GEO-ETKA, INC.

Established 1965

Soil Engineering and Geology
Material Testing and Inspections

1801 East Heim Avenue, Suite 202, Orange, California 92865 • Phone (714) 771-6911• Email: geoetka@aol.com

PRELIMINARY SOIL INVESTIGATION REPORT

FOR

PROPOSED SINGLE FAMILY RESIDENCE
1102 PACIFIC COAST HIGHWAY, LOT 4
HUNTINGTON BEACH, CALIFORNIA 92648

FOR

KASTALA INVESTMENT PARTNERS

[redacted]

Date: April 19, 2022
Project No: FG-11942-22

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April 19, 2022

[redacted]

Attention: Mr. [redacted]

Subject: Preliminary Soil Investigation Report
Geo-Etka, Inc. Job No.: FG-11941-22

Project: Proposed Single Family Residence at 1102 Pacific Coast Highway, Lot 4, Huntington Beach, California 92648

Dear Mr. Montecillo,

In accordance with your authorization, we have performed a preliminary soil investigation at the subject site. The accompanying report presents a summary of our findings, recommendations, and limitation of work for the proposed site development.

The primary purpose of this investigation and report is to provide an evaluation of the existing geotechnical conditions at the site as they relate to the design and construction of the proposed development. More specifically, this investigation was to address geotechnical conditions for the preliminary design of the foundation for the proposed residence.

Based on the results of our investigation, the proposed development is feasible from a geotechnical standpoint and it is our professional opinion that the proposed development will not be subject to a hazard from settlement, slippage, or landslide, provided the recommendations of this report are incorporated into the proposed development. It is also our opinion that the proposed development will not adversely affect the geologic stability of the site or adjacent properties provided the recommendations contained in this report are incorporated into the proposed construction.

Questions, if any, regarding this report should be directed to our office.

Respectfully submitted,
GEO-ETKA, INC.

Ghayas A. Khan, P. E.
Civil Engineer, C-038344
Expires 3-31-23

Ahmed Ali, President
MS, REA

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1.0 INTRODUCTION

1.1 EXISTING SITE CONDITIONS

The subject site is located on the northwest corner of the Pacific Coast Highway and 11th Street intersection, in the City of Huntington Beach, California. Access on site is from either Pacific Coast Highway or unnamed alley off 11th Street. Pacific Coast Highway and 11th Street are AC paved roads with existing concrete curb and gutter improvements and the alley is paved with AC pavement. The geographical relationship of the site and surrounding vicinity is shown on the Site Location Map, Figure 1.

We understand that the property at 1102 Pacific Coast Highway will be subdivided into 4 equal parcels with the fronts of the properties facing PCH. The parcel being addressed in this report is the parcel located furthest northwest of the four proposed parcels. The subject site is rectangular in shape, measuring approximately 25 feet wide and 162 feet long. There had recently been a two-story hotel onsite which is currently demolished and removed offsite. The site consists of level vacant soil lot.

1.2 PROPOSED DEVELOPMENT

Based on our understanding of the project, the site is proposed for the subdivision of the existing parcel into 4 parcels with frontage along 11th Street. This report is for the northern parcel only. We understand that proposed is the construction of a new three-story single-family residence at or near existing grade with a 14 feet deep subterranean garage with access via the alley. We have not been provided with foundation plans but we assume that the building will be supported on shallow concrete foundations and a slab-on-grade. Continuous wall loads are not expected to exceed 2 kips per linear foot and isolated column loads of up to 8 kips for the house on grade. The basement will be 4 kips per linear foot walls and 40 kips isolated column load.

Once the design phase and foundation loading configuration proceeds to a more finalized plan, the recommendations within this report should be reviewed and revised, if necessary. Any changes in the design, location or elevation of any structure, as outlined in this report, should be reviewed by this office. GEO-ETKA should be contacted to determine the necessity for review and possible revision of this report.

1.3 FIELD WORK

One exploratory borehole was drilled up to 50 feet below ground surface on April 2, 2022 utilizing a CME-45 mobile drill rig equipped with 6-inch diameter hollow stem augers, refer to Plate 1 for borehole locations. Relatively undisturbed samples were obtained utilizing the California Ring Sampler (ASTM D 1587). Additional representative samples have been recovered with the SPT (Standard Penetration Test, ASTM D 1586) sampler. Bulk samples were also collected from the auger cuttings during drilling. The samples were collected in plastic bags, tied, and tagged for the location and depth. The geotechnical boring logs are presented in Appendix B and may include a description and classification of each stratum, sample locations, blow counts, groundwater conditions encountered during drilling, results from selected types of laboratory tests, and drilling information.

1.4 LABORATORY TESTING

Laboratory tests were performed on selected soil samples. The tests consisted primarily of the following:

- Moisture Content (ASTM D2216)
- Dry Density (ASTM D2937)
- Grain Size (ASTM C136)
- Direct Shear (ASTM D3080)
- Expansion Index (ASTM D4829)
- Soluble Sulfate Content (Extinction/Turbidimetric Method)

The soil classifications are in conformance with the Unified Soil Classifications System (USCS), as outlined in the Classification and Symbols Chart (Appendix B). A summary of our laboratory testing, ASTM designation, and graphical presentation of test results is presented in Appendix C.

2.0 GEOTECHNICAL CONDITIONS

2.1 REGIONAL GEOLOGIC FINDINGS

Based on the Geologic Map of the Long Beach 30'x60' quadrangle (CGS, CGS, Geologic Compilation of Quaternary Surficial Deposits in Southern, July 2010) the site is located in an area mapped as old lacustrine, playa, and estuarine deposits (Qol), see Figure 2. These deposits are regionally described as consisting of slightly to moderately consolidated, moderately dissected fine-grained sand, silt, mud, and clay deposits.

There are no mapped active or potentially active faults with surface expression that trend through the subject property, according to those references cited herein. The site does not lie within a designated Alquist-Priolo Earthquake Fault Zone (CDMG, 2000). According to the California Department of Conservation, Fault Activity Map of California 2010, the site is located approximately 1.2 miles northeast of the Newport-Inglewood-Rose Canyon fault zone, see Figure 3.

The subject site, as is the case with most of the tectonically-active California area, will be periodically subject to moderate to intense earthquake-induced ground shaking from nearby faults. Significant damage can occur to the site and structural improvements during a strong seismic event. Neither the location nor magnitude of earthquakes can accurately be predicted at this time.

2.1.1 Liquefaction Potential

Liquefaction is a soil strength and stiffness loss phenomenon that typically occurs in loose, saturated cohesionless soils as a result of strong ground shaking during earthquakes. The potential for liquefaction at a site is usually determined based on the results of a subsurface geotechnical investigation and the groundwater conditions beneath the site. Hazards to buildings associated with liquefaction include bearing capacity failure, lateral spreading, and differential settlement of soils below foundations, which can contribute to structural damage or collapse.

According to the CGS, Earthquake Zones of Required Investigation Map for the Seal Beach quadrangle (see Figure 4), the site is not located in an area considered to be susceptible to liquefaction. However, the potential for liquefaction and dynamic settlement has been evaluated as outlined in Chapter 6 of the California Division of Mines and Geology (DMC) Special Publication 117 ("Guidelines for Evaluation and Mitigation of Seismic Hazards in California") and "Recommended Procedures for Implementation of DMG Special Publication 117 - Guidelines for Analyzing and Mitigating Liquefaction in California", published by the Southern California Earthquake Center, 2008 edition. The design and construction recommendations presented in this report include results of liquefaction and dynamic settlement evaluation. The analysis results are included in Appendix E.

2.1.2 Seismic Settlement and Lateral Spreading

Liquefaction analysis indicates that 0.16 inch of total dynamic settlement is estimated during a large earthquake episode. An estimated dynamic differential settlement of 0.08 inch may be anticipated. The historical high ground water during a seismic event has been assumed at 10 feet below ground surface.

Based on SCEC (1999) guidelines, a potential for loss of bearing capacity due to liquefaction is not expected at the site since there is not an upper potentially liquefiable layer at a depth shallower than the estimated depth where the induced vertical stress in the soil is 10% of the bearing pressure imposed by the proposed foundation systems.

In significant conformance with Youd, Hanson, and Bartlett (ASCE Geotechnical Jr. April 1995, and Lecture by Youd on July 7, 1999), no lateral spreading due to liquefaction is expected at this site due to the following reasons:

- Alluvial subsurface soils are essentially horizontally layered.
- There is not a free-face, onsite, toward which liquefied soils could move laterally.
- No saturated liquefiable sand with values of N1(60) <15 exist at the site.

If loose clean sand exists between sampling intervals, their occurrence is expected to be thin and considered to be scattered or have minimal occurrence throughout the site, and cannot reasonably be connected to form a hypothetical "continuous" line of significant length that could reasonably be expected to "exit" on a slope or a free-face, or move significantly below the gentle slope of the site.

Although it is extremely difficult to predict the overall behavior of any site during seismic shaking, it is our opinion that proper design of foundation can substantially improve the structure's resistance to deformation. This is most commonly accomplished by providing adequate lateral connections between all footings with reinforced grade beams and strengthened stem walls. If the owner wishes a higher degree of confidence, then the structures should be designed for higher probable events.

Please note that foundation design is under the purview of the structural engineer. All foundations should be designed by a qualified structural engineer in accordance with the CBC and the latest applicable building codes and structural considerations may govern.

2.1.3 Slope Stability & Seismic Induced Landslides

The site and the surrounding properties are flat and not prone to slope instability hazards, such as landslides. The project will not be impacted by a landslide or impact adjacent properties due to a project generated landslide.

2.2 SUBSURFACE CONDITIONS

Detailed logs of the exploratory excavations are presented in Appendix B of this report. The earth materials encountered within the exploratory excavations are generally described below.

Based on our exploratory borehole, the site soil generally consists of approximately 17 feet of very firm to hard sandy silt (USCS "ML") with some clay content underlain by medium dense to very dense sand (USCS "SP-SM") and sand (USCS "SP").

2.3 EXPANSIVE SOIL

Expansive soils are characterized by their ability to undergo significant volume changes (shrink or swell) due to variations in moisture content. Changes in soil moisture content can result from precipitation, landscape irrigation, utility leakage, roof drainage, perched groundwater, drought, or other factors and may result in unacceptable settlement or heave of structures or concrete slabs supported on grade.

Based on laboratory testing, the soil onsite is expected to have a low expansion potential (EI=33), as defined in ASTM D4829. This would require verification subsequent to completion of new footing excavations.

2.4 CORROSIVE SOIL

To preliminarily assess the sulfate exposure of concrete in contact with the site soils, a representative soil sample was tested for water-soluble sulfate content. The test results suggest the site soils have a negligible potential for sulfate attack (0.030 percent) based on commonly accepted criteria. We recommend following the procedures provided in ACI 318-19, Section 19.3, Table 19.3.2.1 for exposure "S0". We also recommend Type II cement for all concrete work in contact with soil.

Ferrous metal pipes should be protected from potential corrosion by bituminous coating, etc. We recommend that all utility pipes be nonmetallic and/or corrosion resistant. Recommendations should be verified by soluble sulfate and corrosion testing of soil samples obtained from specific locations at the completion of rough grading.

2.5 GROUNDWATER

Groundwater study is not within the scope of this work. Groundwater was encountered in our exploratory borehole at a depth of 30 feet below ground surface. Based on the CDMG, Seismic Hazard Report for the Seal Beach Quadrangle, highest historical groundwater levels at the subject site is around 10 feet below ground surface.

Please note that the potential for rain or irrigation water locally seeping through from elevated areas and showing up near grades cannot be precluded. Our experience indicates that surface or near-surface groundwater conditions can develop in areas where groundwater conditions did not exist prior to site development, especially in areas where a substantial increase in surface water infiltration results from landscape irrigation. Fluctuations in perched water elevations are likely to occur in the future due to variations in precipitation, temperature, consumptive uses, and other factors including mounding of perched water over bedrock or natural soil. Mitigation for nuisance shallow seeps moving from elevated lower areas will be needed if encountered. These mitigations may include subdrains, horizontal drains, toe drains, french drains, heel drains or other devices.

2.6 SEISMIC DESIGN PARAMETERS

Based on current standards, the proposed development is expected to be designed in accordance with the requirements of the 2019 California Building Code (CBC). The 2019 California Building Code (CBC) provides procedures for earthquake resistant structural design that include considerations for on-site soil conditions, occupancy, and the configuration of the structure including the structural system and height.

We have downloaded the seismic design parameters in accordance with the provisions of the current California Building Code (CBC, 2019) and ASCE/SEI 7-16 Standard using the Structural Engineers Association of California, OSHPD Seismic Design Maps Web Application (https://seismicmaps.org). The mapped seismic parameters are attached to this report in Appendix D.

According to ASCE/SEI 7-16, sites subject to liquefaction should be classified as Site Class F, which requires a site-specific response analysis. However, ACSE/SEI 7-16 states that for a short period (less than 1/2 second) structure on liquefiable soils, Site Class D or E may be used instead of Site Class F to estimate design seismic loading on the structure. The selection of Site Class D or E is based on the assessment of the site soil profile assuming no liquefaction.

For structures with a period shorter than 1/2 second, seismic design parameters for Site Class D are below. Structures that have a period longer than 1/2 second will require a site- specific response analysis.

Parameter	ASCE 7-16	2019 CBC	Coefficient	Value
0.2-second Period MCE	Figure 22-1	Figure 1613.2.1(1)	S_S	1.391
1.0-second Period MCE_R	Figure 22-2	Figure 1613.2.1(2)	S_1	0.504
Soil Site Class	Figure 20.3-1	Section 1613.2.2	Site Class	D
Site Coefficient	Figure 11.4-1	Section 1613.2.3(1)	F_a	1.200
Site Coefficient	Figure 11.4-2	Section 1613.2.3(2)	F_v	1.796*
Adjusted MCE Spectral Response Parameters	Equation 11.4-1	Equation 16-36	S_{MS}	1.669
	Equation 11.4-2	Equation 16-37	S_{M1}	0.905*
Design Spectral Acceleration Parameters	Equation 11.4-3	Equation 16-38	S_{DS}	1.113
	Equation 11.4-4	Equation 16-39	S_{D1}	0.603*

*The values provided are valid provided the requirements in Exception Note No. 2 in Section 11.4.8 of ASCE 7-16 are met. If not, a site specific ground motion hazard analysis will be required.

3.0 TENTATIVE RECOMMENDATIONS

3.1 EARTHWORK RECOMMENDATIONS

The following recommendations are provided regarding aspects of the anticipated earthwork construction. These recommendations should be considered subject to revision based on additional geotechnical evaluation of the conditions observed by the Geotechnical Engineer during grading operations. All grading should be performed in accordance with our General Earthwork and Grading Specifications presented in Appendix F except as modified within the text of this report.

3.1.1 Site Clearing, Grubbing and Fill Removal

All debris, undocumented fill, abandoned utility lines, roots, irrigation appurtenances, underground structures, deleterious materials, etc., should be removed from structural fill areas. Cavities created during site clearance should be backfilled in a controlled manner.

3.1.2 Building Pad Preparation

In order to provide adequate support for the proposed residence, the building pad should be overexcavated to a depth of at least 4 feet below existing grade. Overexcavation is not necessary for the basement area. The lateral extent of overexcavation should be at least 4 feet, where achievable. This will require grading around the perimeter to be conducted in sections. Slot cuts recommendations are presented in Section 3.2.3 of this report.

Once the bottom of the excavation is observed by a representative of this firm to be in competent native soil, the bottom of the overexcavation should be scarified, moisture conditioned, and recompacted to at least 90 percent of the maximum dry density, as determined by ASTM D1557 Test Method; prior to placement of fill. Deeper overexcavation, especially to remove loose soils or deleterious material, may be required depending upon field observations of excavation bottom by the soil engineer or his representative.

3.1.3 Trench Backfill

All utility trench backfills should be mechanically compacted to the minimum requirements of at least 90 percent relative compaction. Onsite soils derived from trench excavations can be used as trench backfill except for deleterious materials. Soils with sand equivalent greater than 30 may be utilized for pipe bedding and shading. Pipe bedding should be required to provide uniform support for piping. Excavated material from footing trenches should not be placed in slab-on-grade areas unless properly compacted and tested.

3.1.4 Compacted Fills/Imported Soils

Any soil to be placed as fill, whether presently onsite or import, should be approved by the soil engineer or his representative prior to their placement. All onsite soils to be used as fill should be cleansed of any roots, or other deleterious materials. Rocks larger than 12-inches in diameter should be removed from soil to be used as compacted fill.

All fills should be placed in 6- to 8-inch loose lifts, thoroughly watered, or aerated to near optimum moisture content, mixed and compacted to at least 90 or 95 percent relative compaction depending on the material (subgrade soil or aggregate base) and application (pavement subgrade, building pad, etc.). This is relative to the maximum dry density determined by ASTM D1557 Test Method.

Any imported soils should be sandy (preferably USCS "SM" or "SW", and very low in expansion potential) and approved by the soil engineer. The soil engineer or his representative should observe the placement of all fill and take sufficient tests to verify the moisture content and the uniformity and degree of compaction obtained.

3.2 TEMPORARY EXCAVATIONS

All excavation slopes and shoring systems should meet the minimum requirements of the Occupational Safety and Health (OSHA) Standards. Maintaining safe and stable slopes on excavations is the responsibility of the contractor and will depend on the nature of the soils and groundwater conditions encountered and his method of excavation. Excavations during construction should be carried out in such a manner that failure or ground movement will not occur. The contractor should perform any additional studies deemed necessary to supplement the information contained in this report for the purpose of planning and executing his excavation plan.

3.2.1 Cal/OSHA Soil Type

The subsurface soil expected to be encountered during site development may be classified as "Soil Type B" per the California Occupational Safety and Health Administration (Cal/OSHA).

3.2.2 Excavation Characteristics

The onsite soil is generally composed of hard clayey sand which is not expected to exhibit difficult excavation resistance for typical grading equipment in good working condition.

3.2.3 Safe Vertical Cuts

Temporary un-surcharged excavations of 4 feet high may be made at a vertical gradient for short periods of time. Temporary un-surcharged excavations greater than 4 feet may be trimmed back at 1H:1V gradients to a maximum height of 20 feet. Exposed excavation conditions should be verified by the project geotechnical engineer during construction. No excavations should take place without the direct supervision of the project geotechnical engineer. If potentially unstable soil conditions are encountered, modifications of slope ratios for temporary cuts may be required.

3.2.4 Excavation Setbacks

No excavations should be conducted, without special considerations, along property lines, public right-of-ways, or existing foundations, where the excavation depth will encroach within the "zone of influence". The "zone of influence" of the existing footings, property lines, or public right-of-way may be assumed to be below a 45-degree line projected down from the bottom edge of the footing, property line, or right-of-way.

3.2.5 Slot-Cut Excavations

\Where excavations encroach within a 45-degree line projected down from the property line at ground surface, A-B slot cut excavations should be utilized. Slot cut excavations may be conducted onsite to a maximum width and height of 8 feet and 5 feet, respectively. No excavations should take place without the direct supervision of the project geotechnical engineer. If potentially unstable soil conditions are encountered, modifications of slope ratios for temporary cuts may be required.

3.3 TEMPORARY SHORING

If temporary shoring is used during the project development, the following earth pressures may be utilized to aid in the design. The following earth pressures are based on drained conditions (no hydrostatic or buoyant conditions) and the assumption that the shoring is vertical (no batter), and the ground surface in front and behind the shoring is level. For different geometries or conditions, the above lateral earth pressures should be reevaluated.

Cantilever shoring, up to 15 feet high, may be designed for a triangular load distribution equivalent to the pressure exerted by a fluid weighing 30 pounds per cubic foot (pcf). For an aerial surcharge placed adjacent to the shoring, an equivalent, horizontal (rectangular) pressure of thirty (30) percent of the surcharge may be assumed to act along the entire length of the shoring.

Shoring must extend below the excavation bottom to provide lateral resistance by passive soil pressure. Allowable passive pressures may be taken as equivalent to the pressure exerted by a fluid weighing 300 pcf to a maximum value of 2400 psf.

Shoring adjacent to existing structures or improvements should be designed and constructed to reduce potential movement. The shoring system designer should evaluate potential deflections in their design.

3.4 FOUNDATION RECOMMENDATIONS

The proposed residence may be supported on conventional shallow foundation systems deriving support in compacted fill. All foundation excavations must be observed and approved by the Geotechnical Engineer's representative, prior to placing steel reinforcement or concrete.

3.4.1 Bearing Capacity

Spread, continuous, or pad-type foundations carried at least 24-inches below the lowest adjacent grade may be designed to impose a net dead-plus-live load pressure of 2000 psf. A one-third increase may be used for wind or seismic loads.

3.4.2 Lateral Resistance

Resistance to lateral footing will be provided by passive earth pressure and base friction. For footings bearing against firm native material, passive earth pressure may be considered to be developed at a rate of 300 psf per foot of depth to a maximum of 2000 psf. Base friction may be computed at 0.40 times the normal load. If passive earth pressure and friction are combined to provide required resistance to lateral forces, the value of the passive pressure should be reduced to two-thirds the value.

3.4.3 Settlement

The onsite soils below the foundation depth have relatively high strengths and will not be subject to significant stress increases from foundations of the new structure. Therefore, estimated total long-term static and seismic settlement between similarly loaded adjacent foundation systems should not exceed 1-inch. The structures should be designed to tolerate a differential settlement on the order of 1/2-inch over a 30-foot span.

3.4.4 Reinforcement

Footing reinforcement should be determined by the structural engineer; however, minimum reinforcement should be at least two No. 5 reinforcing bars, top and bottom. Reinforcement and size recommendations presented in this report are considered the minimum necessary for the soil conditions present at the foundation level and are not intended to supersede the design of the project structural engineer or criteria of the governing agencies for the project.

3.5 SLABS-ON-GRADE

Slabs-on-grade should be at least 5-inches thick. Slab-on-grade reinforcement should be at least No. 4 bars at 12-inches on-center both ways, properly centered in mid thickness of slabs. The structural engineer should design the actual slab thickness and reinforcement based on structural load requirements.

3.5.1 Modulus of Subgrade Reaction

A coefficient of vertical subgrade reaction (K_V) of 200 psi/in may be assumed for the building pad compacted fill soils. The modulus of subgrade reaction was estimated based on the NAVFAC 7.1 design charts. This value is for a small loaded area (1 sq. ft or less) such as for wheel loads or point loads and should be adjusted for larger loaded areas, as necessary.

3.5.2 Capillary Break & Vapor Membrane

If vinyl or other moisture-sensitive floor coverings are planned, we recommend that the floor slab in those areas be underlain by a vapor membrane and capillary break consisting of a minimum 10-mil vapor-retarding membrane over a 4-inch thick layer of clean sand. The 4-inch thick layer of sand should be placed between the subgrade soil and the membrane to decrease the possibility of damage to the membrane. This recommendation meets the requirements laid out in the 2019 California Green Building Standards Code.

3.5.3 Slab Curling Precautions

A low-slump concrete should be used to minimize possible curling of the slab. Additionally, a layer of sand may be placed over the vapor retarding membrane to reduce slab curling. If this sand bedding is used, care should be taken during the placement of the concrete to prevent displacement of the sand. However, the need for sand and/or the thickness of sand above the moisture vapor barrier should be specified by the structural engineer or concrete contractor. The selection of sand above the barrier is not a geotechnical engineering issue and hence outside our purview.

3.5.4 Subgrade Exposure

Construction activities and exposure to the environment can cause deterioration of the prepared subgrade. Therefore, we recommend that our field representative observe the condition of the final subgrade soils immediately prior to slab-on-grade construction, and, if necessary, perform further density and moisture content tests to determine the suitability of the final prepared subgrade.

Additionally, the slab subgrade should be moisture conditioned to 2 to 4 percent above the optimum moisture content, to a depth of 12 inches. The moisture content of the floor slab subgrade soils should be verified by the geotechnical engineer within 24 hours prior to placing the vapor retarding membrane.

3.5.5 Below Grade Slab Drainage

Basement slabs and floor slabs below exterior grades should be provided with floor drains. A typical subdrain detail is shown in Plate 2. The perforated pipe should be embedded slightly into the subgrade and sloped to drain to a tightline collector which empties into approved drainage device. The perforated pipe should not be raised high into drain rock in order to attain the desired slope. Subdrain plans should be reviewed by GeoMat Testing Laboratories. All drains should be tightlined to an approved outlet and disposal location. The vapor barrier underlain by 4 inches of protective sand should be installed below the basement slab.

We strongly recommend against connecting roof drains or surface area drains to foundation drain system because the drain system should be free from sediments. The drain system should be provided with cleanouts for regular maintenance.

3.6 RETAINING WALLS

The following lateral earth pressures, in conjunction with the lateral resistance parameters provided in the Foundation Recommendations section of this report, may be used for the design of retaining walls with free draining compacted backfills. If passive earth pressure and friction are combined to provide required resistance to lateral forces, the value of the passive pressure should be reduced to two-thirds the following recommendations.

Lateral Earth Pressure Condition	Soil Backfill Condition	Equivalent Fluid Pressure (pcf)	Earth Pressure Coefficient
Active Case (Drained)*	Level	31	$K_a = 0.26$
At-Rest Case (Drained)	Level	49	$K_o = 0.41$
Total Unit Weight of Soil	120 pcf		

3.6.1 Seismic Earth Pressure

Retaining walls exceeding 6 feet in height shall be designed to resist the additional earth pressure caused by seismic ground shaking. A seismic load of 22 pcf should be used for design of walls that support more than 6 feet of backfill in accordance with Section 1803.5.12 of the 2019 CBC. This incremental pseudo-static pressure was calculated using the methods recommended in NAVFAC 7.2 and a horizontal coefficient equal to one-half of two-thirds PGA_M.

The seismic load is applied as an equivalent fluid pressure along the height of the wall and the calculated loads result in a maximum load exerted at the base of the wall and zero at the top of the wall. When using the load combination equations from the building code, the seismic earth pressure should be combined with the lateral active earth pressure for analyses of restrained basement walls under seismic loading conditions.

3.6.2 Surcharge Loading

Retaining walls should also be designed to resist any lateral surcharges due to the traffic, nearby buildings, construction loads, etc. Surcharge loads within a 1H:1V plane extending up from the base of the wall should be included in the design lateral pressures by multiplying the associated lateral earth pressure coefficient (see table above) with the applied surcharge load. This surcharge load should be applied as a uniform load along the height of the wall. Additional static lateral pressures due to other surcharge loadings in the vicinity of the wall can be estimated using the guidelines provided in Plate 3.

3.6.3 Waterproofing

The backfilled side of all retaining walls should be coated with an approved waterproofing compound or covered with a similar material to inhibit migration of moisture through the walls. It is recommended that the waterproofing system should be inspected and approved by the project civil engineer. The use of a water-stop should be considered for all concrete joints. We recommend contacting a waterproofing professional/consultant for specific recommendations for placement, sealing and protection of below grade walls.

3.6.4 Drainage and Backfill

We recommend drainage for retaining walls to be provided in accordance with Plate 4 of this report. The backdrain pipe should be connected to a system of closed pipe(s) (non-perforated) that lead to the storm runoff discharge facilities. Retaining wall backdrain must be observed by GeoMat Testing Laboratories prior to wall backfill.

The above earth pressures assume that sufficient drainage will be provided behind the walls to prevent the build-up of hydrostatic pressures from surface and subsurface water infiltration. Back-cut distance for conventional retaining walls should be at least 18 inches to facilitate compaction.

All retaining wall backfill must be compacted to at least 90 percent relative compaction (ASTM D-1557), utilizing equipment that will not damage the wall. Maximum precautions should be taken when placing drainage materials and during backfilling. Onsite soils may be used as backfill.

3.7 SWIMMING POOL RECOMMENDATIONS

We anticipate that the proposed pool will consist of a reinforced shotcrete (gunite) swimming pool with concrete decks. Our investigation indicates the swimming pool and pool deck will be constructed on soil with a low expansion potential (EI=33).

3.7.1 Modulus of Subgrade Reaction

A coefficient of vertical subgrade reaction (K_V) of 150 psi/in may be assumed for the natural soil onsite. The modulus of subgrade reaction was estimated based on the NAVFAC 7.1 design charts. This value is for a small loaded area (1 sq. ft or less) such as for wheel loads or point loads and should be adjusted for larger loaded areas, as necessary.

3.7.2 Lateral Resistance

Resistance to lateral footing will be provided by passive earth pressure and base friction. For the spa embedment bearing against firm native material, passive earth pressure may be considered to be developed at a rate of 300 psf per foot of depth to a maximum of 2000 psf. Base friction may be computed at 0.40 times the normal load. If passive earth pressure and friction are combined to provide required resistance to lateral forces, the value of the passive pressure should be reduced to two-thirds the value.

3.7.3 Earth Pressures & Surcharge Loads

The walls of the spa should be designed to resist earth pressures due to adjacent native or engineered backfill materials, hydrostatic pressures, as well as surcharge loads. Pool walls should be designed to resist an equivalent fluid pressure of 62.4 pcf in addition to one-half of any surcharge load applied at the ground surface.

3.8 SITE DRAINAGE

Adequate lot surface drainage is a very important factor in reducing the likelihood of adverse performance of foundations, hardscape, and slopes. Surface drainage should be sufficient to prevent ponding of water anywhere on a lot, and especially near structures and tops of slopes. Lot surface drainage should be carefully taken into consideration during fine grading, landscaping, and building construction. Therefore, care should be taken that future landscaping or construction activities do not create adverse drainage conditions.

Positive site drainage within common areas should be provided and maintained at all times. Drainage should not flow uncontrolled down any descending slope. Water should be directed away from foundations and not allowed to pond and/or seep into the ground. In general, the area within 5 feet around a structure should slope away from the structure. We recommend that unpaved lawn and landscape areas have a minimum gradient of 2 percent sloping away from structures, and whenever possible, should be above adjacent paved areas. Consideration should be given to avoiding construction of planters adjacent to structures.

Planters around the site should be provided with drainage. Planters adjacent to foundation, if constructed, should be provided with sealed bottom. Onsite drainage should be directed to approve drainage collection devices, per the civil engineer recommendations. Location of drainage devices should be in accordance with the design civil engineer's drainage and erosion control recommendations.

Pad drainage should be directed toward the street or other approved area(s). Although not a geotechnical requirement, roof gutters, downspouts, or other appropriate, means may be utilized to control roof drainage. Downspouts, or drainage devices, should outlet a minimum of 5 feet from structures or into a subsurface drainage system. Areas of seepage may develop due to irrigation or heavy rainfall, and should be anticipated. Minimizing irrigation will lessen this potential. If areas of nuisance seepage develop, recommendations such as subdrains, French drains, etc., for minimizing this effect could be provided upon request.

4.0 ADDITIONAL SERVICES

Plan Reviews

The recommendations provided in this report are based on preliminary information and subsurface conditions as interpreted from limited exploratory boreholes at the site. We should be retained to review the final project plans to revise our conclusions and recommendations, as necessary. Professional fees will apply for each review.

Our conclusions and recommendations should also be reviewed and verified during site grading and revised accordingly if exposed geotechnical conditions vary from our preliminary findings and interpretations.

Additional Observation and/or Testing

GEO-ETKA, Inc. should observe and/or test at the following stages of construction.

- During building overexcavation and placement of compacted fill.
- Following footing excavation and prior to placement of footing materials.
- During trench and wall backfill.
- When any unusual conditions are encountered.

Final Report of Compaction During Grading

A final report of compaction control should be prepared subsequent to the completion of grading. The report should include a summary of work performed, laboratory test results, and the results and locations of field density tests performed during grading.

5.0 GEOTECHNICAL RISK

The concept of risk is an important aspect of the geotechnical evaluation. The primary reason for this is that the analytical methods used to develop geotechnical recommendations do not comprise an exact science. The analytical tools which geotechnical engineers use are generally empirical and must be used in conjunction with engineering judgment and experience. Therefore, the solutions and recommendations presented in the geotechnical evaluation should not be considered risk-free and, more importantly, are not a guarantee that the interaction between the soils and the proposed structure will perform as planned.

The engineering recommendations presented in the preceding sections constitute GEO-ETKA, INC. professional estimate of those measures that are necessary for the proposed development to perform according to the proposed design based on the information generated and referenced during this evaluation, and GEO-ETKA, INC. experience in working with these conditions.

6.0 LIMITATION OF INVESTIGATION

This report was prepared for the exclusive use on the new construction. The use by others, or for the purposes other than intended, is at the user's sole risk.

Our investigation was performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable Geotechnical Engineers practicing in this or similar locations within the limitations of scope, schedule, and budget. No other warranty, expressed or implied, is made as to the conclusions and professional advice included in this report.

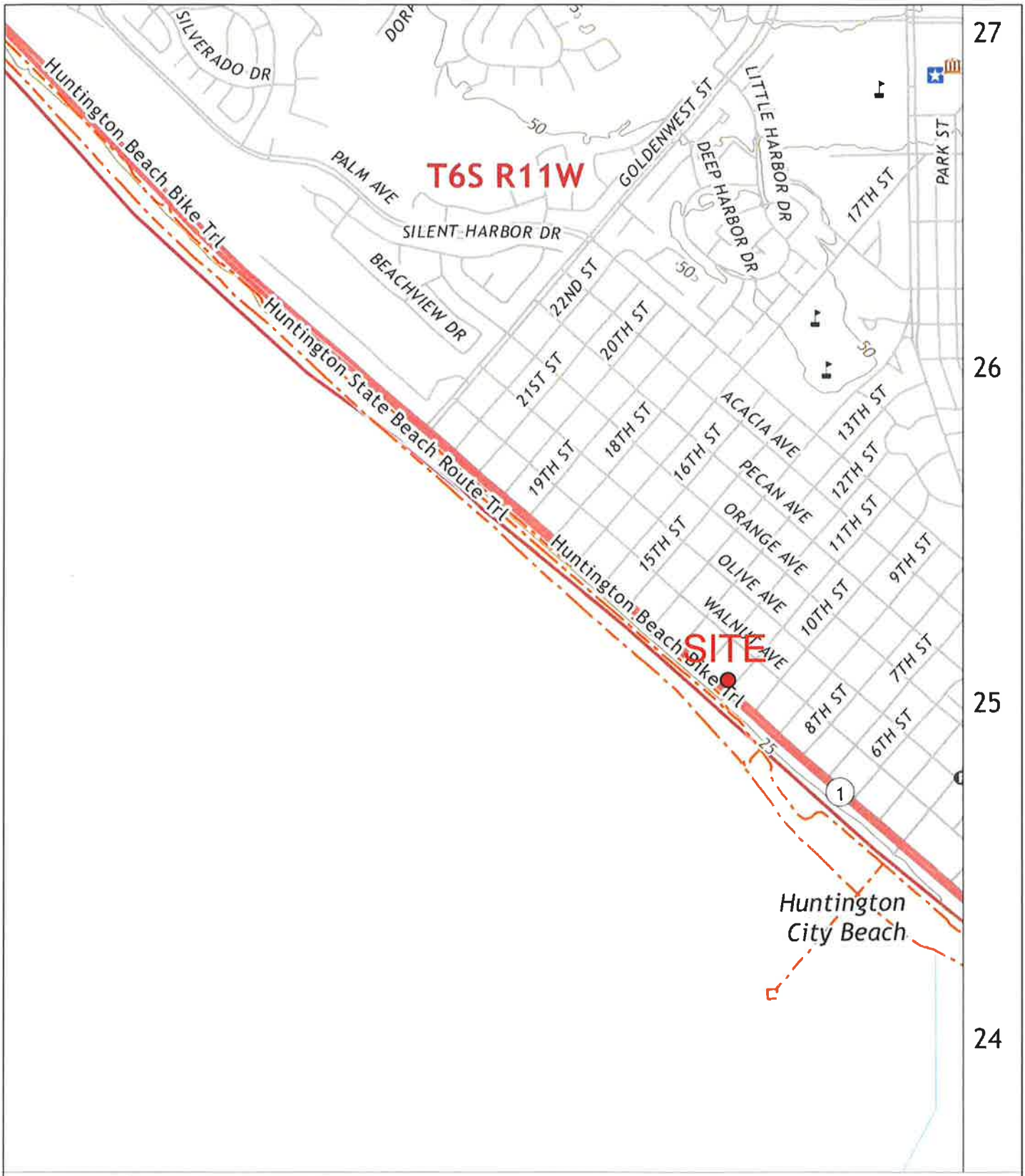
The field and laboratory test data are believed representative of the site; however, soil conditions can vary significantly. As in most projects, conditions revealed during construction may be at variance with preliminary findings. If this condition occurs, the possible variations must be evaluated by the Project Geotechnical Engineer and adjusted as required or alternate design recommended.

This report is issued with the understanding that it is the responsibility of the owner, or his representative, to ensure that the information and recommendations contained herein are brought to the attention of the engineer for the development and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractor carry out such recommendations in the field.

This firm does not practice or consult in the field of safety engineering. We do not direct the contractor's operations, and we cannot be responsible for other than our own personnel on the site; therefore, the safety of others is the responsibility of the contractor. The contractor should notify the owner if he considers any of the recommended actions presented herein to be unsafe.

The findings, conclusions, and recommendations presented herein are based on our understanding of the development and on subsurface conditions observed during our site work, and are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge.

FIGURES & PLATES



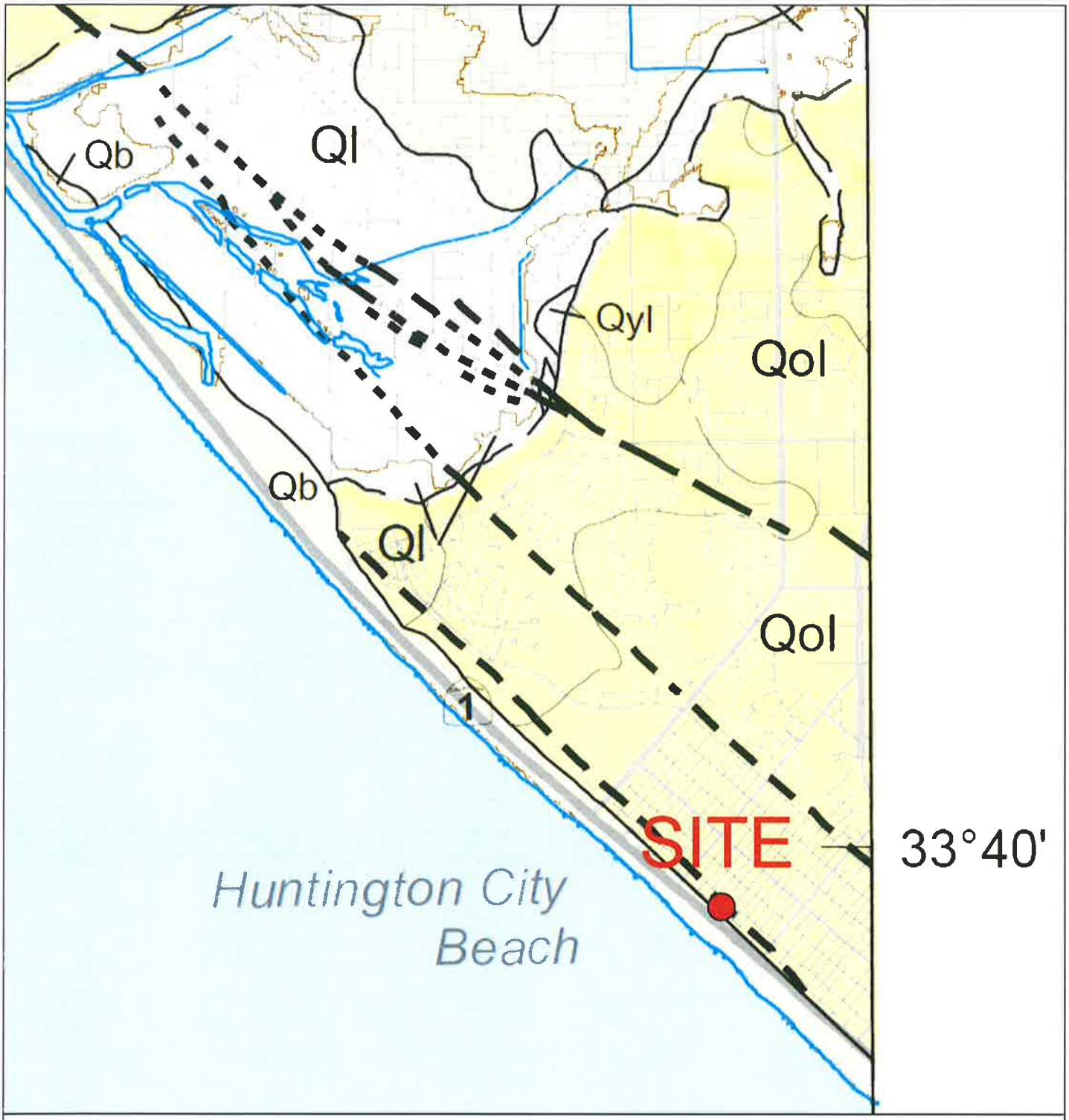
USGS, THE NATIONAL MAP, US TOPO, SEAL BEACH, 2021

ALL LOCATIONS ARE APPROXIMATE

0 0.25 0.5 1.0

APPROXIMATE SCALE (MILES)

GEO-ETKA, INC.	DWN BY: AM CHK'D BY: MN DATUM: -- PROJECTION: -- SCALE: 1" = 1/4 MILE REV. NO.: --	PROJECT: PRELIMINARY SOIL INVESTIGATION REPORT 1102 PACIFIC COAST HIGHWAY HUNTINGTON BEACH, CALIFORNIA TITLE: SITE LOCATION MAP	DATE: APRIL 2022 PROJECT NO.: F-11942-22 FIGURE NO.: Figure 1



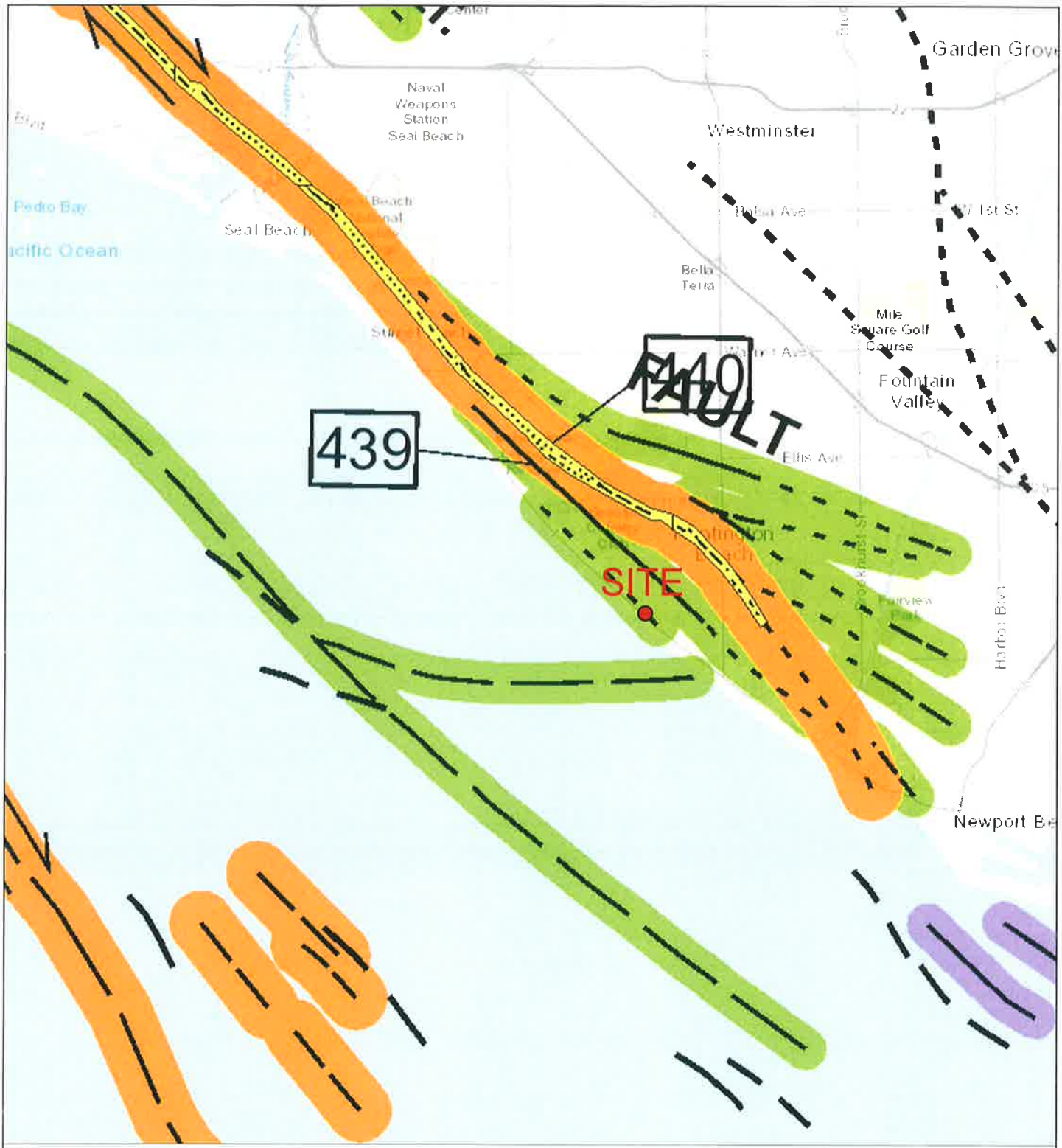
LEGEND:

Qol: Old Lacustrine, Playa, and Estuarine Deposits
Ql: Lacustrine, Playa, and Estuarine Deposits
Qyl: Young Lacustrine, Playa, and Estuarine Deposits
Qb: Beach Deposits

REFERENCE MAP:

CGS, Geologic Compilation of Quaternary Surficial Deposits in Southern California, Onshore Portion Of The Long Beach 30' X 60' Quadrangle, July 2010

GEO-ETKA, INC.	DWN BY: AM CHK'D BY: MN DATUM: -- PROJECTION: -- SCALE: -- REV. NO.: --	PROJECT: PRELIMINARY SOIL INVESTIGATION REPORT 1102 PACIFIC COAST HIGHWAY HUNTINGTON BEACH, CALIFORNIA TITLE: REGIONAL GEOLOGIC MAP	DATE: APRIL 2022 PROJECT NO.: F-11942-22 FIGURE NO.: Figure 2

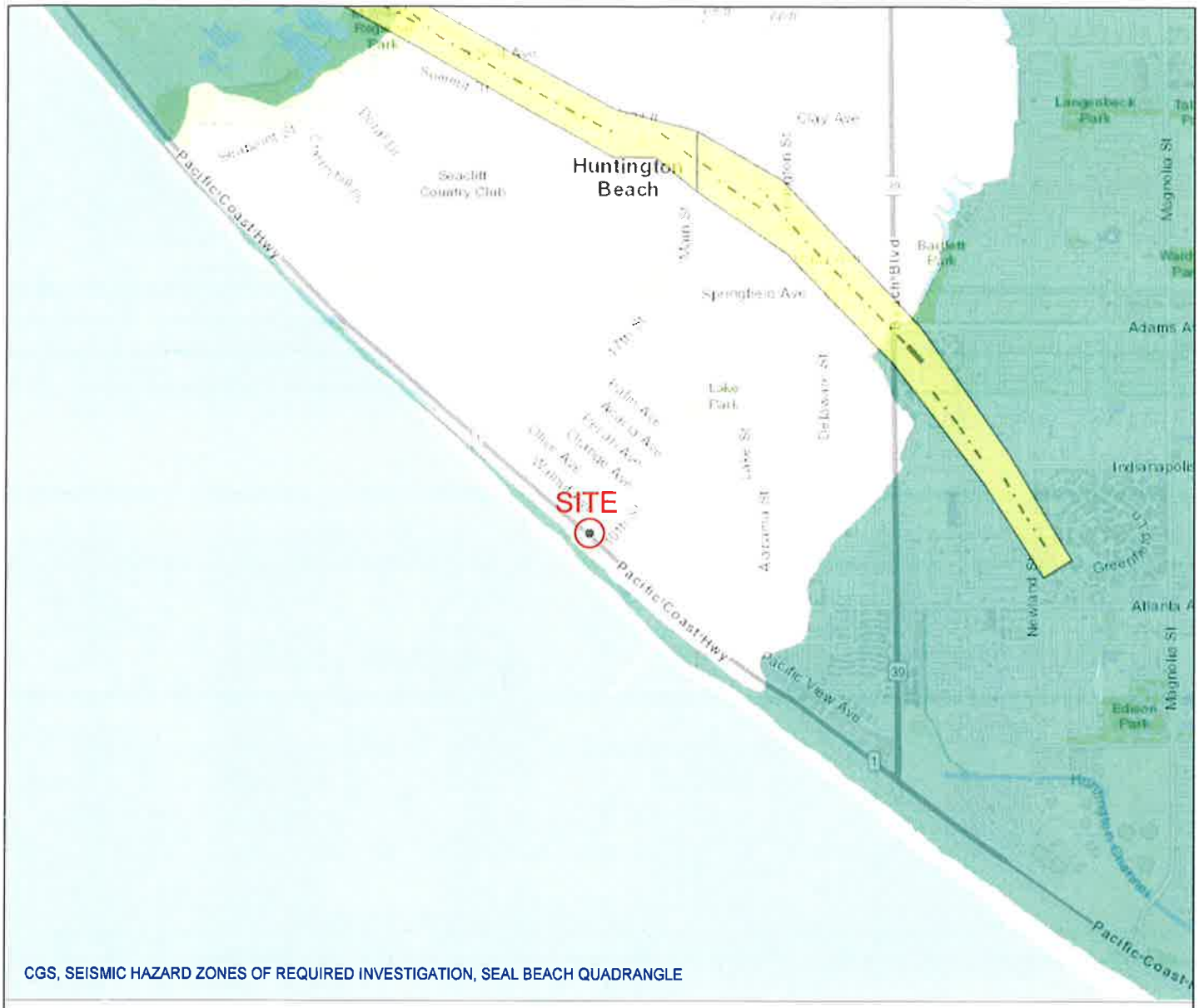


FAULT EXPLANATION:

Historic Fault Displacement | Holocene Fault Displacement | Evidence of Late Quaternary Fault Displacement | Undivided Quaternary Faults

REFERENCES: Jennings, C.W. and Bryant, W.A., 2010,"Fault Activity Map of California," California Geological Survey, GDM-006, May 2010

GEO-ETKA, INC.	DWN BY: AM CHK'D BY: MN DATUM: -- PROJECTION: -- SCALE: -- REV. NO.: --	PROJECT: PRELIMINARY SOIL INVESTIGATION REPORT 1102 PACIFIC COAST HIGHWAY HUNTINGTON BEACH, CALIFORNIA TITLE: REGIONAL FAULT MAP	DATE: APRIL 2022 PROJECT NO.: F-11942-22 FIGURE NO.: Figure 3



CGS, SEISMIC HAZARD ZONES OF REQUIRED INVESTIGATION, SEAL BEACH QUADRANGLE

MAP EXPLANATION

Active Fault Traces
Faults considered to have been active during Holocene time and to have potential for surface rupture: Solid Line in Black or Red where Accurately Located; Long Dash in Black or Solid Line in Purple where Approximately Located; Short Dash in Black or Solid Line in Orange where inferred; Dotted Line in Black or Solid Line in Rose where Concealed; Query (?) indicates additional uncertainty. Evidence of historic offset indicated by year of earthquake associated event or C for displacement aused by fault creep.

Earthquake Fault Zones
Zone boundaraies are delineated by straight-line segments; the boundaries define the zone encompassing active faults that constitute a potential hazard to structures from surface faulting or fault creep such that avoidance as described in Public Resources Code Section 2621.5(a) would be required.

Overlap of Earthquake Fault Zone and Liquefaction Zone
Areas that are covered by both Earthquake Fault Zone and Liquefaction Zone

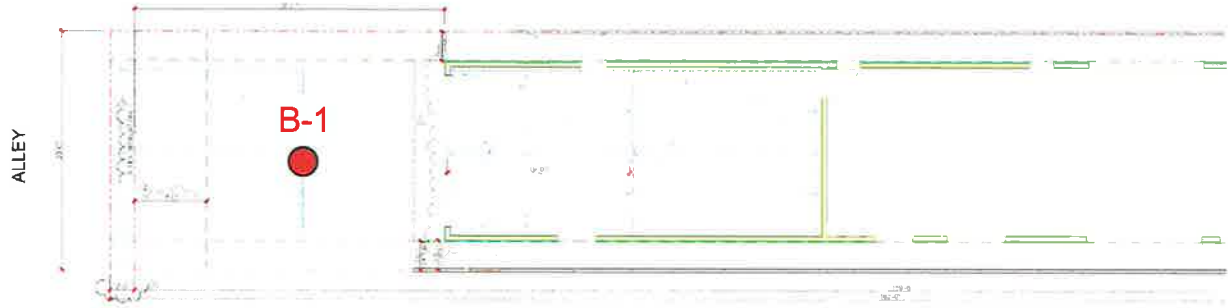
Overlap of Earthquake Fault Zone and Earthquake-Induced Landslide Zone
Areas that are covered by both Earthquake Fault Zone and Earthquake-Induced Landslide Zone

Liquefaction Zones
Areas where historical ocurrance of liquefaction, or local geological, geotechnical and groundwater conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

Earthquake-Induced Landslide Zones
Areas where previous occurance of landside movement, or local topographic, geologic, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2603(c) would be required.

Overlapping Liquefaction and Earthquake-Induced Landslide Zones
Areas that lie within zones of required investigation for both liquefaction and earthquake-induced lanslides.

GEO-ETKA, INC.	DWN BY: AM CHK'D BY: MN DATUM: -- PROJECTION: -- SCALE: -- REV. NO.: --	PROJECT: PRELIMINARY SOIL INVESTIGATION REPORT 1102 PACIFIC COAST HIGHWAY HUNTINGTON BEACH, CALIFORNIA TITLE: GEOLOGIC HAZARD MAP	DATE: APRIL 2022 PROJECT NO.: F-11942-22 FIGURE NO.: Figure 4



SITE TABULATIONS

LOT SIZE=	4,050 FT²
MAXIMUM LOT COVERAGE (50%)	2,025 FT²
ACTUAL LOT COVERAGE	- FT²
MAXIMUM F.A.R. (1.0)	4,050 FT²
+ 756 FT² GARAGE =	4,806 FT² (TOTAL)
ACTUAL F.A.R. (-)	- FT²
+ - FT² GARAGE =	- FT² (TOTAL)

PARKING REQ. = 4 COVERED 2 OPEN

5-6 BEDROOMS + ADU

ADU

EXPLORATORY BOREHOLE LOCATION MAP

PRELIMINARY SOIL INVESTIGATION REPORT
1102 PACIFIC COAST HIGHWAY
HUNTINGTON BEACH, CALIFORNIA

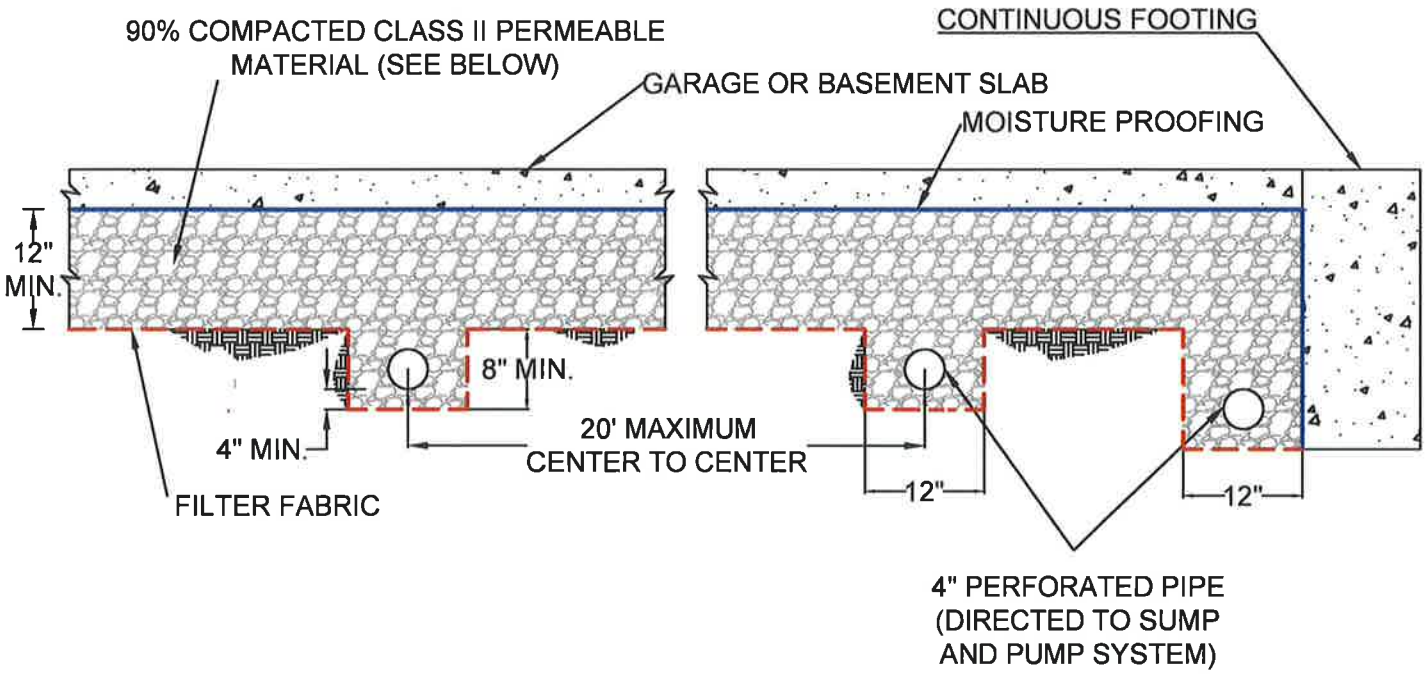
PREPARED BY:	DATE:	APRIL 2022	PLATE 1
GEOETKA, INC.	DRAWN BY:	AM	
	CHECKED BY:	HMN	
	PROJECT NO.:	FG-11942-22	
	SCALE:	1" = 20' (11x17)	

LEGEND:

B-1 ● EXPLORATORY BOREHOLE

ALL LOCATIONS ARE APPROXIMATE

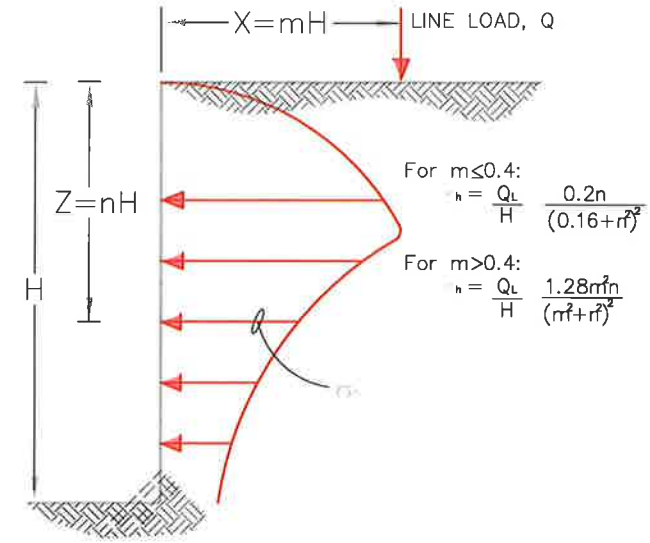
SCHEMATIC ONLY
NOT TO SCALE



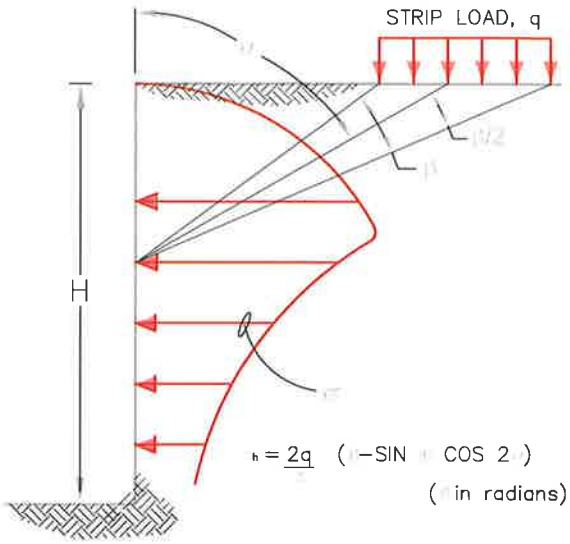
CLASS II PERMEABLE MATERIAL SHOULD CONFORM TO THE FOLLOWING SPECIFICATIONS:

SIEVE SIZE	% 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

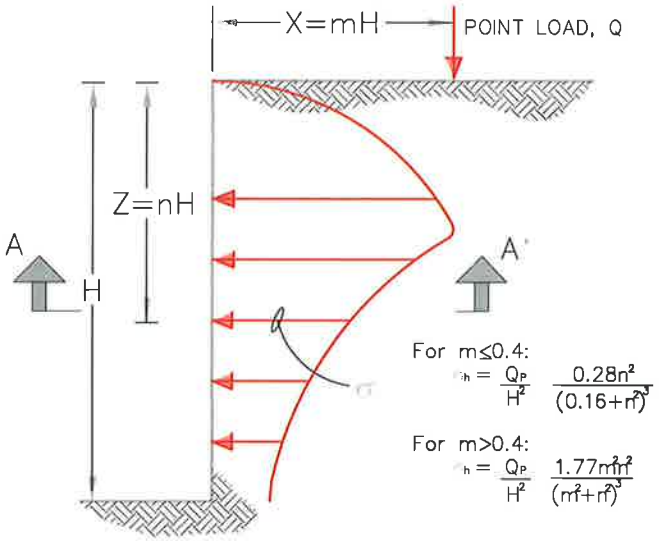
GEO-ETKA, INC.	TYPICAL BELOW GRADE SLAB SUBDRAIN DETAIL	PLATE 2

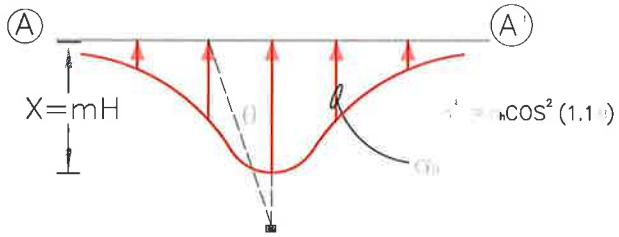


LINE LOAD PARALLEL TO WALL



STRIP LOAD PARALLEL TO WALL





DISTRIBUTION OF HORIZONTAL PRESSURES

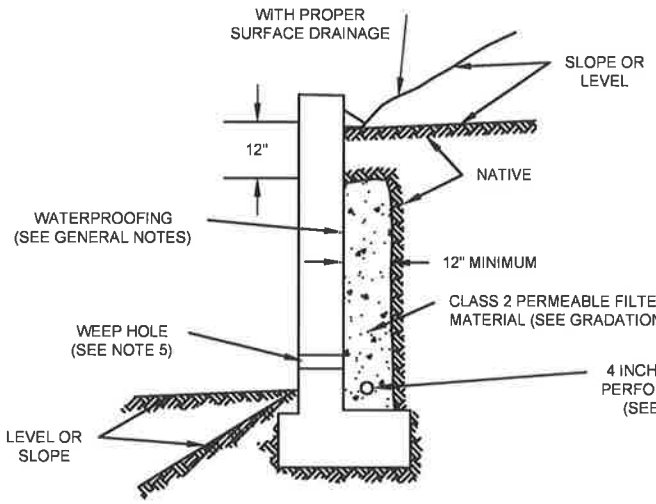
VERTICAL POINT LOAD

NOTES:

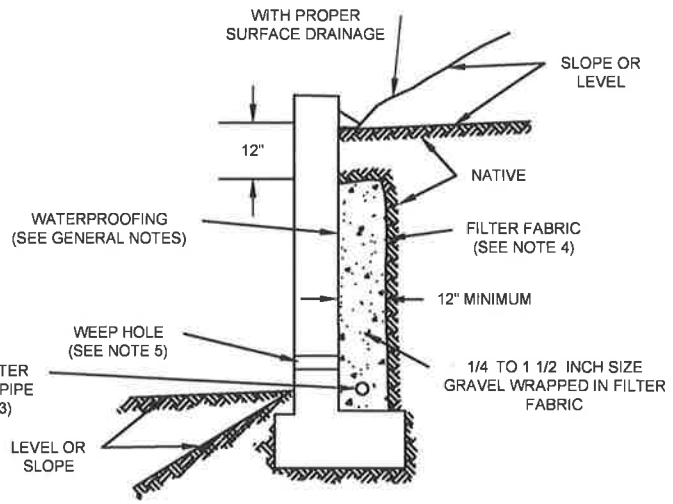
1. These guidelines apply to rigid walls with Poisson's ratio assumed to be 0.5 for backfill materials.
2. Lateral pressures from any combination of above cases may be determined by the principle of superposition.

PLATE 3 - RETAINING WALL SURCHARGE DETAIL

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 undesireable.
*Water proofing of the walls is not under the 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 diamater 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 Chlorise 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.

PLATE 4 - RETAINING WALL BACKFILL AND SUBDRAIN DETAIL

APPENDIX A

SELECTED REFERENCES

CGS, Geologic Compilation of Quaternary Surficial Deposits in Southern California, Onshore Portion Of The Long Beach 30' X 60' Quadrangle, July 2010

CDMG, Seismic Hazard Zone Report for the Seal Beach Minute Quadrangle, Los Angeles and Orange Counties, California, 1998.

CGS, Earthquake Zones of Required Investigation Map (EZRIM), Seal Beach Quadrangle.

USGS TopoView Interactive Webpage (https://ngmdb.usgs.gov/topoview/viewer/#4/39.98/-107.53)

Structural Engineers Association of California, OSHPD Seismic Design Maps Interactive Website (https://seismicmaps.org/)

California Geological Survey, Map No. 6, Fault Activity Map of California, Compiled by Charles W. Jennings and William A. Bryant, California Geologic Data Map Series, 2010

City of Laguna Beach Safety Element, Topic 3.

Department of the Navy, Design Manual 7.01, Soil Mechanics, September 1986.

Department of the Navy, Design Manual 7.02, Foundation and Earth Structures, September 1986.

APPENDIX B

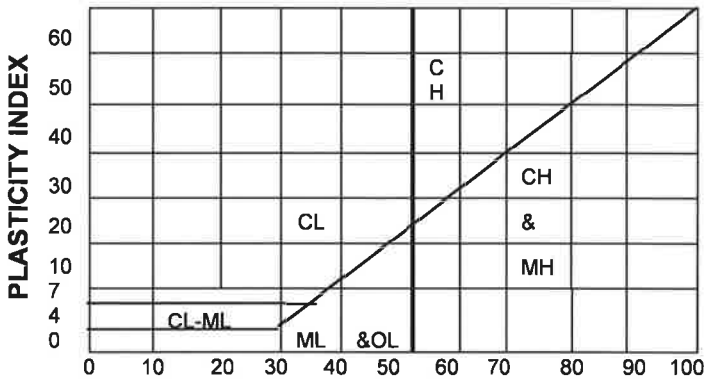
MAJOR DIVISIONS		SYMBOLS		TYPICAL NAMES
COARSE-GRAINED SOILS (More than ½ of soil < No. 200 sieve)	GRAVELS (More than ½ of coarse fraction > No. 4 sieve size)	GW		Well-graded gravels or gravel-sand mixtures, little or no fines
		GP		Poorly graded gravels or gravel-sand mixtures, little or no fines
		GM		Silty gravels, gravel-sand-silt mixtures
		GC		Clayey gravels, gravel-sand-clay mixtures
	SANDS (More than ½ of coarse fraction < No. 4 sieve size)	SW		Well-graded sands or gravely sands, little or no fines
		SP		Poorly graded sands or gravelly sands, little or no fines
		SM		Silty sands, sand-salt mixtures
		SC		Clayey sands, sand-clay mixtures
FINE-GRAINED SOILS (More than ½ of soil < No. 200 sieve)	SILTS & CLAYS LL < 50	ML		Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity.
		CL		Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		OL		Organic silts and organic silty clays of low plasticity.
	SILTS & CLAYS LL > 50	MH		Inorganic silts, caceous or diatonaceous fine sandy or silty soils, elastic silts
		CH		Inorganic clays of medium to high plasticity, organic silty clays, organic silts
		OH		Organic clays of medium to high plasticity, organic silty clays, organic silts
	HIGHLY ORGANIC SOILS	Pt		Peat and other highly organic soils

CLASSIFICATION CHART

(UNIFIED SOIL CLASSIFICATION SYSTEM)

CLASSIFICATION	RANGE OF GRAIN SIZES	
	U.S. Standard Sieve Size	Grain Size in Millimeters
BOULDER	ABOVE 12"	ABOVE 305
COBBLES	3" to 12"	305 to 76.2
GRAVEL	3" to No. 4	762 to 4.76
COARSE	3" TO ¾"	76.2 to 19.1
FINE	¾"to No. 4	19.1 to 4.76
SAND	No. 4 to 200	4.76 to 0.074
COARSE	No. 4 to 10	4.76 to 2.00
MEDIUM	No. 10 to 40	2.00 to 0.420
FINE	No. 40 to 200	0.420 to 0.074
SILT & CLAY	BELOW No. 200	BELOW 0.074

GRAIN SIZE CHART



LIQUID LIMIT

PLASTICITY CHART

METHOD OF SOIL CLASSIFICATION

PROJECT:	1102 PCH (CA-1) Huntington Beach, California	**Log of Boring**	**B-1**	Longitude: Latitude: Elevation:

Project No.	F-11942-22	Location:	See Plate 1	Borehole Logged by:	MN
Excavating Co. / Rig:	GEOETKA / CME-45	Date Started:	4/2/2022	Depth to Groundwater:	30 ft
Method:	Hollow-Stem Auger	Date Finished:	4/2/2022	Depth to Bedrock:	N/A ft
Hammer Weight / Drop:	140 lbs./30-inches	Hammer Type:	Automatic	Total Depth of Borehole:	50 ft

Depth (ft)	Type	Sample	Blows / 6"	SPT "N" Value	Symbol	Classification (USCS)	MATERIAL DESCRIPTION	Moisture Content (%)	Dry Density (pcf)	Fines Content (%)	Pocket Pen (tsf)	Liquid Limit	Plastic Limit	Plast. Index
							SAMPLES / LABORATORY TEST DATA							
5	B R		10 25 34	38		ML	**SANDY SILT** medium to dark brown sandy silt medium to fine grained sand becoming reddish brown in color hard, slightly cohesive	18	112					
10			8 13 18	20			reddish brown sandy silt very firm, moist	18		56				
15	S		7 9 11	20			medium gray and orange-brown sandy silt very firm, moist							
20	S		13 19 21	40		SP-SM	**POORLY-GRADED SAND WITH SILT** gray and orange-brown sand with silt dense, slightly moist	4		8				
25	S		7 8 13	21			gray and orange-brown sandy silt medium dense, slightly moist to moist							
30	S		17 22 29	51		▽	Groundwater at 30 feet bgs very dense, moist	19		8				
35	S		10 24 33	57			very dense							
40	S		3 6 25	31			dense	17		6				
45	S		21 50/6"	100			very dense							
50	S		15 36 50/4"	111		SP	**POORLY-GRADED SAND** gray, medium to fine grained sand with silt moist, very dense	18		2				
							TD = 50'							

LOG LEGEND

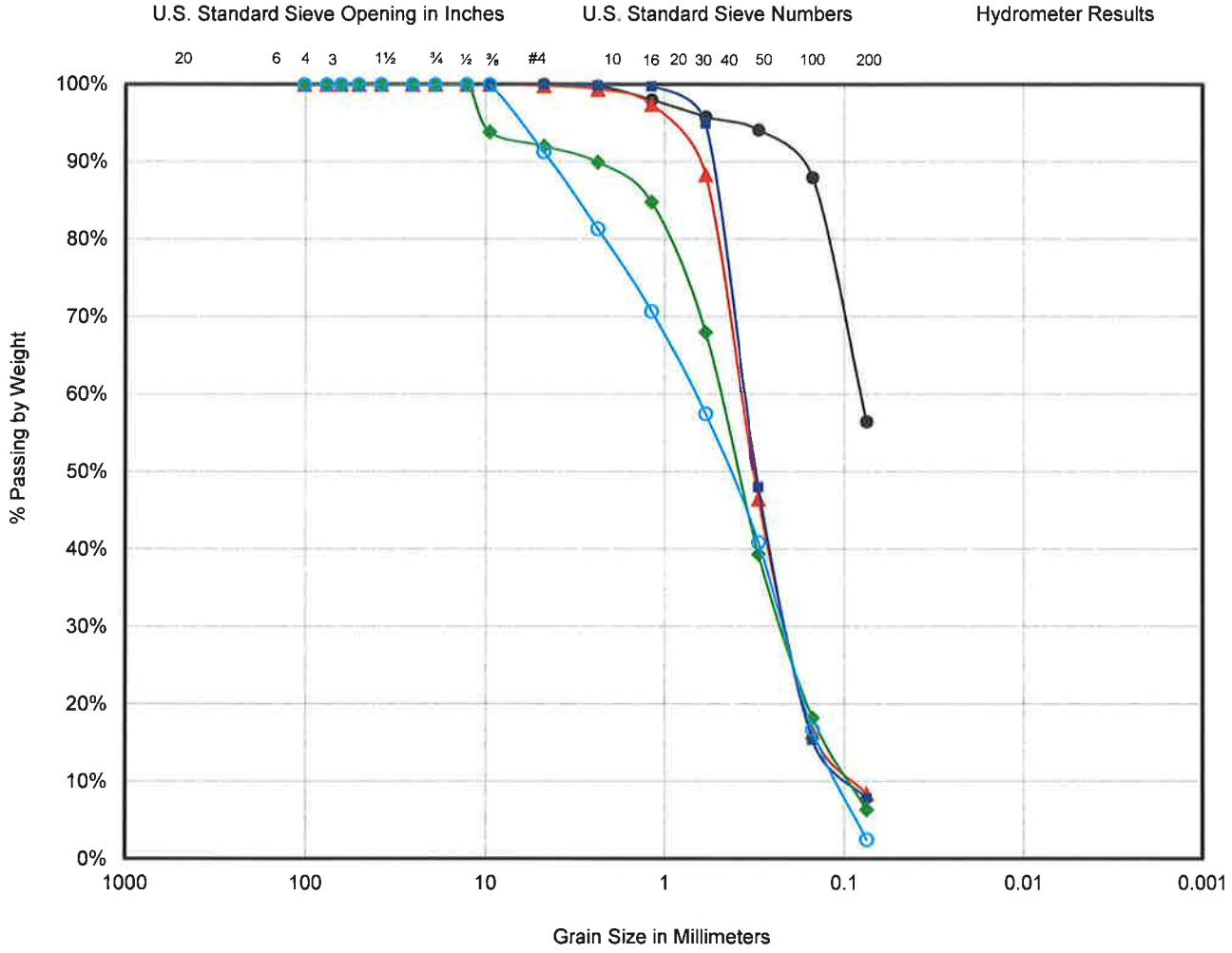
- Bedrock/Formation
- Gravels
- Clean Sands
- Silty Sands
- Silts
- Clayey Sands
- Clays
- Bulk "Grab" Sample (B)
- Modified California Ring (R)
- Standard Penetration (S)
- Modified Dames & Moore (D)
- ▽ Groundwater (Groundwater (During Drillin
- ▼ Groundwater (Groundwater (Stabilized)
- D Disturbed Sample
- N No Sample Recovery

This log is part of the report prepared for this project and should be read together with the report. This summary applies only at the location of the exploration and at the time of drilling or excavation. Subsurface conditions may differ at other locations and may change at this location with tiume. Data presented are a simplification of actual conditions encountered.

APPENDIX C

GRAIN SIZE DISTRIBUTION

(ASTM C136)



Cobbles	Gravels		Sands			Silts	Clays
	Coarse	Fine	Coarse	Medium	Fine		

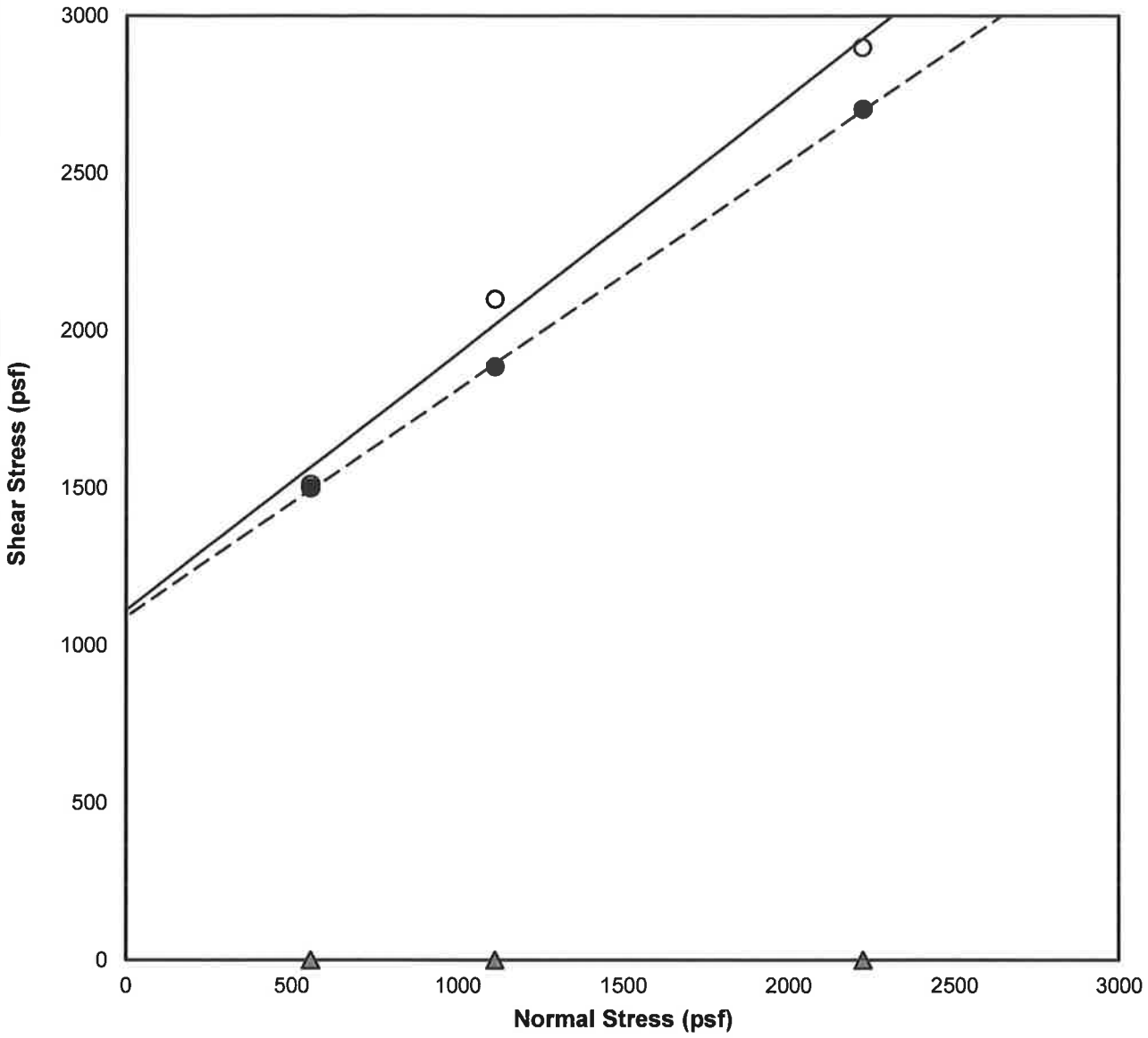
Symbol	Location	Depth	USCS	Classification	Moisture (%)	Fines (%)	D10	D30	D60	Cc	Cu
●	B-1	10'	ML	Sandy Silt	18.0	56	0.01	0.04	0.08	6.28	1.43
▲	B-1	20'	SP-SM	Poorly-Graded Sand with Silt	4.1	8	0.09	0.22	0.39	4.37	1.34
■	B-1	30'	SP-SM	Poorly-Graded Sand with Silt	18.9	8	0.10	0.22	0.37	3.87	1.31
◆	B-1	40'	SP-SM	Poorly-Graded Sand with Silt	16.6	6	0.10	0.23	0.51	1.10	5.18
○	B-1	50'	SP	Poorly-Graded Sand	18.3	2	0.11	0.23	0.70	0.67	6.12

GEOETKA, INC.

PRELIMINARY SOIL INVESTIGATION REPORT
Proposed Single-Family Residence
1102 CA-1
Huntington Beach, California

Project No.: F-11942-22
Date Tested: 4/13/2022
Tested by: AM
Exhibit: Appendix C

DIRECT SHEAR TEST RESULTS



Sample	Symbol	Description	Soil Type [USCS]	Shear Strength	Friction Angle φ [degrees]	Cohesion c [psf]
B-1 @ 5'	—○—	Clayey Sand	SC	Peak	39	1112
B-1 @ 5'	—●—	Clayey Sand	SC	Ultimate	36	1091
B-1 @ 5'	- -△- -	Clayey Sand	SC	*Residual	N/A	N/A

Sample Moisture [%]	Saturated Moisture [%]	Dry Unit Weight [pcf]
20.2	22.1	112.3

Performed in General Accordance with ASTM D-3080

*Residual shear strength results were determined from the lowest of the residual shears shown abve.
(Individual residual shear results plotted with red dashed line above)

GEOETKA, INC.

EXPANSION INDEX TEST

(ASTM D4829)

BORING NUMBER AND SAMPLE DEPTH:	B-1 @ 0-5'
SOIL TYPE (USCS):	SC
CONFINING PRESSURE (psf):	144
INITIAL MOISTURE CONTENT (%):	10.6
FINAL MOISTURE CONTENT (%):	19.2
DRY DENSITY (pcf):	110.0
EXPANSION INDEX:	33
EXPANSION POTENTIAL:	Low
DATE TESTED:	4/13/2022
TESTED BY:	AM

GEO-ETKA. INC.	PRELIMINARY SOIL INVESTIGATION REPORT Proposed Single-Family Residence 1102 Pacific Coast Highway Huntington Beach, California	Project No. Checked: Checked by: Exhibit:	F-11942-22 4/14/2022 HMN Appendix C

SOLUBLE SULFATE AND CHLORIDE TEST RESULTS

Project Name	1102 Pacific Coast Highway, Huntington Beach, CA	**Test Date**	4/13/2022
Project No.	F-11942-22	**Date Sampled**	4/02/2022
Project Location	1102 Pacific Coast Highway, Huntington Beach, CA	**Sampled By**	AM
Location in Structure	B-1 @ 0-5'	**Sample Type**	Bulk
Sampled Classification	SC	**Tested By**	AM

TESTING INFORMATION

Sample weight before drying _____
Sample weight after drying _____
Sample Weight Passing No. 10 Sieve _____
Moisture _____

Location	Mixing Ratio	Dilution Factor	Sulfate Reading (ppm)	Sulfate Content (ppm)	Sulfate Content (%)
B-1	3	1	100	300	0.030
			Average		

Chloride Reading (ppm)	Chloride Content (ppm)	Chloride Content (%)
Average		

pH	
Average	

ACI 318-19 Table 19.3.2.1 - Requirements for Concrete by Exposure Class

Exposure Class		Water-Soluble Sulfate (%)	Maximum *w/cm*	Minimum *f'c* (psi)	Cementitous Material (Types)			Calcium Chloride Admixture
					ASTM C150-	ASTM C595	ASTM C1157	
S0		<0.10	N/A	2500	No Type Restriction	No Type Restriction	No Type Restriction	No Restriction
S1		0.10 to 0.20	0.50	4000	II	Type IP, IS, or IT with (MS) Designation	MS	No Restriction
S2		0.20 to 2.00	0.45	4500	V	Type IP, IS, or IT with (HS) Designation	HS	Not Permitted
S3	Option 1	>2.00	0.45	4500	V + Pozzolan or Slag Cement	Type IP, IS, or IT with (HS) Designation + Pozzolan or Slag Cement	HS + Pozzolan or Slag Cement	Not Permitted
	Option 2	>2.00	0.40	5000	V	Types with (HS) designation	HS	Not Permitted

Exposure Class	Maximum *w/cm*	Minimum *f'c* (psi)	Maximum Water-Soluble Chloride ion (Cl^-) Content in Concrete, Percent by Wight of Cement		Additional Provisions
			Nonprestressed Concrete	Prestressed Concrete	
C0	N/A	2500	1.00	0.06	None
C1	N/A	2500	0.30	0.06	None
C2	0.40	5000	0.15	0.06	Concrete Cover

Caltrans classifies a site as corrosive to structural concrete as an area where soil and/or water contains >500pp chloride, >2000ppm sulfate, or has a pH <5.5. A minimum resistivity of less than 1000 ohm-cm indicates the potential for corrosive environment requiring testing for the above criteria.

The information in this form is not intended for corrosion engineering design. If corrosion is critical, a corrosion specialist should be contacted to provide further recommendations.

APPENDIX D

OSHPD

Latitude, Longitude: 33.661820, -118.007444

Date	4/14/2022, 10:26:43 AM
Design Code Reference Document	ASCE7-16
Risk Category	II
Site Class	D - Default (See Section 11.4.3)

Type	Value	Description
S_S	1.391	MCE_R ground motion. (for 0.2 second period)
S_1	0.504	MCE_R ground motion. (for 1.0s period)
S_{MS}	1.669	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	1.113	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1.2	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.608	MCE_G peak ground acceleration
F_{PGA}	1.2	Site amplification factor at PGA
PGA_M	0.729	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	1.391	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	1.539	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	2.15	Factored deterministic acceleration value. (0.2 second)
S1RT	0.504	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.552	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	0.772	Factored deterministic acceleration value. (1.0 second)
PGAd	0.89	Factored deterministic acceleration value. (Peak Ground Acceleration)
C_{RS}	0.904	Mapped value of the risk coefficient at short periods
C_{R1}	0.913	Mapped value of the risk coefficient at a period of 1 s

DISCLAIMER

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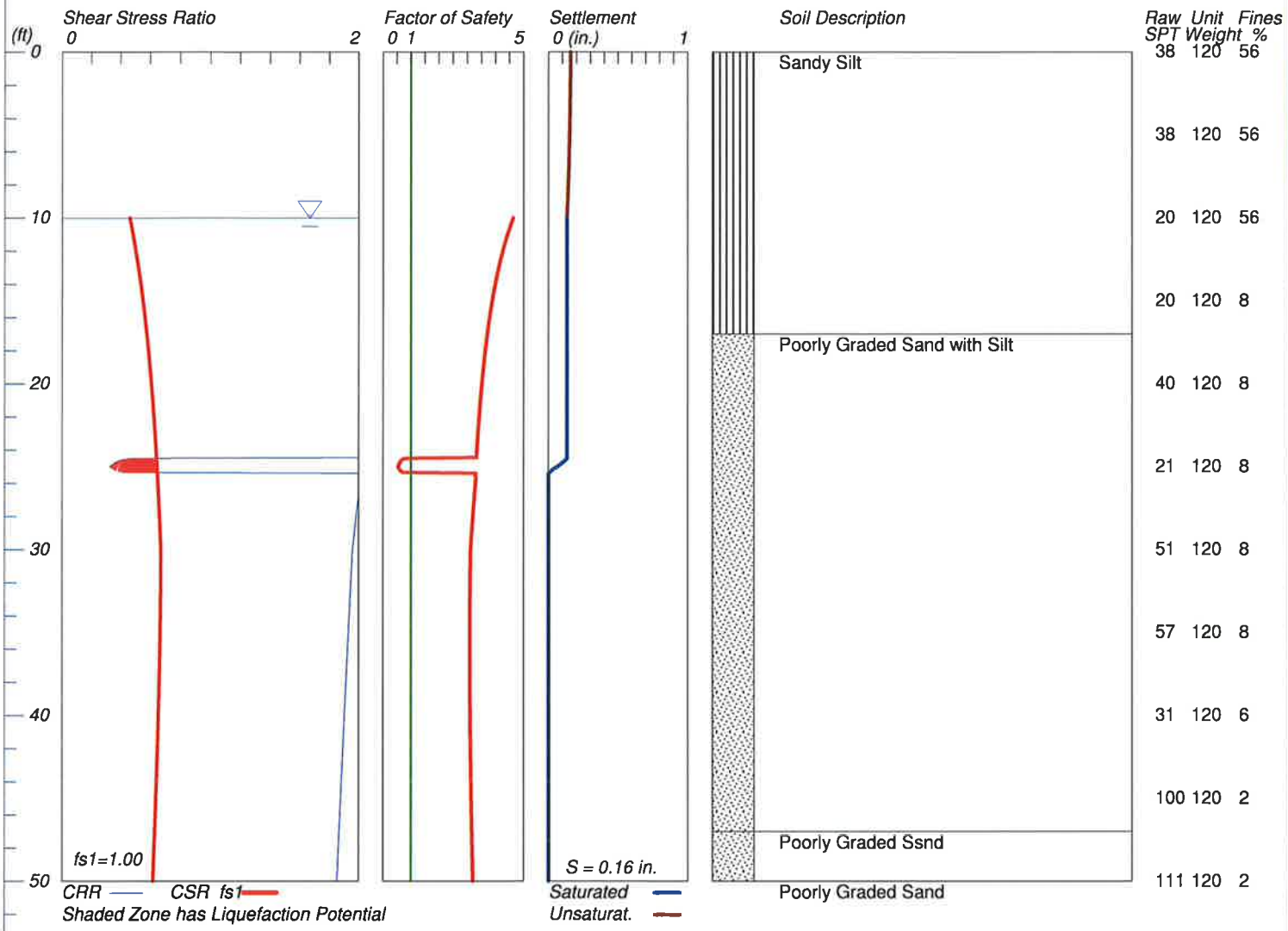
APPENDIX E

LIQUEFACTION ANALYSIS

1102 PCH, Huntington Beach

Hole No.=B-1 Water Depth=10 ft

Magnitude=7.3
Acceleration=0.729g



Raw SPT	Unit Weight	Fines %
38	120	56
38	120	56
20	120	56
20	120	8
40	120	8
21	120	8
51	120	8
57	120	8
31	120	6
100	120	2
111	120	2

****

LIQUEFACTION ANALYSIS CALCULATION SHEET

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****

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Input File Name: UNTITLED
Title: 1102 PCH, Huntington Beach
Subtitle: Project No. F-11942-22

Surface Elev.=
Hole No.=B-1
Depth of Hole= 50.0 ft
Water Table during Earthquake= 10.0 ft
Water Table during In-Situ Testing= 30.0 ft
Max. Acceleration= 0.73 g
Earthquake Magnitude= 7.3

Input Data:

Surface Elev.=
Hole No.=B-1
Depth of Hole=50.0 ft
Water Table during Earthquake= 10.0 ft
Water Table during In-Situ Testing= 30.0 ft
Max. Acceleration=0.73 g
Earthquake Magnitude=7.3

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: During Liquefaction*
5. Settlement Calculation in: All zones*
6. Hammer Energy Ratio, Ce = 1.30
7. Borehole Diameter, Cb= 1.05
8. Sampling Method, Cs= 1.2
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 %
0.0	38.0	120.0	56.0
5.0	38.0	120.0	56.0
10.0	20.0	120.0	56.0
15.0	20.0	120.0	8.0
20.0	40.0	120.0	8.0
25.0	21.0	120.0	8.0
30.0	51.0	120.0	8.0
35.0	57.0	120.0	8.0
40.0	31.0	120.0	6.0
45.0	100.0	120.0	2.0
50.0	111.0	120.0	2.0

Output Results:

Settlement of Saturated Sands=0.13 in.
Settlement of Unsaturated Sands=0.03 in.
Total Settlement of Saturated and Unsaturated Sands=0.16 in.
Differential Settlement=0.079 to 0.104 in.

Depth ft	CRRv	CSRm	F.S.	S_sat. in.	S_dry in.	S_all in.
0.00	2.00	0.47	5.00	0.13	0.03	0.16

1.00	2.00	0.47	5.00	0.13	0.03	0.16
2.00	2.00	0.47	5.00	0.13	0.02	0.16
3.00	2.00	0.47	5.00	0.13	0.02	0.15
4.00	2.00	0.47	5.00	0.13	0.02	0.15
5.00	2.00	0.47	5.00	0.13	0.02	0.15
6.00	2.00	0.47	5.00	0.13	0.02	0.15
7.00	2.00	0.47	5.00	0.13	0.01	0.14
8.00	2.00	0.47	5.00	0.13	0.01	0.14
9.00	2.00	0.46	5.00	0.13	0.00	0.14
10.00	2.00	0.46	4.63	0.13	0.00	0.13
11.00	2.00	0.48	4.42	0.13	0.00	0.13
12.00	2.00	0.50	4.25	0.13	0.00	0.13
13.00	2.00	0.52	4.10	0.13	0.00	0.13
14.00	2.00	0.54	3.98	0.13	0.00	0.13
15.00	2.00	0.55	3.87	0.13	0.00	0.13
16.00	2.00	0.57	3.78	0.13	0.00	0.13
17.00	2.00	0.58	3.70	0.13	0.00	0.13
18.00	2.00	0.59	3.63	0.13	0.00	0.13
19.00	2.00	0.60	3.57	0.13	0.00	0.13
20.00	2.00	0.61	3.51	0.13	0.00	0.13
21.00	2.00	0.62	3.46	0.13	0.00	0.13
22.00	2.00	0.63	3.41	0.13	0.00	0.13
23.00	2.00	0.64	3.37	0.13	0.00	0.13
24.00	2.00	0.64	3.34	0.13	0.00	0.13
25.00	0.33	0.65	0.54*	0.06	0.00	0.06
26.00	2.01	0.65	3.29	0.00	0.00	0.00
27.00	2.00	0.66	3.24	0.00	0.00	0.00
28.00	1.98	0.67	3.19	0.00	0.00	0.00
29.00	1.97	0.67	3.15	0.00	0.00	0.00
30.00	1.96	0.67	3.11	0.00	0.00	0.00
31.00	1.95	0.67	3.10	0.00	0.00	0.00
32.00	1.95	0.67	3.10	0.00	0.00	0.00
33.00	1.94	0.67	3.09	0.00	0.00	0.00
34.00	1.94	0.67	3.09	0.00	0.00	0.00
35.00	1.93	0.67	3.09	0.00	0.00	0.00
36.00	1.93	0.67	3.09	0.00	0.00	0.00
37.00	1.92	0.67	3.09	0.00	0.00	0.00
38.00	1.92	0.66	3.09	0.00	0.00	0.00
39.00	1.91	0.66	3.09	0.00	0.00	0.00
40.00	1.90	0.66	3.10	0.00	0.00	0.00
41.00	1.90	0.66	3.10	0.00	0.00	0.00
42.00	1.89	0.65	3.11	0.00	0.00	0.00
43.00	1.89	0.65	3.11	0.00	0.00	0.00
44.00	1.88	0.65	3.12	0.00	0.00	0.00
45.00	1.88	0.64	3.13	0.00	0.00	0.00
46.00	1.87	0.64	3.14	0.00	0.00	0.00
47.00	1.87	0.64	3.15	0.00	0.00	0.00
48.00	1.86	0.63	3.16	0.00	0.00	0.00
49.00	1.86	0.63	3.18	0.00	0.00	0.00
50.00	1.85	0.62	3.19	0.00	0.00	0.00

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

Units Depth = ft, Stress or Pressure = tsf (atm), Unit Weight = pcf, Settlement = in.

CRRv	Cyclic resistance ratio from soils
CSRm	Cyclic stress ratio induced by a given earthquake (with user request factor of safety)
F.S.	Factor of Safety against liquefaction, F.S.=CRRv/CSRm
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

****

LIQUEFACTION ANALYSIS CALCULATION SHEET

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Input File Name: UNTITLED
Title: 1102 PCH, Huntington Beach
Subtitle: Project No. F-11942-22

Input Data:

Surface Elev.=
Hole No.=B-1
Depth of Hole=50.0 ft
Water Table during Earthquake= 10.0 ft
Water Table during In-Situ Testing= 30.0 ft
Max. Acceleration=0.73 g
Earthquake Magnitude=7.3

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: During Liquefaction*
5. Settlement Calculation in: All zones*
6. Hammer Energy Ratio, Ce = 1.30
7. Borehole Diameter, Cb= 1.05
8. Sampling Method, Cs= 1.2
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 %
0.0	38.0	120.0	56.0
5.0	38.0	120.0	56.0
10.0	20.0	120.0	56.0
15.0	20.0	120.0	8.0
20.0	40.0	120.0	8.0
25.0	21.0	120.0	8.0
30.0	51.0	120.0	8.0
35.0	57.0	120.0	8.0
40.0	31.0	120.0	6.0
45.0	100.0	120.0	2.0
50.0	111.0	120.0	2.0

Output Results:

Calculation segment, dz=0.050 ft
User defined Print Interval, dp=1.00 ft

CSR Calculation:

Depth ft	gamma pcf	sigma tsf	gamma' pcf	sigma' tsf	rd	CSR	fs1	CSRfs *fs1
0.00	120.0	0.000	120.0	0.000	1.00	0.47	1.0	0.47
1.00	120.0	0.060	120.0	0.060	1.00	0.47	1.0	0.47
2.00	120.0	0.120	120.0	0.120	1.00	0.47	1.0	0.47
3.00	120.0	0.180	120.0	0.180	0.99	0.47	1.0	0.47
4.00	120.0	0.240	120.0	0.240	0.99	0.47	1.0	0.47
5.00	120.0	0.300	120.0	0.300	0.99	0.47	1.0	0.47
6.00	120.0	0.360	120.0	0.360	0.99	0.47	1.0	0.47
7.00	120.0	0.420	120.0	0.420	0.98	0.47	1.0	0.47
8.00	120.0	0.480	120.0	0.480	0.98	0.47	1.0	0.47

9.00	120.0	0.540	120.0	0.540	0.98	0.46	1.0	0.46
10.00	120.0	0.600	57.6	0.600	0.98	0.46	1.0	0.46
11.00	120.0	0.660	57.6	0.629	0.97	0.48	1.0	0.48
12.00	120.0	0.720	57.6	0.658	0.97	0.50	1.0	0.50
13.00	120.0	0.780	57.6	0.686	0.97	0.52	1.0	0.52
14.00	120.0	0.840	57.6	0.715	0.97	0.54	1.0	0.54
15.00	120.0	0.900	57.6	0.744	0.97	0.55	1.0	0.55
16.00	120.0	0.960	57.6	0.773	0.96	0.57	1.0	0.57
17.00	120.0	1.020	57.6	0.802	0.96	0.58	1.0	0.58
18.00	120.0	1.080	57.6	0.830	0.96	0.59	1.0	0.59
19.00	120.0	1.140	57.6	0.859	0.96	0.60	1.0	0.60
20.00	120.0	1.200	57.6	0.888	0.95	0.61	1.0	0.61
21.00	120.0	1.260	57.6	0.917	0.95	0.62	1.0	0.62
22.00	120.0	1.320	57.6	0.946	0.95	0.63	1.0	0.63
23.00	120.0	1.380	57.6	0.974	0.95	0.64	1.0	0.64
24.00	120.0	1.440	57.6	1.003	0.94	0.64	1.0	0.64
25.00	120.0	1.500	57.6	1.032	0.94	0.65	1.0	0.65
26.00	120.0	1.560	57.6	1.061	0.94	0.65	1.0	0.65
27.00	120.0	1.620	57.6	1.090	0.94	0.66	1.0	0.66
28.00	120.0	1.680	57.6	1.118	0.93	0.67	1.0	0.67
29.00	120.0	1.740	57.6	1.147	0.93	0.67	1.0	0.67
30.00	120.0	1.800	57.6	1.176	0.93	0.67	1.0	0.67
31.00	120.0	1.860	57.6	1.205	0.92	0.67	1.0	0.67
32.00	120.0	1.920	57.6	1.234	0.91	0.67	1.0	0.67
33.00	120.0	1.980	57.6	1.262	0.91	0.67	1.0	0.67
34.00	120.0	2.040	57.6	1.291	0.90	0.67	1.0	0.67
35.00	120.0	2.100	57.6	1.320	0.89	0.67	1.0	0.67
36.00	120.0	2.160	57.6	1.349	0.88	0.67	1.0	0.67
37.00	120.0	2.220	57.6	1.378	0.87	0.67	1.0	0.67
38.00	120.0	2.280	57.6	1.406	0.86	0.66	1.0	0.66
39.00	120.0	2.340	57.6	1.435	0.86	0.66	1.0	0.66
40.00	120.0	2.400	57.6	1.464	0.85	0.66	1.0	0.66
41.00	120.0	2.460	57.6	1.493	0.84	0.66	1.0	0.66
42.00	120.0	2.520	57.6	1.522	0.83	0.65	1.0	0.65
43.00	120.0	2.580	57.6	1.550	0.82	0.65	1.0	0.65
44.00	120.0	2.640	57.6	1.579	0.82	0.65	1.0	0.65
45.00	120.0	2.700	57.6	1.608	0.81	0.64	1.0	0.64
46.00	120.0	2.760	57.6	1.637	0.80	0.64	1.0	0.64
47.00	120.0	2.820	57.6	1.666	0.79	0.64	1.0	0.64
48.00	120.0	2.880	57.6	1.694	0.78	0.63	1.0	0.63
49.00	120.0	2.940	57.6	1.723	0.78	0.63	1.0	0.63
50.00	120.0	3.000	57.6	1.752	0.77	0.62	1.0	0.62

CSR is based on water table at 10.0 during earthquake

CRR Calculation from SPT or BPT data:

Depth ft	SPT	Cebs	Cr	sigma' tsf	Cn	(N1)60	Fines %	d(N1)60	(N1)60f	CRR7.5
0.00	38.00	1.64	0.75	0.000	1.70	79.36	56.00	7.20	86.56	2.00
1.00	38.00	1.64	0.75	0.060	1.70	79.36	56.00	7.20	86.56	2.00
2.00	38.00	1.64	0.75	0.120	1.70	79.36	56.00	7.20	86.56	2.00
3.00	38.00	1.64	0.75	0.180	1.70	79.36	56.00	7.20	86.56	2.00
4.00	38.00	1.64	0.75	0.240	1.70	79.36	56.00	7.20	86.56	2.00
5.00	38.00	1.64	0.75	0.300	1.70	79.36	56.00	7.20	86.56	2.00
6.00	34.40	1.64	0.75	0.360	1.67	70.43	56.00	7.20	77.63	2.00
7.00	30.80	1.64	0.75	0.420	1.54	58.38	56.00	7.20	65.58	2.00
8.00	27.20	1.64	0.75	0.480	1.44	48.23	56.00	7.20	55.43	2.00
9.00	23.60	1.64	0.85	0.540	1.36	44.71	56.00	7.20	51.91	2.00
10.00	20.00	1.64	0.85	0.600	1.29	35.95	56.00	7.20	43.15	2.00
11.00	20.00	1.64	0.85	0.660	1.23	34.28	46.40	7.20	41.48	2.00
12.00	20.00	1.64	0.85	0.720	1.18	32.82	36.80	7.20	40.02	2.00
13.00	20.00	1.64	0.85	0.780	1.13	31.53	27.20	5.33	36.86	2.00
14.00	20.00	1.64	0.85	0.840	1.09	30.38	17.60	3.02	33.41	2.00
15.00	20.00	1.64	0.95	0.900	1.05	32.81	8.00	0.72	33.53	2.00
16.00	24.00	1.64	0.95	0.960	1.02	38.12	8.00	0.72	38.84	2.00
17.00	28.00	1.64	0.95	1.020	0.99	43.14	8.00	0.72	43.86	2.00
18.00	32.00	1.64	0.95	1.080	0.96	47.92	8.00	0.72	48.64	2.00
19.00	36.00	1.64	0.95	1.140	0.94	52.47	8.00	0.72	53.19	2.00

20.00	40.00	1.64	0.95	1.200	0.91	56.82	8.00	0.72	57.54	2.00
21.00	36.20	1.64	0.95	1.260	0.89	50.18	8.00	0.72	50.90	2.00
22.00	32.40	1.64	0.95	1.320	0.87	43.88	8.00	0.72	44.60	2.00
23.00	28.60	1.64	0.95	1.380	0.85	37.88	8.00	0.72	38.60	2.00
24.00	24.80	1.64	0.95	1.440	0.83	32.16	8.00	0.72	32.88	2.00
25.00	21.00	1.64	0.95	1.500	0.82	26.68	8.00	0.72	27.40	0.33
26.00	27.00	1.64	0.95	1.560	0.80	33.64	8.00	0.72	34.36	2.00
27.00	33.00	1.64	0.95	1.620	0.79	40.34	8.00	0.72	41.06	2.00
28.00	39.00	1.64	1.00	1.680	0.77	49.28	8.00	0.72	50.00	2.00
29.00	45.00	1.64	1.00	1.740	0.76	55.88	8.00	0.72	56.60	2.00
30.00	51.00	1.64	1.00	1.800	0.75	62.26	8.00	0.72	62.98	2.00
31.00	52.20	1.64	1.00	1.830	0.74	63.20	8.00	0.72	63.92	2.00
32.00	53.40	1.64	1.00	1.859	0.73	64.15	8.00	0.72	64.87	2.00
33.00	54.60	1.64	1.00	1.888	0.73	65.09	8.00	0.72	65.81	2.00
34.00	55.80	1.64	1.00	1.917	0.72	66.02	8.00	0.72	66.74	2.00
35.00	57.00	1.64	1.00	1.946	0.72	66.94	8.00	0.72	67.66	2.00
36.00	51.80	1.64	1.00	1.974	0.71	60.39	7.60	0.62	61.01	2.00
37.00	46.60	1.64	1.00	2.003	0.71	53.93	7.20	0.53	54.46	2.00
38.00	41.40	1.64	1.00	2.032	0.70	47.57	6.80	0.43	48.01	2.00
39.00	36.20	1.64	1.00	2.061	0.70	41.31	6.40	0.34	41.64	2.00
40.00	31.00	1.64	1.00	2.090	0.69	35.13	6.00	0.24	35.37	2.00
41.00	44.80	1.64	1.00	2.118	0.69	50.41	5.20	0.05	50.46	2.00
42.00	58.60	1.64	1.00	2.147	0.68	65.50	4.40	0.00	65.50	2.00
43.00	72.39	1.64	1.00	2.176	0.68	80.39	3.60	0.00	80.39	2.00
44.00	86.19	1.64	1.00	2.205	0.67	95.08	2.80	0.00	95.08	2.00
45.00	99.99	1.64	1.00	2.234	0.67	109.59	2.00	0.00	109.59	2.00
46.00	102.20	1.64	1.00	2.262	0.66	111.30	2.00	0.00	111.30	2.00
47.00	104.40	1.64	1.00	2.291	0.66	112.97	2.00	0.00	112.97	2.00
48.00	106.60	1.64	1.00	2.320	0.66	114.64	2.00	0.00	114.64	2.00
49.00	108.80	1.64	1.00	2.349	0.65	116.28	2.00	0.00	116.28	2.00
50.00	111.00	1.64	1.00	2.378	0.65	117.91	2.00	0.00	117.91	2.00

CRR is based on water table at 30.0 during In-Situ Testing

Factor of Safety, - Earthquake Magnitude= 7.3:

Depth ft	sigC' tsf	CRR7.5 tsf	Ksigma	CRRv tsf	CSRfs tsf	MSF	CSRm tsf	F.S. CRRv/CSRm
0.00	0.00	2.00	1.00	2.00	0.47	1.07	0.44	5.00
1.00	0.04	2.00	1.00	2.00	0.47	1.07	0.44	5.00
2.00	0.08	2.00	1.00	2.00	0.47	1.07	0.44	5.00
3.00	0.12	2.00	1.00	2.00	0.47	1.07	0.44	5.00
4.00	0.16	2.00	1.00	2.00	0.47	1.07	0.44	5.00
5.00	0.20	2.00	1.00	2.00	0.47	1.07	0.44	5.00
6.00	0.23	2.00	1.00	2.00	0.47	1.07	0.44	5.00
7.00	0.27	2.00	1.00	2.00	0.47	1.07	0.44	5.00
8.00	0.31	2.00	1.00	2.00	0.47	1.07	0.43	5.00
9.00	0.35	2.00	1.00	2.00	0.46	1.07	0.43	5.00
10.00	0.39	2.00	1.00	2.00	0.46	1.07	0.43	4.63
11.00	0.43	2.00	1.00	2.00	0.48	1.07	0.45	4.42
12.00	0.47	2.00	1.00	2.00	0.50	1.07	0.47	4.25
13.00	0.51	2.00	1.00	2.00	0.52	1.07	0.49	4.10
14.00	0.55	2.00	1.00	2.00	0.54	1.07	0.50	3.98
15.00	0.59	2.00	1.00	2.00	0.55	1.07	0.52	3.87
16.00	0.62	2.00	1.00	2.00	0.57	1.07	0.53	3.78
17.00	0.66	2.00	1.00	2.00	0.58	1.07	0.54	3.70
18.00	0.70	2.00	1.00	2.00	0.59	1.07	0.55	3.63
19.00	0.74	2.00	1.00	2.00	0.60	1.07	0.56	3.57
20.00	0.78	2.00	1.00	2.00	0.61	1.07	0.57	3.51
21.00	0.82	2.00	1.00	2.00	0.62	1.07	0.58	3.46
22.00	0.86	2.00	1.00	2.00	0.63	1.07	0.59	3.41
23.00	0.90	2.00	1.00	2.00	0.64	1.07	0.59	3.37
24.00	0.94	2.00	1.00	2.00	0.64	1.07	0.60	3.34
25.00	0.98	0.33	1.00	0.33	0.65	1.07	0.61	0.54 *
26.00	1.01	2.00	1.00	2.01	0.65	1.07	0.61	3.29
27.00	1.05	2.00	1.00	2.00	0.66	1.07	0.62	3.24
28.00	1.09	2.00	0.99	1.98	0.67	1.07	0.62	3.19
29.00	1.13	2.00	0.99	1.97	0.67	1.07	0.63	3.15
30.00	1.17	2.00	0.98	1.96	0.67	1.07	0.63	3.11

31.00	1.19	2.00	0.98	1.95	0.67	1.07	0.63	3.10
32.00	1.21	2.00	0.97	1.95	0.67	1.07	0.63	3.10
33.00	1.23	2.00	0.97	1.94	0.67	1.07	0.63	3.09
34.00	1.25	2.00	0.97	1.94	0.67	1.07	0.63	3.09
35.00	1.26	2.00	0.97	1.93	0.67	1.07	0.63	3.09
36.00	1.28	2.00	0.96	1.93	0.67	1.07	0.62	3.09
37.00	1.30	2.00	0.96	1.92	0.67	1.07	0.62	3.09
38.00	1.32	2.00	0.96	1.92	0.66	1.07	0.62	3.09
39.00	1.34	2.00	0.95	1.91	0.66	1.07	0.62	3.09
40.00	1.36	2.00	0.95	1.90	0.66	1.07	0.62	3.10
41.00	1.38	2.00	0.95	1.90	0.66	1.07	0.61	3.10
42.00	1.40	2.00	0.95	1.89	0.65	1.07	0.61	3.11
43.00	1.41	2.00	0.94	1.89	0.65	1.07	0.61	3.11
44.00	1.43	2.00	0.94	1.88	0.65	1.07	0.60	3.12
45.00	1.45	2.00	0.94	1.88	0.64	1.07	0.60	3.13
46.00	1.47	2.00	0.94	1.87	0.64	1.07	0.60	3.14
47.00	1.49	2.00	0.93	1.87	0.64	1.07	0.59	3.15
48.00	1.51	2.00	0.93	1.86	0.63	1.07	0.59	3.16
49.00	1.53	2.00	0.93	1.86	0.63	1.07	0.59	3.18
50.00	1.55	2.00	0.93	1.85	0.62	1.07	0.58	3.19

* F.S.<1: Liquefaction Potential Zone. (If above water table: F.S.=5)
^ No-liquefiable Soils.
(F.S. is limited to 5, CRR is limited to 2, CSR is limited to 2)

CPT convert to SPT for Settlement Analysis:
Fines Correction for Settlement Analysis:

Depth ft	Ic	qc/N60	qc1 tsf	(N1)60	Fines %	d(N1)60	(N1)60s
0.00	-	-	-	86.56	56.0	0.00	86.56
1.00	-	-	-	86.56	56.0	0.00	86.56
2.00	-	-	-	86.56	56.0	0.00	86.56
3.00	-	-	-	86.56	56.0	0.00	86.56
4.00	-	-	-	86.56	56.0	0.00	86.56
5.00	-	-	-	86.56	56.0	0.00	86.56
6.00	-	-	-	77.63	56.0	0.00	77.63
7.00	-	-	-	65.58	56.0	0.00	65.58
8.00	-	-	-	55.43	56.0	0.00	55.43
9.00	-	-	-	51.91	56.0	0.00	51.91
10.00	-	-	-	43.15	56.0	0.00	43.15
11.00	-	-	-	41.48	46.4	0.00	41.48
12.00	-	-	-	40.02	36.8	0.00	40.02
13.00	-	-	-	36.86	27.2	0.00	36.86
14.00	-	-	-	33.41	17.6	0.00	33.41
15.00	-	-	-	33.53	8.0	0.00	33.53
16.00	-	-	-	38.84	8.0	0.00	38.84
17.00	-	-	-	43.86	8.0	0.00	43.86
18.00	-	-	-	48.64	8.0	0.00	48.64
19.00	-	-	-	53.19	8.0	0.00	53.19
20.00	-	-	-	57.54	8.0	0.00	57.54
21.00	-	-	-	50.90	8.0	0.00	50.90
22.00	-	-	-	44.60	8.0	0.00	44.60
23.00	-	-	-	38.60	8.0	0.00	38.60
24.00	-	-	-	32.88	8.0	0.00	32.88
25.00	-	-	-	27.40	8.0	0.00	27.40
26.00	-	-	-	34.36	8.0	0.00	34.36
27.00	-	-	-	41.06	8.0	0.00	41.06
28.00	-	-	-	50.00	8.0	0.00	50.00
29.00	-	-	-	56.60	8.0	0.00	56.60
30.00	-	-	-	62.98	8.0	0.00	62.98
31.00	-	-	-	63.92	8.0	0.00	63.92
32.00	-	-	-	64.87	8.0	0.00	64.87
33.00	-	-	-	65.81	8.0	0.00	65.81
34.00	-	-	-	66.74	8.0	0.00	66.74
35.00	-	-	-	67.66	8.0	0.00	67.66
36.00	-	-	-	61.01	7.6	0.00	61.01
37.00	-	-	-	54.46	7.2	0.00	54.46

38.00	-	-	-	48.01	6.8	0.00	48.01
39.00	-	-	-	41.64	6.4	0.00	41.64
40.00	-	-	-	35.37	6.0	0.00	35.37
41.00	-	-	-	50.46	5.2	0.00	50.46
42.00	-	-	-	65.50	4.4	0.00	65.50
43.00	-	-	-	80.39	3.6	0.00	80.39
44.00	-	-	-	95.08	2.8	0.00	95.08
45.00	-	-	-	100.00	2.0	0.00	100.00
46.00	-	-	-	100.00	2.0	0.00	100.00
47.00	-	-	-	100.00	2.0	0.00	100.00
48.00	-	-	-	100.00	2.0	0.00	100.00
49.00	-	-	-	100.00	2.0	0.00	100.00
50.00	-	-	-	100.00	2.0	0.00	100.00

(N1)60s has been fines corrected in liquefaction analysis, therefore d(N1)60=0.
Fines=NoLiq means the soils are not liquefiable.

Settlement of Saturated Sands:
Settlement Analysis Method: Ishihara / Yoshimine*

Depth ft	CSRm	F.S.	Fines %	(N1)60s	Dr %	ec %	dsz in.	dsp in.	S in.
49.95	0.58	3.19	2.0	100.00	100.00	0.000	0.0E0	0.000	0.000
49.00	0.59	3.18	2.0	100.00	100.00	0.000	0.0E0	0.000	0.000
48.00	0.59	3.16	2.0	100.00	100.00	0.000	0.0E0	0.000	0.000
47.00	0.59	3.15	2.0	100.00	100.00	0.000	0.0E0	0.000	0.000
46.00	0.60	3.14	2.0	100.00	100.00	0.000	0.0E0	0.000	0.000
45.00	0.60	3.13	2.0	100.00	100.00	0.000	0.0E0	0.000	0.000
44.00	0.60	3.12	2.8	95.08	100.00	0.000	0.0E0	0.000	0.000
43.00	0.61	3.11	3.6	80.39	100.00	0.000	0.0E0	0.000	0.000
42.00	0.61	3.11	4.4	65.50	100.00	0.000	0.0E0	0.000	0.000
41.00	0.61	3.10	5.2	50.46	100.00	0.000	0.0E0	0.000	0.000
40.00	0.62	3.10	6.0	35.37	100.00	0.000	0.0E0	0.000	0.000
39.00	0.62	3.09	6.4	41.64	100.00	0.000	0.0E0	0.000	0.000
38.00	0.62	3.09	6.8	48.01	100.00	0.000	0.0E0	0.000	0.000
37.00	0.62	3.09	7.2	54.46	100.00	0.000	0.0E0	0.000	0.000
36.00	0.62	3.09	7.6	61.01	100.00	0.000	0.0E0	0.000	0.000
35.00	0.63	3.09	8.0	67.66	100.00	0.000	0.0E0	0.000	0.000
34.00	0.63	3.09	8.0	66.74	100.00	0.000	0.0E0	0.000	0.000
33.00	0.63	3.09	8.0	65.81	100.00	0.000	0.0E0	0.000	0.000
32.00	0.63	3.10	8.0	64.87	100.00	0.000	0.0E0	0.000	0.000
31.00	0.63	3.10	8.0	63.92	100.00	0.000	0.0E0	0.000	0.000
30.00	0.63	3.11	8.0	62.98	100.00	0.000	0.0E0	0.000	0.000
29.00	0.63	3.15	8.0	56.60	100.00	0.000	0.0E0	0.000	0.000
28.00	0.62	3.19	8.0	50.00	100.00	0.000	0.0E0	0.000	0.000
27.00	0.62	3.24	8.0	41.06	100.00	0.000	0.0E0	0.000	0.000
26.00	0.61	3.29	8.0	34.36	100.00	0.000	0.0E0	0.000	0.000
25.00	0.61	0.54	8.0	27.40	84.47	1.491	8.9E-3	0.060	0.060
24.00	0.60	3.34	8.0	32.88	96.96	0.000	0.0E0	0.071	0.131
23.00	0.59	3.37	8.0	38.60	100.00	0.000	0.0E0	0.000	0.131
22.00	0.59	3.41	8.0	44.60	100.00	0.000	0.0E0	0.000	0.131
21.00	0.58	3.46	8.0	50.90	100.00	0.000	0.0E0	0.000	0.131
20.00	0.57	3.51	8.0	57.54	100.00	0.000	0.0E0	0.000	0.131
19.00	0.56	3.57	8.0	53.19	100.00	0.000	0.0E0	0.000	0.131
18.00	0.55	3.63	8.0	48.64	100.00	0.000	0.0E0	0.000	0.131
17.00	0.54	3.70	8.0	43.86	100.00	0.000	0.0E0	0.000	0.131
16.00	0.53	3.78	8.0	38.84	100.00	0.000	0.0E0	0.000	0.131
15.00	0.52	3.87	8.0	33.53	98.63	0.000	0.0E0	0.000	0.131
14.00	0.50	3.98	17.6	33.41	98.32	0.000	0.0E0	0.000	0.131
13.00	0.49	4.10	27.2	36.86	100.00	0.000	0.0E0	0.000	0.131
12.00	0.47	4.25	36.8	40.02	100.00	0.000	0.0E0	0.000	0.131
11.00	0.45	4.42	46.4	41.48	100.00	0.000	0.0E0	0.000	0.131
10.00	0.43	4.63	56.0	43.15	100.00	0.000	0.0E0	0.000	0.131

Settlement of Saturated Sands=0.131 in.
qc1 and (N1)60 is after fines correction in liquefaction analysis
dsz is per each segment, dz=0.05 ft
dsp is per each print interval, dp=1.00 ft

S is cumulated settlement at this depth

Settlement of Unsaturated Sands:

Depth ft	sigma' tsf	sigC' tsf	(N1)60s	CSRfs	Gmax tsf	g*Ge/Gm	g_eff	ec7.5 %	Cec	ec %	dsz in.	dsp in.	S in.
9.95	0.60	0.39	43.56	0.46	979.0	2.8E-4	0.0727	0.0230	1.01	0.0232	2.78E-4	0.000	0.000
9.00	0.54	0.35	51.91	0.46	987.1	2.5E-4	0.0545	0.0172	1.01	0.0174	2.09E-4	0.005	0.005
8.00	0.48	0.31	55.43	0.47	951.2	2.3E-4	0.0567	0.0179	1.01	0.0181	2.17E-4	0.005	0.010
7.00	0.42	0.27	65.58	0.47	941.0	2.1E-4	0.0413	0.0131	1.01	0.0132	1.58E-4	0.004	0.013
6.00	0.36	0.23	77.63	0.47	921.5	1.8E-4	0.0347	0.0110	1.01	0.0111	1.33E-4	0.003	0.016
5.00	0.30	0.20	86.56	0.47	872.3	1.6E-4	0.0291	0.0092	1.01	0.0093	1.11E-4	0.002	0.019
4.00	0.24	0.16	86.56	0.47	780.2	1.4E-4	0.0252	0.0080	1.01	0.0080	9.66E-5	0.002	0.021
3.00	0.18	0.12	86.56	0.47	675.7	1.3E-4	0.0232	0.0073	1.01	0.0074	8.88E-5	0.002	0.023
2.00	0.12	0.08	86.56	0.47	551.7	1.0E-4	0.0208	0.0066	1.01	0.0066	7.95E-5	0.002	0.024
1.00	0.06	0.04	86.56	0.47	390.1	7.3E-5	0.0122	0.0038	1.01	0.0039	4.65E-5	0.001	0.026
0.00	0.00	0.00	86.56	0.47	5.0	9.4E-7	0.0010	0.0003	1.01	0.0003	3.89E-6	0.001	0.026

Settlement of Unsaturated Sands=0.026 in.
dsz is per each segment, dz=0.05 ft
dsp is per each print interval, dp=1.00 ft
S is cumulated settlement at this depth

Total Settlement of Saturated and Unsaturated Sands=0.157 in.
Differential Settlement=0.079 to 0.104 in.

Units Depth = ft, Stress or Pressure = tsf (atm), Unit Weight = pcf, Settlement = in.

SPT	Field data from Standard Penetration Test (SPT)
BPT	Field data from Becker Penetration Test (BPT)
qc	Field data from Cone Penetration Test (CPT)
fs	Friction from CPT testing
gamma	Total unit weight of soil
gamma'	Effective unit weight of soil
Fines	Fines content [%]
D50	Mean grain size
Dr	Relative Density
sigma	Total vertical stress [tsf]
sigma'	Effective vertical stress [tsf]
sigC'	Effective confining pressure [tsf]
rd	Stress reduction coefficient
CRR7.5	Cyclic resistance ratio (M=7.5)
Ksigma	Overburden stress correction factor for CRR7.5
CRRv	CRR after overburden stress correction, CRRv=CRR7.5 * Ksigma
F.S.	Calculated factor of safety against liquefaction F.S.=CRRv/CSRm
User	User request factor of safety, which may apply to CSR
fs1	First CSR curve in graphic defined in #9 of Advanced page
fs2	2nd CSR curve in graphic defined in #9 of Advanced page
CSR	Cyclic stress ratio induced by earthquake
CSRfs	CSRfs=CSR*fs1, fs1=1 or User, defined in #9 of Advanced page
MSF	Magnitude scaling factor for CSR
CSRm	After magnitude scaling correction CSRm=CSRfs/MSF
Cebs	Energy Ratio, Borehole Dia., and Sampling Method Corrections
Cr	Rod Length Corrections
Cn	Overburden Pressure Correction
(N1)60	SPT after corrections, (N1)60=SPT * Cr * Cn * Cebs

d(N1)60	Fines correction of SPT
(N1)60f	(N1)60 after fines corrections, (N1)60f=(N1)60 + d(N1)60
Cq	Overburden stress correction factor
qc1	CPT after Overburden stress correction
dqc1	Fines correction of CPT
qc1f	CPT after Fines and Overburden correction, qc1f=qc1 + dqc1
qc1n	CPT after normalization in Robertson's method
Kc	Fine correction factor in Robertson's Method
qc1f	CPT after Fines correction in Robertson's Method
Ic	Soil type index in Suzuki's and Robertson's Methods
(N1)60s	(N1)60 after settlement fines corrections
ec	Volumetric strain for saturated sands
dz	Calculation segment, dz=0.050 ft
dsz	Settlement in each segment, dz
dp	User defined print interval
dsp	Settlement in each print interval, dp
Gmax	Shear Modulus at low strain
g_eff	gamma_eff, Effective shear Strain
g*Ge/Gm	gamma_eff * G_eff/G_max, Strain-modulus ratio
ec7.5	Volumetric Strain for magnitude=7.5
Cec	Magnitude correction factor for any magnitude
ec	Volumetric strain for unsaturated sands, ec=Cec * ec7.5
NoLiq	No-Liquefy Soils

References:

1. NCEER Workshop on Evaluation of Liquefaction Resistance of Soils. Youd, T.L., and Idriss, I.M., eds., Technical Report NCEER 97-0022.

SP117. Southern California Earthquake Center. Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for
Analyzing and Mitigating Liquefaction in California. University of Southern California. March 1999.

2. RECENT ADVANCES IN SOIL LIQUEFACTION ENGINEERING AND SEISMIC SITE RESPONSE EVALUATION, Paper No. SPL-2, PROCEEDINGS: Fourth
International Conference on Recent Advances in Geotechnical Earthquake Engineering and Soil Dynamics, San Diego, CA, March 2001.

3. RECENT ADVANCES IN SOIL LIQUEFACTION ENGINEERING: A UNIFIED AND CONSISTENT FRAMEWORK, Earthquake Engineering Research Center,
Report No. EERC 2003-06 by R.B Seed and etc. April 2003.

APPENDIX F

TABLE OF CONTENT

GENERAL

The guidelines contained herein and the standard details attached hereto represent this firm's standard recommendation for grading and other associated operations on construction projects. These guidelines should be considered a portion of the project specifications.
All plates attached hereto shall be considered as part of these guidelines.
The Contractor should not vary from these guidelines without prior recommendation by the Geotechnical Consultant and the approval of the Client or his authorized representative. Recommendation by the Geotechnical Consultant and/or Client should not be considered to preclude requirements for the approval by the controlling agency prior to the execution of any changes.
These Standard Grading Guidelines and Standard Details may be modified and/or superseded by recommendations contained in the text of the preliminary Geotechnical Report and/or subsequent reports.
If disputes arise out of the interpretation of these grading guidelines or standard details, the Geotechnical Consultant shall provide the governing interpretation.

DEFINITION OF TERMS

ALLUVIUM
Unconsolidated soil deposits resulting from flow of water, including sediments deposited in river beds, canyons, flood plains, lakes, fans and estuaries.
AS-GRADED (AS-BUILT): The surface and subsurface conditions at completion of grading.
BACKCUT: A temporary construction slope at the rear of earth retaining structures such as buttresses, shear keys, stabilization fills or retaining walls.
BACKDRAIN: Generally a pipe and gravel or similar drainage system placed behind earth retaining structures such buttresses, stabilization fills, and retaining walls.
BEDROCK: Relatively undisturbed formational rock, more or less solid, either at the surface or beneath superficial deposits of soil.
BENCH: A relatively level step and near vertical rise excavated into sloping ground on which fill is to be placed.
BORROW (Import): Any fill material hauled to the project site from off-site areas.
BUTTRESS FILL::A fill mass, the configuration of which is designed by engineering calculations to retain slope conditions containing adverse geologic features. A buttress is generally specified by minimum key width and depth and by maximum backcut angle. A buttress normally contains a back-drainage system.
CIVIL ENGINEER: The Registered Civil Engineer or consulting firm responsible for preparation of the grading plans, surveying and verifying as-graded topographic conditions.
CLIENT: The Developer or his authorized representative who is chiefly in charge of the project. He shall have the responsibility of reviewing the findings and recommendations made by the Geotechnical Consultant and shall authorize the Contractor and/or other consultants to perform work and/or provide services.
COLLUVIUM: Generally loose deposits usually found near the base of slopes and brought there chiefly by gravity through slow continuous downhill creep (also see Slope Wash).
COMPACTION : Densification of man-placed fill by mechanical means.
CONTRACTOR – A person or company under contract or otherwise retained by the Client to perform demolition, grading and other site improvements.
DEBRIS: All products of clearing, grubbing, demolition, and contaminated soil materials unsuitable for reuse as compacted fill, and/or any other material so designated by the Geotechnical Consultant.
ENGINEERING GEOLOGIST: A Geologist holding a valid certificate of registration in the specialty of Engineering Geology.
ENGINEERED FILL: A fill of which the Geotechnical Consultant or his representative, during grading, has made sufficient tests to enable him to conclude that the fill has been placed in substantial compliance with the recommendations of the Geotechnical Consultant and the governing agency requirements.
EROSION: The wearing away of ground surface as a result of the movement of wind, water, and/or ice.
EXCAVATION: The mechanical removal of earth materials.
EXISTING GRADE: The ground surface configuration prior to grading.
FILL: Any deposits of soil, rock, soil-rock blends or other similar materials placed by man.
FINISH GRADE: The ground surface configuration at which time the surface elevations conform to the approved plan.

GEOFABRIC: Any engineering textile utilized in geotechnical applications including subgrade stabilization and filtering.
GEOLOGIST: A representative of the Geotechnical Consultant educated and trained in the field of geology.
GEOTECHNICAL CONSULTANT: The Geotechnical Engineering and Engineering Geology consulting firm retained to provide technical services for the project. For the purpose of these specifications, observations by the Geotechnical Consultant include observations by the Soil Engineer, Geotechnical Engineer, Engineering Geologist and those performed by persons employed by and responsible to the Geotechnical Consultants.
GEOTECHNICAL ENGINEER: A licensed Geotechnical Engineer or Civil Engineer who applies scientific methods, engineering principles and professional experience to the acquisition, interpretation and use of knowledge of materials of the earth's crust for the evaluation of engineering problems. Geotechnical Engineering encompasses many of the engineering aspects of soil mechanics, rock mechanics, geology, geophysics, hydrology and related sciences.
GRADING: Any operation consisting of excavation, filling or combinations thereof and associated operations.
LANDSIDE DEBRIS: Material, generally porous and of low density, produced from instability of natural or man-made slopes.
MAXIMUM DENSITY: Standard laboratory test for maximum dry unit weight. Unless otherwise specified, the maximum dry unity weight shall be determined in accordance with ASTM Method of Test D 1557-91.
OPTIMUM MOISTURE – Soil moisture content at the test maximum density.
RELATIVE COMPACTION: The degree of compaction (expressed as a percentage) of dry unit weight of a material as compared to the maximum dry unit weight of the material.
ROUGH GRADE: The ground surface configuration at which time the surface elevations approximately conform to the approved plan.
SITE: The particular parcel of land where grading is being performed.
SHEAR KEY: Similar to buttress, however, it is generally constructed by excavating a slot within a natural slope, in order to stabilize the upper portion of the slope without grading encroaching into the lower portion of the slope.
SLOPE: An inclined ground surface, the steepness of which is generally specified as a ration of horizontal:vertical (e.g., 2:1)
SLOPE WASH: Soil and/or rock material that has been transported down a slope by action of gravity assisted by runoff water not confined by channels (also see Colluvium).
SOIL: Naturally occurring deposits of sand, silt, clay, etc., or combinations thereof.
SOIL ENGINEER: Licensed Geotechnical Engineer or Civil Engineer experienced in soil mechanics (also see Geotechnical Engineer).
STABILIZATION FILL: A fill mass, the configuration of which is typically related to slope height and specified by the standards of practice for enhancing the stability of locally adverse conditions. A stabilization fill is normally specified by minimum key width and depth and by maximum backcut angle. A stabilization fill may or may not have a backdrainage system specified.
SUBDRAIN: Generally a pipe and gravel or similar drainage system placed beneath a fill in the alignment of canyons or formed drainage channels.
SLOUGH: Loose, non-compacted fill material generated during grading operations.
TAILINGS: Non-engineered fill which accumulates on or adjacent to equipment haul-roads.
TERRACE: Relatively level step constructed in the face of a graded slope surface for drainage control and maintenance purposes.
TOPSOIL: The presumable fertile upper zone of soil, which is usually darker in color and loose.
WINDROW: A string of large rocks buried within engineered fill in accordance with guidelines set forth by the Geotechnical Consultant.

OBLIGATIONS OF PARTIES

The Geotechnical Consultant should provide observation and testing services and should make evaluations in order to advise the Client on Geotechnical matters. The Geotechnical Consultant should report his findings and recommendations to the Client or his authorized representative.
The client should be chiefly responsible for all aspects of the project. He or his authorized representative has the responsibility of reviewing the findings and recommendations of the Geotechnical Consultant. He shall authorize or cause to have authorized the Contractor and/or other consultants to perform work and/or provide services.

During grading the Client or his authorized representative should remain on-site or should remain reasonably accessible to all concerned parties in order to make decisions necessary to maintain the flow of the project. The Contractor should be responsible for the safety of the project and satisfactory completion of all grading and other associated operations on construction projects, including but not limited to, earthwork in accordance with the project plans, specifications and controlling agency requirements. During grading, the Contractor or his authorized representative should remain on-site. Overnight and on days off, the Contractor should remain accessible.

SITE PREPARATION

The Client, prior to any site preparation or grading, should arrange and attend a meeting among the Grading Contractor, the Design Engineer, the Geotechnical Consultant, representatives of the appropriate governing authorities as well as any other concerned parties. All parties should be given at least 48 hours notice.
Clearing and grubbing should consist of the removal of vegetation such as brush, grass, woods, stumps, trees, roots of trees and otherwise deleterious natural materials from the areas to be graded. Clearing and grubbing should extend to the outside of all proposed excavation and fill areas.
Demolition should include removal of buildings, structures, foundations, reservoirs, utilities (including underground pipelines, septic tanks, leach fields, seepage pits, cisterns, mining shafts, tunnels, etc.) and man-made surface and subsurface improvements from the areas to be graded. Demolition of utilities should include proper capping and/or re-routing pipelines at the project perimeter and cutoff and capping of wells in accordance with the requirements of the governing authorities and the recommendations of the Geotechnical Consultant at the time of the demolition.
Trees, plants or man-made improvements not planned to be removed or demolished should be protected by the Contractor from damage or injury.
Debris generated during clearing, grubbing and/or demolition operations should be wasted from areas to be graded and disposed off-site. Clearing, grubbing and demolition operations should be performed under the observation of the Geotechnical Consultant.
The Client or Contractor should obtain the required approvals for the controlling authorities for the project prior, during and/or after demolition, site preparation and removals, etc. The appropriate approvals should be obtained prior to proceeding with grading operations.

SITE PROTECTION

Protection of the site during the period of grading should be the responsibility of the Contractor. Unless other provisions are made in writing and agreed upon among the concerned parties, completion of a portion of the project should not be considered to preclude that portion or adjacent areas from the requirements for site protection until such time as the entire project is complete as identified by the Geotechnical Consultant, the Client and the regulating agencies.
The Contractor should be responsible for the stability of all temporary excavations. Recommendations by the Geotechnical Consultant pertaining to temporary excavations (e.g., backcuts) are made in consideration of stability of the completed project and therefore, should not be considered to preclude the responsibilities of the Contractor. Recommendations by the Geotechnical Consultant should not be considered to preclude more restrictive requirements by the regulating agencies.
Precautions should be taken during the performance of site clearing, excavations and grading to protect the work site from flooding, ponding, or inundation by poor or improper surface drainage. Temporary provisions should be made during the rainy season to adequately direct surface drainage away from and off the work site. Where low areas can not be avoided, pumps should be kept on hand to continually remove water during periods of rainfall.
During periods of rainfall, plastic sheeting should be kept reasonably accessible to prevent unprotected slopes from becoming saturated. Where necessary during periods of rainfall, the Contractor should install check-dams de-silting basins, rip-rap, sandbags or other devices or methods necessary to control erosion and provide safe conditions.
During periods of rainfall, the Geotechnical Consultant should be kept informed by the Contractor as to the nature of remedial or preventative work being performed (e.g., pumping, placement of sandbags or plastic sheeting, other labor, dozing, etc.).

Following periods of rainfall, the Contractor should contact the Geotechnical Consultant and arrange a walk-over of the site in order to visually assess rain related damage. The Geotechnical Consultant may also recommend excavations and testing in order to aid in his assessments. At the request of the Geotechnical Consultant, the Contractor shall make excavations in order to evaluate the extent of rain related damage. Rain-related damage should be considered to include, but may not be limited to, erosion, silting, saturation, swelling, structural distress and other adverse conditions identified by the Geotechnical Consultant. Soil adversely affected should be classified as Unsuitable Materials and should be subject to overexcavation and replaced with compacted fill or other remedial grading as recommended by the Geotechnical Consultant.
Relatively level areas, where saturated soils and/or erosion gullies exist to depths greater then 1 foot, should be overexcavated to unaffected, competent material. Where less than 1 foot in depth, unsuitable materials may be processed in-place to achieve near optimum moisture conditions, then thoroughly recompacted in accordance with the applicable specifications. If the desired results are not achieved, the affected materials should be overexcavated then replaced in accordance with the applicable specifications.
In slope areas, where saturated soil and/or erosion gullies exist to depths of greater than 1 foot, should be over-excavated to unaffected, competent material. Where affected materials exist to depths of 1 foot or less below proposed finished grade, remedial grading by moisture conditioning in-place, followed by thorough recompaction in accordance with the applicable grading guidelines herein may be attempted. If the desired results are not achieved, all affected materials should be overexcavated and replaced as compacted fill in accordance with the slope repair recommendations herein. As field conditions dictate, other slope repair procedures may be recommended by the Geotechnical Consultant.

EXCAVATIONS

UNSUITABLE MATERIALS:
Materials which are unsuitable should be excavated under observation and recommendations of the Geotechnical Consultant. Unsuitable materials include, but may not be limited to dry, loose, soft, wet, organic compressible natural soils and fractured, weathered, soft, bedrock and nonengineered or otherwise deleterious fill materials.
Materials identified by the Geotechnical Consultant as unsatisfactory due to its moisture conditions should be overexcavated, watered or dried, as needed, and thoroughly blended to uniform near optimum moisture condition (per Moisture guidelines presented herein) prior to placement as compacted fill.

CUT SLOPES:
Unless otherwise recommended by the Geotechnical Consultant and approved by the regulating agencies, permanent cut slopes should not be steeper than 2:1 (horizontal:vertical).
If excavations for cut slopes expose loose, cohesionless, significantly fractured or otherwise suitable material, overexcavation and replacement of the unsuitable materials with a compacted stabilization fill should be accomplished as recommended by the Geotechnical Consultant. Unless otherwise specified by the Geotechnical Consultant, stabilization fill construction should conform to the requirements of the Standard Details.
The Geotechnical Consultant should review cut slopes during excavation. The Geotechnical Consultant should be notified by the contractor prior to beginning slope excavations.
If during the course of grading, adverse or potentially adverse geotechnical conditions are encountered which were not anticipated in the preliminary report, the Geotechnical Consultant should explore, analyze and make recommendations to treat these problems.
When cuts slopes are made in the direction of the prevailing drainage, a non-erodible diversion swale (brow ditch) should be provided at the top-of-cut.

PAD AREAS:
All lot pad areas, including side yard terraces, above stabilization fills or buttresses should be over-excavated to provide for a minimum of 3-feet (refer to Standard Details) of compacted fill over the entire pad area. Pad areas with both fill and cut materials exposed and pad areas containing both very shallow (less than 3-feet) and deeper fill should be over- thickness (refer to Standard Details).
Cut areas exposing significantly varying material types should also be overexcavated to provide for at least a 3-foot thick compacted fill blanket. Geotechnical conditions may require greater depth of overexcavation. The actual depth should be delineated by the Geotechnical Consultant during grading.

For pad areas created above cut or natural slopes, positive drainage should be established away from the top-of-slope. This may be accomplished utilizing a berm and/or an appropriate pad gradient. A gradient in soil areas away from the top-of-slope of 2 percent or greater is recommended.

COMPACTED FILL

All fill materials should be compacted as specified below or by other methods specifically recommended by the Geotechnical Consultant. Unless otherwise specified, the minimum degree of compaction (relative compaction) should be 90 percent of the laboratory maximum density.

PLACEMENT

Prior to placement of compacted fill, the Contractor should request a review by the Geotechnical Consultant of the exposed ground surface. Unless otherwise recommended, the exposed ground surface should then be scarified (6-inches minimum), watered or dried as needed, thoroughly blended to achieve near optimum moisture conditions, then thoroughly compacted to a minimum of 90 percent of the maximum density. The review by the Geotechnical Consultants should not be considered to preclude requirements of inspection and approval by the governing agency.

Compacted fill should be placed in thin horizontal lifts not exceeding 8-inches in loose thickness prior to compaction. Each lift should be watered or dried as needed, thoroughly blended to achieve near optimum moisture conditions then thoroughly compacted by mechanical methods to a minimum of 90 percent of laboratory maximum dry density. Each lift should be treated in a like manner until the desired finished grades are achieved.

The Contractor should have suitable and sufficient mechanical compaction equipment and watering apparatus on the job site to handle the amount of fill being placed in consideration of moisture retention properties of the materials. If necessary, excavation equipment should be "shut down" temporarily in order to permit proper compaction of fills. Earth moving equipment should only be considered a supplement and not substituted for conventional compaction equipment.

When placing fill in horizontal lifts adjacent to areas sloping steeper than 5:1 (horizontal:vertical), horizontal keys and vertical benches should be excavated into the adjacent slope area. Keying and benching should be sufficient to provide at least 6-foot wide benches and minimum of 4-feet of vertical bench height within the firm natural ground, firm bedrock or engineered compacted fill. No compacted fill should be placed in an area subsequent to keying and benching until the area has been reviewed by the Geotechnical Consultant. Material generated by the benching operation should be moved sufficiently away from the bench area to allow for the recommended review of the horizontal bench prior to placement of fill. Typical keying and benching details have been included within the accompanying Standard Details.

Within a single fill area where grading procedures dictate two or more separate fills, temporary slopes (false slopes) may be created. When placing fill adjacent to a false slope, benching should be conducted in the same manner as above described. At least a 3-foot vertical bench should be established within the firm core of adjacent approved compacted fill prior to placement of additional fill. Benching should proceed in at least 3-foot vertical increments until the desired finished grades are achieved.

Fill should be tested for compliance with the recommended relative compaction and moisture conditions. Field density testing should conform to ASTM Method of Testing D 1556-64, D 2922-78 and/or D2937-71. Tests should be provided for about every 2 vertical feet or 1,000 cubic yards of fill placed. Actual test intervals may vary as field conditions dictate. Fill found not to be in conformance with the grading recommendations should be removed or otherwise handled as recommended by the Geotechnical Consultant.

The Contractor should assist the Geotechnical Consultant and/or his representative by digging test pits for removal determinations and/or for testing compacted fill.

As recommended by the Geotechnical Consultant, the Contractor should "shutdown" or remove any grading equipment from an area being tested.

The Geotechnical Consultant should maintain a plan with estimated locations of field tests. Unless the client provides for actual surveying of test locations, by the Geotechnical Consultant should only be considered rough estimates and should not be utilized for the purpose of preparing cross sections showing test locations or in any case for the purpose of after-the-fact evaluating of the sequence of fill placement.

MOISTURE

For field testing purposes, "near optimum" moisture will vary with material type and other factors including compaction procedures. "Near optimum" may be specifically recommended in Preliminary Investigation Reports and/or may be evaluated during grading.

Prior to placement of additional compacted fill following an overnight or other grading delay, the exposed surface of previously compacted fill should be processed by scarification, watered or dried as needed, thoroughly blended to near-optimum moisture conditions, then recompacted to a minimum of 90 percent of laboratory maximum dry density. Where wet or other dry or other unsuitable materials exist to depths of greater than one foot, the unsuitable materials should be overexcavated.

Following a period of flooding, rainfall or overwatering by other means, no additional fill should be placed until damage assessments have been made and remedial grading performed as described herein.

FILL MATERIAL

Excavated on-site materials which are acceptable to the Geotechnical Consultant may be utilized as compacted fill, provided trash, vegetation and other deleterious materials are removed prior to placement.

Where import materials are required for use on-site, the Geotechnical Consultant should be notified at least 72 hours in advance of importing, in order to sample and test materials from proposed borrow sites. No import materials should be delivered for use on-site without prior sampling and testing by Geotechnical Consultant.

Where oversized rock or similar irreducible material is generated during grading, it is recommended, where practical, to waste such material off-site or on-site in areas designated as "nonstructural rock disposal areas".

Rock placed in disposal areas should be placed with sufficient fines to fill voids. The rock should be compacted in lifts to an unyielding condition. The disposal area should be covered with at least 3-feet of compacted fill, which is free of oversized material. The upper 3-feet should be placed in accordance with the guidelines for compacted fill herein.

Rocks 3 inches in maximum dimension and smaller may be utilized within the compacted fill, provided they are placed in such a manner that nesting of the rock in avoided. Fill should be placed and thoroughly compacted over and around all rock. The amount of rock should not exceed 40 percent by dry weight passing the $^{3}/_{4}$-inch sieve size. The 3-inch and 40 percent recommendations herein may vary as field conditions dictate.

During the course of grading operations, rocks or similar irreducible materials greater than 3-inch maximum dimension (oversized material) may be generated. These rocks should not be placed within the compacted fill unless placed as recommended by the Geotechnical Consultant.

Where rocks or similar irreducible materials of greater that 3-inches but less than 4-feet of maximum dimension are generated during grading, or otherwise desired to be placed within an engineered fill, special handling in accordance with the accompanying Standard Details is recommended. Rocks greater than 4 feet should be broken down or disposed off-site. Rocks up to 4-feet maximum dimension should be placed below the upper 10-feet of any fill and should not be closer than 20-feet to any slope face. These recommendations could vary as locations of improvements dictate. Where practical, oversized material should not be placed below areas where structures of deep utilities are proposes.

Oversized material should be placed in windrows on a clean, overexcavated or unyielding compacted fill or firm natural ground surface. Select native or imported granular soil (S.E. 30 or higher) should be placed and thoroughly flooded over and around all windrowed rock, such that voids are filled. Windrows of oversized material should be staggered so that successive strata of oversized material are not in the same vertical plane.

It may be possible to dispose of individual larger rock as field conditions dictate and as recommended by the Geotechnical Consultant at time of placement.

Material that is considered unsuitable by the Geotechnical Consultant should not be utilized in the compacted fill.

During grading operations, placing and mixing the materials from the cut and/or borrow areas may result in soil mixtures which possess unique physical properties. Testing may be required of samples obtained directly from the fill areas in order to verify conformance with the specifications. Processing of these additional samples may take two or more working days. The Contractor may elect to move the operation to other areas within the project, or may continue placing compacted fill pending laboratory and field test results. Should he elect the second alternative, fill placed is done so at the Contractor's risk.

Any fill placed in areas not previously reviewed and evaluated by the Geotechnical Consultant, and/or in other areas, without prior notification to the Geotechnical Consultant may require removal and recompaction at the Contractor's expense. Determination of overexcavations should be made upon review of field conditions by the Geotechnical Consultant.

FILL SLOPES

Unless otherwise recommended by the Geotechnical Consultant and approved by the regulating agencies, permanent fill slopes should not be steeper than 2:1 (horizontal to vertical).

Except as specifically recommended otherwise or as otherwise provided for in these grading guidelines (Reference Fill Materials), compacted fill slopes should be overbuilt and cut back to grade, exposing the firm, compacted fill inner core. The actual amount of overbuilding may vary as field conditions dictate. If the desired results are not achieved, the existing slopes should be overexcavated and reconstructed under the guidelines of the Geotechnical Consultant. The degree of overbuilding shall be increased until the desired compacted slope surface condition is achieved. Care should be taken by the Contractor to provide thorough mechanical compaction to the outer edge of the overbuilt slope surface.

Although no construction procedure produces a slope free from risk of future movement, overfilling and cutting back of slope to a compacted inner core is, given no other constraints, the most desirable procedure. Other constraints, however, must often be considered. These constraints may include property line situations, access, the critical nature of the development, and cost. Where such constraints are identified, slope face compaction may be attempted by conventional construction procedures including backrolling techniques upon specific recommendations by the Geotechnical Consultant.

As a second best alternative for slopes of 2:1 (horizontal to vertical) or flatter, slope construction may be attempted as outlined herein. Fill placement should proceed in thin lifts, (i.e., 6 to 8 inch loose thickness). Each lift should be moisture conditioned and thoroughly compacted. The desired moisture condition should be maintained and/or reestablished, where necessary, during the period between successive lifts. Selected lifts should be tested to ascertain that desired compaction is being achieved. Care should be taken to extend compactive effort to the outer edge of the slope. Each lift should extend horizontally to the desired finished slope surface or more as needed to ultimately establish desired grades. Grade during construction should not be allowed to roll off at the edge of the slope. It may be helpful to elevate slightly the outer edge of the slope. Slough resulting from the placement of individual lifts should not be allowed to drift down over previous lifts. At intervals not exceeding 4-feet in vertical slope height or the capability of available equipment, whichever is less, fill slopes should be thoroughly backrolled utilizing a conventional sheepsfoot-type roller. Care should be taken to maintain the desired moisture conditions and/or reestablishing same as needed prior to backrolling. Upon achieving final grade, the slopes should again be moisture conditioned and thoroughly backrolled. The use of a side-boom roller will probably be necessary and vibratory methods are strongly recommended. Without delay, so as to avoid (if possible) further moisture conditioning, the slopes should then be grid-rolled to achieve a relatively smooth surface and uniformly compact condition.

In order to monitor slope construction procedures, moisture and density tests will be taken at regular intervals. Failure to achieve the desired results will likely result in a recommendation by the Geotechnical Consultant to overexcavate the slope surfaces followed by reconstruction of the slopes utilizing overfilling and cutting back procedures and/or further attempt at the conventional backrolling approach. Other recommendations may also be provided which would be commensurate with field conditions.

Where placement of fill above a natural slope or above a cut slope is proposed, the fill slope configuration as presented in the accompanying standard Details should be adopted.

For pad areas above fill slopes, positive drainage should be established away from the top-of-slope. This may be accomplished utilizing a berm and pad gradients of at least 2-percent in soil area.

OFF-SITE FILL

Off-site fill should be treated in the same manner as recommended in these specifications for site preparation, excavation, drains, compaction, etc.

Off-site canyon fill should be placed in preparation for future additional fill, as shown in the accompanying Standard Details.

Off-site fill subdrains temporarily terminated (up canyon) should be surveyed for future relocation and connection.

DRAINAGE

Canyon sub-drain systems specified by the Geotechnical Consultant should be installed in accordance with the Standard Details.
Typical sub-drains for compacted fill buttresses, slope stabilization or sidehill masses, should be installed in accordance with the specifications of the accompanying Standard Details.
Roof, pad and slope drainage should be directed away from slopes and areas of structures to suitable disposal areas via non-erodible devices (i.e., gutters, downspouts, concrete swales).
For drainage over soil areas immediately away from structures (i.e., within 4-feet), a minimum of 4 percent gradient should be maintained. Pad drainage of at least 2 percent should be maintained over soil areas. Pad drainage may be reduced to at least 1 percent for projects where no slopes exist, either natural or man-made, or greater than 10-feet in height and where no slopes are planned, either natural or man-made, steeper than 2:1 (horizontal to vertical slope ratio).
Drainage patterns established at the time of fine grading should be maintained throughout the life of the project. Property owners should be made aware that altering drainage patterns can be detrimental to slope stability and foundation performance.

STAKING

In all fill areas, the fill should be compacted prior to the placement of the stakes. This particularly is important on fill slopes. Slope stakes should not be placed until the slope is thoroughly compacted (backrolled). If stakes must be placed prior to the completion of compaction procedures, it must be recognized that they will be removed and/or demolished at such time as compaction procedures resume.
In order to allow for remedial grading operations, which could include overexcavations or slope stabilization, appropriate staking offsets should be provided. For finished slope and stabilization backcut areas, we recommend at least 10-feet setback from proposed toes and tops-of-cut.

SLOPE MAINTENANCE LANDSCAPE PLANTS

In order to enhance superficial slope stability, slope planting should be accomplished at the completion of grading. Slope planting should consist of deep-rooting vegetation requiring little watering. Plants native to the Southern California area and plants relative to native plants are generally desirable. Plants native to other semiarid and arid areas may also be appropriate. A Landscape Architect would be the best party to consult regarding actual types of plants and planting configuration.

IRRIGATION

Irrigation pipes should be anchored to slope faces, not placed in trenches excavated into slope faces.
Slope irrigation should be minimized. If automatic timing devices are utilized on irrigation systems, provisions should be made for interrupting normal irrigation during periods of rainfall.
Though not a requirement, consideration should be give to the installation of near-surface moisture monitoring control devices. Such devices can aid in the maintenance of relatively uniform and reasonably constant moisture conditions.
Property owners should be made aware that overwatering of slopes is detrimental to slope stability.

MAINTENANCE

Periodic inspections of landscaped slope areas should be planned and appropriate measures should be taken to control weeds and enhance growth of the landscape plants. Some areas may require occasional replanting and/or reseeding.
Terrace drains and downdrains should be periodically inspected and maintained free of debris. Damage to drainage improvements should be repaired immediately.
Property owners should be made aware that burrowing animals can be detrimental to slope stability. A preventative program should be established to control burrowing animals.
As a precautionary measure, plastic sheeting should be readily available, or kept on hand, to protect all slope areas from saturation by periods of heavy or prolonged rainfall. This measure is strongly recommended, beginning with the period of time prior to landscape planting.

REPAIRS

If slope failures occur, the Geotechnical Consultant should be contacted for a field review of site conditions and development of recommendations for evaluation and repair.

If slope failure occurs as a result of exposure to periods of heavy rainfall, the failure areas and currently unaffected areas should be covered with plastic sheeting to protect against additional saturation.

In the accompanying Standard Details, appropriate repair procedures are illustrated for superficial slope failures (i.e., occurring typically within the outer 1 foot to 3 feet of a slope face).

TRENCH BACKFILL

Utility trench backfill should, unless otherwise recommended, be compacted by mechanical means. Unless otherwise recommended, the degree of compaction should be a minimum of 95 percent of the laboratory maximum density.

Approved granular material (sand equivalent greater than 30) should be used to bed and backfill utilities to a depth of at least 1 foot over the pipe. This backfill should be uniformly watered, compacted and/or wheel-rolled from the surface to a firm condition for pipe support.

The remainder of the backfill shall be typical on-site soil or imported soil which should be placed in lifts not exceeding 8 inches in thickness, watered or aerated to at least 3 percent above the optimum moisture content, and mechanically compacted to at least 95 percent of maximum dry density (based on ASTM D1557).

Backfill of exterior and interior trenches extending below a 1:1 projection from the outer edge of foundations should be mechanically compacted to a minimum of 95 percent of the laboratory maximum density.

Within slab areas, but outside the influence of foundations, trenches up to 1 foot wide and 2 feet deep may be backfilled with sand and consolidated by uniformly watering or by mechanical means. If on-site materials are utilized, they should be wheel-rolled, tamped or otherwise compacted to a firm condition. For minor interior trenches, density testing may be deleted or spot testing may be elected if deemed necessary, based on review of back-fill operations during construction.

If utility contractors indicate that it is undesirable to use compaction equipment in close proximity to a buried conduit, the Contractor may elect the utilization of light weight compaction equipment and/or shading of the conduit with clean, granular material, which should be thoroughly jetted in-place above the conduit, prior to initiating mechanical compaction procedures. Other methods of utility trench compaction may also be appropriate, upon review by the Geotechnical Consultant at the time of construction.

In cases where clean granular materials are proposed for use in lieu of native materials or where flooding or jetting is proposed, the procedures should be considered subject to review by the Geotechnical Consultant.

Clean Granular backfill and/or bedding are not recommended in slope areas unless provisions are made for a drainage system to mitigate the potential build-up of seepage forces.

STATUS OF GRADING

Prior to proceeding with any grading operation, the Geotechnical Consultant should be notified at least two working days in advance in order to schedule the necessary observation and testing services.

Prior to any significant expansion of cut back in the grading operation, the Geotechnical Consultant should be provided with adequate notice (i.e., two days) in order to make appropriate adjustments in observation and testing services.

Following completion of grading operations and/or between phases of a grading operation, the Geotechnical Consultant should be provided with at least two working days notice in advance of commencement of additional grading operations.