Appendix E. Geotechnical Investigation

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GEOTECHNICAL INVESTIGATION

WELD DISTRIBUTION CENTER
EL CAJON, CALIFORNIA

PREPARED FOR

CHESNUT PROPERTIES
DEL MAR, CALIFORNIA

OCTOBER 20, 2020
PROJECT NO. G2597-32-01

GEOCON
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GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS

Project No. G2597-32-01
October 20, 2020

Chesnut Properties
1155 Camino Del Mar, Suite 525
Del Mar, California 92014

Attention: Ms. Susan Guerra

Subject: GEOTECHNICAL INVESTIGATION
WELD DISTRIBUTION CENTER
EL CAJON, CALIFORNIA

Dear Ms. Guerra:

In accordance with your authorization of our Proposal No. LG-20353, dated August 17, 2020, we have performed a geotechnical investigation on the subject property. The accompanying report presents the findings of our study and our recommendations relative to the geotechnical aspects of developing the property as presently proposed.

The results of our study indicate that the site can be developed as planned, provided the recommendations of this report are followed. Remedial grading, groundwater, and the potential presence of shallow rock in areas of planned excavation will be important geotechnical considerations during project development.

Should you have questions regarding this report, or if we may be of further service, please contact the undersigned at your convenience.

Very truly yours,

GEOCON INCORPORATED

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GEOTECHNICAL INVESTIGATION

1. PURPOSE AND SCOPE

The purpose of this study was to evaluate the proposed grading for an approximately 32-acre commercial development located northwest of the intersection of Weld Boulevard and Cuyamaca Street in El Cajon, California (see *Vicinity Map*, Figure 1). This report provides recommendations relative to the geotechnical engineering aspects of developing the property as proposed.

The scope of our study consisted of the following:

- Reviewing aerial photographs and readily available published and unpublished geologic literature relative to the site.
- Reviewing the conceptual and grading plans for the project development prepared by Ware Malcomb.
- Excavating twenty-two (22) exploratory trenches using a rubber tire backhoe to evaluate the general extent and condition of surficial deposits (see Appendix A for trench logs).
- Performing laboratory tests on selected soil samples to evaluate the physical characteristics for engineering analysis (see Appendix B).
- Performing two infiltration tests in the proposed basin locations to be utilized during storm water management design and providing storm water management guidelines in accordance with the City of El Cajon Storm Water Standards (See Appendix C).
- Preparing this report providing our conclusions and recommendations regarding the geotechnical aspects of developing the property as presently proposed.

The approximate locations of the exploratory trenches and infiltration tests are shown on the *Geologic Map*, Figure 2.

2. SITE AND PROJECT DESCRIPTION

The property consists of approximately 35-acres of relatively undeveloped land located west of Gillespie Field, northwest of the intersection between Weld Boulevard and Cuyamaca Street in El Cajon, California. Topographically, the property drains towards the northeast towards Forrester Creek. Elevations range from 390 feet above Mean Sea Level (MSL) in the northwest portion of the site to 347 feet MSL in the northwestern portion. A small topographic knob with an elevation of approximately 380 feet MSL is located in the central portion of the site. A concrete-lined open channel (Forrester Creek) exists along the northeastern portion of the property. In addition, a 36-inch diameter sewer transmission line is located along the eastern property boundary. A retaining wall is planned along this area as part of the proposed development. Vegetation consists of low-lying grasses and a few randomly-spaced large trees. Existing improvements consist of a storage yard and unpaved parking area near the southwestern portion of the property. Based on review of historical aerial photographs, a construction storage yard existed along the northern portion of the property and has been removed. Remnants of this yard (i.e. earthen berm, gravel) were observed during our study.

It is our understanding that the property will be developed to accommodate an approximately 141,000 square foot commercial building with parking and driveway areas. Based on review of the grading plans, cuts and fills of approximately 24 feet and 12 feet, respectively are proposed. Cut and fill slopes inclined at 2:1 (maximum:horizontal) are shown with maximum heights of approximately 30 feet and 55 feet, respectively.

If development plans differ significantly from those described herein, Geocon Incorporated should be contacted for review and possible revisions to this report.

3. SOIL AND GEOLOGIC CONDITIONS

Four surficial soil types and one geologic formation were encountered during our field investigation. The surficial soil types consist of artificial fill, topsoil, alluvium and colluvium. The formational unit is the Cretaceous-age granitic rock. The approximate extent of the deposits, excluding topsoil, are presented on the *Geologic Map* (Figure 2). Each of the surficial soil types and geologic unit encountered are described below in order of increasing age.

3.1 Artificial Fill (Qaf)

Artificial fill was observed in several exploratory trenches (T-5, T-14, T-19, T-20, and T-22), primarily associated with the existing storage yard along the southern portion of the property and previous grading on the property. Where this material is generally one-foot-thick or less, it was not mapped on Figure 2. The artificial fill consists of loose to medium dense, damp, silty, fine to medium sand. This material is unsuitable for support of settlement sensitive structures and/or improvements, and will require complete removal and compaction.

3.2 Topsoil (unmapped)

Topsoil was encountered above the colluvium in Trenches T-1, T-2, T-3, T-10, and T-12 through T-15. This deposit varies in thickness from approximately 1 to 2 feet. This surficial soil is characterized as loose, damp, silty fine- to medium-grained sand. Topsoil is unsuitable in its present condition and will require removal and compaction for support of structural fill and settlement-sensitive structures.

3.3 Alluvium (Qal)

Alluvial soils were encountered in Trench Nos. T-2, T-11, T-13, T-14, and T-22. This deposit generally consists of loose to medium dense, damp to saturated, silty to clayey fine- to-coarse-grained sand and sandy clay. The upper unsaturated portions of the alluvial deposits are poorly consolidated and compressible, and will require removal and compaction during grading. The anticipated thickness of surficial soil requiring remedial grading is shown on Figure 2.

3.4 Colluvium (Qcol)

Colluvial soils were encountered beneath the topsoil/artificial fill or was exposed at the surface across the property. This material varies from approximately 2 to 6-feet-thick. These deposits generally consist of loose to dense, damp to moist, silty to clayey fine- to medium-grained sand and sandy clay. The colluvial deposits are considered porous and susceptible to settlement in its present condition. The colluvial deposits are generally unsuitable in their present condition for support of structural fill and settlement-sensitive structures. The anticipated thickness of surficial soil requiring remedial grading is shown on Figure 2.

3.5 Granitic Rock (Kgr)

Cretaceous-age granitic rock underlies the surficial deposits throughout the property. Granitic rock also forms a conical promontory in the center of the site where a primary excavation is planned. The soils derived from excavations within the decomposed portion of this unit typically consist of low-expansive, silty, fine- to coarse-grained sands and provide suitable foundation support in either a natural or properly compacted condition. Deeper excavations than what we encountered in the trenches may generate boulders and oversize material (rocks greater than 12 inches in dimension) that will require special handling and placement. Although not specifically evaluated during this study, difficult excavation conditions may be present in the center promontory area.

Granitic units generally exhibit adequate bearing and slope stability characteristics and cut slopes should be stable if free of adversely oriented joints or fractures.

4. GROUNDWATER

Groundwater was observed in Trenches T-13, T-14, and T-22, located in the alluvium adjacent to Forrester Creek. Groundwater is not expected to be observed in other areas of the site. Where observed, the groundwater generally ranged between 10 to 14 feet below the ground surface. The presence of groundwater will impact the ability to perform remedial grading in the northeast portion of the site.

It is not uncommon for groundwater or seepage conditions to develop where none previously existed. Groundwater elevations are dependent on seasonal precipitation, irrigation, and land use, among other factors, and vary as a result. Proper surface drainage will be important to future performance of the project. Depending upon seasonal conditions at the time of grading, specialized equipment to excavate the alluvial soils and drying or mixing with other onsite materials to reduce the moisture content prior to placement as compacted fill may be required.

5. GEOLOGIC HAZARDS

5.1 Ground Rupture

United States Geological Survey maps (2016) indicates that there are no mapped Quaternary faults crossing or trending toward the property. In addition, the site is not located within a currently established Alquist-Priolo Earthquake Fault Zone.

The nearest known active-fault zones are the Rose Canyon and Newport Inglewood Faults, located approximately 15 miles west of the subject site. The risk associated with ground rupture hazard is low.

5.2 Seismicity

The San Diego County and Southern California region is seismically active. Considerations important in seismic design include the frequency and duration of motion and the soil conditions underlying the site. Seismic design of structures should be performed in accordance with the California Building Code (CBC) guidelines currently adopted by the local agency. The risk associated with strong ground shaking due to earthquake at the site is no greater than that for the region.

5.3 Liquefaction and Seismically Induced Settlement

Liquefaction typically occurs when a site is located in a zone with seismic activity, onsite soils are cohesionless and poorly graded sand, groundwater is encountered within 50 feet of the surface, and soil densities are less than about 70 percent of the relative densities. If the four previous criteria are met, a seismic event could result in a rapid pore water pressure increase from the earthquake-generated ground accelerations.

The risk associated with liquefaction and seismically induced settlement beneath the proposed building is negligible due to planned remedial grading, shallow depth to granitic rock, and lack of groundwater beneath the building.

The risk associated with liquefaction and seismically induced settlement beneath the portion of parking lot underlain by alluvium and shallow groundwater is considered low given the limited thickness of soils below the groundwater and the grainsize characteristics of the alluvium. In addition, remedial grading will provide a compacted fill mat of at least 10 to 15 feet thick above the saturated zone.

5.4 Landslides

The risk associated with landslide hazards at the site is low.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 General

6.1.1 No soil or geologic conditions were encountered that, in the opinion of Geocon Incorporated, would preclude the development of the property as proposed, provided the recommendations of this report are followed. Mitigation of compressible alluvial soils left in-place during grading in the northeast corner of the property will be required as discussed herein.

6.1.2 The site is underlain by surficial units that include artificial fill, topsoil, alluvium and colluvium. The artificial fill, topsoil, colluvium and upper portions of the alluvium are unsuitable in their present condition for support of fill and/or structural loads and will require remedial grading in the form of removal and compaction where improvements are planned. The anticipated thickness of surficial soil deposits requiring remedial grading is shown on Figure 2.

6.1.3 The northeast portion of the property is underlain by saturated, potentially compressible alluvium that will be left in-place during remedial grading. After placing upwards of 10 feet of compacted fill to achieve finish parking lot grade, settlement is anticipated over several months. The magnitude of settlement will need to be evaluated during a future study, particularly where the retaining wall is planned in the vicinity of the existing sewer transmission line. In addition, construction of the proposed parking lot improvements in this area, including retaining walls and underground utilities will be delayed until the primary consolidation of the alluvial deposits is essentially complete. Settlement monitoring should be performed to verify when primary compression has occurred.

6.1.4 Proposed below grade improvements in the northeast portion of the site, such as underground utilities, should consider the groundwater elevation information contained in this study. Temporary and/or permanent design considerations will be necessary in the event that these improvements are located near or below the water table. Additional recommendations may be necessary during construction depending on the conditions encountered.

6.1.5 The planned facility can be supported by shallow or mat foundations supported on compacted fill .

6.1.6 The presence of potentially hard rock within proposed cut areas will require special consideration during site development. It is anticipated that the majority of the proposed excavations will encounter moderate to heavy ripping with conventional heavy-duty grading equipment. Blasting is not expected for shallow excavations but may be required in areas with deeper cuts, particularly in the central promontory. In addition, heavy ripping and blasting will generate oversize materials that may require crushing, special handling and fill placement procedures. Oversize materials should be placed in accordance with Appendix E of this report.

6.1.7 Consideration should be given to performing a supplemental study in the primary proposed excavation areas to evaluate rippability.

6.1.8 Cut slopes should be observed during grading by an engineering geologist to verify that the geologic conditions do not differ significantly from those anticipated.

6.1.9 With the exception of possible strong seismic shaking, no geologic hazards were observed or are known to exist on the site that would adversely affect the proposed project. No special seismic design considerations, other than those recommended herein, are required.

6.2 Soil and Excavation Characteristics

6.2.1 The soil encountered during our study consists of "low" expansive silty sand and silty/clayey sand to "highly" expansive sandy clay.

6.2.2 Excavation of the surficial deposits (artificial fill, topsoil, colluvium, alluvium) should generally require moderate effort using conventional heavy-duty grading equipment.

6.2.3 Excavating within the granitic rock materials will generally vary in difficulty with depth depending on the degree of weathering. Heavy to very heavy ripping is anticipated and may generate oversize materials. The potential for blasting could be evaluated during a supplemental study. Oversize rock should be placed in accordance with *Recommended Grading Specifications* (Appendix E), and the requirements of the County of San Diego. Oversize rock may require breakage/crushing to acceptable sizes for incorporation into fills, or exportation from the property. Placement of oversize rock within the areas of proposed underground utilities should not be permitted.

6.2.4 The alluvial deposits near the creek may be very moist to saturated. Overly wet soils will require drying or mixing with drier material prior to their use as compacted fill.

6.2.5 The soils encountered are considered to be both non-expansive and expansive (expansion index [EI] greater than 20 as defined by 2019 California Building Code [CBC] Section 1803.5.3). The predominant material encountered was silty sand, with some clayey sands, and exhibit a *low* expansion potential. Table 6.2 presents soil classifications based on the expansion index. Table B-III, Appendix B, presents a summary of the laboratory expansion index tests performed.

TABLE 6.2
SOIL CLASSIFICATION BASED ON EXPANSION INDEX

Expansion Index (EI)	ASTM D 4829 Expansion Classification	2019 CBC Expansion Classification
0 – 20	Very Low	Non-Expansive
21 – 50	Low	Expansive
51 – 90	Medium	
91 – 130	High	
Greater Than 130	Very High	

6.3 Corrosion

6.3.1 We performed laboratory tests on samples of the site materials to evaluate the percentage of water-soluble sulfate content (California Test No. 417) and Chloride Ion Content (AASHTO T291). Results from the laboratory water-soluble sulfate content tests are presented in Appendix B and indicate that the on-site materials at the locations tested possess a "Not Applicable" and "S0" sulfate exposure to concrete structures as defined by 2019 CBC Section 1904 and ACI 318-14 Chapter 19. The presence of water-soluble sulfates is not a visually discernible characteristic; therefore, other soil samples from the site could yield different concentrations. Additionally, over time landscaping activities (i.e., addition of fertilizers and other soil nutrients) may affect the concentration. Table 6.3 presents a summary of concrete requirements set forth by 2019 CBC Section 1904 and ACI 318.

TABLE 6.3
REQUIREMENTS FOR CONCRETE EXPOSED TO SULFATE-CONTAINING SOLUTIONS

Sulfate Severity	Exposure Class	Water-Soluble Sulfate (SO_4) Percent by Weight	Cement Type (ASTM C 150)	Maximum Water to Cement Ratio by Weight[1]	Minimum Compressive Strength (psi)
Not Applicable	S0	SO_4<0.10	No Type Restriction	n/a	2,500
Moderate	S1	0.10≤SO_4<0.20	II	0.50	4,000
Severe	S2	0.20≤SO_4≤2.00	V	0.45	4,500
Very Severe	S3	SO_4>2.00	V+Pozzolan or Slag	0.45	4,500

[1] Maximum water to cement ratio limits do not apply to lightweight concrete.

6.3.2 Laboratory chloride ion were performed on samples of on-site soil to evaluate whether the soils are potentially corrosive to buried metal. The results are summarized in Appendix B. The applicable exposure category and class is defined in ACI 318 Table 19.3.1.1. The corrosive nature of the soils should be considered in the design of buried metal pipes and underground structures.

6.3.3 Geocon Incorporated does not practice in the field of corrosion engineering. Therefore, if improvements that could be susceptible to corrosion are planned, it is recommended that further evaluation by a corrosion engineer be performed.

6.4 Grading

6.4.1 All grading should be performed in accordance with the attached *Recommended Grading Specifications* (Appendix E). Where the recommendations of this section conflict with Appendix E, the recommendations of this section take precedence. All earthwork should be observed and all fills tested for proper compaction by Geocon Incorporated.

6.4.2 Prior to commencing grading, a preconstruction conference should be held at the site with the owner or developer, grading contractor, civil engineer, and geotechnical engineer in attendance. Special soil handling and/or the grading plans can be discussed at that time.

6.4.3 Site preparation should begin with the removal of all deleterious material and vegetation. The depth of removal should be such that material exposed in cut areas or soils to be used as fill are relatively free of organic matter. Material generated during stripping and/or site demolition should be exported from the site.

6.4.4 All compressible soil deposits, including artificial fill, topsoil, colluvium, and upper portions of the alluvium within areas where structural improvements are planned, should be removed to firm natural ground, or within 2 feet of groundwater, and properly compacted prior to placing additional fill and/or structural loads. The actual extent of unsuitable soil removals will be determined in the field during grading by the geotechnical engineer and/or engineering geologist.

6.4.5 After removal of unsuitable materials is performed, the site should then be brought to final subgrade elevations with structural fill compacted in layers. In general, soils native to the site are suitable for re-use as fill if free from vegetation, debris and other deleterious material. Layers of fill should be no thicker than will allow for adequate bonding and compaction. All fill, including backfill and scarified ground surfaces, should be compacted to at least 90 percent of maximum dry density at or above optimum moisture content, as determined in accordance with ASTM Test Procedure D1557. Fill materials below optimum moisture content will require additional moisture conditioning prior to placing additional fill.

6.4.6 To reduce the potential for differential settlement, it is recommended that the cut portion of the cut/fill transition building pad be undercut at least 3 feet, or at least 2 feet below the deepest foundation, and replaced with properly compacted "very low" to "low" expansive fill soils. If the thickness of the fill below the building pad exceeds 15 feet, the depth of the undercut should be increased to one-fifth of the maximum fill thickness. The base of the undercuts should be sloped towards the front of the pad.

6.4.7 Oversize material (defined as material greater than 12 inches in nominal dimension) may be generated during ripping of formational materials. Placement of oversize material within fills should be conducted in accordance with the recommendations in Appendix E. Grading operations on the site should be scheduled such that oversize materials are placed in designated rock disposal areas and/or deeper fills.

6.4.8 Rock greater than 6 inches in maximum dimension should not be placed within 3 feet of finish grade in building pad areas or parking lot subgrade. Rock greater than 12 inches in maximum dimension should not be placed within 10 feet of finish pad grade or within 2 feet of the deepest utility. The gradation of capping materials should conform to the project grading specifications.

6.4.9 Where practical, the upper 3 feet of the building pad (cut or fill) should be comprised of soil with a "very low" to "low" expansion potential. The more highly expansive fill soils should be placed in the deeper fill areas and properly compacted. "Very low" to "low" expansive soils are defined by the 2019 California Building Code (CBC) Section 1803.5.3 as those soils that have an Expansion Index of 50 or less.

6.4.10 Undercutting of parking lot areas underlain by granitic rock should be considered to facilitate the excavation of underground utilities. If subsurface improvements or landscape zones are planned, consideration should be given to undercutting these areas as well. This can be evaluated during grading operations by the owner's field representative.

6.4.11 It is the responsibility of the <u>contractor</u> and their <u>competent person</u> to ensure that all excavations, temporary slopes and trenches are properly constructed and maintained in accordance with applicable OSHA regulations in order to maintain safety and the stability of adjacent existing improvements.

6.4.12 Import materials (if required), should consist of “very low” to “low” expansive (Expansion Index of 50 or less) soils. Prior to importing the material, samples from proposed borrow areas should be obtained and subjected to laboratory testing to determine whether the material conforms to the recommended criteria. At least 3 working days should be allowed for laboratory testing of the soil prior to its importation. Import materials should be free of oversize rock and construction debris.

6.5 Settlement Considerations (Alluvium)

6.5.1 Estimates of potential settlement are generally based on the thickness of alluvium left-in-place, the thickness of additional fill to achieve finish grade, and the compressibility characteristics of the alluvial materials. The rate of settlement is generally based on the compressibility characteristics of the alluvial materials and the drainage path thickness that would allow for pore water pressure dissipation. The magnitude of settlement of the alluvial soils left in-place during remedial grading will be evaluated during a future study.

6.5.2 The alluvial deposits observed in the northeast corner of the property beneath a portion of parking lot are considered potentially compressible when subjected to increased vertical stress and will require evaluation to determine remedial grading recommendations. Due to shallow groundwater, the lower portions of the alluvial deposits will remain in-place and monitored for settlement.

6.6 Settlement Monitoring

6.6.1 The proposed structural areas underlain by additional fill and saturated alluvium should be monitored for settlement. In general, surface settlement plates should be installed at several locations and read periodically until primary consolidation has essentially ceased. Survey readings should be performed regularly following placement of the proposed fill. Specific details regarding the location and type of monitoring device as well as monitoring frequency, will be provided once the development plans have been finalized. However, weekly monitoring by a licensed surveyor for at least 2 to 3 months should be expected.

6.7 Slope Stability

6.7.1 Slope stability analysis utilizing average drained direct shear strength parameters based on laboratory tests and experience with similar soil types indicates that proposed fill slopes, constructed of on-site materials up to approximately 20 feet high, should have calculated factors of safety of at least 1.5 under static conditions for both deep-seated failure and shallow sloughing conditions. Proposed cut slopes in granitic rock up to approximately 30 feet were also found to possess a calculated factor of safety in excess of 1.5 for a deep-seated failure condition. Surficial and deep-seated slope stability calculations are presented on Figures 3 through 5.

6.7.2 It is recommended that all cut slope excavations be observed during grading by an engineering geologist to verify that soil and geologic conditions do not differ significantly from those anticipated.

6.7.3 The outer 15 feet (or a distance equal to the height of the slope, whichever is less) of fill slopes should be composed of properly compacted granular "soil" fill to reduce the potential for surficial sloughing. In general, soils with an Expansion Index of less than 90 or at least 35 percent sand size particles should be acceptable as "granular" fill. Soils of questionable strength to satisfy surficial stability should be tested in the laboratory for acceptable drained shear strength.

6.7.4 Fill slopes should be compacted by backrolling with a loaded sheepsfoot roller at vertical intervals not to exceed 4 feet and should be track-walked at the completion of each slope such that the fill soils are uniformly compacted to at least 90 percent relative compaction to the face of the finished sloped. Alternatively, the fill slope may be over-built at least 3 feet and cut back to yield a properly compacted slope face.

6.7.5 Where fill slopes and fill-over-cut slopes are planned, following removal of the surficial soils, a 15-foot-wide, 2-foot-deep, undrained keyway should be constructed prior to placing compacted fill. The keyway should be constructed with a minimum 5 percent inclination away from the toe of slope.

6.7.6 All slopes should be landscaped with drought-tolerant vegetation, having variable root depths and requiring minimal landscape irrigation. In addition, all slopes should be drained and properly maintained to reduce erosion.

6.8 Seismic Design Criteria – 2019 California Building Code

6.8.1 The seismic design criteria is presented for general and preliminary purposes. Geocon Incorporated should be contacted to provide specific seismic design criteria once project plans are developed. Table 6.8.1 summarizes site-specific design criteria obtained from the 2019 California Building Code (CBC; Based on the 2018 International Building Code [IBC] and ASCE 7-16), Chapter 16 Structural Design, Section 1613 Earthquake Loads. We used the computer program *U.S. Seismic Design Maps*, provided by the Structural Engineers Association (SEA) to calculate the seismic design parameters. The short spectral response uses a period of 0.2 second. We evaluated the Site Class based on the discussion in

Section 1613.2.2 of the 2019 CBC and Table 20.3-1 of ASCE 7-16. The values presented herein are for the risk-targeted maximum considered earthquake (MCE_R). Sites designated as Site Class D, E and F may require additional analyses if requested by the project structural engineer and client.

TABLE 6.8.1
2019 CBC SEISMIC DESIGN PARAMETERS

Parameter	Value	2019 CBC Reference
Site Class	C	Section 1613.2.2
MCE_R Ground Motion Spectral Response Acceleration – Class B (short), S_S	0.772g	Figure 1613.2.1(1)
MCE_R Ground Motion Spectral Response Acceleration – Class B (1 sec), S_1	0.284g	Figure 1613.2.1(2)
Site Coefficient, F_A	1.2	Table 1613.2.3(1)
Site Coefficient, F_V	1.5*	Table 1613.2.3(2)
Site Class Modified MCE_R Spectral Response Acceleration (short), S_{MS}	0.926g	Section 1613.2.3 (Eqn 16-36)
Site Class Modified MCE_R Spectral Response Acceleration – (1 sec), S_{M1}	0.425g*	Section 1613.2.3 (Eqn 16-37)
5% Damped Design Spectral Response Acceleration (short), S_{DS}	0.618g	Section 1613.2.4 (Eqn 16-38)
5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.284g*	Section 1613.2.4 (Eqn 16-39)

* Using the code-based values presented in this table, in lieu of a performing a ground motion hazard analysis, requires the exceptions outlined in ASCE 7-16 Section 11.4.8 be followed by the project structural engineer. Per Section 11.4.8 of ASCE/SEI 7-16, a ground motion hazard analysis should be performed for projects for Site Class "E" sites with Ss greater than or equal to 1.0g and for Site Class "D" and "E" sites with S1 greater than 0.2g. Section 11.4.8 also provides exceptions which indicates that the ground motion hazard analysis may be waived provided the exceptions are followed.

6.8.2 Table 6.8.2 presents the mapped maximum considered geometric mean (MCE_G) seismic design parameters for projects located in Seismic Design Categories of D through F in accordance with ASCE 7-16.

TABLE 6.8.2
ASCE 7-16 PEAK GROUND ACCELERATION

Parameter	Value	ASCE 7-16 Reference
Mapped MCE_G Peak Ground Acceleration, PGA	0.331g	Figure 22-7
Site Coefficient, F_{PGA}	1.2	Table 11.8-1
Site Class Modified MCE_G Peak Ground Acceleration, PGA_M	0.397g	Section 11.8.3 (Eqn 11.8-1)

6.8.3 Conformance to the criteria in Tables 6.8.1 and 6.8.2 for seismic design does not constitute any kind of guarantee or assurance that significant structural damage or ground failure will not occur in the event of a large earthquake. The primary goal of seismic design is to protect life, not to avoid all damage, since such design may be economically prohibitive.

6.8.4 The project structural engineer and architect should evaluate the appropriate Risk Category and Seismic Design Category for the planned structures. The values presented herein assume a Risk Category of II and resulting in a Seismic Design Category D. Table 6.8.3 presents a summary of the risk categories in accordance with ASCE 7-16.

TABLE 6.8.3
ASCE 7-16 RISK CATEGORIES

Risk Category	Building Use	Examples
I	Low risk to Human Life at Failure	Barn, Storage Shelter
II	Nominal Risk to Human Life at Failure (Buildings Not Designated as I, III or IV)	Residential, Commercial and Industrial Buildings
III	Substantial Risk to Human Life at Failure	Theaters, Lecture Halls, Dining Halls, Schools, Prisons, Small Healthcare Facilities, Infrastructure Plants, Storage for Explosives/Toxins
IV	Essential Facilities	Hazardous Material Facilities, Hospitals, Fire and Rescue, Emergency Shelters, Police Stations, Power Stations, Aviation Control Facilities, National Defense, Water Storage

6.9 Foundations

6.9.1 The proposed commercial structure may be supported by a conventional shallow foundation system founded entirely on compacted fill.

6.9.2 Foundations for the structure should consist of continuous strip footings and/or isolated spread footings. Continuous footings should be at least 12 inches wide and extend at least 18 inches below lowest adjacent pad grade. Isolated spread footings should have a minimum width of 2 feet and should extend at least 18 inches below lowest adjacent pad grade. A typical wall/column footing detail is presented on Figure 6. Steel reinforcement for continuous footings should consist of at least two No. 5 steel reinforcing bars placed horizontally in the footings, one near the top and one near the bottom. Steel reinforcement for the spread footings should be designed by the project structural engineer.

6.9.3 The minimum reinforcement recommended above is based on soil characteristics only (Expansion Index of 90 or less) and is not intended to replace reinforcement required for structural considerations.

6.9.4 The recommended allowable bearing capacity for foundations with minimum dimensions described above is 2,500 pounds per square foot (psf). This allowable soil bearing pressure may be increased by an additional 500 psf for each additional foot of depth and 300 psf for each additional foot of width, to a maximum allowable bearing capacity of 5,000 psf. The values presented above are for dead plus live loads and may be increased by one-third when considering transient loads due to wind or seismic forces.

6.9.5 A modulus of subgrade reaction of 150 pounds per cubic inch (pci) may be used for compacted fill. This value should be modified as necessary using standard equations for mat size as required by the structural engineer. This value is a unit value for use with a 1-foot square footing. The modulus should be reduced in accordance with the following equation when used with larger foundations:

$$K_R = K\left[\frac{B+1}{2B}\right]^2$$

where: K_R = reduced subgrade modulus
K = unit subgrade modulus
B = foundation width (in feet)

6.9.6 Special subgrade presaturation is not deemed necessary prior to placing concrete; however, the exposed foundation and slab subgrade soil should be moisture conditioned, as necessary, to maintain a moist condition as would be expected in any such concrete placement.

6.9.7 Settlement due to footing loads conforming to the above recommended allowable soil bearing pressures are expected to be less than 1-inch total and ½-inch differential across the building.

6.9.8 Geocon Incorporated should be consulted to provide additional design parameters as required by the structural engineer.

6.9.9 Foundation excavations should be observed by the geotechnical engineer (a representative of Geocon Incorporated) prior to the placement of reinforcing steel and concrete to verify that the exposed soil conditions are consistent with those anticipated and have been extended to appropriate bearing strata. If unanticipated soil conditions are encountered, foundation modifications may be required.

6.10 Concrete Slab-On-Grade Recommendations

6.10.1 Concrete slabs-on-grade supported on shallow footings founded entirely in compacted fill should be at least 5 inches thick and reinforced with No. 3 steel reinforcing bars at 18 inches on center in both horizontal directions. The structural engineer should design the slab and steel required for the planned loading conditions.

6.10.2 Slabs that may receive moisture-sensitive floor coverings or may be used to store moisture-sensitive materials should be underlain by a vapor retarder. The vapor retarder design should be consistent with the guidelines presented in the American Concrete Institute's (ACI) Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials (ACI 302.2R-06). In addition, the membrane should be installed in accordance with manufacturer's recommendations and ASTM requirements and installed in a manner that prevents puncture. The vapor retarder used should be specified by the project architect or developer based on the type of floor covering that will be installed and if the structure will possess a humidity-controlled environment.

6.10.3 The bedding sand thickness should be determined by the project foundation engineer, architect, and/or developer. It is common to have 4 inches of sand for slabs-on-grade in the southern California region. However, we should be contacted to provide recommendations if the bedding sand is thicker than 6 inches. The foundation design engineer should provide appropriate concrete mix design criteria and curing measures to assure proper curing of the slab by reducing the potential for rapid moisture loss and subsequent cracking and/or slab curl. We suggest that the foundation design engineer present the concrete mix design and proper curing methods on the foundation plans. It is critical that the foundation contractor understands and follows the recommendations presented on the foundation plans.

6.10.4 As a substitute, the layer of clean sand (or crushed rock) beneath the vapor inhibitor recommended in the previous section can be omitted if a vapor inhibitor that meets or exceeds the requirements of ASTM E 1745 (Class A), and that exhibits permeance not greater than 0.012 perm (measured in accordance with ASTM E 96) is used. This vapor inhibitor may be placed directly on properly compacted fill or formational materials. The vapor inhibitor should be installed in general conformance with ASTM E 1643 and the manufacturer's recommendations. Two inches of clean sand should then be placed on top of the vapor inhibitor to reduce the potential for differential curing, slab curl, and cracking. Floor coverings should be installed in accordance with the manufacturer's recommendations.

6.10.5 We should observe the foundation excavations prior to the placement of reinforcing steel to check that the exposed soil conditions are similar to those expected and that they have been extended to the appropriate bearing strata. If unexpected soil conditions are encountered, foundation modifications may be required.

6.10.6 Special subgrade presaturation is not deemed necessary prior to placing concrete; however, it is imperative that the exposed foundation and slab subgrade soils be moisture conditioned regularly after grading and a moist condition is maintained until the concrete is placed. Additional testing/observation may be necessary to verify that the appropriate moisture content is being maintained. It is the responsibility of the client's project field management team to coordinate such testing/observation with Geocon representatives prior to concrete placement.

6.10.7 The foundation and concrete slab-on-grade recommendations are based on soil support characteristics only. The project structural engineer should evaluate the structural requirements of the concrete slabs for supporting expected loads.

6.10.8 Concrete slabs should be provided with adequate construction joints and/or expansion joints to control unsightly shrinkage cracking. The design of joints should consider criteria of the American Concrete Institute when establishing crack-control spacing. Additional steel reinforcing, concrete admixtures and/or closer crack control joint spacing should be considered where concrete-exposed concrete finished floors are planned.

6.10.9 The recommendations of this report are intended to reduce the potential for cracking of slabs due to expansive soil (if present), differential settlement of existing soil or soil with varying thicknesses. However, even with the incorporation of the recommendations presented herein, foundations, stucco walls, and slabs-on-grade placed on such conditions may still exhibit some cracking due to soil movement and/or shrinkage. The occurrence of concrete shrinkage cracks is independent of the supporting soil characteristics. Their occurrence may be reduced and/or controlled by limiting the slump of the concrete, proper concrete placement and curing, and by the placement of crack control joints at periodic intervals, in particular, where re-entrant slab corners occur.

6.10.10 Geocon Incorporated should be consulted to provide additional design parameters as required by the structural engineer.

6.11 Concrete Flatwork

6.11.1 The following recommendations apply to exterior concrete flatwork where near surface soils are low to medium expansive (EI less than 90). Exterior slabs not subjected to vehicular traffic should be a minimum of 4 inches thick and reinforced with 6 x 6-6/6 welded wire mesh or No. 3 rebar spaced at 24 inches on center in both directions. The mesh should be placed in the middle of the slab. Proper mesh positioning is critical to future performance of the slabs. The contractor should take extra measures to provide proper mesh placement. Prior to construction of slabs, the upper 12 inches of subgrade soils should be moisture conditioned at or slightly above optimum moisture content and compacted to at least 90 percent of the laboratory maximum dry density per ASTM 1557.

6.11.2 Concrete flatwork should be provided with crack control joints to reduce and/or control shrinkage cracking. Crack control spacing should be determined by the project structural engineer based upon the slab thickness and intended usage. Criteria of the American Concrete Institute (ACI) should be taken into consideration when establishing crack control spacing. A 4-inch-thick slab should have a maximum joint spacing of 10 feet. Subgrade soil for exterior slabs not subjected to vehicle loads should be compacted in accordance with criteria presented above prior to concrete placement. Subgrade soil should be properly compacted and the moisture content of subgrade soil should be checked prior to placing concrete.

6.11.3 The recommendations of this report are intended to reduce the potential for cracking of slabs due to expansive soil (if present), differential settlement of existing soil or soil with varying thicknesses. However, even with the incorporation of the recommendations presented herein, foundations, stucco walls, and slabs-on-grade placed on such conditions may still exhibit some cracking due to soil movement and/or shrinkage. Periotic maintenance such as slab replacement and/or grinding of elevated slab margins may be necessary due to the highly expansive soils. The occurrence of concrete shrinkage cracks is independent of the supporting soil characteristics. Their occurrence may be reduced and/or controlled by limiting the slump of the concrete, proper concrete placement and curing, and by the placement of crack control joints at periodic intervals, in particular, where re-entrant slab corners occur.

6.12 Preliminary Pavement Recommendations

6.12.1 We calculated the preliminary flexible pavement sections in general conformance with the *Caltrans Method of Flexible Pavement Design* (Highway Design Manual, Section 608.4) using estimated Traffic Indices (TI) of 4.5, 5.0, 6.0, 7.0 and 8.0 for light-duty parking stalls, light-duty driveways, medium-duty, and heavy-duty traffic areas, respectively. The project civil engineer, architect, and owner should review the pavement designations to determine appropriate locations for pavement thickness. The final pavement sections should be based on the R-Value of the subgrade soil encountered at final subgrade elevation. For preliminary design purposes, we have utilized an assumed R-value of 20. Table 6.12.1 presents the preliminary flexible pavement sections for private parking lots and roadways.

TABLE 6.12.1
PRELIMINARY FLEXIBLE PAVEMENT SECTIONS

Location	Assumed Traffic Index	Assumed Subgrade R-Value	Asphalt Concrete (inches)	Class 2 Aggregate Base (inches)
Light-duty vehicle parking stalls	4.5	20	3	6
Light-duty vehicle traffic areas	5.0	20	3	8
Medium-duty truck traffic areas	6.0	20	3.5	10
Heavy-duty truck traffic areas	7.0	20	4	12
Heavy-duty truck traffic areas	8.0	20	5	14

6.12.2 Prior to placing base materials, the upper 12 inches of the subgrade soil should be scarified, moisture conditioned as necessary, and recompacted to a dry density of at least 95 percent of the laboratory maximum dry density near to slightly above optimum moisture content as determined by ASTM D 1557. Similarly, the base material should be compacted to a dry density of at least 95 percent of the laboratory maximum dry density near to slightly above optimum moisture content. Asphalt concrete should be compacted to a density of at least 95 percent of the laboratory Hveem density in accordance with ASTM D 2726.

6.12.3 Base materials should conform to Section 26-1.028 of the *Standard Specifications for The State of California Department of Transportation (Caltrans)* with a ¾-inch maximum size aggregate. The asphalt concrete should conform to Section 203-6 of the *Standard Specifications for Public Works Construction (Greenbook)*.

6.12.4 A rigid Portland Cement concrete (PCC) pavement section should be placed in driveway entrance aprons, trash bin loading/storage areas and loading dock areas. The concrete pad for trash truck areas should be large enough such that the truck wheels will be positioned on the concrete during loading. We calculated the rigid pavement section in general conformance with the procedure recommended by the American Concrete Institute report ACI 330R-08 *Guide for Design and Construction of Concrete Parking Lots* using the parameters presented in Table 6.12.2.

TABLE 6.12.2
RIGID PAVEMENT DESIGN PARAMETERS

Design Parameter	Design Value
Modulus of subgrade reaction, k	100 pci
Modulus of rupture for concrete, M_R	500 psi
Traffic Category, TC	B and C
Average daily truck traffic, ADTT	300 and 300

6.12.5 Based on the criteria presented herein, the PCC pavement sections should have a minimum thickness as presented in Table 6.12.3.

TABLE 6.12.3
RIGID PAVEMENT RECOMMENDATIONS

Location	Portland Cement Concrete (inches)
Medium-Duty Vehicles (TC=B, ADTT = 300)	7.0
Heavy-Duty Vehicles (TC=C, ADTT =300)	7.5

6.12.6 The PCC pavement should be placed over subgrade soil that is compacted to a dry density of at least 95 percent of the laboratory maximum dry density near to slightly above optimum moisture content. This pavement section is based on a minimum concrete compressive strength of approximately 3,000 psi (pounds per square inch).

6.12.7 A thickened edge or integral curb should be constructed on the outside of concrete slabs subjected to wheel loads. The thickened edge should be 1.2 times the slab thickness or a minimum thickness of 2 inches, whichever results in a thicker edge, and taper back to the recommended slab thickness 4 feet behind the face of the slab (e.g., a 7-inch-thick slab would have a 9-inch-thick edge).

6.12.8 Reinforcing steel should consist of No. 3 rebar placed at 18 inches on center, both directions, or 6x6-6/6 welded wire mesh.

6.12.9 To control the location and spread of concrete shrinkage cracks, crack-control joints (weakened plane joints) should be included in the design of the concrete pavement slab. Criteria of the American Concrete Institute (ACI) should be taken into consideration when establishing crack control spacing. However, we recommend a spacing not to exceed 10 feet. The depth of the crack-control joints should be determined by the referenced ACI report.

6.12.10 The performance of pavement is highly dependent on providing positive surface drainage away from the edge of the pavement. Ponding of water on or adjacent to the pavement will likely result in pavement distress and subgrade failure. Drainage from landscaped areas should be directed to controlled drainage structures. Landscape areas adjacent to the edge of asphalt pavements are not recommended due to the potential for surface or irrigation water to infiltrate the underlying permeable aggregate base and cause distress. Where such a condition cannot be avoided, consideration should be given to incorporating measures that will significantly reduce the potential for subsurface water migration into the aggregate base. If planter islands are planned, the perimeter curb should extend at least 6 inches below the level of the base materials.

6.13 Retaining Walls and Lateral Loads Recommendations

6.13.1 Retaining walls not restrained at the top and having a level backfill surface should be designed for an active soil pressure equivalent to the pressure exerted by a fluid with a density of 35 pounds per cubic foot (pcf). Where the backfill will be inclined at 2:1 (horizontal:vertical), an active soil pressure of 50 pcf is recommended. These soil pressures assume that the backfill materials within an area bounded by the wall and a 1:1 plane extending upward from the base of the wall possess an Expansion Index ≤50. Geocon Incorporated should be consulted for additional recommendations if backfill materials have an EI >50.

6.13.2 Retaining walls shall be designed to ensure stability against overturning sliding, excessive foundation pressure and water uplift. Where a keyway is extended below the wall base with the intent to engage passive pressure and enhance sliding stability, it is not necessary to consider active pressure on the keyway.

6.13.3 Where walls are restrained from movement at the top, an additional uniform pressure of 8H psf (where H equals the height of the retaining wall portion of the wall in feet) should be added to the active soil pressure where the wall possesses a height of 8 feet or less and 12H where the wall is greater than 8 feet. For retaining walls subject to vehicular loads within a horizontal distance equal to two-thirds the wall height, a surcharge equivalent to two feet of fill soil should be added (total unit weight of soil should be taken as 130 pcf).

6.13.4 Soil contemplated for use as retaining wall backfill, including import materials, should be identified in the field prior to backfill. At that time Geocon Incorporated should obtain samples for laboratory testing to evaluate its suitability. Modified lateral earth pressures may be necessary if the backfill soil does not meet the required expansion index or shear strength. County of San Diego or regional standard wall designs, if used, are based on a specific active lateral earth pressure and/or soil friction angle. In this regard, on-site soil to be used as backfill may or may not meet the values for standard wall designs. Geocon

Incorporated should be consulted to assess the suitability of the on-site soil for use as wall backfill if standard wall designs will be used.

6.13.5 Unrestrained walls will move laterally when backfilled and loading is applied. The amount of lateral deflection is dependent on the wall height, the type of soil used for backfill, and loads acting on the wall. The wall designer should provide appropriate lateral deflection quantities for planned retaining walls structures, if applicable. These lateral values should be considered when planning types of improvements above retaining wall structures.

6.13.6 Retaining walls should be provided with a drainage system adequate to prevent the buildup of hydrostatic forces and should be waterproofed as required by the project architect. The use of drainage openings through the base of the wall (weep holes) is not recommended where the seepage could be a nuisance or otherwise adversely affect the property adjacent to the base of the wall. The above recommendations assume a properly compacted granular (EI $\leq$50) free-draining backfill material with no hydrostatic forces or imposed surcharge load. A typical retaining wall drainage detail is presented on Figure 7. If conditions different than those described are expected, or if specific drainage details are desired, Geocon Incorporated should be contacted for additional recommendations.

6.13.7 In general, wall foundations having a minimum depth and width of one foot may be designed for an allowable soil bearing pressure of 2,500 psf, provided the soil within three feet below the base of the wall has an Expansion Index $\leq$ 90. The recommended allowable soil bearing pressure may be increased by 300 psf and 500 psf for each additional foot of foundation width and depth, respectively, up to a maximum allowable soil bearing pressure of 5,000 psf.

6.13.8 The proximity of the foundation to the top of a slope steeper than 3:1 could impact the allowable soil bearing pressure. Therefore, Geocon Incorporated should be consulted where such a condition is anticipated. As a minimum, wall footings should be deepened such that the bottom outside edge of the footing is at least seven feet from the face of slope when located adjacent and/or at the top of descending slopes.

6.13.9 The structural engineer should determine the Seismic Design Category for the project in accordance with Section 1613.3.5 of the 2019 CBC or Section 11.6 of ASCE 7-16. For structures assigned to Seismic Design Category of D, E, or F, retaining walls that support more than 6 feet of backfill should be designed with seismic lateral pressure in accordance with Section 1803.5.12 of the 2019 CBC. The seismic load is dependent on the retained height where H is the height of the wall, in feet, and the calculated loads result in pounds per square foot (psf) exerted at the base of the wall and zero at the top of the wall. A seismic load of 17H should be used for design. We used the peak ground acceleration adjusted for Site Class effects, PGA_M, of 0.397g calculated from ASCE 7-16 Section 11.8.3 and applied a pseudo-static coefficient of 0.33.

6.13.10 For resistance to lateral loads, a passive earth pressure equivalent to a fluid density of 300 pcf is recommended for footings or shear keys poured neat against properly compacted granular fill soils or undisturbed formational materials. The passive pressure assumes a horizontal surface extending away from the base of the wall at least five feet or three times the surface generating the passive pressure, whichever is greater. The upper 12 inches of material not protected by floor slabs or pavement should not be included in the design for lateral resistance.

6.13.11 An ultimate friction coefficient of 0.35 may be used for resistance to sliding between soil and concrete. This friction coefficient may be combined with the passive earth pressure when determining resistance to lateral loads.

6.13.12 The recommendations presented above are generally applicable to the design of rigid concrete or masonry retaining walls having a maximum height of 12 feet. In the event that walls higher than 12 feet are planned, Geocon Incorporated should be consulted for additional recommendations.

6.14 Slope Maintenance

6.14.1 Slopes steeper than 3:1 (horizontal: vertical) may, under conditions that are both difficult to prevent and predict, be susceptible to near-surface (surficial) slope instability. The instability is typically limited to the outer three feet of the slope and usually does not directly impact the improvements on pad areas above or below the slope. The occurrence of surficial instability is more prevalent on fill slopes and is generally preceded by a period of heavy rainfall, excessive irrigation or the migration of subsurface seepage. Disturbance and/or loosening of the surficial soils, as might result from root growth, soil expansion or excavation for irrigation lines and slope planting, may also be a significant contributing factor to surficial instability. We recommend that, to the maximum extent practical, (a) disturbed/loosened surficial soils be either removed or properly compacted, (b) irrigation systems be periodically inspected and maintained to eliminate leaks and excessive irrigation, and (c) surface drains on and adjacent to slopes be periodically maintained to preclude ponding or erosion. Although the incorporation of the above recommendations should reduce the potential for surficial slope instability, it will not eliminate the possibility, and it may be necessary to rebuild or repair a portion of the project's slopes in the future.

6.15 Site Drainage and Maintenance

6.15.1 Adequate site drainage is critical to reduce the potential for differential soil movement, erosion and subsurface seepage. Under no circumstances should water be allowed to pond adjacent to footings. The site should be graded and maintained such that surface drainage is directed away from structures in accordance with 2019 CBC 1803.3 or other applicable standards. In addition, surface drainage should be directed away from the top of slopes into swales or other controlled drainage devices. Roof and pavement drainage should be directed into storm drains and conduits that carry runoff away from the proposed structure.

6.15.2 Underground utilities should be leak free. Utility and irrigation lines should be checked periodically for leaks, and detected leaks should be repaired promptly. Detrimental soil movement could occur if water is allowed to infiltrate the soil for prolonged periods of time.

6.15.3 Landscaping planters adjacent to paved areas are not recommended due to the potential for surface or irrigation water to infiltrate the pavement's subgrade and base course. We recommend that area drains to collect excess irrigation water and transmit it to drainage structures or impervious above-grade planter boxes be used. In addition, where landscaping is planned adjacent to the pavement, we recommend construction of a cutoff wall along the edge of the pavement that extends at least 6 inches below the bottom of the base material.

6.16 Grading and Foundation Plan Review

6.16.1 Geocon Incorporated should review the grading and foundation plans prior to finalization to verify their compliance with the recommendations of this report and determine the need for additional comments, recommendations, and/or analysis.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

1. The firm that performed the geotechnical investigation for the project should be retained to provide testing and observation services during construction to provide continuity of geotechnical interpretation and to check that the recommendations presented for geotechnical aspects of site development are incorporated during site grading, construction of improvements, and excavation of foundations. If another geotechnical firm is selected to perform the testing and observation services during construction operations, that firm should prepare a letter indicating their intent to assume the responsibilities of project geotechnical engineer of record. A copy of the letter should be provided to the regulatory agency for their records. In addition, that firm should provide revised recommendations concerning the geotechnical aspects of the proposed development, or a written acknowledgement of their concurrence with the recommendations presented in our report. They should also perform additional analyses deemed necessary to assume the role of Geotechnical Engineer of Record.

2. The recommendations of this report pertain only to the site investigated and are based upon the assumption that the soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon Incorporated should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon Incorporated.

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

4. The findings of this report are valid as of the present date. However, changes in the conditions of a property can occur with the passage of time, whether they be due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.

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NO SCALE

VICINITY MAP

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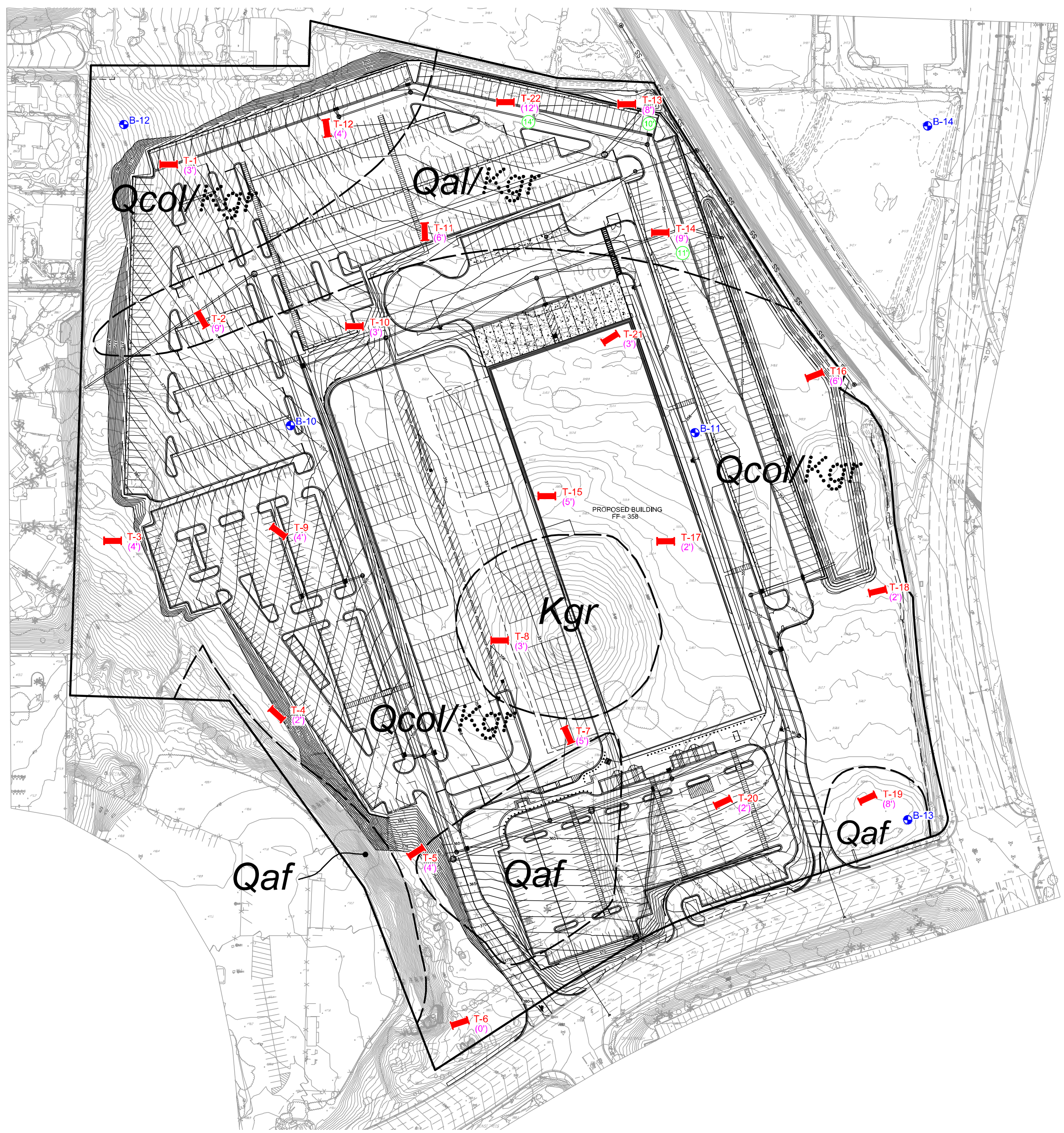
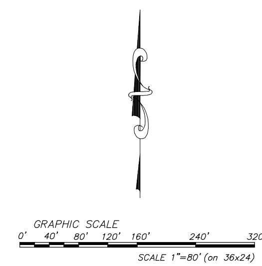
RM / AML		DSK/GTYPD	DATE 10 - 20 - 2020	PROJECT NO. G2597 - 32 - 01	FIG. 1





GEOCON LEGEND

Qaf ....ARTIFICIAL FILL

Qal ....ALLUVIUM

Qcol ....COLLUVIUM

Kgr ....GRANITIC ROCK (Dotted Where Buried)

........APPROX. LOCATION OF GEOLOGIC CONTACT

T-22 ....APPROX. LOCATION OF EXPLORATORY TRENCH

(9') ....APPROX. THICKNESS (Feet) OF SURFICIAL SOIL REQUIRING REMEDIAL GRADING

(14') ....APPROX. DEPTH (Feet) TO GROUNDWATER

B-14 ....APPROX. LOCATION OF EXPLORATORY BORING (Geocon, 1983)

GEOLOGIC MAP

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SCALE	1" = 100'	DATE	10 - 20 - 2020
PROJECT NO.	G2597 - 32 - 01	FIGURE	2
SHEET	1 OF 1		

ASSUMED CONDITIONS :

SLOPE HEIGHT	H	=	20 feet
SLOPE INCLINATION	2 : 1		(Horizontal : Vertical)
TOTAL UNIT WEIGHT OF SOIL	γ_t	=	125 pounds per cubic foot
ANGLE OF INTERNAL FRICTION	ϕ	=	29 degrees
APPARENT COHESION	C	=	300 pounds per square foot
NO SEEPAGE FORCES			

ANALYSIS :

$\lambda_{c\phi}$	=	$\frac{\gamma_t H \tan\phi}{C}$	EQUATION (3-3), REFERENCE 1
FS	=	$\frac{N_{cf} C}{\gamma_t H}$	EQUATION (3-2), REFERENCE 1
$\lambda_{c\phi}$	=	4.6	CALCULATED USING EQ. (3-3)
Ncf	=	18	DETERMINED USING FIGURE 10, REFERENCE 2
FS	=	2.2	FACTOR OF SAFETY CALCULATED USING EQ. (3-2)

REFERENCES :

1......Janbu, N., Stability Analysis of Slopes with Dimensionless Parameters, Harvard Soil Mechanics, Series No. 46, 1954

2......Janbu, N., Discussion of J.M. Bell, Dimensionless Parameters for Homogeneous Earth Slopes, Journal of Soil Mechanics and Foundation Design, No. SM6, November 1967.

SLOPE STABILITY ANALYSIS - FILL SLOPES

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ASSUMED CONDITIONS :

SLOPE HEIGHT	H	= 30 feet
SLOPE INCLINATION	2 : 1	(Horizontal : Vertical)
TOTAL UNIT WEIGHT OF SOIL	γ_t	= 130 pounds per cubic foot
ANGLE OF INTERNAL FRICTION	ϕ	= 33 degrees
APPARENT COHESION	C	= 500 pounds per square foot
NO SEEPAGE FORCES		

ANALYSIS :

$\lambda_{c\phi} = \dfrac{\gamma_t H \tan\phi}{C}$		EQUATION (3-3), REFERENCE 1
$FS = \dfrac{N_{cf} C}{\gamma_t H}$		EQUATION (3-2), REFERENCE 1
$\lambda_{c\phi}$ =	5.1	CALCULATED USING EQ. (3-3)
Ncf =	20	DETERMINED USING FIGURE 10, REFERENCE 2
FS =	2.6	FACTOR OF SAFETY CALCULATED USING EQ. (3-2)

REFERENCES :

1......Janbu, N., Stability Analysis of Slopes with Dimensionless Parameters, Harvard Soil Mechanics, Series No. 46, 1954

2......Janbu, N., Discussion of J.M. Bell, Dimensionless Parameters for Homogeneous Earth Slopes, Journal of Soil Mechanics and Foundation Design, No. SM6, November 1967.

SLOPE STABILITY ANALYSIS - CUT SLOPES

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ASSUMED CONDITIONS :

SLOPE HEIGHT	H =	Infinite
DEPTH OF SATURATION	Z =	3 feet
SLOPE INCLINATION	2 : 1	(Horizontal : Vertical)
SLOPE ANGLE	i =	26.6 degrees
UNIT WEIGHT OF WATER	γ_w =	62.4 pounds per cubic foot
TOTAL UNIT WEIGHT OF SOIL	γ_t =	125 pounds per cubic foot
ANGLE OF INTERNAL FRICTION	ϕ =	29 degrees
APPARENT COHESION	C =	300 pounds per square foot

SLOPE SATURATED TO VERTICAL DEPTH Z BELOW SLOPE FACE

SEEPAGE FORCES PARALLEL TO SLOPE FACE

ANALYSIS :

$$FS = \frac{C + (\gamma_t - \gamma_w)\ Z \cos^2 i \tan \phi}{\gamma_t\ Z \sin i \cos i} = 2.5$$

REFERENCES :

1......Haefeli, R. *The Stability of Slopes Acted Upon by Parallel Seepage*, Proc. Second International Conference, SMFE, Rotterdam, 1948, 1, 57-62

2......Skempton, A. W., and F.A. Delory, *Stability of Natural Slopes in London Clay*, Proc. Fourth International Conference, SMFE, London, 1957, 2, 378-81

SURFICIAL SLOPE STABILITY ANALYSIS

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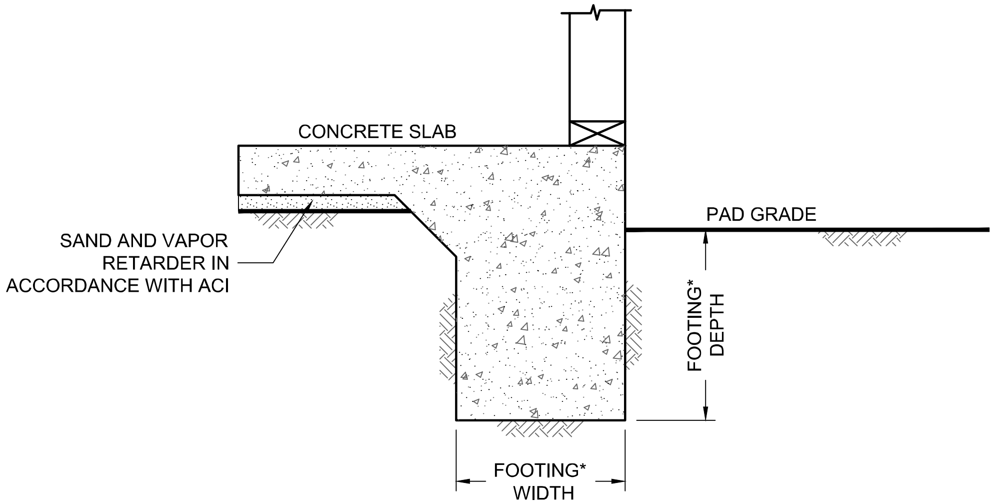

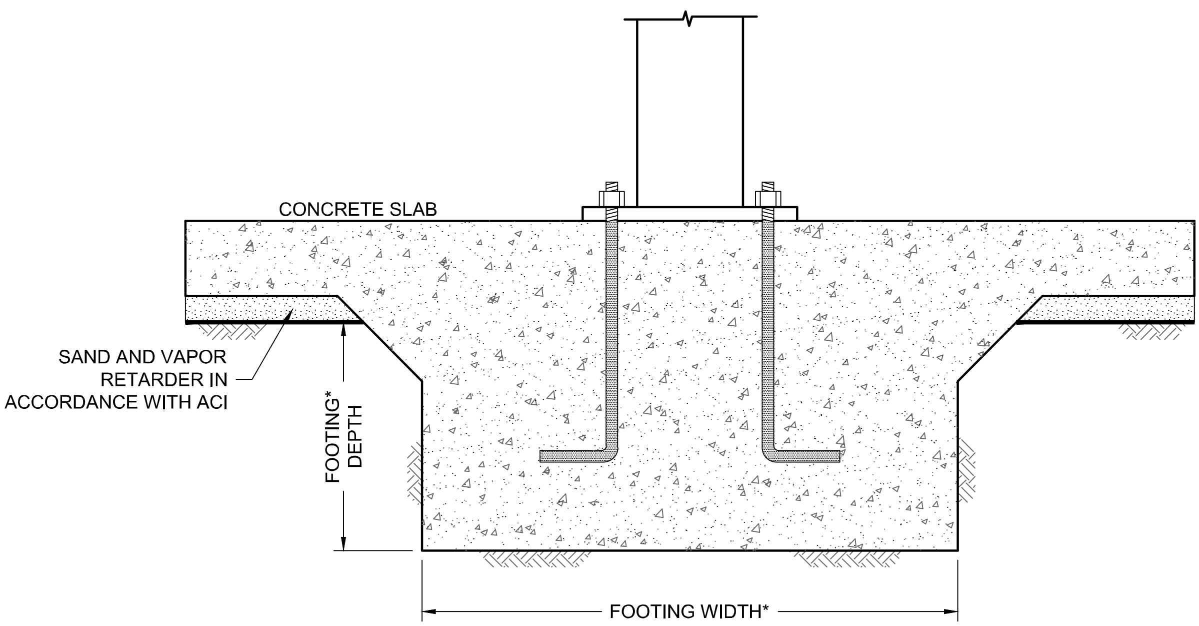

*....SEE REPORT FOR FOUNDATION WIDTH AND DEPTH RECOMMENDATION

NO SCALE

WALL / COLUMN FOOTING DIMENSION DETAIL

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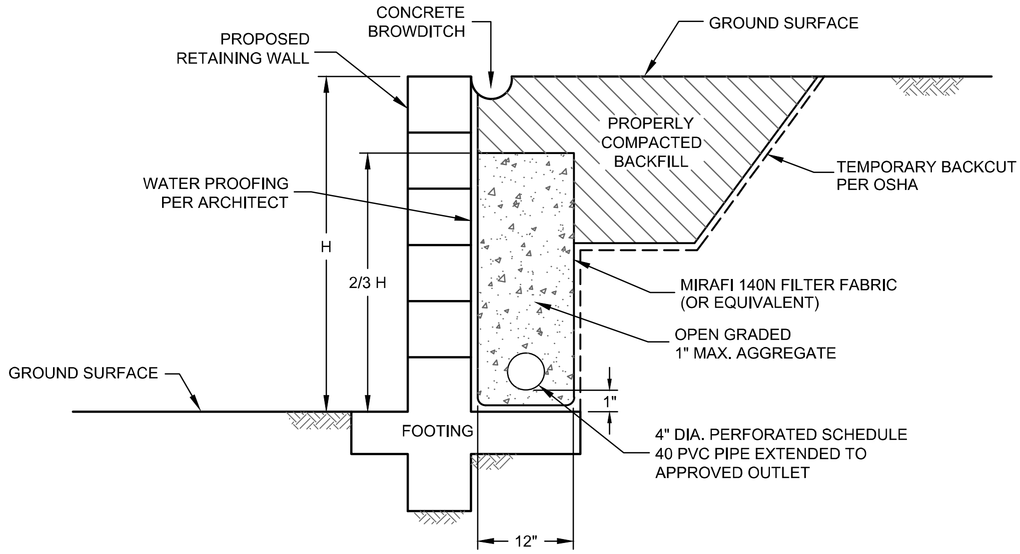
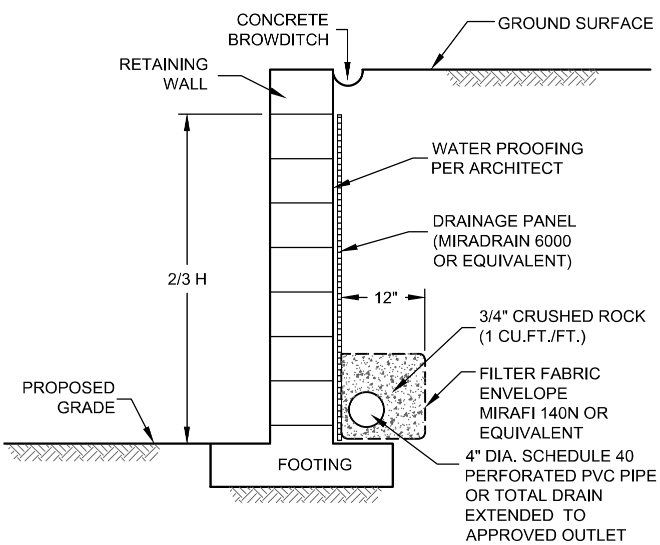
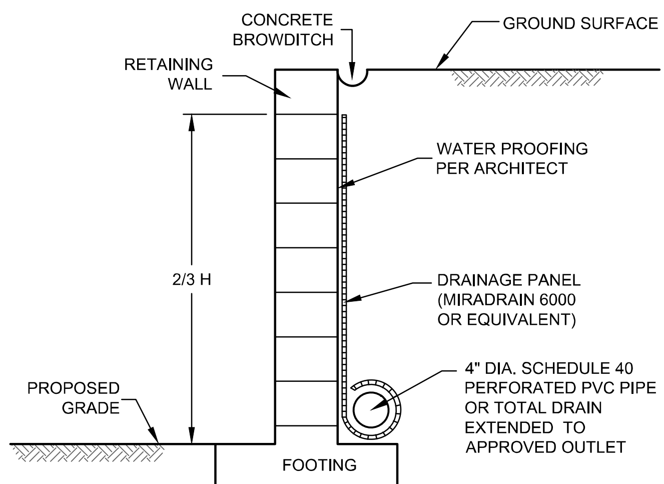
RM / AML		DSK/GTYPD	DATE 10 - 20 - 2020	PROJECT NO. G2597 - 32 - 01	FIG. 6

Plotted:10/20/2020 10:12AM | By:JONATHAN WILKINS | File Location:Y:\PROJECTS\G2597-32-01 (Weld Distributiion Center)\DETAILS\Wall-Column Footing Dimension Detail (COLFOOT2).dwg







NOTE :

DRAIN SHOULD BE UNIFORMLY SLOPED TO GRAVITY OUTLET
OR TO A SUMP WHERE WATER CAN BE REMOVED BY PUMPING

NO SCALE

TYPICAL RETAINING WALL DRAIN DETAIL

GEOCON INCORPORATED

GEOTECHNICAL ■ ENVIRONMENTAL ■ MATERIALS

6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121 - 2974

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WELD DISTRIBUTION CENTER
EL CAJON, CALIFORNIA

RM / AML		DSK/GTYPD	DATE 10 - 20 - 2020	PROJECT NO. G2597 - 32 - 01	FIG. 7

Plotted:10/20/2020 10:12AM | By:JONATHAN WILKINS | File Location:Y:\PROJECTS\G2597-32-01 (Weld Distributiion Center)\DETAILS\Typical Retaining Wall Drainage Detail (RWDD7A).dwg

APPENDIX A

APPENDIX A

FIELD INVESTIGATION

The field investigation, performed on September 14 and 15, 2020, consisted of excavating 22 exploratory trenches (Trench Nos. T-1 through T-22). In addition, two infiltration tests (I-1 and I-2) were performed within a proposed storm water management area. The approximate locations of the trenches and infiltration tests are shown on the *Geologic Map*, Figure 2.

The exploratory trenches were excavated with a John Deere 310L backhoe, using a 24-inch-wide bucket. Logs of the trenches depicting the soil and geologic conditions encountered are presented on Figures A-1 through A-22.

Exploratory boring logs from a previous study by Geocon performed in 1983 are presented in Appendix C. The approximate boring locations are shown on the Geologic Map, Figure 2.

The soils encountered in the excavations were visually classified and logged in general accordance with American Society for Testing and Materials (ASTM) practice for Description and Identification of Soils (Visual Manual Procedure D 2488).

PROJECT NO. G2597-32-01

TRENCH T 1

ELEV. (MSL.) **371'** DATE COMPLETED **09-14-2020**

EQUIPMENT **JD 310L BACKHOE** BY: **T. MYERS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, damp, olive-brown, Silty, fine to medium SAND			
2				SM	**COLLUVIUM (Qcol)** Medium dense, damp, reddish-brown, Silty, fine to coarse SAND			
4					**GRANITIC ROCK (Kgr)** Completely weathered, weak GRANITIC ROCK, excavates as orangish brown, black, and white, Silty, fine to coarse SAND			
					TRENCH TERMINATED AT 5 FEET Groundwater not encountered			

Figure A-1,
Log of Trench T 1, Page 1 of 1

G2597-32-01.GPJ

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

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

GEOCON

PROJECT NO. G2597-32-01

TRENCH T 2

ELEV. (MSL.) 358' DATE COMPLETED 09-14-2020

EQUIPMENT JD 310L BACKHOE BY: T. MYERS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry, light brown, Silty, fine to medium SAND			
2				SM	**ALLUVIUM (Qal)** Loose, damp, light brown, Silty, fine to medium SAND; porous			
4	T2-1			SM-SC	Medium dense, moist, olive-brown to dark brown, Silty/Clayey, fine to medium SAND			
6								
8								
10					**GRANITIC ROCK (Kgr)** Completely weathered, weak GRANITIC ROCK, excavates as gray and orangish brown, Silty, fine to coarse SAND			

TRENCH TERMINATED AT 10 FEET
Groundwater not encountered

Figure A-2,
Log of Trench T 2, Page 1 of 1

G2597-32-01.GPJ

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

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

GEOCON

PROJECT NO. G2597-32-01

TRENCH T 3

ELEV. (MSL.) 381' DATE COMPLETED 09-14-2020

EQUIPMENT JD 310L BACKHOE BY: T. MYERS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry, light brown, Silty, fine to medium SAND			
2				SM	**COLLUVIUM (Qcol)** Loose, damp, light brown, Silty, fine to medium SAND; porous			
4				SM-SC	Medium dense to dense, moist, olive-brown to dark brown, Silty/Clayey, fine to medium SAND			
					GRANITIC ROCK (Kgr) Moderately weathered, moderately weak GRANITIC ROCK, excavates as Silty, fine to coarse SAND			
					TRENCH TERMINATED AT 5 FEET Groundwater not encountered			

Figure A-3,
Log of Trench T 3, Page 1 of 1

G2597-32-01.GPJ

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

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

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DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	**TRENCH T 4** ELEV. (MSL.) **381'** DATE COMPLETED **09-14-2020** EQUIPMENT **JD 310L BACKHOE** BY: **T. MYERS**	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**COLLUVIUM (Qcol)** Medium dense, damp, light reddish-brown, Silty, fine to medium SAND; porous			
2					**GRANITIC ROCK (Kgr)** Moderately weathered, moderately weak, black yellowish-brown and white, GRANITIC ROCK, excavates as Silty, fine to coarse SAND			
					TRENCH TERMINATED AT 3 FEET Groundwater not encountered			

Figure A-4,
Log of Trench T 4, Page 1 of 1

G2597-32-01.GPJ

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

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

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DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 5 ELEV. (MSL.) 376' DATE COMPLETED 09-14-2020 EQUIPMENT JD 310L BACKHOE BY: T. MYERS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**ARTIFICIAL FILL (Qaf)** Loose, damp, light tan, Silty, fine to medium SAND			
2				SM	**COLLUVIUM (Qcol)** Medium dense, damp, reddish-brown, Silty, fine to medium SAND			
4					**GRANITIC ROCK (Kgr)** Completely weathered, weak black, white, gray GRANITIC ROCK, excavates as Silty, fine to coarse SAND			
					TRENCH TERMINATED AT 5 FEET Groundwater not encountered			

Figure A-5,
Log of Trench T 5, Page 1 of 1

G2597-32-01.GPJ

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

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

GEOCON

PROJECT NO. G2597-32-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 6 ELEV. (MSL.) 382' DATE COMPLETED 09-14-2020 EQUIPMENT JD 310L BACKHOE BY: T. MYERS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0 – 4	T6-1	+ +			**GRANITIC ROCK (Kgr)** Completely weathered, weak yellowish-brown, black, white GRANITIC ROCK, excavates as Silty, fine to coarse SAND			
					TRENCH TERMINATED AT 4 FEET Groundwater not encountered			

Figure A-6,
Log of Trench T 6, Page 1 of 1

G2597-32-01.GPJ

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

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

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DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 7 ELEV. (MSL.) 365' DATE COMPLETED 09-14-2020 EQUIPMENT JD 310L BACKHOE BY: T. MYERS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**COLLUVIUM (Qcol)** Loose, damp, light brown, Silty, fine to medium SAND			
2	T7-1			SC	Medium dense to dense, moist, reddish-brown, Clayey, fine to medium SAND			
4					Dense, moist, reddish-brown, Silty/Clayey, fine to medium SAND (Completely weathered D.G.)			
6					**GRANITIC ROCK (Kgr)** Highly weathered, weak, black, gray, white, GRANITIC ROCK, excavates as Silty, fine to coarse SAND			
					TRENCH TERMINATED AT 6 FEET Groundwater not encountered			

Figure A-7,
Log of Trench T 7, Page 1 of 1

G2597-32-01.GPJ

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

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

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TRENCH T 8

ELEV. (MSL.) **366'** DATE COMPLETED **09-14-2020**

EQUIPMENT **JD 310L BACKHOE** BY: **T. MYERS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 3	T8-1			SM	**COLLUVIUM (Qcol)** Medium dense to dense, damp, light brown, Silty, fine to medium SAND; porous			
3 – 5					**GRANITIC ROCK (Kgr)** Moderately weathered, weak, black, white, orange GRANITIC ROCK, excavates as Silty, fine to coarse SAND			
					TRENCH TERMINATED AT 5 FEET Groundwater not encountered			

Figure A-8,
Log of Trench T 8, Page 1 of 1

G2597-32-01.GPJ

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

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

PROJECT NO. G2597-32-01

TRENCH T 9

ELEV. (MSL.) **364'** DATE COMPLETED **09-14-2020**

EQUIPMENT **JD 310L BACKHOE** BY: **T. MYERS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**COLLUVIUM (Qcol)** Loose, dry, light brown, Silty, fine to medium SAND; porous			
2				SM-SC	Medium dense to dense, moist, reddish-brown, Silty/Clayey, fine to medium SAND; pinhole porosity			
4					**GRANITIC ROCK (Kgr)** Highly weathered, moderately weak, gray, black, white, GRANITIC ROCK, excavates as Silty, fine to coarse SAND			

TRENCH TERMINATED AT 5 FEET
Groundwater not encountered

Figure A-9,
Log of Trench T 9, Page 1 of 1

G2597-32-01.GPJ

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

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

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PROJECT NO. G2597-32-01

TRENCH T 10

ELEV. (MSL.) **353'** DATE COMPLETED **09-14-2020**

EQUIPMENT **JD 310L BACKHOE** BY: **T. MYERS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry, light brown, Silty, fine to medium SAND			
2	T10-1			SM-SC	**COLLUVIUM (Qcol)** Medium dense, moist, reddish-brown, Silty/Clayey, fine to medium SAND; porous			
4	T10-2				**GRANITIC ROCK (Kgr)** Completely weathered, weak black, gray, white GRANITIC ROCK, excavates as Silty, fine to coarse SAND			

TRENCH TERMINATED AT 5 FEET
Groundwater not encountered

Figure A-10,
Log of Trench T 10, Page 1 of 1

G2597-32-01.GPJ

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

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

GEOCON

TRENCH T 11

ELEV. (MSL.) **348'** DATE COMPLETED **09-14-2020**

EQUIPMENT **JD 310L BACKHOE** BY: **T. MYERS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 3				SM	**ALLUVIUM (Qal)** Loose to medium dense, damp, olive-brown, Silty, fine to medium SAND; porous			
3 – 6	T11-1			SC	Medium dense, moist, grayish-brown, Clayey, fine to medium SAND			
6 – 8					**GRANITIC ROCK (Kgr)** Completely weathered, moderately weak GRANITIC ROCK, excavates as orangish and grayish-brown, Silty, fine to coarse SAND			

TRENCH TERMINATED AT 8 FEET
Groundwater not encountered

Figure A-11,
Log of Trench T 11, Page 1 of 1

G2597-32-01.GPJ

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

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

GEOCON

TRENCH T 12

ELEV. (MSL.) **350'** DATE COMPLETED **09-14-2020**

EQUIPMENT **JD 310L BACKHOE** BY: **T. MYERS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose to medium dense, dry, light brown, Silty, fine to medium SAND; porous; rootlets			
2	T12-1			SM-SC	**COLLUVIUM (Qcol)** Dense, damp, reddish-brown, Silty/Clayey, fine to medium SAND			
4	T12-2				**GRANITIC ROCK (Kgr)** Completely weathered, moderately weak GRANITIC ROCK, excavates as dense, orangish brown, Silty, fine to coarse SAND			
6					TRENCH TERMINATED AT 6 FEET Groundwater not encountered			

Figure A-12,
Log of Trench T 12, Page 1 of 1

G2597-32-01.GPJ

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

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

GEOCON

TRENCH T 13

ELEV. (MSL.) 344'   DATE COMPLETED 09-14-2020

EQUIPMENT JD 310L BACKHOE   BY: T. MYERS

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, damp, light brown, Silty, fine to medium SAND			
2	T13-1			CH	**ALLUVIUM (Qal)** Stiff, moist, dark brown, fine to medium Sandy CLAY			
4								
6				SM	Medium dense, moist, reddish-brown, Silty, fine to coarse SAND			
8	T13-2							
10			▼		- Groundwater encountered at 10 feet			
12								
14					TRENCH TERMINATED AT 14 FEET Groundwater encountered at 10 feet			

Figure A-13,
Log of Trench T 13, Page 1 of 1

G2597-32-01.GPJ

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

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

PROJECT NO. G2597-32-01

TRENCH T 14

ELEV. (MSL.) **346'** DATE COMPLETED **09-14-2020**

EQUIPMENT **JD 310L BACKHOE** BY: **T. MYERS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**ARTIFICIAL FILL (Qaf)** Loose, damp, white to light tan, Silty, fine to coarse SAND			
2				SM-SC	**ALLUVIUM (Qal)** Medium dense, moist, olive-brown, Silty/Clayey, SAND			
4				SC	Medium dense, moist, reddish-brown to dark brown, Clayey, fine to medium SAND			
6	T14-1							
8								
10			▼					
12					-Groundwater at 11 feet			
14								

TRENCH TERMINATED AT 14 FEET
Groundwater encountered at 11 feet

Figure A-14,
Log of Trench T 14, Page 1 of 1

G2597-32-01.GPJ

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

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

GEOCON

TRENCH T 15

ELEV. (MSL.) **360'** DATE COMPLETED **09-14-2020**

EQUIPMENT **JD 310L BACKHOE** BY: **T. MYERS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**TOPSOIL** Loose, dry, light brown, Silty, fine to medium SAND			
2				SM	**COLLUVIUM (Qcol)** Loose, damp, olive- brown to brown, Silty, fine to medium SAND			
4	T15-1			CH	Stiff, moist, reddish-brown, fine to medium Sandy CLAY			
6	T15-2				**GRANITIC ROCK (Kgr)** Highly weathered, weak, black, gray, white, GRANITIC ROCK, excavates as Silty, fine to coarse SAND			
					TRENCH TERMINATED AT 6 FEET Groundwater not encountered			

Figure A-15,
Log of Trench T 15, Page 1 of 1

G2597-32-01.GPJ

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

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

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PROJECT NO. G2597-32-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 16 ELEV. (MSL.) 348' DATE COMPLETED 09-14-2020 EQUIPMENT JD 310L BACKHOE BY: T. MYERS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				CH	**COLLUVIUM (Qcol)** Stiff, damp to moist, olive-brown, Sandy CLAY			
	T16-1							
2								
4								
6					**GRANITIC ROCK (Kgr)** Completely weathered, weak, black, white, orangish-brown GRANITIC ROCK, excavates as Silty, fine to coarse SAND			

TRENCH TERMINATED AT 7 FEET
Groundwater not encountered

Figure A-16,
Log of Trench T 16, Page 1 of 1

G2597-32-01.GPJ

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

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

GEOCON

PROJECT NO. G2597-32-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 17 ELEV. (MSL.) 356' DATE COMPLETED 09-14-2020 EQUIPMENT JD 310L BACKHOE BY: T. MYERS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM-SC	**COLLUVIUM (Qcol)** Loose, damp, reddish-brown, Silty/Clayey, fine to medium SAND; porous			
2					**GRANITIC ROCK (Kgr)** Highly weathered, moderately weak, black, white, orange GRANITIC ROCK, excavates as Silty, fine to coarse SAND			
					TRENCH TERMINATED AT 3 FEET Groundwater not encountered			

Figure A-17,
Log of Trench T 17, Page 1 of 1

G2597-32-01.GPJ

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

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

GEOCON

PROJECT NO. G2597-32-01

TRENCH T 18

ELEV. (MSL.) **354'** DATE COMPLETED **09-15-2020**

EQUIPMENT **JD 310L BACKHOE** BY: **T. MYERS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**COLLUVIUM (Qcol)** Medium dense, damp, olive-brown, Silty, fine to medium SAND; blocky			
2					**GRANITIC ROCK (Kgr)** Highly weathered, weak, black, white, reddish-brown GRANITIC ROCK, excavates as Silty, fine to coarse SAND			
					TRENCH TERMINATED AT 3 FEET Groundwater not encountered			

Figure A-18,
Log of Trench T 18, Page 1 of 1

G2597-32-01.GPJ

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

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

GEOCON

TRENCH T 19

ELEV. (MSL.) **365'** DATE COMPLETED **09-15-2020**

EQUIPMENT **JD 310L BACKHOE** BY: **T. MYERS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**ARTIFICIAL FILL (Qaf)** Loose, damp, olive-brown, Silty, fine to medium SAND			
2				SM-SC	**COLLUVIUM (Qcol)** Medium dense, moist, reddish-brown, Silty/Clayey SAND; porous			
4	T19-1			CH	Stiff, moist, reddish-brown, Sandy CLAY			
6								
8					**GRANITIC ROCK (Kgr)** Completely weathered, weak, orangish-brown GRANITIC ROCK, excavates as Silty/Clayey, fine to coarse SAND			

TRENCH TERMINATED AT 9 FEET
Groundwater not encountered

Figure A-19,
Log of Trench T 19, Page 1 of 1

G2597-32-01.GPJ

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

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

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PROJECT NO. G2597-32-01

TRENCH T 20

ELEV. (MSL.) **365'** DATE COMPLETED **09-15-2020**

EQUIPMENT **JD 310L BACKHOE** BY: **T. MYERS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0				SM	**ARTIFICIAL FILL (Qaf)** Loose, dry, light tan, Silty, fine to coarse SAND with gravel			
				SM-SC	**COLLUVIUM (Qcol)** Medium dense, moist, reddish-brown, Silty/Clayey, fine to medium SAND			
2					**GRANITIC ROCK (Kgr)** Highly weathered, moderately weak, black, orange, white GRANITIC ROCK, excavates as Silty, fine to coarse SAND			
					TRENCH TERMINATED AT 9 FEET Groundwater not encountered			

Figure A-20,
Log of Trench T 20, Page 1 of 1

G2597-32-01.GPJ

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

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

GEOCON

TRENCH T 21

ELEV. (MSL.) **348'** DATE COMPLETED **09-15-2020**

EQUIPMENT **JD 310L BACKHOE** BY: **T. MYERS**

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	MATERIAL DESCRIPTION	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0 – 3				SM-SC	**COLLUVIUM (Qcol)** Medium dense to dense, damp, light brown, Silty/Clayey, fine to medium SAND			
3 – 5					**GRANITIC ROCK (Kgr)** Completely weathered, weak, orangish-brown, black, white GRANITIC ROCK, excavates as Silty, fine to coarse SAND			

TRENCH TERMINATED AT 5 FEET
Groundwater not encountered

Figure A-21,
Log of Trench T 21, Page 1 of 1

G2597-32-01.GPJ

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

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

PROJECT NO. G2597-32-01

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	TRENCH T 22 ELEV. (MSL.) 344' DATE COMPLETED 09-15-2020 EQUIPMENT JD 310L BACKHOE BY: T. MYERS	PENETRATION RESISTANCE (BLOWS/FT.)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					MATERIAL DESCRIPTION			
0				SM	**ARTIFICIAL FILL (Qaf)** Loose, damp, light tan to white, Silty, fine to medium SAND with gravel			
2				SM	**ALLUVIUM (Qal)** Loose, damp, reddish-brown, Silty, fine SAND			
				CH	Soft, moist, black, Sandy CLAY			
4				SC	Medium dense, moist, reddish-brown, Clayey, fine to medium SAND			
6								
8								
10				SM	Medium dense, wet, grayish-brown, Silty, fine to medium SAND			
12								
14			▼		-Groundwater encountered at 14 feet			
					TRENCH TERMINATED AT 15 FEET Groundwater encountered at 14 feet			

Figure A-22,
Log of Trench T 22, Page 1 of 1

G2597-32-01.GPJ

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

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

APPENDIX B

APPENDIX B

LABORATORY TESTING

Laboratory tests were performed in accordance with generally accepted test methods of the American Society for Testing and Materials (ASTM) or other suggested procedures. Selected bulk samples were tested for maximum dry density and optimum moisture content, expansion index, soluble sulfate content, and direct shear strength. Selected relatively undisturbed samples were tested for their in-place dry density and moisture content and consolidation characteristics. The in-place dry density and moisture content results are indicated on the exploratory trench logs. The results of our laboratory tests are summarized on Tables B-I through B-III. The results of the consolidation tests and direct shear tests are also presented.

TABLE B-I
SUMMARY OF LABORATORY MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT TEST RESULTS

Sample No.	Description	Maximum Dry Density (pcf)	Optimum Moisture Content (% dry wt.)
T2-1	Dark brown, Clayey, fine to medium SAND	131.7	9.3
T10-2	Brown, silty, fine to coarse SAND	125.8	9.4

TABLE B-II
SUMMARY OF LABORATORY DIRECT SHEAR TEST RESULTS

Sample No.	Geologic Unit Symbol (USCS Soil Type)	Dry Density (pcf)	Moisture Content (%)	Peak [Ultimate] Cohesion (psf)	Peak [Ultimate] Angle of Shear Resistance (degrees)
T2-1	Qal - SC	117.1	10.6	620 [600]	26 [26]
T10-2	Kgr - SM	113.5	9.0	560 [360]	31 [33]

TABLE B-III
SUMMARY OF LABORATORY EXPANSION INDEX TEST RESULTS

Sample No.	Moisture Content (%)		Dry Density (pcf)	Expansion Index
	Before Test	After Test		
T7-1	9.9	18.2	111.3	27
T13-1	12.6	25.0	101.8	64
T16-1	12.7	28.4	101.3	109

TABLE B-IV
SUMMARY OF LABORATORY WATER-SOLUBLE SULFATE TEST RESULTS

Sample No.	Water-Soluble Sulfate Content (%)	Exposure
T7-1	0.006	Not Applicable
T13-1	0.019	Not Applicable
T16-1	0.005	Not Applicable

TABLE B-V
SUMMARY OF LABORATORY PLASTICITY INDEX TEST RESULTS

Sample No.	Geologic Unit	Liquid Limit (LL)	Plastic Limit (PL)	Plasticity Index (PI)	Unified Soil Classification (Group Symbol)
T16-1	Qcol – Sandy CLAY	56	20	36	CH

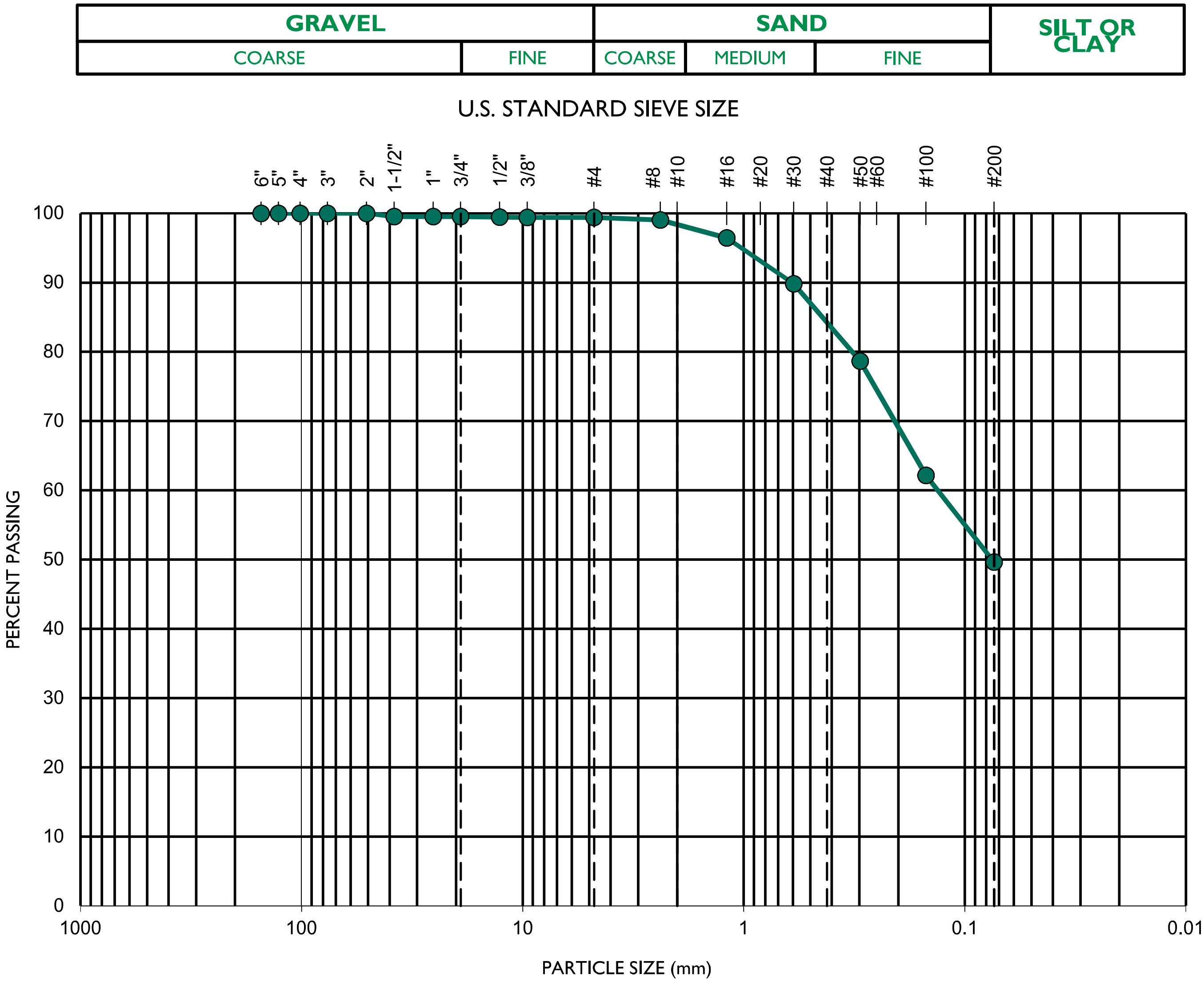
TABLE B-VI
SUMMARY OF LABORATORY WATER-SOLUBLE SULFATE AND CHLORIDE CONTENT TEST RESULTS
AASHTO T 291

Sample No.	Geologic Unit	Chloride Content, %
T2-1	Qal	0.011
T7-1	Qcol	0.008
T10-2	Kgr	0.009

SAMPLE NO.: **T7-1**

SAMPLE DEPTH (FT.): **2 to 4**

GEOLOGIC UNIT: **Qcol**



TEST DATA					
D_{10} (mm)	D_{30} (mm)	D_{60} (mm)	C_c	C_u	SOIL DESCRIPTION
0.015	0.045	0.137	1.0	9.2	SC - Clayey SAND

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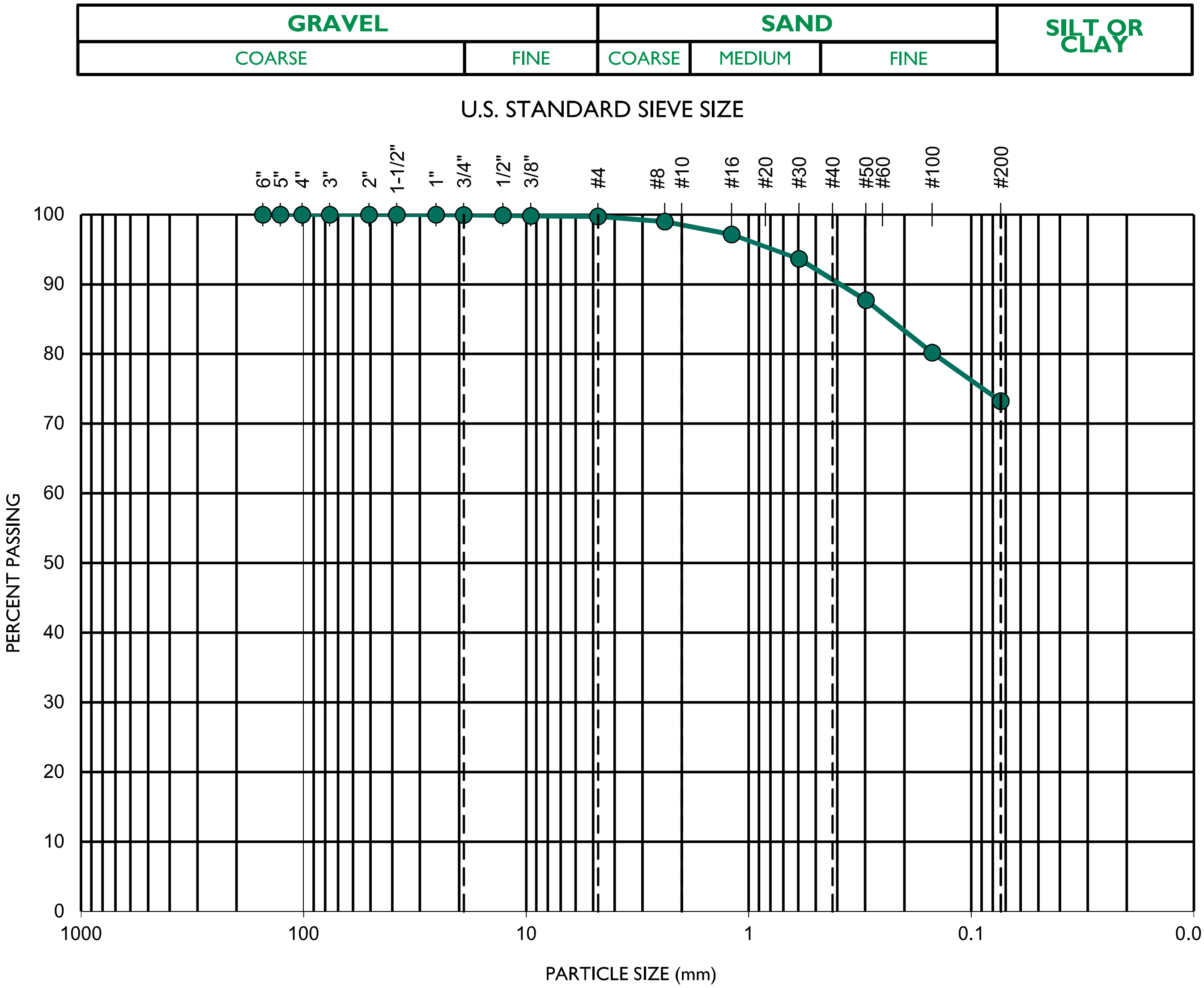
SIEVE ANALYSES - ASTM D 135

WELD DISTRIBUTION CENTER

PROJECT NO.: G2597-32-01

SAMPLE NO.: **T16-1** GEOLOGIC UNIT: **Qcol**

SAMPLE DEPTH (FT.): **1 to 3**



TEST DATA					
D_{10} (mm)	D_{30} (mm)	D_{60} (mm)	C_c	C_u	SOIL DESCRIPTION
0.010	0.030	0.060	1.5	5.9	CH - Fat CLAY with sand

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SIEVE ANALYSES - ASTM D 135

WELD DISTRIBUTION CENTER

PROJECT NO.: G2597-32-01

APPENDIX C

APPENDIX C

STORM WATER MANAGEMENT

FOR

WELD DISTRIBUTION CENTER
EL CAJON, CALIFORNIA

PROJECT NO. G2597-32-01

APPENDIX C

STORM WATER MANAGEMENT INVESTIGATION

We understand storm water management devices are being proposed in accordance with the *2016 City of El Cajon BMP Design Manual,* commonly referred to as the *Storm Water Standards* (SWS). If not properly constructed, there is a potential for distress to improvements and properties located hydrologically down gradient or adjacent to these devices. Factors such as the amount of water to be detained, its residence time, and soil permeability have an important effect on seepage transmission and the potential adverse impacts that may occur if the storm water management features are not properly designed and constructed. We have not performed a hydrogeological study at the site. If infiltration of storm water runoff occurs, downstream properties may be subjected to seeps, springs, slope instability, raised groundwater, movement of foundations and slabs, or other undesirable impacts as a result of water infiltration.

Hydrologic Soil Group

The United States Department of Agriculture (USDA), Natural Resources Conservation Services, possesses general information regarding the existing soil conditions for areas within the United States. The USDA website also provides the Hydrologic Soil Group. Table C-1 presents the descriptions of the hydrologic soil groups. In addition, the USDA website also provides an estimated saturated hydraulic conductivity for the existing soil.

TABLE C-1
HYDROLOGIC SOIL GROUP DEFINITIONS

Soil Group	Soil Group Definition
A	Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.
B	Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.
C	Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.
D	Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high-water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

The property is underlain by two units identified as Falbrook-Vista sandy loams (FvD) and Salinas clay loam (SbA). The Fallbrook-Vista sandy loam and Salinas clay loam are identified as Soil Group C. Table C-2 presents the information from the USDA website for the subject property.

TABLE C-2
USDA WEB SOIL SURVEY – HYDROLOGIC SOIL GROUP

Map Unit Name	Map Unit Symbol	Approximate Percentage of Property	Hydrologic Soil Group	k_{SAT} of Most Limiting Layer (inches/hour)
Fallbrook-Vista sandy loam	FvD	57	C	0.20 – 0.57
Salinas clay loam	SbA	43	C	0.00 – 0.14

In-Situ Testing

The infiltration rate, percolation rates and saturated hydraulic conductivity are different and have different meanings. Percolation rates tend to overestimate infiltration rates and saturated hydraulic conductivities by a factor of 10 or more. Table C-3 describes the differences in the definitions.

TABLE C-3
SOIL PERMEABILITY DEFINITIONS

Term	Definition
Infiltration Rate	The observation of the flow of water through a material into the ground downward into a given soil structure under long term conditions. This is a function of layering of soil, density, pore space, discontinuities and initial moisture content.
Percolation Rate	The observation of the flow of water through a material into the ground downward and laterally into a given soil structure under long term conditions. This is a function of layering of soil, density, pore space, discontinuities and initial moisture content.
Saturated Hydraulic Conductivity (k_{SAT}, Permeability)	The volume of water that will move in a porous medium under a hydraulic gradient through a unit area. This is a function of density, structure, stratification, fines content and discontinuities. It is also a function of the properties of the liquid as well as of the porous medium.

The degree of soil compaction or in-situ density has a significant impact on soil permeability and infiltration. Based on our experience and other studies we performed, an increase in compaction results in a decrease in soil permeability.

We performed two constant head, borehole Infiltration Tests, I-1 and I-2, at locations shown on the attached Geologic Map, Figure 2. The test borings were 4 inches in diameter. The results of the tests provide parameters for the saturated hydraulic conductivity characteristics of on-site soil and geologic units. Table C-4 presents the results of the estimated field saturated hydraulic conductivity and estimated infiltration rates obtained from the borehole percolation tests. The field sheets are also attached herein. We applied a feasibility factor of safety of 2 to the field results for use in preparation of Worksheet C.4-1. The results of the testing indicate adjusted soil infiltration rates of 0.057 and 0.042 inches per hour after applying a Factor of Safety of 2. Based on a discussion in the County of Riverside *Design Handbook for Low Impact Development Best Management Practices*, the infiltration rate should be considered equal to the saturated hydraulic conductivity rate.

TABLE C-4
FIELD PERMEAMETER INFILTRATION TEST RESULTS

Test No.	Geologic Unit	Test Depth (feet)	Field-Saturated Hydraulic Conductivity, k_{sat} (inch/hour)	Worksheet[1] Saturated Hydraulic Conductivity, k_{sat} (inch/hour)
I-1	Qal	2.0	0.113	0.057
I-2	Qcol	2.0	0.085	0.042

[1] Using a factor of safety of 2 for Worksheet C.4-1.

STORM WATER MANAGEMENT CONCLUSIONS

The Geologic Map, Figure 2, depicts the existing property, proposed development, the approximate lateral limits of the geologic units, the locations of the field excavations and the in-situ infiltration test locations.

Soil Types

Proposed Compacted Fill – Compacted fill will be placed across the entire property during site development. Proposed remedial grading will consist of removing the upper 3 to 6 feet of soil and replacement as compacted fill. The proposed storm water BMP's will be founded in compacted fill placed above alluvium/colluvium. The compacted fill will be comprised of on-site silty/clayey sand and sandy clay. The fill will be compacted to a dry density of at least 90 percent of the laboratory maximum dry density. In our experience, compacted fill does not possess infiltration rates appropriate for infiltration BMP's. Hazards that occur as a result of fill soil saturation include a potential for hydro-consolidation of the granular fill soils, long term fill settlement, differential fill settlement, and lateral movement associated with saturated fill relaxation. The potential for lateral water migration to adversely impact existing or proposed structures, foundations, utilities, and roadways, is high. Therefore, full infiltration should be considered infeasible.

Section D.4.2 of the *2016 Storm Water Standards* (SWS) provides a discussion regarding fill materials used for infiltration. The SWS states:

- *For engineered fills, infiltration rates may still be quite uncertain due to layering and heterogeneities introduced as part of construction that cannot be precisely controlled.* Due to these uncertainties, full and partial infiltration should be considered geotechnically infeasible and liners and subdrains should be used in areas where infiltration BMP's are founded in compacted fill.

- *Where possible, infiltration BMPs on fill material should be designed such that their infiltrating surface extends into native soils*. Full and partial infiltration should be considered geotechnically infeasible within the compacted fill and liners and subdrains should be used. If the infiltration BMP's extended below the compacted fill, partial infiltration may be feasible.

- *Because of the uncertainty of fill parameters as well as potential compaction of the native soils, an infiltration BMP may not be feasible.* Therefore, full infiltration should be considered geotechnically infeasible. Partial infiltration may be feasible if the infiltration BMP extends below the compacted fill.

Infiltration Rates

The results of the two infiltration tests (including the feasibility factor of safety of 2) obtained within the alluvium/colluvium were 0.057 and 0.042 inches per hour (iph). Based on the results of the infiltration testing, none of the tests meet the minimum threshold for full infiltration; therefore, full infiltration is considered infeasible.

Groundwater Elevations

Groundwater was encountered during the field investigation approximately 10 to 14 feet below existing grades. The proposed basin is shown approximately 2 to 9 feet below existing grades. Groundwater is expected within 10 feet from the bottom of the proposed basin, therefore full and partial infiltration is infeasible.

Soil or Groundwater Contamination

Based on our review of the Geotracker website, no soil or groundwater contamination is suspected.

New or Existing Utilities

Existing utilities are present within right of ways adjacent to the existing streets, generally beneath public sidewalks and roadways. Existing utilities were located near the proposed basin. We expect that all on-site utilities will be removed prior to site development. Full infiltration near existing or proposed utilities should be avoided to prevent lateral water migration into the permeable trench backfill materials. Any infiltration BMP's should be setback at least 10 feet from closest utility.

Existing and Planned Structures

The proposed basin is located adjacent to Forrester Creek, a concrete lined open channel. The proposed parking lot is located immediately to the west. No structures are situated adjacent to the proposed basin.

Slopes

The site gently to moderately slopes towards the east. No significant slopes are proposed adjacent to the basin.

Recommendations

Due to the relatively low infiltration rates obtained, shallow depth to groundwater, and presence of granitic rock, full and partial infiltration of storm water is considered geotechnically infeasible and the proposed development exhibits a "*No Infiltration*" condition. Liners and subdrains should be incorporated into the design and construction of the planned storm water devices. The liners should be impermeable (e.g. High-density polyethylene, HDPE, with a thickness of about 30 mil or equivalent Polyvinyl Chloride, PVC) to prevent water migration. The subdrains should be perforated within the liner area, installed at the base and above the liner, be at least 3 inches in diameter and consist of Schedule 40 PVC pipe. The subdrains outside of the liner should consist of solid pipe. Seams and penetrations of the liners should be properly waterproofed. The subdrains should be connected to a proper outlet. The devices should also be installed in accordance with the manufacturer's recommendations. If designing any storm water infiltration BMP's for partial infiltration, side liners and a subdrain are recommended.

Storm Water Standard Worksheets

The SWS requests the geotechnical engineer complete the *Categorization of Infiltration Feasibility Condition* (Worksheet C.4-1 or I-8) worksheet information to help evaluate the potential for infiltration on the property. The attached Form 1-8 presents the completed information for the submittal process.

The regional storm water standards also have a worksheet (Worksheet D.5-1 or Form I-9) that helps the project civil engineer estimate the factor of safety based on several factors. Table C-5 describes the suitability assessment input parameters related to the geotechnical engineering aspects for the factor of safety determination.

TABLE C-5
SUITABILITY ASSESSMENT RELATED CONSIDERATIONS
FOR INFILTRATION FACILITY SAFETY FACTORS

Consideration	High Concern – 3 Points	Medium Concern – 2 Points	Low Concern – 1 Point
Assessment Methods	Use of soil survey maps or simple texture analysis to estimate short-term infiltration rates. Use of well permeameter or borehole methods without accompanying continuous boring log. Relatively sparse testing with direct infiltration methods	Use of well permeameter or borehole methods with accompanying continuous boring log. Direct measurement of infiltration area with localized infiltration measurement methods (e.g., Infiltrometer). Moderate spatial resolution	Direct measurement with localized (i.e. small-scale) infiltration testing methods at relatively high resolution or use of extensive test pit infiltration measurement methods.
Predominant Soil Texture	Silty and clayey soils with significant fines	Loamy soils	Granular to slightly loamy soils
Site Soil Variability	Highly variable soils indicated from site assessment or unknown variability	Soil boring/test pits indicate moderately homogenous soils	Soil boring/test pits indicate relatively homogenous soils
Depth to Groundwater/ Impervious Layer	<5 feet below facility bottom	5-15 feet below facility bottom	>15 feet below facility bottom

Based on our geotechnical investigation and the information in Table C-5, Table C-6 presents the estimated factor values for the evaluation of the factor of safety. This table only provides the suitability assessment safety factor (Part A) of the worksheet. The project civil engineer should evaluate the safety factor for design (Part B) and use the combined safety factor for the design infiltration rate.

TABLE C-6
FACTOR OF SAFETY WORKSHEET DESIGN VALUES – PART A[1]

Suitability Assessment Factor Category	Assigned Weight (w)	Factor Value (v)	Product (p = w x v)
Assessment Methods	0.25	3	0.75
Predominant Soil Texture	0.25	3	0.75
Site Soil Variability	0.25	3	0.75
Depth to Groundwater/ Impervious Layer	0.25	2	0.50
Suitability Assessment Safety Factor, $S_A = \sum p$			2.75

[1] The project civil engineer should complete Worksheet D.5-1 or Form I-9 using the data on this table. Additional information is required to evaluate the design factor of safety.

Categorization of Infiltration Feasibility Condition			Appendix E.2
Part 1 - Full Infiltration Feasibility Screening Criteria **Would infiltration of the full design volume be feasible from a physical perspective without any undesirable consequences that cannot be reasonably mitigated?**			
Criteria	Screening Question	**Yes**	**No**
1	**Is the estimated reliable infiltration rate below proposed facility locations greater than 0.5 inches per hour?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.		X
Provide basis: Based on results of permeability testing in 2 locations within the proposed basin footprint, the unfactored infiltration rate was measured to be 0.113 and 0.085 inches/hour (iph) using a constant head borehole permeameter. If applying a feasibility factor of safety of 2.0, the infiltration rates would be 0.057 and 0.042 iph, which are less than the required threshold value of 0.5 iph. The USDA web soil survey website indicates the underlying soils belong to Fallbrook-Vista sandy loam (FvD) and Salinas clay (SbA) which is identified as Hydrologic Soil Group C, which is not conducive to infiltration BMP's. Information collected from the USDA website is attached. The infiltration test results are attached. In accordance with the Riverside County storm water procedures, which reference the United States Bureau of Reclamation Well Permeameter Method (USBR 7300), the saturated hydraulic conductivity is equal to the unfactored infiltration rate.			
2	**Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.		X
Provide basis: The proposed basin would be underlain by potentially liquefiable alluvium and shallow groundwater. Infiltration of storm water would increase the potential for liquefaction.			

Appendix E.2			
Criteria	Screening Question	**Yes**	**No**
3	**Can infiltration greater than 0.5 inches per hour be allowed without increasing risk of groundwater contamination (shallow water table, storm water pollutants or other factors) that cannot be mitigated to an acceptable level?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.		X
Provide basis: Groundwater is located within 10 feet from the proposed infiltration BMP, therefore there is a risk of storm water infiltration BMP's adversely impacting groundwater.			
4	**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 or increased discharge of contaminated groundwater to surface waters?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.	X	
Provide basis: It is our opinion there are no adverse impacts to groundwater, water balance impacts to stream flow, or impacts on any downstream water rights. It should be noted that researching downstream water rights or evaluating water balance issues to stream flows is beyond the scope of the geotechnical consultant.			
Part 1 Result*	If all answers to rows 1 - 4 are "**Yes**" a full infiltration design is potentially feasible. The feasibility screening category is **Full Infiltration** If any answer from row 1-4 is "**No**", infiltration may be possible to some extent but would not generally be feasible or desirable to achieve a "full infiltration" design. Proceed to Part 2		No Full Infiltration

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

Appendix E.2

Part 2 – Partial Infiltration vs. No Infiltration Feasibility Screening Criteria

Would infiltration of water in any appreciable amount be physically feasible without any negative consequences that cannot be reasonably mitigated?

Criteria	Screening Question	Yes	No
5	**Do soil and geologic conditions allow for infiltration in any appreciable rate or volume?** The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2 and Appendix D.		X
Provide basis: Based on results of permeability testing in 2 locations within the proposed basin footprint, the unfactored infiltration rate was measured to be 0.113 and 0.085 inches/hour (iph) using a constant head borehole permeameter. If applying a feasibility factor of safety of 2.0, the infiltration rates would be 0.057 and 0.042 iph. It is our opinion that these low rates do not support infiltration BMP's. After grading, the actual BMP's would be situated in compacted fill over saturated alluvium or colluvium, and infiltration BMP's founded in compacted fill are not recommended (see discussion in Appendix C of the Geotechnical Investigation).			
6	**Can Infiltration in any appreciable quantity be allowed without increasing risk of geotechnical hazards (slope stability, groundwater mounding, utilities, or other factors) that cannot be mitigated to an acceptable level**? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.2.		X
Provide basis: The proposed basin would be underlain by potentially liquefiable alluvium and shallow groundwater. Infiltration of storm water would increase the potential for liquefaction.			

<table>
<tr><th colspan="4">Appendix E.2</th></tr>
<tr><th>Criteria</th><th>Screening Question</th><th>Yes</th><th>No</th></tr>
<tr><td>7</td><td>Can Infiltration in any appreciable quantity be allowed without posing significant risk for groundwater related concerns (shallow water table, storm water pollutants or other factors)? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.</td><td></td><td>X</td></tr>
<tr><td colspan="4">Provide basis:

Groundwater is located within 10 feet from the proposed infiltration BMP, therefore there is a risk of storm water infiltration BMP’s adversely impacting groundwater.</td></tr>
<tr><td>8</td><td>Can infiltration be allowed without violating downstream water rights? The response to this Screening Question shall be based on a comprehensive evaluation of the factors presented in Appendix C.3.</td><td>X</td><td></td></tr>
<tr><td colspan="4">Provide basis: It is our opinion there are no adverse impacts to groundwater, water balance impacts to stream flow, or impacts on any downstream water rights. It should be noted that researching downstream water rights or evaluating water balance issues to stream flows is beyond the scope of the geotechnical consultant.</td></tr>
<tr><td>Part 2 Result*</td><td colspan="2">If all answers from row 1-4 are yes then partial infiltration design is potentially feasible. The feasibility screening category is Partial Infiltration.

If any answer from row 5-8 is no, then infiltration of any volume is considered to be infeasible within the drainage area. The feasibility screening category is No Infiltration.</td><td>No Infiltration</td></tr>
</table>

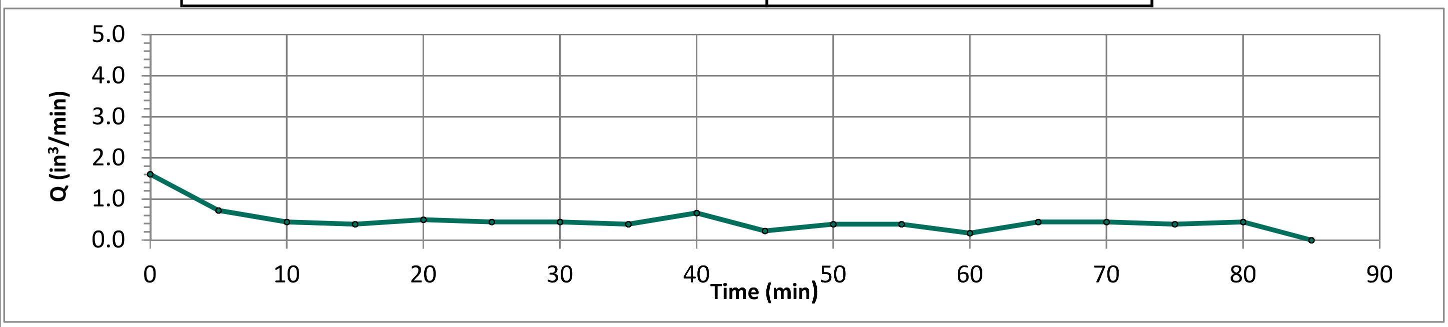
*To be completed using gathered site information and best professional judgment considering the definition of MEP in the MS4 Permit. Additional testing and/or studies may be required by the City to substantiate findings.

TEST NO.: I-1 GEOLOGIC UNIT: Qcol

EXCAVATION ELEVATION (MSL, FT): 350

TEST INFORMATION	
BOREHOLE DIAMETER (IN):	4
BOREHOLE DEPTH (FT):	1.8
TEST/BOTTOM ELEVATION (MSL, FT):	348
MEASURED HEAD HEIGHT (IN):	4.5
FACTOR OF SAFETY:	2.0

TEST RESULTS	
STEADY FLOW RATE (IN3/MIN):	**0.443**
FIELD-SATURATED INFILTRATION RATE (IN/HR):	**0.113**
FACTORED INFILTRATION RATE (IN/HR):	**0.057**



TEST DATA				
Reading	**Time Elapsed (min)**	**Water Weight Consumed (lbs)**	**Water Volume Consumed (in3)**	**Q (in3/min)**
1	0.00	0.000	0.00	0.00
2	5.00	0.290	8.03	1.606
3	5.00	0.130	3.60	0.720
4	5.00	0.080	2.22	0.443
5	5.00	0.070	1.94	0.388
6	5.00	0.090	2.49	0.498
7	5.00	0.080	2.22	0.443
8	5.00	0.080	2.22	0.443
9	5.00	0.070	1.94	0.388
10	5.00	0.120	3.32	0.665
11	5.00	0.040	1.11	0.222
12	5.00	0.070	1.94	0.388
13	5.00	0.070	1.94	0.388
14	5.00	0.030	0.83	0.166
15	5.00	0.080	2.22	0.443
16	5.00	0.080	2.22	0.443
17	5.00	0.070	1.94	0.388
18	5.00	0.080	2.22	0.443

GEOCON
INCORPORATED
GEOTECHNICAL CONSULTANTS
6960 FLANDERS DRIVE - SAN DIEGO, CALIFORNIA 92121-2974
PHONE 858 558-6900 - FAX 858 558-6159

Infiltration Test Results

Weld Distribution Center

PROJECT NO.: G2597-32-01

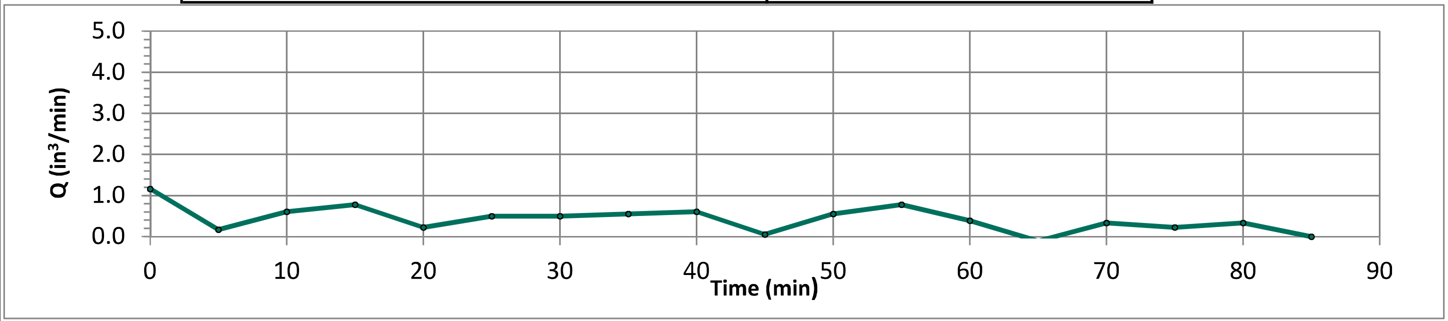
TEST NO.: **I-2**

GEOLOGIC UNIT: **Qal**

EXCAVATION ELEVATION (MSL, FT): **350**

TEST INFORMATION	
BOREHOLE DIAMETER (IN):	4
BOREHOLE DEPTH (FT):	2.0
TEST/BOTTOM ELEVATION (MSL, FT):	348
MEASURED HEAD HEIGHT (IN):	4.5
FACTOR OF SAFETY:	2.0

TEST RESULTS	
STEADY FLOW RATE (IN3/MIN):	**0.332**
FIELD-SATURATED INFILTRATION RATE (IN/HR):	**0.085**
FACTORED INFILTRATION RATE (IN/HR):	**0.042**



TEST DATA

Reading	Time Elapsed (min)	Water Weight Consumed (lbs)	Water Volume Consumed (in3)	Q (in3/min)
1	0.00	0.000	0.00	0.00
2	5.00	0.210	5.82	1.163
3	5.00	0.030	0.83	0.166
4	5.00	0.110	3.05	0.609
5	5.00	0.140	3.88	0.775
6	5.00	0.040	1.11	0.222
7	5.00	0.090	2.49	0.498
8	5.00	0.090	2.49	0.498
9	5.00	0.100	2.77	0.554
10	5.00	0.110	3.05	0.609
11	5.00	0.010	0.28	0.055
12	5.00	0.100	2.77	0.554
13	5.00	0.140	3.88	0.775
14	5.00	0.070	1.94	0.388
15	5.00	-0.020	-0.55	-0.111
16	5.00	0.060	1.66	0.332
17	5.00	0.040	1.11	0.222
18	5.00	0.060	1.66	0.332

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Infiltration Test Results

Weld Distribution Center

PROJECT NO.: **G2597-32-01**

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

San Diego County Area, California

Weld Distribution Center, El Cajon, CA

October 2, 2020

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

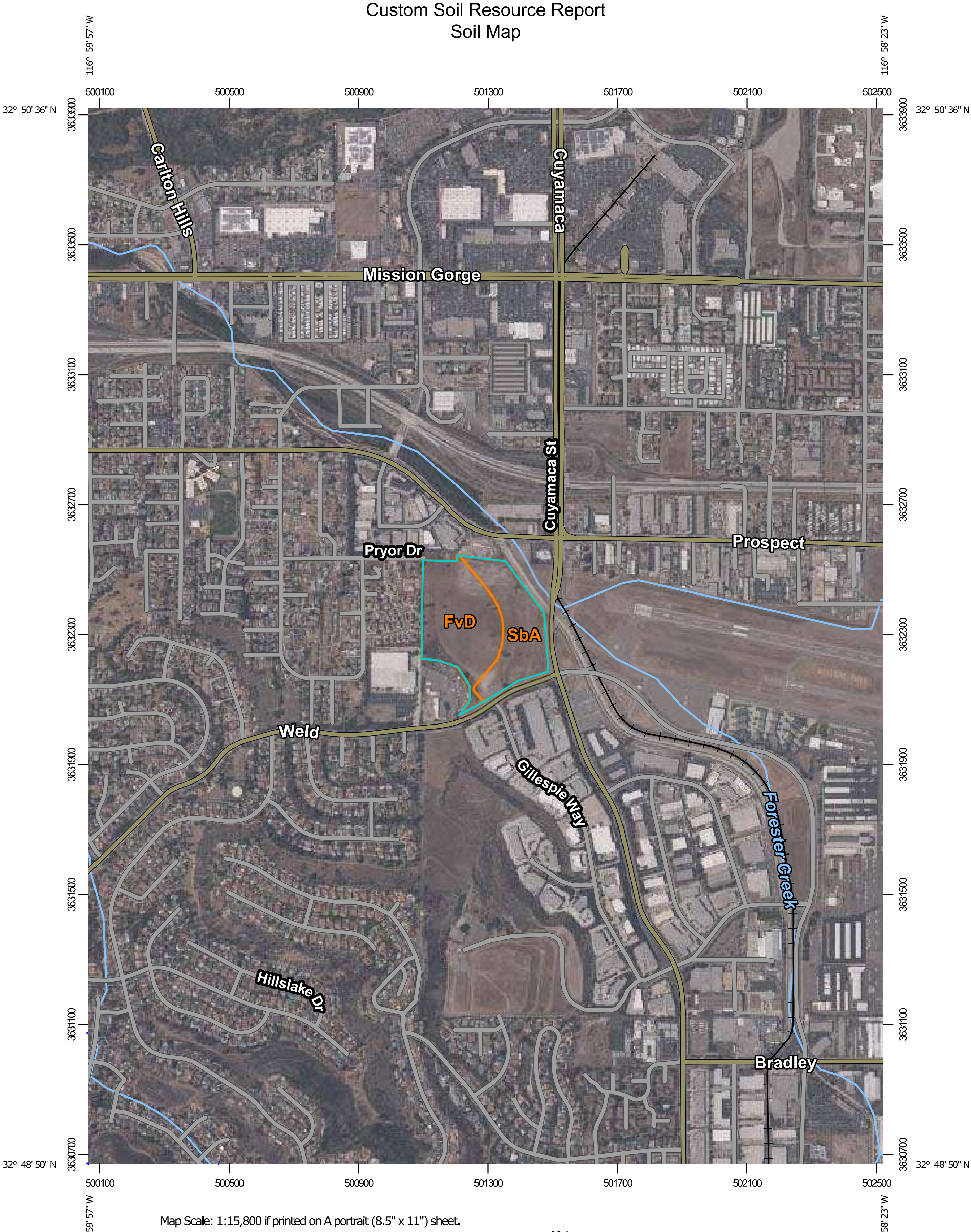
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map



Map Scale: 1:15,800 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 200, 400, 800, 1200

Feet: 0, 500, 1000, 2000, 3000

N

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Diego County Area, California
Survey Area Data: Version 15, May 27, 2020

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Aug 18, 2018—Aug 22, 2018

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
FvD	Fallbrook-Vista sandy loams, 9 to 15 percent slopes	18.6	57.3%
SbA	Salinas clay loam, 0 to 2 percent slopes, warm MAAT, MLRA 19	13.9	42.7%
Totals for Area of Interest		**32.5**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

San Diego County Area, California

FvD—Fallbrook-Vista sandy loams, 9 to 15 percent slopes

Map Unit Setting

National map unit symbol: hbc1
Elevation: 200 to 3,900 feet
Mean annual precipitation: 10 to 18 inches
Mean annual air temperature: 59 to 64 degrees F
Frost-free period: 210 to 320 days
Farmland classification: Not prime farmland

Map Unit Composition

Fallbrook and similar soils: 50 percent
Vista and similar soils: 40 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Fallbrook

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from granodiorite

Typical profile

H1 - 0 to 8 inches: sandy loam
H2 - 8 to 12 inches: loam, sandy loam
H2 - 8 to 12 inches: sandy clay loam, clay loam
H3 - 12 to 28 inches: loam, sandy loam
H3 - 12 to 28 inches: weathered bedrock
H4 - 28 to 41 inches:
H4 - 28 to 41 inches:
H5 - 41 to 44 inches:

Properties and qualities

Slope: 9 to 15 percent
Depth to restrictive feature: 40 to 60 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: High (about 11.1 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Hydric soil rating: No

Description of Vista

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Grus derived from granodiorite and/or grus derived from quartz-diorite

Typical profile

H1 - 0 to 19 inches: sandy loam
H2 - 19 to 35 inches: coarse sandy loam, sandy loam
H2 - 19 to 35 inches: weathered bedrock
H3 - 35 to 39 inches:

Properties and qualities

Slope: 9 to 15 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 5.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Hydric soil rating: No

Minor Components

Cieneba

Percent of map unit: 5 percent
Hydric soil rating: No

Las posas

Percent of map unit: 5 percent
Hydric soil rating: No

SbA—Salinas clay loam, 0 to 2 percent slopes, warm MAAT, MLRA 19

Map Unit Setting

National map unit symbol: 2tyy2
Elevation: 0 to 900 feet

Mean annual precipitation: 10 to 18 inches
Mean annual air temperature: 61 to 64 degrees F
Frost-free period: 330 to 360 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Salinas and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Salinas

Setting

Landform: Alluvial fans
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, rise
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Alluvium derived from sedimentary rock

Typical profile

Ap - 0 to 7 inches: clay loam
A - 7 to 22 inches: clay loam
C1 - 22 to 32 inches: clay loam
C2 - 32 to 46 inches: clay loam
2Ck1 - 46 to 55 inches: clay loam
2Ck2 - 55 to 64 inches: loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.14 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: High (about 10.4 inches)

Interpretive groups

Land capability classification (irrigated): 1
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: C
Hydric soil rating: No

Minor Components

Tujunga

Percent of map unit: 3 percent
Hydric soil rating: No

Diablo

Percent of map unit: 3 percent
Hydric soil rating: No

Huerhuero

Percent of map unit: 3 percent
Hydric soil rating: No

Cropley

Percent of map unit: 2 percent
Hydric soil rating: No

Sorrento

Percent of map unit: 1 percent
Hydric soil rating: No

Garretson

Percent of map unit: 1 percent
Hydric soil rating: No

Pacheco

Percent of map unit: 1 percent
Hydric soil rating: No

Mocho

Percent of map unit: 1 percent
Hydric soil rating: No

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APPENDIX D

APPENDIX D

PREVIOUS BORING LOGS BY GEOCON, 1983

FOR

WELD DISTRIBUTION CENTER
EL CAJON, CALIFORNIA

PROJECT NO. G2597-32-01

File No. D-2923-M01
June 3, 1983

DEPTH IN FEET	SAMPLE NUMBER	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY p.c.f	IN-PLACE MOISTURE CONTENT % dry wt
0				BORING 10		
0–3	10-1 (at 2–3)		33	TOPSOIL Firm, moist, dark brown, Silty fine SAND		
3–6	10-2 (at 5–6)		50/ 2"	SLOPEWASH Moderately dense, moist, medium brown, Clayey, fine to medium SAND (moderately plastic)	109.0	13.4
6–10				DECOMPOSED GRANITICS Dense, damp, gray-tan, Silty, fine to coarse SAND		
10				BORING TERMINATED AT 10.0 FEET NO GROUNDWATER		
0				BORING 11		
0–2				TOPSOIL Firm, moist, dark brown, Silty, fine to medium SAND		
2–4	11-1 (at 3–4)		50/ 3"	SLOPEWASH Dense, very moist, dark orange-brown, Clayey, fine to medium SAND		
4–15				DECOMPOSED GRANITICS Very dense, damp, gray-tan, Silty, fine to medium SAND		
15				BORING TERMINATED AT 15.0 FEET NO GROUNDWATER		

Figure A-10, Log of Test Borings 10 and 11

File No. D-2923-M01
June 3, 1983

DEPTH IN FEET	SAMPLE NUMBER	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY p.c.f	IN-PLACE MOISTURE CONTENT % dry wt
0				BORING 12		
				TOPSOIL Slightly dense, moist, medium orange-brown, Silty fine SAND		
2						
4	12-1		50/ 4"	COLLUVIUM Slightly dense, moist, medium reddish-brown, Clayey fine SAND		
6				DECOMPOSED GRANITICS Very dense, damp, light orange-brown, Silty fine SAND		
8				Very dense, moist, gray-tan, Silty, fine to coarse, well graded SAND with gravel		
10				BORING TERMINATED AT 10.0 FEET NO GROUNDWATER		

Figure A-11, Log of Test Boring 12

File No. D-2923-M01
June 3, 1983

DEPTH IN FEET	SAMPLE NUMBER	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY p.c.f	IN-PLACE MOISTURE CONTENT % dry wt
0				BORING 13		
				FILL Firm, moist, dark gray-brown, Silty fine SAND		
4	13-1		41	Medium dense, moist, brown-black, Clayey Silty fine SAND with sedimentary rock (organic)		
6	13-2		36		96.2	27.8
8				Medium dense, highly plastic, very moist, reddish-brown, slightly Sandy CLAY		
10	13-3		50/ 5"	ORIGINAL TOPSOIL Dense, moist, light brown, slightly Clayey Silty fine SAND		
14				DECOMPOSED GRANITICS Very dense, damp, white/orange/gray/black, Silty fine SAND		
16				BORING TERMINATED AT 15.0 FEET NO GROUNDWATER		

Figure A-12, Log of Test Boring 13

File No. D-2923-M01
June 3, 1983

DEPTH IN FEET	SAMPLE NUMBER	LOG & LOCATION OF SAMPLE	Penetration Resistance Blows/ft	DESCRIPTION	IN-PLACE DRY DENSITY p.c.f	IN-PLACE MOISTURE CONTENT % dry wt
				BORING 14		
0				SLOPEWASH/COLLUVIUM Stiff, firm, very moist to wet, dark brownish-black, slightly Silty CLAY (very plastic)		
2						
4	14-1		36			
6	14-2		27	Slightly stiff, wet, light brown, Clayey fine SAND		
8				Slightly dense, saturated, gray-tan, Silty, fine to medium SAND		
10	14-3		28			
12				Water Table		
				BORING TERMINATED AT 11.0 FEET WATER AT 8'9"		

Figure A-13, Log of Test Boring 14

APPENDIX E

APPENDIX E

RECOMMENDED GRADING SPECIFICATIONS

FOR

WELD DISTRIBUTION CENTER
EL CAJON, CALIFORNIA

PROJECT NO. G2597-32-01

RECOMMENDED GRADING SPECIFICATIONS

1. GENERAL

1.1 These Recommended Grading Specifications shall be used in conjunction with the Geotechnical Report for the project prepared by Geocon. The recommendations contained in the text of the Geotechnical Report are a part of the earthwork and grading specifications and shall supersede the provisions contained hereinafter in the case of conflict.

1.2 Prior to the commencement of grading, a geotechnical consultant (Consultant) shall be employed for the purpose of observing earthwork procedures and testing the fills for substantial conformance with the recommendations of the Geotechnical Report and these specifications. The Consultant should provide adequate testing and observation services so that they may assess whether, in their opinion, the work was performed in substantial conformance with these specifications. It shall be the responsibility of the Contractor to assist the Consultant and keep them apprised of work schedules and changes so that personnel may be scheduled accordingly.

1.3 It shall be the sole responsibility of the Contractor to provide adequate equipment and methods to accomplish the work in accordance with applicable grading codes or agency ordinances, these specifications and the approved grading plans. If, in the opinion of the Consultant, unsatisfactory conditions such as questionable soil materials, poor moisture condition, inadequate compaction, and/or adverse weather result in a quality of work not in conformance with these specifications, the Consultant will be empowered to reject the work and recommend to the Owner that grading be stopped until the unacceptable conditions are corrected.

2. DEFINITIONS

2.1 **Owner** shall refer to the owner of the property or the entity on whose behalf the grading work is being performed and who has contracted with the Contractor to have grading performed.

2.2 **Contractor** shall refer to the Contractor performing the site grading work.

2.3 **Civil Engineer** or **Engineer of Work** shall refer to the California licensed Civil Engineer or consulting firm responsible for preparation of the grading plans, surveying and verifying as-graded topography.

2.4 **Consultant** shall refer to the soil engineering and engineering geology consulting firm retained to provide geotechnical services for the project.

2.5 **Soil Engineer** shall refer to a California licensed Civil Engineer retained by the Owner, who is experienced in the practice of geotechnical engineering. The Soil Engineer shall be responsible for having qualified representatives on-site to observe and test the Contractor's work for conformance with these specifications.

2.6 **Engineering Geologist** shall refer to a California licensed Engineering Geologist retained by the Owner to provide geologic observations and recommendations during the site grading.

2.7 **Geotechnical Report** shall refer to a soil report (including all addenda) which may include a geologic reconnaissance or geologic investigation that was prepared specifically for the development of the project for which these Recommended Grading Specifications are intended to apply.

3. MATERIALS

3.1 Materials for compacted fill shall consist of any soil excavated from the cut areas or imported to the site that, in the opinion of the Consultant, is suitable for use in construction of fills. In general, fill materials can be classified as *soil* fills, *soil-rock* fills or *rock* fills, as defined below.

3.1.1 **Soil fills** are defined as fills containing no rocks or hard lumps greater than 12 inches in maximum dimension and containing at least 40 percent by weight of material smaller than ¾ inch in size.

3.1.2 **Soil-rock fills** are defined as fills containing no rocks or hard lumps larger than 4 feet in maximum dimension and containing a sufficient matrix of soil fill to allow for proper compaction of soil fill around the rock fragments or hard lumps as specified in Paragraph 6.2. **Oversize rock** is defined as material greater than 12 inches.

3.1.3 **Rock fills** are defined as fills containing no rocks or hard lumps larger than 3 feet in maximum dimension and containing little or no fines. Fines are defined as material smaller than ¾ inch in maximum dimension. The quantity of fines shall be less than approximately 20 percent of the rock fill quantity.

3.2 Material of a perishable, spongy, or otherwise unsuitable nature as determined by the Consultant shall not be used in fills.

3.3 Materials used for fill, either imported or on-site, shall not contain hazardous materials as defined by the California Code of Regulations, Title 22, Division 4, Chapter 30, Articles 9 and 10; 40CFR; and any other applicable local, state or federal laws. The Consultant shall not be responsible for the identification or analysis of the potential presence of hazardous materials. However, if observations, odors or soil discoloration cause Consultant to suspect the presence of hazardous materials, the Consultant may request from the Owner the termination of grading operations within the affected area. Prior to resuming grading operations, the Owner shall provide a written report to the Consultant indicating that the suspected materials are not hazardous as defined by applicable laws and regulations.

3.4 The outer 15 feet of *soil-rock* fill slopes, measured horizontally, should be composed of properly compacted *soil* fill materials approved by the Consultant. *Rock* fill may extend to the slope face, provided that the slope is not steeper than 2:1 (horizontal:vertical) and a soil layer no thicker than 12 inches is track-walked onto the face for landscaping purposes. This procedure may be utilized provided it is acceptable to the governing agency, Owner and Consultant.

3.5 Samples of soil materials to be used for fill should be tested in the laboratory by the Consultant to determine the maximum density, optimum moisture content, and, where appropriate, shear strength, expansion, and gradation characteristics of the soil.

3.6 During grading, soil or groundwater conditions other than those identified in the Geotechnical Report may be encountered by the Contractor. The Consultant shall be notified immediately to evaluate the significance of the unanticipated condition.

4. CLEARING AND PREPARING AREAS TO BE FILLED

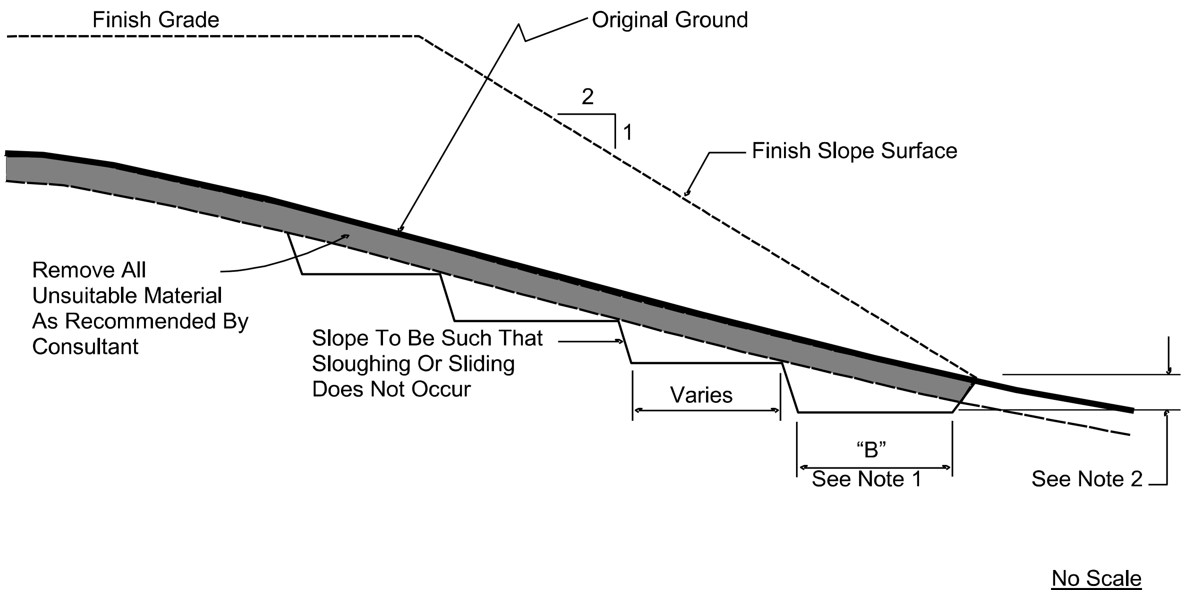
4.1 Areas to be excavated and filled shall be cleared and grubbed. Clearing shall consist of complete removal above the ground surface of trees, stumps, brush, vegetation, man-made structures, and similar debris. Grubbing shall consist of removal of stumps, roots, buried logs and other unsuitable material and shall be performed in areas to be graded. Roots and other projections exceeding 1½ inches in diameter shall be removed to a depth of 3 feet below the surface of the ground. Borrow areas shall be grubbed to the extent necessary to provide suitable fill materials.

4.2 Asphalt pavement material removed during clearing operations should be properly disposed at an approved off-site facility or in an acceptable area of the project evaluated by Geocon and the property owner. Concrete fragments that are free of reinforcing steel may be placed in fills, provided they are placed in accordance with Section 6.2 or 6.3 of this document.

4.3 After clearing and grubbing of organic matter and other unsuitable material, loose or porous soils shall be removed to the depth recommended in the Geotechnical Report. The depth of removal and compaction should be observed and approved by a representative of the Consultant. The exposed surface shall then be plowed or scarified to a minimum depth of 6 inches and until the surface is free from uneven features that would tend to prevent uniform compaction by the equipment to be used.

4.4 Where the slope ratio of the original ground is steeper than 5:1 (horizontal:vertical), or where recommended by the Consultant, the original ground should be benched in accordance with the following illustration.

TYPICAL BENCHING DETAIL



DETAIL NOTES: (1) Key width "B" should be a minimum of 10 feet, or sufficiently wide to permit complete coverage with the compaction equipment used. The base of the key should be graded horizontal, or inclined slightly into the natural slope.

(2) The outside of the key should be below the topsoil or unsuitable surficial material and at least 2 feet into dense formational material. Where hard rock is exposed in the bottom of the key, the depth and configuration of the key may be modified as approved by the Consultant.

4.5 After areas to receive fill have been cleared and scarified, the surface should be moisture conditioned to achieve the proper moisture content, and compacted as recommended in Section 6 of these specifications.

5. COMPACTION EQUIPMENT

5.1 Compaction of *soil* or *soil-rock* fill shall be accomplished by sheepsfoot or segmented-steel wheeled rollers, vibratory rollers, multiple-wheel pneumatic-tired rollers, or other types of acceptable compaction equipment. Equipment shall be of such a design that it will be capable of compacting the *soil* or *soil-rock* fill to the specified relative compaction at the specified moisture content.

5.2 Compaction of *rock* fills shall be performed in accordance with Section 6.3.

6. PLACING, SPREADING AND COMPACTION OF FILL MATERIAL

6.1 *Soil* fill, as defined in Paragraph 3.1.1, shall be placed by the Contractor in accordance with the following recommendations:

6.1.1 *Soil* fill shall be placed by the Contractor in layers that, when compacted, should generally not exceed 8 inches. Each layer shall be spread evenly and shall be thoroughly mixed during spreading to obtain uniformity of material and moisture in each layer. The entire fill shall be constructed as a unit in nearly level lifts. Rock materials greater than 12 inches in maximum dimension shall be placed in accordance with Section 6.2 or 6.3 of these specifications.

6.1.2 In general, the *soil* fill shall be compacted at a moisture content at or above the optimum moisture content as determined by ASTM D 1557.

6.1.3 When the moisture content of *soil* fill is below that specified by the Consultant, water shall be added by the Contractor until the moisture content is in the range specified.

6.1.4 When the moisture content of the *soil* fill is above the range specified by the Consultant or too wet to achieve proper compaction, the *soil* fill shall be aerated by the Contractor by blading/mixing, or other satisfactory methods until the moisture content is within the range specified.

6.1.5 After each layer has been placed, mixed, and spread evenly, it shall be thoroughly compacted by the Contractor to a relative compaction of at least 90 percent. Relative compaction is defined as the ratio (expressed in percent) of the in-place dry density of the compacted fill to the maximum laboratory dry density as determined in accordance with ASTM D 1557. Compaction shall be continuous over the entire area, and compaction equipment shall make sufficient passes so that the specified minimum relative compaction has been achieved throughout the entire fill.

6.1.6 Where practical, soils having an Expansion Index greater than 50 should be placed at least 3 feet below finish pad grade and should be compacted at a moisture content generally 2 to 4 percent greater than the optimum moisture content for the material.

6.1.7 Properly compacted *soil* fill shall extend to the design surface of fill slopes. To achieve proper compaction, it is recommended that fill slopes be over-built by at least 3 feet and then cut to the design grade. This procedure is considered preferable to track-walking of slopes, as described in the following paragraph.

6.1.8 As an alternative to over-building of slopes, slope faces may be back-rolled with a heavy-duty loaded sheepsfoot or vibratory roller at maximum 4-foot fill height intervals. Upon completion, slopes should then be track-walked with a D-8 dozer or similar equipment, such that a dozer track covers all slope surfaces at least twice.

6.2 *Soil-rock* fill, as defined in Paragraph 3.1.2, shall be placed by the Contractor in accordance with the following recommendations:

6.2.1 Rocks larger than 12 inches but less than 4 feet in maximum dimension may be incorporated into the compacted *soil* fill, but shall be limited to the area measured 15 feet minimum horizontally from the slope face and 5 feet below finish grade or 3 feet below the deepest utility, whichever is deeper.

6.2.2 Rocks or rock fragments up to 4 feet in maximum dimension may either be individually placed or placed in windrows. Under certain conditions, rocks or rock fragments up to 10 feet in maximum dimension may be placed using similar methods. The acceptability of placing rock materials greater than 4 feet in maximum dimension shall be evaluated during grading as specific cases arise and shall be approved by the Consultant prior to placement.

6.2.3 For individual placement, sufficient space shall be provided between rocks to allow for passage of compaction equipment.

6.2.4 For windrow placement, the rocks should be placed in trenches excavated in properly compacted *soil* fill. Trenches should be approximately 5 feet wide and 4 feet deep in maximum dimension. The voids around and beneath rocks should be filled with approved granular soil having a Sand Equivalent of 30 or greater and should be compacted by flooding. Windrows may also be placed utilizing an "open-face" method in lieu of the trench procedure, however, this method should first be approved by the Consultant.

6.2.5 Windrows should generally be parallel to each other and may be placed either parallel to or perpendicular to the face of the slope depending on the site geometry. The minimum horizontal spacing for windrows shall be 12 feet center-to-center with a 5-foot stagger or offset from lower courses to next overlying course. The minimum vertical spacing between windrow courses shall be 2 feet from the top of a lower windrow to the bottom of the next higher windrow.

6.2.6 Rock placement, fill placement and flooding of approved granular soil in the windrows should be continuously observed by the Consultant.

6.3 *Rock* fills, as defined in Section 3.1.3, shall be placed by the Contractor in accordance with the following recommendations:

6.3.1 The base of the *rock* fill shall be placed on a sloping surface (minimum slope of 2 percent). The surface shall slope toward suitable subdrainage outlet facilities. The *rock* fills shall be provided with subdrains during construction so that a hydrostatic pressure buildup does not develop. The subdrains shall be permanently connected to controlled drainage facilities to control post-construction infiltration of water.

6.3.2 *Rock* fills shall be placed in lifts not exceeding 3 feet. Placement shall be by rock trucks traversing previously placed lifts and dumping at the edge of the currently placed lift. Spreading of the *rock* fill shall be by dozer to facilitate *seating* of the rock. The *rock* fill shall be watered heavily during placement. Watering shall consist of water trucks traversing in front of the current rock lift face and spraying water continuously during rock placement. Compaction equipment with compactive energy comparable to or greater than that of a 20-ton steel vibratory roller or other compaction equipment providing suitable energy to achieve the required compaction or deflection as recommended in Paragraph 6.3.3 shall be utilized. The number of passes to be made should be determined as described in Paragraph 6.3.3. Once a *rock* fill lift has been covered with *soil* fill, no additional *rock* fill lifts will be permitted over the *soil* fill.

6.3.3 Plate bearing tests, in accordance with ASTM D 1196, may be performed in both the compacted *soil* fill and in the *rock* fill to aid in determining the required minimum number of passes of the compaction equipment. If performed, a minimum of three plate bearing tests should be performed in the properly compacted *soil* fill (minimum relative compaction of 90 percent). Plate bearing tests shall then be performed on areas of *rock* fill having two passes, four passes and six passes of the compaction equipment, respectively. The number of passes required for the *rock* fill shall be determined by comparing the results of the plate bearing tests for the *soil* fill and the *rock* fill and by evaluating the deflection variation with number of passes. The required number of passes of the compaction equipment will be performed as necessary until the plate bearing deflections are equal to or less than that determined for the properly compacted *soil* fill. In no case will the required number of passes be less than two.

6.3.4 A representative of the Consultant should be present during *rock* fill operations to observe that the minimum number of "passes" have been obtained, that water is being properly applied and that specified procedures are being followed. The actual number of plate bearing tests will be determined by the Consultant during grading.

6.3.5 Test pits shall be excavated by the Contractor so that the Consultant can state that, in their opinion, sufficient water is present and that voids between large rocks are properly filled with smaller rock material. In-place density testing will not be required in the *rock* fills.

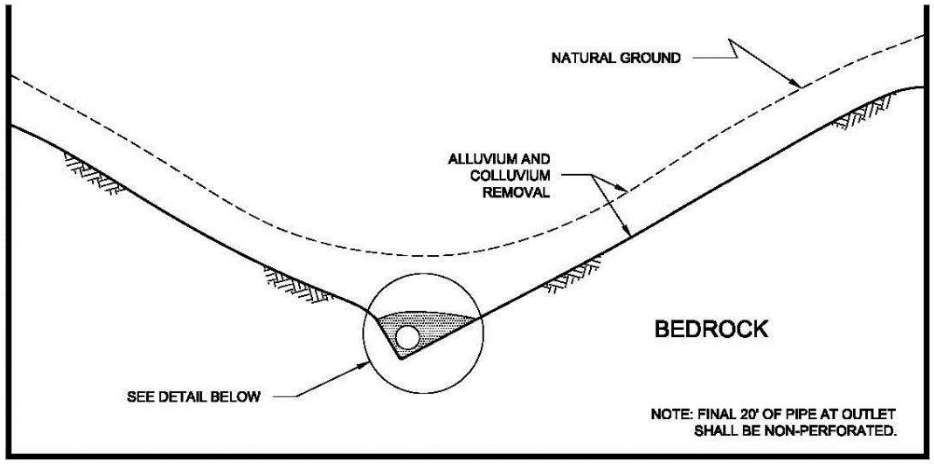
6.3.6 To reduce the potential for "piping" of fines into the *rock* fill from overlying *soil* fill material, a 2-foot layer of graded filter material shall be placed above the uppermost lift of *rock* fill. The need to place graded filter material below the *rock* should be determined by the Consultant prior to commencing grading. The gradation of the graded filter material will be determined at the time the *rock* fill is being excavated. Materials typical of the *rock* fill should be submitted to the Consultant in a timely manner, to allow design of the graded filter prior to the commencement of *rock* fill placement.

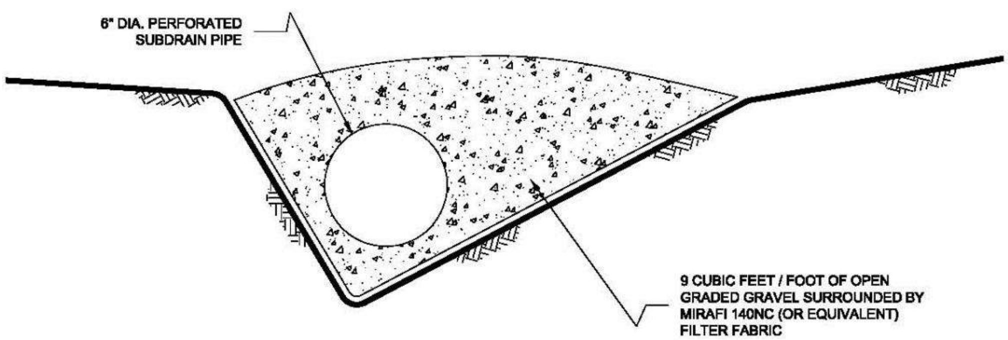
6.3.7 *Rock* fill placement should be continuously observed during placement by the Consultant.

7. SUBDRAINS

7.1 The geologic units on the site may have permeability characteristics and/or fracture systems that could be susceptible under certain conditions to seepage. The use of canyon subdrains may be necessary to mitigate the potential for adverse impacts associated with seepage conditions. Canyon subdrains with lengths in excess of 500 feet or extensions of existing offsite subdrains should use 8-inch-diameter pipes. Canyon subdrains less than 500 feet in length should use 6-inch-diameter pipes.

TYPICAL CANYON DRAIN DETAIL





NOTES:

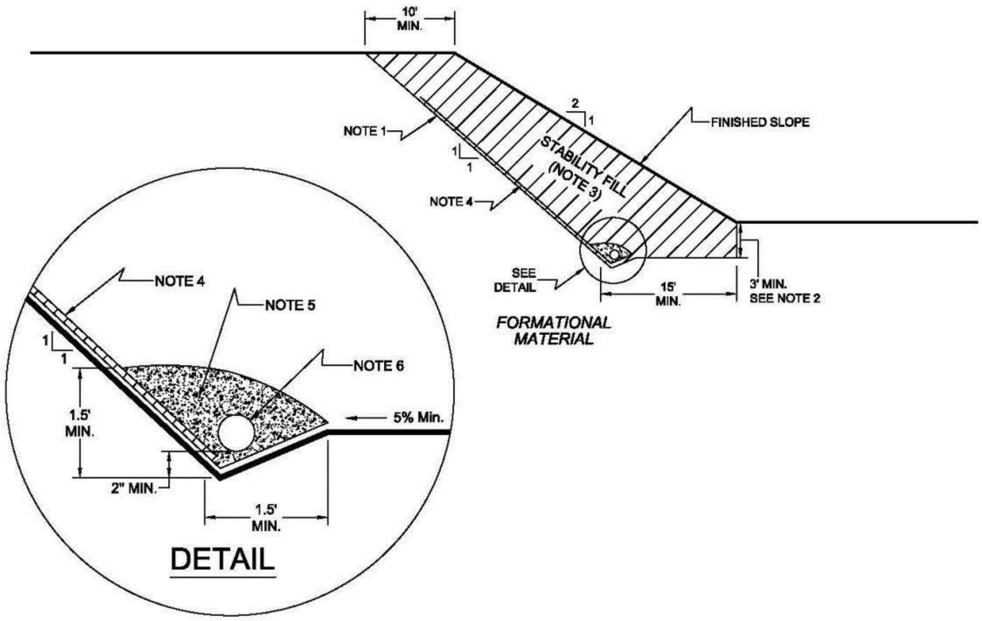
1......6-INCH DIAMETER, SCHEDULE 80 PVC PERFORATED PIPE FOR FILLS IN EXCESS OF 100-FEET IN DEPTH OR A PIPE LENGTH OF LONGER THAN 500 FEET.

2......6-INCH DIAMETER, SCHEDULE 40 PVC PERFORATED PIPE FOR FILLS LESS THAN 100-FEET IN DEPTH OR A PIPE LENGTH SHORTER THAN 500 FEET.

NO SCALE

7.2 Slope drains within stability fill keyways should use 4-inch-diameter (or lager) pipes.

TYPICAL STABILITY FILL DETAIL



NOTES:

1.....EXCAVATE BACKCUT AT 1:1 INCLINATION (UNLESS OTHERWISE NOTED).

2.....BASE OF STABILITY FILL TO BE 3 FEET INTO FORMATIONAL MATERIAL, SLOPING A MINIMUM 5% INTO SLOPE.

3.....STABILITY FILL TO BE COMPOSED OF PROPERLY COMPACTED GRANULAR SOIL.

4.....CHIMNEY DRAINS TO BE APPROVED PREFABRICATED CHIMNEY DRAIN PANELS (MIRADRAIN G200N OR EQUIVALENT) SPACED APPROXIMATELY 20 FEET CENTER TO CENTER AND 4 FEET WIDE. CLOSER SPACING MAY BE REQUIRED IF SEEPAGE IS ENCOUNTERED.

5.....FILTER MATERIAL TO BE 3/4-INCH, OPEN-GRADED CRUSHED ROCK ENCLOSED IN APPROVED FILTER FABRIC (MIRAFI 140NC).

6.....COLLECTOR PIPE TO BE 4-INCH MINIMUM DIAMETER, PERFORATED, THICK-WALLED PVC SCHEDULE 40 OR EQUIVALENT, AND SLOPED TO DRAIN AT 1 PERCENT MINIMUM TO APPROVED OUTLET.

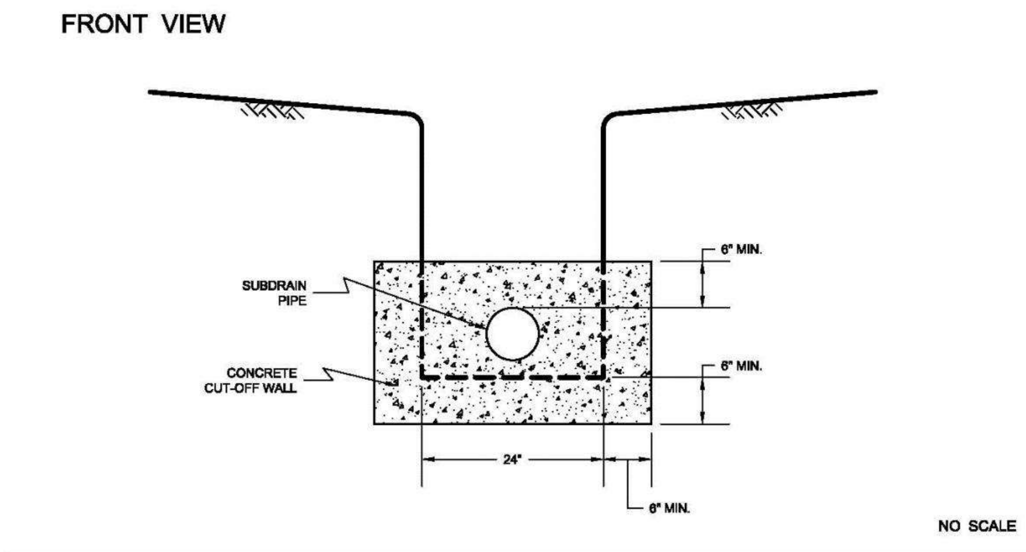
NO SCALE

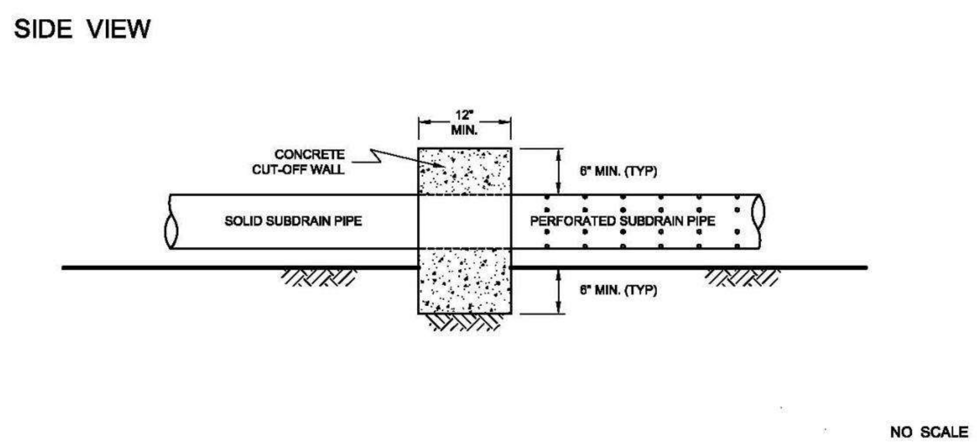
7.3 The actual subdrain locations will be evaluated in the field during the remedial grading operations. Additional drains may be necessary depending on the conditions observed and the requirements of the local regulatory agencies. Appropriate subdrain outlets should be evaluated prior to finalizing 40-scale grading plans.

7.4 *Rock* fill or *soil-rock* fill areas may require subdrains along their down-slope perimeters to mitigate the potential for buildup of water from construction or landscape irrigation. The subdrains should be at least 6-inch-diameter pipes encapsulated in gravel and filter fabric. *Rock* fill drains should be constructed using the same requirements as canyon subdrains.

7.5 Prior to outletting, the final 20-foot segment of a subdrain that will not be extended during future development should consist of non-perforated drainpipe. At the non-perforated/ perforated interface, a seepage cutoff wall should be constructed on the downslope side of the pipe.

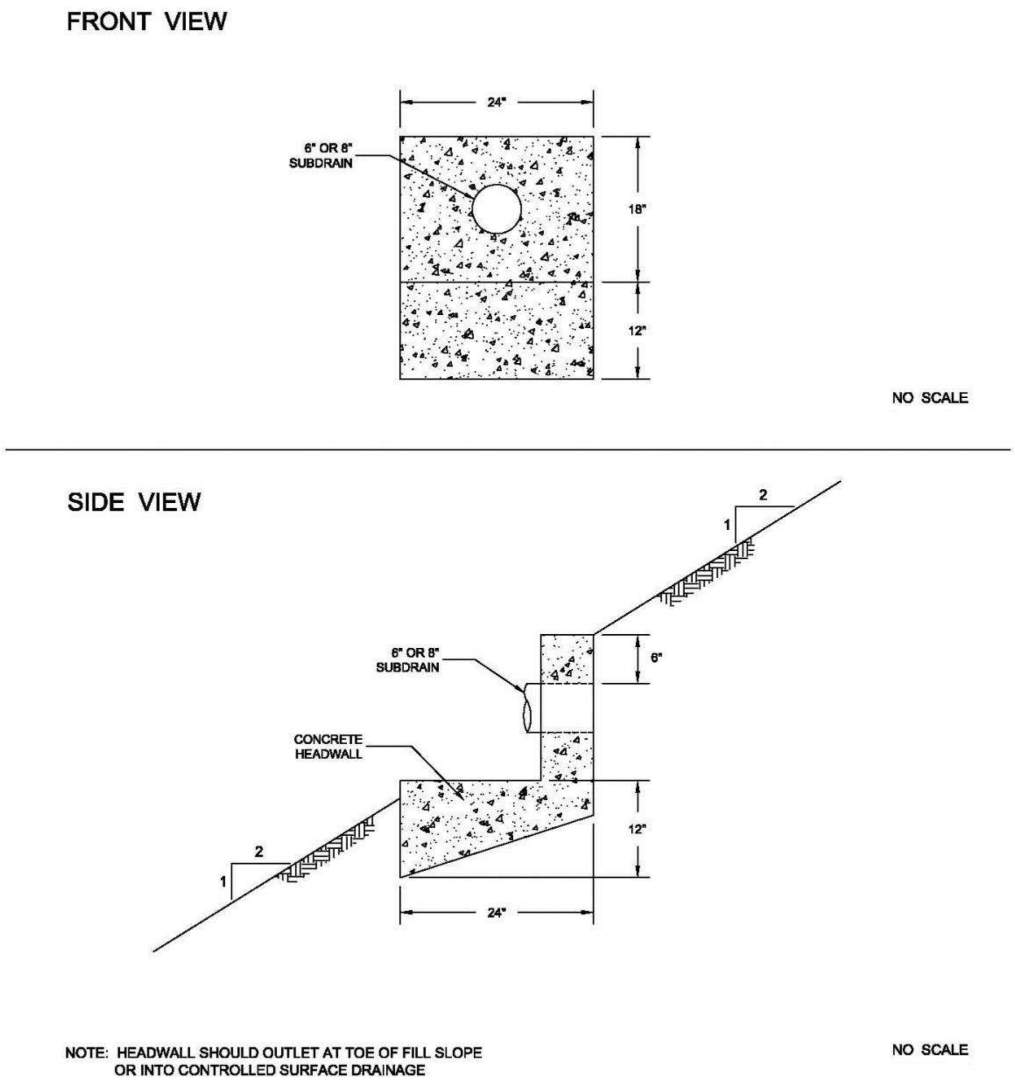
TYPICAL CUT OFF WALL DETAIL





7.6 Subdrains that discharge into a natural drainage course or open space area should be provided with a permanent headwall structure.

TYPICAL HEADWALL DETAIL



7.7 The final grading plans should show the location of the proposed subdrains. After completion of remedial excavations and subdrain installation, the project civil engineer should survey the drain locations and prepare an "as-built" map showing the drain locations. The final outlet and connection locations should be determined during grading operations. Subdrains that will be extended on adjacent projects after grading can be placed on formational material and a vertical riser should be placed at the end of the subdrain. The grading contractor should consider videoing the subdrains shortly after burial to check proper installation and functionality. The contractor is responsible for the performance of the drains.

8. OBSERVATION AND TESTING

8.1 The Consultant shall be the Owner's representative to observe and perform tests during clearing, grubbing, filling, and compaction operations. In general, no more than 2 feet in vertical elevation of *soil* or *soil-rock* fill should be placed without at least one field density test being performed within that interval. In addition, a minimum of one field density test should be performed for every 2,000 cubic yards of *soil* or *soil-rock* fill placed and compacted.

8.2 The Consultant should perform a sufficient distribution of field density tests of the compacted *soil* or *soil-rock* fill to provide a basis for expressing an opinion whether the fill material is compacted as specified. Density tests shall be performed in the compacted materials below any disturbed surface. When these tests indicate that the density of any layer of fill or portion thereof is below that specified, the particular layer or areas represented by the test shall be reworked until the specified density has been achieved.

8.3 During placement of *rock* fill, the Consultant should observe that the minimum number of passes have been obtained per the criteria discussed in Section 6.3.3. The Consultant should request the excavation of observation pits and may perform plate bearing tests on the placed *rock* fills. The observation pits will be excavated to provide a basis for expressing an opinion as to whether the *rock* fill is properly seated and sufficient moisture has been applied to the material. When observations indicate that a layer of *rock* fill or any portion thereof is below that specified, the affected layer or area shall be reworked until the *rock* fill has been adequately seated and sufficient moisture applied.

8.4 A settlement monitoring program designed by the Consultant may be conducted in areas of *rock* fill placement. The specific design of the monitoring program shall be as recommended in the Conclusions and Recommendations section of the project Geotechnical Report or in the final report of testing and observation services performed during grading.

8.5 We should observe the placement of subdrains, to check that the drainage devices have been placed and constructed in substantial conformance with project specifications.

8.6 Testing procedures shall conform to the following Standards as appropriate:

8.6.1 Soil and Soil-Rock Fills:

8.6.1.1 Field Density Test, ASTM D 1556, *Density of Soil In-Place By the Sand-Cone Method.*

8.6.1.2 Field Density Test, Nuclear Method, ASTM D 6938, *Density of Soil and Soil-Aggregate In-Place by Nuclear Methods (Shallow Depth)*.

8.6.1.3 Laboratory Compaction Test, ASTM D 1557, *Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-Pound Hammer and 18-Inch Drop*.

8.6.1.4. Expansion Index Test, ASTM D 4829, *Expansion Index Test*.

9. PROTECTION OF WORK

9.1 During construction, the Contractor shall properly grade all excavated surfaces to provide positive drainage and prevent ponding of water. Drainage of surface water shall be controlled to avoid damage to adjoining properties or to finished work on the site. The Contractor shall take remedial measures to prevent erosion of freshly graded areas until such time as permanent drainage and erosion control features have been installed. Areas subjected to erosion or sedimentation shall be properly prepared in accordance with the Specifications prior to placing additional fill or structures.

9.2 After completion of grading as observed and tested by the Consultant, no further excavation or filling shall be conducted except in conjunction with the services of the Consultant.

10. CERTIFICATIONS AND FINAL REPORTS

10.1 Upon completion of the work, Contractor shall furnish Owner a certification by the Civil Engineer stating that the lots and/or building pads are graded to within 0.1 foot vertically of elevations shown on the grading plan and that all tops and toes of slopes are within 0.5 foot horizontally of the positions shown on the grading plans. After installation of a section of subdrain, the project Civil Engineer should survey its location and prepare an *as-built* plan of the subdrain location. The project Civil Engineer should verify the proper outlet for the subdrains and the Contractor should ensure that the drain system is free of obstructions.

10.2 The Owner is responsible for furnishing a final as-graded soil and geologic report satisfactory to the appropriate governing or accepting agencies. The as-graded report should be prepared and signed by a California licensed Civil Engineer experienced in geotechnical engineering and by a California Certified Engineering Geologist, indicating that the geotechnical aspects of the grading were performed in substantial conformance with the Specifications or approved changes to the Specifications.

LIST OF REFERENCES

1. California Geological Survey (2003), *Seismic Shaking Hazards in California, Based on the USGS/CGS Probabilistic Seismic Hazards Assessment (PSHA) Model, 2002 (revised April 2003). 10% probability of being exceeded in 50 years.* (http://redirect.conservation.ca.gov/cgs/rghm/pshamap/pshamain.html).

2. *City of El Cajon Best Management Practices (BMP) Design Manual*, February 2016.

3. *Fault Activity Map of California and Adjacent Areas,* California Division of Mines and Geology, compiled by C. W. Jennings, 1994.

4. Geocon Incorporated, *Preliminary Soil and Geologic Reconnaissance For Gillespie Airport Master Plan, Sites 1 Through 6, El Cajon, California*, dated June 3, 1983 (Project No. D-2923-M01).

5. http://www.historicaerials.com.

6. Wesnousky, S. G., *Earthquakes, Quaternary Faults, and Seismic Hazard in California,* Journal of Geophysical Research, Vol. 91, No. B12, 1986, pp. 12, 587, 631.

7. Unpublished reports and maps on file with Geocon Incorporated.

8. USGS (2011), Seismic Hazard Curves and Uniform Hazard Response Spectra (version 5.1.0, dated February 2, 2011), http://earthquake.usgs.gov/research/hazmaps/design/.