APPENDIX F

Geotechnical Evaluation

GEOTECHNICAL EVALUATION FOR
2685, 2687, AND 2689 GARFIELD STREET
CITY OF CARLSBAD
SAN DIEGO COUNTY, CALIFORNIA 92008
APNs 203-141-27-01, 02, & 03

FOR

MS. RENEE WAILES
2292 FARADAY AVENUE, SUITE 100
CARLSBAD, CALIFORNIA 92008

W.O. 7886-A-SC AUGUST 4, 2020

GeoSoils, Inc.

Geotechnical • Geologic • Coastal • Environmental

5741 Palmer Way • Carlsbad, California 92010 • (760) 438-3155 • FAX (760) 931-0915 • www.geosoilsinc.com

August 4, 2020

W.O. 7886-A-SC

Ms. Renee Wailes
c/o **BGI Architecture**
2292 Faraday Avenue, Suite 100
Carlsbad, California 92008

Attention: Mr. John Beery

Subject: Geotechnical Evaluation for 2685, 2687, and 2689 Garfield Street, City of Carlsbad, San Diego County, California 92008, APNs 203-141-27-01, -02, & -03

Dear Mr. Beery:

In accordance with your request and authorization, GeoSoils, Inc. (GSI) is pleased to present the results of our geotechnical evaluation at the subject site. The purpose of our study was to evaluate the geologic and geotechnical conditions at the site in order to develop preliminary recommendations for site earthwork and the design of foundations, walls, and pavements related to the proposed residential construction at the property. It is our understanding that this project is governed by the City of Carlsbad and the current edition of the California Building Code (CBSC, 2019a).

EXECUTIVE SUMMARY

Based upon our field exploration, geologic and geotechnical engineering analyses, the proposed development appears feasible from a soils engineering and geologic viewpoint, provided that the recommendations presented in the text of this report are properly incorporated into the design and construction of the project. The most significant elements of our study are summarized below:

- In general, the site may be characterized as a gentle, southwest facing slope underlain with surficial deposits of colluvium (topsoil) and undocumented fill, overlying formational soils at depth, consisting of Quaternary-age, old paralic deposits.

- Proposed development generally consists of removing an existing residential structure located on the property, and constructing a new multi-family condominium structure with lower level (tuck under) garage space along the western side of the building. Additional improvements generally consist of retaining walls, traffic pavements, concrete flatwork (hardscapes), and landscaping.

- Due to the relatively compressible nature of undocumented fill colluvium (topsoil), and weathered, near surface old paralic deposits onsite, these materials are considered unsuitable for the support of settlement-sensitive improvements (e.g., residential foundations, concrete slab-on-grade floors, site walls, exterior hardscape, etc.) and/or engineered fill in its existing state. As such, it is recommended that this material is removed, moisture conditioned, and recompacted, prior to foundation and improvements construction.

- The 2019 California Building Code ([2019 CBC], California Building Standards Commission [CBSC], 2019a) indicates that removals of unsuitable soils be performed across all areas to be graded, under the purview of the grading permit, not just within the influence of the residential structure. Relatively deep removals may also necessitate a special zone of consideration on perimeter/confining areas. This zone would be approximately equal to the depth of removals, if removals cannot be performed onsite or offsite. Thus, any settlement-sensitive improvements (walls, curbs, flatwork, etc.), constructed within this zone may require deepened foundations, reinforcement, etc., or will retain some potential for settlement and associated distress. This will also require proper disclosure to any owners and all interested/affected parties should this condition exist at the conclusion of grading.

- Expansion index (E.I.) testing performed on a representative sample of the onsite soil indicates an E.I. of less than 20 (very low expansive). The soils expansion potential should be re-evaluated at the conclusion of grading and provide updated data for final foundation design.

- Site soils are considered mildly alkaline, mildly corrosive to exposed buried metals when saturated, present negligible sulfate exposure to concrete, and a negligible chloride exposure, on a preliminary basis (Exposure Classes S0, C1, and W0 per ACI 318-14). Corrosion testing at the completion of grading is recommended in order to obtain corrosion data specific to as-graded conditions.

- Neither a regional groundwater table nor perched water was encountered during our subsurface studies to the depth explored. As such, regional groundwater is not anticipated to significantly affect the planned improvements. Perched water may occur in the future along zones of contrasting permeability and/or density. This potential should be disclosed to all interested/affected parties.

- Our evaluation indicates there are no known active faults crossing the site and the natural slope upon which the site is located has very low susceptibility to deep-seated landslides. Owing to the depth to groundwater and the relatively dense nature of the underlying paralic deposits, the potential for the site to be adversely affected by liquefaction is considered very low. Site soils are considered erosive. Thus, properly designed site drainage is necessary in reducing erosion damage to the planned improvements.

- The seismic acceleration values and design parameters provided herein should be considered during the design of the proposed development. The adverse effects of seismic shaking on the structure(s) will likely be wall cracks, some foundation/slab distress, and some seismic settlement. However, it is anticipated that the structure will be repairable in the event of the design seismic event. This potential should be disclosed to any owners and all interested/affected parties.

- Additional adverse geologic features that would preclude project feasibility were not encountered, based on the available data.

- Infiltration testing with respect to storm water treatment indicates that a full or partial infiltration design is not considered feasible, per City BMP criteria.

- The recommendations presented in this report should be incorporated into the design and construction considerations of the project.

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

Respectfully submitted,

GeoSoils, Inc.

Robert G. Crisman
Engineering Geologist, CEG 1934

David W. Skelly
Civil Engineer, RCE 47857

MJS/RGC/JPF/DWS/mn

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CITY OF CARLSBAD
SAN DIEGO COUNTY, CALIFORNIA 92008
APNS 203-141-27-01, 02, & 03

SCOPE OF SERVICES

The scope of our services has included the following:

1. Review of readily available published literature, and maps of the vicinity (see Appendix A), including proprietary in-house geologic/geotechnical reports for other nearby sites.

2. Site reconnaissance mapping and the excavation of two (2) exploratory excavations with hand equipment, and two (2) exploratory borings with a hollow stem auger drill rig, to evaluate the soil/formation profiles, sample representative earth materials, and delineate the horizontal and vertical extent of earth material units (see Appendix B).

3. General areal seismicity evaluation (see Appendix C).

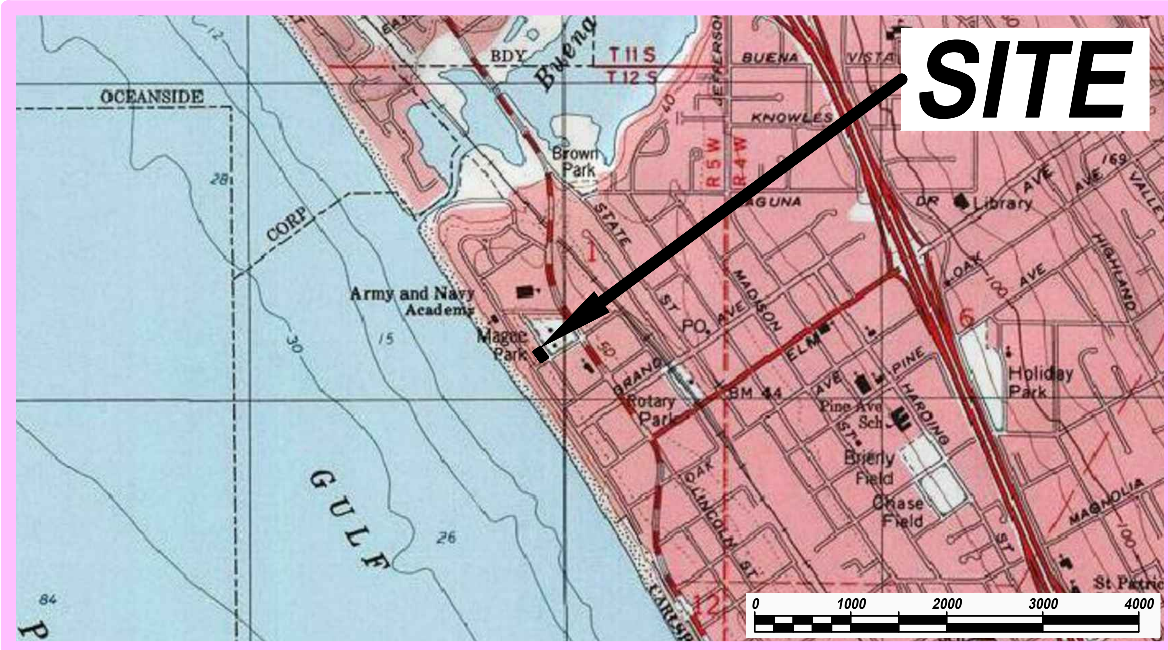
4. Appropriate laboratory testing of relatively undisturbed and representative bulk soil samples collected during our geologic mapping and subsurface exploration program.

5. Analysis of field and laboratory data relative to the proposed development.

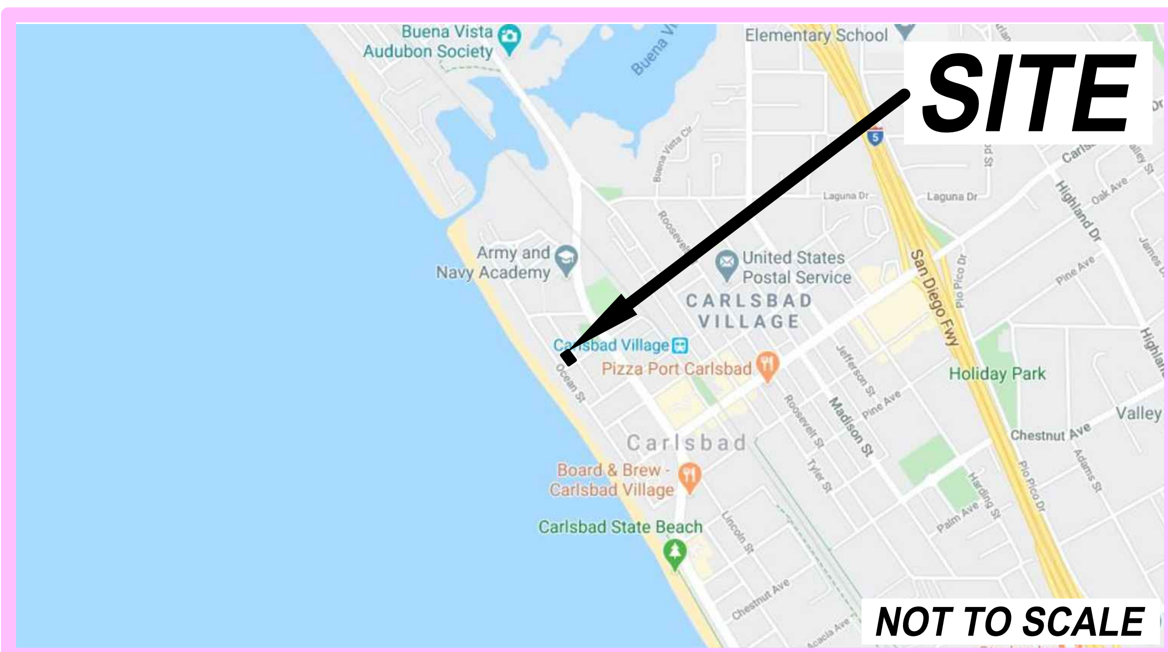
6. Appropriate engineering and geologic analyses of data collected, and the preparation of this summary report and accompaniments.

SITE DESCRIPTION AND PROPOSED DEVELOPMENT

The subject site consists of a rectangular shaped property, consisting of a multi-family residence located at 2685, 2687, and 2689 Garfield Street, in the City of Carlsbad, San Diego County, California (see Site Location Map, Figure 1). The property is bounded by existing residential property to the northwest and southwest, Garfield Street to the northeast, and Beech Avenue to the southeast. Topographically, the site is situated across a gentle, southwest facing slope, descending from Garfield Street, towards the existing residence below and southwest of the site. Based on a review of Google Earth Imagery (GEI, 2020), site elevations appear to vary from approximately 54 feet Mean Sea Level (MSL) along the upper, northeastern edge of the property, to about 44 feet MSL along the lower, southwestern edge of the property, for an overall relief of up to about 10 feet. Site drainage generally appears to be directed to the southwest, where it then appears to be



Base Map: TOPO!® ©2003 National Geographic, U.S.G.S. Oceanside Quadrangle, California -- San Diego Co., 7.5 Minute, dated 1996, current, 2000.



Base Map: Google Maps, Copyright 2020 Google, Map Data Copyright 2020 Google

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SITE LOCATION MAP

Figure 1

redirected offsite along an existing driveway, southward towards Beech Avenue. Vegetation onsite generally consists of typical residential landscaping (i.e., grasses, ornamental shrubs, and trees).

Existing improvements generally consist of an existing multi-family residential structure on a split level building pad, including three two-car garages below the residence (west side lower pad). The ground floor level for the main floor of the residence is on the upper pad, adjacent to Garfield Street. Other improvements consist of typical exterior flatwork, retaining walls, and landscaping. Based on a review of the Geotechnical Map (see Figure 2), which uses the building plan prepared by Beery Group Inc. Architecture ([BGI],2020) as a base, proposed re-development of the site appears to consist of removing the existing residential structure/improvements and preparing the site for the construction of three new condominiums across a similar split level pad configuration, with associated improvements consisting of new planters, pavements, and a lower level garage. Cut and fill grading techniques are anticipated for site earthwork. Based on site observations and the distribution of proposed construction, shown on Figure 2, plan cuts and fills on the order of less than 10 feet are anticipated. Significant graded slopes are not indicated, and planned retaining walls appear to be on the order of up to about 10 feet in maximum height (i.e. interior garage wall). GSI anticipates that construction would consist of wood frames with typical foundations and slab-on-grade ground floors, with the rear retaining wall for the garage likely using concrete masonry unit (CMU) construction. Building loads are assumed to be typical for this type of relatively light construction. Sewage disposal is anticipated to be connected into the regional, municipal system. Storm water may be treated onsite prior to its delivery into the municipal system. Proposed site development is shown on Figure 2, which uses BGI (2020) as a base.

FIELD STUDIES

Site-specific field studies were conducted by GSI during June 2020, and consisted of reconnaissance geologic mapping and the excavation of two (2) subsurface excavations completed with hand equipment, and two (2) exploratory soil borings completed with a small diameter, hollow stem auger drill rig, for an evaluation of near-surface soil and geologic conditions onsite. The test excavations were logged by a representative of this office who collected representative bulk and undisturbed soil samples for appropriate laboratory testing. The logs of the test excavations are presented in Appendix B. The approximate location of the test excavations are presented on the Geotechnical Map (see Figure 2).

REGIONAL GEOLOGY

The subject property lies within the coastal plain physiographic region of the Peninsular Ranges Geomorphic Province of southern California. This region consists of dissected, mesa-like terraces that transition inland to rolling hills. The encompassing Peninsular Ranges Geomorphic Province is characterized as elongated mountain ranges and valleys that trend northwesterly. This geomorphic province extends from the base of the east-west aligned Santa Monica - San Gabriel Mountains, and continues south into Baja California. The mountain ranges within this province are underlain by basement rocks consisting of pre-Cretaceous metasedimentary rocks, Cretaceous plutonic (granitic) rocks, and Jurassic metasedimentary and metavolcanic rocks. In the southern California region, deposition occurred during the Cretaceous Period and Cenozoic Era in the continental margin of a forearc basin. Sediments, derived from Cretaceous-age plutonic rocks and Jurassic-age volcanic rocks, were deposited during the Tertiary Period (Eocene-age) into the narrow, steep, coastal plain and continental margin of the basin. These rocks have been uplifted, eroded, and deeply incised. During early Pleistocene time, a broad coastal plain was developed from the deposition of marine terrace deposits. During mid to late Pleistocene time, this plain was uplifted, eroded and incised. Alluvial deposits have since filled the lower valleys, and young marine sediments are currently being deposited/eroded within coastal and beach areas. Regional geologic mapping by Kennedy and Tan (2007) indicates the site is underlain by Quaternary-age old paralic deposits. For the purposes of this report, Old paralic deposits are considered to be the “formational” soils underlying the site.

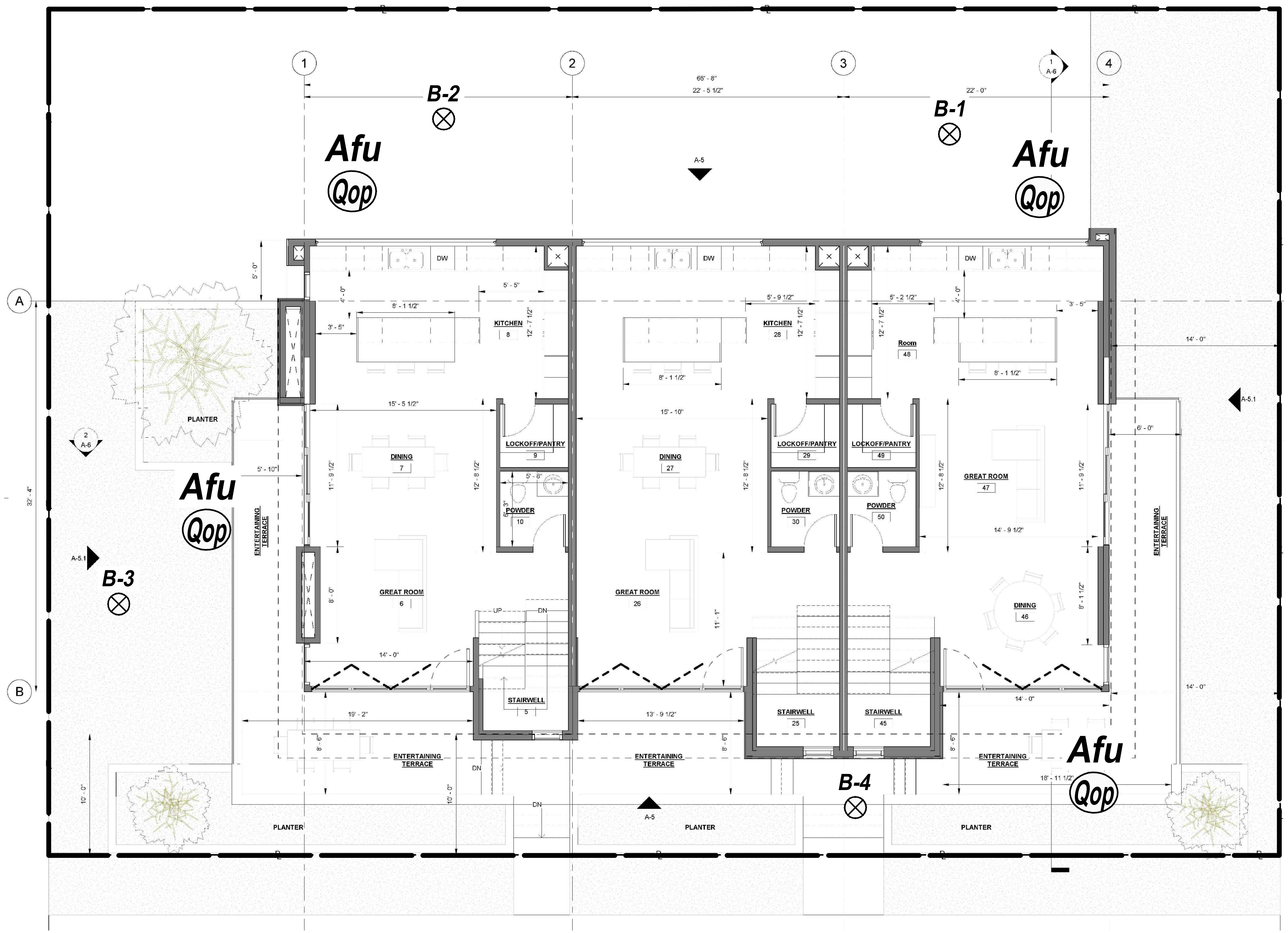
SITE GEOLOGIC UNITS

General

The earth material units that were observed and/or encountered at the subject site consist of surficial deposits of colluvium (topsoil) and undocumented artificial fill, overlying Quaternary-age, Old Paralic deposits, at depth. A general description of each material type is presented as follows, from youngest to oldest.

Undocumented Artificial Fill (Not Mapped)

Undocumented artificial fill was observed as a discontinuous surficial layer, ranging from about 1 to 2½ feet in thickness, generally consisting of silty sand (fine to medium grained sand) that is typically dark brown to dark olive brown, slightly moist, loose, with few roots and some construction debris (metal). A pavement section, consisting of asphaltic concrete over a pea gravel base was also noted within the existing driveway area, in the vicinity of Borings B-1 and B-2. While not directly observed, it is likely that existing fills are also present as backfill behind the existing garage wall. All undocumented fill is considered compressible, and therefore should be removed, cleaned on any deleterious material and may be reused as properly engineered fill, in areas proposed for settlement-sensitive improvements.



BASE MAP FROM:

BGI ARCHITECTURE
Beery Group Inc.
2091 Las Palmas Drive, St. D
Carlsbad, CA 92011
(760) 438-2963
bgiarchitect.com

3 ON GARFIELD CONDOMINIUMS

2689, 2687, 2685 GARFIELD STREET
CARLSBAD, CA 92008

REVISIONS By

Date 2020.06.18
Scale 1/4" = 1'-0"
Drawn By BPB
Job No. -
Sheet Name MAIN FLOOR PLAN
Sheet No. A-2

GSI LEGEND

- **Afu** — ARTIFICIAL FILL – UN DOCUMENTED
- **Qop** — QUATERNARY OLD PARALIC DEPOSITS, CIRCLED WHERE BURIED
- — APPROXIMATE LOCATION OF GEOLOGIC CONTACT
- **B-2** — APPROXIMATE LOCATION OF HAND–AUGER BORING

N

GRAPHIC SCALE

10 0 5 10 20

1" = 10'

ALL LOCATIONS ARE APPROXIMATE

This document or efile is not a part of the Construction Documents and should not be relied upon as being an accurate depiction of design.

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GEOTECHNICAL MAP

Figure 2

W.O. 7886-A-SC | DATE: 08/20 | SCALE: 1" = 10'

Colluvium/Topsoil

Colluvium (topsoil) was observed as a discontinuous surficial layer of soil, primarily occuring within the upper elevations of the site, near Garfield Street. Where observed, colluvium consists of a slightly moist and loose, dark brown sand, on the order of about 1 foot thick. All colluvium (topsoil) is considered compressible, and therefore should be removed, cleaned of any deleterious material and reused as properly engineered fill, in areas proposed for settlements-sensitive improvements.

Quaternary-Age, Old Paralic Deposits (Map Symbol - Qop)

Old Paralic Deposits appear to underlie the entire site, and consist of brown, yellowish brown, reddish brown, and pale yellow well-sorted sand, with trace amounts of silt, typically observed to be dry to slightly moist, dense to very dense, and typically less cemented and coarser grained with depth. Within the eastern, upper elevations of the site, old paralic deposits within about 2 to 3 feet from surface grades are considered loose and compressible, and should be remediated (i.e., removed and recompacted) prior to use as fill. Old Paralic deposits below the weathered zone are considered to be formation for this site and considered to be suitable bearing materials for the support of fills, or settlement-sensitive improvements.

Older sedimentary bedrock belonging to the Eocene-age Santiago Formation also underlies the site at depth. While not encountered during our subsurface site work to the maximum depth explored of about 19½ feet (i.e., approximate elevation of 25 feet MSL), other site explorations completed by this office in the vicinity have evaluated the approximate elevation of the Eocene contact at about 15 to 17 feet MSL, or about 27 to 29 feet below the lowest elevation of the site.

GROUNDWATER

GSI did not observe evidence of a regional groundwater table nor perched water within our subsurface explorations. Regional groundwater is anticipated to occur at depths around 50 feet below the site and is not anticipated to significantly affect proposed site development, provided that the recommendations contained in this report are properly incorporated into final design and construction. These observations reflect site conditions at the time of our investigation and do not preclude future changes in local groundwater conditions from excessive irrigation, precipitation, or that were not obvious, at the time of our investigation.

Seeps, springs, or other indications of subsurface water were not noted on the subject property during the time of our field investigation. However, perched water seepage may occur locally (as the result of heavy precipitation and/or irrigation, or damaged wet utilities) along zones of contrasting permeabilities/densities (fill/formation contacts, sandy/clayey fill lifts, etc.) or along geologic discontinuities (joints, fractures). This potential should be anticipated and disclosed to all interested/affected parties.

Due to the potential for post-development perched water to manifest near the surface, owing to as-graded permeability/density contrasts, more robust slab design is necessary for any new slab-on-grade floor (State of California, 2020). Recommendations for reducing the amount of water and/or water vapor through slab-on-grade floors are provided in the "Soil Moisture Considerations" sections of this report.

GEOLOGIC HAZARDS EVALUATION

Mass Wasting/Landslide Susceptibility

Mass wasting refers to the various processes by which earth materials are moved down slope in response to the force of gravity. Examples of these processes include slope creep, surficial failures, and deep-seated landslides. Creep is the slowest form of mass wasting and generally involves the outer 5 to 10 feet of a slope surface. During heavy rains, such as those in El Niño years, creep-affected materials may become saturated, resulting in a more rapid form of downslope movement (i.e., landslides and/or surficial failures).

According to regional landslide susceptibility mapping by Tan and Giffen (1995), the site is located within landslide susceptibility Subarea 2, which is characterized as being "marginally susceptible" to landsliding. Geomorphic expressions indicative of past mass wasting events (i.e., scarps and hummocky terrain) were not observed on the property during our field studies nor our review of regional geologic mapping. Further, no adverse geologic structures were encountered during our subsurface exploration. Regional geologic maps do not indicate the presence of landslides on the property.

The onsite soils are considered erosive. Therefore, slopes comprised of these materials may be subject to rilling, gullying, sloughing, and surficial slope failures depending on rainfall severity and surface drainage practices. Such risks can be minimized through properly designed, and regularly and periodically maintained surface drainage.

FAULTING AND REGIONAL SEISMICITY

Regional Faults

Our review indicates that there are no known active faults crossing the project and the site is not within an Alquist-Priolo Earthquake Fault Zone (California Geological Survey [CGS], 2018). However, the site is situated in an area of active faulting. The Newport Inglewood (offshore) fault is the closest known active fault to the site (located at a distance of approximately 4.7 miles [7.6 kilometers]) and should have the greatest effect on the site in the form of strong ground shaking, should the design earthquake occur. The location of the Newport Inglewood fault and other major faults relative to the site is shown on the "California Fault Map" in Appendix C. The possibility of ground acceleration, or shaking at the site, may be considered as approximately similar to the southern California region as a whole.

Local Faulting

Although active faults lie within a few miles of the site, no local active faulting was noted in our review, nor observed to specifically transect the site during the field investigation. Additionally, a review of available regional geologic maps does not indicate the presence of local active faults crossing the specific project site.

Seismicity

It is our understanding that site-specific seismic design criteria from the 2019 California Building Code ([2019 CBC], California Building Standards Commission [CBSC], 2019a), are to be utilized for foundation design. Much of the 2019 CBC relies on the American Society of Civil Engineers (ASCE) Minimum Design Loads for Buildings and Other Structures (ASCE Standard 7-16). The seismic design parameters provided herein are based on the 2019 CBC.

The acceleration-attenuation relation of Bozorgnia, Campbell, and Niazi (1999) has been incorporated into EQFAULT (Blake, 2000a). EQFAULT is a computer program developed by Thomas F. Blake (2000a), which performs deterministic seismic hazard analyses using digitized California faults as earthquake sources. The program estimates the closest distance between each fault and a given site. If a fault is found to be within a user-selected radius, the program estimates peak horizontal ground acceleration that may occur at the site from an upper bound (formerly "maximum credible earthquake"), on that fault. Upper bound refers to the maximum expected ground acceleration produced from a given fault. Site acceleration (g) was computed by one user-selected acceleration-attenuation relation that is contained in EQFAULT. Based on the EQFAULT program, a peak horizontal ground acceleration from an upper bound event on the Newport Inglewood fault may be on the order of 0.630g (1-sigma). The computer printouts of pertinent portions of the EQFAULT program are included within Appendix C.

Historical site seismicity was evaluated with the acceleration-attenuation relation of Bozorgnia, Campbell, and Niazi (1999), and the computer program EQSEARCH (Blake, 2000b, updated to August 2018). This program performs a search of the historical earthquake records for magnitude 5.0 to 9.0 seismic events within a 100-kilometer radius, between the years 1800 through August 2018. Based on the selected acceleration-attenuation relationship, a peak horizontal ground acceleration is estimated, which may have affected the site during the specific event listed. Based on the available data and the attenuation relationship used, the estimated maximum (peak) site acceleration during the period 1800 through August 2018 was about 0.239 g. A historic earthquake epicenter map and a seismic recurrence curve are also estimated/generated from the historical data. Computer printouts of the EQSEARCH program are presented in Appendix C.

Seismic Shaking Parameters

Based on the site conditions, the following table summarizes the updated site-specific design criteria obtained from the 2019 CBC (CBSC, 2019a), Chapter 16 Structural Design, Section 1613, Earthquake Loads. The computer program "OSHPD Seismic design Maps," provided by a joint effort between the Structural Engineers Association of California and the Office of Statewide Health Planning and Development ([OSHPD] SEAC/OSHPD, 2020) was utilized for design (http://seismicmaps.org). The short spectral response utilizes a period of 0.2 seconds.

2019 CBC SEISMIC DESIGN PARAMETERS		
PARAMETER	**VALUE**	**2019 CBC/ASCE REFERENCE**
Risk Category	II, III, or IV	Table 1604.5
Site Class (top 100 feet)	C	Section 1613.2.2/ Chap. 20 ASCE 7-16 (p. 203-204)
Spectral Response - (0.2 sec), S_s	1.098 g	Section 1613.2.1 Figure 1613.2.1(1)
Spectral Response - (1 sec), S_1	0.397 g	Section 1613.2.1 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)
Maximum Considered Earthquake Spectral Response Acceleration (0.2 sec), S_{MS}	1.318 g	Section 1613.2.3 (Eqn 16-36)
Maximum Considered Earthquake Spectral Response Acceleration (1 sec), S_{M1}	0.595 g	Section 1613.2.3 (Eqn 16-37)
5% Damped Design Spectral Response Acceleration (0.2 sec), S_{DS}	0.879 g	Section 1613.2.4 (Eqn 16-38)
5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.397 g	Section 1613.2.4 (Eqn 16-39)
PGA_M - Probabilistic Vertical Ground Acceleration may be assumed as about 50% of these values.	0.583 g	ASCE 7-16 (Eqn 11.8.1)
Seismic Design Category	D	Section 1613.2.5/ASCE 7-16 (p. 85: Table 11.6-1 or 11.6-2)

1. F_V = 1.5 S1>0.2 per Section 21.3,
2. SDS shall be taken as 90% of maximum spectral acceleration, Sa, obtained from site-specific spectrum, at any period within the range from 0.2 to 5 s inclusive, as per Section 21.4

GENERAL SEISMIC DESIGN PARAMETERS	
PARAMETER	VALUE
Distance to Seismic Source (Newport Inglewood) "B" fault[1]	±4.7 mi (7.6 km)[2]
Upper Bound Earthquake (Newport Inglewood) "B" fault[1]	M_w = 7.1[1]
[1] - Cao, et al. (2003). [2] - From Blake (2000a)	

Conformance to the criteria above 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 eliminate all damage, since such design may be economically prohibitive. Cumulative effects of seismic events are not addressed in the 2019 CBC (CBSC, 2019a) and regular maintenance and repair following locally significant seismic events (i.e., M_w5.5) will likely be necessary, as is the case in all of southern California.

SECONDARY SEISMIC HAZARDS

The following list includes other geologic/seismic related hazards that have been considered during our evaluation of the site. The hazards listed are considered negligible and/or mitigated as a result of site location, soil characteristics, and typical site development procedures:

- Liquefaction
- Lateral Spreading
- Subsidence
- Ground Lurching or Shallow Ground Rupture
- Tsunami
- Seiche

LABORATORY TESTING

Laboratory tests were performed on representative samples of site earth materials collected during our subsurface exploration in order to evaluate their physical characteristics. Test procedures used and results obtained are presented below.

Classification

Soils were visually classified with respect to the Unified Soil Classification System (U.S.C.S.) in general accordance with ASTM D 2487 and D 2488. The soil classifications of the onsite soils are provided on the Boring logs in Appendix B.

Moisture-Density Relations

The field moisture content of bulk soil samples and the field moisture content, and dry density of relatively undisturbed soil samples were evaluated in the laboratory, in general accordance with ASTM D 2216 and ASTM D 2937. The results of these tests are shown on the Boring Logs in Appendix B.

Laboratory Standard

The maximum density and optimum moisture content was evaluated for representative soil types in general accordance with the laboratory standard, ASTM D 1557. The moisture-density relationships obtained for this soil is shown in the following table:

SAMPLE LOCATION	DESCRIPTION	MAXIMUM DENSITY (PCF)	OPTIMUM MOISTURE CONTENT (%)
B-1 @ 0' -5' (Bulk)	Brown, Silty SAND	124.1	9.0

Expansion Index

Tests were performed on representative soil samples general accordance with ASTM D 4829. Test results and the soils expansion potential are presented in the following table.

SAMPLE LOCATION	DESCRIPTION	EXPANSION INDEX	EXPANSION POTENTIAL
B-1 @ 0'-5' (Bulk)	Silty Sand	<21	Very Low

Particle-Size Analysis

A particle-size evaluation was performed on a representative bulk soil sample obtained from Boring B-1 at 10 to 15 feet below grade, in general accordance with ASTM D 422-63. The grain-size distribution curve is presented in Appendix D. The testing was utilized to evaluate the soil classification in accordance with the Unified Soil Classification System (USCS). The results of the particle-size evaluation (see Appendix D) indicate that the tested soil is a silty SAND (SM).

Direct Shear

Shear testing was performed on a representative, undisturbed sample of site soil in general accordance with ASTM Test Method D 3080 in a Direct Shear Machine of the strain control type. The shear test results are presented as follows and in Appendix D:

SAMPLE LOCATION AND DEPTH (FT)	PRIMARY		RESIDUAL	
	COHESION (PSF)	FRICTION ANGLE (DEGREES)	COHESION (PSF)	FRICTION ANGLE (DEGREES)
B-1 @ 2½ feet (undisturbed)	22	33.7	8	31.9

Saturated Resistivity, pH, and Soluble Sulfates, and Chlorides

GSI conducted sampling of onsite earth materials for general soil corrosivity and soluble sulfates, and chlorides testing. The testing included evaluation of soil pH, soluble sulfates, chlorides, and saturated resistivity. Test results are presented in the following table:

SAMPLE LOCATION	pH	SATURATED RESISTIVITY (ohm-cm)	SOLUBLE SULFATES (ppm)	SOLUBLE CHLORIDES (ppm)
B-3/B-4 Bulk Composite @ 1'-6'	7.6	14,000	Non Detect	Non Detect

Corrosion Summary

Laboratory testing indicates that tested samples of the onsite soils are mildly alkaline with respect to soil acidity/alkalinity, are mildly corrosive to exposed, buried metals when saturated; present negligible (“not applicable” per ACI 318R-14) sulfate exposure to concrete; and negligible chloride exposure. Reinforced concrete mix design for foundations, slab-on-grade floors, and pavements should minimally conform to “Exposure Classes S0, W0, and C1” in Table 19.3.1.1 of ACI 318R-14, as concrete would likely be exposed to moisture. It should be noted that GSI does not consult in the field of corrosion engineering. The client and project architect should agree on the level of corrosion protection required for the project and seek consultation from a qualified corrosion consultant as warranted. Conformation testing is recommended upon the completion of rough grading.

STORM WATER INFILTRATION RATE EVALUATION AND DISCUSSION

USDA Study

A review of the United States Department of Agriculture database ([USDA]; 1973, 2019) indicates moderately high to high infiltration rates, between 0.57-1.98 inches per hour for the Marina loamy coarse sand (2 to 9 percent slopes) mapped on the site. The USDA study further indicates that site soils are classified as belonging to Hydrologic Soil Group B. It should be noted that the USDA data generally characterizes surficial soil conditions.

Infiltration Feasibility

In general accordance with the City BMP design manual (City, 2016), the infiltration feasibility for this site was evaluated. An evaluation of the soils infiltration characteristics and potential impact on site development was performed for this evaluation, using a "desk top" analysis. Based on our review, including; adjacent slopes, existing (or proposed) utility backfill, and/or existing moisture-sensitive improvements, such as pavements, and utility trench backfill, foundations, retaining walls, and below grade building walls, would likely be adversely affected by soil infiltration, including offsite improvements, causing settlement and distress.

Storm Water BMPs can adversely affect the performance of the onsite and offsite structures foundation systems by: 1) Increasing soil moisture transmission rates through concrete flooring; 2) reducing the stability of slopes and; and 3) increase the potential for a loss in bearing strength of soil. Any onsite mitigative grading of compressible near-surface soils for the support of structures generally involves removal and recompaction. This is anticipated to create a permeability contrast, and the potential for the development of a shallow "perched" and mounded water table, which can reasonably be anticipated to migrate laterally, beneath the structure(s), and offsite onto adjacent property, causing settlement and associated distress to public and private.

As indicated in the attached (Appendix E) City Form I-8, "Categorization of Infiltration Feasibility Condition," a full or partial infiltration BMP does not appear feasible due to the elevated potential for distress to the existing retaining wall along the western property line, existing offsite street improvements/utilities, planned retaining walls within the project, and an increase in the potential for the lateral migration of subsurface water and slope instability.

Onsite Filtration/Infiltration-Runoff Retention Systems

General design criteria regarding the use of onsite filtration-infiltration-runoff retention systems (OIRRS) are presented below.

Should onsite infiltration-runoff retention systems (OIRRS) be required for Best Management Practices (BMPs) or Low Impact Development (LID) principles for the project, some guidelines should/must be followed in the planning, design, and construction of such systems. Such facilities, if improperly designed or implemented without consideration of the geotechnical aspects of site conditions, can contribute to flooding, saturation of bearing materials beneath site improvements, slope instability, and possible concentration and contribution of pollutants into the groundwater or storm drain and/or utility trench systems.

Some of the methods which are utilized for onsite infiltration include percolation basins, dry wells, bio-swale/bio-retention, permeable pavers/pavement, infiltration trenches, filter boxes and subsurface infiltration galleries/chambers. Some of these systems are constructed using native and import soils, perforated piping, and filter fabrics while others employ structural components such as storm water infiltration chambers and filters/separators. Every site will have characteristics which should lend themselves to one or more of these methods, but not every site is suitable for OIRRS. In practice, OIRRS are usually initially designed by the project design civil engineer. Selection of methods should include (but should not be limited to) review by licensed professionals including the geotechnical engineer, hydrogeologist, engineering geologist, project civil engineer, landscape architect, environmental professional, and industrial hygienist. Applicable governing agency requirements should be reviewed and included in design considerations.

Based on our evaluation, the following issues should be addressed when considering any storm water BMP design:

- The probability of limited space and proximity of settlement-sensitive improvements to potential treatment area BMPs.

- The presence of a thin layer of engineered fill overlying formation (as-built condition) and the potential for developing a shallow, perched water table beneath foundations.

- Potential for adverse performance of planned improvements such as floor slabs, below grade walls, and foundations, due to potential settlement from saturation, or other distress due to water vapor transmission.

- The potential for the migration of subsurface water offsite, beneath adjacent residential properties, or streets, and/or into utility line trenches.

The following geotechnical guidelines should be considered when designing onsite infiltration-runoff retention systems:

- It is not good engineering practice to allow water to saturate soils, especially near slopes or improvements; however, the controlling agency/authority may now require this.

- Areas adjacent to, or within, the OIRRS that are subject to inundation should be properly protected against scouring, undermining, and erosion, in accordance with the recommendations of the design engineer.

- Should they be required, where infiltration systems are located near slopes or improvements, impermeable liners and subdrains should be used along the bottom of bioretention swales/basins located within the influence of such slopes and structures. Impermeable liners used in conjunction with bioretention basins should consist of a 30-mil polyvinyl chloride (PVC) membrane that is covered by a minimum of 12 inches of clean soil, free from rocks and debris, with a maximum 4:1 (h:v) slope inclination, or flatter, and meets the following minimum specifications:

> Specific Gravity (ASTM D792): 1.2 (g/cc, min.); Tensile (ASTM D882): 73 (lb/in-width, min); Elongation at Break (ASTM D882): 380 (%, min); Modulus (ASTM D882): 32 (lb/in-width, min.); and Tear Strength (ASTM D1004): 8 (lb/in, min); Seam Shear Strength (ASTM D882) 58.4 (lb/in, min); Seam Peel Strength (ASTM D882) 15 (lb/in, min).

- Subdrains for basins should consist of at least 4-inch diameter Schedule 40 or SDR 35 drain pipe with perforations oriented down. The drain pipe should be sleeved with a filter sock.

- Utility backfill within OIRRS should consist of a two-sack mix of slurry.

Final project plans (infiltration, grading, precise grading, foundation, retaining wall, landscaping, etc.), should be reviewed by this office prior to construction, so that construction is in accordance with the conclusions and recommendations of this report. Based on our review, supplemental recommendations and/or further geotechnical studies may be warranted. It should be noted that structural and landscape plans were not available for review at this time.

PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

Based on our field exploration, laboratory testing, and geotechnical engineering analysis, it is our opinion that the subject site is suitable for the proposed residential development from a geotechnical engineering and geologic viewpoint, provided that the recommendations presented in the following sections are incorporated into the design and construction phases of site development. The primary geotechnical concerns with respect to the proposed development and improvements are:

- Earth materials characteristics and depth to competent bearing material.
- On-going expansion and corrosion potential of site soils.
- Erosiveness of site earth materials.
- Potential for perched water during and following site development.
- Temporary slope stability.
- Regional seismic activity.

The recommendations presented herein consider these as well as other aspects of the site. The engineering analyses performed concerning site preparation and the recommendations presented herein have been completed using the information provided and obtained during our field work.

In the event that any significant changes are made to proposed site development, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and the recommendations of this report verified or modified in writing by this office. Foundation design parameters are considered preliminary until the foundation design, layout, and structural loads are provided to this office for review.

EARTHWORK CONSTRUCTION RECOMMENDATIONS

General

All earthwork should conform to the guidelines presented in the 2019 CBC (CBSC, 2019a), the requirements of the City, and the General Earthwork and Grading Guidelines presented in Appendix F, except where specifically superceded in the text of this report. Prior to earthwork, a GSI representative should be present at the preconstruction meeting to provide additional earthwork guidelines, if needed, and review the earthwork schedule. This office should be notified in advance of any fill placement, supplemental regrading of the site, or backfilling underground utility trenches and retaining walls after rough earthwork has been completed. This includes grading for pools, driveway approaches, driveways, and exterior hardscape.

During earthwork construction, all site preparation and the general grading procedures of the contractor should be observed and the fill selectively tested by a representative(s) of GSI. If unusual or unexpected conditions are exposed in the field, they should be reviewed by this office and, if warranted, modified and/or additional recommendations will be offered. All applicable requirements of local and national construction and general industry safety orders, the Occupational Safety and Health Act (OSHA), and the Construction Safety Act should be met. It is the onsite general contractor and individual subcontractors responsibility to provide a save working environment for our field staff who are onsite. GSI does not consult in the area of safety engineering.

Demolition/Grubbing

1. Vegetation and any miscellaneous debris should be removed from the areas of proposed grading.

2. Any existing structures should be removed from the site. Any subsurface structures uncovered during the recommended removal should be observed by GSI so that appropriate remedial recommendations can be provided.

3. Cavities or loose soils remaining after demolition and site clearance should be cleaned out and observed by the soil engineer. The cavities should be replaced with fill materials that have been moisture conditioned to at least optimum moisture content and compacted to at least 90 percent of the laboratory standard.

4. Onsite septic systems (if encountered) should be removed in accordance with San Diego County Department of Environmental Health standards/guidelines.

Treatment of Existing Ground

1. Removals should consist of all surficial deposits of undocumented fill and highly weathered formation (where present). Based on our site work, removals depths ranging on the order of approximately 2 to 3 feet should be anticipated throughout the site. These soils may be re-used as fill, provided that the soil is cleaned of any deleterious material, moisture conditioned, and compacted to a minimum 90 percent relative compaction per ASTM D 1557. Removals should be completed throughout the site, and minimally at least 5 feet beyond the limits of any settlement-sensitive improvement, or to a lateral distance equal to the depth of the removal beneath the improvement, whichever is greater.

2. In addition to removals within the building envelope, overexcavation of the underlying formation (if encountered) should be performed in order to provide for at least 4 feet of compacted fill below finish pad grade.

3. Subsequent to the above removals/overexcavation, the exposed bottom should be scarified to a depth of at least 8 inches, brought to at least optimum moisture content, and recompacted to a minimum relative compaction of 90 percent of the laboratory standard, prior to any fill placement.

4. Localized deeper removals may be necessary due to buried drainage channel meanders or dry porous materials, septic systems, etc. The project soils engineer/geologist should observe all removal areas during the grading.

5. Existing fill and removed natural ground materials may be reused as compacted fill provided that major concentrations of vegetation and miscellaneous debris are removed from the site, prior to or during fill placement. See subsequent sections for a discussion of select grading.

Earthwork Balance (Shrinkage/Bulking)

The volume change of excavated materials upon compaction as engineered fill is anticipated to vary with material type and location. The overall earthwork shrinkage and bulking may be approximated by using the following parameters:

Colluvium(topsoil)/Undocumented Fill . . . . 10-15% Shrinkage
Paralic Deposits . . . . 5-8% Shrinkage

It should be noted that the above factors are estimates only, based on preliminary data. The undocumented fill and any formational material may achieve higher shrinkage if organics or clay content is higher than anticipated, if a high degree of porosity is encountered, or if compaction averages more than 92 percent of the laboratory standard (ASTM D 1557). Final earthwork balance factors could vary.

Fill Suitability

Onsite soils (undocumented fill & weathered formation) generally appear to consist of silty sand and sand. Oversize material (12-inch plus) within the formation is not anticipated. Onsite soils can likely be excavated with light to moderate effort using heavy grading/trenching equipment.

Onsite soils are generally very low expansive. Any soil import should be evaluated by this office prior to importing in order to assure compatibility with the onsite site soils and the recommendations presented in this report. Import soils, if used, should be relatively sandy and very low expansive (i.e., E.I. less than 20).

Fill Placement

1. Subsequent to ground preparation, fill materials should be brought to <u>at least</u> optimum moisture content, placed in thin 6- to 8-inch lifts, and mechanically compacted to obtain a minimum relative compaction of 90 percent of the laboratory standard.

2. Fill materials should be cleansed of major vegetation and debris prior to placement.

Perimeter Conditions

It should be noted, that the 2019 CBC (CBSC, 2019a) indicates that removals of unsuitable soils be performed across all areas under the purview of the grading permit, not just within the influence of the proposed buildings. Relatively deep removals may also necessitate a special zone of consideration, on perimeter/confining areas. Remedial earthwork adjacent to the existing retaining wall along the western property line should be performed so that the existing wall is not adversely surcharged with construction equipment.

Any proposed improvement or future homeowner improvements such as walls, swimming pools, house additions, etc. that are located above a 1:1 (h:v) projection up from the outermost limit of the remedial grading excavations will require deepened foundations that extend below this plane. Other site improvements, such as pavements, constructed above the aforementioned plane would retain some potential for settlement and associated distress, which may require increased maintenance/repair or replacement. This potential should be disclosed to all interested/affected parties should remedial grading excavations be constrained by property lines.

Graded Slope Construction

If planned, graded fill slopes should be constructed at gradients no steeper than 2:1 (h:v) to heights up to 15 feet, without further analysis. Fill slopes should be properly keyed and benched if constructed along surfaces steeper than 5:1 (h:v). All fill slopes should be compacted to at least 90 percent of the laboratory standard (ASTM D 1557) throughout, including the slope face. Keyways for any planned fill slope should be constructed in accordance with Appendix F.

Graded cut slopes (if planned) should be constructed at gradients no steeper than 1.5:1 (h:v) to heights up to 10 feet without further evaluation. All cut slopes should be mapped by a geologist during construction. Although not anticipated at this time, should intersecting planes of joints/fractures daylight the cut slope face, or should undocumented fill or highly weathered formation be exposed in cut slopes, remedial grading including stabilization fills, or inclining the cut slope to a gradient flatter than the adverse structure, may be necessary. The type of remedial grading would be based on the conditions exposed during cut slope construction. Cut slopes may be difficult to vegetate.

Fill Drainage

Slope subdrainage may be recommended for any perimeter fill slope, based on conditions exposed during site grading. A schematic detail for subdrains is presented in Appendix E.

Temporary Slopes

Temporary slopes for excavations greater than 4 feet, but less than 20 feet in overall height should conform to CAL-OSHA and/or OSHA requirements for Type "B" soils. Temporary slopes, up to a maximum height of ±20 feet, may be excavated at a 1:1 (h:v) gradient, or flatter, provided groundwater and/or running sands are not exposed. Construction materials or soil stockpiles should not be placed within 'H' of any temporary slope where 'H' equals the height of the temporary slope. All temporary slopes should be observed by a licensed engineering geologist and/or geotechnical engineer prior to worker entry into the excavation.

PRELIMINARY RECOMMENDATIONS - FOUNDATIONS

General

Preliminary recommendations for foundation design and construction are provided in the following sections. These preliminary recommendations have been developed from our understanding of the currently planned site development, site observations, subsurface exploration, laboratory testing, and engineering analyses. Foundation design should be re-evaluated at the conclusion of site grading/remedial earthwork for the as-graded soil conditions. Although not anticipated, revisions to these recommendations may be necessary. In the event that the information concerning the proposed development plan is not correct, or any changes in the design, location or loading conditions of the proposed additions are made, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report are modified or approved in writing by this office.

The information and recommendations presented in this section are not meant to supercede design by the project structural engineer or civil engineer specializing in structural design. Upon request, GSI could provide additional input/consultation regarding soil parameters, as related to foundation design.

Expansive/Corrosive Soils

Current laboratory testing indicates expansive soil conditions appear to be very low expansive (E.I. of 20, or less). As such, site soils do not appear to meet the criteria of detrimentally expansive soils as defined in Section 1803.5.3 of the 2019 CBC. Foundation systems constructed within the influence of detrimentally expansive soils (i.e., E.I. > 20 and P.I. $\geq$ 15) will require specific design to resist expansive soil effects per Sections 1808.6.1 or 1808.6.2 of the 2019 CBC, and should be reviewed by the project structural engineer.

Preliminary testing indicates that site soils present a negligible sulfate exposure (exposure class S0 per Table 19.3.2.1 of ACI 318R-14) to concrete. However, reinforced concrete mix design for foundations, slab-on-grade floors, and pavements should also conform to "Exposure Classes S0, W0, and C1" in Table 19.3.1.1 of ACI 318R-14, as concrete would likely be exposed to moisture.

Preliminary Foundation Design

The following foundation construction recommendations are presented as a minimum criteria from a soils engineering viewpoint.

1. The foundation systems should be designed and constructed in accordance with guidelines presented in the 2019 CBC.

2. An allowable bearing value of 2,000 pounds per square foot (psf) may be used for the design of footings that maintain a minimum width of 12 inches and a minimum depth of 12 inches (below the lowest adjacent grade) and are founded entirely into properly compacted, engineered fill or suitable formation. This value may be increased by 20 percent for each additional 12 inches in footing depth to a maximum value of 2,500 psf. These values may be increased by one-third when considering short duration seismic or wind loads. Isolated pad footings should have a minimum dimension of at least 24 inches square and a minimum

embedment of 24 inches below the lowest adjacent grade into properly engineered fill or suitable formation. Foundation embedment depth excludes concrete slabs-on-grade, and/or slab underlayment. Foundations should not simultaneously bear on formation and engineered fill.

3. For foundations deriving passive resistance from engineered fill, a passive earth pressure may be computed as an equivalent fluid having a density of 150 pcf, with a maximum earth pressure of 2,000 psf.

4. The upper 6 inches of passive pressure should be neglected if not confined by slabs or pavement.

5. For lateral sliding resistance, a 0.25 coefficient of friction may be utilized for a concrete to soil contact when multiplied by the dead load.

6. When combining passive pressure and frictional resistance, the passive pressure component should be reduced by one-third.

7. All footing setbacks from slopes should comply with Figure 1808.7.1 of the 2019 CBC. GSI recommends a minimum horizontal setback distance of 7 feet as measured from the bottom, outboard edge of the footing to the slope face.

8. Footings for structures adjacent to retaining walls should be deepened so as to extend below a 1:1 projection from the heel of the wall. Alternatively, walls may be designed to accommodate structural loads from buildings or appurtenances as described in the "Retaining Wall" section of this report.

9. Provided that the earthwork and foundation recommendations in this reported are adhered, foundations bearing on engineered fill should be minimally designed to accommodate a differential settlement of 1 inch over a 40-foot horizontal span (angular distortion = 1/480).

PRELIMINARY FOUNDATION CONSTRUCTION RECOMMENDATIONS

Current laboratory testing indicates that onsite soils do not meet the criteria of detrimentally expansive soils as defined in Section 1803.5.3 of the 2019 CBC. The following foundation construction recommendations are presented as a minimum criteria from a soils engineering viewpoint. The following foundation construction recommendations are intended to support planned improvements underlain by at least 7 feet of non-detrimentally expansive soils (i.e., E.I.<21 and P.I. <15). Should foundations be underlain by expansive soils at depths of less than 7 feet, they will require specific design to mitigate expansive soil effects as required in Sections 1808.6.1 or 1808.6.2 of the 2019 CBC (CBSC, 2019a).

1. Exterior and interior footings should be founded into engineered fill, or suitable formation, at minimum depths of 12 inches to 18 inches below the lowest adjacent grade, for planned, one- or two-story floor loads, respectively, with footing width per Code. Isolated, exterior column and panel pads, or wall footings, should be at least 24 inches, square, and founded at a minimum depth of 24 inches into properly engineered fill or suitable formation. All footings should be minimally reinforced with four No. 4 reinforcing bars, two placed near the top and two placed near the bottom of the footing. Reinforcement of pad footings should be provided by the projects structural engineer.

2. All exterior column footings, and perimeter wall footings, should be tied together via grade beams in one direction. The grade beam should be at least 12 inches square in cross section, and should be provided with a minimum of one No. 4 reinforcing bar at the top, and one No. 4 reinforcing bar at the bottom of the grade beam. The base of the reinforced grade beam should be at the same elevation as the adjoining footings.

3. A grade beam, reinforced as previously recommended and at least 12 inches square, should be provided across large (garage) entrances. The base of the reinforced grade beam should be at the same elevation as the adjoining footings.

4. A minimum concrete slab-on-grade thickness of 5 inches is recommended. Recommendations for floor slab underlayment are presented in a later section of this report. Concrete slabs should be reinforced with a minimum of No. 3 reinforcement bars placed at 18-inch on centers, in two horizontally perpendicular directions (i.e., long axis and short axis).

5. All slab reinforcement should be supported to ensure proper mid-slab height positioning during placement of the concrete. "Hooking" of reinforcement is not an acceptable method of positioning.

6. The slab subgrade should be pre-soaked to at least the soils “optimum moisture content,” to a depth of at least 12 inches, prior to the placement of underlayment sand and vapor retarder. Slab subgrade pre-soaking should be evaluated by the geotechnical consultant within 72 hours of the placement of the underlayment sand and vapor retarder.

7. Soils generated from footing excavations to be used onsite should be compacted to a minimum relative compaction of 90 percent of the laboratory standard (ASTM D 1557), whether the soils are to be placed inside the foundation perimeter or in the yard/right-of-way areas. This material must not alter positive drainage patterns that direct drainage away from the structural areas and toward the street.

8. Reinforced concrete mix design should conform to “Exposure Class S0, W0, and C1” in Table 19.3.2.1 of ACI 318R-14.

SOIL MOISTURE TRANSMISSION CONSIDERATIONS

GSI has evaluated the potential for vapor or water transmission through the concrete floor slab, in light of typical floor coverings and improvements. Please note that slab moisture emission rates range from about 2 to 27 lbs/24 hours/1,000 square feet from a typical slab (Kanare, 2005), while floor covering manufacturers generally recommend about 3 lbs/24 hours as an upper limit. The recommendations in this section are not intended to preclude the transmission of water or vapor through the foundation or slabs. Foundation systems and slabs shall not allow water or water vapor to enter into the structure so as to cause damage to another building component or to limit the installation of the type of flooring materials typically used for the particular application (State of California, 2020). These recommendations may be exceeded or supplemented by a water "proofing" specialist, project architect, or structural consultant. Thus, the client will need to evaluate the following in light of a cost vs. benefit analysis (owner expectations and repairs/replacement), along with disclosure to all interested/affected parties. It should also be noted that vapor transmission will occur in new slab-on-grade floors as a result of chemical reactions taking place within the curing concrete. Vapor transmission through concrete floor slabs as a result of concrete curing has the potential to adversely affect sensitive floor coverings depending on the thickness of the concrete floor slab and the duration of time between the placement of concrete, and the floor covering. It is possible that a slab moisture sealant may be needed prior to the placement of sensitive floor coverings if a thick slab-on-grade floor is used and the time frame between concrete and floor covering placement is relatively short.

Considering the E.I. test results presented herein, and known soil conditions in the region, the anticipated typical water vapor transmission rates, floor coverings, and improvements (to be chosen by the Client and/or project architect) that can tolerate vapor transmission rates without significant distress, the following alternatives are provided:

- Concrete slabs should be increased in thickness (5 inches is considered the minimum).

- Concrete slab underlayment should consist of a 15-mil vapor retarder, or equivalent, with all laps sealed per the 2019 CBC and the manufacturer's recommendation. The vapor retarder should comply with the ASTM E 1745 - Class A criteria, and be installed in accordance with ACI 302.1R-04 and ASTM E 1643.

- The 15-mil vapor retarder (ASTM E 1745 - Class A) shall be installed per the recommendations of the manufacturer, including <u>all</u> penetrations (i.e., pipe, ducting, rebar, etc.).

- Concrete slabs, including the garage areas, shall be underlain by 2 inches of clean, washed sand (SE $\geq$ 30) above a 15-mil vapor retarder (ASTM E-1745 - Class A, per Engineering Bulletin 119 [Kanare, 2005]) installed per the recommendations of the manufacturer, including all penetrations (i.e., pipe, ducting, rebar, etc.). The manufacturer shall provide instructions for lap sealing, including minimum width of lap, method of sealing, and either supply or specify suitable products for lap sealing (ASTM E 1745), and per Code.

ACI 302.1R-04 (2004) states "If a cushion or sand layer is desired between the vapor retarder and the slab, care must be taken to protect the sand layer from taking on additional water from a source such as rain, curing, cutting, or cleaning. Wet cushion or sand layer has been directly linked in the past to significant lengthening of time required for a slab to reach an acceptable level of dryness for floor covering applications." Therefore, additional observation and/or testing will be necessary for the cushion or sand layer for moisture content, and relatively uniform thicknesses, prior to the placement of concrete.

- The vapor retarder shall be underlain by 2 inches of sand (SE $\geq$ 30) placed directly on the prepared, moisture conditioned, subgrade and should be sealed to provide a continuous retarder under the entire slab, as discussed above. As discussed previously, GSI indicated this layer of import sand may be eliminated below the vapor retarder, <u>if</u> laboratory testing indicates that the slab subgrade soil have a sand equivalent (SE) of 30 or greater.

- Concrete should have a maximum water/cement ratio of 0.50. This does not supercede Table 19.3.2.1 of the ACI (2014) for corrosion or other corrosive requirements. Additional concrete mix design recommendations should be provided by the structural consultant and/or waterproofing specialist. Concrete finishing and workablity should be addressed by the structural consultant and a waterproofing specialist.

- Where slab water/cement ratios are as indicated herein, and/or admixtures used, the structural consultant should also make changes to the concrete in the grade beams and footings in kind, so that the concrete used in the foundation and slabs are designed and/or treated for more uniform moisture protection.

- The owner(s) should be specifically advised which areas are suitable for tile flooring, vinyl flooring, or other types of water/vapor-sensitive flooring and which are not suitable. In all planned floor areas, flooring shall be installed per the manufactures recommendations.

- Additional recommendations regarding water or vapor transmission should be provided by the architect/structural engineer/slab or foundation designer and should be consistent with the specified floor coverings indicated by the architect.

Regardless of the mitigation, some limited moisture/moisture vapor transmission through the slab should be anticipated. Construction crews may require special training for installation of certain product(s), as well as concrete finishing techniques. The use of specialized product(s) should be approved by the slab designer and water-proofing consultant. A technical representative of the flooring contractor should review the slab and moisture retarder plans and provide comment prior to the construction of the foundations or improvements. The vapor retarder contractor should have representatives onsite during the initial installation.

WALL DESIGN PARAMETERS

Conventional Retaining Walls

The design parameters provided below assume that either non expansive soils (typically Class 2 permeable filter material or Class 3 aggregate base) or native onsite materials (up to and including an E.I. of 20) are used to backfill any retaining walls. The type of backfill (i.e., select or native), should be specified by the wall designer, and clearly shown on the plans. Building walls, below grade, should be water-proofed. To reduce the potential for site retaining walls to suffer efflorescence staining, they may also be water-proofed. The foundation system for the proposed retaining walls should be designed in accordance with the recommendations presented in this and preceding sections of this report, as appropriate. Recommendations for specialty walls (i.e., crib, earthstone, geogrid, etc.) can be provided upon request, and would be based on site specific conditions.

Preliminary Retaining Wall Foundation Design

Preliminary foundation design for retaining walls should incorporate the following recommendations:

Minimum Footing Embedment - 18 inches below the lowest adjacent grade (excluding landscape layer [upper 6 inches]).

Minimum Footing Width - 24 inches.

Allowable Bearing Pressure - An allowable bearing pressure of 2,500 pcf may be used in the preliminary design of retaining wall foundations provided that the footing maintains a minimum width of 24 inches and extends at least 18 inches into approved engineered fill overlying dense formational materials (excluding the top 6 inches [landscape zone]). This pressure may be increased by one-third for short-term wind and/or seismic loads. NOTE: where retaining walls are associated with storm water BMP's, the allowable bearing value shall be reduced to 1,000 psf.

Passive Earth Pressure - A passive earth pressure of 250 pcf with a maximum earth pressure of 2,500 psf may be used in the preliminary design of retaining wall foundations provided the foundation is embedded into properly compacted fill. NOTE: where retaining walls are associated with storm water BMP's, passive earth pressure shall be reduced to 150 psf, with a maximum earth pressure of 1,000 psf.

Lateral Sliding Resistance - A 0.35 coefficient of friction may be utilized for a concrete to soil contact when multiplied by the dead load. When combining passive pressure and frictional resistance, the passive pressure component should be reduced by one-third. NOTE: where retaining walls are associated with storm water BMP's, the lateral sliding resistance (coefficient of friction) shall be reduced to 0.25.

Backfill Soil Density - Soil densities ranging between 125 pcf and 130 pcf may be used in the design of retaining wall foundations. This assumes an average engineered fill compaction of at least 90 percent of the laboratory standard (ASTM D 1557).

Any retaining wall footings near the perimeter of the site will likely need to be deepened into suitable formation for adequate vertical and lateral bearing support, when adequate remedial grading (i.e., removal recompact) cannot be performed. All retaining wall footing setbacks from slopes should comply with Figure 1808.7.1 of the 2019 CBC. GSI recommends a minimum horizontal setback distance of 7 feet as measured from the bottom, outboard edge of the footing to the slope face.

Restrained Walls

Any retaining walls that will be restrained prior to placing and compacting backfill material or that have re-entrant or male corners, should be designed for an at-rest equivalent fluid pressure (EFP) of 60 pcf for very low expansive soil. The design should include any applicable surcharge loading. For areas of male or re-entrant corners, the restrained wall design should extend a minimum distance of twice the height of the wall (2H) laterally from the corner.

Cantilevered Walls

The recommendations presented below are for cantilevered retaining walls up to 10 feet high. Design parameters for walls less than 3 feet in height may be superceded by County of San Diego regional standard design. Active earth pressure may be used for retaining wall design, provided the top of the wall is not restrained from minor deflections. An equivalent fluid pressure approach may be used to compute the horizontal pressure against the wall. Appropriate fluid unit weights are given below for specific slope gradients of the retained material. These do not include other superimposed loading conditions due to traffic, structures, seismic events or adverse geologic conditions. When wall configurations are finalized, the appropriate loading conditions for superimposed loads can be provided upon request.

For preliminary planning purposes, the structural consultant/wall designer should incorporate the surcharge of traffic on the back of retaining walls where vehicular traffic could occur within horizontal distance “H” from the back of the retaining wall (where “H” equals the wall height). The traffic surcharge may be taken as 100 psf/ft in the upper 5 feet of backfill for light truck and cars traffic. This does not include the surcharge of parked vehicles which should be evaluated at a higher surcharge to account for the effects of seismic loading. Equivalent fluid pressures for the design of cantilevered retaining walls are provided in the following table:

SURFACE SLOPE OF RETAINED MATERIAL (HORIZONTAL:VERTICAL)	EQUIVALENT FLUID WEIGHT P.C.F. (SELECT BACKFILL)[2]	EQUIVALENT FLUID WEIGHT P.C.F. (NATIVE BACKFILL)[3]
Level[1]	38	45
2 to 1	55	60

[1] Level backfill behind a retaining wall is defined as compacted earth materials, properly drained, without a slope for a distance of 2H behind the wall, where H is the height of the wall.
[2] SE $\geq$ 30, P.I. < 15, E.I. < 21, and $\leq$ 10% passing No. 200 sieve.
[3] E.I. = 0 to 50, SE $\geq$ 25, P.I. < 15, E.I. < 21, and $\leq$ 20% passing No. 200 sieve (may not be sufficiently present onsite).

Seismic Surcharge

For engineered retaining walls, GSI recommends that the walls be evaluated for a seismic surcharge (in general accordance with 2019 CBC requirements), should walls be within 6 feet of ingress/egress areas. The site walls in this category should maintain an overturning Factor-of-Safety (FOS) of approximately 1.25 when the seismic surcharge (increment), is applied. For restrained walls, the seismic surcharge should be applied as a uniform surcharge load from the bottom of the footing (excluding shear keys) to the top of the backfill at the heel of the wall footing. This seismic surcharge pressure (seismic increment) may be taken as 15H where "H" for retained walls is the dimension previously noted as the height of the backfill to the bottom of the footing. The resultant force should be applied at a distance 0.6 H up from the bottom of the footing. For the evaluation of the seismic surcharge, the bearing pressure may exceed the static value by one-third, considering the transient nature of this surcharge. For cantilevered walls the pressure should be an inverted triangular distribution using 18H. Please note this is for local wall stability only.

The 18H is derived from a Mononobe-Okabe solution for both restrained cantilever walls. This accounts for the increased lateral pressure due to shakedown or movement of the sand fill soil in the zone of influence from the wall or roughly a $45^{\circ} - \phi/2$ plane away from the back of the wall. The 18H seismic surcharge is derived from the formula:

$P_h = \frac{3}{8} \bullet a_h \bullet \gamma_t H$

Where:	P_h	=	Seismic increment
	a_h	=	Probabilistic horizontal site acceleration with a percentage of "g"
	γ_t	=	total unit weight (120 to 125 pcf for site soils @ 90% relative compaction).
	H	=	Height of the wall from the bottom of the footing or point of pile fixity.

Retaining Wall Backfill and Drainage

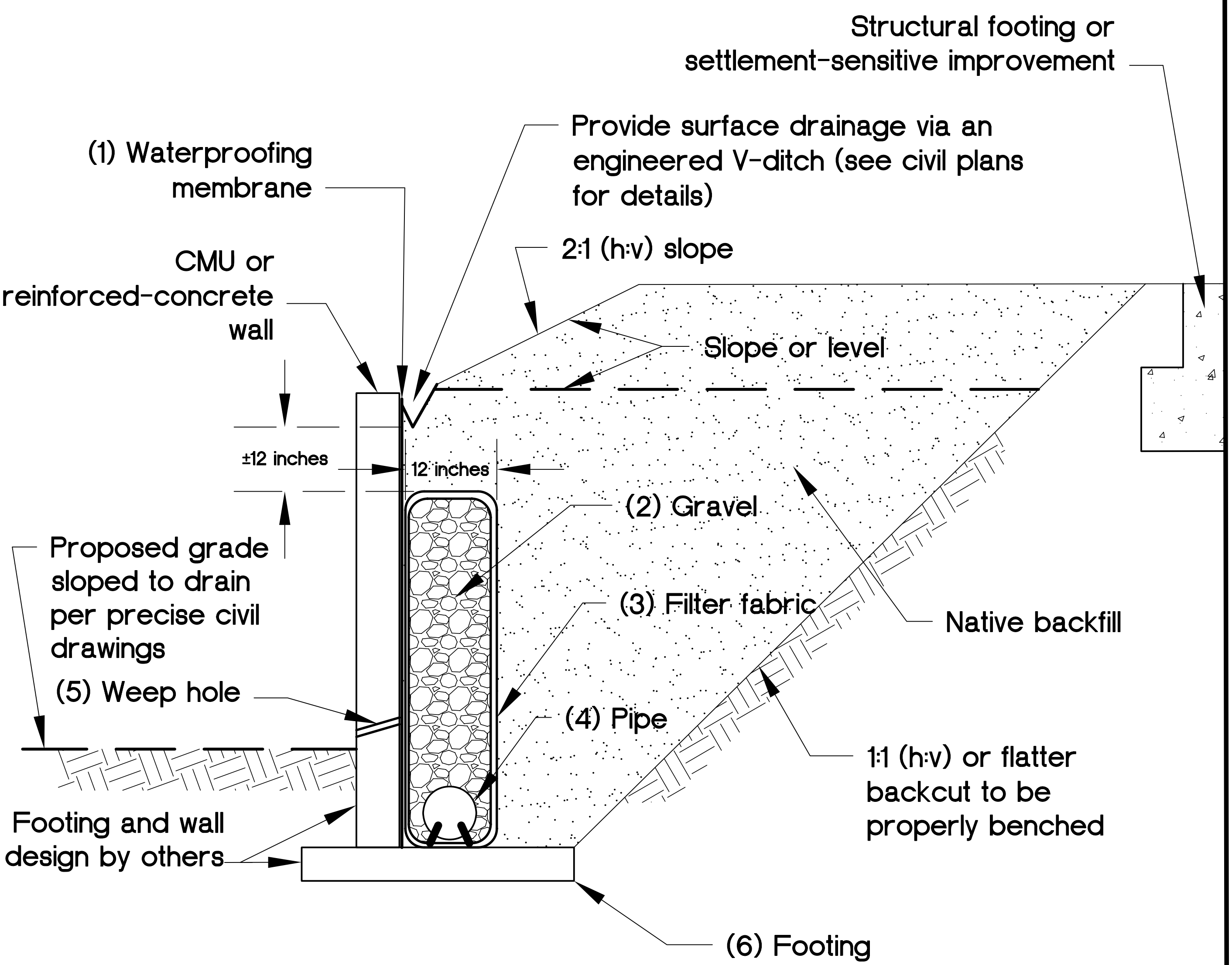
Positive drainage must be provided behind all retaining walls in the form of gravel wrapped in geofabric and outlets. A backdrain system is considered necessary for retaining walls that are 2 feet or greater in height. Details 1, 2, and 3, present the back drainage options discussed below. Backdrains should consist of a 4-inch diameter perforated PVC or ABS pipe encased in either Class 2 permeable filter material or ¾-inch to 1½-inch gravel wrapped in approved filter fabric (Mirafi 140 or equivalent). For low expansive backfill, the filter material should extend a minimum of 1 horizontal foot behind the base of the walls and upward at least 1 foot. For native backfill that has up to medium expansion potential, continuous Class 2 permeable drain materials should be used behind the wall. This material should be continuous (i.e., full height) behind the wall, and it should be constructed in accordance with the enclosed Detail 1 (Typical Retaining Wall Backfill and Drainage Detail). For limited access and confined areas, (panel) drainage behind the wall may be constructed in accordance with Detail 2 (Retaining Wall Backfill and Subdrain Detail Geotextile Drain). Materials with an E.I. potential of greater than 50 should not be used as backfill for retaining walls. For more onerous expansive situations, backfill and drainage behind the retaining wall should conform with Detail 3 (Retaining Wall And Subdrain Detail Clean Sand Backfill).

Drain outlets should consist of a 4-inch diameter solid PVC or ABS pipe spaced no greater than ±100 feet apart, with a minimum of two outlets, one on each end. The use of weep holes, only, in walls higher than 2 feet, is not recommended. The surface of the backfill should be sealed by pavement or the top 18 inches compacted with native soil (E.I. $\leq$50). Proper surface drainage should also be provided. For additional mitigation, consideration should be given to applying a water-proof membrane to the back of all retaining structures. The use of a waterstop should be considered for all concrete and masonry joints.

Wall/Retaining Wall Footing Transitions

Site walls are anticipated to be founded on footings designed in accordance with the recommendations in this report. Although not anticipated, should wall footings transition from cut to fill, the civil designer may specify either:

a) A minimum of a 2-foot overexcavation and recompaction of cut materials for a distance of 2H, from the point of transition.



(1) Waterproofing membrane.

(2) Gravel: Clean, crushed, $\frac{3}{4}$ to $1\frac{1}{2}$ inch.

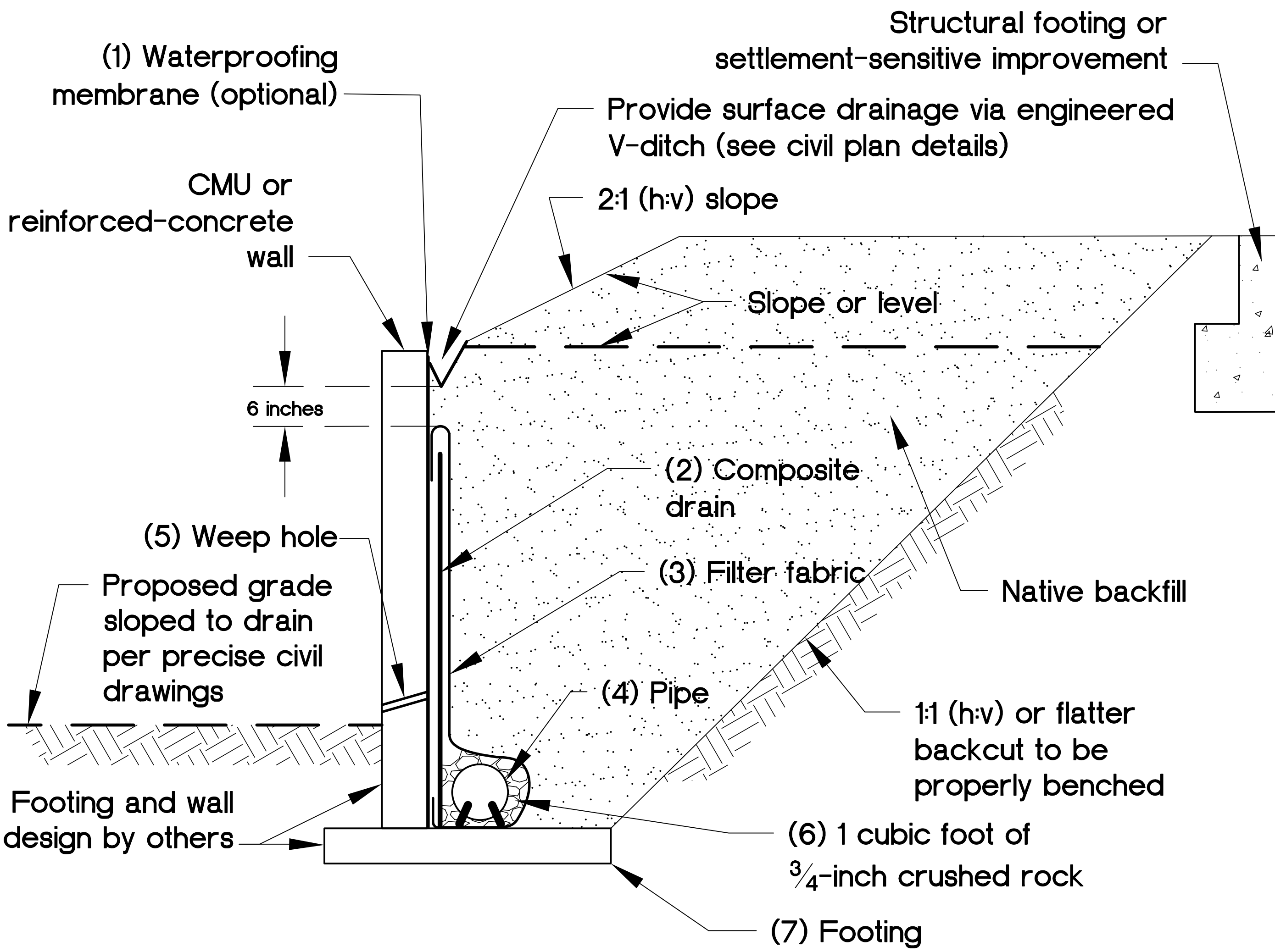
(3) Filter fabric: Mirafi 140N or approved equivalent.

(4) Pipe: 4-inch-diameter perforated PVC, Schedule 40, or approved alternative with minimum of 1 percent gradient sloped to suitable, approved outlet point (perforations down).

(5) Weep hole: Minimum 2-inch diameter placed at 20-foot centers along the wall and placed 3 inches above finished surface. Design civil engineer to provide drainage at toe of wall. No weep holes for below-grade walls.

(6) Footing: If bench is created behind the footing greater than the footing width, use level fill or cut natural earth materials. An additional "heel" drain will likely be required by geotechnical consultant.

GeoSoils, Inc.	RETAINING WALL DETAIL — ALTERNATIVE A	Detail 1



(1) Waterproofing membrane (optional): Liquid boot or approved mastic equivalent.

(2) Drain: Miradrain 6000 or J-drain 200 or equivalent for non-waterproofed walls; Miradrain 6200 or J-drain 200 or equivalent for waterproofed walls (all perforations down).

(3) Filter fabric: Mirafi 140N or approved equivalent; place fabric flap behind core.

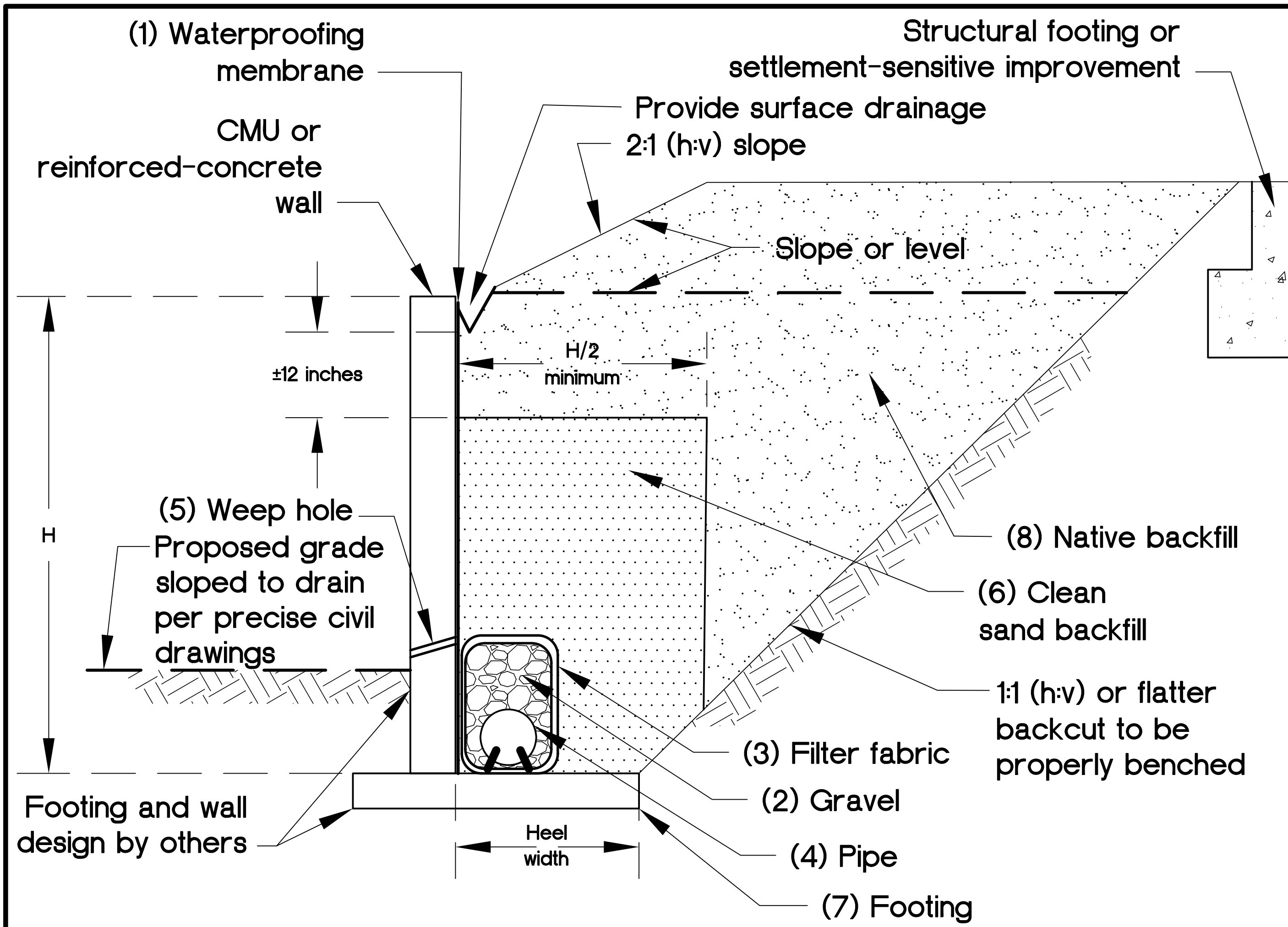
(4) Pipe: 4-inch-diameter perforated PVC, Schedule 40, or approved alternative with minimum of 1 percent gradient to proper outlet point (perforations down).

(5) Weep hole: Minimum 2-inch diameter placed at 20-foot centers along the wall and placed 3 inches above finished surface. Design civil engineer to provide drainage at toe of wall. No weep holes for below-grade walls.

(6) Gravel: Clean, crushed, ¾ to 1½ inch.

(7) Footing: If bench is created behind the footing greater than the footing width, use level fill or cut natural earth materials. An additional "heel" drain will likely be required by geotechnical consultant.

GeoSoils, Inc.	RETAINING WALL DETAIL — ALTERNATIVE B	Detail 2



(1) Waterproofing membrane: Liquid boot or approved masticequivalent.

(2) Gravel: Clean, crushed, $^3/_4$ to $1^1/_2$ inch.

(3) Filter fabric: Mirafi 140N or approved equivalent.

(4) Pipe: 4-inch-diameter perforated PVC, Schedule 40, or approved alternative with minimum of 1 percent gradient to proper outlet point (perforations down).

(5) Weep hole: Minimum 2-inch diameter placed at 20-foot centers along the wall and placed 3 inches above finished surface. Design civil engineer to provide drainage at toe of wall. No weep holes for below-grade walls.

(6) Clean sand backfill: Must have sand equivalent value (S.E.) of 35 or greater; can be densified by water jetting upon approval by geotechnical engineer.

(7) Footing: If bench is created behind the footing greater than the footing width, use level fill or cut natural earth materials. An additional "heel" drain will likely be required by geotechnical consultant.

(8) Native backfill: If E.I. <21 and S.E. ≥ 35 then all sand requirements also may not be required and will be reviewed by the geotechnical consultant.

b) Increase of the amount of reinforcing steel and wall detailing (i.e., expansion joints or crack control joints) such that a angular distortion of 1/360 for a distance of 2H on either side of the transition may be accommodated. Expansion joints should be placed no greater than 20 feet on-center, in accordance with the structural engineer's/wall designer's recommendations, regardless of whether or not transition conditions exist. Expansion joints should be sealed with a flexible, non-shrink grout.

c) Embed the footings entirely into native formational material (i.e., deepened footings).

If transitions from cut to fill transect the wall footing alignment at an angle of less than 45 degrees (plan view), then the designer should follow recommendation "a" (above) and until such transition is between 45 and 90 degrees to the wall alignment.

DRIVEWAY/PARKING, FLATWORK, AND OTHER IMPROVEMENTS

The effects of expansive soils are cumulative, and typically occur over the lifetime of any improvements. On relatively level areas, when the soils are allowed to dry, the dessication and swelling process tends to cause heaving and distress to flatwork and other improvements. The resulting potential for distress to improvements may be reduced, but not totally eliminated. To that end, it is important that the homeowner be aware of this long-term potential for distress. To reduce the likelihood of distress, the following recommendations are presented for all exterior flatwork:

1. The subgrade area for concrete slabs should be compacted to achieve a minimum 90 percent relative compaction (sidewalks, patios), and 95 percent relative compaction (traffic pavements), and then be presoaked to 2 to 3 percentage points above (or 125 percent of) the soils' optimum moisture content, to a depth of 18 inches below subgrade elevation. If very low expansive soils are present, only optimum moisture content, or greater, is required and specific presoaking is not warranted. The moisture content of the subgrade should be proof tested within 72 hours prior to pouring concrete.

2. Concrete slabs should be cast over a non-yielding surface, consisting of a 4-inch layer of crushed rock, gravel, or clean sand, that should be compacted and level prior to pouring concrete. If very low expansive soils are present, the rock or gravel or sand may be deleted. The layer or subgrade should be wet-down completely prior to pouring concrete, to minimize loss of concrete moisture to the surrounding earth materials.

3. Exterior slabs (sidewalks, patios, etc.) should be a minimum of 4 inches thick.

4. Driveway and parking area slabs and approaches should be at least 5½ inches thick. A thickened edge (12 inches) should also be considered adjacent to all

landscape areas, to help impede infiltration of landscape water under the slab(s). All pavement construction should minimally be performed in general accordance with industry standards and properly transitioned.

5. The use of transverse and longitudinal control joints are recommended to help control slab cracking due to concrete shrinkage or expansion. Two ways to mitigate such cracking are: a) add a sufficient amount of reinforcing steel, increasing tensile strength of the slab; and, b) provide an adequate amount of control and/or expansion joints to accommodate anticipated concrete shrinkage and expansion.

6. In order to reduce the potential for unsightly cracks, slabs should be reinforced at mid-height with a minimum of No. 3 bars placed at 18 inches on center, in each direction. If subgrade soils within the top 7 feet from finish grade are very low expansive soils (i.e., E.I. $\leq$20), then 6x6-W1.4xW1.4 welded-wire mesh may be substituted for the rebar, provided the reinforcement is placed on chairs, at slab mid-height. The exterior slabs should be scored or saw cut, ½ to ⅜ inches deep, often enough so that no section is greater than 10 feet by 10 feet. For sidewalks or narrow slabs, control joints should be provided at intervals of every 6 feet. The slabs should be separated from the foundations and sidewalks with expansion joint filler material.

7. No traffic should be allowed upon the newly poured concrete slabs until they have been properly cured to within 75 percent of design strength. Concrete compression strength should be a minimum of 2,500 psi for sidewalks and patios, and a minimum 3,250 psi for traffic pavements.

8. Driveways, sidewalks, and patio slabs adjacent to the structure should be separated from the structure with thick expansion joint filler material. In areas directly adjacent to a continuous source of moisture (i.e., irrigation, planters, etc.), all joints should be additionally sealed with flexible mastic.

9. Planters and walls should not be tied to the structure.

10. Overhang structures should be supported on the slabs, or structurally designed with continuous footings tied in at least two directions. If very low expansion soils are present, footings need only be tied in one direction.

11. Any masonry landscape walls that are to be constructed throughout the property should be grouted and articulated in segments no more than 20 feet long. These segments should be keyed or doweled together.

12. Utilities should be enclosed within a closed utilidor (vault) or designed with flexible connections to accommodate differential settlement and expansive soil conditions.

13. Positive site drainage should be maintained at all times. Finish grade on the lot should provide a minimum of 1 to 2 percent fall to the street, as indicated herein. It should be kept in mind that drainage reversals could occur, including post-construction settlement, if relatively flat yard drainage gradients are not periodically maintained by the homeowner.

14. Air conditioning (A/C) units should be supported by slabs that are incorporated into the building foundation or constructed on a rigid slab with flexible couplings for plumbing and electrical lines. A/C waste water lines should be drained to a suitable non-erosive outlet.

15. Shrinkage cracks could become excessive if proper finishing and curing practices are not followed. Finishing and curing practices should be performed per the Portland Cement Association Guidelines. Mix design should incorporate rate of curing for climate and time of year, sulfate content of soils, corrosion potential of soils, and fertilizers used on site.

DEVELOPMENT CRITERIA

Slope Maintenance and Planting

Water has been shown to weaken the inherent strength of all earth materials. Slope stability is significantly reduced by overly wet conditions. Positive surface drainage away from slopes should be maintained and only the amount of irrigation necessary to sustain plant life should be provided for planted slopes. Over-watering should be avoided as it adversely affects site improvements, and causes perched groundwater conditions. Graded slopes constructed utilizing onsite materials would be erosive. Eroded debris may be minimized and surficial slope stability enhanced by establishing and maintaining a suitable vegetation cover soon after construction. Compaction to the face of fill slopes would tend to minimize short-term erosion until vegetation is established. Plants selected for landscaping should be light weight, deep rooted types that require little water and are capable of surviving the prevailing climate. Jute-type matting or other fibrous covers may aid in allowing the establishment of a sparse plant cover. Utilizing plants other than those recommended above will increase the potential for perched water, staining, mold, etc., to develop. A rodent control program to prevent burrowing should be implemented. Irrigation of natural (ungraded) slope areas is generally not recommended. These recommendations regarding plant type, irrigation practices, and rodent control should be provided to all interested/affected parties. Over-steepening of slopes should be avoided during building construction activities and landscaping.

Drainage

Adequate surface drainage is a very important factor in reducing the likelihood of adverse performance of foundations, hardscape, and slopes. Surface drainage should be sufficient to mitigate ponding of water anywhere on the property, and especially near structures and tops of slopes. Surface drainage should be carefully taken into consideration during fine grading, landscaping, and building construction. Therefore, care should be taken that future landscaping or construction activities do not create adverse drainage conditions. Positive site drainage within the property should be provided and maintained at all times. Drainage should not flow uncontrolled down any descending slope. Water should be directed away from foundations and tops of slopes, and not allowed to pond and/or seep into the ground. In general, site drainage should conform to Section 1804.3 of the 2019 CBC. Consideration should be given to avoiding construction of planters adjacent to structures (buildings, pools, spas, etc.). Building pad drainage should be directed toward the street or other approved area(s). Although not a geotechnical requirement, roof gutters, down spouts, or other appropriate means may be utilized to control roof drainage. Down spouts, or drainage devices should outlet a minimum of 5 feet from structures or into a subsurface drainage system. Areas of seepage may develop due to irrigation or heavy rainfall, and should be anticipated. Minimizing irrigation will lessen this potential. If areas of seepage develop, recommendations for minimizing this effect could be provided upon request.

Erosion Control

Cut and fill slopes will be subject to surficial erosion during and after grading. Onsite earth materials have a moderate to high erosion potential. Consideration should be given to providing hay bales and silt fences for the temporary control of surface water, from a geotechnical viewpoint.

Landscape Maintenance

Only the amount of irrigation necessary to sustain plant life should be provided. Over-watering the landscape areas will adversely affect proposed site improvements. We would recommend that any proposed open-bottom planters adjacent to proposed structures be eliminated for a minimum distance of 10 feet. As an alternative, closed-bottom type planters could be utilized. An outlet placed in the bottom of the planter, could be installed to direct drainage away from structures or any exterior concrete flatwork. If planters are constructed adjacent to structures, the sides and bottom of the planter should be provided with a moisture barrier to prevent penetration of irrigation water into the subgrade. Provisions should be made to drain the excess irrigation water from the planters without saturating the subgrade below or adjacent to the planters. Graded slope areas should be planted with drought resistant vegetation. Consideration should be given to the type of vegetation chosen and their potential effect upon surface improvements (i.e., some trees will have an effect on concrete flatwork with their extensive root systems). From a geotechnical standpoint leaching is not recommended for establishing landscaping. If the surface soils are processed for the purpose of adding amendments, they should be recompacted to 90 percent minimum relative compaction.

Gutters and Downspouts

As previously discussed in the drainage section, the installation of gutters and downspouts should be considered to collect roof water that may otherwise infiltrate the soils adjacent to the structures. If utilized, the downspouts should be drained into PVC collector pipes or other non-erosive devices (e.g., paved swales or ditches; below grade, solid tight-lined PVC pipes; etc.), that will carry the water away from the structure, to an appropriate outlet, in accordance with the recommendations of the design civil engineer. Downspouts and gutters are not a requirement; however, from a geotechnical viewpoint, provided that positive drainage is incorporated into project design (as discussed previously).

Subsurface and Surface Water

Subsurface and surface water are not anticipated to affect site development, provided that the recommendations contained in this report are incorporated into final design and construction and that prudent surface and subsurface drainage practices are incorporated into the construction plans. Perched groundwater conditions along zones of contrasting permeabilities may not be precluded from occurring in the future due to site irrigation, poor drainage conditions, or damaged utilities, and should be anticipated. Should perched groundwater conditions develop, this office could assess the affected area(s) and provide the appropriate recommendations to mitigate the observed groundwater conditions. Groundwater conditions may change with the introduction of irrigation, rainfall, or other factors.

Site Improvements

If in the future, any additional improvements (e.g., pools, spas, etc.) are planned for the site, recommendations concerning the geological or geotechnical aspects of design and construction of said improvements could be provided upon request. Pools and/or spas should not be constructed without specific design and construction recommendations from GSI, and this construction recommendation should be provided to all interested/affected parties. This office should be notified in advance of any fill placement, grading of the site, or trench backfilling after rough grading has been completed. This includes any grading, utility trench and retaining wall backfills, flatwork, etc.

Tile Flooring

Tile flooring can crack, reflecting cracks in the concrete slab below the tile, although small cracks in a conventional slab may not be significant. Therefore, the designer should consider additional steel reinforcement for concrete slabs-on-grade where tile will be placed. The tile installer should consider installation methods that reduce possible cracking of the tile such as slipsheets. Slipsheets or a vinyl crack isolation membrane (approved by the Tile Council of America/Ceramic Tile Institute) are recommended between tile and concrete slabs on grade.

Additional Grading

This office should be notified in advance of any fill placement, supplemental regrading of the site, or trench backfilling after rough grading has been completed. This includes completion of grading in the street, driveway approaches, driveways, parking areas, and utility trench and retaining wall backfills.

Footing Trench Excavation

All footing excavations should be observed by a representative of this firm subsequent to trenching and prior to concrete form and reinforcement placement. The purpose of the observations is to evaluate that the excavations have been made into the recommended bearing material and to the minimum widths and depths recommended for construction. If loose or compressible materials are exposed within the footing excavation, a deeper footing or removal and recompaction of the subgrade materials would be recommended at that time. Footing trench spoil and any excess soils generated from utility trench excavations should be compacted to a minimum relative compaction of 90 percent, if not removed from the site.

Trenching/Temporary Construction Backcuts

Considering the nature of the onsite earth materials, it should be anticipated that caving or sloughing could be a factor in subsurface excavations and trenching. Shoring or excavating the trench walls/backcuts at the angle of repose (typically 25 to 45 degrees [except as specifically superceded within the text of this report]), should be anticipated. All excavations should be observed by an engineering geologist or soil engineer from GSI, prior to workers entering the excavation or trench, and minimally conform to CAL-OSHA, state, and local safety codes. Should adverse conditions exist, appropriate recommendations would be offered at that time. The above recommendations should be provided to any contractors and/or subcontractors, or homeowners, etc., that may perform such work.

Utility Trench Backfill

1. All interior utility trench backfill should be brought to at least 2 percent above optimum moisture content and then compacted to obtain a minimum relative compaction of 90 percent of the laboratory standard. As an alternative for shallow (12-inch to 18-inch) under-slab trenches, sand having a sand equivalent value of 30 or greater may be utilized and jetted or flooded into place. Observation, probing and testing should be provided to evaluate the desired results.

2. Exterior trenches adjacent to, and within areas extending below a 1:1 plane projected from the outside bottom edge of the footing, and all trenches beneath hardscape features and in slopes, should be compacted to at least 90 percent of

the laboratory standard. Sand backfill, unless excavated from the trench, should not be used in these backfill areas. Compaction testing and observations, along with probing, should be accomplished to evaluate the desired results.

3. All trench excavations should conform to CAL-OSHA, state, and local safety codes.

4. Utilities crossing grade beams, perimeter beams, or footings should either pass below the footing or grade beam utilizing a hardened collar or foam spacer, or pass through the footing or grade beam in accordance with the recommendations of the structural engineer.

SUMMARY OF RECOMMENDATIONS REGARDING GEOTECHNICAL OBSERVATION AND TESTING

We recommend that observation and/or testing be performed by GSI at each of the following construction stages:

- During grading/recertification.
- During excavation.
- During placement of subdrains or other subdrainage devices, prior to placing fill and/or backfill.
- After excavation of building footings, retaining wall footings, and free standing walls footings, prior to the placement of reinforcing steel or concrete.
- Prior to pouring any slabs or flatwork, after presoaking/presaturation of building pads and other flatwork subgrade, before the placement of concrete, reinforcing steel, capillary break (i.e., sand, pea-gravel, etc.), or vapor retarders (i.e., visqueen, etc.).
- During retaining wall subdrain installation, prior to backfill placement.
- During placement of backfill for area drain, interior plumbing, utility line trenches, and retaining wall backfill.
- During slope construction/repair.
- When any unusual soil conditions are encountered during any construction operations, subsequent to the issuance of this report.

- When any homeowner improvements, such as flatwork, spas, pools, walls, etc., are constructed, prior to construction.

- A report of geotechnical observation and testing should be provided at the conclusion of each of the above stages, in order to provide concise and clear documentation of site work, and/or to comply with code requirements.

OTHER DESIGN PROFESSIONALS/CONSULTANTS

The design civil engineer, structural engineer, post-tension designer, architect, landscape architect, wall designer, etc., should review the recommendations provided herein, incorporate those recommendations into all their respective plans, and by explicit reference, make this report part of their project plans. This report presents minimum design criteria for the design of slabs, foundations and other elements possibly applicable to the project. These criteria should not be considered as substitutes for actual designs by the structural engineer/designer. Please note that the recommendations contained herein are not intended to preclude the transmission of water or vapor through the slab or foundation. The structural engineer/foundation and/or slab designer should provide recommendations to not allow water or vapor to enter into the structure so as to cause damage to another building component, or so as to limit the installation of the type of flooring materials typically used for the particular application.

The structural engineer/designer should analyze actual soil-structure interaction and consider, as needed, bearing, expansive soil influence, and strength, stiffness and deflections in the various slab, foundation, and other elements in order to develop appropriate, design-specific details. As conditions dictate, it is possible that other influences will also have to be considered. The structural engineer/designer should consider all applicable codes and authoritative sources where needed. If analyses by the structural engineer/designer result in less critical details than are provided herein as minimums, the minimums presented herein should be adopted. It is considered likely that some, more restrictive details will be required.

If the structural engineer/designer has any questions or requires further assistance, they should not hesitate to call or otherwise transmit their requests to GSI. In order to mitigate potential distress, the foundation and/or improvement's designer should confirm to GSI and the governing agency, in writing, that the proposed foundations and/or improvements can tolerate the amount of differential settlement and/or expansion characteristics and other design criteria specified herein.

PLAN REVIEW

Final project plans (grading, precise grading, foundation, retaining wall, landscaping, etc.), should be reviewed by this office prior to construction, so that construction is in accordance with the conclusions and recommendations of this report. Based on our review, supplemental recommendations and/or further geotechnical studies may be warranted.

LIMITATIONS

The materials encountered on the project site and utilized for our analysis are believed representative of the area; however, soil and formation/bedrock materials vary in character between excavations and natural outcrops or conditions exposed during mass grading. Site conditions may vary due to seasonal changes or other factors.

Inasmuch as our study is based upon our review and engineering analyses and laboratory data, the conclusions and recommendations are professional opinions. These opinions have been derived in accordance with current standards of practice, and no warranty, either express or implied, is given. Standards of practice are subject to change with time. GSI assumes no responsibility or liability for work or testing performed by others, or their inaction; or work performed when GSI is not requested to be onsite, to evaluate if our recommendations have been properly implemented. Use of this report constitutes an agreement and consent by the user to all the limitations outlined above, notwithstanding any other agreements that may be in place. In addition, this report may be subject to review by the controlling authorities. Thus, this report brings to completion our scope of services for this portion of the project. All samples will be disposed of after 30 days, unless specifically requested by the client, in writing.

APPENDIX A

REFERENCES

APPENDIX A

REFERENCES

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APPENDIX B

BORING LOGS

UNIFIED SOIL CLASSIFICATION SYSTEM				
Major Divisions			Group Symbols	Typical Names
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels 50% or more of coarse fraction retained on No. 4 sieve	Clean Gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		Gravel with	GM	Silty gravels gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sands more than 50% of coarse fraction passes No. 4 sieve	Clean Sands	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly graded sands and gravelly sands, little or no fines
		Sands with Fines	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
Fine-Grained Soils 50% or more passes No. 200 sieve	Silts and Clays Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts and organic silty clays of low plasticity
	Silts and Clays Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
			CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
Highly Organic Soils			PT	Peat, mucic, and other highly organic soils

CONSISTENCY OR RELATIVE DENSITY

CRITERIA

Standard Penetration Test

Penetration Resistance N (blows/ft)	Relative Density
0 - 4	Very loose
4 - 10	Loose
10 - 30	Medium
30 - 50	Dense
> 50	Very dense

Standard Penetration Test

Penetration Resistance N (blows/ft)	Consistency	Unconfined Compressive Strength (tons/ft^2)
<2	Very Soft	<0.25
2 - 4	Soft	0.25 - .050
4 - 8	Medium	0.50 - 1.00
8 - 15	Stiff	1.00 - 2.00
15 - 30	Very Stiff	2.00 - 4.00
>30	Hard	>4.00

	3"	3/4"	#4	#10	#40	#200 U.S. Standard Sieve
Unified Soil Classification	Cobbles	Gravel		Sand		Silt or Clay
		coarse	fine	coarse	medium	fine

MOISTURE CONDITIONS

Dry	Absence of moisture: dusty, dry to the touch
Slightly Moist	Below optimum moisture content for compaction
Moist	Near optimum moisture content
Very Moist	Above optimum moisture content
Wet	Visible free water; below water table

MATERIAL QUANTITY

trace	0 - 5 %
few	5 - 10 %
little	10 - 25 %
some	25 - 45 %

OTHER SYMBOLS

C Core Sample
S SPT Sample
B Bulk Sample
– Groundwater
Qp Pocket Penetrometer

BASIC LOG FORMAT:
Group name, Group symbol, (grain size), color, moisture, consistency or relative density. Additional comments: odor, presence of roots, mica, gypsum, coarse grained particles, etc.

EXAMPLE:
Sand (SP), fine to medium grained, brown, moist, loose, trace silt, little fine gravel, few cobbles up to 4" in size, some hair roots and rootlets.

GeoSoils, Inc.

BORING LOG

PROJECT: WAILES-BERRY
2685 Garfield Street, Carlsbad

W.O. 7886-A-SC *BORING* B-1 *SHEET* 1 *OF* 1

DATE EXCAVATED 6-26-20 *LOGGED BY:* MS *APPROX. ELEV.:* 44' MSL

SAMPLE METHOD: Hollow Stem Auger - 140 lb Hammer

Depth (ft.)	Sample: Bulk	Sample: Undisturbed	Sample: Blows/Ft.	USCS Symbol	Dry Unit Wt. (pcf)	Moisture (%)	Saturation (%)	Material Description
0				SM				**ASPHALTIC CONCRETE:**
					108.3	5.5	27.9	**PEA GRAVEL BASE:** @ 2" SAND with GRAVEL, dark olive brown, slightly moist.
			6	SM				
								UNDOCUMENTED FILL: @ 6" SAND with SILT, dark brown to dark olive brown, slightly moist, loose; fine to medium grain SAND.
5								**OLD PARALIC DEPOSITS:** @ 2½' SAND with SILT, medium brown to reddish brown, slightly moist, medium dense; medium grain SAND, well sorted.
			71	SP-SM	117.2	6.9	44.1	@ 7½' SILTY SAND, light reddish brown, dry, dense; fine to medium grain SAND, well sorted.
10								
			40/ 50-5"	SP				@ 12½' SAND with trace SILT, light to medium yellowish brown, dry, very dense; medium to coarse grain SAND, well sorted.
15								
			64					@ 17½' SAND with trace SILT, light yellow.
20								Total Depth = 19.5' No Caving or Groundwater Encountered Backfilled 6-26-20
25								
30								

Standard Penetration Test
Undisturbed, Ring Sample
Groundwater
Seepage

GeoSoils, Inc.

PLATE B-2

GeoSoils, Inc. BORING LOG

PROJECT: WAILES-BERRY
2685 Garfield Street, Carlsbad

W.O. 7886-A-SC BORING B-2 SHEET 1 OF 1

DATE EXCAVATED 6-26-20 LOGGED BY: MS APPROX. ELEV.: 44' MSL

SAMPLE METHOD: Hollow Stem Auger - 140 lb Hammer

Depth (ft.)	Sample: Bulk	Sample: Undisturbed	Sample: Blows/Ft.	USCS Symbol	Dry Unit Wt. (pcf)	Moisture (%)	Saturation (%)	Material Description
0				SM				**ASPHALTIC CONCRETE:**
								PEA GRAVEL BASE: @ 3" SAND with GRAVEL, dark olive brown, slightly moist.
								UNDOCUMENTED FILL: @ 6" SAND with SILT, dark brown to dark olive brown, slightly moist, loose; fine to medium grain SAND, metal debris.
5			22	SP-SM	111.5	10.4	56.9	**OLD PARALIC DEPOSITS:** @ 2½' SAND with SILT, dark reddish brown, slightly moist, medium dense; medium grain sand, well sorted. @ 5' As per 2½'; medium dense.
10			77	SP	113.7	7.2	41.7	@ 10' SAND with trace SILT, light to medium reddish brown, dry, very dense, medium grain sand, well sorted.
15			33/ 50-6"		106.1	2.5	11.9	@ 15' SAND with trace SILT, pale yellow to grayish white, dry, very dense; medium grain sand, well sorted.
			56		100.4	2.8	11.3	@ 19' As per 15'; dense.
20								Total Depth = 19½' No Caving or Groundwater Encountered Backfilled 6-26-20
25								
30								

Standard Penetration Test
Undisturbed, Ring Sample
Groundwater
Seepage

GeoSoils, Inc. BORING LOG

PROJECT: WAILES-BERRY 2685 Garfield Street, Carlsbad	*W.O.* 7886-A-SC *BORING* B-3 *SHEET* 1 *OF* 1 *DATE EXCAVATED* 6-26-20 *LOGGED BY:* MS *APPROX. ELEV.:* 54' MSL *SAMPLE METHOD:* Hand Auger

Depth (ft.)	Sample: Bulk	Sample: Undisturbed	Sample: Blows/Ft.	USCS Symbol	Dry Unit Wt. (pcf)	Moisture (%)	Saturation (%)	Material Description
0				SC				**COLLUVIUM (TOPSOIL):** @ 0' SILTY SAND, dark brown, slightly moist, loose; abundant roots.
5				SP-SM				**OIL PARALIC DEPOSITS:** @ 2' SAND with SILT, dark reddish brown, slightly moist, loose; medium grain sand, well sorted, weathered. @ 3' As per 2', medium dense, reddish brown. @ 4' As per 3', dark yellowish brown to reddish brown.
								Total Depth = 6' No Caving or Groundwater Encountered Backfilled 6-26-20
10								
15								
20								
25								
30								

Standard Penetration Test
Undisturbed, Ring Sample
Groundwater
Seepage

GeoSoils, Inc.

BORING LOG

PROJECT: WAILES-BERRY
2685 Garfield Street, Carlsbad

W.O. 7886-A-SC *BORING* B-4 *SHEET* 1 *OF* 1

DATE EXCAVATED 6-26-20 *LOGGED BY:* MS *APPROX. ELEV.:* 50' MSL

SAMPLE METHOD: Hand Auger

Depth (ft.)	Sample: Bulk	Sample: Undisturbed	Sample: Blows/Ft.	USCS Symbol	Dry Unit Wt. (pcf)	Moisture (%)	Saturation (%)	Material Description
0				SC				**UNDOCUMENTED FILL:** @ 0' CLAYEY SAND, light olive brown, slightly moist, medium dense.
	■			SP-SM				**OLD PARALIC DEPOSITS:** @ 1' SAND with SILT, dark brown to dark reddish brown, slightly moist, loose; medium grain sand, well sorted, weathered. @ 2' As per 1; reddish brown, medium dense. @ 4' As per 2'; dark yellowish brown.
5	■							
								Total Depth = 6' No Caving or Groundwater Encountered Backfilled 6-26-20
10								
15								
20								
25								
30								

Standard Penetration Test
Undisturbed, Ring Sample
Groundwater
Seepage

APPENDIX C

SEISMICITY

```
**********************
*                    *
*    E Q F A U L T   *
*                    *
*    Version 3.00    *
*                    *
**********************
```

DETERMINISTIC ESTIMATION OF
PEAK ACCELERATION FROM DIGITIZED FAULTS

JOB NUMBER: 7886-A-SC

DATE: 08-04-2020

JOB NAME: wailes

CALCULATION NAME: Test Run Analysis

FAULT-DATA-FILE NAME: C:\EQ\EQFAULT\CGSFLTE.DAT

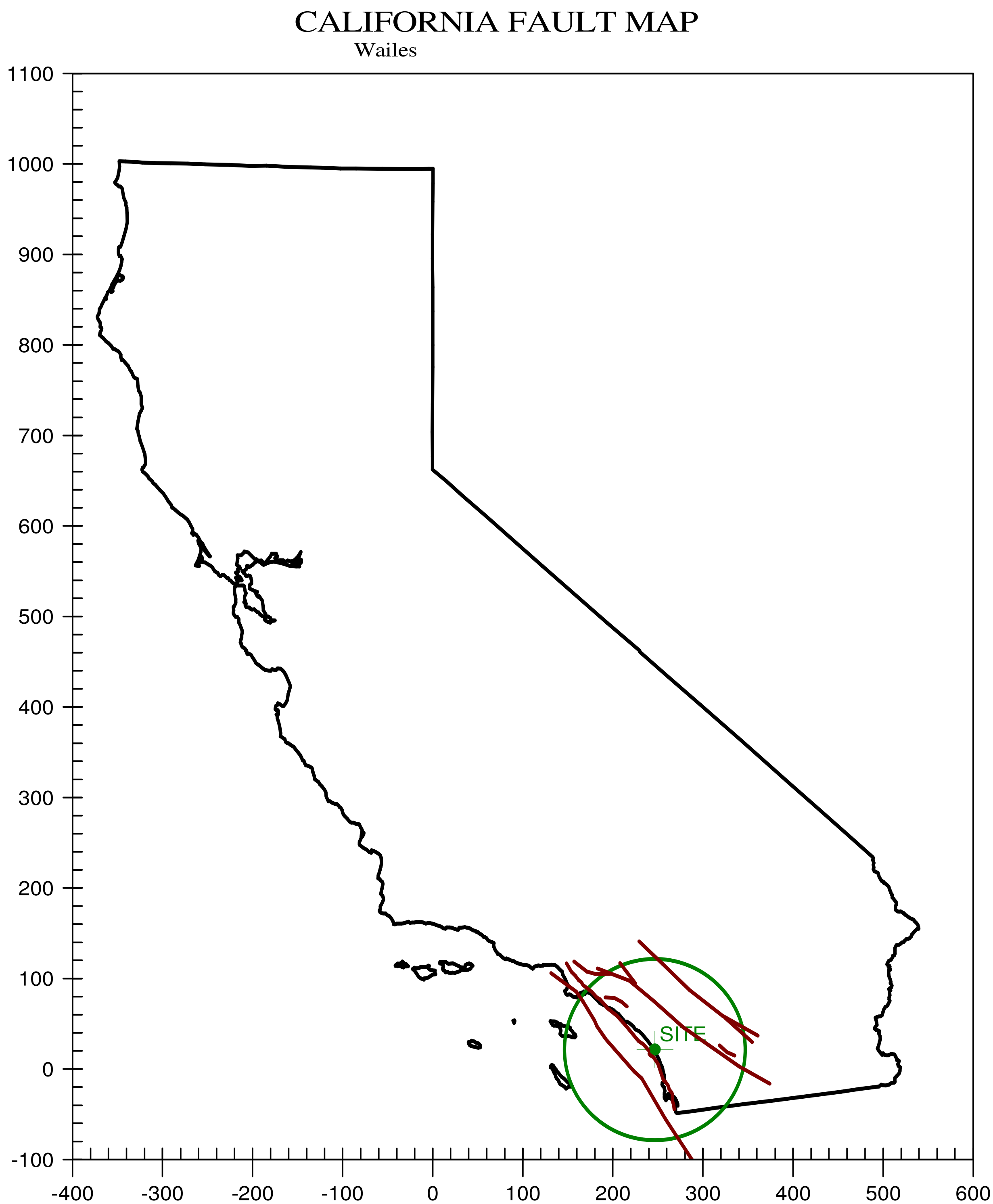
SITE COORDINATES:
SITE LATITUDE: 33.1605
SITE LONGITUDE: 117.3548

SEARCH RADIUS: 62.4 mi

ATTENUATION RELATION: 11) Bozorgnia Campbell Niazi (1999) Hor.-Pleist. Soil-Cor.
UNCERTAINTY (M=Median, S=Sigma): S Number of Sigmas: 1.0
DISTANCE MEASURE: cdist
SCOND: 1
Basement Depth: .01 km Campbell SSR: 0 Campbell SHR: 0
COMPUTE PEAK HORIZONTAL ACCELERATION

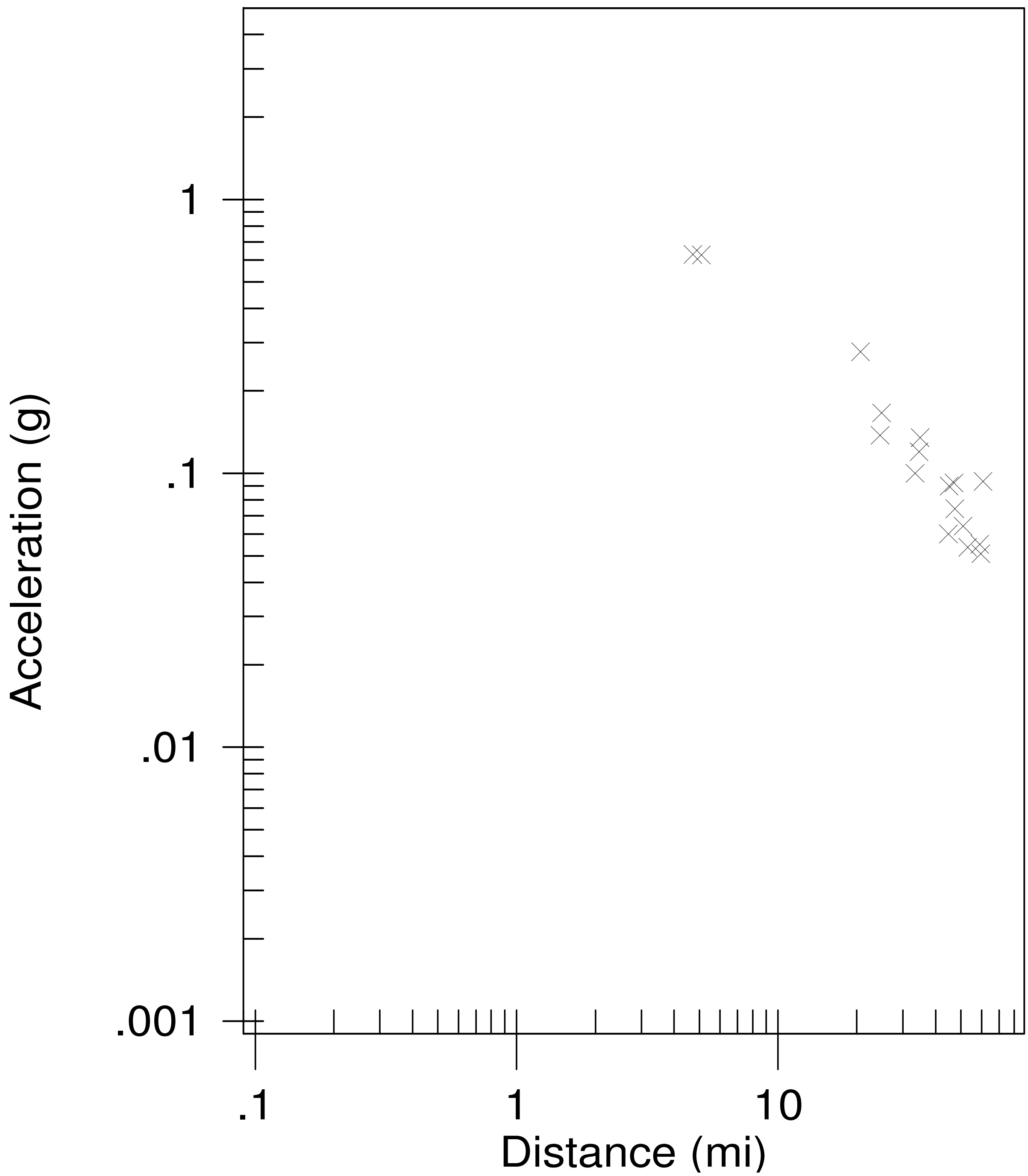
FAULT-DATA FILE USED: C:\EQ\EQFAULT\CGSFLTE.DAT

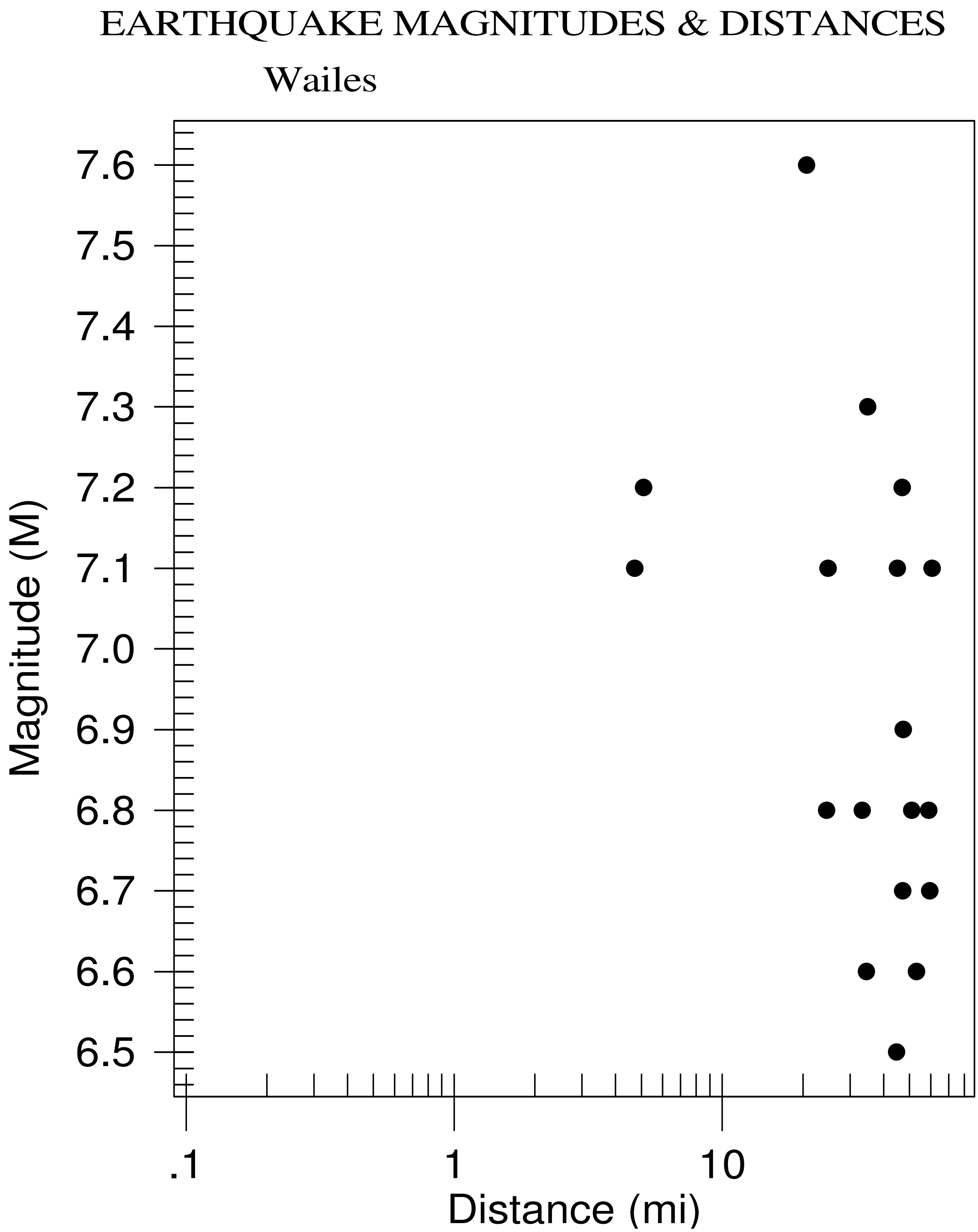
MINIMUM DEPTH VALUE (km): 3.0


CALIFORNIA FAULT MAP
Wailes
1100
1000
900
800
700
600
500
400
300
200
100
0
-100
-400
-300
-200
-100
0
100
200
300
400
500
600
SITE

MAXIMUM EARTHQUAKES

Wailes




EARTHQUAKE MAGNITUDES & DISTANCES
Wailes
Magnitude (M)
7.6
7.5
7.4
7.3
7.2
7.1
7.0
6.9
6.8
6.7
6.6
6.5
.1
1
10
Distance (mi)

```
*************************
*                       *
*     E Q S E A R C H   *
*                       *
*      Version 3.00     *
*                       *
*************************
```

ESTIMATION OF
PEAK ACCELERATION FROM
CALIFORNIA EARTHQUAKE CATALOGS

JOB NUMBER: 7886-A-SC

DATE: 08-04-2020

JOB NAME: Wailes

EARTHQUAKE-CATALOG-FILE NAME: ALLQUAKE.DAT

MAGNITUDE RANGE:
MINIMUM MAGNITUDE: 5.00
MAXIMUM MAGNITUDE: 9.00

SITE COORDINATES:
SITE LATITUDE: 33.1605
SITE LONGITUDE: 117.3548

SEARCH DATES:
START DATE: 1800
END DATE: 2020

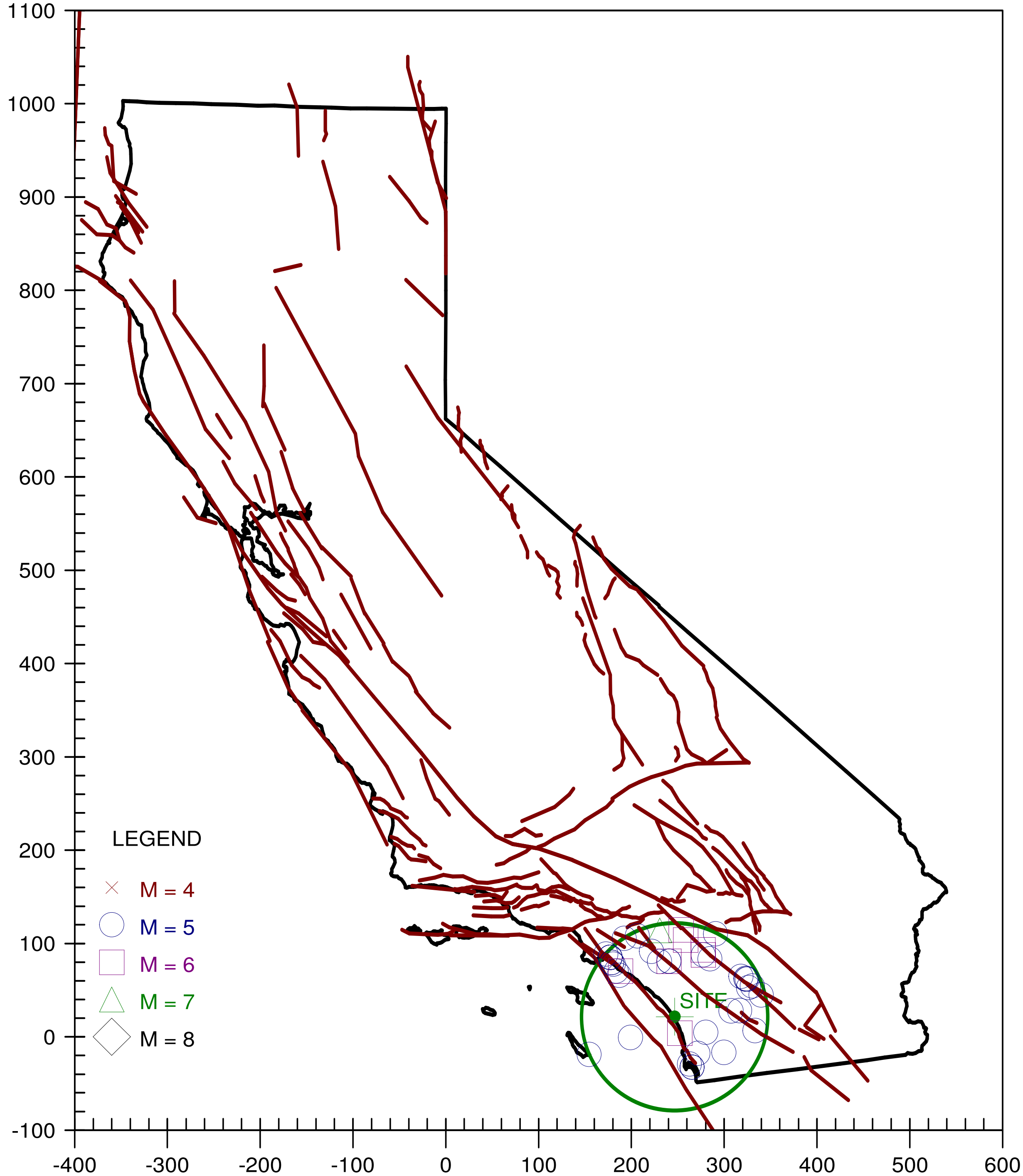
SEARCH RADIUS:
62.5 mi
100.6 km

ATTENUATION RELATION: 11) Bozorgnia Campbell Niazi (1999) Hor.-Pleist. Soil-Cor.
UNCERTAINTY (M=Median, S=Sigma): S Number of Sigmas: 1.0
ASSUMED SOURCE TYPE: SS [SS=Strike-slip, DS=Reverse-slip, BT=Blind-thrust]
SCOND: 1 Depth Source: A
Basement Depth: .01 km Campbell SSR: 0 Campbell SHR: 0
COMPUTE PEAK HORIZONTAL ACCELERATION

MINIMUM DEPTH VALUE (km): 3.0

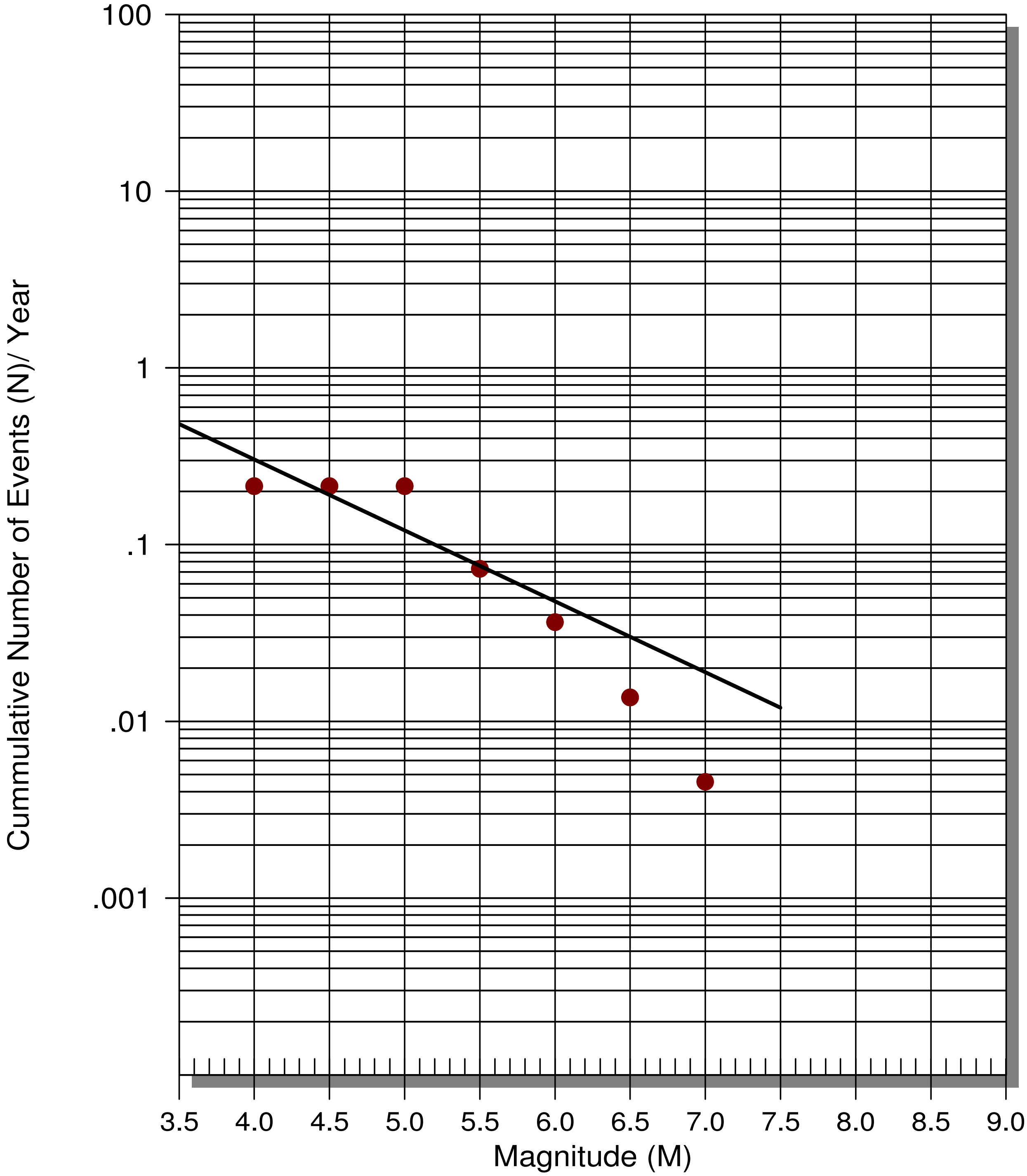
EARTHQUAKE EPICENTER MAP

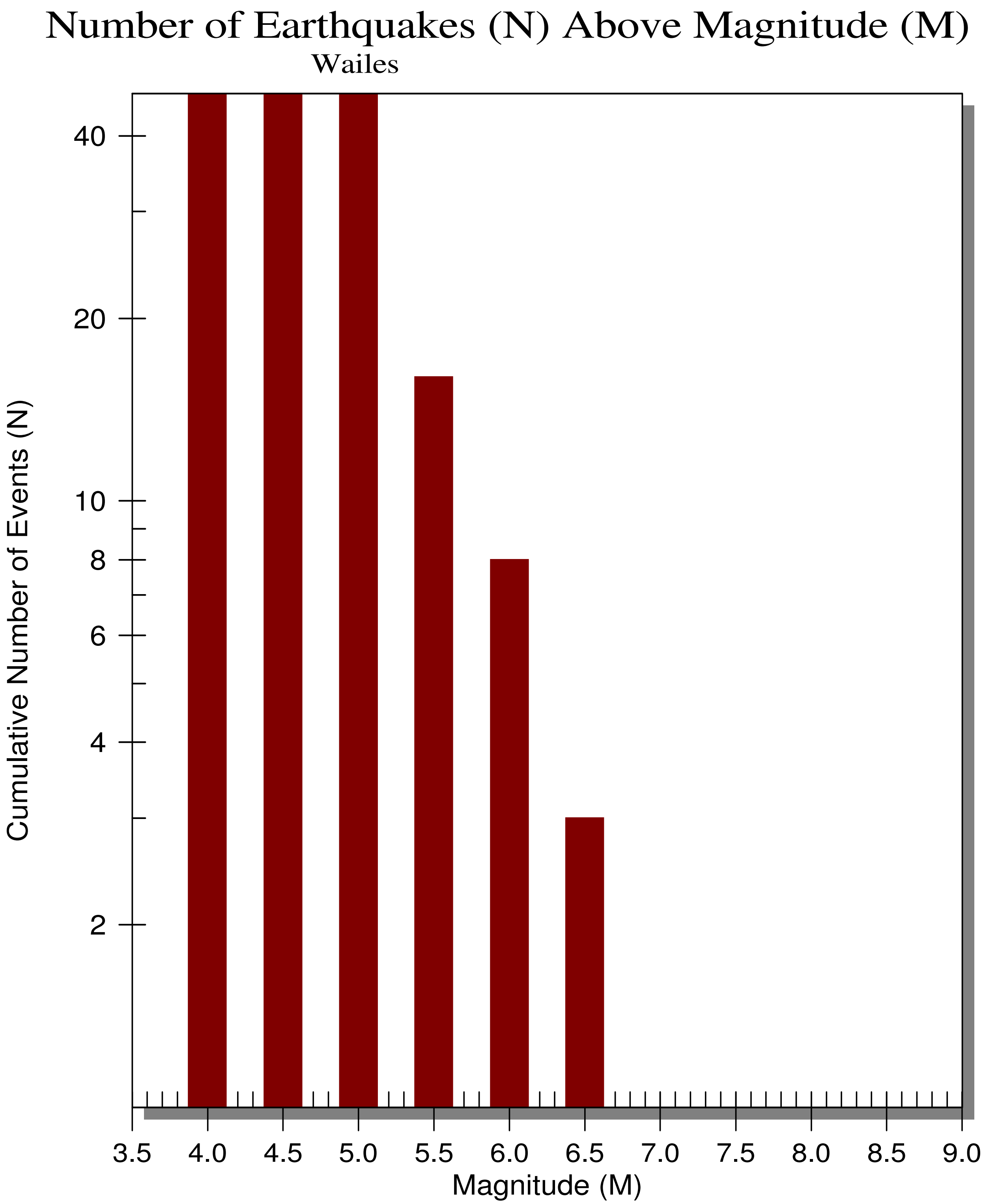
Wailes



EARTHQUAKE RECURRENCE CURVE

Wailes



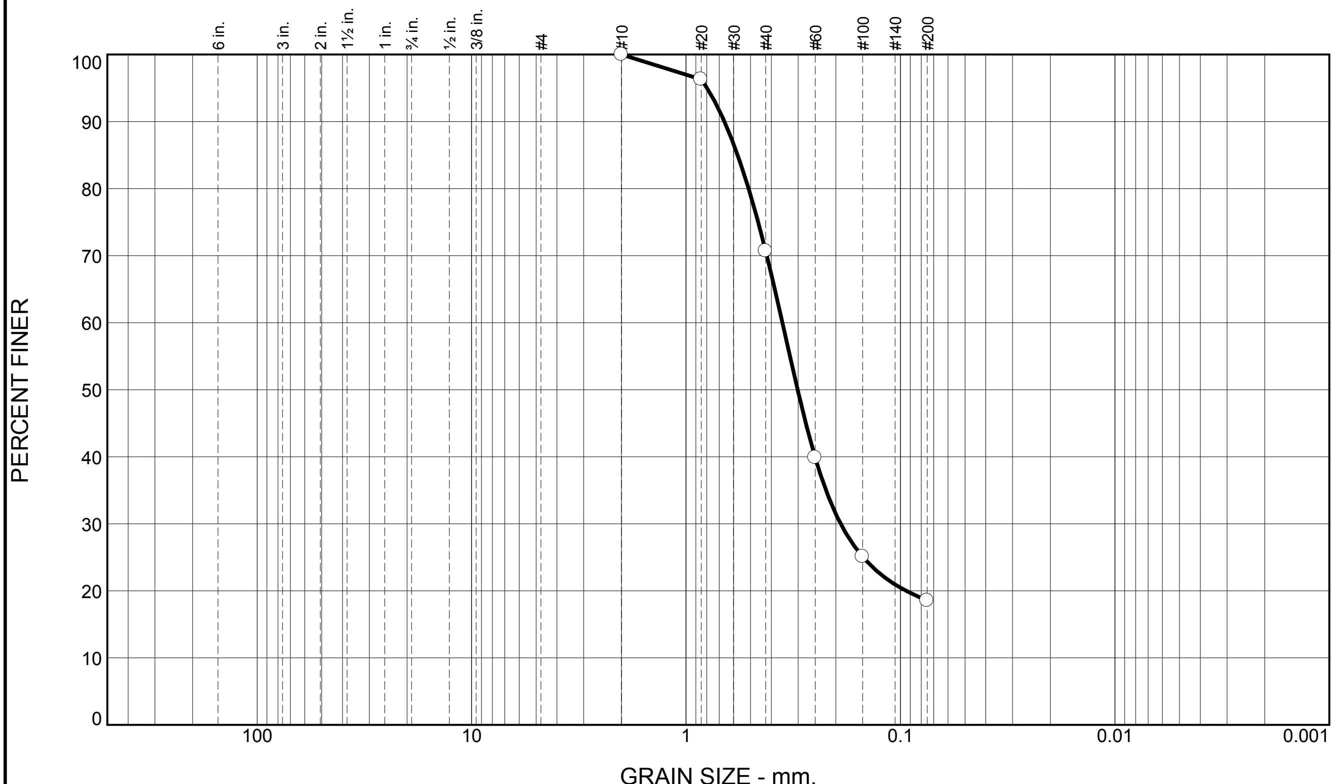


Number of Earthquakes (N) Above Magnitude (M)
Wailes
Cumulative Number of Events (N)
40
20
10
8
6
4
2
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
Magnitude (M)

APPENDIX D

LABORATORY TESTING

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	29.3	52.2	18.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#20	96.3		
#40	70.7		
#60	39.9		
#100	25.1		
#200	18.5		

* (no specification provided)

Soil Description

Brown Silty Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.6617 D_{85}= 0.5745 D_{60}= 0.3554
D_{50}= 0.3017 D_{30}= 0.1901 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

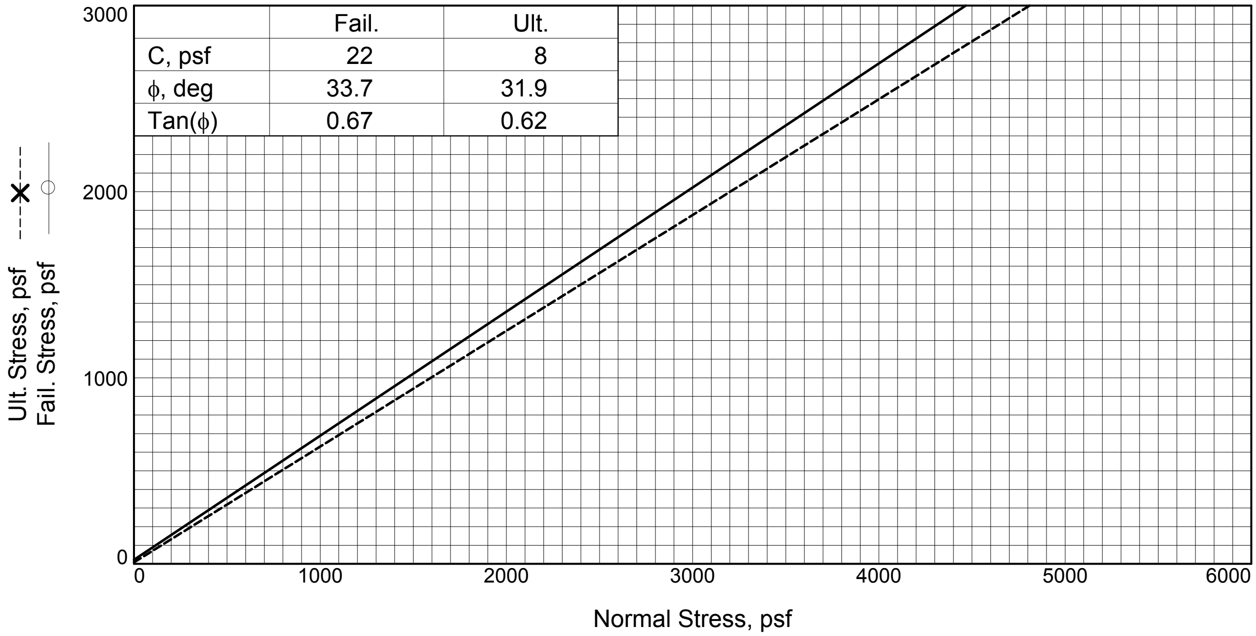
Source of Sample: B-1 **Depth:** 10-15
Sample Number: B-1 **Date:** 7-6-20

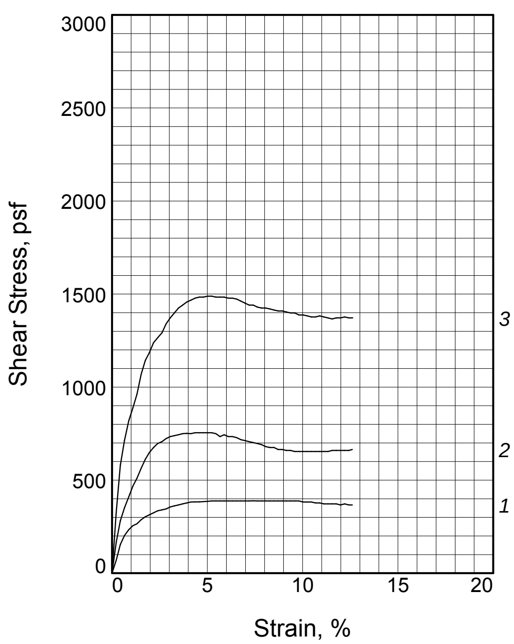
GeoSoils, Inc.

Client: Wailes-Berry
Project: 2685 Garfield St.
Project No: 7886-A-SC **Figure** D-1

Tested By: TR **Checked By:** TR

	Fail.	Ult.
C, psf	22	8
ϕ, deg	33.7	31.9
Tan(ϕ)	0.67	0.62





Sample No.		1	2	3
Initial	Water Content, %	5.5	5.5	5.5
	Dry Density, pcf	105.6	109.2	107.5
	Saturation, %	25.7	28.3	27.1
	Void Ratio	0.5673	0.5147	0.5388
	Diameter, in.	2.38	2.38	2.38
	Height, in.	1.00	1.00	1.00
At Test	Water Content, %	17.0	16.7	14.8
	Dry Density, pcf	105.9	109.7	108.7
	Saturation, %	80.2	86.9	75.2
	Void Ratio	0.5626	0.5086	0.5219
	Diameter, in.	2.38	2.38	2.38
	Height, in.	1.00	1.00	0.99
Normal Stress, psf		550	1100	2200
Fail. Stress, psf		388	755	1489
Strain, %		7.0	4.4	5.0
Ult. Stress, psf		372	659	1388
Strain, %		11.3	9.2	9.8
Strain rate, in./min.		0.005	0.005	0.005

Sample Type: Undisturbed
Description: Brown Silty Sand

Specific Gravity= 2.65
Remarks:

Figure D-2

Client: Wailes-Berry

Project: 2685 Garfield St.

Source of Sample: B-1 **Depth:** 2.0
Sample Number: B-1
Proj. No.: 7886-A-SC **Date Sampled:**

GeoSoils, Inc.

Tested By: TR **Checked By:** TR

SoilCor
CORROSION & THERMAL SCIENCES
42184 Remington Ave, Temecula CA 92590
ph (951) 795-3135 • fx (951) 894-2683

Work Order No.: 20G1141
Client: GeoSoils, Inc.
Project No.: 7886-A-SC
Project Name: Wailes-Berry
Report Date: July 7, 2020

Laboratory Test(s) Results Summary

The subject soil sample was processed with the U.S. Standard No. 10 Sieve and tested for pH (ASTM G 51-95 2012), Soil Resistivity (ASTM G 57-06 2012), Sulfate Ion Content (ASTM D 516-16) and Chloride Ion Content (ASTM D 512-12B). The test results follow:

Sample Identification	pH (H+)	As Rec'd Resistivity (ohm-cm)	Saturated Resistivity (ohm-cm)	Sulfate Content (mg/L)	Chloride Content (mg/L)
B3/B4 @ 1-6ft	7.6	33,000	14,000	ND	ND

*ND=No Detection

We appreciate the opportunity to serve you. Please do not hesitate to contact us with any questions or clarifications regarding these results or procedures.

Ahmet K. Kaya, Laboratory Manager

APPENDIX E

STORM WATER BMP CHECKLISTS/FORMS

Categorization of Infiltration Feasibility Condition		Form I-8	
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.	✔	
Provide basis: The USDA indicates that the site is underlain by the Marina Loamy Coarse Sand, which is noted to have infiltration rates varying from 0.57-1.98 inches/hour, and is categorized as Hydrologic Soil Group B. As the Marina Loamy Coarse Sand appears to be the dominant soil type, an infiltration rate in the range of 0.57 - 1.98 inches/hour should govern BMP design. Please note that a minimum factor of safety = 2.0 (per Form I-9) has not been applied. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			
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.		✔
Provide basis: Since the site is bounded by retaining walls to the west and north, and consists of a westward slope at a gradient of about 4:1 (h:v), planned BMPs that incorporate a full infiltration design will likely adversely affect wall performance and slope stability. Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.			

<table>
<tr><th colspan="4">Form I-8 Page 2 of 4</th></tr>
<tr><td>Criteri a</td><td>Screening Question</td><td>Yes</td><td>No</td></tr>
<tr><td>3</td><td>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.</td><td>✔</td><td></td></tr>
<tr><td colspan="4">Provide basis:

The site is not located near a drainage course. Based on our geotechnical site exploration, groundwater is greater than 20 feet below existing site grades, and likely at much lower elevations (>50 feet) near sea level.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
<tr><td>4</td><td>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.</td><td>✔</td><td></td></tr>
<tr><td colspan="4">Provide basis:

The site is not located near a drainage course. Based on our geotechnical site exploration, groundwater is greater than 20 feet below existing site grades, and likely at much lower elevations (>50 feet) near sea level.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability.</td></tr>
<tr><td>Part 1 Result *</td><td colspan="2">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</td><td>NO</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.

Form I-8 Page 3 of 4

<u>Part 2 – Partial Infiltration vs. No Infiltration Feasibility Screening Criteria</u>

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.	✔	

Provide basis:

The USDA indicates that the site is underlain by the Marina Loamy Coarse Sand, which is noted to have infiltration rates varying from 0.57-1.98 inches/hour, and is categorized as Hydrologic Soil Group B. As the Marina Loamy Coarse Sand appears to be the dominant soil type, an infiltration rate in the range of 0.57 - 1.98 inches/hour should govern BMP design. Please note that a minimum factor of safety = 2.0 (per Form I-9) has not been applied.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.

Criteria	Screening Question	Yes	No
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.	✔	

Provide basis:

Mitigation including, but not limited to: deepened foundations, and reduced soil design parameters (bearing value, lateral pressures, etc.) would be necessary for retaining wall improvements in the vicinity of any BMP.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.

<table>
<tr><th colspan="4">Form I-8 Page 4 of 4</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></td></tr>
<tr><td colspan="4">Provide basis:

Based on our geotechnical site exploration, groundwater is greater than 20 feet below existing site grades, and likely at much lower elevations (>50 feet) near sea level.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.</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>✔</td><td></td></tr>
<tr><td colspan="4">Provide basis:

Down stream water rights are considered a legal matter and typically do not fall within the purview of geotechnical engineering. However, GSI is not aware of any significant downstream water rights issues of concern on the adjoining properties. Given the relatively low infiltration rate evaluated onsite, infiltration should not significantly affect down stream water rights, from a geotechnical perspective.

Summarize findings of studies; provide reference to studies, calculations, maps, data sources, etc. Provide narrative discussion of study/data source applicability and why it was not feasible to mitigate low infiltration rates.</td></tr>
<tr><td>Part 2 Result*</td><td colspan="2">If all answers from row 5-8 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>Partial 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.

APPENDIX F

GENERAL EARTHWORK AND GRADING GUIDELINES

GENERAL EARTHWORK AND GRADING GUIDELINES

General

These guidelines present general procedures and requirements for earthwork and grading as shown on the approved grading plans, including preparation of areas to be filled, placement of fill, installation of subdrains, excavations, and appurtenant structures or flatwork. The recommendations contained in the geotechnical report are part of these earthwork and grading guidelines and would supercede the provisions contained hereafter in the case of conflict. Evaluations performed by the consultant during the course of grading may result in new or revised recommendations which could supercede these guidelines or the recommendations contained in the geotechnical report. Generalized details follow this text.

The contractor is responsible for the satisfactory completion of all earthwork in accordance with provisions of the project plans and specifications and latest adopted code. In the case of conflict, the most onerous provisions shall prevail. The project geotechnical engineer and engineering geologist (geotechnical consultant), and/or their representatives, should provide observation and testing services, and geotechnical consultation during the duration of the project.

EARTHWORK OBSERVATIONS AND TESTING

Geotechnical Consultant

Prior to the commencement of grading, a qualified geotechnical consultant (soil engineer and engineering geologist) should be employed for the purpose of observing earthwork procedures and testing the fills for general conformance with the recommendations of the geotechnical report(s), the approved grading plans, and applicable grading codes and ordinances.

The geotechnical consultant should provide testing and observation so that an evaluation may be made that the work is being accomplished as specified. It is the responsibility of the contractor to assist the consultants and keep them apprised of anticipated work schedules and changes, so that they may schedule their personnel accordingly.

All remedial removals, clean-outs, prepared ground to receive fill, key excavations, and subdrain installation should be observed and documented by the geotechnical consultant prior to placing any fill. It is the contractor’s responsibility to notify the geotechnical consultant when such areas are ready for observation.

Laboratory and Field Tests

Maximum dry density tests to determine the degree of compaction should be performed in accordance with American Standard Testing Materials test method ASTM designation D 1557. Random or representative field compaction tests should be performed in accordance with test methods ASTM designation D-1556, D-2937 or D-2922, and D-3017, at intervals of approximately ±2 feet of fill height or approximately every 1,000 cubic yards placed. These criteria would vary depending on the soil conditions and the size of the project. The location and frequency of testing would be at the discretion of the geotechnical consultant.

Contractor's Responsibility

All clearing, site preparation, and earthwork performed on the project should be conducted by the contractor, with observation by a geotechnical consultant, and staged approval by the governing agencies, as applicable. It is the contractor's responsibility to prepare the ground surface to receive the fill, to the satisfaction of the geotechnical consultant, and to place, spread, moisture condition, mix, and compact the fill in accordance with the recommendations of the geotechnical consultant. The contractor should also remove all non-earth material considered unsatisfactory by the geotechnical consultant.

Notwithstanding the services provided by the geotechnical consultant, it is the sole responsibility of the contractor to provide adequate equipment and methods to accomplish the earthwork in strict accordance with applicable grading guidelines, latest adopted codes or agency ordinances, geotechnical report(s), and approved grading plans. Sufficient watering apparatus and compaction equipment should be provided by the contractor with due consideration for the fill material, rate of placement, and climatic conditions. If, in the opinion of the geotechnical consultant, unsatisfactory conditions such as questionable weather, excessive oversized rock or deleterious material, insufficient support equipment, etc., are resulting in a quality of work that is not acceptable, the consultant will inform the contractor, and the contractor is expected to rectify the conditions, and if necessary, stop work until conditions are satisfactory.

During construction, the contractor shall properly grade all surfaces to maintain good drainage and prevent ponding of water. The contractor shall take remedial measures to control surface water and to prevent erosion of graded areas until such time as permanent drainage and erosion control measures have been installed.

SITE PREPARATION

All major vegetation, including brush, trees, thick grasses, organic debris, and other deleterious material, should be removed and disposed of off-site. These removals must be concluded prior to placing fill. In-place existing fill, soil, alluvium, colluvium, or rock materials, as evaluated by the geotechnical consultant as being unsuitable, should be removed prior to any fill placement. Depending upon the soil conditions, these materials may be reused as compacted fills. Any materials incorporated as part of the compacted fills should be approved by the geotechnical consultant.

Any underground structures such as cesspools, cisterns, mining shafts, tunnels, septic tanks, wells, pipelines, or other structures not located prior to grading, are to be removed or treated in a manner recommended by the geotechnical consultant. Soft, dry, spongy, highly fractured, or otherwise unsuitable ground, extending to such a depth that surface processing cannot adequately improve the condition, should be overexcavated down to firm ground and approved by the geotechnical consultant before compaction and filling operations continue. Overexcavated and processed soils, which have been properly mixed and moisture conditioned, should be re-compacted to the minimum relative compaction as specified in these guidelines.

Existing ground, which is determined to be satisfactory for support of the fills, should be scarified (ripped) to a minimum depth of 6 to 8 inches, or as directed by the geotechnical consultant. After the scarified ground is brought to optimum moisture content, or greater and mixed, the materials should be compacted as specified herein. If the scarified zone is greater than 6 to 8 inches in depth, it may be necessary to remove the excess and place the material in lifts restricted to about 6 to 8 inches in compacted thickness.

Existing ground which is not satisfactory to support compacted fill should be overexcavated as required in the geotechnical report, or by the on-site geotechnical consultant. Scarification, disc harrowing, or other acceptable forms of mixing should continue until the soils are broken down and free of large lumps or clods, until the working surface is reasonably uniform and free from ruts, hollows, hummocks, mounds, or other uneven features, which would inhibit compaction as described previously.

Where fills are to be placed on ground with slopes steeper than 5:1 (horizontal to vertical [h:v]), the ground should be stepped or benched. The lowest bench, which will act as a key, should be a minimum of 15 feet wide and should be at least 2 feet deep into firm material, and approved by the geotechnical consultant. In fill-over-cut slope conditions, the recommended minimum width of the lowest bench or key is also 15 feet, with the key founded on firm material, as designated by the geotechnical consultant. As a general rule, unless specifically recommended otherwise by the geotechnical consultant, the minimum width of fill keys should be equal to ½ the height of the slope.

Standard benching is generally 4 feet (minimum) vertically, exposing firm, acceptable material. Benching may be used to remove unsuitable materials, although it is understood that the vertical height of the bench may exceed 4 feet. Pre-stripping may be considered for unsuitable materials in excess of 4 feet in thickness.

All areas to receive fill, including processed areas, removal areas, and the toes of fill benches, should be observed and approved by the geotechnical consultant prior to placement of fill. Fills may then be properly placed and compacted until design grades (elevations) are attained.

COMPACTED FILLS

Any earth materials imported or excavated on the property may be utilized in the fill provided that each material has been evaluated to be suitable by the geotechnical consultant. These materials should be free of roots, tree branches, other organic matter, or other deleterious materials. All unsuitable materials should be removed from the fill as directed by the geotechnical consultant. Soils of poor gradation, undesirable expansion potential, or substandard strength characteristics may be designated by the consultant as unsuitable and may require blending with other soils to serve as a satisfactory fill material.

Fill materials derived from benching operations should be dispersed throughout the fill area and blended with other approved material. Benching operations should not result in the benched material being placed only within a single equipment width away from the fill/formation contact.

Oversized materials defined as rock, or other irreducible materials, with a maximum dimension greater than 12 inches, should not be buried or placed in fills unless the location of materials and disposal methods are specifically approved by the geotechnical consultant. Oversized material should be taken offsite, or placed in accordance with recommendations of the geotechnical consultant in areas designated as suitable for rock disposal. GSI anticipates that soils to be utilized as fill material for the subject project may contain some rock. Appropriately, the need for rock disposal may be necessary during grading operations on the site. From a geotechnical standpoint, the depth of any rocks, rock fills, or rock blankets, should be a sufficient distance from finish grade. This depth is generally the same as any overexcavation due to cut-fill transitions in hard rock areas, and generally facilitates the excavation of structural footings and substructures. Should deeper excavations be proposed (i.e., deepened footings, utility trenching, swimming pools, spas, etc.), the developer may consider increasing the hold-down depth of any rocky fills to be placed, as appropriate. In addition, some agencies/jurisdictions mandate a specific hold-down depth for oversize materials placed in fills. The hold-down depth, and potential to encounter oversize rock, both within fills, and occurring in cut or natural areas, would need to be disclosed to all interested/affected parties. Once approved by the governing agency, the hold-down depth for oversized rock (i.e., greater than 12 inches) in fills on this project is provided as 10 feet, unless specified differently in the text of this report. The governing agency may require that these materials need to be deeper, crushed, or reduced to less than 12 inches in maximum dimension, at their discretion.

To facilitate future trenching, rock (or oversized material), should not be placed within the hold-down depth feet from finish grade, the range of foundation excavations, future utilities, or underground construction unless specifically approved by the governing agency, the geotechnical consultant, and/or the developer's representative.

If import material is required for grading, representative samples of the materials to be utilized as compacted fill should be analyzed in the laboratory by the geotechnical consultant to evaluate it's physical properties and suitability for use onsite. Such testing should be performed three (3) days prior to importation. If any material other than that previously tested is encountered during grading, an appropriate analysis of this material should be conducted by the geotechnical consultant as soon as possible.

Approved fill material should be placed in areas prepared to receive fill in near horizontal layers, that when compacted, should not exceed about 6 to 8 inches in thickness. The geotechnical consultant may approve thick lifts if testing indicates the grading procedures are such that adequate compaction is being achieved with lifts of greater thickness. Each layer should be spread evenly and blended to attain uniformity of material and moisture suitable for compaction.

Fill layers at a moisture content less than optimum should be watered and mixed, and wet fill layers should be aerated by scarification, or should be blended with drier material. Moisture conditioning, blending, and mixing of the fill layer should continue until the fill materials have a uniform moisture content at, or above, optimum moisture.

After each layer has been evenly spread, moisture conditioned, and mixed, it should be uniformly compacted to a minimum of 90 percent of the maximum density as evaluated by ASTM test designation D-1557, or as otherwise recommended by the geotechnical consultant. Compaction equipment should be adequately sized and should be specifically designed for soil compaction, or of proven reliability to efficiently achieve the specified degree of compaction.

Where tests indicate that the density of any layer of fill, or portion thereof, is below the required relative compaction, or improper moisture is in evidence, the particular layer or portion shall be re-worked until the required density and/or moisture content has been attained. No additional fill shall be placed in an area until the last placed lift of fill has been tested and found to meet the density and moisture requirements, and is approved by the geotechnical consultant.

In general, per the latest adopted version of the California Building Code (CBC), fill slopes should be designed and constructed at a gradient of 2:1 (h:v), or flatter. Compaction of slopes should be accomplished by over-building a minimum of 3 feet horizontally, and subsequently trimming back to the design slope configuration. Testing shall be performed as the fill is elevated to evaluate compaction as the fill core is being developed. Special efforts may be necessary to attain the specified compaction in the fill slope zone. Final slope shaping should be performed by trimming and removing loose materials with appropriate equipment. A final evaluation of fill slope compaction should be based on observation and/or testing of the finished slope face. Where compacted fill slopes are designed steeper than 2:1 (h:v), prior approval from the governing agency, specific material types, a higher minimum relative compaction, special reinforcement, and special grading procedures will be recommended.

If an alternative to over-building and cutting back the compacted fill slopes is selected, then special effort should be made to achieve the required compaction in the outer 10 feet of each lift of fill by undertaking the following:

1. An extra piece of equipment consisting of a heavy, short-shanked sheepsfoot should be used to roll (horizontal) parallel to the slopes continuously as fill is placed. The sheepsfoot roller should also be used to roll perpendicular to the

slopes, and extend out over the slope to provide adequate compaction to the face of the slope.

2. Loose fill should not be spilled out over the face of the slope as each lift is compacted. Any loose fill spilled over a previously completed slope face should be trimmed off or be subject to re-rolling.

3. Field compaction tests will be made in the outer (horizontal) ± 2 to ± 8 feet of the slope at appropriate vertical intervals, subsequent to compaction operations.

4. After completion of the slope, the slope face should be shaped with a small tractor and then re-rolled with a sheepsfoot to achieve compaction to near the slope face. Subsequent to testing to evaluate compaction, the slopes should be grid-rolled to achieve compaction to the slope face. Final testing should be used to evaluate compaction after grid rolling.

5. Where testing indicates less than adequate compaction, the contractor will be responsible to rip, water, mix, and recompact the slope material as necessary to achieve compaction. Additional testing should be performed to evaluate compaction.

SUBDRAIN INSTALLATION

Subdrains should be installed in approved ground in accordance with the approximate alignment and details indicated by the geotechnical consultant. Subdrain locations or materials should not be changed or modified without approval of the geotechnical consultant. The geotechnical consultant may recommend and direct changes in subdrain line, grade, and drain material in the field, pending exposed conditions. The location of constructed subdrains, especially the outlets, should be recorded/surveyed by the project civil engineer. Drainage at the subdrain outlets should be provided by the project civil engineer.

EXCAVATIONS

Excavations and cut slopes should be examined during grading by the geotechnical consultant. If directed by the geotechnical consultant, further excavations or overexcavation and refilling of cut areas should be performed, and/or remedial grading of cut slopes should be performed. When fill-over-cut slopes are to be graded, unless otherwise approved, the cut portion of the slope should be observed by the geotechnical consultant prior to placement of materials for construction of the fill portion of the slope. The geotechnical consultant should observe all cut slopes, and should be notified by the contractor when excavation of cut slopes commence.

If, during the course of grading, unforeseen adverse or potentially adverse geologic conditions are encountered, the geotechnical consultant should investigate, evaluate, and make appropriate recommendations for mitigation of these conditions. The need for cut slope buttressing or stabilizing should be based on in-grading evaluation by the geotechnical consultant, whether anticipated or not.

Unless otherwise specified in geotechnical and geological report(s), no cut slopes should be excavated higher or steeper than that allowed by the ordinances of controlling governmental agencies. Additionally, short-term stability of temporary cut slopes is the contractor's responsibility.

Erosion control and drainage devices should be designed by the project civil engineer and should be constructed in compliance with the ordinances of the controlling governmental agencies, and/or in accordance with the recommendations of the geotechnical consultant.

COMPLETION

Observation, testing, and consultation by the geotechnical consultant should be conducted during the grading operations in order to state an opinion that all cut and fill areas are graded in accordance with the approved project specifications. After completion of grading, and after the geotechnical consultant has finished observations of the work, final reports should be submitted, and may be subject to review by the controlling governmental agencies. No further excavation or filling should be undertaken without prior notification of the geotechnical consultant or approved plans.

All finished cut and fill slopes should be protected from erosion and/or be planted in accordance with the project specifications and/or as recommended by a landscape architect. Such protection and/or planning should be undertaken as soon as practical after completion of grading.

JOB SAFETY

General

At GSI, getting the job done safely is of primary concern. The following is the company's safety considerations for use by all employees on multi-employer construction sites. On-ground personnel are at highest risk of injury, and possible fatality, on grading and construction projects. GSI recognizes that construction activities will vary on each site, and that site safety is the prime responsibility of the contractor; however, everyone must be safety conscious and responsible at all times. To achieve our goal of avoiding accidents, cooperation between the client, the contractor, and GSI personnel must be maintained.

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

Safety Meetings: GSI field personnel are directed to attend contractor's regularly scheduled and documented safety meetings.

Safety Vests: Safety vests are provided for, and are to be worn by GSI personnel, at all times, when they are working in the field.

Safety Flags: Two safety flags are provided to GSI field technicians; one is to be affixed to the vehicle when on site, the other is to be placed atop the spoil pile on all test pits.

Flashing Lights: All vehicles stationary in the grading area shall use rotating or flashing amber beacons, or strobe lights, on the vehicle during all field testing. While operating a vehicle in the grading area, the emergency flasher on the vehicle shall be activated.

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

Test Pits Location, Orientation, and Clearance

The technician is responsible for selecting test pit locations. A primary concern should be the technician's safety. Efforts will be made to coordinate locations with the grading contractor's authorized representative, and to select locations following or behind the established traffic pattern, preferably outside of current traffic. The contractor's authorized representative (supervisor, grade checker, dump man, operator, etc.) should direct excavation of the pit and safety during the test period. Of paramount concern should be the soil technician's safety, and obtaining enough tests to represent the fill.

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

A zone of non-encroachment should be established for all test pits. No grading equipment should enter this zone during the testing procedure. The zone should extend approximately 50 feet outward from the center of the test pit. This zone is established for safety and to avoid excessive ground vibration, which typically decreases test results.

When taking slope tests, the technician should park the vehicle directly above or below the test location. If this is not possible, a prominent flag should be placed at the top of the slope. The contractor's representative should effectively keep all equipment at a safe operational distance (e.g., 50 feet) away from the slope during this testing.

The technician is directed to withdraw from the active portion of the fill as soon as possible following testing. The technician's vehicle should be parked at the perimeter of the fill in a highly visible location, well away from the equipment traffic pattern. The contractor should inform our personnel of all changes to haul roads, cut and fill areas or other factors that may affect site access and site safety.

In the event that the technician’s safety is jeopardized or compromised as a result of the contractor’s failure to comply with any of the above, the technician is required, by company policy, to immediately withdraw and notify his/her supervisor. The grading contractor’s representative will be contacted in an effort to affect a solution. However, in the interim, no further testing will be performed until the situation is rectified. Any fill placed can be considered unacceptable and subject to reprocessing, recompaction, or removal.

In the event that the soil technician does not comply with the above or other established safety guidelines, we request that the contractor bring this to the technician’s attention and notify this office. Effective communication and coordination between the contractor’s representative and the soil technician is strongly encouraged in order to implement the above safety plan.

Trench and Vertical Excavation

It is the contractor's responsibility to provide safe access into trenches where compaction testing is needed. Our personnel are directed not to enter any excavation or vertical cut which: 1) is 5 feet or deeper unless shored or laid back; 2) displays any evidence of instability, has any loose rock or other debris which could fall into the trench; or 3) displays any other evidence of any unsafe conditions regardless of depth.

All trench excavations or vertical cuts in excess of 5 feet deep, which any person enters, should be shored or laid back. Trench access should be provided in accordance with Cal/OSHA and/or state and local standards. Our personnel are directed not to enter any trench by being lowered or “riding down” on the equipment.

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

If GSI personnel become aware of anyone working beneath an unsafe trench wall or vertical excavation, we have a legal obligation to put the contractor and owner/developer on notice to immediately correct the situation. If corrective steps are not taken, GSI then has an obligation to notify Cal/OSHA and/or the proper controlling authorities.