GEOTEK

PRELIMINARY GEOTECHNICAL EVALUATION
FOR
PROPOSED EMERALD HILLS DEVELOPMENT
APN 543-340-02-00
NORTH OF OLD MEMORY LANE
SAN DIEGO, CALIFORNIA

PREPARED FOR

D.R. HORTON LOS ANGELES HOLDING COMPANY, INC
2280 WARDLOW CIRCLE, SUITE 100
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PREPARED BY

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PROJECT NO. 3680-SD NOVEMBER 13, 2023

GEOTEK

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November 13, 2023
Project No. 3680-SD

D•R•Horton Los Angeles Holding Company, Inc.
2280 Wardlow Circle, Suite 100
Corona, California 92878

Attention: Mr. Dan Boyd

Subject: **Preliminary Geotechnical Evaluation**
Proposed Emerald Hills Development
North of Old Memory lane
APN 543-340-02-00
San Diego, California

Dear Mr. Boyd:

GeoTek, Inc. (GeoTek) is pleased to provide herein the results of a preliminary geotechnical evaluation for the subject project. This report presents the results of GeoTek's evaluation and provides preliminary geotechnical recommendations for earthwork, foundation design, and construction. Based upon review, site development appears feasible from a geotechnical viewpoint provided that the recommendations included herein are incorporated into the design and construction phases of site development.

The opportunity to be of service is sincerely appreciated. If you should have any questions, please do not hesitate to call GeoTek.

Respectfully submitted,
GeoTek, Inc.

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1. PURPOSE AND SCOPE OF SERVICES

The purpose of this study was to evaluate the geotechnical conditions of the project site. Services provided for this study included the following:

- Research and review of available geologic and geotechnical data, and general information pertinent to the site.
- Excavation of eleven exploratory test pits and collection of bulk soil samples for subsequent laboratory testing.
- Excavation of three percolation test holes for subsequent infiltration analysis.
- Laboratory testing of the soil samples collected during the field investigation.
- Compilation of this geotechnical report which presents GeoTek's findings of pertinent site geotechnical conditions, geotechnical analysis, and geotechnical recommendations for the proposed site development.

2. SITE DESCRIPTION AND PROPOSED DEVELOPMENT

2.1 SITE DESCRIPTION

The project site is located at 5702 Memory Lane, San Diego, California (See Figure 1). The site can be accessed from a private driveway off Memory Lane leading into the site. The site is an irregular-shaped property consisting of approximately 31.2 acres in the City of San Diego, California. The property is bounded to the south/southwest by residential property along Old Memory Lane and to the north by Tooley Street, bounded to the east by 60th Street, and bounded along portions of the west by Emerald Hills Park. The site is largely unimproved, however there are two existing transmission trellis style towers, a facility building, and a relatively level pad for equipment (presumably generators and outdoor storage). An approximately 3-4' tall berm, eroded and overgrown with vegetation, exists near the entrance.

Based on our reconnaissance and a review of topographic maps, site topography is characterized by two broad topographic knolls located in the northeast and southwest.

2.2 PROPOSED DEVELOPMENT

Based on the "Vesting Tentative Map" prepared by Hunsaker & Associates (2023), it is our understanding that the proposed development will consist of 123 single-family homes and interior streets. Additionally, assumed improvements consist of earthwork improvements to existing grades to construct level or terraced building pads, underground utilities, hardscape, as well as, landscape improvements. Fill and cut slopes with a maximum inclination of 2:1 (horizontal to vertical) are proposed to approximate heights of 90 and 17 feet, respectively.

It is anticipated that the residential buildings will be of wood frame construction and will be supported by conventional shallow foundations (continuous and isolated pad) and a conventional slab on-grade or raised-wood floor. For the purposes of this report, it is assumed maximum column and wall loads will be approximately 25 kips and 2 kips per foot, respectively. Once actual loads are known that information should be provided to GeoTek to determine if modifications to the recommendations presented in this report are warranted.

Offsite proposed improvements consist of raising street grades along 60th Street, construction of retaining walls for the widening within the City of San Diego's Right of Way (ROW) improvements. Extension of existing utility service lines into the site.

As site planning progresses and additional or revised plans become available, they should be provided to GeoTek for review and comment. If plans vary significantly, additional geotechnical field exploration, laboratory testing and engineering analyses may be necessary to provide specific earthwork recommendations and geotechnical design parameters for actual site development plans.

3. FIELD EXPLORATION AND LABORATORY TESTING

3.1 FIELD EXPLORATION

GeoTek's field study, was conducted on September 19th and 20th, 2022 and consisted of a site reconnaissance and excavation of eleven exploratory test pits with a rubber tracked CAT 305.5E (mini) excavator. Test pits TP-1 through TP-11 were excavated to depths ranging between 5 and 10 feet below existing grade. Table 3.1 presents a summary of approximate depths relative design grades for each test pit location.

Table 3.1 Summary of Test Pit Depths Relative to Grading Conditions

Test Pit ID	Excavation Depth Below Existing Grade (Feet)	Location and Design Condition	Depth of Excavation Relative to Design Condition	Additional Comments
TP-1	8	Lot 46 Fill Lot	8	Excavated deeper than anticipated remedial grading
TP-2	5	Lot 80 Transition Lot	At cut pad grade	Practical Refusal of equipment
TP-3	8	Lot 33 Fill Lot	8	Excavated deeper than anticipated remedial grading
TP-4	10	Between Lot 62 and 77 Cut Slope	At Cut Pad Grade	Refusal due to maxim reach of equipment
TP-5	10	Lot 65 Transition Lot	At Cut Pad Grade	Refusal due to maxim reach of equipment
TP-6	10	Lot 25 Fill Lot	10	Excavated deeper than anticipated remedial grading
TP-7	10	Lot 17 Fill Lot	10	Excavated deeper than anticipated remedial grading
TP-8	10	Lot 8 Fill Lot	10	Excavated deeper than anticipated remedial grading
TP-9	7	Slope Below Lots 1 & 2 Fill Slope	7	Excavated deeper than anticipated remedial grading
TP-10	6	Lot 121 Fill Lot	6	Excavated deeper than anticipated remedial grading
TP-11	8	Lot 91 Fill Lot	8	Excavated deeper than anticipated remedial grading

A portable nuclear gauge densometer was utilized to obtain in-situ moisture and dry density values. Based on the data, the results indicate low densities are a result of air gap between the gauge and bottom (ie, the area was not flat, irregular from the excavator's bucket and excavation technique). In addition to the test pits, excavation of three auger borings, P-1 through P-3, where drilled to a depth of about three feet below grade for percolation testing. A representative from GeoTek visually logged the test pits, collected loose bulk soil samples for laboratory analysis, and transported the samples to GeoTek's laboratory. Percolation tests were performed the following day. Approximate locations of the exploratory test pits and percolation test holes are presented on the Geotechnical Map, Figure 2. A description of material encountered in the test pits is included in Appendix A.

3.2 PERCOLATION TESTING

Three percolation borings (Borings P-1 through P-3) were excavated to a depth of approximately 36 inches below the existing ground surface. The boring bottom and side walls were scarified and cleaned as feasible of potential drilling fines adhered to the boring walls. The test hole was then filled with potable water to pre-soak. Following overnight pre-soaking, the test holes were filled with water and the drop in water level was recorded every 30 minutes. The test was continued for a minimum of twelve readings and the final reading was used in the calculation of the infiltration rate. Infiltration analysis was performed based on the Porchet method. The rates presented below do not include a factor of safety, the BMP designer should include appropriate factors of safety in their design.

INFILTRATION TEST RESULTS			
Test No.	Approximate Boring Depth (Inches)	Infiltration Rate (Inches per hour)	Design Infiltration Rate with 3.5 Factor of Safety (Inches per hour)
P-1	36	0.14	0.04
P-2	36	0.78	0.22
P-3	36	0.00	0.00

Copies of the percolation data sheets and infiltration conversion sheets (Porchet Method) are included in Appendix B.

3.3 LABORATORY TESTING

Laboratory testing was performed on bulk soil samples collected during the field explorations. The purpose of the laboratory testing was to evaluate their physical and chemical properties for use in engineering design and analysis. Results of the laboratory testing program, along with a brief description and relevant information regarding testing procedures, are included in Appendix C.

4. GEOLOGIC AND SOILS CONDITIONS

4.1 REGIONAL SETTING

The subject property is located in the Peninsular Ranges geomorphic province. The Peninsular Ranges province is one of the largest geomorphic units in western North America. It extends roughly 975 miles from the north and northeasterly adjacent the Transverse Ranges geomorphic province to the peninsula of Baja California. This province varies in width from about 30 to 100 miles. It is bounded on the west by the Pacific Ocean, on the south by the Gulf of California and on the east by the Colorado Desert Province.

The Peninsular Ranges are essentially a series of northwest-southeast oriented fault blocks. Several major fault zones are found in this province. The Elsinore Fault zone and the San Jacinto Fault zones trend northwest-southeast and are found in the near the middle of the province. The San Andreas Fault zone borders the northeasterly margin of the province. The Newport-Inglewood-Rose Canyon Fault zone meanders the southwest margin of the province. No faults are shown in the immediate site vicinity on the map reviewed for the area.

4.2 EARTH MATERIALS

A brief description of the earth materials encountered during the current subsurface exploration is presented in the following sections. Based on the field observations and review of published geologic maps the subject site is locally underlain by a relatively thin layer of colluvium over Mission Valley Formation.

4.2.1 Hydrological Classification

The site is mapped as 85% Diablo, 10% Altamont, 3% Linne, and 2% Olivenhain (UCDavis, 1997). The hydrologic classification of the units are Group "D". The mapped hydrological unit is consistent with infiltration analysis performed on the site, with exception to location P-2, which is considered to be a local outlier and should not be relied upon.

4.2.2 Artificial Fill (Map Symbol Af)

Artificial fill was observed in local areas as erosional berms and earthen pads to facilitate building and facility equipment. Other area of fill such as the entry roadway should be anticipated, but are considered to be relatively shallow. Direct observation of the fill was not encountered in the subsurface explorations, but are considered to be derived from onsite material and consist of silty fine sands, loose, and potentially compressible.

4.2.3 Quaternary-age Colluvium (Map Symbol Qcol)

Quaternary alluvium was encountered all test pits and ranged in thickness between two to eight feet thick. The colluvium consisted of sandy clay, damp to very moist, medium stiff, with some cobbles.

4.2.4 Tertiary-age Misson Valley Formation (Map Symbol Tmv)

Tertiary-age Mission Valley Formation was encountered beneath the colluvium in all test pits, to the full depth of exploration. This material consisted of fine to medium sandstone, light tan brown to greyish white with orange oxidization in color, moist, and dense to very dense. Six of the test pits (TP-1, -2, -3, -9, -10, & -11) reached refusal before the maximum reach of the equipment.

4.3 SURFACE WATER AND GROUNDWATER

4.3.1 Surface Water

Surface water was not observed during the recent site exploration. If encountered during earthwork construction, surface water on this site will most likely be the result of precipitation. Overall site area drainage is in a southwestern direction. Provisions for surface drainage will need to be accounted for by the project civil engineer.

4.3.2 Groundwater

No groundwater was encountered during exploration of the subject site. Groundwater is anticipated to be greater than 50 feet below surface grades. Based on the anticipated depth of removals, groundwater is not anticipated to be a factor in site development. Localized perched groundwater may be present but is also not anticipated to be a factor in site development.

4.4 EARTHQUAKE HAZARDS

4.4.1 Surface Fault Rupture

Active Earthquake Faults

The geologic structure of the entire southern California area is dominated mainly by northwest-trending faults associated with the San Andreas system. The site is not in a seismically active region. No active fault is known to exist at this site nor is the site situated within an *"Alquist-Priolo"* Earthquake Fault Zone or a Special Studies Zone (Bryant and Hart, 2007). The nearest known active fault is the Newport Inglewood-Rose Canyon fault located about 4.5 miles to the west-southwest of the site.

Potentially Active, Inactive, Presumed Inactive, or Activity Unknown Earthquake Faults

The City of San Diego identifies potentially active, inactive, presumed inactive, or activity unknown earthquake faults as category 12 in their Seismic Safety Study for Geologic Hazards and Faults. The La Nacion Fault System is identified as a category 12 geologic feature. The La Nacion Fault System is characterized by a series of generally west dipping, en-echelon (stepping over in parallel), north-south trending, moderate to high angle normal faults that extend from the US-Mexico border northward through much of southeast San Diego. Based on the City of San Diego Seismic Safety Hazard Map, the Site resides within a step-over sequence of the La Nacion Fault (LNF). The LNF is approximately 380 feet to the east of the site and 1,250 feet to the west of the site. However, the regional geologic map prepared by Kennedy and Tan, 2008 presents the eastern strand of the LNF projected though the eastern portion of the site. During GeoTek's due diligence phase of work, a digital map with GPS ability was utilized to locate the eastern LNF strand, as mapped by Kennedy and Tan, 2008. A slight linear erosional feature was observed. Linear features are commonly associated with earthquake faults. Based on this observation, test pit TP-9 was advanced across this feature to identify if the erosional feature was associated with the LNF. An earthquake fault was not identified in TP-9 based on review and observations by the undersigned engineering geologist. Based on our analysis we conclude, that the La Nacion Fault, does not transect the site.

4.4.2 Liquefaction/Seismic Settlement

Liquefaction describes a phenomenon in which cyclic stresses, produced by earthquake-induced ground motion, create excess pore pressures in relatively cohesionless soils. These soils may thereby acquire a high degree of mobility, which can lead to lateral movement, sliding, consolidation and settlement of loose sediments, sand boils and other damaging deformations. This phenomenon occurs only below the water table, but, after liquefaction has developed, the effects can propagate upward into overlying non-saturated soil as excess pore water dissipates.

The factors known to influence liquefaction potential include soil type and grain size, relative density, groundwater level, confining pressures, and both intensity and duration of ground shaking. In general, materials that are susceptible to liquefaction are loose, saturated granular soils having low fines content under low confining pressures.

The liquefaction potential and seismic settlement potential on this site is considered negligible due to the apparent density of the underlying formation and lack of a shallow groundwater table.

4.4.3 Slope Stability

Proposed engineered fill and cut slopes with a maximum inclination of 2:1 (horizontal to vertical) are proposed to approximate heights of 90 and 17 feet, respectively. Two Global slope stability sections were evaluated that represent the most critical slopes:

Section AA':
Represents a proposed 35 foot tall engineered fill slope constructed at a 2:1 gradient, six feet from property line, followed by a 14 foot tall descending slope to an offsite rear yard.

Section CC':
Represents a proposed 90 foot tall engineered fill slope constructed at a 2:1 slope gradient.

Global slope stability was analyzed based on soil strength derived from laboratory analysis and engineering judgment. Results of the analysis indicate the proposed global slope stability of the proposed slopes are grossly stable. Surficial slope stability was performed by utilizing GeoTek, proprietary software and indicate the proposed fill slopes are surficially stable.

4.4.4 Other Seismic Hazards

The potential for landslides and rockfall is considered negligible. The potential for secondary seismic hazards such as seiche and tsunami is remote due to site elevation and distance from an open body of water.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 GENERAL

Provided the geotechnical recommendations presented in this report (and all supplemental, addendum, and revised recommendations) are followed the proposed development of the site appears feasible from a geotechnical viewpoint provided that the following recommendations are incorporated in the design and construction phases of the development.

Active, potentially active, inactive, presumed inactive, or activity unknown earthquake faults, do not transect the site, nor do offsite earthquake faults pose a geotechnical condition that precludes the development of the site. It should be noted that nearby active earthquake faulting will induce seismic shaking. However, provided that the recommendations presented in this report are followed this condition does not preclude the development and occupancy of the site.

The proposed improvements are designed to not adversely impact existing offsite improvements.

The following sections present general recommendations for currently anticipated site development plans.

5.2 EARTHWORK CONSIDERATIONS

5.2.1 General

Earthwork and grading should be performed in accordance with the applicable grading ordinances of the City of San Diego, the 2022 (or current) California Building Code (CBC), and recommendations contained in this report. The Grading Guidelines included in Appendix E outline general procedures and do not anticipate all site-specific situations. In the event of conflict, the recommendations presented in the text of this report should supersede those contained in Appendix E.

5.2.2 Site Clearing and Preparation

Site preparation should start with removal of deleterious materials, vegetations, trees/shrubs, and existing improvements in conflict with the proposed improvement areas. These materials should be disposed of properly off site. Any existing underground improvements, utilities and trench backfill should also be removed or be further evaluated as part of site development operations.

5.2.3 Remedial Grading

Prior to placement of fill materials and in all structural areas, the upper variable, potentially compressible materials should be removed. Removals should include at a minimum all colluvium and one to two feet of weathered Mission Valley Formation. Based on the explored locations, and average removal depth of five to seven feet from existing grades may be anticipated, but does not include stabilization fill keys. In general, areas of ridgelines and knolls should anticipate colluvial soils to be approximately two to three feet thick and areas of topographic lows should anticipate colluvial soils to be thicker than the average. The bottom of the removals should be observed by a GeoTek representative prior to processing the bottom for receiving placement of compacted fills. Depending on actual field conditions encountered during grading, locally deeper and/or shallower areas of removal may be necessary.

Prior to fill placement, the bottom of all removals should be scarified to a minimum depth of six inches, moisture conditioned to slightly above optimum moisture content, and then compacted to at least 90% of the soil's maximum dry density as determined by ASTM D1557 test procedures. The resultant voids from remedial grading/over-excavation should be filled with materials placed in general accordance with Section 5.2.5 Engineered Fill of this report.

5.2.4 Cut/Fill Transition Lots

Grading may result in a cut/fill transition at the proposed building pad finish grades. If a geologic contact of Mission Valley bedrock against engineered fills is encountered at finish pad grades, the cut portion should be over-excavated a minimum of three feet or one third the thickness of the engineered fill underlying the building footprint and replaced with engineered fill.

5.2.5 Engineered Fill

Onsite materials are generally considered suitable for reuse as engineered fill provided they are free from vegetation, roots, debris, and rock/concrete or hard lumps greater than six inches in maximum dimension. The earthwork contractor should have the proposed excavated materials to be used as engineered fill at this project approved by the soils engineer prior to placement.

Engineered fill materials should be moisture conditioned to at or above optimum moisture content and compacted in horizontal lifts not exceeding 8 inch in loose thickness to a minimum relative compaction of 90% as determined by ASTM D1557 test procedures.

If fill is being placed on slopes steeper than 5:1 (horizontal : vertical), the fill should be properly benched into the existing slopes and a sufficient size keyway shall be constructed in accordance with grading guidelines presented in Appendix E.

5.2.6 Slope Construction

An engineering geologist should observe all cut slopes. Cut slopes should expose competent bedrock. If adverse structure or unsuitable materials are exposed and identified in the cut slopes, stabilization fills may be recommended.

Where fill is to be placed against sloping ground with gradients of 5:1 (horizontal:vertical) or steeper, the sloping ground surface should be benched to provide horizontal surfaces for fill placement. A keyway should be constructed at the toe of the fill slope areas into dense natural material and in accordance with Plate G-3, Appendix E.

The base of the keyways and benches should be sloped back into the hillside at a gradient of at least two percent. The base of the benches should be evaluated by a representative of GeoTek prior to processing. Upon approval, the exposed materials should be moistened to at least the optimum moisture content and densified to a relative compaction of at least 90 percent (ASTM D1557). Details showing slope construction are presented in Appendix E.

Fill slopes should be overfilled during construction and then cut back to expose compacted soil. A suitable alternative would be to compact the slopes during construction and then roll the final slope to provide a dense, erosion resistant surface.

Back drains should be installed in the keyways in accordance with the recommendations outlined in Appendix E.

5.2.7 Excavation Characteristics

Excavations in the onsite materials can generally be accomplished with heavy-duty earthmoving (Caterpillar D9) or excavating equipment in good operating condition. The colluvium and upper zone of the Mission Valley Formation is anticipated to be rippable with conventional heavy earth moving equipment in good working order.

5.2.8 Shrinkage and Bulking

Several factors will impact earthwork balancing on the site, including undocumented fill shrinkage, trench spoil from utilities and footing excavations, as well as the accuracy of topography.

Shrinkage and bulking are largely dependent upon the degree of compactive effort achieved during construction. For planning purposes, a shrinkage factor of 5 percent may be considered for colluvial sources. For excavations in the sandstone, a bulking factor of 10 percent may be considered. Subsidence should not be a factor on the subject site due to the presence of bedrock if removals are completed as recommended.

5.2.9 Trench Excavations and Backfill

Temporary excavations within the onsite materials should be stable at 1:1 inclinations for short durations during construction, and where cuts do not exceed 10 feet in height. Temporary cuts to a maximum height of 4 feet can be excavated vertically.

Trench excavations should conform to Cal-OSHA regulations. The contractor should have a competent person, per OSHA requirements, on site during construction to observe conditions and to make the appropriate recommendations.

Utility trench backfill should be compacted to at least 90% relative compaction of the maximum dry density as determined by ASTM D1557 test procedures. Under-slab trenches should also be compacted to project specifications.

Onsite materials may not be suitable for use as bedding material but should be suitable as backfill provided particles larger than 6± inches are removed.

Compaction should be achieved with a mechanical compaction device. Ponding or jetting of trench backfill is not recommended. If backfill soils have dried out, they should be thoroughly moisture conditioned prior to placement in trenches.

5.3 DESIGN RECOMMENDATIONS

5.3.1 Stormwater Infiltration

Many factors control infiltration of surface waters into the subsurface, such as consistency of native soils and bedrock, geologic structure, fill consistency, material density differences, and existing groundwater conditions.

The hydrological unit as mapped by the USDA is a group "D". Percolation testing and infiltration analysis indicates that the site consistent as a hydrological group D.

Discussions were performed with the BMP design team, regarding proposed locations. No reasonable alternative design location is feasible, from the locations presented on Figure 2.

GeoTek does not recommend full or partial infiltration. Proposed basins are located on a existing slopes. In addition onsite soils expansive based on the California Building Code. We recommend filtration of stormwater in lieu of infiltration. City of San Diego, Storm Water Standards, Worksheets C.4-1: Form I-8A, I-8B, and I-9 are presented in Appendix B.

A 30 mil PVC liner should be constructed along the bottom and sides of the basin. Where seams between the liner meet, the manufacturer recommendations should be followed to provide a leak free seem.

Discharge of filtrated storm water is assumed to be transmitted via an underground conduit (RCP or HDPE or PVC) from a high-water riser and subdrains inside the basin to new and existing stormdrain conduits. Shading material consisting of gravel or sand are common materials recommended/designed for backfill around pipe zones. However, as shading material is a high permeable material and may provide a conduit and point of failure of the basin, shading material is not recommended to be constructed in the pipe zone within the basin. We recommend the pipe zone to be backfilled with a cement-sand slurry consisting of two 94 lb bags of Portland concrete cement per yard of sand slurry. The slurry for the discharge pipes should extend to the basin's high water mark of five feet outside the termination of the impermeable liner.

Placement of slurry mix should take into account the buoyant forces that may act on the conduit pipe. Slurry placement may need to be performed in multiple pours with set time allowed between pours.

The proposed impermeable liner along the fill berm/slope should be extended into the berm at an elevation up to the designed high-water mark. As an alternative, the liner may be extended one foot above the high water mark along the earthen berms. For inlet structures and outlet structures the liner should bonded to the structures to be leak free.

5.3.2 Foundation Design Criteria

Preliminary foundation design criteria, in general conformance with the 2022 CBC, are presented herein. These are typical design criteria and are not intended to supersede the design by the structural engineer. The preliminary recommendations are presented below.

Based on visual classification of materials encountered onsite and as verified by laboratory testing, site soils are anticipated to exhibit a "very low" (EI < 20) and "low" (21≤ EI ≤ 49) expansion index per ASTM D4829. Additional laboratory testing should be performed at the time of supplemental geotechnical evaluations and upon completion of site grading to verify the expansion potential and plasticity index of the subgrade soils. The following criteria for design of foundations are preliminary. Additional laboratory testing of the samples obtained during grading should be performed and final recommendations should be based on as-graded soil conditions.

DESIGN PARAMETERS FOR CONVENTIONALLY REINFORCED SHALLOW FOUNDATIONS		
DESIGN PARAMETER	DESIGN PARAMETERS FOR TYPICAL 2-STORY FOUNDATION	DESIGN PARAMETERS FOR TYPICAL 2-STORY FOUNDATION
Expansion Potential	"Very Low" Expansion Potential (EI ≤ 20)	"Low" Expansion Potential (21 ≤ EI ≤ 50)
Foundation Embedment Depth or Minimum Perimeter Beam Depth (inches below lowest adjacent finished grade)	18 - Inches	24 - Inches
Minimum Foundation Width for continuous / perimeter footings	15 - Inches	15 - Inches
Minimum Foundation Width for isolated / column footings*	24 – Inches (Square)	24 – Inches (Square)
Minimum Slab Thickness (actual)	4.0 inches	4.0 inches
Minimum Slab Reinforcing	6" x 6" – W.1.4/W1.4 welded wire fabric, or No. 3 rebar 18" on-center, each way, placed in the middle one-third of the slab thickness	No. 3 rebar 18" on-center, each way, placed in the middle one-third of the slab thickness
Minimum Footing Reinforcement	Two No. 4 reinforcing bars, one top and one bottom	Two No. 4 reinforcing bars, one top and one bottom
Pre-saturation of Subgrade Soil (percent of optimum moisture content)	Minimum 100% to a depth of 12 inches	Minimum 110% to a depth of 18 inches

It should be noted that the above recommendations are based on soil support characteristics only. The structural engineer should design the slab and beam reinforcement based on actual loading conditions.

The following recommendations should be implemented into the design:

- An allowable bearing capacity of 2,000 pounds per square foot (psf) may be considered for design of continuous and perimeter footings that meet the depth and width requirements in the table above. This value may be increased by 300 psf for each additional 12 inches in depth and 300 psf for each additional 12 inches in width to a maximum value of 3,000 psf. Additionally, an increase of one-third may be applied when considering short-term live loads (e.g., seismic and wind loads).

- Structural foundations may be designed in accordance with 2022 CBC, and to withstand a total settlement of 1 inch and maximum differential settlement of one-half of the total settlement over a horizontal distance of 40 feet. Seismically induced settlement is considered to be minimal.

- The passive earth pressure may preliminarily be computed as an equivalent fluid having a density of 350 psf per foot of depth, to a maximum earth pressure of 2,000 psf for footings founded on engineered fill. A coefficient of friction between soil and concrete of 0.30 may be used with dead load forces. When combining passive pressure and frictional resistance, the passive pressure component should be reduced by one-third.

- A grade beam should be utilized across large entrances. The beam should be a minimum of 12 inches wide and be at the same elevation as the bottom of the adjoining footings.

5.3.3 Under Slab Moisture Membrane

A moisture and vapor retarding system should be placed below slabs-on-grade where moisture migration through the slab is undesirable. Guidelines for these are provided in the 2022 California Green Building Standards Code (CALGreen) Section 4.505.2 and the 2019 CBC Section 1907.1

It should be realized that the effectiveness of the vapor retarding membrane can be adversely impacted as a result of construction related punctures (e.g., stake penetrations, tears, punctures from walking on the vapor retarder placed atop the underlying aggregate layer, etc.). These occurrences should be limited as much as possible during construction. Thicker membranes are generally more resistant to accidental puncture that thinner ones. Products specifically designed for use as moisture/vapor retarders may also be more puncture resistant. Although the CBC specifies a 6-mil vapor retarder membrane, it is GeoTek's opinion that a minimum 10 mil membrane with joints properly overlapped and sealed should be considered, unless otherwise specified by the slab design professional.

Moisture and vapor retarding systems are intended to provide a certain level of resistance to vapor and moisture transmission through the concrete, but do not eliminate it. The acceptable level of moisture transmission through the slab is to a large extent based on the type of flooring used and environmental conditions. Ultimately, the vapor retarding system should be comprised of suitable elements to limit migration of water and reduce transmission of water vapor through the slab to acceptable levels. The selected elements should have suitable properties (i.e., thickness, composition, strength, and permeability) to achieve the desired performance level.

Moisture retarders can reduce, but not eliminate, moisture vapor rise from the underlying soils up through the slab. Moisture retarder systems should be designed and constructed in accordance with applicable American Concrete Institute, Portland Cement Association, Post-Tensioning Concrete Institute, ASTM and California Building Code requirements and guidelines.

GeoTek does not practice in the field of moisture vapor transmission evaluation/migration since that practice is not a geotechnical discipline. Therefore, GeoTek recommends that a qualified person, such as the flooring contractor, structural engineer, architect, and/or other experts specializing in moisture control within the building be consulted to evaluate the general and specific moisture and vapor transmission paths and associated potential impact on the proposed construction. That person (or persons) should provide recommendations relative to the slab moisture and vapor retarder systems and for migration of potential adverse impact of moisture vapor transmission on various components of the structures, as deemed appropriate. In addition, the recommendations in this report and GeoTek's services in general are not intended to address mold prevention; since GeoTek, along with geotechnical consultants in general, do not practice in the area of mold prevention. If specific recommendations addressing potential mold issues are desired, then a professional mold prevention consultant should be contacted.

5.3.4 Miscellaneous Foundation Recommendations

- To reduce moisture penetration beneath the slab on grade areas, utility trenches should be backfilled with engineered fill, lean concrete, or concrete slurry where they intercept the perimeter footing or thickened slab edge.

- Spoils from the footing excavations should not be placed in the slab-on-grade areas unless properly moisture-conditioned, compacted and tested. The excavations should be free of loose/sloughed materials and be neatly trimmed at the time of concrete placement.

5.3.5 Foundation Setbacks

Where applicable, the following setbacks should apply to all foundations. Any improvements not conforming to these setbacks may be subject to lateral movements and/or differential settlements:

- The outside bottom edge of all footings should be set back a minimum of H/3 (where H is the slope height) from the face of any descending slope. The setback should be at least 7 feet and need not exceed 40 feet.

- The bottom of all footings for structures near retaining walls should be deepened so as to extend below a 1:1 projection upward from the bottom inside edge of the wall stem. This applies to the existing retaining walls along the perimeter if they are to remain.

- The bottom of any existing foundations for structures should be deepened to extend below a 1:1 projection upward from the bottom of the nearest excavation.

5.3.6 Seismic Design Parameters

The site is located at approximately 32.7214 degrees west latitude and -117.0708 degrees north longitude. Site spectral accelerations (Ss and S1), for 0.2 and 1.0 second periods for a risk targeted two (2) percent probability of exceedance in 50 years (MCER) were determined using the web interface provided by SEAOC/OSHPD (https://seismicmaps.org) to access the USGS Seismic Design Parameters. Due to the very apparent density of the underlying sandstone, a Site Class "C" is considered appropriate for this site. The results, based on ASCE 7-16 and the 2022 CBC, are presented in the following table:

SITE SEISMIC PARAMETERS	
Mapped 0.2 sec Period Spectral Acceleration, S_S	0.994g
Mapped 1.0 sec Period Spectral Acceleration, S_1	0.345g
Site Coefficient for Site Class "C", F_a	1.2
Site Coefficient for Site Class "C", F_v	1.5
Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration for 0.2 Second, S_{MS}	1.192g
Maximum Considered Earthquake (MCE_R) Spectral Response Acceleration for 1.0 Second, S_{M1}	0.518g
5% Damped Design Spectral Response Acceleration Parameter at 0.2 Second, S_{DS}	0.795g
5% Damped Design Spectral Response Acceleration Parameter at 1 second, S_{D1}	0.345g
Site Modified Peak Ground Acceleration (PGA_M)	0.527g
Seismic Design Category	D
Risk Category	II

5.3.7 Soil Sulfate Content and Corrosivity

A total of eight representative samples from various explorations and depths were delivered to our subconsultant, HDR, Inc, for corrosion testing and recommendations. A copy of the reported results and recommendations is presented in Appendix C.

The report on Page 3 references CalTrans minimum design criteria for mechanical stabilized earth (MSE) walls. A statement is made, based on corrosion test results and CalTran's design guidelines, that the onsite soils do not meet Caltrans requirements for MSE wall backfill and are not suitable for MSE wall backfill.

CalTrans MSE standard specifications and details for MSE walls are constructed with metal wire mesh. Therefore, it is reasonable to understand the basis for CalTran's criteria for MSE wall backfill. However, if MSE walls are designed for the project, the common materials of construction for MSE walls is anticipated to be concrete and plastic wire mesh (non-metallic). Provided the proposed MSE walls are not constructed of metals, on site soils are considered to be non-corrosive to MSE walls. The corrosion engineer from HDR was emailed, however a response has not been received.

5.3.8 Preliminary Pavement Design

Traffic indices have not been provided during this stage of site planning. In addition, site conditions have not been graded to a final design to evaluate specific pavement subgrade conditions. Therefore, the structural sections based on a variety of traffic indices and an assumed R-value of 25 are presented below.

PRELIMINARY ASPHALT PAVEMENT STRUCTURAL SECTION FOR ON-SITE STREETS				
Design Criteria	Traffic Index	R-Value	Asphaltic Concrete (AC) Thickness (inches)	Aggregate Base (AB) Thickness (inches)
Local Street	4	25	4.0	6.0
Local Street	5	25	5.0	8.0

As noted in the City of San Diego Standard Specifications, actual structural pavement design is to be determined by the geotechnical engineer's testing (R-Value) of the subgrade. Thus, the actual R-Value of the subgrade soils can only be determined at the completion of grading for street subgrades and the above values are subject to change based laboratory testing of the as-graded soils near subgrade elevations.

Asphalt concrete and aggregate base should conform to current Caltrans Standard Specifications Section 39 and 26-1.02, respectively. As an alternative, asphalt concrete can conform to Section 203-6 of the current Standard Specifications for Public Work (Green Book). Crushed aggregate base or crushed miscellaneous base can conform to Section 200-2.2 and 200-2.4 of the Green Book, respectively. Pavement base should be compacted to at least 95 percent of the ASTM D1557 laboratory maximum dry density as determined by ASTM D 1557 test procedures

All pavement installation, including preparation and compaction of subgrade, compaction of base material, placement and rolling of asphaltic concrete, should be done in accordance with the City of San Diego specifications, and under the observation and testing of GeoTek and a City Inspector where required. Jurisdictional minimum compaction requirements in excess of the aforementioned minimums may govern.

5.3.9 Portland Cement Concrete (PCC)

As an option, Portland Cement concrete (PCC) pavements could also be used at the site for the pavement areas. Based on the traffic loading provided, the following recommended minimum PCC pavement section is provided for these areas:

6 Inches Portland Cement Concrete (PCC) over
6 Inches Aggregate Base (AB) over
12-inches compacted subgrade to 95% per ASTM D 1557

For the PCC options, it is recommended concrete having a minimum 28-day flexural strength of 650 psi be used. A maximum joint spacing of 15 feet is also recommended.

5.4 RETAINING WALL DESIGN AND CONSTRUCTION

5.4.1 General Design Criteria

Preliminary grading plans are not yet available. If retaining walls are added at a later date, the recommendations presented herein may apply to typical masonry or concrete vertical retaining walls to a maximum height of 10 feet. The 2022 CBC only requires the additional earthquake induced lateral force be considered on retaining walls in excess of six feet in height. Therefore, additional review and recommendations should be requested for higher walls.

Retaining wall foundations embedded a minimum of 18 inches into engineered fill or dense formational materials should be designed using an allowable bearing capacity of 2,000 psf. This value may be increased by 300 psf for each additional 12 inches in depth and 300 psf for each additional 12 inches in width to a maximum value of 3,000 psf. An increase of one-third may be applied when considering short-term live loads (e.g., seismic and wind loads). The passive earth pressure may be computed as an equivalent fluid having a density of 350 psf per foot of depth, to a maximum earth pressure of 3,500 psf. A coefficient of friction between soil and concrete of 0.35d may be used with dead load forces. When combining passive pressure and frictional resistance, the passive pressure component should be reduced by one-third.

Cantilevered Retaining Walls

An equivalent fluid pressure approach may be used to compute the horizontal active pressure against the wall. The appropriate fluid unit weights are given in the table below for specific slope gradients of retained materials of non-expansive soils. Based on laboratory analysis, some on site soils are suitable for use of retaining wall backfill, however some selective grading may be desired to separate expansive from non-expansive soils.

Surface Slope of Retained Materials (H:V)	Equivalent Fluid Pressure (PCF) Select Backfill*
Level	40
2:1	65

*Select backfill should consist of approved materials with an EI≤20 and should be provided throughout the active zone.

The above equivalent fluid weights do not include other superimposed loading conditions such as expansive soil, vehicular traffic, structures, seismic conditions or adverse geologic conditions. For cantilevered retaining walls that have male or reentrant corners should be designed with supplemental recommendations as noted in section 5.4.2.

5.4.2 Restrained (At-Rest) Retaining Walls

Any retaining wall that will be restrained prior to placing backfill or walls that have male or reentrant corners should be designed for at-rest soil conditions using an equivalent fluid pressure of 65 pcf (select backfill), plus any applicable surcharge loading. For areas having male or reentrant corners, the restrained wall design should extend a minimum distance equal to twice the height of the wall laterally from the corner, or as otherwise determined by the structural engineer.

Restrained retaining walls may be designed for at-rest loading condition or the active and seismic loading condition combined. Typically, it appears the design of the restrained at-rest condition for retaining wall loading may be adequate for the seismic design of the retaining walls. However, the active earth pressure combined with the seismic design load should be reviewed and also considered in the design of the retaining walls.

5.4.3 Seismic Induced Incremental Design Parameters

Additional lateral forces can be induced on retaining walls during an earthquake. For level backfill and a Site Class "C", the minimum earthquake-induced force (F_{eq}) should be $13H^2$ (lbs/linear foot of wall) for cantilever walls and $25H^2$ for restrained Retaining Walls. This force can be assumed to act at a distance of 0.6H above the base of the wall, where "H" is the height of the retaining wall measured from the base of the footing (in feet). The 2022 CBC only requires the additional earthquake induced lateral force be considered on retaining walls in excess of six feet in height; however, the additional force may be applied in design of lesser walls at the discretion of the wall designer.

5.4.4 Wall Backfill and Drainage

Wall backfill should include a minimum one (1) foot wide section of ¾ to 1-inch clean crushed rock (or approved equivalent). The rock should be placed immediately adjacent to the back of wall and extend up from the backdrain to within approximately 12 inches of finish grade. The upper 12 inches should consist of compacted onsite materials. If the walls are designed using the "select" backfill design parameters, then the "select" materials shall be placed within the active zone as defined by a 1:1 (H:V) projection from the back of the retaining wall footing up to the retained surface behind the wall. Presence of other materials might necessitate revision to the parameters provided and modification of wall designs.

The backfill materials should be placed in lifts no greater than 8-inches in thickness and compacted to a minimum of 90% of the maximum dry density as determined in accordance with ASTM Test Method D 1557. Proper surface drainage needs to be provided and maintained. Water should not be allowed to pond behind retaining walls. Waterproofing of site walls should be performed where moisture migration through the wall is undesirable.

Retaining walls should be provided with an adequate pipe and gravel back drain system to reduce the potential for hydrostatic pressures to develop. A 4-inch diameter perforated collector pipe (Schedule 40 PVC, or approved equivalent) in a minimum of one (1) cubic foot per lineal foot of 3/8 to one (1) inch clean crushed rock or equivalent, wrapped in filter fabric should be placed near the bottom of the backfill and be directed (via a solid outlet pipe) to an appropriate disposal area.

As an alternative to the drain, rock and fabric, a pre-manufactured wall drainage product (example: Mira Drain 6000 or approved equivalent) may be used behind the retaining wall. The wall drainage product should extend from the base of the wall to within two (2) feet of the ground surface. The subdrain should be placed in direct contact with the wall drainage product.

Drain outlets should be maintained over the life of the project and should not be obstructed or plugged by adjacent improvements.

6. CONCRETE FLATWORK

6.1 GENERAL CONCRETE FLATWORK

6.1.1 Exterior Concrete Slabs and Sidewalks

Exterior concrete slabs, sidewalks and driveways should be designed using a four-inch minimum thickness supported on subgrade compacted to engineered fill recommendations (90% relative compaction). Some shrinkage and cracking of the concrete should be anticipated because of typical mix designs and curing practices typically utilized in construction.

Sidewalks and driveways may be under the jurisdiction of the governing agency. If so, jurisdictional design and construction criteria would apply, if more restrictive than the recommendations presented in this report.

Subgrade soils should be pre-moistened prior to placing concrete. The subgrade soils below exterior slabs, sidewalks, driveways, etc. should be pre-saturated to:

- For very low expansive soils, 100 percent of the optimum moisture content to a depth of 12 inches.

- For low expansive soils, 110 percent of the optimum moisture content to a depth of 12 inches.

All concrete installation, including preparation and compaction of subgrade, should be done in accordance with the City of San Diego specifications, and under the observation and testing of GeoTek, Inc. and a City inspector, if necessary.

6.1.2 Concrete Performance

Concrete cracks should be expected. These cracks can vary from sizes that are essentially unnoticeable to more than 1/8 inch in width. Most cracks in concrete, while unsightly, do not significantly impact long-term performance. While it is possible to take measures (proper concrete mix, placement, curing, control joints, etc.) to reduce the extent and size of cracks that occur, some cracking will occur despite the best efforts to minimize it. Concrete undergoes chemical processes that are dependent on a wide range of variables, which are difficult, at best, to control. Concrete, while seemingly a stable material, is subject to internal expansion and contraction due to external changes over time.

One of the simplest means to control cracking is to provide weakened control joints for cracking to occur along. These do not prevent cracks from developing; they simply provide a relief point for the stresses that develop. These joints are a widely accepted means to control cracks but are not always effective. Control joints are more effective the more closely spaced they are. GeoTek, Inc. suggests that control joints be placed in two directions and located a distance apart approximately equal to 24 to 36 times the slab thickness.

7. POST CONSTRUCTION CONSIDERATIONS

7.1 LANDSCAPE MAINTENANCE AND PLANTING

Water has been shown to weaken the inherent strength of soil, and slope stability is significantly reduced by overly wet conditions. Positive surface drainage away from graded slopes should be maintained and only the amount of irrigation necessary to sustain plant life should be provided for planted slopes. Controlling surface drainage and runoff and maintaining a suitable vegetation cover can minimize erosion. Plants selected for landscaping should be lightweight, deep-rooted types that require little water and are capable of surviving the prevailing climate.

Overwatering should be avoided. The soils should be maintained in a solid to semi-solid state as defined by the materials Atterberg Limits. Care should be taken when adding soil amendments to avoid excessive watering. Leaching as a method of soil preparation prior to planting is not recommended. An abatement program to control ground-burrowing rodents should be implemented and maintained. This is critical as burrowing rodents can decreased the long-term performance of slopes.

It is common for planting to be placed adjacent to structures in planter or lawn areas. This will result in the introduction of water into the ground adjacent to the foundation. This type of landscaping should be avoided. If used, then extreme care should be exercised with regard to the irrigation and drainage in these areas. Waterproofing of the foundation and/or subdrains may be warranted and advisable. GeoTek could discuss these issues, if desired, when plans are made available.

7.2 DRAINAGE

The need to maintain proper surface drainage and subsurface systems cannot be overly emphasized. Positive site drainage should be 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 or seep into the ground adjacent to the footings. Site drainage should conform to Section 1804.4 of the 2022 CBC. Roof gutters and downspouts should discharge onto paved surfaces sloping away from the structure or into a closed pipe system which outfalls to the street gutter pan or directly to the storm drain system. Pad drainage should be directed toward approved areas and not be blocked by other improvements.

7.3 PLAN REVIEW AND CONSTRUCTION OBSERVATIONS

GeoTek recommends that site grading, specifications, retaining wall/shoring plans and foundation plans be reviewed by this office prior to construction to check for conformance with the recommendations of this report. Additional recommendations may be necessary based on these reviews. It is also recommended that GeoTek representatives be present during site grading and foundation construction to check for proper implementation of the geotechnical recommendations. The owner/developer should have GeoTek's representative perform at least the following duties:

- Observe site clearing and grubbing operations for proper removal of unsuitable materials.
- Observe and bottom of removals prior to fill placement.
- Evaluate the suitability of on-site and import materials for fill placement and collect soil samples for laboratory testing when necessary.
- Observe the fill for uniformity during placement, including utility trenches.

- Observe and test the fill for field density and relative compaction.
- Observe and probe foundation excavations to confirm suitability of bearing materials.

If requested, a construction observation and compaction report can be provided by GeoTek, which can comply with the requirements of the governmental agencies having jurisdiction over the project. GeoTek recommends that these agencies be notified prior to commencement of construction so that necessary grading permits can be obtained.

8. LIMITATIONS

The scope of this evaluation is limited to the area explored that is shown on the Geotechnical Map (Figure 2). This evaluation does not and should in no way be construed to encompass any areas beyond the specific area of proposed construction as indicated to us by the client. The scope is based on GeoTek's understanding of the project and the client's needs, GeoTek's proposal (Proposal No. P-0100521-SDCO1) dated August 25th, 2022, and geotechnical engineering standards normally used on similar projects in this region.

The materials observed on the project site appear to be representative of the area; however, soil and bedrock materials vary in character between excavations and natural outcrops, or conditions exposed during site construction. Site conditions may vary due to seasonal changes or other factors. GeoTek, Inc. assumes no responsibility or liability for work, testing or recommendations performed or provided by others.

Since GeoTek's recommendations are based on the site conditions observed and encountered, and laboratory testing, GeoTek's conclusions and recommendations are professional opinions that are limited to the extent of the available data. Observations during construction are important to allow for any change in recommendations found to be warranted. These opinions have been derived in accordance with current standards of practice and no warranty is expressed or implied. Standards of practice are subject to change with time.

9. SELECTED REFERENCES

American Society of Civil Engineers (ASCE), 2016, "Minimum Design Loads for Buildings and Other Structures," ASCE/SEI 7-16.

Artim, E.R., and Pinckney, C.J., 1973, "La Nacion Fault System, San Diego, California," Geological Society of America Bulletin v. 84, p.1075-1080, 3 figs., March 1973

ASTM International (ASTM), "ASTM Volumes 4.08 and 4.09 Soil and Rock."

Bryant, W.A., and Hart, E.W., 2007, "Fault Rupture Hazard Zones in California, Alquist-Priolo Earthquake Fault Zoning Act with Index to Earthquake Fault Zones Maps," California Geological Survey: Special Publication 42.

California Code of Regulations, Title 24, 2019 "California Building Code," 2 volumes.

California Geological Survey (CGS, formerly referred to as the California Division of Mines and Geology), 1977, "Geologic Map of California."

_____, 1998, "Maps of Known Active Fault Near-Source Zones in California and Adjacent Portions of Nevada," International Conference of Building Officials.

Elliott, W.J., and Hart, M.W., 1977, "New evidence concerning age of movement of the La Nacion Fault, southwestern San Diego County, California," in Farrand, G.T., (ed.), Geology of southwestern San Diego County, California and northwestern Baja California: San Diego Association of Geologists, p. 53.

GeoTek, Inc., In-house proprietary information.

Hart, M.W., 1974, "Radiocarbon Ages of Alluvium Overlying La Nacion Fault, San Diego, California," Geological Society of America Bulletin, v. 85, p. 1329-1332, 5 figs, August 1974

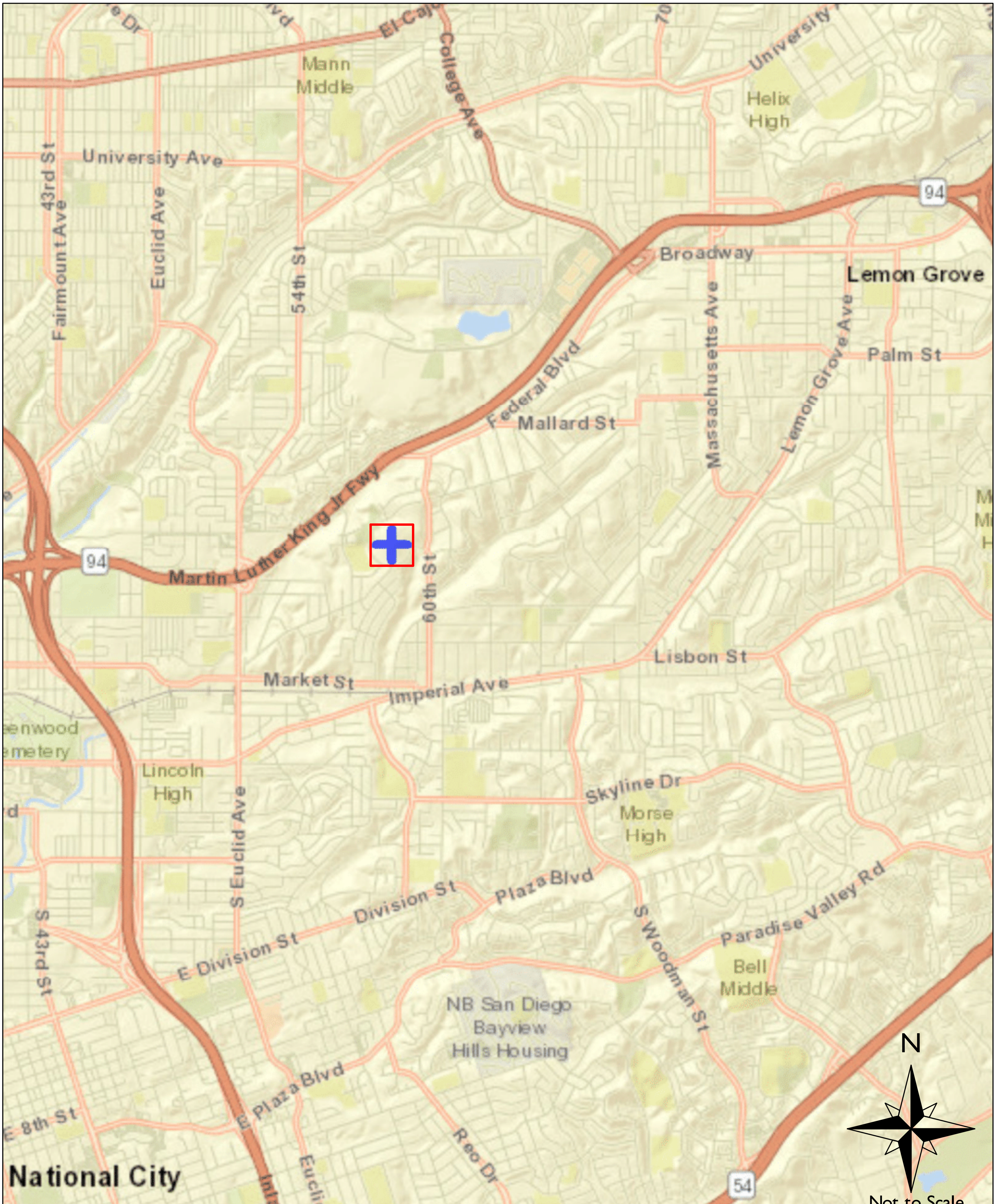
Hunsaker & Associates, Inc. 2023, Vesting Tentative Map, Grading and Drainage Plan, Emerald Hills, 16 sheets, W.O. 1375-0238, dated October 24, 2023.

Kennedy, M.P., and Tan, S.S., 2008, "Geologic Map of the Oceanside 30x60-minute Quadrangle, California," California Geological Survey, Regional Geologic Map No. 2, map scale 1:100,000.

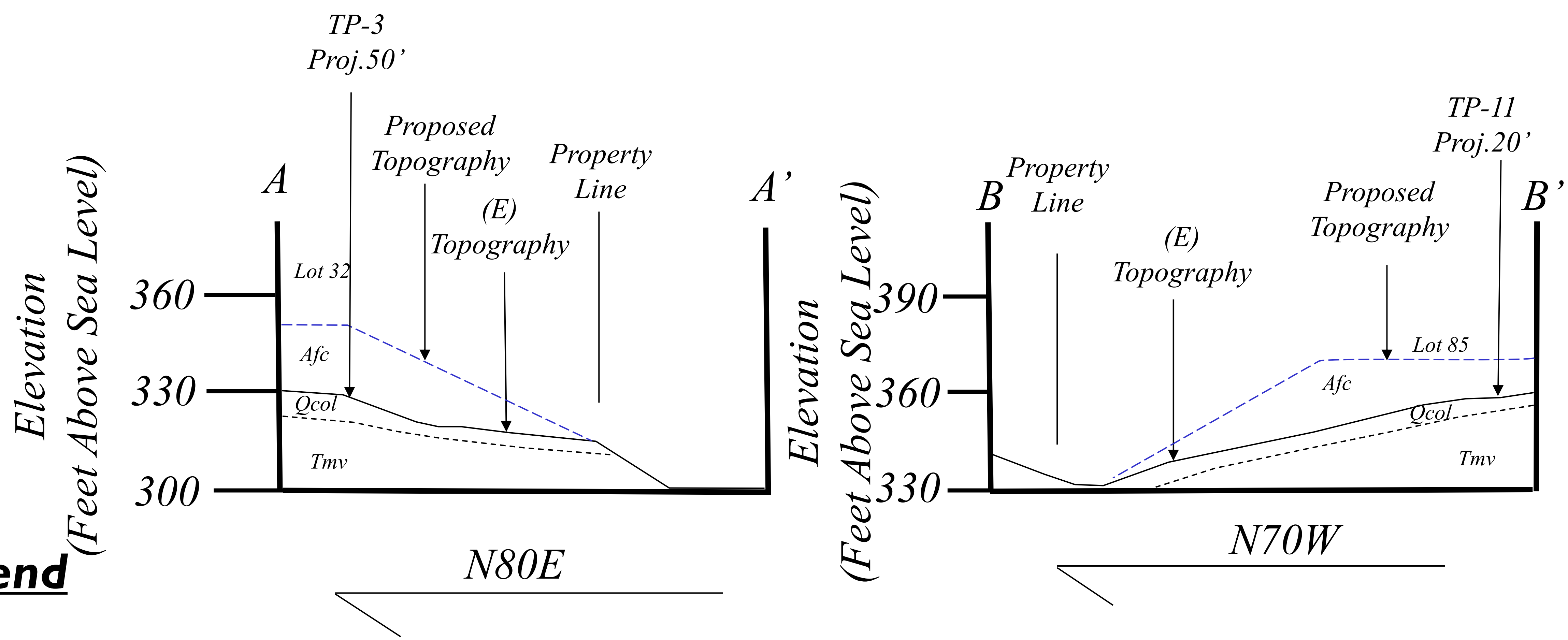
Structural Engineers Association of California/California Office of Statewide Health Planning and Development (SEOC/OSHPD), 2019, Seismic Design Maps web interface, https://seismicmaps.org

Terzaghi, K. and Peck, R., 1967, "Soil Mechanics in Engineering Practice", second edition.

University of California Davis, 1997, Soil Web Interactive Map, SoilWeb: An Online Soil Survey Browser | California Soil Resource Lab (ucdavis.edu)



D.R. Horton, Inc. Emerald Hills Project APN: 543-340-02 San Diego, Ca 92114	Figure 1 Site Location	GEOTEK 1384 Poinsettia Avenue, Suite A Vista, California 92081
PN: 3680-SD DATE: November 2023		



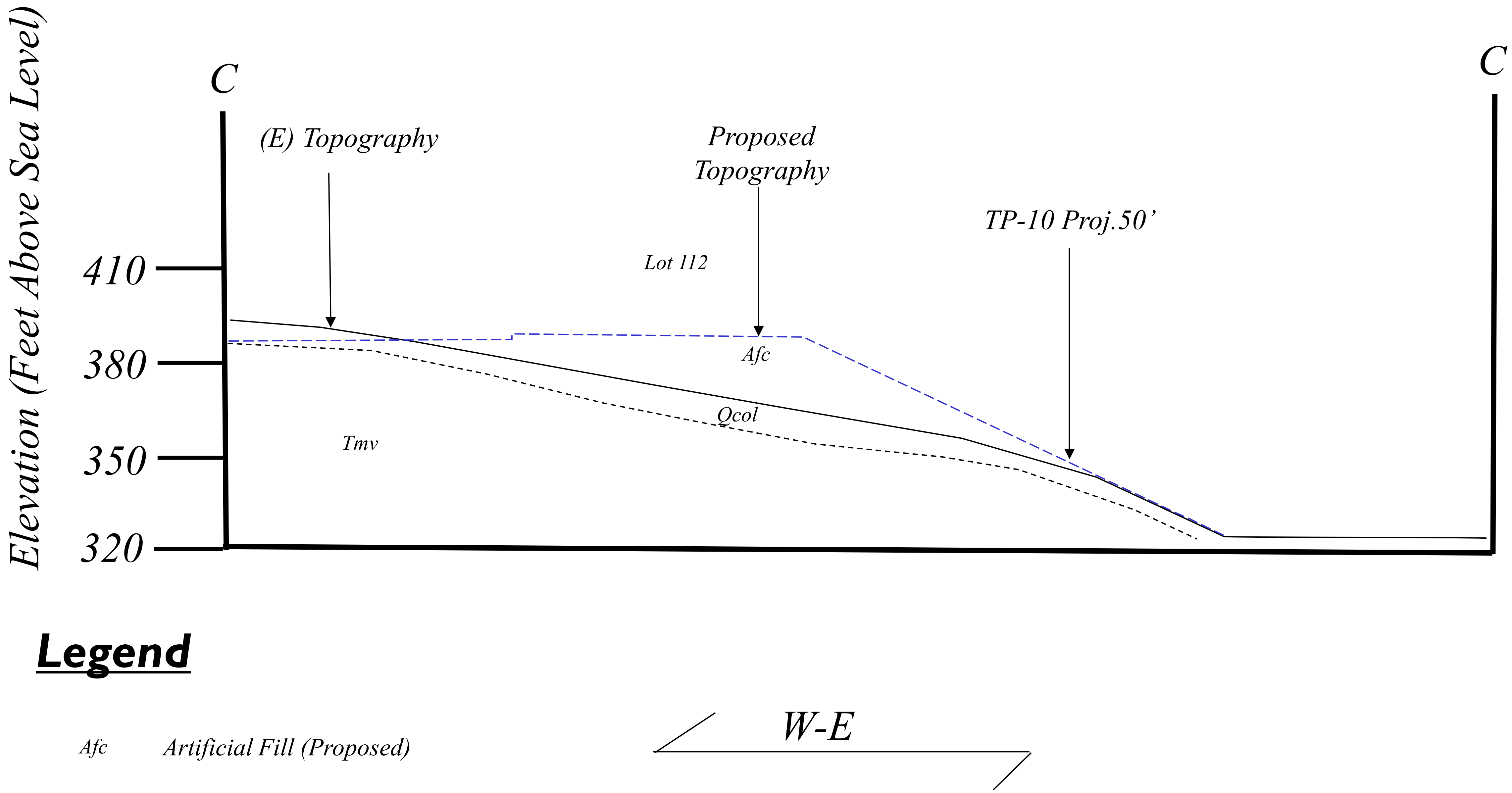
Legend

Afc	Artificial Fill (Proposed)
Qcol	Colluvium
Tmv	Mission Valley Formation
---------	Approximate Geologic Contact

GEOTEK

Cross Section A-A' & B-B' **Emerald Hills**

November 2023 PN: 3680-SD **Figure 2**



Legend

Afc	*Artificial Fill (Proposed)*
Qcol	*Colluvium*
Tmv	*Mission Valley Formation*
----------	*Approximate Geologic Contact*

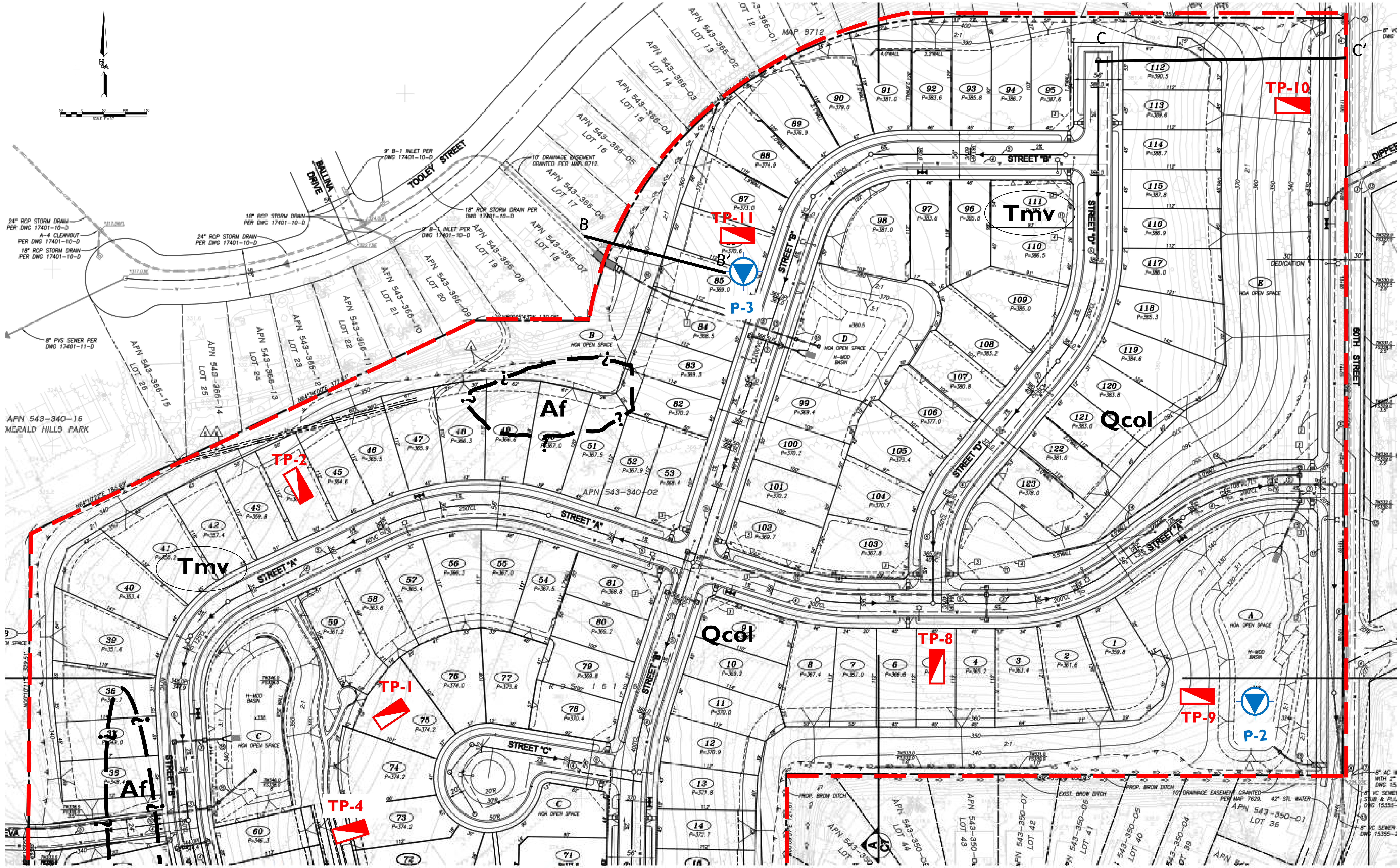
GEOTEK

Cross Section C-C’

Emerald Hills

November 2023 *PN: 3680-SD*

Figure 3



See Plate 2

Legend

Af	Artificial Fill
Qcol	Colluvium
Tmv	Mission Valley Formation (Circled where buried)
–?–	Approximate Geologic Contact (Dashed where inferred)
P-2	Approximate Location of Percolation Boring
TP-1	Approximate Location and Orientation of Test Pit
C —— C'	Geotechnical Cross Section

Figure Adapted from *Site Plan (2023)*, Hunsaker & Associates

DR Horton
Emerald Hills
San Diego, California

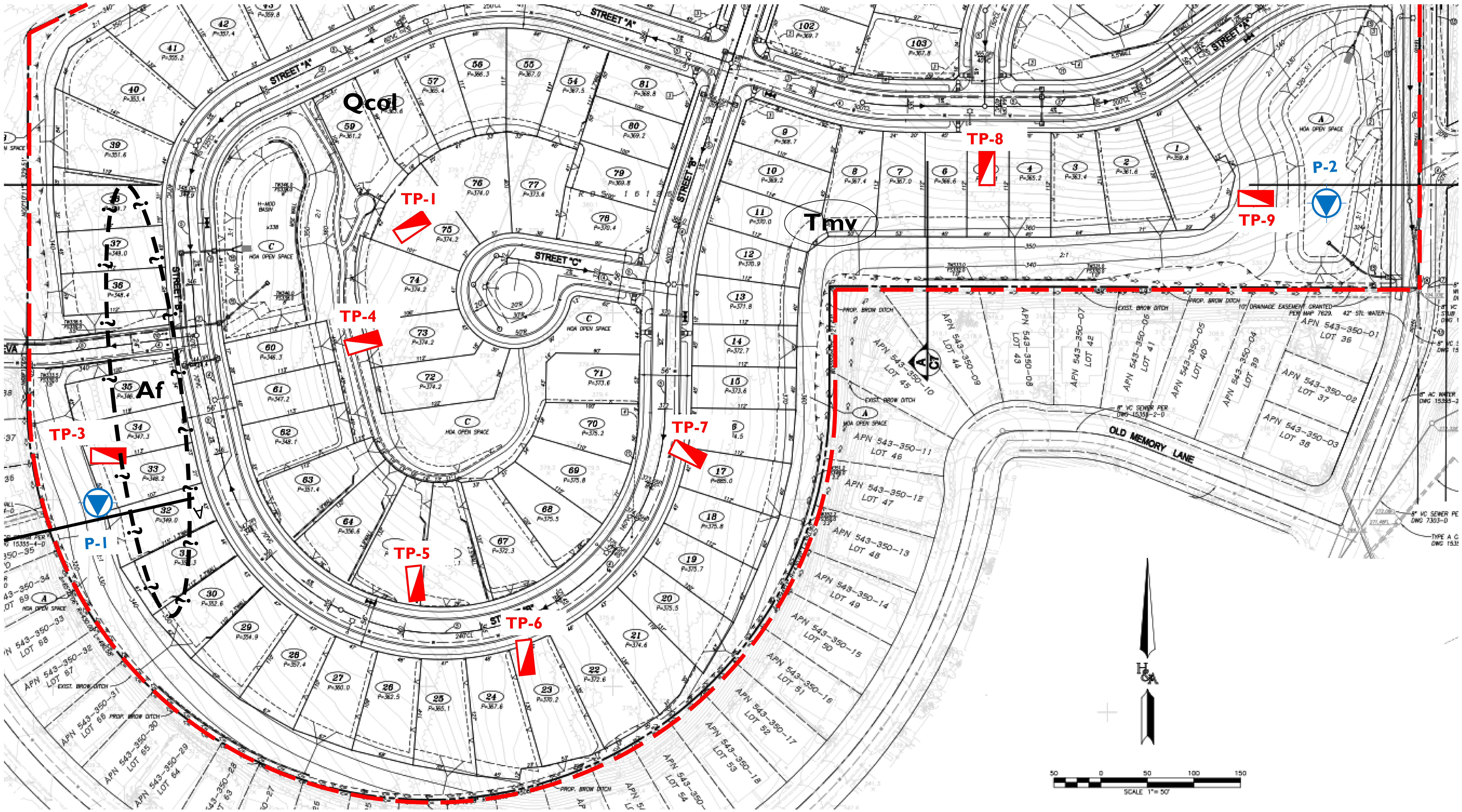
PN: 3680-SD | *November 2023*

Plate 1

Geotechnical Map

GEOTEK
1384 Poinsettia Avenue, Suite A
Vista, California 92081

See Plate 1



Legend

Af	Artificial Fill
Qcol	Colluvium
Tmv	Mission Valley Formation (Circled where buried)
─ ─ ?	Approximate Geologic Contact (Dashed where inferred)
P-2	Approximate Location of Percolation Boring
TP-1	Approximate Location and Orientation of Test Pit
C ─── C'	Geotechnical Cross Section

Figure Adapted from *Site Plan (2023)*, Hunsaker & Associates

DR Horton
Emerald Hills
San Diego, California

PN: 3680-SD | November 2023

Plate 2

Geotechnical Map

GEOTEK
1384 Poinsettia Avenue, Suite A
Vista, California 92081

APPENDIX A

LOGS OF EXPLORATION

A - FIELD TESTING AND SAMPLING PROCEDURES

Bulk Samples (Large)
These samples are normally large bags of earth materials over 20 pounds in weight collected from the field by means of hand digging or exploratory cuttings.

B – BORING/TRENCH LOG LEGEND

The following abbreviations and symbols often appear in the classification and description of soil and rock on the logs of borings/trenches:

SOILS

USCS	Unified Soil Classification System
f-c	Fine to coarse
f-m	Fine to medium

GEOLOGIC

B: Attitudes	Bedding: strike/dip
J: Attitudes	Joint: strike/dip
C: Contact line	
………..	Dashed line denotes USCS material change
———	Solid Line denotes unit / formational change
———	Thick solid line denotes end of boring/trench

(Additional denotations and symbols are provided on the log of borings/trenches)

GeoTek, Inc.

LOG OF EXPLORATORY TRENCH

CLIENT:	DR Horton	**DRILLER:**	Luna Construction	**LOGGED BY:**	CH
PROJECT NAME:	Emerald Hills	**DRILL METHOD:**	1.5' bucket	**OPERATOR:**	Sal
PROJECT NO.:	3680-SD	**HAMMER:**	-	**RIG TYPE:**	Mini-Excavator
LOCATION:	San Diego, CA	**ELEVATION:**	371 ft	**DATE:**	9/19/2022

TRENCH NO.: TP-1

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing:	Laboratory Testing: Others
	Large Bulk		BB-1		**Coluvvium (Qcol)** Sandy CLAY with silt, dark brown, dry to slightly moist with depth, medium stiff, probed 2 inches				
5					**Misson Valley Formation (Tmv)** Fine to medium SANDSTONE, gray brown, moist, medium to very dense with depth, slightly weathered, probed < 1 inch				
	Small Bulk		S-1		Practical refusal with bucket				
					HOLE TERMINATED AT 8 FEET				
10					Practical refusal at 8 feet No groundwater encountered Backfilled with soil cuttings				
15									
20									
25									
30									

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---Water Table

Lab testing:
AL = Atterberg Limits
EI = Expansion Index
SA = Sieve Analys
RV = R-Value Test
SR = Sulfate/Resisitivity Test
SH = Shear Test
CO = Consolidatic
MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY TRENCH

CLIENT:	DR Horton	**DRILLER:**	Luna Construction	**LOGGED BY:**	CH
PROJECT NAME:	Emerald Hills	**DRILL METHOD:**	1.5' bucket	**OPERATOR:**	Sal
PROJECT NO.:	3680-SD	**HAMMER:**	-	**RIG TYPE:**	Mini-Excavator
LOCATION:	San Diego, CA	**ELEVATION:**	370 ft	**DATE:**	9/19/2022

TRENCH NO.: TP-2

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)	Laboratory Testing:	Laboratory Testing: Others
					Quaternary Colluvium (Qcol) Sandy CLAY, dark brown, slightly moist, stiff, probed 1.5 inch, some cobbles				
					Misson Valley Formation (Tmv) SANDSTONE, white gray, moist, very dense, slightly weathered, probed < 1 inch				
5	Small Bulk		S-1		Bucket scrapes and practical refusal				
					HOLE TERMINATED AT 5 FEET Practical refusal at 5 feet No groundwater encountered Backfilled with soil cuttings				
10									
15									
20									
25									
30									

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---Water Table

Lab testing:
AL = Atterberg Limits
EI = Expansion Index
SA = Sieve Analys
RV = R-Value Test
SR = Sulfate/Resisitivity Test
SH = Shear Test
CO = Consolidatic
MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY TRENCH

CLIENT:	DR Horton	**DRILLER:**	Luna Construction	**LOGGED BY:**	CH
PROJECT NAME:	Emerald Hills	**DRILL METHOD:**	1.5' bucket	**OPERATOR:**	Sal
PROJECT NO.:	3680-SD	**HAMMER:**	-	**RIG TYPE:**	Mini-Excavator
LOCATION:	San Diego, CA	**ELEVATION:**	325 ft	**DATE:**	9/19/2022

TRENCH NO.: TP-3

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)		Others
					Quaternary Colluvium (Qcol)				
				CL	Sandy CLAY, dark brown, sligthly moist, stiff, probes 1.5 inches				
	Large Bulk		BB-1	SC	Clayey fine to medium SAND, light orange brown, moist to very moist, very dense				
5					Probes < 1 inch	23.2	95		
					Misson Valley Formation (Tmv)				
					SANDSTONE, white gray, leads to refusal				
					HOLE TERMINATED AT 8 FEET				
10					Practical refusal at 8 feet No groundwater encountered Backfilled with soil cuttings				
15									
20									
25									
30									

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---Water Table

Lab testing:
AL = Atterberg Limits
EI = Expansion Index
SA = Sieve Analys
RV = R-Value Test
SR = Sulfate/Resisitivity Test
SH = Shear Test
CO = Consolidatic
MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY TRENCH

CLIENT:	DR Horton	**DRILLER:**	Luna Construction	**LOGGED BY:**	CH
PROJECT NAME:	Emerald Hills	**DRILL METHOD:**	1.5' bucket	**OPERATOR:**	Sal
PROJECT NO.:	3680-SD	**HAMMER:**	-	**RIG TYPE:**	Mini-Excavator
LOCATION:	San Diego, CA	**ELEVATION:**	369 ft	**DATE:**	9/19/2022

TRENCH NO.: TP-4

Depth (ft)	SAMPLES: Sample Type	Blows/ 6 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)		Others
					Quaternary Colluvium (Qcol) Sandy CLAY, dark brown, dry, stiff Clayey fine to medium SAND with silt, light orange brown, slightly moist with white chunks of sand, probes 1.5 inches				
5					Sandy CLAY, dark brown, moist, medium stiff	15.2	98		
	Small Bulk		S-1		**Misson Valley Formation (Tmv)** SANDSTONE, white olive brown, slightly moist, very dense				
10					Mini-ex reaches max arm length, practical refusal				
					HOLE TERMINATED AT 10 FEET Practical refusal at 10 feet No groundwater encountered Backfilled with soil cuttings				
15									
20									
25									
30									

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---Water Table

Lab testing:
AL = Atterberg Limits EI = Expansion Index SA = Sieve Analys RV = R-Value Test
SR = Sulfate/Resisitivity Test SH = Shear Test CO = Consolidatic MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY TRENCH

CLIENT:	DR Horton	**DRILLER:**	Luna Construction	**LOGGED BY:**	CH
PROJECT NAME:	Emerald Hills	**DRILL METHOD:**	1.5' bucket	**OPERATOR:**	Sal
PROJECT NO.:	3680-SD	**HAMMER:**	-	**RIG TYPE:**	Mini-Excavator
LOCATION:	San Diego, CA	**ELEVATION:**	358 ft	**DATE:**	9/19/2022

TRENCH NO.: TP-5

Depth (ft)	SAMPLES: Sample Type	Blows/ 6 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)		Others
				CL	**Quaternary Colluvium (Qcol)** Sandy CLAY, dark brown, dry very stiff				
				SC	Clayey medium to coarse SAND, light brown, some white specks, very moist, medium dense				
5	Small Bulk		S-1		**Misson Valley Formation (Tmv)** SANDSTONE, white, very moist, very dense with depth, slightly weathered	20.3	93		
10					Practical refusal				
					HOLE TERMINATED AT 10 FEET Practical refusal at 10 feet No groundwater encountered Backfilled with soil cuttings				
15									
20									
25									
30									

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---Water Table

Lab testing:
AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analys; RV = R-Value Test
SR = Sulfate/Resisitivity Test; SH = Shear Test; CO = Consolidatic; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY TRENCH

CLIENT:	DR Horton	**DRILLER:**	Luna Construction	**LOGGED BY:**	CH
PROJECT NAME:	Emerald Hills	**DRILL METHOD:**	1.5' bucket	**OPERATOR:**	Sal
PROJECT NO.:	3680-SD	**HAMMER:**	-	**RIG TYPE:**	Mini-Excavator
LOCATION:	San Diego, CA	**ELEVATION:**	361 ft	**DATE:**	9/19/2022

TRENCH NO.: TP-6

Depth (ft)	SAMPLES: Sample Type	Blows/ 6 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)		Others
					Quaternary Colluvium (Qcol) Sandy CLAY, dark brown, moist, medium stiff				
					Misson Valley Formation (Tmv) Fine to medium SANDSTONE, white, light brown, very moist, very dense with depth, slightly weathered	20.2	98		
5									
10					Practical refusal				
					HOLE TERMINATED AT 10 FEET Practical refusal at 10 feet No groundwater encountered Backfilled with soil cuttings				
15									
20									
25									
30									

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---Water Table

Lab testing:
AL = Atterberg Limits | EI = Expansion Index | SA = Sieve Analys | RV = R-Value Test
SR = Sulfate/Resisitivity Test | SH = Shear Test | CO = Consolidatic | MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY TRENCH

CLIENT:	DR Horton	**DRILLER:**	Luna Construction	**LOGGED BY:**	CH
PROJECT NAME:	Emerald Hills	**DRILL METHOD:**	1.5' bucket	**OPERATOR:**	Sal
PROJECT NO.:	3680-SD	**HAMMER:**	-	**RIG TYPE:**	Mini-Excavator
LOCATION:	San Diego, CA	**ELEVATION:**	377 ft	**DATE:**	9/19/2022

TRENCH NO.: TP-7

Depth (ft)	SAMPLES: Sample Type	Blows/ 6 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)		Others
					Quaternary Colluvium (Qcol) Sandy CLAY, dark brown, moist, very stiff, probes < 1.5 inches				
5	Small Bulk		S-1		**Misson Valley Formation (Tmv)** SANDSTONE and some clays, reddish brown, very moist, very dense, probes < 1 inch, becomes more white at 5 feet				
10					Practical refusal				
					HOLE TERMINATED AT 10 FEET Practical refusal at 10 feet No groundwater encountered Backfilled with soil cuttings				
15									
20									
25									
30									

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---Water Table

Lab testing:
AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analys; RV = R-Value Test
SR = Sulfate/Resisitivity Test; SH = Shear Test; CO = Consolidatic; MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY TRENCH

CLIENT:	DR Horton	**DRILLER:**	Luna Construction	**LOGGED BY:**	CH
PROJECT NAME:	Emerald Hills	**DRILL METHOD:**	1.5' bucket	**OPERATOR:**	Sal
PROJECT NO.:	3680-SD	**HAMMER:**	-	**RIG TYPE:**	Mini-Excavator
LOCATION:	San Diego, CA	**ELEVATION:**	339 ft	**DATE:**	9/19/2022

TRENCH NO.: TP-8

Depth (ft)	SAMPLES: Sample Type	Blows/ 6 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)		Others
0–7	Large Bulk		BB-1		**Quaternary Colluvium (Qcol)** Sandy CLAY, dark brown, dry to moist with depth, medium stiff, probed < 2 inches				
7–10					**Misson Valley Formation (Tmv)** SANDSTONE, olive brown, slightly moist, very dense Practical refusal				
10					**HOLE TERMINATED AT 10 FEET** Practical refusal at 10 feet No groundwater encountered Backfilled with soil cuttings				

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---Water Table

Lab testing:
AL = Atterberg Limits | EI = Expansion Index | SA = Sieve Analys | RV = R-Value Test
SR = Sulfate/Resisitivity Test | SH = Shear Test | CO = Consolidatic | MD = Maximum Density

GeoTek, Inc.

LOG OF EXPLORATORY TRENCH

CLIENT:	DR Horton	**DRILLER:**	Luna Construction	**LOGGED BY:**	CH
PROJECT NAME:	Emerald Hills	**DRILL METHOD:**	1.5' bucket	**OPERATOR:**	Sal
PROJECT NO.:	3680-SD	**HAMMER:**	-	**RIG TYPE:**	Mini-Excavator
LOCATION:	San Diego, CA	**ELEVATION:**	348 ft	**DATE:**	9/19/2022

TRENCH NO.: TP-9

Depth (ft)	SAMPLES: Sample Type	SAMPLES: Blows/ 6 in	SAMPLES: Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Laboratory Testing: Dry Density (pcf)		Others
					Quaternary Colluvium (Qcol) CLAY with some sand, dry to moist, very stiff, probes < 1 inch				
					Misson Valley Formation (Tmv) SANDSTONE, white to tan, moist, very dense, slightly weathered	16.2	97.2		
5									
					Bucket scrapes, practical refusal				
					HOLE TERMINATED AT 7 FEET Practical refusal at 7 feet No groundwater encountered Backfilled with soil cuttings				
10									
15									
20									
25									
30									

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---Water Table

Lab testing:

AL = Atterberg Limits	EI = Expansion Index	SA = Sieve Analys	RV = R-Value Test
SR = Sulfate/Resisitivity Test	SH = Shear Test	CO = Consolidatic	MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY TRENCH

CLIENT:	DR Horton	**DRILLER:**	Luna Construction	**LOGGED BY:**	CH
PROJECT NAME:	Emerald Hills	**DRILL METHOD:**	1.5' bucket	**OPERATOR:**	Sal
PROJECT NO.:	3680-SD	**HAMMER:**	-	**RIG TYPE:**	Mini-Excavator
LOCATION:	San Diego, CA	**ELEVATION:**	359 ft	**DATE:**	9/19/2022

TRENCH NO.: TP-10

Depth (ft)	SAMPLES: Sample Type	Blows/ 6 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)		Others
					Quaternary Colluvium (Qcol) CLAY, dark brown, moist with depth, medium stiff				
5					**Misson Valley Formation (Tmv)** SANDSTONE, white to light tan brown, moist to very moist, very dense Practical refusal, bucket scrapes				
10					**HOLE TERMINATED AT 6 FEET** Practical refusal at 6 feet No groundwater encountered Backfilled with soil cuttings				
15									
20									
25									
30									

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---Water Table

Lab testing:
AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analys; RV = R-Value Test
SR = Sulfate/Resisitivity Test; SH = Shear Test; CO = Consolidatic; MD = Maximum Density

GeoTek, Inc.
LOG OF EXPLORATORY TRENCH

CLIENT:	DR Horton	**DRILLER:**	Luna Construction	**LOGGED BY:**	CH
PROJECT NAME:	Emerald Hills	**DRILL METHOD:**	1.5' bucket	**OPERATOR:**	Sal
PROJECT NO.:	3680-SD	**HAMMER:**	-	**RIG TYPE:**	Mini-Excavator
LOCATION:	San Diego, CA	**ELEVATION:**	347 ft	**DATE:**	9/19/2022

TRENCH NO.: TP-11

Depth (ft)	SAMPLES: Sample Type	Blows/ 6 in	Sample Number	USCS Symbol	MATERIAL DESCRIPTION AND COMMENTS	Laboratory Testing: Water Content (%)	Dry Density (pcf)		Others
					Quaternary Colluvium (Qcol) Sandy CLAY, dark brown, moist, stiff Clayey SAND, dark brown, moist to very moist, medium dense to very dense, probes < 2 inches				
5									
					Misson Valley Formation (Tmv) SANDSTONE, white to tan, moist, very dense Bucket scrapes, practical refusal				
					HOLE TERMINATED AT 8 FEET				
10					Practical refusal at 8 feet No groundwater encountered Backfilled with soil cuttings				
15									
20									
25									
30									

LEGEND

Sample type: ---Ring ---SPT ---Small Bulk ---Large Bulk ---Water Table

Lab testing: AL = Atterberg Limits; EI = Expansion Index; SA = Sieve Analys; RV = R-Value Test; SR = Sulfate/Resisitivity Test; SH = Shear Test; CO = Consolidatic; MD = Maximum Density

PERCOLATION DATA SHEET

Project: Emerald Hills **Job No.:** 3680-SD.

Test Hole No.: P-1 **Tested By:** CH, **Date:** 9/20/22.

Depth of Hole As Drilled: 36" **Before Test:** 36" **After Test:** 36".

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ In Water Level (Inches)		Comments
1	6:00	30	28	13	16	3		
2	6:30	30	28	13	14	1		
3	7:00	30	28	14	16	2		
4	7:30	30	28	14	16	2		
5	8:00	30	28	14	16	2		
6	8:30	30	28	15	16	1		
7	9:00	30	28	15	16	1		
8	9:30	30	28	15.25	16	0.75		
9	10:00	30	28	14.5	16	1.5		
10	10:30	30	28	14.25	16	1.75		
11	11:00	30	28	14.75	16	1.25		
12	11:30	30	28	15	16	1		

Client:	**D.R. Horton**
Project:	**Emerald Hills**
Project No:	**3680-SD**
Date:	**9/20/2022**

Boring No. **P-1**

Infiltration Rate (Porchet Method)

Time Interval, Δt =	30
Final Depth to Water, D_F =	16.00
Test Hole Radius, r =	3.00
Initial Depth to Water, D_O =	15
Total Test Hole Depth, D_T =	36

Equation - $I_t = \dfrac{\Delta H\,(60r)}{\Delta t\,(r+2H_{avg})}$

$H_O = D_T - D_O$ =	21.00
$H_F = D_T - D_F$ =	20.00
$\Delta H = \Delta D = H_O - H_F$ =	1.00
Havg = $(H_O+H_F)/2$ =	20.50

I_t = 0.14 **Inches per Hour**

GEOTEK

PERCOLATION DATA SHEET

Project: Emerald Hills **Job No.:** 3680-SD.

Test Hole No.: P-2 **Tested By:** CH, **Date:** 9/20/22.

Depth of Hole As Drilled: 36" **Before Test:** 36" **After Test:** 36".

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ In Water Level (Inches)		Comments
1	6:10	30	31	10	16	0		
2	6:40	30	31	10	16	6		
3	7:10	30	31	11	16.25	5.25		
4	7:40	30	31	11.25	16.25	5		
5	8:10	30	31	12	18	6		
6	8:40	30	31	12.25	18.5	6.25		
7	9:10	30	31	13	18.5	5.5		
8	9:40	30	31	13.75	19.25	5.5		
9	10:10	30	31	13.25	19	5.75		
10	10:40	30	31	14	19.5	5.5		
11	11:10	30	31	14.25	19.5	5.25		
12	11:40	30	31	14.75	20	5.25		

Client:	**D.R. Horton**
Project:	**Emerald Hills**
Project No:	**3680-SD**
Date:	**9/20/2022**

Boring No. **P-2**

Infiltration Rate (Porchet Method)

Time Interval, Δt =	30
Final Depth to Water, D_F =	20.00
Test Hole Radius, r =	3.00
Initial Depth to Water, D_O =	14.75
Total Test Hole Depth, D_T =	36

Equation - $$I_t = \frac{\Delta H\,(60r)}{\Delta t\,(r+2H_{avg})}$$

$H_O = D_T - D_O$ =	21.25
$H_F = D_T - D_F$ =	16.00
$\Delta H = \Delta D = H_O - H_F$ =	5.25
Havg = $(H_O+H_F)/2$ =	18.63

I_t = 0.78 **Inches per Hour**

GEOTEK

PERCOLATION DATA SHEET

Project: Emerald Hills **Job No.:** 3680-SD.

Test Hole No.: P-3 **Tested By:** CH, **Date:** 9/20/22.

Depth of Hole As Drilled: 36" **Before Test:** 36" **After Test:** 36".

Reading No.	Time	Time Interval (Min)	Total Depth of Hole (Inches)	Initial Water Level (Inches)	Final Water Level (Inches)	Δ In Water Level (Inches)		Comments
1	6:20	30	28	10	13	0		
2	6:50	30	28	10	13	3		
3	7:20	30	28	11	13	2		
4	7:50	30	28	11	13	2		
5	8:20	30	28	11.25	13	1.75		
6	8:50	30	28	12	13	1		
7	9:20	30	28	11.75	13	1.25		
8	9:50	30	28	12.25	13	0.75		
9	10:20	30	28	12	13	1		
10	10:50	30	28	13	13	0		
11	11:20	30	28	13	13	0		
12	11:50	30	28	13	13	0		

Client:	**D.R. Horton**
Project:	**Emerald Hills**
Project No:	**3680-SD**
Date:	**9/20/2022**

Boring No. **P-3**

Infiltration Rate (Porchet Method)

Time Interval, Δt =	30
Final Depth to Water, D_F =	13.00
Test Hole Radius, r =	3.00
Initial Depth to Water, D_O =	13
Total Test Hole Depth, D_T =	36

Equation - $I_t = \frac{\Delta H\ (60r)}{\Delta t\ (r+2H_{avg})}$

$H_O = D_T - D_O$ =	23.00
$H_F = D_T - D_F$ =	23.00
$\Delta H = \Delta D = H_O - H_F$ =	0.00
$H_{avg} = (H_O+H_F)/2$ =	23.00

I_t = 0.00 **Inches per Hour**

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APPENDIX B

INFILTRATION WORKSHEETS

GEOTEK

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions[1]		Worksheet C.4-1: Form I-8A[2]
Part 1 - Full Infiltration Feasibility Screening Criteria		
DMA(s) Being Analyzed:		**Project Phase:**
Lot "A" - Eastern Basin - Test Location P-2		Planning Phase
Criteria 1: Infiltration Rate Screening		
1A	Is the mapped hydrologic soil group according to the NRCS Web Soil Survey or UC Davis Soil Web Mapper Type A or B and corroborated by available site soil data[3]? ○ Yes; the DMA may feasibly support full infiltration. Answer "Yes" to Criteria 1 Result or continue to Step 1B if the applicant elects to perform infiltration testing. ○ No; the mapped soil types are A or B but is not corroborated by available site soil data (continue to Step 1B). ● No; the mapped soil types are C, D, or "urban/unclassified" and is corroborated by available site soil data. Answer "No" to Criteria 1 Result. ○ No; the mapped soil types are C, D, or "urban/unclassified" but is not corroborated by available site soil data (continue to Step 1B).	
1B	Is the reliable infiltration rate calculated using planning phase methods from Table D.3-1? ● Yes; Continue to Step 1C. ○ No; Skip to Step 1D.	
1C	Is the reliable infiltration rate calculated using planning phase methods from Table D.3-1 greater than 0.5 inches per hour? ○ Yes; the DMA may feasibly support full infiltration. Answer "Yes" to Criteria 1 Result. ● No; full infiltration is not required. Answer "No" to Criteria 1 Result.	
1D	**Infiltration Testing Method.** Is the selected infiltration testing method suitable during the design phase (see Appendix D.3)? Note: Alternative testing standards may be allowed with appropriate rationales and documentation. ● Yes; continue to Step 1E. ○ No; select an appropriate infiltration testing method.	

[1] Note that it is not required to investigate each and every criterion in the worksheet, a single "no" answer in Part 1, Part 2, Part 3, or Part 4 determines a full, partial, or no infiltration condition.

[2] This form must be completed each time there is a change to the site layout that would affect the infiltration feasibility condition. Previously completed forms shall be retained to document the evolution of the site storm water design.

[3] Available data includes site-specific sampling or observation of soil types or texture classes, such as obtained from borings or test pits necessary to support other design elements.

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]
1E	**Number of Percolation/Infiltration Tests.** Does the infiltration testing method performed satisfy the minimum number of tests specified in Table D.3-2? ● Yes; continue to Step 1F. ○ No; conduct appropriate number of tests.	
IF	**Factor of Safety.** Is the suitable Factor of Safety selected for full infiltration design? See guidance in D.5; Tables D.5-1 and D.5-2; and Worksheet D.5-1 (Form I-9). ● Yes; continue to Step 1G. ○ No; select appropriate factor of safety.	
1G	**Full Infiltration Feasibility.** Is the average measured infiltration rate divided by the Factor of Safety greater than 0.5 inches per hour? ○ Yes; answer "Yes" to Criteria 1 Result. ● No; answer "No" to Criteria 1 Result.	
Criteria 1 Result	Is the estimated reliable infiltration rate greater than 0.5 inches per hour within the DMA where runoff can reasonably be routed to a BMP? ○ Yes; the DMA may feasibly support full infiltration. Continue to Criteria 2. ● No; full infiltration is not required. Skip to Part 1 Result.	

Summarize infiltration testing methods, testing locations, replicates, and results and summarize estimates of reliable infiltration rates according to procedures outlined in D.5. Documentation should be included in project geotechnical report.

Small diameter bore hole testing and infiltration analysis by the Porchet method. The test was performed within the proposed basin location and resulted in an infiltration rate of 0.78 inches per hour, 0.22 inches per hour with the design factor of safety. See GeoTek's preliminary geotechnical report Proposed Emerald Hills Development, North of Old Memory lane, APN 543-340-02-00, San Diego, California"
PN 3680-SD, dated November 13, 2023

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
Criteria 2: Geologic/Geotechnical Screening			
2A	If all questions in Step 2A are answered "Yes," continue to Step 2B. For any "No" answer in Step 2A answer "No" to Criteria 2, and submit an "Infiltration Feasibility Condition Letter" that meets the requirements in Appendix C.1.1. The geologic/geotechnical analyses listed in Appendix C.2.1 do not apply to the DMA because one of the following setbacks cannot be avoided and therefore result in the DMA being in a no infiltration condition. The setbacks must be the closest horizontal radial distance from the surface edge (at the overflow elevation) of the BMP.		
2A-1	Can the proposed full infiltration BMP(s) avoid areas with existing fill materials greater than 5 feet thick below the infiltrating surface?	● Yes	○ No
2A-2	Can the proposed full infiltration BMP(s) avoid placement within 10 feet of existing underground utilities, structures, or retaining walls?	● Yes	○ No
2A-3	Can the proposed full infiltration BMP(s) avoid placement within 50 feet of a natural slope (>25%) or within a distance of 1.5H from fill slopes where H is the height of the fill slope?	○ Yes	● No
2B	When full infiltration is determined to be feasible, a geotechnical investigation report must be prepared that considers the relevant factors identified in Appendix C.2.1. If all questions in Step 2B are answered "Yes," then answer "Yes" to Criteria 2 Result. If there are "No" answers continue to Step 2C.		
2B-1	**Hydroconsolidation.** Analyze hydroconsolidation potential per approved ASTM standard due to a proposed full infiltration BMP. Can full infiltration BMPs be proposed within the DMA without increasing hydroconsolidation risks?	● Yes	○ No
2B-2	**Expansive Soils.** Identify expansive soils (soils with an expansion index greater than 20) and the extent of such soils due to proposed full infiltration BMPs. Can full infiltration BMPs be proposed within the DMA without increasing expansive soil risks?	○ Yes	● No

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
2B-3	**Liquefaction**. If applicable, identify mapped liquefaction areas. Evaluate liquefaction hazards in accordance with Section 6.4.2 of the City of San Diego's Guidelines for Geotechnical Reports (2011 or most recent edition). Liquefaction hazard assessment shall take into account any increase in groundwater elevation or groundwater mounding that could occur as a result of proposed infiltration or percolation facilities. Can full infiltration BMPs be proposed within the DMA without increasing liquefaction risks?	● Yes	○ No
2B-4	**Slope Stability**. If applicable, perform a slope stability analysis in accordance with the ASCE and Southern California Earthquake Center (2002) Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California to determine minimum slope setbacks for full infiltration BMPs. See the City of San Diego's Guidelines for Geotechnical Reports (2011) to determine which type of slope stability analysis is required. Can full infiltration BMPs be proposed within the DMA without increasing slope stability risks?	○ Yes	● No
2B-5	**Other Geotechnical Hazards.** Identify site-specific geotechnical hazards not already mentioned (refer to Appendix C.2.1). Can full infiltration BMPs be proposed within the DMA without increasing risk of geologic or geotechnical hazards not already mentioned?	● Yes	○ No
2B-6	**Setbacks.** Establish setbacks from underground utilities, structures, and/or retaining walls. Reference applicable ASTM or other recognized standard in the geotechnical report. Can full infiltration BMPs be proposed within the DMA using established setbacks from underground utilities, structures, and/or retaining walls?	○ Yes	● No

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions			Worksheet C.4-1: Form I-8A[2]
2C	**Mitigation Measures.** Propose mitigation measures for each geologic/geotechnical hazard identified in Step 2B. Provide a discussion of geologic/geotechnical hazards that would prevent full infiltration BMPs that cannot be reasonably mitigated in the geotechnical report. See Appendix C.2.1.8 for a list of typically reasonable and typically unreasonable mitigation measures. Can mitigation measures be proposed to allow for full infiltration BMPs? If the question in Step 2 is answered "Yes," then answer "Yes" to Criteria 2 Result. If the question in Step 2C is answered "No," then answer "No" to Criteria 2 Result.	○ Yes	● No
Criteria 2 Result	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geologic or geotechnical hazards that cannot be reasonably mitigated to an acceptable level?	○ Yes	● No

Summarize findings and basis; provide references to related reports or exhibits.

Small diameter bore hole testing and infiltration analysis by the Porchet method. The test was performed within the proposed basin location and resulted in an infiltration rate of 0.78 inches per hour, 0.22 inches per hour with a design factor of safety. See GeoTek's preliminary geotechnical report Proposed Emerald Hills Development, North of Old Memory lane, APN 543-340-02-00, San Diego, California"
PN 3680-SD, dated November 13, 2023

Part 1 Result – Full Infiltration Geotechnical Screening [4]	Result
If answers to both Criteria 1 and Criteria 2 are "Yes", a full infiltration design is potentially feasible based on Geotechnical conditions only. If either answer to Criteria 1 or Criteria 2 is "No", a full infiltration design is not required.	○ Full infiltration Condition ● Complete Part 2

[4] To be completed using gathered site information and best professional judgement considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by City Engineer to substantiate findings.

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Worksheet C.4-1: Form I-8A[2]
Part 2 – Partial vs. No Infiltration Feasibility Screening Criteria	
DMA(s) Being Analyzed:	Project Phase:
Lot "A" - Eastern Basin - Test Location P-2	Planning Phase
Criteria 3 : Infiltration Rate Screening	

3A	**NRCS Type C, D, or "urban/unclassified":** Is the mapped hydrologic soil group according to the NRCS Web Soil Survey or UC Davis Soil Web Mapper is Type C, D, or "urban/unclassified" and corroborated by available site soil data? ○ Yes; the site is mapped as C soils and a reliable infiltration rate of 0.15 in/hr. is used to size partial infiltration BMPS. Answer "Yes" to Criteria 3 Result. ● Yes; the site is mapped as D soils or "urban/unclassified" and a reliable infiltration rate of 0.05 in/hr. is used to size partial infiltration BMPS. Answer "Yes" to Criteria 3 Result. ○ No; infiltration testing is conducted (refer to Table D.3-1), continue to Step 3B.
3B	**Infiltration Testing Result:** Is the reliable infiltration rate (i.e. average measured infiltration rate/2) greater than 0.05 in/hr. and less than or equal to 0.5 in/hr? ● Yes; the site may support partial infiltration. Answer "Yes" to Criteria 3 Result. ○ No; the reliable infiltration rate (i.e. average measured rate/2) is less than 0.05 in/hr., partial infiltration is not required. Answer "No" to Criteria 3 Result.
Criteria 3 Result	Is the estimated reliable infiltration rate (i.e., average measured infiltration rate/2) greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour at any location within each DMA where runoff can reasonably be routed to a BMP? ● Yes; Continue to Criteria 4. ○ No: Skip to Part 2 Result.

Summarize infiltration testing and/or mapping results (i.e. soil maps and series description used for infiltration rate).

Small diameter bore hole testing and infiltration analysis by the Porchet method. The test was performed within the proposed basin location and resulted in an infiltration rate of 0.78 inches per hour, 0.22 with a design factor of safety. See GeoTek's preliminary geotechnical report Proposed Emerald Hills Development, North of Old Memory lane, APN 543-340-02-00, San Diego, California"
PN 3680-SD, dated October 13, 2022

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
Criteria 4: Geologic/Geotechnical Screening			
4A	If all questions in Step 4A are answered "Yes," continue to Step 2B. For any "No" answer in Step 4A answer "No" to Criteria 4 Result, and submit an "Infiltration Feasibility Condition Letter" that meets the requirements in Appendix C.1.1. The geologic/geotechnical analyses listed in Appendix C.2.1 do not apply to the DMA because one of the following setbacks cannot be avoided and therefore result in the DMA being in a no infiltration condition. The setbacks must be the closest horizontal radial distance from the surface edge (at the overflow elevation) of the BMP.		
4A-1	Can the proposed partial infiltration BMP(s) avoid areas with existing fill materials greater than 5 feet thick?	● Yes	○ No
4A-2	Can the proposed partial infiltration BMP(s) avoid placement within 10 feet of existing underground utilities, structures, or retaining walls?	● Yes	○ No
4A-3	Can the proposed partial infiltration BMP(s) avoid placement within 50 feet of a natural slope (>25%) or within a distance of 1.5H from fill slopes where H is the height of the fill slope?	○ Yes	● No
4B	When full infiltration is determined to be feasible, a geotechnical investigation report must be prepared that considers the relevant factors identified in Appendix C.2.1. If all questions in Step 4B are answered "Yes," then answer "Yes" to Criteria 4 Result. If there are any "No" answers continue to Step 4C.		
4B-1	**Hydroconsolidation.** Analyze hydroconsolidation potential per approved ASTM standard due to a proposed full infiltration BMP. Can partial infiltration BMPs be proposed within the DMA without increasing hydroconsolidation risks?	● Yes	○ No
4B-2	**Expansive Soils.** Identify expansive soils (soils with an expansion index greater than 20) and the extent of such soils due to proposed full infiltration BMPs. Can partial infiltration BMPs be proposed within the DMA without increasing expansive soil risks?	○ Yes	● No
4B-3	**Liquefaction**. If applicable, identify mapped liquefaction areas. Evaluate liquefaction hazards in accordance with Section 6.4.2 of the City of San Diego's Guidelines for Geotechnical Reports (2011). Liquefaction hazard assessment shall take into account any increase in groundwater elevation or groundwater mounding that could occur as a result of proposed infiltration or percolation facilities. Can partial infiltration BMPs be proposed within the DMA without increasing liquefaction risks?	● Yes	○ No

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
4B-4	**Slope Stability**. If applicable, perform a slope stability analysis in accordance with the ASCE and Southern California Earthquake Center (2002) Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California to determine minimum slope setbacks for full infiltration BMPs. See the City of San Diego's Guidelines for Geotechnical Reports (2011) to determine which type of slope stability analysis is required. Can partial infiltration BMPs be proposed within the DMA without increasing slope stability risks?	○ Yes	● No
4B-5	**Other Geotechnical Hazards.** Identify site-specific geotechnical hazards not already mentioned (refer to Appendix C.2.1). Can partial infiltration BMPs be proposed within the DMA without increasing risk of geologic or geotechnical hazards not already mentioned?	● Yes	○ No
4B-6	**Setbacks.** Establish setbacks from underground utilities, structures, and/or retaining walls. Reference applicable ASTM or other recognized standard in the geotechnical report. Can partial infiltration BMPs be proposed within the DMA using recommended setbacks from underground utilities, structures, and/or retaining walls?	○ Yes	● No
4C	**Mitigation Measures.** Propose mitigation measures for each geologic/geotechnical hazard identified in Step 4B. Provide a discussion on geologic/geotechnical hazards that would prevent partial infiltration BMPs that cannot be reasonably mitigated in the geotechnical report. See Appendix C.2.1.8 for a list of typically reasonable and typically unreasonable mitigation measures. Can mitigation measures be proposed to allow for partial infiltration BMPs? If the question in Step 4C is answered "Yes," then answer "Yes" to Criteria 4 Result. If the question in Step 4C is answered "No," then answer "No" to Criteria 4 Result.	○ Yes	● No
Criteria 4 Result	Can infiltration of greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour be allowed without increasing the risk of geologic or geotechnical hazards that cannot be reasonably mitigated to an acceptable level?	○ Yes	● No

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Worksheet C.4-1: Form I-8A[2]
Summarize findings and basis; provide references to related reports or exhibits. Small diameter bore hole testing and infiltration analysis by the Porchet method. The test was performed within the proposed basin location and resulted in an infiltration rate of 0.78 inches per hour, 0.22 inches per hour with a design factor of safety. See GeoTek's preliminary geotechnical report Proposed Emerald Hills Development, North of Old Memory lane, APN 543-340-02-00, San Diego, California" PN 3680-SD, dated November 13, 2023	

Part 2 – Partial Infiltration Geotechnical Screening Result[5]	Result
If answers to both Criteria 3 and Criteria 4 are "Yes", a partial infiltration design is potentially feasible based on geotechnical conditions only. If answers to either Criteria 3 or Criteria 4 is "No", then infiltration of any volume is considered to be infeasible within the site.	○ Partial Infiltration Condition ● No Infiltration Condition

[5] To be completed using gathered site information and best professional judgement considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by City Engineer to substantiate findings.

Lot "□" □ □a□t□rn □a□in □T□□t Location □□2

Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions		Worksheet C.4-2: Form I-8B[2]
Part 1 - Full Infiltration Feasibility Screening Criteria		
DMA(s) Being Analyzed:		**Project Phase:**
Lot "A" - Eastern Basin - Test Location P-2		Planning Phase
Criteria 1: Groundwater Screening		
1A	**Groundwater Depth.** Is the depth to seasonally high groundwater tables (normal high depth during the wet season) beneath the base of any full infiltration BMP greater than 10 feet? ● Yes; continue to Step 1B. ○ No; The depth to groundwater is less than or equal to 10 feet, but site layout changes or reasonable mitigation measures can be proposed to support full infiltration BMPs. Continue to step 1B. ○ No; The depth to groundwater is less than or equal to 10 feet and site layout changes or reasonable mitigation measures cannot be proposed to support full infiltration BMPs. Answer "No" for Criteria 1 Result.	
1B	**Contaminated Soil/Groundwater.** Are proposed full infiltration BMPs at least 250 feet away from contaminated soil or groundwater sites? This can be confirmed using GeoTracker (geotracker.waterboards.ca.gov) to identify open contaminated sites. The setbacks must be the closest horizontal radial distance from the surface edge (at the overflow elevation) of the BMP. ● Yes; continue to Step 1C. ○ No; However, site layout changes or reasonable mitigation measures can be proposed to support full infiltration BMPs. Continue to Step 1C. ○ No; Site layout changes or reasonable mitigation measures cannot be proposed to support full infiltration BMPs. Answer "No" to Criteria 1 Result.	

[1] Note that it is not required to investigate each and every criterion in the worksheet, a single "no" answer in Part 1, Part 2, part 3, or Part 4 determines a full, partial, or no infiltration condition.

[2] This form must be completed each time there is a change to the site layout that would affect the infiltration feasibility condition. Previously completed forms shall be retained to document the evolution of the site storm water design.

Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions	Worksheet C.4-2: Form I-8B[2]
1C	**Inadequate Soil Treatment Capacity.** Are full infiltration BMPs proposed in DMA soils that have adequate soil treatment capacity? The DMA has adequate soil treatment capacity if **ALL** of the following criteria (detailed in C.2.2.1) for all soil layers beneath the infiltrating surface are met: • USDA texture class is sandy loam or loam or silt loam or silt or sandy clay loam or clay loam or silty clay loam or sandy clay or silty clay or clay; and • Cation Exchange Capacity (CEC) greater than 5 milliequivalents/100g; and • Soil organic matter is greater than 1%; and • Groundwater table is equal to or greater than 10 feet beneath the base of the full infiltration BMP. ○ Yes; continue to Step 1D. ○ No; However, site layout changes or reasonable mitigation measures can be proposed to support full infiltration BMPs. Continue to Step 1D. ● No; Site layout changes or reasonable mitigation measures cannot be proposed to support full infiltration BMPs. Answer "No" to Criteria 1 Result.
1D	**Other Groundwater Contamination Hazards.** Are there site-specific groundwater contamination hazards not already mentioned (refer to Appendix C.2.2) that can be reasonably mitigated to support full infiltration BMPs? ○ Yes; there are other contamination hazards identified that can be mitigated. Answer "Yes" to Criteria 1 Result. ○ No; there are other contamination hazards identified that cannot be mitigated. Answer "No" to Criteria 1 Result. ● N/A; no contamination hazards are identified. Answer "Yes" to Criteria 1 Result.
Criteria 1 Result	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of groundwater contamination that cannot be reasonably mitigated to an acceptable level? See Appendix C.2.2.8 for a list of typically reasonable and typically unreasonable mitigation measures. ● Yes; Continue to Part 1, Criteria 2. ○ No; Continue to Part 1 Result.

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Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions	Worksheet C.4-2: Form I-8B[2]

Summarize groundwater quality and any mitigation measures proposed. Documentation should focus on groundwater table, mapped soil types and contaminated site locations.

Mapped soil is a hydrological type "D".
Small diameter bore hole testing and infiltration analysis by the Porchet method. The test was performed within the proposed basin location and resulted in an infiltration rate of 0.78 inches per hour, 0.22 with a design factor of safety. See GeoTek's preliminary geotechnical report Proposed Emerald Hills Development, North of Old Memory lane, APN 543-340-02-00, San Diego, California"
PN 3680-SD, dated November 13, 2023

Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions	Worksheet C.4-2: Form I-8B[2]
Criteria 2: Water Balance Screening	
2A	**Ephemeral Stream Setback.** Does the proposed full infiltration BMP meet both the following? • The full infiltration BMP is located at least 250 feet away from an ephemeral stream; **AND** • The bottom surface of the full infiltration BMP is at a depth 20 feet or greater from seasonally high groundwater tables. ● Yes; Answer "Yes" to Criteria 2 Result. ○ No; Continue to Step 2B.
2B	**Mitigation Measures.** Can site layout changes be proposed to support full infiltration BMPs? ○ Yes; the site can be reconfigured to mitigate potential water balance issues. Answer "Yes" to Criteria 2 Result. ● No; the site cannot be reconfigured to mitigate potential water balance issues. Continue to Step 2C and provide discussion.
2C	**Additional studies.** Do additional studies support full infiltration BMPs? In the event that water balance effects are used to reject full infiltration (anticipated to be rare), additional analysis shall be completed and documented by a qualified professional indicating the site-specific information evaluated and the technical basis for this finding. ○ Yes; Answer "Yes" to Criteria 2 Result. ● No; Answer "No" to Criteria 2 Result.
Criteria 2 Result	Can infiltration greater than 0.5 inches per hour be allowed without causing potential water balance issues such as change of seasonality of ephemeral streams? ● Yes; Continue to Part 1 Result. ○ No; Continue to Part 1 Result.

Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions	Worksheet C.4-2: Form I-8B[2]
Summarize potential water balance effects. Documentation should focus on mapping and soil data regarding proximity to ephemeral streams and groundwater depth.	
Part 1 – Full Infiltration Groundwater and Water Balance Screening Result[3]	**Result**
If answers to Criteria 1 and 2 are "Yes", a full infiltration design is potentially feasible. The feasibility screening category is Full Infiltration based on groundwater conditions. If answer to Criteria 1 or Criteria 2 is "No", infiltration may be possible to some extent but would not generally be feasible or desirable to achieve a "full infiltration" design based on groundwater conditions. Proceed to Part 2.	○ Full Infiltration ● Complete Part 2

[3] To be completed using gathered site information and best professional judgement considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by City Engineer to substantiate findings.

Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions	Worksheet C.4-2: Form I-8B[2]
Part 2 – Partial vs. No Infiltration Feasibility Screening Criteria	
DMA(s) Being Analyzed:	**Project Phase:**
Lot "A" - Eastern Basin - Test Location P-2	Planning Phase

Criteria 3: Groundwater Screening

Contaminated Soil/Groundwater. Are partial infiltration BMPs proposed at least 100 feet away from contaminated soil or groundwater sites? This can be confirmed using GeoTracker (geotracker.waterboards.ca.gov) to identify open contaminated sites. This criterion is intentionally a smaller radius than full infiltration, as the potential quantity of infiltration from partial infiltration BMPs is smaller.

● Yes; Answer "Yes" to Criteria 3 Result.

○ No; However, site layout changes can be proposed to avoid contaminated soils or soils that lack adequate treatment capacity. Select "Yes" to Criteria 3 Result. It is a requirement for the SWQMP preparer to identify potential mitigation measures.

○ No; Contaminated soils or soils that lack adequate treatment capacity cannot be avoided and partial infiltration BMPs are not feasible. Select "No" to Criteria 3 Result.

Criteria 3 Result: Can infiltration of greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour be allowed without increasing risk of groundwater contamination that cannot be reasonably mitigated to an acceptable level?

● Yes; Continue to Part 2, Criteria 4.

○ No; Skip to Part 2 Result.

Summarize findings and basis. Documentation should focus on mapped soil types and contaminated site locations.

Mapped soil is a hydrological type "D".
Small diameter bore hole testing and infiltration analysis by the Porchet method. The test was performed within the proposed basin location and resulted in an infiltration rate of 0.78 inches per hour, 0.22 inches per hour with a design factor of safety. See GeoTek's preliminary geotechnical report Proposed Emerald Hills Development, North of Old Memory lane, APN 543-340-02-00, San Diego, California"
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Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions	Worksheet C.4-2: Form I-8B[2]

Criteria 4: Water Balance Screening

Additional studies. In the event that water balance effects are used to reject partial infiltration (anticipated to be rare), a qualified professional must provide an analysis of the incremental effects of partial infiltration BMPs on the water balance compared to incidental infiltration under a no infiltration scenario (e.g. precipitation, irrigation, etc.).

Criteria 4 Result: Can infiltration of greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour be allowed without causing potential water balance issues such as change of seasonality of ephemeral streams?

- [x] Yes: Continue to Part 2 Result.
- [ ] No: Continue to Part 2 Result.

Summarize potential water balance effects. Documentation should focus on mapping and soil data regarding proximity to ephemeral streams and groundwater depth.

Part 2 – Partial Infiltration Groundwater and Water Balance Screening Result[4]	Result
If answers to Criteria 3 and Criteria 4 are "Yes", a partial infiltration design is potentially feasible. The feasibility screening category is Partial Infiltration based on groundwater and water balance conditions. If answer to Criteria 3 or Criteria 4 is "No", then infiltration of any volume is considered to be infeasible within the site. The feasibility screening category is No Infiltration based on groundwater or water balance condition.	[x] Partial Infiltration Condition [ ] No Infiltration Condition

[4] To be completed using gathered site information and best professional judgement considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by City Engineer to substantiate findings.

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Factor of Safety and Design Infiltration Rate Worksheet			Worksheet D.5-1: Form I-9		
Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = w x v
A	Suitability Assessment	Soil assessment methods	0.25	3	.75
		Predominant soil texture	0.25	3	.75
		Site soil variability	0.25	1	.25
		Depth to groundwater / impervious layer	0.25	1	.25
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			2
B	Design	Level of pretreatment/ expected sediment loads	0.5	1	0.5
		Redundancy/resiliency	0.25	2	0.5
		Compaction during construction	0.25	3	0.75
		Design Safety Factor, $S_B = \Sigma p$			1.75
Combined Safety Factor, $S_{total} = S_A \times S_B$ [Minimum of 2 and Maximum of 9]					3.5
Observed Infiltration Rate, inch/hr., $K_{observed}$ (corrected for test-specific bias) Note: This worksheet is only applicable when the observed infiltration rate is greater than or equal to 1 inch/hr.					0.78
Design Infiltration Rate, in/hr., $K_{design} = K_{observed} / S_{total}$ Note: If the estimated design infiltration rate is less than or equal to 0.5 inch/hr. then the applicant may choose to implement partial infiltration BMPs.					0.22
Supporting Data					
Briefly describe infiltration test and provide reference to test forms: Small diameter bore hole testing and infiltration analysis by the Porchet method. The test was performed within the proposed basin location and resulted in an infiltration rate of 0.78 inches per hour, 0.22 inches per hour with a design factor of safety. See GeoTek's preliminary geotechnical report Proposed Emerald Hills Development, North of Old Memory lane, APN 543-340-02-00, San Diego, California" PN 3680-SD, dated November 13, 2023					

Note: Worksheet D.5-1: Form I-9 is only applicable to design BMPs in "full infiltration condition". This form is not applicable for categorization of infiltration feasibility (Worksheet C.4-1: Form I-8) and/or for designing BMPs in "partial infiltration condition" or "no infiltration condition".

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Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions[1]	Worksheet C.4-1: Form I-8A[2]
Part 1 - Full Infiltration Feasibility Screening Criteria	
DMA(s) Being Analyzed:	**Project Phase:**
Lot "C" - Western Basin - Test Location P-1	Planning Phase
Criteria 1: Infiltration Rate Screening	

1A	Is the mapped hydrologic soil group according to the NRCS Web Soil Survey or UC Davis Soil Web Mapper Type A or B and corroborated by available site soil data[3]? ○ Yes; the DMA may feasibly support full infiltration. Answer "Yes" to Criteria 1 Result or continue to Step 1B if the applicant elects to perform infiltration testing. ○ No; the mapped soil types are A or B but is not corroborated by available site soil data (continue to Step 1B). ● No; the mapped soil types are C, D, or "urban/unclassified" and is corroborated by available site soil data. Answer "No" to Criteria 1 Result. ○ No; the mapped soil types are C, D, or "urban/unclassified" but is not corroborated by available site soil data (continue to Step 1B).
1B	Is the reliable infiltration rate calculated using planning phase methods from Table D.3-1? ● Yes; Continue to Step 1C. ○ No; Skip to Step 1D.
1C	Is the reliable infiltration rate calculated using planning phase methods from Table D.3-1 greater than 0.5 inches per hour? ○ Yes; the DMA may feasibly support full infiltration. Answer "Yes" to Criteria 1 Result. ● No; full infiltration is not required. Answer "No" to Criteria 1 Result.
1D	**Infiltration Testing Method.** Is the selected infiltration testing method suitable during the design phase (see Appendix D.3)? Note: Alternative testing standards may be allowed with appropriate rationales and documentation. ● Yes; continue to Step 1E. ○ No; select an appropriate infiltration testing method.

[1] Note that it is not required to investigate each and every criterion in the worksheet, a single "no" answer in Part 1, Part 2, Part 3, or Part 4 determines a full, partial, or no infiltration condition.

[2] This form must be completed each time there is a change to the site layout that would affect the infiltration feasibility condition. Previously completed forms shall be retained to document the evolution of the site storm water design.

[3] Available data includes site-specific sampling or observation of soil types or texture classes, such as obtained from borings or test pits necessary to support other design elements.

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Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Worksheet C.4-1: Form I-8A[2]
1E	**Number of Percolation/Infiltration Tests.** Does the infiltration testing method performed satisfy the minimum number of tests specified in Table D.3-2? ● Yes; continue to Step 1F. ○ No; conduct appropriate number of tests.
IF	**Factor of Safety.** Is the suitable Factor of Safety selected for full infiltration design? See guidance in D.5; Tables D.5-1 and D.5-2; and Worksheet D.5-1 (Form I-9). ● Yes; continue to Step 1G. ○ No; select appropriate factor of safety.
1G	**Full Infiltration Feasibility.** Is the average measured infiltration rate divided by the Factor of Safety greater than 0.5 inches per hour? ○ Yes; answer "Yes" to Criteria 1 Result. ● No; answer "No" to Criteria 1 Result.
Criteria 1 Result	Is the estimated reliable infiltration rate greater than 0.5 inches per hour within the DMA where runoff can reasonably be routed to a BMP? ○ Yes; the DMA may feasibly support full infiltration. Continue to Criteria 2. ● No; full infiltration is not required. Skip to Part 1 Result.

Summarize infiltration testing methods, testing locations, replicates, and results and summarize estimates of reliable infiltration rates according to procedures outlined in D.5. Documentation should be included in project geotechnical report.

Small diameter bore hole testing and infiltration analysis by the Porchet method. The test was performed within the proposed basin location and resulted in an infiltration rate of 0.14 inches per hour, 0.04 with a design factor of safety of 3.5.
See GeoTek's preliminary geotechnical report Proposed Emerald Hills Development, North of Old Memory lane, APN 543-340-02-00, San Diego, California" PN 3680-SD, dated November 13, 2023

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
Criteria 2: Geologic/Geotechnical Screening			
2A	If all questions in Step 2A are answered "Yes," continue to Step 2B. For any "No" answer in Step 2A answer "No" to Criteria 2, and submit an "Infiltration Feasibility Condition Letter" that meets the requirements in Appendix C.1.1. The geologic/geotechnical analyses listed in Appendix C.2.1 do not apply to the DMA because one of the following setbacks cannot be avoided and therefore result in the DMA being in a no infiltration condition. The setbacks must be the closest horizontal radial distance from the surface edge (at the overflow elevation) of the BMP.		
2A-1	Can the proposed full infiltration BMP(s) avoid areas with existing fill materials greater than 5 feet thick below the infiltrating surface?	● Yes	○ No
2A-2	Can the proposed full infiltration BMP(s) avoid placement within 10 feet of existing underground utilities, structures, or retaining walls?	● Yes	○ No
2A-3	Can the proposed full infiltration BMP(s) avoid placement within 50 feet of a natural slope (>25%) or within a distance of 1.5H from fill slopes where H is the height of the fill slope?	○ Yes	● No
2B	When full infiltration is determined to be feasible, a geotechnical investigation report must be prepared that considers the relevant factors identified in Appendix C.2.1. If all questions in Step 2B are answered "Yes," then answer "Yes" to Criteria 2 Result. If there are "No" answers continue to Step 2C.		
2B-1	**Hydroconsolidation.** Analyze hydroconsolidation potential per approved ASTM standard due to a proposed full infiltration BMP. Can full infiltration BMPs be proposed within the DMA without increasing hydroconsolidation risks?	○ Yes	● No
2B-2	**Expansive Soils.** Identify expansive soils (soils with an expansion index greater than 20) and the extent of such soils due to proposed full infiltration BMPs. Can full infiltration BMPs be proposed within the DMA without increasing expansive soil risks?	○ Yes	● No

Lot "C" □ □ □□t□rn □a□in □T□□t Location □□1

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
2B-3	**Liquefaction**. If applicable, identify mapped liquefaction areas. Evaluate liquefaction hazards in accordance with Section 6.4.2 of the City of San Diego's Guidelines for Geotechnical Reports (2011 or most recent edition). Liquefaction hazard assessment shall take into account any increase in groundwater elevation or groundwater mounding that could occur as a result of proposed infiltration or percolation facilities. Can full infiltration BMPs be proposed within the DMA without increasing liquefaction risks?	● Yes	○ No
2B-4	**Slope Stability**. If applicable, perform a slope stability analysis in accordance with the ASCE and Southern California Earthquake Center (2002) Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California to determine minimum slope setbacks for full infiltration BMPs. See the City of San Diego's Guidelines for Geotechnical Reports (2011) to determine which type of slope stability analysis is required. Can full infiltration BMPs be proposed within the DMA without increasing slope stability risks?	○ Yes	● No
2B-5	**Other Geotechnical Hazards.** Identify site-specific geotechnical hazards not already mentioned (refer to Appendix C.2.1). Can full infiltration BMPs be proposed within the DMA without increasing risk of geologic or geotechnical hazards not already mentioned?	● Yes	○ No
2B-6	**Setbacks.** Establish setbacks from underground utilities, structures, and/or retaining walls. Reference applicable ASTM or other recognized standard in the geotechnical report. Can full infiltration BMPs be proposed within the DMA using established setbacks from underground utilities, structures, and/or retaining walls?	○ Yes	● No

Lot "C" □ □ □□t□rn □a□in □T□□t Location □□1

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
2C	**Mitigation Measures.** Propose mitigation measures for each geologic/geotechnical hazard identified in Step 2B. Provide a discussion of geologic/geotechnical hazards that would prevent full infiltration BMPs that cannot be reasonably mitigated in the geotechnical report. See Appendix C.2.1.8 for a list of typically reasonable and typically unreasonable mitigation measures. Can mitigation measures be proposed to allow for full infiltration BMPs? If the question in Step 2 is answered "Yes," then answer "Yes" to Criteria 2 Result. If the question in Step 2C is answered "No," then answer "No" to Criteria 2 Result.	○ Yes	● No
Criteria 2 Result	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geologic or geotechnical hazards that cannot be reasonably mitigated to an acceptable level?	○ Yes	● No

Summarize findings and basis; provide references to related reports or exhibits.

Small diameter bore hole testing and infiltration analysis by the Porchet method. The test was performed within the proposed basin location and resulted in an infiltration rate of 0.14 inches per hour, 0.04 with a design factor of safety of 3.5.
See GeoTek's preliminary geotechnical report Proposed Emerald Hills Development, North of Old Memory lane, APN 543-340-02-00, San Diego, California"
PN 3680-SD, dated November 13, 2023

Part 1 Result – Full Infiltration Geotechnical Screening [4]	Result
If answers to both Criteria 1 and Criteria 2 are "Yes", a full infiltration design is potentially feasible based on Geotechnical conditions only. If either answer to Criteria 1 or Criteria 2 is "No", a full infiltration design is not required.	○ Full infiltration Condition ● Complete Part 2

[4] To be completed using gathered site information and best professional judgement considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by City Engineer to substantiate findings.

Lot "C" □ □ □□t□rn □a□in □T□□t Location □□1

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Worksheet C.4-1: Form I-8A[2]
Part 2 – Partial vs. No Infiltration Feasibility Screening Criteria	
DMA(s) Being Analyzed:	Project Phase:
Lot "C" - Western Basin - Test Location P-1	Planning Phase
Criteria 3 : Infiltration Rate Screening	

3A	**NRCS Type C, D, or "urban/unclassified":** Is the mapped hydrologic soil group according to the NRCS Web Soil Survey or UC Davis Soil Web Mapper is Type C, D, or "urban/unclassified" and corroborated by available site soil data? ○ Yes; the site is mapped as C soils and a reliable infiltration rate of 0.15 in/hr. is used to size partial infiltration BMPS. Answer "Yes" to Criteria 3 Result. ● Yes; the site is mapped as D soils or "urban/unclassified" and a reliable infiltration rate of 0.05 in/hr. is used to size partial infiltration BMPS. Answer "Yes" to Criteria 3 Result. ○ No; infiltration testing is conducted (refer to Table D.3-1), continue to Step 3B.
3B	**Infiltration Testing Result:** Is the reliable infiltration rate (i.e. average measured infiltration rate/2) greater than 0.05 in/hr. and less than or equal to 0.5 in/hr? ● Yes; the site may support partial infiltration. Answer "Yes" to Criteria 3 Result. ○ No; the reliable infiltration rate (i.e. average measured rate/2) is less than 0.05 in/hr., partial infiltration is not required. Answer "No" to Criteria 3 Result.
Criteria 3 Result	Is the estimated reliable infiltration rate (i.e., average measured infiltration rate/2) greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour at any location within each DMA where runoff can reasonably be routed to a BMP? ● Yes; Continue to Criteria 4. ○ No: Skip to Part 2 Result.

Summarize infiltration testing and/or mapping results (i.e. soil maps and series description used for infiltration rate).

Small diameter bore hole testing and infiltration analysis by the Porchet method. The test was performed within the proposed basin location and resulted in an infiltration rate of 0.14 inches per hour, 0.04 inches per hour with a design factor of safety of 3.5. See GeoTek's preliminary geotechnical report Proposed Emerald Hills Development, North of Old Memory lane, APN 543-340-02-00, San Diego, California"
PN 3680-SD, dated November 13, 2023

Lot "C" □ □ □□t□rn □a□in □T□□t Location □□1

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
Criteria 4: Geologic/Geotechnical Screening			
4A	If all questions in Step 4A are answered "Yes," continue to Step 2B. For any "No" answer in Step 4A answer "No" to Criteria 4 Result, and submit an "Infiltration Feasibility Condition Letter" that meets the requirements in Appendix C.1.1. The geologic/geotechnical analyses listed in Appendix C.2.1 do not apply to the DMA because one of the following setbacks cannot be avoided and therefore result in the DMA being in a no infiltration condition. The setbacks must be the closest horizontal radial distance from the surface edge (at the overflow elevation) of the BMP.		
4A-1	Can the proposed partial infiltration BMP(s) avoid areas with existing fill materials greater than 5 feet thick?	● Yes	○ No
4A-2	Can the proposed partial infiltration BMP(s) avoid placement within 10 feet of existing underground utilities, structures, or retaining walls?	● Yes	○ No
4A-3	Can the proposed partial infiltration BMP(s) avoid placement within 50 feet of a natural slope (>25%) or within a distance of 1.5H from fill slopes where H is the height of the fill slope?	○ Yes	● No
4B	When full infiltration is determined to be feasible, a geotechnical investigation report must be prepared that considers the relevant factors identified in Appendix C.2.1. If all questions in Step 4B are answered "Yes," then answer "Yes" to Criteria 4 Result. If there are any "No" answers continue to Step 4C.		
4B-1	**Hydroconsolidation.** Analyze hydroconsolidation potential per approved ASTM standard due to a proposed full infiltration BMP. Can partial infiltration BMPs be proposed within the DMA without increasing hydroconsolidation risks?	● Yes	○ No
4B-2	**Expansive Soils.** Identify expansive soils (soils with an expansion index greater than 20) and the extent of such soils due to proposed full infiltration BMPs. Can partial infiltration BMPs be proposed within the DMA without increasing expansive soil risks?	○ Yes	● No
4B-3	**Liquefaction**. If applicable, identify mapped liquefaction areas. Evaluate liquefaction hazards in accordance with Section 6.4.2 of the City of San Diego's Guidelines for Geotechnical Reports (2011). Liquefaction hazard assessment shall take into account any increase in groundwater elevation or groundwater mounding that could occur as a result of proposed infiltration or percolation facilities. Can partial infiltration BMPs be proposed within the DMA without increasing liquefaction risks?	● Yes	○ No

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
4B-4	**Slope Stability**. If applicable, perform a slope stability analysis in accordance with the ASCE and Southern California Earthquake Center (2002) Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California to determine minimum slope setbacks for full infiltration BMPs. See the City of San Diego's Guidelines for Geotechnical Reports (2011) to determine which type of slope stability analysis is required. Can partial infiltration BMPs be proposed within the DMA without increasing slope stability risks?	○ Yes	● No
4B-5	**Other Geotechnical Hazards.** Identify site-specific geotechnical hazards not already mentioned (refer to Appendix C.2.1). Can partial infiltration BMPs be proposed within the DMA without increasing risk of geologic or geotechnical hazards not already mentioned?	● Yes	○ No
4B-6	**Setbacks.** Establish setbacks from underground utilities, structures, and/or retaining walls. Reference applicable ASTM or other recognized standard in the geotechnical report. Can partial infiltration BMPs be proposed within the DMA using recommended setbacks from underground utilities, structures, and/or retaining walls?	○ Yes	● No
4C	**Mitigation Measures.** Propose mitigation measures for each geologic/geotechnical hazard identified in Step 4B. Provide a discussion on geologic/geotechnical hazards that would prevent partial infiltration BMPs that cannot be reasonably mitigated in the geotechnical report. See Appendix C.2.1.8 for a list of typically reasonable and typically unreasonable mitigation measures. Can mitigation measures be proposed to allow for partial infiltration BMPs? If the question in Step 4C is answered "Yes," then answer "Yes" to Criteria 4 Result. If the question in Step 4C is answered "No," then answer "No" to Criteria 4 Result.	○ Yes	● No
Criteria 4 Result	Can infiltration of greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour be allowed without increasing the risk of geologic or geotechnical hazards that cannot be reasonably mitigated to an acceptable level?	○ Yes	● No

Lot "C" □ □ □□t□rn □a□in □T□□t Location □□1

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Worksheet C.4-1: Form I-8A[2]

Summarize findings and basis; provide references to related reports or exhibits.

Small diameter bore hole testing and infiltration analysis by the Porchet method. The test was performed within the proposed basin location and resulted in an infiltration rate of 0.14 inches per hour, 0.04 with a design factor of safety of 3.5.
See GeoTek's preliminary geotechnical report Proposed Emerald Hills Development, North of Old Memory lane, APN 543-340-02-00, San Diego, California" PN 3680-SD, dated November 13, 2023

Part 2 – Partial Infiltration Geotechnical Screening Result[5]	Result
If answers to both Criteria 3 and Criteria 4 are "Yes", a partial infiltration design is potentially feasible based on geotechnical conditions only. If answers to either Criteria 3 or Criteria 4 is "No", then infiltration of any volume is considered to be infeasible within the site.	○ Partial Infiltration Condition ● No Infiltration Condition

[5] To be completed using gathered site information and best professional judgement considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by City Engineer to substantiate findings.

Lot "C" □ □ □□t□rn □a□in □T□□t Location □□1

Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions	Worksheet C.4-2: Form I-8B[2]
Part 1 - Full Infiltration Feasibility Screening Criteria	
DMA(s) Being Analyzed:	Project Phase:
Lot "C" - Western Basin - Test Location P-1	Planning Phase
Criteria 1: Groundwater Screening	
1A	**Groundwater Depth.** Is the depth to seasonally high groundwater tables (normal high depth during the wet season) beneath the base of any full infiltration BMP greater than 10 feet? ● Yes; continue to Step 1B. ○ No; The depth to groundwater is less than or equal to 10 feet, but site layout changes or reasonable mitigation measures can be proposed to support full infiltration BMPs. Continue to step 1B. ○ No; The depth to groundwater is less than or equal to 10 feet and site layout changes or reasonable mitigation measures cannot be proposed to support full infiltration BMPs. Answer "No" for Criteria 1 Result.
1B	**Contaminated Soil/Groundwater.** Are proposed full infiltration BMPs at least 250 feet away from contaminated soil or groundwater sites? This can be confirmed using GeoTracker (geotracker.waterboards.ca.gov) to identify open contaminated sites. The setbacks must be the closest horizontal radial distance from the surface edge (at the overflow elevation) of the BMP. ● Yes; continue to Step 1C. ○ No; However, site layout changes or reasonable mitigation measures can be proposed to support full infiltration BMPs. Continue to Step 1C. ○ No; Site layout changes or reasonable mitigation measures cannot be proposed to support full infiltration BMPs. Answer "No" to Criteria 1 Result.

[1] Note that it is not required to investigate each and every criterion in the worksheet, a single "no" answer in Part 1, Part 2, part 3, or Part 4 determines a full, partial, or no infiltration condition.

[2] This form must be completed each time there is a change to the site layout that would affect the infiltration feasibility condition. Previously completed forms shall be retained to document the evolution of the site storm water design.

Lot "C" □ □ □□t□rn □a□in □T□□t Location □□1

Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions	Worksheet C.4-2: Form I-8B[2]
1C	**Inadequate Soil Treatment Capacity.** Are full infiltration BMPs proposed in DMA soils that have adequate soil treatment capacity? The DMA has adequate soil treatment capacity if **ALL** of the following criteria (detailed in C.2.2.1) for all soil layers beneath the infiltrating surface are met: • USDA texture class is sandy loam or loam or silt loam or silt or sandy clay loam or clay loam or silty clay loam or sandy clay or silty clay or clay; and • Cation Exchange Capacity (CEC) greater than 5 milliequivalents/100g; and • Soil organic matter is greater than 1%; and • Groundwater table is equal to or greater than 10 feet beneath the base of the full infiltration BMP. ○ Yes; continue to Step 1D. ○ No; However, site layout changes or reasonable mitigation measures can be proposed to support full infiltration BMPs. Continue to Step 1D. ● No; Site layout changes or reasonable mitigation measures cannot be proposed to support full infiltration BMPs. Answer "No" to Criteria 1 Result.
1D	**Other Groundwater Contamination Hazards.** Are there site-specific groundwater contamination hazards not already mentioned (refer to Appendix C.2.2) that can be reasonably mitigated to support full infiltration BMPs? ○ Yes; there are other contamination hazards identified that can be mitigated. Answer "Yes" to Criteria 1 Result. ○ No; there are other contamination hazards identified that cannot be mitigated. Answer "No" to Criteria 1 Result. ● N/A; no contamination hazards are identified. Answer "Yes" to Criteria 1 Result.
Criteria 1 Result	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of groundwater contamination that cannot be reasonably mitigated to an acceptable level? See Appendix C.2.2.8 for a list of typically reasonable and typically unreasonable mitigation measures. ○ Yes; Continue to Part 1, Criteria 2. ● No; Continue to Part 1 Result.

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Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions	Worksheet C.4-2: Form I-8B[2]

Summarize groundwater quality and any mitigation measures proposed. Documentation should focus on groundwater table, mapped soil types and contaminated site locations.

Mapped soil is a hydrological type "D".
Small diameter bore hole testing and infiltration analysis by the Porchet method. The test was performed within the proposed basin location and resulted in an infiltration rate of 0.14 inches per hour, 0.04 with a design factor of safety of 3.5.
See GeoTek's preliminary geotechnical report Proposed Emerald Hills Development, North of Old Memory lane, APN 543-340-02-00, San Diego, California" PN 3680-SD, dated November 13, 2023

Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions	Worksheet C.4-2: Form I-8B[2]
Criteria 2: Water Balance Screening	
2A	**Ephemeral Stream Setback.** Does the proposed full infiltration BMP meet both the following? • The full infiltration BMP is located at least 250 feet away from an ephemeral stream; **AND** • The bottom surface of the full infiltration BMP is at a depth 20 feet or greater from seasonally high groundwater tables. ● Yes; Answer “Yes” to Criteria 2 Result. ○ No; Continue to Step 2B.
2B	**Mitigation Measures.** Can site layout changes be proposed to support full infiltration BMPs? ○ Yes; the site can be reconfigured to mitigate potential water balance issues. Answer “Yes” to Criteria 2 Result. ● No; the site cannot be reconfigured to mitigate potential water balance issues. Continue to Step 2C and provide discussion.
2C	**Additional studies.** Do additional studies support full infiltration BMPs? In the event that water balance effects are used to reject full infiltration (anticipated to be rare), additional analysis shall be completed and documented by a qualified professional indicating the site-specific information evaluated and the technical basis for this finding. ○ Yes; Answer “Yes” to Criteria 2 Result. ● No; Answer “No” to Criteria 2 Result.
Criteria 2 Result	Can infiltration greater than 0.5 inches per hour be allowed without causing potential water balance issues such as change of seasonality of ephemeral streams? ○ Yes; Continue to Part 1 Result. ● No; Continue to Part 1 Result.

Lot "C" □ □ □□t□rn □a□in □T□□t Location □□1

Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions	Worksheet C.4-2: Form I-8B[2]
Summarize potential water balance effects. Documentation should focus on mapping and soil data regarding proximity to ephemeral streams and groundwater depth. Small diameter bore hole testing and infiltration analysis by the Porchet method. The test was performed within the proposed basin location and resulted in an infiltration rate of 0.14 inches per hour, 0.04 with a design factor of safety of 3.5. See GeoTek's preliminary geotechnical report Proposed Emerald Hills Development, North of Old Memory lane, APN 543-340-02-00, San Diego, California" PN 3680-SD, dated November 13, 2023	

Part 1 – Full Infiltration Groundwater and Water Balance Screening Result[3]	Result
If answers to Criteria 1 and 2 are "Yes", a full infiltration design is potentially feasible. The feasibility screening category is Full Infiltration based on groundwater conditions. If answer to Criteria 1 or Criteria 2 is "No", infiltration may be possible to some extent but would not generally be feasible or desirable to achieve a "full infiltration" design based on groundwater conditions. Proceed to Part 2.	○ Full Infiltration ● Complete Part 2

[3] To be completed using gathered site information and best professional judgement considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by City Engineer to substantiate findings.

Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions	Worksheet C.4-2: Form I-8B[2]
Part 2 – Partial vs. No Infiltration Feasibility Screening Criteria	
DMA(s) Being Analyzed:	Project Phase:
Lot "C" - Western Basin - Test Location P-1	Planning Phase
Criteria 3: Groundwater Screening	

Contaminated Soil/Groundwater. Are partial infiltration BMPs proposed at least 100 feet away from contaminated soil or groundwater sites? This can be confirmed using GeoTracker (geotracker.waterboards.ca.gov) to identify open contaminated sites. This criterion is intentionally a smaller radius than full infiltration, as the potential quantity of infiltration from partial infiltration BMPs is smaller.

● Yes; Answer "Yes" to Criteria 3 Result.

○ No; However, site layout changes can be proposed to avoid contaminated soils or soils that lack adequate treatment capacity. Select "Yes" to Criteria 3 Result. It is a requirement for the SWQMP preparer to identify potential mitigation measures.

○ No; Contaminated soils or soils that lack adequate treatment capacity cannot be avoided and partial infiltration BMPs are not feasible. Select "No" to Criteria 3 Result.

Criteria 3 Result: Can infiltration of greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour be allowed without increasing risk of groundwater contamination that cannot be reasonably mitigated to an acceptable level?

○ Yes; Continue to Part 2, Criteria 4.

● No; Skip to Part 2 Result.

Summarize findings and basis. Documentation should focus on mapped soil types and contaminated site locations.

Mapped soil is a hydrological type "D".
Small diameter bore hole testing and infiltration analysis by the Porchet method. The test was performed within the proposed basin location and resulted in an infiltration rate of 0.14 inches per hour, 0.04 with a design factor of safety of 3.5.
See GeoTek's preliminary geotechnical report Proposed Emerald Hills Development, North of Old Memory lane, APN 543-340-02-00, San Diego, California"
PN 3680-SD, dated November 13, 2023

Lot "C" □ □ □□t□rn □a□in □T□□t Location □□1

Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions	Worksheet C.4-2: Form I-8B[2]

Criteria 4: Water Balance Screening

Additional studies. In the event that water balance effects are used to reject partial infiltration (anticipated to be rare), a qualified professional must provide an analysis of the incremental effects of partial infiltration BMPs on the water balance compared to incidental infiltration under a no infiltration scenario (e.g. precipitation, irrigation, etc.).

Criteria 4 Result: Can infiltration of greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour be allowed without causing potential water balance issues such as change of seasonality of ephemeral streams?

● Yes: Continue to Part 2 Result.

○ No: Continue to Part 2 Result.

Summarize potential water balance effects. Documentation should focus on mapping and soil data regarding proximity to ephemeral streams and groundwater depth.

Part 2 – Partial Infiltration Groundwater and Water Balance Screening Result[4]	Result
If answers to Criteria 3 and Criteria 4 are "Yes", a partial infiltration design is potentially feasible. The feasibility screening category is Partial Infiltration based on groundwater and water balance conditions. If answer to Criteria 3 or Criteria 4 is "No", then infiltration of any volume is considered to be infeasible within the site. The feasibility screening category is No Infiltration based on groundwater or water balance condition.	○ Partial Infiltration Condition ● No Infiltration Condition

[4] To be completed using gathered site information and best professional judgement considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by City Engineer to substantiate findings.

Factor of Safety and Design Infiltration Rate Worksheet					Worksheet D.5-1: Form I-9
Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = w x v
A	Suitability Assessment	Soil assessment methods	0.25	3	.75
		Predominant soil texture	0.25	3	.75
		Site soil variability	0.25	1	.25
		Depth to groundwater / impervious layer	0.25	1	.25
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			2
B	Design	Level of pretreatment/ expected sediment loads	0.5	1	0.5
		Redundancy/resiliency	0.25	2	0.5
		Compaction during construction	0.25	3	0.75
		Design Safety Factor, $S_B = \Sigma p$			1.75

Combined Safety Factor, $S_{total} = S_A \times S_B$ [Minimum of 2 and Maximum of 9]	3.5
Observed Infiltration Rate, inch/hr., $K_{observed}$ (corrected for test-specific bias) Note: This worksheet is only applicable when the observed infiltration rate is greater than or equal to 1 inch/hr.	0.14
Design Infiltration Rate, in/hr., $K_{design} = K_{observed} / S_{total}$ Note: If the estimated design infiltration rate is less than or equal to 0.5 inch/hr. then the applicant may choose to implement partial infiltration BMPs.	0.04

Supporting Data

Briefly describe infiltration test and provide reference to test forms:

[illegible] an [illegible]-diameter bore hole testing and infiltration analysis by the Porchet Method. The test was performed within the proposed basin location and resulted in an infiltration rate of 0.[illegible] inches per hour, 0.04 inches per hour with a design factor of safety. See [illegible] "Preliminary Geotechnical Report Proposed Emerald Hills Development, North of [illegible] Memory Lane, [illegible] [illegible]3[illegible]3[illegible]0[illegible]02[illegible]00, San Diego, California"
[illegible] 3[illegible]80[illegible], dated November [illegible]3, 2023

Note: Worksheet D.5-1: Form I-9 is only applicable to design BMPs in "full infiltration condition". This form is not applicable for categorization of infiltration feasibility (Worksheet C.4-1: Form I-8) and/or for designing BMPs in "partial infiltration condition" or "no infiltration condition".

Lot "D" □ □ort□□rn □a□in □T□□t Location □□3

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions[1]		Worksheet C.4-1: Form I-8A[2]
Part 1 - Full Infiltration Feasibility Screening Criteria		
DMA(s) Being Analyzed:		**Project Phase:**
Lot "D" - Northern Basin - Test Location P-3		Planning Phase
Criteria 1: Infiltration Rate Screening		
1A	Is the mapped hydrologic soil group according to the NRCS Web Soil Survey or UC Davis Soil Web Mapper Type A or B and corroborated by available site soil data[3]? ○ Yes; the DMA may feasibly support full infiltration. Answer "Yes" to Criteria 1 Result or continue to Step 1B if the applicant elects to perform infiltration testing. ○ No; the mapped soil types are A or B but is not corroborated by available site soil data (continue to Step 1B). ● No; the mapped soil types are C, D, or "urban/unclassified" and is corroborated by available site soil data. Answer "No" to Criteria 1 Result. ○ No; the mapped soil types are C, D, or "urban/unclassified" but is not corroborated by available site soil data (continue to Step 1B).	
1B	Is the reliable infiltration rate calculated using planning phase methods from Table D.3-1? ● Yes; Continue to Step 1C. ○ No; Skip to Step 1D.	
1C	Is the reliable infiltration rate calculated using planning phase methods from Table D.3-1 greater than 0.5 inches per hour? ○ Yes; the DMA may feasibly support full infiltration. Answer "Yes" to Criteria 1 Result. ● No; full infiltration is not required. Answer "No" to Criteria 1 Result.	
1D	**Infiltration Testing Method.** Is the selected infiltration testing method suitable during the design phase (see Appendix D.3)? Note: Alternative testing standards may be allowed with appropriate rationales and documentation. ● Yes; continue to Step 1E. ○ No; select an appropriate infiltration testing method.	

[1] Note that it is not required to investigate each and every criterion in the worksheet, a single "no" answer in Part 1, Part 2, Part 3, or Part 4 determines a full, partial, or no infiltration condition.

[2] This form must be completed each time there is a change to the site layout that would affect the infiltration feasibility condition. Previously completed forms shall be retained to document the evolution of the site storm water design.

[3] Available data includes site-specific sampling or observation of soil types or texture classes, such as obtained from borings or test pits necessary to support other design elements.

Lot "D" □ □ort□□rn □a□in □T□□t Location □□3

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Worksheet C.4-1: Form I-8A[2]
1E	**Number of Percolation/Infiltration Tests.** Does the infiltration testing method performed satisfy the minimum number of tests specified in Table D.3-2? ● Yes; continue to Step 1F. ○ No; conduct appropriate number of tests.
IF	**Factor of Safety.** Is the suitable Factor of Safety selected for full infiltration design? See guidance in D.5; Tables D.5-1 and D.5-2; and Worksheet D.5-1 (Form I-9). ● Yes; continue to Step 1G. ○ No; select appropriate factor of safety.
1G	**Full Infiltration Feasibility.** Is the average measured infiltration rate divided by the Factor of Safety greater than 0.5 inches per hour? ○ Yes; answer "Yes" to Criteria 1 Result. ● No; answer "No" to Criteria 1 Result.
Criteria 1 Result	Is the estimated reliable infiltration rate greater than 0.5 inches per hour within the DMA where runoff can reasonably be routed to a BMP? ○ Yes; the DMA may feasibly support full infiltration. Continue to Criteria 2. ● No; full infiltration is not required. Skip to Part 1 Result.

Summarize infiltration testing methods, testing locations, replicates, and results and summarize estimates of reliable infiltration rates according to procedures outlined in D.5. Documentation should be included in project geotechnical report.

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Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
Criteria 2: Geologic/Geotechnical Screening			
2A	If all questions in Step 2A are answered "Yes," continue to Step 2B. For any "No" answer in Step 2A answer "No" to Criteria 2, and submit an "Infiltration Feasibility Condition Letter" that meets the requirements in Appendix C.1.1. The geologic/geotechnical analyses listed in Appendix C.2.1 do not apply to the DMA because one of the following setbacks cannot be avoided and therefore result in the DMA being in a no infiltration condition. The setbacks must be the closest horizontal radial distance from the surface edge (at the overflow elevation) of the BMP.		
2A-1	Can the proposed full infiltration BMP(s) avoid areas with existing fill materials greater than 5 feet thick below the infiltrating surface?	● Yes	○ No
2A-2	Can the proposed full infiltration BMP(s) avoid placement within 10 feet of existing underground utilities, structures, or retaining walls?	● Yes	○ No
2A-3	Can the proposed full infiltration BMP(s) avoid placement within 50 feet of a natural slope (>25%) or within a distance of 1.5H from fill slopes where H is the height of the fill slope?	○ Yes	● No
2B	When full infiltration is determined to be feasible, a geotechnical investigation report must be prepared that considers the relevant factors identified in Appendix C.2.1. If all questions in Step 2B are answered "Yes," then answer "Yes" to Criteria 2 Result. If there are "No" answers continue to Step 2C.		
2B-1	**Hydroconsolidation.** Analyze hydroconsolidation potential per approved ASTM standard due to a proposed full infiltration BMP. Can full infiltration BMPs be proposed within the DMA without increasing hydroconsolidation risks?	● Yes	○ No
2B-2	**Expansive Soils.** Identify expansive soils (soils with an expansion index greater than 20) and the extent of such soils due to proposed full infiltration BMPs. Can full infiltration BMPs be proposed within the DMA without increasing expansive soil risks?	○ Yes	● No

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
2B-3	**Liquefaction**. If applicable, identify mapped liquefaction areas. Evaluate liquefaction hazards in accordance with Section 6.4.2 of the City of San Diego's Guidelines for Geotechnical Reports (2011 or most recent edition). Liquefaction hazard assessment shall take into account any increase in groundwater elevation or groundwater mounding that could occur as a result of proposed infiltration or percolation facilities. Can full infiltration BMPs be proposed within the DMA without increasing liquefaction risks?	● Yes	○ No
2B-4	**Slope Stability**. If applicable, perform a slope stability analysis in accordance with the ASCE and Southern California Earthquake Center (2002) Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California to determine minimum slope setbacks for full infiltration BMPs. See the City of San Diego's Guidelines for Geotechnical Reports (2011) to determine which type of slope stability analysis is required. Can full infiltration BMPs be proposed within the DMA without increasing slope stability risks?	○ Yes	● No
2B-5	**Other Geotechnical Hazards.** Identify site-specific geotechnical hazards not already mentioned (refer to Appendix C.2.1). Can full infiltration BMPs be proposed within the DMA without increasing risk of geologic or geotechnical hazards not already mentioned?	● Yes	○ No
2B-6	**Setbacks.** Establish setbacks from underground utilities, structures, and/or retaining walls. Reference applicable ASTM or other recognized standard in the geotechnical report. Can full infiltration BMPs be proposed within the DMA using established setbacks from underground utilities, structures, and/or retaining walls?	○ Yes	● No

Lot "D" [illegible] Northern Basin [illegible] Test Location [illegible]3

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
2C	**Mitigation Measures.** Propose mitigation measures for each geologic/geotechnical hazard identified in Step 2B. Provide a discussion of geologic/geotechnical hazards that would prevent full infiltration BMPs that cannot be reasonably mitigated in the geotechnical report. See Appendix C.2.1.8 for a list of typically reasonable and typically unreasonable mitigation measures. Can mitigation measures be proposed to allow for full infiltration BMPs? If the question in Step 2 is answered "Yes," then answer "Yes" to Criteria 2 Result. If the question in Step 2C is answered "No," then answer "No" to Criteria 2 Result.	○ Yes	● No
Criteria 2 Result	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geologic or geotechnical hazards that cannot be reasonably mitigated to an acceptable level?	○ Yes	● No

Summarize findings and basis; provide references to related reports or exhibits.

[illegible] diameter bore hole testing and infiltration analysis by the Porchet method. The test was performed within the proposed basin location and resulted in an infiltration rate of 0.00 inches per hour. See [illegible] preliminary geotechnical report proposed Emerald [illegible] Development, North of Old Memory Lane, APN [illegible]3[illegible]3[illegible]0[illegible]02[illegible]00, San Diego, California" [illegible] 3[illegible]80[illegible], dated November [illegible]3, 2023

Part 1 Result – Full Infiltration Geotechnical Screening [4]	Result
If answers to both Criteria 1 and Criteria 2 are "Yes", a full infiltration design is potentially feasible based on Geotechnical conditions only. If either answer to Criteria 1 or Criteria 2 is "No", a full infiltration design is not required.	○ Full infiltration Condition ● Complete Part 2

[4] To be completed using gathered site information and best professional judgement considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by City Engineer to substantiate findings.

Lot "D" □ □ort□□rn □a□in □T□□t Location □□3

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]
Part 2 – Partial vs. No Infiltration Feasibility Screening Criteria		
DMA(s) Being Analyzed:		Project Phase:
Lot "D" - Northern Basin - Test Location P-3		Planning Phase
Criteria 3 : Infiltration Rate Screening		
3A	**NRCS Type C, D, or “urban/unclassified”:** Is the mapped hydrologic soil group according to the NRCS Web Soil Survey or UC Davis Soil Web Mapper is Type C, D, or “urban/unclassified” and corroborated by available site soil data? ○ Yes; the site is mapped as C soils and a reliable infiltration rate of 0.15 in/hr. is used to size partial infiltration BMPS. Answer “Yes” to Criteria 3 Result. ● Yes; the site is mapped as D soils or “urban/unclassified” and a reliable infiltration rate of 0.05 in/hr. is used to size partial infiltration BMPS. Answer “Yes” to Criteria 3 Result. ○ No; infiltration testing is conducted (refer to Table D.3-1), continue to Step 3B.	
3B	**Infiltration Testing Result:** Is the reliable infiltration rate (i.e. average measured infiltration rate/2) greater than 0.05 in/hr. and less than or equal to 0.5 in/hr? ● Yes; the site may support partial infiltration. Answer “Yes” to Criteria 3 Result. ○ No; the reliable infiltration rate (i.e. average measured rate/2) is less than 0.05 in/hr., partial infiltration is not required. Answer “No” to Criteria 3 Result.	
Criteria 3 Result	Is the estimated reliable infiltration rate (i.e., average measured infiltration rate/2) greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour at any location within each DMA where runoff can reasonably be routed to a BMP? ● Yes; Continue to Criteria 4. ○ No: Skip to Part 2 Result.	
Summarize infiltration testing and/or mapping results (i.e. soil maps and series description used for infiltration rate). □□ a□dia□ eter □ore ho□e testi□□ a□d i□fi□tratio□ a□a□ysis □y the □orchet □ ethod. □he test was □erfor□ ed withi□ the □ro□osed □asi□ □ocatio□ a□d res□□ted i□ a□ i□fi□tratio□ rate of 0.00 i□ches □er ho□r. □ee □ eo□e□□s □re□□ i□ary □eotech□ica□ re□ort □ro□osed E□ era□d □ i□s □ e□e□o□□ e□t, □ orth of □ □d Me□ ory □a□e, □□□ □□3□3□0□02□00, □a□ □ie□o, □a□for□ia" □□ 3□80□□□, dated November □3, 2023		

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions			Worksheet C.4-1: Form I-8A[2]
Criteria 4: Geologic/Geotechnical Screening			
4A	If all questions in Step 4A are answered "Yes," continue to Step 2B. For any "No" answer in Step 4A answer "No" to Criteria 4 Result, and submit an "Infiltration Feasibility Condition Letter" that meets the requirements in Appendix C.1.1. The geologic/geotechnical analyses listed in Appendix C.2.1 do not apply to the DMA because one of the following setbacks cannot be avoided and therefore result in the DMA being in a no infiltration condition. The setbacks must be the closest horizontal radial distance from the surface edge (at the overflow elevation) of the BMP.		
4A-1	Can the proposed partial infiltration BMP(s) avoid areas with existing fill materials greater than 5 feet thick?	● Yes	○ No
4A-2	Can the proposed partial infiltration BMP(s) avoid placement within 10 feet of existing underground utilities, structures, or retaining walls?	● Yes	○ No
4A-3	Can the proposed partial infiltration BMP(s) avoid placement within 50 feet of a natural slope (>25%) or within a distance of 1.5H from fill slopes where H is the height of the fill slope?	○ Yes	● No
4B	When full infiltration is determined to be feasible, a geotechnical investigation report must be prepared that considers the relevant factors identified in Appendix C.2.1. If all questions in Step 4B are answered "Yes," then answer "Yes" to Criteria 4 Result. If there are any "No" answers continue to Step 4C.		
4B-1	**Hydroconsolidation.** Analyze hydroconsolidation potential per approved ASTM standard due to a proposed full infiltration BMP. Can partial infiltration BMPs be proposed within the DMA without increasing hydroconsolidation risks?	● Yes	○ No
4B-2	**Expansive Soils.** Identify expansive soils (soils with an expansion index greater than 20) and the extent of such soils due to proposed full infiltration BMPs. Can partial infiltration BMPs be proposed within the DMA without increasing expansive soil risks?	○ Yes	● No
4B-3	**Liquefaction**. If applicable, identify mapped liquefaction areas. Evaluate liquefaction hazards in accordance with Section 6.4.2 of the City of San Diego's Guidelines for Geotechnical Reports (2011). Liquefaction hazard assessment shall take into account any increase in groundwater elevation or groundwater mounding that could occur as a result of proposed infiltration or percolation facilities. Can partial infiltration BMPs be proposed within the DMA without increasing liquefaction risks?	● Yes	○ No

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Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions		Worksheet C.4-1: Form I-8A[2]	
4B-4	**Slope Stability**. If applicable, perform a slope stability analysis in accordance with the ASCE and Southern California Earthquake Center (2002) Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Landslide Hazards in California to determine minimum slope setbacks for full infiltration BMPs. See the City of San Diego's Guidelines for Geotechnical Reports (2011) to determine which type of slope stability analysis is required. Can partial infiltration BMPs be proposed within the DMA without increasing slope stability risks?	○ Yes	● No
4B-5	**Other Geotechnical Hazards.** Identify site-specific geotechnical hazards not already mentioned (refer to Appendix C.2.1). Can partial infiltration BMPs be proposed within the DMA without increasing risk of geologic or geotechnical hazards not already mentioned?	● Yes	○ No
4B-6	**Setbacks.** Establish setbacks from underground utilities, structures, and/or retaining walls. Reference applicable ASTM or other recognized standard in the geotechnical report. Can partial infiltration BMPs be proposed within the DMA using recommended setbacks from underground utilities, structures, and/or retaining walls?	○ Yes	● No
4C	**Mitigation Measures.** Propose mitigation measures for each geologic/geotechnical hazard identified in Step 4B. Provide a discussion on geologic/geotechnical hazards that would prevent partial infiltration BMPs that cannot be reasonably mitigated in the geotechnical report. See Appendix C.2.1.8 for a list of typically reasonable and typically unreasonable mitigation measures. Can mitigation measures be proposed to allow for partial infiltration BMPs? If the question in Step 4C is answered "Yes," then answer "Yes" to Criteria 4 Result. If the question in Step 4C is answered "No," then answer "No" to Criteria 4 Result.	○ Yes	● No
Criteria 4 Result	Can infiltration of greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour be allowed without increasing the risk of geologic or geotechnical hazards that cannot be reasonably mitigated to an acceptable level?	○ Yes	● No

Categorization of Infiltration Feasibility Condition based on Geotechnical Conditions	Worksheet C.4-1: Form I-8A[2]
Summarize findings and basis; provide references to related reports or exhibits. □□ a□□dia□ eter □ore ho□e testi□□ a□d i□fi□tratio□ a□a□ysis □y the □orchet □ ethod. □he test was □erfor□ ed withi□ the □ro□osed □asi□ □ocatio□ a□d res□□ted i□ a□ i□fi□tratio□ rate of 0.00 i□ches □er ho□r. □ee □ eo□e□□s □re□□ i□ary □eotech□ica□re□ort □ro□osed E□ era□d □ i□□s De□e□o□□□ e□t, □ orth of □ □d Me□ ory □a□e, □□□ □□3□3□0□02□00, □a□ □ie□o, □a□for□ia" □□ 3□80□□□, dated November □3, 2023	

Part 2 – Partial Infiltration Geotechnical Screening Result[5]	Result
If answers to both Criteria 3 and Criteria 4 are "Yes", a partial infiltration design is potentially feasible based on geotechnical conditions only. If answers to either Criteria 3 or Criteria 4 is "No", then infiltration of any volume is considered to be infeasible within the site.	○ Partial Infiltration Condition ● No Infiltration Condition

[5] To be completed using gathered site information and best professional judgement considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by City Engineer to substantiate findings.

Lot "D" □ □ort□□rn □a□in □T□□t Location □□3

Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions	Worksheet C.4-2: Form I-8B[2]
Part 1 - Full Infiltration Feasibility Screening Criteria	
DMA(s) Being Analyzed:	Project Phase:
Lot "D" - Northern Basin - Test Location P-3	Planning Phase
Criteria 1: Groundwater Screening	
1A	**Groundwater Depth.** Is the depth to seasonally high groundwater tables (normal high depth during the wet season) beneath the base of any full infiltration BMP greater than 10 feet? ● Yes; continue to Step 1B. ○ No; The depth to groundwater is less than or equal to 10 feet, but site layout changes or reasonable mitigation measures can be proposed to support full infiltration BMPs. Continue to step 1B. ○ No; The depth to groundwater is less than or equal to 10 feet and site layout changes or reasonable mitigation measures cannot be proposed to support full infiltration BMPs. Answer "No" for Criteria 1 Result.
1B	**Contaminated Soil/Groundwater.** Are proposed full infiltration BMPs at least 250 feet away from contaminated soil or groundwater sites? This can be confirmed using GeoTracker (geotracker.waterboards.ca.gov) to identify open contaminated sites. The setbacks must be the closest horizontal radial distance from the surface edge (at the overflow elevation) of the BMP. ● Yes; continue to Step 1C. ○ No; However, site layout changes or reasonable mitigation measures can be proposed to support full infiltration BMPs. Continue to Step 1C. ○ No; Site layout changes or reasonable mitigation measures cannot be proposed to support full infiltration BMPs. Answer "No" to Criteria 1 Result.

[1] Note that it is not required to investigate each and every criterion in the worksheet, a single "no" answer in Part 1, Part 2, part 3, or Part 4 determines a full, partial, or no infiltration condition.

[2] This form must be completed each time there is a change to the site layout that would affect the infiltration feasibility condition. Previously completed forms shall be retained to document the evolution of the site storm water design.

Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions	Worksheet C.4-2: Form I-8B[2]
1C	**Inadequate Soil Treatment Capacity.** Are full infiltration BMPs proposed in DMA soils that have adequate soil treatment capacity? The DMA has adequate soil treatment capacity if **ALL** of the following criteria (detailed in C.2.2.1) for all soil layers beneath the infiltrating surface are met: • USDA texture class is sandy loam or loam or silt loam or silt or sandy clay loam or clay loam or silty clay loam or sandy clay or silty clay or clay; and • Cation Exchange Capacity (CEC) greater than 5 milliequivalents/100g; and • Soil organic matter is greater than 1%; and • Groundwater table is equal to or greater than 10 feet beneath the base of the full infiltration BMP. ○ Yes; continue to Step 1D. ○ No; However, site layout changes or reasonable mitigation measures can be proposed to support full infiltration BMPs. Continue to Step 1D. ● No; Site layout changes or reasonable mitigation measures cannot be proposed to support full infiltration BMPs. Answer "No" to Criteria 1 Result.
1D	**Other Groundwater Contamination Hazards.** Are there site-specific groundwater contamination hazards not already mentioned (refer to Appendix C.2.2) that can be reasonably mitigated to support full infiltration BMPs? ○ Yes; there are other contamination hazards identified that can be mitigated. Answer "Yes" to Criteria 1 Result. ○ No; there are other contamination hazards identified that cannot be mitigated. Answer "No" to Criteria 1 Result. ● N/A; no contamination hazards are identified. Answer "Yes" to Criteria 1 Result.
Criteria 1 Result	Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of groundwater contamination that cannot be reasonably mitigated to an acceptable level? See Appendix C.2.2.8 for a list of typically reasonable and typically unreasonable mitigation measures. ○ Yes; Continue to Part 1, Criteria 2. ● No; Continue to Part 1 Result.

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Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions	Worksheet C.4-2: Form I-8B[2]
Summarize groundwater quality and any mitigation measures proposed. Documentation should focus on groundwater table, mapped soil types and contaminated site locations.	

Mapped soil type is "D".
□□ a□□dia□ eter □ore ho□e testi□□ a□d i□fi□tratio□ a□a□ysis □y the □orchet □ ethod. □he test was □erfor□ ed withi□ the □ro□osed □asi□ □ocatio□ a□d res□□ted i□ a□ i□fi□tratio□ rate of 0.00 i□ches □er ho□r. □ee □ eo□e□□s □re□□ i□ary □eotech□ica□re□ort □ro□osed E□ era□d □ i□□s □ e□e□o□□□ e□t, □ orth of □ □d Me□ ory □a□e, □□□ □□3□3□0□02□00, □a□ □ie□o, □a□ifor□ia" □□ 3□80□□□, dated November □3, 2023

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Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions	Worksheet C.4-2: Form I-8B[2]
Criteria 2: Water Balance Screening	
2A	**Ephemeral Stream Setback.** Does the proposed full infiltration BMP meet both the following? • The full infiltration BMP is located at least 250 feet away from an ephemeral stream; **AND** • The bottom surface of the full infiltration BMP is at a depth 20 feet or greater from seasonally high groundwater tables. ○ Yes; Answer "Yes" to Criteria 2 Result. ● No; Continue to Step 2B.
2B	**Mitigation Measures.** Can site layout changes be proposed to support full infiltration BMPs? ○ Yes; the site can be reconfigured to mitigate potential water balance issues. Answer "Yes" to Criteria 2 Result. ● No; the site cannot be reconfigured to mitigate potential water balance issues. Continue to Step 2C and provide discussion.
2C	**Additional studies.** Do additional studies support full infiltration BMPs? In the event that water balance effects are used to reject full infiltration (anticipated to be rare), additional analysis shall be completed and documented by a qualified professional indicating the site-specific information evaluated and the technical basis for this finding. ○ Yes; Answer "Yes" to Criteria 2 Result. ● No; Answer "No" to Criteria 2 Result.
Criteria 2 Result	Can infiltration greater than 0.5 inches per hour be allowed without causing potential water balance issues such as change of seasonality of ephemeral streams? ○ Yes; Continue to Part 1 Result. ● No; Continue to Part 1 Result.

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Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions	Worksheet C.4-2: Form I-8B[2]

Summarize potential water balance effects. Documentation should focus on mapping and soil data regarding proximity to ephemeral streams and groundwater depth.

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Part 1 – Full Infiltration Groundwater and Water Balance Screening Result[3]	Result
If answers to Criteria 1 and 2 are "Yes", a full infiltration design is potentially feasible. The feasibility screening category is Full Infiltration based on groundwater conditions. If answer to Criteria 1 or Criteria 2 is "No", infiltration may be possible to some extent but would not generally be feasible or desirable to achieve a "full infiltration" design based on groundwater conditions. Proceed to Part 2.	○ Full Infiltration ● Complete Part 2

[3] To be completed using gathered site information and best professional judgement considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by City Engineer to substantiate findings.

Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions	Worksheet C.4-2: Form I-8B[2]
Part 2 – Partial vs. No Infiltration Feasibility Screening Criteria	
DMA(s) Being Analyzed:	**Project Phase:**
Lot "D" - Northern Basin - Test Location P-3	Planning Phase
Criteria 3: Groundwater Screening	

Contaminated Soil/Groundwater. Are partial infiltration BMPs proposed at least 100 feet away from contaminated soil or groundwater sites? This can be confirmed using GeoTracker (geotracker.waterboards.ca.gov) to identify open contaminated sites. This criterion is intentionally a smaller radius than full infiltration, as the potential quantity of infiltration from partial infiltration BMPs is smaller.

- ◉ Yes; Answer “Yes” to Criteria 3 Result.
- ○ No; However, site layout changes can be proposed to avoid contaminated soils or soils that lack adequate treatment capacity. Select “Yes” to Criteria 3 Result. It is a requirement for the SWQMP preparer to identify potential mitigation measures.
- ○ No; Contaminated soils or soils that lack adequate treatment capacity cannot be avoided and partial infiltration BMPs are not feasible. Select “No” to Criteria 3 Result.

Criteria 3 Result: Can infiltration of greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour be allowed without increasing risk of groundwater contamination that cannot be reasonably mitigated to an acceptable level?

- ◉ Yes; Continue to Part 2, Criteria 4.
- ○ No; Skip to Part 2 Result.

Summarize findings and basis. Documentation should focus on mapped soil types and contaminated site locations.

Mapped soil type is "D".
[illegible] an diameter bore hole testing and infiltration analysis by the Porchet method. The test was performed within the proposed basin location and resulted in an infiltration rate of 0.00 inches per hour. See GeoTek's preliminary geotechnical report proposed Emerald Hills Development, North of Old Memory Lane, [illegible] [illegible]3[illegible]3[illegible]0[illegible]02[illegible]00, San Diego, California" [illegible] 3[illegible]80[illegible], dated November [illegible]3, 2023

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Categorization of Infiltration Feasibility Condition based on Groundwater and Water Balance Conditions	Worksheet C.4-2: Form I-8B[2]

Criteria 4: Water Balance Screening

Additional studies. In the event that water balance effects are used to reject partial infiltration (anticipated to be rare), a qualified professional must provide an analysis of the incremental effects of partial infiltration BMPs on the water balance compared to incidental infiltration under a no infiltration scenario (e.g. precipitation, irrigation, etc.).

Criteria 4 Result: Can infiltration of greater than or equal to 0.05 inches/hour and less than or equal to 0.5 inches/hour be allowed without causing potential water balance issues such as change of seasonality of ephemeral streams?

● Yes: Continue to Part 2 Result.

○ No: Continue to Part 2 Result.

Summarize potential water balance effects. Documentation should focus on mapping and soil data regarding proximity to ephemeral streams and groundwater depth.

Part 2 – Partial Infiltration Groundwater and Water Balance Screening Result[4]	Result
If answers to Criteria 3 and Criteria 4 are "Yes", a partial infiltration design is potentially feasible. The feasibility screening category is Partial Infiltration based on groundwater and water balance conditions. If answer to Criteria 3 or Criteria 4 is "No", then infiltration of any volume is considered to be infeasible within the site. The feasibility screening category is No Infiltration based on groundwater or water balance condition.	● Partial Infiltration Condition ○ No Infiltration Condition

[4] To be completed using gathered site information and best professional judgement considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by City Engineer to substantiate findings.

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Factor of Safety and Design Infiltration Rate Worksheet			Worksheet D.5-1: Form I-9		
Factor Category		Factor Description	Assigned Weight (w)	Factor Value (v)	Product (p) p = w x v
A	Suitability Assessment	Soil assessment methods	0.25	3	.75
		Predominant soil texture	0.25	3	.7□
		Site soil variability	0.25	1	.25
		Depth to groundwater / impervious layer	0.25	1	.2□
		Suitability Assessment Safety Factor, $S_A = \Sigma p$			2
B	Design	Level of pretreatment/ expected sediment loads	0.5	1	0.5
		Redundancy/resiliency	0.25	2	0.5
		Compaction during construction	0.25	3	0.75
		Design Safety Factor, $S_B = \Sigma p$			1.75
Combined Safety Factor, $S_{total} = S_A \times S_B$ [Minimum of 2 and Maximum of 9]					3.5
Observed Infiltration Rate, inch/hr., $K_{observed}$ (corrected for test-specific bias) Note: This worksheet is only applicable when the observed infiltration rate is greater than or equal to 1 inch/hr.					0.00
Design Infiltration Rate, in/hr., $K_{design} = K_{observed} / S_{total}$ Note: If the estimated design infiltration rate is less than or equal to 0.5 inch/hr. then the applicant may choose to implement partial infiltration BMPs.					0.00
Supporting Data					
Briefly describe infiltration test and provide reference to test forms: □□ a□□dia□ eter □ore ho□e testi□□ a□d i□fi□tratio□ a□a□ysis □y the □orchet □ ethod. □he test was □erfor□ ed withi□ the □ro□osed □asi□ □ocatio□ a□d res□□ted i□ a□ i□fi□tratio□ rate of 0.00 i□ches □er ho□r. □ee □ eo□e□□s □re□□ i□ary □eotech□ica□re□ort □ro□osed E□ era□d □ i□□s □ e□e□o□□ e□t, □ orth of □ □d Me□ ory □a□e, □□□ □□3□3□0□02□00, □a□ □ ie□o, □a□ifor□ia" □□ 3□80□□□, dated November □3, 2023					

Note: Worksheet D.5-1: Form I-9 is only applicable to design BMPs in “full infiltration condition”. This form is not applicable for categorization of infiltration feasibility (Worksheet C.4-1: Form I-8) and/or for designing BMPs in “partial infiltration condition” or “no infiltration condition”.

APPENDIX C

RESULTS OF LABORATORY TESTING

SUMMARY OF LABORATORY TESTING

Identification and Classification

Soils were identified visually in general accordance with the standard practice for description and identification of soils (ASTM D 2488). The soil identifications and classifications are shown on the Logs of Exploration in Appendix A.

Moisture Density Modified Proctor

Laboratory testing was performed on one sample collected during the subsurface exploration for compaction characteristics. The laboratory maximum dry density and optimum moisture content for the soil was determined in general accordance with ASTM Test Method D 1557 procedures. The test results are graphically presented in Appendix C.

Expansion Index Test

Expansion Index testing was performed on one sample collected during the subsurface exploration. The expansion index was determined in general accordance with ASTM Test Method D 4829 procedures. The test results are presented in Appendix C.

Full Corrosion Suite

A full corrosion series was performed in general accordance with several ASTM Test Methods on representative samples collected during the subsurface exploration. The samples were obtained from Test Pit TP-6 and TP-7 and tested by HDR.

Percent of Soil Passing No 200 Sieve

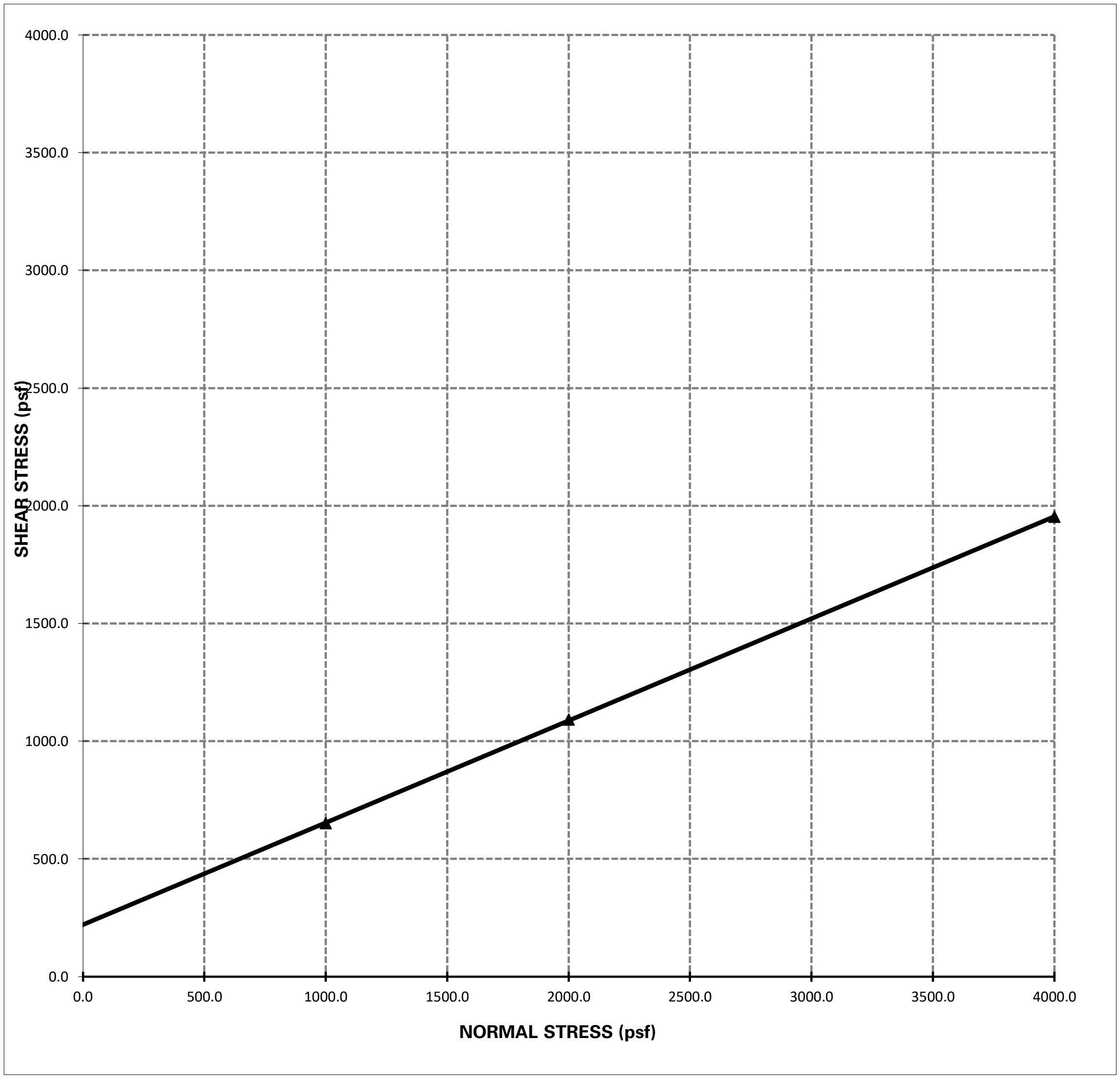
The amount of soil finer than No. 200 sieve was determined for samples collected from the site. The tests were performed in general accordance with ASTM D 1140. The test results are presented in Appendix C.

Direct Shear

Shear testing was performed in a direct shear machine of the strain-control type in general accordance with ASTM Test Method D 3080 procedures. The rate of deformation is approximately 0.025 inches per minute. The samples were sheared under varying confining loads to determine the coulomb shear strength parameters, angle of internal friction and cohesion. One test was performed on a bulk sample that was remolded to approximately 90 percent of the maximum dry density as determined by ASTM D 1557. The results of the testing are graphically presented in Appendix C.

DIRECT SHEAR TEST

Project Name: Emerald Hills
Project Number: 3680-SD
Sample Location: TP-1 BB-1 @ 0'-4'
Date Tested: 10/27/2022



Shear Strength: **Φ = 23 °** **C = 221 psf**

Notes: 1 - The soil specimen used in the shear box was a ring sample remolded to approximately 90% relative compaction from a bulk sample collected during the field investigation.

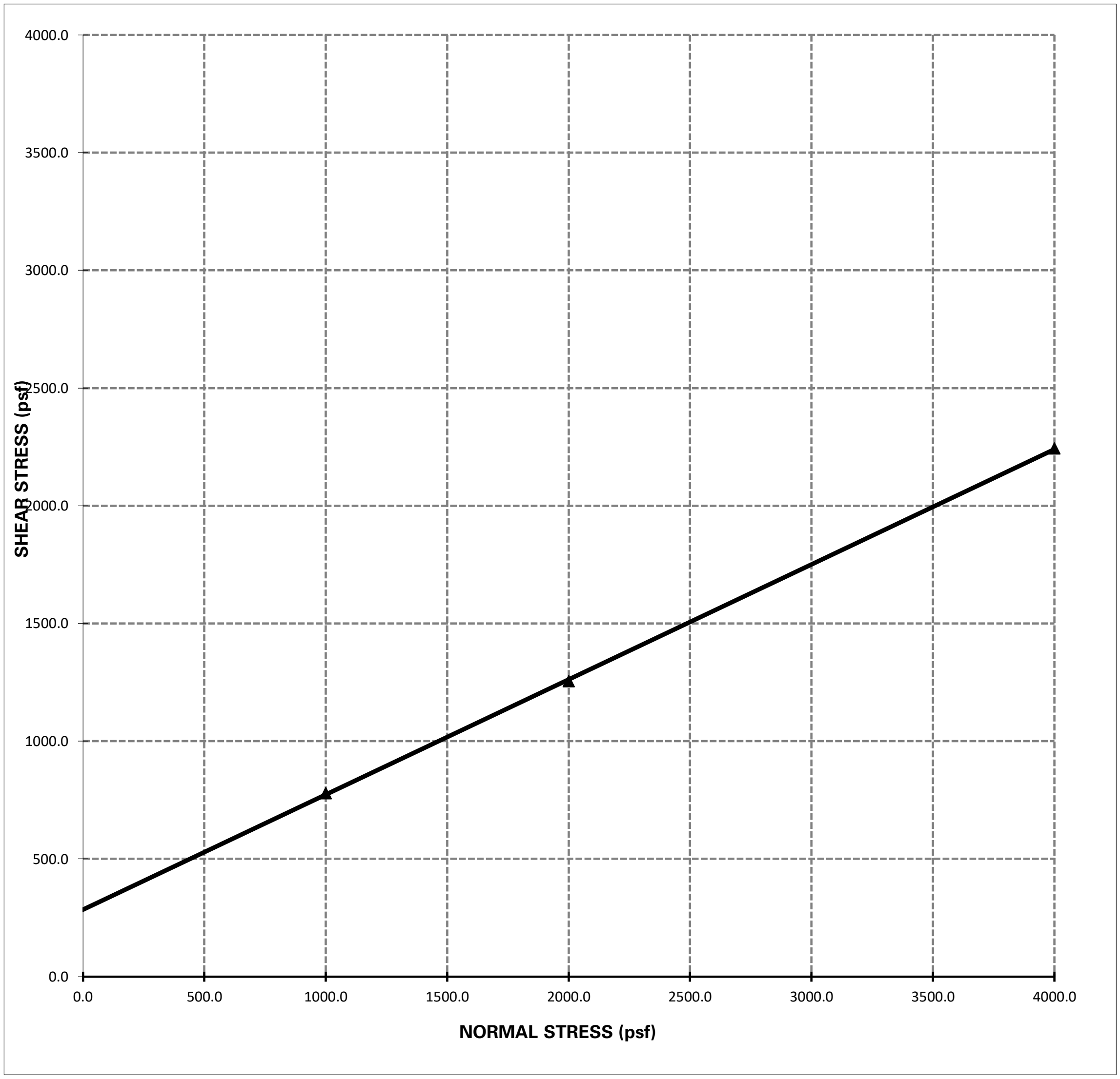
2 - The above reflect direct shear strength at saturated conditions.

3 - The tests were run at a shear rate of 0.01 in/min.

DIRECT SHEAR TEST

Project Name:	Emerald Hills	***Sample Location:***	TP-1 BB-1 @ 0'-4'
Project Number:	3680-SD	***Date Tested:***	10/27/2022

PEAK VALUE



Shear Strength: **Φ = 26 °** **C = 285 psf**

Notes: 1 - The soil specimen used in the shear box was a ring sample remolded to approximately 90% relative compaction from a bulk sample collected during the field investigation.

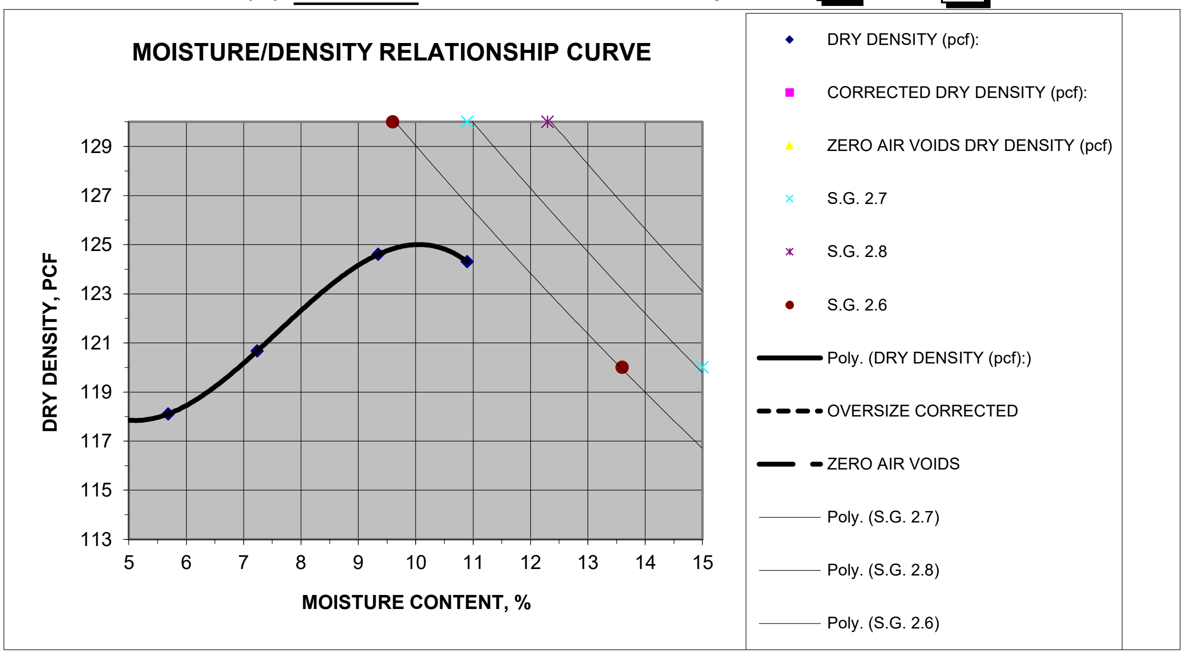
2 - The above reflect direct shear strength at saturated conditions.

3 - The tests were run at a shear rate of 0.01 in/min.

MOISTURE/DENSITY RELATIONSHIP

Client:	DR Horton	**Job No.:**	3680-SD
Project:	Emerald Hills	**Lab No.:**	3795
Location:	San Diego, CA		
Material Type:	Light Brown Silty Sand		
Material Supplier:	-		
Material Source:	-		
Sample Location:	TP-1 BB-1		
	-		
Sampled By:	CH	**Date Sampled:**	9/19/2022
Received By:	CH	**Date Received:**	9/19/2022
Tested By:	KP	**Date Tested:**	9/30/2022
Reviewed By:	-	**Date Reviewed:**	-

Test Procedure: ASTM D1557 **Method:** A
Oversized Material (%): 0.0 **Correction Required:** [ ] yes [x] no



MOISTURE DENSITY RELATIONSHIP VALUES

Maximum Dry Density, pcf	125.0	**@ Optimum Moisture, %**	10.0
Corrected Maximum Dry Density, pcf		**@ Optimum Moisture, %**	

MATERIAL DESCRIPTION

Grain Size Distribution:

	% Gravel (retained on No. 4)
	% Sand (Passing No. 4, Retained on No. 200)
	% Silt and Clay (Passing No. 200)

Atterberg Limits:

	Liquid Limit, %
	Plastic Limit, %
	Plasticity Index, %

Classification:

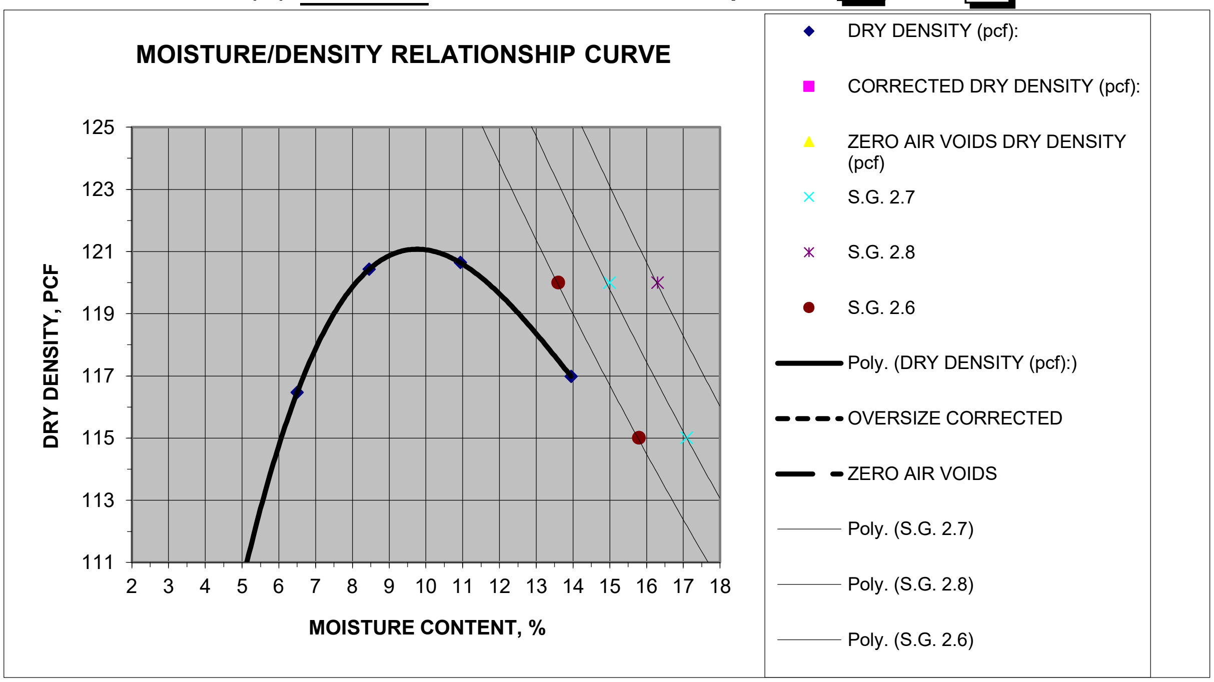
Unified Soils Classification: ______

AASHTO Soils Classification: ______

MOISTURE/DENSITY RELATIONSHIP

Client:	DR Horton	**Job No.:**	3680-SD
Project:	Emerald Hills	**Lab No.:**	3795
Location:	San Diego, CA		
Material Type:	Dark Brown Silty Clayey Fine Sand		
Material Supplier:	-		
Material Source:	-		
Sample Location:	TP-3		
	-		
Sampled By:	CH	**Date Sampled:**	9/19/2022
Received By:	CH	**Date Received:**	9/19/2022
Tested By:	KP	**Date Tested:**	9/29/2022
Reviewed By:	-	**Date Reviewed:**	-

Test Procedure: ASTM D1557 **Method:** A
Oversized Material (%): 0.0 **Correction Required:** [ ] yes [x] no



MOISTURE DENSITY RELATIONSHIP VALUES

Maximum Dry Density, pcf	121.0	**@ Optimum Moisture, %**	10.0
Corrected Maximum Dry Density, pcf		**@ Optimum Moisture, %**	

MATERIAL DESCRIPTION

Grain Size Distribution:

	% Gravel (retained on No. 4)
	% Sand (Passing No. 4, Retained on No. 200)
	% Silt and Clay (Passing No. 200)

Atterberg Limits:

	Liquid Limit, %
	Plastic Limit, %
	Plasticity Index, %

Classification:

Unified Soils Classification: ____________________

GEOTEK

EXPANSION INDEX TEST

(ASTM D4829)

Project Name:	Emeral Hills	***Tested/ Checked By:***	***KP*** Lab No 3795
Project Number:	3680-SD	***Date Tested:***	10/3/2022
Project Location:	San Diego, CA	***Sample Source:***	TP-1 BB-1
		Sample Description:	Dark Brown Silty Sand

Ring Id: 12 Ring Dia. " : 4" Ring I 1"

Loading weight: 5516. grams

DENSITY DETERMINATION

A	Weight of compacted sample & ring	**773**
B	Weight of ring	370
C	Net weight of sample	403
D	Wet Density, lb / ft3 (C*0.3016)	121.5
E	Dry Density, lb / ft3 (D/1.F)	**110.8**

SATURATION DETERMINATION

	Wet Weight of sample & tare	**168.4**
	Dry Weight of sample & tare	**154**
	Tare	**4.8**
F	Initial Moisture Content, %	**9.7**
G	(E*F)	1069.8
H	(E/167.232)	0.66
I	(1.-H)	0.34
J	(62.4*I)	21.0
K	(G/J)= **L** % Saturation	**50.8**

READINGS

DATE	TIME	READING	
10/3/2022	13:05	128	Initial
	13:15	128	10 min/Dry
	13:16	129	1 min/Wet
	13:21	134	5 min/Wet
10/4/2022	9:03	142	Random
	9:08	142	Final

FINAL MOISTURE

Weight of wet sample & tare	Wt. of dry sample & tare	Tare	% Moisture
213	182.9	4.8	16.9%

EXPANSION INDEX = 14

GEOTEK

EXPANSION INDEX TEST

(ASTM D4829)

Project Name:	Emeral Hills	***Tested/ Checked By:***	***KP*** Lab No 3795
Project Number:	3680-SD	***Date Tested:***	10/3/2022
Project Location:	San Diego, CA	***Sample Source:***	TP-8 BB-1
		Sample Description:	Dark Brown Silty Sand

Ring Id: 12 Ring Dia. " : 4" Ring I 1"

Loading weight: 5516. grams

DENSITY DETERMINATION

A	Weight of compacted sample & ring	**764**
B	Weight of ring	370
C	Net weight of sample	394
D	Wet Density, lb / ft3 (C*0.3016)	118.8
E	Dry Density, lb / ft3 (D/1.F)	**107.7**

SATURATION DETERMINATION

	Wet Weight of sample & tare	**127.9**
	Dry Weight of sample & tare	**116.4**
	Tare	**4.8**
F	Initial Moisture Content, %	**10.3**
G	(E*F)	1110.1
H	(E/167.232)	0.64
I	(1.-H)	0.36
J	(62.4*I)	22.2
K	(G/J)= **L** % Saturation	**50.0**

READINGS

DATE	TIME	READING	
10/3/2022	9:01	137	Initial
	9:11	137	10 min/Dry
	9:13	141	1 min/Wet
	9:18	147	5 min/Wet
10/4/2022	8:40	162	Random
	8:50	162	Final

FINAL MOISTURE

Weight of wet sample & tare	Wt. of dry sample & tare	Tare	% Moisture
270	236	4.8	14.7%

EXPANSION INDEX = 25

-200 WASH

Date:	10/5/2022		
W.O.:	3680-SD	sample ID	TP-7 S-1
Client:	DR Horton	depth	5'
Project:	Emerald Hills		

Sieve Size	Particle Diameter		Wt. Retained	Wt. Passing	% Passing	Specs
	in.	mm.				
#200	0.0029	0.074	112.6	156.8	58.2%	

Dry Weight 269.4

Soak Time 40 Minutes

October 31, 2022 via email: clivesey@geotekusa.com

Geotek, Inc.
1384 Pointsettia Avenue, Suite A
Vista, CA, 92081

Attention: Mr. Christopher Livesey

Re: Soil Corrosivity Study
Emerald Hills
San Diego, CA
HDR #22-0975SCS, Geotek #3680-SD

Introduction

Laboratory tests have been completed on eight soil samples provided to HDR for the Emerald Hills project. The purpose of these tests was to determine whether the soils are likely to have deleterious effects on underground utility piping, MSE walls, post tensioning systems, and concrete structures. HDR assumes that the provided samples are representative of the most corrosive soils at the site.

The proposed structures are single family homes and have one to two stories with no subterranean levels. The site is identified as County of San Diego Assessor's Parcel Number 543-340-02-00 and can be located on a map adjacent to 5706 Memory Lane in San Diego, California, and the water table is reportedly greater than 20 feet deep.

The scope of this study is limited to a determination of soil corrosivity and general corrosion control recommendations for materials likely to be used for construction. HDR's recommendations do not constitute, and are not meant as a substitute for, design documents for the purpose of construction. If the architects and/or engineers desire more specific information, designs, specifications, or review of design, HDR will be happy to work with them as a separate phase of this project.

Soil Corrosivity Testing

Laboratory Testing

The electrical resistivity of each sample was measured in a soil box per *ASTM International (ASTM)* G187 in its as-received condition and again after saturation with distilled water. Resistivities are at about their lowest value when the soil is saturated. The pH of the saturated samples was measured per ASTM G51. A 5:1 water:soil extract from each sample was chemically analyzed for the major soluble salts commonly found in soil per ASTM D4327, ASTM D6919, and *American Water Works Association (AWWA*) Standard Method 2320-B.

431 West Baseline Road, Claremont, CA 91711-1608
(909) 626-0967

The laboratory analyses were performed under HDR laboratory number 22-0975SCS. The full set of test results are shown in the attached Table A1.

Discussion

A major factor in determining soil corrosivity is electrical resistivity. The electrical resistivity of a soil is a measure of its resistance to the flow of electrical current. Corrosion of buried metal is an electrochemical process in which the amount of metal loss due to corrosion is directly proportional to the flow of electrical current (DC) from the metal into the soil. Corrosion currents, following Ohm's Law, are inversely proportional to soil resistivity. Lower electrical resistivities result from higher moisture and soluble salt contents and indicate corrosive soil. A correlation between electrical resistivity and corrosivity toward ferrous metals is shown in Table 1.[1]

Table 1: Soil Corrosivity Categories

Soil Resistivity (ohm-cm)	Corrosivity Category
Greater than 10,000	Mildly Corrosive
2,001 to 10,000	Moderately Corrosive
1,001 to 2,000	Corrosive
0 to 1,000	Severely Corrosive

Other soil characteristics that may influence corrosivity towards metals are pH, soluble salt content, soil types, aeration, anaerobic conditions, and site drainage.

Electrical resistivities were in the mildly corrosive to corrosive categories with as-received moisture. When saturated, the resistivities were in the moderately corrosive to severely corrosive categories. The resistivities dropped considerably with added moisture because the samples were dry as-received.

Soil pH values varied from 6.6 to 7.6. This range is neutral to mildly alkaline.[2]

The soluble salt content of the samples ranged from low to high.

Per ACI-318, the soil is classified as S0 with respect to sulfate concentration.[3]

Nitrate was detected in low concentrations. Ammonium was not detected.

The Caltrans Corrosion Guidelines were used as a basis for mechanically stabilized embankment (MSE) material backfill evaluation.[4] Section 8.1, Corrosion Requirements for MSE Structure Backfill, references Caltrans Standard Specification Section 47-2.02 for properties of structure backfill. The minimum requirements for soil in contact with MSE are shown in Table 2.

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[1] Romanoff, Melvin. Underground Corrosion, NBS Circular 579. Reprinted by NACE. Houston, TX, 1989, pp. 166–167.
[2] Romanoff, Melvin. Underground Corrosion, NBS Circular 579. Reprinted by NACE. Houston, TX, 1989, p. 8.
[3] American Concrete Institute (ACI) 318-19 Table 19.3.1.1.
[4] Corrosion Guidelines, Version 3.0. California Department of Transportation (Caltrans),Sacramento, CA, 2018.

Table 2: MSE Backfill Minimum Soil Requirements.

Property Requirements		
Test	Requirement	ASTM Test
Minimum Resistivity	2000 ohm-cm min.	G187
Chloride	Less than 250 ppm	D4327 and D6919
Sulfate	Less than 500 ppm	D4327 and D6919
pH	5.5 to 10.0	G51

MSE backfill material that meets the above criteria is what Caltrans considers “non-corrosive” to the metallic soil reinforcement. Comparison of the attached Table A1 soil sample analysis results with the above criteria indicates that the material does not satisfy all of the above requirements and is therefore unsuitable for use as MSE backfill.

In conclusion, this soil is classified as severely corrosive to ferrous metals, negligible (S0) for sulfate attack on concrete, and unsuitable for use as MSE backfill.

Corrosion Control Recommendations

The life of buried materials depends on thickness, strength, loads, construction details, soil moisture, etc., in addition to soil corrosivity, and is, therefore, difficult to predict. Of more practical value are corrosion control methods that will increase the life of materials that would be subject to significant corrosion. The following recommendations are based on the evaluation of soil corrosivity described above. Unless otherwise indicated, these recommendations apply to the entire site or alignment.

All Pipe

1. On all pipes, appurtenances, and fittings not protected by cathodic protection, coat bare metal such as valves, bolts, flange joints, joint harnesses, and flexible couplings with wax tape per AWWA C217 after assembly.

2. Where metallic pipelines penetrate concrete structures such as building floors, vault walls, and thrust blocks use plastic sleeves, rubber seals, or other dielectric material to prevent pipe contact with the concrete and reinforcing steel.

3. To prevent differential aeration corrosion cells, provide at least 2 inches of pipe bedding or backfill material all around metallic piping, including the bottom. Do not lay pipe directly on undisturbed soil.

Steel Pipe

1. Underground steel pipe with rubber gasketed, mechanical, grooved end, or other nonconductive type joints should be bonded for electrical continuity. Electrical continuity is necessary for corrosion monitoring and cathodic protection.

2. Install corrosion monitoring test stations to facilitate corrosion monitoring and the application of cathodic protection:

    a. At each end of the pipeline.

    b. At each end of all casings.

    c. Other locations as necessary so the interval between test stations does not exceed 1,200 feet.

3. To prevent dissimilar metal corrosion cells and to facilitate the application of cathodic protection, electrically isolate each buried steel pipeline per NACE SP0286 from:

    a. Dissimilar metals.

    b. Dissimilarly coated piping (cement-mortar vs. dielectric).

    c. Above ground steel pipe.

    d. All existing piping.

4. Apply a suitable dielectric coating intended for underground use such as:

    a. Polyurethane per AWWA C222 *or*

    b. Extruded polyethylene per AWWA C215 *or*

    c. A tape coating system per AWWA C214 *or*

    d. Hot applied coal tar enamel per AWWA C203 *or*

    e. Fusion bonded epoxy per AWWA C213.

5. Apply cathodic protection to steel piping as per NACE SP0169.

NOTE: Some steel piping systems, such as oil, gas, insulated, or high-pressure piping systems, have special corrosion and cathodic protection requirements that must be evaluated for each specific application.

Ductile Iron Pipe

1. To prevent dissimilar metal corrosion cells and to facilitate the application of cathodic protection, electrically insulate underground iron pipe from dissimilar metals and from above ground iron pipe with insulating joints per NACE SP0286.

2. Bond all nonconductive type joints for electrical continuity. Electrical continuity is necessary for corrosion monitoring and cathodic protection.

3. Install corrosion monitoring test stations to facilitate corrosion monitoring and the application of cathodic protection:

    a. At each end of the pipeline.

    b. At each end of any casings.

    c. Other locations as necessary so the interval between test stations does not exceed 1,200 feet.

4. Apply a suitable coating intended for underground use such as:

    a. Polyethylene encasement per AWWA C105; *or*

    b. Epoxy coating; *or*

    c. Polyurethane; *or*

    d. Wax tape.

    NOTE: The thin factory-applied asphaltic coating applied to ductile iron pipe for transportation and aesthetic purposes does not constitute a corrosion control coating.

5. Apply cathodic protection to ductile iron piping as per NACE SP0169.

NOTE: Some iron piping systems, such as for fire water piping, have special corrosion and cathodic protection requirements that must be evaluated for each specific application.

Cast Iron Soil Pipe

1. Protect cast iron soil pipe with either a double wrap 4-mil or single wrap 8-mil polyethylene encasement per AWWA C105.

2. It is not necessary to bond the pipe joints or apply cathodic protection.

3. Provide 6 inches of clean sand backfill all around the pipe. Use the following parameters for clean sand backfill:

    a. Minimum saturated resistivity of no less than 3,000 ohm-cm; *and*

    b. pH between 6.0 and 8.0.

c. All backfill testing should be performed by a corrosion engineering laboratory.

Copper Tubing

1. Use Type K or Type L copper tubing as required by the applicable local plumbing code. Type M tubing should not be used for buried applications.[5]

2. Electrically insulate underground copper pipe from dissimilar metals and from above ground copper pipe with insulating devices per NACE SP0286. Sleeve copper pipe through footings and foundations to prevent pH concentration cells and prevent leaks caused by settlement.

3. Electrically insulate cold water piping from hot water piping systems.

4. Protect cold water pipe using all of the following measures:

    a. Place cold water copper tubing in an 8-mil polyethylene sleeve or encase in double 4-mil thick polyethylene sleeves. Ensure that sleeves are intact and free of cuts, tears, punctures, or other damage.

    b. Remove any construction debris, rocks, wood, or organic matter from the trench prior to backfill.

    c. Bed and backfill with at least 2 inches of clean sand all around the tubing, including the bedding. Use the following parameters for clean sand backfill:

        i. Minimum saturated resistivity of no less than 3,000 ohm-cm; and

        ii. pH between 6.0 and 8.0.

        iii. All backfill testing should be performed by a corrosion engineering laboratory.

    d. Copper tubing for cold water can also be treated the same as for hot water.

5. Hot water tubing may be subject to a higher corrosion rate. Protect hot copper tubing using one of the following measures:

    a. Prevent soil contact. Soil contact may be prevented by placing the tubing above ground or encasing the tubing with PVC pipe with solvent-welded joints. Either seal the PVC pipe at both ends using ammonia- and methanol-free caulk, or terminate both ends above-grade in a manner that doesn't allow water to infiltrate; *or*

    b. Applying cathodic protection per NACE SP0169. The amount of cathodic protection current needed can be minimized by coating the tubing with a suitable

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[5] *2016 California Plumbing Code (CPC), July 1, 2018 Supplement, Section 604.3.*

dielectric coating that is compatible with cathodic protection, such as Polyken 930.

Plastic and Vitrified Clay Pipe

1. No special corrosion control measures are required for plastic and vitrified clay piping placed underground.

2. Protect all metallic fittings and valves with wax tape per AWWA C217, or with epoxy and appropriately designed cathodic protection system per NACE SP0169.

Concrete Structures and Pipe

1. From a corrosion standpoint, any type of ASTM C150 cement may be used for concrete structures and pipe because the sulfate concentration is negligible (S0), from 0 to 0.10 percent. Use a minimum strength of 2,500 psi per applicable codes.[6,7,8]

2. Chloride concentrations were measured at levels where additional protective measures are required to protect steel and iron embedded in concrete from chloride attack.[9] This applies to such items as reinforcing steel and anchor bolts, but not post-tensioning strands and anchors, which have separate requirements. The protection could be one or a combination of the following:

   a. Install protective concrete, a concrete mix designed to protect embedded steel and iron based on the following parameters:

      i. A chloride ion content of 800 ppm in the soil;

      ii. The desired service life;

      iii. The design concrete cover; and

      iv. The applicable building code.

   Note that a protective concrete mix may include a corrosion inhibitor admixture and/or supplementary cementitious materials such as fly ash or silica fume.

   b. Install waterproof concrete. Waterproofing for concrete could be a gravel capillary break under the concrete, a waterproof membrane such as the Grace PrePrufe® products, a waterproofing admixture, and/or a liquid applied waterproof barrier coating. Visqueen, similar rolled barriers, or bentonite-based membranes are not viable waterproofing systems for corrosion protection.[10]

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[6] 2021 International Building Code (IBC) which refers to American Concrete Institute (ACI) 318-19 Table 19.3.2.1
[7] 2021 International Residential Code (IRC) which refers to American Concrete Institute (ACI) 318-19 Table 19.3.2.1
[8] 2019 California Building Code (CBC) which refers to American Concrete Institute (ACI) 318-19 Table 19.3.2.1
[9] Design Manual 303: Concrete Cylinder Pipe. Ameron. p.65
[10] ASTM E1643-18a: Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs. ASTM International, 2018.

c. Coat embedded metal. A coating for embedded steel and iron could be an epoxy coating applied to the metal. Purple fusion bonded epoxy (FBE) (ASTM A934) intended for prefabricated reinforcing steel reinforcing steel is suitable. Any damage to the coating must be repaired in accordance with the manufacturer's specifications prior to installation. The green flexible FBE (ASTM A775) is not recommended.

d. Apply cathodic protection. Cathodic protection is most practical for pipelines and must be designed for each application. The amount of cathodic protection current needed can be minimized by coating the steel or iron.

Post-Tensioned Slabs: Unbonded Single-Stranded Tendons and Anchors

Soil is considered an aggressive environment for post-tensioning strands and anchors. The high chloride concentration measured in soil on site makes this soil particularly aggressive. Protect post-tensioning strands and anchors against corrosion by implementing all the following measures:[11,12,13]

1. Limit the water-soluble chloride ion content in the concrete mix design to less than 0.06 percent by weight of cement.
2. Completely encapsulate the tendon and anchor with polyethylene to create a watertight seal.
3. Use non-shrink grout mixes for all post-tensioning pockets.
4. Protect all components from moisture prior to installation and within one working day after installation.
5. Ensure the minimum concrete cover over the tendon tail is 1 inch, or greater if required by the applicable building code.
6. Caps should be installed within one working day after the cutting of the tendon tails and acceptance of the elongation records by the engineer.
7. Inspect the following to ensure the encapsulated system is completely watertight:
    a. Sheathing: Verify that all damaged areas, including pin-holes, are repaired.
    b. Stressing tails: After removal, ensure they are cut to a length for proper installation of coating filled end caps.
    c. End caps: Ensure proper installation before patching the pocket recesses.

[11] *Post-Tensioning Manual, sixth edition. Post-Tensioning Institute (PTI), Phoenix, AZ, 2006.*
[12] *PTI M10.2-17 Specification for Unbonded Single Strand Tendons. Post-Tensioning Institute (PTI), Phoenix, AZ, 2017*
[13] *ACI 423.6-01: Specification for Unbonded Single Strand Tendons. American Concrete Institute (ACI), 2001*

   d. Patching: Ensure the patch is of an approved material and mix design, and installed void-free.

8. Limit the access of direct runoff onto the anchorage area by designing proper drainage. Do not allow water to pond against anchors.

9. The amount of space between the anchorage area and the nearest point of soil contact should be based on the following parameters: 1) a chloride content of 800 ppm in the soil; 2) the desired service life.

Closure

The analysis and recommendations presented in this report are based upon data obtained from the laboratory samples. This report does not reflect variations that may occur across the site or due to the modifying effects of construction. If variations appear, HDR should be notified immediately so that further evaluation and supplemental recommendations can be provided.

HDR's services have been performed with the usual thoroughness and competence of the engineering profession. No other warranty or representation, either expressed or implied, is included or intended.

Please call if you have any questions.

Respectfully Submitted,
HDR Engineering, Inc.

Teddie Algorri
Laboratory Coordinator

Bradley M. Stuart, PE
Corrosion Engineer

Enc: Table A1

22-0975SCS SCS TA-BS-TA.docx

Table A1 - Laboratory Tests on Soil Samples

Geotek, Inc.
Emerald Hills
Your #3680-SD, HDR Lab #22-0975SCS
21-Oct-22

Sample ID			TP-1 (BB-1) @ 0-4'	TP-2 (S-1) @ -5'	TP-1 (S-1) @ -5'	TP-3 (BB-1) @ 3-5'	TP-4 (S-1) @ -10'
Resistivity		**Units**					
as-received		ohm-cm	252,000	18,000	2,720	10,400	1,880
saturated		ohm-cm	920	2,080	312	352	400
pH			6.6	6.7	6.9	6.9	6.6
Electrical Conductivity		mS/cm	0.24	0.12	0.90	0.94	1.25
Chemical Analyses							
Cations							
calcium	Ca^{2+}	mg/kg	59	37	41	51	61
magnesium	Mg^{2+}	mg/kg	6.7	13	18	16	37
sodium	Na^{1+}	mg/kg	221	125	974	961	1,250
potassium	K^{1+}	mg/kg	7.1	2.5	6.2	8.6	11
ammonium	NH_4^{1+}	mg/kg	ND	ND	ND	ND	ND
Anions							
carbonate	CO_3^{2-}	mg/kg	ND	24	18	6.0	12
bicarbonate	HCO_3^{1-}	mg/kg	519	268	290	134	207
fluoride	F^{1-}	mg/kg	6.0	4.2	11	4.9	3.8
chloride	Cl^{1-}	mg/kg	17	6.2	358	301	793
sulfate	SO_4^{2-}	mg/kg	15	7.1	361	564	229
nitrate	NO_3^{1-}	mg/kg	2.3	ND	2.7	2.5	22
phosphate	PO_4^{3-}	mg/kg	ND	ND	ND	ND	ND
Other Tests							
sulfide	S^{2-}	qual	na	na	na	na	na
Redox		mV	na	na	na	na	na

Resistivity per ASTM G187, pH per ASTM G51, Cations per ASTM D6919, Anions per ASTM D4327, and Alkalinity per APHA 2320-B.

Electrical conductivity in millisiemens/cm and chemical analyses were made on a 1:5 soil-to-water extract.

mg/kg = milligrams per kilogram (parts per million) of dry soil.

Redox = oxidation-reduction potential in millivolts

ND = not detected

na = not analyzed

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Phone: 909.962.5485 · Fax: 909.626.3316

Table A1 - Laboratory Tests on Soil Samples

Geotek, Inc.
Emerald Hills
Your #3680-SD, HDR Lab #22-0975SCS
21-Oct-22

Sample ID			TP-5 (S-1) @ 5-6'	TP-9 (S-1) @ -5'	TP-11 (S-1) @ 0-5'
Resistivity		**Units**			
as-received		ohm-cm	2,920	5,200	4,800
saturated		ohm-cm	800	1,120	880
pH			7.2	7.6	6.8
Electrical Conductivity		mS/cm	0.11	0.48	0.35
Chemical Analyses					
Cations					
calcium	Ca^{2+}	mg/kg	27	34	41
magnesium	Mg^{2+}	mg/kg	9.2	15	16
sodium	Na^{1+}	mg/kg	135	560	425
potassium	K^{1+}	mg/kg	0.9	7.2	9.1
ammonium	NH_4^{1+}	mg/kg	ND	ND	ND
Anions					
carbonate	CO_3^{2-}	mg/kg	6.0	59	ND
bicarbonate	HCO_3^{1-}	mg/kg	101	381	451
fluoride	F^{1-}	mg/kg	2.2	5.1	8.8
chloride	Cl^{1-}	mg/kg	13	106	91
sulfate	SO_4^{2-}	mg/kg	59	175	53
nitrate	NO_3^{1-}	mg/kg	2.2	5.2	2.4
phosphate	PO_4^{3-}	mg/kg	ND	ND	ND
Other Tests					
sulfide	S^{2-}	qual	na	na	na
Redox		mV	na	na	na

Resistivity per ASTM G187, pH per ASTM G51, Cations per ASTM D6919, Anions per ASTM D4327, and Alkalinity per APHA 2320-B.

Electrical conductivity in millisiemens/cm and chemical analyses were made on a 1:5 soil-to-water extract.

mg/kg = milligrams per kilogram (parts per million) of dry soil.

Redox = oxidation-reduction potential in millivolts

ND = not detected

na = not analyzed

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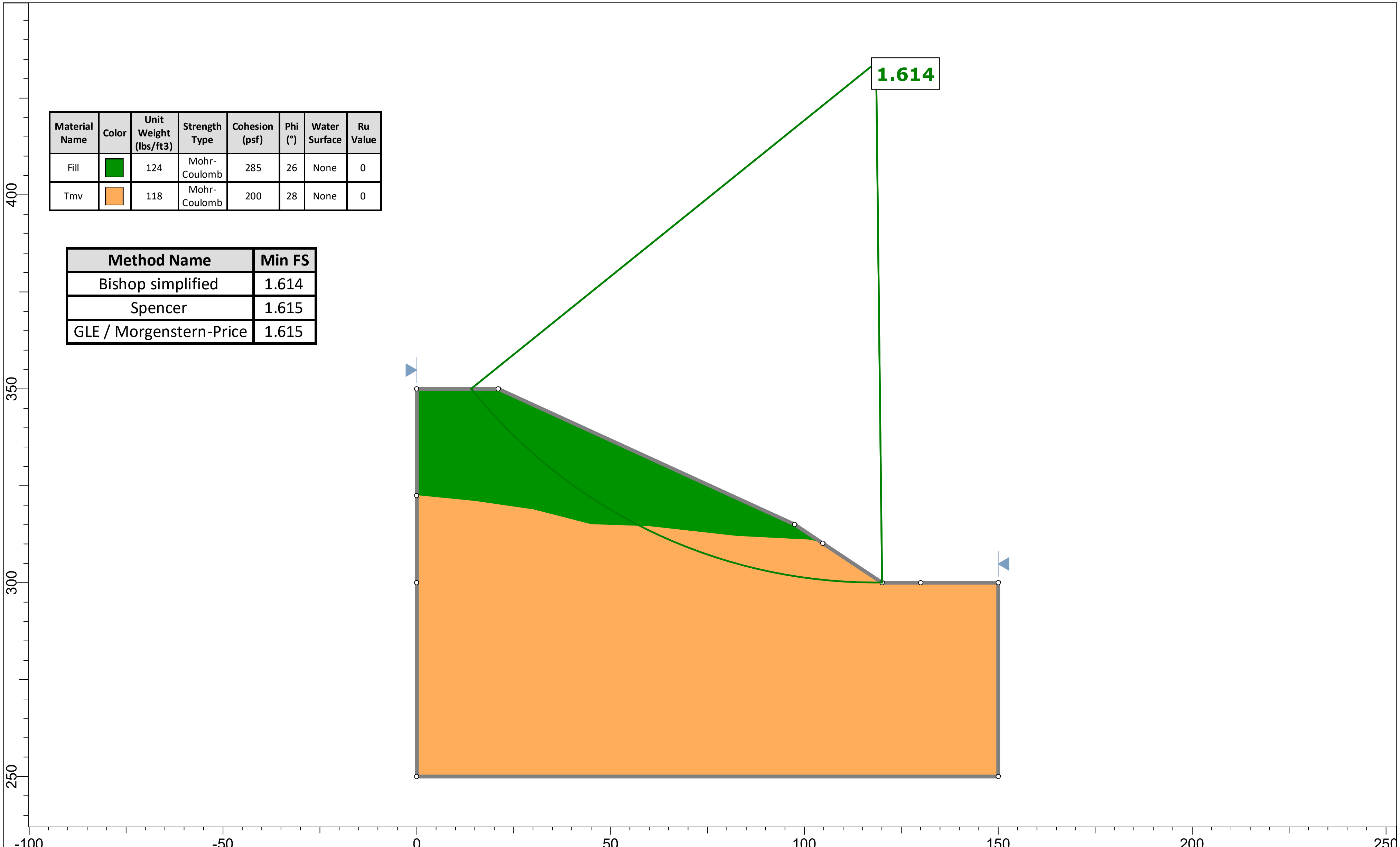
APPENDIX D

SLOPE STABILITY ANALYSIS

GEOTEK

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)	Water Surface	Ru Value
Fill		124	Mohr-Coulomb	285	26	None	0
Tmv		118	Mohr-Coulomb	200	28	None	0

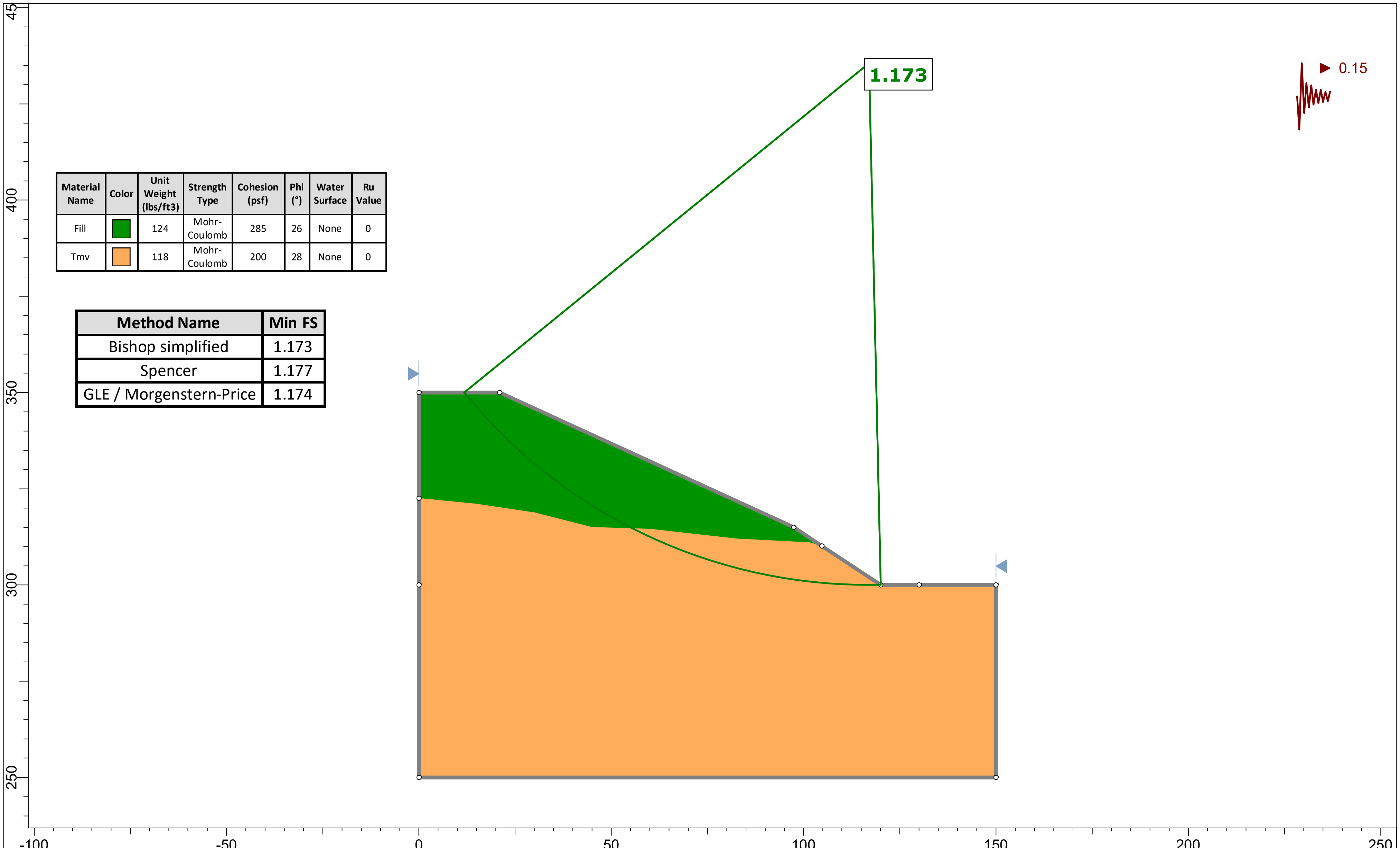
Method Name	Min FS
Bishop simplified	1.614
Spencer	1.615
GLE / Morgenstern-Price	1.615



Project	3680-SD Cross-Section A-A' Static
Group	
Scenario	
Drawn By	ERC
Company	GeoTek, Inc.
Date	11/8/2023, 2:41:16 PM
File Name	3680-SD_Cross-Section_A-A_ERC.slmd

rocscience

SLIDEINTERPRET 9.029



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)	Water Surface	Ru Value
Fill		124	Mohr-Coulomb	285	26	None	0
Tmv		118	Mohr-Coulomb	200	28	None	0

Method Name	Min FS
Bishop simplified	1.173
Spencer	1.177
GLE / Morgenstern-Price	1.174

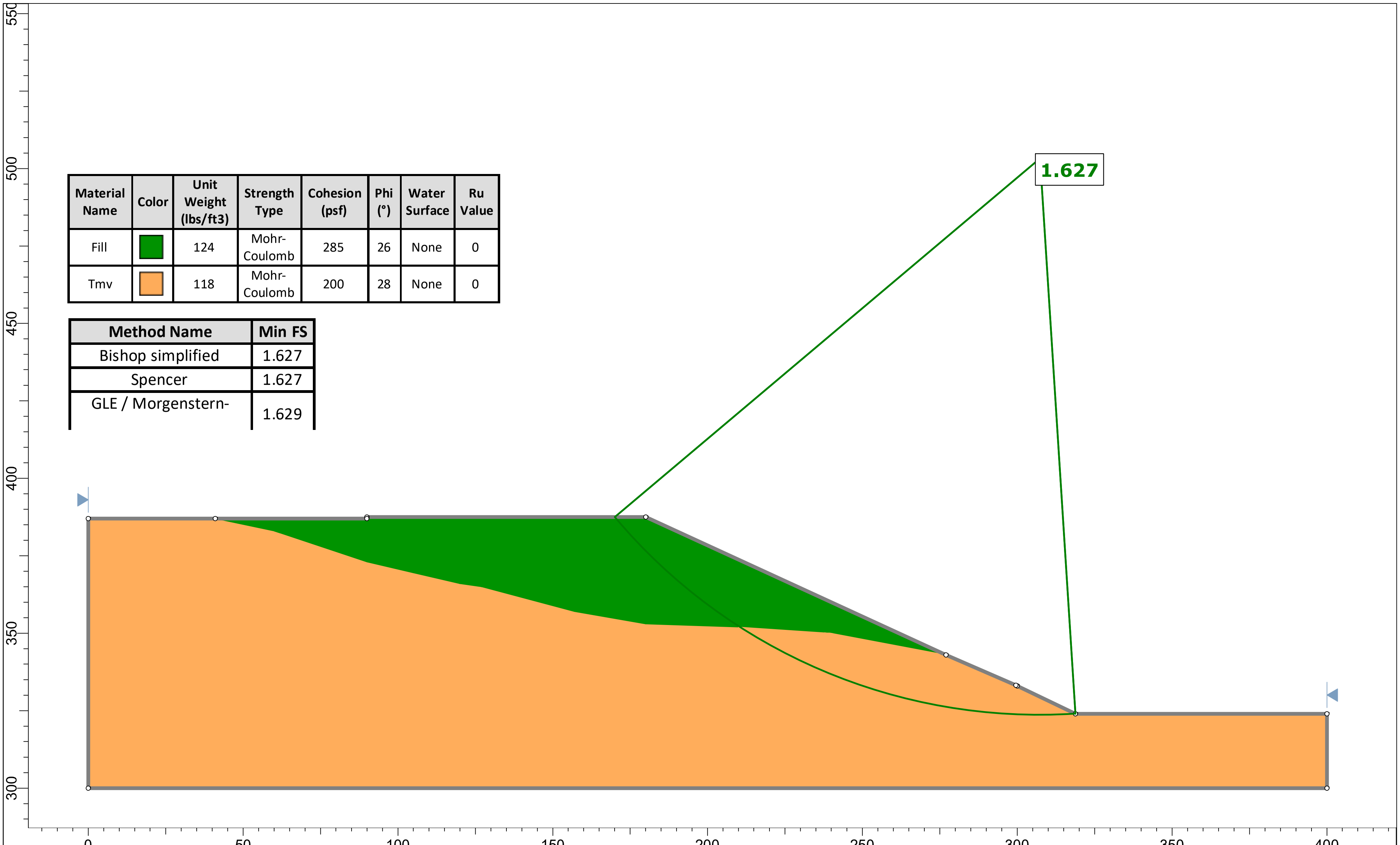
rocscience

SLIDEINTERPRET 9.029

Project	Cross-Section A-A' Pseudostatic		
Group	Group 1	*Scenario*	
Drawn By	ERC	*Company*	GeoTek, Inc.
Date	11/8/2023, 2:41:16 PM	*File Name*	3680-SD_Cross-Section_A-A_ERC.slmd

Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)	Water Surface	Ru Value
Fill		124	Mohr-Coulomb	285	26	None	0
Tmv		118	Mohr-Coulomb	200	28	None	0

Method Name	Min FS
Bishop simplified	1.627
Spencer	1.627
GLE / Morgenstern-	1.629



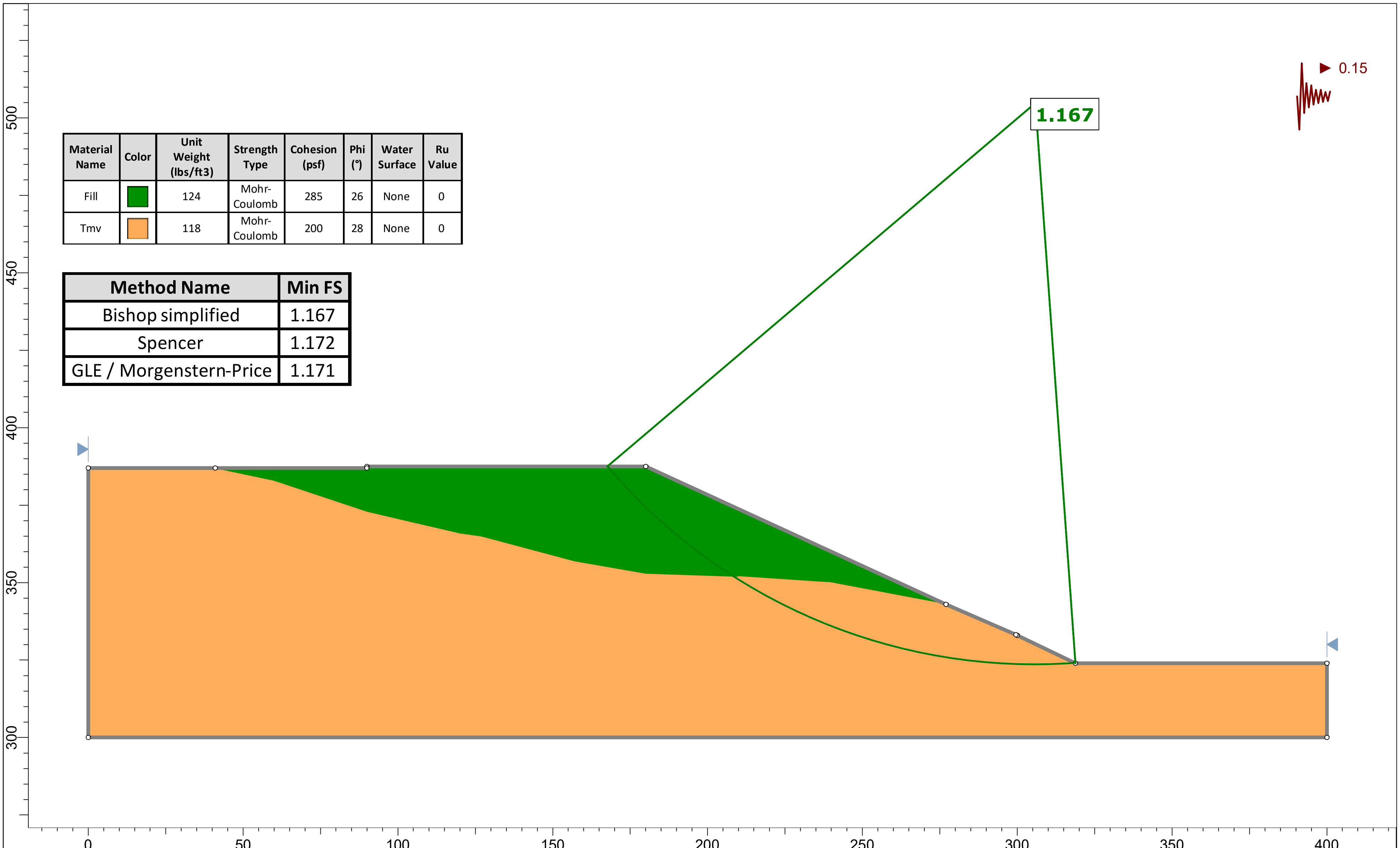
Project	3680-SD Cross-Section C-C' Static
Group	
Scenario	
Drawn By	ERC
Company	GeoTek, Inc.
Date	11/9/2023, 12:02:15 PM
File Name	3680-SD_Cross-Section_C-C_ERC.slmd

rocscience

SLIDEINTERPRET 9.029

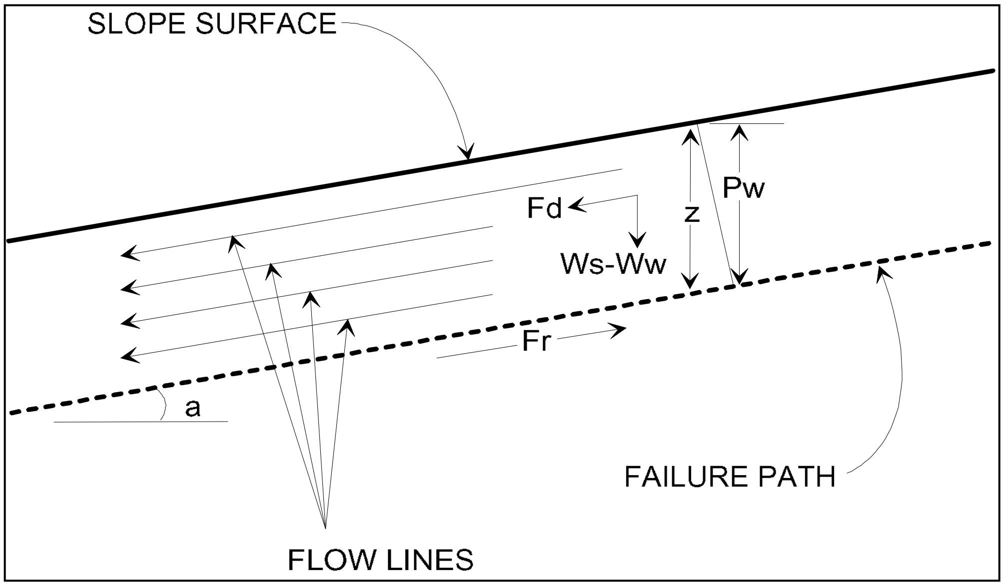
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (°)	Water Surface	Ru Value
Fill		124	Mohr-Coulomb	285	26	None	0
Tmv		118	Mohr-Coulomb	200	28	None	0

Method Name	Min FS
Bishop simplified	1.167
Spencer	1.172
GLE / Morgenstern-Price	1.171



rocscience	*Project*	3680-SD Cross-Section C-C' Pseodostatic	
	Group		*Scenario*
	Drawn By ERC		*Company* GeoTek, Inc.
SLIDEINTERPRET 9.029	*Date* 11/9/2023, 12:02:15 PM		*File Name* 3680-SD_Cross-Section_C-C_ERC.slmd

SURFICIAL STABILITY ANALYSIS



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

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

2:1 Fill Slope

Given:

Ws	z	a		phi		c
(pcf)	(ft)	(degrees)	(radians)	(degrees)	(radians)	(psf)
123	2	26.56505	0.463648	23	0.401426	200

Calculations:

Pw	u	Fd	Fr	**FS**
1.60	99.84	98.40	241.16	**2.45**

Project No. 3680-SD

GEOTEK

APPENDIX E

GENERAL EARTHWORK GRADING GUIDELINES

GEOTEK

GENERAL GRADING GUIDELINES

Guidelines presented herein are intended to address general construction procedures for earthwork construction. Specific situations and conditions often arise which cannot reasonably be discussed in general guidelines, when anticipated these are discussed in the text of the report. Often unanticipated conditions are encountered which may necessitate modification or changes to these guidelines. It is our hope that these will assist the contractor to more efficiently complete the project by providing a reasonable understanding of the procedures that would be expected during earthwork and the testing and observation used to evaluate those procedures.

General

Grading should be performed to at least the minimum requirements of governing agencies, the California Building Code, CBC (2022) and the guidelines presented below.

Preconstruction Meeting

A preconstruction meeting should be held prior to site earthwork. Any questions the contractor has regarding our recommendations, general site conditions, apparent discrepancies between reported and actual conditions and/or differences in procedures the contractor intends to use should be brought up at that meeting. The contractor (including the main onsite representative) should review our report and these guidelines in advance of the meeting. Any comments the contractor may have regarding these guidelines should be brought up at that meeting.

Grading Observation and Testing

1. Observation of the fill placement should be provided by our representative during grading. Verbal communication during the course of each day will be used to inform the contractor of test results. The contractor should receive a copy of the "Daily Field Report" indicating results of field density tests that day. If our representative does not provide the contractor with these reports, our office should be notified.
2. Testing and observation procedures are, by their nature, specific to the work or area observed and location of the tests taken, variability may occur in other locations. The contractor is responsible for the uniformity of the grading operations; our observations and test results are intended to evaluate the contractor's overall level of efforts during grading. The contractor's personnel are the only individuals participating in all aspect of site work. Compaction testing and observation should not be considered as relieving the contractor's responsibility to properly compact the fill.
3. Cleanouts, processed ground to receive fill, key excavations, and subdrains should be observed by our representative prior to placing any fill. It will be the contractor's responsibility to notify our representative or office when such areas are ready for observation.
4. Density tests may be made on the surface material to receive fill, as considered warranted by this firm.
5. In general, density tests would be made at maximum intervals of two feet of fill height or every 1,000 cubic yards of fill placed. Criteria will vary depending on soil conditions and size of the fill. More frequent testing may be performed. In any case, an adequate number of field density tests should be made to evaluate the required compaction and moisture content is generally being obtained.

6. Laboratory testing to support field test procedures will be performed, as considered warranted, based on conditions encountered (e.g. change of material sources, types, etc.) Every effort will be made to process samples in the laboratory as quickly as possible and in progress construction projects are our first priority. However, laboratory workloads may cause in delays and some soils may require a **minimum of 48 to 72 hours to complete test procedures**. Whenever possible, our representative(s) should be informed in advance of operational changes that might result in different source areas for materials.
7. Procedures for testing of fill slopes are as follows:
   a) Density tests should be taken periodically during grading on the flat surface of the fill, three to five feet horizontally from the face of the slope.
   b) If a method other than over building and cutting back to the compacted core is to be employed, slope compaction testing during construction should include testing the outer six inches to three feet in the slope face to determine if the required compaction is being achieved.
8. Finish grade testing of slopes and pad surfaces should be performed after construction is complete.

Site Clearing

1. All vegetation, and other deleterious materials, should be removed from the site. If material is not immediately removed from the site it should be stockpiled in a designated area(s) well outside of all current work areas and delineated with flagging or other means. Site clearing should be performed in advance of any grading in a specific area.
2. Efforts should be made by the contractor to remove all organic or other deleterious material from the fill, as even the most diligent efforts may result in the incorporation of some materials. This is especially important when grading is occurring near the natural grade. All equipment operators should be aware of these efforts. Laborers may be required as root pickers.
3. Nonorganic debris or concrete may be placed in deeper fill areas provided the procedures used are observed and found acceptable by our representative. Typical procedures are similar to those indicated on Plate G-4.

Treatment of Existing Ground

1. Following site clearing, all surficial deposits of alluvium and colluvium as well as weathered or creep effected bedrock, should be removed (see Plates G-1, G-2 and G-3) unless otherwise specifically indicated in the text of this report.
2. In some cases, removal may be recommended to a specified depth (e.g. flat sites where partial alluvial removals may be sufficient). The contractor should not exceed these depths unless directed otherwise by our representative.
3. Groundwater existing in alluvial areas may make excavation difficult. Deeper removals than indicated in the text of the report may be necessary due to saturation during winter months.
4. Subsequent to removals, the natural ground should be processed to a depth of six inches, moistened to near optimum moisture conditions and compacted to fill standards.
5. Exploratory back hoe or dozer trenches still remaining after site removal should be excavated and filled with compacted fill if they can be located.

Subdrainage

1. Subdrainage systems should be provided in canyon bottoms prior to placing fill, and behind buttress and stabilization fills and in other areas indicated in the report. Subdrains should conform to schematic diagrams G-1 and G-5, and be acceptable to our representative.
2. For canyon subdrains, runs less than 500 feet may use six-inch pipe. Typically, runs in excess of 500 feet should have the lower end as eight-inch minimum.
3. Filter material should be clean, 1/2 to 1-inch gravel wrapped in a suitable filter fabric. Class 2 permeable filter material per California Department of Transportation Standards tested by this office to verify its suitability, may be used without filter fabric. A sample of the material should be provided to the Soils Engineer by the contractor at least two working days before it is delivered to the site. The filter should be clean with a wide range of sizes.
4. Approximate delineation of anticipated subdrain locations may be offered at 40-scale plan review stage. During grading, this office would evaluate the necessity of placing additional drains.
5. All subdrainage systems should be observed by our representative during construction and prior to covering with compacted fill.
6. Subdrains should outlet into storm drains where possible. Outlets should be located and protected. The need for backflow preventers should be assessed during construction.
7. Consideration should be given to having subdrains located by the project surveyors.

Fill Placement

1. Unless otherwise indicated, all site soil and bedrock may be reused for compacted fill; however, some special processing or handling may be required (see text of report).
2. Material used in the compacting process should be evenly spread, moisture conditioned, processed, and compacted in thin lifts six (6) to eight (8) inches in compacted thickness to obtain a uniformly dense layer. The fill should be placed and compacted on a nearly horizontal plane, unless otherwise found acceptable by our representative.
3. If the moisture content or relative density varies from that recommended by this firm, the contractor should rework the fill until it is in accordance with the following:
    a) Moisture content of the fill should be at or above optimum moisture. Moisture should be evenly distributed without wet and dry pockets. Pre-watering of cut or removal areas should be considered in addition to watering during fill placement, particularly in clay or dry surficial soils. The ability of the contractor to obtain the proper moisture content will control production rates.
    b) Each six-inch layer should be compacted to at least 90 percent of the maximum dry density in compliance with the testing method specified by the controlling governmental agency. In most cases, the testing method is ASTM Test Designation D 1557.
4. Rock fragments less than eight inches in diameter may be utilized in the fill, provided:
    a) They are not placed in concentrated pockets;
    b) There is a sufficient percentage of fine-grained material to surround the rocks;
    c) The distribution of the rocks is observed by, and acceptable to, our representative.
5. Rocks exceeding eight (8) inches in diameter should be taken off site, broken into smaller fragments, or placed in accordance with recommendations of this firm in areas designated suitable for rock disposal (see Plate G-4). On projects where significant large quantities of oversized materials are anticipated, alternate guidelines for placement may be included. If

significant oversize materials are encountered during construction, these guidelines should be requested.

6. In clay soil, dry or large chunks or blocks are common. If in excess of eight (8) inches minimum dimension, then they are considered as oversized. Sheepsfoot compactors or other suitable methods should be used to break up blocks. When dry, they should be moisture conditioned to provide a uniform condition with the surrounding fill.

Slope Construction

1. The contractor should obtain a minimum relative compaction of 90 percent out to the finished slope face of fill slopes. This may be achieved by either overbuilding the slope and cutting back to the compacted core, or by direct compaction of the slope face with suitable equipment.
2. Slopes trimmed to the compacted core should be overbuilt by at least three (3) feet with compaction efforts out to the edge of the false slope. Failure to properly compact the outer edge results in trimming not exposing the compacted core and additional compaction after trimming may be necessary.
3. If fill slopes are built "at grade" using direct compaction methods, then the slope construction should be performed so that a constant gradient is maintained throughout construction. Soil should not be "spilled" over the slope face nor should slopes be "pushed out" to obtain grades. Compaction equipment should compact each lift along the immediate top of slope. Slopes should be back rolled or otherwise compacted at approximately every 4 feet vertically as the slope is built.
4. Corners and bends in slopes should have special attention during construction as these are the most difficult areas to obtain proper compaction.
5. Cut slopes should be cut to the finished surface. Excessive undercutting and smoothing of the face with fill may necessitate stabilization.

Keyways, Buttress and Stabilization Fills

Keyways are needed to provide support for fill slope and various corrective procedures.

1. Side-hill fills should have an equipment-width key at their toe excavated through all surficial soil and into competent material and tilted back into the hill (Plates G-2, G-3). As the fill is elevated, it should be benched through surficial soil and slopewash, and into competent bedrock or other material deemed suitable by our representatives (See Plates G-1, G-2, and G-3).
2. Fill over cut slopes should be constructed in the following manner:
   a) All surficial soils and weathered rock materials should be removed at the cut-fill interface.
   b) A key at least one and one-half (1.5) equipment width wide (or as needed for compaction), and tipped at least one (1) foot into slope, should be excavated into competent materials and observed by our representative.
   c) The cut portion of the slope should be excavated prior to fill placement to evaluate if stabilization is necessary. The contractor should be responsible for any additional earthwork created by placing fill prior to cut excavation. (see Plate G-3 for schematic details.)
3. Daylight cut lots above descending natural slopes may require removal and replacement of the outer portion of the lot. A schematic diagram for this condition is presented on Plate G-2.

4. A basal key is needed for fill slopes extending over natural slopes. A schematic diagram for this condition is presented on Plate G-2.
5. All fill slopes should be provided with a key unless within the body of a larger overall fill mass. Please refer to Plate G-3 for specific guidelines.

Anticipated buttress and stabilization fills are discussed in the text of the report. The need to stabilize other proposed cut slopes will be evaluated during construction. Plate G-5 shows a schematic of buttress construction.

1. All backcuts should be excavated at gradients of 1:1 or flatter. The backcut configuration should be determined based on the design, exposed conditions, and need to maintain a minimum fill width and provide working room for the equipment.
2. On longer slopes, backcuts and keyways should be excavated in maximum 250 feet long segments. The specific configurations will be determined during construction.
3. All keys should be a minimum of two (2) feet deep at the toe and slope toward the heel at least one foot or two (2%) percent, whichever is greater.
4. Subdrains are to be placed for all stabilization slopes exceeding 10 feet in height. Lower slopes are subject to review. Drains may be required. Guidelines for subdrains are presented on Plate G-5.
5. Benching of backcuts during fill placement is required.

Lot Capping

1. When practical, the upper three (3) feet of material placed below finish grade should be comprised of the least expansive material available. Preferably, highly and very highly expansive materials should not be used. We will attempt to offer advice based on visual evaluations of the materials during grading, but it must be realized that laboratory testing is needed to evaluate the expansive potential of soil. Minimally, this testing takes two (2) to four (4) days to complete.
2. Transition lots (cut and fill) both per plan and those created by remedial grading (e.g. lots above stabilization fills, along daylight lines, above natural slopes, etc.) should be capped with a minimum three foot thick compacted fill blanket.
3. Cut pads should be observed by our representative(s) to evaluate the need for overexcavation and replacement with fill. This may be necessary to reduce water infiltration into highly fractured bedrock or other permeable zones, and/or due to differing expansive potential of materials beneath a structure. The overexcavation should be at least three feet. Deeper overexcavation may be recommended in some cases.

ROCK PLACEMENT AND ROCK FILL GUIDELINES

If large quantities of oversize material would be generated during grading, it's likely that such materials may require special handling for burial. Although alternatives may be developed in the field, the following methods of rock disposal are recommended on a preliminary basis.

Limited Larger Rock

When materials encountered are principally soil with limited quantities of larger rock fragments or boulders, placement in windrows is recommended. The following procedures should be applied:

1. Oversize rock (greater than 8 inches) should be placed in windrows.
    a) Windrows are rows of single file rocks placed to avoid nesting or clusters of rock.

b) Each adjacent rock should be approximately the same size (within ~one foot in diameter).

c) The maximum rock size allowed in windrows is four feet

2. A minimum vertical distance of three feet between lifts should be maintained. Also, the windrows should be offset from lift to lift. Rock windrows should not be closer than 15 feet to the face of fill slopes and sufficient space must be maintained for proper slope construction (see Plate G-4).

3. Rocks greater than eight inches in diameter should not be placed within seven feet of the finished subgrade for a roadway or pads and should be held below the depth of the lowest utility. This will allow easier trenching for utility lines.

4. Rocks greater than four feet in diameter should be broken down, if possible, or they may be placed in a dozer trench. Each trench should be excavated into the compacted fill a minimum of one foot deeper than the largest diameter of rock.

   a) The rock should be placed in the trench and granular fill materials (SE>30) should be flooded into the trench to fill voids around the rock.

   b) The over size rock trenches should be no closer together than 15 feet from any slope face.

   c) Trenches at higher elevation should be staggered and there should be a minimum of four feet of compacted fill between the top of the one trench and the bottom of the next higher trench.

   d) It would be necessary to verify 90 percent relative compaction in these pits. A 24 to 72 hour delay to allow for water dissipation should be anticipated prior to additional fill placement.

Structural Rock Fills

If the materials generated for placement in structural fills contains a significant percentage of material more than six (6) inches in one dimension, then placement using conventional soil fill methods with isolated windrows would not be feasible. In such cases the following could be considered:

1. Mixes of large rock or boulders may be placed as rock fill. They should be below the depth of all utilities both on pads and in roadways and below any proposed swimming pools or other excavations. If these fills are placed within seven (7) feet of finished grade, they may affect foundation design.

2. Rock fills are required to be placed in horizontal layers that should **not exceed two feet in thickness, or the maximum rock size present, which ever is less**. All rocks exceeding two feet should be broken down to a smaller size, windrowed (see above), or disposed of in non-structural fill areas. Localized larger rock up to 3 feet in largest dimension may be placed in rock fill as follows:

   a) individual rocks are placed in a given lift so as to be roughly 50% exposed above the typical surface of the fill ,

   b) loaded rock trucks or alternate compactors are worked around the rock on all sides to the satisfaction of the soil engineer,

   c) the portion of the rock above grade is covered with a second lift.

3. Material placed in each lift should be well graded. No unfilled spaces (voids) should be permitted in the rock fill.

Compaction Procedures

Compaction of rock fills is largely procedural. The following procedures have been found to generally produce satisfactory compaction.

1. Provisions for routing of construction traffic over the fill should be implemented.
   a) Placement should be by rock trucks crossing the lift being placed and dumping at its edge.
   b) The trucks should be routed so that each pass across the fill is via a different path and that all areas are uniformly traversed.
   c) The dumped piles should be knocked down and spread by a large dozer (D-8 or larger suggested). (Water should be applied before and during spreading.)

2. Rock fill should be generously watered (sluiced)
   a) Water should be applied by water trucks to the:
      i) dump piles,
      ii) front face of the lift being placed and,
      iii) surface of the fill prior to compaction.
   b) No material should be placed without adequate water.
   c) The number of water trucks and water supply should be sufficient to provide constant water.
   d) Rock fill placement should be suspended when water trucks are unavailable:
      i) for more than 5 minutes straight, or,
      ii) for more than 10 minutes/hour.

3. In addition to the truck pattern and at the discretion of the soil engineer, large, rubber tired compactors may be required.
   a) The need for this equipment will depend largely on the ability of the operators to provide complete and uniform coverage by wheel rolling with the trucks.
   b) Other large compactors will also be considered by the soil engineer provided that required compaction is achieved.

4. Placement and compaction of the rock fill is largely procedural. Observation by trenching should be made to check:
   a) the general segregation of rock size,
   b) for any unfilled spaces between the large blocks, and
   c) the matrix compaction and moisture content.

5. Test fills may be required to evaluate relative compaction of finer grained zones or as deemed appropriate by the soil engineer.
   a) A lift should be constructed by the methods proposed, as proposed

6. Frequency of the test trenching is to be at the discretion of the soil engineer. Control areas may be used to evaluate the contractor's procedures.

7. A minimum horizontal distance of 15 feet should be maintained from the face of the rock fill and any finish slope face. At least the outer 15 feet should be built of conventional fill materials.

Piping Potential and Filter Blankets

Where conventional fill is placed over rock fill, the potential for piping (migration) of the fine grained material from the conventional fill into rock fills will need to be addressed.

The potential for particle migration is related to the grain size comparisons of the materials present and in contact with each other. Provided that 15 percent of the finer soil is larger than the effective pore size of the coarse soil, then particle migration is substantially mitigated. This can be accomplished with a well-graded matrix material for the rock fill and a zone of fill similar to the matrix above it. The specific gradation of the fill materials placed during grading must be known to evaluate the need for any type of filter that may be necessary to cap the rock fills. This, unfortunately, can only be accurately determined during construction.

In the event that poorly graded matrix is used in the rock fills, properly graded filter blankets 2 to 3 feet thick separating rock fills and conventional fill may be needed. As an alternative, use of two layers of filter fabric (Mirafi 700 x or equivalent) could be employed on top of the rock fill. In order to mitigate excess puncturing, the surface of the rock fill should be well broken down and smoothed prior to placing the filter fabric. The first layer of the fabric may then be placed and covered with relatively permeable fill material (with respect to overlying material) 1 to 2 feet thick. The relative permeable material should be compacted to fill standards. The second layer of fabric should be placed and conventional fill placement continued.

Subdrainage

Rock fill areas should be tied to a subdrainage system. If conventional fill is placed that separates the rock from the main canyon subdrain, then a secondary system should be installed. A system consisting of an adequately graded base (3 to 4 percent to the lower side) with a collector system and outlets may suffice.

Additionally, at approximately every 25 foot vertical interval, a collector system with outlets should be placed at the interface of the rock fill and the conventional fill blanketing a fill slope.

Monitoring

Depending upon the depth of the rock fill and other factors, monitoring for settlement of the fill areas may be needed following completion of grading. Typically, if rock fill depths exceed 40 feet, monitoring would be recommend prior to construction of any settlement sensitive improvements. Delays of 3 to 6 months or longer can be expected prior to the start of construction.

UTILITY TRENCH CONSTRUCTION AND BACKFILL

Utility trench excavation and backfill is the contractor's responsibility. The geotechnical consultant typically provides periodic observation and testing of these operations. While efforts are made to make sufficient observations and tests to verify that the contractors' methods and procedures are adequate to achieve proper compaction, it is typically impractical to observe all backfill procedures. As such, it is critical that the contractor use consistent backfill procedures.

Compaction methods vary for trench compaction and experience indicates many methods can be successful. However, procedures that "worked" on previous projects may or may not prove effective on a given site. The contractor(s) should outline the procedures proposed, so that we may discuss them **prior** to construction. We will offer comments based on our knowledge of site conditions and experience.

1. Utility trench backfill in slopes, structural areas, in streets and beneath flat work or hardscape should be brought to at least optimum moisture and compacted to at least 90 percent of the laboratory standard. Soil should be moisture conditioned prior to placing in the trench.

2. Flooding and jetting are not typically recommended or acceptable for native soils. Flooding or jetting may be used with select sand having a Sand Equivalent (SE) of 30 or higher. This is typically limited to the following uses:
   a) shallow (12 + inches) under slab interior trenches and,
   b) as bedding in pipe zone.

   The water should be allowed to dissipate prior to pouring slabs or completing trench compaction.
3. Care should be taken not to place soils at high moisture content within the upper three feet of the trench backfill in street areas, as overly wet soils may impact subgrade preparation. Moisture may be reduced to 2% below optimum moisture in areas to be paved within the upper three feet below sub grade.
4. Sand backfill should not be allowed in exterior trenches adjacent to and within an area extending below a 1:1 projection from the outside bottom edge of a footing, unless it is similar to the surrounding soil.
5. Trench compaction testing is generally at the discretion of the geotechnical consultant. Testing frequency will be based on trench depth and the contractor's procedures. A probing rod would be used to assess the consistency of compaction between tested areas and untested areas. If zones are found that are considered less compact than other areas, this would be brought to the contractor's attention.

JOB SAFETY

General

Personnel safety is a primary concern on all job sites. The following summaries are safety considerations for use by all our employees on multi-employer construction sites. On ground personnel are at highest risk of injury and possible fatality on grading construction projects. The company recognizes that construction activities will vary on each site and that job site safety is the contractor's responsibility. However, it is, imperative that all personnel be safety conscious to avoid accidents and potential injury.

In an effort to minimize risks associated with geotechnical testing and observation, the following precautions are to be implemented for the safety of our field personnel on grading and construction projects.

1. Safety Meetings: Our field personnel are directed to attend the contractor's regularly scheduled safety meetings.
2. Safety Vests: Safety vests are provided for and are to be worn by our personnel while on the job site.
3. Safety Flags: Safety flags are provided to our field technicians; one is to be affixed to the vehicle when on site, the other is to be placed atop the spoil pile on all test pits.

In the event that the contractor's representative observes any of our personnel not following the above, we request that it be brought to the attention of our office.

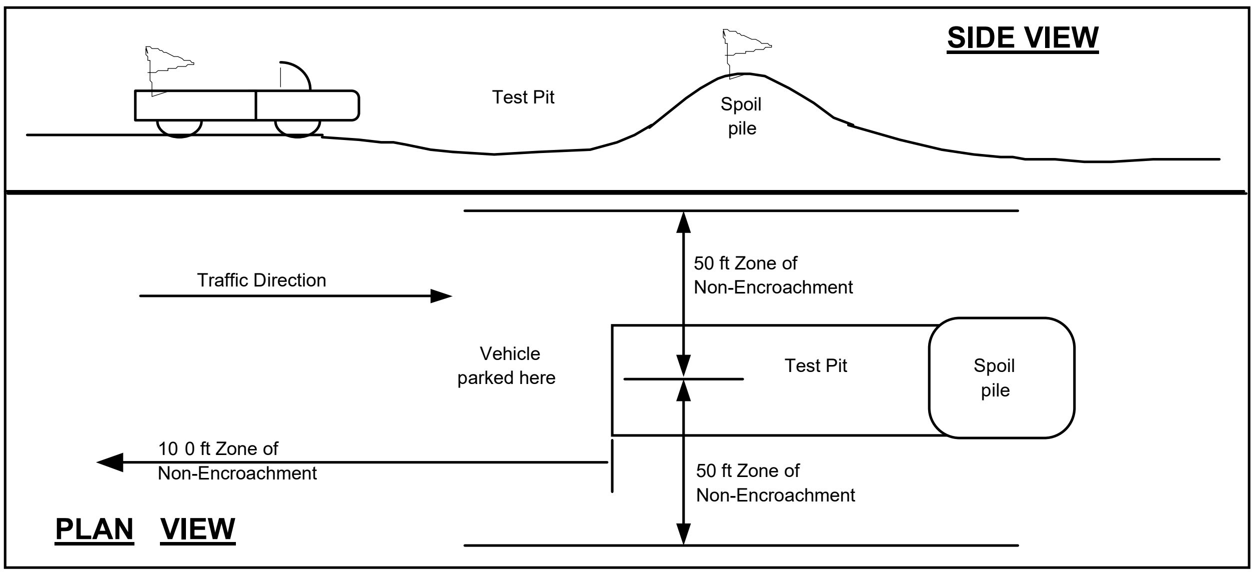
Test Pits Location, Orientation and Clearance

The technician is responsible for selecting test pit locations. The primary concern is the technician's safety. However, it is necessary to take sufficient tests at various locations to obtain a representative sampling of the fill. As such, efforts will be made to coordinate locations with the grading contractors authorized representatives (e.g. dump man, operator, supervisor, grade checker, etc.), and to select locations following or behind the established traffic pattern, preferably outside of current traffic. The contractors authorized representative should direct excavation of the pit and safety during the test period. Again, safety is the paramount concern.

Test pits should be excavated so that the spoil pile is placed away from oncoming traffic. The technician's vehicle is to be placed next to the test pit, opposite the spoil pile. This necessitates that the fill be maintained in a drivable condition. Alternatively, the contractor may opt to park a piece of equipment in front of test pits, particularly in small fill areas or those with limited access.

A zone of non-encroachment should be established for all test pits (see diagram below). No grading equipment should enter this zone during the test procedure. The zone should extend outward to the sides approximately 50 feet from the center of the test pit and 100 feet in the direction of traffic flow. This zone is established both for safety and to avoid excessive ground vibration, which typically decreases test results.

TEST PIT SAFETY PLAN



Slope Tests

When taking slope tests, the technician should park their vehicle directly above or below the test location on the slope. The contractor's representative should effectively keep all equipment at a safe operation distance (e.g. 50 feet) away from the slope during testing.

The technician is directed to withdraw from the active portion of the fill as soon as possible following testing. The technician's vehicle should be parked at the perimeter of the fill in a highly visible location.

Trench Safety

It is the contractor's responsibility to provide safe access into trenches where compaction testing is needed. Trenches for all utilities should be excavated in accordance with CAL-OSHA and any other applicable safety standards. Safe conditions will be required to enable compaction testing of the trench backfill.

All utility trench excavations in excess of 5 feet deep, which a person enters, are to be shored or laid back. Trench access should be provided in accordance with OSHA standards. Our personnel are directed not to enter any trench by being lowered or "riding down" on the equipment.

Our personnel are directed not to enter any excavation which;

1. is 5 feet or deeper unless shored or laid back,
2. exit points or ladders are not provided,
3. displays any evidence of instability, has any loose rock or other debris which could fall into the trench, or
4. displays any other evidence of any unsafe conditions regardless of depth.

If the contractor fails to provide safe access to trenches for compaction testing, our company policy requires that the soil technician withdraws and notifies their supervisor. The contractor's representative will then be contacted in an effort to affect a solution. All backfill not tested due to safety concerns or other reasons is subject to reprocessing and/or removal.

Procedures

In the event that the technician's safety is jeopardized or compromised as a result of the contractor's failure to comply with any of the above, the technician is directed to inform both the developer's and contractor's representatives. If the condition is not rectified, the technician is required, by company policy, to immediately withdraw and notify their supervisor. The contractor's representative will then be contacted in an effort to affect a solution. No further testing will be performed until the situation is rectified. Any fill placed in the interim can be considered unacceptable and subject to reprocessing, recompaction or removal.

In the event that the soil technician does not comply with the above or other established safety guidelines, we request that the contractor bring this to technician's attention and notify our project manager or office. Effective communication and coordination between the contractors' representative and the field technician(s) is strongly encouraged in order to implement the above safety program and safety in general.

The safety procedures outlined above should be discussed at the contractor's safety meetings. This will serve to inform and remind equipment operators of these safety procedures particularly the zone of non-encroachment.

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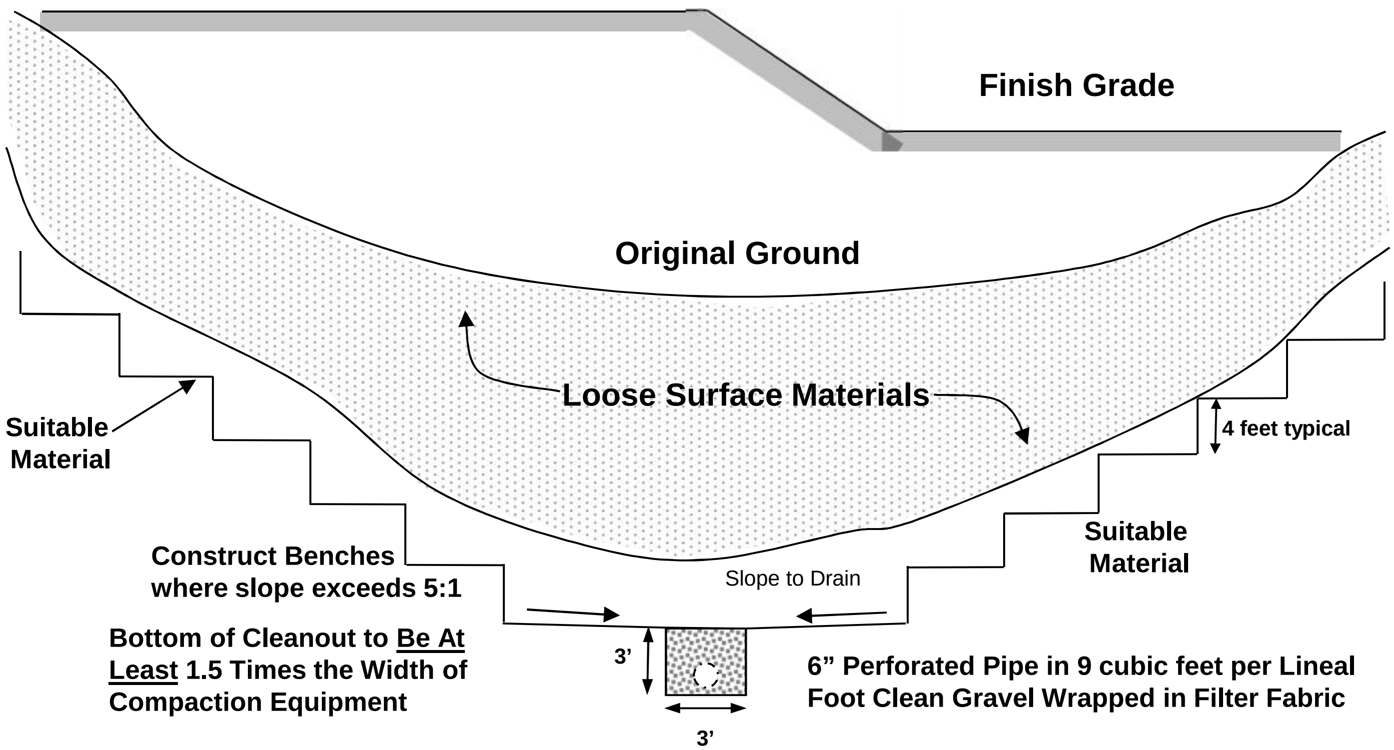
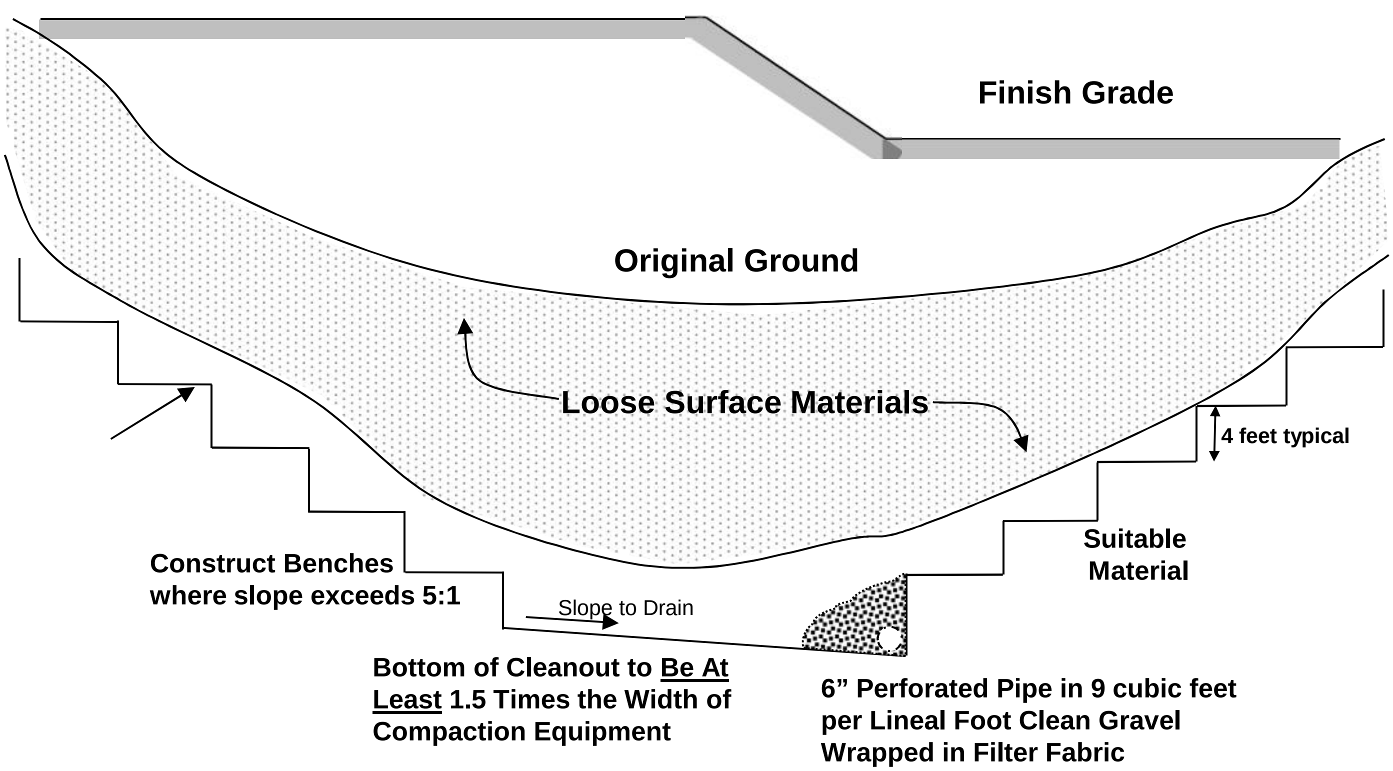
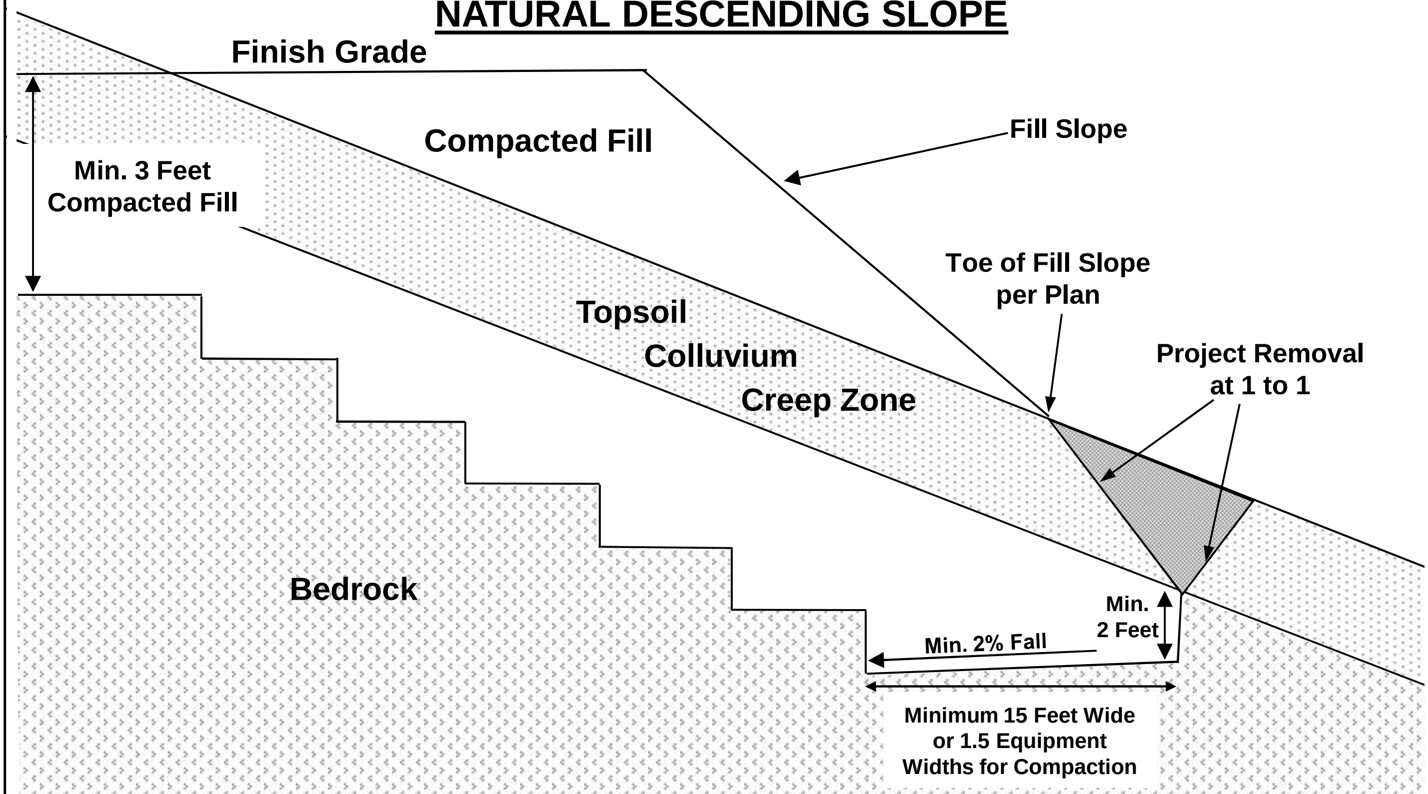
ALTERNATES



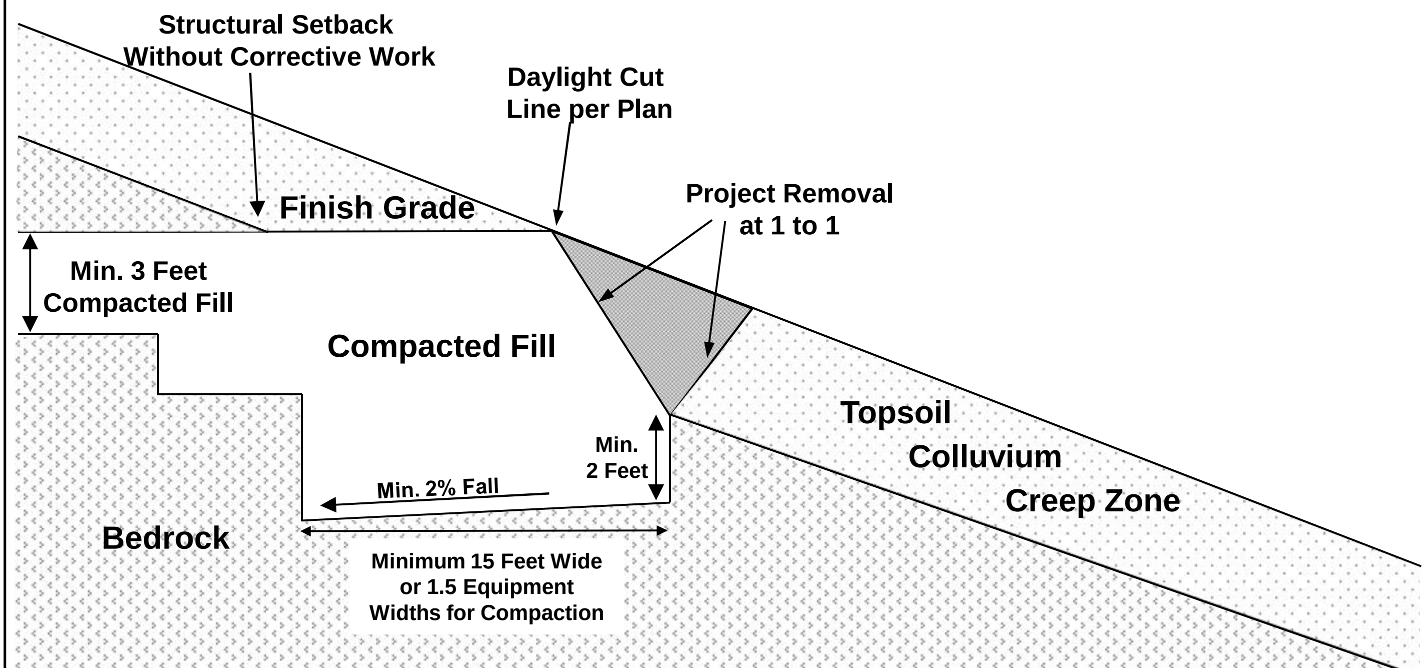


GEOTEK	1384 Poinsettia Avenue, Suite A Vista, California 92083	TYPICAL CANYON CLEANOUT	STANDARD GRADING GUIDELINES PLATE G-1

TYPICAL FILL SLOPE OVER NATURAL DESCENDING SLOPE



DAYLIGHT CUT AREA OVER NATURAL DESCENDING SLOPE



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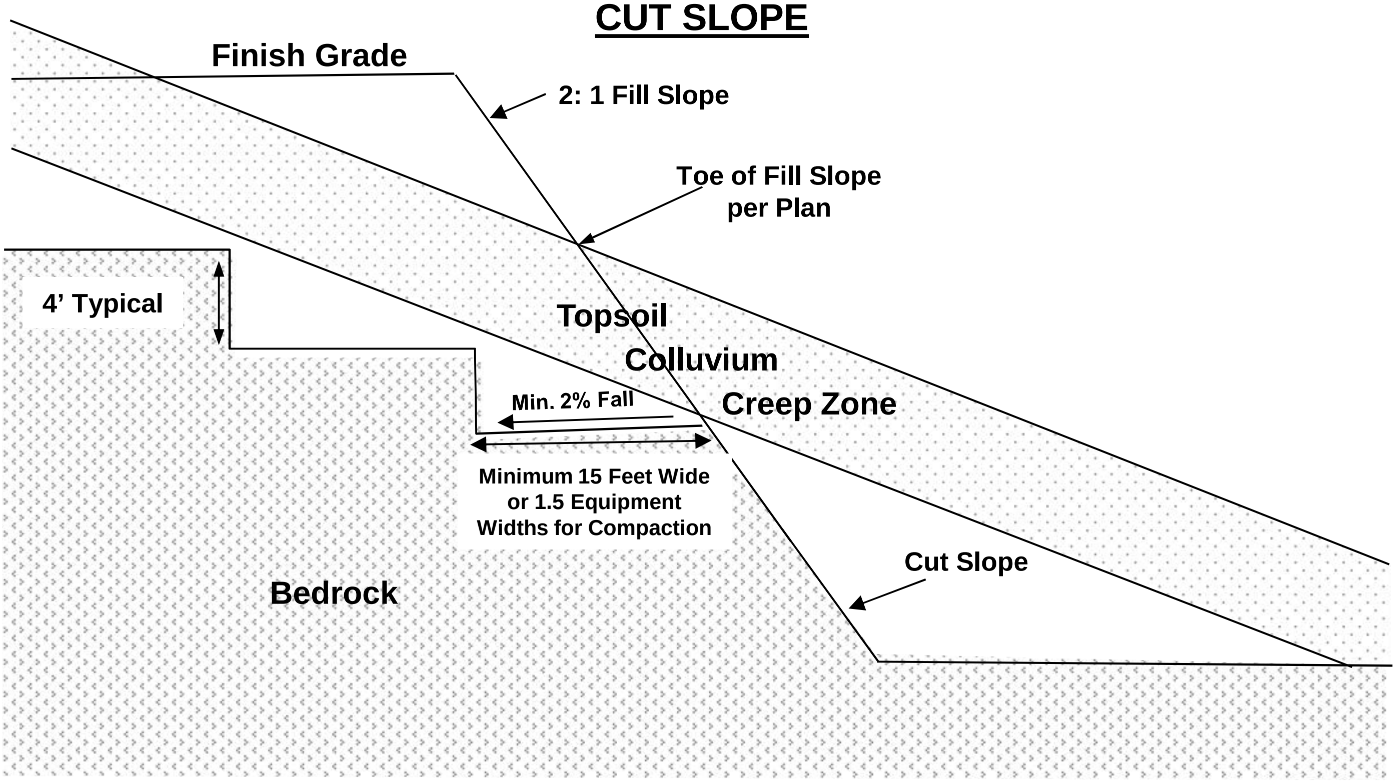
TREATMENT ABOVE NATURAL SLOPES

STANDARD GRADING GUIDELINES

PLATE G-2

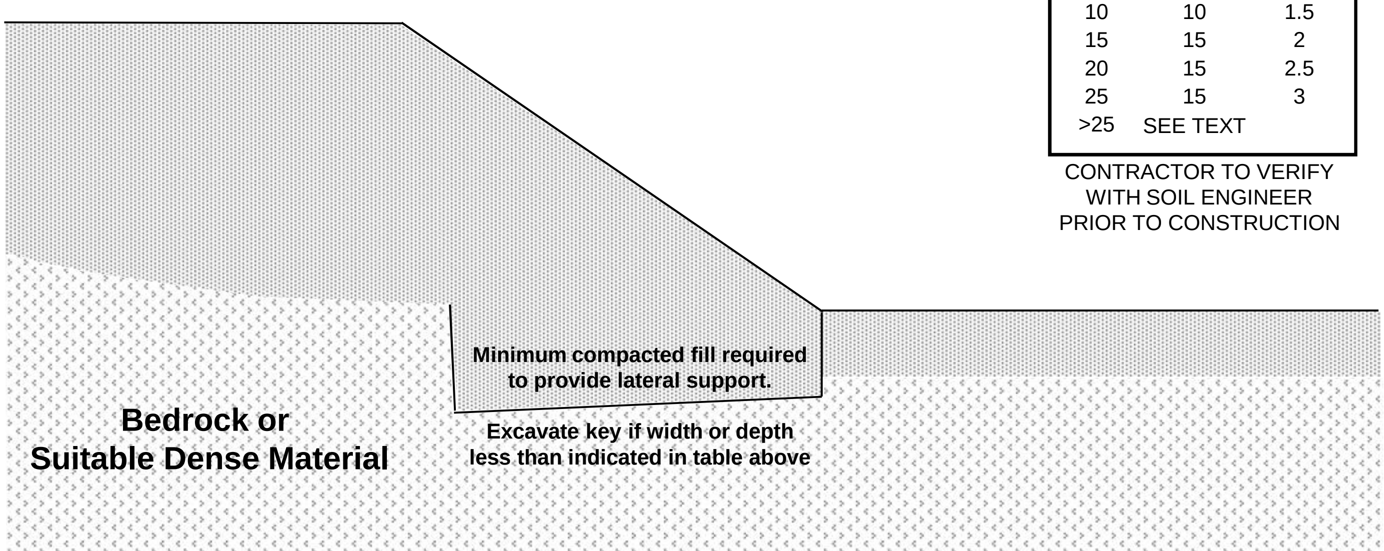
TYPICAL FILL SLOPE OVER CUT SLOPE



TYPICAL FILL SLOPE

SLOPE HEIGHT	MIN. KEY WIDTH	MIN. KEY DEPTH
5	7	1
10	10	1.5
15	15	2
20	15	2.5
25	15	3
>25	SEE TEXT	

CONTRACTOR TO VERIFY WITH SOIL ENGINEER PRIOR TO CONSTRUCTION



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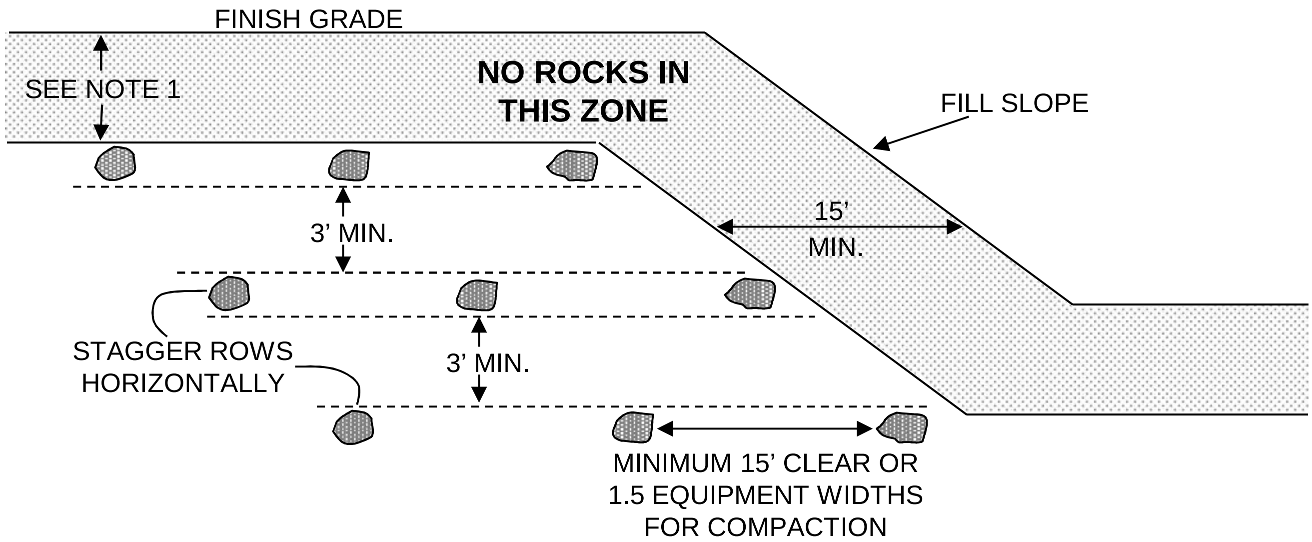
COMMON FILL SLOPE KEYS

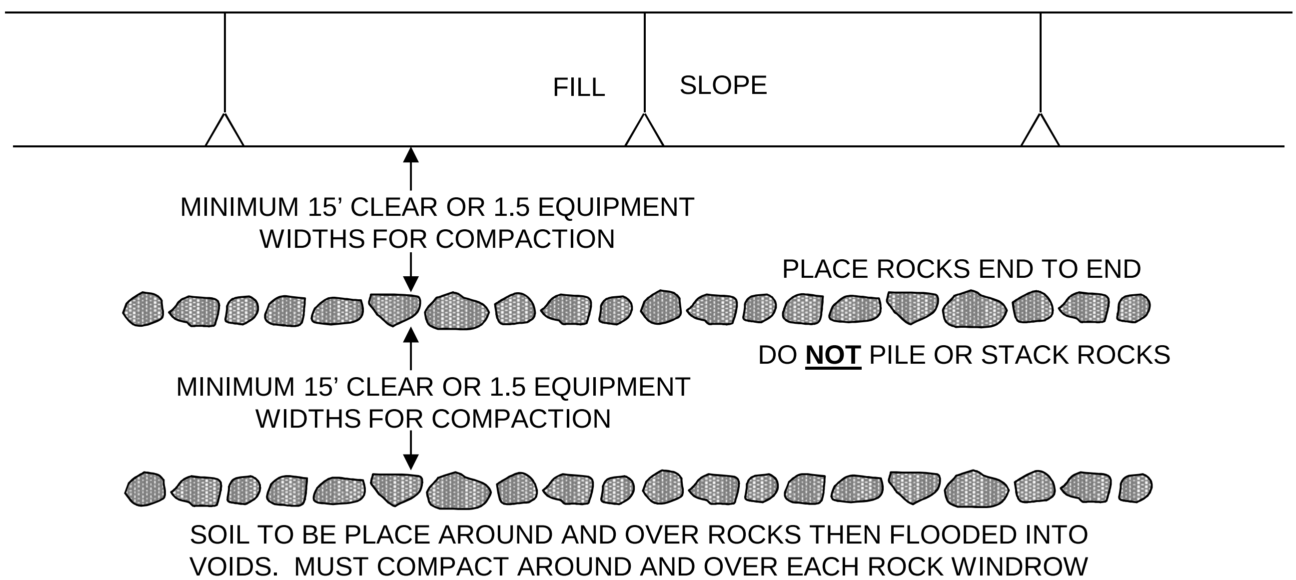
STANDARD GRADING GUIDELINES

PLATE G-3

CROSS SECTIONAL VIEW



PLAN VIEW



NOTES:

1) SOIL FILL OVER WINDROW SHOULE BE 7 FEET OR PER JURISDUICTIONAL STANDARDS AND SUFFICIENT FOR FUTURE EXCAVATIONS TO AVOID ROCKS
2) MAXIMUM ROCK SIZE IN WINDROWS IS 4 FEET MINIMUM DIAMETER
3) SOIL AROUND WINDROWS TO BE SANDY MATERIAL SUBJECT TO SOIL ENGINEER ACCEPTANCE
4) SPACING AND CLEARANCES MUST BE SUFFICIENT TO ALLOW FOR PROPER COMPACTION
5) INDIVDUAL LARGE ROCKS MAY BE BURIED IN PITS.

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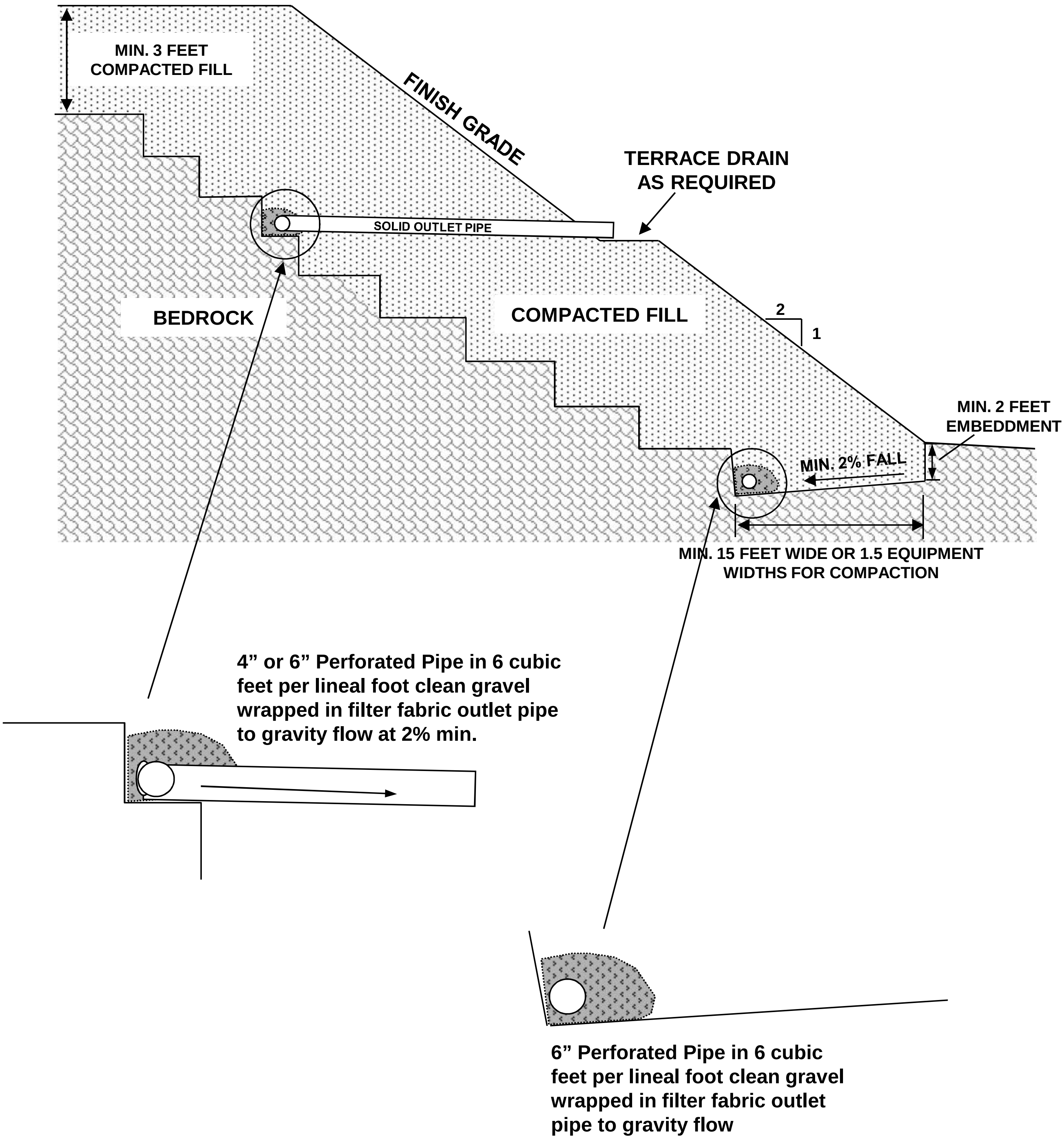
ROCK BURIAL DETAILS

STANDARD GRADING GUIDELINES

PLATE G-4



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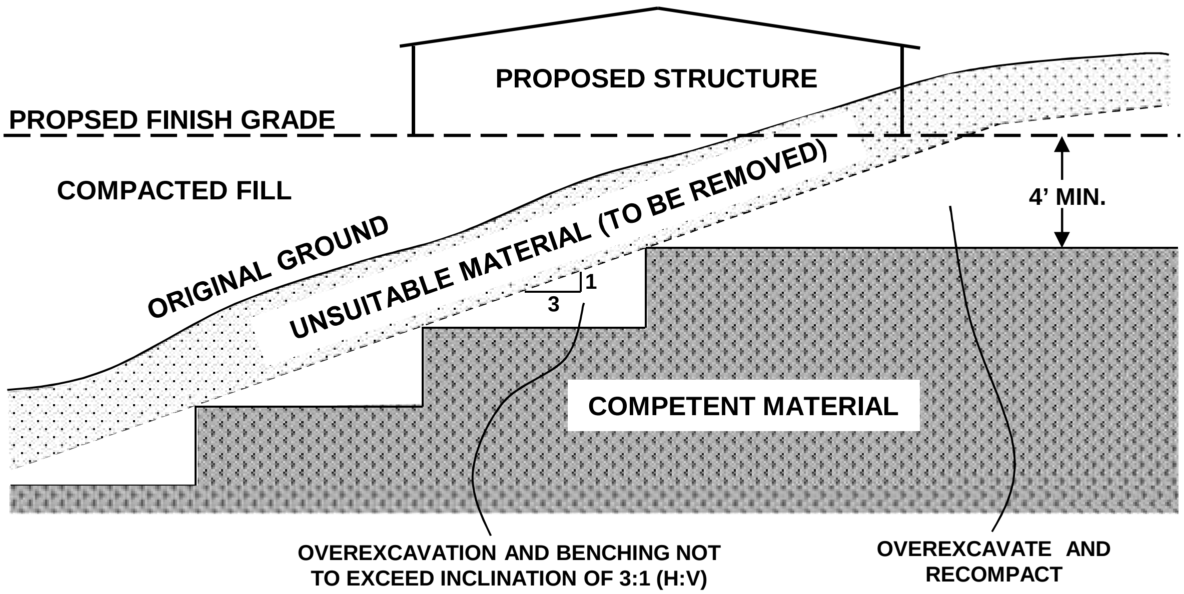
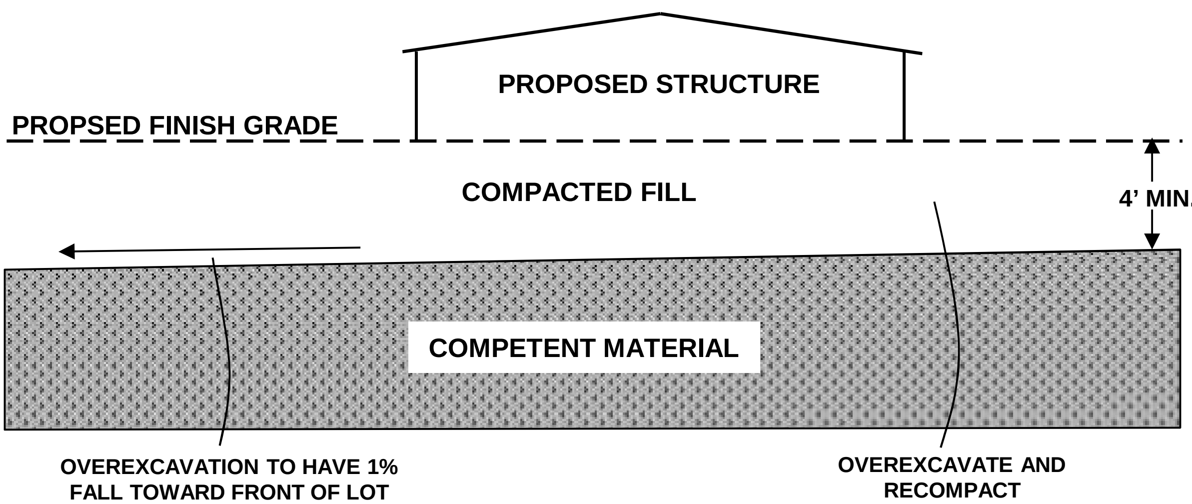
Typical Buttress and Stabilization Fill

PLATE G-5

TRANSITION LOT



UNDERCUT LOT



Notes:
1. Removed/overexcavated soils should be recompacted in accordance with recommendations included in the text of the report.
2. Location of cut/fill transition should verified in the field during site grading.

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TRANSITION & UNDERCUT LOTS

STANDARD GRADING GUIDELINES

PLATE G-6