Leighton and Associates, Inc.
A LEIGHTON GROUP COMPANY

TRANSMITTAL

To: Rancho Diamante Investments
550 Laguna Drive, Suite B
Carlsbad, California 92008

August 25, 2015

Project No. 11061.001

Attention: Mr. Richard T. Robotta

Transmitted:		*The Following:*		*For:*	
X	Mail/Overnight		Draft Report	X	Your Use
	Courier	X	Final Report		As Requested
	Pick Up		Extra Report		
			Proposal		
			Other		

Subject: Supplemental Geotechnical Exploration, Rancho Diamante Residential Development, Tentative Tract Map No. 36841, City of Hemet, California

LEIGHTON AND ASSOCIATES, INC.

By: Robert F. Riha, CEG / Simon I. Saiid, GE

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SUPPLEMENTAL GEOTECHNICAL EXPLORATION
RANCHO DIAMANTE RESIDENTIAL DEVELOPMENT
TENTATIVE TRACT MAP NO. 36841
CITY OF HEMET, CALIFORNIA

Prepared for

RANCHO DIAMANTE INVESTMENTS
550 Laguna Drive, Suite B
Carlsbad, California 92008

Project No. 11061.001

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Project No. 11061.001

Rancho Diamante Investments
C/O Benchmark Pacific
550 Laguna Drive, Suite B
Carlsbad, California 92008

Attention: Mr. Richard T. Robotta

Subject: Supplemental Geotechnical Exploration
Rancho Diamante Residential Development
Tentative Tract Map No. 36841
City of Hemet, California

In accordance with your request, we are pleased to present herewith the results of our supplemental geotechnical evaluation for the subject project. This report summarizes our findings and conclusions, and provides preliminary geotechnical recommendations for the proposed residential development. Based on the results of this exploration, it is our opinion that the overall site appears suitable for the intended use provided our recommendations included herein are properly incorporated during design and construction phases of development.

If you have any questions regarding this report, please do not hesitate to contact the undersigned. We appreciate this opportunity to be of service on this project.

Respectfully submitted,

LEIGHTON AND ASSOCIATES, INC.

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1.0 INTRODUCTION

1.1 Purpose and Scope

This supplemental geotechnical exploration is for Rancho Diamante Residential Development, located west of Mustang Way and Warren Road in the Hemet area, Riverside County, California. Our scope of services for this geotechnical exploration included the following:

- Review of available site-specific information and relevant publications listed in the references at the end of this report.
- A site geologic reconnaissance and visual observations of surface conditions.
- A detailed analysis and review of aerial photographs of the project and adjacent areas;
- Excavation of eight (8) exploratory borings at locations as depicted on Plate 1. Borings were advanced to approximately 15 to 50 feet below existing ground surface. During the field exploration, representative samples were collected for laboratory testing. The logs of borings are included in Appendix A.
- Laboratory testing was performed on representative samples and results are included in Appendix B.
- Geotechnical engineering analyses performed or as directed by a California registered Geotechnical Engineer (GE) including preliminary foundation and seismic design parameters based on the 2013 California Building Code (CBC). A California Certified Engineering Geologist (CEG) performed engineering geology review of site geologic hazards.
- Preparation of this report which presents the results of our exploration and provides preliminary geotechnical recommendations for the proposed development. It should be noted that additional subsurface investigation and evaluation may be needed based on future site rough-grading plans.

This report is not intended to be used as an environmental assessment (Phase I or other), and foundation and/or a rough grading plan review.

1.2 Site Location and Description

The approximately 245-acre site is located west of Mustang Way and Warren Road in the City of Hemet, Riverside County, California (*see Figure 1, Site Location Map*). Topographically, the site is generally flat and gently sloping to the southwest. The property is bordered on the north and south by existing drainage channels. The site is currently vacant with light to moderate vegetative growth observed throughout.

Existing nearby improvements include paved Warren Road along the eastern boundary. The San Diego County Aqueduct is located immediately west of the site. The properties to the north and south of the site are currently vacant and dry farmed.

1.3 Proposed Development

Based on the provided tentative tract map (Pangea Land Consultants, Inc., 2015), we understand that the proposed residential development will consist of 634 residential lots, open space lots and a public park along with associated site roadway improvements. Each residential lot is to host a one- or two-story single-family residential home consisting of typical wood-frame structure with conventional slab-on-grade foundation. The foundation loads are not expected to exceed 2,500 pounds per lineal foot (plf) for continuous footings.

It is anticipated that site grading will generally involve cuts and fills on the order of 6 feet or less. If final site development significantly differs from the assumptions made herein, the recommendations included in this report should be subject to further review and evaluation.

2.0 FIELD EXPLORATION AND LABORATORY TESTING

2.1 Field Exploration

Our field exploration consisted of the excavation of 8 geotechnical borings to explore and verify the subsurface soils conditions. Borings were advanced to depths of approximately 15 to 50 feet using a truck mounted drill rig using 8-inch diameter hollow stem augers. During excavation, bulk samples and relatively “undisturbed” ring samples were collected from the exploration borings for further laboratory testing and evaluation. The relatively undisturbed samples were obtained utilizing a modified California drive sampler (2⅜-inch inside diameter and 3-inch outside diameter) driven 18 inches in general accordance with ASTM Test Method D3550. Standard penetration tests (SPT) were performed using a 2-inch outside diameter (1⅜-inch inside diameter) sampler driven 18 inches in general accordance with ASTM Test Method D1586. The number of blows to drive the samplers are recorded on the boring logs for each 6-inch increment (unless encountering refusal or >50 blows per 6 inches). Approximate locations of the borings are depicted on the *Boring Location Map* (Figure 4) and the corresponding logs are presented in Appendix A. Sampling was conducted by a staff geologist from our firm. After logging and sampling, the excavations were loosely backfilled with spoils generated during excavation.

The exploration logs included within Appendix A and related information depicts subsurface conditions only at the locations indicated and at the particular date designated on the logs. Subsurface conditions at other locations may differ from conditions occurring at these borings locations. The passage of time may result in altered subsurface conditions due to environmental changes. In addition, any stratification lines on the logs represent the approximate boundary between soil types and the transition may be gradual.

2.2 Laboratory Testing

Laboratory tests were performed on representative bulk and undisturbed drive samples to provide a basis for development of remedial earthwork and geotechnical design parameters. Selected samples were tested to determine pertinent engineering parameters of the encountered soils including, but not limited to the following: modified proctor compaction test, grain size analysis, collapse potential, expansion potential, and corrosion potential. The results of the in-situ moisture and density determinations are presented on the boring logs (Appendix A). The results of our laboratory testing are presented in Appendix B.

3.0 GEOTECHNICAL AND GEOLOGIC FINDINGS

3.1 Regional Geology

The proposed development site is located in the southwestern margin of the San Jacinto Valley southwest of the San Jacinto River and southeast of the Lakeview Mountains. The San Jacinto Valley is a relatively flat-lying depositional surface surrounded by hills and mountains. The valley is divided on the east by an alluvial filled, down dropped, rotated along its lengthwise axis, fault bounded graben (trough), and on the west by a broad, gently sloping (to the east) alluvial mesa (bajada). The northwest trending graben is bounded on the east by the main trace of the San Jacinto Fault, which forms the east margin of the valley and on the west by the Casa-Loma segment of the San Jacinto Fault. Each fault is a portion of the San Jacinto Fault Zone Complex.

Sediments derived from the San Jacinto River and Bautista Creek have been deposited across the valley. The sediment thickness is thought to be highly variable with a minimum thickness of 500 ± feet in the southwest portion of the valley. Paleo-estuary silts and sands, Quaternary-aged terrace deposits, and fanglomerates flank major abandoned drainage channels, and the base of mountain slopes. Mesozoic-aged metamorphic country rock intruded by Cretaceous aged granitics dominate the hills and mountains surrounding the site.

3.2 Site Specific Geology

Based on the results of our field exploration and review of the referenced reports (References), the site subsurface materials consist of fill soils, topsoil, young alluvial-valley deposits and older alluvial-fan deposits (See Figure 2-Regional Geologic Map). These units are discussed in the following sections in order of increasing age and further described on the logs of geotechnical borings in Appendix A.

3.2.1 Artificial Fill

Based on our field observations and previous explorations (Leighton, 2007), previously place artificial fill was observed within the project boundaries. We understand these fill soils were imported as a result of grading the nearby flood control channel, old Warren road, and storm water basin. The artificial fill generally consists of approximately 2 to 7 feet of dark brown to red brown silty sands and sandy silts with scattered gravel/cobble.

The results of our field observation and previous study indicate that the existing fill should be suitable for use on this site pending further verification during construction.

3.2.2 Topsoil

Topsoil is expected to mantle the majority of the site. The topsoil generally consists of a thin surface layer (6 to 12 inches) of brown to light brown, dry, loose silty sand with rootlets from surface vegetation. Topsoil materials cleared of significant amounts of debris and organic materials are suitable for use as compacted fills.

3.2.3 Young Alluvial-Valley Deposits

Young alluvial deposits generally underlie the entire site and consist generally of dry to moist, loose to very dense, silty and clayey sands (SC-SM) with interbedded layers of poorly graded sand (SP-SM) and sandy silt (ML). The alluvial soils were deposited as part of a complex fluvial/channel depositional environment that included interbedded sands and silts. Alluvial materials cleared of significant amounts of debris and organic materials are suitable for use as compacted fills.

3.2.4 Older Alluvium

Although not specifically encountered in our borings, older alluvial deposits are expected to underlie the younger alluvium.

3.3 Groundwater and Surface Water

Groundwater was not encountered in any of our borings in this or previous explorations; however, a previous investigation (Geocon, 2003) encountered perched groundwater at 36 feet in a single boring. No standing or surface water was observed on the site at the time of our field subsurface exploration. However, surface runoff from the adjacent elevated portions of the site and adjacent properties should be anticipated. In addition, saturated soils condition may be encountered along eastern boundary due to potential groundwater seepage from the existing aqueduct. In general, we do not anticipate that groundwater or surface water will be a significant constraint during the grading of the subject site.

3.4 Landslides/Debris Flow and Rockfalls

No evidence of on-site landslides/debris flow or rock fall was observed during our field investigation or in review of California Geologic Survey landslide inventory maps (CGS, 2012). The potential for rock fall due to either erosion or seismic ground shaking is considered nonexistent.

3.5 Rippability

Based on the results of our geotechnical borings and test pits, we anticipate that the alluvium to be readily rippable with conventional heavy earth moving equipment in good operating conditions.

3.6 Faulting

The subject site, like the rest of Southern California, is located within a seismically active region as a result of being located near the active margin between the North American and Pacific tectonic plates. The principal source of seismic activity is movement along the northwest-trending regional fault systems such as the San Andreas, San Jacinto and Elsinore Fault Zones. The nearest zoned active faults are the San Jacinto-San Jacinto Valley Fault, located approximately 4.9 miles (7.9 km) northeast of the site; the San Jacinto-Anza Fault, located approximately 6.1 miles (9.8 km) southeast and the Elsinore-Temecula Fault, located approximately 17.2 miles (27.7 km) southwest of the site (Blake, 2000c).

No active or inactive fault traces are known to traverse the site (Hart, 2007 and Morton, 2003) and no evidence of onsite faulting was observed during our investigation. This site is not located within a currently designated Alquist-Priolo Earthquake Fault Zone or County of Riverside Fault Zone. As defined by the California Geologic Survey, an active fault is one that has had surface displacement within the Holocene Epoch (roughly the last 11,000 years).

3.7 Ground Rupture

Ground rupture is generally considered most likely to occur along pre-existing active faults. Our review of available maps and current observations of the subject site and adjacent areas indicate that there is no active or potentially active faulting on site. The potential for ground subsidence/fissuring due to groundwater withdrawal should be considered low for the subject site and surrounding region.

3.8 Ground Shaking

Strong ground shaking can be expected at the site during moderate to severe earthquakes in this general region. This is common to virtually all of Southern California. Intensity of ground shaking at a given location depends primarily upon earthquake magnitude, site distance from the source, and site response (soil type) characteristics. The site-specific seismic coefficients based on the 2013 California Building Code (CBC) are provided in table below and may be used in the structural calculations.

Table 1. CBC Site-Specific Seismic Coefficients

CBC Categorization/Coefficient		Value (g)
Site Longitude (decimal degrees)	-117.03841	
Site Latitude (decimal degrees)	33.71867	
Site Class Definition	**D**	
Mapped Spectral Response Acceleration at 0.2s Period, S_s		**1.50**
Mapped Spectral Response Acceleration at 1s Period, S_1		**0.60**
Short Period Site Coefficient at 0.2s Period, F_a		**1.00**
Long Period Site Coefficient at 1s Period, F_v		**1.30**
Adjusted Spectral Response Acceleration at 0.2s Period, S_{MS}		**1.50**
Adjusted Spectral Response Acceleration at 1s Period, S_{M1}		**0.90**
Design Spectral Response Acceleration at 0.2s Period, S_{DS}		***1.00***
Design Spectral Response Acceleration at 1s Period, S_{D1}		***0.60***

* g- Gravity acceleration

3.9 Dynamic Settlement (Liquefaction and Dry Settlement)

The site contains thin deposits of relatively loose surficial soils overlying dense younger or older alluvium. Assuming that the loose, near-surface soils (topsoil and young alluvium) will be removed and recompacted in accordance with the recommendations of Section 5.0 of this report, the potential for liquefaction or dynamic settlement due to the design earthquake event to affect structures at this site is considered low. Based on our settlement analysis (Appendix C), a total dynamic settlement of 1-inch and differential settlement of 0.5 inch in 40 feet horizontal distance should be anticipated.

3.10 Lateral Spreading

Due to the lack of shallow groundwater, the potential for lateral spreading due to the design earthquake event to affect this site is considered very low or non-existent.

3.11 Flooding

The extreme western portion of the site is located within a Diamond Valley reservoir dam inundation flood zone according to Riverside County Hazard Maps (See Figure 3). Flood zones and grading configuration within the area subject to inundation should be considered by the project design civil engineer.

3.12 Tsunami

Due to the sites remote location from coastal waters, the possibility of the affects due to tsunami is considered non-existent.

3.13 Expansive Soils

Limited laboratory testing indicated that onsite soils generally possess a very low expansion potential. However, localized deposits of low to medium expansive soils (21<EI<91) may be encountered during grading, particularly in the highly weathered older alluvium, if any. The mitigation for such geologic hazard is discussed in Section 5.2.4 of this report.

3.14 Collapsible Soils

Laboratory testing indicated that the onsite soils are expected to possess a slight collapse potential (<2.5%). Based on the remedial grading recommendations to remove and compacted the near surface soils (Section 5.2.1), the collapsible soils hazard on this site is considered very low.

3.15 Rock Falls

Due to the lack of boulders and/or elevated rock out-cropping's within areas of proposed development and adjacent properties, the possibility of rock falls to impact the proposed development is considered nil.

4.0 SUMMARY OF FINDINGS AND CONCLUSIONS

Based on the results of this geologic/geotechnical exploration, it is our professional opinion that the proposed development is feasible from a geotechnical standpoint. The following is a summary of the geotechnical findings or factors that may affect development of the site.

- The existing onsite soils appear to be suitable for reuse as fill during proposed grading provided they are relatively free of organic material, debris, and any oversize rock (greater than 12 inches). While not anticipated, oversize rock will require special handling and placement at depths of at least 10 feet below finish grade.
- Topsoil, artificial fill and near surface alluvium are considered to be potentially compressible if subjected to additional loads. These materials should be removed and recompacted. Deeper removals may be required locally in younger alluvium.
- Based on laboratory testing and visual classification, onsite earth materials generally possess a very low to low expansion potential; however moderately expansive clayey lenses may be encountered locally during rough-grading. Additional testing should be performed during site grading to verify these observations and limited laboratory data.
- Although fill slopes onsite are anticipated to be less than 10 feet in height and will likely meet minimum factors of safety for stability, there may be a potential for significant erosion if granular fill soils are used on slope faces.
- Based on our subsurface explorations, it is our opinion that the onsite earth materials in most areas can be excavated with heavy-duty conventional grading equipment in good working condition.
- Evidence of active faulting was not identified within or immediately adjacent to the subject site. However, strong ground shaking may occur at this site due to local earthquake activity.
- Perched groundwater was not encountered during our investigation. However, perched water may develop in areas adjacent to the existing aqueduct or soils with contrasting permeabilities or geologic contact, depending on seasonal variation and site irrigation practices prior to grading. In general, groundwater is not expected to be a major constraint during grading.

5.0 RECOMMENDATIONS

5.1 General

Based on the results of this exploration, it is our opinion that the site is suitable for residential development from a geotechnical viewpoint. Grading of the site should be in accordance with our recommendations included in this report and future recommendations based on additional site-specific development plans and evaluations made during construction by the geotechnical consultant.

5.2 Earthwork Considerations

Earthwork should be performed in accordance with the General Earthwork and Grading Specifications in Appendix D as well as the following recommendations. The recommendations contained in Appendix D, are general grading specifications provided for typical grading projects and some of the recommendations may not be strictly applicable to this project. The specific recommendations contained in the text of this report supersede the general recommendations in Appendix D.

The contract between the developer and earthwork contractor should be worded such that it is the responsibility of the contractor to place the fill properly in accordance with the recommendations of this report, the specifications in Appendix D, applicable County Grading Ordinances, notwithstanding the testing and observation of the geotechnical consultant during construction.

5.2.1 Site Preparation and Remedial Grading

Prior to grading, the proposed structural improvement areas (i.e. all structural fill areas, pavement areas, buildings, etc.) of the site should be cleared of surface and subsurface obstructions, heavy vegetation and boulders. Roots and debris should be disposed of offsite. Wells, septic tanks or seepage pits, if encountered, should be abandoned in accordance with the County of Riverside Department of Health Services guidelines.

The near surface soils (including topsoil, artificial fill, and younger alluvium,) are potentially compressible in their present state and may settle under the surcharge of fills or foundation loading. As such, these materials should be removed in all settlement-sensitive areas including building pads, pavement, and slopes. The depth of removal should extend a minimum of 3 feet below existing ground surface into underlying dense alluvium. The removal depth should provide at least 3 feet of compacted fill below building pads and 2 feet below street subgrade elevations.

Dense/competent alluvium should be non-porous and possess a minimum of 85 percent relative compaction (based on ASTM D1557). Acceptability of all removal bottoms should be reviewed by an engineering geologist or geotechnical engineer and documented in the as-graded geotechnical report. The removal limit should be established by a 1:1 (horizontal:vertical) projection from the edge of fill soils supporting settlement-sensitive structures downward and outward to competent material identified by the geotechnical consultant. This may require remedial grading that extends beyond the limits of design grading. Removal will also include benching into competent material as the fills rise. Areas adjacent to existing property limits or protected habitat areas may require special considerations and monitoring. Steeper temporary slopes in these areas may be considered.

5.2.2 Cut/Fill Transition Lots

In order to mitigate the impact of underlying cut/fill transition conditions, we recommend overexcavation of the cut portion of transition lots similar to the fill portion so that a minimum of 3 feet of compacted fill underlie the lot. This overexcavation does not include scarification or preprocessing prior to placement of fill. Overexcavation can encompass the entire lot or extend laterally beyond the building limits a horizontal distance equal to the depth of overexcavation or to a minimum distance of 3 feet, whichever is greater. Overexcavation bottoms should be sloped as needed to reduce the accumulation of subsurface water.

5.2.3 Cut Lots and Streets

In order to facilitate excavation and provide uniform subgrade, we recommend that cut lots be overexcavated to a depth of 2 feet below finish grades and then capped with compacted fill. Lot overexcavation should be sloped to the street a minimum of 1 percent to reduce the accumulation of water.

5.2.4 Structural Fills

The onsite soils are generally suitable for re-use as compacted fill, provided they are free of debris and organic matter. Fills placed within 5 feet of finish pad grades or slope faces should contain no rocks over 12 inches in maximum dimension. In addition, encountered clayey soils layers (EI>21), if any, should be placed at depth greater than 3 feet below finished grades.

Areas to receive structural fill and/or other surface improvements should be scarified to a minimum depth of 8 inches, conditioned to at least optimum moisture content, and recompacted. Fill soils should be placed at a minimum of 90 percent relative compaction (based on ASTM D1557) and near or above optimum moisture content. Placement and compaction of fill should be performed in accordance with local grading ordinances under the observation and testing of the geotechnical consultant. The optimum lift thickness to produce a uniformly compacted fill will depend on the type and size of compaction equipment used. In general, fill should be placed in uniform lifts not exceeding 8 inches in thickness.

Fill slope keyways will be necessary at the toe of all fill slopes and at fill-over-cut contacts. Keyway schematics, including dimensions and subdrain recommendations, are provided in Appendix D. All keyways should be excavated into dense bedrock or dense alluvium as determined by the geotechnical engineer. The cut portions of all slope and keyway excavations should be geologically mapped and approved by a geologist prior to fill placement.

Fills placed on slopes steeper than 5:1 (horizontal:vertical) should be benched into dense soils (see Appendix D for benching detail). Benching should be of sufficient depth to remove all loose material. A minimum bench height of 2 feet into approved material should be maintained at all times.

5.2.5 Bulk and Shrinkage Factors

The volume change of excavated onsite materials upon compaction is expected to vary with depth of excavation, location, material type and compaction effort during grading. As such, the in-place and compacted densities of soil/bedrock materials vary and accurate determination of shrinkage and bulking for any specific area cannot be made, especially in the case of this project where soils vary considerably from one area to another.

For preliminary planning purposes and based on our field and laboratory test results, we recommend that the shrinkage factors included in table below be applied.

Table 2. Shrinkage Factor (%)

Depth	Topsoil & Alluvium
0 to 5 feet	10 to 15 shrinkage
5 to 10 feet	5 to 10 shrinkage

In addition, we recommend that a surface subsidence value of 0.1 to 0.2 foot be applied to topographic elevations in alluvial areas subjected to agricultural disking.

5.2.6 Import Soils

Import soils and/or borrow sites, if needed, should be evaluated by the geotechnical consultant prior to import. Import soils should be uncontaminated, granular in nature, free of organic material (loss on ignition less-than 2 percent),

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have a very low expansion potential (with an Expansion Index less than 21) and have a low corrosion impact to the proposed improvements.

5.2.7 Utility Trenches

Utility trenches should be backfilled with compacted fill in accordance with the Standard Specifications for Public Works Construction, (“Greenbook”), 2015 Edition. Fill material above the pipe zone should be placed in lifts not exceeding 8 inches in uncompacted thickness and should be compacted to at least 90 percent relative compaction (ASTM D 1557) by mechanical means only. Site soils may generally be suitable as trench backfill provided these soils are screened of rocks over 1½ inches in diameter and organic matter. If imported sand is used as backfill, the upper 3 feet in building and pavement areas should be compacted to 95 percent. The upper 6 inches of backfill in all pavement areas should be compacted to at least 95 percent relative compaction.

Where granular backfill is used in utility trenches adjacent moisture sensitive subgrades and foundation soils, we recommend that a cut-off “plug” of impermeable material be placed in these trenches at the perimeter of buildings, and at pavement edges adjacent to irrigated landscaped areas. A “plug” can consist of a 5-foot long section of clayey soils with more than 35-percent passing the No. 200 sieve, or a Controlled Low Strength Material (CLSM) consisting of one sack of Portland-cement plus one sack of bentonite per cubic-yard of sand. CLSM should generally conform to Section 201-6 of the “Greenbook”. This is intended to reduce the likelihood of water permeating trenches from landscaped areas, then seeping along permeable trench backfill into the building and pavement subgrades, resulting in wetting of moisture sensitive subgrade earth materials under buildings and pavements.

Excavation of utility trenches should be performed in accordance with the project plans, specifications and the California Construction Safety Orders (most current Edition). The contractor should be responsible for providing a "competent person" as defined in Article 6 of the California Construction Safety Orders. Contractors should be advised that sandy soils (such as fills generated from the onsite alluvium) could make excavations particularly unsafe if all safety precautions are not properly implemented. In addition, excavations at or near the toe of slopes and/or parallel to slopes may be highly unstable due to the increased driving force and load on the trench wall. Spoil piles from the excavation(s) and construction equipment should be kept away from the sides of the trenches. Leighton does not consult in the area of safety engineering.

5.2.8 Drainage

All drainage should be directed away from slopes, structures and pavements by means of approved permanent/temporary drainage devices. Adequate storm drainage of any proposed pad should be provided to avoid wetting of foundation soils. Irrigation adjacent to buildings should be avoided when possible. As an option, sealed-bottom planter boxes and/or drought resistant vegetation should be used within 5-feet of buildings.

5.2.9 Slope Design and Construction

Based on our review of the tentative tract map, it is our understanding that all fill and cut slopes will be designed and constructed at 2:1 (horizontal:vertical) or flatter with a maximum height of approximately 10 feet. These slopes are considered grossly stable for static and pseudostatic conditions. Cut slopes should be observed by an engineering geologist during grading to verify jointing or fracture patterns and recommend remedial measures, if needed.

Keys should be constructed at the toe of all fill slopes located on existing or cut grade as depicted in Appendix D. Compaction of each fill lift should extend out to the face of fill slope. The outer portion of fill slopes should be either overbuilt by 2 feet (minimum) and trimmed back to the finished slope configuration or compacted in vertical increments of 5 feet (maximum) by a weighted sheeps foot roller as the fill is placed. The slope face should then be track-walked by dozers of appropriate weight to achieve the final slope configuration and compaction to the slope face.

Slope faces are inherently subject to erosion, particularly if exposed to rainfall and irrigation. Landscaping and slope maintenance should be conducted as soon as possible in order to increase long-term surficial stability. Berms should be provided at the top of fill slopes. Drainage should be directed such that surface runoff on the slope face is minimized

5.3 Foundation Design

5.3.1 Bearing and Lateral Pressures

Based on our analysis, the proposed single-family residential structures may be founded on conventional or Post-tensioned slab on-grade foundation systems based on a Plasticity Index of 15 and the design parameters provided below. The proposed foundations and slabs should be designed in accordance with the structural consultants' design, the minimum geotechnical recommendations presented herein, and the applicable CBC. In utilizing the minimum geotechnical foundation recommendations, the structural consultant should design the foundation system to acceptable deflection criteria as determined by the architect. Foundation footings may be designed with the following geotechnical design parameters:

- Allowable Bearing Capacity:	2,000 psf at a minimum depth of embedment of 12 inches (minimum width of 12 inches). This bearing capacity may be increased by ⅓ for short-term loading conditions (e.g., wind, seismic).
- Sliding Coefficient:	0.35
- Differential Settlement:	1 inch in 40 feet horizontal distance

The footing width, depth, reinforcement, slab reinforcement, and the slab-on-grade thickness should be designed by the structural consultant based on recommendations and soil characteristics indicated herein. If exterior footings are within 5 feet horizontally of side yard swales, the footing should be embedded sufficiently to ensure embedment below the swale bottom is maintained.

5.3.2 Vapor Retarder

It has been a standard of care to install a moisture retarder underneath all slabs where moisture condensation is undesirable. Moisture vapor retarders may retard but not totally eliminate moisture vapor movement from the underlying soils up through the slabs. Moisture vapor transmission may be additionally reduced by use of concrete additives. Leighton does not practice in the field of moisture vapor transmission evaluation/mitigation. Therefore, we recommend that a qualified person/firm be engaged/consulted with to evaluate the general and specific moisture vapor transmission paths and any impact on the proposed construction. This person/firm should provide recommendations for mitigation of potential adverse impact of moisture vapor transmission on various components of the structure as deemed appropriate. The slab subgrade soils should be well wetted prior to placing concrete.

5.4 Retaining Walls

Retaining wall earth pressures are a function of the amount of wall yielding horizontally under load. If the wall can yield enough to mobilize full shear strength of backfill soils, then the wall can be designed for "active" pressure. If the wall cannot yield under the applied load, the shear strength of the soil cannot be mobilized and the earth pressure will be higher. Such walls should be designed for "at rest" conditions. If a structure moves toward the soils, the resulting resistance developed by the soil is the "passive" resistance. Retaining walls backfilled with non-expansive soils should be designed using the following equivalent fluid pressures:

Table 3. Retaining Wall Design Earth Pressures (Static, Drained)

Loading Conditions	Equivalent Fluid Density (pcf)	
	Level Backfill	2:1 Backfill
Active	36	50
At-Rest	55	80
Passive*	300	150 (2:1, sloping down)

* This assumes level condition in front of the wall will remain for the duration of the project, not to exceed 3,500 psf at depth. If sloping down (2:1) grades exist in front of walls, then they should be designed using passive values reduced to ½ of level backfill passive resistance values.

Unrestrained (yielding) cantilever walls should be designed for the active equivalent-fluid weight value provided above for very low to low expansive soils that are free draining. In the design of walls restrained from movement at the top (non-yielding) such as basement or elevator pit/utility vaults, the at-rest equivalent fluid weight value should be used. Total depth of retained earth for design of cantilever walls should be measured as the vertical distance below the ground surface measured at the wall face for stem design, or measured at the heel of the footing for overturning and sliding calculations. Should a sloping backfill other than a 2:1 (horizontal:vertical) be constructed above the wall (or a backfill is loaded by an adjacent surcharge load), the equivalent fluid weight values provided above should be re-evaluated on an individual case basis by us. Non-standard wall designs should also be reviewed by us prior to construction to check that the proper soil parameters have been incorporated into the wall design.

All retaining walls should be provided with appropriate drainage. The outlet pipe should be sloped to drain to a suitable outlet. Typical wall drainage design is illustrated in Appendix D, *Retaining Wall Backfill and Subdrain Detail*. Wall backfill should be non-expansive (EI $\leq$ 21) sands compacted by mechanical methods to a minimum of 90 percent relative compaction (ASTM D 1557). Clayey site soils should not be used as wall backfill. Walls should not be backfilled until wall concrete attains the 28-day compressive strength and/or as determined by the Structural Engineer that the wall is structurally capable of supporting backfill. Lightweight compaction equipment should be used, unless otherwise approved by the Structural Engineer.

5.5 Footing Setback

We recommend a minimum horizontal setback distance from the face of slopes for all structural footings (retaining and decorative walls, building footings, pools etc.). This distance is measured from the outside bottom edge of the footing horizontally to the slope face (or to the face of a retaining wall) and should be a minimum of H/2, where H is the slope height (in feet).

Table 4. Footing Setback

Slope Height	Recommended Footing Setback
<5 feet	5 feet minimum
5 to 15 feet	7 feet minimum
>15 feet	H/2, where H is the slope height, not to exceed 10 feet to 2:1 slope face

Please note that the soils within the structural setback area possess poor lateral stability and improvements (such as retaining walls, sidewalks, fences, pavements, pools, etc.) constructed within this setback area may be subject to lateral movement and/or differential settlement. Potential distress to such improvements may be mitigated by providing a deepened footing or a pier and grade-beam foundation system to support the improvement. The deepened footing should meet the setback as described above. Modifications of slope inclinations near foundations may increase the setback and should be reviewed by the design team prior to completion of design or implementation.

5.6 Geochemical Characteristics

Limited laboratory testing indicated a negligible concentration of soluble sulfates in onsite soils for representative samples. The laboratory test results are presented in Appendix B.

Additional corrosion testing should be performed on representative finish grade soils at the completion of rough grading. Concrete foundations in contact with site soils should be designed in accordance with applicable codes. A qualified corrosion engineer should be consulted to review the results of laboratory tests and coordinate additional testing if corrosion sensitive materials are to be used.

5.7 Preliminary Pavement Design Parameters

In order to provide the following preliminary recommendations, we have assumed an R-value of 35 for preliminary design purposes. These recommendations are intended for planning purposes only and should not supersede minimum County requirements. For the final pavement design, appropriate traffic indices should be selected by the project civil engineer or traffic engineering consultant and representative samples of actual subgrade materials should be tested for R-value.

Table 5. Preliminary Pavement Design

Loading Conditions	***AC Pavement Section Thickness***	
	Asphaltic-Concrete (AC) Thickness (inches)	Aggregate Base (AB) Thickness (inches)
5	3.0	4.5
6	3.5	6.5
7	4.0	8.0

The subgrade soils in the upper 6 inches should be properly compacted to at least 95 percent relative compaction (ASTM D1557) and should be moisture-conditioned to near optimum and kept in this condition until the pavement section is constructed. Proof-rolling subgrade to identify localized areas of yielding subgrade (if any) should be performed prior to placement of aggregate base and under the observation of the geotechnical consultant.

Minimum relative compaction requirements for aggregate base should be 95 percent of the maximum laboratory density as determined by ASTM D1557. Base rock should conform to the "Standard Specifications for Public Works Construction" (green book) current edition or Caltrans Class 2 aggregate base having a minimum R-value of 78. Asphaltic concrete should be placed on compacted aggregate base and compacted to a minimum 95 percent relative compaction based on the laboratory standards ASTM D1561 and D2726.

The preliminary pavement sections provided in this section are meant as minimum, if thinner or highly variable pavement sections are constructed, increased maintenance and repair may be needed.

6.0 GEOTECHNICAL CONSTRUCTION SERVICES

Geotechnical review is of paramount importance in engineering practice. Poor performances of many foundation and earthwork projects have been attributed to inadequate construction review. We recommend that Leighton be provided the opportunity to review the grading plan and foundation plan(s) prior to bid.

Reasonably-continuous construction observation and review during site grading and foundation installation allows for evaluation of the actual soil conditions and the ability to provide appropriate revisions where required during construction. Geotechnical conclusions and preliminary recommendations should be reviewed and verified by Leighton during construction, and revised accordingly if geotechnical conditions encountered vary from our findings and interpretations. Geotechnical observation and testing should be provided:

- After completion of site demolition and clearing,
- During preparation and overexcavation of surface soils as described herein,
- During compaction of all fill materials,
- After excavation of all footings, and prior to placement of concrete,
- During utility trench backfilling and compaction, and
- When any unusual conditions are encountered.

Additional geotechnical exploration and analysis may be required based on final development plans, for reasons such as significant changes in proposed structure locations/footprints. We should review grading (civil) and foundation (structural) plans, and comment further on geotechnical aspects of this project.

7.0 LIMITATIONS

This report was necessarily based in part upon data obtained from a limited number of observances, site visits, soil samples, tests, analyses, histories of occurrences, spaced subsurface explorations and limited information on historical events and observations. Such information is necessarily incomplete. The nature of many sites is such that differing characteristics can be experienced within small distances and under various climatic conditions. Changes in subsurface conditions can and do occur over time. This investigation was performed with the understanding that the subject site is proposed for residential and commercial development. The client is referred to Appendix E regarding important information provided by the Geoprofessional Business Association (GBA) on geotechnical engineering studies and reports and their applicability.

This report was prepared for Rancho Diamante Investments based on their needs, directions, and requirements at the time of our investigation. This report is not authorized for use by, and is not to be relied upon by any party except Rancho Diamante Investments., and its successors and assigns as owner of the property, with whom Leighton and Associates, Inc. has contracted for the work. Use of or reliance on this report by any other party is at that party's risk. Unauthorized use of or reliance on this report constitutes an agreement to defend and indemnify Leighton and Associates, Inc. from and against any liability which may arise as a result of such use or reliance, regardless of any fault, negligence, or strict liability of Leighton and Associates, Inc.

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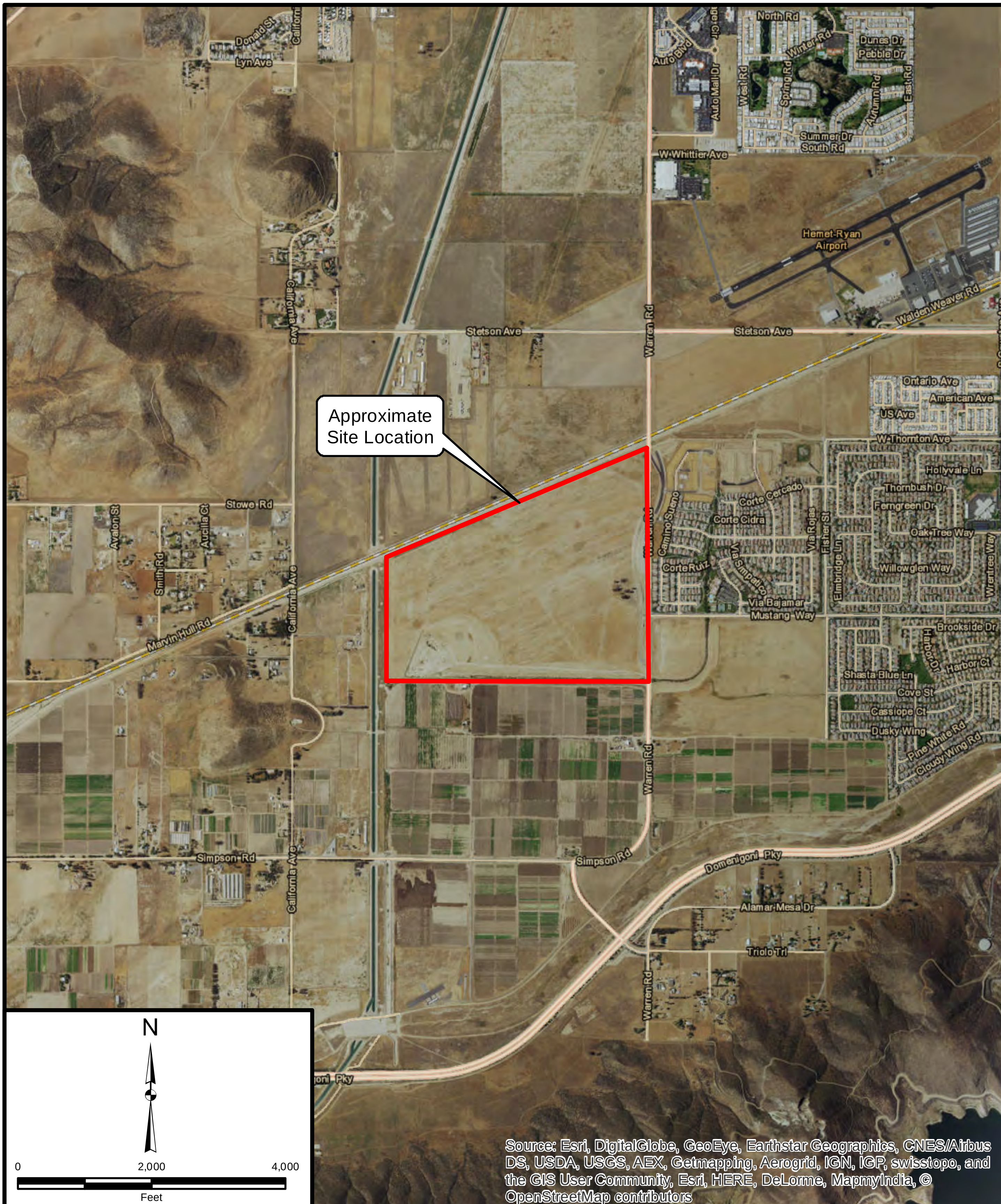

Project: 11061.001	Eng/Geol: SIS/RFR	Figure 1
Scale: 1 " = 2,000 '	Date: August 2015	

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

SITE LOCATION MAP
Rancho Diamante TTM 36841
Hemet, California

Leighton

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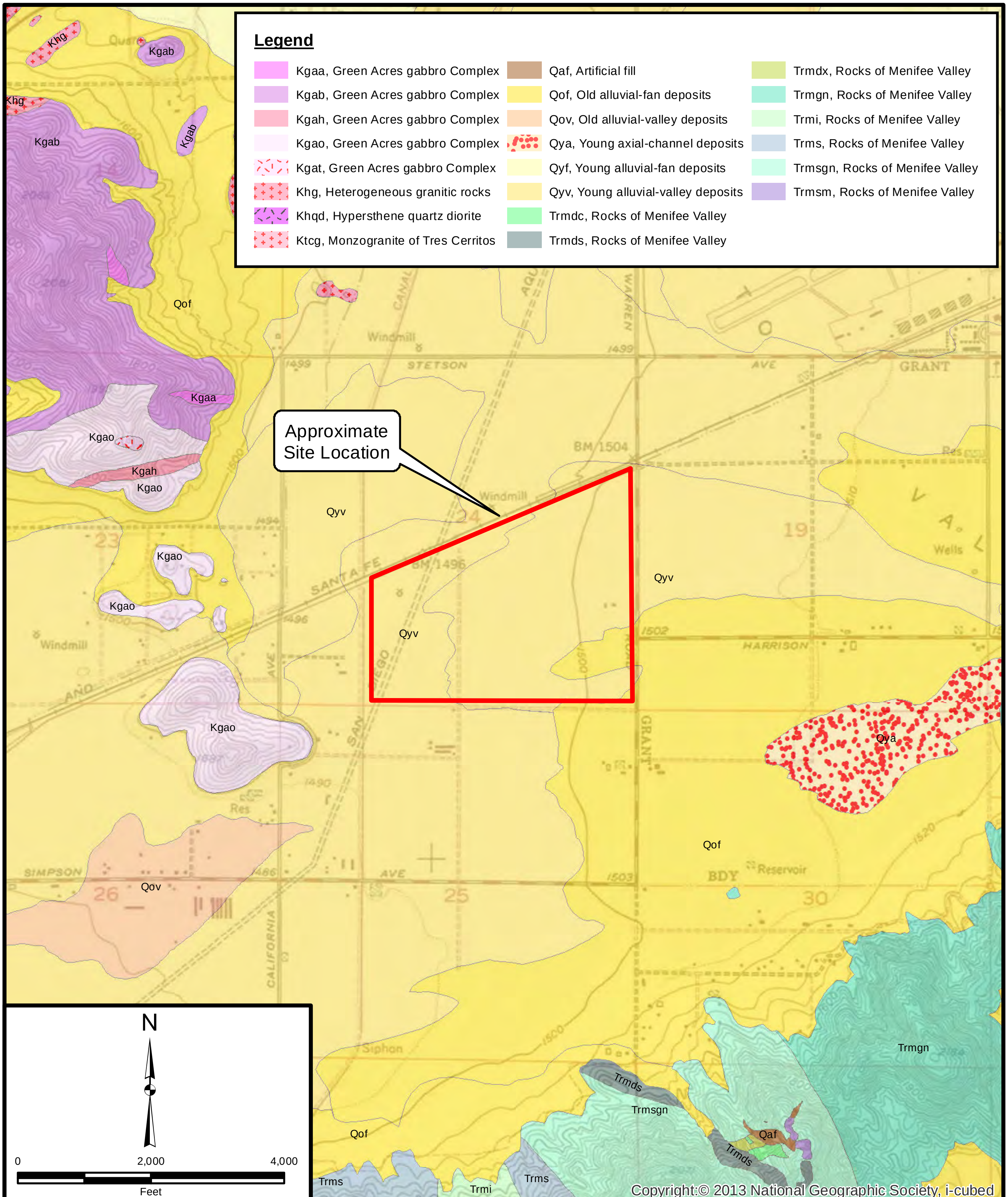

Project: 11061.001	Eng/Geol: SIS/RFR	REGIONAL GEOLOGY MAP	Figure 2
Scale: 1 " = 2,000 '	Date: August 2015	Rancho Diamante TTM 36841	Leighton
Base Map: ESRI ArcGIS Online 2015 Thematic Information: Leighton Author: Leighton Geomatics (mmurphy)		Hemet, California	

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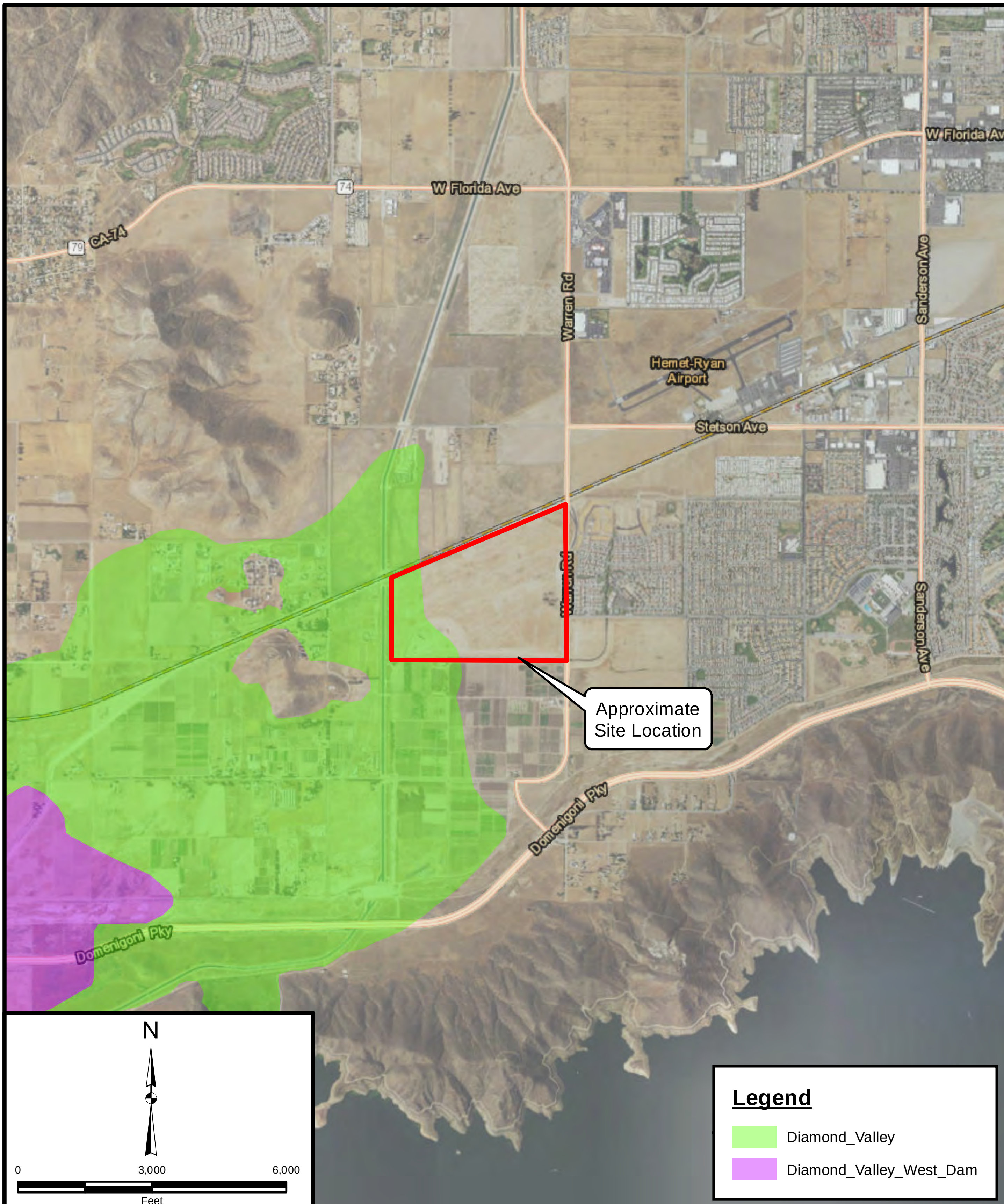

Project: 11061.001	Eng/Geol: SIS/RFR
Scale: 1 " = 3,000 '	Date: August 2015

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

DAM INUNDATION MAP

Rancho Diamante TTM 36841
Hemet, California

Figure 3

Leighton

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Project: 11061.001	Eng/Geol: SIS/RFR
Scale: 1 " = 400 '	Date: August 2015

Reference: Pangaea Land Consultants, Inc., 2015, Rancho Diamante, TM35394, Site Plan, Scale 1"=100', dated May 6, 2015.

Author: Leighton Geomatics (mmurphy)

BORING LOCATION MAP

Rancho Diamante TTM 36841
Hemet, California

Figure 4

Leighton

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A P P E N D I X A

FIELD EXPLORATION
LOGS OF EXPLORATORY BORINGS

GEOTECHNICAL BORING LOG B-1

Project No.	11061.001	**Date Drilled**	7-14-15
Project	Rancho Diamante	**Logged By**	BSS
Drilling Co.	Martini Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Auto Hammer - 30" Drop	**Ground Elevation**	1502'
Location	See Boring Location Map	**Sampled By**	BSS

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.

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-1				SM	**Quaternary Alluvium (Qal):** SILTY SAND, medium dense, brown, dry to moist, fine sand	SA, MD, EI, CR
1500										
				R-1	19 38 50-5"	122	6	SP-SC	Poorly graded SAND with CLAY, dense, olive brown, moist, fine sand, micaceous, trace clay	
	5			R-2	14 35 43				dense, grayish brown, dry to moist, fine sand, some mica (CO=1.5%)	CO
1495										
	10			R-3	16 43 50-4"	125	9		very dense, grayish brown, moist, fine to medium sand	
1490										
	15			R-4	6 13 22	120	11	SC-SM	SILTY, CLAYEY SAND, medium dense, brown, moist, fine sand, some mica	
1485										
	20			R-5	13 26 42			SM	SILTY SAND, dense, brown, moist, fine to medium sand	
1480										
	25			R-6	8 20 30	125	11		dense, light brown, moist, fine to medium sand, some clay, micaceous	
1475										
	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 B-1

Project No.	11061.001	**Date Drilled**	7-14-15
Project	Rancho Diamante	**Logged By**	BSS
Drilling Co.	Martini Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Auto Hammer - 30" Drop	**Ground Elevation**	1502'
Location	See Boring Location Map	**Sampled By**	BSS

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	19 40 50-4"			SP-SM	Poorly graded SAND with SILT, very dense, light brown, moist, fine to medium sand, some gravel	
1470										
	35			R-8	12 26 28	124	9		dense, brown, moist, fine to medium sand, some mica	
1465										
	40			R-9	12 12 15			SC	CLAYEY SAND, medium dense, dark grayish brown, moist, fine to medium sand, more sand in the top of sample	
1460										
	45			R-10	5 12 22	115	15		medium dense, dark brown, moist, fine sand, some mica	
1455										
	50			R-11	6 15 28			SP-SC	Poorly graded SAND with CLAY, medium dense, dark grayish brown, moist, fine to medium sand, some silt	
1450									Drilled to 50' Sampled to 51.5' Groundwater not encountered Backfilled with soil cuttings (7/14/15)	
	55									
1445										
	60									

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
- 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

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GEOTECHNICAL BORING LOG B-2

Project No.	11061.001	**Date Drilled**	7-14-15
Project	Rancho Diamante	**Logged By**	BSS
Drilling Co.	Martini Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Auto Hammer - 30" Drop	**Ground Elevation**	1503'
Location	See Boring Location Map	**Sampled By**	BSS

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.

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							SM	**Quaternary Alluvium (Qal):** SILTY SAND, loose, brown, dry to moist, fine to medium sand	
1500				R-1	16 50-5"	122	5		dense, light brown, dry to moist, fine sand, few gravel	
	5			R-2	22 46 47	127	4	SP-SM	Poorly graded SAND with SILT, dense, dark brown, dry to moist, fine to medium sand, some clay	
1495										
	10			R-3	9 14 18				medium dense, light brown, moist, fine to medium sand, some gravel and mica	
1490										
	15			R-4	17 20 26	114	3	SP	Poorly graded SAND, dense, light yellowish brown, dry to moist, fine to coarse sand with fine gravel, micaceous	
1485										
	20			R-5	10 21 28	121	12	SC-SM	SILTY, CLAYEY SAND, dense, dark brown, moist, fine sand, some mica, few gravel	
1480										
	25			R-6	8 18 24			SM	SILTY SAND, medium dense, brown, moist, fine to medium sand, micaceous, trace clay	
1475									Drilled to 25' Sampled to 26.5' Groundwater not encountered Backfilled with soil cuttings (7/14/15)	
	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

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GEOTECHNICAL BORING LOG B-3

Project No.	11061.001	**Date Drilled**	7-14-15
Project	Rancho Diamante	**Logged By**	BSS
Drilling Co.	Martini Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Auto Hammer - 30" Drop	**Ground Elevation**	1502'
Location	See Boring Location Map	**Sampled By**	BSS

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.

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							SM	**Quaternary Alluvium (Qal):** SILTY SAND, medium dense, brown, moist, fine sand	
1500				R-1	27 42 50	128	6		very dense, dark brown, dry to moist, fine sand	
	5			R-2	16 20 25	123	6	SM	dense, brown, moist, fine to medium sand, some clay (CO=1.7%)	CO
1495										
	10			R-3	6 10 13	105	13	SC-SM	SILTY, CLAYEY SAND, medium dense, light olive brown, moist, fine sand, micaceous (CO=2.3%)	CO
1490										
	15			R-4	4 7 11	111	17	ML	SANDY SILT, stiff, olive brown, moist, fine sand, some mica	
1485										
	20			R-5	10 16 23	121	10	SM	SILTY SAND, medium dense, brown, moist, fine to medium sand, some mica, trace clay	
1480										
	25			R-6	7 18 30			SC-SM	SILTY, CLAYEY SAND, dense, grayish brown, moist, fine to medium sand, micaceous	
1475									Drilled to 25' Sampled to 26.5' Groundwater not encountered Backfilled with soil cuttings (7/14/15)	
	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

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GEOTECHNICAL BORING LOG B-4

Project No.	11061.001	**Date Drilled**	7-14-15
Project	Rancho Diamante	**Logged By**	BSS
Drilling Co.	Martini Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Auto Hammer - 30" Drop	**Ground Elevation**	1500'
Location	See Boring Location Map	**Sampled By**	BSS

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.

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
1500	0			B-1				SM	**Quaternary Alluvium (Qal):** SILTY SAND, medium dense, brown, dry to moist, fine sand	
				R-1	13 19 37	113	7		dense, dark brown, dry to moist, fine sand, some clay	
1495	5			R-2	11 22 27	118	7		dense, brown, moist, fine to medium sand, some mica	
1490	10			R-3	4 10 16	105	11		medium dense, brown, moist, fine sand, some mica, few thin clay layers	
1485	15			R-4	7 11 15	119	13	SC	CLAYEY SAND, medium dense, dark brown, moist, fine sand, some mica	
1480	20			R-5	8 15 26			SC-SM	SILTY, CLAYEY SAND, medium dense, brown, moist, fine sand, micaceous	
1475	25			R-6	8 8 11				medium dense, grayish brown, moist, fine to medium sand	
								CL	SANDY Lean CLAY, stiff, dark grayish brown, moist, very fine sand, some mica	
									Drilled to 25' Sampled to 26.5' Groundwater not encountered Backfilled with soil cuttings (7/14/15)	
1470	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 B-5

Project No.	11061.001	**Date Drilled**	7-14-15
Project	Rancho Diamante	**Logged By**	BSS
Drilling Co.	Martini Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Auto Hammer - 30" Drop	**Ground Elevation**	1500'
Location	See Boring Location Map	**Sampled By**	BSS

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.

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
1500	0							SM	**Quaternary Alluvium (Qal):** SILTY SAND, medium dense, light brown, dry to moist, fine sand	
				R-1	20 38 35	121	3		dense, dark brown, moist, fine to medium sand	
1495	5			R-2	15 50-6"	107	11		very dense, brown, moist, fine sand, some mica	
1490	10			R-3	4 12 15			SC-SM	SILTY, CLAYEY SAND, medium dense, grayish brown, moist, fine to medium sand, (CO=1.3%)	CO
1485	15			R-4	6 16 26	122	11		medium dense, brown, moist, fine sand, micaceous	
1480	20			R-5	5 9 11	109	18	SC	CLAYEY SAND, medium dense, dark grayish brown, moist, fine sand, micaceous	
1475	25			R-6	5 9 12				medium dense, dark grayish brown, moist, very fine to fine sand, micaceous	
									Drilled to 25' Sampled to 26.5' Groundwater not encountered Backfilled with soil cuttings (7/14/15)	
1470	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

GEOTECHNICAL BORING LOG B-6

Project No.	11061.001	**Date Drilled**	7-14-15
Project	Rancho Diamante	**Logged By**	BSS
Drilling Co.	Martini Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Auto Hammer - 30" Drop	**Ground Elevation**	1501'
Location	See Boring Location Map	**Sampled By**	BSS

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.

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
1500	0							SC-SM	**Quaternary Alluvium (Qal):** SILTY, CLAYEY SAND, medium dense, brown, dry to moist, fine sand	
				R-1	11 25 45	124	3	SP-SM	Poorly graded SAND with SILT, dense, light brown, dry to moist, fine to medium sand, some gravel	
1495	5			R-2	16 26 50-5"	125	7		very dense, brown, moist, fine to medium sand, some clay	
1490	10			R-3	13 19 27	118	14	SC	CLAYEY SAND, dense, olive brown, moist, fine to medium sand, some mica	
1485	15			R-4	9 19 28			SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY), dense, grayish brown, moist, fine to medium sand, micaceous	
1480	20			R-5	13 18 26			SP	Poorly graded SAND, medium dense, light yellowish brown, moist, fine to coarse sand with fine gravel, micaceous	
1475	25			R-6	15 20 32				dense, light brown, moist, fine to coarse sand, micaceous, some silt	
									Drilled to 25' Sampled to 26.5' Groundwater not encountered Backfilled with soil cuttings (7/14/15)	
	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 B-7

Project No.	11061.001	**Date Drilled**	7-14-15
Project	Rancho Diamante	**Logged By**	BSS
Drilling Co.	Martini Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Auto Hammer - 30" Drop	**Ground Elevation**	1502'
Location	See Boring Location Map	**Sampled By**	BSS

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.

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-1				SM	**Quaternary Alluvium (Qal):** SILTY SAND, medium dense, light brown, dry, fine sand, some roots	SA, H, MD, CR
1500				R-1	22 32 43	123	1	SP	Poorly graded SAND, dense, light brown, dry to moist, fine to medium sand, some silt and gravel, micaceous	
	5			R-2	8 12 21	116	2		medium dense, light brown, moist, fine to coarse sand, micaceous	
1495										
	10			R-3	6 10 11	113	3		medium dense, light brown, dry to moist, fine to coarse sand with fine gravel, micaceous	
1490										
	15			R-4	12 19 22				medium dense, brown, moist, fine to medium sand, some silt, micaceous	
1485										
	20			R-5	11 15 23	111	8		medium dense, light brown, moist, fine to medium sand, some silt and gravel, micaceous	
1480										
	25			R-6	10 20 28				dense, brown, moist, fine to coarse sand, some gravel, micaceous	
1475									Drilled to 25' Sampled to 26.5' Groundwater not encountered Backfilled with soil cuttings (7/14/15)	
	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

GEOTECHNICAL BORING LOG B-8

Project No.	11061.001	**Date Drilled**	7-14-15
Project	Rancho Diamante	**Logged By**	BSS
Drilling Co.	Martini Drilling	**Hole Diameter**	8"
Drilling Method	Hollow Stem Auger - 140lb - Auto Hammer - 30" Drop	**Ground Elevation**	1502'
Location	See Boring Location Map	**Sampled By**	BSS

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.

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
1502	0							SP-SM	**Quaternary Alluvium (Qal):** Poorly graded SAND with SILT, medium dense, light brown, dry to moist, fine to medium sand	
1500										
	5			R-1	14 20 27	122	8	SM	SILTY SAND, dense, dark olive brown, moist, fine to medium sand, some mica	
1495										
	10			R-2	5 10 16	113	16	SC-SM	SILTY, CLAYEY SAND, medium dense, olive brown, moist, fine sand, some mica	
1490										
	15			R-3	9 19 23	119	11		medium dense, olive brown, moist, fine to medium sand, some mica	
1485									Drilled to 15' Sampled to 16.5' Groundwater not encountered Backfilled with soil cuttings (7/14/15)	
	20									
1480										
	25									
1475										
	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

GEOTECHNICAL BORING LOG B-5

Date 12-29-03 **Sheet** 1 **of** 2
Project Pulte Rancho Diamante **Project No.** 111116-001
Drilling Co. Cal Pac **Type of Rig** B53
Hole Diameter 8" **Drive Weight** 140 lbs **Drop** 30"
Elevation Top of Hole +/- 1507' **Location** See Map

Logged By SER
Sampled By SER

Elevation Feet	Depth Feet	Notes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0	Bulk 3 @0-5'					SM	DISCED/TILLED ZONE @ Surface: Brown, very moist, loose, silty, fine to coarse SAND; abundant rootlets	MD
1505							SM	QUATERNARY ALLUVIUM (Qal) @ 1.5': Yellow-brown, moist, medium dense, silty, fine to medium SAND	
			1	36	90.6	15.1		@ 2.5': Yellow-brown, moist, medium dense to dense, silty, fine to medium SAND; non-porous	
	5		2	41	124.7	5.5		@ 5': Dark brown to brown, moist, dense, silty, very fine to medium SAND; non-porous, scattered root hairs, mottling present	HCO, -200
1500			4	30	121.3	3.6		@ 7.5': Dark brown to brown, moist, medium dense, silty, very fine to medium SAND	HCO
	10			20				@ 10': Yellow-brown, damp to moist, medium dense, silty, very fine to medium SAND	
1495			5	17			SM	@ 12.5': Brown, damp, medium dense, fine to coarse, silty SAND; friable	-200
	15			51				@ 15': Yellow-brown, moist, very dense, silty, fine to medium SAND	
1490									
	20		6	15			SP	@ 20': Brown, damp, medium dense, fine to coarse SAND; friable	-200
1485									
	25		7	27	102.6	5.4		@ 25': Yellow-brown to brown, damp, medium dense, fine to medium SAND; friable	
1480									
	30								

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

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

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL BORING LOG B-5

Date 12-29-03 | Sheet 2 of 2
Project Pulte Rancho Diamante | Project No. 111116-001
Drilling Co. Cal Pac | Type of Rig B53
Hole Diameter 8" | Drive Weight 140 lbs | Drop 30"
Elevation Top of Hole +/- 1507' | Location See Map

Logged By SER
Sampled By SER

Elevation Feet	Depth Feet	Graphic Log (N S)	Notes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	30			8	19			SP/SM	@ 30': Light brown, damp, medium dense, fine to coarse SAND with silt; highly friable	-200
1475										
	35			9	27	114.3	7.4	SM	@ 35': Gray-brown, damp, medium dense, silty, fine to medium SAND	
1470										
	40			10	18			SC/SM	@ 40': Brown, moist, stiff, silty, clayey SAND	AL, -200
1465										
	45			11	21	117.5	14.5		@ 45': Gray-brown, moist, stiff, sandy SILT	
1460										
	50			12	19				@ 50': Gray-brown, moist, stiff, sandy SILT	
1455										
	55								Total Depth 52' No Groundwater Encountered Backfilled with Native 12-29-03	
1450										
	60									

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

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

LEIGHTON AND ASSOCIATES, INC.

GEOTECHNICAL TEST PIT LOG TP-8

Date 5-8-07 **Sheet** 1 **of** 1
Project Rancho Diamante - Geotechnical Investigation **Project No.** 112177-001
Equipment Co. **Type of Rig** Cat 4200 Backhoe
Bucket Size " **Drive Weight** **Drop** "
Elevation Top of Hole +/- ' **Location** See Geotechnical Map

Logged By ELM
Sampled By ELM

Elevation Feet	Depth Feet	Graphic Log (N S)	Notes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0							SP	TOPSOIL @ 0-1.5': SAND, tan, dry, loose; roots	
								SM	QUATERNARY ALLUVIUM (Qal) @ 1.5-6': Silty SAND with clay, tan, moist, dense	
	5			R10		117.0	7.0			MD
									Total Depth 6 ft No Groundwater Encountered Backfilled 5/8/07	
	10									
	15									
	20									
	25									
	30									

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

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

Leighton

GEOTECHNICAL TEST PIT LOG TP-9

Date 5-8-07 **Sheet** 1 **of** 1
Project Rancho Diamante - Geotechnical Investigation **Project No.** 112177-001
Equipment Co. **Type of Rig** Cat 4200 Backhoe
Bucket Size " **Drive Weight** **Drop** "
Elevation Top of Hole +/- ' **Location** See Geotechnical Map

Logged By ELM
Sampled By ELM

Elevation Feet	Depth Feet	Graphic Log (N S)	Notes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0							SP	TOPSOIL @ 0-1': Fine SAND, tan, dry, loose to medium dense; roots	
								SM	QUATERNARY ALLUVIUM (Qal) @ 1-7': Silty, fine SAND with clay, tan, moist, dense	
	5									
									Total Depth 7 ft No Groundwater Encountered Backfilled 5/8/07	
	10									
	15									
	20									
	25									
	30									

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

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

Leighton

GEOTECHNICAL TEST PIT LOG TP-10

Date 5-8-07 | Sheet 1 of 1
Project Rancho Diamante - Geotechnical Investigation | Project No. 112177-001
Equipment Co. | Type of Rig Cat 4200 Backhoe
Bucket Size " | Drive Weight | Drop "
Elevation Top of Hole +/- ' | Location See Geotechnical Map

Elevation Feet	Depth Feet	Graphic Log (N S)	Notes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION Logged By ELM Sampled By ELM	Type of Tests
	0							ML	TOPSOIL @ 0-1': Sandy SILT, tan, dry, loose; roots	
								SP/SM	QUATERNARY ALLUVIUM (Qal) @ 1-9.5': Fine to coarse SAND, tan, moist, dense; trace silt	
	5									
				B12						HD, SA
	10								Total Depth 9.5 ft No Groundwater Encountered Backfilled 5/8/07	
	15									
	20									
	25									
	30									

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

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

Leighton

GEOTECHNICAL TEST PIT LOG TP-11

Date	5-8-07	**Sheet**	1 **of** 1
Project	Rancho Diamante - Geotechnical Investigation	**Project No.**	112177-001
Equipment Co.		**Type of Rig**	Cat 4200 Backhoe
Bucket Size	"	**Drive Weight**	**Drop** "
Elevation Top of Hole +/-	'	**Location**	See Geotechnical Map

DESCRIPTION

Logged By ELM
Sampled By ELM

Elevation Feet	Depth Feet	Graphic Log (N S)	Notes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	Description	Type of Tests
	0							ML	TOPSOIL @ 0-1': Sandy SILT, tan, dry, loose to medium dense; roots	
								SM	QUATERNARY ALLUVIUM (Qal) @ 1-5': Silty, fine SAND with clay, tan, moist, very dense	
	5			R13		109.0*	5.1			HCO
									Refusal @ 5 ft No Groundwater Encountered Backfilled 5/8/07 *Field dry density by Nuclear Gauge corrected for moisture content	
	10									
	15									
	20									
	25									
	30									

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

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

Leighton

GEOTECHNICAL TEST PIT LOG TP-12

Date 5-8-07 **Sheet** 1 **of** 1
Project Rancho Diamante - Geotechnical Investigation **Project No.** 112177-001
Equipment Co. **Type of Rig** Cat 4200 Backhoe
Bucket Size " **Drive Weight** **Drop** "
Elevation Top of Hole +/- ' **Location** See Geotechnical Map

Logged By ELM
Sampled By ELM

Elevation Feet	Depth Feet	Graphic Log (N S)	Notes	Sample No.	Blows Per Foot	Dry Density pcf	Moisture Content, %	Soil Class. (U.S.C.S.)	DESCRIPTION	Type of Tests
	0							ML	TOPSOIL @ 0-1.5': SILT, tan, dry, loose; roots	
								ML	QUATERNARY ALLUVIUM (Qal) @ 1.5-9': SILT, tan, moist, stiff	
	5									
	10								Total Depth 9 ft No Groundwater Encountered Backfilled 5/8/07	
	15									
	20									
	25									
	30									

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

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

Leighton

PROJECT NO. 20106-12-01

BORING B 6

ELEV. (MSL.) 1509 DATE COMPLETED 8/2/02

EQUIPMENT CME 55 8" HOLLOW STM

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	B6-1				**ALLUVIUM** Dense to very dense, dry, light brown, very Sandy SILT to Silty, very fine to fine SAND, micaceous			
2					-Becomes very dense, dry to damp at 2 feet			
	B6-2			ML/SM		50/6"	135.2	7.8
4								
6	B6-3				-Becomes medium dense	27	115.3	3.1
8								
	B6-4				Medium dense, dry to damp, light brown, fine to medium SAND, trace silt, coarse sand	22	112.9	2.1
10								
12								
14								
	B6-5			SP	-Loose	8		
16								
18								
20	B6-6					18	110.2	6.5
					-Damp, medium dense			
22								
24								
	B6-7					25		
26								
28								
					-Becomes damp to moist			

Figure A-8, Log of Boring B 6

BD

SAMPLE SYMBOLS
☐ ... SAMPLING UNSUCCESSFUL ◧ ... STANDARD PENETRATION TEST ■ ... DRIVE SAMPLE (UNDISTURBED)
⊠ ... DISTURBED OR BAG SAMPLE ◪ ... CHUNK SAMPLE ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 20106-12-01

BORING B 6

ELEV. (MSL.) 1509 DATE COMPLETED 8/2/02

EQUIPMENT CME 55 8" HOLLOW STM

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
30	B6-8			SM	Medium dense, damp, medium brown, Silty, fine to medium SAND	24		
32	B6-9							
34	B6-10			SP/SM	Becomes moist to damp, silt content increases slightly Silty SAND	40	111.0	10.4
40	B6-11					42		
44	B6-12					33		
48				ML	Stiff, damp to moist, medium brown, SILT, micaceous, trace fine sand			
50	B6-13					20		
					BORING TERMINATED AT 51.5 FEET			

Figure A-9, Log of Boring B 6

BD

SAMPLE SYMBOLS ☐ ... SAMPLING UNSUCCESSFUL ◧ ... STANDARD PENETRATION TEST ■ ... DRIVE SAMPLE (UNDISTURBED) ⊠ ... DISTURBED OR BAG SAMPLE ◪ ... CHUNK SAMPLE ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 20106-12-01

BORING B 7

ELEV. (MSL.) 1504 DATE COMPLETED 8/6/02

EQUIPMENT CME 55 8" HOLLOW STM

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**ALLUVIUM** Very dense, dry, medium brown, Silty, very fine to fine SAND			
2	B7-1					72/11"		
					-Becomes dense, damp			
4								
	B7-2				-Some medium sand in few lenses	53	121.5	2.5
6								
	B7-3			SM		21	119.5	9.1
8					-Becomes medium dense			
10	B7-4					25	118.0	5.4
12								
14								
	B7-5					12		
16								
18								
20	B7-6			SP	-At 20 feet <1 foot thick lense of dense, moist, light brown, fine to medium SAND, trace silt	37	119.1	5.7

BORING TERMINATED AT 21 FEET

Figure A-10, Log of Boring B 7

BD

SAMPLE SYMBOLS
- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 20106-12-01

TRENCH T 26

ELEV. (MSL.) 1504 DATE COMPLETED 8/8/02

EQUIPMENT CASE 580 W/24" BUCKT

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					**ALLUVIUM**			
					Medium stiff, dry, brown, very fine Sandy SILT			
2				ML	-At 2 feet becomes medium dense to dense, damp			
4					-Sand content increases, becomes hard to excavate			
					TRENCH TERMINATED AT 5 FEET			

Figure A-44, Log of Trench T 26

BD

SAMPLE SYMBOLS
- ☐ ... SAMPLING UNSUCCESSFUL
- ◧ ... STANDARD PENETRATION TEST
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ⊠ ... DISTURBED OR BAG SAMPLE
- ◪ ... CHUNK SAMPLE
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 20106-12-01

TRENCH T 32

ELEV. (MSL.) 1503 DATE COMPLETED 8/8/02

EQUIPMENT CASE 580 W/24" BUCKT

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				ML	**ALLUVIUM** Stiff, dry, brown, SILT, some very fine to fine sand, rootlets			
2 – 6				ML/SM	Dense, damp, brown, Silty, very fine to fine SAND to a very fine to fine Sandy SILT			
6					TRENCH TERMINATED AT 6 FEET			

Figure A-50, Log of Trench T 32

BD

SAMPLE SYMBOLS			
	... SAMPLING UNSUCCESSFUL	... STANDARD PENETRATION TEST	... DRIVE SAMPLE (UNDISTURBED)
	... DISTURBED OR BAG SAMPLE	... CHUNK SAMPLE	... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

PROJECT NO. 20106-12-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 33 ELEV. (MSL.) 1504 DATE COMPLETED 8/8/02 EQUIPMENT CASE 580 W/24" BUCKT	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0 2				ML/SM	**ALLUVIUM** Loose, dry, Silty, very fine to fine SAND to very fine to fine Sandy SILT, rootlets -At 1 foot becomes damp, dense			
4 6				SM/SP	Dense, damp, brown to olive brown, Silty, very fine to fine SAND, trace medium to coarse sand -Becomes harder to excavate with depth			
					TRENCH TERMINATED AT 7 FEET			

Figure A-51, Log of Trench T 33

BD

SAMPLE SYMBOLS
- ☐ ... SAMPLING UNSUCCESSFUL
- ▧ ... DISTURBED OR BAG SAMPLE
- ◧ ... STANDARD PENETRATION TEST
- ◪ ... CHUNK SAMPLE
- ■ ... DRIVE SAMPLE (UNDISTURBED)
- ▼ ... WATER TABLE OR SEEPAGE

NOTE: THE LOG OF SUBSURFACE CONDITIONS SHOWN HEREON APPLIES ONLY AT THE SPECIFIC BORING OR TRENCH LOCATION AND AT THE DATE INDICATED. IT IS NOT WARRANTED TO BE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT OTHER LOCATIONS AND TIMES.

APPENDIX B

RESULTS OF GEOTECHNICAL LABORATORY TESTING

MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Leighton

Project Name:	RDI / TT36841	Tested By :	F. Mina	Date:	7/31/15
Project No.:	11061.001	Input By :	M. Vinet	Date:	8/11/15
Exploration No.:	B-1	Depth (ft.)	0 - 5.0		
Sample No. :	B-1				
Soil Identification:	Silty Sand (SM), brown.				

Preparation Method: [X] Moist [ ] Dry

[ ] Mechanical Ram [X] Manual Ram

Mold Volume (ft³) 0.03330

Ram Weight = 10 lb.; Drop = 18 in.

Moisture Added (ml)	0	50	100	150		
TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	6182	6323	6406	6413		
Weight of Mold (g)	4250	4250	4250	4250		AS REC'D
Net Weight of Soil (g)	1932	2073	2156	2163		MOISTURE
Wet Weight of Soil + Cont. (g)	727.0	481.5	665.3	582.6		717.0
Dry Weight of Soil + Cont. (g)	714.0	467.3	625.0	540.2		692.5
Weight of Container (g)	409.0	231.0	152.3	152.3		163.3
Moisture Content (%)	4.3	6.0	8.5	10.9		4.6
Wet Density (pcf)	127.9	137.2	142.7	143.2		
Dry Density (pcf)	122.7	129.5	131.5	129.1		

Maximum Dry Density (pcf) 131.9 **Optimum Moisture Content (%)** 7.8

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

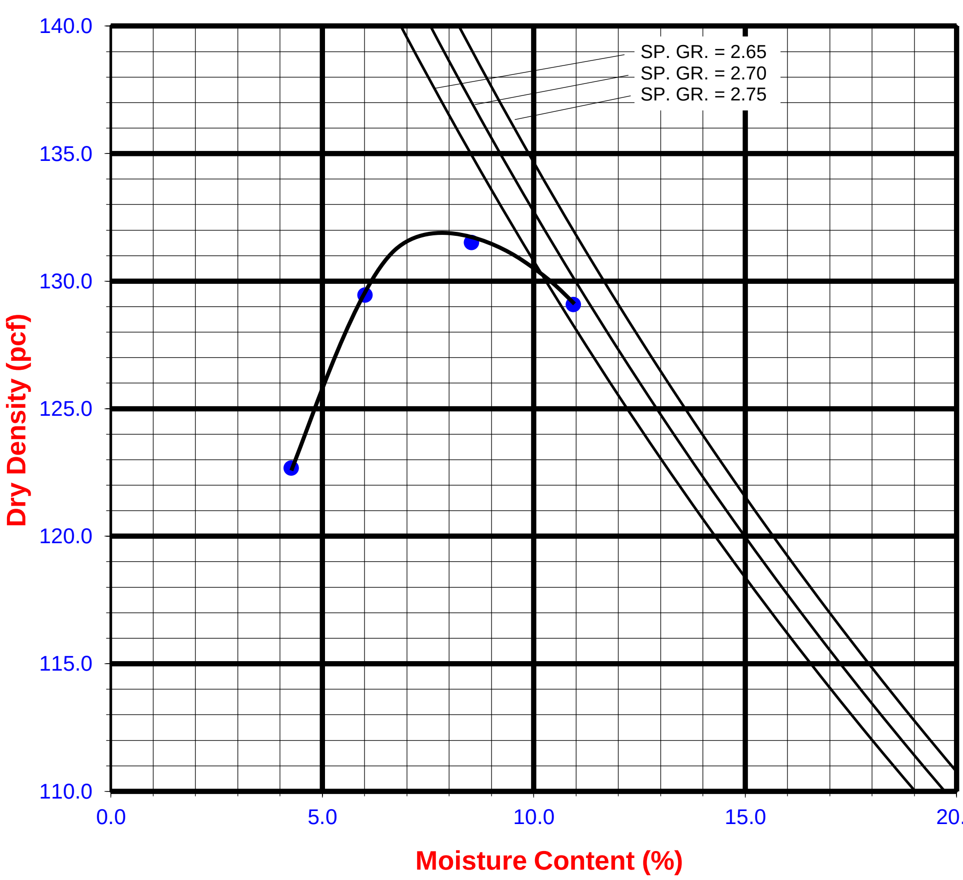
[ ] **Procedure B**
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
Use if +#4 is >20% and +3/8 in. is 20% or less

[ ] **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:
0:69:31
GR:SA:FI

Atterberg Limits:

LL,PL,PI



MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Leighton

Project Name:	RDI / TT36841	Tested By :	F. Mina	Date:	8/5/15
Project No.:	11061.001	Input By :	M. Vinet	Date:	8/11/15
Exploration No.:	B-7	Depth (ft.)	0 - 5.0		
Sample No. :	B-1				
Soil Identification:	Silty Sand (SM), brown.				

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

Mold Volume (ft³) 0.03330 *Ram Weight = 10 lb.; Drop = 18 in.*

Moisture Added (ml)	50	100	150	200		
TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	6294	6394	6408	6334		
Weight of Mold (g)	4250	4250	4250	4250		AS REC'D
Net Weight of Soil (g)	2044	2144	2158	2084		MOISTURE
Wet Weight of Soil + Cont. (g)	593.8	1265.3	1047.8	365.6		679.3
Dry Weight of Soil + Cont. (g)	581.6	1246.0	1018.0	338.2		666.3
Weight of Container (g)	312.4	946.3	672.8	81.0		152.1
Moisture Content (%)	4.5	6.4	8.6	10.7		2.5
Wet Density (pcf)	135.3	141.9	142.9	138.0		
Dry Density (pcf)	129.5	133.4	131.5	124.7		

Maximum Dry Density (pcf) 133.7 **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

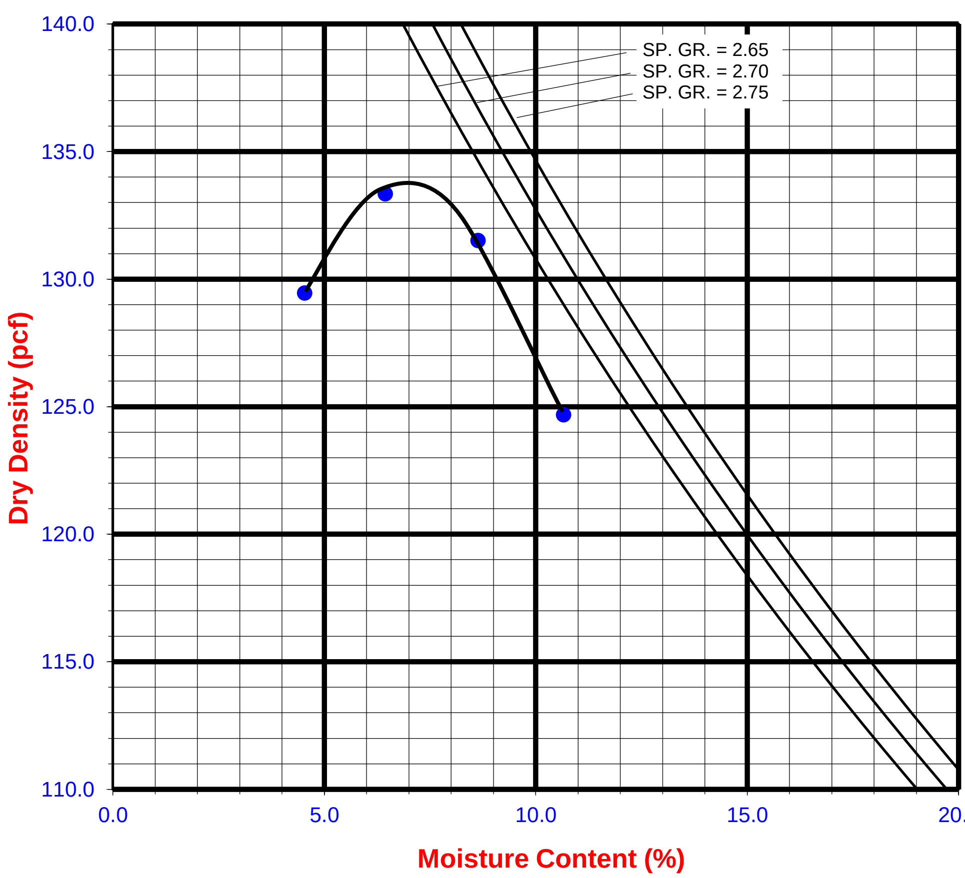
[ ] **Procedure B**
Soil Passing 3/8 in. (9.5 mm) Sieve
Mold : 4 in. (101.6 mm) diameter
Layers : 5 (Five)
Blows per layer : 25 (twenty-five)
Use if +#4 is >20% and +3/8 in. is 20% or less

[ ] **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:
4:70:26
GR:SA:FI

Atterberg Limits:

LL,PL,PI



PARTICLE-SIZE DISTRIBUTION (GRADATION) of SOILS USING SIEVE ANALYSIS
ASTM D 6913

Leighton

Project Name:	RDI / TT36841	Tested By:	FLM	Date:	07/31/15
Project No.:	11061.001	Checked By:	MRV	Date:	08/11/15
Exploration No.:	B-1	Depth (feet):	0 - 5.0		
Sample No.:	B-1				
Soil Identification:	Silty Sand (SM), brown.				

		Moisture Content of Total Air - Dry Soil	
Container No.:	Z	Wt. of Air-Dry Soil + Cont. (g)	811.1
Wt. of Air-Dried Soil + Cont.(g)	811.1	Wt. of Dry Soil + Cont. (g)	793.4
Wt. of Container (g)	418.6	Wt. of Container No.______ (g)	418.6
Dry Wt. of Soil (g)	374.8	Moisture Content (%)	4.7

After Wet Sieve	Container No.	Z
	Wt. of Dry Soil + Container (g)	680.5
	Wt. of Container (g)	418.6
	Dry Wt. of Soil Retained on # 200 Sieve (g)	261.9

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
3"	75.000		100.0
1"	25.000		100.0
3/4"	19.000		100.0
1/2"	12.500		100.0
3/8"	9.500		100.0
#4	4.750	0.0	100.0
#8	2.360	8.1	97.8
#16	1.180	24.3	93.5
#30	0.600	57.5	84.7
#50	0.300	124.8	66.7
#100	0.150	203.4	45.7
#200	0.075	258.6	31.0
PAN			

GRAVEL: **0 %**

SAND: **69 %**

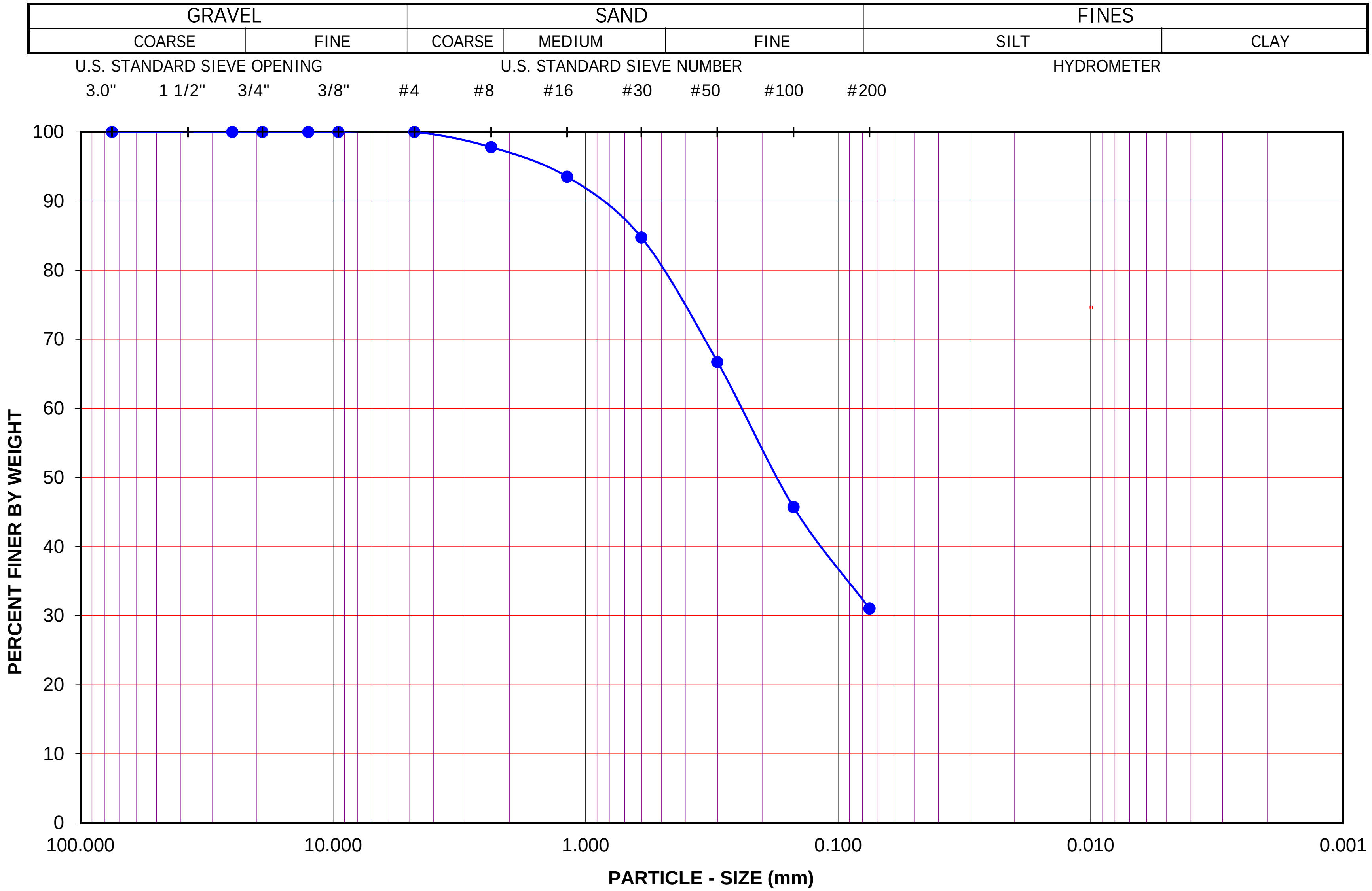
FINES: **31 %**

GROUP SYMBOL: **SM**

Cu = D60/D10 = N/A

Cc = $(D30)^2/(D60*D10)$ = N/A

Remarks:



Project Name: RDI / TT36841

Project No.: 11061.001

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 6913

Exploration No.: B-1 | Sample No.: B-1

Depth (feet): 0 - 5.0 | Soil Type : SM

Soil Identification: Silty Sand (SM), brown.

GR:SA:FI : (%) 0 : 69 : 31

Aug-15

Sieve; B-1, B-1 (7-14-15)

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Leighton

Project Name:	RDI / TT36841	Tested By :	FLM/MRV	Date:	08/07/15
Project No. :	11061.001	Data Input By:	MRV	Date:	08/11/15
Boring No.:	B-7	Checked By:	MRV	Date:	08/11/15
Sample No.:	B-1	Depth (ft.) :	0 - 5.0		

Visual Sample Description: Silty Sand (SM), brown.

				Hygroscopic Moisture Content of Soils Passing #10	Corrected Weight of Air-Dry Soil Passing #10	After Hydrometer & wet sieve ret. on #200 sieve
Liquid Limit:	N/A	LL,PL,PI:	N/A			
Plastic Limit:	N/A	GR:SA:FI:	4:70:26			
Plasticity Index:	N/A	Grp. Symbol:	SM			
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(gm.)		53.26	**	**
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (gm.)		53.26	99.74	72.00
Wt.of Air-Dry Soil + Cont. (gm.)	513.9	Wt. of Container No.___ (gm.)		35.95	**	0.00
Wt. of Container	0.0	Moisture Content (%)		0.0	**	**
Dry Wt. of Soil (gm.)	513.90	Wt. of Dry Soil (gm.)		17.31	99.74	72.00

Coarse Sieve

U.S. Sieve Size	Cumulative Wt.of Dry Soil Retained(gm)	% Passing
3"	0.0	100.0
1½"	0.0	100.0
3/4"	0.0	100.0
3/8"	0.0	100.0
No. 4	18.5	96.4
No. 10	60.7	88.2
Pan		

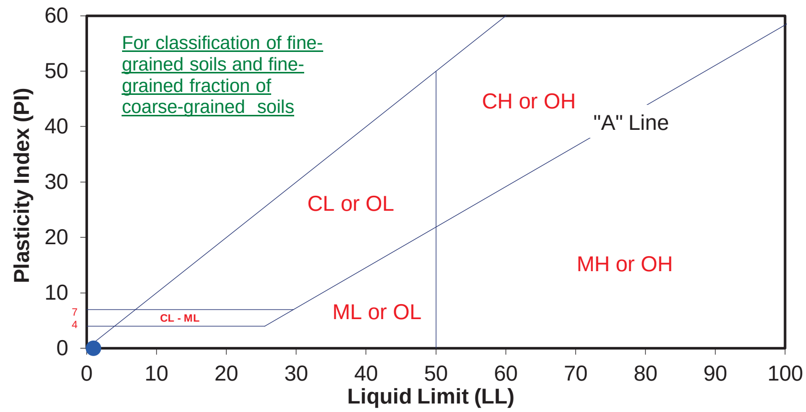
Sieve after Hydrometer & Wet Sieve

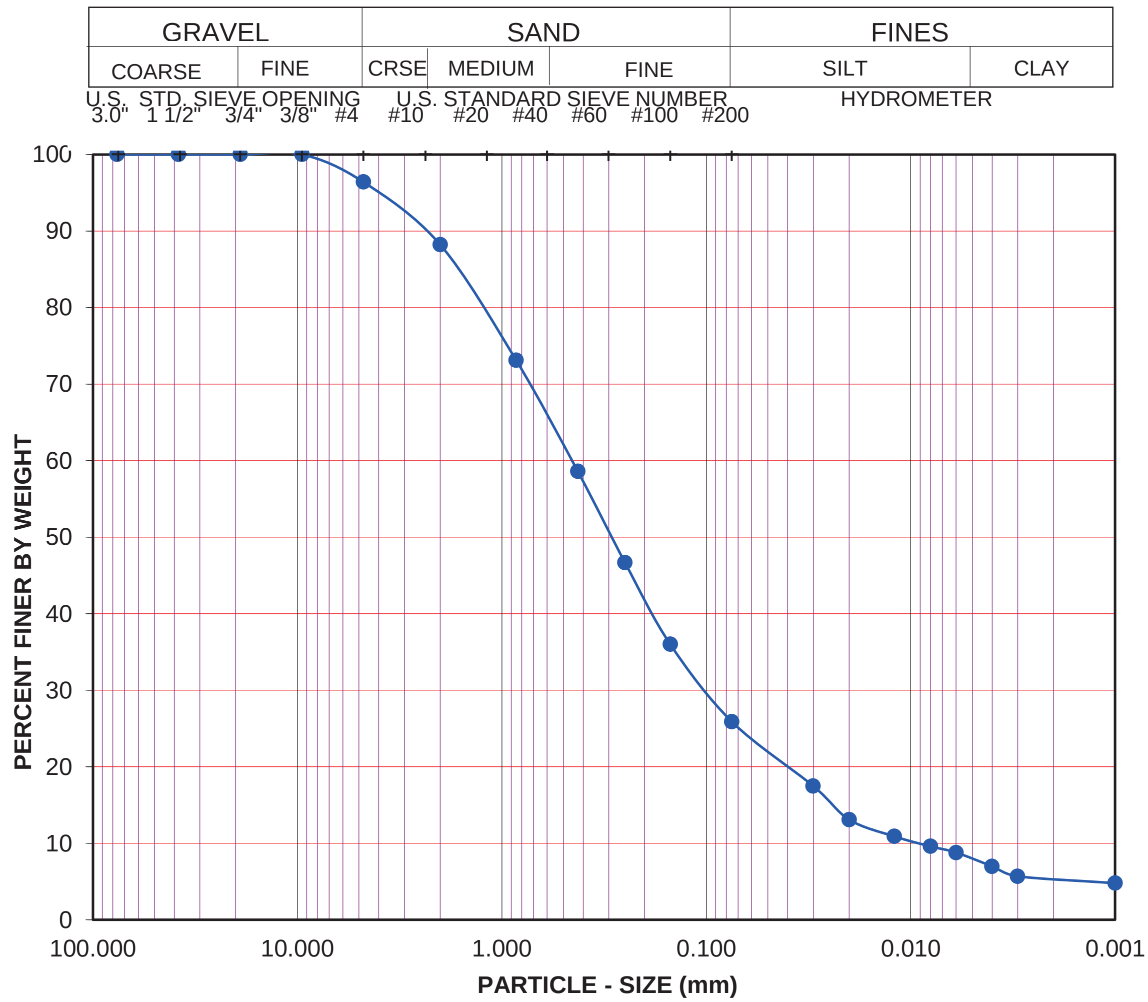
U.S. Sieve Size	Cumulative Wt. of Dry Soil Retained (gm)	% Passing	% Total Sample
No. 10	0.0	100.0	88.2
No. 20	17.0	82.9	73.1
No. 40	33.5	66.4	58.6
No. 60	47.0	52.9	46.7
No. 100	59.0	40.8	36.0
No. 200	70.4	29.4	25.9
Pan			

Hydrometer Wt. of Air-Dry Soil (gm) 99.7 Wt. of Dry Soil (gm) 99.7

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°c)	Composite Correction 152 H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
8/7/15	9:36	0	27	5.0			
	9:38	2	27	5.0	25.0	17.5	0.030
	9:41	5	27	5.0	20.0	13.1	0.020
	9:51	15	27	5.0	17.5	10.9	0.012
	10:06	30	27	5.0	16.0	9.6	0.008
	10:36	60	27	5.0	15.0	8.8	0.006
	11:36	120	27	5.0	13.0	7.0	0.004
	13:46	250	27	5.0	11.5	5.7	0.003
8/8/15	9:36	1440	27	5.0	10.5	4.8	0.001





Boring No.	Sample No.	Depth (ft.)	Soil Type	GR:SA:FI (%)	LL,PL,PI
B-7	B-1	0 - 5.0	SM	4:70:26	N/A

Sample Description:

Silty Sand (SM), brown.

Project No.: 11061.001

RDI / TT36841

Leighton

ATTERBERG LIMITS, PARTICLE - SIZE CURVE

ASTM D 4318, D 422

Rev. 08-04

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

Leighton

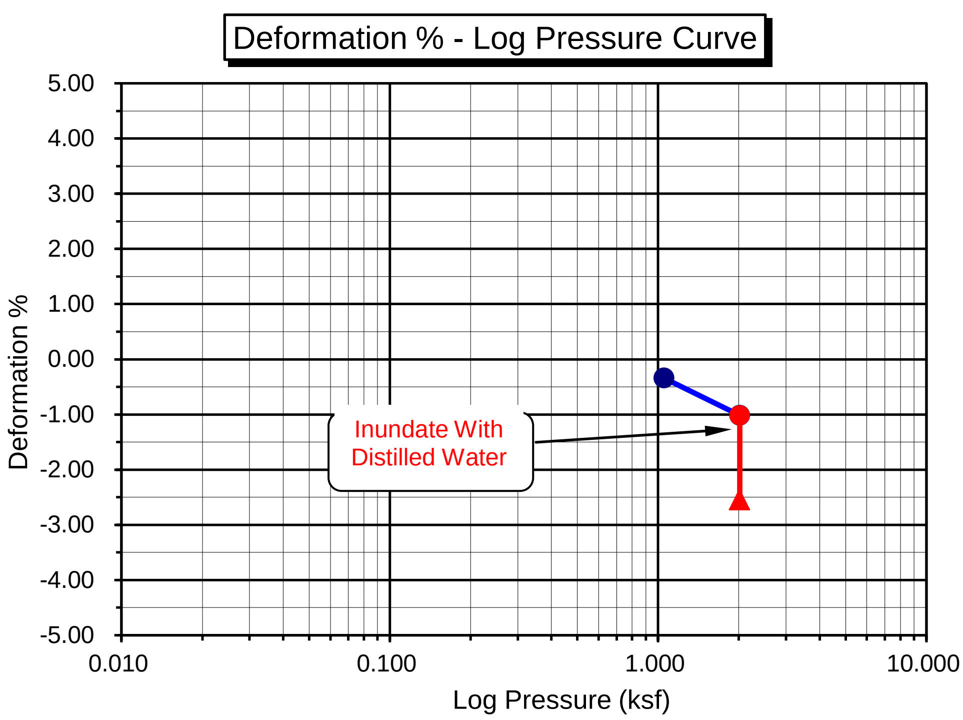
Project Name: RDI / TT36841 Tested By: F. Mina Date: 8/5/15
Project No.: 11061.001 Checked By: M. Vinet Date: 8/11/15
Boring No.: B-1 Sample Type: IN SITU
Sample No.: R-2 Depth (ft.) 5.0
Sample Description: Silty Sand (SM), brown.
Source and Type of Water Used for Inundation: Arrowhead (Distilled)
** Note: Loading After Wetting (Inundation) not Performed Using this Test Method.

Initial Dry Density (pcf):	116.4
Initial Moisture (%):	8.7
Initial Height (in.):	0.9950
Initial Dial Reading (in):	0.0500
Inside Diameter of Ring (in):	2.410

Final Dry Density (pcf):	121.3
Final Moisture (%) :	11.6
Initial Void ratio:	0.4482
Specific Gravity (assumed):	2.70
Initial Degree of Saturation (%):	52.2

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
1.050	0.0584	0.9916	0.00	-0.34	0.4433	-0.34
2.013	0.0651	0.9849	0.00	-1.02	0.4335	-1.02
H2O	0.0804	0.9696	0.00	-2.55	0.4113	-2.55

Percent Swell / Settlement After Inundation = -1.55



Rev. 01-10

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

Leighton

Project Name: RDI / TT36841	Tested By: F. Mina	Date:	8/5/15
Project No.: 11061.001	Checked By: M. Vinet	Date:	8/11/15
Boring No.: **B-3**	Sample Type: IN SITU		
Sample No.: **R-2**	Depth (ft.) 5.0		

Sample Description: Silty Sand (SM), brown.

Source and Type of Water Used for Inundation: Arrowhead (Distilled)

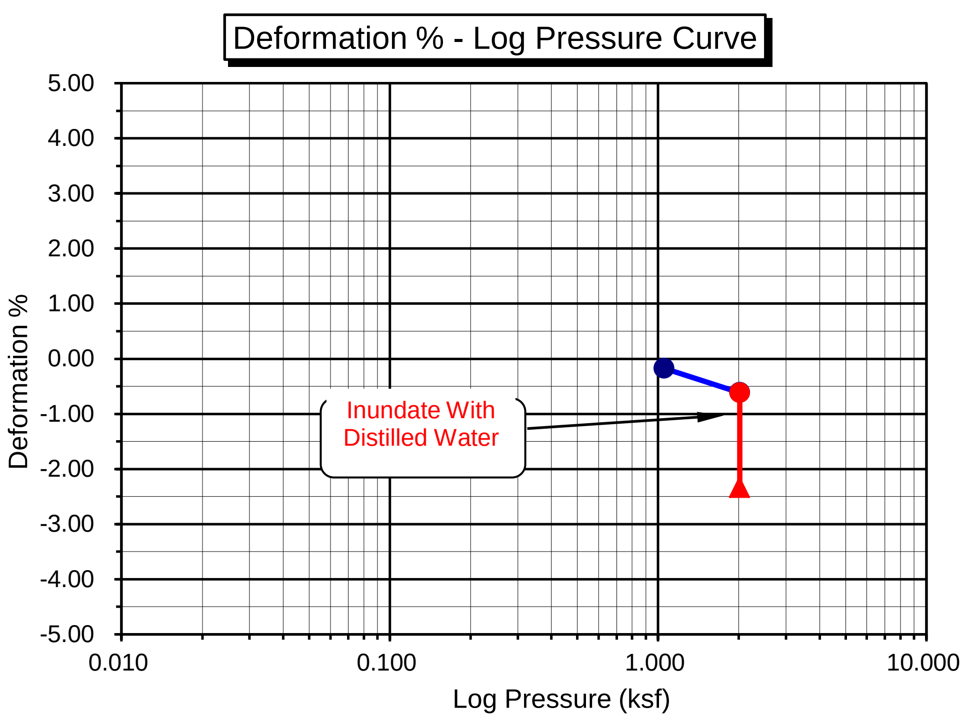
** Note: Loading After Wetting (Inundation) not Performed Using this Test Method.

Initial Dry Density (pcf):	117.8
Initial Moisture (%):	6.1
Initial Height (in.):	0.9950
Initial Dial Reading (in):	0.0500
Inside Diameter of Ring (in):	2.417

Final Dry Density (pcf):	121.8
Final Moisture (%) :	13.0
Initial Void ratio:	0.4307
Specific Gravity (assumed):	2.70
Initial Degree of Saturation (%):	38.0

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
1.050	0.0567	0.9933	0.00	-0.17	0.4282	-0.17
2.013	0.0611	0.9889	0.00	-0.61	0.4219	-0.61
H2O	0.0783	0.9717	0.00	-2.34	0.3972	-2.34

Percent Swell / Settlement After Inundation = -1.74



Rev. 01-10

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

Leighton

Project Name:	RDI / TT36841	Tested By:	F. Mina	Date:	8/6/15
Project No.:	11061.001	Checked By:	M. Vinet	Date:	8/11/15
Boring No.:	B-3	Sample Type:	IN SITU		
Sample No.:	R-3	Depth (ft.)	10.0		

Sample Description: Poorly Graded Sand with Silt (SP-SM), brown.

Source and Type of Water Used for Inundation: Arrowhead (Distilled)

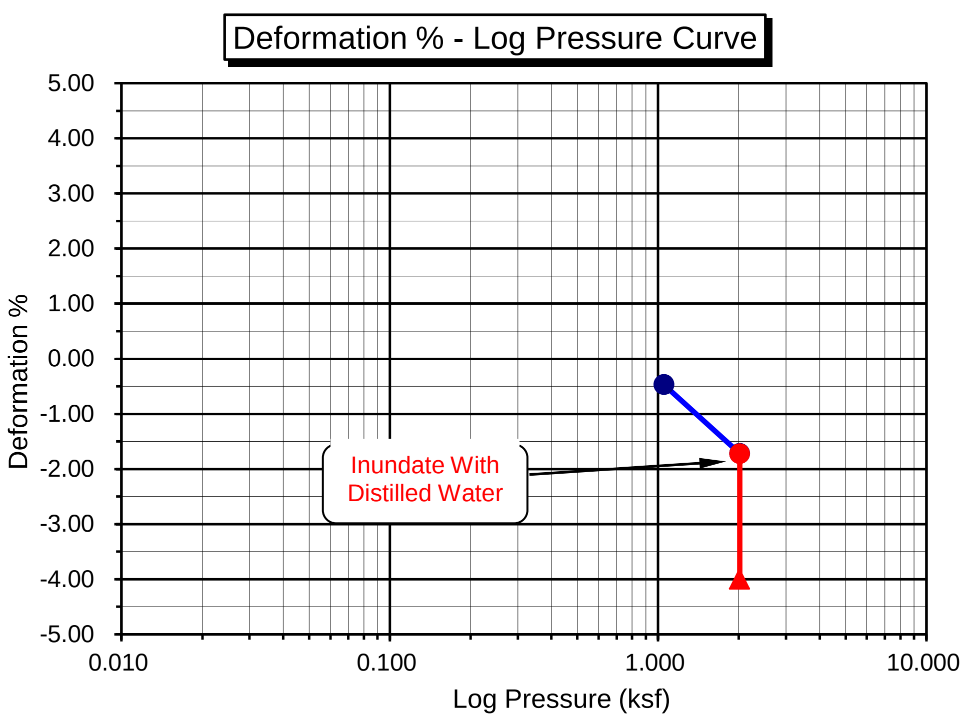
** Note: Loading After Wetting (Inundation) not Performed Using this Test Method.

Initial Dry Density (pcf):	100.5
Initial Moisture (%):	12.1
Initial Height (in.):	0.9820
Initial Dial Reading (in):	0.0500
Inside Diameter of Ring (in):	2.408

Final Dry Density (pcf):	109.4
Final Moisture (%) :	19.7
Initial Void ratio:	0.6771
Specific Gravity (assumed):	2.70
Initial Degree of Saturation (%):	48.2

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
1.050	0.0726	0.9774	0.00	-0.47	0.6692	-0.47
2.013	0.0849	0.9651	0.00	-1.72	0.6482	-1.72
H2O	0.1073	0.9427	0.00	-4.00	0.6099	-4.00

Percent Swell / Settlement After Inundation = -2.32



Rev. 01-10

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

Leighton

Project Name:	RDI / TT36841	Tested By:	F. Mina	Date:	8/6/15
Project No.:	11061.001	Checked By:	M. Vinet	Date:	8/11/15
Boring No.:	B-5	Sample Type:	IN SITU		
Sample No.:	R-3	Depth (ft.)	10.0		

Sample Description: Silty Sand (SM), brown.

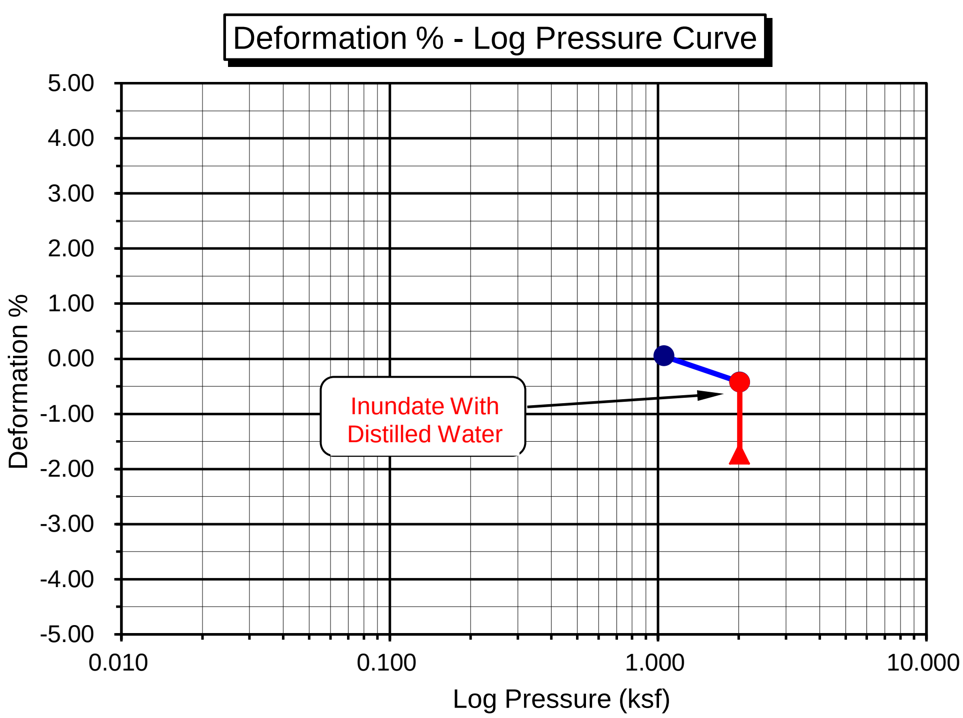
Source and Type of Water Used for Inundation: Arrowhead (Distilled)

** Note: Loading After Wetting (Inundation) not Performed Using this Test Method.

Initial Dry Density (pcf):	106.7	Final Dry Density (pcf):	111.3
Initial Moisture (%):	12.7	Final Moisture (%) :	16.8
Initial Height (in.):	0.9910	Initial Void ratio:	0.5791
Initial Dial Reading (in):	0.0500	Specific Gravity (assumed):	2.70
Inside Diameter of Ring (in):	2.409	Initial Degree of Saturation (%):	59.3

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
1.050	0.0585	0.9915	0.00	0.05	0.5799	0.05
2.013	0.0632	0.9868	0.00	-0.42	0.5725	-0.42
H2O	0.0762	0.9738	0.00	-1.74	0.5517	-1.74

Percent Swell / Settlement After Inundation = -1.32



Rev. 01-10

Leighton

EXPANSION INDEX of SOILS

ASTM D 4829

Project Name:	RDI / TT36841	Tested By:	F. Mina	Date:	8/3/15
Project No. :	11061.001	Checked By:	M. Vinet	Date:	8/11/15
Boring No.:	B-1	Depth:	0 - 5.0		
Sample No. :	B-1	Location:	**		
Sample Description:	Silty Sand (SM), brown.				

Dry Wt. of Soil + Cont. (gm.)	4264.8
Wt. of Container No. (gm.)	0.0
Dry Wt. of Soil (gm.)	4264.8
Weight Soil Retained on #4 Sieve	0.0
Percent Passing # 4	100.0

MOLDED SPECIMEN	Before Test	After Test
Specimen Diameter (in.)	4.01	4.01
Specimen Height (in.)	1.0000	1.0065
Wt. Comp. Soil + Mold (gm.)	608.8	634.7
Wt. of Mold (gm.)	188.5	188.5
Specific Gravity (Assumed)	2.70	2.70
Container No.	7	7
Wet Wt. of Soil + Cont. (gm.)	463.3	634.7
Dry Wt. of Soil + Cont. (gm.)	441.1	389.2
Wt. of Container (gm.)	163.3	188.5
Moisture Content (%)	8.0	14.7
Wet Density (pcf)	126.8	134.4
Dry Density (pcf)	117.4	117.2
Void Ratio	0.436	0.445
Total Porosity	0.304	0.308
Pore Volume (cc)	62.9	64.2
Degree of Saturation (%) [S meas]	**49.5**	**88.8**

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

Date	Time	Pressure (psi)	Elapsed Time (min.)	Dial Readings (in.)
8/3/15	14:29	1.0	0	0.5000
8/3/15	14:39	1.0	10	0.5000
	Add Distilled Water to the Specimen			
8/4/15	7:15	1.0	996	0.5065
8/4/15	8:15	1.0	1056	0.5065

Expansion Index (EI meas) =	((Final Rdg - Initial Rdg) / Initial Thick.) x 1000	6.5
Expansion Index (Report) =	Nearest Whole Number or Zero (0) if Initial Height is > than Final Height	**7**

Rev. 03-08

TESTS for SULFATE CONTENT CHLORIDE CONTENT and pH of SOILS

Leighton

Project Name: RDI / TT36841 | Tested By : G. Berdy | Date: 08/06/15

Project No. : 11061.001 | Data Input By: J. Ward | Date: 08/13/15

Boring No.	B-1	B-7		
Sample No.	B-1	B-1		
Sample Depth (ft)	0-5	0-5		
Soil Identification:	SM, brown	SM, brown		
Wet Weight of Soil + Container (g)	196.54	253.38		
Dry Weight of Soil + Container (g)	190.28	247.08		
Weight of Container (g)	62.03	67.51		
Moisture Content (%)	4.88	3.51		
Weight of Soaked Soil (g)	100.24	100.06		

SULFATE CONTENT, DOT California Test 417, Part II

Beaker No.	0	51		
Crucible No.	23	6		
Furnace Temperature (°C)	850	850		
Time In / Time Out	11:00/11:35	11:00/11:35		
Duration of Combustion (min)	35	35		
Wt. of Crucible + Residue (g)	18.4296	23.3467		
Wt. of Crucible (g)	18.4254	23.3439		
Wt. of Residue (g) (A)	0.0042	0.0028		
PPM of Sulfate (A) x 41150	172.83	115.22		
PPM of Sulfate, Dry Weight Basis	**182**	**119**		

CHLORIDE CONTENT, DOT California Test 422

ml of Extract For Titration (B)				
ml of AgNO3 Soln. Used in Titration (C)				
PPM of Chloride (C -0.2) * 100 * 30 / B				
PPM of Chloride, Dry Wt. Basis	**N/A**	**N/A**		

pH TEST, DOT California Test 643

pH Value	**N/A**	**N/A**		
Temperature °C				

MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Leighton

Project Name:	RANCHO DIAMONTE	Tested By :	BRM	Date:	5/15/07
Project No.:	112177-001	Input By :	JMB	Date:	5/18/07
Boring No.:	TP-8	Depth (ft.)	6.0		
Sample No. :	B-11				
Soil Identification:	SM, BROWN SILTY SAND.				

Preparation Method: [X] Moist [ ] Dry

[ ] Mechanical Ram [X] Manual Ram

Mold Volume (ft³) 0.03340

Ram Weight = 10 lb.; Drop = 18 in.

Moisture Added (ml)	-50	0	50	100		
TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	6181	6246	6327	6356		
Weight of Mold (g)	4238	4238	4238	4238		
Net Weight of Soil (g)	1943	2008	2089	2118		
Wet Weight of Soil + Cont. (g)	133.1	223.0	131.5	137.4		
Dry Weight of Soil + Cont. (g)	128.3	211.4	123.0	126.3		
Weight of Container (g)	22.8	22.7	22.8	22.8		
Moisture Content (%)	4.5	6.1	8.5	10.7		
Wet Density (pcf)	128.2	132.5	137.9	139.8		
Dry Density (pcf)	122.7	124.9	127.1	126.3		

Maximum Dry Density (pcf) 127.5 **Optimum Moisture Content (%)** 9.5

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

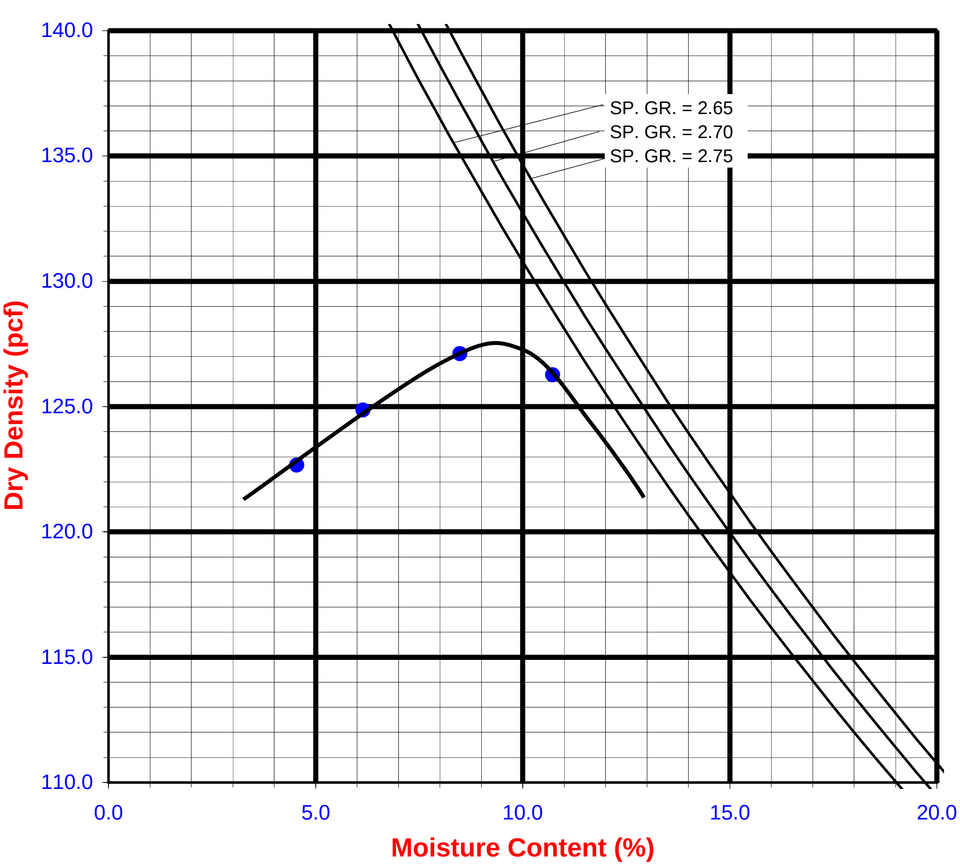
[ ] **Procedure C**
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)
Use if +3/8 in. is >20% and +¾ in. is <30%

Particle-Size Distribution:

GR:SA:FI

Atterberg Limits:

LL,PL,PI



PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Leighton

Project Name:	RANCHO DIAMONTE	Tested By :	VRO/ JRH	Date:	05/15/07
Project No. :	112177-001	Data Input By:	VRO	Date:	05/16/07
Boring No.:	TP-10	Checked By:	JMB	Date:	05/18/07
Sample No.:	B-12	Depth (ft.) :	9.0		

Visual Sample Description: (SW-SM), BROWN WELL-GRADED SAND WITH SILT AND TRACE GRAVEL.

				Moisture Content of Total Air-Dry Soils	Moisture Content of Air-Dry Soils Passing # 10	After Hydrometer & wet sieve ret. on #200 sieve
Liquid Limit:	**	LL,PL,PI:	**			
Plastic Limit:	**	GR:SA:FI:	5:89:6			
Plasticity Index:	**	Grp. Symbol:	(SW-SM)			
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(gm.)		1920.3	99.96	**
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (gm.)		1867.7	99.96	92.24
Wt.of Air-Dry Soil + Cont. (gm.)	1920.3	Wt. of Container No.___ (gm.)		218.8	0.00	0.00
Wt. of Container	218.8	Moisture Content (%)		3.2	0.0	**
Dry Wt. of Soil (gm.)	1648.9	Wt. of Dry Soil (gm.)		1648.9	100.0	92.24

Coarse Sieve

U.S. Sieve Size	Cumulative Wt.of Dry Soil Retained(gm)	% Passing
3"	0.0	100.0
1½"	0.0	100.0
3/4"	0.0	100.0
3/8"	2.1	99.9
No. 4	75.2	95.4
No. 10	507.2	69.2
Pan		

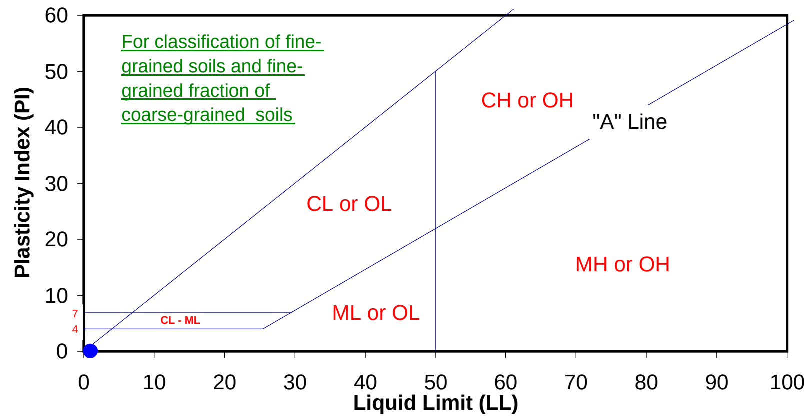
Sieve after Hydrometer & Wet Sieve

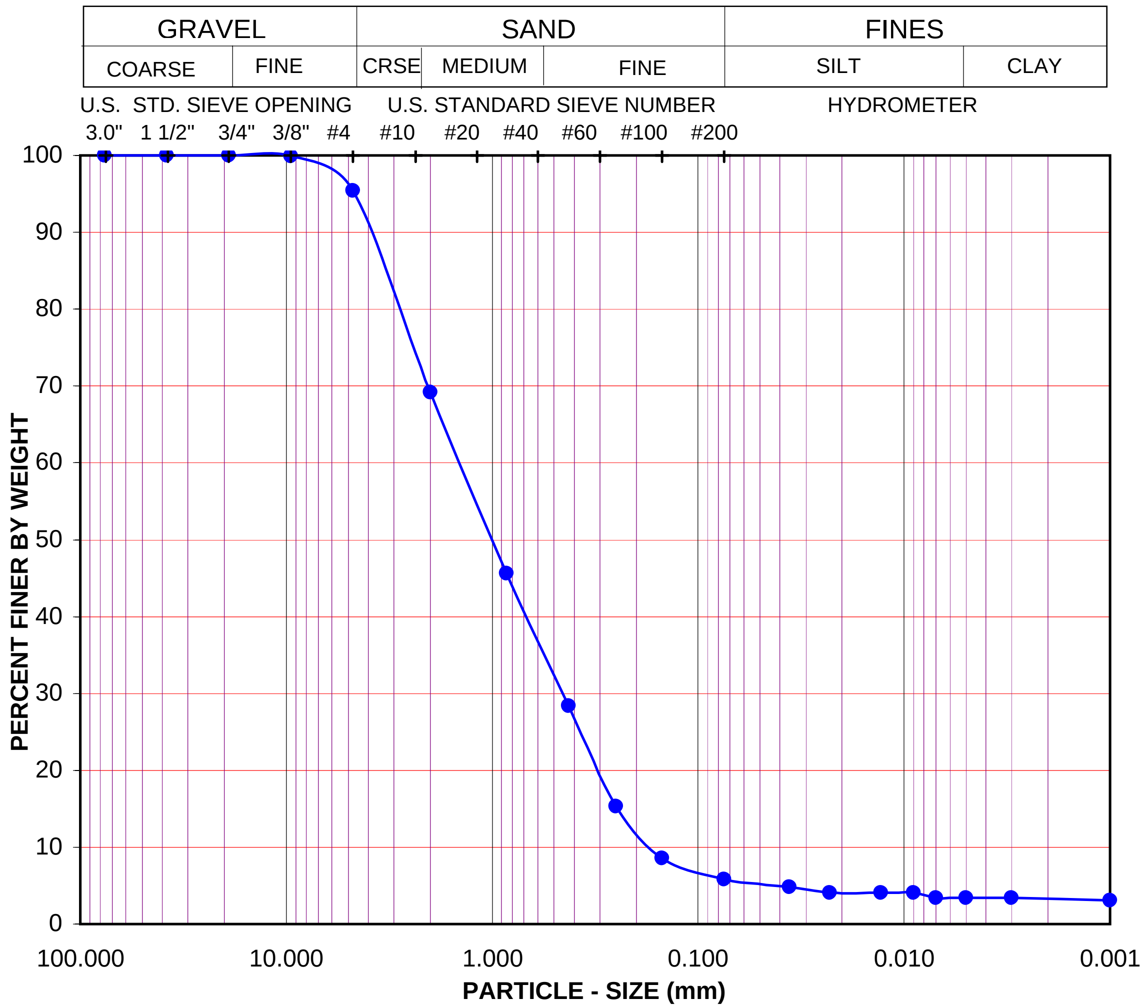
U.S. Sieve Size	Cumulative Wt. of Dry Soil Retained (gm)	% Passing	% Total Sample
No. 10	0.0	100.0	69.2
No. 20	34.14	65.9	45.6
No. 40	58.99	41.0	28.4
No. 60	77.87	22.1	15.3
No. 100	87.59	12.4	8.6
No. 200	91.61	8.4	5.8
Pan			

Hydrometer Wt. of Air-Dry Soil (gm) 100.0 Wt. of Dry Soil (gm) 100.0

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°c)	Composite Correction 152 H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
5/15/07	9:12	0	21	4.0			
	9:14	2	21	4.0	11.0	4.8	0.036
	9:17	5	21	4.0	10.0	4.1	0.023
	9:27	15	21	4.0	10.0	4.1	0.013
	9:42	30	21	4.0	10.0	4.1	0.009
	10:12	60	21	4.0	9.0	3.4	0.007
	11:12	120	21	4.0	9.0	3.4	0.005
	13:22	250	21	4.0	9.0	3.4	0.003
5/16/07	9:12	1440	21	4.0	8.5	3.1	0.001





Boring No.	Sample No.	Depth (ft.)	Soil Type	GR:SA:FI (%)	LL,PL,PI
TP-10	B-12	9.0	(SW-SM)	5:89:6	**

Sample Description:
(SW-SM), BROWN WELL-GRADED SAND WITH SILT AND TRACE GRAVEL.

Leighton

Project No.: 112177-001

RANCHO DIAMONTE

ATTERBERG LIMITS, PARTICLE - SIZE CURVE

ASTM D 4318, D 422

Rev. 08-04

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

Leighton

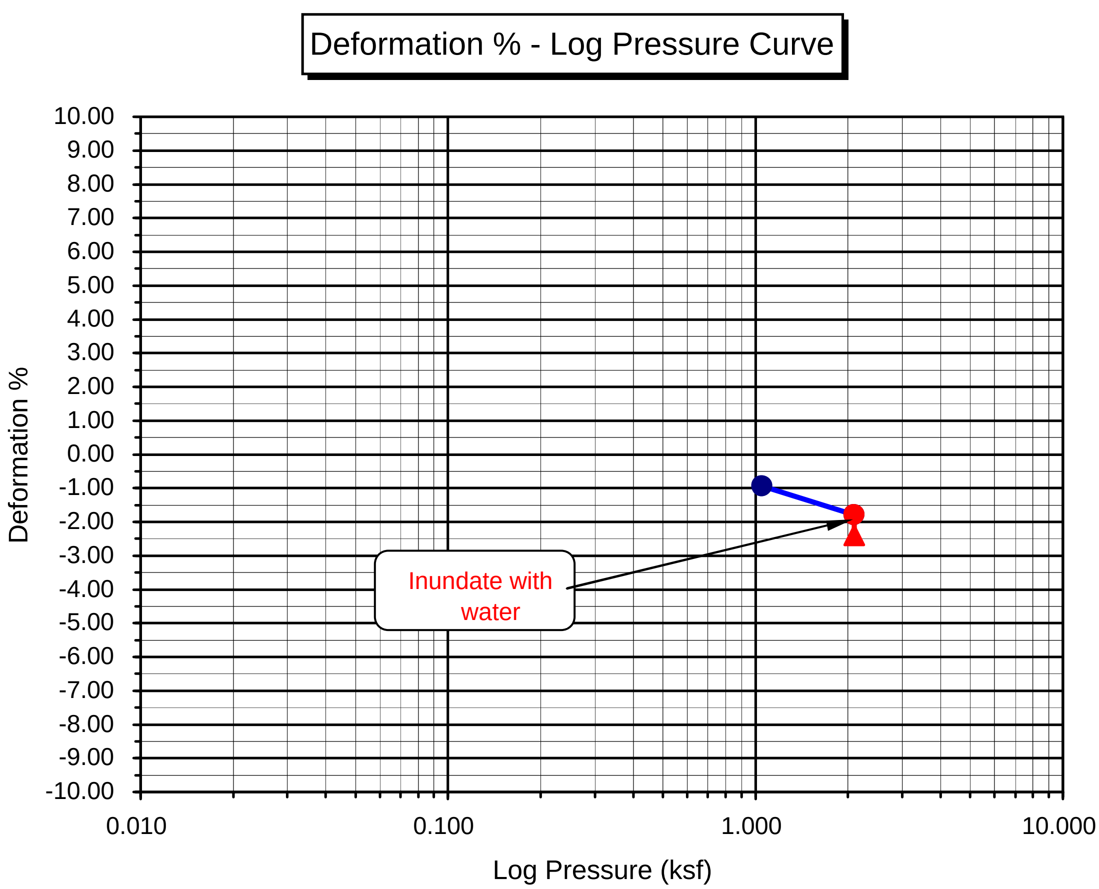
Project Name:	RANCHO DIAMONTE	Tested By:	JCM	Date:	5/14/07
Project No.:	112177-001	Checked By:	JMB	Date:	5/17/07
Boring No.:	TP-11	Sample Type:	IN SITU		
Sample No.:	R-13	Depth (ft.)	5-6.0		
Sample Description:	(ML)s, BROWN SILT WITH SAND. *** DISTURBED.				

Initial Dry Density (pcf):	106.6
Initial Moisture (%):	4.7
Initial Length (in.):	1.0000
Initial Dial Reading:	0.0500
Diameter(in):	2.416

Final Dry Density (pcf):	109.2
Final Moisture (%) :	15.2
Initial Void ratio:	0.5810
Specific Gravity(assumed):	2.70
Initial Saturation (%)	21.7

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
1.050	0.0594	0.9906	0.00	-0.94	0.5661	-0.94
2.100	0.0679	0.9821	0.00	-1.79	0.5527	-1.79
H2O	0.0739	0.9761	0.00	-2.39	0.5432	-2.39

Percent Swell / Settlement After Inundation = -0.61



Rev. 08-04

MODIFIED PROCTOR COMPACTION TEST

ASTM D 1557

Teratest Labs, Inc.
A LEIGHTON GROUP COMPANY

Project Name:	Rancho Diamante	Tested By :	RTD	Date:	02/06/04
Project No.:	111116-001	Input By :	LF	Date:	02/19/04
Boring No.:	B-5	Depth (ft.)	0-5		
Sample No. :	3				
Soil Identification:	Brown silty sand (SM)				

Preparation Method: ☐ Moist ☒ Dry

☒ Mechanical Ram ☐ Manual Ram

Mold Volume (ft³) 0.03323

Ram Weight = 10 lb.; Drop = 18 in.

TEST NO.	1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)	3650.0	3796.0	3879.0	3810.0		
Weight of Mold (g)	1771.0	1771.0	1771.0	1771.0		
Net Weight of Soil (g)	1879.0	2025.0	2108.0	2039.0		
Wet Weight of Soil + Cont. (g)	548.30	581.90	536.30	506.70		
Dry Weight of Soil + Cont. (g)	520.50	540.00	488.50	453.20		
Weight of Container (g)	54.70	54.00	49.60	54.00		
Moisture Content (%)	5.97	8.62	10.89	13.40		
Wet Density (pcf)	124.7	134.3	139.9	135.3		
Dry Density (pcf)	117.6	123.7	126.1	119.3		

Maximum Dry Density (pcf) 126.0 **Optimum Moisture Content (%)** 11.0

PROCEDURE USED

☒ **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

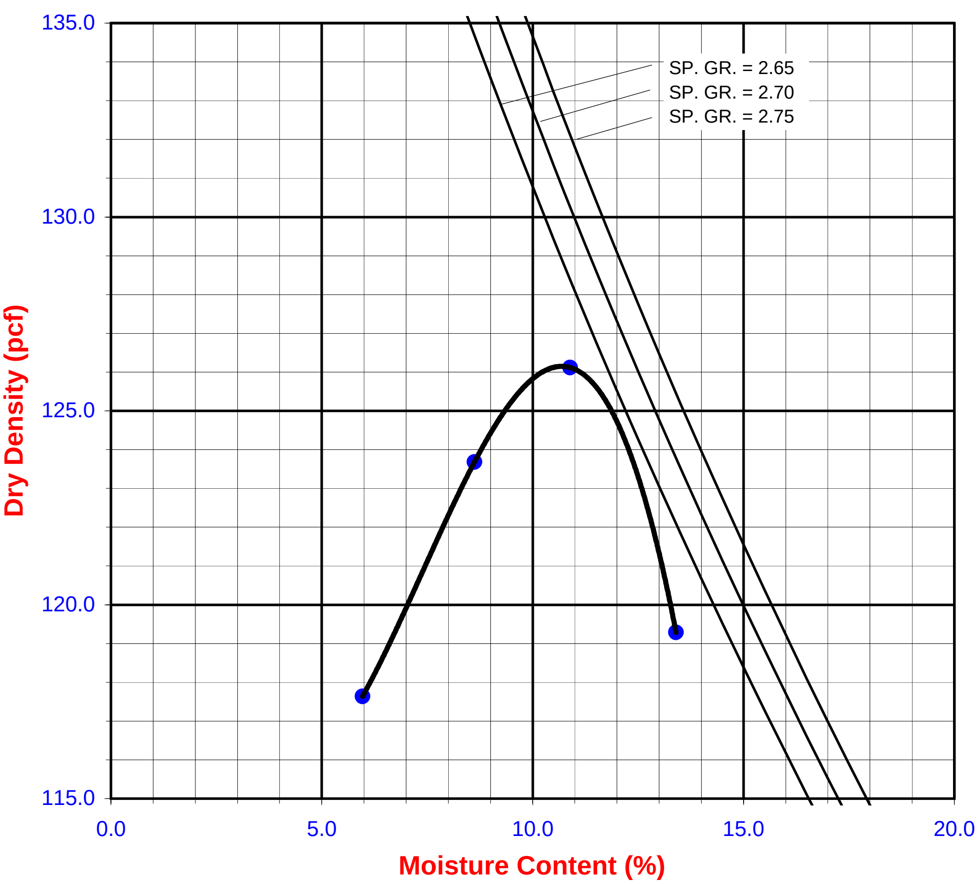
☐ **Procedure C**
Soil Passing 3/4 in. (19.0 mm) Sieve
Mold : 6 in. (152.4 mm) diameter
Layers : 5 (Five)
Blows per layer : 56 (fifty-six)
Use if +3/8 in. is >20% and +¾ in. is <30%

Particle-Size Distribution:

GR:SA:FI

Atterberg Limits:

LL,PL,PI



Boring No.	B-5	B-5	B-5	B-5	B-5			
Sample No.	4	5	6	8	10			
Depth (ft.)	7.5-9	12.5-14	20-21.5	30-31.5	40-41.5			
Sample Type	SPT	SPT	SPT	SPT	SPT			
Soil Identification	Olive brown silty sand (SM)	Brown silty sand (SM)	Brown well-graded sand with silt and gravel (SW-SM)g	Brown well-graded sand with silt (SW-SM)	Brown silty, clayey sand (SC-SM)			
Moisture Correction								
Wet Weight of Soil + Container (g)	0.00	0.00	0.00	0.00	0.00			
Dry Weight of Soil + Container (g)	0.00	0.00	0.00	0.00	0.00			
Weight of Container (g)	1.00	1.00	1.00	1.00	1.00			
Moisture Content (%)	0.00	0.00	0.00	0.00	0.00			
Sample Dry Weight Determination								
Weight of Sample + Container (g)	396.81	396.03	578.79	746.92	252.89			
Weight of Container (g)	0.00	0.00	0.00	0.00	0.00			
Weight of Dry Sample (g)	396.81	396.03	578.79	746.92	252.89			
Container No.:								
After Wash								
Method (A or B)	B	B	B	B	B			
Dry Weight of Sample + Cont. (g)	293.36	257.08	543.51	703.58	171.38			
Weight of Container (g)	0.00	0.00	0.00	0.00	0.00			
Dry Weight of Sample (g)	293.36	257.08	543.51	703.58	171.38			
% Passing No. 200 Sieve	**26.1**	**35.1**	**6.1**	**5.8**	**32.2**			
% Retained No. 200 Sieve	73.9	64.9	93.9	94.2	67.8			

Teratest Labs, Inc.

A LEIGHTON GROUP COMPANY

PERCENT PASSING
No. 200 SIEVE
ASTM D 1140

Project Name: Rancho Diamante

Project No.: 111116-001

Client Name: L & A / Temecula

Tested By: ESS Date: 02/05/04

ATTERBERG LIMITS

ASTM D 4318

Teratest Labs, Inc.
A LEIGHTON GROUP COMPANY

Project Name:	Rancho Diamante	Tested By:	ACS	Date:	02/11/04
Project No. :	111116-001	Input By:	LF	Date:	02/19/04
Boring No.:	B-5	Checked By:	LF		
Sample No.:	10	Depth (ft.)	40-41.5		
Soil Identification:	Brown silty, clayey sand (SC-SM)				

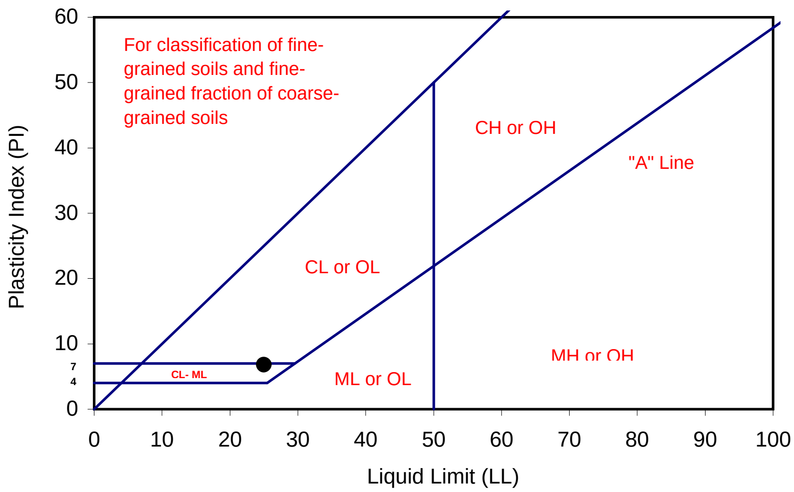
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	24	16	
Wet Wt. of Soil + Cont. (g)	9.29	9.01	17.42	17.77	17.81	
Dry Wt. of Soil + Cont. (g)	8.02	7.78	14.26	14.44	14.31	
Wt. of Container (g)	1.03	1.02	1.03	1.09	1.07	
Moisture Content (%) [Wn]	18.17	18.20	23.89	24.94	26.44	

Liquid Limit	**25**
Plastic Limit	**18**
Plasticity Index	**7**
Classification	**CL-ML**

PI at "A" - Line = 0.73(LL-20) | 3.65

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



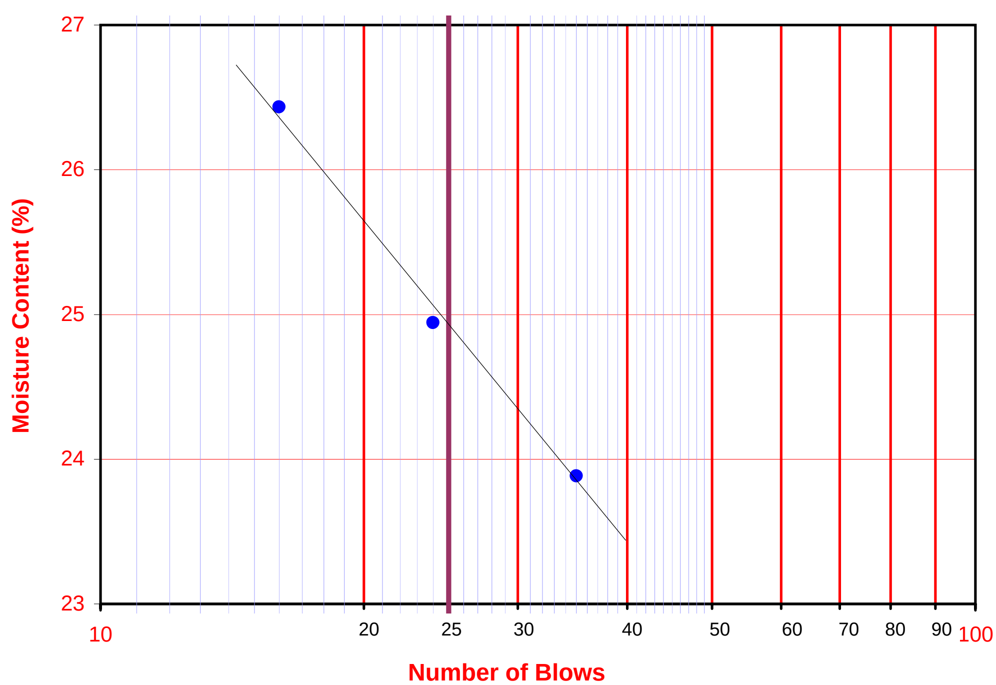
PROCEDURES USED

[ ] Wet Preparation
Multipoint - Wet

[X] Dry Preparation
Multipoint - Dry

[X] Procedure A
Multipoint Test

[ ] Procedure B
One-point Test



Teratest Labs, Inc.
A LEIGHTON GROUP COMPANY

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

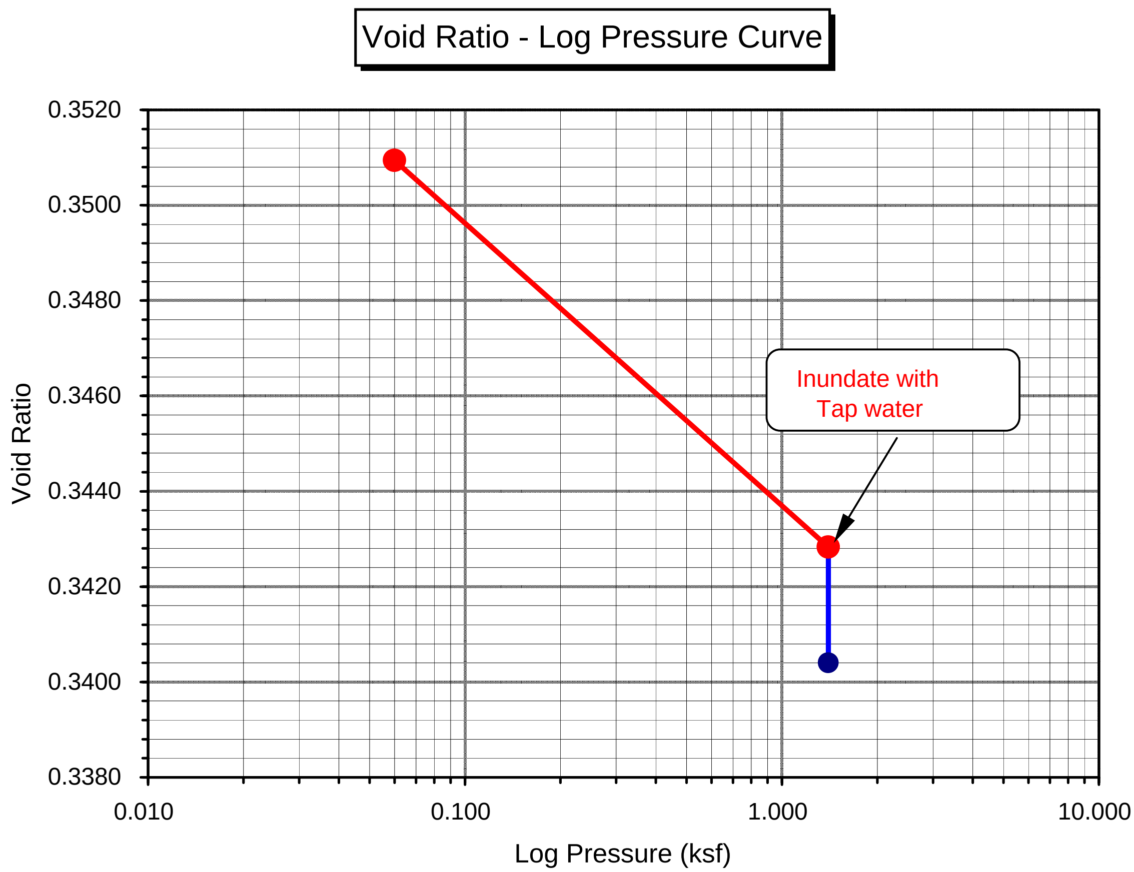
Project Name:	Rancho Diamante	Tested By:	FT, ESS	Date:	02/12/04
Project No.:	111116-001	Checked By:	LF	Date:	02/20/04
Boring No.:	B-5	Sample Type:	Drive		
Sample No.:	2	Depth (ft.)	5-6.5		
Sample Description:	Brown silty sand (SM)				

Initial Dry Density (pcf):	124.7
Initial Moisture (%):	5.52
Initial Length (in.):	1.0000
Initial Dial Reading:	0.1000
Diameter(in):	2.416

Final Dry Density (pcf):	124.5
Final Moisture (%) :	12.0
Initial Void ratio:	0.3516
Specific Gravity(assumed):	2.70
Initial Saturation (%)	42.4

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.060	0.1005	0.9995	0.00	-0.05	0.3509	-0.05
1.400	0.1065	0.9935	0.00	-0.65	0.3428	-0.65
H2O	0.1083	0.9917	0.00	-0.83	0.3404	-0.83

Percent Swell (+) / Settlement (-) After Inundation = -0.18



Collapse B-5 #2 @ 5-6.5

Teratest Labs, Inc.
A LEIGHTON GROUP COMPANY

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

Project Name:	Rancho Diamante	Tested By:	FT, ESS	Date:	02/12/04
Project No.:	111116-001	Checked By:	LF	Date:	02/20/04
Boring No.:	B-5	Sample Type:	Drive		
Sample No.:	4	Depth (ft.)	7.5-9		
Sample Description:	Olive brown silty sand (SM)				

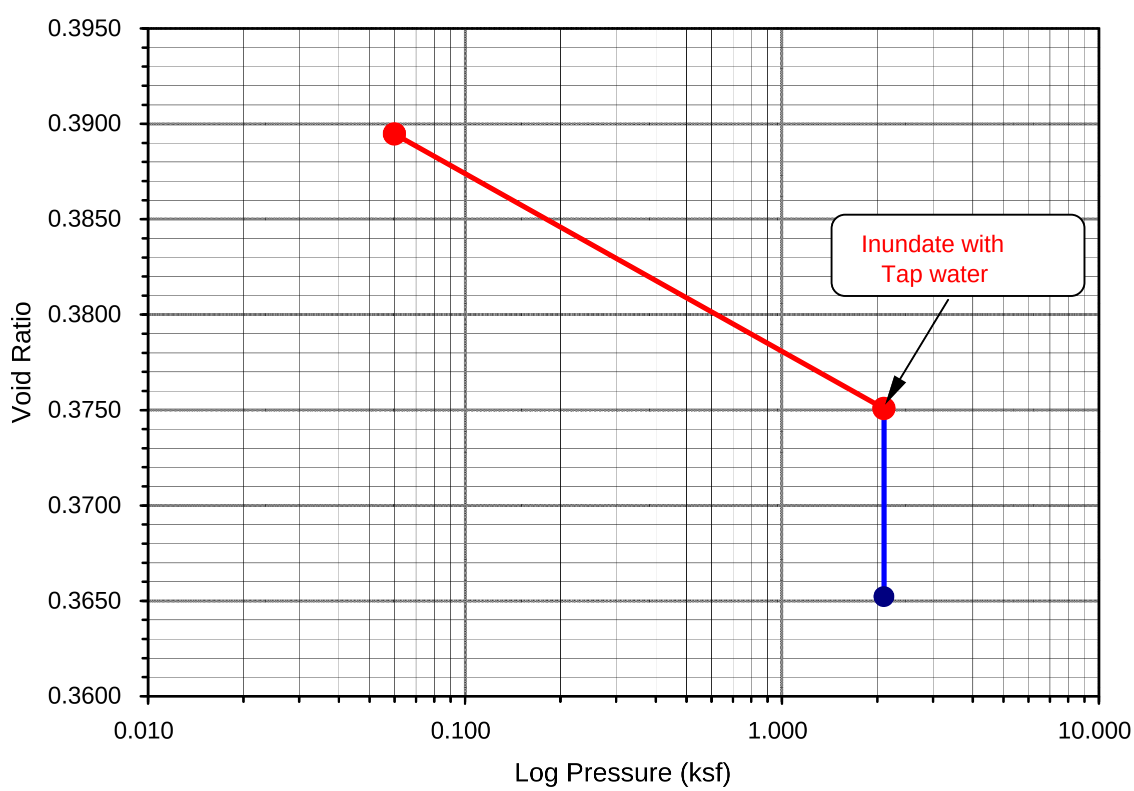
Initial Dry Density (pcf):	121.3
Initial Moisture (%):	3.60
Initial Length (in.):	1.0000
Initial Dial Reading:	0.1000
Diameter(in):	2.416

Final Dry Density (pcf):	122.7
Final Moisture (%) :	12.0
Initial Void ratio:	0.3900
Specific Gravity(assumed):	2.70
Initial Saturation (%)	24.9

Pressure (p) (ksf)	Final Reading (in)	Apparent Thickness (in)	Load Compliance (%)	Swell (+) Settlement (-) % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.060	0.1004	0.9997	0.00	-0.03	0.3895	-0.03
2.100	0.1107	0.9893	0.00	-1.07	0.3751	-1.07
H2O	0.1178	0.9822	0.00	-1.78	0.3652	-1.78

Percent Swell (+) / Settlement (-) After Inundation = -0.72

Void Ratio - Log Pressure Curve



APPENDIX C

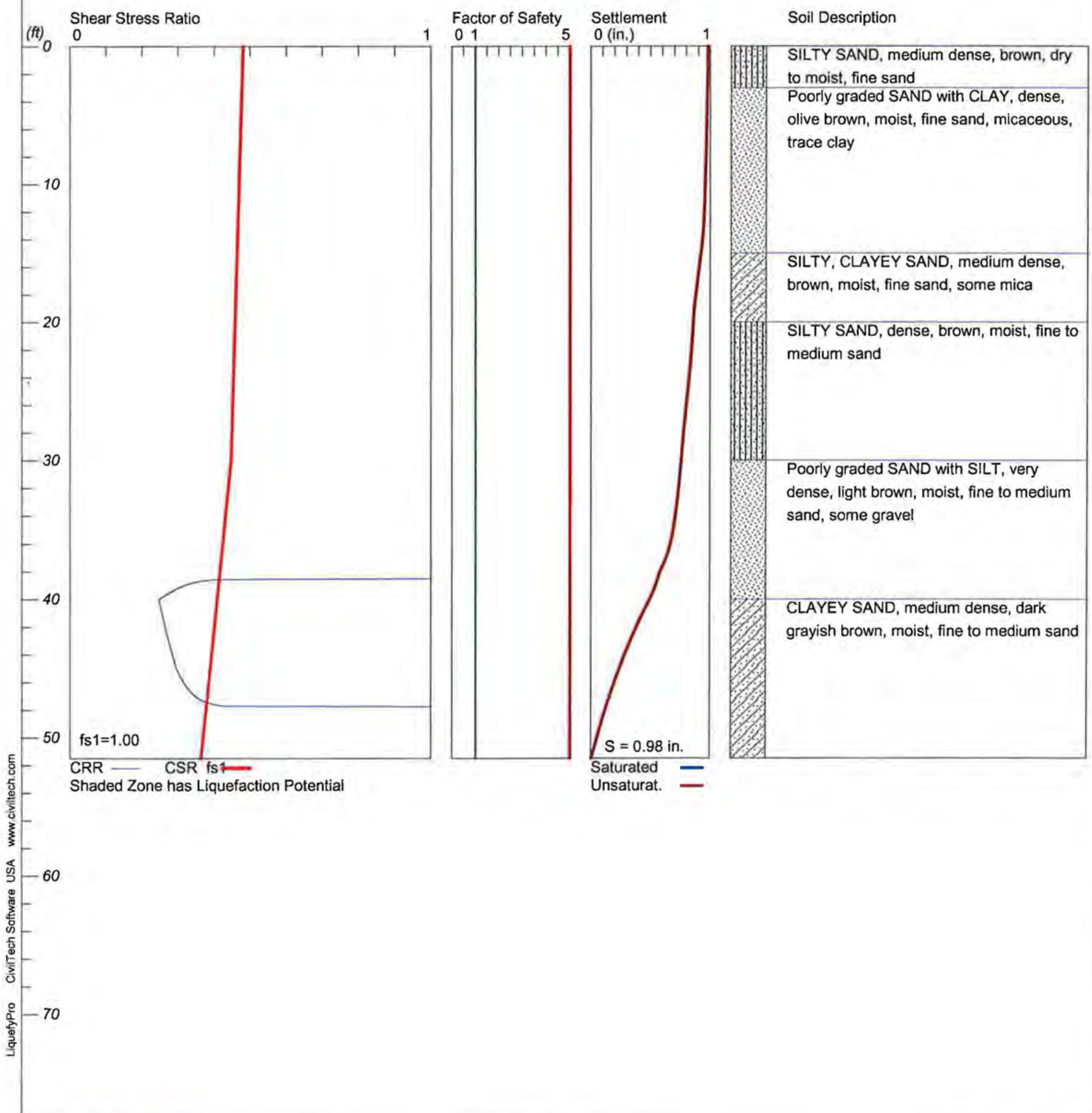
SEISMIC COEFFICIENTS AND SETTLEMENT ANALYSIS

DRY SETTLEMENT ANALYSIS

Rancho Diamante

Hole No.=B-1 Surface Elev.=1502

Magnitude=7.59
Acceleration=0.74g



Leighton

11061.001

Plate A-1

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LIQUEFACTION ANALYSIS SUMMARY

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Title: Rancho Diamante
Subtitle: 11061.001

Surface Elev.=1502
Hole No.=B-1
Depth of Hole= 51.50 ft
Water Table during Earthquake= 999.00 ft
Water Table during In-Situ Testing= 999.00 ft
Max. Acceleration= 0.74 g
Earthquake Magnitude= 7.59

Input Data:
Surface Elev.=1502
Hole No.=B-1
Depth of Hole=51.50 ft
Water Table during Earthquake= 999.00 ft
Water Table during In-Situ Testing= 999.00 ft
Max. Acceleration=0.74 g
Earthquake Magnitude=7.59
No-Liquefiable Soils: CL, OL are Non-Liq. Soil

1. SPT or BPT Calculation.
2. Settlement Analysis Method: Ishihara / Yoshimine
3. Fines Correction for Liquefaction: Stark/Olson et al.*
4. Fine Correction for Settlement: Post Liquefaction
5. Settlement Calculation in: All zones*
6. Hammer Energy Ratio, Ce = 1.25
7. Borehole Diameter, Cb= 1
8. Sampling Method, Cs= 1
9. User request factor of safety (apply to CSR) , User= 1
   Plot one CSR curve (fs1=User)
10. Use Curve Smoothing: Yes*
* Recommended Options

In-Situ Test Data:

Depth ft	SPT	gamma pcf	Fines %
0.00	70.40	128.00	25.00
5.00	62.40	128.00	25.00
10.00	74.40	128.00	25.00
15.00	28.00	128.00	40.00
20.00	54.40	130.00	40.00
25.00	40.00	130.00	40.00
30.00	72.00	128.00	25.00
35.00	43.20	128.00	25.00
40.00	21.60	124.00	45.00

45.00	27.20	124.00	45.00
50.00	34.40	124.00	35.00

Output Results:
Settlement of Saturated Sands=0.00 in.
Settlement of Unsaturated Sands=0.98 in.
Total Settlement of Saturated and Unsaturated Sands=0.98 in.
Differential Settlement=0.490 to 0.646 in.

Depth ft	CRRm	CSRfs	F.S.	S_sat. in.	S_dry in.	S_all in.
0.00	1.94	0.48	5.00	0.00	0.98	0.98
1.00	1.94	0.48	5.00	0.00	0.98	0.98
2.00	1.94	0.48	5.00	0.00	0.98	0.98
3.00	1.94	0.48	5.00	0.00	0.98	0.98
4.00	1.94	0.48	5.00	0.00	0.97	0.97
5.00	1.94	0.48	5.00	0.00	0.97	0.97
6.00	1.94	0.47	5.00	0.00	0.97	0.97
7.00	1.94	0.47	5.00	0.00	0.97	0.97
8.00	1.94	0.47	5.00	0.00	0.96	0.96
9.00	1.94	0.47	5.00	0.00	0.96	0.96
10.00	1.94	0.47	5.00	0.00	0.96	0.96
11.00	1.94	0.47	5.00	0.00	0.95	0.95
12.00	1.94	0.47	5.00	0.00	0.95	0.95
13.00	1.94	0.47	5.00	0.00	0.94	0.94
14.00	1.94	0.47	5.00	0.00	0.94	0.94
15.00	1.94	0.46	5.00	0.00	0.92	0.92
16.00	1.94	0.46	5.00	0.00	0.91	0.91
17.00	1.94	0.46	5.00	0.00	0.89	0.89
18.00	1.94	0.46	5.00	0.00	0.88	0.88
19.00	1.94	0.46	5.00	0.00	0.87	0.87
20.00	1.94	0.46	5.00	0.00	0.86	0.86
21.00	1.94	0.46	5.00	0.00	0.85	0.85
22.00	1.94	0.46	5.00	0.00	0.84	0.84
23.00	1.94	0.46	5.00	0.00	0.83	0.83
24.00	1.94	0.45	5.00	0.00	0.82	0.82
25.00	1.94	0.45	5.00	0.00	0.81	0.81
26.00	1.94	0.45	5.00	0.00	0.80	0.80
27.00	1.93	0.45	5.00	0.00	0.79	0.79
28.00	1.92	0.45	5.00	0.00	0.78	0.78
29.00	1.91	0.45	5.00	0.00	0.77	0.77
30.00	1.90	0.45	5.00	0.00	0.76	0.76
31.00	1.88	0.44	5.00	0.00	0.75	0.75
32.00	1.87	0.44	5.00	0.00	0.74	0.74
33.00	1.86	0.44	5.00	0.00	0.72	0.72
34.00	1.85	0.43	5.00	0.00	0.71	0.71
35.00	1.84	0.43	5.00	0.00	0.69	0.69
36.00	1.83	0.42	5.00	0.00	0.67	0.67
37.00	1.82	0.42	5.00	0.00	0.63	0.63
38.00	1.81	0.42	5.00	0.00	0.58	0.58
39.00	0.32	0.41	5.00	0.00	0.54	0.54
40.00	0.25	0.41	5.00	0.00	0.49	0.49
41.00	0.25	0.40	5.00	0.00	0.43	0.43
42.00	0.26	0.40	5.00	0.00	0.38	0.38
43.00	0.27	0.40	5.00	0.00	0.33	0.33
44.00	0.28	0.39	5.00	0.00	0.28	0.28
45.00	0.30	0.39	5.00	0.00	0.24	0.24
46.00	0.32	0.38	5.00	0.00	0.19	0.19
47.00	0.35	0.38	5.00	0.00	0.15	0.15
48.00	1.72	0.38	5.00	0.00	0.12	0.12
49.00	1.71	0.37	5.00	0.00	0.08	0.08

50.00	1.70	0.37	5.00	0.00	0.05	0.05
51.00	1.69	0.37	5.00	0.00	0.02	0.02

* F.S.<1, Liquefaction Potential Zone
(F.S. is limited to 5, CRR is limited to 2, CSR is limited to 2)

Units: Unit: qc, fs, Stress or Pressure = atm (1.0581tsf); Unit Weight = pcf; Depth = ft; Settlement = in.

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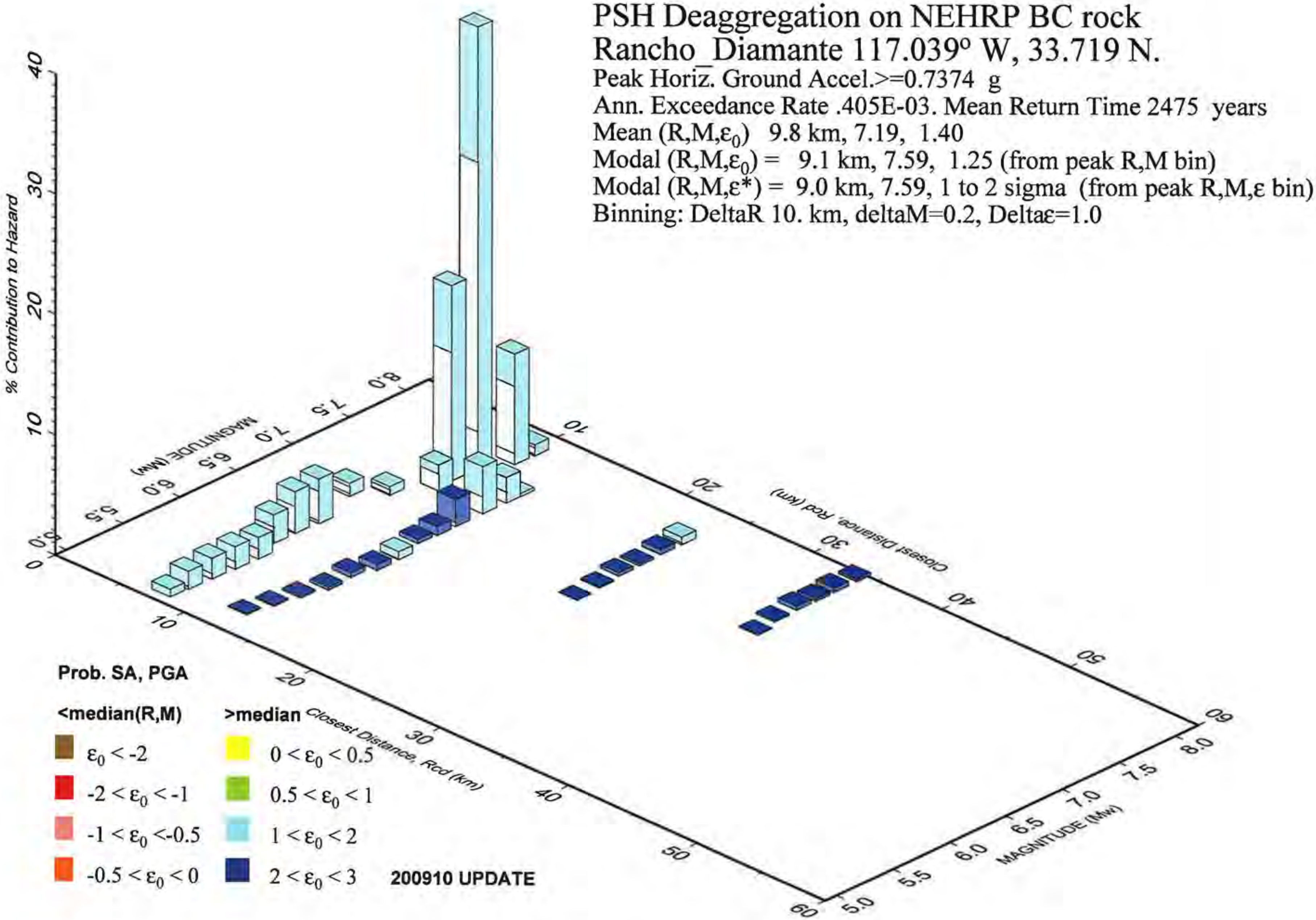
1 atm (atmosphere) = 1 tsf (ton/ft2)

CRRm	Cyclic resistance ratio from soils
CSRsf	Cyclic stress ratio induced by a given earthquake (with user request factor of safety)
F.S.	Factor of Safety against liquefaction, F.S.=CRRm/CSRsf
S_sat	Settlement from saturated sands
S_dry	Settlement from Unsaturated Sands
S_all	Total Settlement from Saturated and Unsaturated Sands
NoLiq	No-Liquefy Soils



GMT 2015 Aug 17 18:49:59 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on rock with average vs= 760. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

APPENDIX D

EARTHWORK AND GRADING SPECIFICATIONS

APPENDIX D

GENERAL EARTHWORK AND GRADING SPECIFICATIONS

TABLE OF CONTENTS

Standard Details

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. 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).

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). 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.

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. 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 OSHA and Cal/OSHA requirements for safety of trench excavations.

7.2 Bedding and Backfill

All bedding and backfill of utility trenches shall be performed 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 relative compaction 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.

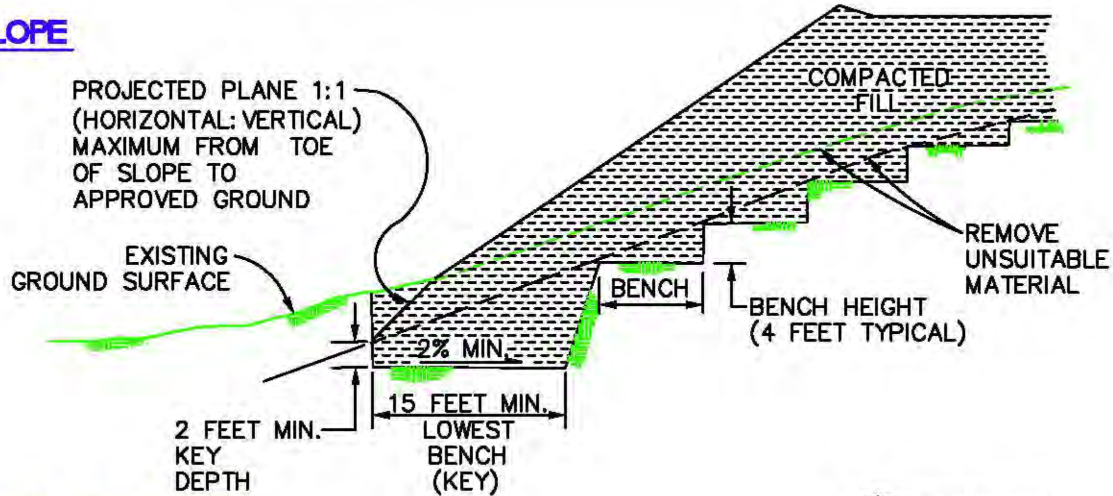
7.3 Lift Thickness

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.

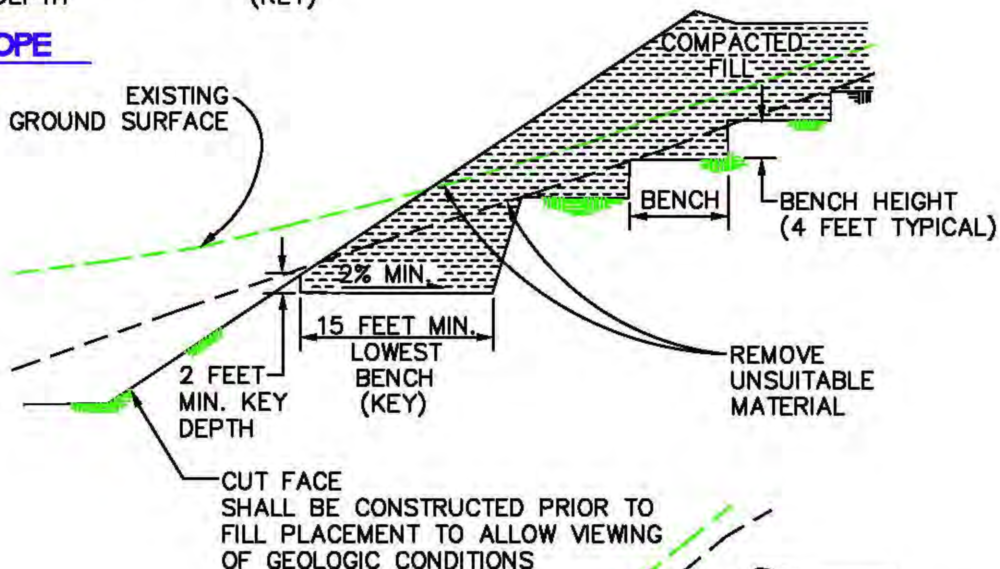
7.4 Observation and Testing

The jetting of the bedding around the conduits shall be observed by the Geotechnical Consultant.

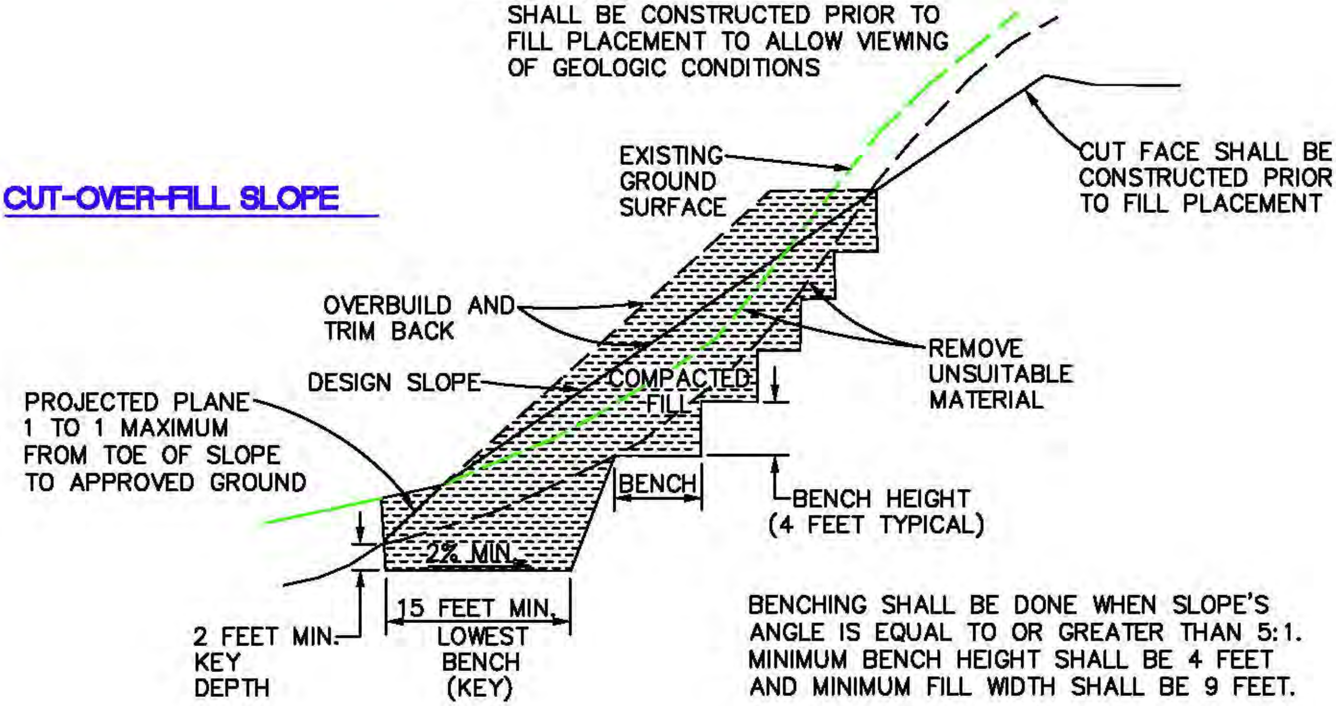
FILL SLOPE



FILL-OVER-CUT SLOPE

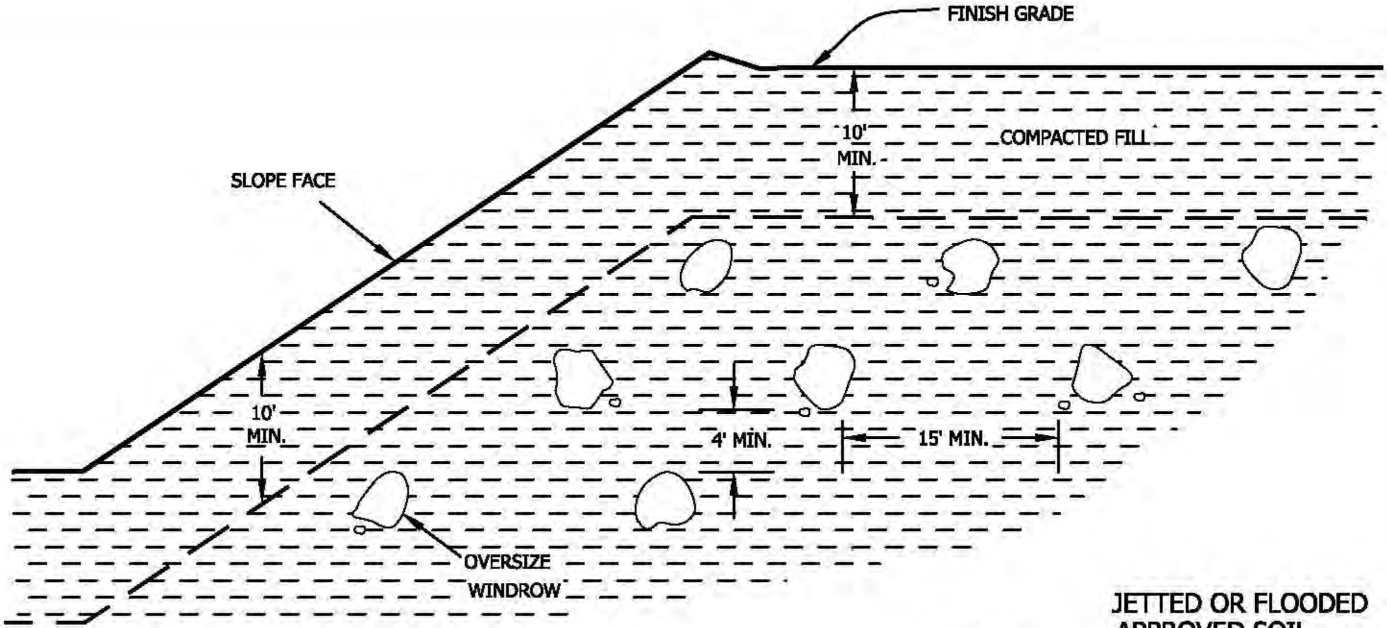


CUT-OVER-FILL SLOPE

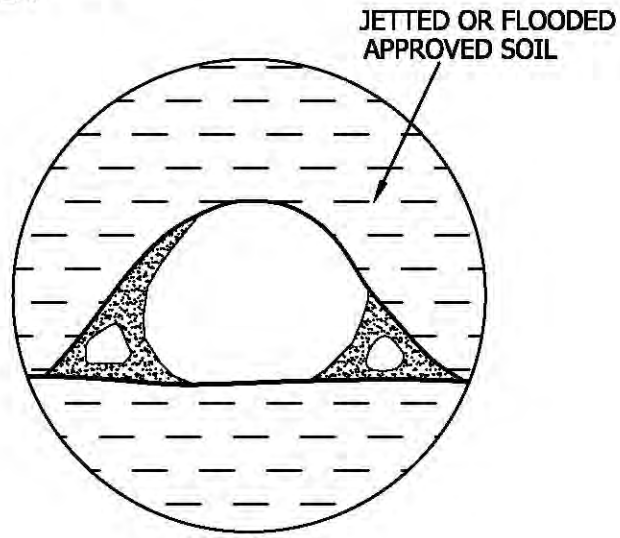


BENCHING SHALL BE DONE WHEN SLOPE'S ANGLE IS EQUAL TO OR GREATER THAN 5:1. MINIMUM BENCH HEIGHT SHALL BE 4 FEET AND MINIMUM FILL WIDTH SHALL BE 9 FEET.

KEYING AND BENCHING	GENERAL EARTHWORK AND GRADING SPECIFICATIONS STANDARD DETAILS A	Leighton

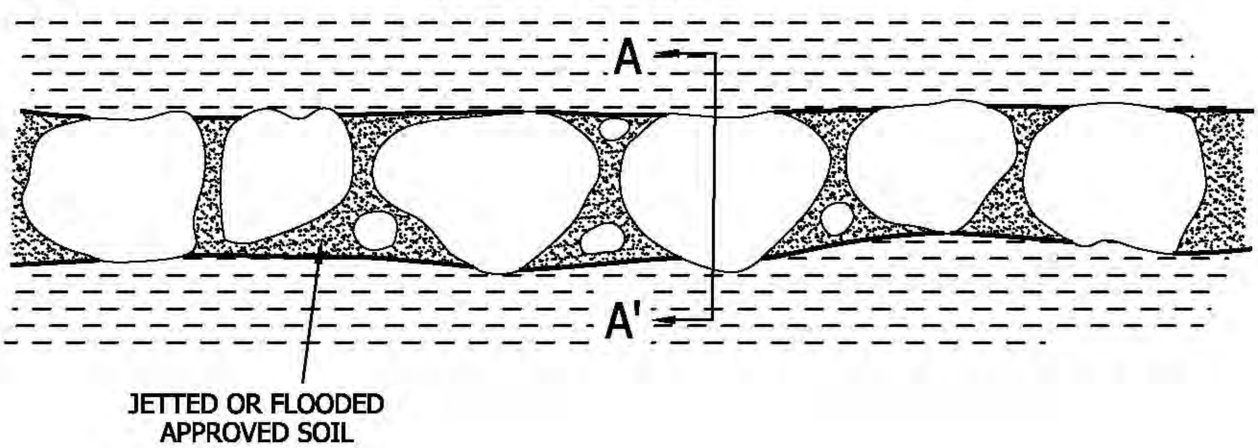


- Oversize rock is larger than 8 inches in largest dimension.
- Backfill with approved soil jetted or flooded in place to fill all the voids.
- Do not bury rock within 10 feet of finish grade.
- Windrow of buried rock shall be parallel to the finished slope face.



SECTION A-A'

PROFILE ALONG WINDROW



OVERSIZE ROCK DISPOSAL

GENERAL EARTHWORK AND GRADING SPECIFICATIONS
STANDARD DETAILS B

Leighton

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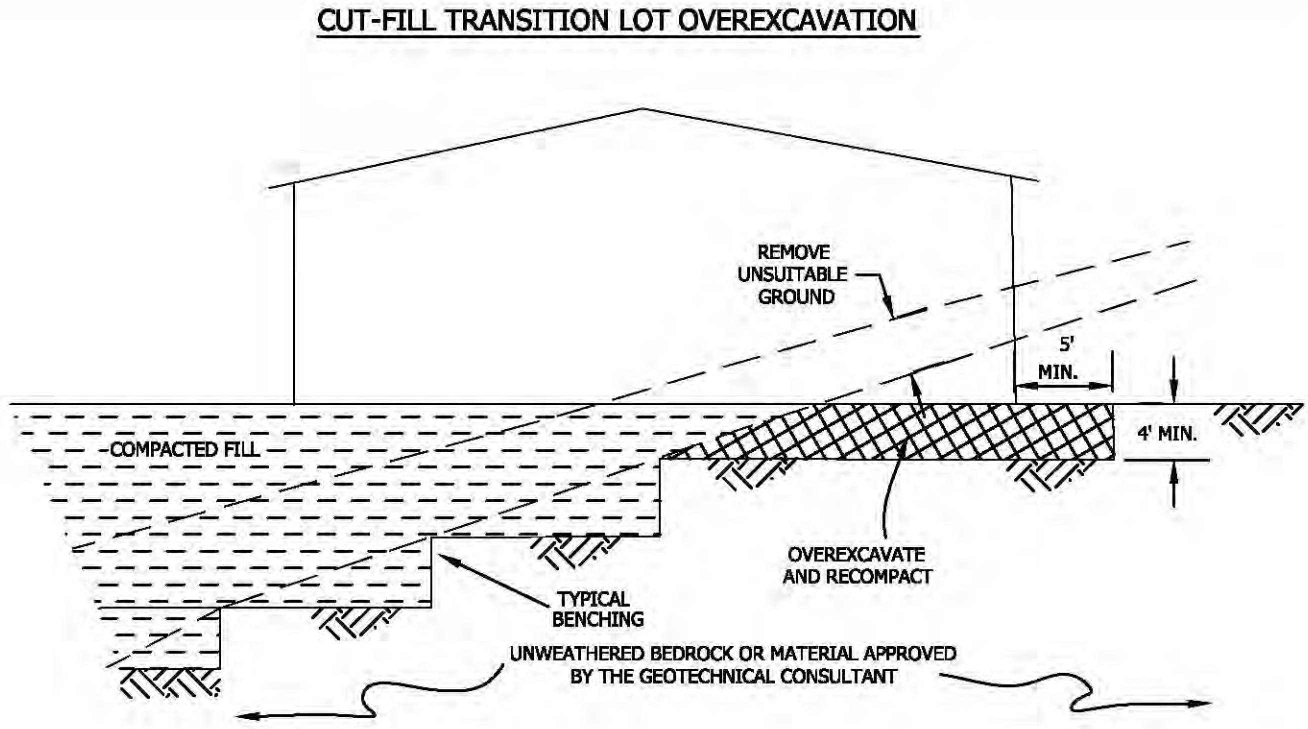

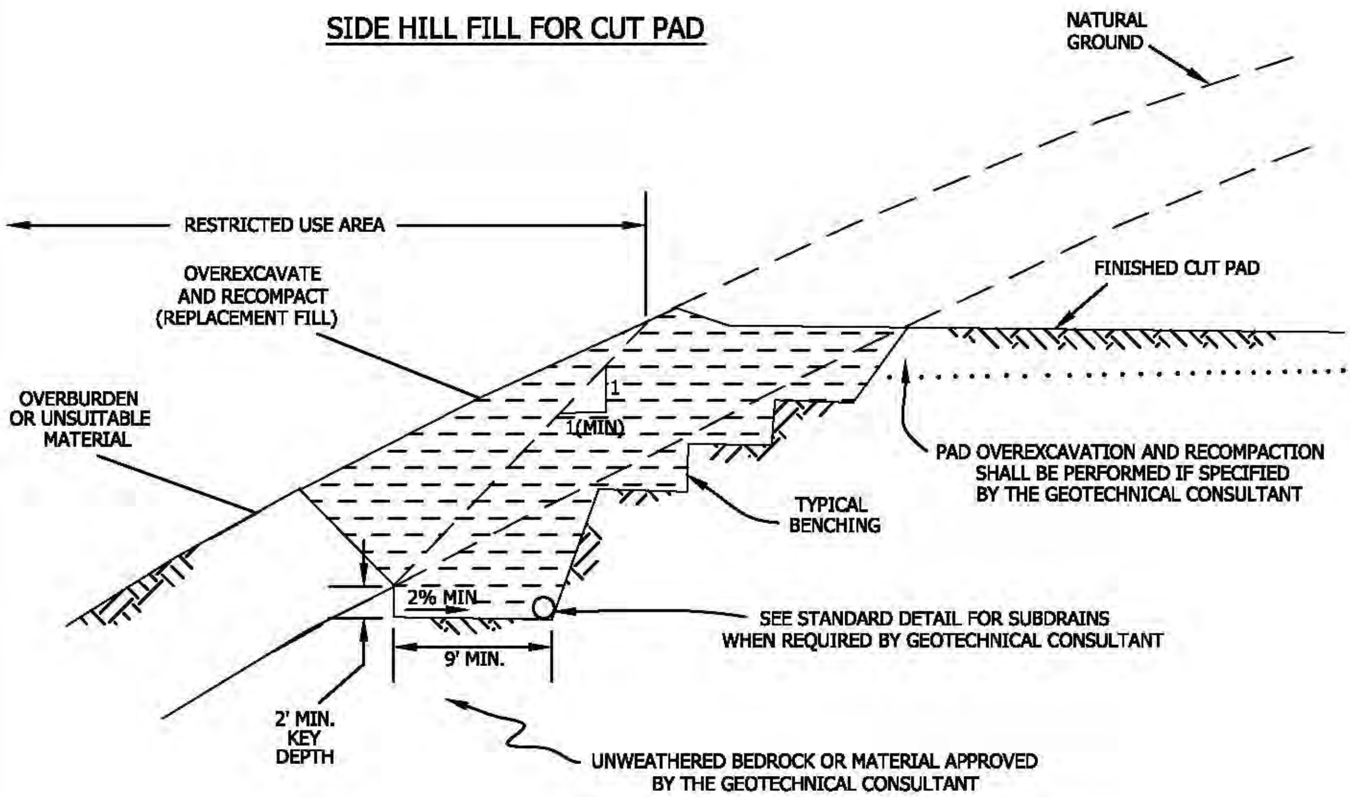

TRANSITION LOT FILLS AND SIDE HILL FILLS	GENERAL EARTHWORK AND GRADING SPECIFICATIONS STANDARD DETAILS E	Leighton

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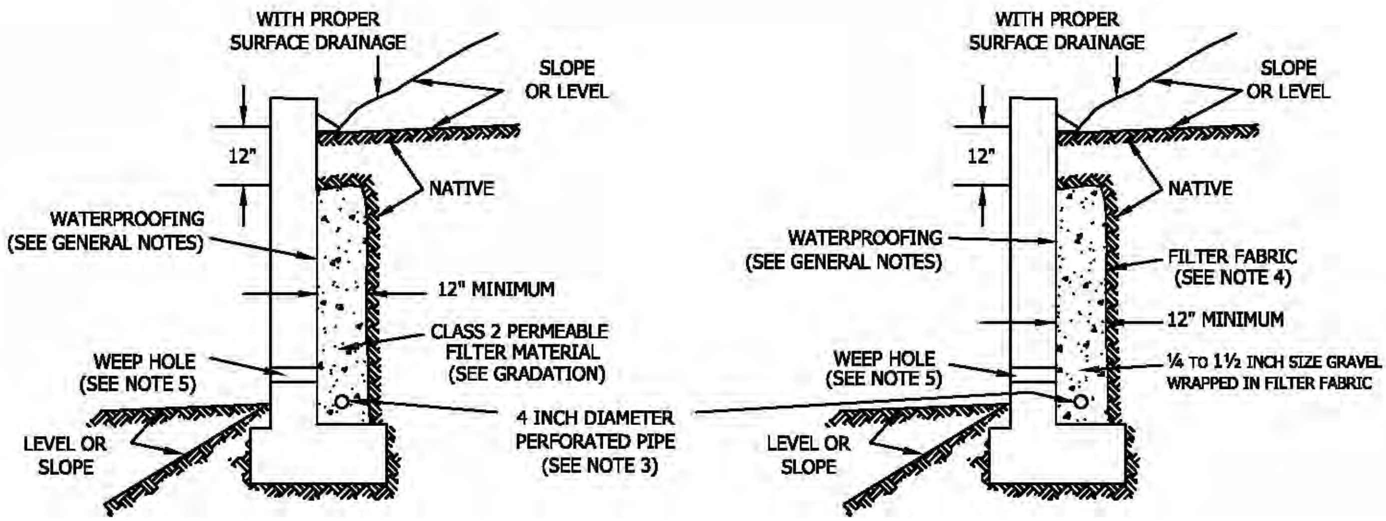
SUBDRAIN OPTIONS AND BACKFILL WHEN NATIVE MATERIAL HAS EXPANSION INDEX OF ≤50

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

APPENDIX E

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.

Geotechnical 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 civil engineer may not fulfill the needs of a constructor — a construction contractor — or even another civil engineer. Because each geotechnical- engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. No one except you 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 the Full Report

Serious problems have occurred because those relying on a geotechnical-engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

Geotechnical Engineers Base Each Report on a Unique Set of Project-Specific Factors

Geotechnical engineers consider many unique, project-specific factors when establishing the scope of a study. Typical factors include: the client's goals, objectives, and risk-management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical-engineering report that was:

- not prepared for you;
- not prepared for your project;
- not prepared for the specific site explored; or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical-engineering report include those that affect:

- 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. *Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.*

Subsurface Conditions Can Change

A geotechnical-engineering report is based on conditions that existed at the time the geotechnical engineer performed the study. *Do not rely on a geotechnical-engineering report whose adequacy may have been affected by*: the passage of time; man-made events, such as construction on or adjacent to the site; or natural events, such as floods, droughts, earthquakes, or groundwater fluctuations. *Contact the geotechnical engineer before applying this report to determine if it is still reliable.* A minor amount of additional testing or analysis could prevent major problems.

Most Geotechnical Findings Are Professional Opinions

Site exploration identifies subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ — sometimes significantly — from those indicated in your report. Retaining the geotechnical engineer who developed your report to provide geotechnical-construction observation is the most effective method of managing the risks associated with unanticipated conditions.

A Report's Recommendations Are Not Final

Do not overrely on the confirmation-dependent recommendations included in your report. *Confirmation-dependent recommendations are not final,* because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations *only* by observing actual subsurface conditions revealed during construction. *The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's confirmation-dependent recommendations if that engineer does not perform the geotechnical-construction observation required to confirm the recommendations' applicability.*

A Geotechnical-Engineering Report Is Subject to Misinterpretation

Other design-team members' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Constructors can also misinterpret a geotechnical-engineering report. Confront that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing geotechnical construction observation.

Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical-engineering report should *never* be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, *but recognize that separating logs from the report can elevate risk.*

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make constructors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give constructors the complete geotechnical-engineering report, *but* preface it with a clearly written letter of transmittal. In that letter, advise constructors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. *Be sure constructors have sufficient time* to perform additional study. Only then might you be in a position to give constructors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

Read Responsibility Provisions Closely

Some clients, design professionals, and constructors fail to recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of 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.

Environmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform an *environmental* study differ significantly from those used to perform a *geotechnical* 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 environmental problems have led to numerous project failures.* If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. *Do not rely on an environmental report prepared for someone else.*

Obtain Professional Assistance To Deal with Mold

Diverse strategies can be applied during building design, construction, operation, and maintenance to prevent significant amounts of mold from growing on indoor surfaces. To be effective, all such strategies should be devised for the *express purpose* of mold prevention, integrated into a comprehensive plan, and executed with diligent oversight by a professional mold-prevention consultant. Because just a small amount of water or moisture can lead to the development of severe mold infestations, many mold- prevention strategies focus on keeping building surfaces dry. While groundwater, water infiltration, and similar issues may have been addressed as part of the geotechnical- engineering study whose findings are conveyed in this report, the geotechnical engineer in charge of this project is not a mold prevention consultant; *none of the services performed in connection with the geotechnical engineer's study were designed or conducted for the purpose of mold prevention. Proper implementation of the recommendations conveyed in this report will not of itself be sufficient to prevent mold from growing in or on the structure involved.*

Rely, on Your GBC-Member Geotechnical Engineer for Additional Assistance

Membership in the Geotechnical Business Council of 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. Confer with you GBC-Member geotechnical engineer for more information.

GBC GEOTECHNICAL BUSINESS COUNCIL
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