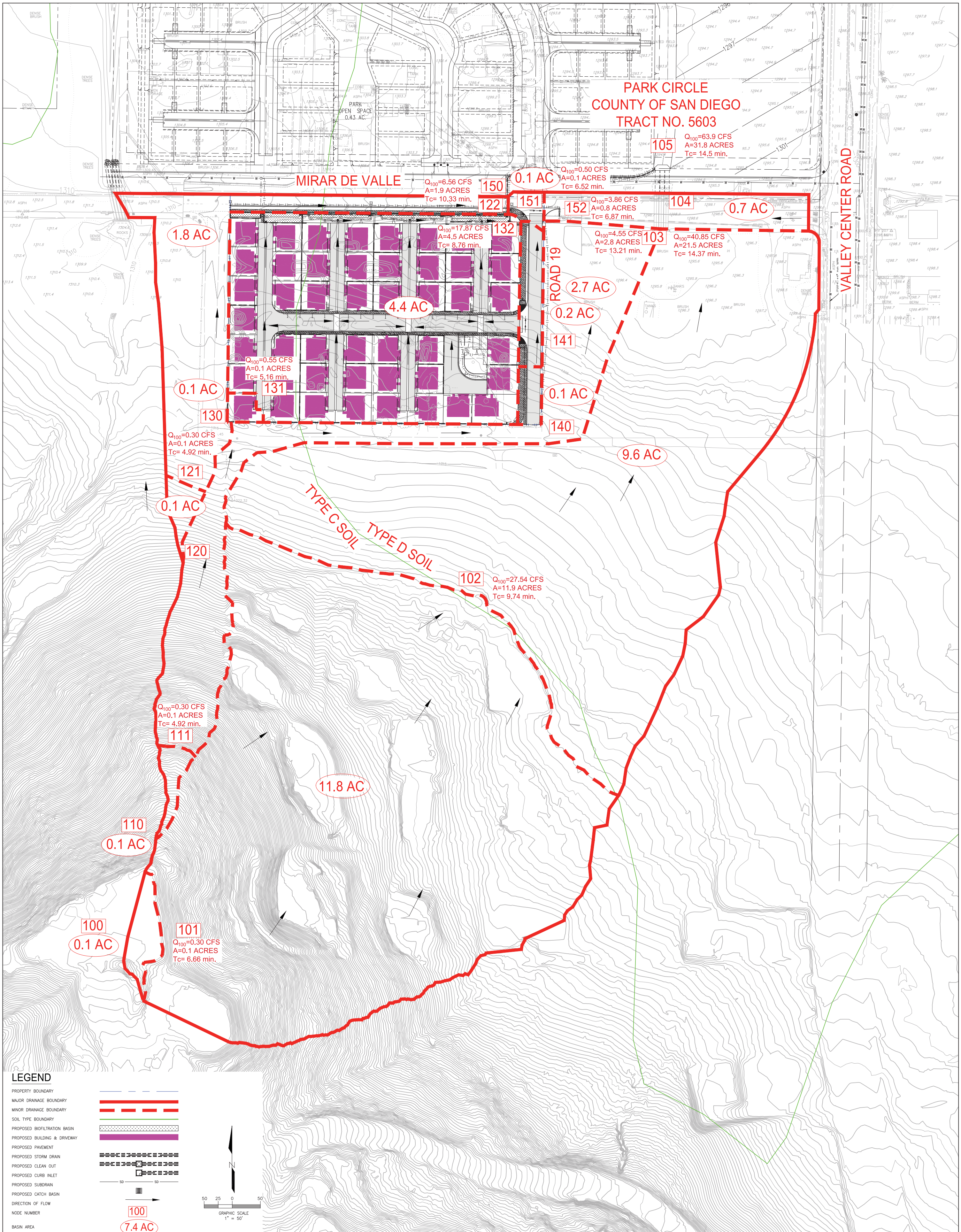

PREPARED BY:
TSAC ENGINEERING
PHONE: 858.762.9611 FAX: 858.762.9612

POST-PROJECT DRAINAGE MAP FOR SHADY OAK

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ATTACHMENT 7

Copy of Project's Geotechnical and Groundwater Investigation Report

This is the cover sheet for Attachment 7.

If hardcopy or CD is not attached, the following information should be provided:

Title:
Prepared By:
Date:

CHRISTIAN WHEELER
ENGINEERING

GEOTECHNICAL INVESTIGATION

SHADY OAK

27522 VALLEY CENTER ROAD

VALLEY CENTER, CALIFORNIA

PREPARED FOR

TOUCHSTONE COMMUNITIES

9909 MIRA MESA BOULEVARD, SUITE #150

SAN DIEGO, CALIFORNIA 92131

PREPARED BY

CHRISTIAN WHEELER ENGINEERING

3980 HOME AVENUE

SAN DIEGO, CALIFORNIA 92105

CHRISTIAN WHEELER
ENGINEERING

August 5, 2016

Touchstone Communities CWE 2150438.01
9909 Mira Mesa Boulevard, Suite #150
San Diego, California 92131
Attention: Brian Nestoroff

Subject: Geotechnical Investigation, Shady Oak
27522 Valley Center Road, Valley Center, California

In accordance with your request and our proposal dated July 24, 2015, we have completed a preliminary geotechnical investigation for the subject project. We are presenting herein our findings and recommendations.

In general, we found the subject property suitable for the proposed construction, provided the recommendations provided herein are followed. Compressible surficial soils, including residual soils and previous fills, will need to be removed and replaced as properly compacted fill during the site grading. Specific remedial grading recommendations and geotechnical design criteria are presented in the attached report.

If you have any questions after reviewing this report, please do not hesitate to contact our office. This opportunity to be of professional service is sincerely appreciated.

Respectfully submitted,
CHRISTIAN WHEELER ENGINEERING

Shawn Caya, R.G.E. #2748 Troy S. Wilson, C.E.G. #2551
SCC:scc;tsw

REGISTERED PROFESSIONAL ENGINEER SHAWN C. CAYA GE2748 EXP. 6-30-18 GEOTECHNICAL STATE OF CALIFORNIA

PROFESSIONAL GEOLOGIST TROY S. WILSON No. 2551 CERTIFIED ENGINEERING GEOLOGIST Expires 7-31-17 STATE OF CALIFORNIA

Distribution: brian@touchstonecommunities.com

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CHRISTIAN WHEELER
ENGINEERING

GEOTECHNICAL INVESTIGATION

SHADY OAK

27522 VALLEY CENTER ROAD

VALLEY CENTER, CALIFORNIA

INTRODUCTION AND PROJECT DESCRIPTION

This report presents the results of a geotechnical investigation performed for a 47-Lot subdivision to be constructed within a mostly vacant lot at 27522 Valley Center Road, in the Valley Center area of the County of San Diego, California. The following Figure Number 1 presents a vicinity map showing the location of the project.

We understand that it is proposed to construct a residential subdivision on the property. The subdivision will include 47 single-family homes and associated streets and utility improvements. We expect that the homes will be one- and/or two-story, wood-frame structures with concrete on-grade floor slabs. Grading will consist of cuts and fills of less than about five feet from the existing site grades with site retaining walls of similar heights. Biofiltration basins are planned along the northern boundary of the site.

To assist in the preparation of this report, our firm has been given a Grading Plan prepared by TSAC Engineering (undated). This plan has been used as the base for our Site Plan and Geotechnical Map, which is included herewith as Plate Number 1.

This report has been prepared for the exclusive use of Touchstone Communities and its consultants for specific application to the project described herein. Should the project be modified, the new plans should be submitted to Christian Wheeler Engineering for review to determine whether the findings and recommendations presented herein remain applicable and if any additional subsurface investigation, laboratory testing and/or recommendations are necessary. Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted engineering principles and practices. This warranty is in lieu of all other warranties, expressed or implied.

3980 Home Avenue ✦ San Diego, CA 92105 ✦ 619-550-1700 ✦ FAX 619-550-1701

SITE VICINITY

© OpenStreetMap contributors

SHADY OAK
27522 VALLEY CENTER ROAD
VALLEY CENTER, CALIFORNIA

DATE:	AUGUST 2016	JOB NO.:	2150438
BY:	SRD	FIGURE NO.:	1

CHRISTIAN WHEELER
ENGINEERING

INVESTIGATION SCOPE

Our preliminary geotechnical investigation consisted of surface reconnaissance, subsurface exploration, obtaining representative soil samples, laboratory testing, analysis of the field and laboratory data and review of relevant geologic literature. Our scope of service did not include assessment of hazardous substance contamination, recommendations to prevent floor slab moisture intrusion or the formation of mold within the structure, or any other services not specifically described in the scope of services presented below. More specifically, our intent was to provide the services listed below.

- Excavate nine backhoe trenches on the site to explore the existing soil conditions.
- Backfill the trenches with the removed soil. It should be noted that the soil was not compacted and will have to be removed and replaced as compacted fill during site grading.
- Evaluate, by laboratory tests and our past experience with similar soil types, the engineering properties of the various soil strata that may influence the proposed construction, including bearing capacities, expansive characteristics and settlement potential.
- Describe the general geology at the site, including possible geologic hazards that could have an effect on the proposed construction, and provide the seismic design parameters as required by the 2013 edition of the California Building Code.
- Address potential construction difficulties that may be encountered due to soil conditions, groundwater or geologic hazards, and provide geotechnical recommendations to deal with these difficulties.
- Provide site preparation and grading recommendations for the anticipated work.
- Provide foundation recommendations for the type of construction anticipated and develop soil engineering design criteria for the recommended foundation designs.
- Provide design parameters for unrestrained retaining walls.
- Provide preliminary pavement section recommendations.
- Prepare this report, which includes, in addition to our conclusions and recommendations, a plot plan showing the areal extent of the geological units and the locations of our exploratory borings, exploration logs, and a summary of the laboratory test results.

Although a test for the presence of soluble sulfates within the soils that may be in contact with reinforced concrete was performed as part of the scope of our services, it should be understood Christian Wheeler Engineering does not practice corrosion engineering. If such an analysis is considered necessary, we recommend that the client retain an engineering firm that specializes in this field to consult with them on this matter. The results of these tests should only be used as a guideline to determine if additional testing and analysis is necessary.

FINDINGS

SITE DESCRIPTION

The subject site is a 4.56 acre, rectangular-shaped lot identified as Assessor's Parcel Number 186-270-01.The lot is located just west of the intersection of Valley Center Road and Mirar de Valle and is bordered by Mirar de Valle to the north and by vacant land on the remaining sides. The property supports an existing residence and associated improvements in the southeastern portion and is undeveloped in the remaining portions. It appears that portions of the property have been used as a dump site as there are several small stockpiles of dirt, concrete, and other debris. Topographically, the site slopes gently to the north-northeast with elevations ranging from about 1296 feet (datum unknown) in the northeast corner to 1315 feet in the southwest corner.

GENERAL GEOLOGY AND SUBSURFACE CONDITIONS

GEOLOGIC SETTING AND SOIL DESCRIPTION: The subject site is located in the Foothills Physiographic Province of San Diego County. Based upon the results of our subsurface exploration and analysis of readily available, pertinent geologic literature, it was determined that the project area is underlain by Cretaceous-age granitic bedrock, residual soil, and artificial fill. These materials are described below.

> **ARTIFICIAL FILL (Qaf):** Artificial fill was encountered in areas that support the existing development in the southeast portion of the property. As encountered in trenches T-5 and T-7, the fill soils extended to a depth of about 2 to 2½ feet below existing site grade and generally consisted of brown to grayish-brown, dry to damp, loose to medium dense, silty sand (SM) with some gravel. The fill materials were judged to have a very low expansion index (EI<20).

> **RESIDUAL SOIL:** A layer of residual soil consisting of natural topsoil and/or subsoil was encountered in each of our exploratory trenches. The topsoil layer, which was encountered in all the trenches, extended to depths ranging from about 1 foot to 4 feet below existing grade. The topsoil consists of brown, dry to damp, loose, porous, silty sand (SM) that is judged to have a very low expansion index (EI<20). A layer of subsoil was encountered underlying the topsoil in 6 of our 9 exploratory trenches. Where encountered, the subsoil layer ranged from about 1 foot to 1½ feet in thickness and extended to approximately 2 to 4 feet below the existing grade. The subsoil consists

of reddish-brown, damp to moist, medium dense, clayey sand (SC) that was found to have a low expansion index (EI=35).

WEATHERED GRANITICS (Kgr): Weathered granitic bedrock underlies the surficial soils. Within our trenches, the weathered granitics were encountered at depths ranging from about 2 to 4 feet below the existing grades. This material consists of reddish-brown and light gray, damp, dense to very dense, silty sand (SM) and well-graded sand with silt (SW-SM). These deposits were judged to have a very low expansion index (EI<20).

GROUNDWATER: No groundwater or wet soil was encountered in any of our subsurface explorations. It should be recognized that minor groundwater seepage problems might occur after development of a site even where none were present before development. These are usually minor phenomena and are often the result of an alteration in drainage patterns and/or an increase in irrigation water. Based on the permeability characteristics of the soil and the anticipated usage and development, it is our opinion that any seepage problems which may occur will be minor in extent. It is further our opinion that these problems can be most effectively corrected on an individual basis if and when they occur.

TECTONIC SETTING: No active or potentially active faults are known to traverse the subject site. However, it should be noted that much of Southern California, including the San Diego County area, is characterized by a series of Quaternary-age fault zones that consist of several individual, en echelon faults that generally strike in a northerly to northwesterly direction. Some of these fault zones (and the individual faults within the zone) are classified as "active" according to the criteria of the California Division of Mines and Geology. Active fault zones are those that have shown conclusive evidence of faulting during the Holocene Epoch (the most recent 11,000 years). The Division of Mines and Geology used the term "potentially active" on Earthquake Fault Zone maps until 1988 to refer to all Quaternary-age (last 1.6 million years) faults for the purpose of evaluation for possible zonation in accordance with the Alquist-Priolo Earthquake Fault Zoning Act and identified all Quaternary-age faults as "potentially active" except for certain faults that were presumed to be inactive based on direct geologic evidence of inactivity during all of Holocene time or longer. Some faults considered to be "potentially active" would be considered to be "active" but lack specific criteria used by the State Geologist, such as *sufficiently active* and *well-defined*. Faults older than Quaternary-age are not specifically defined in Special Publication 42, Fault Rupture Hazard Zones in California, published by the California Division of Mines and Geology. However, it is generally accepted that faults showing no movement during the Quaternary period may be considered to be "inactive".

A review of available geologic maps indicates that the nearest active fault zone is the Elsinore Fault Zone (Julian portion), located approximately 15 kilometers northeast of the site. Other active fault zones in the region that could possibly affect the site include the Rose Canyon, Newport-Inglewood and Coronado Bank Fault Zone to the west; Palos Verdes Fault Zones to the northwest; and the Earthquake Valley and San Andreas Fault Zones to the east.

TABLE I: PROXIMAL FAULT ZONES

Fault Zone	Distance
Elsinore (Julian)	15 km
Rose Canyon	35 km
Newport-Inglewood	37 km
Earthquake Valley	42 km
Coronado Bank	58 km
Palos Verdes	84 km

GEOLOGIC HAZARDS

LANDSLIDE POTENTIAL AND SLOPE STABILITY: As part of this investigation we reviewed the publication, "Landslide Hazards in the Northern Part of the San Diego Metropolitan Area" by Tan, 1995. This reference is a comprehensive study that classifies San Diego County into areas of relative landslide susceptibility. According to this publication, the site is located in Relative Landslide Susceptibility Area 2. Area 2 is considered to be "marginally susceptible" to landsliding. Based on our findings, it is our professional opinion that the potential for slope failures within the site is very low.

SEISMIC HAZARD: A likely geologic hazard to affect the site is ground shaking as a result of movement along one of the major active fault zones mentioned in the "Tectonic Setting" section of this report. Per Chapter 16 of the 2013 California Building Code (CBC), the Risk-Targeted Maximum Considered Earthquake (MCE_R) ground acceleration is that which results in the largest maximum response to horizontal ground motions with adjustments for a targeted risk of structural collapse equal to one percent in 50 years. Figures 1613.3.1(1) and 1613.3.1(2) of the CBC present MCE_R accelerations for short (0.2 sec.) and long (1.0 sec.) periods, respectively, based on a soil Site Class B (CBC 1613.3.2) and a structural damping of five percent. For the subject site, correlation with the known properties of the underlying bedrock indicates that the upper 100 feet of geologic subgrade can be characterized as Site Class C. In this case, the mapped MCE_R accelerations are modified using the Site Coefficients presented in Tables 1613.3.3(1) and (2). The modified MCE spectral accelerations are then multiplied by two-thirds in order to obtain the design spectral accelerations. These seismic design parameters for the subject site (33.2105°, -117.0364°), based on Chapter 16 of the CBC, are presented in Table II below.

TABLE II: CBC 2013 EDITION – SEISMIC DESIGN PARAMETERS

CBC – Chapter 16 Section	Seismic Design Parameter	Recommended Value
Section 1613.3.2	Soil Site Class	C
Figure 1613.3.1 (1)	MCE_R Acceleration for Short Periods (0.2 sec), S_s	1.205 g
Figure 1613.3.1 (2)	MCE_R Acceleration for 1.0 Sec Periods (1.0 sec), S_1	0.460 g
Table 1613.3.3 (1)	Site Coefficient, F_a	1.000
Table 1613.3.3 (2)	Site Coefficient, F_v	1.340
Section 1613.3.3	S_{MS} = MCE_R Spectral Response at 0.2 sec. = $(S_s)(F_a)$	1.204 g
Section 1613.3.3	S_{M1} = MCE_R Spectral Response at 1.0 sec. = $(S_1)(F_v)$	0.617 g
Section 1613.3.4	S_{DS} = Design Spectral Response at 0.2 sec. = $2/3(S_{MS})$	0.804 g
Section 1613.3.4	S_{D1} = Design Spectral Response at 1.0 sec. = $2/3(S_{M1})$	0.411 g
Section 1803.2.12	PGA_M per Section 11.8.3 of ASCE 7	0.46 g

LIQUEFACTION: The near-surface soils encountered at the site are not considered susceptible to liquefaction due to such factors as depth to the groundwater table, soil density and grain-size distribution.

FLOODING: The site is not located flood hazard area according to the maps prepared by the Federal Emergency Management Agency.

TSUNAMIS: Tsunamis are great sea waves produced by submarine earthquakes or volcanic eruptions. According to the San Diego County Multi-Jurisdictional Hazard Mitigation Plan, the project site is located outside the limits of the maximum projected tsunami runup.

SEICHES: Seiches are periodic oscillations in large bodies of water such as lakes, harbors, bays or reservoirs. Due to the site's location, it should not be affected by seiches.

CONCLUSIONS

Based on our investigation, it is our opinion that the subject property is suitable for the proposed subdivision provided the geotechnical recommendations presented in this report are followed. The main geotechnical condition affecting the proposed development is the presence of potentially compressible, near-surface soils comprised of artificial fill and residual soil. These materials will need to be overexcavated and recompacted in order to support the proposed improvements. Additionally, stockpiled debris will need to be removed from the site prior to grading.

The site is located in an area that is relatively free of geologic hazards that will have a significant effect on the proposed development. The most likely geologic hazard that could affect the site is ground shaking due to seismic activity along one of the regional active faults. However, construction in accordance with the requirements of the most recent edition of the California Building Code and the local governmental agencies should provide a level of life-safety suitable for the type of development proposed.

RECOMMENDATIONS

GRADING AND EARTHWORK

GENERAL: All grading should conform to the guidelines presented in Appendix J of the California Building Code, the minimum requirements of the County of San Diego, and the recommended Grading Specifications and Special Provisions attached hereto, except where specifically superseded in the text of this report. Prior to grading, a representative of Christian Wheeler Engineering should be present at the pre-construction meeting to provide additional grading guidelines, if necessary, and to review the earthwork schedule.

OBSERVATION OF GRADING: Continuous observation by the Geotechnical Consultant is essential during the grading operation to confirm conditions anticipated by our investigation, to allow adjustments in design criteria to reflect actual field conditions exposed, and to determine that the grading proceeds in general accordance with the recommendations contained herein.

CLEARING AND GRUBBING: Site preparation should begin with demolition and removal of the existing improvements and the stripping and removal of vegetation, construction debris and other deleterious materials from the site. This should include all significant root material and any debris from the on-site stockpiles. The resulting materials should be disposed of off-site in a legal dumpsite.

SITE PREPARATION: Where it is not removed by the planned grading, the upper 4 feet of existing soil should be removed. We anticipate that such removals will expose competent weathered granitics at the base of the excavation. Deeper removals may be necessary in areas of the site not investigated or in areas where loose, dry, or otherwise unacceptable soils are exposed. The removals can be limited to 3 feet below the existing grade where granitic rock is exposed at the base of the removal. Laterally, the removals should extend to the property line or 5 feet outside areas to support fill and/or settlement-sensitive improvements, whichever is less. No removals are recommended beyond property lines except along the eastern boundary where permission for off-site grading has been granted. All excavated areas should be approved by the geotechnical engineer or his representative prior to replacing any of the excavated soils. The excavated material can be replaced as properly compacted fill provided that it is free of deleterious debris. Fill soils should be compacted in accordance with the recommendations presented in the "Compaction and Method of Filling" section of this report.

TEST TRENCH BACKFILL: Backfill associated with our subsurface explorations underlying settlement-sensitive improvements not removed as part of site preparation operations should be removed and replaced as compacted fill.

PROCESSING OF REMOVAL BOTTOM: Prior to placing any new fill soils or constructing any new improvements in areas that have been overexcavated as recommended in the "Site Preparation" section of this report, the exposed soils should be scarified to a depth of 12 inches, moisture conditioned, and compacted to at least 90 percent relative compaction. In areas to support fill slopes, keys should be cut into the competent supporting materials such as the weathered granitics. The keys should be at least twelve feet wide and be sloped back at least two percent. The keys should extend at least one foot into the competent supporting materials. Where the existing ground has a slope of 5:1 (horizontal to vertical) or steeper, it should be benched into as the fill extends upward from the keyways. The benching should remove all loose surficial soils and should create level areas on which to place the fill material.

COMPACTION AND METHOD OF FILLING: All structural fill and backfill material placed at the site, except as noted below, should be compacted to a relative compaction of at least 90 percent of maximum dry density as determined by ASTM Laboratory Test D1557. Fills should be placed at or slightly above optimum moisture content, in lifts six to eight inches thick, with each lift compacted by mechanical means. Fills should consist of approved earth material, free of trash or debris, roots, vegetation, or other materials determined to be unsuitable by our soil technicians or project geologist. Fill material should be free of rocks or lumps of soil in excess of twelve inches in maximum dimension; however, this should be reduced to six inches within four feet of finish grade.

All utility trench backfill should be compacted to a minimum of 90 percent of its maximum dry density. The upper twelve inches of subgrade beneath paved areas should be compacted to 95 percent of the materials maximum dry density. This compaction should be obtained by the paving contractor just prior to placing the aggregate base material and should not be part of the mass grading requirements or operation.

FILL SLOPE CONSTRUCTION: Fill slopes may be constructed at an inclination of 2:1 or flatter (horizontal to vertical). Compaction of slopes should be performed by back-rolling with a sheepsfoot compactor at vertical intervals of four feet or less as the fill is being placed, and track-walking the face of the slope when the slope is completed. As an alternative, the fill slopes may be overfilled by at least three feet and then cut back to the compacted core at the design line and grade. Keys should be made at the toe of fill slopes in accordance with the recommendations presented above under "Processing of Removal Bottom."

IMPORTED FILL MATERIAL: Soils to be imported to the site should be evaluated and approved by the Geotechnical Consultant prior to being imported. At least five working days-notice of a potential import source should be given to the Geotechnical Consultant so that appropriate testing can be accomplished. The type of material considered most desirable for import is granular material containing some silt or clay binder, which has an Expansion Index of less than 50. Less than 25 percent of the material should be larger than the Standard #4 sieve, and less than 25 percent finer than the Standard # 200 sieve. Soils not meeting there criteria should not be used for structural fill or backfill.

TEMPORARY CUT SLOPES: The contractor is solely responsible for designing and constructing stable, temporary excavations and will need to shore, slope, or bench the sides of trench excavations as required to maintain the stability of the excavation sides. The contractor's "competent person", as defined in the OSHA Construction Standards for Excavations, 29 CFR, Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety process. We anticipate that the existing on-site soils will consist of Type C material. Our firm should be contacted to observe all temporary cut slopes during grading to ascertain that no unforeseen adverse conditions exist. No surcharge loads such as foundation loads, or soil or equipment stockpiles, vehicles, etc. should be allowed within a distance from the top of temporary slopes equal to half the slope height.

SURFACE DRAINAGE: The ground around the proposed structures should be graded so that surface water flows rapidly away from the structures without ponding. In general, we recommend that the ground adjacent to structure slope away at a gradient of at least two percent. Densely vegetated areas where runoff can be impaired should have a minimum gradient of five percent within the first five feet from the structure. It is our opinion that the project site is not suitable for storm water infiltration/percolation BMPs. We recommend that the biofiltration basins be lined in such a manner as to prevent the storm water from infiltrating into the underlying soils and should be connected via pipes to the storm drain system.

GRADING PLAN REVIEW: The final grading plans should be submitted to this office for review in order to ascertain that the recommendations of this report have been implemented, and that no additional recommendations are needed due to changes in the anticipated development plans.

CONVENTIONAL SHALLOW FOUNDATIONS

GENERAL: It is our opinion that the proposed buildings may be supported by conventional continuous and isolated spread footings. The following recommendations are considered the minimum based on the anticipated soil conditions anticipated after the recommendations contained in this report are implemented and are not intended to be in lieu of structural considerations. All foundations should be designed by a qualified structural engineer.

MINIMUM DIMENSIONS: New spread footings supporting the planned structures should be embedded at least 18 inches below the finish pad grade. Continuous and isolated footings should have minimum widths of 12 and 24 inches, respectively.

BEARING CAPACITY: Footings with the above minimum dimensions may be designed for an allowable soil bearing pressure of 2,500 pounds per square foot (psf). This value can be increased by 500 psf for each additional foot of depth and width up to a maximum capacity of 4,000 psf. The allowable bearing capacity may be increased by one-third for combinations of temporary loads, such as those due to wind or seismic loads.

FOOTING REINFORCING: Reinforcement requirements for foundations should be provided by a structural engineer. However, based on the anticipated soil conditions, we recommend that the minimum reinforcing for continuous footings consist of at least one No. 4 bar positioned near the bottom of the footing and at least one No. 4 bar positioned near the top of the footing.

LATERAL LOAD RESISTANCE: Lateral loads against foundations may be resisted by friction between the bottom of the footing and the supporting soil, and by the passive pressure against the footing. The coefficient of friction between concrete and soil may be considered to be 0.35. The passive resistance may be considered to be equal to an equivalent fluid weight of 350 pounds per cubic foot. This assumes the footings are poured tight against undisturbed soil. If a combination of the passive pressure and friction is used, the friction value should be reduced by one-third.

SETTLEMENT CHARACTERISTICS: Provided the recommendations presented in this report are followed, the anticipated total and differential foundation settlement is expected to be less than about 1 inch and 1 inch over 40 feet, respectively. It should be recognized that minor cracks normally occur in concrete slabs and foundations due to shrinkage during curing or redistribution of stresses, therefore some cracks should be anticipated. Such cracks are not necessarily an indication of excessive vertical movements.

EXPANSIVE CHARACTERISTICS: The anticipated foundation soils are expected to have a low expansion potential (EI<50). The recommendations presented in this report reflect this condition.

POST-TENSIONED FOUNDATIONS

As an alternative to conventional shallow foundations, post-tensioned foundations could be used to support the proposed buildings. Post-tensioned foundations should be designed in accordance with the design procedures of the Post-Tension Institute, using the design criteria presented below in Table III and the applicable information from the "Conventional Shallow Foundations" section above.

TABLE III: POST-TENSION DESIGN CRITERIA

Post-Tensioning Institute (PTI) – 3rd Edition	**Design Value**
Edge Moisture Variation, e_m	
Center Lift (ft)	9.0
Edge Lift (ft)	5.4
Differential Soil Movement, y_m	
Center Lift (in)	0.37
Edge Lift (in)	0.85

FOUNDATION PLAN REVIEW

The final foundation plan and accompanying details and notes should be submitted to this office for review. The intent of our review will be to verify that the plans used for construction reflect the minimum dimensioning and reinforcing criteria presented in this section and that no additional criteria are required due to changes in the foundation type or layout. It is not our intent to review structural plans, notes, details, or calculations to verify that the design engineer has correctly applied the geotechnical design values. It is the responsibility of the design engineer to properly design/specify the foundations and other structural elements based on the requirements of the structure and considering the information presented in this report.

FOUNDATION EXCAVATION OBSERVATION

All foundation excavations should be observed by the Geotechnical Consultant prior to placing reinforcing steel or formwork in order to determine if the foundation recommendations presented herein are followed. All footing excavations should be excavated neat, level, and square. All loose or unsuitable material should be removed prior to the placement of concrete.

SOLUBLE SUFATES

The water soluble sulfate content was determined in accordance with California Test Method 417 for a representative soil sample from the site. The result of this test indicates that the representative soil sample had a soluble sulfate content of 0.016, which is considered negligible.

ON-GRADE SLABS

GENERAL: It is our understanding that the building floors will consist of concrete slabs-on-grade. The following recommendations are considered the minimum slab requirements based on the soil conditions and are not intended to be in lieu of structural considerations. Post-tensioned slabs should be specified by the design engineer.

INTERIOR SLAB: We recommend that the interior slab-on-grade floors be at least 4 inches thick and be reinforced with at least No. 3 bars spaced at 18 inches on center each way. The reinforcing bars should extend at least six inches into the foundations and should be supported by chairs and be positioned in the center of the slab. The owner and the project structural engineer should determine if the on-grade slabs need to be designed for special loading conditions. For such cases, a subgrade modulus of 100 pounds per cubic inch can be assumed for the subgrade provided it is prepared as recommended in this report. The allowable bearing load for the slab is 1,500 pounds per square foot.

UNDER-SLAB VAPOR RETARDERS: Steps should be taken to minimize the transmission of moisture vapor from the subsoil through the interior slabs where it can potentially damage the interior floor coverings. We recommend that the owner/contractor follow national standards for the installation of vapor retarders below interior slabs as presented in currently published standards including ACI 302, "Guide to Concrete Floor and Slab Construction" and ASTM E1643, "Standard Practice for Installation of Water Vapor Retarder Used in Contact with Earth or Granular Fill Under Concrete Slabs". If sand is placed below the vapor retarding material, it should have a sand equivalent of at least 30 and contain less than 20% passing the Number 100 sieve and less than 10% passing the Number 200 sieve.

We recommend that the flooring installer perform standard moisture vapor emission tests prior to the installation of all moisture-sensitive floor coverings in accordance with ASTM F1869 "Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride".

EXTERIOR CONCRETE FLATWORK: Exterior concrete on-grade slabs should have a minimum thickness of four inches. Exterior slabs abutting perimeter foundations should be doweled into the footings. All slabs should be provided with weakened plane joints in accordance with the American Concrete Institute (ACI) guidelines. Alternative patterns consistent with ACI guidelines can also be used. A concrete mix with a 1-inch maximum aggregate size and a water/cement ratio of less than 0.6 is recommended for exterior slabs. Lower water content will decrease the potential for shrinkage cracks. Both coarse and fine aggregate should conform to the latest edition of the “Standard Specifications for Public Works Construction” (‘Greenbook”). Special attention should be paid to the method of concrete curing to reduce the potential for excessive shrinkage and resultant random cracking. It should be recognized that minor cracks occur normally in concrete slabs due to shrinkage. Some shrinkage cracks should be expected and are not necessarily an indication of excessive movement or structural distress.

EARTH RETAINING WALLS

FOUNDATIONS: Foundations for retaining walls can be designed in accordance with the foundation recommendations previously presented.

ACTIVE PRESSURES: The active soil pressure for the design of unrestrained earth retaining structures with level backfill surface may be assumed to be equivalent to the pressure of a fluid weighing 30 pounds per cubic foot. An additional 15 pounds per cubic foot can be added to the above values for 2:1 (H:V) sloping backfill. Thirty percent of any area surcharge placed adjacent to the retaining wall may be assumed to act as a uniform horizontal pressure against the wall. Where vehicles will be allowed within ten feet of the retaining wall, a uniform horizontal pressure of 100 pounds per square foot should be added to the upper 10 feet of the retaining wall to account for the effects of adjacent traffic. Special cases such as a combination of shored and sloping temporary slopes, or other surcharge loads not described above, may require an increase in the design values recommended above. These conditions should be evaluated by the project geotechnical engineer on a case-by-case basis. If any other loads are anticipated, the Geotechnical Consultant should be contacted for the necessary increase in soil pressure. All values are based on a drained backfill condition.

If it is necessary to consider seismic pressure, it may be assumed to be equivalent to the pressure of a fluid weighing 8 pounds per cubic foot, but the pressure distribution should be inverted so that the highest value is at the top of the wall. This corresponds to an approximate pseudo-static acceleration (Kh) of 0.10 g.

PASSIVE PRESSURE: The passive pressure for the anticipated foundation soils may be considered to be 350 pounds per square foot per foot of depth. The upper foot of embedment should be neglected when calculating passive pressures, unless the foundation abuts a hard surface such as a concrete slab. The passive pressure may be increased by one-third for seismic loading. The coefficient of friction for concrete to soil may be assumed to be 0.35 for the resistance to lateral movement. When combining frictional and passive resistance, the friction should be reduced by one-third.

WATERPROOFING AND SUBDRAINS: The project architect should provide (or coordinate) waterproofing details for the retaining walls. The design values presented above are based on a drained backfill condition and do not consider hydrostatic pressures. Unless hydrostatic pressures are incorporated into the design, the retaining wall designer should provide a subdrain detail. A typical retaining wall subdrain detail is presented as Plate No. 2 of this report. Additionally, outlets points for the retaining wall subdrains should be coordinated by the project civil engineer.

BACKFILL: All retaining wall backfill should be compacted to at least 90 percent relative compaction. It is anticipated that the on-site soils are suitable for use as backfill material provided the design parameters given herein are used in the wall design. Wall backfill material should be free of rocks or lumps of soil in excess of three inches in maximum dimension. Retaining walls should not be backfilled until the masonry/concrete has reached an adequate strength.

PRELIMINARY PAVEMENT SECTIONS

GENERAL: We expect that new pavement will be installed as part of the project. The following presents preliminary sections for asphalt concrete (AC) or Portland Cement Concrete (PCC) construction. The pavement sections provided in Table IV and Table VI should be considered preliminary and should be used for planning purposes only. Final pavement designs should be determined after R-value tests have been performed in the actual subgrade material in place after grading. Presuming the grading recommendations presented previously are followed, we estimate that the subgrade soils will have an R-Value of at least 25. The Traffic Index and Traffic Categories shown below are assumed. The project client and/or civil engineer should determine whether these assumed values are appropriate for the traffic conditions.

ASPHALT CONCRETE: We expect that the streets and drive aisles will primarily support passenger vehicles with heavily loaded vehicles such as garbage trucks and large moving vans on a daily basis. Parking stalls are expected to support primarily passenger vehicles and occasional moving vans. The asphalt concrete pavement section was calculated using the Caltrans design method using an assumed Traffic Index of 5.5 for interior streets and drive aisles and 4.5 for parking stalls.

TABLE IV: ASPHALT CONCRETE SECTIONS

Pavement Type	Traffic Index	Pavement Thickness	Base Thickness	Base Material	Subgrade Compaction
Asphalt Concrete					
Interior Streets	5.5	3.0 in.	8.5 in.	CAB or Class II	95% in upper 12”
Parking Stalls	4.5	3.0 in.	5.0 in.	CAB or Class II	95% in upper 12”

Prior to placing the base material beneath asphalt concrete pavements, the subgrade soil should be scarified to a depth of 12 inches and compacted to at least 95 percent of its maximum dry density at a moisture content one to three percent above optimum.

The base material could consist of Crushed Aggregate Base (CAB) or Class II Aggregate Base. The Crushed Aggregate Base should conform to the requirements set forth in Section 200-2.2 of the Standard Specifications for Public Works Construction. The Class II Aggregate Base should conform to requirements set forth in Section 26-1.02A of the Standard Specifications for California Department of Transportation. Asphalt concrete should be placed in accordance with ‘Standard Specifications for Public Works Construction (Greenbook), Section 302-5. Asphalt concrete pavement should be compacted to at least 95% of Hveem density.

CONCRETE PAVEMENTS: Portland cement concrete (PCC) pavement thickness can be determined from Table VI. The PCC pavement section was determined in general accordance with the procedure recommended within the American Concrete Institute report ACI-330R-08 Guide for Design and Construction of Concrete Parking Lots using the parameters listed in Table V. We recommend that the referenced ACI-330R Guide be used to determine the appropriate requirements for control joint configuration, reinforcing, and dowelling of the construction joints. Portland Cement Concrete pavement placed in front of trash enclosures should be reinforced with at least No. 4 bars placed at 12 inches on center each way.

TABLE V: CONCRETE PAVEMENT DESIGN PARAMETERS

Design Parameter	Design Value
Modulus of Subgrade Reaction, k	50 pci
Modulus of Rupture for Concrete, M_R	500 psi
Traffic Category (Main Driveways)	A (ADTT = 10)

ADTT = Average Daily Truck Traffic. Trucks defined as vehicles with at least six wheels.

Based on the design parameters summarized in Table V, the PCC pavements should have the minimum thicknesses shown in Table VI.

TABLE VI: MINIMUM CONCRETE PAVEMENT THICKNESS

Pavement Use	Thickness
Interior Streets/Aisles/Trash Enclosures	6.5 in
Parking Stalls	6.0 in

Prior to placing concrete pavement, the subgrade soils should be scarified to a depth of 12 inches and compacted to at least 95 percent of their maximum dry density at a moisture content one to three percent above optimum. Concrete pavement construction should comply with the requirements set forth in Sections 201-1.1.2 and 302-6 of the Standard Specifications for Public Works Construction (concrete Class 560-C-3250).

The outside edge of concrete slabs that will support wheel loads should have a thickened edge or integral curb. The thickened edge should be at least 2 inches thicker than the slab and should taper back to the recommended slab thickness 3 feet from the edge of the slab.

LIMITATIONS

REVIEW, OBSERVATION AND TESTING

The recommendations presented in this report are contingent upon our review of final plans and specifications. Such plans and specifications should be made available to the geotechnical engineer and engineering geologist so that they may review and verify their compliance with this report and with the California Building Code.

It is recommended that Christian Wheeler Engineering be retained to provide continuous soil engineering services during the earthwork operations. This is to verify compliance with the design concepts, specifications or recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to start of construction.

UNIFORMITY OF CONDITIONS

The recommendations and opinions expressed in this report reflect our best estimate of the project requirements based on an evaluation of the subsurface soil conditions encountered at the subsurface exploration locations and on the assumption that the soil conditions do not deviate appreciably from those encountered. It should be recognized that the performance of the foundations and/or cut and fill slopes may be influenced by undisclosed or unforeseen variations in the soil conditions that may occur in the intermediate and unexplored areas. Any unusual conditions not covered in this report that may be encountered during site development should be brought to the attention of the geotechnical engineer so that he may make modifications if necessary.

CHANGE IN SCOPE

This office should be advised of any changes in the project scope or proposed site grading so that we may determine if the recommendations contained herein are appropriate. This should be verified in writing or modified by a written addendum.

TIME LIMITATIONS

The findings of this report are valid as of this date. Changes in the condition of a property can, however, occur with the passage of time, whether they be due to natural processes or the work of man on this or adjacent properties. In addition, changes in the Standards-of-Practice and/or Government Codes may occur. Due to such changes, the findings of this report may be invalidated wholly or in part by changes beyond our control. Therefore, this report should not be relied upon after a period of two years without a review by us verifying the suitability of the conclusions and recommendations.

PROFESSIONAL STANDARD

In the performance of our professional services, we comply with that level of care and skill ordinarily exercised by members of our profession currently practicing under similar conditions and in the same locality. The client recognizes that subsurface conditions may vary from those encountered at the locations where our test pits, surveys, and explorations are made, and that our data, interpretations, and recommendations be based solely on the information obtained by us. We will be responsible for those data, interpretations, and recommendations, but shall not be responsible for the interpretations by others of the information developed. Our services consist of professional consultation and observation only, and no warranty of any kind whatsoever, express or implied, is made or intended in connection with the work performed or to be performed by us, or by our proposal for consulting or other services, or by our furnishing of oral or written reports or findings.

CLIENT'S RESPONSIBILITY

It is the client's responsibility, or its representatives, to ensure that the information and recommendations contained herein are brought to the attention of the structural engineer and architect for the project and incorporated into the project's plans and specifications. It is further their responsibility to take the necessary measures to insure that the contractor and his subcontractors carry out such recommendations during construction.

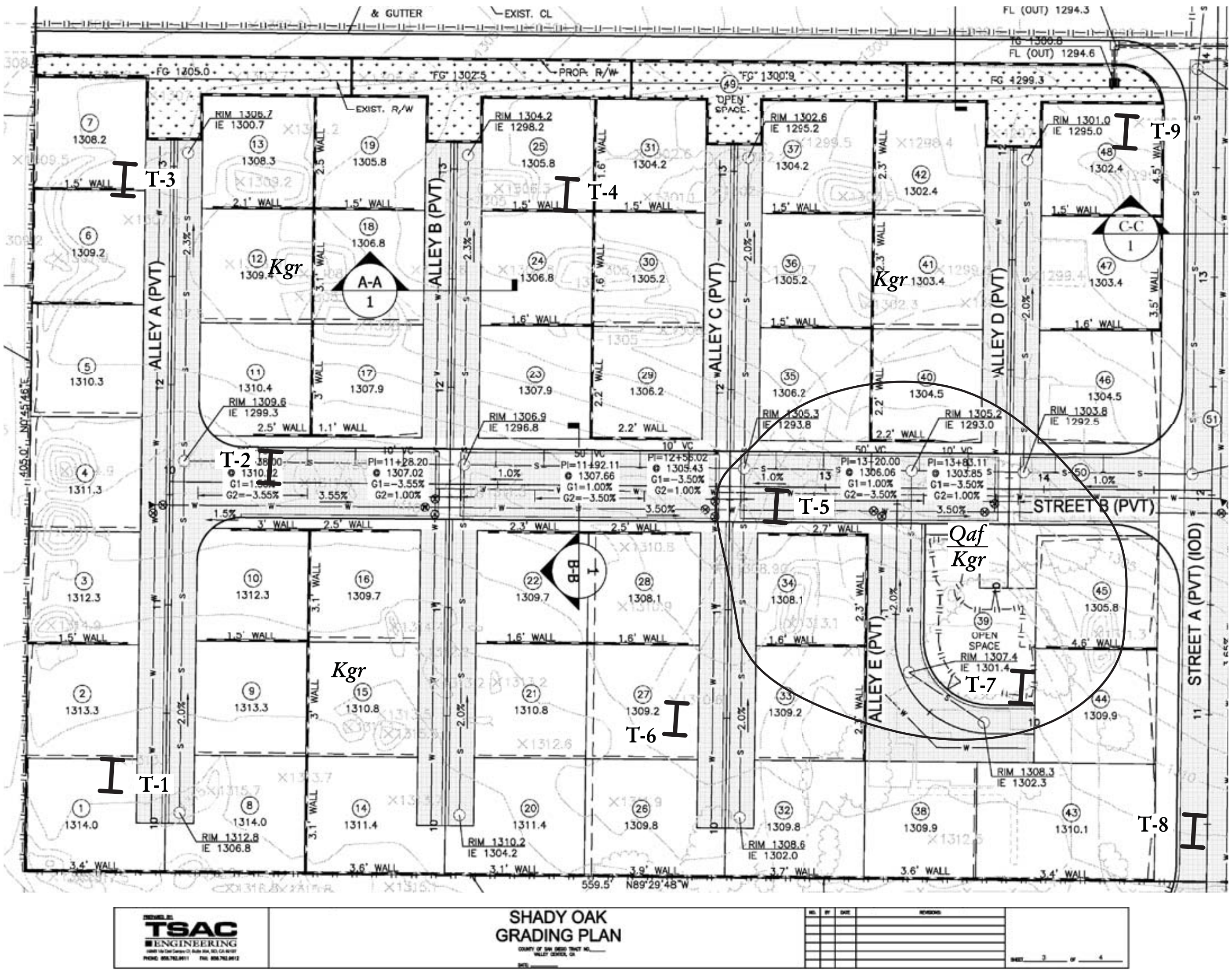
FIELD EXPLORATIONS

Nine subsurface explorations were made at the locations indicated on the site plans included herewith as Plate No. 1. These explorations consisted of test trenches excavated with a backhoe on August 5, 2015. The fieldwork was conducted by or under the observation of our engineering geology personnel.

The trenches were carefully logged when made. The trench logs are presented in the attached Appendix A. The soils are described in accordance with the Unified Soils Classification. In addition, a verbal textural description, the wet color, the apparent moisture and the density or consistency are provided. The density of granular soils is given as either very loose, loose, medium dense, dense or very dense. The consistency of silts or clays is given as either very soft, soft, medium stiff, stiff, very stiff, or hard. Undisturbed chunk samples and bulk samples of disturbed soil were collected and transported to the laboratory for testing.

LABORATORY TESTING

Laboratory tests were performed in accordance with the generally accepted American Society for Testing and Materials (ASTM) test methods or suggested procedures. A brief description of the tests performed and the subsequent results are presented in Appendix B.



W+E

0 50' 100'

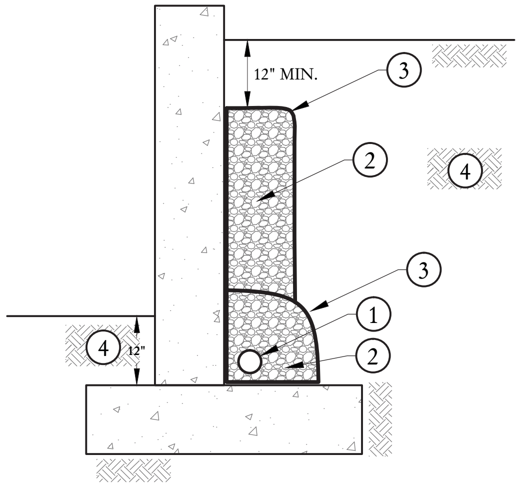
SCALE: 1" = 50'

CWE LEGEND	
T-9	APPROXIMATE TRENCH LOCATION
	APPROXIMATE GEOLOGIC CONTACT
Qaf / Kgr	ARTIFICIAL FILL OVER WEATHERED GRANITICS
Kgr	WEATHERED GRANITICS

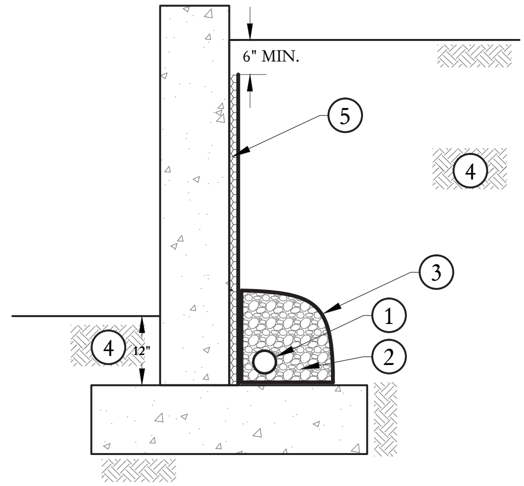
SITE PLAN AND GEOTECHNICAL MAP

SHADY OAK 27522 VALLEY CENTER ROAD VALLEY CENTER, CALIFORNIA			
DATE:	AUGUST 2016	JOB NO.:	2150438.01
BY:	SRD	PLATE NO.:	1

CHRISTIAN WHEELER ENGINEERING



1 DETAIL



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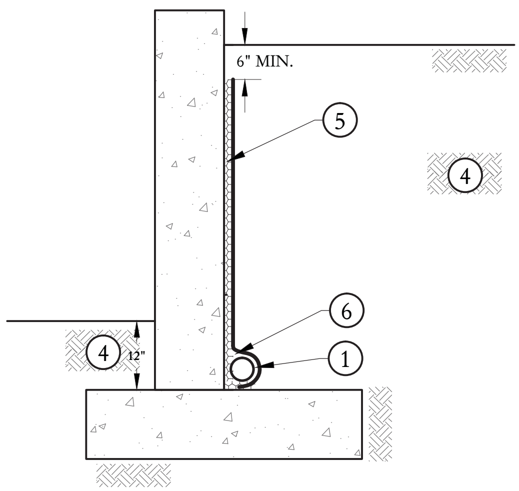
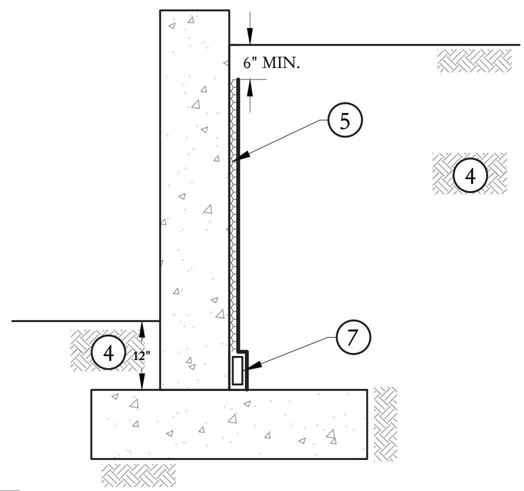


3 DETAIL



4 DETAIL

NOTES AND DETAILS

GENERAL NOTES:

1) THE NEED FOR WATERPROOFING SHOULD BE EVALUATED BY OTHERS.
2) WATERPROOFING TO BE DESIGNED BY OTHERS (CWE CAN PROVIDE A DESIGN IF REQUESTED).
3) EXTEND DRAIN TO SUITABLE DISCHARGE POINT PER CIVIL ENGINEER.
4) DO NOT CONNECT SURFACE DRAINS TO SUBDRAIN SYSTEM.

DETAILS:

1. 4-INCH PERFORATED PVC PIPE ON TOP OF FOOTING, HOLES POSITIONED DOWNWARD (SDR 35, SCHEDULE 40, OR EQUIVALENT).
2. ¾ INCH OPEN-GRADED CRUSHED AGGREGATE.
3. GEOFARBRIC WRAPPED COMPLETELY AROUND ROCK.
4. PROPERLY COMPACTED BACKFILL SOIL.
5. WALL DRAINAGE PANELS (MIRADRAIN OR EQUIVALENT) PLACED PER MANUFACTURER'S REC'S.
6. UNDERLAY SUBDRAIN WITH AND CUT FABRIC BACK FROM DRAINAGE PANELS AND WRAP FABRIC AROUND PIPE.
7. COLLECTION DRAIN (TOTAL DRAIN OR EQUIVALENT) LOCATED AT BASE OF WALL DRAINAGE PANEL PER MANUFACTURER'S RECOMMENDATIONS.

CANTILEVER RETAINING WALL DRAINAGE SYSTEMS	**SHADY OAK** 27522 VALLEY CENTER ROAD VALLEY CENTER, CALIFORNIA			CHRISTIAN WHEELER ENGINEERING
	DATE: AUGUST 2016		JOB NO.: 2150438.01	
	BY: SRD		PLATE NO.: 2	

Appendix A

Trench Logs

LOG OF TEST TRENCH T-1

Sample Type and Laboratory Test Legend

Cal	Modified California Sampler	CK	Chunk Density
SPT	Standard Penetration Test	DR	Density Ring
ST	Shelby Tube		
MD	Max Density	DS	Direct Shear
SO4	Soluble Sulfates	Con	Consolidation
SA	Sieve Analysis	EI	Expansion Index
HA	Hydrometer	R-Val	Resistance Value
SE	Sand Equivalent	Chl	Soluble Chlorides
PI	Plasticity Index	Res	pH & Resistivity
CP	Collapse Potential		

Date Logged:	8/5/15	Equipment:	Case 580L Backhoe
Logged By:	DJF	Auger Type:	N/A
Existing Elevation:	1314 feet	Drive Type:	18-inch Bucket
Finish Elevation:	1314 feet	Depth to Water:	N/A

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS SYMBOL	SUMMARY OF SUBSURFACE CONDITIONS (based on Unified Soil Classification System)	PENETRATION (blows per foot)	SAMPLE TYPE	BULK	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	RELATIVE COMPACTION (%)	LABORATORY TESTS
0–2			SM	**Topsoil:** Brown, dry, loose, fine- to medium-grained, SILTY SAND; porous with rootlets.		CK		5.4	107.5		
2–3			SM	**Subsoil:** Brown to reddish-brown, moist, medium dense, SILTY SAND with trace CLAY; slightly porous.		CK		5.6	122.4		
3–5			SW-SM	**Weathered Granitic (Kgr):** Reddish-brown to light grayish-brown, damp, very dense, fine- to coarse-grained, WELL-GRADED SAND with SILT.		CK		2.4	136.9		
5				Test trench terminated at 5 feet. No groundwater or seepage encountered.							

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

Notes:

Symbol Legend

- Groundwater Level During Drilling
- Groundwater Level After Drilling
- Apparent Seepage
- * No Sample Recovery
- ** Non-Representative Blow Count (rocks present)

SHADY OAK
27522 VALLEY CENTER ROAD
VALLEY CENTER, CALIFORNIA

DATE:	AUGUST 2016	JOB NO.:	2150438
BY:	SRD	FIGURE NO.:	A-1

CHRISTIAN WHEELER ENGINEERING

LOG OF TEST TRENCH T-2

Sample Type and Laboratory Test Legend

Cal	Modified California Sampler	CK	Chunk Density
SPT	Standard Penetration Test	DR	Density Ring
ST	Shelby Tube		
MD	Max Density	DS	Direct Shear
SO4	Soluble Sulfates	Con	Consolidation
SA	Sieve Analysis	EI	Expansion Index
HA	Hydrometer	R-Val	Resistance Value
SE	Sand Equivalent	Chl	Soluble Chlorides
PI	Plasticity Index	Res	pH & Resistivity
CP	Collapse Potential		

Date Logged:	8/5/15	Equipment:	Case 580L Backhoe
Logged By:	DJF	Auger Type:	N/A
Existing Elevation:	1310 feet	Drive Type:	18-inch Bucket
Finish Elevation:	1310 feet	Depth to Water:	N/A

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS SYMBOL	SUMMARY OF SUBSURFACE CONDITIONS (based on Unified Soil Classification System)	PENETRATION (blows per foot)	SAMPLE TYPE	BULK	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	RELATIVE COMPACTION (%)	LABORATORY TESTS
0			SM	**Topsoil:** Brown, dry, loose, fine- to medium-grained, SILTY SAND; porous with rootlets.							
2			SM	**Weathered Granitics (Kgr):** Light grayish-brown to reddish-brown, damp, dense, fine- to medium-grained, SILTY SAND; moderately weathered.							R-Val
5				Test trench terminated at 5 feet. No groundwater or seepage encountered.							

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Notes:

Symbol Legend

- ∇ Groundwater Level During Drilling
- ▼ Groundwater Level After Drilling
- Apparent Seepage
- * No Sample Recovery
- ** Non-Representative Blow Count (rocks present)

SHADY OAK
27522 VALLEY CENTER ROAD
VALLEY CENTER, CALIFORNIA

DATE:	AUGUST 2016	JOB NO.:	2150438
BY:	SRD	FIGURE NO.:	A-2

CHRISTIAN WHEELER
ENGINEERING

LOG OF TEST TRENCH T-3

Date Logged:	8/5/15	Equipment:	Case 580L Backhoe
Logged By:	DJF	Auger Type:	N/A
Existing Elevation:	1309 feet	Drive Type:	18-inch Bucket
Finish Elevation:	1308 feet	Depth to Water:	N/A

Sample Type and Laboratory Test Legend

Cal	Modified California Sampler	CK	Chunk Density
SPT	Standard Penetration Test	DR	Density Ring
ST	Shelby Tube		
MD	Max Density	DS	Direct Shear
SO4	Soluble Sulfates	Con	Consolidation
SA	Sieve Analysis	EI	Expansion Index
HA	Hydrometer	R-Val	Resistance Value
SE	Sand Equivalent	Chl	Soluble Chlorides
PI	Plasticity Index	Res	pH & Resistivity
CP	Collapse Potential		

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS SYMBOL	SUMMARY OF SUBSURFACE CONDITIONS (based on Unified Soil Classification System)	PENETRATION (blows per foot)	SAMPLE TYPE	BULK	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	RELATIVE COMPACTION (%)	LABORATORY TESTS
0–2			SM	**Topsoil:** Brown, dry, loose, fine- to medium-grained, SILTY SAND with gravels; porous.							
2–3.5			SC	**Subsoil:** Brown, damp, medium dense, fine- to medium-grained, CLAYEY SAND with gravels.		CK		5.8	121.6		
3.5–6			SW-SM	**Weathered Granitics (Kgr):** Light grayish-brown to reddish-brown, damp, very dene, fine- to coarse-grained, WELL-GRADED SAND with SILT.							
6				Test trench terminated at 6 feet. No groundwater or seepage encountered.							

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

Notes:

Symbol Legend

- Groundwater Level During Drilling
- Groundwater Level After Drilling
- Apparent Seepage
- * No Sample Recovery
- ** Non-Representative Blow Count (rocks present)

SHADY OAK
27522 VALLEY CENTER ROAD
VALLEY CENTER, CALIFORNIA

DATE:	AUGUST 2016	JOB NO.:	2150438
BY:	SRD	FIGURE NO.:	A-3

CHRISTIAN WHEELER ENGINEERING

LOG OF TEST TRENCH T-4

Date Logged:	8/5/15	Equipment:	Case 580L Backhoe
Logged By:	DJF	Auger Type:	N/A
Existing Elevation:	1302 feet	Drive Type:	18-inch Bucket
Finish Elevation:	1305 feet	Depth to Water:	N/A

Sample Type and Laboratory Test Legend

Cal	Modified California Sampler	CK	Chunk Density
SPT	Standard Penetration Test	DR	Density Ring
ST	Shelby Tube		
MD	Max Density	DS	Direct Shear
SO4	Soluble Sulfates	Con	Consolidation
SA	Sieve Analysis	EI	Expansion Index
HA	Hydrometer	R-Val	Resistance Value
SE	Sand Equivalent	Chl	Soluble Chlorides
PI	Plasticity Index	Res	pH & Resistivity
CP	Collapse Potential		

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS SYMBOL	SUMMARY OF SUBSURFACE CONDITIONS (based on Unified Soil Classification System)	PENETRATION (blows per foot)	SAMPLE TYPE	BULK	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	RELATIVE COMPACTION (%)	LABORATORY TESTS
0–2.5			SM	**Topsoil:** Brown, dry, loose, fine- to medium-grained, SILTY SAND; porous with rootlets.		CK		7.6	99.8		
2.5–4			SC	**Subsoil:** Brown, moist, medium dense, very fine- to medium-grained, CLAYEY SAND with clay and gravels.		CK		8.5	124.3		SA EI MD SO4 DS
4–6			SW-SM	**Weathered Granitics (Kgr):** Light grayish-brown to reddish-brown, damp, very dene, fine- to coarse-grained, WELL-GRADED SAND with SILT.		CK		3.2	140.0		SA MD DS
6				Test trench terminated at 6 feet. No groundwater or seepage encountered.							

Depth scale: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Notes:

Symbol Legend

- Groundwater Level During Drilling
- Groundwater Level After Drilling
- Apparent Seepage
- * No Sample Recovery
- ** Non-Representative Blow Count (rocks present)

SHADY OAK
27522 VALLEY CENTER ROAD
VALLEY CENTER, CALIFORNIA

DATE:	AUGUST 2016	JOB NO.:	2150438
BY:	SRD	FIGURE NO.:	A-4

CHRISTIAN WHEELER ENGINEERING

LOG OF TEST TRENCH T-5

Date Logged:	8/5/15	Equipment:	Case 580L Backhoe
Logged By:	DJF	Auger Type:	N/A
Existing Elevation:	1305 feet	Drive Type:	18-inch Bucket
Finish Elevation:	1306 feet	Depth to Water:	N/A

Sample Type and Laboratory Test Legend

Cal	Modified California Sampler	CK	Chunk Density
SPT	Standard Penetration Test	DR	Density Ring
ST	Shelby Tube		
MD	Max Density	DS	Direct Shear
SO4	Soluble Sulfates	Con	Consolidation
SA	Sieve Analysis	EI	Expansion Index
HA	Hydrometer	R-Val	Resistance Value
SE	Sand Equivalent	Chl	Soluble Chlorides
PI	Plasticity Index	Res	pH & Resistivity
CP	Collapse Potential		

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS SYMBOL	SUMMARY OF SUBSURFACE CONDITIONS (based on Unified Soil Classification System)	PENETRATION (blows per foot)	SAMPLE TYPE	BULK	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	RELATIVE COMPACTION (%)	LABORATORY TESTS
0			SM	**Artificial Fill (Qaf):** Brown to gryaish-brown, damp, loose to medium dense, fine- to medium-grained, SILTY SAND with AC debris and gravels.							R-Val
2						CK		4.4	130.4		
2.5			SC	**Topsoil:** Brown, damp, loose, fine- to medium-grained, SILTY SAND; porous with rootlets.							
4			SW-SM	**Weathered Granitics (Kgr):** Reddish-brown to grayish-brown, damp, very dense, fine- to coarse-grained, WELL-GRADED SAND with SILT.							
6				Test trench terminated at 6 feet. No groundwater or seepage encountered.							

Depth scale: 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Notes:

Symbol Legend

- Groundwater Level During Drilling
- Groundwater Level After Drilling
- Apparent Seepage
- * No Sample Recovery
- ** Non-Representative Blow Count (rocks present)

SHADY OAK
27522 VALLEY CENTER ROAD
VALLEY CENTER, CALIFORNIA

DATE:	AUGUST 2016	JOB NO.:	2150438
BY:	SRD	FIGURE NO.:	A-5

CHRISTIAN WHEELER
ENGINEERING

LOG OF TEST TRENCH T-6

Sample Type and Laboratory Test Legend

Cal	Modified California Sampler	CK	Chunk Density
SPT	Standard Penetration Test	DR	Density Ring
ST	Shelby Tube		
MD	Max Density	DS	Direct Shear
SO4	Soluble Sulfates	Con	Consolidation
SA	Sieve Analysis	EI	Expansion Index
HA	Hydrometer	R-Val	Resistance Value
SE	Sand Equivalent	Chl	Soluble Chlorides
PI	Plasticity Index	Res	pH & Resistivity
CP	Collapse Potential		

Date Logged:	8/5/15	Equipment:	Case 580L Backhoe
Logged By:	DJF	Auger Type:	N/A
Existing Elevation:	1306 feet	Drive Type:	18-inch Bucket
Finish Elevation:	1309 feet	Depth to Water:	N/A

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS SYMBOL	SUMMARY OF SUBSURFACE CONDITIONS (based on Unified Soil Classification System)	PENETRATION (blows per foot)	SAMPLE TYPE	BULK	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	RELATIVE COMPACTION (%)	LABORATORY TESTS
0			SM	**Topsoil:** Light brown, damp, loose, fine- to medium-grained, SILTY SAND; porous.							
2			SC	**Subsoil:** Light grayish-brown to reddish-brown, damp, medium dense, CLAYEY SAND with gravels.							
3			SW-SM	**Weathered Granitics (Kgr):** Light grayish-brown, damp, very dense, fine- to coarse-grained, WELL-GRADED SAND with SILT.							
4½				Practical refusal at 4½ feet . No groundwater or seepage encountered.							

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

Notes:

Symbol Legend

- Groundwater Level During Drilling
- Groundwater Level After Drilling
- Apparent Seepage
- * No Sample Recovery
- ** Non-Representative Blow Count (rocks present)

SHADY OAK
27522 VALLEY CENTER ROAD
VALLEY CENTER, CALIFORNIA

DATE:	AUGUST 2016	JOB NO.:	2150438
BY:	SRD	FIGURE NO.:	A-6

CHRISTIAN WHEELER
ENGINEERING

LOG OF TEST TRENCH T-7

Date Logged:	8/5/15	Equipment:	Case 580L Backhoe
Logged By:	DJF	Auger Type:	N/A
Existing Elevation:	1311 feet	Drive Type:	18-inch Bucket
Finish Elevation:	1307 feet	Depth to Water:	N/A

Sample Type and Laboratory Test Legend

Cal	Modified California Sampler	CK	Chunk Density
SPT	Standard Penetration Test	DR	Density Ring
ST	Shelby Tube		
MD	Max Density	DS	Direct Shear
SO4	Soluble Sulfates	Con	Consolidation
SA	Sieve Analysis	EI	Expansion Index
HA	Hydrometer	R-Val	Resistance Value
SE	Sand Equivalent	Chl	Soluble Chlorides
PI	Plasticity Index	Res	pH & Resistivity
CP	Collapse Potential		

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS SYMBOL	SUMMARY OF SUBSURFACE CONDITIONS (based on Unified Soil Classification System)	PENETRATION (blows per foot)	SAMPLE TYPE	BULK	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	RELATIVE COMPACTION (%)	LABORATORY TESTS
0			SM	**Artificial Fill (Qaf):** Light grayish-brown, dry, loose, very fine- to medium-grained, SILTY SAND with gravel and trace AC debris.							
2			SM	**Topsoil:** Brown, damp, loose, very fine- to medium-grained, SILTY SAND; porous.							
3			SW-SM	**Weathered Granitics (Kgr):** Light grayish-brown to reddish-brown, damp, very dense, very fine- to coarse-grained, WELL-GRADED SAND with SILT.							
5				Test trench terminated at 5 feet . No groundwater or seepage encountered.							

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

Notes:

Symbol Legend

- Groundwater Level During Drilling
- Groundwater Level After Drilling
- Apparent Seepage
- * No Sample Recovery
- ** Non-Representative Blow Count (rocks present)

SHADY OAK
27522 VALLEY CENTER ROAD
VALLEY CENTER, CALIFORNIA

DATE:	AUGUST 2016	JOB NO.:	2150438
BY:	SRD	FIGURE NO.:	A-7

CHRISTIAN WHEELER
ENGINEERING

LOG OF TEST TRENCH T-8

Sample Type and Laboratory Test Legend

Cal	Modified California Sampler	CK	Chunk Density
SPT	Standard Penetration Test	DR	Density Ring
ST	Shelby Tube		
MD	Max Density	DS	Direct Shear
SO4	Soluble Sulfates	Con	Consolidation
SA	Sieve Analysis	EI	Expansion Index
HA	Hydrometer	R-Val	Resistance Value
SE	Sand Equivalent	Chl	Soluble Chlorides
PI	Plasticity Index	Res	pH & Resistivity
CP	Collapse Potential		

Date Logged:	8/5/15	Equipment:	Case 580L Backhoe
Logged By:	DJF	Auger Type:	N/A
Existing Elevation:	1311 feet	Drive Type:	18-inch Bucket
Finish Elevation:	1310 feet	Depth to Water:	N/A

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS SYMBOL	SUMMARY OF SUBSURFACE CONDITIONS (based on Unified Soil Classification System)	PENETRATION (blows per foot)	SAMPLE TYPE	BULK	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	RELATIVE COMPACTION (%)	LABORATORY TESTS
0			SM	**Topsoil:** Brown, dry, very loose, very fine- to medium grained, SILTY SAND; porous.							
1			SM	**Subsoil:** Brown, damp, medium dense, very fine- to medium-grained, SILTY SAND with CLAY; slightly porous.		CK		5.7	116.7		
2			SW-SM	**Weathered Granitics (Kgr):** Light grayish-brown to reddish-brown, damp, very dense, fine- to coarse-grained, SILTY SAND; moderately weathered.		CK		2.2	146.9		
3											
4											
5				Test trench terminated at 5 feet . No groundwater or seepage encountered.							
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											

Notes:

Symbol Legend

- ∇ Groundwater Level During Drilling
- ▼ Groundwater Level After Drilling
- Apparent Seepage
- * No Sample Recovery
- ** Non-Representative Blow Count (rocks present)

SHADY OAK
27522 VALLEY CENTER ROAD
VALLEY CENTER, CALIFORNIA

DATE:	AUGUST 2016	JOB NO.:	2150438
BY:	SRD	FIGURE NO.:	A-8

CHRISTIAN WHEELER
ENGINEERING

LOG OF TEST TRENCH T-9

Sample Type and Laboratory Test Legend

Cal	Modified California Sampler	CK	Chunk Density
SPT	Standard Penetration Test	DR	Density Ring
ST	Shelby Tube		
MD	Max Density	DS	Direct Shear
SO4	Soluble Sulfates	Con	Consolidation
SA	Sieve Analysis	EI	Expansion Index
HA	Hydrometer	R-Val	Resistance Value
SE	Sand Equivalent	Chl	Soluble Chlorides
PI	Plasticity Index	Res	pH & Resistivity
CP	Collapse Potential		

Date Logged:	8/5/15	Equipment:	Case 580L Backhoe
Logged By:	DJF	Auger Type:	N/A
Existing Elevation:	1296 feet	Drive Type:	18-inch Bucket
Finish Elevation:	1302 feet	Depth to Water:	N/A

DEPTH (ft)	ELEVATION (ft)	GRAPHIC LOG	USCS SYMBOL	SUMMARY OF SUBSURFACE CONDITIONS (based on Unified Soil Classification System)	PENETRATION (blows per foot)	SAMPLE TYPE	BULK	MOISTURE CONTENT (%)	DRY DENSITY (pcf)	RELATIVE COMPACTION (%)	LABORATORY TESTS
0			SM	**Topsoil:** Brown, dry, vloose, very fine- to medium-grained, SILTY SAND; porous with rootlets.							
2			SM	**Subsoil:** Brown, damp, medium dense, SILTY SAND with CLAY and gravels.							
3			SW-SM	**Weathered Granitics (Kgr):** Light grayish-brown to reddish-brown, damp, very dense, fine- to coarse-grained, WELL-GRADED SAND with SILT.							
5				Test trench terminated at 5 feet . No groundwater or seepage encountered.							

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

Notes:

Symbol Legend

- Groundwater Level During Drilling
- Groundwater Level After Drilling
- Apparent Seepage
- * No Sample Recovery
- ** Non-Representative Blow Count (rocks present)

SHADY OAK
27522 VALLEY CENTER ROAD
VALLEY CENTER, CALIFORNIA

DATE:	AUGUST 2016	JOB NO.:	2150438
BY:	SRD	FIGURE NO.:	A-9

CHRISTIAN WHEELER ENGINEERING

Appendix B

Laboratory Test Results

Laboratory tests were performed in accordance with the generally accepted American Society for Testing and Materials (ASTM) test methods or suggested procedures. Brief descriptions of the tests performed are presented below:

a) **CLASSIFICATION:** Field classifications were verified in the laboratory by visual examination. The final soil classifications are in accordance with the Unified Soil Classification System and are presented on the exploration logs in Appendix A.

b) **MOISTURE-DENSITY:** In-place moisture contents and dry densities were determined for representative soil samples. This information was an aid to classification and permitted recognition of variations in material consistency with depth. The dry unit weight is determined in pounds per cubic foot, and the in-place moisture content is determined as a percentage of the soil's dry weight. The results of these tests are summarized in the exploration logs presented in Appendix A.

c) **DIRECT SHEAR:** Direct shear tests were performed to determine the failure envelope of selected soils based on yield shear strength. The shear box was designed to accommodate a sample having a diameter of 2.375 inches or 2.50 inches and a height of 1.0 inch. Samples were tested at different vertical loads and a saturated moisture content. The shear stress was applied at a constant rate of strain of approximately 0.05 inch per minute.

d) **EXPANSION INDEX TEST:** The expansion index of a selected soil was determined in accordance with ASTM D4829. A 1-inch-thick by 4-inch-diameter specimen was prepared by compacting the soil with a specified energy at approximately 50 percent saturation. The specimen was placed in a consolidometer with porous stones at the top and bottom and a total normal pressure of 144.7 psf was applied. The specimen was allowed to consolidate for a period of 10 minutes and then saturated. The change in vertical movement was recorded until the rate of expansion became nominal.

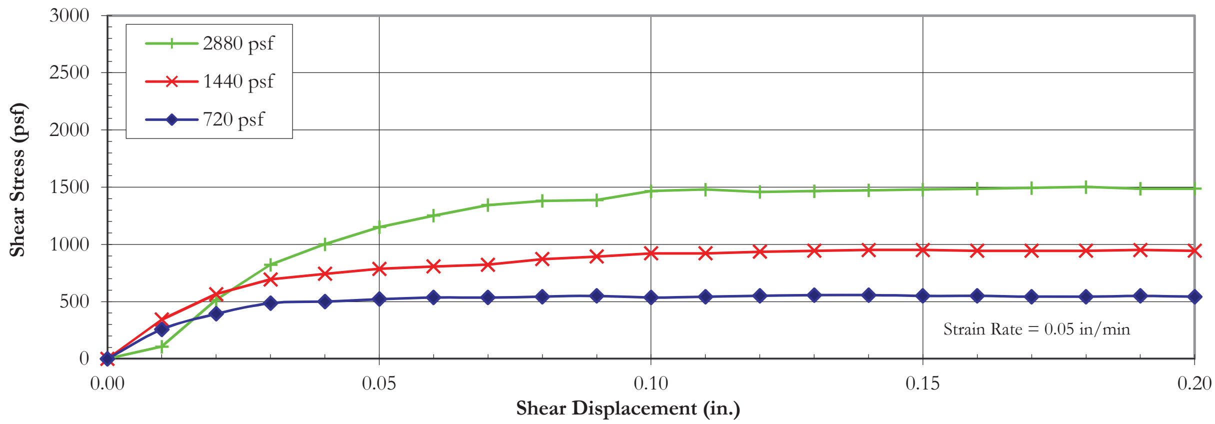
e) **GRAIN SIZE DISTRIBUTION:** The grain size distributions of selected samples were determined in accordance with ASTM C136 and/or ASTM D422.

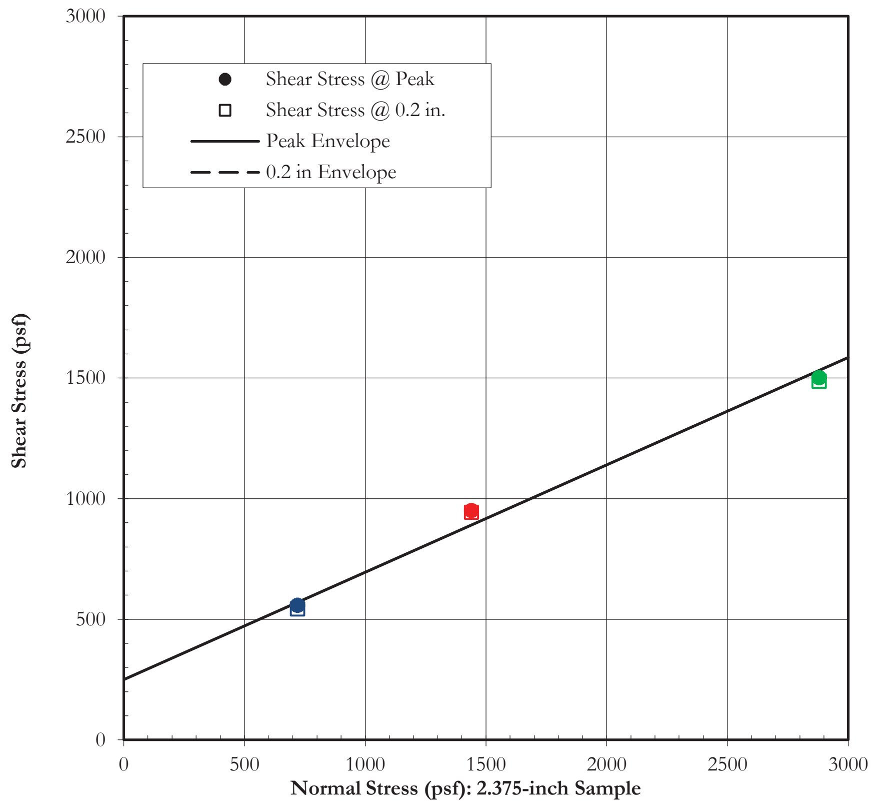
f) **MAXIMUM DENSITY & OPTIMUM MOISTURE CONTENT:** The maximum dry density and optimum moisture content of typical soils were determined in the laboratory in accordance with ASTM Standard Test D-1557, Method A.

g) **RESISTANCE VALUE:** The R-Value was determined for one or more samples of soil likely to be present at the subgrade level. The R-Value was determined in accordance with California Test Method 301.

h) **SOLUBLE SULFATES:** The soluble sulfate content was determined for samples of soil likely to be present at the foundation level. The soluble sulfate content was determined in accordance with California Test Method 417.

DIRECT SHEAR TEST (ASTM D3080)





Sample No. T-4 @ 2½'-4'

Sample Type: Remolded to 90%

Normal Stress (psf)	**720**	**1440**	**2880**
Peak Shear Stress (psf)	558	951	1502
Shear Stress at 0.2 in (psf)	543	944	1487
Initial Dry Density (pcf)	105.0	105.0	105.0
Initial Moisture Content (%)	11.9	11.9	11.9

	Peak	**at 0.2 in Displacement**
Friction Angle, ϕ (deg):	24	
Cohesion Intercept, c (psf):	250	

CHRISTIAN WHEELER
ENGINEERING

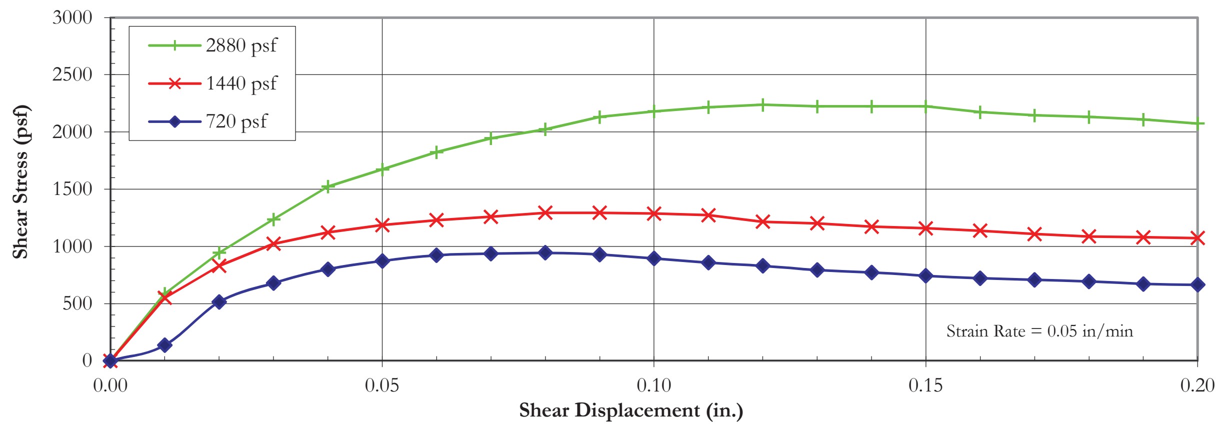
LABORATORY TEST RESULTS

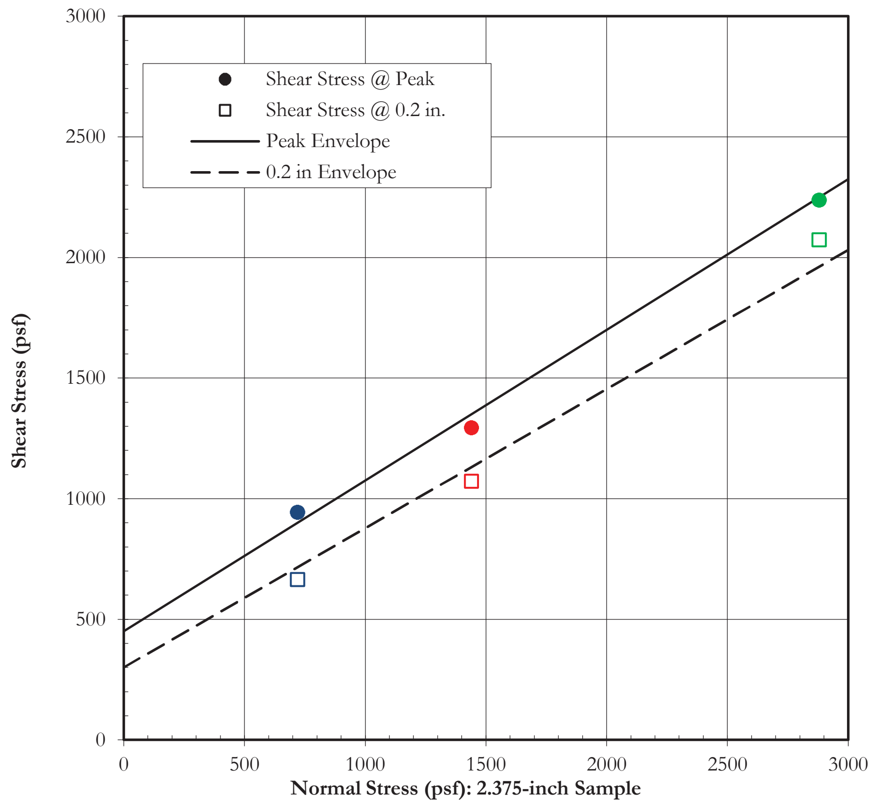
SHADY OAK
27522 VALLEY CENTER ROAD
VALLEY CENTER, CALIFORNIA

FIGURE: **B-2**

BY: SCC	DATE: AUGUST 2016	REPORT NO: 2150438.01

DIRECT SHEAR TEST (ASTM D3080)





Sample No. T-4 @ 4'-6'

Sample Type: Remolded to 90%

Normal Stress (psf)	**720**	**1440**	**2880**
Peak Shear Stress (psf)	944	1294	2238
Shear Stress at 0.2 in (psf)	665	1073	2074
Initial Dry Density (pcf)	118.0	118.0	118.0
Initial Moisture Content (%)	8.6	8.6	8.6

	Peak	**at 0.2 in Displacement**
Friction Angle, ϕ (deg):	32	30
Cohesion Intercept, c (psf):	450	300

CHRISTIAN WHEELER ENGINEERING

LABORATORY TEST RESULTS

SHADY OAK
27522 VALLEY CENTER ROAD
VALLEY CENTER, CALIFORNIA

FIGURE: **B-3**

BY: SCC | DATE: AUGUST 2016 | REPORT NO: 2150438.01

EXPANSION INDEX (ASTM D2849)

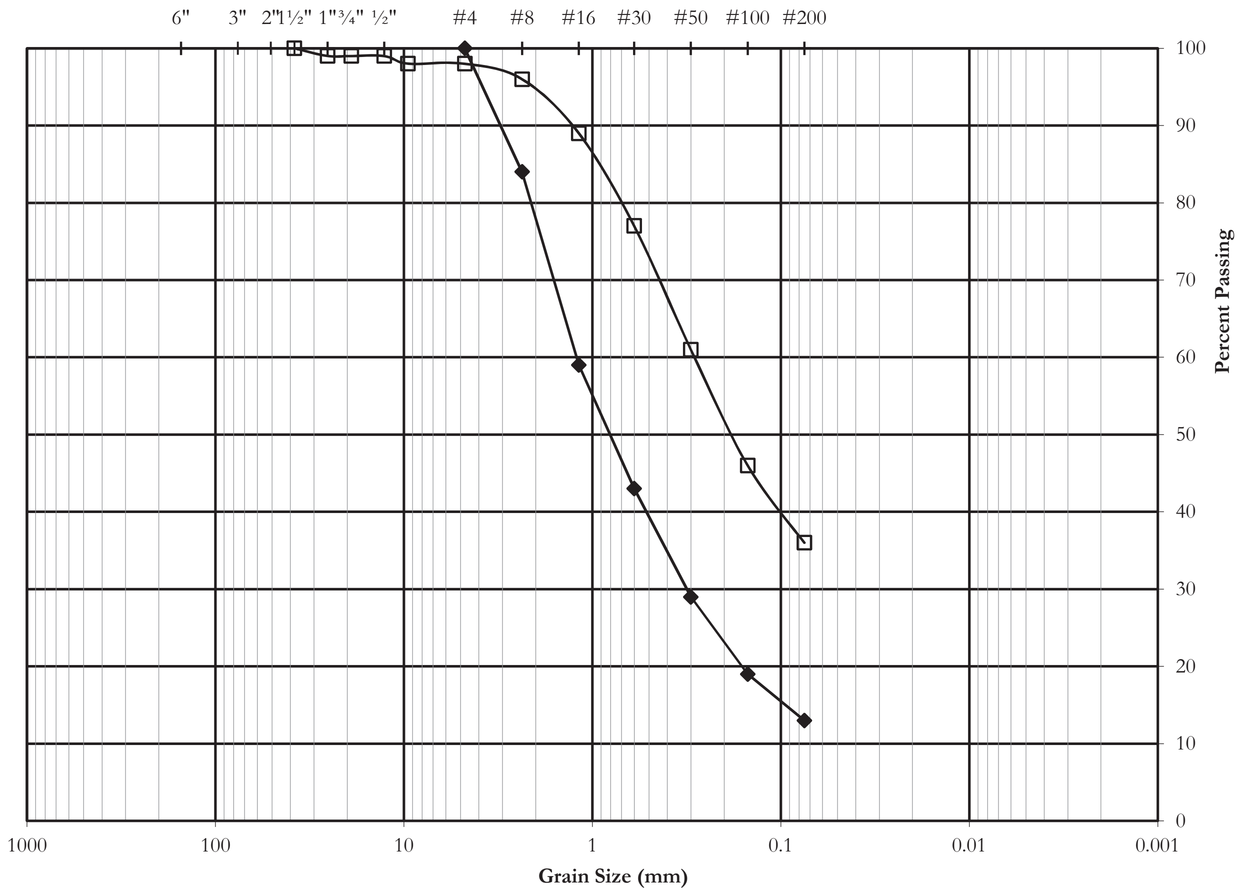
Sample No.	Initial Moisture (%)	Initial Dry Density (pcf)	Final Moisture (%)	Expansion Index	Expansion Potential
T-4 @ 2½'-4'	10.1	107.6	21.7	35	Low

CLASSIFICATION OF EXPANSION POTENTIAL

Expansion Index	Expansion Potential
1-20	Very Low
21-50	Low
51-90	Medium
91-130	High
> 130	Very High

GRAIN SIZE DISTRIBUTION (ASTM D422)

Cobble	Gravel		Sand			Silt and Clay
	Coarse	Fine	Coarse	Medium	Fine	



Symbol	Sample No.	Liquid Limit	Plastic Limit	Plasticity Index	D_{10}	D_{30}	D_{60}	C_u	C_c	USCS
□	**T-4 @ 2½'-4'**									SC
♦	**T-4 @ 4'-6'**									SM

CHRISTIAN WHEELER
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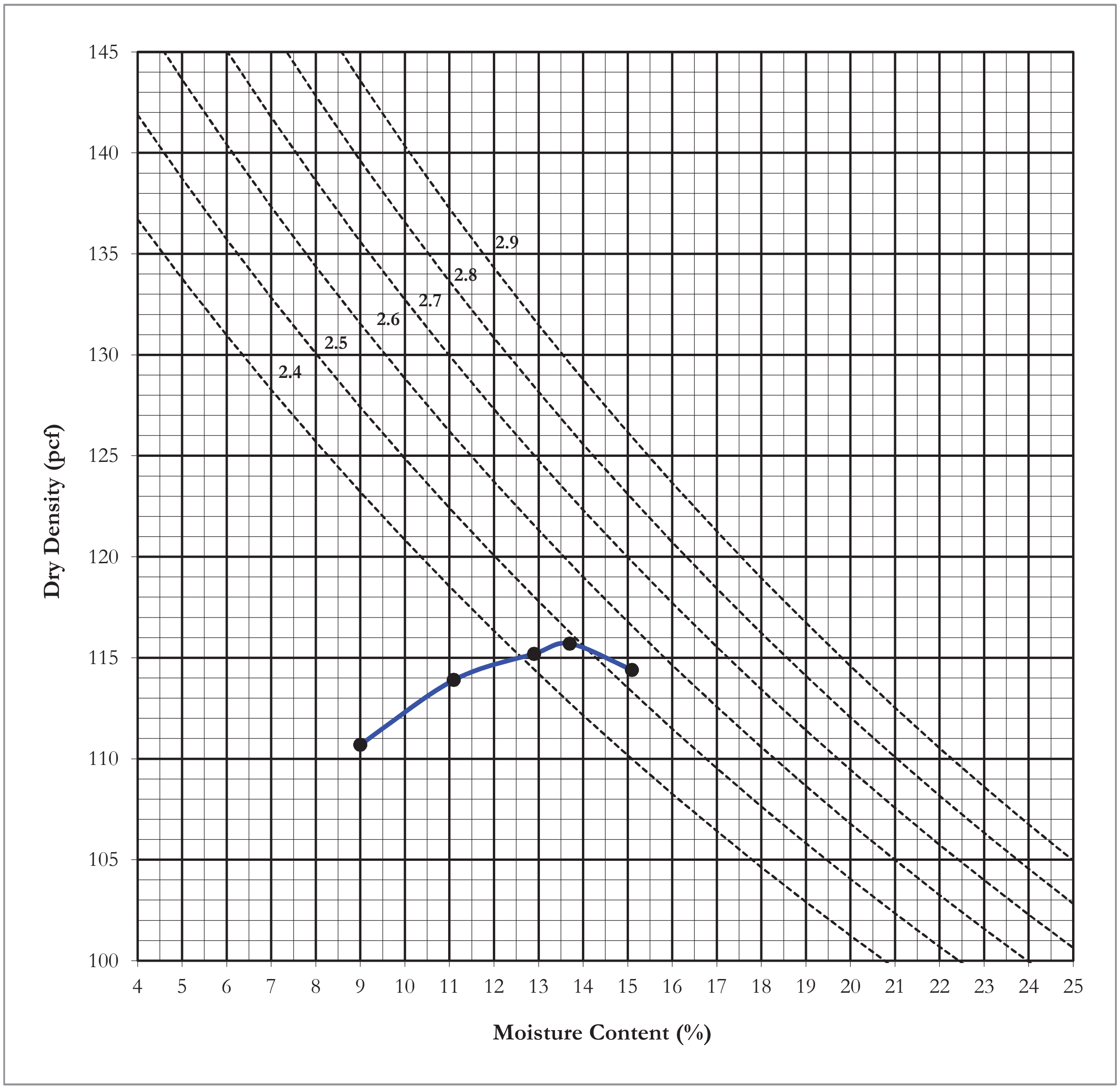
LABORATORY TEST RESULTS

SHADY OAK
27522 VALLEY CENTER ROAD
VALLEY CENTER, CALIFORNIA

FIGURE: **B-5**

BY: SCC | DATE: AUGUST 2016 | REPORT NO: 2150438.01

MAXIMUM DENSITY AND OPTIMUM MOISTURE CONTENT (ASTM D1557)

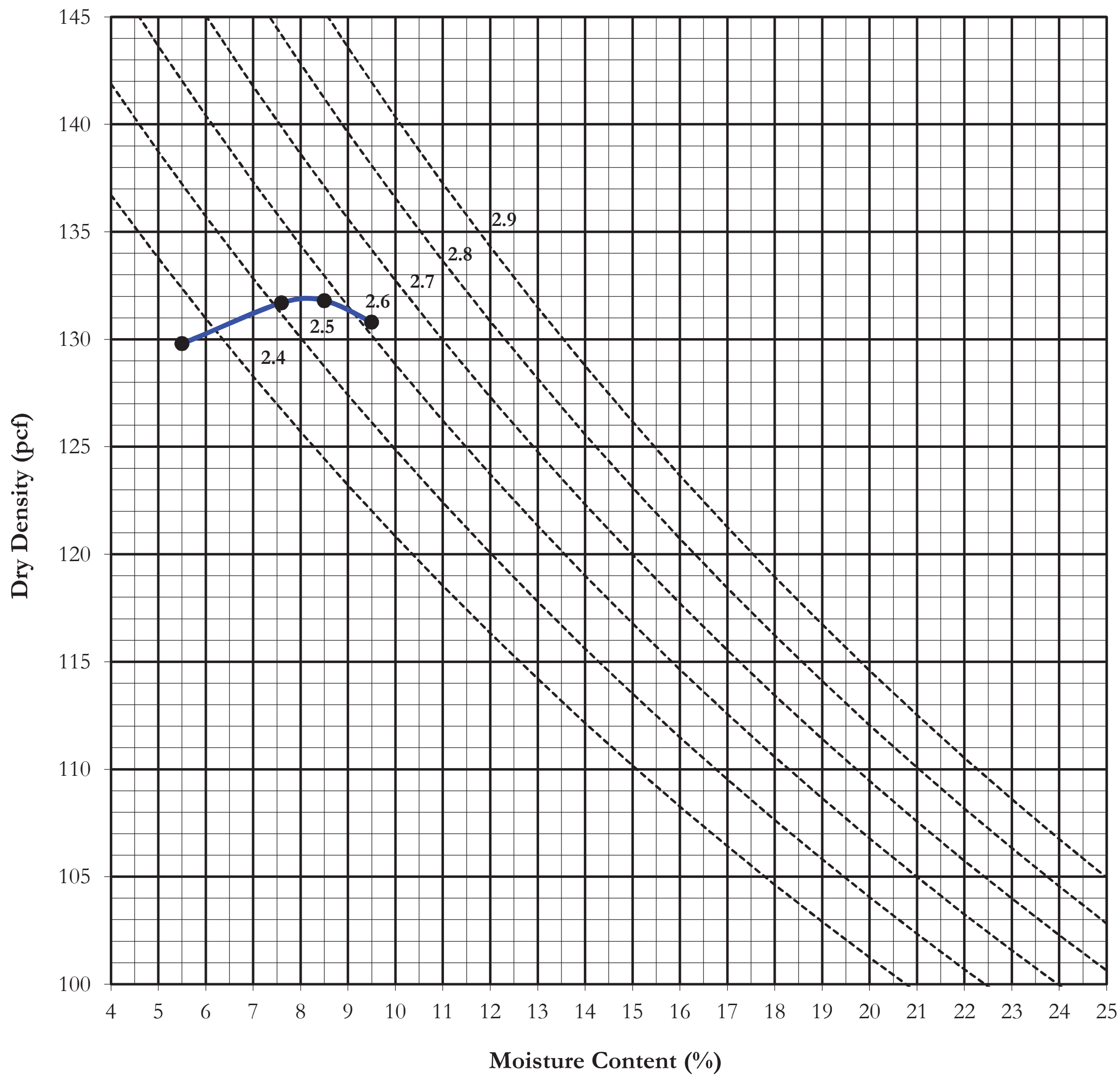


Sample No	Sample Description	Method	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
T-4 @ 2½'-4'	Reddish-brown, clayey sand	A	115.7	13.7

CHRISTIAN WHEELER ENGINEERING

LABORATORY TEST RESULTS		
SHADY OAK 27522 VALLEY CENTER ROAD VALLEY CENTER, CALIFORNIA		FIGURE: **B-6**
BY: SCC	DATE: AUGUST 2016	REPORT NO: 2150438.01

MAXIMUM DENSITY AND OPTIMUM MOISTURE CONTENT (ASTM D1557)



Sample No	Sample Description	Method	Maximum Dry Density (pcf)	Optimum Moisture Content (%)
T-4 @ 4'-6'	Reddish- to grayish-brown, silty sand	A	131.8	8.5

CHRISTIAN WHEELER ENGINEERING

LABORATORY TEST RESULTS

SHADY OAK
27522 VALLEY CENTER ROAD
VALLEY CENTER, CALIFORNIA

FIGURE: **B-7**

BY: SCC | DATE: AUGUST 2016 | REPORT NO: 2150438.01

RESISTANCE VALUE (CALTEST 301)

Sample No.	Sample Description	R-Value
T-2 @ 2'-5'	Reddish- to grayish-brown, silty sand	69
T-5 @ 0-2½'	Grayish-brown, silty sand	32

CHRISTIAN WHEELER
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LABORATORY TEST RESULTS

SHADY OAK
27522 VALLEY CENTER ROAD
VALLEY CENTER, CALIFORNIA

FIGURE: **B-8**

BY: SCC | DATE: AUGUST 2016 | REPORT NO: 2150438.01

CORROSIVITY TESTS

Sample No.	CALTEST 417	CALTEST 643		CALTEST 422
	Sulfate Content (% SO_4)	pH	Resistivity (ohm-cm)	Chloride Content (ppm)
T-4 @ 2½'-4'	0.016	--	--	--

Appendix C

References

REFERENCES

California Division of Mines and Geology, 1998, Maps of Known Active Fault Near Source-Zones in California and Adjacent Portions of Nevada

Hart, E. W. and Bryant, W. A., 1997, Fault-Rupture Hazard Zones in California; California Division of Mines and Geology Special Publication 42

Kennedy, M.P. and others, 1975, Character and Recency of Faulting, San Diego Metropolitan Area, California, California Division of Mines and Geology Special Report 123

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Tan, S.S., 1995, Landslide Hazards in the Northern Part of the San Diego Metropolitan Area, San Diego County, California, California Division of Mines and Geology Open-File Report 95-03.

U.S. Geological Survey, U.S. Seismic Design Maps Web Application, http://geohazards.usgs.gov/designmaps/us/application.php

U.S. Geological Survey, Quaternary Faults in Google Earth, http://earthquake.usgs.gov/hazards/qfaults/google.php

Appendix D

Recommended Grading Specifications – General Provisions

RECOMMENDED GRADING SPECIFICATIONS - GENERAL PROVISIONS

SHADY OAK
27522 VALLEY CENTER ROAD
VALLEY CENTER, CALIFORNIA

GENERAL INTENT

The intent of these specifications is to establish procedures for clearing, compacting natural ground, preparing areas to be filled, and placing and compacting fill soils to the lines and grades shown on the accepted plans. The recommendations contained in the preliminary geotechnical investigation report and/or the attached Special Provisions are a part of the Recommended Grading Specifications and shall supersede the provisions contained hereinafter in the case of conflict. These specifications shall only be used in conjunction with the geotechnical report for which they are a part. No deviation from these specifications will be allowed, except where specified in the geotechnical report or in other written communication signed by the Geotechnical Engineer.

OBSERVATION AND TESTING

Christian Wheeler Engineering shall be retained as the Geotechnical Engineer to observe and test the earthwork in accordance with these specifications. It will be necessary that the Geotechnical Engineer or his representative provide adequate observation so that he may provide his opinion as to whether or not the work was accomplished as specified. It shall be the responsibility of the contractor to assist the Geotechnical Engineer and to keep him appraised of work schedules, changes and new information and data so that he may provide these opinions. In the event that any unusual conditions not covered by the special provisions or preliminary geotechnical report are encountered during the grading operations, the Geotechnical Engineer shall be contacted for further recommendations.

If, in the opinion of the Geotechnical Engineer, substandard conditions are encountered, such as questionable or unsuitable soil, unacceptable moisture content, inadequate compaction, adverse weather, etc., construction should be stopped until the conditions are remedied or corrected or he shall recommend rejection of this work.

Tests used to determine the degree of compaction should be performed in accordance with the following American Society for Testing and Materials test methods:

Maximum Density & Optimum Moisture Content - ASTM D-1557
Density of Soil In-Place - ASTM D-1556 or ASTM D-6938

All densities shall be expressed in terms of Relative Compaction as determined by the foregoing ASTM testing procedures.

PREPARATION OF AREAS TO RECEIVE FILL

All vegetation, brush and debris derived from clearing operations shall be removed, and legally disposed of. All areas disturbed by site grading should be left in a neat and finished appearance, free from unsightly debris.

After clearing or benching the natural ground, the areas to be filled shall be scarified to a depth of 6 inches, brought to the proper moisture content, compacted and tested for the specified minimum degree of compaction. All loose soils in excess of 6 inches thick should be removed to firm natural ground which is defined as natural soil which possesses an in-situ density of at least 90 percent of its maximum dry density.

When the slope of the natural ground receiving fill exceeds 20 percent (5 horizontal units to 1 vertical unit), the original ground shall be stepped or benched. Benches shall be cut to a firm competent formational soil. The lower bench shall be at least 10 feet wide or 1-1/2 times the equipment width, whichever is greater, and shall be sloped back into the hillside at a gradient of not less than two (2) percent. All other benches should be at least 6 feet wide. The horizontal portion of each bench shall be compacted prior to receiving fill as specified herein for compacted natural ground. Ground slopes flatter than 20 percent shall be benched when considered necessary by the Geotechnical Engineer.

Any abandoned buried structures encountered during grading operations must be totally removed. All underground utilities to be abandoned beneath any proposed structure should be removed from within 10 feet of the structure and properly capped off. The resulting depressions from the above described procedure should be backfilled with acceptable soil that is compacted to the requirements of the Geotechnical Engineer. This includes, but is not limited to, septic tanks, fuel tanks, sewer lines or leach lines, storm drains and water lines. Any buried structures or utilities not to be abandoned should be brought to the attention of the Geotechnical Engineer so that he may determine if any special recommendation will be necessary.

All water wells which will be abandoned should be backfilled and capped in accordance to the requirements set forth by the Geotechnical Engineer. The top of the cap should be at least 4 feet below finish grade or 3 feet below the bottom of footing whichever is greater. The type of cap will depend on the diameter of the well and should be determined by the Geotechnical Engineer and/or a qualified Structural Engineer.

FILL MATERIAL

Materials to be placed in the fill shall be approved by the Geotechnical Engineer and shall be free of vegetable matter and other deleterious substances. Granular soil shall contain sufficient fine material to fill the voids. The definition and disposition of oversized rocks and expansive or detrimental soils are covered in the geotechnical report or Special Provisions. Expansive soils, soils of poor gradation, or soils with low strength characteristics may be thoroughly mixed with other soils to provide satisfactory fill material, but only with the explicit consent of the Geotechnical Engineer. Any import material shall be approved by the Geotechnical Engineer before being brought to the site.

PLACING AND COMPACTION OF FILL

Approved fill material shall be placed in areas prepared to receive fill in layers not to exceed 6 inches in compacted thickness. Each layer shall have a uniform moisture content in the range that will allow the compaction effort to be efficiently applied to achieve the specified degree of compaction. Each layer shall be uniformly compacted to the specified minimum degree of compaction with equipment of adequate size to economically compact the layer. Compaction equipment should either be specifically designed for soil compaction or of proven reliability. The minimum degree of compaction to be achieved is specified in either the Special Provisions or the recommendations contained in the preliminary geotechnical investigation report.

When the structural fill material includes rocks, no rocks will be allowed to nest and all voids must be carefully filled with soil such that the minimum degree of compaction recommended in the Special Provisions is achieved. The maximum size and spacing of rock permitted in structural fills and in non-structural fills is discussed in the geotechnical report, when applicable.

Field observation and compaction tests to estimate the degree of compaction of the fill will be taken by the Geotechnical Engineer or his representative. The location and frequency of the tests shall be at the Geotechnical Engineer's discretion. When the compaction test indicates that a particular layer is at less than the required degree of compaction, the layer shall be reworked to the satisfaction of the Geotechnical Engineer and until the desired relative compaction has been obtained.

Fill slopes shall be compacted by means of sheepsfoot rollers or other suitable equipment. Compaction by sheepsfoot roller shall be at vertical intervals of not greater than four feet. In addition, fill slopes at a ratio of two horizontal to one vertical or flatter, should be trackrolled. Steeper fill slopes shall be over-built and cut-back to finish contours after the slope has been constructed. Slope compaction operations shall result in all fill material six or more inches inward from the finished face of the slope having a relative compaction of at least 90 percent of maximum dry density or the degree of compaction specified in the Special Provisions section of this specification. The compaction operation on the slopes shall be continued until the Geotechnical Engineer is of the opinion that the slopes will be surficially stable.

Density tests in the slopes will be made by the Geotechnical Engineer during construction of the slopes to determine if the required compaction is being achieved. Where failing tests occur or other field problems arise, the Contractor will be notified that day of such conditions by written communication from the Geotechnical Engineer or his representative in the form of a daily field report.

If the method of achieving the required slope compaction selected by the Contractor fails to produce the necessary results, the Contractor shall rework or rebuild such slopes until the required degree of compaction is obtained, at no cost to the Owner or Geotechnical Engineer.

CUT SLOPES

The Engineering Geologist shall inspect cut slopes excavated in rock or lithified formational material during the grading operations at intervals determined at his discretion. If any conditions not anticipated in the preliminary report such as perched water, seepage, lenticular or confined strata of a potentially adverse nature, unfavorably inclined bedding, joints or fault planes are encountered during grading, these conditions shall be analyzed by the Engineering Geologist and Geotechnical Engineer to determine if mitigating measures are necessary.

Unless otherwise specified in the geotechnical report, no cut slopes shall be excavated higher or steeper than that allowed by the ordinances of the controlling governmental agency.

ENGINEERING OBSERVATION

Field observation by the Geotechnical Engineer or his representative shall be made during the filling and compaction operations so that he can express his opinion regarding the conformance of the grading with acceptable standards of practice. Neither the presence of the Geotechnical Engineer or his representative or the observation and testing shall release the Grading Contractor from his duty to compact all fill material to the specified degree of compaction.

SEASON LIMITS

Fill shall not be placed during unfavorable weather conditions. When work is interrupted by heavy rain, filling operations shall not be resumed until the proper moisture content and density of the fill materials can be achieved. Damaged site conditions resulting from weather or acts of God shall be repaired before acceptance of work.

RECOMMENDED GRADING SPECIFICATIONS - SPECIAL PROVISIONS

RELATIVE COMPACTION: The minimum degree of compaction to be obtained in compacted natural ground, compacted fill, and compacted backfill shall be at least 90 percent. For street and parking lot subgrade, the upper twelve inches should be compacted to at least 95 percent relative compaction.

EXPANSIVE SOILS: Detrimentally expansive soil is defined as clayey soil which has an expansion index of 50 or greater when tested in accordance with the American Society of Testing Materials (ASTM) Laboratory Test D4829-95.

OVERSIZED MATERIAL: Oversized fill material is generally defined herein as rocks or lumps of soil over six inches in diameter. Oversized materials should not be placed in fill unless recommendations of placement of such material is provided by the Geotechnical Engineer. At least 40 percent of the fill soils shall pass through a No. 4 U.S. Standard Sieve.

TRANSITION LOTS: Where transitions between cut and fill occur within the proposed building pad, the cut portion should be undercut a minimum of one foot below the base of the proposed footings and recompacted as structural backfill. In certain cases that would be addressed in the geotechnical report, special footing reinforcement or a combination of special footing reinforcement and undercutting may be required.

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