DRILL CALIBRATIONS	
DATE: 5/14/13		DRILL MAKE/MODEL: INGERSAL RAND ECM 720 CRAWLER DRILL #838	
RIPPABLE/OVERBURDEN:		NEUTRAL NO LOAD: FEED 500 PSI / ROTATION 100 PSI	
Marginal:		ROTATION UNDER LOAD: FEED 500 PSI / ROTATION 900 PSI	
PROBABLE BLASTING:		DRILL W/PERCUSION : PERCUSSION 1200 PSI / FEED 800 PSI / ROTATION 1000	

DEPTH	TIME	RQ	NOTES	DEPTH	TIME	RQ	NOTES
1				41			
2				42			
3				43			
4			WATER INJECTION	44			
5		medium	COLLAR	45			
6				46			
7				47			
8				48			
9				49			
10	1m46s	med hard	PERCUSSION	50			
11				51			
12				52			
13				53			
14				54			
15	1m25s	hard	PERCUSSION	55			
16				56			
17				57			
18				58			
19				59			
20	1m40s	hard	PERCUSSION	60			
21				61			
22				62			
23				63			
24				64			
25	1m14s	hard	PERCUSSION	65			
26				66			
27				67			
28				68			
29				69			
30				70			
31				71			
32				72			
33				73			
34				74			
35				75			
36				76			
37				77			
38				78			
39				79			
40				80			

The following Data contains estimated Rippable/Marginal and Marginal/Blasting Horizons are based upon experience in Massive Homogeneous Granite Rock Types. Deviations due to changes in geologic formations, bedding planes, joints sets, faulting or hydrological conditions as well as ripper equipment types and conditions can result in wide variances in either direction in the actual rippability limits encountered.

Earth, Construction, & Mining
CA LIC. No. 651848
NV LIC. NO. 0071919

E C M

11542 Knott Street #10, Garden Grove CA 92841
PH: 714-897-4ECM [4326] · FX: 714-897-2016

INVESTIGATIVE DRILL LOGS

HOLE #16 LOCATION: N 34.02518 W 117.40664

JOB# 4257	HOLE #16	DRILL CALIBRATIONS
DATE: 5/14/13		DRILL MAKE/MODEL: INGERSAL RAND ECM 720 CRAWLER DRILL #838
RIPPABLE/OVERBURDEN:		NEUTRAL NO LOAD: FEED 500 PSI / ROTATION 100 PSI
Marginal:		ROTATION UNDER LOAD: FEED 500 PSI / ROTATION 900 PSI
PROBABLE BLASTING:		DRILL W/PERCUSION : PERCUSSION 1200 PSI / FEED 800 PSI / ROTATION 1000

DEPTH	TIME	RQ	NOTES	DEPTH	TIME	RQ	NOTES
1				41			
2				42			
3				43			
4			BROWN GREY	44			
5				45	1m39s	hard	PERCUSSION
6			WATERINJECTION	46			
7		med soft	COLLAR	47			
8				48			GREY
9				49			
10				50	1m51s	hard	PERCUSSION
11				51			
12	52s	medium	PERCUSSION	52			
13				53			
14				54			
15	1m34s	medium	PERCUSSION	55			
16				56			
17				57			
18			GREY	58			
19				59			
20	1m50s	med hard	PERCUSSION	60			
21				61			
22				62			
23				63			
24				64			
25	1m40s	medium	PERCUSSION	65			
26				66			
27				67			
28				68			
29				69			
30	1m31s	medium	PERCUSION	70			
31				71			
32		med hard		72			
33				73			
34				74			
35	1m44s	hard	PERCUSSION	75			
36				76			
37				77			
38				78			
39				79			
40	1m01s	hard	PERCUSSION	80			

The following Data contains estimated Rippable/Marginal and Marginal/Blasting Horizons are based upon experience in Massive Homogeneous Granite Rock Types. Deviations due to changes in geologic formations, bedding planes, joints sets, faulting or hydrological conditions as well as ripper equipment types and conditions can result in wide variances in either direction in the actual rippability limits encountered.

Earth, Construction, & Mining
CA LIC. No. 651848
NV LIC. NO. 0071919

E C M

11542 Knott Street #10, Garden Grove CA 92841
PH: 714-897-4ECM [4326] · FX: 714-897-2016

INVESTIGATIVE DRILL LOGS

HOLE #17 LOCATION: N 34.02313 W 117.40657

JOB# 4257	HOLE #17	DRILL CALIBRATIONS
DATE: 5/14/13		DRILL MAKE/MODEL: INGERSAL RAND ECM 720 CRAWLER DRILL #838
RIPPABLE:		NEUTRAL NO LOAD: FEED 500 PSI / ROTATION 100 PSI
Marginal:		ROTATION UNDER LOAD: FEED 500 PSI / ROTATION 900 PSI
PROBABLE BLASTING:		DRILL W/PERCUSION : PERCUSSION 1200 PSI / FEED 800 PSI / ROTATION 1000

DEPTH	TIME	RQ	NOTES	DEPTH	TIME	RQ	NOTES
1				41			
2				42			
3				43			
4				44			
5				45			
6			WATER INJECTION	46			
7		med soft	COLLAR	47			
8				48			
9				49			
10		medium		50			
11				51			
12	50s	hard	PERCUSSION	52			
13				53			
14				54			
15	45s	hard	PERCUSSION	55			
16				56			
17				57			
18			GREY	58			
19				59			
20	1m18s	hard	PERCUSSION	60			
21				61			
22				62			
23				63			
24				64			
25	1m27s	hard	PERCUSSION	65			
26				66			
27				67			
28				68			
29				69			
30	1m23s	hard	PERCUSSION	70			
31				71			
32				72			
33			BROWN GREY	73			
34				74			
35	1m16s	hard	PERCUSSION	75			
36				76			
37				77			
38				78			
39				79			
40				80			

The following Data contains estimated Rippable/Marginal and Marginal/Blasting Horizons are based upon experience in Massive Homogeneous Granite Rock Types. Deviations due to changes in geologic formations, bedding planes, joints sets, faulting or hydrological conditions as well as ripper equipment types and conditions can result in wide variances in either direction in the actual rippability limits encountered.

Earth, Construction, & Mining
CA LIC. No. 651848
NV LIC. NO. 0071919

E C M

11542 Knott Street #10, Garden Grove CA 92841
PH: 714-897-4ECM [4326] · FX: 714-897-2016

INVESTIGATIVE DRILL LOGS

HOLE #18 LOCATION: N 34.02293 W 117.40349			
JOB# 4257	HOLE #18	DRILL CALIBRATIONS	
DATE: 5/14/13		DRILL MAKE/MODEL: INGERSAL RAND ECM 720 CRAWLER DRILL #838	
RIPPABLE/OVERBURDEN:		NEUTRAL NO LOAD: FEED 500 PSI / ROTATION 100 PSI	
MARGINAL:		ROTATION UNDER LOAD: FEED 500 PSI / ROTATION 900 PSI	
PROBABLE BLASTING:		DRILL W/PERCUSION : PERCUSSION 1200 PSI / FEED 800 PSI / ROTATION 1000	

DEPTH	TIME	RQ	NOTES	DEPTH	TIME	RQ	NOTES
1				41		Xxtra hard	
2				42			
3				43			GREY
4				44			
5				45	3m41s	Xxtra hard	PERCUSSION
6			WATER INJECTION	46			
7		soft	COLLAR	47			
8				48			
9				49			
10				50			
11				51			
12	1m05s	med soft	PERCUSSION	52			
13				53			
14				54			
15			GREY	55			
16				56			
17	1m19s	med hard	PERCUSSION	57			
18				58			
19				59			
20		M		60			
21				61			
22	1m43s	hard	PERCUSSION	62			
23				63			
24				64			
25				65			
26	1m45s	hard	PERCUSSION	66			
27				67			
28				68			
29				69			
30				70			
31	2m19s	XTRA hard	PERCUSSION	71			
32				72			
33			DARK GREY	73			
34				74			
35				75			
36	1m38s	hard	PERCUSSION	76			
37				77			
38				78			
39				79			
40	1m45s	XTRA hard	PERCUSSION	80			

The following Data contains estimated Rippable/Marginal and Marginal/Blasting Horizons are based upon experience in Massive Homogeneous Granite Rock Types. Deviations due to changes in geologic formations, bedding planes, joints sets, faulting or hydrological conditions as well as ripper equipment types and conditions can result in wide variances in either direction in the actual rippability limits encountered.

Percolation Test Calculation Sheet

Adapted from San Bernardino County WQMP Appendix D, dated May 19, 2011

Project Name: Richland Rio Vista
Project No.: 10270.002
Prepared by: Jay Dupre
Date Prepared: 8/13/2015

Test Hole No.	Δt (min.)	D_0 (in.)	D_f (in.)	ΔD (in.)	D_T (in.)	Boring Diameter (in.)	5 Gallon Bottle Diameter (in.)	ΔV_{BOTTLE} ($in.^3$)	Q ($in.^3$/hr)	SA_{BORING} ($in.^2$)	I_t (in./hr)
TP-1	6	-6.00	0.00	6.00	20.00	6.0	10.0	471	4712	405.27	11.63
TP-1	7	-14.00	-8.00	6.00	20.00	6.0	10.0	471	4039	405.27	9.97
TP-1	10	-8.00	-1.00	7.00	20.00	6.0	10.0	550	3299	405.27	8.14
TP-1	10	-14.00	-7.00	7.00	20.00	6.0	10.0	550	3299	405.27	8.14
TP-1	10	-7.00	0.00	7.00	20.00	6.0	10.0	550	3299	405.27	8.14
TP-1	10	-13.00	-8.50	4.50	20.00	6.0	10.0	353	2121	405.27	5.23
TP-1	10	-8.50	-2.50	6.00	20.00	6.0	10.0	471	2827	405.27	6.98
TP-1	10	-14.00	-10.00	4.00	20.00	6.0	10.0	314	1885	405.27	4.65
TP-1	10	-10.00	-5.00	5.00	20.00	6.0	10.0	393	2356	405.27	5.81
TP-4	3	-13.00	-7.00	6.00	20.00	6.0	10.0	471	9425	405.27	23.26
TP-4	3	-7.00	-1.00	6.00	20.00	6.0	10.0	471	9425	405.27	23.26
TP-4	10	-12.00	-2.00	10.00	20.00	6.0	10.0	785	4712	405.27	11.63
TP-4	10	-13.50	-6.50	7.00	20.00	6.0	10.0	550	3299	405.27	8.14
TP-4	10	-6.50	1.50	8.00	20.00	6.0	10.0	628	3770	405.27	9.30
TP-4	10	-12.00	-3.50	8.50	20.00	6.0	10.0	668	4006	405.27	9.88
TP-4	10	-3.50	4.50	8.00	20.00	6.0	10.0	628	3770	405.27	9.30
TP-4	10	-9.50	-2.00	7.50	20.00	6.0	10.0	589	3534	405.27	8.72

Results of Well Permeameter, from USBR 7300-89 Method.

Leighton

Project:	Rio Vista # 10270.002
Exploration #/Location:	**LB-1**
Depth Boring drilled to (ft):	15
Tested by:	BER
USCS Soil Type:	
Weather (start to finish)	Sunny
Liquid Used/pH:	Hydrant H_2O
Diameter of barrel (in.):	22.5
No. of Supply barrels:	1
Measured boring diameter	9 in.
Approx Depth to GW below GS	100 ft
Well Prep:	Straight Drilled

Approx Ht from water surface to top of float assembly (in.): #N/A

Approx float assem length (w/out extension), in.: #N/A

	a.*	b.*
Initial estimated Depth to Water Surface (in.):	#N/A	#N/A
Initial est. depth of water in well, "h" (in.):	#N/A	#N/A
approx. h/r (prelim):	#N/A	#N/A

Tu (Fig. 8): #N/A

Tu>3h?: #N/A

397.4 Total Area of barrels (in.^2):

4.5 Well Radius, "r"

*a. Est. by measurements from top of float assm.

*b. Est. by measurements from top of sand

	ft	in.	(total)			
Depth to Bot of well (or top of soil over Bentonite)	15. ft	0. in.	180			
Depth to top of dry sand before casing install	10. ft	8. in.	128		52	sand thickness
Length of casing			0			
Casing stickup (+ is above ground)			0		80	sand thickness
Depth to Top of Sand from top of casing	8. ft	4. in.	100	100	0	check by casing length
Pilot Tube stickup (+ is above ground)		48. in.	48			
Depth to top of float assembly from top of pilot tube	9. ft	9. in.	117	69	Depth below GS (in.)	
Float Assembly ID	D					
Float assembly Extension length (in.)		34				

Field Data **Calculations**

Date	Time	Water Level in Supply Barrel (in.)	Depth to WL in Boring (measured from top of pilot tube)		Water Temp (deg F)	Comments (or "y" for DL interpre-tation)	Δt (min)	Total Elapsed Time (min.)	Depth to WL in well (in.)	h, Height of Water in Well (in.)	Δh (in.)	Avg. h	Vol Change (in.^3)			Flow (in^3/ min)	q, Flow (in^3/ hr)	V (Fig 9)	K20, Coef. Of Perme-ability at 20 deg C (in./hr)	Infiltration Rate [flow/surf area] (in./hr) (FS=1)
Start Date	Start time:		ft	in.									from barrels	from Δh	Total					
7/22/2015	8:12 AM																			
-									#N/A	#N/A	<--est. from setup measurements									
7/22/15	8:12	27	11.92		77			0	95.0	85.0										
7/22/15	8:39	16.625	11.8		77		27	27	93.6	86.4	1.44	86	4123	-43	4080	151	9067	0.9	0.45	**3.15**
7/22/15	8:52	13	11.81		78		13	40	93.7	86.3	-0.12	86	1441	4	1444	111	6665	0.9	0.33	**2.27**
7/22/15	8:55	30.625	11.77		78			43	93.2	86.8										
7/22/15	9:10	27	11.77		78		15	58	93.2	86.8	0	87	1441	0	1441	96	5762	0.9	0.28	**1.95**
7/22/15	10:09	12.25	11.78		81		59	117	93.4	86.6	-0.12	87	5862	4	5865	99	5965	0.8	0.28	**1.95**
7/22/15	10:14	31.125	11.78		81			122	93.4	86.6	0	87	7501	0	7501			0.8		
7/22/15	11:34	10.625	11.8		85		80	202	93.6	86.4	-0.24	87	8147	7	8154	102	6115	0.8	0.28	**1.92**
7/22/15	11:40	30.625	11.8		82			208	93.6	86.4										
7/22/15	12:44	13.375	11.8		86		64	272	93.6	86.4	0	86	6855	0	6855	107	6427	0.8	0.29	**2.00**
7/22/15	12:50	30.625	11.76		83			278	93.1	86.9										
7/22/15	13:44	16.375	11.79		86		54	332	93.5	86.5	-0.36	87	5663	11	5674	105	6304	0.8	0.28	**1.96**

Results of Well Permeameter, from USBR 7300-89 Method.

Leighton

Project:	Rio Vista # 10270.002
Exploration #/Location:	**LB-2**
Depth Boring drilled to (ft):	30
Tested by:	BER
USCS Soil Type:	
Weather (start to finish)	Sunny
Liquid Used/pH:	Hydrant H_2O
Diameter of barrel (in.):	22.5
No. of Supply barrels:	1
Measured boring diameter	9 in.
Approx Depth to GW below GS	100 ft
Well Prep:	Straight Drilled

Approx Ht from water surface to top of float assembly (in.): #N/A

Approx float assem length (w/out extension), in.: #N/A

	a.*	b.*
Initial estimated Depth to Water Surface (in.):	#N/A	#N/A
Initial est. depth of water in well, "h" (in.):	#N/A	#N/A
approx. h/r (prelim):	#N/A	#N/A

Tu (Fig. 8): #N/A

Tu>3h?: #N/A

397.4 Total Area of barrels (in.^2):

4.5 Well Radius, "r"

*a. Est. by measurements from top of float assm.

*b. Est. by measurements from top of sand

	ft	in.	(total)			
Depth to Bot of well (or top of soil over Bentonite)	30. ft	0. in.	360			
Depth to top of dry sand before casing install	22. ft	5. in.	269		91	sand thickness
Length of casing			0			
Casing stickup (+ is above ground)			0		128	sand thickness
Depth to Top of Sand from top of casing	19. ft	4. in.	232	232	0	check by casing length
Pilot Tube stickup (+ is above ground)		36. in.	36			
Depth to top of float assembly from top of pilot tube	20. ft		240	204	Depth below GS (in.)	
Float Assembly ID	B					
Float assembly Extension length (in.)		30				

Field Data **Calculations**

Date	Time	Water Level in Supply Barrel (in.)	Depth to WL in Boring (measured from top of pilot tube)		Water Temp (deg F)	Comments (or "y" for DL interpre-tation)	Δt (min)	Total Elapsed Time (min.)	Depth to WL in well (in.)	h, Height of Water in Well (in.)	Δh (in.)	Avg. h	Vol Change (in.^3)			Flow (in^3/ min)	q, Flow (in^3/ hr)	V (Fig 9)	K20, Coef. Of Perme-ability at 20 deg C (in./hr)	Infiltration Rate [flow/surf area] (in./hr) (FS=1)
Start Date	Start time:		ft	in.									from barrels	from Δh	Total					
7/22/2015	9:04 AM																			
-									#N/A	#N/A	<--est. from setup measurements									
7/22/15	9:04	25.375	22.35		78			0	232.2	127.8										
7/22/15	10:19	18	21.99		80		75	75	227.9	132.1	4.32	130	2931	-128	2803	37	2242	0.8	0.05	**0.50**
7/22/15	10:25	31.75	22		80			81	228.0	132.0										
7/22/15	11:43	27.5	22.22		83		78	159	230.6	129.4	-2.64	131	0	78	78	1	60	0.8	0.00	**0.01**
7/22/15	12:54	23.5	22.19		85		71	230	230.3	129.7	0.36	130	0	-11	-11	0	-9	0.8	0.00	**0.00**
7/22/15	13:48	20.5	22.19		86		54	284	230.3	129.7	0	130	0	0	0	0	0	0.8	0.00	**0.00**

Results of Well Permeameter, from USBR 7300-89 Method.

Leighton

Project:	Rio Vista # 10270.002
Exploration #/Location:	LB-3
Depth Boring drilled to (ft):	12
Tested by:	BER
USCS Soil Type:	
Weather (start to finish)	Sunny
Liquid Used/pH:	Hydrant H_2O
Diameter of barrel (in.):	22.5
No. of Supply barrels:	1
Measured boring diameter	9 in.
Approx Depth to GW below GS	100 ft
Well Prep:	Straight Drilled

Approx Ht from water surface to top of float assembly (in.): #N/A

Approx float assem length (w/out extension), in.: #N/A

	a.*	b.*
Initial estimated Depth to Water Surface (in.):	#N/A	#N/A
Initial est. depth of water in well, "h" (in.):	#N/A	#N/A
approx. h/r (prelim):	#N/A	#N/A

Tu (Fig. 8): #N/A

Tu>3h?: #N/A

397.4 Total Area of barrels (in.^2):

4.5 Well Radius, "r"

*a. Est. by measurements from top of float assm.

*b. Est. by measurements from top of sand

	ft	in.	(total)		
Depth to Bot of well (or top of soil over Bentonite)	12. ft	0. in.	144		
Depth to top of dry sand before casing install	9. ft	1. in.	109	35	sand thickness
Length of casing			0		
Casing stickup (+ is above ground)			0	72	sand thickness
Depth to Top of Sand from top of casing	6. ft		72	72 0	check by casing length
Pilot Tube stickup (+ is above ground)		42. in.	42		
Depth to top of float assembly from top of pilot tube	7. ft	9. in.	93	51 Depth below GS (in.)	
Float Assembly ID	F				
Float assembly Extension length (in.)		24			

Field Data **Calculations**

Date	Time	Water Level in Supply Barrel (in.)	Depth to WL in Boring (measured from top of pilot tube)		Water Temp (deg F)	Comments (or "y" for DL interpre-tation)	Δt (min)	Total Elapsed Time (min.)	Depth to WL in well (in.)	h, Height of Water in Well (in.)	Δh (in.)	Avg. h	Vol Change (in.^3)			Flow (in^3/ min)	q, Flow (in^3/ hr)	V (Fig 9)	K20, Coef. Of Perme-ability at 20 deg C (in./hr)	Infiltration Rate [flow/surf area] (in./hr) (FS=1)
Start Date	Start time:		ft	in.									from barrels	from Δh	Total					
7/22/2015	11:14 AM																			
-									#N/A	#N/A	<--est. from setup measurements									
7/22/15	11:14	28.625	9.25		81			0	69.0	75.0										
7/22/15	11:26	25.125	9.36		81		12	12	70.3	73.7	-1.32	74	1391	39	1430	119	7150	0.8	0.44	**2.71**
7/22/15	12:03	18.625	9.34		84		37	49	70.1	73.9	0.24	74	2583	-7	2576	70	4177	0.8	0.25	**1.55**
7/22/15	12:07	30	9.35		83			53	70.2	73.8										
7/22/15	13:15	19.75	9.35		86		68	121	70.2	73.8	0	74	4073	0	4073	60	3594	0.8	0.21	**1.30**
7/22/15	14:10	12.125	9.39		88		55	176	70.7	73.3	-0.48	74	3030	14	3044	55	3321	0.8	0.19	**1.19**
7/22/15	14:14	31.375	9.33		85			180	70.0	74.0	0.72	74	7650	-21	7629			0.8		
7/22/15	15:03	24.75	9.36		87		49	229	70.3	73.7	-0.36	74	2633	11	2643	54	3237	0.8	0.19	**1.16**
7/22/15	16:07	16.125	9.35		90		64	293	70.2	73.8	0.12	74	3428	-4	3424	54	3210	0.8	0.18	**1.13**

Results of Well Permeameter, from USBR 7300-89 Method.

Leighton

Project:	Rio Vista # 10270.002
Exploration #/Location:	LB-4
Depth Boring drilled to (ft):	30
Tested by:	BER
USCS Soil Type:	
Weather (start to finish)	Sunny
Liquid Used/pH:	Hydrant H_2O
Diameter of barrel (in.):	22.5
No. of Supply barrels:	1
Measured boring diameter	8 in.
Approx Depth to GW below GS	100 ft
Well Prep:	Straight Drilled

Approx Ht from water surface to top of float assembly (in.): #N/A

Approx float assem length (w/out extension), in.: #N/A

	a.*	b.*
Initial estimated Depth to Water Surface (in.):	#N/A	#N/A
Initial est. depth of water in well, "h" (in.):	#N/A	#N/A
approx. h/r (prelim):	#N/A	#N/A

Tu (Fig. 8): #N/A

Tu>3h?: #N/A

397.4 Total Area of barrels (in.^2):

4 Well Radius, "r"

*a. Est. by measurements from top of float assm.

*b. Est. by measurements from top of sand

	ft	in.	(total)			
Depth to Bot of well (or top of soil over Bentonite)	30. ft	0. in.	360			
Depth to top of dry sand before casing install	23. ft	9. in.	285		75	sand thickness
Length of casing			0			
Casing stickup (+ is above ground)			0		108	sand thickness
Depth to Top of Sand from top of casing	21. ft		252	252	0	check by casing length
Pilot Tube stickup (+ is above ground)		6. in.	6			
Depth to top of float assembly from top of pilot tube	18. ft	8. in.	224	218 Depth below GS (in.)		
Float Assembly ID	A					
Float assembly Extension length (in.)		30				

Field Data | **Calculations**

Date	Time	Water Level in Supply Barrel (in.)	Depth to WL in Boring (measured from top of pilot tube)		Water Temp (deg F)	Comments (or "y" for DL interpre-tation)	Δt (min)	Total Elapsed Time (min.)	Depth to WL in well (in.)	h, Height of Water in Well (in.)	Δh (in.)	Avg. h	Vol Change (in.^3)			Flow (in^3/ min)	q, Flow (in^3/ hr)	V (Fig 9)	K20, Coef. Of Perme-ability at 20 deg C (in./hr)	Infiltration Rate [flow/surf area] (in./hr) (FS=1)
Start Date	Start time:		ft	in.									from barrels	from Δh	Total					
7/22/2015	10:52 AM																			
-									#N/A	#N/A	<--est. from setup measurements									
7/22/15	10:52	24.125	21.25		80			0	249.0	111.0										
7/22/15	11:18	11.25	21.3		82		26	26	249.6	110.4	-0.6	111	5117	15	5131	197	11841	0.8	0.38	**3.40**
7/22/15	11:22	30.25	21.36		81			30	250.3	109.7										
7/22/15	11:55	17.875	21.29		84		33	63	249.5	110.5	0.84	110	4918	-20	4897	148	8904	0.8	0.28	**2.52**
7/22/15	11:59	30.375	21.31		83			67	249.7	110.3										
7/22/15	13:06	6.125	21.38		86		67	134	250.6	109.4	-0.84	110	9637	20	9658	144	8649	0.8	0.27	**2.40**
7/22/15	13:11	31	21.32		82			139	249.8	110.2										
7/22/15	13:35	22.375	21.35		84		24	163	250.2	109.8	-0.36	110	3428	9	3436	143	8591	0.8	0.27	**2.43**
7/22/15	14:02	12.625	21.35		85		27	190	250.2	109.8	0	110	3875	0	3875	144	8610	0.8	0.27	**2.41**
7/22/15	14:06	30.375	21.32		84			194	249.8	110.2										
7/22/15	14:54	12.5	21.32		87		48	242	249.8	110.2	0	110	7104	0	7104	148	8880	0.8	0.27	**2.44**
7/22/15	14:59	30	21.35		85			247	250.2	109.8										
7/22/15	15:40	15	21.35		87		41	288	250.2	109.8	0	110	5961	0	5961	145	8724	0.8	0.27	**2.40**

BYERLY, 2006

Boring 1

Boring Date: 10/19/05
Surface Elevation:
Drilling Method: Flight-auger

Depth	SPT Blows Per Foot	Driving Energy (k-ft/ft)	Dry Density (PCF)	Moisture Content (%)	Rel. Compaction (%)	Water Table		
0	2.8	105	4.2	79		SM	Brown silty fine to medium sand, damp and loose
	4.2	106	3.1	80			
5	6.0	112	3.2	84			
	14.0	119	11.3	89		SM	Red-brown silty fine to medium sand, moist and medium dense
10	12.6	117	11.1	88			
	10.5	115	6.5	86			- becoming damp at 15.5 feet
15							
20	42.0	125	3.7	94			- becoming very dense at 20.5 feet
	35.0	---	---	---		END	Total Depth at 26.0 Feet No Free Groundwater Encountered
25							
30							
35							

SuperLog V2.6 CivilTech Software, USA www.civiltech.com File: C:\superlogproject\S-11403 (Rpt. No. 8552).log Date: 1/20/2006

LOG OF BORING

Boring 2

Boring Date: 10/19/05
Surface Elevation:
Drilling Method: Flight-auger

Depth	SPT Blows Per Foot	Driving Energy (k-ft/ft)	Dry Density (PCF)	Moisture Content (%)	Rel. Compaction (%)	Water Table		
0	3.2	112	5.4	84			SM	Brown silty fine to medium sand, slightly porous, damp and loose
	4.9	110	7.6	83				- becoming moist at 3.5 feet
5	26.3	120	10.3	90				- becoming dense at 5.5 feet
	2.5	110	6.7	82			SM	Brown and gray-brown silty fine to coarse sand, damp and loose
10	3.2	112	6.7	83				
15	26.3	118	7.5	89			SM	Brown silty fine to medium sand, moist and medium dense
20	20.0	114	3.9	86				- becoming damp at 20.5 feet
25	52.5	121	5.2	91				- becoming dense to very dense at 25.0 feet
30							END	Total Depth at 26.0 Feet No Free Groundwater Encountered
35								

SuperLog V2.6 CivilTech Software, USA www.civiltech.com File: C:\superlog\project\S-11403 (Rpt. No. 8552).log Date: 1/20/2006

LOG OF BORING

Boring 3

Boring Date: 10/19/05
Surface Elevation:
Drilling Method: Flight-auger

Depth	SPT Blows Per Foot	Driving Energy (k-ft/ft)	Dry Density (PCF)	Moisture Content (%)	Rel. Compaction (%)	Water Table		
0	2.5		96	4.1	72		SM	Orange-brown silty fine to medium sand, slightly porous, damp and loose
	3.5		100	5.1	75			
5	7.7		119	13.3	89			- becoming moist and medium dense at 5.5 feet
	3.9		110	11.5	83			- becoming loose at 7.5 feet
10	4.9		113	8.8	85			- becoming medium dense at 10.5 feet
15	7.7		117	4.3	87		SM	Brown silty fine to coarse sand with gravel, damp and medium dense
20	21.0		122	5.9	90			- becoming dense at 20.5 feet
25	21.0		122	3.3	90			
30	26.3		126	4.4	93			
35							END	Total Depth at 31.0 Feet No Free Groundwater Encountered

SuperLog V2.6 CivilTech Software, USA www.civiltech.com File: C:\superlog\project\S-11403 (Rpt. No. 8552).log Date: 1/20/2006

LOG OF BORING

Boring 4

Boring Date: 10/19/05
Surface Elevation:
Drilling Method: Flight-auger

Depth	SPT Blows Per Foot	Driving Energy (k-ft/ft)	Dry Density (PCF)	Moisture Content (%)	Rel. Compaction (%)	Water Table		
0	7.4	114	3.0	84			SM	Brown and dark brown silty fine to coarse sand, damp and loose
	10.9	116	4.0	87			SM	Brown silty fine to medium sand, damp and medium dense
5	12.6	117	6.7	88			SM	Red-brown silty fine to coarse sand, damp and medium dense
	10.9	116	3.0	86				
10	26.3	123	2.9	91			BR	Gray and gray-brown weathered granitic rock, dry and dense
15							END	Total Depth at 15.0 Feet No Free Groundwater Encountered
20								
25								
30								
35								

SuperLog V2.6 CivilTech Software, USA www.civiltech.com File: C:\super\log\project\S-11403 (Rpt. No. 8552).log Date: 1/20/2006

LOG OF BORING

Boring 5

Boring Date: 10/19/05
Surface Elevation:
Drilling Method: Flight-auger

Depth	SPT Blows Per Foot	Driving Energy (k-ft/ft)	Dry Density (PCF)	Moisture Content (%)	Rel. Compaction (%)	Water Table		
0							SM	Red-brown silty fine to medium sand, moist and loose
2	16.1	120	7.7	89			BR	Gray-brown weathered granitic rock, moist and medium dense
4	26.3	126	6.0	93				- becoming damp and very dense at 3.5 feet
6								
8							END	Refusal on Very Dense Rock at 7.0 Feet No Free Groundwater Encountered
10								
12								
14								

SuperLog V2.6 CivilTech Software, USA www.civiltech.com File: C:\superlog\project\S-11403 (Rpt. No. 8552).log Date: 1/20/2006

LOG OF BORING

Boring 6

Boring Date: 10/19/05
Surface Elevation:
Drilling Method: Flight-auger

Depth	SPT Blows Per Foot	Driving Energy (k-ft/ft)	Dry Density (PCF)	Moisture Content (%)	Rel. Compaction (%)	Water Table		
0	2.8		105	2.7	78		SM	Brown silty fine to coarse sand, dry and loose
	6.0		112	4.4	83			- becoming damp at 3.5 feet
5	4.9		114	4.1	84			
	7.4		116	3.8	86			- becoming medium dense at 7.5 feet
10	30.0		122	6.6	90		BR	Gray-brown weathered granitic rock, damp and dense
								- becoming very dense at 14.0 feet
15	105.0		---	---	---		END	Total Depth at 15.5 Feet No Free Groundwater Encountered
20								
25								
30								
35								

SuperLog V2.6 CivilTech Software, USA www.civiltech.com File: C:\superlog\project\S-11403 (Rpt. No. 8552).log Date: 1/20/2006

LOG OF BORING

Test Pit 1

Depth | SPT Blows Per Foot | Driving Energy (k-ft/ft) | Dry Density (PCF) | Moisture Content (%) | Rel. Compaction (%) | Water Table

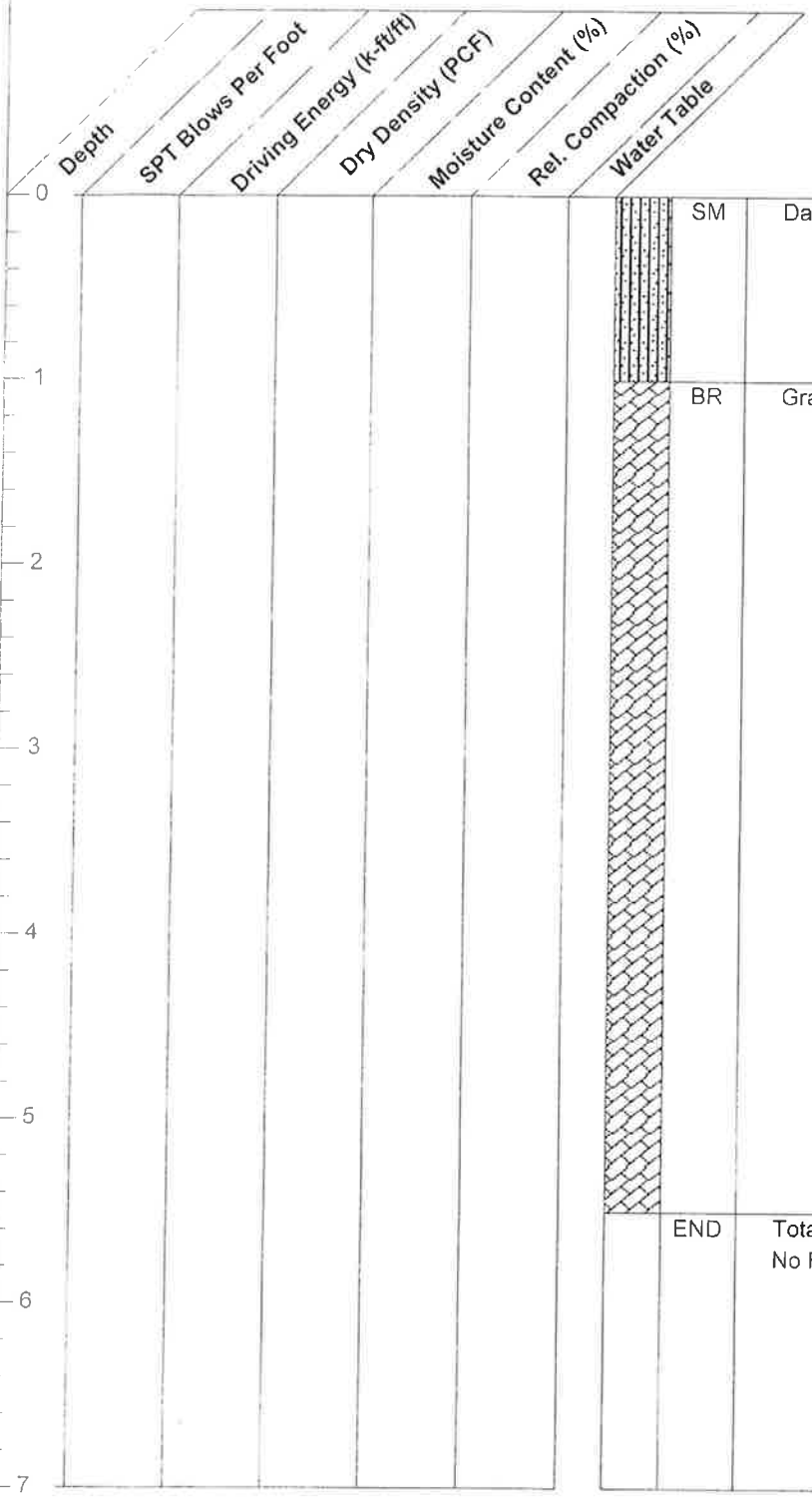
Boring Date: 10/20/05
Surface Elevation:
Drilling Method: Backhoe

Depth		
0	SM	Brown and dark brown silty fine to coarse sand with some gravel, damp and loose
1		
2	BR	Gray and gray-brown weathered granitic rock, damp and dense
3		
4	END	Total Depth at 4.0 Feet No Free Groundwater Encountered
5		
6		
7		

SuperLog V2.6 CivilTech Software, USA www.civiltech.com File: C:\superlog\project\S-11403 (Rpt. No. 8552).log Date: 1/20/2006

LOG OF BORING

Test Pit 2



Boring Date: 10/20/05
Surface Elevation:
Drilling Method: Backhoe

0	SM	Dark brown silty fine to medium sand, damp and loose
1	BR	Gray-brown weathered granitic rock, damp and dense
5.5	END	Total Depth at 5.5 Feet No Free Groundwater Encountered

SuperLog V2.6 CivilTech Software, USA www.civiltech.com File: C:\superlog\project\S-11403 (Rpt. No. 8552).log Date: 1/20/2006

LOG OF BORING

John R. Byerly, Inc.

Rio Vista Specific Plan 243
Rubidoux Area of Riverside County

Enclosure 2, Page 8
Report No.: 8552
File No.: S-11403

Test Pit 3

Boring Date: 10/20/05
Surface Elevation:
Drilling Method: Backhoe

Depth	SPT Blows Per Foot	Driving Energy (k-ft/ft)	Dry Density (PCF)	Moisture Content (%)	Rel. Compaction (%)	Water Table		
0							SM	Dark brown silty fine to coarse sand, damp and loose
2							SM	Gray and gray-brown silty fine to coarse sand with gravel, damp and loose
4								
6			105	5.2	78			
8								
10			---	4.8	---		BR	Gray weathered granitic rock, damp and dense
12							END	Total Depth at 12.0 Feet No Free Groundwater Encountered
14								

SuperLog V2.6 CivilTech Software, USA www.civiltech.com File: C:\supertog\project\S-11403 (Rpt. No. 8552).log Date: 1/20/2006

LOG OF BORING

Test Pit 4

Boring Date: 10/20/05
Surface Elevation:
Drilling Method: Backhoe

Depth	SPT Blows Per Foot	Driving Energy (k-ft/ft)	Dry Density (PCF)	Moisture Content (%)	Rel. Compaction (%)	Water Table		
0							SM	Gray-brown silty fine to coarse sand, damp and loose
		---	5.3	---			SM	Brown silty fine to medium sand with a trace of clay, damp and loose
5		---	4.4	---			SM	Gray-brown silty fine to coarse sand, damp and medium dense - becoming slightly cemented at 6.0 feet
		127	7.2	94				- becoming moist and very dense at 9.0 feet
10							BR	Brown and gray-brown weathered granitic rock, damp and dense
15							END	Total Depth at 14.5 Feet No Free Groundwater Encountered
20								
25								
30								
35								

SuperLog V2.6 CivilTech Software, USA www.civiltech.com File: C:\superlog\project\S-11403 (Rpt No 8552).log Date: 1/20/2006

LOG OF BORING

Test Pit 5

Depth | SPT Blows Per Foot | Driving Energy (k-ft/ft) | Dry Density (PCF) | Moisture Content (%) | Rel. Compaction (%) | Water Table

Boring Date: 10/20/05
Surface Elevation:
Drilling Method: Backhoe

0
1
2
3
4
5
6
7

SM	Brown and gray-brown silty fine to coarse sand with gravel and glass and metal fragments, damp and loose (FILL)
SP	Brown fine to coarse sand with a trace of silt, damp and medium dense (ORIGINAL GROUND)
BR	Brown and gray-brown weathered granitic rock, damp and very dense
END	Total Depth at 4.0 Feet No Free Groundwater Encountered

SuperLog V2.6 CivilTech Software, USA www.civiltech.com File: C:\superlog\project\S-11403 (Rpt. No. 8552).log Date: 1/25.2006

LOG OF BORING

Test Pit 6

Depth | SPT Blows Per Foot | Driving Energy (k-ft/ft) | Dry Density (PCF) | Moisture Content (%) | Rel. Compaction (%) | Water Table

Boring Date: 10/20/05
Surface Elevation:
Drilling Method: Backhoe

Depth		
0	SM	Brown silty fine to coarse sand with glass fragments, damp and loose (FILL)
1		
2	SM	Gray-brown silty fine to coarse sand, damp and medium dense (ORIGINAL GROUND)
3		- with some boulders below 3.5 feet
4	BR	Gray weathered granitic rock, damp and very dense
5		
6	END	Total Depth at 5.5 Feet No Free Groundwater Encountered
7		

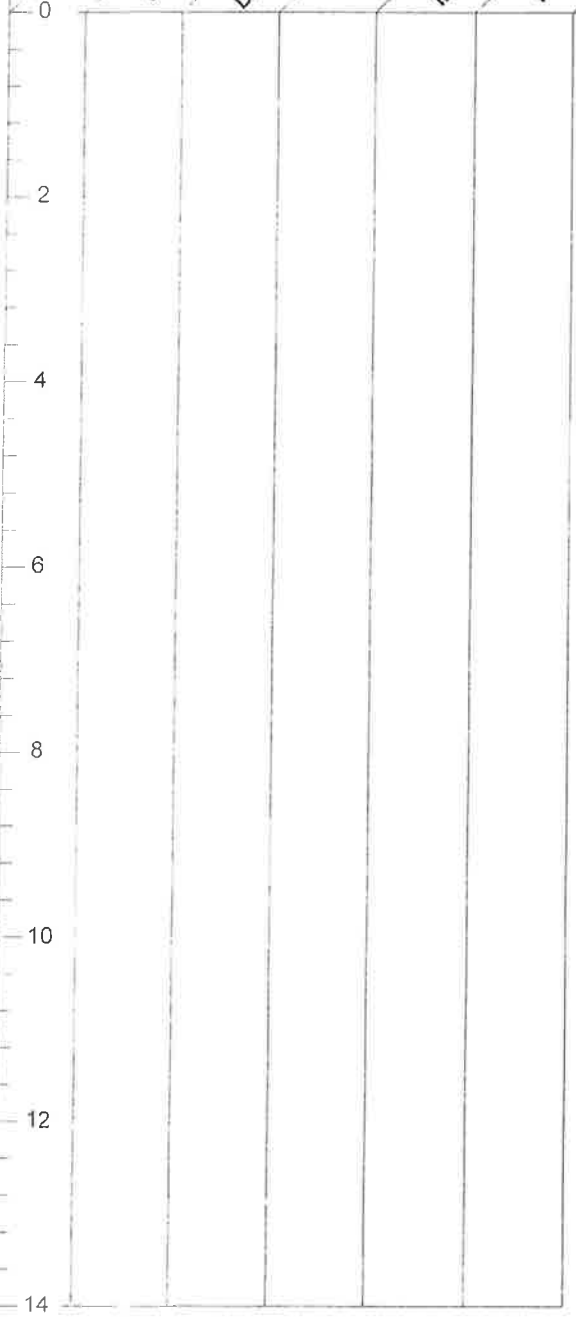
SuperLog V2.6 CivilTech Software, USA www.civiltech.com File: C:\superlog\project\S-11403 (Rpt No. 8552).log Date: 1/20/2006

LOG OF BORING

Test Pit 7

Depth | SPT Blows Per Foot | Driving Energy (k-ft/ft) | Dry Density (PCF) | Moisture Content (%) | Rel. Compaction (%) | Water Table

Boring Date: 10/20/05
Surface Elevation:
Drilling Method: Backhoe



0	SM	Brown and dark brown silty fine to medium sand, damp and loose
4	SM	Dark brown silty fine to coarse sand with a trace of gravel, damp and medium dense
8	BR	Gray weathered granitic rock, damp and very dense
	END	Total Depth at 8.5 Feet No Free Groundwater Encountered

SuperLog V2.6 CivilTech Software, USA www.civiltech.com File: C:\superlog\project\S-11403 (Rpt. No. 8552).log Date: 1/25/2006

LOG OF BORING

Test Pit 8

Boring Date: 10/20/05
Surface Elevation:
Drilling Method: Backhoe

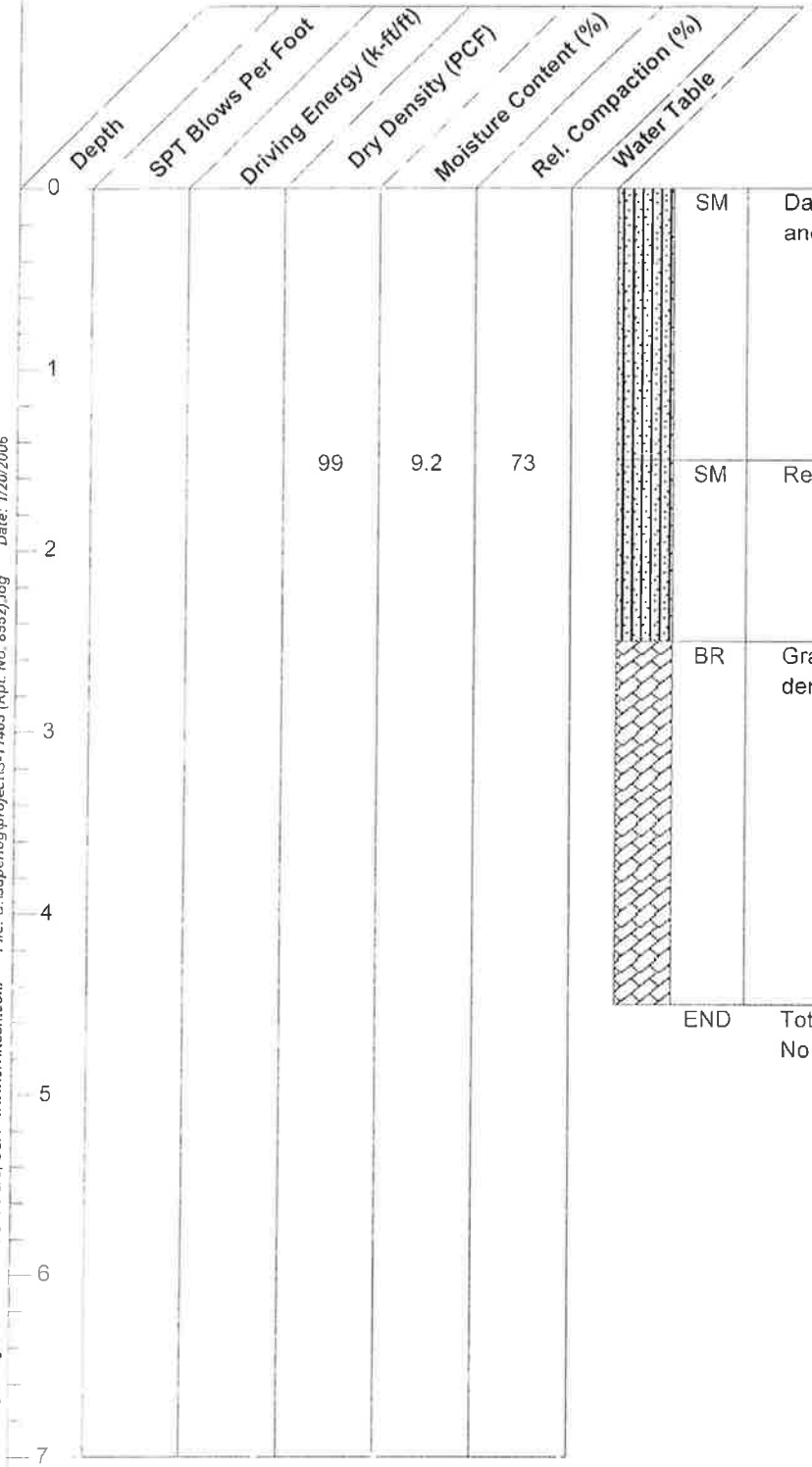
Depth	SPT Blows Per Foot	Driving Energy (k-ft/ft)	Dry Density (PCF)	Moisture Content (%)	Rel. Compaction (%)	Water Table		
0							SM	Brown silty fine to coarse sand, damp and loose
1	---		105	4.3	78			
2								
3							SM	Brown silty fine to medium sand, damp and loose
4							BR	Gray weathered granitic rock, damp and very dense
5								
6							END	Total Depth at 5.5 Feet No Free Groundwater Encountered
7								

SuperLog V2.6 CivilTech Software, USA www.civiltech.com File: C:\superlog\project\S-11403 (Rpt. No. 8552).log Date: 1/20/2006

LOG OF BORING

Test Pit 9

Boring Date: 10/20/05
Surface Elevation:
Drilling Method: Backhoe



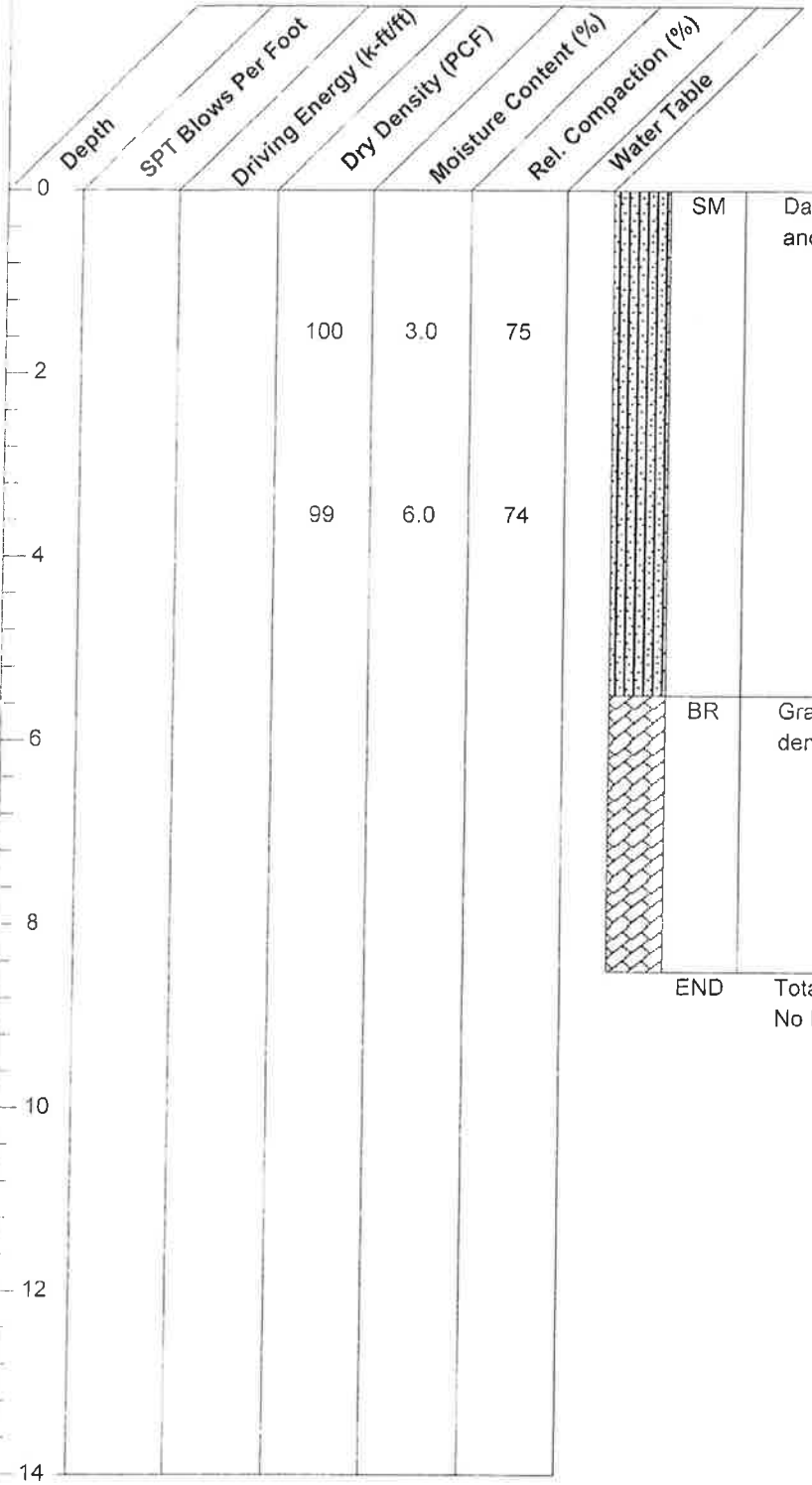
SM	Dark brown silty fine to medium sand, slightly porous, moist and loose
SM	Red-brown silty fine to coarse sand, moist and loose
BR	Gray and gray-brown weathered granitic rock, damp and very dense
END	Total Depth at 4.5 Feet No Free Groundwater Encountered

SuperLog V2.6 CivilTech Software, USA www.civiltech.com File: C:\superlog\project\S-11403 (Rpt. No. 8552).log Date: 1/20/2006

LOG OF BORING

Test Pit 10

Boring Date: 10/20/05
Surface Elevation:
Drilling Method: Backhoe



0	SM	Dark brown silty fine to medium sand, slightly porous, damp and loose
6	BR	Gray and gray-brown weathered granitic rock, damp and dense
8.5	END	Total Depth at 8.5 Feet No Free Groundwater Encountered

SuperLog V2.6 CivilTech Software, USA www.civiltech.com File: C:\superlog\projects\S-11403 (Rpt. No. 8552).log Date: 1/25/2006

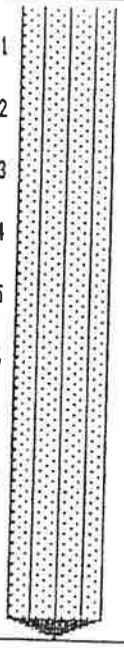
LOG OF BORING

GEOLABS, 1988

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: KK

Job Number: 7545
Test Pit No.: TP1
Elevation: 1040

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
					1	[SM] BRN.-RED BRN., VERY SILTY F-M SAND, DAMP, LOOSE.
					2	
					3	
					4	
					5	
					6	
					7	
					8	
					9	LT. BRN., SILTY F-M SAND W/TRACE OF COARSE, DAMP, MOD. DENSE, CEMENTED.
					10	



Enclosure 2, Page 17
Rpt. No.: 8552
File No.: S-11403

PLATE 3.1

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: KK

Job Number: 7545
Test Pit No.: TP2
Elevation: 1020

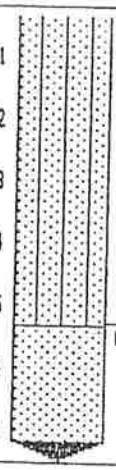
Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
					1	(SM) LT.BRN SLIGHTY SILTY F-M SAND, DRY, LOOSE
					2	
					3	RED/BRN. VERY SILTY F-M SAND, MOIST, LOOSE
					4	
					5	
					6	
					7	
					8	
					9	
					10	(SP) LT.BRN. F-C SAND W/TRACE OF SILT
					11	
					12	

PLATE 3.2

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: KK

Job Number: 7545
Test Pit No.: TP3
Elevation: 1035

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maxiaum Density %	Bulk Sample	Feet	Visual Classification
					1	(SM) LT.BRN SILTY F-C SAND, DRY LOOSE
					2	
					3	
					4	
					5	
					6	(SP) LT.BRN GRANITIC BEDROCK, FRACTURED DENSE
					7	



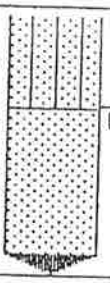
Enclosure 2, Page 19
Rpt. No.: 8552
File No.: S-11403

PLATE 3.3

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: KK

Job Number: 7545
Test Pit No.: TP4
Elevation: 1040

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
					1	[SM] LT. BRN. SILTY F-C SAND W/ ANGULAR GRAVELS AND COBBLES
					2	[SP] MOTTLED GRANITIC BEDROCK, MASSIVE, DENSE
					3	
					4	



Enclosure 2, Page 20
Rpt. No.: 8552
File No.: S-11403

PLATE 3.4

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: KK

Job Number: 7545
Test Pit No.: TP5
Elevation: 1090

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
					1	(SM) LT. BRN. SLIGHTLY SILTY F-C SAND, DAMP LOOSE, SLIGHTLY CEMENTED BELOW 11 FT.
					2	
					3	
					4	
					5	
					6	
					7	
					8	
					9	
					10	
					11	
					12	
					13	

PLATE 3.5

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: KK

Job Number: 7545
Test Pit No.: TP6
Elevation: 1200

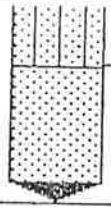
Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
					1	[SM] TAN SILTY F-C SAND, DRY, LOOSE.
					2	TAN, F-C SAND, DRY, LOOSE.
					3	
					4	RED/BRN SILTY F-M SAND, MOIST, LOOSE.
					5	
					6	
					7	
					8	[SP] MOTTLED GRANITIC BEDROCK, SLIGHTLY WEATHERED
					9	
					10	

PLATE 3.6

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: KK

Job Number: 7545
Test Pit No.: TP7
Elevation: 1180

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
					1	[SM] TAN SLIGHTLY SILTY F-C SAND, DRY LOOSE
					2	[SP] MOTTLED GRANITIC BEDROCK, SLIGHTLY WEATHERED
					3	



Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: KK

Job Number: 7545
Test Pit No.: TP8
Elevation: 1100

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
					1	[SM] LT.BRN. SILTY F-C SAND, DRY LOOSE
					2	[SP] MOTTLED GRANITIC BEDROCK
					3	



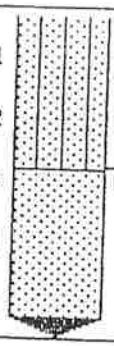
Enclosure 2, Page 24
Rpt. No.: 8552
File No.: S-11403

PLATE 3.8

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: KK

Job Number: 7545
Test Pit No.: TP9
Elevation: 1200

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maxiaum Density %	Bulk Sample	Feet	Visual Classification
					1	[SM] LT. RED/BRN., SILTY F-M SAND, DRY, LOOSE.
					2	
					3	[SP] MOTTLED GRANITIC BEDROCK, SLIGHTLY WEATHERED
					4	
					5	



Enclosure 2, Page 25
Rpt. No.: 8552
File No.: S-11403

PLATE 3.9

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: TIM L.

Job Number: 7545
Test Pit No.: 10
Elevation: 1100

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
					1	[SM] TAN SILTY SAND, DRY, LOOSE
					2	
					3	
					4	
					5	
					6	
					7	TAN/RUST SILTY SAND, DRY, MOD DENSE, W/GRAVELS
					8	
					9	
					10	
					11	
					12	
					13	
					14	

PLATE 3.10

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: TIM L.

Job Number: 7545
Test Pit No.: 11
Elevation: 1080

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
					1	(SM) BRN SILTY SAND, DRY, DENSE
					2	LT. TAN SILTY SAND, DRY, LOOSE, POROUS
					3	
					4	
					5	LT. TAN-RUST SILTY SAND, DRY, MOD DENSE
					6	
					7	LT TAN-ORANGE SILTY SAND W/GRAVELS, DRY, MOD DENSE
					8	
					9	
					10	
					11	
					12	

PLATE 3.11

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: TIM L.

Job Number: 7545
Test Pit No.: 12
Elevation: 1040

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
					1	(SM) TAN SILTY SAND, DRY, MOD DENSE
					2	
					3	
					4	TAN-ORANGE SILTY SAND, DRY, MOD DENSE
					5	
					6	LT. BRN/ORANGE SILTY SAND, DRY, DENSE
					7	
					8	
					9	
					10	
					11	
					12	
					13	
					14	
					15	

PLATE 3.12

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: TIM L.

Job Number: 7545
Test Pit No.: 13
Elevation: 1085

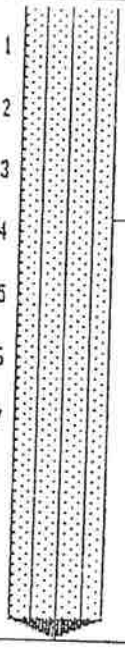
Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
					1	[SM] TAN SILTY SAND, DRY, MOD DENSE
					2	
					3	
					4	
					5	[SP] ORANGE-TAN SAND
					6	[SM] LT. BRN SILTY SAND, DAMP, DENSE, POROUS
					7	
					8	
					9	
					10	
					11	
					12	TAN-DK. BRN. INTERBEDED SANDS AND SILTY SAND, DAMP, DENSE
					13	

PLATE 3.13

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: TIM L.

Job Number: 7545
Test Pit No.: 14
Elevation: 1065

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
					1	(SM) TAN SILTY SAND, DRY, LOOSE
					2	
					3	
					4	TAN SILTY SAND, DRY DENSE
					5	
					6	
					7	
					8	
					9	
					10	



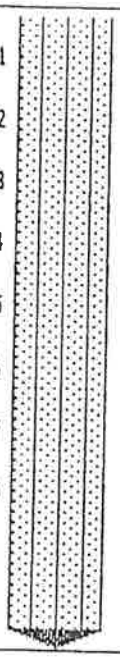
Enclosure 2, Page 30
Rpt. No.: 8552
File No.: S-11403

PLATE 3.14

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: TIM L.

Job Number: 7545
Test Pit No.: 15
Elevation: 1100

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
					1	[SM] TAN/YELLOW SILTY SAND, DAMP, POROUS, DENSE
					2	
					3	
					4	ORANGE/BRN., SILTY SAND, DAMP, W/TRASH.
					5	
					6	
					7	
					8	
					9	
					10	



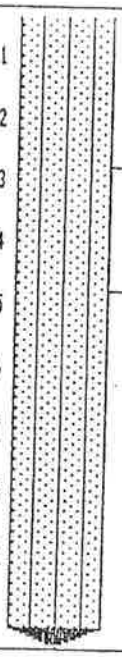
Enclosure 2, Page 31
Rpt. No.: 8552
File No.: S-11403

PLATE 3.15

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: TIM L.

Job Number: 7545
Test Pit No.: 16
Elevation: 1080

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
					1	(SM) TAN SILTY SAND DAMP, DENSE
					2	
					3	LT. TAN, SILTY SAND, W/ABUNDANT TRASH.
					4	
					5	LT BRN-ORANGE SILTY SAND, MOIST, DENSE
					6	
					7	
					8	
					9	
					10	



Enclosure 2, Page 32
Rpt. No.: 8552
File No.: S-11403

PLATE 3.16

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: TIM L.

Job Number: 7545
Test Pit No.: 17
Elevation: 1100

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
					1	[SM] TAN/YELLOW SILTY SAND, DAMP, MOD DENSE
					2	
					3	
					4	
					5	
					6	
					7	LT TAN SILTY SAND, MOIST, DENSE
					8	
					9	
					10	

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: SL

Job Number: 7545
Test Pit No.: 18
Elevation: 1010

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
					1	(SM) MED. BRN., SILTY F SAND, DRY, LOOSE.
					2	(SP) RED/BRN., WEATHERED GRANITIC BEDROCK, DRY, DENSE.
					3	



Enclosure 2, Page 34
Rpt. No.: 8552
File No.: S-11403

PLATE 3.18

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: SL

Job Number: 7545
Test Pit No.: 19
Elevation: 1070

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
					1	(SM) RED/BRN., SILTY F SAND, DRY, LOOSE, ROOTLETS.
					2	(SP) RED/BRN., WEATHERED GRANITIC BEDROCK, DRY, DENSE.
					3	
					4	
					5	
					6	
					7	

PLATE 3.19

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: SL

Job Number: 7545
Test Pit No.: 20
Elevation: 1180

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maxiaum Density %	Bulk Sample	Feet	Visual Classification
					1	[SM] MED. BRN., F-C SAND, DRY, LOOSE.
					2	[SP] LT. GRAY-WHITE, WEATHERED GRANITIC BEDROCK, DRY, LOOSE.
					3	MOIST W/DEPTH
					4	
					5	
					6	
					7	

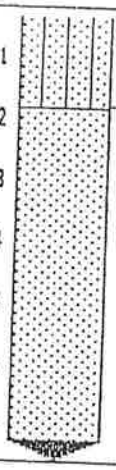


PLATE 3.20

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: SL

Job Number: 7545
Test Pit No.: 21
Elevation: 1250

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
					1	(SM) MED. BRN., F-M SAND, DRY, LOOSE.
					2	(SP) MOTTLED GRANITIC BEDROCK, DRY, DENSE.
					3	
					4	



Enclosure 2, Page 37
Rpt. No.: 8552
File No.: S-11403

PLATE 3.21

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: SL

Job Number: 7545
Test Pit No.: 22
Elevation: 1110

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
					1	(SM) MED. BRN., SILTY F SAND, DRY, LOOSE, (Qal).
					2	
					3	
					4	
					5	
					6	
					7	RUSTY BRN.,F SAND, DRY, DENSE, HARD, CEMENTED.
					8	

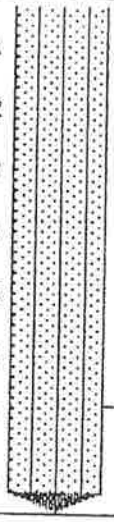


PLATE 3.22

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: SL

Job Number: 7545
Test Pit No.: 23
Elevation: 1190

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
					1	(SM) MED. BRN., SILTY F SAND, DRY, LOOSE.
						RUSTY BRN.,F SAND, DENSE, HARD, CEMENTED.

PLATE 3.23

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: SL

Job Number: 7545
Test Pit No.: 24
Elevation: 1270

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
						[SM] MED. BRN., SILTY F SAND, DRY-SLIGHTLY MOIST, LOOSE.
					1	[SP] RUSTY BRN., WEATHERED GRANITIC BEDROCK, MOIST, DENSE.
					2	
					3	
					4	LESS WEATHERING W/DEPTH, BECOMES HARD.

PLATE 3.24

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: SL

Job Number: 7545
Test Pit No.: 25
Elevation: 1335

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
					1	[SM] MED. BRN., SILTY F SAND, DRY, LOOSE, ROOTLETS.
						[SP] RUSTY BRN., WEATHERED GRANITIC BEDROCK, DRY, DENSE.
					2	
					3	
					4	LESS WEATHERING, DENSE, HARD.
					5	
					6	
					7	
					8	
					9	
					10	

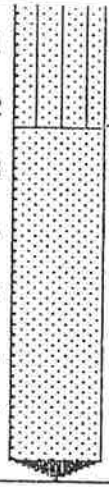


PLATE 3.25

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: SL

Job Number: 7545
Test Pit No.: 26
Elevation: 1260

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
					1	[SM] RED/BRN., SILTY F SAND, DRY, LOOSE, ROOTLETS.
					2	
					3	[SP] RUSTY BRN., WEATHERED GRANITIC BEDROCK, MOIST, DENSE.
					4	
					5	FINER GRAINED GRANITIC BEDROCK, W/LINEATIONS, DENSE, HARD.
					6	
					7	



Enclosure 2, Page 42
Rpt. No.: 8552
File No.: S-11403

PLATE 3.26

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: SL

Job Number: 7545
Test Pit No.: 27
Elevation: 1210

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
					1	[SP] RED/BRN., SILTY F SAND, DRY, LOOSE.
					2	
					3	RUSTY BRN., WEATHERED GRANITIC BEDROCK, DRY, DENSE, HARD.
					4	
					5	
					6	
					7	

PLATE 3.27

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: SL

Job Number: 7545
Test Pit No.: 28
Elevation: 1170

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
						[SM] RED/BRN., SILTY F SAND, DRY, LOOSE.
				X	1	[SP] REDDISH, WEATHERED GRANITIC BEDROCK, DRY, DENSE.
					2	
					3	
					4	
					5	HARDER TO DIG, LESS WEATHERING.
				X	6	
					7	
					8	
					9	
					10	
					11	



Enclosure 2, Page 44
Rpt. No.: 8552
File No.: S-11403

PLATE 3.28

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: SL

Job Number: 7545
Test Pit No.: 29
Elevation: 1250

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
					1	[SM] MED. BRN., SILTY F SAND, DRY, LOOSE.
					2	RUSTY BRN., SILTY F-M SAND, DRY, LOOSE, LOCALLY CEMENTED.
					3	
					4	[SP] MOTTLED GRANITIC BEDROCK, WEATHERED, DRY, DENSE.
					5	
					6	HARDER TO DIG, SLIGHTLY MOIST, DENSE, HARD.
					7	
					8	
				X	9	



Enclosure 2, Page 45
Rpt. No.: 8552
File No.: S-11403

PLATE 3.29

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: SL

Job Number: 7545
Test Pit No.: 30
Elevation: 1270

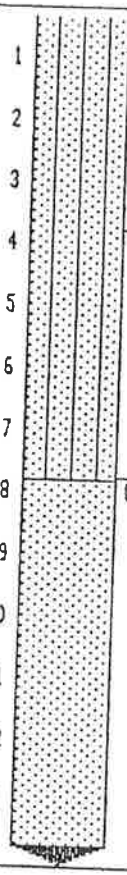
Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
				X	1	(SM) MED. BRN., SILTY F SAND, DRY, LOOSE.
					2	(SP) RUSTY BRN., WEATHERED GRANITIC BEDROCK, DRY, DENSE.
					3	
					4	
					5	
					6	HARDER TO DIG, SLIGHTLY MOIST, DENSE, HARD.
					7	
				X	8	VERY HARD TO DIG.

PLATE 3.30

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: SL

Job Number: 7545
Test Pit No.: 31
Elevation: 1200

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
					1	(SM) MED. BRN., VERY SILTY F SAND, DRY, LOOSE.
					2	RED/BRN., VERY SILTY F SAND, DRY, LOOSE.
					3	
				X	4	DK. RUSTY BRN., VERY SILTY F SAND, MOIST, MOD. DENSE.
				X	5	
					6	
					7	
					8	(SP) MOTTLED GRANITIC BEDROCK, WEATHERED, MOIST, DENSE.
					9	
					10	
				X	11	HARDER TO DIG.
					12	
				X	13	



Enclosure 2, Page 47
Rpt. No.: 8552
File No.: S-11403

PLATE 3.31

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: SL

Job Number: 7545
Test Pit No.: 32
Elevation: 1100

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
					1	(SM) DK. BRN., SILTY F SAND, DRY, LOOSE.
					2	(SP) MED. GRAY, GRANITIC BEDROCK, DENSE, HARD. DK. RUSTY BRN., WEATHERED GRANITIC BEDROCK, DRY, DENSE, HARD.
					3	
					4	
					5	

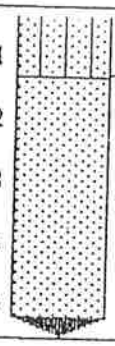


PLATE 3.32

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: SL

Job Number: 7545
Test Pit No.: 33
Elevation: 1170

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
					1	[SM] MED. BRN., SILTY F SAND, DRY, LOOSE.
					2	[SP] FINE GRAINED GRANITIC BEDROCK, DRY, DENSE, HARD.
					3	



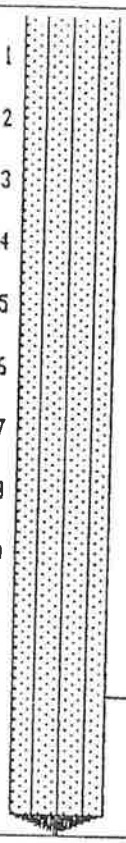
Enclosure 2, Page 49
Rpt. No.: 8552
File No.: S-11403

PLATE 3.33

Job Name: RIO VISTA
Job Location: RIVERSIDE
Field Geologist: SL

Job Number: 7545
Test Pit No.: 34
Elevation: 1130

Blows Per Foot	Dry Density P.C.F.	Natural Moist. Content %	Percent Maximum Density %	Bulk Sample	Feet	Visual Classification
				X	1	[SM] MED. BRN., SILTY VERY F SAND, DRY-SLIGHTLY MOIST, LOOSE.
					2	
					3	
					4	
					5	
					6	
					7	
					8	
					9	
					10	
					11	
					12	LT.-MED. BRN., SILTY F SAND, MOIST, DENSE, LOCALLY CEMENTED
				X	13	



Enclosure 2, Page 50
Rpt. No.: 8552
File No.: S-11403

PLATE 3.34

APPENDIX C

LABORATORY TEST RESULTS

Leighton

ONE-DIMENSIONAL SWELL OR SETTLEMENT POTENTIAL OF COHESIVE SOILS

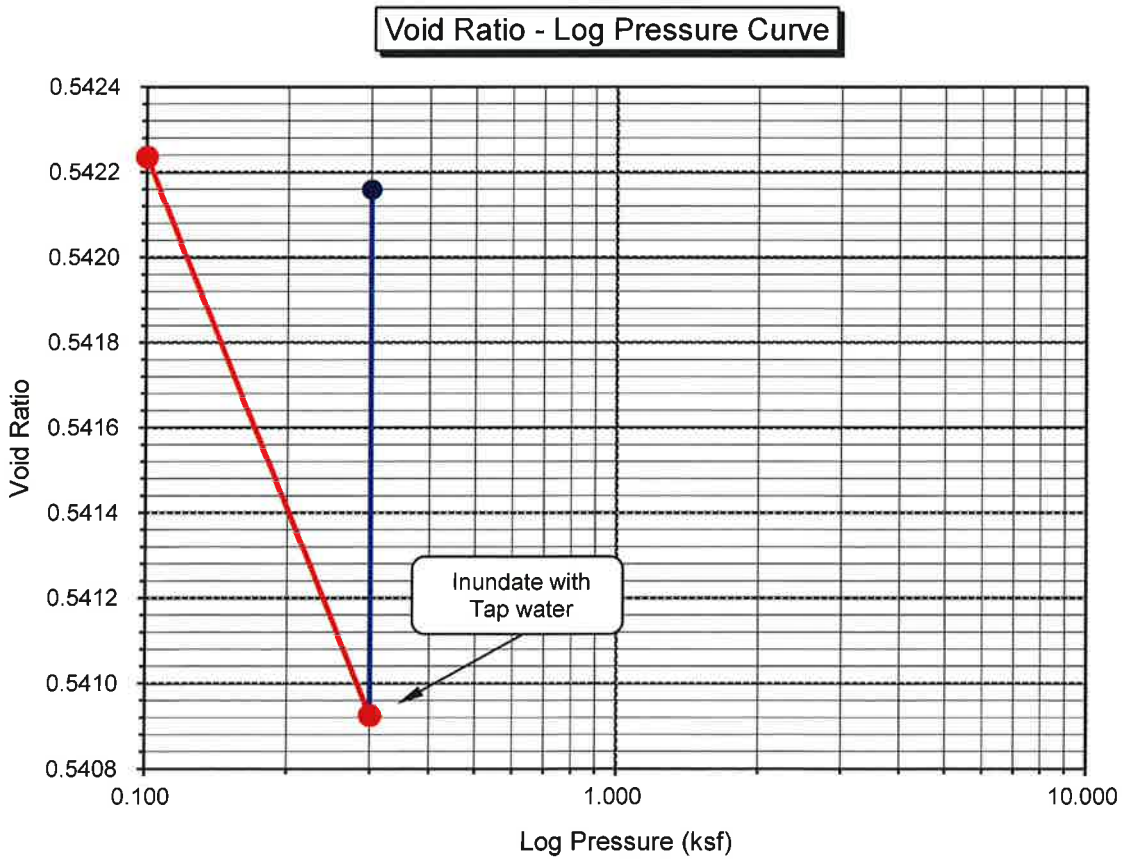
ASTM D 4546

Project Name:	Richland/Rio Vista		Tested By:	G. Bathala	Date: 08/10/15
Project No.:	10270.002		Checked By:	J. Ward	Date: 08/24/15
Boring No.:	LB-9		Sample Type:	Ring	
Sample No.:	R-1		Depth (ft.)	2.5	
Sample Description:	Brown silty clay (CL-ML)				

Initial Dry Density (pcf):	109.3	Final Dry Density (pcf):	109.3
Initial Moisture (%):	2.75	Final Moisture (%) :	17.6
Initial Length (in.):	1.0000	Initial Void Ratio:	0.5427
Initial Dial Reading:	0.2960	Specific Gravity(assumed):	2.70
Diameter(in):	2.415	Initial Saturation (%)	13.7

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.100	0.2957	0.9997	0.00	-0.03	0.5422	-0.03
0.300	0.2944	0.9984	0.05	-0.16	0.5409	-0.11
H2O	0.2952	0.9992	0.05	-0.09	0.5422	-0.04

Percent Swell (+) / Settlement (-) After Inundation = 0.08



Leighton

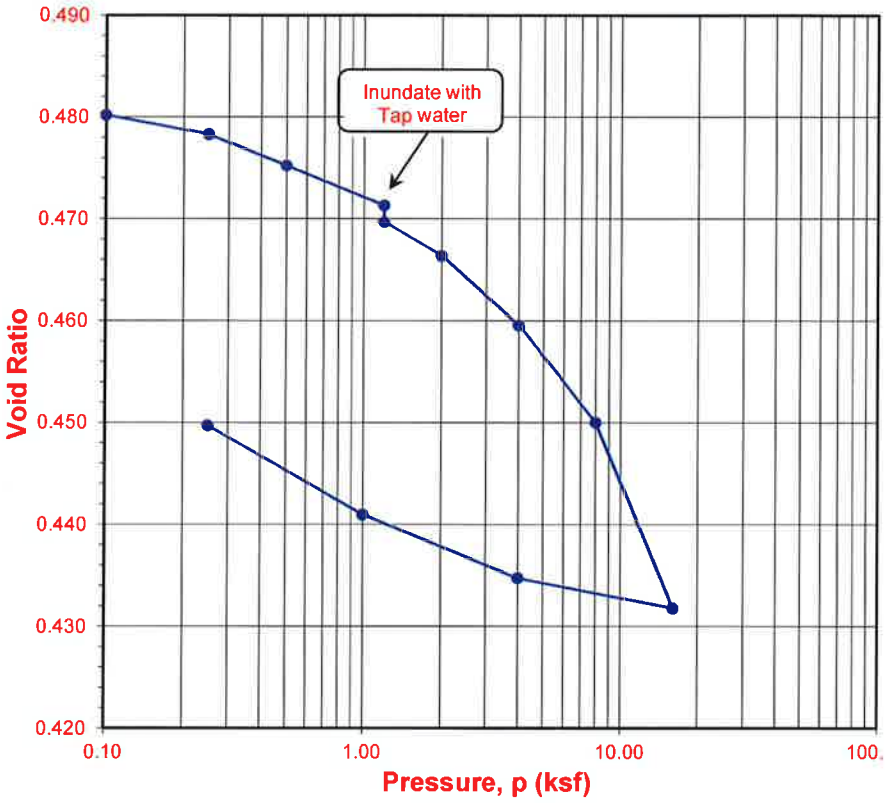
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS

ASTM D 2435

Project Name: Richland/Rio Vista
Project No.: 10270.002
Boring No.: LB-3
Sample No.: R-4
Soil Identification: Brown silty clay with sand (CL-ML)s

Tested By: G. Bathala Date: 08/03/15
Checked By: J. Ward Date: 08/24/15
Depth (ft.): 10.0
Sample Type: Ring

Sample Diameter (in.)	2.415
Sample Thickness (in.)	1.000
Wt. of Sample + Ring (g)	186.43
Weight of Ring (g)	42.11
Height after consol. (in.)	0.9791
Before Test	
Wt.Wet Sample+Cont. (g)	173.47
Wt.of Dry Sample+Cont. (g)	166.57
Weight of Container (g)	39.55
Initial Moisture Content (%)	5.4
Initial Dry Density (pcf)	113.8
Initial Saturation (%)	31
Initial Vertical Reading (in.)	0.3390
After Test	
Wt.of Wet Sample+Cont. (g)	257.12
Wt. of Dry Sample+Cont. (g)	235.82
Weight of Container (g)	57.54
Final Moisture Content (%)	15.64
Final Dry Density (pcf)	115.7
Final Saturation (%)	92
Final Vertical Reading (in.)	0.3145
Specific Gravity (assumed)	2.70
Water Density (pcf)	62.43

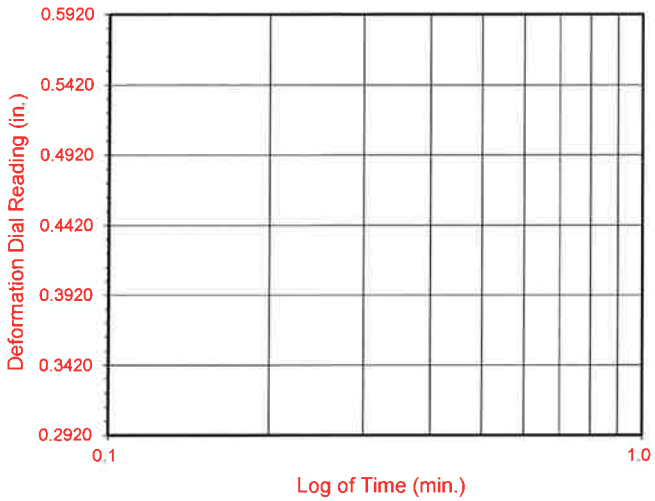


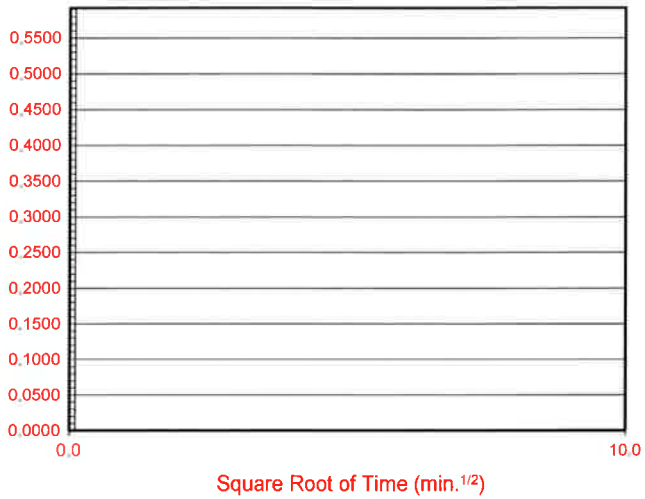
Pressure (p) (ksf)	Final Reading (in.)	Apparent Thickness (in.)	Load Compliance (%)	Deformation % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.10	0.3387	0.9997	0.00	0.03	0.480	0.03
0.25	0.3370	0.9980	0.04	0.20	0.478	0.16
0.50	0.3343	0.9953	0.11	0.48	0.475	0.37
1.20	0.3301	0.9911	0.26	0.89	0.471	0.63
1.20	0.3290	0.9900	0.26	1.00	0.470	0.74
2.00	0.3256	0.9866	0.38	1.35	0.466	0.96
4.00	0.3191	0.9801	0.57	2.00	0.460	1.43
8.00	0.3104	0.9714	0.79	2.86	0.450	2.07
16.00	0.2954	0.9564	1.06	4.36	0.432	3.30
4.00	0.3005	0.9615	0.75	3.85	0.435	3.10
1.00	0.3071	0.9681	0.51	3.19	0.441	2.68
0.25	0.3145	0.9755	0.36	2.45	0.450	2.09

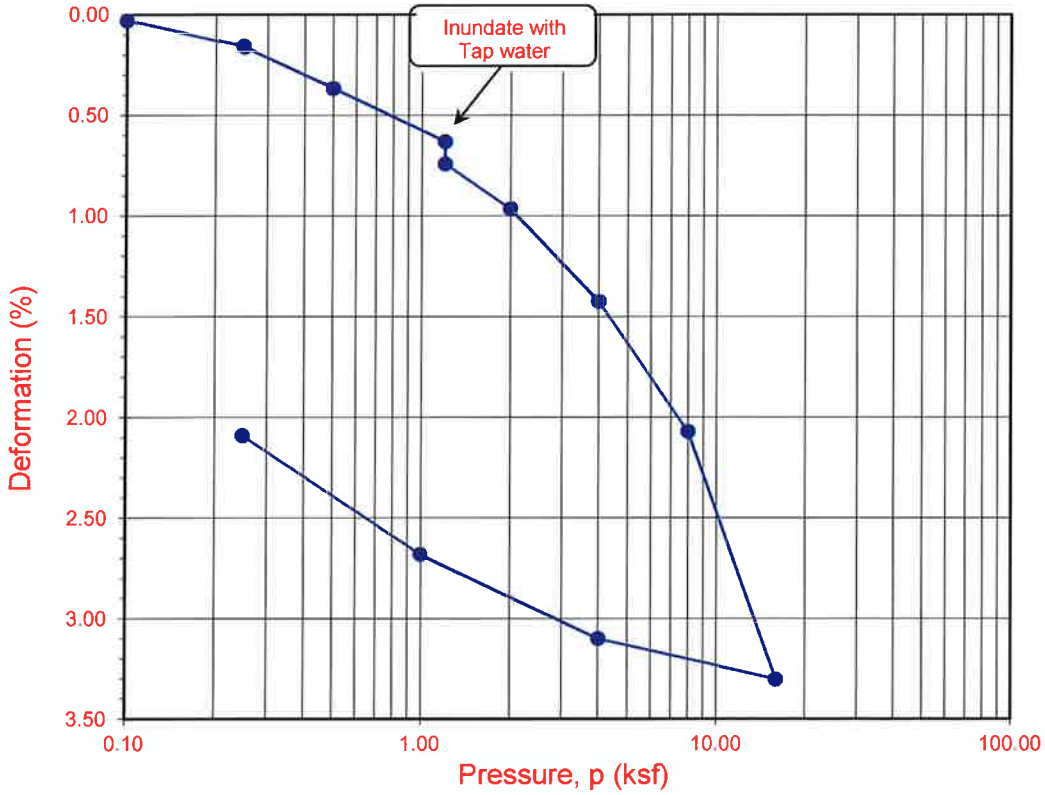
No Time Readings

Date	Time	Elapsed Time (min)	Square Root of Time	Dial Rdgs. (in.)

No Time Readings







Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
LB-3	**R-4**	**10.0**	**5.4**	**15.6**	**113.8**	**115.7**	**0.481**	**0.450**	**31**	**92**

Soil Identification: Brown silty clay with sand (CL-ML)s

Leighton

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
ASTM D 2435

Project No.: 10270.002

Richland/Rio Vista

08-15

Leighton

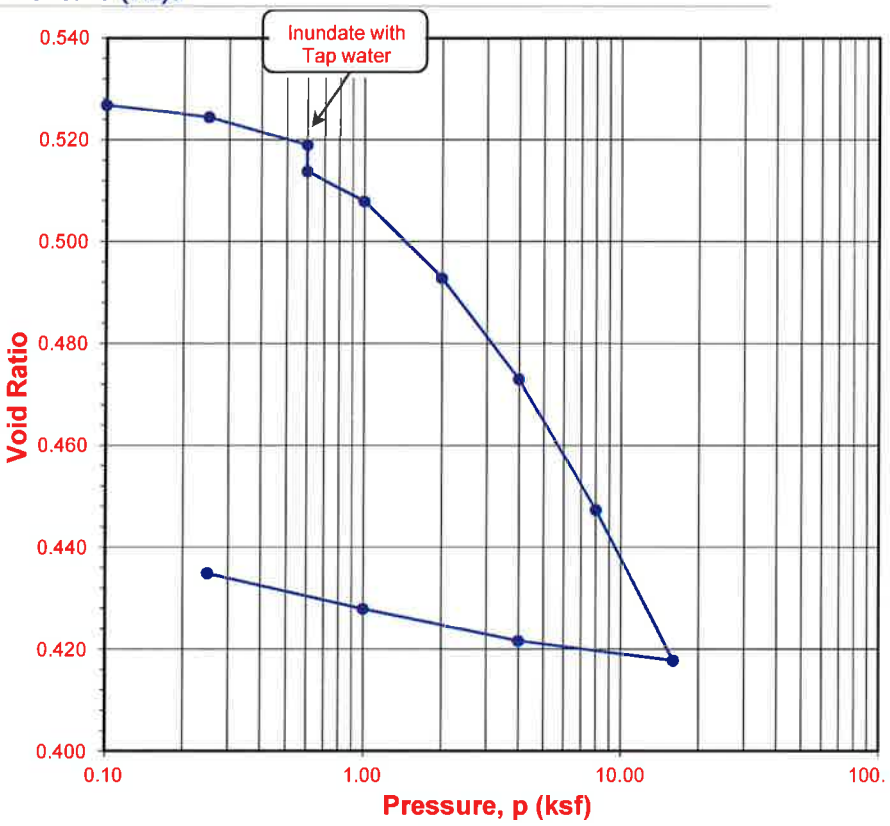
ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS

ASTM D 2435

Project Name: Richland/Rio Vista
Project No.: 10270.002
Boring No.: LB-9
Sample No.: R-2
Soil Identification: Yellowish brown silt with sand (ML)s

Tested By: G. Bathala Date: 08/03/15
Checked By: J. Ward Date: 08/24/15
Depth (ft.): 5.0
Sample Type: Ring

Sample Diameter (in.)	2.415
Sample Thickness (in.)	1.000
Wt. of Sample + Ring (g)	180.34
Weight of Ring (g)	43.24
Height after consol. (in.)	0.9392
Before Test	
Wt.Wet Sample+Cont. (g)	196.68
Wt.of Dry Sample+Cont. (g)	191.55
Weight of Container (g)	38.46
Initial Moisture Content (%)	3.4
Initial Dry Density (pcf)	110.3
Initial Saturation (%)	17
Initial Vertical Reading (in.)	0.3478
After Test	
Wt.of Wet Sample+Cont. (g)	232.74
Wt. of Dry Sample+Cont. (g)	212.42
Weight of Container (g)	37.66
Final Moisture Content (%)	15.45
Final Dry Density (pcf)	116.5
Final Saturation (%)	93
Final Vertical Reading (in.)	0.2837
Specific Gravity (assumed)	2.70
Water Density (pcf)	62.43

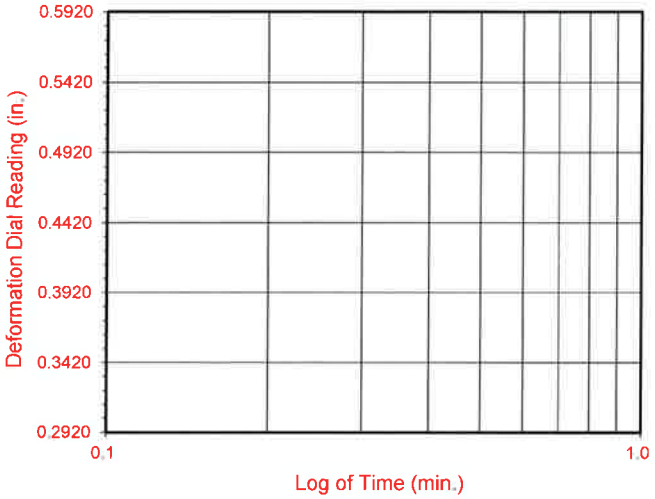


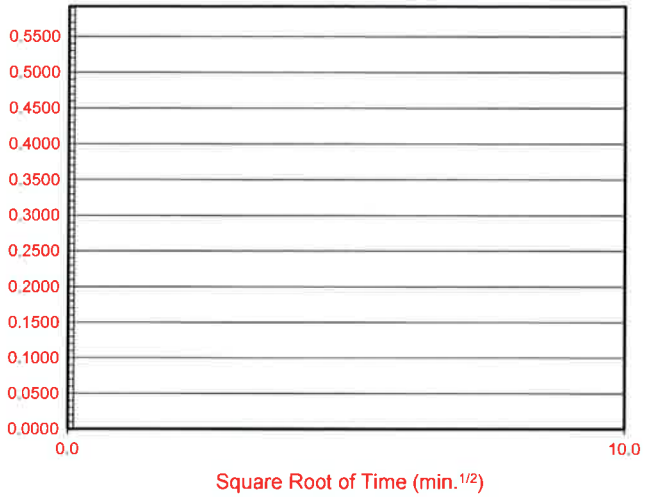
Pressure (p) (ksf)	Final Reading (in.)	Apparent Thickness (in.)	Load Compliance (%)	Deformation % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.10	0.3472	0.9994	0.00	0.07	0.527	0.07
0.25	0.3454	0.9976	0.02	0.24	0.525	0.22
0.60	0.3411	0.9933	0.09	0.67	0.519	0.58
0.60	0.3377	0.9899	0.09	1.01	0.514	0.92
1.00	0.3331	0.9853	0.17	1.48	0.508	1.31
2.00	0.3222	0.9744	0.27	2.56	0.493	2.29
4.00	0.3077	0.9599	0.42	4.01	0.473	3.59
8.00	0.2892	0.9414	0.59	5.86	0.447	5.27
16.00	0.2680	0.9202	0.78	7.99	0.418	7.21
4.00	0.2726	0.9248	0.57	7.52	0.422	6.95
1.00	0.2781	0.9303	0.43	6.97	0.428	6.54
0.25	0.2837	0.9359	0.33	6.41	0.435	6.08

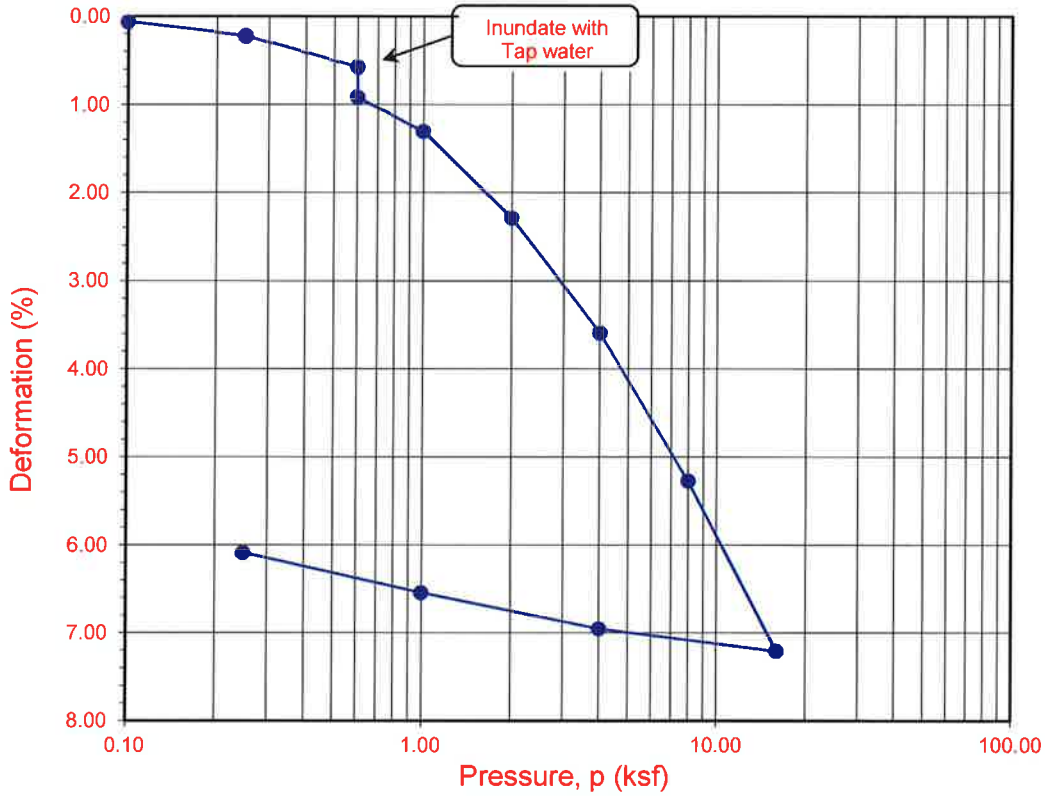
No Time Readings

Date	Time	Elapsed Time (min)	Square Root of Time	Dial Rdgs. (in.)

No Time Readings







Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
LB-9	**R-2**	**5.0**	**3.4**	**15.5**	**110.3**	**116.5**	**0.528**	**0.435**	**17**	**93**

Soil Identification: Yellowish brown silt with sand (ML)s

Leighton

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
ASTM D 2435

Project No.: 10270.002

Richland/Rio Vista

08-15

Leighton

MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Project Name:	Richland/Rio Vista	Tested By:	O. Figueroa	Date:	08/11/15
Project No.:	10270.002	Input By:	J. Ward	Date:	08/24/15
Boring No.:	LB-7	Depth (ft.):	0-5		
Sample No.:	B-0				
Soil Identification:	Dark yellowish brown sandy silt s(ML)				

Preparation Method: [X] Moist [ ] Dry

[X] Mechanical Ram [ ] Manual Ram

Mold Volume (ft³) 0.03340

Ram Weight = 10 lb.; Drop = 18 in.

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	3878	3963	3932			
Weight of Mold (g)	1861	1861	1861			
Net Weight of Soil (g)	2017	2102	2071			
Wet Weight of Soil + Cont. (g)	394.1	409.4	430.2			
Dry Weight of Soil + Cont. (g)	371.0	377.8	388.8			
Weight of Container (g)	38.5	39.3	38.2			
Moisture Content (%)	6.95	9.34	11.81			
Wet Density (pcf)	133.1	138.7	136.7			
Dry Density (pcf)	124.5	126.9	122.3			

Maximum Dry Density (pcf) 127.0 **Optimum Moisture Content (%)** 9.0

PROCEDURE USED

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

[ ] **Procedure B**
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
Use if +#4 is >20% and +3/8 in. is 20% or less

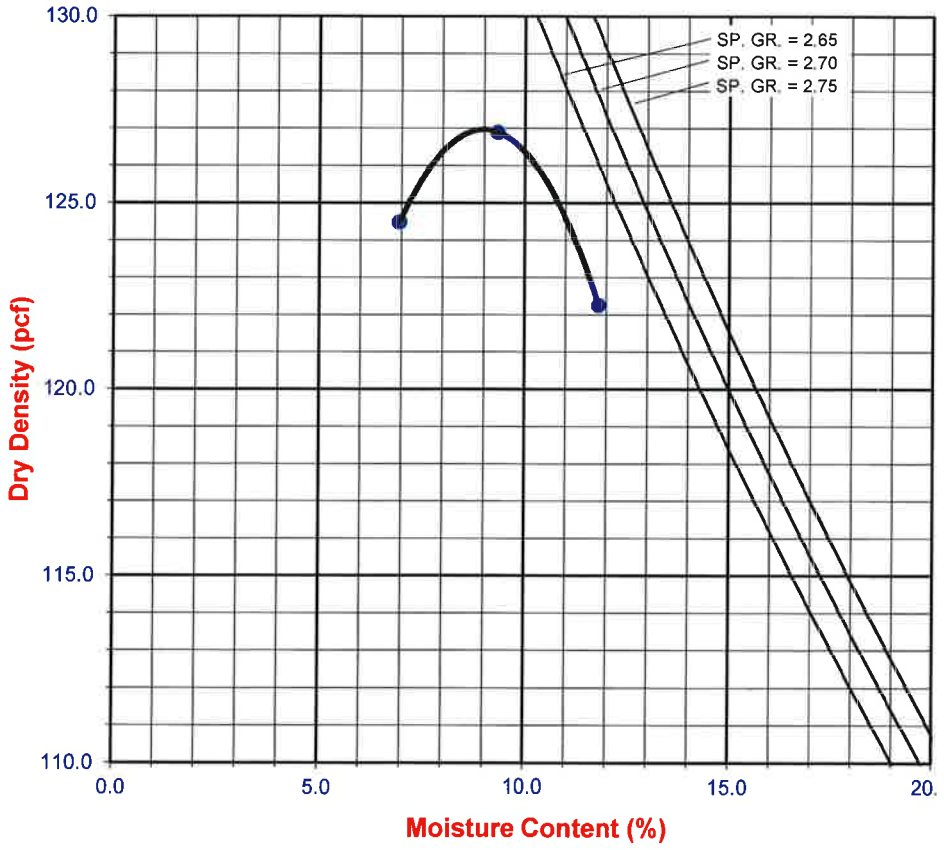
[ ] **Procedure C**
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)
Use if +3/8 in. is >20% and +¾ in. is <30%

Particle-Size Distribution:

GR:SA:FI

Atterberg Limits:

LL,PL,PI



MX LB-7, B-0 @ 0-5

Leighton

MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Project Name:	Richland/Rio Vista	Tested By:	O. Figueroa	Date:	08/13/15
Project No.:	10270.002	Input By:	J. Ward	Date:	08/24/15
Boring No.:	TP-9	Depth (ft.):	4.0		
Sample No.:	Bulk-4				
Soil Identification:	Dark yellowish brown silty sand (SM)				

Preparation Method: [X] Moist [ ] Dry

[X] Mechanical Ram [ ] Manual Ram

Mold Volume (ft³) 0.03340 *Ram Weight = 10 lb.; Drop = 18 in.*

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	3972	4057	4028			
Weight of Mold (g)	1861	1861	1861			
Net Weight of Soil (g)	2111	2196	2167			
Wet Weight of Soil + Cont. (g)	424.0	429.0	460.9			
Dry Weight of Soil + Cont. (g)	402.4	399.1	421.2			
Weight of Container (g)	38.7	38.8	38.5			
Moisture Content (%)	5.94	8.30	10.37			
Wet Density (pcf)	139.3	144.9	143.0			
Dry Density (pcf)	131.5	133.8	129.6			

Maximum Dry Density (pcf) 134.0 **Optimum Moisture Content (%)** 8.0

PROCEDURE USED

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

[ ] **Procedure B**
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
Use if +#4 is >20% and +3/8 in. is 20% or less

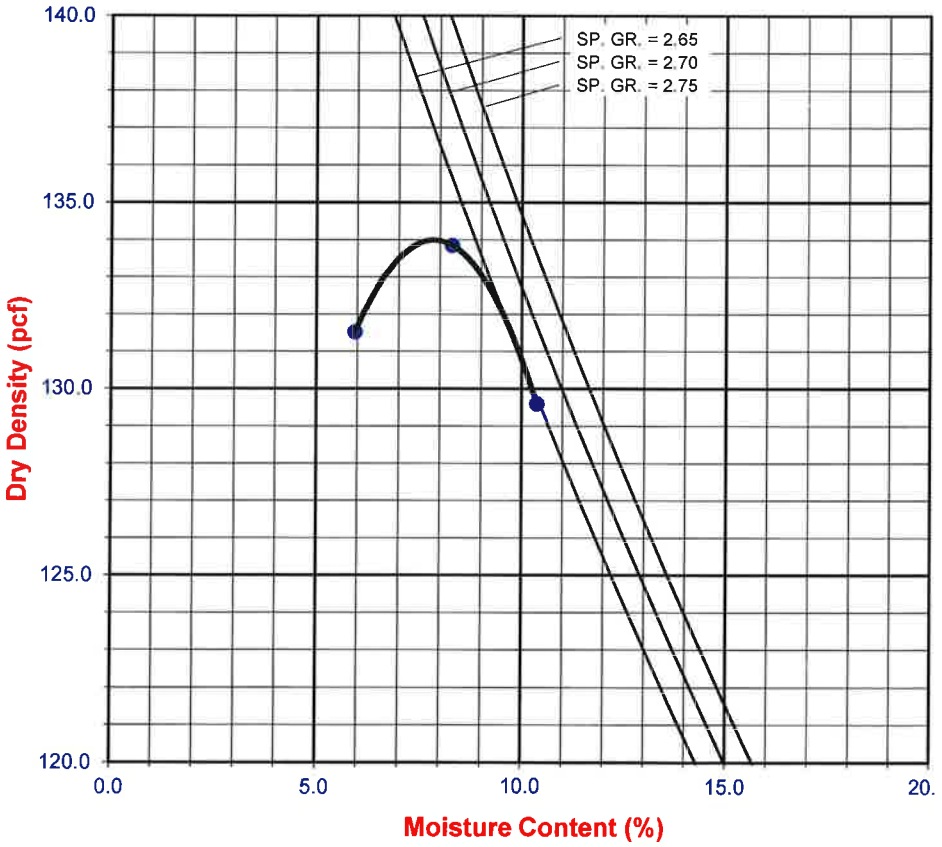
[ ] **Procedure C**
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)
Use if +3/8 in. is >20% and +¾ in. is <30%

Particle-Size Distribution:

GR:SA:FI

Atterberg Limits:

LL,PL,PI



Leighton

MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Project Name:	Richland/Rio Vista	Tested By:	O. Figueroa	Date:	08/18/15
Project No.:	10270.002	Input By:	J. Ward	Date:	08/19/15
Boring No.:	TP-12	Depth (ft.):	4.0		
Sample No.:	B-1				
Soil Identification:	Dark yellowish brown silty sand (SM)				

Preparation Method: [X] Moist [ ] Dry

[X] Mechanical Ram [ ] Manual Ram

Mold Volume (ft³) 0.03340 *Ram Weight = 10 lb.; Drop = 18 in.*

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	3859	3933	3946			
Weight of Mold (g)	1861	1861	1861			
Net Weight of Soil (g)	1998	2072	2085			
Wet Weight of Soil + Cont. (g)	390.7	405.5	448.6			
Dry Weight of Soil + Cont. (g)	374.4	380.7	412.4			
Weight of Container (g)	38.2	38.5	38.7			
Moisture Content (%)	4.85	7.25	9.69			
Wet Density (pcf)	131.9	136.8	137.6			
Dry Density (pcf)	125.8	127.5	125.5			

Maximum Dry Density (pcf) 127.5 **Optimum Moisture Content (%)** 7.0

PROCEDURE USED

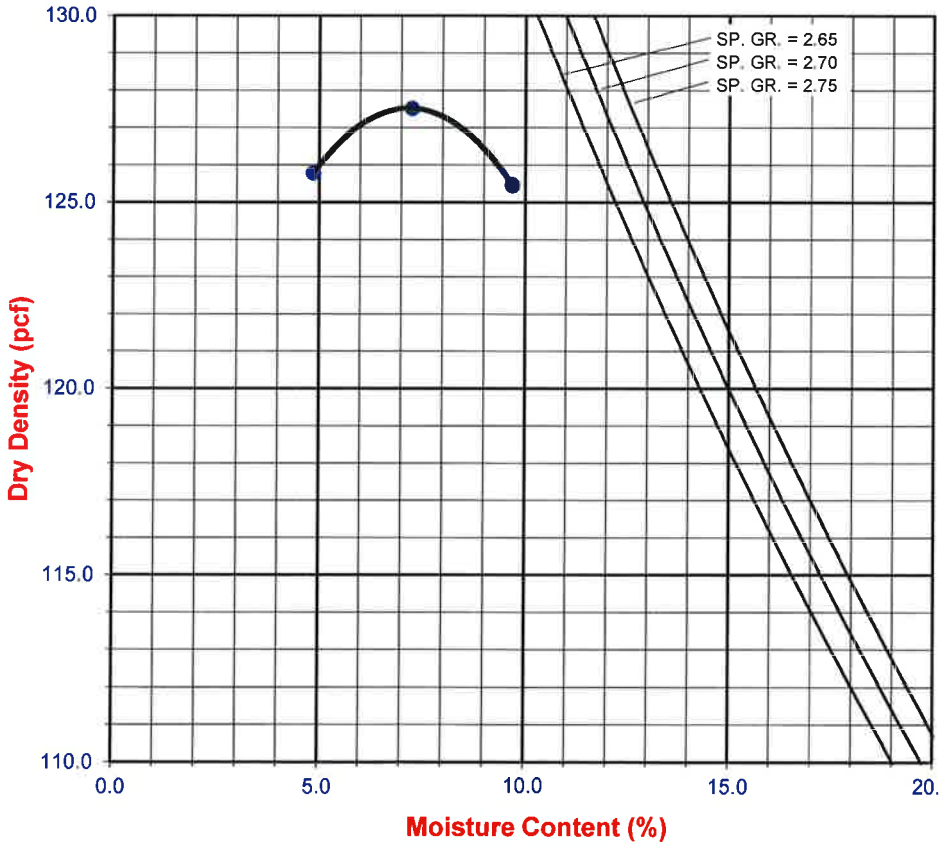
[X] **Procedure A**
Soil Passing No. 4 (4.75 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
May be used if +#4 is 20% or less

[ ] **Procedure B**
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
Use if +#4 is >20% and +3/8 in. is 20% or less

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

Particle-Size Distribution:
GR:SA:FI

Atterberg Limits:
LL,PL,PI



Richland/Rio Vista
10270.002

Summary of Pocket Penetrometer Test Results for Borings LB-1 through LB-10
Prepared by JHW, 08-24-15

LB-1	R-1	3.75
	R-2	>4.50
	R-4	>4.50
LB-2	R-1	4.25
	R-2	>4.50
	R-3	>4.50
LB-3	R-1	>4.50
	R-2	>4.50
	R-4	>4.50
	R-6	>4.50
LB-4	R-1	>4.50
	R-2	>4.50
	R-3	>4.50
	R-4	>4.50
LB-5	R-1	>4.50
	R-2	2.75
	R-3	3.50
LB-6	R-1	>4.50
	R-2	3.75
	R-3	4.25
LB-7	R-1	3.25
	R-2	>4.50
	R-3	>4.50
LB-8	R-1	>4.50
	R-2	>4.50
	R-3	>4.50
	R-4	>4.50
LB-9	R-1	2.75/4.50
	R-2	4.00/>4.50
	R-3	>4.50
LB-10	R-1	>4.50
	R-2	>4.50

Leighton

TESTS for SULFATE CONTENT
CHLORIDE CONTENT and pH of SOILS

Project Name: Richland/Rio Vista Tested By : G. Berdy Date: 08/12/15

Project No. : 10270.002 Data Input By: J. Ward Date: 08/24/15

Boring No.	TP-9			
Sample No.	Bulk-4			
Sample Depth (ft)	4.0			
Soil Identification:	Dark yellowish brown SM			
Wet Weight of Soil + Container (g)	230.10			
Dry Weight of Soil + Container (g)	225.38			
Weight of Container (g)	57.26			
Moisture Content (%)	2.81			
Weight of Soaked Soil (g)	100.18			

SULFATE CONTENT, DOT California Test 417, Part II

Beaker No.	26			
Crucible No.	24			
Furnace Temperature (°C)	850			
Time In / Time Out	11:00/11:35			
Duration of Combustion (min)	35			
Wt. of Crucible + Residue (g)	17.0778			
Wt. of Crucible (g)	17.0768			
Wt. of Residue (g) (A)	0.0010			
PPM of Sulfate (A) x 41150	41.15			
PPM of Sulfate, Dry Weight Basis	**42**			

CHLORIDE CONTENT, DOT California Test 422

ml of Extract For Titration (B)	30			
ml of AgNO3 Soln. Used in Titration (C)	0.4			
PPM of Chloride (C -0.2) * 100 * 30 / B	20			
PPM of Chloride, Dry Wt. Basis	**21**			

pH TEST, DOT California Test 643

pH Value	**7.52**			
Temperature °C	20.8			

Leighton

SOIL RESISTIVITY TEST

DOT CA TEST 643

Project Name: Richland/Rio Vista
Project No. : 10270.002
Boring No.: TP-9
Sample No. : Bulk-4
Soil Identification:* Dark yellowish brown SM

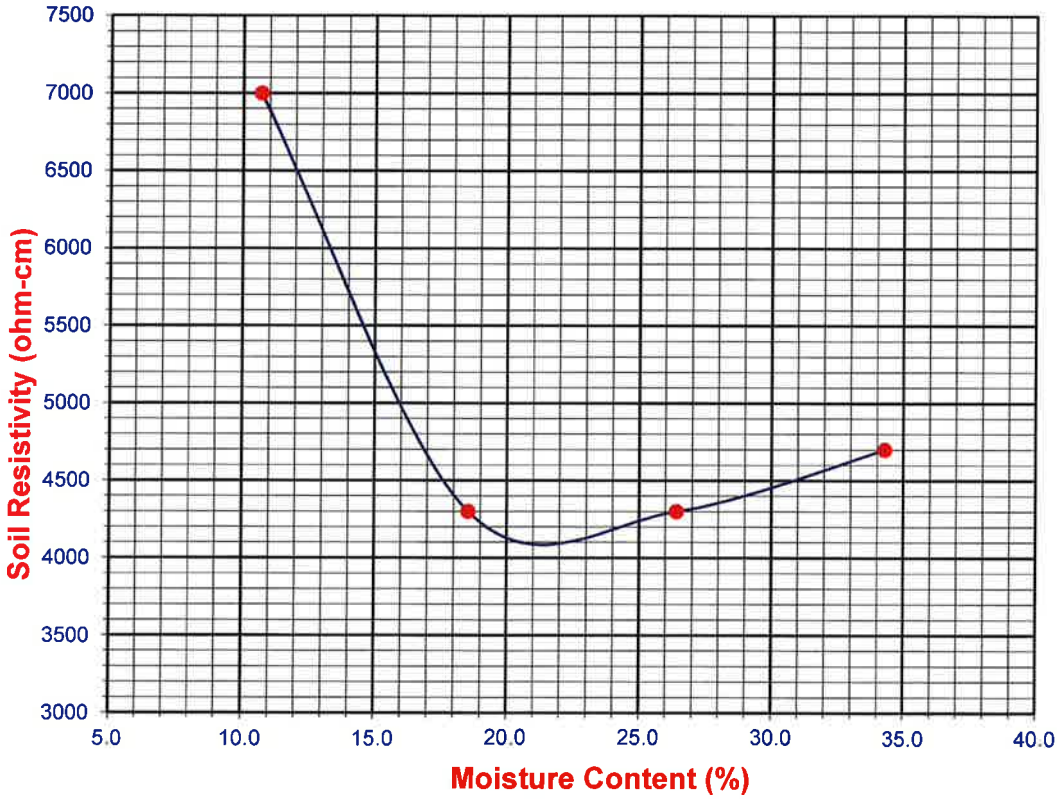
Tested By : G. Berdy Date: 08/14/15
Data Input By: J. Ward Date: 08/24/15
Depth (ft.) : 4.0

*California Test 643 requires soil specimens to consist only of portions of samples passing through the No. 8 US Standard Sieve before resistivity testing. Therefore, this test method may not be representative for coarser materials.

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	10	10.68	7000	7000
2	20	18.54	4300	4300
3	30	26.41	4300	4300
4	40	34.28	4700	4700
5				

Moisture Content (%) (MCi)	2.81
Wet Wt. of Soil + Cont. (g)	230.10
Dry Wt. of Soil + Cont. (g)	225.38
Wt. of Container (g)	57.26
Container No.	
Initial Soil Wt. (g) (Wt)	130.66
Box Constant	1.000
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 643	
4080	**21.3**	**42**	**21**	**7.52**	**20.8**



Leighton

TESTS for SULFATE CONTENT
CHLORIDE CONTENT and pH of SOILS

Project Name: Richland/Rio Vista — Tested By : G. Berdy — Date: 08/11/15

Project No. : 10270.002 — Data Input By: J. Ward — Date: 08/24/15

Boring No.	LB-7			
Sample No.	B-0			
Sample Depth (ft)	0-5			
Soil Identification:	Dark yellowish brown s(ML)			
Wet Weight of Soil + Container (g)	231.24			
Dry Weight of Soil + Container (g)	224.56			
Weight of Container (g)	59.27			
Moisture Content (%)	4.04			
Weight of Soaked Soil (g)	100.14			

SULFATE CONTENT, DOT California Test 417, Part II

Beaker No.	36			
Crucible No.	23			
Furnace Temperature (°C)	850			
Time In / Time Out	10:30/11:05			
Duration of Combustion (min)	35			
Wt. of Crucible + Residue (g)	18.4278			
Wt. of Crucible (g)	18.4261			
Wt. of Residue (g) (A)	0.0017			
PPM of Sulfate (A) x 41150	69.95			
PPM of Sulfate, Dry Weight Basis	**73**			

CHLORIDE CONTENT, DOT California Test 422

ml of Extract For Titration (B)	15			
ml of AgNO3 Soln. Used in Titration (C)	0.5			
PPM of Chloride (C -0.2) * 100 * 30 / B	60			
PPM of Chloride, Dry Wt. Basis	**63**			

pH TEST, DOT California Test 643

pH Value	**7.83**			
Temperature °C	20.9			

Leighton

SOIL RESISTIVITY TEST

DOT CA TEST 643

Project Name:	Richland/Rio Vista		Tested By :	G. Berdy	Date: 08/12/15
Project No. :	10270.002		Data Input By:	J. Ward	Date: 08/24/15
Boring No.:	LB-7		Depth (ft.) :	0-5	
Sample No. :	B-0				

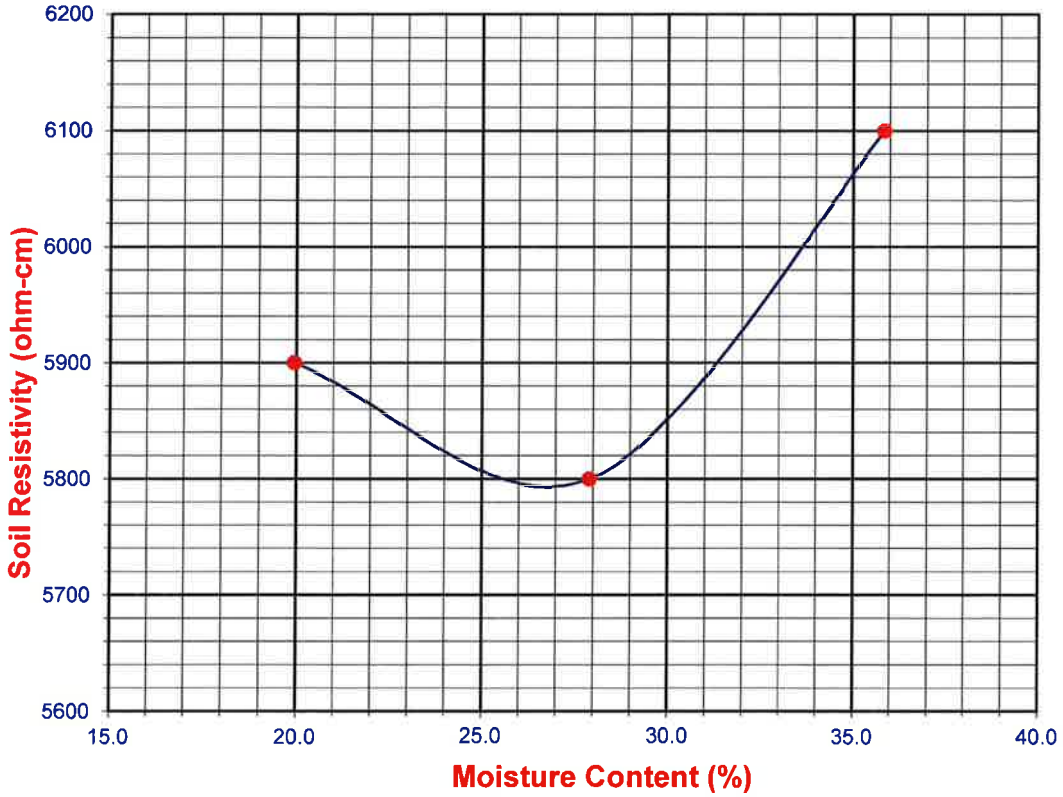
Soil Identification:* Dark yellowish brown s(ML)

*California Test 643 requires soil specimens to consist only of portions of samples passing through the No. 8 US Standard Sieve before resistivity testing. Therefore, this test method may not be representative for coarser materials.

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	20	19.95	5900	5900
2	30	27.90	5800	5800
3	40	35.85	6100	6100
4				
5				

Moisture Content (%) (MCi)	4.04
Wet Wt. of Soil + Cont. (g)	231.24
Dry Wt. of Soil + Cont. (g)	224.56
Wt. of Container (g)	59.27
Container No.	
Initial Soil Wt. (g) (Wt)	130.82
Box Constant	1.000
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 643	
5790	**26.8**	**73**	**63**	**7.83**	**20.9**



APPENDIX D

SUMMARY OF SECONDARY SEISMIC HAZARD ANALYSIS

U.S. Geological Survey - Earthquake Hazards Program

Unified Hazard Tool

Please do not use this tool to obtain ground motion parameter values for the design code reference documents covered by the U.S. Seismic Design Maps web tools (e.g., the International Building Code and the ASCE 7 or 41 Standard). The values returned by the two applications are not identical.

Input

Edition

Dynamic: Conterminous U.S. 2014 (u…

Spectral Period

Peak Ground Acceleration

Latitude

Decimal degrees

34.0282

Time Horizon

Return period in years

2475

Longitude

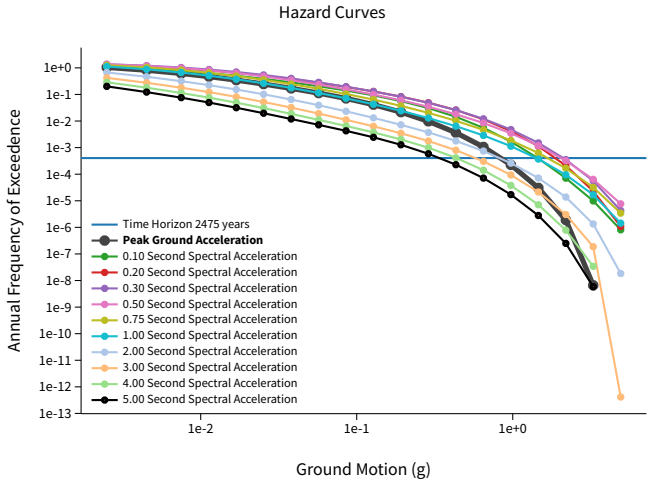
Decimal degrees, negative values for western longitudes

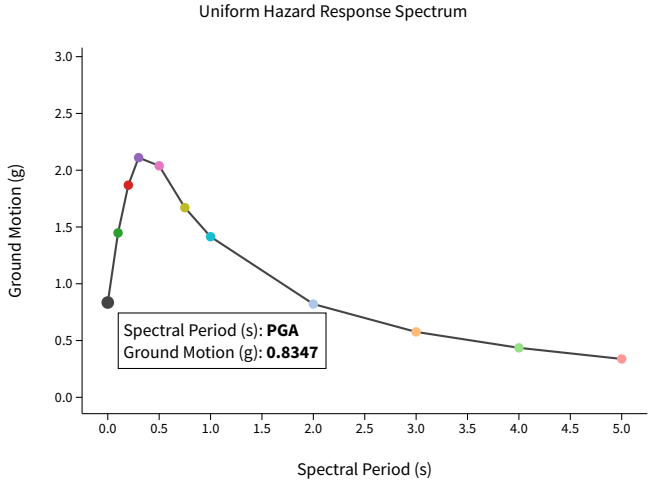
-117.4038

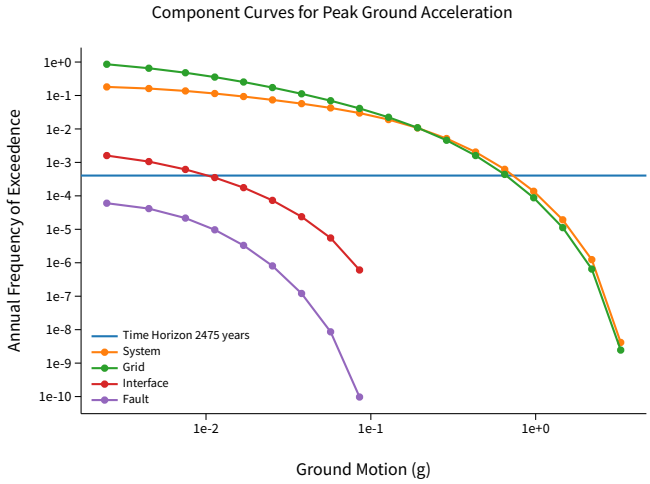
Site Class

259 m/s (Site class D)

Hazard Curve





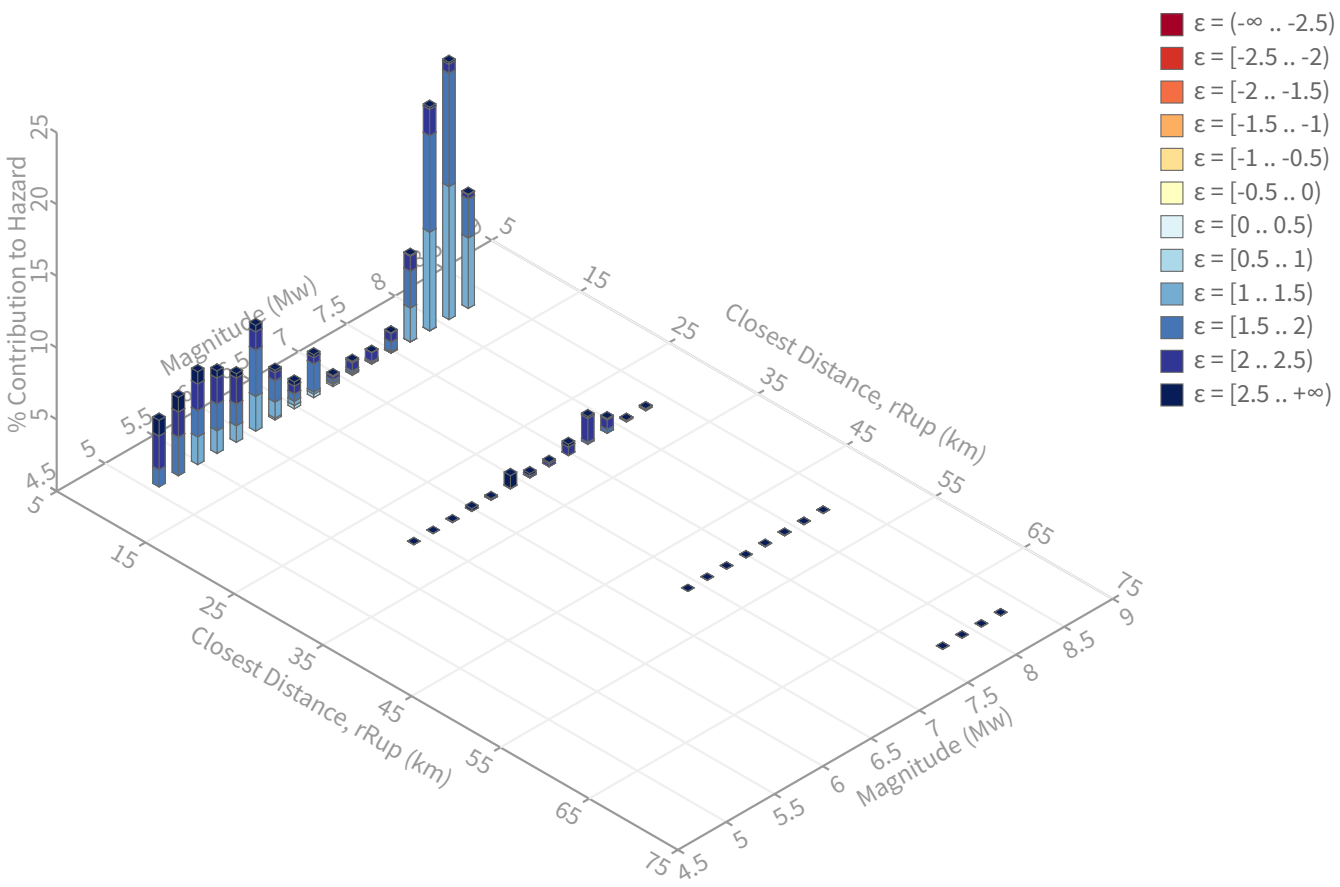


View Raw Data

Deaggregation

Component

Total



Summary statistics for, Deaggregation: Total

Deaggregation targets

Return period: 2475 yrs
Exceedance rate: 0.0004040404 yr^{-1}
PGA ground motion: 0.83467655 g

Recovered targets

Return period: 3134.0202 yrs
Exceedance rate: 0.00031907899 yr^{-1}

Totals

Binned: 100 %
Residual: 0 %
Trace: 0.04 %

Mean (over all sources)

m: 7
r: 12.39 km
ε_0: 1.77 σ

Mode (largest m-r bin)

m: 8.1
r: 13.64 km
ε_0: 1.52 σ
Contribution: 17.92 %

Mode (largest m-r-ε_0 bin)

m: 8.1
r: 10.99 km
ε_0: 1.29 σ
Contribution: 9.27 %

Discretization

r: min = 0.0, max = 1000.0, Δ = 20.0 km
m: min = 4.4, max = 9.4, Δ = 0.2
ε: min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0: [-∞ .. -2.5)
ε1: [-2.5 .. -2.0)
ε2: [-2.0 .. -1.5)
ε3: [-1.5 .. -1.0)
ε4: [-1.0 .. -0.5)
ε5: [-0.5 .. 0.0)
ε6: [0.0 .. 0.5)
ε7: [0.5 .. 1.0)
ε8: [1.0 .. 1.5)
ε9: [1.5 .. 2.0)
ε10: [2.0 .. 2.5)
ε11: [2.5 .. +∞]

Deaggregation Contributors

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
UC33brAvg_FM31	System							29.71
San Jacinto (San Bernardino) [3]		10.84	8.03	1.42	117.316°W	34.092°N	48.57	15.65
San Andreas (San Bernardino N) [4]		20.00	7.86	1.95	117.287°W	34.180°N	32.40	6.88
San Andreas (North Branch Mill Creek) [0]		19.59	8.01	1.74	117.270°W	34.171°N	37.63	1.54
Fontana (Seismicity) [1]		9.56	6.59	1.91	117.477°W	34.087°N	314.13	1.32
UC33brAvg_FM32	System							29.52
San Jacinto (San Bernardino) [3]		10.84	8.03	1.42	117.316°W	34.092°N	48.57	15.57
San Andreas (San Bernardino N) [4]		20.00	7.87	1.95	117.287°W	34.180°N	32.40	6.95
San Andreas (North Branch Mill Creek) [0]		19.59	8.01	1.74	117.270°W	34.171°N	37.63	1.61
Fontana (Seismicity) [1]		9.56	6.59	1.91	117.477°W	34.087°N	314.13	1.09
UC33brAvg_FM31 (opt)	Grid							20.41
PointSourceFinite: -117.404, 34.060		6.15	5.68	1.61	117.404°W	34.060°N	0.00	4.75
PointSourceFinite: -117.404, 34.060		6.15	5.68	1.61	117.404°W	34.060°N	0.00	4.75
PointSourceFinite: -117.404, 34.096		8.81	5.68	2.01	117.404°W	34.096°N	0.00	2.17
PointSourceFinite: -117.404, 34.096		8.81	5.68	2.01	117.404°W	34.096°N	0.00	2.17
PointSourceFinite: -117.404, 34.123		10.81	5.84	2.19	117.404°W	34.123°N	0.00	1.18
PointSourceFinite: -117.404, 34.123		10.81	5.84	2.19	117.404°W	34.123°N	0.00	1.18
UC33brAvg_FM32 (opt)	Grid							20.37
PointSourceFinite: -117.404, 34.060		6.15	5.68	1.61	117.404°W	34.060°N	0.00	4.75
PointSourceFinite: -117.404, 34.060		6.15	5.68	1.61	117.404°W	34.060°N	0.00	4.75
PointSourceFinite: -117.404, 34.096		8.81	5.68	2.01	117.404°W	34.096°N	0.00	2.17
PointSourceFinite: -117.404, 34.096		8.81	5.68	2.01	117.404°W	34.096°N	0.00	2.17
PointSourceFinite: -117.404, 34.123		10.82	5.84	2.19	117.404°W	34.123°N	0.00	1.18
PointSourceFinite: -117.404, 34.123		10.82	5.84	2.19	117.404°W	34.123°N	0.00	1.18

Although this information is a product of the U.S. Geological Survey, we provide no warranty, expressed or implied, as to the accuracy of the data contained therein. This tool is not a substitute for technical subject-matter knowledge.

USGS Design Maps Detailed Report

ASCE 7-10 Standard (34.0282°N, 117.4038°W)

Site Class D – "Stiff Soil", Risk Category I/II/III

Section 11.4.1 — Mapped Acceleration Parameters

Note: Ground motion values provided below are for the direction of maximum horizontal spectral response acceleration. They have been converted from corresponding geometric mean ground motions computed by the USGS by applying factors of 1.1 (to obtain S_S) and 1.3 (to obtain S_1). Maps in the 2010 ASCE-7 Standard are provided for Site Class B. Adjustments for other Site Classes are made, as needed, in Section 11.4.3.

From Figure 22-1 [1] $S_S = 1.500$ g

From Figure 22-2 [2] $S_1 = 0.600$ g

Section 11.4.2 — Site Class

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class D, based on the site soil properties in accordance with Chapter 20.

Table 20.3–1 Site Classification

Site Class	$\bar{v}_s$	$\bar{N}$ or $\bar{N}_{ch}$	$\bar{s}_u$
A. Hard Rock	>5,000 ft/s	N/A	N/A
B. Rock	2,500 to 5,000 ft/s	N/A	N/A
C. Very dense soil and soft rock	1,200 to 2,500 ft/s	>50	>2,000 psf
D. Stiff Soil	600 to 1,200 ft/s	15 to 50	1,000 to 2,000 psf
E. Soft clay soil	<600 ft/s	<15	<1,000 psf
	Any profile with more than 10 ft of soil having the characteristics: • Plasticity index PI > 20, • Moisture content $w \geq 40\%$, and • Undrained shear strength $\bar{s}_u$ < 500 psf		
F. Soils requiring site response analysis in accordance with Section 21.1	See Section 20.3.1		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Section 11.4.3 — Site Coefficients and Risk-Targeted Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration Parameters

Table 11.4-1: Site Coefficient F_a

Site Class	Mapped MCE_R Spectral Response Acceleration Parameter at Short Period				
	$S_S \leq 0.25$	$S_S = 0.50$	$S_S = 0.75$	$S_S = 1.00$	$S_S \geq 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight-line interpolation for intermediate values of S_S

For Site Class = D and S_S = 1.500 g, F_a = 1.000

Table 11.4-2: Site Coefficient F_v

Site Class	Mapped MCE_R Spectral Response Acceleration Parameter at 1-s Period				
	$S_1 \leq 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \geq 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See Section 11.4.7 of ASCE 7				

Note: Use straight-line interpolation for intermediate values of S_1

For Site Class = D and S_1 = 0.600 g, F_v = 1.500

Equation (11.4–1): $S_{MS} = F_a S_S = 1.000 \times 1.500 = 1.500$ g

Equation (11.4–2): $S_{M1} = F_v S_1 = 1.500 \times 0.600 = 0.900$ g

Section 11.4.4 — Design Spectral Acceleration Parameters

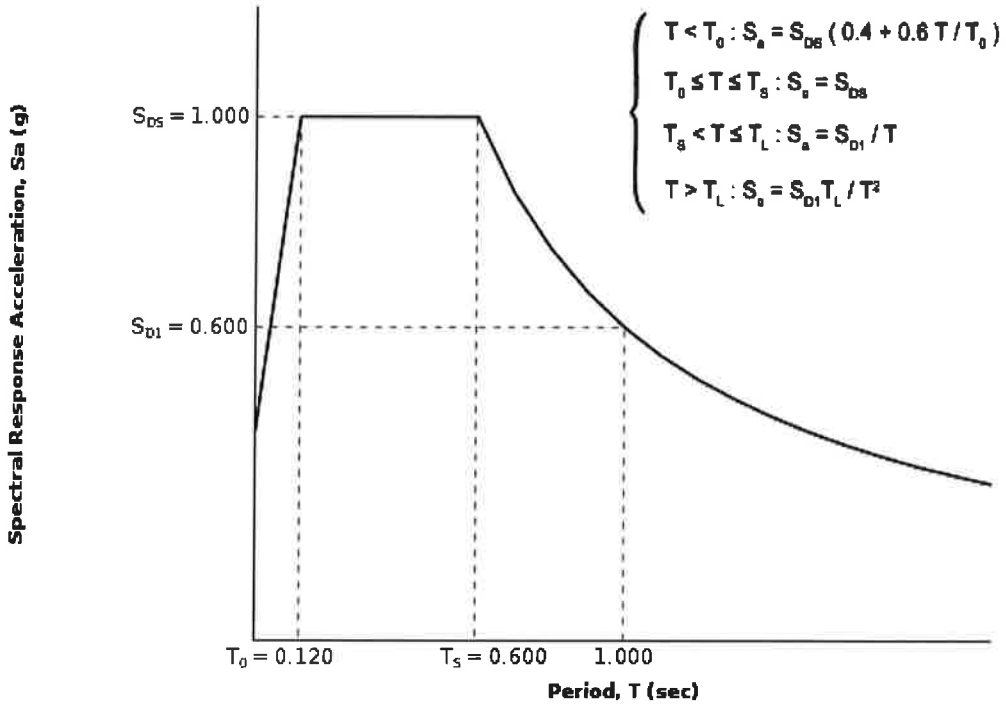
Equation (11.4–3): $S_{DS} = \frac{2}{3} S_{MS} = \frac{2}{3} \times 1.500 = 1.000$ g

Equation (11.4–4): $S_{D1} = \frac{2}{3} S_{M1} = \frac{2}{3} \times 0.900 = 0.600$ g

Section 11.4.5 — Design Response Spectrum

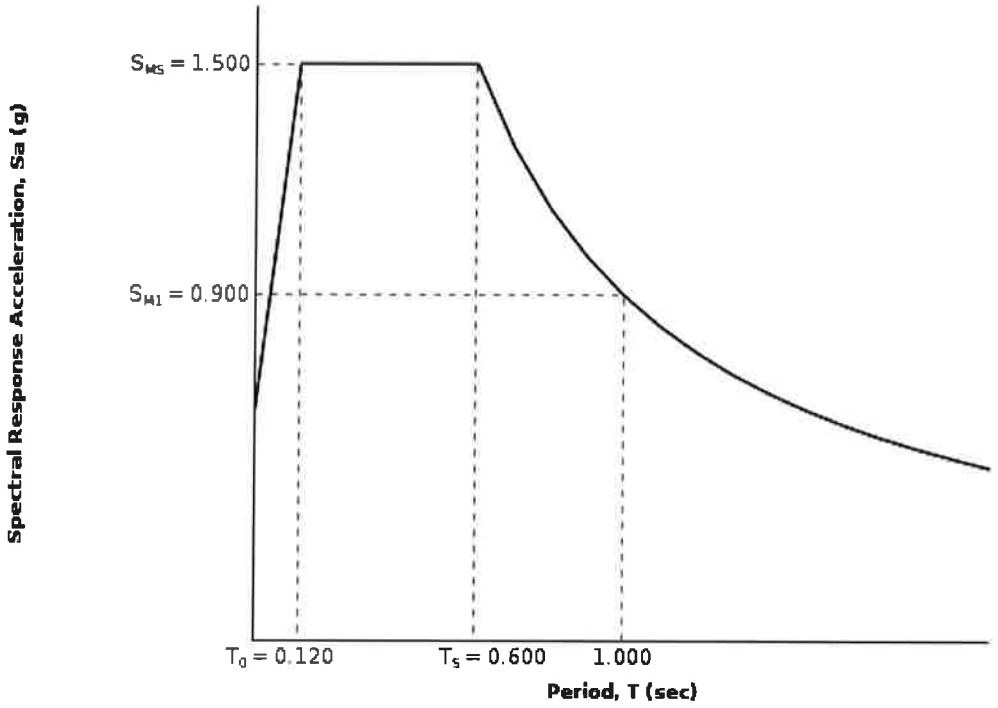
From Figure 22-12 [3] $T_L = 8$ seconds

Figure 11.4-1: Design Response Spectrum



Section 11.4.6 — Risk-Targeted Maximum Considered Earthquake (MCE_R) Response Spectrum

The MCE_R Response Spectrum is determined by multiplying the design response spectrum above by 1.5.



Section 11.8.3 — Additional Geotechnical Investigation Report Requirements for Seismic Design Categories D through F

From Figure 22-7 [4] PGA = 0.525

Equation (11.8–1): $PGA_M = F_{PGA}PGA = 1.000 \times 0.525 = 0.525$ g

Table 11.8–1: Site Coefficient F_{PGA}

Site Class	Mapped MCE Geometric Mean Peak Ground Acceleration, PGA				
	PGA ≤ 0.10	PGA = 0.20	PGA = 0.30	PGA = 0.40	PGA ≥ 0.50
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See Section 11.4.7 of ASCE 7				

Note: Use straight–line interpolation for intermediate values of PGA

For Site Class = D and PGA = 0.525 g, F_{PGA} = 1.000

Section 21.2.1.1 — Method 1 (from Chapter 21 – Site-Specific Ground Motion Procedures for Seismic Design)

From Figure 22-17 [5] C_{RS} = 1.095

From Figure 22-18 [6] C_{R1} = 1.053

Section 11.6 — Seismic Design Category

Table 11.6-1 Seismic Design Category Based on Short Period Response Acceleration Parameter

VALUE OF S_{DS}	RISK CATEGORY		
	I or II	III	IV
$S_{DS} < 0.167g$	A	A	A
$0.167g \le S_{DS} < 0.33g$	B	B	C
$0.33g \le S_{DS} < 0.50g$	C	C	D
$0.50g \le S_{DS}$	D	D	D

For Risk Category = I and S_{DS} = 1.000 g, Seismic Design Category = D

Table 11.6-2 Seismic Design Category Based on 1-S Period Response Acceleration Parameter

VALUE OF S_{D1}	RISK CATEGORY		
	I or II	III	IV
$S_{D1} < 0.067g$	A	A	A
$0.067g \le S_{D1} < 0.133g$	B	B	C
$0.133g \le S_{D1} < 0.20g$	C	C	D
$0.20g \le S_{D1}$	D	D	D

For Risk Category = I and S_{D1} = 0.600 g, Seismic Design Category = D

Note: When S_1 is greater than or equal to 0.75g, the Seismic Design Category is **E** for buildings in Risk Categories I, II, and III, and **F** for those in Risk Category IV, irrespective of the above.

Seismic Design Category ≡ "the more severe design category in accordance with Table 11.6-1 or 11.6-2" = D

Note: See Section 11.6 for alternative approaches to calculating Seismic Design Category.

References

1. *Figure 22-1*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-1.pdf
2. *Figure 22-2*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-2.pdf
3. *Figure 22-12*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-12.pdf
4. *Figure 22-7*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-7.pdf
5. *Figure 22-17*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-17.pdf
6. *Figure 22-18*: http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/2010_ASCE-7_Figure_22-18.pdf

APPENDIX E

SEISMIC REFRACTION SURVEY

TERRA GEOSCIENCES

SEISMIC REFRACTION SURVEY

PROPOSED RIO VISTA RESIDENTIAL DEVELOPMENT PROJECT

CITY OF JURUPA VALLEY, CALIFORNIA

Project No. 132644-1

June 12, 2013

Prepared for:

Leighton and Associates, Inc.
10532 Acacia Street, Suite B-6
Rancho Cucamonga, CA 91730

Consulting Engineering Geology & Geophysics

P.O. Box 1090, Loma Linda, CA 92354 • 909-796-4667

Leighton and Associates, Inc.
10532 Acacia Street, Suite B-6
Rancho Cucamonga, CA 91730

Attention: Mr. Phil Buchiarelli, Principal Geologist

Regarding: Seismic Refraction Survey
Proposed Rio Vista Residential Development Project
City of Jurupa Valley, California
L&A Project Number 10270.001

INTRODUCTION

As requested, this firm has performed a geophysical survey using the seismic refraction method for the above-referenced site, along the areas selected by you. The purpose of this investigation was to assess the general seismic velocity characteristics of the underlying earth materials and to evaluate whether high velocity earth materials (non-rippable) are present which could possibly indicate areas of potential excavation difficulties, and also to aid in evaluating the subsurface structure and seismic velocity distribution. Morton (2003) has mapped the underlying bedrock earth materials as being Cretaceous age granitics rocks generally described as a relatively uniform, medium-to coarse-grained equigranular gray biotite-hornblende tonalite.

As requested, the locations of the seismic survey lines have been approximated on a captured Google™ Earth image (Google™ Earth, 2013) which is presented as the Seismic Line Location Map, Plate 1. As authorized by you, the following services were performed during this study:

- **Review of available published and unpublished geologic/geophysical data in our files pertinent to the site.**
- **Performing a geophysical survey by a State of California licensed Professional Geophysicist; to include ten seismic refraction traverses.**
- **Preparation of this report, presenting our findings and conclusions with respect to the bedrock velocity characteristics and the expected excavation potentials.**

Accompanying Map and Appendices

Plate 1 - Seismic Line Location Map
Appendix A - Layer Velocity Models
Appendix B - Tomographic Models
Appendix C - Excavation Considerations
Appendix D - References

SEISMIC REFRACTION SURVEY

Methodology

The seismic refraction method consists of measuring (at known points along the surface of the ground) the travel times of compressional waves generated by an impulsive energy source and can be used to estimate the layering, structure, and seismic acoustic velocities of subsurface horizons. Seismic waves travel down and through the soils and rocks, and when the wave encounters a contact between two earth materials having different velocities, some of the wave's energy travels along the contact at the velocity of the lower layer. The fundamental assumption is that each successively deeper layer has a velocity greater than the layer immediately above it. As the wave travels along the contact, some of the wave's energy is refracted toward the surface where it is detected by a series of motion-sensitive transducers (geophones). The arrival time of the seismic wave at the geophone locations can be related to the relative seismic velocities of the subsurface layers in feet per second (fps), which can then be used to aid in interpreting both the depth and type of materials encountered.

Field Procedures

Ten seismic refraction survey lines were performed each being 200 feet in length and were located in the field where shown on the provided cut/fill map. These traverses were subsequently transferred to a Google™ Earth image for inclusion as the Seismic Line Location Map, Plate 1. A 16-pound sledge-hammer was used as an energy source to produce the seismic waves and twenty-four, 14-Hz geophones spaced at eight-foot intervals, were employed to detect both the direct and refracted waves. The seismic wave arrivals were digitally recorded in SEG-2 format on a Geometrics StrataVisor™ NZXP model signal enhancement refraction seismograph. Seven shot points were utilized along the spread using forward, reverse, and several intermediate locations in order to obtain high resolution survey data for velocity analysis and depth modeling purposes. The data was acquired using a sampling rate of 0.0625 milliseconds having a record length of 0.08 seconds with no acquisition filters.

During acquisition, the seismograph provides both a hard copy and screen display of the seismic wave arrivals, of which are digitally recorded on the in-board seismograph computer. The data on the paper record and/or display screen were used to analyze the arrival time of the primary seismic "P"-waves at each geophone station, in the form of a wiggle trace for quality control purposes in the field. Each geophone and shot location was surveyed using a hand level and ruler for relative topographic correction, with "0" representing the lowest point along the survey line.

Data Processing

All of the recorded data was subsequently transferred to our office computer for further processing, analyzing, and printing purposes, using the computer programs **SIPwin** (**S**eismic Refraction **I**nterpretation **P**rogram for **Win**dows) developed by Rimrock Geophysics, Inc. (2004), and **Rayfract™** (Intelligent Resources, Inc., 1996-2013).

SIPwin is a ray-trace modeling program that evaluates the subsurface using layer assignments based on time-distance curves and is better suited for layered media, using the "Seismic Refraction Modeling by Computer" method (Scott, 1973). The first step in the modeling procedure is to compute layer velocities by least-squares techniques. Then the program uses the delay-time method to estimate depths to the top of layer-2. A forward modeling routine traces rays from the shot points to each geophone that received a first-arrival ray refracted along the top of layer-2. The travel time of each such ray is compared with the travel time recorded in the field by the seismic system. The program then adjusts the layer-2 depths so as to minimize discrepancies between the computed ray-trace travel times and the first arrival times picked from the seismic waveform record. The process of ray tracing and model adjustment is repeated a total of six times to improve the accuracy of depths to the top of layer-2. This first-arrival picks were then used to generate the Layer Velocity Models using the **SIPwin** computer program, which presents the subsurface velocities as individual layers and is presented within Appendix A for reference. In addition, the Time-Distance Plots for each survey line also appears in Appendix A, which shows the individual data picks of the first "P-wave" arrival times, for reference.

Rayfract™ is a seismic refraction tomography software program that models subsurface refraction, transmission, and diffraction of acoustic waves which generally indicates the relative structure and velocity distribution of the subsurface using first break energy propagation modeling. An initial 1D gradient model is created using the Delta-t-V method which gives a good initial fit between modeled and picked first breaks. This initial model is then refined automatically with a true 2D WET (Wavepath Eikonal Traveltime) tomographic inversion (Schuster and Quintus-Bosz, 1993). WET tomography models multiple signal propagation paths contributing to one first break, whereas conventional ray tracing tomography is limited to the modeling of just one ray per first break. This computer program performs the analysis by using the first-arrival P-wave times (see Time-Distance Plots, Appendix A) and line geometry that were derived from the **SIPwin** analyses.

SUMMARY OF GEOPHYSICAL INTERPRETATION

To begin our discussion, it is important to consider that the seismic velocities obtained within bedrock materials are influenced by the nature and character of the localized major structural discontinuities (foliation, fracturing, relic bedding, etc.), creating anisotropic conditions. Anisotropy (direction-dependent properties of materials) can be caused by "micro-cracks," jointing, foliation, layered or inter-bedded rocks with unequal layer stiffness, small-scale lithologic changes, etc. (Barton, 2007). Velocity anisotropy complicates interpretation and it should be noted that the seismic velocities obtained during this survey may have been influenced by the nature and character of any localized structural discontinuities within granitic bedrock underlying the subject site. Generally, it is expected that higher (truer) velocities will be obtained when the seismic waves propagate along direction (strike) of the dominant structure, with a damping

effect when the seismic waves travel in a perpendicular direction. Such variable directions can result in velocity differentials of between 2% to 40% (Barton, 2007) depending upon the degree of the structural fabric (i.e., weakly-moderately-strongly foliated, respectively). Therefore, the seismic velocities obtained during our field study and as discussed below, should be considered minimum velocities at this time.

The analysis of the data was performed using the two methods as previously discussed. The first method described below is the traditional layer method (**SIPwin**). Using this method, it should be understood that the data obtained represents an average of seismic velocities within any given layer. For example, high seismic velocity boulders, dikes, or other local lithologic inconsistencies, may be isolated within a low velocity matrix, thus yielding an average medium velocity for that layer. Therefore, in any given layer, a range of velocities could be anticipated, which can also result in a wide range of excavation characteristics. In general, the site where locally surveyed was noted to be characterized by three major subsurface layers with respect to seismic velocities. The following velocity layer summaries have been prepared using the **SIPwin** analysis, with the representative Layer Velocity Models presented within Appendix A.

- Velocity Layer V1:

  This uppermost velocity layer (V1) is most likely comprised of topsoil, alluvium, colluvium, and/or completely-weathered and fractured bedrock. This layer has an average weighted velocity of 1,320 to 2,330 fps, which is typical for near-surface earth materials and/or completely-weathered bedrock. Locally, the relatively higher V1 velocity materials (>2,000 ft/sec) may possibly indicate the presence of older alluvial deposits mantling the bedrock or possibly surficial weathered bedrock.

- Velocity Layer V2:

  The second layer (V2) yielded seismic velocities of 3,374 to 4,504 fps, indicating the presence of highly- to moderately-weathered bedrock materials, which are typical for the near surface weathered zone commonly found in granitic rocks in the southern California region. This velocity either indicates the presence of homogeneous weathered granitic bedrock with a relatively wide spacing of the local joint/fracture system and/or the possibility of buried relatively-fresher boulders within a decomposed bedrock matrix. Either subsurface conditions or both could exist.

- Velocity Layer V3:

  The third layer (V3) indicates the presence of moderate- to slightly-weathered bedrock, with a wide range of average weighted velocities between 5,688 to 11,773 fps. This wide range of velocities may be in part due to varying lithologic constituents within the bedrock and/or localized weathering effects as a function of depth. These velocities most likely indicate a relatively less-weathered crystalline bedrock matrix that has a wide-spaced fracture system or possibly a moderately-weathered bedrock matrix with abundant widely-scattered buried fresh large crystalline boulders.

Using the computer program **Rayfract™**, Refraction Tomographic Models were also prepared (see Appendix B) for comparative purposes to better illustrate the general structure and velocity distribution of the subsurface. Although no discrete velocity layers or boundaries are created, the tomographic models generally resemble the corresponding average **SIPwin** velocities. For comparison purposes between the survey lines, these models utilized the same relative color velocity scheme. Several of the models indicate the potential for buried corestone rock or lithologic inconsistencies as evidenced by localized lateral velocity contrasts. As expected, below the surficial earth materials the seismic velocity of the bedrock increases with depth.

GENERALIZED RIPPABILITY CHARACTERISTICS OF BEDROCK

A summary of the generalized rippability characteristics of bedrock based on a compilation of rippability performance charts prepared by Caterpillar, Inc. (2004), Caltrans (Stephens, 1978), and Santi (2006), has been provided to aid in evaluating potential excavation difficulties with respect to the seismic velocities obtained along the local areas surveyed. These seismic velocity ranges and rippability potentials have been tabulated below for reference.

TABLE 1- CATERPILLAR RIPPABILITY CHART (D9 Ripper)

Granitic Rock Velocity (feet/sec ±)	Rippability
< 6,800	Rippable
6,800 – 8,000	Moderately Rippable
> 8,000	Non-Rippable

Additionally, we have provided the Caltrans Rippability Chart as presented below within Table 2 for comparison. These values are from published Caltrans studies (Stephens, 1978) that are based on their experience which are more conservative than Caterpillar's rippability charts. It should be noted that the type of bedrock was not indicated.

TABLE 2- STANDARD CALTRANS RIPPABILITY CHART

Velocity (feet/sec ±)	Rippability
< 3,500	Easily Ripped
3,500 – 5,000	Moderately Difficult
5,000 – 6,600	Difficult Ripping / Light Blasting
> 6,600	Blasting Required

Table 3 is partially modified from the "Engineering Behavior from Weathering Grade" as presented by Santi (2006), which also provides velocity ranges with respect to rippability potentials, along with other rock engineering properties that are pertinent for this study.

TABLE 3- SUMMARY OF ROCK ENGINEERING PROPERTIES

ENGINEERING PROPERTY:	Slightly Weathered	Moderately Weathered	Highly Weathered	Completely Weathered
Excavatability	Blasting necessary	Blasting to rippable	Generally rippable	Rippable
Slope Stability	½ :1 to 1:1 (H:V)	1:1 (H:V)	1:1 to 1.5:1 (H:V)	1.5:1 to 2:1 (H:V)
Schmidt Hammer Value	51 – 56	37 – 48	12 – 21	5 – 20
Seismic Velocity (fps)	8,200 – 13,125	5,000 – 10,000	3,300 – 6,600	1,650 – 3,300

A summary of the generalized rippability characteristics of granitic bedrock has been provided to aid in evaluating potential excavation difficulties with respect to the seismic velocities obtained along the local areas surveyed. The velocity ranges that are described below are approximate and assume typical, good-working, heavy excavation equipment, such as single shank or D9R dozer, such as described by Caterpillar, Inc. (2000 and 2004); however, different excavating equipment (i.e., trenching equipment) may not correlate well with these velocity ranges.

Trenching operations within granitic bedrock materials with seismic velocities generally greater than 4,000±-fps, typically encounter very difficult to non-productable conditions. The seismic velocity ranges described below are considered approximate and assume typical, good-working, heavy excavation equipment, such as a D9R/D9T dozer, such as described by Caterpillar, Inc. (2000 and 2004).

- **Rippable Condition (0 - 4,000± ft/sec)**:

  This velocity range indicates rippable materials which may consist of alluvial-type deposits and decomposed granitic bedrock, with random hardrock floaters. These materials typically break down into silty sands (depending on parent lithologic materials), whereas floaters will require special disposal. Some areas containing numerous hardrock floaters may present utility trench problems. Large floaters exposed at or near finished grade may present problems for footing or infrastructure trenching.

- **Marginally Rippable Condition (4,000± - 7,000± ft/sec)**:

  This range of seismic velocities indicates materials which may consist of moderately weathered bedrock and/or large areas of fresh bedrock materials separated by weathered fractured zones. These bedrock materials are generally rippable with difficulty by a Caterpillar D9R or equivalent. Excavations may produce material that will partially break down into a coarse, silty to clean sand, with a high percentage of very coarse sand to pebble-sized material depending on the parent bedrock lithology. Less fractured or weathered materials will probably require blasting to facilitate removal.

- **Non-Rippable Condition (7,000± ft/sec or greater)**:

  This velocity range includes non-rippable material consisting primarily of moderately fractured bedrock at lower velocities and only slightly fractured or unfractured rock at higher velocities. Materials in this velocity range may be marginally rippable, depending upon the degree of fracturing and the skill and experience of the operator. Tooth penetration is often the key to ripping success, regardless of seismic velocity. If the fractures and joints do not allow tooth penetration, the material may not be ripped effectively; however, pre-blasting or "popping" may induce sufficient fracturing to permit tooth entry. In their natural state, materials with these velocities are generally not desirable for building pad grade, due to difficulty in footing and utility trench excavation. Blasting will most likely produce oversized material, requiring special disposal.

GEOLOGIC & EARTHWORK CONSIDERATIONS

To evaluate whether a particular bedrock material can be ripped or excavated, this geophysical survey should be used in conjunction with the geologic and/or geotechnical report and/or information gathered for the subject project which may describe the physical properties of the bedrock. The physical characteristics of bedrock materials that favor ripping generally include the presence of fractures, faults, and other structural discontinuities, weathering effects, brittleness or crystalline structure, stratification or lamination, large grain size, moisture permeated clay, and low compressive strength. If the bedrock is foliated and/or fractured at depth, this structure could aid in excavation production.

Unfavorable bedrock conditions can include such characteristics as massive and homogeneous formations, non-crystalline structure, absence of planes of weakness, fine-grained materials, and formations of clay origin where moisture makes the material plastic. Use of these physical bedrock conditions along with the subsurface velocity characteristics as presented within this report should aid in properly evaluating the type of equipment that will be necessary and the production levels that can be anticipated for this project.

A summary of excavation considerations has been included within Appendix C in order to provide you and your client with a better understanding of the complexities of excavation in bedrock materials. These concepts should be understood so that proper planning and excavation techniques can be employed by the selected grading contractor. For purposes of the discussion in this report with respect to the expected bedrock rippability characteristics, we are assuming that a D9R dozer will be used as a minimum. Smaller excavating equipment will most likely result in slower production rates and possible refusal within relatively lower velocity bedrock materials. The decision for blasting of the bedrock materials for facilitating the excavation is sometimes made based upon economic production reasons and not solely on the rippability (velocity/hardness) characteristics of the bedrock.

SUMMARY OF FINDINGS AND CONCLUSIONS

The raw field data was considered to be of good quality which had only minor amounts of ambient "noise" that was introduced during our survey that originated predominantly from wind sources. Analysis of the data and picking of the primary "P"-wave arrivals was performed with only minor difficulty, with very little interpolation of data being necessary.

Based on the results of our comparative seismic analyses of both computer programs **SIPwin** and **Rayfract™** (of which both software programs use exactly the same input data), the seismic refraction survey line models appear to generally coincide with one another, with some minor variances due to the methods that these programs process and integrate the input data. The anticipated excavation potentials of the velocity layers encountered locally during our survey are as follows:

- Velocity Layer V1:

  No excavating difficulties are expected to be encountered within the uppermost, low-velocity layer V1 (average weighted velocity of 1,320 to 2,330 fps) and should excavate with conventional ripping. This layer is expected to be comprised of topsoil, alluvium, colluvium, and/or completely-weathered and fractured bedrock. It is important to note that locally, fresher boulders should be anticipated within this layer based on large bedrock outcroppings noted locally across the site.

- Velocity Layer V2:

  The second layer V2 is believed to consist of highly- to moderately-weathered granitic bedrock materials (average weighted velocity of 3,374 to 4,504 fps) and is expected to excavate with slight to moderate difficulty. Isolated floaters (i.e., boulders, corestones, etc.) also should be expected to be present within this layer and will most likely produce very difficult conditions locally. Localized blasting cannot be ruled out if this layer is composed of numerous buried fresher corestones within a decomposed rock matrix. Placement of infrastructure within this velocity layer may require significant breaking and/or blasting to obtain desired grade.

- Velocity Layer V3:

  The third layer V3 is highly variable with respect to seismic velocities and is believed to consist of moderate- to slightly-weathered bedrock. Very hard excavation difficulties within this deeper velocity layer (average weighted velocity of 5,688 to 11,773 fps) are anticipated. This layer may consist of relatively fresher homogeneous bedrock with wide-spaced fracturing, or may contain higher velocity scattered boulders, dikes, and other lithologic variables, within a relatively lower velocity bedrock matrix. Significant blasting will be required within this velocity layer within areas where the velocities exceed 7,000± ft/sec to achieve desired grade, including any infrastructure.

Based on the tomographic models and typical excavation characteristics observed within granitic bedrock of the southern California region, anticipation of gradual increasing hardness with depth along with lateral variations (generally due to the presence of buried corestones, dikes, or other lithologic variations), should be anticipated. Using the rock classifications as presented within Tables 1 through 3, seismic wave velocities of less than 6,600± to 6,800± fps are generally noted to be within the threshold for conventional ripping and therefore, significant blasting should be anticipated within any higher velocity materials (>7,000± fps) where locally encountered.

It should be also noted that any large surficial boulders/outcrops that mantle the hillsides (if present) will require special consideration when encountered during grading. It may be necessary to blast or use other special mechanical means to remove these surficial rocks or reduce them down into useable earth work materials. These rocks are the remnant corestones that were originally interspersed within weathered bedrock that has since been removed by erosion over the geologic past.

CLOSURE & LIMITATIONS

The field survey was performed by the undersigned on May 20 and 21, 2013 using "state of the art" geophysical equipment and techniques along selected portions of the subject study area as directed by you. The seismic data was further evaluated using recently developed tomographic inversion techniques to provide a more thorough analysis and understanding of the subsurface structural conditions. It should be noted that our data was obtained along only ten specific locations therefore other areas in the local vicinity beyond the limits of our seismic lines may contain different velocity layers and depths not encountered during our field survey. Additional survey traverses may be necessary to further evaluate the excavation characteristics across other portions of the site where cut grading will be proposed. Estimates of layer velocity boundaries as presented in this report are generally considered to be within 10± percent of the total depth of the contact.

In summary, the results of this seismic refraction survey are to be considered as an aid to assessing the rippability and excavation potentials of the bedrock locally. This information should be carefully reviewed by the grading contractor and representative "test" excavations with the proposed type of excavation equipment for the proposed construction should be considered, so that they may be correlated with the data presented within this report.

It should be understood that the fundamental limitation for seismic refraction surveys is known as nonuniqueness, wherein a specific seismic refraction data set does not provide sufficient information to determine a single "true" earth model. Therefore, the interpretation of any seismic data set uses "best-fit" approximations along with the geologic models that appear to be most reasonable for the local area being surveyed. Client should also understand that when using the theoretical geophysical principles

interpretation of any seismic data set uses "best-fit" approximations along with the geologic models that appear to be most reasonable for the local area being surveyed. Client should also understand that when using the theoretical geophysical principles and techniques discussed in this report, sources of error are possible in both the data obtained and in the interpretation and that the results of this survey may not represent actual subsurface conditions. These are all factors beyond **Terra Geosciences** control and no guarantees as to the results of this survey can be made. We make no warranty, either expressed or implied. If the client does not understand the limitations of this geophysical survey, additional input should be sought from the consultant.

Respectfully submitted,
TERRA GEOSCIENCES

Donn C. Schwartzkopf
Principal Geophysicist
PGP 1002



SEISMIC LINE LOCATION MAP

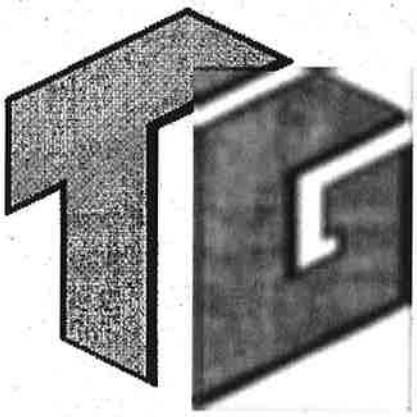


PROJECT NO. 132644-1

PLATE 1

APPENDIX A

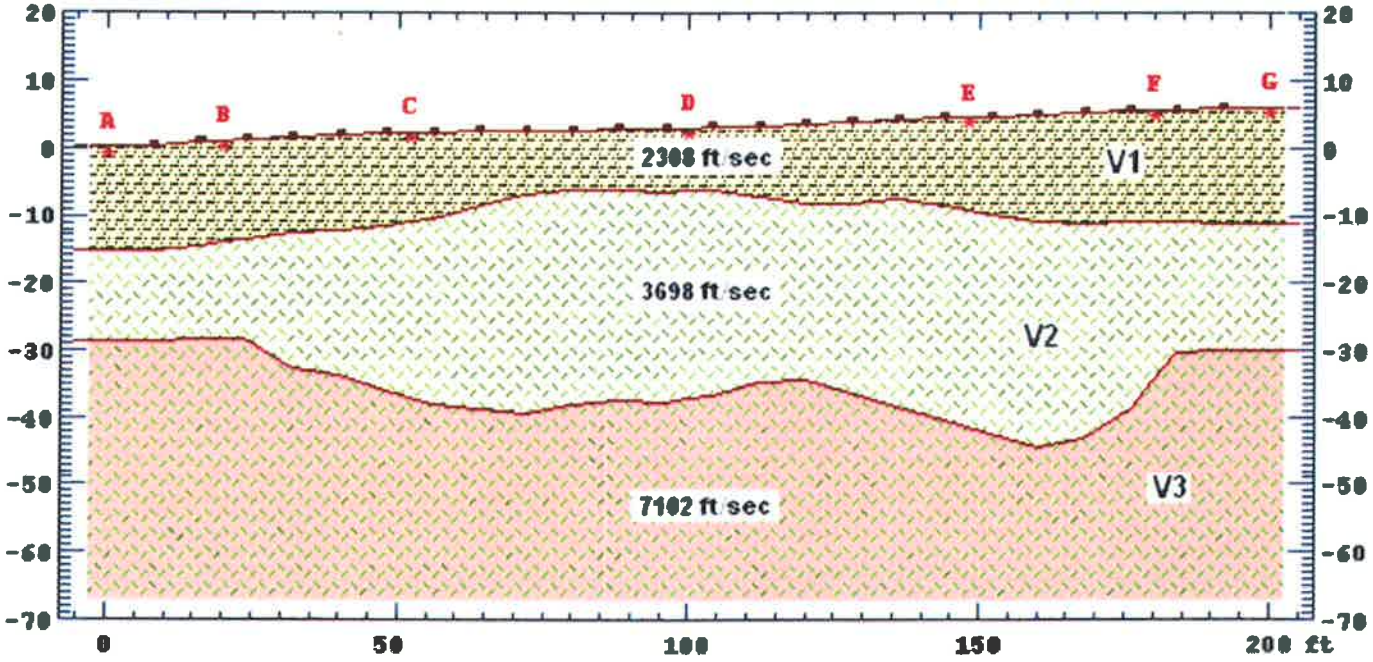
LAYER VELOCITY MODELS



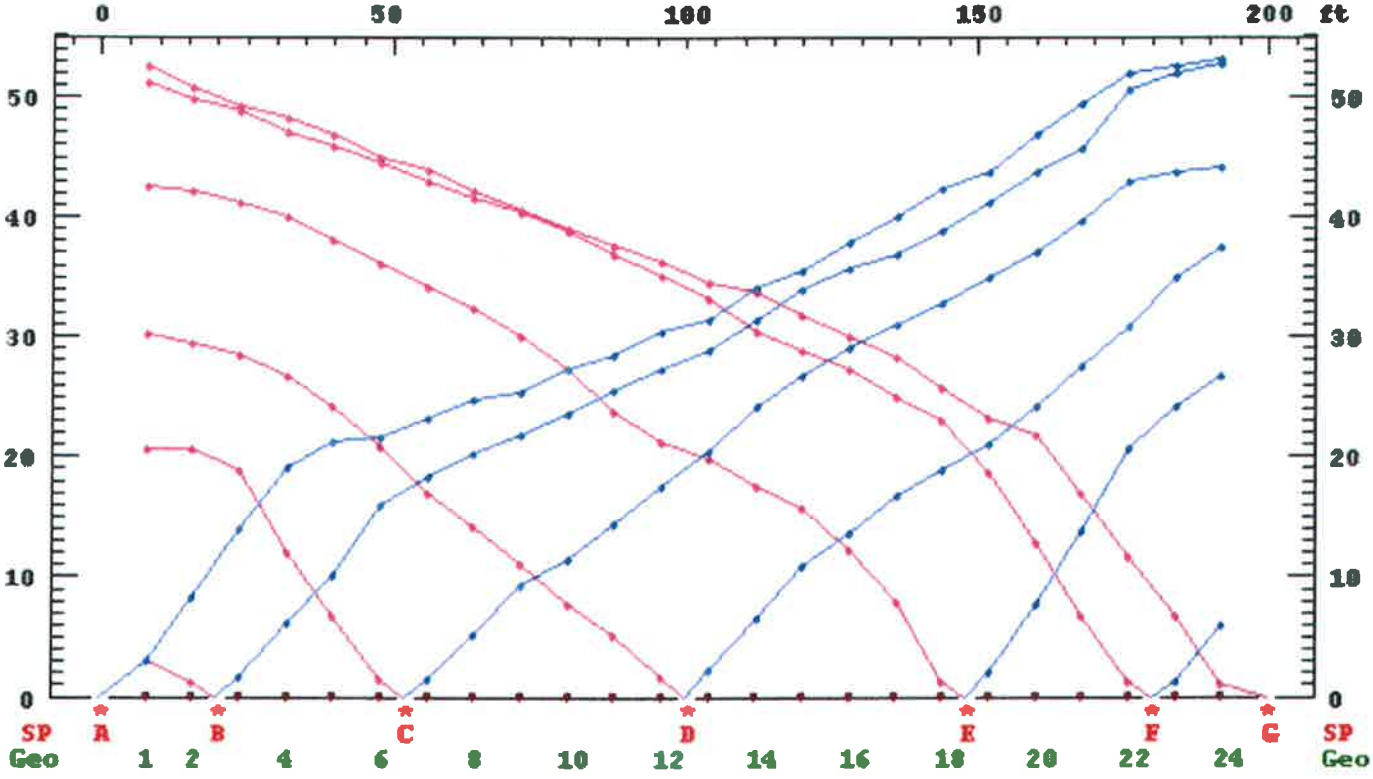
SEISMIC LINE S-1

< South - North >

LAYER VELOCITY MODEL



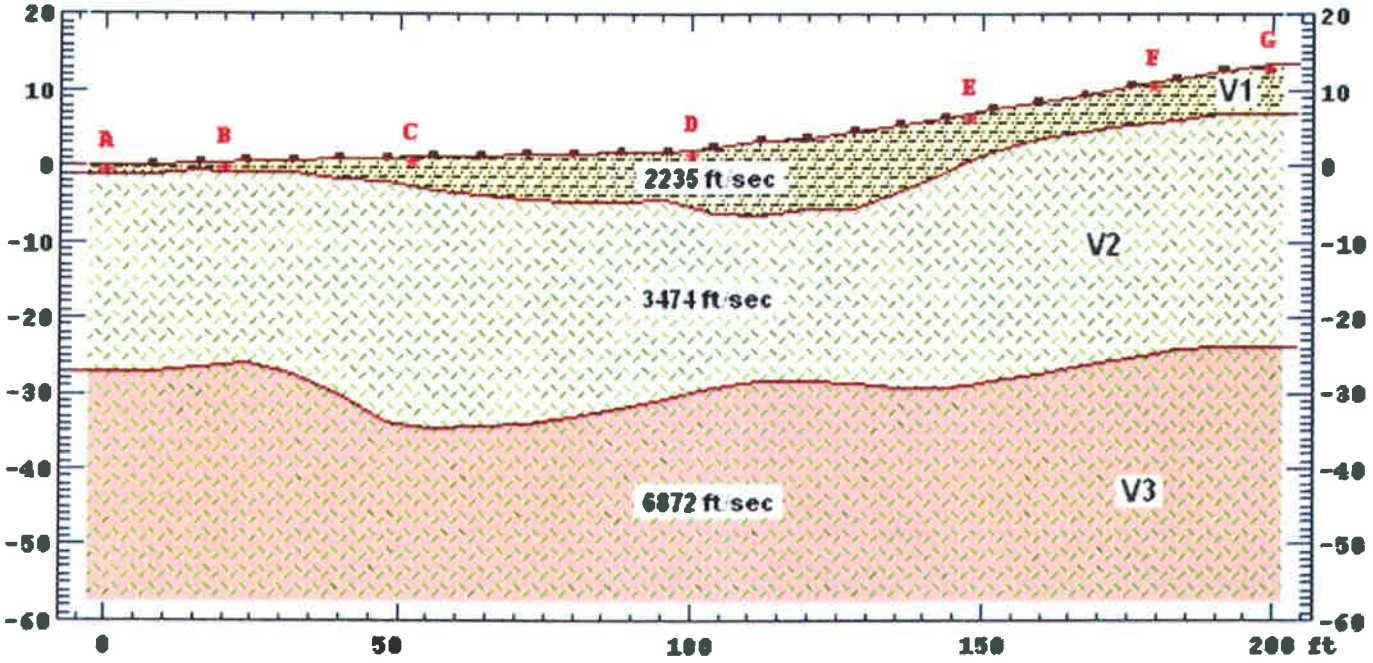
TIME-DISTANCE PLOT



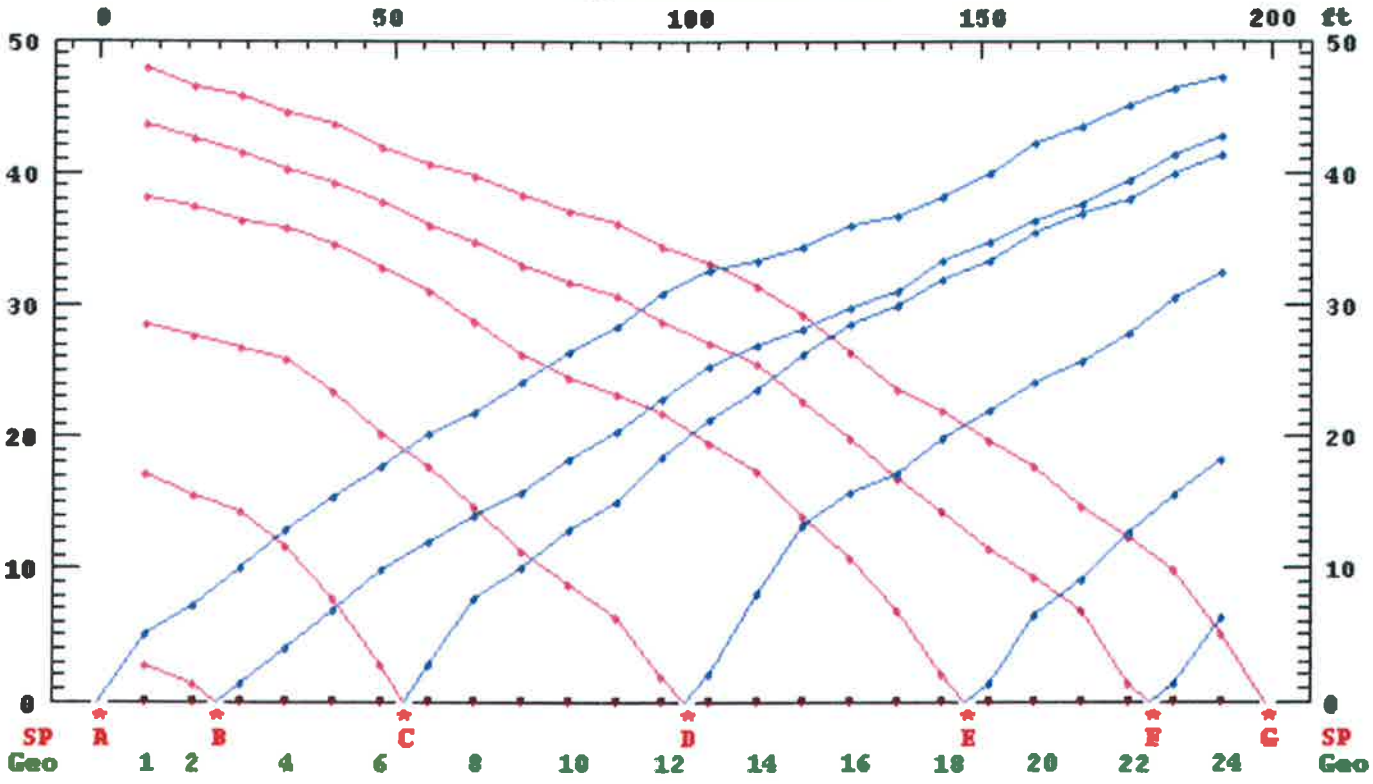
SEISMIC LINE S-2

North 10° West >

LAYER VELOCITY MODEL



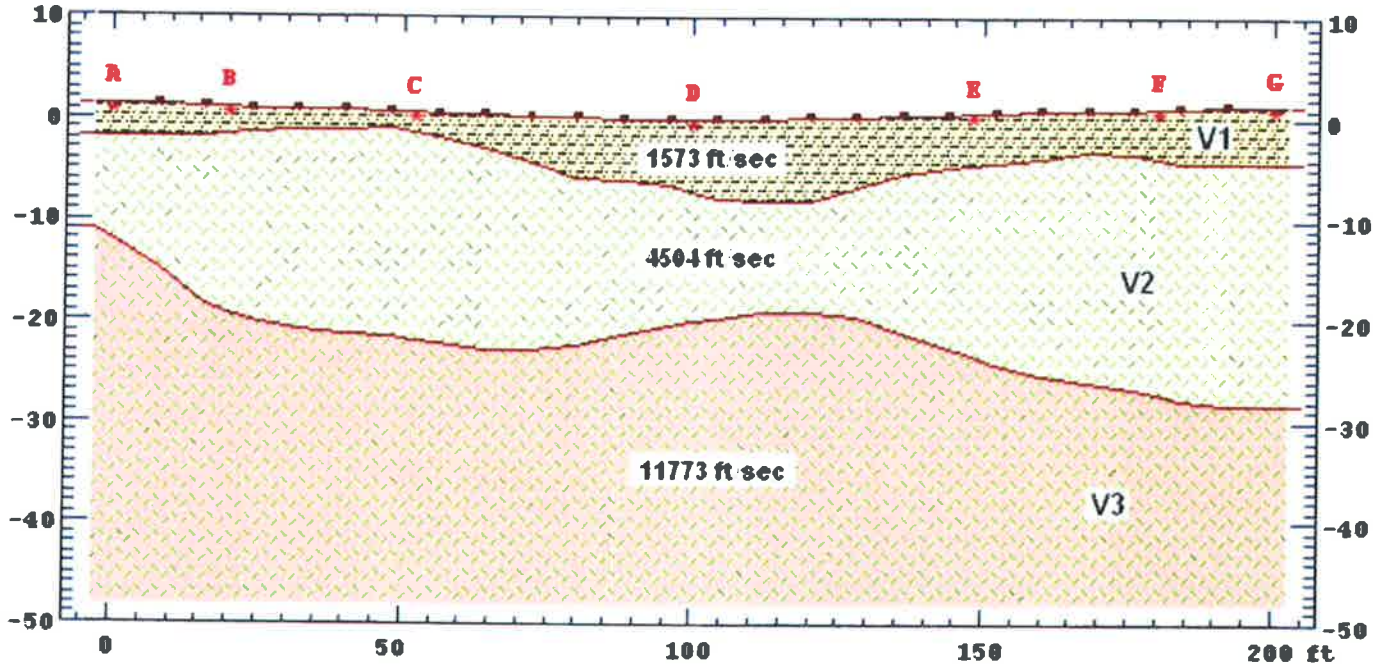
TIME-DISTANCE PLOT



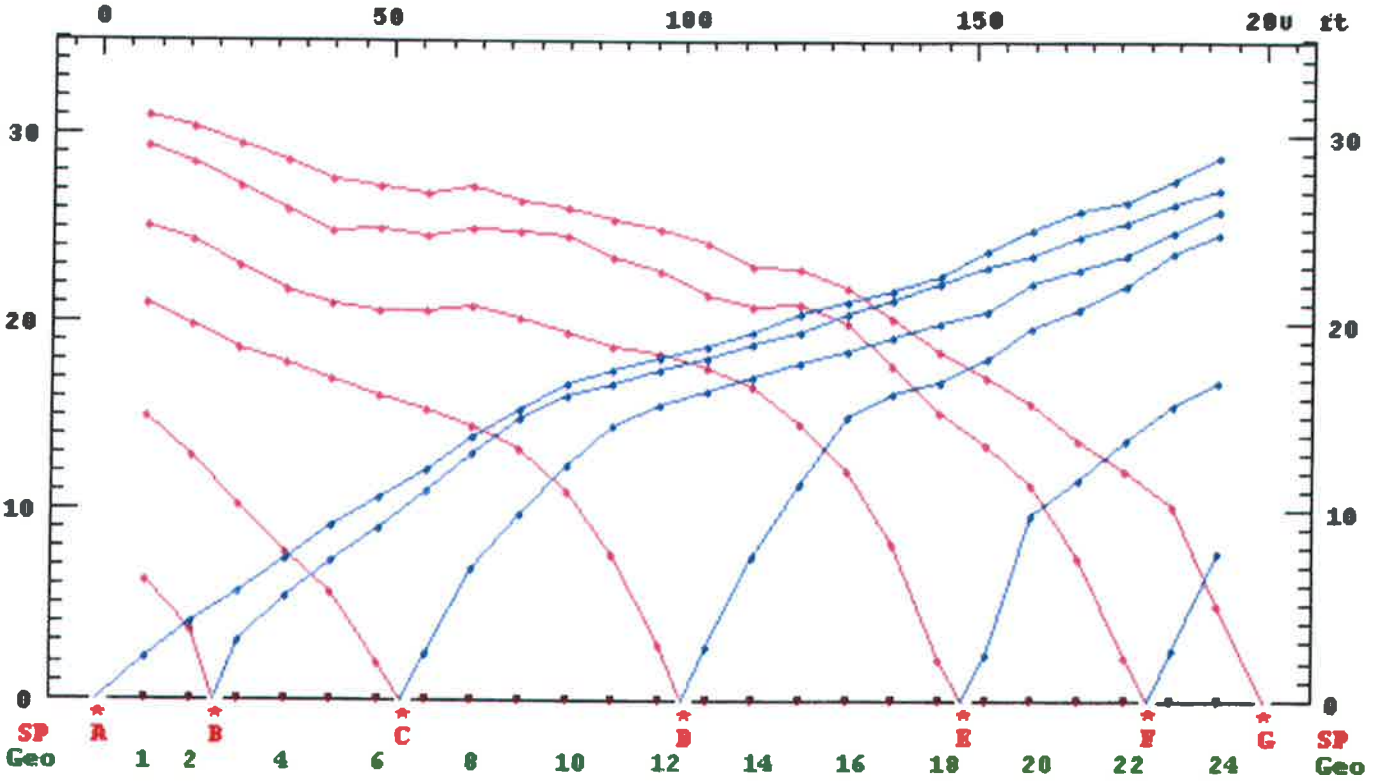
SEISMIC LINE S-3

North 35° East >

LAYER VELOCITY MODEL



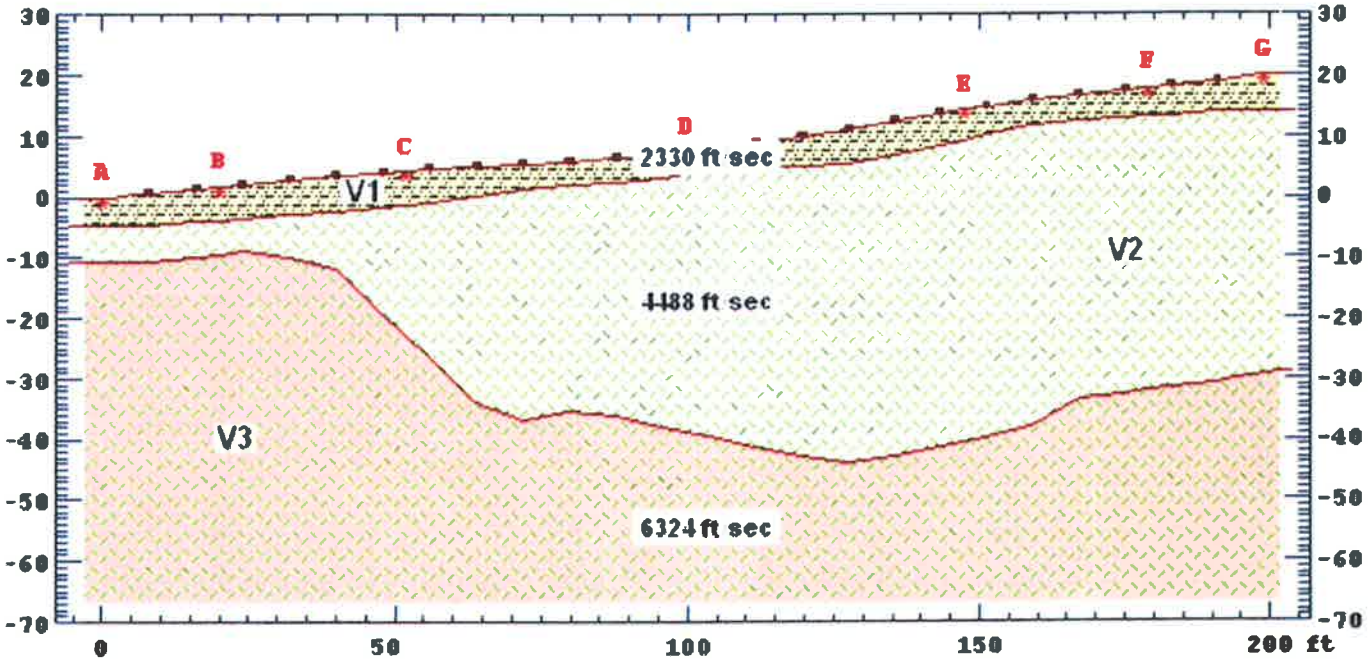
TIME-DISTANCE PLOT



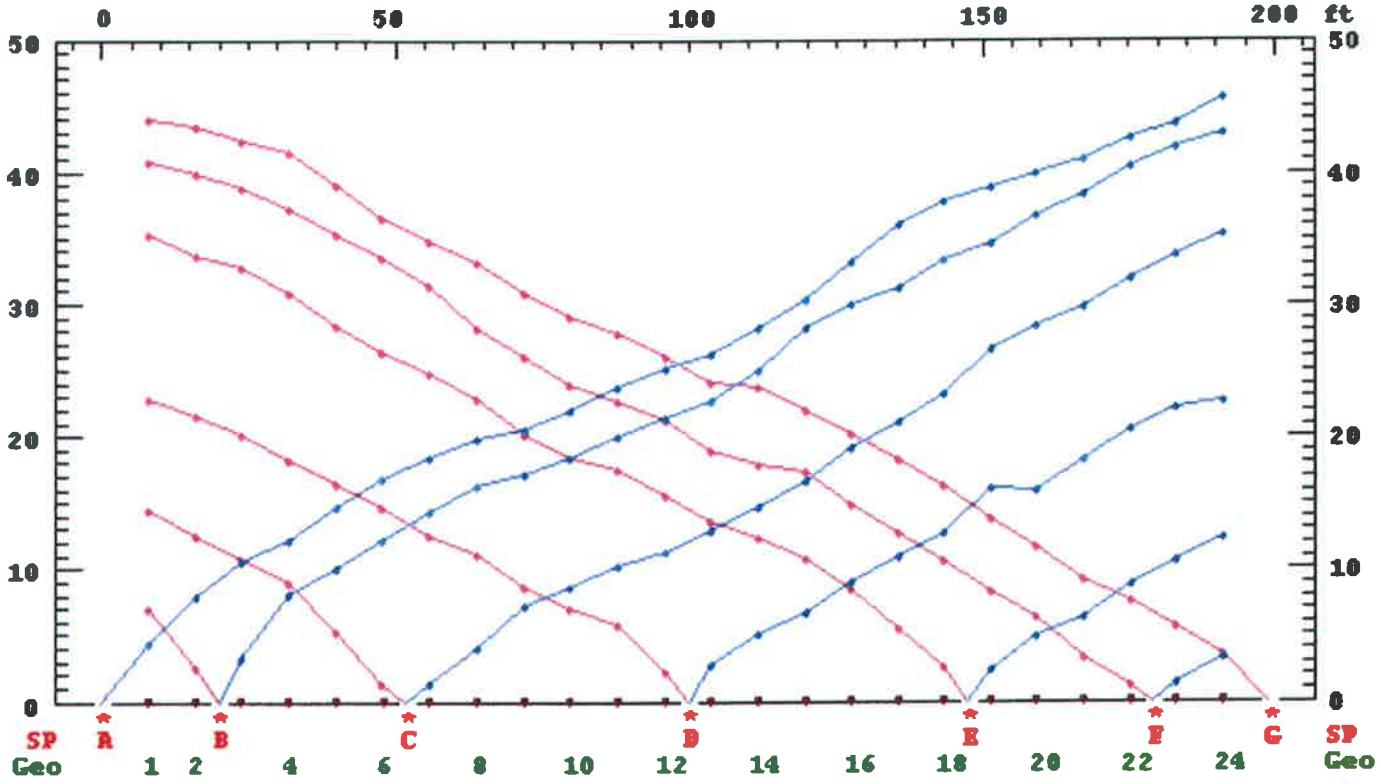
SEISMIC LINE S-4

North 40° East >

LAYER VELOCITY MODEL



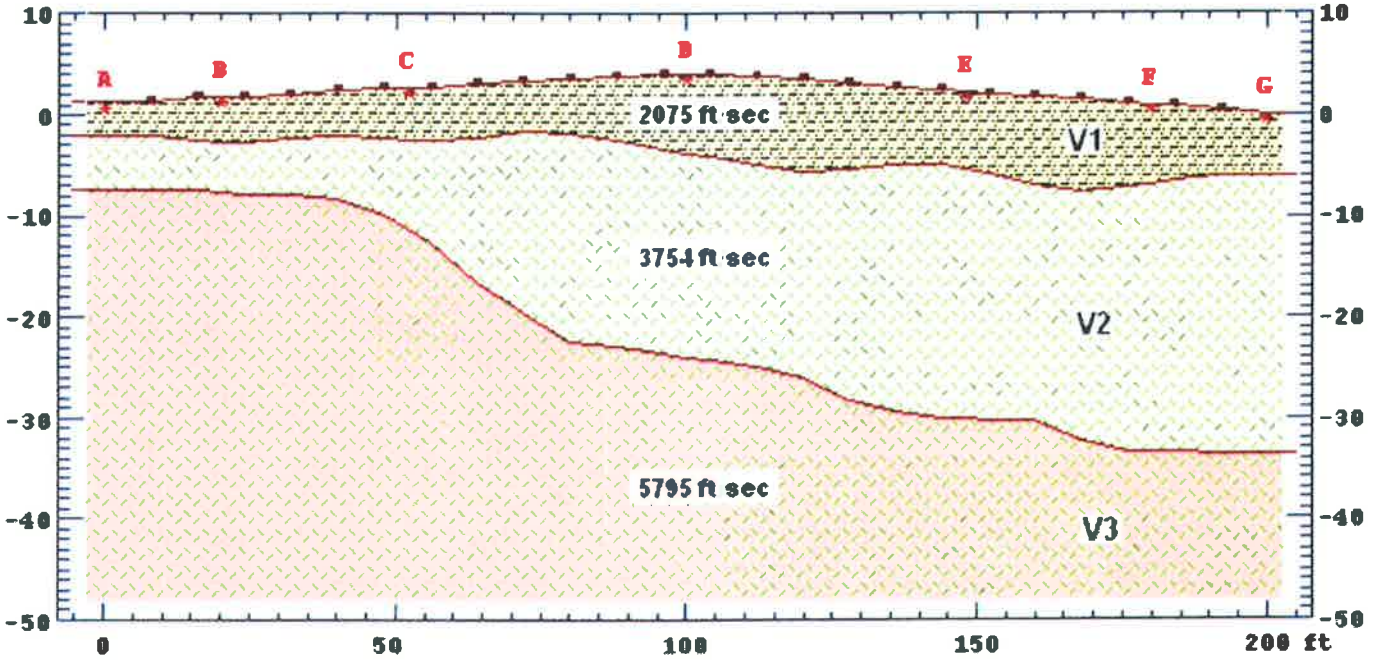
TIME-DISTANCE PLOT



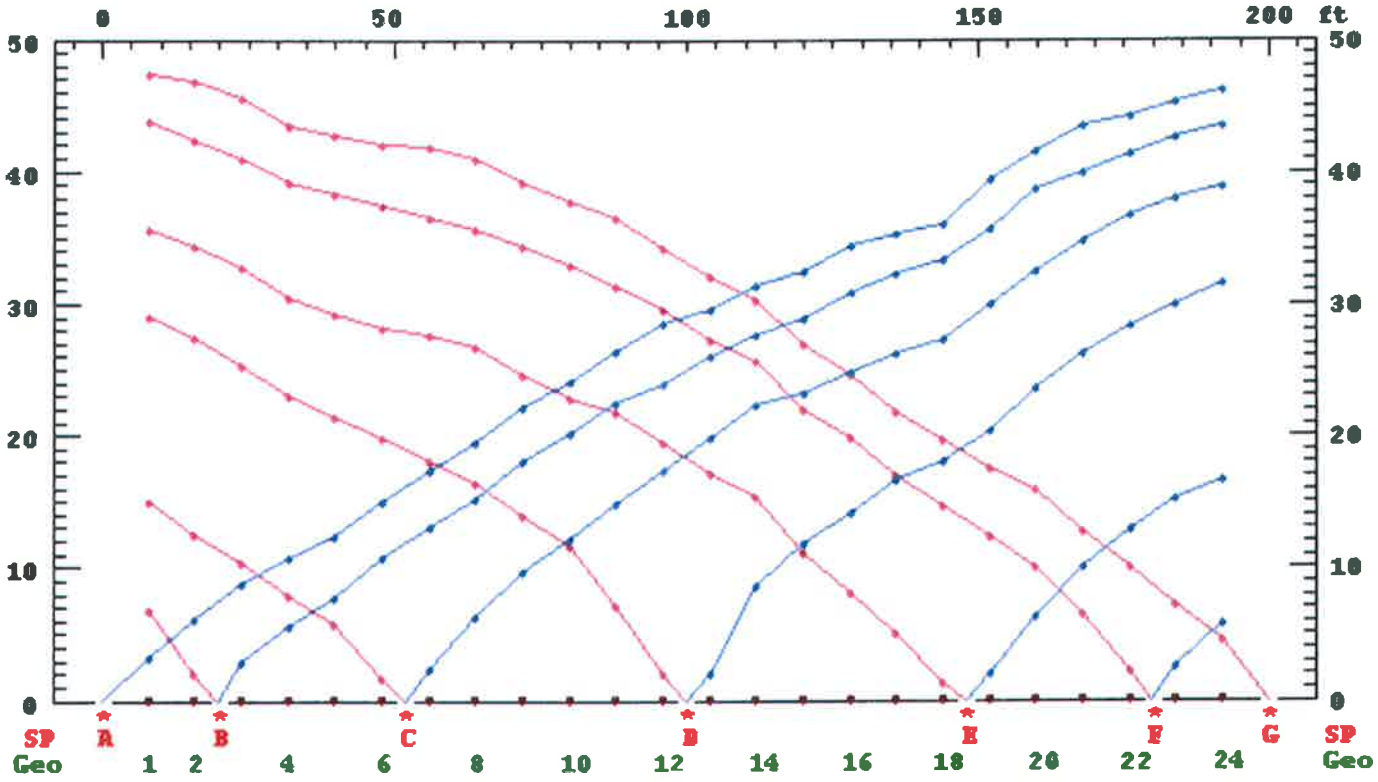
SEISMIC LINE S-5

North 45° East >

LAYER VELOCITY MODEL



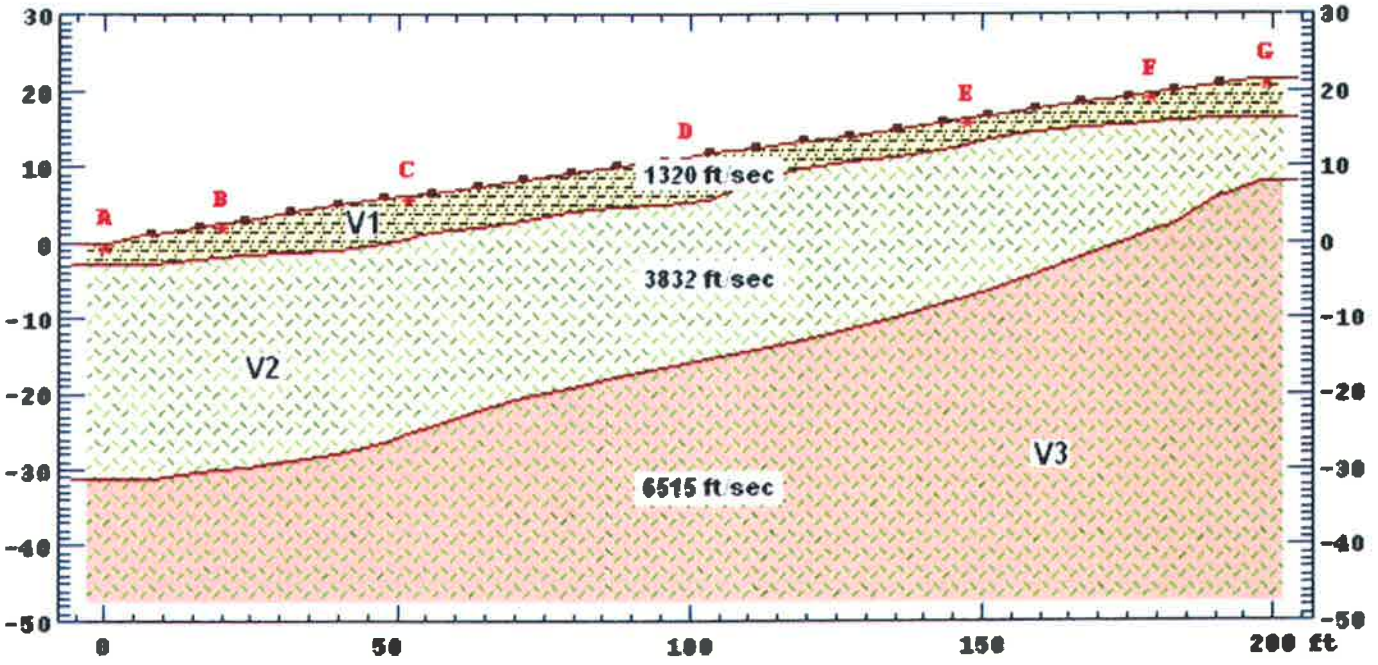
TIME-DISTANCE PLOT



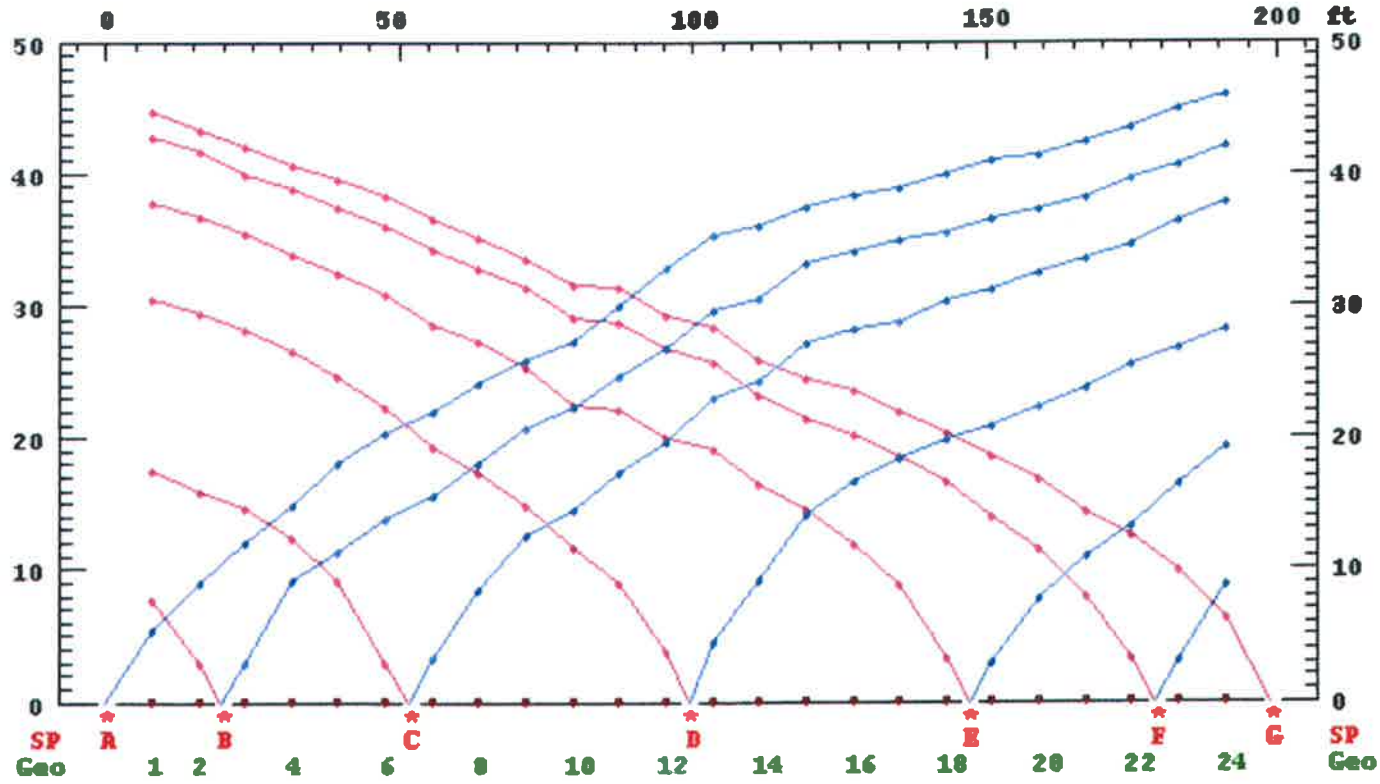
SEISMIC LINE S-6

South 10° East >

LAYER VELOCITY MODEL



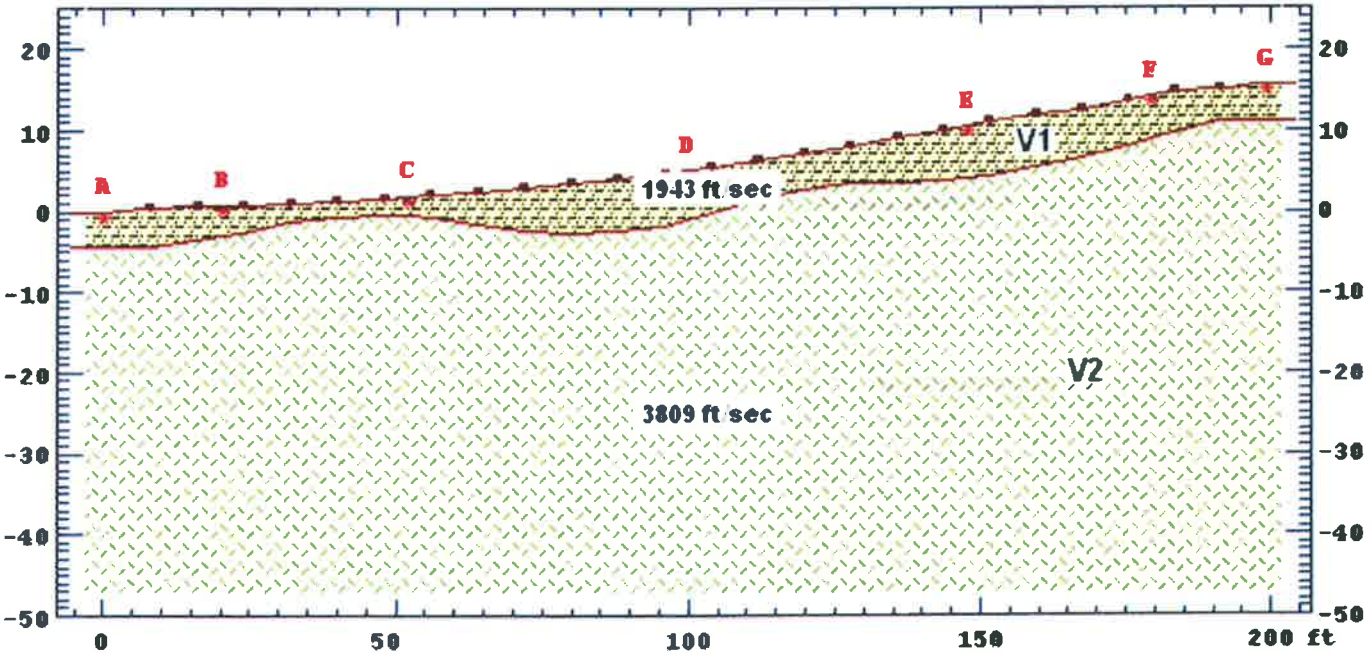
TIME-DISTANCE PLOT



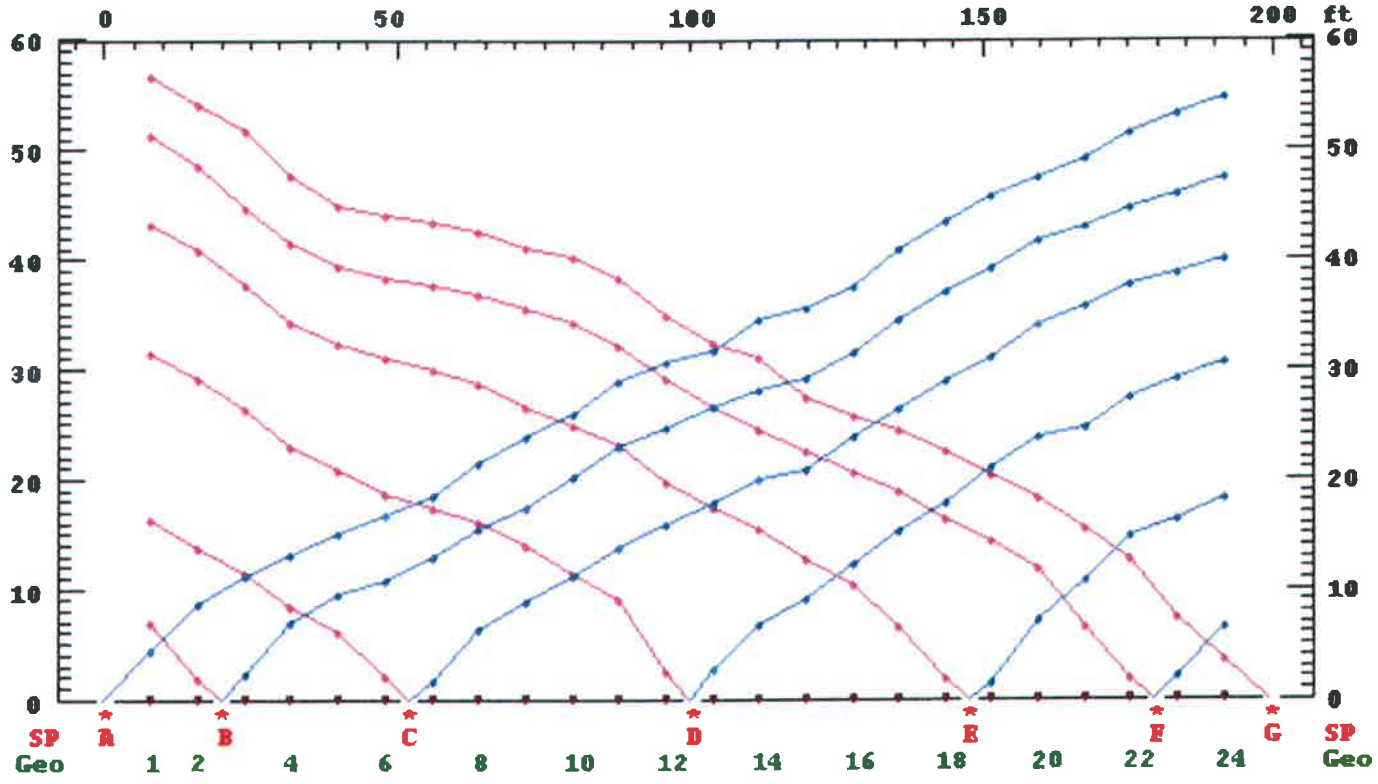
SEISMIC LINE S-7

South 85° East >

LAYER VELOCITY MODEL



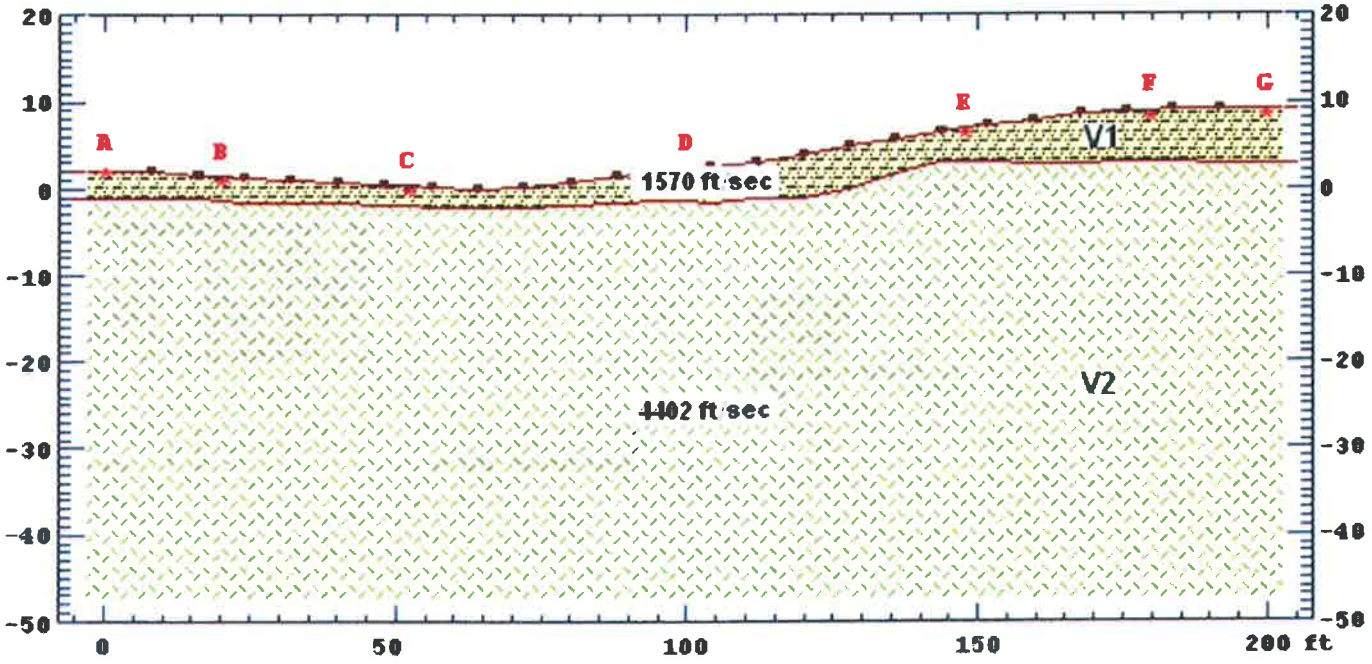
TIME-DISTANCE PLOT



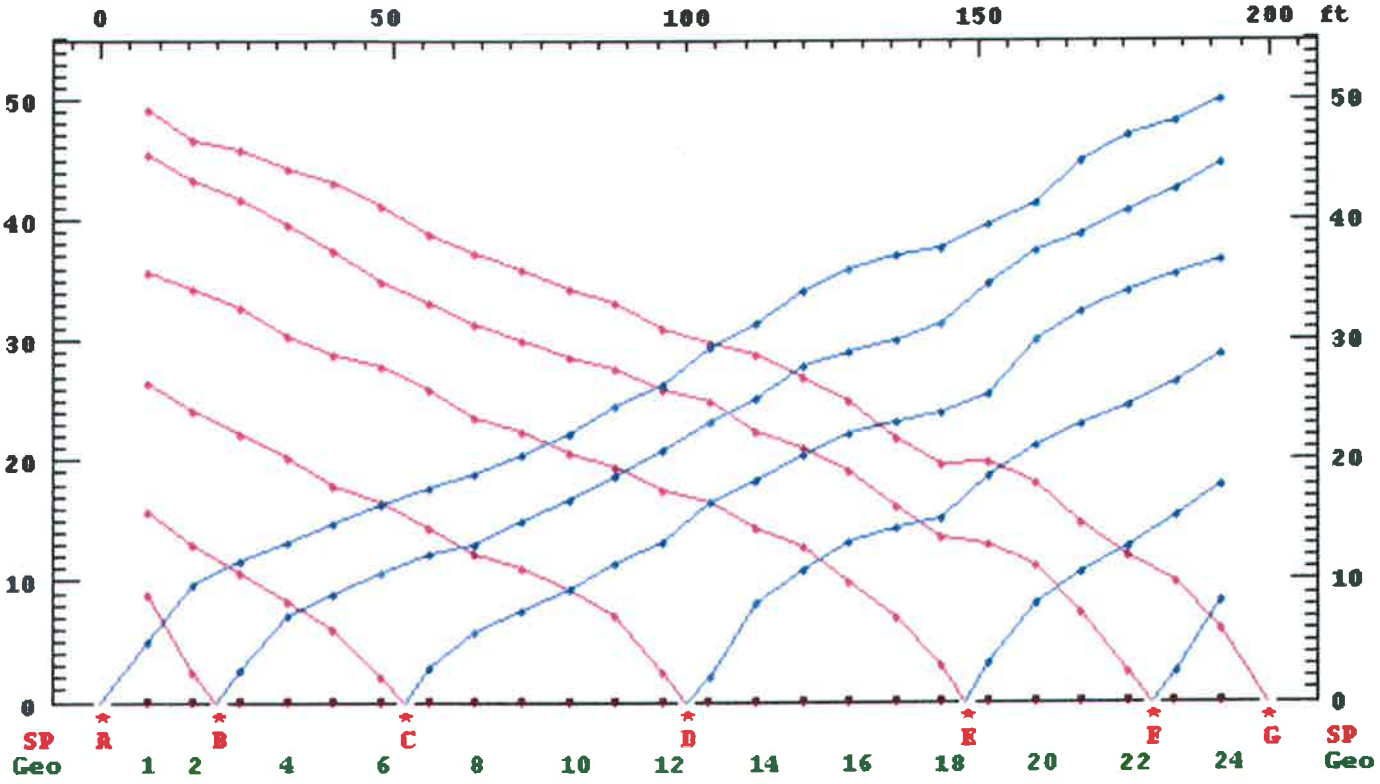
SEISMIC LINE S-8

North 55° East >

LAYER VELOCITY MODEL



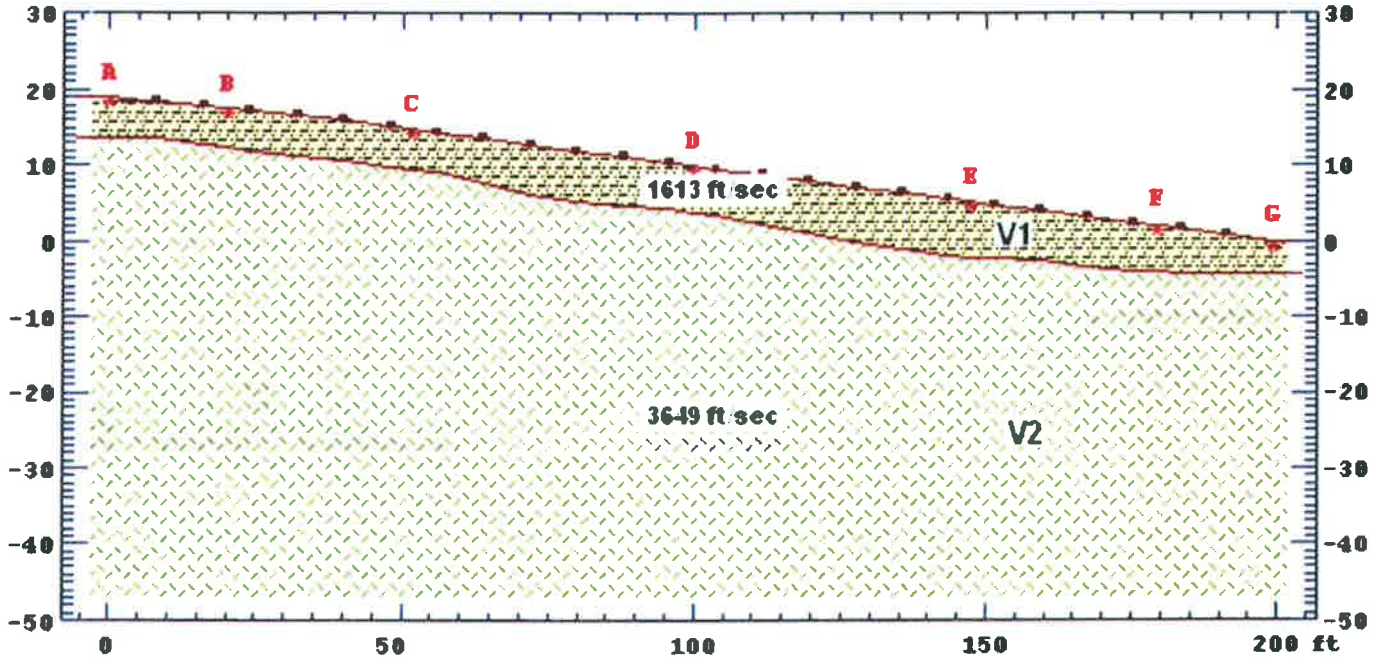
TIME-DISTANCE PLOT



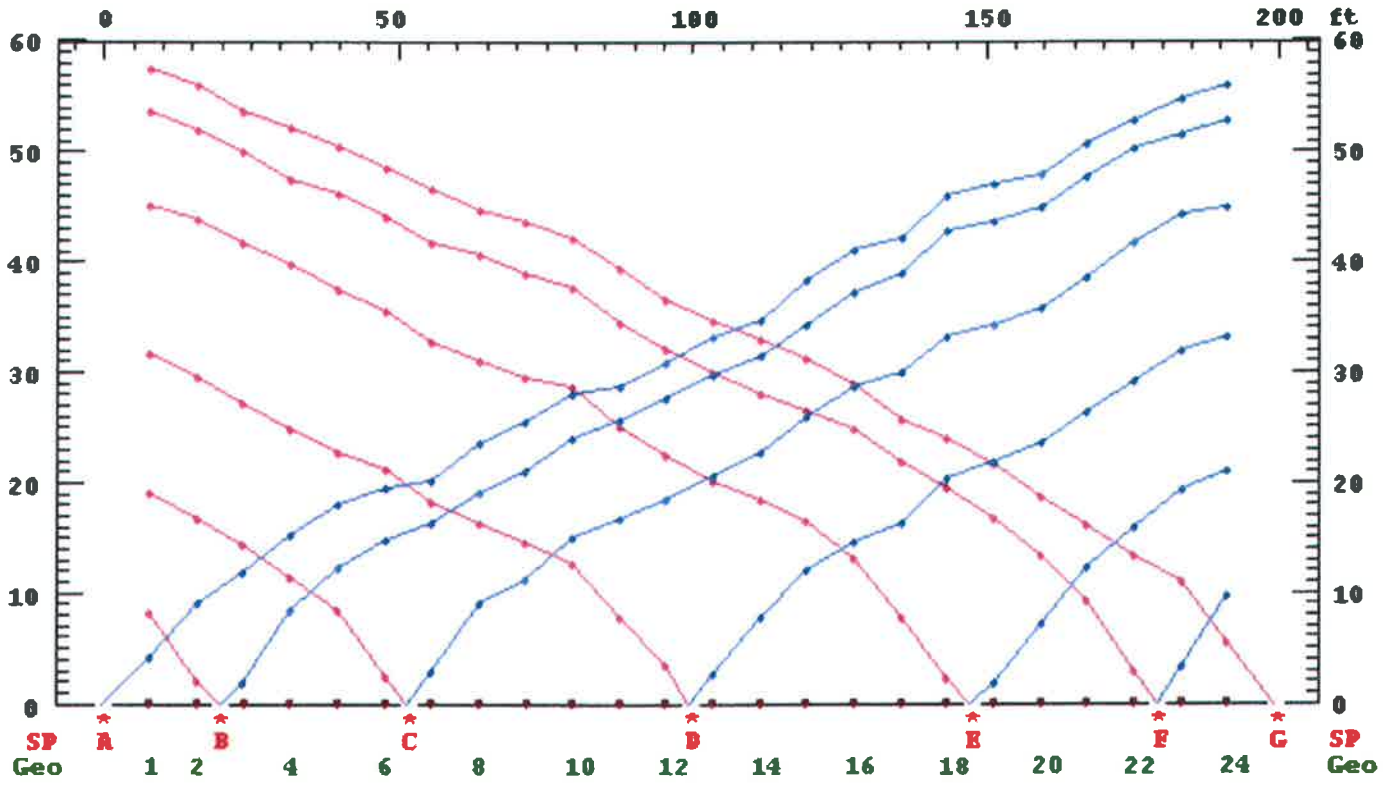
SEISMIC LINE S-9

South 35° East >

LAYER VELOCITY MODEL



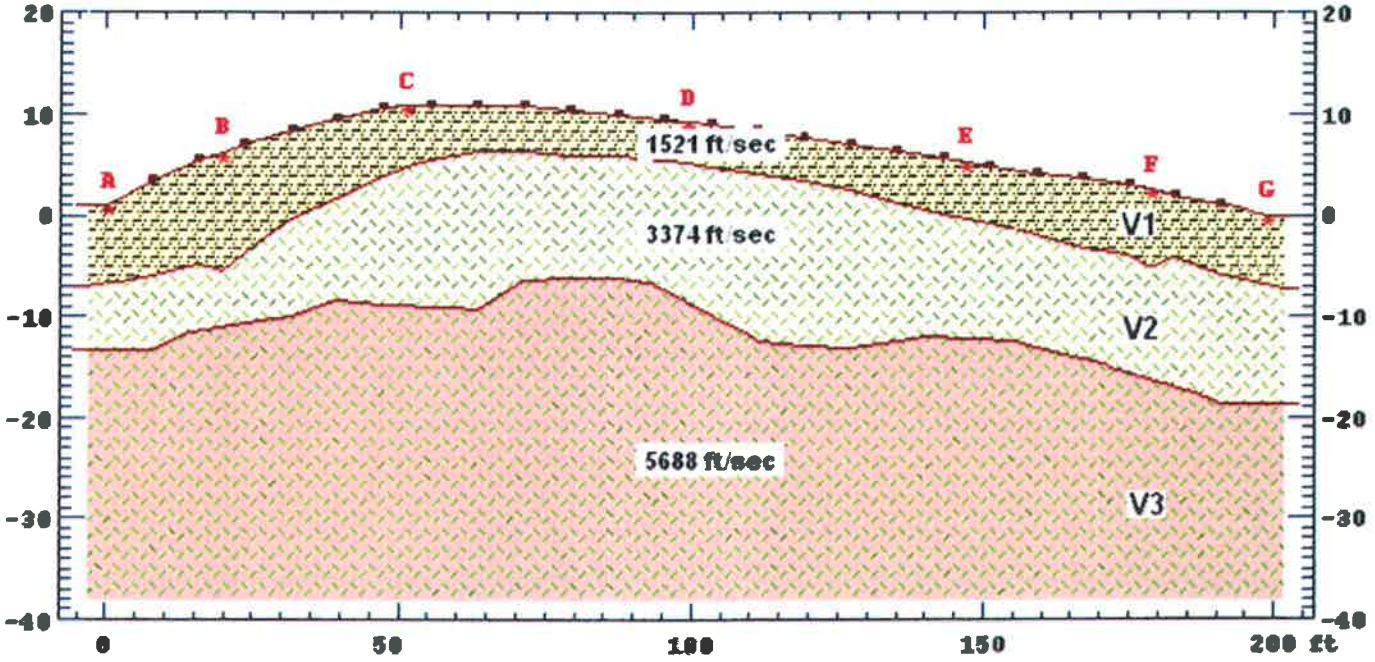
TIME-DISTANCE PLOT



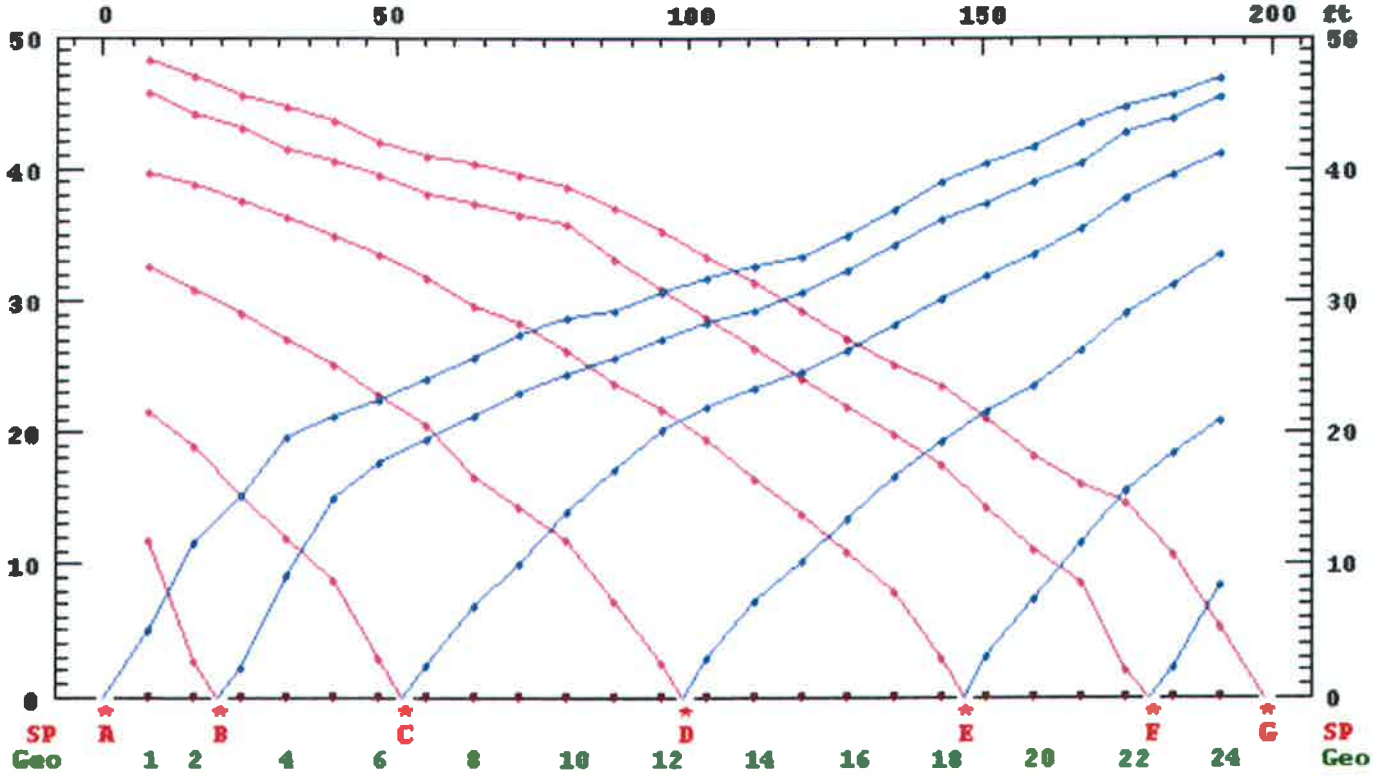
SEISMIC LINE S-10

North 10° East >

LAYER VELOCITY MODEL

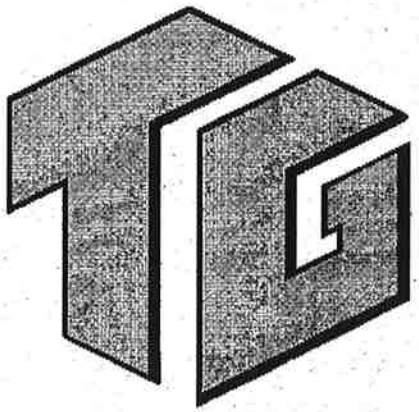


TIME-DISTANCE PLOT



APPENDIX B

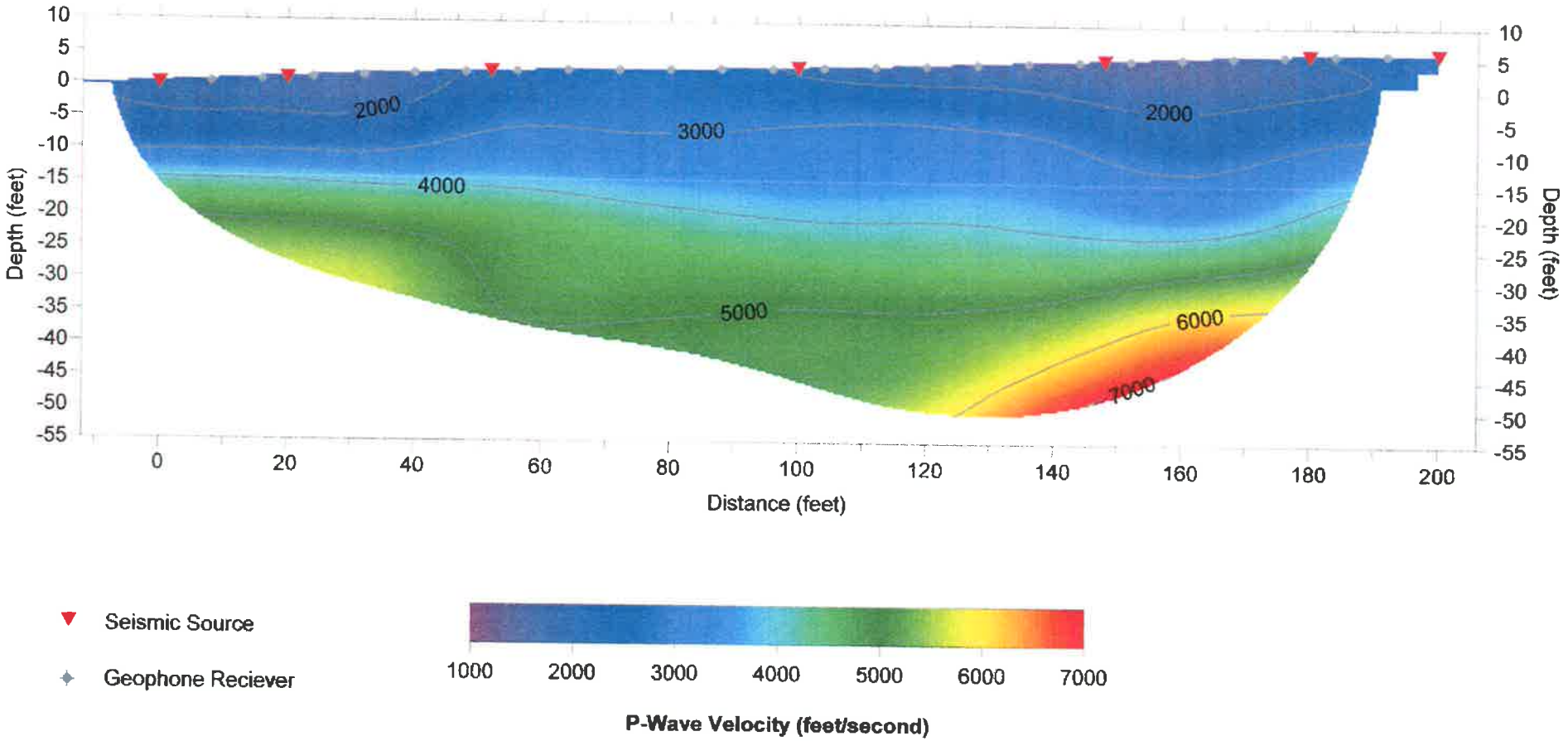
REFRACTION TOMOGRAPHIC MODELS



SEISMIC LINE S-1

← South - North →

REFRACTION TOMOGRAPHIC MODEL

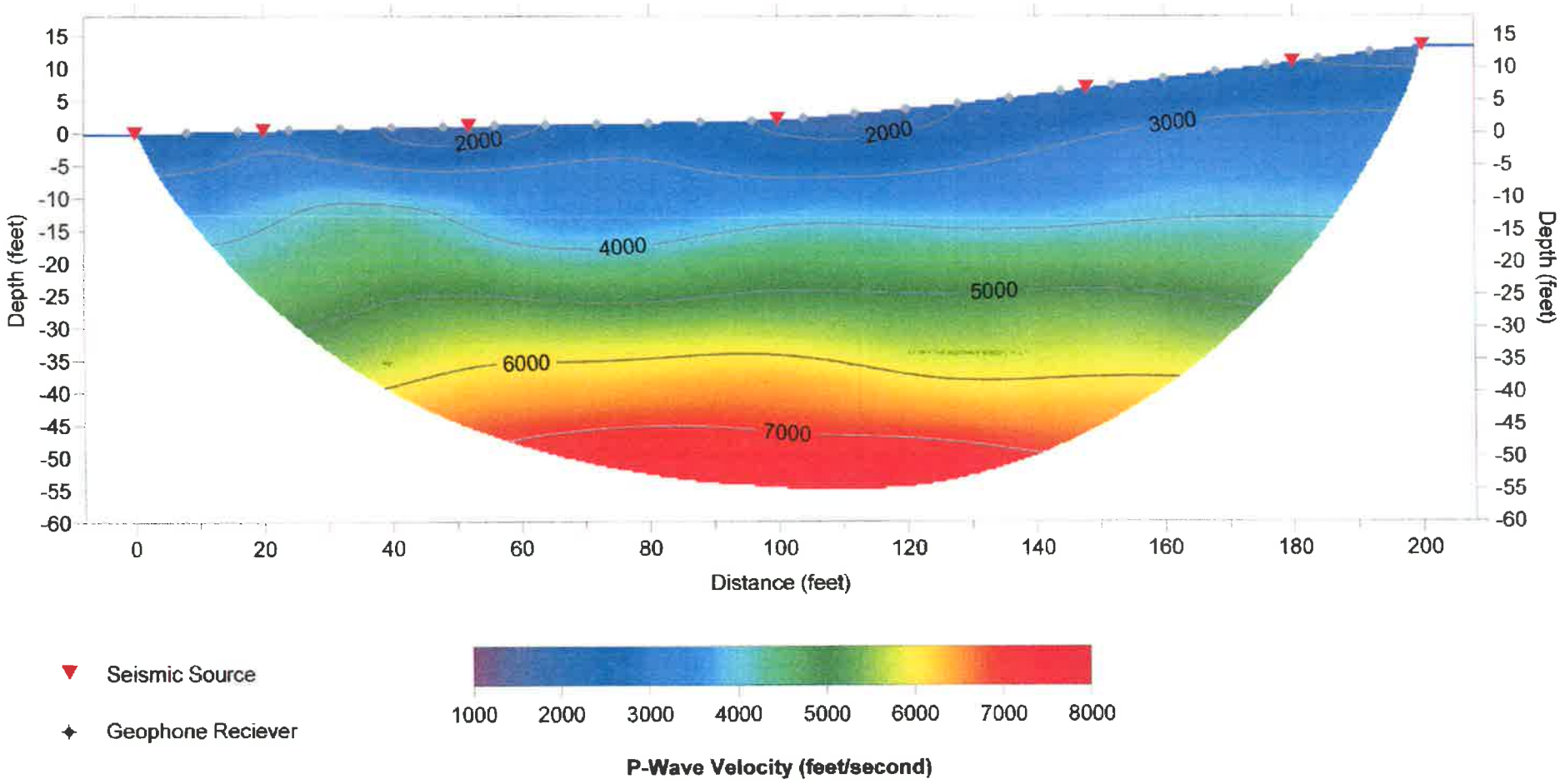


RMS error 1.6 %, Rayfract Version 3.24

SEISMIC LINE S-2

North 10° West →

REFRACTION TOMOGRAPHIC MODEL

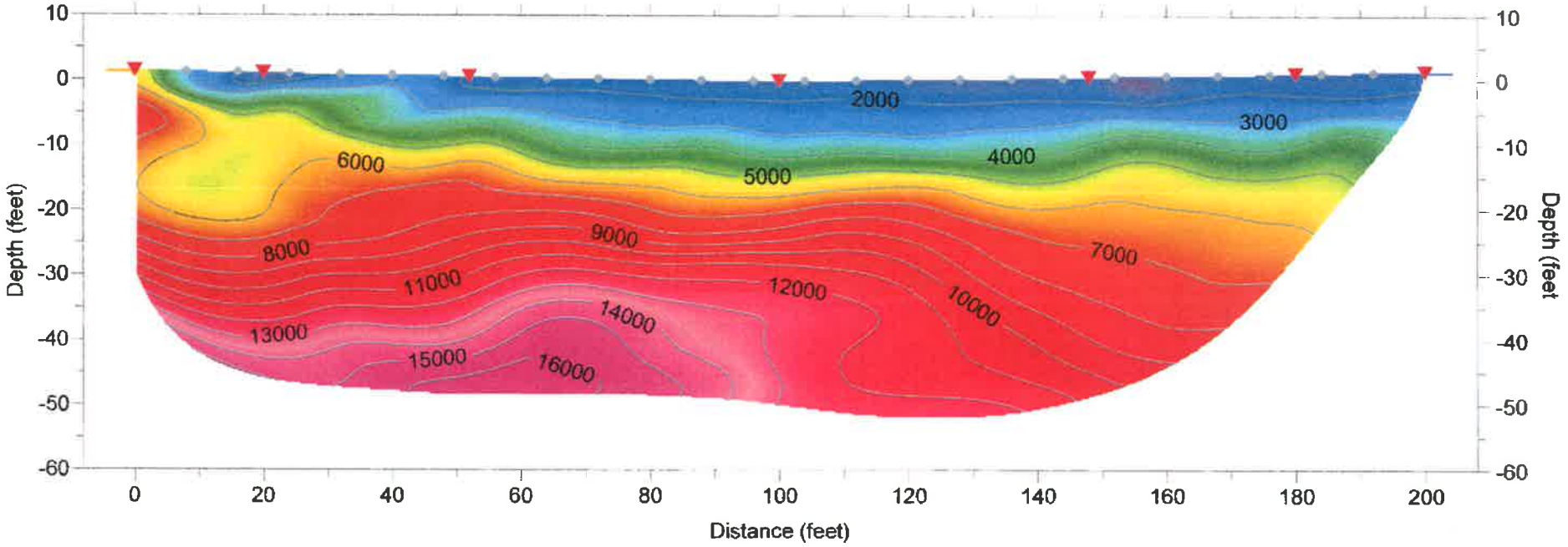


RMS error 2.0 %, Rayfract Version 3.24

SEISMIC LINE S-3

North 35° East →

REFRACTION TOMOGRAPHIC MODEL



▼ Seismic Source

✦ Geophone Reciever



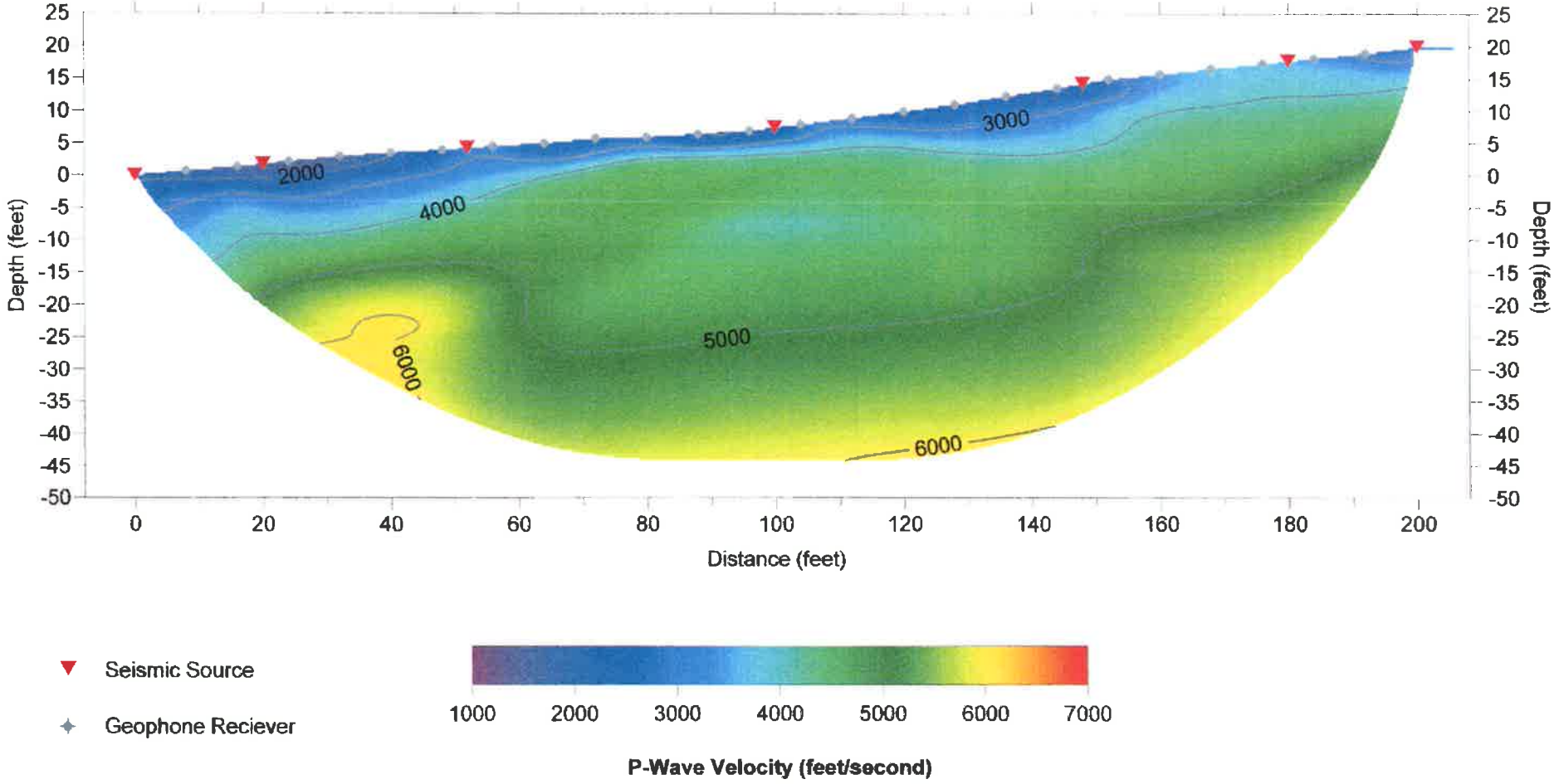
P-Wave Velocity (feet/second)

RMS error 1.9 %, Rayfract Version 3.24

SEISMIC LINE S-4

North 40° East →

REFRACTION TOMOGRAPHIC MODEL

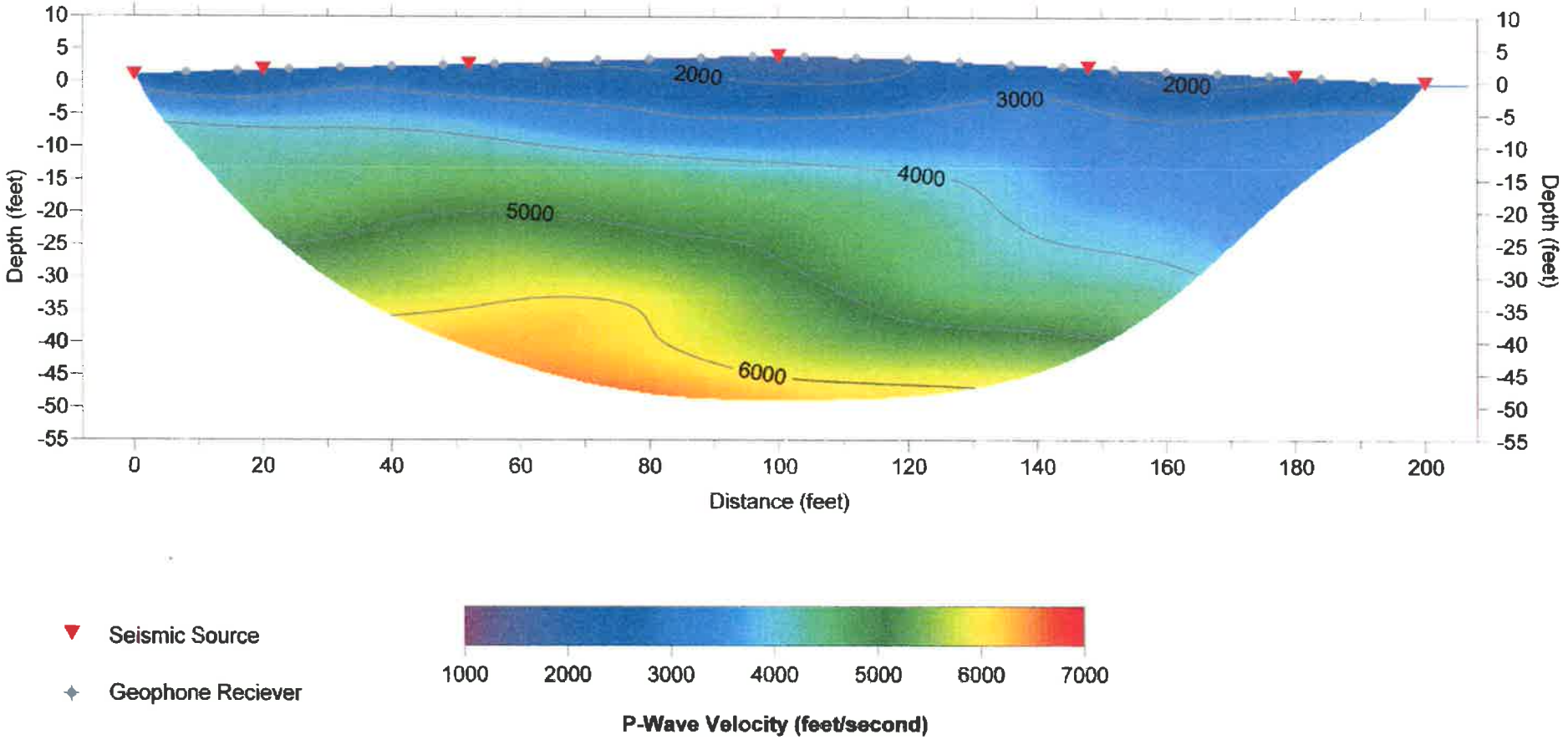


RMS error 1.3 %, Rayfract Version 3.24

SEISMIC LINE S-5

North 45° East →

REFRACTION TOMOGRAPHIC MODEL

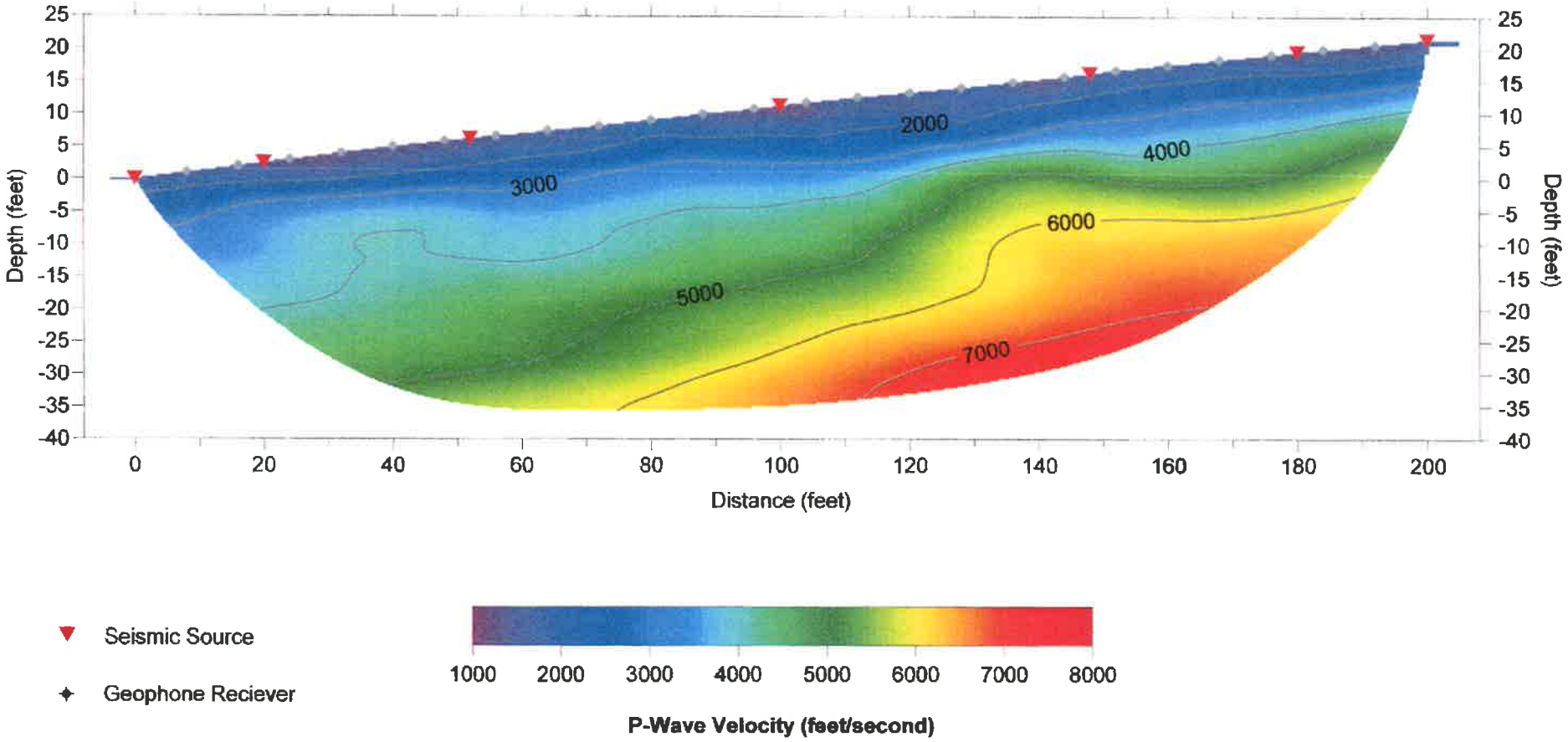


RMS error 1.0 %, Rayfract Version 3.24

SEISMIC LINE S-6

South 10° East →

REFRACTION TOMOGRAPHIC MODEL

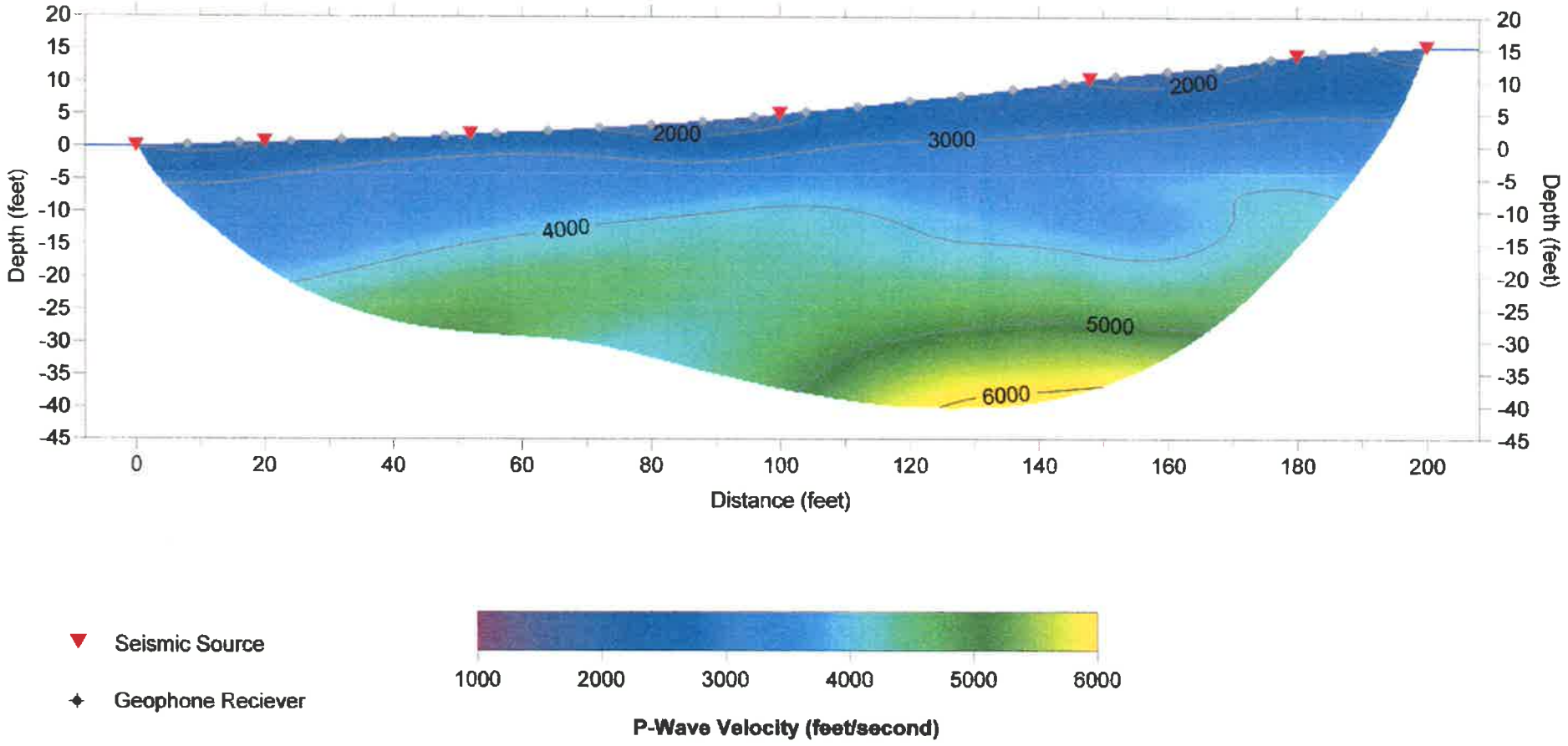


RMS error 0.7 %, Rayfract Version 3.24

SEISMIC LINE S-7

South 85° East →

REFRACTION TOMOGRAPHIC MODEL

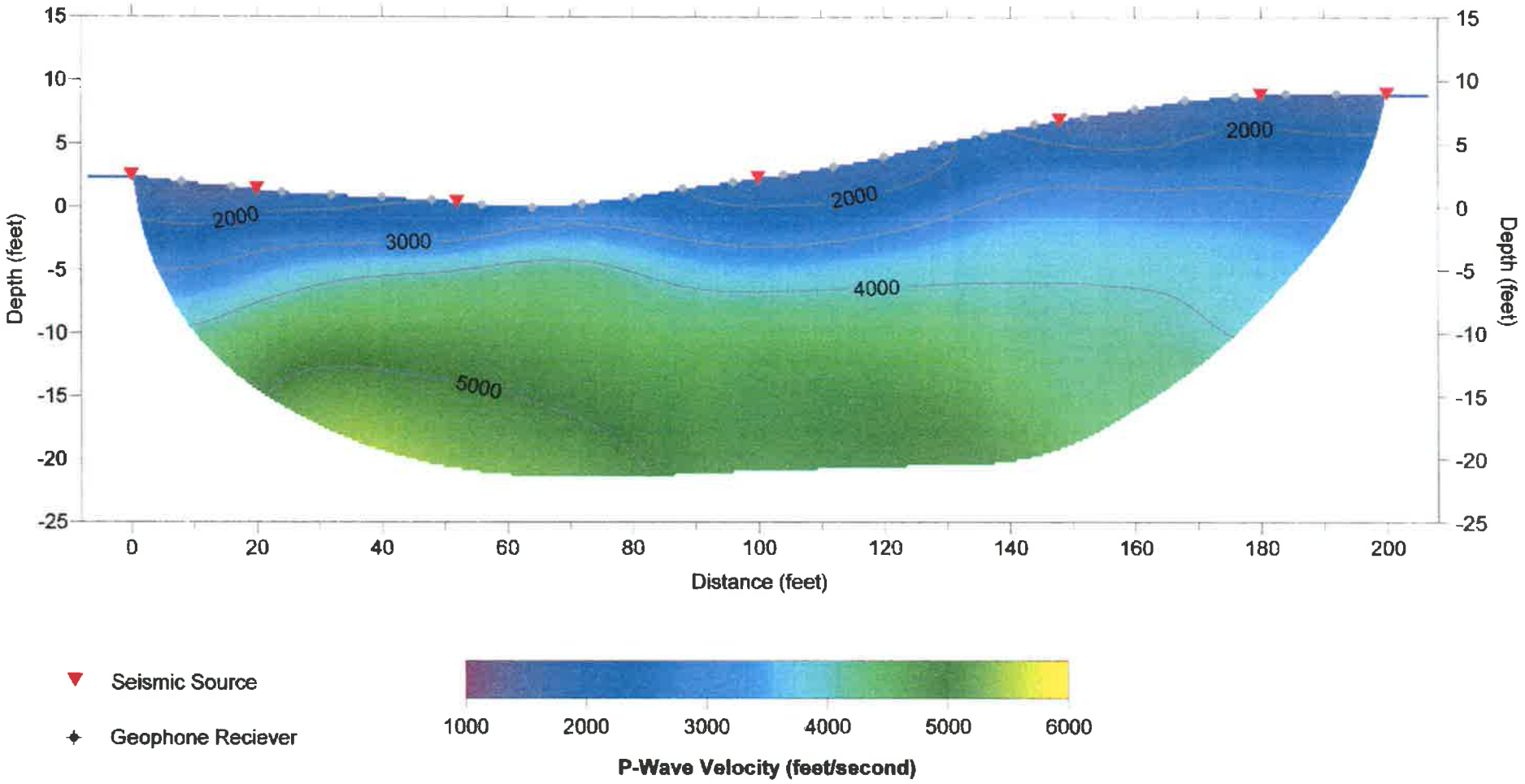


RMS error 1.3 %, Rayfract Version 3.24

SEISMIC LINE S-8

North 55° East →

REFRACTION TOMOGRAPHIC MODEL



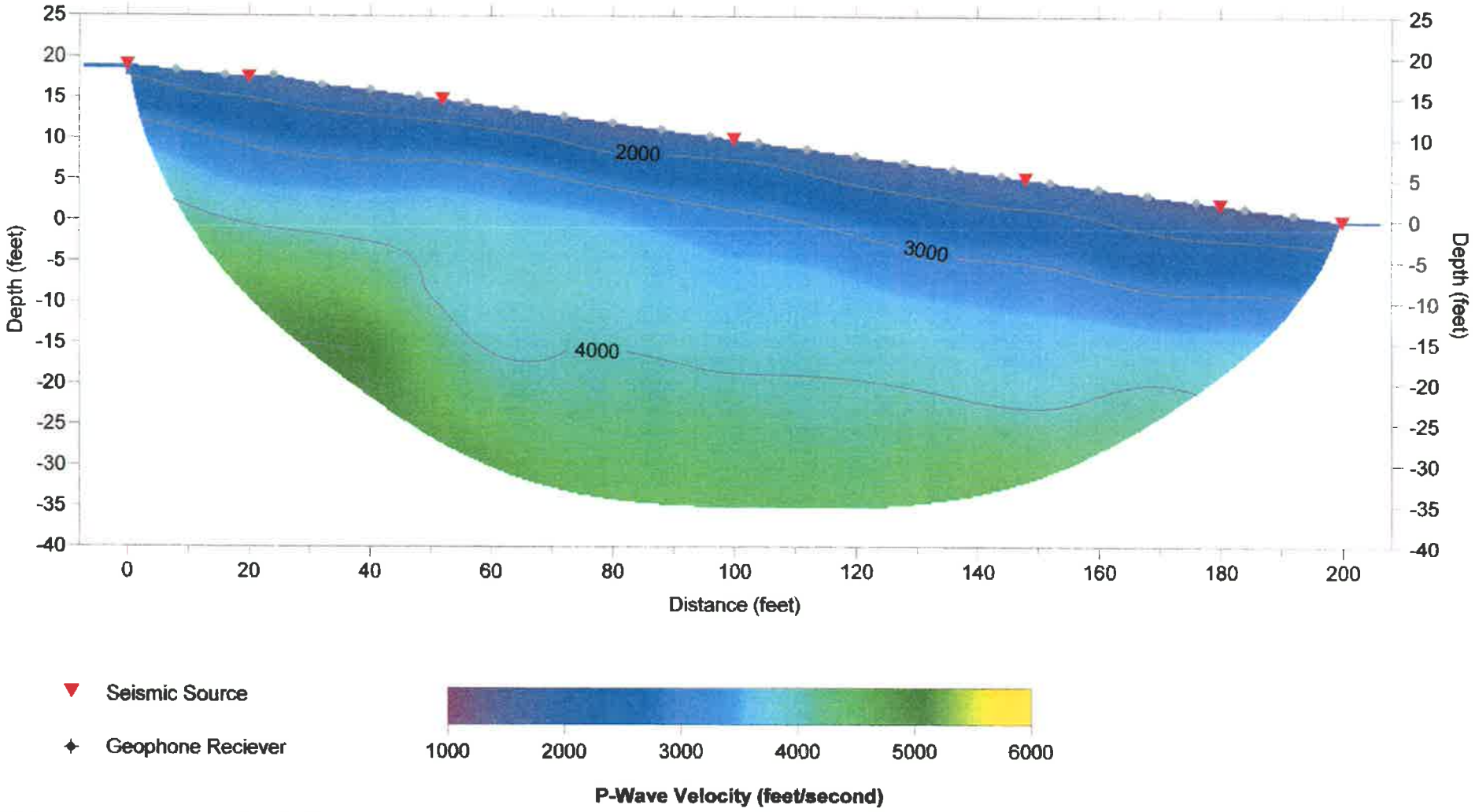
NOTE: Vertcal Exaggeration 2X

RMS error 1.2 %, Rayfract Version 3.24

SEISMIC LINE S-9

South 35° East →

REFRACTION TOMOGRAPHIC MODEL



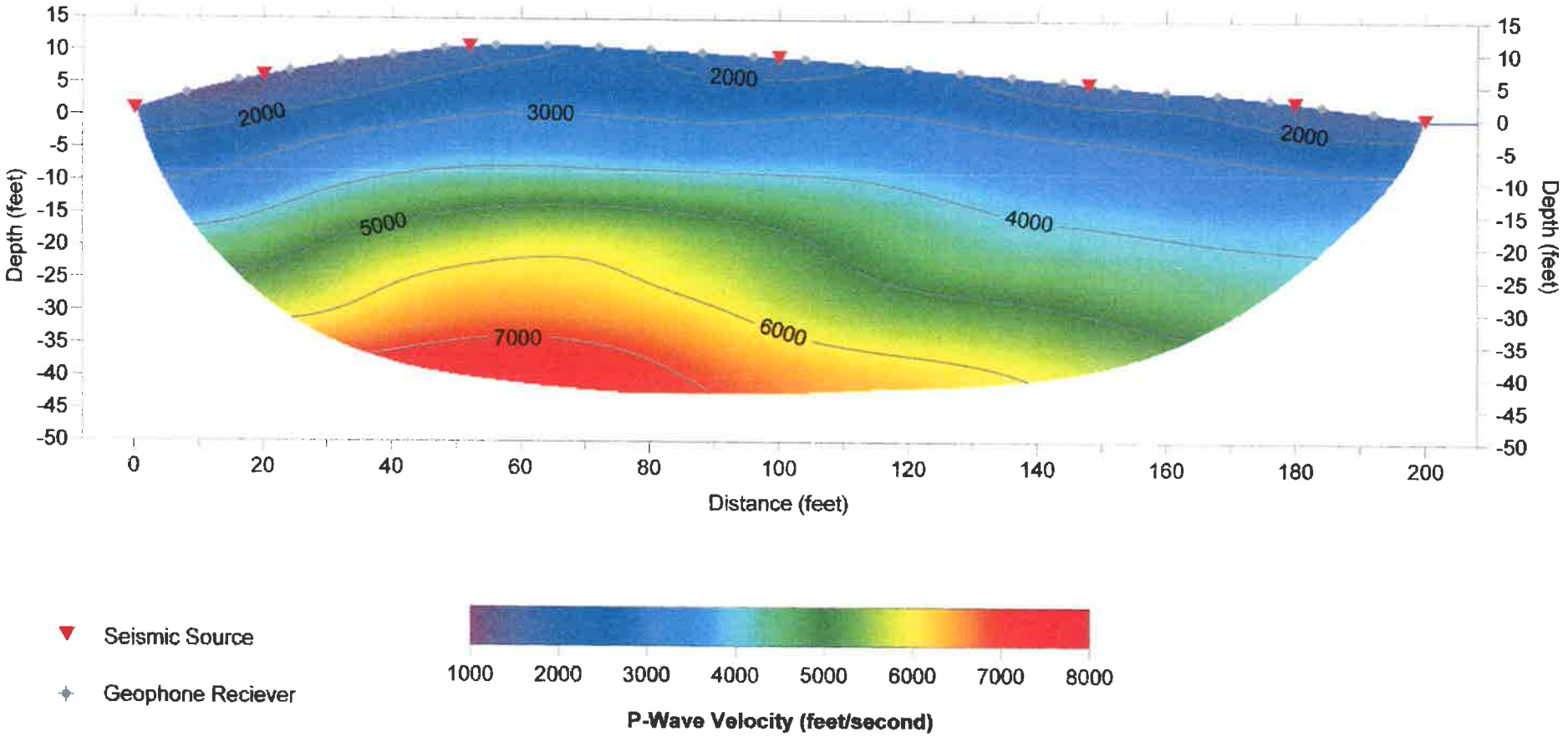
NOTE: Vertcal Exaggeration 1.5X

RMS error 0.9 %, Rayfract Version 3.24

SEISMIC LINE S-10

North 10° East →

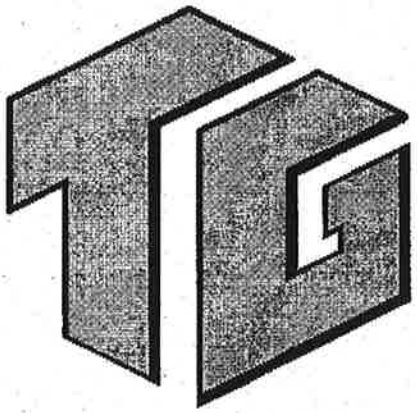
REFRACTION TOMOGRAPHIC MODEL



RMS error 1.2 %, Rayfract Version 3.24

APPENDIX C

EXCAVATION CONSIDERATIONS



EXCAVATION CONSIDERATIONS

These excavation considerations have been included to provide the client with a brief overall summary of the general complexity of hard bedrock excavation. It is considered the clients responsibility to insure that the grading contractor they select is both properly licensed and qualified, with experience in hard-bedrock ripping processes. To evaluate whether a particular bedrock material can be ripped, this geophysical survey should be used in conjunction with the geologic or geotechnical report prepared for the project which describes the physical properties of the bedrock. The physical characteristics of bedrock materials that favor ripping generally include the presence of fractures, faults and other structural discontinuities, weathering effects, brittleness or crystalline structure, stratification of lamination, large grain size, moisture permeated clay, and low compressive strength. Unfavorable conditions can include such characteristics as massive and homogeneous formations, non-crystalline structure, absence of planes of weakness, fine-grained materials, and formations of clay origin where moisture makes the material plastic.

When assessing the potential rippability of the underlying bedrock of a given site, the above geologic characteristics along with the estimated seismic velocities can then be used to evaluate what type of equipment may be appropriate for the proposed grading. When selecting the proper ripping equipment there are three primary factors to consider, which are:

- **Down Pressure available at the tip, which determines the ripper penetration that can be attained and maintained,**
- **Tractor flywheel horsepower, which determines whether the tractor can advance the tip, and,**
- **Tractor gross-weight, which determines whether the tractor will have sufficient traction to use the horsepower.**

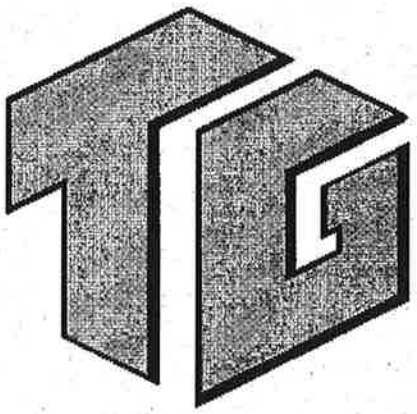
In addition to selecting the appropriate tractor, selection of the proper ripper design is also important. There are basically three designs, being radial, parallelogram, and adjustable parallelogram, of which the contractor should be aware of when selecting the appropriate design to be used for the project. The penetration depth will depend upon the down-pressure and penetration angle, as well as the length of the shank tips (short, intermediate, and long).

Also important in the excavation process is the ripping technique used as well as the skill of the individual tractor operator. These techniques include the use of one or more ripping teeth, up- and down-hill ripping, and the direction of ripping with respect to the geologic structure of the bedrock locally. The use of two tractors (one to push the first tractor-ripper) can extend the range of materials that can be ripped. The second tractor can also be used to supply additional down-pressure on the ripper. Consideration of light blasting can also facilitate the ripper penetration and reduce the cost of moving highly consolidated rock formations.

All of the combined factors above should be considered by both the client and the grading contractor, to insure that the proper selection of equipment and ripping techniques are used for the proposed grading.

APPENDIX D

REFERENCES



REFERENCES

American Society for Testing and Materials, Intl. (ASTM), 2000, Standard Guide for Using the Seismic Refraction Method for Subsurface Investigation, Designation D 5777-00, 13 pp.

Barton, N., 2007, Rock Quality, Seismic Velocity, Attenuation and Anisotropy, Taylor & Francis Group Publishers, 729 pp.

California State Board for Geologists and Geophysicists, Department of Consumer Affairs, 1998, Guidelines for Geophysical Reports for Environmental and Engineering Geology, 5 pp.

Caterpillar, Inc., 2000, Handbook of Ripping, Twelfth Edition, Caterpillar, Inc., Peoria, Illinois, 31 pp.

Caterpillar, Inc., 2004, Caterpillar Performance Handbook, 35th Edition, Caterpillar, Inc., Peoria, Illinois.

Geometrics, Inc., 2004, StrataVisor™ NZXP Operation Manual, Revision B, San Jose, California, 234 pp.

Google™ Earth, 2013, http://earth.google.com/, Version 7.1.1.1580 (beta).

Intelligent Resources, Inc., 1991-2013, Rayfract™ Seismic Refraction Tomography Software, Version 3.24, http://rayfract.com/.

Morton, D.M., 2003, Geologic Map of the Fontana 7.5 Minute Quadrangle, San Bernardino and Riverside Counties, California, U.S.G.S. Open-File Report 03-418, Scale 1:24,000.

Rimrock Geophysics, Inc., 1995, User Manuals for Computer Programs SIP Shell, SIPIK, SIPIN, SIPEDIT, and SIPT2.

Rimrock Geophysics, Inc., 2004, **SIPwin**, Seismic Refraction Interpretation Program for Windows, Version 2.78, User Manual 78 pp.

Santi, P.M., 2006, Field Methods for Characterizing Weak Rock for Engineering, *in*, Environmental & Engineering Geoscience, Volume XII, No. 1, February 2006, pp. 1-11.

Scott, James H., 1973, Seismic Refraction Modeling by Computer, *in* Geophysics, Volume 38, No. 2, pp. 271-284.

Schuster, G. T. and Quintus-Bosz, A., (1993), Wavepath Eikonal Traveltime Inversion: Theory, *in*, *Geophysics*, Vol. 58, No. 9, September, pp. 1314-1323.

Stephens, E., 1978, Calculating Earthwork Factors Using Seismic Velocities, California Department of Transportation Report No. FHWA-CA-TL-78-23, 63 pp.

APPENDIX F

GENERAL EARTHWORK AND GRADING SPECIFICATIONS

Leighton

LEIGHTON AND ASSOCIATES, INC.

GENERAL EARTHWORK AND GRADING SPECIFICATIONS FOR ROUGH GRADING

Table of Contents

Section			Page
1.0	GENERAL		1
	1.1	Intent	1
	1.2	The Geotechnical Consultant of Record	1
	1.3	The Earthwork Contractor	2
2.0	PREPARATION OF AREAS TO BE FILLED		2
	2.1	Clearing and Grubbing	2
	2.2	Processing	3
	2.3	Overexcavation	3
	2.4	Benching	3
	2.5	Evaluation/Acceptance of Fill Areas	3
3.0	FILL MATERIAL		4
	3.1	General	4
	3.2	Oversize	4
	3.3	Import	4
4.0	FILL PLACEMENT AND COMPACTION		4
	4.1	Fill Layers	4
	4.2	Fill Moisture Conditioning	4
	4.3	Compaction of Fill	5
	4.4	Compaction of Fill Slopes	5
	4.5	Compaction Testing	5
	4.6	Frequency of Compaction Testing	5
	4.7	Compaction Test Locations	5
5.0	SUBDRAIN INSTALLATION		6
6.0	EXCAVATION		6
7.0	TRENCH BACKFILLS		6
	7.1	Safety	6
	7.2	Bedding and Backfill	6
	7.3	Lift Thickness	6
	7.4	Observation and Testing	6

1.0 General

1.1 Intent: These General Earthwork and Grading Specifications are for the grading and earthwork shown on the approved grading plan(s) and/or indicated in the geotechnical report(s). These Specifications are a part of the recommendations contained in the geotechnical report(s). In case of conflict, the specific recommendations in the geotechnical report shall supersede these more general Specifications. Observations of the earthwork by the project Geotechnical Consultant during the course of grading may result in new or revised recommendations that could supersede these specifications or the recommendations in the geotechnical report(s).

1.2 The Geotechnical Consultant of Record: Prior to commencement of work, the owner shall employ the Geotechnical Consultant of Record (Geotechnical Consultant). The Geotechnical Consultants shall be responsible for reviewing the approved geotechnical report(s) and accepting the adequacy of the preliminary geotechnical findings, conclusions, and recommendations prior to the commencement of the grading.

Prior to commencement of grading, the Geotechnical Consultant shall review the "work plan" prepared by the Earthwork Contractor (Contractor) and schedule sufficient personnel to perform the appropriate level of observation, mapping, and compaction testing.

During the grading and earthwork operations, the Geotechnical Consultant shall observe, map, and document the subsurface exposures to verify the geotechnical design assumptions. If the observed conditions are found to be significantly different than the interpreted assumptions during the design phase, the Geotechnical Consultant shall inform the owner, recommend appropriate changes in design to accommodate the observed conditions, and notify the review agency where required. Subsurface areas to be geotechnically observed, mapped, elevations recorded, and/or tested include natural ground after it has been cleared for receiving fill but before fill is placed, bottoms of all "remedial removal" areas, all key bottoms, and benches made on sloping ground to receive fill.

The Geotechnical Consultant shall observe the moisture-conditioning and processing of the subgrade and fill materials and perform relative compaction testing of fill to determine the attained level of compaction. The Geotechnical Consultant shall provide the test results to the owner and the Contractor on a routine and frequent basis.

1.3 The Earthwork Contractor: The Earthwork Contractor (Contractor) shall be qualified, experienced, and knowledgeable in earthwork logistics, preparation and processing of ground to receive fill, moisture-conditioning and processing of fill, and compacting fill. The Contractor shall review and accept the plans, geotechnical report(s), and these Specifications prior to commencement of grading. The

Contractor shall be solely responsible for performing the grading in accordance with the plans and specifications.

The Contractor shall prepare and submit to the owner and the Geotechnical Consultant a work plan that indicates the sequence of earthwork grading, the number of "spreads" of work and the estimated quantities of daily earthwork contemplated for the site prior to commencement of grading. The Contractor shall inform the owner and the Geotechnical Consultant of changes in work schedules and updates to the work plan at least 24 hours in advance of such changes so that appropriate observations and tests can be planned and accomplished. The Contractor shall not assume that the Geotechnical Consultant is aware of all grading operations.

The Contractor shall have the sole responsibility to provide adequate equipment and methods to accomplish the earthwork in accordance with the applicable grading codes and agency ordinances, these Specifications, and the recommendations in the approved geotechnical report(s) and grading plan(s). If, in the opinion of the Geotechnical Consultant, unsatisfactory conditions, such as unsuitable soil, improper moisture condition, inadequate compaction, insufficient buttress key size, adverse weather, etc., are resulting in a quality of work less than required in these specifications, the Geotechnical Consultant shall reject the work and may recommend to the owner that construction be stopped until the conditions are rectified.

2.0 Preparation of Areas to be Filled

2.1 Clearing and Grubbing: Vegetation, such as brush, grass, roots, and other deleterious material shall be sufficiently removed and properly disposed of in a method acceptable to the owner, governing agencies, and the Geotechnical Consultant.

The Geotechnical Consultant shall evaluate the extent of these removals depending on specific site conditions. Earth fill material shall not contain more than 1 percent of organic materials (by volume). No fill lift shall contain more than 5 percent of organic matter. Nesting of the organic materials shall not be allowed.

If potentially hazardous materials are encountered, the Contractor shall stop work in the affected area, and a hazardous material specialist shall be informed immediately for proper evaluation and handling of these materials prior to continuing to work in that area.

As presently defined by the State of California, most refined petroleum products (gasoline, diesel fuel, motor oil, grease, coolant, etc.) have chemical constituents that are considered to be hazardous waste. As such, the indiscriminate dumping or spillage of these fluids onto the ground may constitute a misdemeanor, punishable by fines and/or imprisonment, and shall not be allowed.

2.2 Processing: Existing ground that has been declared satisfactory for support of fill by the Geotechnical Consultant shall be scarified to a minimum depth of 6 inches. Existing ground that is not satisfactory shall be overexcavated as specified in the following section. Scarification shall continue until soils are broken down and free of large clay lumps or clods and the working surface is reasonably uniform, flat, and free of uneven features that would inhibit uniform compaction.

2.3 Overexcavation: In addition to removals and overexcavations recommended in the approved geotechnical report(s) and the grading plan, soft, loose, dry, saturated, spongy, organic-rich, highly fractured or otherwise unsuitable ground shall be overexcavated to competent ground as evaluated by the Geotechnical Consultant during grading.

2.4 Benching: Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical units), the ground shall be stepped or benched. Please see the Standard Details for a graphic illustration. The lowest bench or key shall be a minimum of 15 feet wide and at least 2 feet deep, into competent material as evaluated by the Geotechnical Consultant. Other benches shall be excavated a minimum height of 4 feet into competent material or as otherwise recommended by the Geotechnical Consultant. Fill placed on ground sloping flatter than 5:1 shall also be benched or otherwise overexcavated to provide a flat subgrade for the fill.

2.5 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 the survey control for determining elevations of processed areas, keys, and benches.

3.0 Fill Material

3.1 General: Material to be used as fill shall be essentially free of organic matter and other deleterious substances evaluated and accepted by the Geotechnical Consultant prior to placement. 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.

3.2 Oversize: Oversize material defined as rock, or other irreducible material with a maximum dimension greater than 8 inches, shall not be buried or placed in fill unless location, materials, and placement methods are specifically accepted by the Geotechnical Consultant. Placement operations shall be such that nesting of oversized material does not occur and such that oversize material is completely surrounded by compacted or densified fill. Oversize material shall not be placed within 10 vertical feet of finish grade or within 2 feet of future utilities or underground construction.

3.3 Import: If importing of fill material is required for grading, proposed import material shall meet the requirements of Section 3.1. The potential import source shall be given to the Geotechnical Consultant at least 48 hours (2 working days) before importing begins so that its suitability can be determined and appropriate tests performed.

4.0 Fill Placement and Compaction

4.1 Fill Layers: Approved fill material shall be placed in areas prepared to receive fill (per Section 3.0) in near-horizontal layers not exceeding 8 inches in loose thickness. The Geotechnical Consultant may accept thicker layers if testing indicates the grading procedures can adequately compact the thicker layers. Each layer shall be spread evenly and mixed thoroughly to attain relative uniformity of material and moisture throughout.

4.2 Fill 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 over optimum. Maximum density and optimum soil moisture content tests shall be performed in accordance with the American Society of Testing and Materials (ASTM Test Method D1557-91).

4.3 Compaction of Fill: After each layer has been moisture-conditioned, mixed, and evenly spread, it shall be uniformly compacted to not less than 90 percent of maximum dry density (ASTM Test Method D1557-91). Compaction equipment shall be adequately sized and be either specifically designed for soil compaction or of proven reliability to efficiently achieve the specified level of compaction with uniformity.

4.4 Compaction of Fill Slopes: In addition to normal compaction procedures specified above, compaction of slopes shall be accomplished by backrolling of slopes with sheepsfoot rollers at increments of 3 to 4 feet in fill elevation, or by other methods producing satisfactory results acceptable to the Geotechnical Consultant. Upon completion of grading, relative compaction of the fill, out to the slope face, shall be at least 90 percent of maximum density per ASTM Test Method D1557-91.

4.5 Compaction Testing: Field tests for moisture content and relative compaction of the fill soils shall be performed by the Geotechnical Consultant. Location and frequency of tests shall be at the Consultant's discretion based on field conditions encountered. Compaction test locations will not necessarily be selected on a random basis. Test locations shall be selected to verify adequacy of compaction levels in areas that are judged to be prone to inadequate compaction (such as close to slope faces and at the fill/bedrock benches).

4.6 Frequency of Compaction Testing: Tests shall be taken at intervals not exceeding 2 feet in vertical rise and/or 1,000 cubic yards of compacted fill soils embankment. In addition, as a guideline, at least one test shall be taken on slope faces for each 5,000 square feet of slope face and/or each 10 feet of vertical height of slope. The Contractor shall assure that fill construction is such that the testing schedule can be accomplished by the Geotechnical Consultant. The Contractor shall stop or slow down the earthwork construction if these minimum standards are not met.

4.7 Compaction Test Locations: The Geotechnical Consultant shall document the approximate elevation and horizontal coordinates of each test location. The Contractor shall coordinate with the project surveyor to assure that sufficient grade stakes are established so that the Geotechnical Consultant can determine the test locations with sufficient accuracy. At a minimum, two grade stakes within a horizontal distance of 100 feet and vertically less than 5 feet apart from potential test locations shall be provided.

5.0 Subdrain Installation

Subdrain systems shall be installed in accordance with the approved geotechnical report(s), the grading plan, and the Standard Details. The Geotechnical Consultant may recommend additional subdrains and/or changes in subdrain extent, location, grade, or material depending on conditions encountered during grading. All subdrains shall be surveyed by a land surveyor/civil engineer for line and grade after installation and prior to burial. Sufficient time should be allowed by the Contractor for these surveys.

6.0 Excavation

Excavations, as well as over-excavation for remedial purposes, shall be evaluated by the Geotechnical Consultant during grading. Remedial removal depths shown on geotechnical plans are estimates only. The actual extent of removal shall be determined by the Geotechnical Consultant based on the field evaluation of exposed conditions during grading. Where fill-over-cut slopes are to be graded, the cut portion of the slope shall be made, evaluated, and accepted by the Geotechnical Consultant prior to placement of materials for construction of the fill portion of the slope, unless otherwise recommended by the Geotechnical Consultant.

7.0 Trench Backfills

7.1 Safety: The Contractor shall follow all OHSA and Cal/OSHA requirements for safety of trench excavations.

7.2 Bedding and Backfill: All bedding and backfill of utility trenches shall be done in accordance with the applicable provisions of Standard Specifications of Public Works Construction. Bedding material shall have a Sand Equivalent greater than 30 (SE>30). The bedding shall be placed to 1 foot over the top of the conduit and densified by jetting. Backfill shall be placed and densified to a minimum of 90 percent of maximum from 1 foot above the top of the conduit to the surface.

The Geotechnical Consultant shall test the trench backfill for relative compaction. At least one test should be made for every 300 feet of trench and 2 feet of fill.

7.3 Lift Thickness: Lift thickness of trench backfill shall not exceed those allowed in the Standard Specifications of Public Works Construction unless the Contractor can demonstrate to the Geotechnical Consultant that the fill lift can be compacted to the minimum relative compaction by his alternative equipment and method.

7.4 Observation and Testing: The jetting of the bedding around the conduits shall be observed by the Geotechnical Consultant.

F.2 - Phase I Paleontological Resources Inventory

THIS PAGE INTENTIONALLY LEFT BLANK

L&L ENVIRONMENTAL, INC.
REGULATORY SERVICES
BIOLOGICAL & CULTURAL INVESTIGATIONS & MONITORING

REVISED PHASE I PALEONTOLOGICAL RESOURCES INVENTORY
RIO VISTA, SPECIFIC PLAN 16001,
JURUPA VALLEY, RIVERSIDE COUNTY, CALIFORNIA

±917 Acre Property, ±917 Acres Surveyed
APNs 175-080-010, 175-090-001 through -005, 175-100-003, -005, & -006, 175-150-002, 175-160-001, -005, & -007, 177-030-012 & -014, 177-040-002, & -008, SP 16001, Rubidoux Area, Sections 3 & 4 & Interpolated Sections 9 & 10 in Rancho Jurupa, Township 2 South, Range 5 West, USGS Fontana 7.5' Topographic Quadrangle Map

Prepared On Behalf Of:
Brian Hardy
RMD Inland Investors, LLC & Canadian Pacific Land, LLC/Richland Real Estate Fund, LLC
3161 Michelson Drive, Suite 425
Irvine, CA 92612
949-383-4124

Prepared For:
City of Jurupa Valley Planning Department
8930 Limonite Avenue
Jurupa Valley, CA 92509
951-332-6464

Prepared By:
L&L Environmental, Inc.
Hugh Wagner, PhD, Principal Investigator
Leslie Nay Irish, CEO/Principal Project Manager
Jeffery Sonnentag, Technical Editor

Report Summary:

The parcel is underlain by metasedimentary rocks, plutonic rocks of the Peninsular Ranges, dike rocks, and older surficial sediments. Those rocks originating from igneous processes (cooled from magma), which is what cover most of the site, do not generally contain fossils and do not require monitoring during excavation. However, areas around the outer edges of the site that contain Quaternary older alluvial fan deposits are considered to have high potential to contain significant fossil material. Because of this potential, any excavation in these areas should be monitored by a qualified paleontologist.

Surveys Conducted By: Mark Roeder **Surveys Conducted On:** June 18, 2014
Report Date: March 20, 2015, **Revised:** September 5, 2017, December 21, 2021

Celebrating 25+ Years of Service to Southern CA and the Great Basin, WBE Certified (Caltrans, CPUC, WBENC)
Mailing Address: 700 East Redlands Blvd, Suite U, PMB #351, Redlands CA 92373
Delivery Address: 721 Nevada Street, Suite 307, Redlands, CA 92373
Webpage: llenviroinc.com | Phone: 909-335-9897 | FAX: 909-335-9893

TABLE OF CONTENTS

MANAGEMENT SUMMARY ii

1.0) INTRODUCTION AND SETTING 1
1.1) Introduction 1
1.2) Project Goals 1
1.3) Location 2
1.4) Water Resources 2
Figure 1. Project Vicinity 3
Figure 2. Project Location 4
Figure 3. Aerial Photograph 5

2.0) REGULATORY BACKGROUND 6
2.1) Paleontologic Resource Requirements Under CEQA 6
2.2) County of Riverside Requirements 6
2.3) City of Jurupa Valley Requirements 7
2.4) Professional Standards 7

3.0) RESEARCH DESIGN AND METHODS 9
3.1) Paleontological Research Design and Goals 9
3.2) Assessment Criteria 9
Table 1. Potential Paleontological Sensitivity Criteria 10
3.3) Paleontological Records and Collections Search 10
3.4) Paleontological Fieldwork Procedure 11

4.0) RESULTS 12
4.1) Literature Search 12
4.2) Paleontological Records Search 13
4.3) Paleontological Field Survey 13
Figure 4. Geologic Map 14

5.0) PROJECT SUMMARY WITH MITIGATION RECOMMENDATIONS 15
5.1) Paleontological Summary 15
Table 2. Paleontological Sensitivity Potential of Lithologic Unit(s) Present 15
5.2) Paleontological Mitigation Recommendations 15

6.0) REFERENCES 16

7.0) CERTIFICATION 17

APPENDICES 18
Appendix A – Record Search Results 18
Appendix B – Paleontologic Resource Impact Mitigation Plan (PRIMP) 26

MANAGEMENT SUMMARY

In compliance with CEQA and other regulations, L & L Environmental, Inc. (L&L) was retained to perform an updated records/literature review of paleontologic resources known to exist on or near the project area, as well as a paleontological field survey to identify any previously unrecorded paleontologic resources that may exist there. The goal of this study was to identify all paleontological resources situated within the boundaries of the project area. A paleontological records search and a field survey were completed.

The property is located in the City of Jurupa Valley within the County of Riverside. The property is located east of Armstrong Road and north of the 60 freeway.

The parcel is underlain by metasedimentary rocks, plutonic rocks of the Peninsular Ranges, dike rocks, and older surficial sediments. Those rocks originating from igneous processes (cooled from magma), which is what cover most of the site, do not generally contain fossils and do not require monitoring during excavation. However, areas around the outer edges of the site that contain Quaternary older alluvial fan deposits are considered to have high potential to contain significant fossil material and require monitoring during earthmoving activities. Because of this potential, any excavation in these areas should be monitored by a qualified paleontologist. The recommended Paleontologic Resource Impact Mitigation Plan (PRIMP) for the project is included in Appendix B.

1.0) INTRODUCTION AND SETTING

1.1) Introduction

This report provides the results of the paleontological resources inventory for the proposed development of ±600 acres of a ±913-acre group of parcels with housing units in the City of Jurupa Valley in the County of Riverside, California. State law, as set forth in the California Environmental Quality Act (CEQA) of 1970, requires public agencies not approve projects as proposed unless there are feasible alternatives or mitigation measures available that would substantially lessen significant environmental effects of such projects (Chapter 1, Section 21002). The California Public Resources Code 5097 protects vertebrate fossil sites, including fossilized footprints or any other paleontologic feature, situated on public land. Typical California requirements for paleontologic resource investigations and impact mitigation are outlined in Chapter 12.5, California Business and Professions Code, and Title 20, California Code of Regulations, Section 2012 et seq.

In compliance with CEQA and other regulations, L & L Environmental, Inc. (L&L) was retained to perform an updated records/literature review of paleontologic resources known to exist on or near the project area, as well as a paleontological field survey to identify any previously unrecorded paleontologic resources that may exist there. The paleontologic resources inventory, presented herein, consists of the results of the paleontological record/literature review and the results of the paleontological field survey of the project parcels.

1.2) Project Goals

The goal of this study was to identify all paleontological resources situated within the boundaries of the project area. This information is required, since construction of the project could adversely affect such resources.

The paleontological resource study consisted of:

(1) A paleontological records search, conducted to determine whether any previously recorded significant fossil bearing formations underlie the subject parcel.

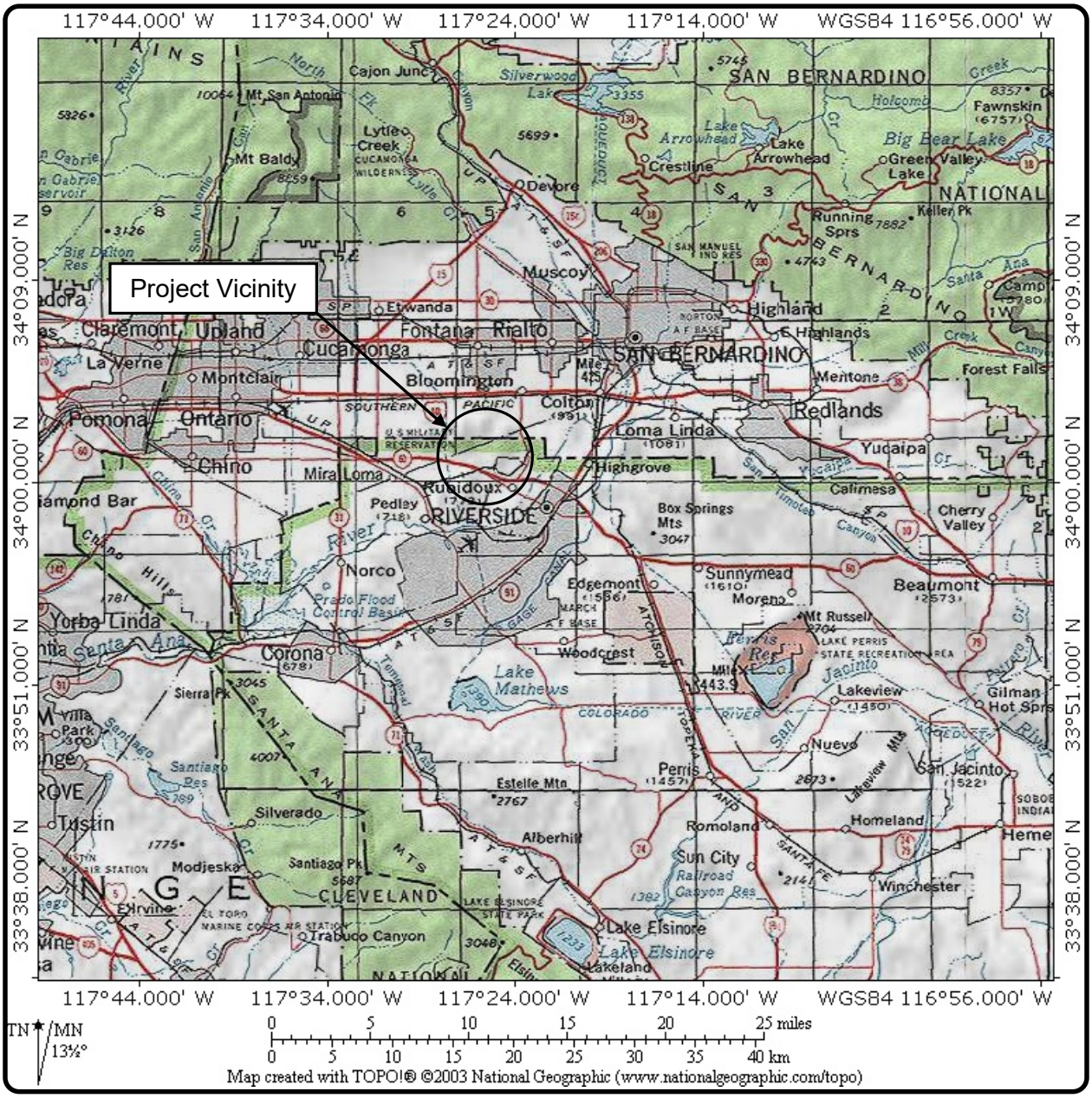
(2) Paleontological field reconnaissance in the form of a meandering pedestrian survey designed to confirm the lithologic units and to determine if any fossils are exposed at the surface.

1.3) Location

The property is located in the City of Jurupa Valley within the County of Riverside (Figure 1). The property is located east of Armstrong Road and north of the 60 freeway. The property is located in the parts of Sections 3 and 4 and interpolated Sections 9 and 10 in Rancho Jurupa, Township 2 south, Range 5 west, USGS Fontana quadrangle (Figure 2). The 913-acre project area can be accessed from the 60 freeway by taking the Rubidoux Boulevard exit north and then taking one of many roads (28th Street, 20th Street, . . .) leading to the west where the project site is located.

1.4) Water Resources

No mapped blueline streams are located within the property boundaries. No springs or seeps appear on the topographic map. The closest source of water is the ponds at the Oak Quarry Golf Club (approximately 1 mile west of the site) or the Santa Ana River (approximately 1.3 miles east).



L&L Environmental, Inc.

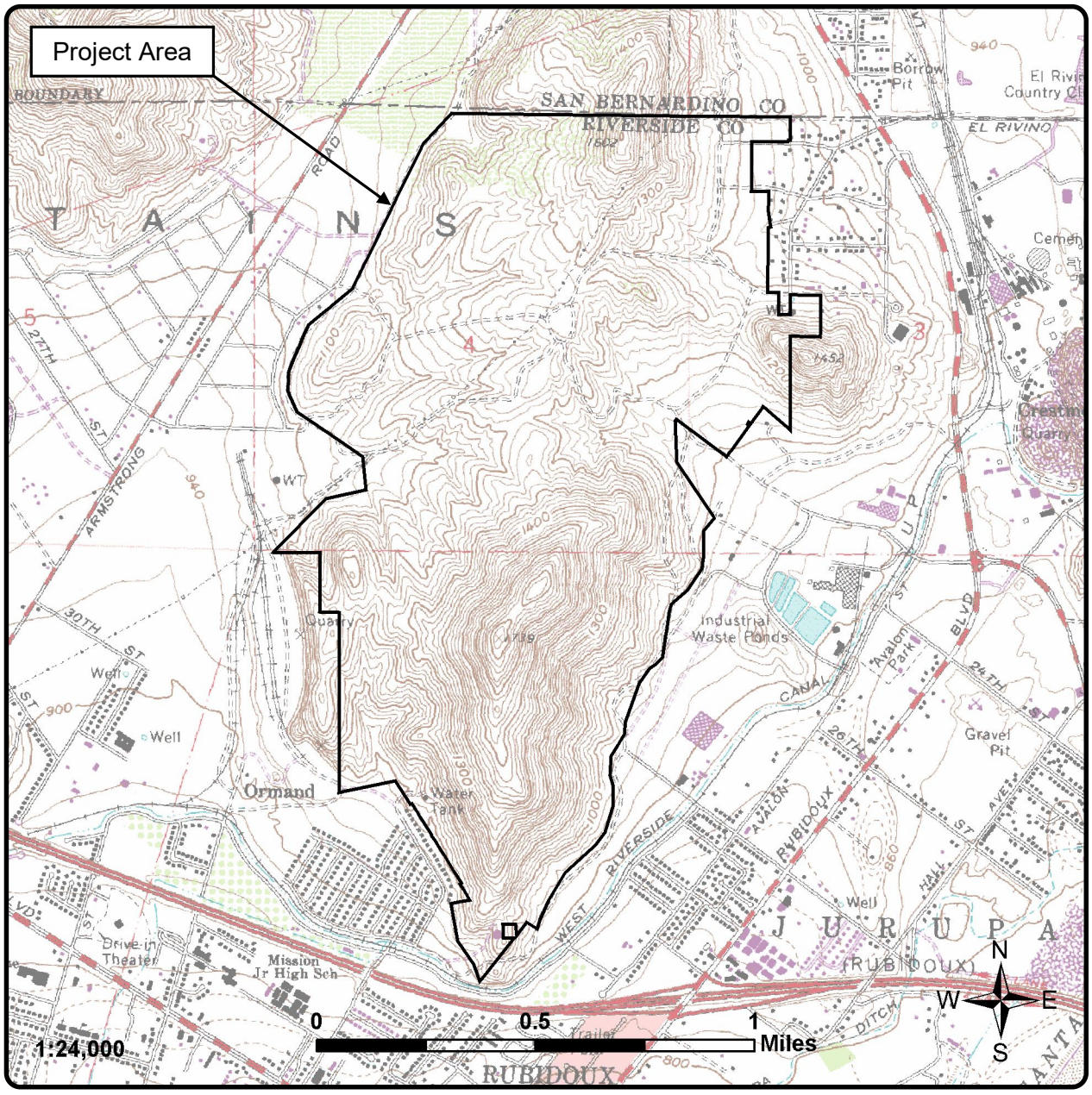
BIOLOGICAL AND CULTURAL INVESTIGATIONS AND MONITORING

RLCC-13-396
December 2021

Figure 1

Project Vicinity Map

Rio Vista, Crestmore Heights Area
County of Riverside, California



L&L Environmental, Inc.

BIOLOGICAL AND CULTURAL INVESTIGATIONS AND MONITORING

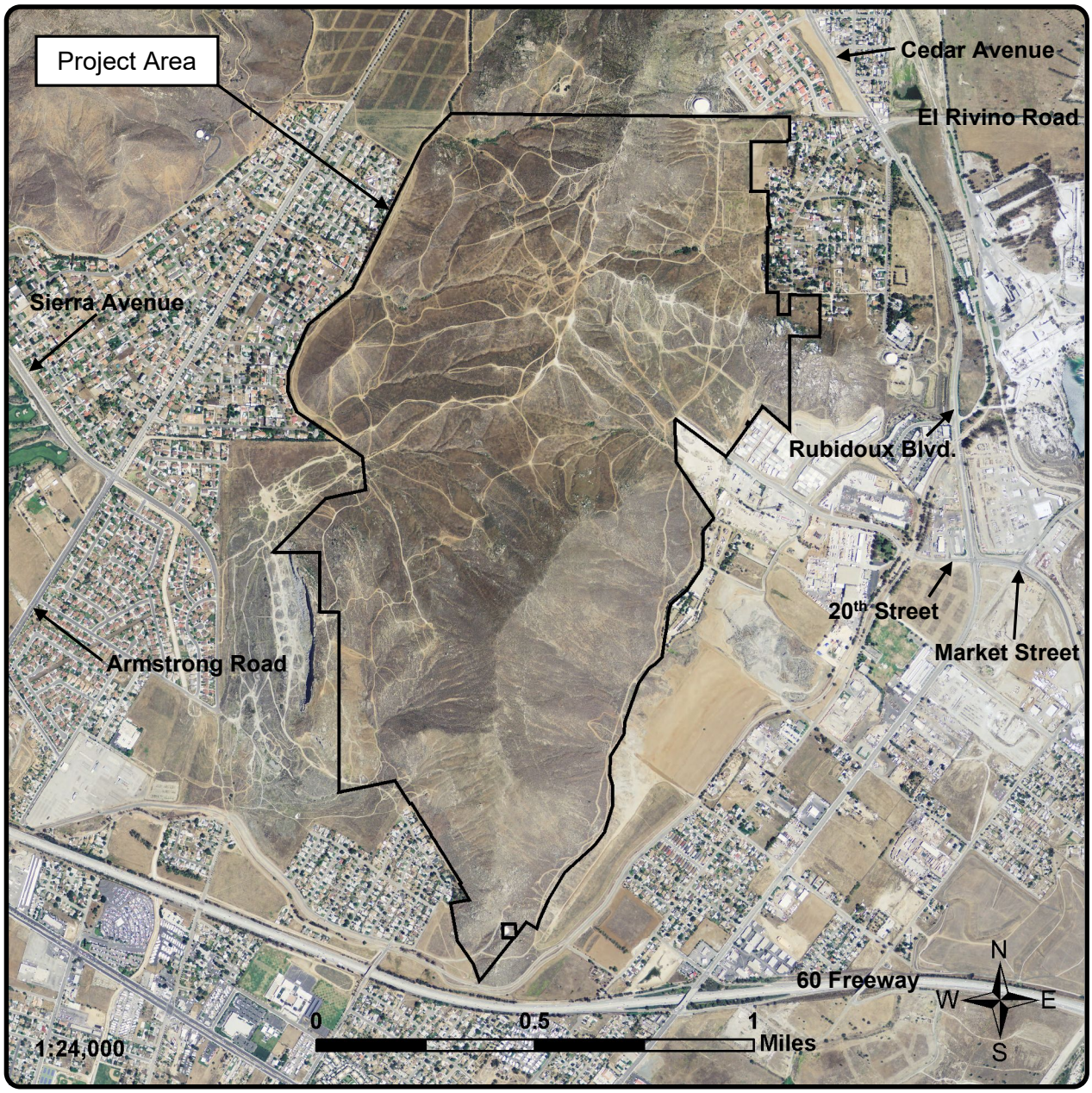
RLCC-13-396
December 2021

Figure 2

Project Location Map

(USGS Fontana [1980] quadrangle,
Sections 3 & 4 & Interpolated Sections 9 & 10 in
Rancho Jurupa, Township 2 South, Range 5 West)

Rio Vista, Crestmore Heights Area
County of Riverside, California



L&L Environmental, Inc.

BIOLOGICAL AND CULTURAL INVESTIGATIONS AND MONITORING

RLCC-13-396
December 2021

Figure 3

Aerial Photograph
(Photo obtained from *The National Map*, 4-28-2012)

Rio Vista, Crestmore Heights Area
County of Riverside, California

2.0) REGULATORY BACKGROUND

The paleontological resource of a rock encompasses any evidence preserved in the rock of once living organisms. As recognized here, this pertains to fossils preserved either as impressions of soft or hard parts, mineralized remains of hard parts, tracks, burrows, or other trace fossils, coprolites, seeds or pollen, and other microfossils. These organisms may have been terrestrial, aquatic, or aerial in life habit.

Fossils are an important resource to science, as they are useful in demonstrating and documenting the evolution of particular groups of organisms. Fossil remains enable geologists to reconstruct the environment in which the organisms lived and hence the environment during deposition of the rock. Fossils are also extremely useful in determining the age of the rock in which they are preserved. Paleontological resources include fossil remains, fossil localities, and formations that have produced fossil material in other nearby areas. The paleontological resource is a limited, nonrenewable, sensitive scientific and educational resource afforded protection under federal, state, and local legislation and policies.

2.1) Paleontologic Resource Requirements Under CEQA

The California Environmental Quality Act (CEQA) requires a lead agency to determine whether a project may have a significant effect on paleontological resources. State of California environmental regulations (California Environmental Quality Act [CEQA], Section 15064.5, Appendix G) address construction activities that may impact paleontological resources. Appendix G provides a checklist of questions that a lead agency should normally address if relevant to a project's environmental impacts. A relevant section of Appendix G that addresses an analysis of Geology and Paleontology is Section (V) (c), which asks if the project will directly or indirectly destroy a unique paleontological resource or site or unique geological feature.

2.2) County of Riverside Requirements

On October 25, 2011 the Riverside County Board of Supervisors voted to approve the SABER Policy (Safeguard Artifacts Being Excavated in Riverside County). The policy mandates preferential transfer of paleontological fossils to the Western Science Center located in the City of Hemet.

The policy also directs that the following condition be implemented when applicable: "The property owner and/or applicant on whose land the paleontological fossils are discovered shall

provide appropriate funding for monitoring, reporting, delivery and curating the fossils at the institution where the fossils will be placed, and will provide confirmation to the County that such funding has been paid to the institution."

2.3) City of Jurupa Valley Requirements

The newly formed City of Jurupa Valley would continue to be compliant with the following policies of the County of Riverside General Plan's Multipurpose Open Space Element (Kelly 2009):

> *OS 19.9*: This policy requires that when existing information indicates that a site proposed for development may contain paleontological resources, a paleontologist shall monitor site grading activities, with the authority to halt grading to collect uncovered paleontological resources, curate any resources collected with an appropriate repository, and file a report with the Planning Department documenting any paleontological resources that are found during the course of site grading.

2.4) Professional Standards

Within the Society of Vertebrate Paleontology (SVP) are guidelines titled, "The Assessment and Mitigation of Adverse Impacts to Non-Renewable Paleontologic Resources." They are a set of procedures and standards for assessing and mitigating impacts to vertebrate paleontological resources (SVP 2010).

Paleontological sensitivity is defined as the potential for a geologic unit to produce scientifically significant fossils. This is determined by rock type, past history of the geologic unit in producing significant fossils, and fossil localities recorded from that unit. Paleontological sensitivity is derived from the known fossil data collected from the entire geologic unit, not just from a specific survey. In its "Standard Guidelines for the Assessment and Mitigation of Adverse Impacts to Nonrenewable Paleontologic Resources," the SVP (2010) defines four categories of paleontological sensitivity (potential) for sedimentary rock units: high, low, and undetermined:

- High Potential: Rock units from which vertebrate or significant invertebrate fossils or suites of plant fossils have been recovered and are considered to have a high potential for containing significant nonrenewable fossiliferous resources. These units include, but are not limited to, sedimentary formations and some volcanic formations that contain significant nonrenewable paleontological resources anywhere within their geographical extent and sedimentary rock units temporally or lithologically suitable for the preservation of fossils. Sensitivity comprises both (a) the potential for yielding abundant or significant vertebrate fossils or for yielding a few significant fossils, large or small,

vertebrate, invertebrate, or botanical, and (b) the importance of recovered evidence for new and significant taxonomic, phylogenetic, ecologic, or stratigraphic data. Areas that contain potentially datable organic remains older than Recent, including deposits associated with nests or middens, and areas that may contain new vertebrate deposits, traces, or trackways are also classified as significant.

- Low Potential: Reports in the paleontologic literature or field surveys by a qualified vertebrate paleontologist may allow determination that some areas or units have low potentials for yielding significant fossils. Such units will be poorly represented by specimens in institutional collections.

- No Potential: Some rock units have no potential to contain significant paleontological resources, for instance high-grade metamorphic rocks (such as gneisses and schists) and plutonic igneous rocks (such as granites and diorites). Rock units with no potential require no protection or impact mitigation measures relative to paleontological resources.

- Undetermined Potential: Specific areas underlain by sedimentary rock units for which little information is available are considered to have undetermined fossiliferous potentials.

Note that highly metamorphosed rocks and granitic rock units generally do not yield fossils and therefore have no potential to yield significant nonrenewable fossiliferous resources.

For geologic units with high potential, full-time monitoring is recommended during any project-related ground disturbance, including initial ground clearing/vegetation removal where resources maybe present at or near the surface. Where sediments have clay or other indurating substances, the monitor will periodically wet screen and check for microvertebrate fossils using a 10x hand lens (loupe).

For geologic units with low potential, protection or salvage efforts typically are not required. For geologic units with undetermined potential, field surveys by a qualified paleontologist are recommended to specifically determine the paleontologic potential of the rock units present within the study area.

3.0) RESEARCH DESIGN AND METHODS

3.1) Paleontological Research Design and Goals

The paleontologic resource of a rock encompasses any evidence preserved of once living organisms in the rock. As recognized here, this pertains to fossils preserved either as impressions of soft or hard parts, mineralized remains of hard parts, tracks, burrows, or other trace fossils, coprolites, seeds or pollen and other microfossils. These organisms may have been terrestrial, aquatic, or aerial in life habit.

Fossils are an important resource to science as they are useful in demonstrating and documenting the evolution of particular groups of organisms. Fossils also enable geologists to reconstruct the environment in which the organisms lived and the environment during deposition of the rock, and are also extremely useful in determining the age of the rock in which they are preserved. Paleontologic resources include fossil remains, fossil localities, and formations that have produced fossil material in other nearby areas. The paleontologic resource is a limited, nonrenewable, sensitive scientific educational resource afforded protection under federal laws and regulations designed to preserve environmental quality. In California, the paleontologic resource is offered protection under CEQA.

Potential adverse environmental impacts that could result from excavation on the parcel and that might affect paleontologic resources (unrecorded fossil sites and remains) were assessed. Mitigation measures were then developed to reduce these impacts to an insignificant level. The assessment and mitigation measures are in compliance with 2010 Society of Vertebrate Paleontology (Society of Vertebrate Paleontology 2010) standard guidelines for reducing the potential adverse impact of construction on paleontologic resources.

3.2) Assessment Criteria

The paleontological sensitivity of a formation or unnamed sedimentary unit-described as high, low, unknown, or none, is the measurement most conducive to assessing the sensitivity of the paleontologic resources and reflects the potential productivity and importance of the fossils produced within a study area. The procedures utilized in this study to evaluate the paleontologic resource of a rock unit are similar to those utilized by the Society of Vertebrate Paleontology guidelines (2010).

The potential productivity of a formation is measured as high, low, unknown, or none, based upon the densities of fossil specimens or localities within or near the study area. Exposures of a particular formation within a study area most likely will yield fossils similar in number and kind to those previously recorded from the formation in the surrounding area, and may contain a similar density of fossil sites. The criteria for establishing the potential productivity of a formation exposed within the study area are described in the table below:

Table 1. Potential Paleontological Sensitivity Criteria

Paleontological Sensitivity	Criteria
High potential	Formation contains a high density of fossil sites and/or has produced numerous remains locally and is very likely to yield additional remains.
Low potential	Poorly exposed or studied formation that contains a very low density of recorded fossil localities and has produced little remains locally.
Unknown potential	Formations for which no data, or insufficient data is available from the immediate vicinity to allow an accurate assessment of its potential for yielding important fossil remains within the study area.
No potential	Unfossiliferous igneous and metamorphic rock units with no potential for yielding any fossil remains or Recent to sub-Recent sedimentary deposits that are too young to yield organic remains greater than 10,000 years old.

3.3) Paleontological Records and Collections Search

Due to the random nature of the fossil record, paleontologists cannot ascertain either the quality or the quantity of fossils present in a given geologic unit prior to exposure by natural erosion or human-caused disturbance. Therefore, in the absence of surface fossils it is necessary to assess the sensitivity of the rock units based on their known potential to yield scientifically significant paleontological resources elsewhere in the same geologic units (both within and outside of the study area) or a unit representative of the same depositional environment.

The paleontology impacts of the proposed project are discussed below under subheadings corresponding to each of the significance criterion presented in the preceding section. The analysis describes the impacts of the proposed project related to paleontological resources for each criterion and determines whether implementation of the proposed project would result in significant impacts by evaluating effects of earthmoving by the proposed project against the affected environment.

To evaluate potential paleontological impacts due to earthmoving associated with construction, a paleontological records and literature search was conducted at institutions and museums (LACM, SBCM, WSC) that house paleontological collections from the study area. Pertinent published literature and unpublished manuscripts on the geology and paleontology of the City of

Riverside and surrounding areas were reviewed. This included a published article on late Pleistocene vertebrate localities of California (Jefferson 2008). Additionally, the results of a previous paleontological survey of the study area by CRM TECH (2005) were reviewed.

The geologic rock units present proposed project area were rated for paleontological resources that may be present on the surface or would be exposed during ground disturbing construction activities based on the Society of Vertebrate Paleontology Guidelines (Society of Vertebrate Paleontology 2010).

3.4) Paleontological Fieldwork Procedure

On June 18, 2014 the L & L Environmental, Inc. paleontologist conducted a pedestrian survey of the project area.

4.0) RESULTS

4.1) Literature Search

During the comprehensive literature search it was found that the property was originally surveyed for paleontological resources by CRM TECH in 2005. The parcel is underlain by metasedimentary rocks, plutonic rocks of the Peninsular Ranges, dike rocks, and older surficial sediments (Dibblee 2004, see Figure 4).

Metasedimentary Rocks

Biotite schist (ms)

Present in three areas in the northwestern portion of the property, the biotite schist consisted of dark gray, fine grained, foliated, with minor biotite-quartiz-feldspar schist or gneiss. Although these rocks are thought to be Paleozoic in age (Dibblee 2004), they have been subjected to metamorphic processes (heat and pressure) and contain no fossils (McLeod 2005; Scott 2005).

Marble (ml)

Present in one area on the western boundary in the northwestern portion of the property, the marble consisted of white to bluish white, medium to coarse grained, bedded to massive, limestone or dolomite (Dibblee 2004). Although these rocks are thought to be Paleozoic in age (Dibblee 2004), they have been subjected to metamorphic processes (heat and pressure) and contain no fossils (McLeod 2005; Scott 2005).

Plutonic Rocks of the Peninsular Ranges

Quartz diorite (tonalite) (qdi)

Quartz diorite, a coarse-grained granitic rock, is present over most of the property and was formed at depth from very slow cooling magma (molten rock). It is thought to be Cretaceous in age (Cox and Morton 2001; Dibblee 2004), but because of its igneous rock origin it contains no fossils (McLeod 2005; Scott 2005).

Dike Rocks

Dike Rocks (p)-pegmatite to aplite dike rock

A dike of fine grained aplitic to coarse-rocked pegmatite material is intruded into the quartz diorite (qdi) and occurs in the southwest corner of the property (Figure 4). The dike rocks are

thought to be Cretaceous in age (Cox and Morton 2001; Dibblee 2004), but because of its igneous rock origin contains no fossils (McLeod 2005; Scott 2005).

Older Surficial Sediments

Quaternary older alluvial fan deposits (Qoa)

Present primarily in the northeast corner of the property, Quaternary older alluvial fan deposits are present in small areas around the boundaries (Figure 4). These deposits consist of tan to reddish brown sand with minor gravel. The top surfaces slope slightly from the source area and are dissected by stream channels. The Quaternary older alluvial fan deposits (Qoa) are late Pleistocene in age (Dibblee 2004).

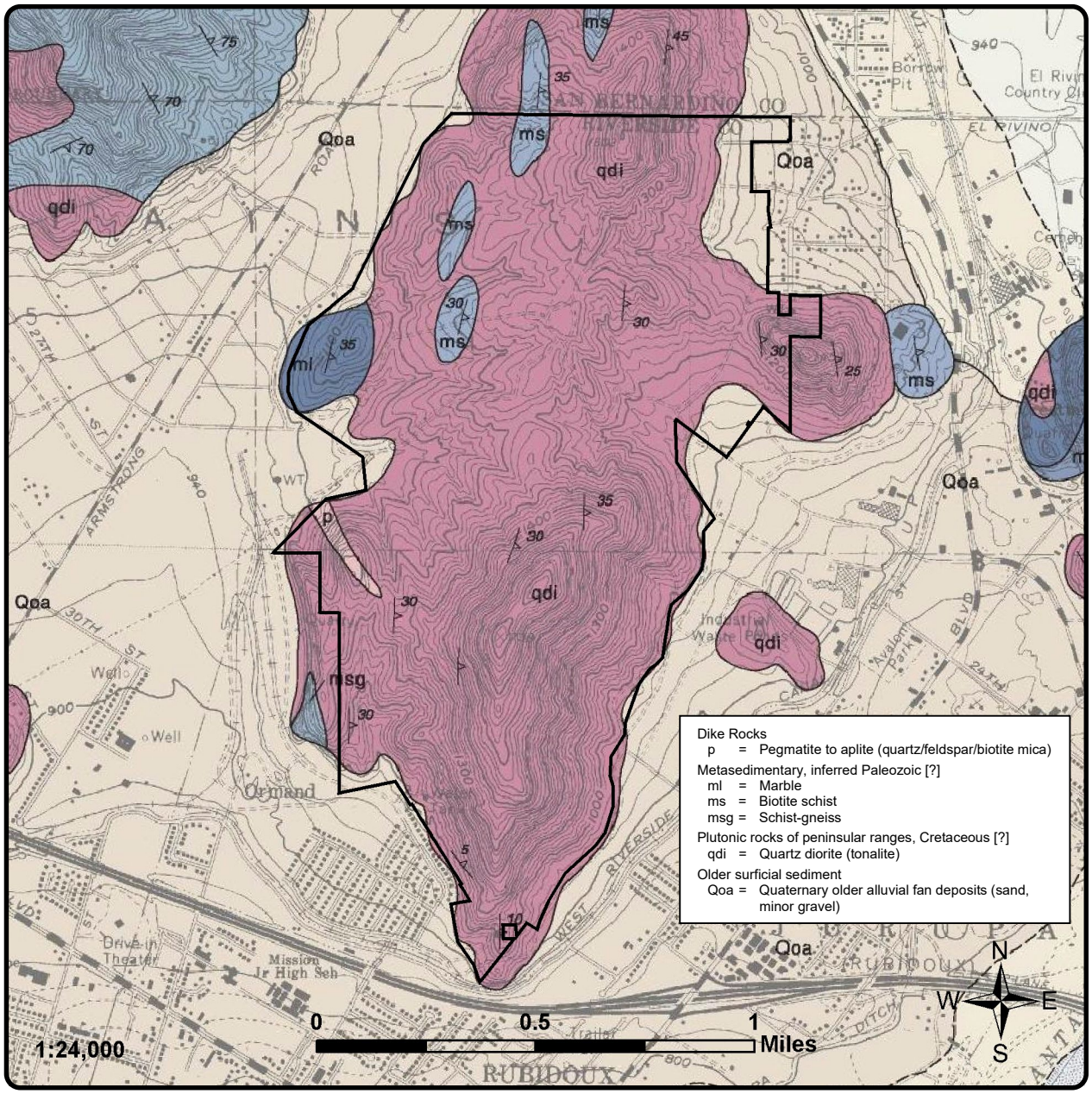
4.2) Paleontological Records Search

A comprehensive museum collections records search of the Vertebrate Paleontology Section collections of the Natural History Museum of Los Angeles County (McLeod 2005), the San Bernardino County Museum (Scott 2005), and the Western Science Center (Radford 2014) indicated no previously recorded sites on or immediately adjacent to the property.

However, each received record search letter response recommended paleontological resource monitoring of earth moving activities within areas of Quaternary/Pleistocene deposits (Qoa), which are located around the edges of the project area (Figure 4).

4.3) Paleontological Field Survey

The comprehensive paleontological resources reconnaissance field survey was performed by Mark Roeder on June 18, 2014. Originally, CRM TECH (2005) surveyed and assessed the entire property for paleontological resources. Most of the underlying geology of the parcel was plutonic and metamorphic rocks which, because of their origins, have no potential to yield significant fossils. Because of the results of the original survey by CRM TECH (2005), the current survey focused on sedimentary rocks (Quaternary older alluvium) present in the northeast corner of the property. These sediments had the most potential to yield significant paleontological resources. No fossils were observed in surficial outcrops of this rock unit, but paleontological resource monitoring during future grading activities for development of the parcel may yield fossil resources.



L&L Environmental, Inc.

BIOLOGICAL AND CULTURAL INVESTIGATIONS AND MONITORING

RLCC-13-396
December 2021

Figure 4

Geologic Map

(Geologic Map of the Riverside West/South ½ of Fontana Quadrangles, T. W. Dibblee, Jr., 2004)

Rio Vista, Crestmore Heights Area
County of Riverside, California

5.0) PROJECT SUMMARY WITH MITIGATION RECOMMENDATIONS

5.1) Paleontological Summary

The paleontologic resources record searches did not identify any previously recorded paleontological localities on or near the project area. The entire parcel has been surveyed for paleontologic resources and no fossil materials have been identified with its boundaries. The potential for destruction of paleontological resources during surficial earthmoving during construction is high in Quaternary older alluvial fan deposits (Table 2).

Table 2. Paleontological sensitivity* potential of lithologic unit(s) present.

Lithologic Unit	Paleontological Sensitivity*
Pegmatite to apetite (p)	No potential
Marble (ml)	No potential
Biotite schist (ms)	No potential
Schist-gneiss (msg)	No potential
Quartz diorite (qdi)	No potential
Quaternary older alluvial fan deposits (Qoa)	High potential

***** based on Society of Vertebrate Paleontology guidelines (2010)

5.2) Paleontological Mitigation Recommendations

There is high potential for locating significant paleontological resources during excavations within the Quaternary older alluvial fan deposits (Qoa) present in several areas around the outer edges of the project area (Figure 4). Because of this potential, the project paleontologist should evaluate and identify the areas of the project that should be monitored and any excavation in these areas should be monitored by a qualified paleontologist. The recommended Paleontologic Resource Impact Mitigation Plan (PRIMP) for the project is included in Appendix B.

6.0) REFERENCES

CRM TECH. 2005. Paleontological Resources Assessment Report - Rio Vista Specific Plan Amendment - Near the Community of Rubidoux, Riverside County, California.

Dibblee, T. M. Jr. 2004. Geologic Map of the Riverside West/South ½ of Fontana Quadrangles. Dibblee Foundation, Santa Barbara Natural History Museum.

Jefferson, G. T. 2008. Catalogue of Late Quaternary Vertebrates from California. Unpublished revision on file at Anza-Borrego Desert State Park, Stout Research Center.

Morton, D. M., and D. F. Cox. 2001. Geologic map of the Riverside East 7.5 minute quadrangle, Riverside County, California. U. S. Geological Survey Open File Report 01-452, map scale 1:24000.

Kelly, J. P. 2009. Negative Declaration-Jurupa Valley Incorporation. Prepared for Riverside Local Agency Formation Commission, Riverside by Bonterra Consulting, Irvine.

Radford, D. 2014. Letter regarding record search conducted for the Rio Vista Project in Riverside County, California. Western Science Center.

Scott, E. 2005. Paleontology Records Review, "1552: Rio Vista Specific Plan Amendment", Jurupa Region, Riverside County, California. San Bernardino County Museum.

Society of Vertebrate Paleontology 2010. Paleontology Records Review, "1552: Rio Vista Specific Plan Amendment", Jurupa Region, Riverside County, California. San Bernardino County Museum.

7.0) CERTIFICATION

Certification: I hereby certify that the statements furnished above and in the attached exhibits present the data and information required for this biological evaluation, and that the facts, statements, and information presented are true and correct to the best of my knowledge and belief.

DATE: December 21, 2021 SIGNED: _____

Leslie Irish, Principal, L&L Environmental, Inc.
909-335-9897

DATE: September 5, 2017 SIGNED: _____

Mark Roeder, Sr. Paleontologist, L&L Environmental, Inc.
909-335-9897

APPENDICES

Appendix A – Record Search Results

WESTERN SCIENCE CENTER

April 29, 2014

Jeff Sonnentag
L&L Environmental, Inc.
700 East Redlands Blvd., #U351
Redlands CA 92373

Dear Jeff,

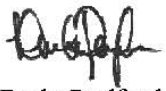
This letter presents the results of a record search conducted for the Rio Vista Project in Riverside County, California. The project site consists of one area designated as the current study area, located within section 28 of the Winchester USGS 7.5 minute topographic quadrangle. The current study area consists of land located west of Rubidoux Blvd. and north of California State Route 60 in Riverside, California.

The Western Science Center does not have any fossil localities associated within the Rio Vista Project study area. Geologic reports indicate that the study area is mapped as significantly tonalite and schist deposits dating from the Cretaceous Period, with minor portions of very old alluvial fan deposits dating from the middle to early Pliestocene.

Tonalite and schist deposits are considered to be of limited paleontological sensitivity. Pleistocene alluvial units however, are considered to be of high paleontological sensitivity. If excavation activity associated with development of the project area would impact the paleontologically sensitive Pleistocene alluvial units, it is the suggestion of the Western Science Center that a paleontological resource mitigation program be in place to monitor, salvage, and curate any recovered fossils.

If you have any questions, please feel free to contact me at dradford@westerncentermuseum.org.

Sincerely,



Darla Radford,
Curator

2345 Searl Parkway ♦ Hemet, CA 92543 ♦ phone 951.791.0033 ♦ fax 951.791.0032 ♦ westerncentermuseum.org

NATURAL HISTORY MUSEUM
OF LOS ANGELES COUNTY

Vertebrate Paleontology Section
Telephone: (213) 763-3325
FAX: (213) 746-7431
e-mail: smcleod@nhm.org

16 February 2005

CRM Tech
4472 Orange Street
Riverside, CA 92501

Attn: Laura Hensley Shaker

re: Paleontological resources for the proposed 1552: Rio Vista Specific Plan Amendment, Paleo project area

Dear Laura:

I have conducted a thorough search of our paleontology collection records for the locality and specimen data for the proposed 1552: Rio Vista Specific Plan Amendment, Paleo project area as outlined on the section of the Fontana USGS topographic quadrangle map that you faxed to me on 15 February 2005. We do not have any vertebrate fossil localities that lie within the project boundaries, nor do we have any localities very nearby from the same or similar sedimentary deposits as occur within the proposed project area.

Almost all of the proposed project area has bedrock composed of igneous and metamorphic rocks that, of course, will not contain recognizable fossils. In the lower lying portions on the margins of the proposed project area, however, there are surficial sediments composed of older Quaternary alluvial fan deposits derived from the hills in the core of the proposed project area. We have no localities nearby from these deposits. Our closest fossil vertebrate locality in the somewhat similar older Quaternary sediments is LACM 1207, directly southwest of the proposed project area just north of the city of Corona, where a specimen of a fossil deer, *Odocoileus*, was found.

Excavations in the igneous and metamorphic rocks exposed throughout almost all of the proposed project area will not encounter any fossils and therefore would require no paleontological mitigation. Excavations in the relatively small exposures of older Quaternary deposits in the proposed project area may possibly encounter significant vertebrate fossil remains. Any substantial subsurface excavation in the older Quaternary deposits on the margins of the proposed project area should be monitored to quickly and professionally collect any fossils discovered without impeding development. Any fossils recovered during mitigation should be deposited in an accredited and permanent scientific institution for the benefit of current and future generations.

900 Exposition Boulevard Los Angeles, CA 90007

RECEIVED FEB 18 2005

This records search covers only the vertebrate paleontology records of the Natural History Museum of Los Angeles County. It is not intended to be a thorough paleontological survey of the proposed project area covering other institutional records, a literature survey, or any potential on-site survey.

Sincerely,

Samuel A. McLeod

Samuel A. McLeod, Ph.D.
Vertebrate Paleontology

enclosure: invoice

SAN BERNARDINO COUNTY MUSEUM
2024 Orange Tree Lane • Redlands, California USA 92374-4560
(909) 307-2669 • Fax (909) 307-0539 • www.sbcountymuseum.org

COUNTY OF SAN BERNARDINO
ECONOMIC DEVELOPMENT
AND PUBLIC SERVICES GROUP

ROBERT L. McKERNAN
Director

2 March 2005

CRM Tech
attn: Laura Hensley Shaker
4472 Orange Street
Riverside, CA 92501

re: **PALEONTOLOGY RECORDS REVIEW, "1552: RIO VISTA SPECIFIC PLAN AMENDMENT", JURUPA REGION, RIVERSIDE COUNTY, CALIFORNIA**

Dear Laura,

The Division of Geological Sciences of the San Bernardino County Museum (SBCM) has completed a records search for the above-referenced ~918-acre property near Jurupa in Riverside County. The proposed study area is located in portions of sections 3, 4 and 9, Township 2 South, Range 5 West, San Bernardino Base and Meridian, as seen on the Fontana, California 7.5' United States Geological Survey topographic quadrangle map (1967 edition, photorevised 1980).

Previous geologic mapping of the region including the proposed study area (Bortugno and Spittler, 1986; Morton and Miller, 2003) indicates that the proposed study area is located almost entirely upon surface exposures of Cretaceous granitic rocks, including tonalite (= unit **Kt**) and heterogeneous tonalite (= **Kht**). Some pockets of mixed Paleozoic and/or Cretaceous tonalite and biotite schist (= **KP,ts**) are also present within the boundaries of the study area. None of these rock units has potential to contain significant fossil resources, and so these rocks are assigned low paleontologic sensitivity.

Along the flanks of the hills to the northeast, geologic mapping (Bortugno and Spittler, 1986; Morton and Miller, 2003) indicates the presence of alluvial fan deposits of Pleistocene age (= **Qof**) as well as Pleistocene older alluvium (= **Qoa**) in the more flat-lying portions of the property. These older Pleistocene sediments have high potential to contain significant nonrenewable paleontologic resources, depending upon their lithology, and so are assigned high paleontologic sensitivity. Pleistocene alluvium elsewhere throughout Riverside County and the Inland Empire has been repeatedly demonstrated to have high paleontologic sensitivity (Jefferson, 1991; Reynolds and Reynolds, 1991; Woodburne, 1991; Springer and Scott, 1994; Scott, 1997; Springer and others, 1998, 1999; Anderson and others, 2002). Fossils recovered from these Pleistocene sediments represent extinct taxa including mammoths, mastodons, ground sloths, dire wolves, sabre-toothed cats, large and small horses, large and small camels, and bison (Jefferson, 1991; Reynolds and Reynolds, 1991; Woodburne, 1991; Springer and Scott, 1994; Scott, 1997; Springer and others, 1998, 1999).

MARK L. UFFER
County Administrative Officer
NORMAN A. KANOLD
Assistant County Administrator
Economic Development and
Public Services Group

Board of Supervisors
BILL POSTMUS ..... First District
PAUL BIANE ..... Second District
JOSIE GONZALES ..... Third District
DENNIS HANSBERGER ..... Third District
GARY C. OVITT ..... Fourth District

RECEIVED MAR 0 4 2005

For this review, I conducted a search of the Regional Paleontologic Locality Inventory (RPLI) at the SBCM. The results of this search indicate that no previously-recorded paleontologic resource localities are present within the boundaries of the proposed development property, nor from within approximately one mile in any direction. The nearest locality that has yielded fossils from Pleistocene older alluvium is SBCM 5.1.11, located in Fontana and situated approximately 2½ miles northwest of the proposed study area. This locality yielded fossil remains of the extinct sabre-toothed cat, *Smilodon*, from Pleistocene older alluvium similar to that within the boundaries of the study area..

Recommendations

The results of the literature review and the check of the RPLI at the SBCM demonstrate that excavation in conjunction with development has high potential to adversely impact significant nonrenewable paleontologic resources present within the boundaries of the proposed Rio Vista Specific Plan. A qualified vertebrate paleontologist must therefore be retained to develop a program to mitigate impacts to such resources. This mitigation program should be consistent with the provisions of the California Environmental Quality Act (Scott and Springer, 2003), as well as with regulations currently implemented by the County of Riverside and the proposed guidelines of the Society of Vertebrate Paleontology. This program should include, but not be limited to:

1. Monitoring of excavation in areas identified as likely to contain paleontologic resources by a qualified paleontologic monitor. Based upon the results of this review, areas of concern include any and all previously-undisturbed sediments of Pleistocene older fan alluvium present within the boundaries of the property. These exposures are restricted to the low flanks of the hills and flat-lying areas in the northeastern portion of the property (western edge of section 3) *only*. Paleontologic monitors should be equipped to salvage fossils as they are unearthed to avoid construction delays and to remove samples of sediments which are likely to contain the remains of small fossil invertebrates and vertebrates. Monitors must be empowered to temporarily halt or divert equipment to allow removal of abundant or large specimens. Monitoring may be reduced or eliminated if the potentially-fossiliferous units described herein are not present, or if present are determined upon exposure and examination by qualified paleontologic personnel to have low potential to contain fossil resources.

2. Preparation of recovered specimens to a point of identification and permanent preservation, including washing of sediments to recover small invertebrates and vertebrates. Preparation and stabilization of all recovered fossils are essential in order to fully mitigate adverse impacts to the resources (Scott and others, 2004).

3. Identification and curation of specimens into an established, accredited museum repository with permanent retrievable paleontologic storage (e.g., SBCM). These procedures are also essential steps in effective paleontologic mitigation (Scott and others, 2004) and CEQA compliance (Scott and Springer, 2003). The paleontologist must have a written repository agreement in hand prior to the initiation of mitigation activities. Mitigation of adverse

impacts to significant paleontologic resources is not complete until such curation into an established museum repository has been fully completed and documented.

4. Preparation of a report of findings with an appended itemized inventory of specimens. The report and inventory, when submitted to the appropriate Lead Agency along with confirmation of the curation of recovered specimens into an established, accredited museum repository, will signify completion of the program to mitigate impacts to paleontologic resources.

References

Anderson, R.S., M.J. Power, S.J. Smith, K.B. Springer and E. Scott, 2002. Paleoecology of a Middle Wisconsin deposit from southern California. Quaternary Research 58(3): 310-317.

Bortugno, E.J. and T. E. Spittler, 1986. Geologic map of California, San Bernardino sheet, scale 1:250,000. California Division of Mines and Geology Regional Geologic Map Series, Map 3A.

Jefferson, G.T., 1991. A catalogue of late Quaternary vertebrates from California: Part Two, mammals. Natural History Museum of Los Angeles County Technical Reports, No. 7.

Morton, D.M. and F.K. Miller, 2003. Preliminary digital geologic map of the San Bernardino 30' x 60' quadrangle, California, version 1.0. United States Geological Survey Open-File Report 03-XXX. Digital preparation by P.M. Cossette and K.R. Bovard. 189 p.

Reynolds, S.F.B. and R.L. Reynolds, 1991. The Pleistocene beneath our feet: near-surface Pleistocene fossils in inland southern California basins, *in* Inland Southern California: the last 70 million years, M.O. Woodburne, S.F.B. Reynolds, and D.P. Whistler, eds. Redlands, San Bernardino County Museum Special Publication 38(3&4), p. 41-43.

Scott, E., 1997. A review of *Equus conversidens* in southern California, with a report on a second, previously-unrecognized species of Pleistocene small horse from the Mojave Desert. Journal of Vertebrate Paleontology 17(3): 75-A.

Scott, E. and K. Springer, 2003. CEQA and fossil preservation in southern California. The Environmental Monitor, Fall 2003, p. 4-10, 17.

Scott, E., K. Springer and J.C. Sagebiel, 2004. Vertebrate paleontology in the Mojave Desert: the continuing importance of "follow-through" in preserving paleontologic resources. In M.W. Allen and J. Reed (eds.) The human journey and ancient life in California's deserts: Proceedings from the 2001 Millennium Conference. Ridgecrest: Maturango Museum Publication No. 15, p. 65-70.

Springer, K.B. and E. Scott, 1994. First record of late Pleistocene vertebrates from the Domenigoni Valley, Riverside County, California. Journal of Vertebrate Paleontology 14 (3): 47A.

Springer, K.B., E. Scott, L.K. Murray and W.G. Spaulding, 1998. Partial skeleton of a large individual of *Mammut americanum* from the Domenigoni Valley, Riverside County, California. Journal of Vertebrate Paleontology 18(3): 78-A.

Springer, K.B., E. Scott, J.C. Sagebiel and K.M. Scott, 1999. A late Pleistocene lake edge vertebrate assemblage from the Diamond Valley, Riverside County, California. Journal of Vertebrate Paleontology 19(3): 77-A.

Woodburne, M.O., 1991. The Cajon Valley, *in* Inland Southern California: the last 70 million years, M.O. Woodburne, S.F.B. Reynolds, and D.P. Whistler, eds. Redlands, San Bernardino County Museum Special Publication 38(3&4), p. 41-43.

Please do not hesitate to contact us with any further questions you may have.

Sincerely,

Eric Scott, Curator of Paleontology
Division of Geological Sciences
San Bernardino County Museum

Appendix B – Paleontologic Resource Impact Mitigation Plan (PRIMP)

THIS PAGE INTENTIONALLY LEFT BLANK

F.3 - Paleontological Resource Impact Mitigation Plan

THIS PAGE INTENTIONALLY LEFT BLANK

L&L ENVIRONMENTAL, INC.
REGULATORY SERVICES
BIOLOGICAL & CULTURAL INVESTIGATIONS & MONITORING

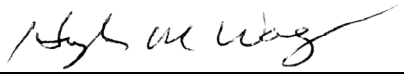
PALEONTOLOGIC RESOURCE IMPACT MITIGATION PLAN (PRIMP) FOR RIO VISTA, SPECIFIC PLAN 16001, JURUPA VALLEY, RIVERSIDE COUNTY, CALIFORNIA

±917 Acre Property, ±917 Acres Surveyed
APNs 175-080-010, 175-090-001 through -005, 175-100-003, -005, & -006, 175-150-002, 175-160-001, -005, & -007, 177-030-012 & -014, 177-040-002, & -008, SP 16001, Rubidoux Area, Sections 3 & 4 & Interpolated Sections 9 & 10 in Rancho Jurupa, Township 2 South, Range 5 West, USGS Fontana 7.5' Topographic Quadrangle Map

Prepared On Behalf Of:
Brian Hardy
RMD Inland Investors, LLC & Canadian Pacific Land, LLC/Richland Real Estate Fund, LLC
3161 Michelson Drive, Suite 425
Irvine, CA 92612
949-383-4124

Prepared For:
City of Jurupa Valley Planning Department
8930 Limonite Avenue
Jurupa Valley, CA 92509
951-332-6464

Prepared By:
L&L Environmental, Inc.
Hugh Wagner, PhD, Principal Investigator, hmcwagner2@gmail.com
Leslie Nay Irish, CEO/Principal Project Manager lirish@llenviroinc.com
Jeffery Sonnentag, Technical Editor, jsonnentag@llenviroinc.com



Hugh M. Wagner, PhD: Supervising Paleontologist

Surveys Conducted By: Mark Roeder **Surveys Conducted On:** June 18, 2014
Report Date: March 20, 2015, **Revised:** September 5, 2017, December 21, 2021

Celebrating 30 Years of Service to Southern CA and the Great Basin, WBE Certified (Caltrans, CPUC, WBENC)
Mailing Address: 700 East Redlands Blvd, Suite U, PMB#351, Redlands CA 92373
Delivery Address: 721 Nevada Street, Suite 307, Redlands, CA 92373
Webpage: llenviroinc.com | Phone: 909-335-9897 | FAX: 909-335-9893

TABLE OF CONTENTS

SECTION 1 3
INTRODUCTION 3
SECTION 2 5
MITIGATION PROGRAM PROCEDURES 5
Paleontology 1: Review Geotechnical Report Data 5
Paleontology 2: Museum Storage Agreement 5
Paleontology 3: Discovery Clause/Treatment Plan 6
Paleontology 4: Preconstruction Meeting 6
Paleontology 5: Monitoring Earth Moving 8
Paleontology 6A: Large-Specimen Evaluation and Recovery Option 9
Paleontology 6B: Small-Specimen Sample Evaluation, Recovery, and Processing 10
Paleontology 7: Fossil Treatment 14
Paleontology 8: Final Report 14
SECTION 3 15
ACRONYMS 15
SECTION 4 16
LITERATURE CITED 16

SECTION 1

INTRODUCTION

A paleontologic resource impact mitigation program (PRIMP) is required by the County of Riverside for the planned housing development within APNs 175-080-010, 175-090-001 through -005, 175-100-003, -005, and -006, 175-150-002, 175-160-001, -005, and -007, 177-030-012 and -014, 177-040-002, and -008. The site is currently an undeveloped group of parcels covered with native vegetation located in the City of Jurupa Valley in the County of Riverside, California. This PRIMP is being required because of the potential for scientifically important fossil remains being uncovered by earth moving at previously unrecorded fossil sites at the site. Without the PRIMP, fossil remains and associated specimen data and corresponding geologic and geographic site data could be lost to earth moving and unauthorized fossil collecting.

The mitigation measures detailed below are based on measures presented in the paleontologic resource inventory/impact assessment within which this PRIMP is found. The measures were developed in compliance with Society of Vertebrate Paleontology (SVP 2010; 1996) standard measures for reducing construction-related impacts on paleontologic resources and museum repository conditions for accepting a paleontologic mitigation program fossil collection. The PRIMP will be implemented by Hugh M. Wagner, PhD, project paleontologist, L&L Environmental, Inc. (L&L).

The PRIMP will substantially reduce the potentially significant adverse environmental impacts of earth moving on the paleontologic resources of the site to an acceptable level by: 1) allowing for the recovery of fossil remains and associated specimen data and corresponding geologic and geographic site data; 2) allowing for their preservation in the Western Science Center (WSC) or other qualified repositories (such as the Natural History Museum of Los Angeles County [LACM], San Bernardino County Museum [SBCM], San Diego Natural History Museum [SDNHM], or Riverside Metropolitan Museum [RMM]) where they will be available for future study by qualified investigators. Moreover, with the PRIMP earth moving could result in beneficial effects, including the exposure and recovery of numerous scientifically highly important fossil remains and associated data.

The parcels were researched and surveyed by Mark Roeder and portions of the site were found to be underlain by Quaternary older alluvial fan deposits (Qoa) (Dibblee 2004).

The site has not been impacted by agricultural or development activities; however, if previously undisturbed Quaternary older alluvial fan deposits are present at the ground surface and there is potential for remains being uncovered by earth moving activities. Identifiable fossil remains (particularly of vertebrates), if any, recovered at the site will be scientifically highly important if they represent new or rare species, geologic (temporal) and/or geographic range extensions, age-diagnostic taxa, and/or more complete specimens than are now available for their respective taxa. The recovery of remains representing age-diagnostic taxa will be critical in confirming, refining, and/or correcting previous age assignments for the fossil-bearing rock unit and its fauna, and the recovery of remains representing environmentally sensitive taxa will be critical in paleoenvironmental reconstruction. Moreover, the remains will contribute to a more comprehensive documentation of the diversity of extinct animal life that existed in the Jurupa Valley area during the Quaternary Epoch and to a more accurate reconstruction of the geologic history of the area.

The PRIMP will consist of paleontologic monitoring of earth moving to ensure the recovery of larger fossil remains and, if warranted, processing of rock samples to ensure recovery of smaller fossil remains. The level of monitoring in any particular area of the site will be based on the rock unit underlying that area. Recovery of fossil remains as part of the PRIMP will be allowed under CEQA Appendix G (5.c). Recovered remains will be prepared and submitted to knowledgeable paleontologists for identification. The remains will then be curated and accessioned into the WSC, LACM, SDNHM, SBCM, or RMM fossil collection and associated specimen data and corresponding site data archived (entered into corresponding museum catalogs and computerized databases).

SECTION 2

MITIGATION PROGRAM PROCEDURES

The mitigation measures detailed below for the PRIMP are in compliance with Mitigation Measures Paleontology for the overall project as recommended in the Phase I Paleontological Resources Inventory.

Paleontology 1: Review Geotechnical Report Data

In conjunction with the final design phase of each program-related improvement, a qualified vertebrate paleontologist will review the geotechnical report data, with particular regard to location and depth of earth moving and the rock unit(s) being encountered. The review is for the purpose of assessing potential for fossil remains being encountered by earth moving. If previously undisturbed strata with potential for containing fossil remains will be encountered by earth moving, the following measures will be implemented.

Paleontology 2: Museum Storage Agreement

The WSC, LACM, SDNHM, SBCM, or RMM will be the designated museum repository for any vertebrate, invertebrate, and plant fossil remains and associated specimen data and corresponding geologic and geographic site data that might be recovered from the site as a result of the PRIMP. Prior to any earth moving at the project site, the paleontologist will develop a formal agreement with the museum regarding final disposition and permanent storage and maintenance of the fossil collection and associated data. The agreement will cover, but not necessarily be limited to, museum requirements regarding: 1) level of treatment of the collection; 2) storage and maintenance fees, if any; 3) purchase of specimen storage cabinets and drawers, as well as specimen trays, vials, specimen data cards, and other curatorial supplies, if required.

Paleontology 3: Discovery Clause/Treatment Plan

As part of the PRIMP, the paleontologist will develop a discovery clause/treatment plan DC/TP to allow for the additional tasks (recovery; geologic mapping; fossiliferous rock sample processing; specimen preparation, identification, curation, cataloguing, data entry; specimen storage and maintenance by museum) and manpower required to treat a large or productive fossil occurrence that cannot be treated without diverting the monitor from routine monitoring. The DC/TP will also include approved procedures and lines of communication to be followed by specific individuals if fossil remains are uncovered by earth moving, particularly when a paleontologic monitor is not present at the site. Names and telephone numbers of contact personnel will be included in the lines of communication. The preparation of this PRIMP insures compliance with Paleontology 3.

Paleontology 4: Preconstruction Meeting

The paleontologist or field supervisor, as well as a paleontologic construction monitor, will attend a preconstruction meeting to explain the PRIMP to construction contractor and Richland Communities staff. The presentation will summarize mitigation procedures to be employed by PRIMP personnel and will detail procedures and lines of communication, as specified in the Riverside County, Conditions of Approval, to be followed by specific project personnel when fossil remains are found at the site.

The paleontologist or field supervisor will inform construction contractor and Richland Communities staff of the following items:

1) Routine mitigation measures (primarily monitoring and test screening) to be employed by a monitor during earth moving.

2) The potential for fossil remains being uncovered by earth moving in particular areas of the site and the need to implement specific actions and additional mitigation measures when a fossil occurrence is uncovered by earth moving.

3) Functions and responsibilities of the monitor when fossil remains are uncovered by earth moving and can be recovered without diverting the monitor from monitoring (temporarily divert earth moving around fossil site until remains evaluated, recovered, and earth moving allowed to proceed through site by monitor; if approved by construction contractor, enlist assistance of earth-moving equipment and operator to expedite recovery of remains, obviate need for additional personnel, and reduce any potential construction delay).

4) Functions and responsibilities of the monitor when a fossil occurrence is uncovered by earth moving and is sufficiently large or productive that it cannot be recovered without diverting the monitor from monitoring.

   4a) Flag the site.

   4b) Advise construction contractor to avoid fossil site until further notice (probably less than 2 days).

   4c) Call the project paleontologist or field supervisor to site.

5) Functions and responsibilities of the paleontologist or field supervisor when notified by the monitor that a large or productive fossil occurrence has been uncovered by earth moving and cannot be recovered without diverting the monitor from monitoring. Evaluate occurrence to determine if recovery is warranted.

   5a) If recovery is warranted - notify construction contractor and Richland Communities of necessity for implementing additional mitigation measures specified in DC/TP initiating increased level of monitoring, if not already in effect, in immediate vicinity of fossil site and assigning additional personnel to PRIMP.

   5b) Within 24 hours after Richland Communities approval as secured by L&L, mobilize recovery crew to recover occurrence; supervise recovery of occurrence and its transport to laboratory facility or to location elsewhere at site approved by construction contractor for initial/field processing of a fossiliferous rock sample or to laboratory facility for preparation of a fossil specimen.

   5c) If warranted and approved by construction contractor, enlist assistance of the earth-moving equipment and operator to expedite recovery of occurrence.

   5d) To obviate need for additional personnel and reduce any potential construction delay, after recovery of occurrence, have construction contractor allow earth moving to proceed through fossil site.

   5e) Notify Richland Communities of recovery (or of decision not to recover fossil occurrence, if appropriate) and of authorization for earth moving to proceed through fossil site.

6) Responsibilities of the construction contractor and earth-moving equipment operators if fossil remains are uncovered by earth moving, particularly if a monitor is not present at the site when the remains are encountered.

6a) Avoid disturbance of fossil site by earth moving.

6b) Notify monitor, the paleontologist, or the field supervisor and Richland Communities of the fossil occurrence.

6c) Avoidance of fossil site by earth-moving activities.

6d) Assist with equipment and operator to expedite recovery of occurrence.

These measures will obviate need for additional personnel, reduce any potential construction delay, and allow for earth moving to proceed through the site following approval by monitor. The construction contractor and Richland Communities staff will be shown examples of fossil specimens similar to those that might be encountered by earth moving at the site.

If warranted, the paleontologist or field supervisor and a monitor will give a similar presentation to the earth-moving equipment operators at one of their earliest safety meetings. The operators will be instructed on recognizing fossil remains in the field, informed of their responsibilities if they observe fossil remains when the monitor is not present at the site (avoid disturbance of occurrence by earth moving; have construction contractor call monitor to fossil site; expedite recovery of occurrence, if requested), and advised that unauthorized collecting of fossil remains is illegal.

Paleontology 5: Monitoring Earth Moving

Earth moving will be monitored by a paleontologic monitor supervised by a qualified paleontologist, as defined by the SVP (2010) (supervising paleontologist). Monitoring will consist of visually inspecting freshly exposed rock and debris for larger fossil remains and periodically screening a small (25 pound) sample with a 20-mesh box screen for micro vertebrate fossil remains.

Monitors will be equipped with water, screens, and a 10x magnifying lens so that any sediments encountered that are not clean sands or gravels can be periodically checked for microvertebrate fossils. Monitoring will be conducted on a full-time basis until the supervising paleontologist has determined that additional fossil remains are not likely to be uncovered by earth moving in specific area(s), underlain by a specific rock unit.

Where warranted, the supervising project paleontologist may reduce monitoring to half to quarter time based on monitoring results. The supervising paleontologist may terminate

monitoring of rock unit(s) which do not yield fossil resources after 50% of the earth has been moved in that rock unit. Alternatively, if sufficient fossil remains are uncovered by earth moving and with the approval of Richland Communities as secured by L&L, monitoring may be increased in areas underlain by the fossil-bearing rock unit, at least in the immediate vicinity of the fossil site.

Paleontology 6A: Large-Specimen Evaluation and Recovery Option

1) If a large fossil specimen is found as a result of monitoring earth moving and the specimen can be recovered without significantly diverting the monitor from monitoring, earth moving will be temporarily diverted around the fossil site and the specimen will be evaluated, and, if warranted, excavated, covered with a protective plaster-impregnated burlap jacket, if required, and recovered.

   If necessary and approved by the construction contractor, earth-moving equipment and an operator will be enlisted to expedite recovery of the specimen and obviate the need for additional personnel, and the construction contractor will be allowed to have earth moving proceed through the fossil site immediately after recovery of the specimen. A temporary field number will be assigned to the specimen; the field number, a preliminary field identification, and pertinent specimen (field number, identification by taxon and element) and geologic (particularly stratigraphic level within rock unit) and geographic site data (location, elevation) recorded in the monitor's daily monitoring log; and the field number recorded and the fossil site location plotted on a map of the site.

   At the end of the day the monitor or (following his next site inspection) the field supervisor will transport the fossil remains and associated data to a laboratory facility for further treatment (see Paleontology 7). If appropriate, samples of fossil wood will be submitted for carbon-14 dating analysis.

2) If a fossil specimen is found and is sufficiently large that it cannot be recovered without significantly diverting the monitor from monitoring, the fossil site will be flagged with colored survey ribbon to temporarily divert earth moving around the site, the construction contractor will be advised to avoid the site until further notice (probably less than 2 days), and the paleontologist or field supervisor will be called to the site. The grading contractor will notify Richland Communities and L&L of the occurrence and of the avoidance of the site. The paleontologist or field supervisor in turn will evaluate the specimen to determine if recovery is warranted.

   2a) If specimen recovery is not warranted, no further action will be taken to preserve the fossil site or remains, the construction contractor will be allowed to have earth moving proceed through the site immediately, and Richland Communities will be notified of the decision not to recover the specimen and of authorization for earth moving to proceed through the fossil site.

2b) If specimen recovery is warranted, the paleontologist or field supervisor will notify the construction contractor, and Richland Communities of the necessity for implementing additional mitigation measures specified in the DC/TP, initiating full-time monitoring, if not already in effect, at least in the immediate vicinity of the site in areas underlain by the fossil-bearing rock unit, and assigning additional personnel to the PRIMP. Within 24 hours after Richland Communities approval as secured by L&L, a recovery crew will be mobilized to recover the specimen. The size of the crew will reflect the size of the specimen and the need to recover the specimen as quickly as possible.

The specimen will be excavated with hand tools, covered with a protective plaster-impregnated burlap jacket, and recovered. If necessary and approved by the construction contractor, earth-moving equipment and an operator will be enlisted to expedite recovery of the specimen, reduce any potential construction delay, and obviate the need for additional personnel. The construction contractor will be allowed to have earth moving proceed through the fossil site immediately after recovery of the specimen. Richland Communities will be notified of the recovery and of authorization for earth moving to proceed through the fossil site.

A temporary field number will be assigned to the specimen; the field number, a preliminary field identification, and pertinent specimen (field number, identification by taxon and element) and geologic (particularly stratigraphic level within rock unit) and geographic site data (location, elevation) recorded in the monitor's daily monitoring log; and the field number recorded and the fossil site location plotted on a map of the site. The field supervisor and, if necessary, a crew member will transport the fossil specimen and associated site data to a laboratory facility for further treatment (see Paleontology 7).

Paleontology 6B: Small-Specimen Sample Evaluation, Recovery, and Processing

If a sufficient number of smaller vertebrate fossil remains are found at one (1) site as a result of test screening by the monitor the fossil site will be flagged with colored survey ribbon to temporarily divert earth moving around the site. The construction contractor will be advised to avoid the site until further notice (probably less than two [2] days), and if requested by the monitor to expedite recovery of a fossiliferous rock sample reduce any potential construction delay and obviate the need for additional personnel, the construction contractor will have earth-moving equipment and an operator acquire a sample from the fossil site and transport the sample, if possible, to a nearby temporary location at the site approved by the construction contractor. SVP Guidelines require a 6,000-pound sample to be processed for microvertebrates if indicators of potential microvertebrates are found (e.g., plant debris, abundant mollusks, clay clasts, carbonate-rich paleosols, or mudstones).

The construction contractor will notify Richland Communities and L&L of the occurrence and of the avoidance of the fossil/storage site. If a sample is recovered, the construction contractor will be allowed to ave earth moving proceed through the fossil site immediately after recovery of the sample. The monitor will notify Richland Communities of the recovery of the sample and of authorization for earth moving to proceed through the fossil site. The paleontologist or field supervisor will be called to the fossil/storage site to determine if the fossil site/sample is sufficiently productive to warrant recovery of a large sample of fossiliferous rock to process for additional small remains. Previous experience has demonstrated that only some fossil sites require sampling/sample processing. On the other hand, more than 95 percent of the specimens recovered as a result of some mitigation programs were recovered as a result of sample processing.

1) If the site/sample is determined too unproductive or the remains too poorly preserved or insufficiently diagnostic, no further action will be taken to preserve the fossil site/sample or remains, the construction contractor will be allowed to have earth moving proceed through the fossil/storage site immediately, and Richland Communities will be notified of the decision not to recover/process a sample and of authorization for earth moving to proceed through the fossil/storage site.

2) If sample recovery is warranted, the paleontologist or field supervisor will notify the construction contractor and Richland Communities of the necessity for implementing additional mitigation measures specified in the DC/TP and assigning additional personnel to the PRIMP.

    2a) Within 24 hours after Richland Communities approval as secured by L&L, a recovery crew will be mobilized to recover the sample. The size of the crew will reflect the need to recover the sample as quickly as possible. The field supervisor will record the size and supervise recovery of the sample. Approximately 3 tons (6,000 pounds or about 4 cubic yards) of fossiliferous rock will be recovered. The sample will be excavated with hand tools for recovery. If necessary and if approved by the construction contractor, earth-moving equipment and an operator will be enlisted to expedite transportation of the sample to the processing facility site, obviate the need for additional personnel, and reduce any potential construction delay and the construction contractor will be allowed to have earth moving proceed through the fossil site immediately after recovery of the sample. The paleontologist or field supervisor will notify Richland Communities of recovery of the sample and of authorization for earth moving to proceed through the fossil site.

    2b) A temporary field number will be assigned to the sample; the field number and pertinent specimen (field number, identification by taxon and element) and geologic (particularly stratigraphic level within rock unit) and

geographic site data (location, elevation) recorded in the monitor's daily monitoring log; and the field number recorded and the fossil site location plotted on a map of the site. The field supervisor and, if necessary, a crew member will transport the sample to a location elsewhere at the site approved by the construction contractor or to an offsite location for initial/field processing (wet screening) of the sample. The total weight of all samples from each fossil-bearing rock unit at the site will not exceed 3 tons.

2c) If warranted, the field supervisor will setup a field processing facility for wet screening the sample at a site location approved by the construction contractor. Wet screening will consist of sieving rock through a 20- (and/or finer) mesh box screen immersed in a tub of water to remove the smaller (clay and silt) particles from the larger (sand and rock) particles and small fossil remains, and could result in a reduction in sample weight/volume in excess of 90%. If necessary, rock will be soaked in an environmentally safe dispersant (citrus oil) prior to screening to improve the separation of the clay particles from the rest of the sample during screening. The monitor will conduct wet screening if screening can be accomplished without diverting the monitor from monitoring. If it is not possible to have the monitor perform the wet screening, a field technician will be assigned to the task. Following his next site inspection, the field supervisor will transport the concentrate (larger particles and small fossil remains) generated by initial processing to a laboratory facility for final/laboratory processing.

2d) If the fossil remains in the concentrate are sufficiently fossilized (dense), an environmentally safe heavy liquid (sodium polytungstate), if appropriate, will be used by the senior vertebrate paleontologist to separate the remains from the remaining sand and rock particles. When added to a beaker filled with heavy liquid, the concentrate will separate, the particles floating to the surface, and the remains sinking to the bottom, from where they are retrieved. This technique can result in a further sample weight/volume reduction in excess of 90% (less than 1% of original sample size). The final concentrate will be examined under a microscope and fossil specimens recovered from any remaining sand and rock particles. If the fossil bone in the original concentrate is not sufficiently dense for use of the heavy-liquid separation technique, the entire sample of concentrate will be sorted under a microscope for fossil remains. Recovered fossil remains will then be treated (see Paleontology 7).

2e) During the final processing of a sample, the senior vertebrate paleontologist will continually evaluate the results of field and laboratory processing. If the sample is insufficiently productive or the fossil remains, too poorly preserved, the senior vertebrate paleontologist will have the option of discontinuing further laboratory processing of the sample, having field processing of the remainder of the sample suspended, and disposing of the remainder of the sample and unprocessed concentrate.

Similarly, processing will be discontinued if, after preliminary identification of some specimens, the remains are determined insufficiently diagnostic or diverse taxonomically, or the species represented are the same as those in another sample from the fossil-bearing rock unit. Previous experience has demonstrated that only some fossil sites require sample processing, and only some of these sites require processing of an entire 3-ton sample. If appropriate, small splits from one or more samples will be submitted for palynological analysis.

Paleontology 7: Fossil Treatment

Final treatment of all fossil specimens recovered from the site as a result of the PRIMP will be conducted at a laboratory facility. Larger vertebrate fossil specimens will be removed from their protective jackets, prepared to the point of identification using hand tools, and hardened or stabilized with a penetrating solution by a preparator. All recovered fossil specimens will be identified to the lowest taxonomic level possible by knowledgeable vertebrate and invertebrate paleontologists and, if required, other knowledgeable paleontologists (i.e., paleobotanists, micropaleontologists, palynologists). The specimens will then be curated (assigned and labeled with museum specimen data and corresponding site numbers, placed in specimen trays and, if appropriate, vials with completed specimen data cards), catalogued (specimen and site numbers and specimen data and corresponding geologic and geographic site data, respectively, archived [entered into appropriate catalogs and computerized databases]), and accessioned into the museum fossil collection, where they will be permanently stored, maintained, and, along with associated data, made available for future study by qualified investigators. With the possible exception of those tasks (curation, cataloging) that might be conducted by museum staff, all treatment of the fossil specimens will be conducted by a laboratory technician. Fossil specimen preparation, identification, curation, and cataloguing are now required before a fossil collection will be accepted by most museum repositories, including the WSC, LACM, SDNHM, SBCM, and RMM. Moreover, the scientific importance of a fossil specimen cannot be evaluated until the specimen has been identified to the lowest taxonomic level possible, and specimen identification often is not possible without prior preparation.

Paleontology 8: Final Report

A final technical report of findings will be prepared by the paleontologist and will describe the site's stratigraphy, summarize field and laboratory methods employed during the PRIMP, include a taxonomic list and an inventory of catalogued fossil specimens recovered as a result of the PRIMP, evaluate the scientific importance of the specimens, and discuss the relationship of the fossil assemblage from any newly recorded fossil site at the project site to relevant fossil assemblages from fossil sites in other areas. The report will be submitted to the contractor and to Richland Communities.

Submission of the final report will signify completion of the PRIMP and will ensure Richland Communities compliance with Public Resources Code Section 21081.6 (mitigation monitoring, reporting, and compliance).

SECTION 3

ACRONYMS

CEQA	California Environmental Quality Act
EIR	Environmental Impact Report
DC/TP	Discovery clause/Treatment plan
L&L	L&L Environmental, Inc.
LACM	Natural History Museum of Los Angeles County
PRIMP	Paleontologic Resource Impact Mitigation Program
RMM	Riverside Metropolitan Museum
SBCM	San Bernardino County Museum
SDNHM	San Diego Natural History Museum
SVP	Society of Vertebrate Paleontology
WSC	Western Science Center

SECTION 4

LITERATURE CITED

Dibblee, T. M. Jr. 2004. Geologic Map of the Riverside West/South ½ of Fontana Quadrangles. Dibblee Foundation, Santa Barbara Natural History Museum.

Society of Vertebrate Paleontology. 2010. Standard Procedures for the Assessment and Mitigation of Adverse Impacts to Paleontological Resources. Society of Vertebrate Paleontology, 11 pp.