ENGINEERING GEOLOGY AND GEOTECHNICAL ENGINEERING REPORT

ANTHEM CHAPEL MAIN SANCTUARY
6595 COVINGTON WAY
GOLETA, CALIFORNIA

PROJECT NO.: 306481-001
MARCH 8, 2024
(REVISED JUNE 13, 2024)

PREPARED FOR

Anthem Chapel
6595 Covington Way
Goleta, California 93117

BY

EARTH SYSTEMS PACIFIC
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March 8, 2024
(Revised June 13, 2024)

Project No.: 306481-001
Report No.: 24-3-18

Anthem Chapel
Attention: Pastor Nate Wagner and Pastor Lars Linton
6595 Covington Way
Goleta, California 93117

Project: Anthem Chapel Main Sanctuary
6595 Covington Way
Goleta, California
Subject: Engineering Geology and Geotechnical Engineering Report

As authorized, Earth Systems Pacific (Earth Systems) has prepared this Engineering Geology and Geotechnical Engineering Report for proposed construction of a new sanctuary and parking lot at the Anthem Chapel, which is located at 6595 Covington Way in Goleta, California. The accompanying Engineering Geology and Geotechnical Engineering Report presents the results of our subsurface exploration and laboratory testing programs, and our conclusions and recommendations pertaining to geotechnical aspects of project design. We appreciate the opportunity to be of service to you on this project. Please call if you have any questions, or if we can be of further service.

Respectfully submitted,

EARTH SYSTEMS PACIFIC

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INTRODUCTION

Project Description

This report presents results of an Engineering Geology and Geotechnical Engineering study performed for a main sanctuary and a parking lot at the Anthem Chapel in Goleta, California (see the Vicinity Map in Appendix A). The main sanctuary will be a two-story, approximately 16,000 square-foot building. The new parking lot is anticipated to be paved with asphalt concrete and permeable pavers. The main sanctuary will be located on North Los Carneros Road just south of Covington Way. The parking lot will be on the southwest side of the proposed main sanctuary building.

Some grading involving minor cuts and fills of a few feet or less is anticipated to create a level pad for the main sanctuary. Similar minor grading is anticipated for the parking lot. The construction type for the main sanctuary was unknown when this report was prepared. However, it is expected that the building will be supported by conventional shallow continuous and isolated pad footings. Structural loads are not expected to exceed 25 kips at columns and 3 kips per lineal foot at walls. Retaining walls are not indicated on the project plans but retaining wall recommendations are provided in this report.

Purpose and Scope of Work

The purpose of the geologic/geotechnical study that led to this report was to analyze the soil conditions in the area of the proposed main sanctuary and parking lot and to provide geologic/geotechnical recommendations for design and construction. The soil conditions include surface and subsurface soil types, expansion potential, soil strength, settlement potential, bearing capacity, and the presence or absence of subsurface water. The scope of work included:

- Performing a reconnaissance of the areas adjacent to the proposed main sanctuary.
- Drilling, sampling, and logging nine hollow-stem-auger borings, six in or immediately adjacent to the main sanctuary area, and three near or in the proposed parking lot near Covington Way, to study soil and groundwater conditions.
- Nine additional infiltration borings were drilled. The infiltration results are being reported separately.
- Laboratory testing soil samples obtained during the subsurface exploration to determine their physical and engineering properties.

- Consulting with owner representatives and design professionals.
- Analyzing the geotechnical data obtained.
- Preparing this report.

Contained in this report are:

- Descriptions and results of field and laboratory tests that were performed.
- Conclusions and recommendations pertaining to site grading, structural design, paving.

Site Setting

The proposed construction area is located at the southeast corner of North Los Carneros Road and Covington Way in Goleta, California. The property is bounded by North Los Carneros Road on the southwest, by Covington Way on the northwest, by a Goleta Valley Historical Society site and Los Carneros Lake Park to the northeast, and by Santa Barbara County Fire Station 14 to the southeast.

The proposed main sanctuary will be located southwest of existing church and chapel buildings, northeast of a fire station, and will front onto North Los Carneros Road. The proposed parking lot will wrap around the proposed main sanctuary on its southeast, northeast, and northwest sides. There will also be a new parking lot with access from Covington Way (hereafter referred to as the Covington Way parking lot) constructed northwest of the proposed main sanctuary.

The area on which the proposed main sanctuary will be constructed is flat and slopes southward at a small gradient. The area of the proposed main sanctuary and most of the proposed parking lot is a combination of bare earth and annual grasses. Some trees are located along the northwest edge of the main sanctuary site, and a lone tree is located in the proposed Covington Way parking lot. The remainder of the site is vegetated with annual grasses.

The approximate geographic coordinates of the proposed main sanctuary are 34.4437˚ North Latitude and 119.8536° West Longitude.

REGIONAL GEOLOGY

The site lies on a piedmont within the Santa Barbara coast plain at the foot of the Santa Ynez Mountains in the western portion of the Transverse Ranges geologic province. Numerous east-west trending folds and reverse faults indicative of active north-south transpressional tectonics characterize the region. The ongoing regional compression produces the east-west trending faults that deform early Pleistocene- to Tertiary-aged marine and non-marine sedimentary bedrock units. These sedimentary bedrock units appear to underlie the site at a depth of about 23.5 feet based on our borings.

Both T.W. Dibblee, Jr. (Geologic Map of the Goleta Quadrangle, 1987) and the United States Geologic Survey (USGS) (Geologic Map of the Santa Barbara Coastal Plain, 2009) show the east-west trending Glenn Annie fault to be the fault closest to the project site. Dibblee maps this fault about 2,200 feet northeast of the proposed main sanctuary (see Regional Geologic Map 1 in Appendix A) and USGS maps this fault about 2,000 feet northeast of the proposed main sanctuary (see Regional Geologic Map 2 in Appendix A).

Dibblee maps the proposed main sanctuary area as underlain by Pleistocene age older alluvium consisting of silts, sands, and gravel, whereas the USGS maps the proposed main sanctuary as underlain by Holocene and upper Pleistocene age alluvium and colluvium that is 10 meters or less thick also consisting of silts, sands and gravel. Our field study encountered interbedded clays, clayey sands, and silty sands. At a depth of 23.5 feet (about 7 meters), the soils appear to be weathered Rincon Formation, which became hard at a depth of about 35 feet.

SEISMICITY AND SEISMIC DESIGN

The site is located in an active seismic region where large numbers of earthquakes are recorded each year. Historically, major earthquakes felt in the vicinity of the subject site have originated from faults inside and/or outside the area. These include the December 21, 1812 “Santa Barbara Region” earthquake, which was presumably centered in the Santa Barbara Channel, the 1857 Fort Tejon earthquake, the 1872 Owens Valley earthquake, and the 1952 Arvin-Tehachapi earthquake.

It is assumed that the 2022 CBC and ASCE 7-16 guidelines will apply for the seismic design parameters. The 2022 CBC includes several seismic design parameters that are influenced by the geographic site location with respect to active and potentially active faults, and with respect to subsurface soil or rock conditions. One of these factors is risk category. According to CBC Table 1604.5, because the primary occupancy of the proposed main sanctuary is public assemble greater than 300 persons, the proposed structure’s risk category is “III”. The “general procedure" (i.e., probabilistic) seismic design parameters presented below were retrieved from the U.S. Seismic Design Maps web services using the SEAOC/OSHPD website which presents the data in a report format. The data were retrieved for ASCE 7-16 design code, site coordinates 34.4437° North Latitude and 119.8536° West Longitude, Soil Site Class D, and Occupancy (Risk) Category III. A listing of the 2022 CBC and ASCE 7-16 Seismic Parameters is presented below and again in Appendix D.

Summary of Seismic Parameters – 2022 CBC "General Procedure"	
Site Class (ASCE 7-16)	D
Occupancy (Risk) Category	III
Seismic Design Category	Null*
Maximum Considered Earthquake (MCE) Ground Motion	
Spectral Response Acceleration, Short Period – S_s	2.263 g
Spectral Response Acceleration at 1 sec. – S_1	0.800 g
Site Coefficient – F_a	1.0
Site Coefficient – F_v	Null*
Site-Modified Spectral Response Acceleration, Short Period – S_{MS}	2.263 g
Site-Modified Spectral Response Acceleration at 1 sec. – S_{M1}	Null*
Design Earthquake Ground Motion	
Short Period Spectral Response – S_{DS}	1.509 g
One Second Spectral Response – S_{D1}	Null*
Site Modified Peak Ground Acceleration - PGA_M	1.095 g
Values appropriate for a 2% probability of exceedance in 50 years	

*See Section 11.4.8, ASCE 7-16

The Fault Parameters table in Appendix D lists the significant "active" and "potentially active" faults within an approximate 43-mile radius of the proposed construction location. The distance between the proposed main sanctuary and the nearest portion of each fault is shown as well as the respective estimated maximum earthquake magnitudes.

SOIL AND GROUNDWATER CONDITIONS

Evaluation of the subsurface indicates that much of the proposed main sanctuary area is underlain by alluvium composed of lean sand clays, clayey sands, and silty sands within the depth of influence of anticipated shallow foundations. The clayey soils vary from medium stiff to very stiff, and the sandy soils vary from medium dense to dense. The density and stiffness of the soils increase with depth. At a depth of about 23.5 feet a very stiff fat clay was encountered, and below a depth of 40 feet was hard sandy clay. These two latter units are thought to be weathered and unweathered Rincon Formation bedrock.

Testing indicates that anticipated bearing soils at the main sanctuary lie in the "Medium" expansion range based on a measured expansion index of 68. In addition, two consolidation samples swelled about 2% to 3% when water was added under a pressure of 1,000 psf. Soil swelling under this pressure is a further indication that the soils are expansive.

Groundwater was encountered at a depth of about 20 feet in Borings B-1. Groundwater was not encountered in the other eight borings, but all of them were less than 20 feet deep. It should be noted that fluctuations in groundwater levels may occur because of variations in rainfall, regional climate, and other factors.

A sample of near-surface soil was tested for pH, resistivity, soluble sulfates, and soluble chlorides. The test results provided in Appendix B should be distributed to the design team for their interpretations pertaining to the corrosivity or reactivity of various construction materials (such as concrete and piping) with the soils. It should be noted that the sulfate contents (35 mg/Kg) is in the "S0" exposure class (i.e., "Negligible" severity range) of Table 19.3.1.1 of ACI 318-14. Therefore, special concrete designs will not be necessary for the measured sulfate content according to Table 19.3.2.1 of ACI 318-14.

Based on criteria established by the County of Los Angeles (2013), the measured resistivities of the near-surface soil samples (12,700 ohms-cm indicates that near-surface soils are "Mildly" corrosive to ferrous metal (i.e., cast iron, etc.) pipes. It should be noted that Earth Systems does not practice soil corrosion engineering.

HYDROCOLLAPSE POTENTIAL

Hydrocollapse is a phenomenon in which naturally occurring soil deposits, or non-engineered fill soils, collapse when wetted. Natural soils that are susceptible to this phenomenon are typically aeolian, debris flow, alluvial, or colluvial deposits with high apparent strength when dry. Loosely compacted fills can also be susceptible to this phenomenon. The dry strength is attributed to salts, clays, silts, and in some cases capillary tension, "bonding" larger soil grains together. So long as these soils remain dry, their strength and resistance to compression are retained. However, when wetted, the salt, clay, or silt bonding agent is weakened or dissolved, or capillary tension reduced, eventually leading to collapse. Soils susceptible to this phenomenon are found throughout the southwestern United States.

Two consolidation tests were performed in which the samples were flooded with water under a pressure of 1,000 psf. Both samples swelled when the water was added, one over 3% and the other over 2%. This is the opposite of collapse. For both samples, the pressure at flooding exceeded its in-situ overburden pressure. Considering these test results, the relatively high densities of the recovered soil samples, and high sampler driving resistance, is appears that the potential for hydrocollapse at the proposed main sanctuary is low.

LIQUEFACTION POTENTIAL

Earthquake-induced cyclic loading can be the cause of several significant phenomena, including liquefaction in fine sands and silty sands. Liquefaction results in a loss of soil strength and can cause structures to settle and, in extreme cases, to experience bearing failure.

We have analyzed liquefaction potential in accordance with the guidelines presented by the California Geologic Survey (2008) in Guidelines for Evaluating and Mitigation Seismic Hazards in California. We used the data from Boring B-1 and the results of laboratory data to perform liquefaction potential analysis. Although groundwater was encountered at a depth of about 20 feet, for the analysis, the groundwater depth was conservatively set at a depth of 13.5 feet. The results of the analysis are presented in Appendix E and show that the liquefaction potential at the site is low. No liquefaction is predicted.

SEISMIC-INDUCED SETTLEMENT OF DRY SANDS

Dry (unsaturated) soils tend to settle and densify when subjected to earthquake shaking. The amount of settlement is a function of relative density, cyclic shear strain magnitude, and the number of strain cycles. A procedure to evaluate this type of settlement was developed by Seed and Silver (1972) and later modified by Pyke, et al. (1975). Tokimatsu and Seed (1987) presented a simplified procedure that has been reduced to a series of equations by Pradel (1998).

The potential for seismic induced settlement of dry sands was evaluated in the same spreadsheet that was used to analysis liquefaction. The analysis, presented in Appendix E, predicts 0.1-inch of seismic-induced settlement of dry sands. This amount of seismic settlement can be ignored, and it can be concluded that the potential for seismic-induced settlement at the project site is low.

FAULT RUPTURE HAZARD

A fault is a break in the earth's crust upon which movement has occurred in the recent geologic past and at which future movement is expected. A summary of nearby active faults is presented in Appendix D under Table 1 Fault Parameters.

The proposed main sanctuary area does not lie within a State of California designated active fault hazard zone. The activity of faults is classified by the State of California based on the Alquist-Priolo Earthquake Fault Zoning Act (California Division of Mines and Geology 1972, Revised 1999). An active fault has had surface rupture with Holocene time (the past 11,000 years). A potentially active fault shows evidence of surface displacement during Quaternary time (last 1.6 million years). An inactive fault has no evidence of movement within the Quaternary time.

As previously discussed in the Regional Geology section of this report, the Glen Annie Fault is the closest fault to the proposed main sanctuary and both Dibblee (1987) and the USGS (2009) map this fault 2,000 feet or more from the project. Hence, the potential for fault rupture in the area of the proposed main sanctuary is low.

LANDSLIDES

Landsliding is a process where a distinct mass of rock or soil moves downslope because of gravity. No landslides are mapped in the area of the main sanctuary by Dibblee or USGS (see Regional Geologic Maps in Appendix A). In addition, the site is flat and there are no nearby sloping areas. Because there are no identified landslides either at or trending toward the proposed main sanctuary and there are no sloping areas near the proposed main sanctuary, the hazard associated with this phenomenon is considered low.

ROCKFALL

Loose boulder-sized rocks and/or weathering bedrock outcrops located upslope from construction can lead to a rockfall hazard. Because the area of the proposed main sanctuary is distal from slopes with rockfall potential, the potential for rockfall should be considered low.

FLOODING

According to a FEMA 100-Year and 500-Year Flood Risk Map available online at the Santa Barbara County Emergency Preparedness, Response, and Recovery web page (Santa Barbara County, 2024), the proposed main sanctuary is neither in a 100- nor a 500-year flood hazard zone.

CONCLUSIONS AND RECOMMENDATIONS

Based on the data provided in this report, it is Earth Systems' opinion that the area of the proposed main sanctuary is suitable for the planned improvements from engineering geology and geotechnical engineering perspectives provided that the recommendations provided in this report are properly implemented into the project.

Conventional spread foundations (continuous and isolated), and concrete utility pads can be used to support the proposed main sanctuary. The expansiveness of the soils will require that foundation and slab-on-grade designs exceed typical minimums.

Because some of the soils are medium stiff and medium dense, and because a cut-fill line may be created from leveling the building pad, overexcavation and recompaction in the main sanctuary area is recommended.

Specific conclusions and recommendations addressing these geologic/geotechnical considerations, as well as general recommendations regarding the geotechnical aspects of design and construction, are presented in the following sections. Because the current plans appear to be conceptual, final project plans should be reviewed by Earth Systems when they are available, and current recommendations may need to be modified based on the final project plans.

A. Grading

1. Pre-Grading Considerations

a. Preliminary plans do not show any grading details. However, considering the size of the project and the average ground gradient in the project area, it seems grading will be limited to cuts and fills of a few feet. It is anticipated that grading will be used to re-shape the ground surface and improve drainage patterns. Final plans and specifications should be provided to Earth Systems prior to grading and should include the grading plans, foundation plans, and foundation details.

b. Shrinkage of soils (uncertified fills) affected by compaction is estimated to be about 5 percent based on an anticipated average compaction of 92 percent.

c. Earth Systems should be retained to provide engineering geology and geotechnical engineering services during site development and grading, and foundation construction phases of the work to observe compliance with the design concepts, specifications and recommendations. This will allow for timely design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

d. Plans and specifications should be provided to Earth Systems prior to grading. Plans should include the grading plans, foundation plans, and foundation details. Earth Systems will review these plans only for conformity with geotechnical parameters, not including drainage. It is the responsibility of the Client and other Engineers to review and approve designs and plans for conformity with all engineering and design requirements necessary for the proper function and performance of the structure.

e. Compaction tests should be made per ASTM D 6938 to determine the relative compaction of the fills in accordance with the following minimum guidelines: two tests for each 1-foot to 2-foot vertical lift in every isolated area graded; one test for each 500 cubic yards of material placed; and two tests at finished subgrade elevation in every area of remedial grading.

2. Rough Grading/Areas of Development
   a. Grading at a minimum should conform to the 2022 California Building Code and local grading ordinances.
   b. The existing ground surface should be initially prepared for grading by removing and vegetation, trees, large roots, debris, other organic material and non-complying fill from construction areas. Organics and debris should be stockpiled away from areas to be graded, and ultimately removed from the proposed construction location to prevent their inclusion in fills. Voids created by removal of such material should be properly backfilled and compacted. No compacted fill should be placed unless the underlying soil has been observed by the Geotechnical Engineer.
   c. The main sanctuary building area should be overexcavated to a depth of 2-foot below the bottom of foundations, 3.5 feet below existing grade, or until disturbed or loose soil is removed. The overexcavation should extend to a distance of 5 feet beyond the outside perimeters of the building's foundations. The exposed surfaces should be scarified to a depth of 6 inches, brought to 3% above the optimum moisture content determined by ASTM D 1557, and compacted to a minimum of 90% of the maximum dry density determined by ASTM D 1557 before placing fill.
   d. If any retaining and garden walls are proposed, their foundation areas should be overexcavated the same as recommended for building areas, except the lateral extent of the grading can be limited to 2 feet beyond the wall foundation edges.
   e. Areas to receive hardscapes (paving, concrete sidewalks, concrete patios) or fill should be overexcavated through any disturbed soil, but not less than a depth of 1 foot, scarified to a depth of 6 inches, conditioned to above the optimum moisture content for compaction, and recompacted.
   f. Voids created by dislodging cobbles (and boulders if encountered) during excavation should be backfilled and recompacted and the dislodged cobbles and boulders larger than 6 inches in diameter should be removed from the subgrade.
   g. On-site soils, including the removed existing fill, may be used for fill once they are cleaned of all organic material, rocks, debris, and irreducible material larger than 6 inches.

h. Fill and backfill placed at 3% above the optimum moisture for compaction, in layers with a loose thickness not greater than 6 inches, should be compacted to a minimum of 90 percent of the maximum dry density obtainable by the ASTM D 1557 test method unless otherwise recommended or specified by the Geotechnical Engineer or his/her representative. Random compaction tests by Earth Systems can assist the Grading Contractor in evaluating whether the Grading Contractor is meeting compaction requirements. However, compaction tests pertain only to a specific location and do not guarantee that all fill has been compacted to the prescribed percentage of maximum density. It is the ultimate responsibility of the Grading Contractor to achieve uniform compaction in accordance with the requirements of this report and the grading ordinance.

i. Import soils used (if any) to raise site grade should be equal to, or better than, on-site soils in strength, expansion, and compressibility characteristics. Import soil can be evaluated, but will not be prequalified by the Geotechnical Engineer. Final comments on the characteristics of the import will be given after the material is at the proposed construction location.

3. Utility Trenches

a. Utility trench backfill should be governed by the provisions of this report relating to minimum compaction standards. In general, on-site service lines may be backfilled with engineered fill compacted to 90 percent of the maximum density. Backfill of offsite service lines will be subject to the specifications of the jurisdictional agency or this report, whichever are greater.

b. Utility trenches running parallel to footings should be located at least 5 feet outside the footing line, and above a 1-horizontal to 1-vertical projection downward from the outside edge of the bottom of the footing. If the utility line is located below the 1:1 projection, the trench will need to be backfilled with slurry to a level above the 1:1 projection.

c. Compacted fills should be utilized for backfill. Clean sand backfill should be avoided under structures because it provides a conduit for water to migrate under foundations.

d. Backfill operations should be observed and tested by the Geotechnical Engineer to monitor compliance with these recommendations.

e. Although not anticipated, if any caving sand is encountered, shoring and/or sloping of trenches will be required.

f. Rocks greater than 6 inches in diameter should not be placed in trench zones (from 12 inches below pavement subgrade or ground surface to 12 inches above top of pipe or box); rocks greater than 2.5 inches in diameter should not be placed in pipe zones (from 12 inches above top of pipe or box to 6 inches below bottom of pipe or box exterior).

g. Jetting should not be utilized for compaction in utility trenches.

h. If any utilities are to be located in public rights-of-way, construction will need to comply with the requirements of the public agency.

B. Structural Design

1. Spread Foundations

a. Spread foundations for the proposed building, walls, and retaining walls, should bear into compacted fill as recommended previously in this report. At a minimum spread foundations should be designed for the “Medium” expansion range or the recommendations of this report when they exceed expansive soil minimum foundation design criteria. Foundation excavations should be cleaned of all loosened soils, rocks, and debris.

b. Spread foundations should be a minimum of 21 inches deep below lowest adjacent grade.

c. Footings that are a minimum of 12 inches wide and embedded 21 inches deep and bearing into dense compacted fill may be designed based on an allowable bearing value of 1,500 psf. This value includes a safety factor of 3. This allowable bearing value is net (weight of footing and soil surcharge may be neglected) and is applicable for dead plus reasonable live loads. Increasing the bearing capacity for increased depth or width is not recommended.

d. A one-third increase in the allowable bearing values is permitted for use with the alternative load combinations given in Section 1806.1 of the 2022 CBC.

e. Continuous spread foundations should be reinforced with a minimum of two No. 4 bars top and two No. 4 bars bottom.

f. Lateral loads may be resisted by soil friction foundation bottoms and by passive resistance of the soils acting on foundation stem walls. Lateral capacity assumes that any required backfill adjacent to foundations and grade beams is properly compacted.

g. A member of Earth Systems should check footing excavations prior to placing reinforcing to confirm bearing conditions.

h. Because the soils at the main sanctuary site have a measured expansion index in the "Medium" expansion range, soil pre-saturation before placing concrete is required. Soils should be premoistened to 3% above the optimum moisture for compaction to a depth of 27 inches. Testing of premoistening is required.

2. Slabs-on-Grade
   a. Concrete slabs-on-grade should be supported by compacted fill as recommended elsewhere in this report. The reinforcing and thickness recommendations provided below are for non-structural slabs-on-grade. The design of structural slabs is the responsibility of the Structural Engineer.
   b. The information that follows regarding design criteria for slabs-on-grade is generally the same as that given in the Minimum Foundation Design table for the "Medium" expansion range. Actual slab designs should be provided by the project Structural Engineer, but the reinforcement and slab thicknesses recommended should not be less than the criteria set forth in the attached table for the appropriate expansion range, or as recommended below, whichever is more stringent.
   c. A minimum slab-on-grade thickness of 4 inches is recommended and floor slabs should be underlain by a minimum of 4 inches of sand.
   d. Reinforcement data given herein for slabs are generally the same as those given in the Minimum Foundation Design table in Appendix D for soils in the "Medium" expansion range. However, Earth Systems recommends minimum slab reinforcement of No. 4 reinforcing bars spaced 18 inches on center each way. In addition, No. 4 bars acting as dowels should also extend out of the perimeter footings, and should be bent so that they extend a minimum of 3 feet into adjacent slabs.
   e. Where dampness of floor slabs is to be minimized, or where slab surfaces are to receive moisture sensitive floor coverings, the slabs should be constructed with both a capillary break material and a vapor retarder. The vapor retarder should be selected by the project architect but should not be less than 10-mils thick. Construction should be in accordance with the architect's recommendations.
   f. Slabs should be cast using concrete with a maximum slump of 4 inches or less. Excessive water content is the major cause of concrete cracking. To reduce concrete shrinkage, a water reducing agent or plasticizer may be utilized in the concrete to increase slump while maintaining an appropriate water/cement ratio. Hot reinforcing steel should be cooled prior to concrete placement to help prevent

concrete shrinkage at the bar location. Control joints should be provided at appropriate intervals to control the location of shrinkage cracks.

g. Exterior concrete slabs-on-grade (walkways, patios, etc.) should be supported by firm recompacted fills as recommended elsewhere in this report and designed relatively independent of footing stems (i.e., free floating) so foundation adjustment will be less likely to cause cracking. Because exterior slabs-on-grade are exposed to weather, vapor retarders to reduce moisture transmission from the subgrade soils to the slab ae thought to be unnecessary.

h. Soils underlying slabs that are in the "Medium" expansion range will require pre-moistening to 3% above the optimum moisture for compaction to a depth of 27 inches below lowest adjacent grade. Pre-moistening should be confirmed by testing.

3. Retaining Walls

a. On-site soils should not be used for wall backfill because of their expansiveness. Instead, retaining walls should be backfill with non-expansive import soil (soil in the “Very Low” expansion range within the active wedge behind retaining walls. The active wedge can be defined as the zone behind a retaining wall between the back of the wall and a plain rising at a 45-degree angle from the base of the wall.

b. Conventional cantilever retaining walls backfilled with compacted imported soils in the “Very Low’ expansive range may be designed for active pressures developed from 35 pcf of equivalent fluid weight for well-drained, level backfill.

c. Restrained retaining walls backfilled with compacted imported non-expansive soils may be designed for active pressures developed from 55 pcf of equivalent fluid weight for well-drained, level backfill.

d. The pressures listed above assumed that backfill soils will be compacted to 90 percent of the maximum dry density as determined by the ASTM D 1557 Test Method.

e. Retaining walls that retain more than 6 feet of soil will need to be designed for a seismic loading force that is applied in addition to the static forces when seismic shaking occurs. Seismic increments of earth pressure can be determined using 35 and 49 pcf of additional equivalent fluid weight need to be considered for cantilever and restrained retaining walls, respectively. These equivalent fluid weights have been determined by a procedure presented by Al Atik and Sitar (2010). The seismic increment of pressure can be assumed to be distributed so that the centroid of pressure acts at 0.33H above the base of a retaining wall, where H is the wall height in feet. Because this seismic force is transient, and in accordance with CBC Section 1807.2.3, a minimum safety factor of 1.1 may be used for sliding and overturning when seismic loads are included.

f. The lateral earth pressure resisted by the retaining walls or similar structures should also be increased to allow for other applicable surcharge loads. The surcharges considered should include forces generated by structures or temporary loads that would influence the wall design.

g. A system of backfill drainage should be incorporated into retaining wall designs. Backfill comprising the drainage system immediately behind retaining structures should be free-draining granular material with a filter fabric between it and the rest of the backfill soils. As an alternative, the backs of walls could be lined with geodrain systems. The backdrains should extend from the bottoms of the walls to about 12 to 18 inches from finished backfill grade. Waterproofing may aid in reducing the potential for efflorescence on the faces of retaining walls.

h. Compaction on the uphill sides of walls within a horizontal distance equal to one wall height should be performed by hand-operated or other lightweight compaction equipment. This is intended to reduce potential "locked-in" lateral pressures caused by compaction with heavy grading equipment.

i. Water should not be allowed to pond near the tops of retaining walls. To accomplish this, final backfill site grades should be such that all water is diverted away from retaining walls.

4. <u>Frictional and Lateral Coefficients</u>

a. Resistance to lateral loading may be provided by soil friction acting on the base of foundations. A coefficient of friction of 0.40 may be applied to dead load forces. This value does not include a safety factor.

b. Passive resistance acting on the sides of foundation stems equal to 260 pcf of equivalent fluid weight may be included for resistance to lateral load. This value does not include a safety factor.

c. A minimum safety factor of 1.5 should be used when designing for sliding or overturning.

d. Passive resistance may be combined with frictional resistance provided that a one-third reduction in the coefficient of friction is used.

5. Settlement Considerations
   a. Maximum settlements of about half of an inch (0.5”) are anticipated for spread foundations, when supported by dense compacted fill as recommended
   b. Differential settlement between adjacent load bearing members could be about one-half the maximum settlement.
   c. Seismic-induced settlement from earthquake shaking is estimated to be negligible.
   d. The Project Structural Engineer will need to design the foundation system to accommodate the potential settlement values.

6. Preliminary Asphalt Pavement Sections
   a. Two samples of the anticipated subgrade soil were tested to determine their R-values. The tests yielded R-values of 45 and 32. We recommend that pavement designs be based on the lower and more conservative of the two values, R = 32.
   b. The intent of this report is to provide preliminary paving sections for planning and rough grading purposes. When grading is performed, the parking lot subgrades appear to be different the samples tested, subgrades should be sampled and tested to determine final design R-values, from which final paving designs and their approximate limits can be developed.
   c. Preliminary asphalt pavement sections for a 20-year design-life using untreated subgrade soils are presented below based on R-value of 32, current Caltrans design procedures, and traffic indices (TIs) ranging from 4.0 to 5.0 for parking stalls and drives.

TRAFFIC INDEX	ASPHALT CONCRETE (Inches)	AGGREGATE BASE (Inches)
4.0	3.0	4.0
4.5	3.0	5.0
5.0	3.0	5.5

   d. TIs can represent the accumulative effect of a wide range of traffic types, from automotive traffic to 5-axle truck traffic. Descriptively, a TI of 4.0 represents automotive traffic only, a TI of 5.0 represents lightly traveled areas with occasional delivery and trash trucks.
   e. The preliminary paving sections provided above have been designed for the type of traffic indicated. If the pavement is placed before project construction is complete,

construction loads, which could increase the traffic index values assumed above, should be considered.

f. The subgrade soils in the upper 12 inches below the finished subgrade elevation should be properly moisture conditioned to above optimum moisture and compacted to achieve a minimum relative compaction of 90% of the ASTM D1557 maximum dry density. We do not recommend compacting the subgrade to 95% of maximum density because this will increase the expansion potential of the pavement subgrade. The subgrade soils should be in a stable, non-pumping condition at the time the aggregate base material is placed and compacted.

g. The aggregate base materials can be Processed Miscellaneous Base (with Class 2 gradation) per the "Greenbook" or Caltrans Class 2 Aggregate Base.

h. Adequate drainage (both surface and subsurface) should be provided such that the subgrade soils and aggregate base materials are not allowed to become continuously wet.

ADDITIONAL SERVICES

This report assumes that an adequate program of monitoring and testing will be performed by Earth Systems during construction to check compliance with the recommendations given in this report. The recommended tests and observations include, but are not necessarily limited to the following:

- Review of the structural and grading plans during the design phase of the project.
- Observation and testing during site preparation, grading, placing of engineered fill, and foundation construction.
- Consultation as required during construction.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

The analyses and recommendations submitted in this report are based in part upon the data obtained from the on-site borings. The nature and extent of variations between and beyond the points of exploration may not become evident until construction. If variations then appear evident, it will be necessary to reevaluate the recommendations of this report.

The scope of services did not include any environmental assessment or investigation for the presence or absence of wetlands, hazardous or toxic materials in the soil, surface water, groundwater or air, on, below, or around this site. Any statements in this report or on the soil boring logs regarding odors noted, unusual or suspicious items or conditions observed, are strictly for the information of the client.

Findings of this report are valid as of this date; however, changes in conditions of a property can occur with passage of time whether they are because of natural processes or works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur whether they result from legislation or broadening of knowledge. Accordingly, findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of 1 year.

In the event that any changes in the nature, design, or location of the proposed main sanctuary and associated improvements are planned, the conclusions and recommendations contained in this report should not be considered valid unless the changes are reviewed, and conclusions of this report modified or verified in writing.

This report is issued with the understanding that it is the responsibility of the Owner, or of his representative to ensure that the information and recommendations contained herein are called to the attention of the Architect and Engineers for the project and incorporated into the plan and that the necessary steps are taken to see that the Contractor and Subcontractors carry out such recommendations in the field.

As the Geotechnical Engineers for this project, Earth Systems has striven to provide services in accordance with generally accepted geotechnical engineering practices in this community at this time. No warranty or guarantee is expressed or implied. This report was prepared for the exclusive use of the Client for the purposes stated in this document for the referenced project only. No third party may use or rely on this report without express written authorization from Earth Systems for such use or reliance.

It is recommended that Earth Systems be provided the opportunity for a general review of final design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications. If Earth Systems is not accorded the privilege of making this recommended review, it can assume no responsibility for misinterpretation of the recommendations contained herein.

BIBLIOGRAPHY

Al Atik, and N. Sitar, 2010, Seismic Earth Pressures on Cantilever Retaining Structures, Journal of Geotechnical and Geoenvironmental Engineering, ASCE, October.

American Institute of Concrete (ACI), 2014, Building Code Requirements for Structural Concrete (ACI 318-14).

American Society of Civil Engineers (ASCE), 2017, Minimum Design Loads and Associated Criteria for Buildings and other Structures (ASCE/SEI 7-16)

Boore, D.M., Stewart, J.P., Seyhand, E., and Atkinson, G., 2014, NGA-West 2 Equations for Predicting PGA, PGV, nd5% Damped PGA for Shallow Crustal Earthquakes.

California Building Standards Commission, 2019, California Building Code, California Code of Regulations Title 24.

California Division of Mines and Geology (CDMG.), 1972 (Revised 1999), Fault Rupture Hazard Zones in California, Special Publication 42.

CDMG, 1998, Maps of Known Active Fault Near-Source Zones in California and Adjacent Portions of Nevada to Be Used with the 1997 Uniform Building Code. .

California Geologic Survey, 2008, Guidelines for Evaluating and Mitigating Seismic Hazards in California, Special Publication 117A.

Campbell, K.W., and Bozorgnia, Y., 2014, NGA-West2 Ground Motion Model for the Average Horizontal Components of PGA, PGV and 5% Damped Linear Acceleration Response Spectra

Chiou, B.S-J, and Youngs, R.R., 2014, Update of the Chiou and Youngs NGA Model for the Average Horizontal Component of Peak Ground Motion and Response Spectra.

County of Los Angeles Department of Public Works, 2013, Manual for Preparation of Geotechnical Reports, July 1.

Dibblee, Jr., Thomas W., and Helmut E. Ehrenspeck, 1987, Geologic Map of the Goleta Quadrangle, Santa Barbara County, California, Dibblee Foundation Map No. DF-08.

Idriss, I.M., 2014, An NGA-West2 Empirical Model for Estimating the Horizontal Spectral Values Generated by Shallow Crustal Earthquakes.

Jennings, C.W. and W.A. Bryant, 2010, Fault Activity Map of California, CGS Geologic Data Map No. 6.

Petersen, M.D., W.A. Bryant, C.H. Cramer, T. Cao, M.S. Reichle, A.D. Frankel, J.J. Lienkaemper, P.A. McCrory and D.P. Schwartz, 1996, Probabilistic Seismic Hazard Assessment for the State of California, CDMG. Open-File Report 96-08, USGS Open-File Report 96-706.

Petersen, M., D. Beeby, W. Bryant, C. Cao, C. Cramer, J. Davis, M. Reichle, G. Saucedo, S. Tan, G. Taylor, T. Toppozada, J. Treiman, C. Wills, 1999, Seismic Shaking Hazard Maps of California, CDMG. Map Sheet 48.

Pradel, D., 1998, Procedure to Evaluate Earthquake-Induced Settlements in Dry Sandy Soils, Journal of Geotechnical and Geoenvironmental Engineering, ASCE, Vol. 124, No. 4, April.

Pyke, R., H. B. Seed, and C. K. Chan, 1975, Settlement of Sands Under Multidirectional Shaking, ASCE, Journal of Geotechnical Engineering, Vol. 101, No. 4, April.

Santa Barbara County, 2024, FEMA 100-Year and 500-Year Flood Risk Maps, https://sbcoem.maps.arcgis.com/apps/webappviewer/index.html?id=5acbb13b4f7f4e75af8431c78e95d695

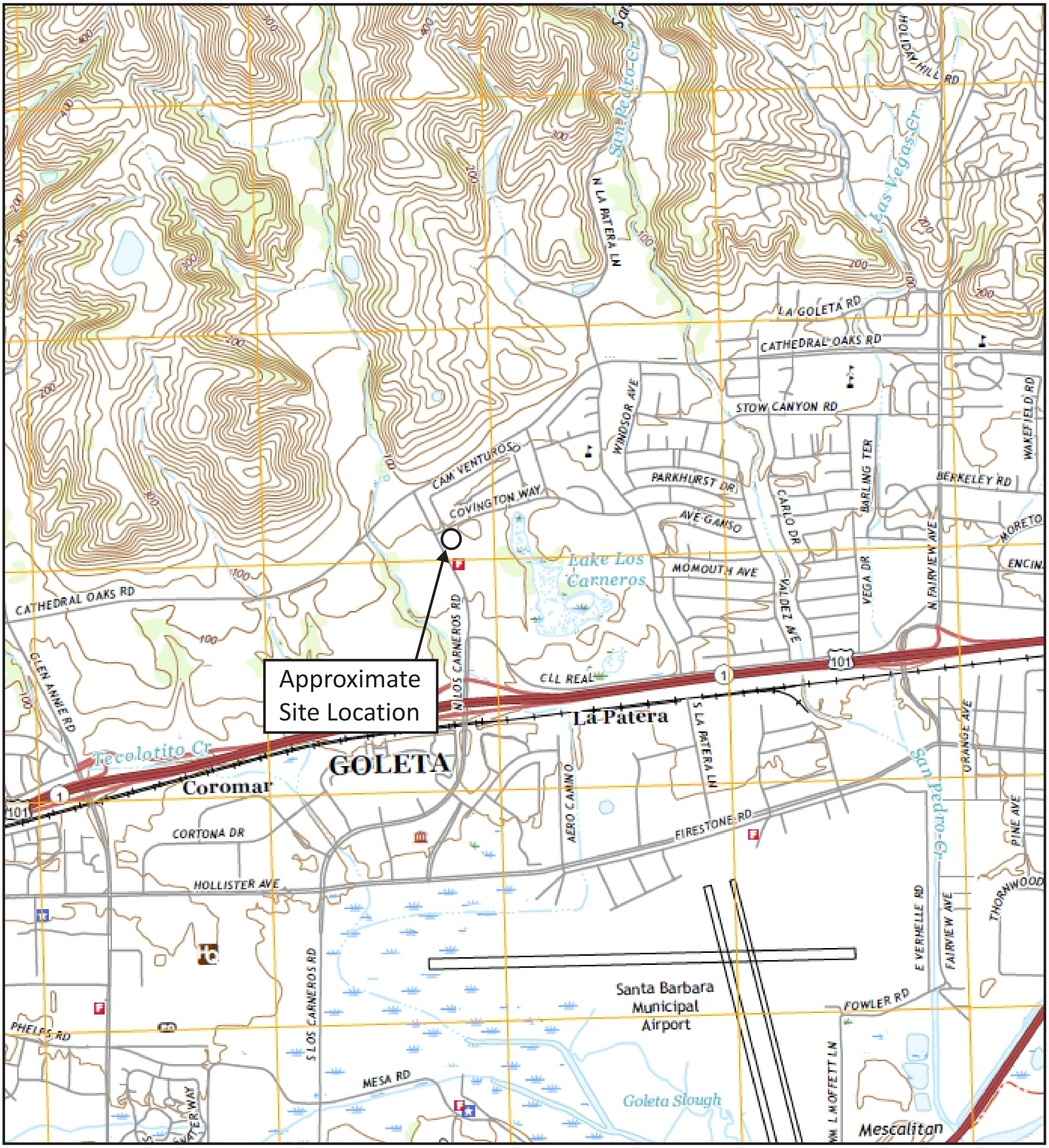
Seed, H. B., and M. L. Silver, 1972, Settlement of Dry Sands During Earthquakes, ASCE, Journal of Geotechnical Engineering, Vol. 98, No. 4, April.

Structural Engineers Association of California (SEAOC)a nd California Office of Staetwide Health Planning and Development (OSHPD), 2024, Seismic Design Maps, https://www.seismicmaps.org/

Tokimatsu, K., and H. B. Seed, 1987, Evaluation of Settlements in Sands Due to Earthquake Shaking, ASCE, Journal of Geotechnical Engineering, Vol. 113, No. 8, August.

United States Geological Survey (USGS), 2009, Geological Map of the Santa Barbara Coastal Plain Area, Santa Barbara County, California.

APPENDIX A



*Taken from USGS Topo Map, Goleta Quadrangle, California, 2022.

Approximate Scale: 1" = 2,000’

0 2,000’ 4,000’

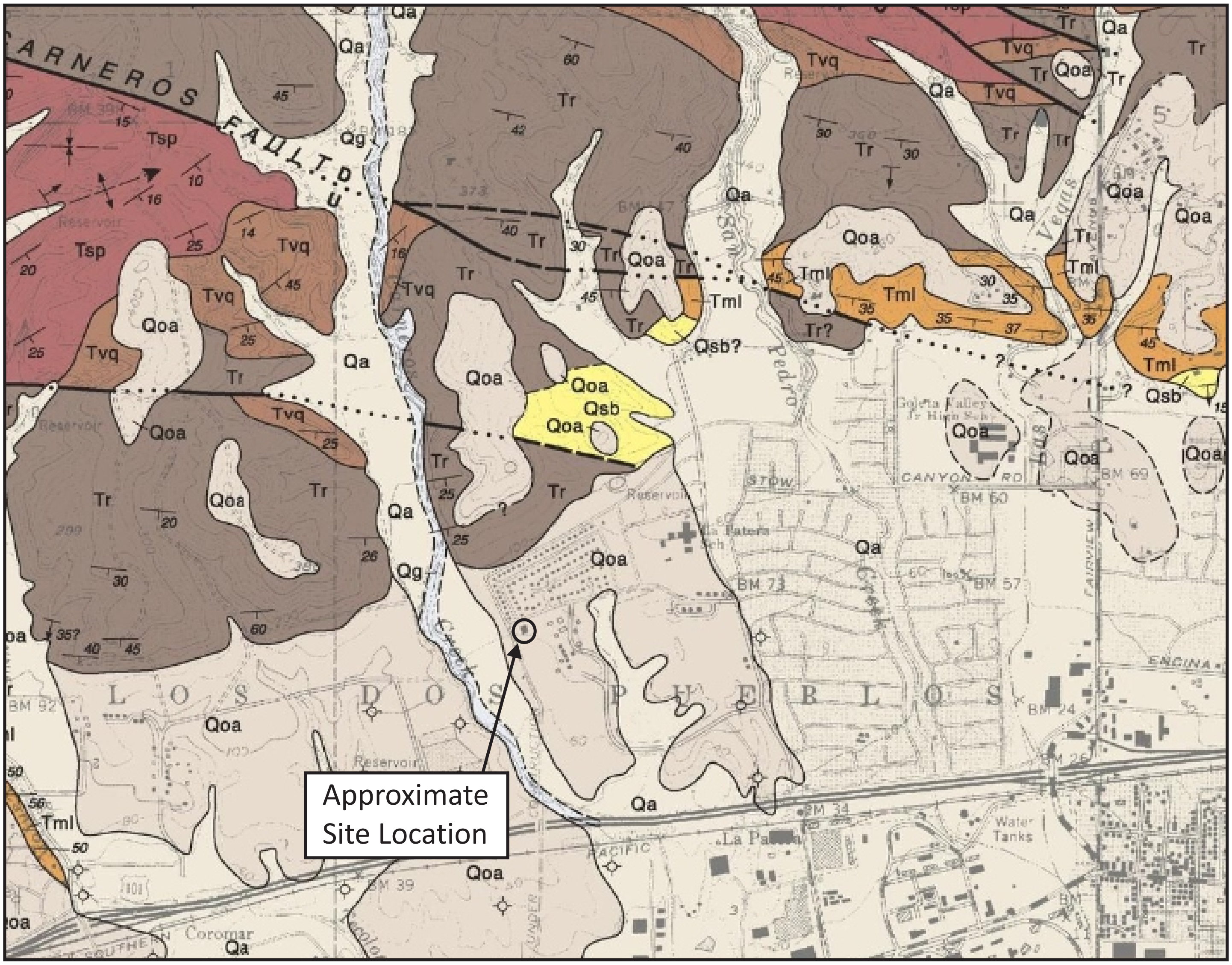
N

VICINITY MAP

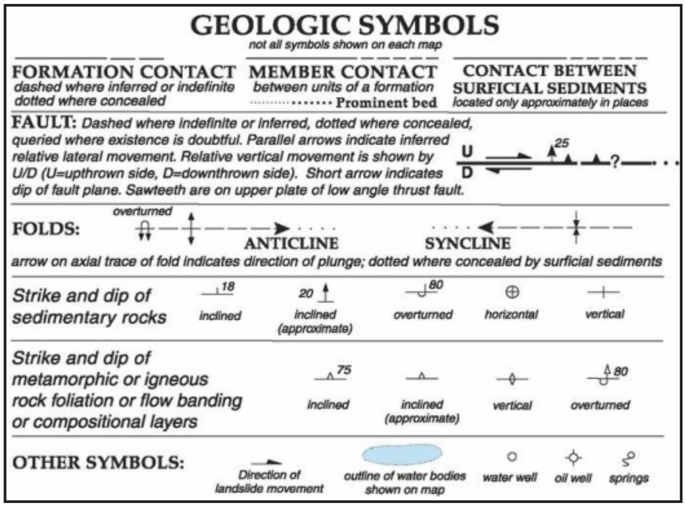
6595 Covington Way
Goleta Area of Santa Barbara County, California

Earth Systems

January 2024	306481-001



*Taken from Dibblee, Jr., Geologic Map of The Goleta Quadrangle, Santa Barbara County, California, 1987, DF-07.



GEOLOGIC SYMBOLS

not all symbols shown on each map

FORMATION CONTACT *dashed where inferred or indefinite dotted where concealed*

MEMBER CONTACT *between units of a formation* .... **Prominent bed**

CONTACT BETWEEN SURFICIAL SEDIMENTS *located only approximately in places*

FAULT: *Dashed where indefinite or inferred, dotted where concealed, queried where existence is doubtful. Parallel arrows indicate inferred relative lateral movement. Relative vertical movement is shown by U/D (U=upthrown side, D=downthrown side). Short arrow indicates dip of fault plane. Sawteeth are on upper plate of low angle thrust fault.*

FOLDS: *overturned* **ANTICLINE** **SYNCLINE**

arrow on axial trace of fold indicates direction of plunge; dotted where concealed by surficial sediments

Strike and dip of sedimentary rocks: *inclined*, *inclined (approximate)*, *overturned*, *horizontal*, *vertical*

Strike and dip of metamorphic or igneous rock foliation or flow banding or compositional layers: *inclined*, *inclined (approximate)*, *vertical*, *overturned*

OTHER SYMBOLS: *Direction of landslide movement*, *outline of water bodies shown on map*, *water well*, *oil well*, *springs*

Qs / Qg / Qa

SURFICIAL SEDIMENTS

Qs *Beach sand deposits*
Qg *Stream channel deposits, mostly gravel and sand*
Qa *Alluvium: unconsolidated floodplain deposits of silt, sand and gravel*

Qoa / Qog

OLDER DISSECTED SURFICIAL SEDIMENTS

Qoa *Former alluvial deposits of silt, sand and gravel, in places weakly consolidated; local unconformities at base*
Qog *Cobble-boulder fan gravel and fanglomerate deposits composed largely of sandstone detritus*

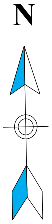
Tr

RINCON SHALE

Marine; early Miocene age

Tr *Poorly bedded gray clay shale or claystone; Saucesian and upper Zemorrian Stages*

Approximate Scale: 1" = 2,000'

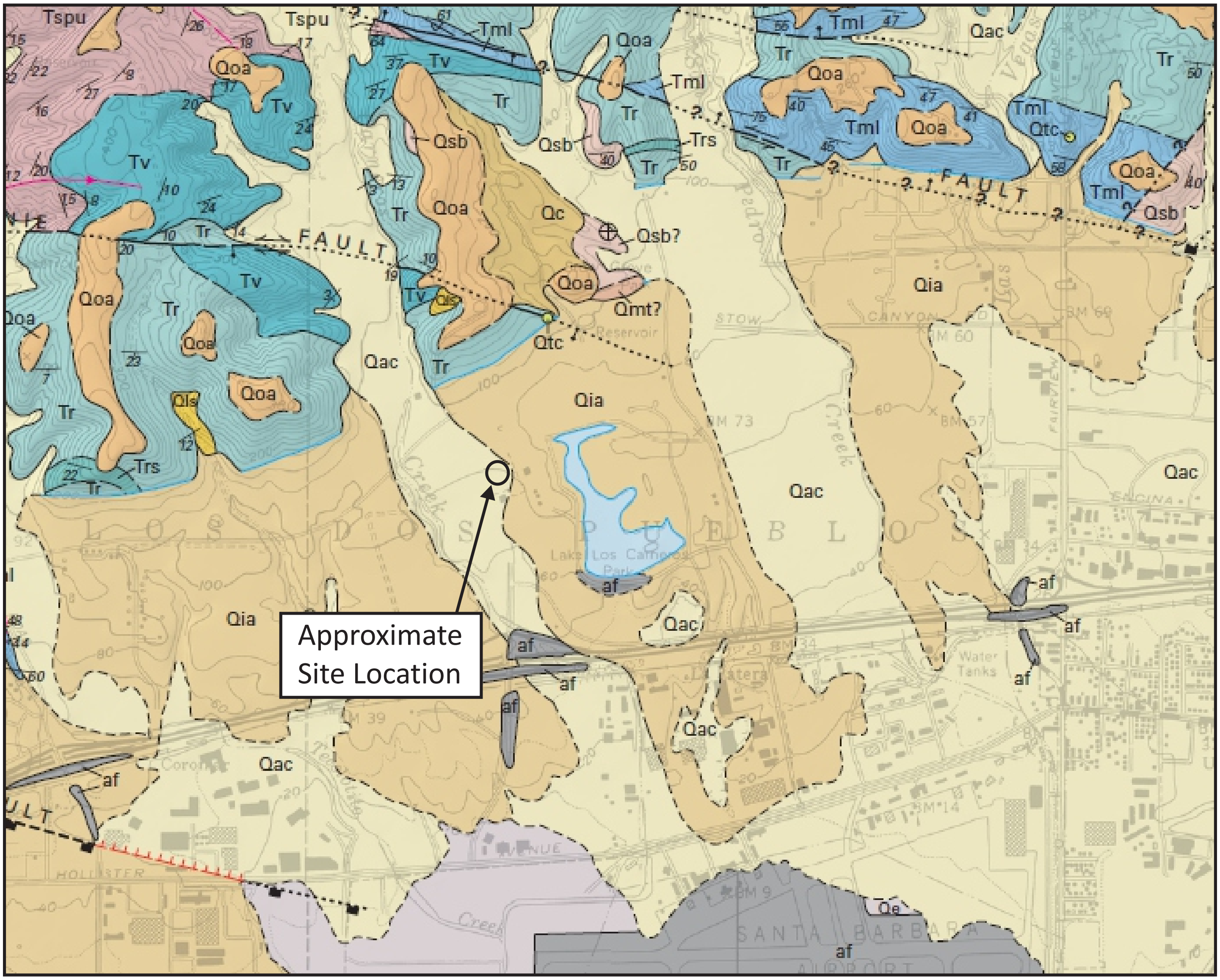


REGIONAL GEOLOGIC MAP 1

6595 Covington Way
Goleta Area of Santa Barbara County, California

Earth Systems

January 2024	306481-001



Approximate Site Location

*Taken from Geologic Map of the Santa Barbara Coastal Plain Area, Santa Barbara County, California, 2009.

Contact—Long-dashed where approximately located; short-dashed where inferred; dotted where concealed; tic shows direction and angle of dip

Trace of marker bed

Outline of erosionally beveled geomorphic surface

Marine-terrace shoreline angle—Approximately located based on subtle to strong topographic steps of terrace surface; locally coincides with contact between Qmt and older units

Faults—Long-dashed where approximately located; short dashed where inferred; dotted where concealed; queried where uncertain; small red arrow shows direction and angle of dip; red diamond-headed arrow shows bearing and rake of slickenlines and inferred slip direction of hanging-wall block

Strike-slip fault—Opposing arrows show sense of strike-slip movement, queried where uncertain; bi-directional arrows indicate superposed dextral and sinistral slip on same fault

Normal fault—Ball and bar on apparent downthrown side

Reverse fault—Rectangles on apparent upthrown side

Thrust fault—Sawteeth on apparent upthrown side

Fault-line scarp—Inferred from aerial photographs; hachures point downscarp

Slide-block boundary—Inferred; hachures on slide block

Fold and warp axial traces—Long-dashed where approximately located; short-dashed where inferred; dotted where concealed

Anticline—Large arrow indicates plunge direction

Overturned anticline

Upwarp axis—Large arrow indicates plunge direction; mapped in Quaternary deposits where geomorphically expressed

Syncline—Large arrow indicates plunge direction

Overturned syncline

Downwarp axis—Mapped in Quaternary deposits where geomorphically expressed

⊕ **Horizontal bedding**

Inclined bedding—Showing strike and dip

Inclined bedding—Showing approximate strike and dip

Inclined bedding—Showing strike and dip of beds calculated from bedding trace

Vertical bedding—Showing strike

Overturned bedding—Showing strike and dip

(Tsq) **Concealed bedding**—Measured in unit indicated where temporarily exposed at low tide or in construction excavation

Qac	**Alluvium and colluvium (Holocene and upper Pleistocene)**—Poorly consolidated silt, sand, and gravel deposits of modern drainages and piedmont alluvial fans and floodplains. Exposed thickness generally less than 10 m
Qia	**Intermediate alluvial deposits (upper Pleistocene)**—Weakly consolidated, stratified silt, sand, and gravel that form low, rounded, moderately dissected terraces and piedmont alluvial fans that rest at higher elevations than the modern coastal piedmont surface underlain by unit Qac. Thickness probably locally exceeds 20 m
Tr	**Rincon Shale (lower Miocene)**—Marine, primarily massive and thick-bedded, light-brown-weathering mudstone, with subordinate dolomite, siliceous shale, sandstone, and tuff. Mudstone is bioturbated and massive, pervasively hackly fractured, and locally contains abundant microfossils. Single or multiple white-weathering tuff layers limited to upper 10 m of Rincon section. Thickness ranges from about 400 m to 460 m

N

Approximate Scale: 1" = 2,000'

0
2,000'
4,000'

REGIONAL GEOLOGIC MAP 2

6595 Covington Way
Goleta Area of Santa Barbara County, California

Earth Systems

January 2024
306481-001

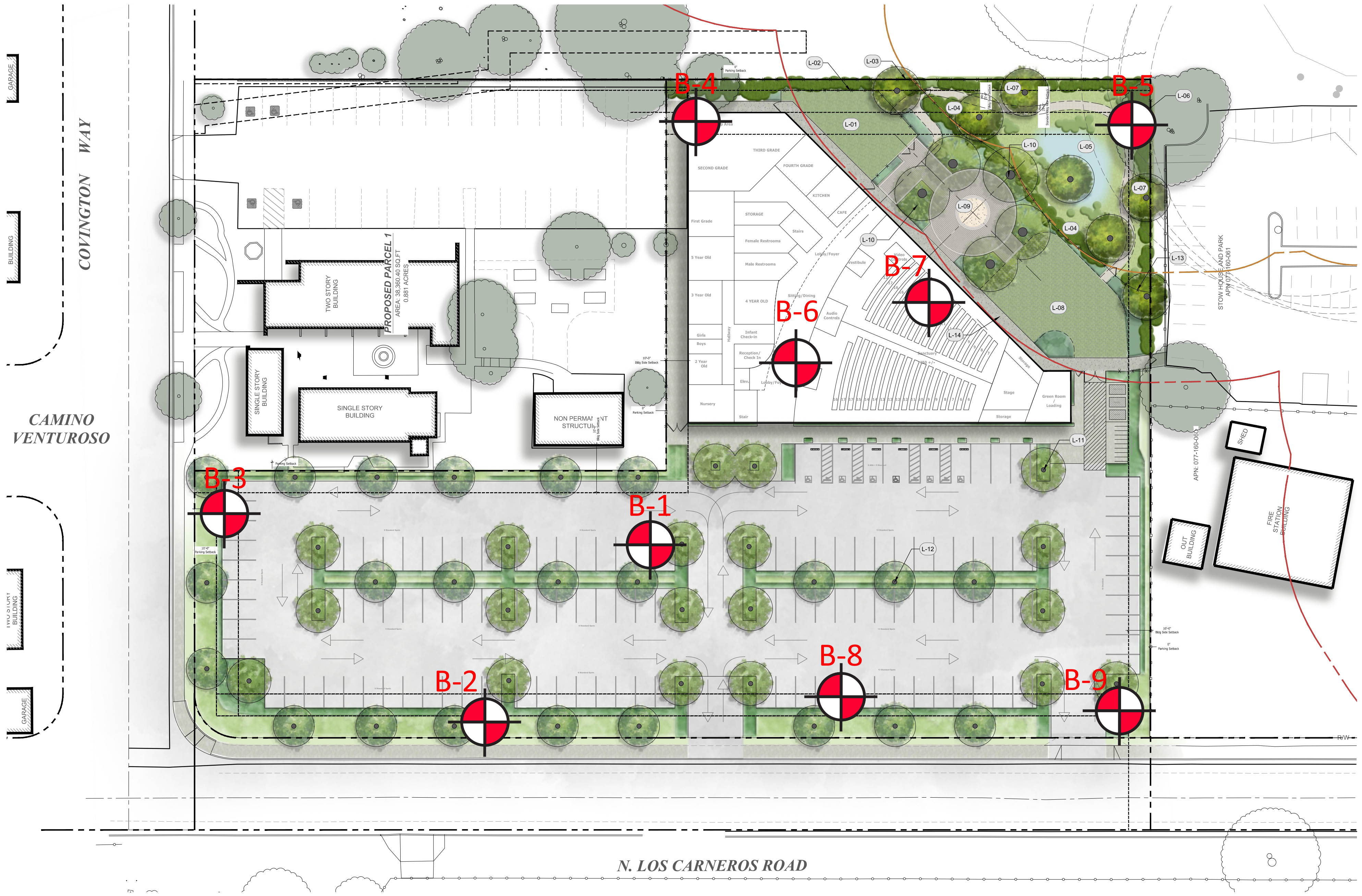
FIELD STUDY

A. Nine borings were drilled to depths of approximately 16.5 to 51.5 feet below the existing ground surface to observe the soil profile and to obtain samples for laboratory analyses. The borings were drilled on December 28, 2023, using 8-inch diameter hollow-stem continuous flight auger powered by SIMCO 2600 truck mounted drilling rig. The approximate locations of the borings were determined in the field by pacing and sighting, and are shown on the Site Plan in this Appendix.

B. Samples were obtained within the borings with a Modified California (M.C.) ring sampler (ASTM D 3550 with a shoe similar to ASTM D 1586) and a standard penetration split-spoon (SPT) sampler. The M.C. sampler has a 3-inch outside diameter, and a 2.42-inch inside diameter when used with brass ring liners (as it was during this study). The SPT sampler has a 2-inch outside diameter, and a 1.67-inch inside diameter when used without a liner (as it was during this study). The samples were obtained from the borings drilled by driving the sampler with a 140-pound hammer dropping 30 inches in accordance with ASTM D 1586. The hammer was operated with an automatic trip mechanism.

C. Bulk samples were collected from the cuttings of the soils encountered in borings B-1 and B-2 between the depths of 0 and 5 feet.

D. The final logs of the borings represent interpretations of the contents of the field logs obtained during the subsurface study and the results of laboratory testing performed on the samples. The final logs are included in this Appendix.



B-9 : Approximate boring locations.

Approximate Scale: 1" = 60'

0 60' 120'

N

SITE PLAN

Anthem Chapel
6595 Covington Way
Goleta Area of Santa Barbara County, California

Earth Systems

June 2024	306481-001

Logs of Borings

Boring Log Symbols

Unified Soil Classification System

BORING NO: B-1
PROJECT NAME: Anthem Chapel
PROJECT NUMBER: 306481-001
BORING LOCATION: Per Plan

DRILLING DATE: December 28, 2023
DRILL RIG: SIMCO
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: A. Luna/S. Jensen

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0	☒		■	4/9/16	▨	CL	106.2	20.2	**ALLUVIUM:** Dark Brown fine Sandy Lean Clay, very stiff, damp
5			■	15/25/37	▨	SM	111.0	12.0	**ALLUVIUM:** Light Orange Brown Silty fine Sand, trace Clay, dense, damp
			■	16/26/32	▨	SC	119.6	10.6	**ALLUVIUM:** Orange Brown Clayey fine Sand, dense, damp
10			■	14/24/31	▨	SM	112.2	8.3	**ALLUVIUM:** Orange Brown Silty fine Sand, dense, damp
15		◧		8/12/12	▨	SM		6.9	**ALLUVIUM:** Light Orange Brown Silty fine to medium Sand, medium dense, damp
20		◧		6/14/21	▨	SM	▼	20.6	**ALLUVIUM:** Brown Silty fine Sand, dense, wet
25		◧		6/9/11	▨	CH		32.4	**RINCON FORMATION:** Weathered gray Fat Clay, iron oxide staining, very stiff, wet
30		◧		6/11/14	▨				
35		◧		25/50-6"	▨	CH		25.8	same as above

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

BORING NO: B-1	DRILLING DATE: December 28, 2023
PROJECT NAME: Anthem Chapel	DRILL RIG: SIMCO
PROJECT NUMBER: 306481-001	DRILLING METHOD: Hollow-Stem Auger
BORING LOCATION: Per Plan	LOGGED BY: A. Luna/S.

Vertical Depth	Sample Type			PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	**DESCRIPTION OF UNITS**
	Bulk	SPT	Mod. Calif.						
40		■		27/39/50-5"	▨	CL			**RINCON FORMATION:** Gray to black fine Sandy Lean Clay, hard, wet
45		■		15/40/44	▨				
50		■		11/26/44	▨	CL		26.0	**same as above**
									Total Depth: 51.5 feet **Groundwater Depth: 20.0 feet**
55									
60									
65									
70									
75									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

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BORING NO: B-2
PROJECT NAME: Anthem Chapel
PROJECT NUMBER: 306481-001
BORING LOCATION: Per Plan

DRILLING DATE: December 28, 2023
DRILL RIG: SIMCO
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: A. Luna/S. Jensen

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0	☒		■	9/19/24	░	SM	111.8	6.6	**ALLUVIUM:** Brown Silty fine Sand, little to some Clay, medium dense, damp
5			■	10/17/22	▨		111.9	18.1	
			■	13/25/33		CL	112.6	15.5	**ALLUVIUM:** Brown fine Sandy Lean Clay, very stiff, damp
10			■	13/24/42			108.4	19.3	
15			■	14/25/27	░	SM	108.0	7.2	**ALLUVIUM:** Brown Silty fine Sand, trace to little Clay, dense, damp
20									**Total Depth: 16.5 feet** **No Groundwater Encountered**
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

BORING NO: B-3	DRILLING DATE: December 28, 2023
PROJECT NAME: Anthem Chapel	DRILL RIG: SIMCO
PROJECT NUMBER: 306481-001	DRILLING METHOD: Hollow-Stem Auger
BORING LOCATION: Per Plan	LOGGED BY: A. Luna/S. Jensen

Vertical Depth	Sample Type			PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
	Bulk	SPT	Mod. Calif.						
0					▨				
		■		4/5/7	▨	CL			**ALLUVIUM:** Gray Silty Lean Clay, stiff to very stiff, damp to moist
5					▨				
		■		6/10/13	▨				
		■		7/9/10	▨	SC			**ALLUVIUM:** Dark Brown Clayey fine Sand, medium dense, damp
10					▨				
		■		5/8/9	▨				
		■		11/13/12	▨	SM			**ALLUVIUM:** Brown Silty fine Sand, medium dense, damp
15		■		5/6/7	▨	CL			**ALLUVIUM:** Brown fine Sandy Clay, stiff, damp
									Total Depth: 16.5 feet **No Groundwater Encountered**
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

BORING NO: B-4
PROJECT NAME: Anthem Chapel
PROJECT NUMBER: 306481-001
BORING LOCATION: Per Plan

DRILLING DATE: December 28, 2023
DRILL RIG: SIMCO
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: A. Luna/S. Jensen

Vertical Depth	Sample Type Bulk	 SPT	 Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0					▨				
		■		7/8/14	▨	CL			**ALLUVIUM:** Brown fine Sandy Lean Clay, very stiff, damp
5		■		10/12/14	▨				
10		■		10/11/11	▒	SC			**ALLUVIUM:** Brown Clayey fine Sand, medium dense, damp
		■		10/13/15	░	SM			**ALLUVIUM:** Light Brown Silty fine Sand, medium dense, dry to damp
15									**Total Depth: 15.0 feet** **No Groundwater Encountered**
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

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BORING NO: B-5	DRILLING DATE: December 28, 2023
PROJECT NAME: Anthem Chapel	DRILL RIG: SIMCO
PROJECT NUMBER: 306481-001	DRILLING METHOD: Hollow-Stem Auger
BORING LOCATION: Per Plan	LOGGED BY: A. Luna/S. Jensen

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6"	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0					▨	SC			**ALLUVIUM:** Gray Brown Clayey fine Sand, some Silt, loose to medium dense, moist to very moist
5		■		16/17/18	▨	CL			**ALLUVIUM:** Brown fine Sandy Lean Clay, damp, hard
10		■		8/10/13	▨	SC			**ALLUVIUM:** Brown Clayey fine Sand, medium dense, damp
		■		7/8/8	▨	SM			**ALLUVIUM:** Brown Silty fine Sand, trace Clay, medium dense, damp
15									**Total Depth: 15.0 feet** **No Groundwater Encountered**
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

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BORING NO: B-6
PROJECT NAME: Anthem Chapel
PROJECT NUMBER: 306481-001
BORING LOCATION: Per Plan

DRILLING DATE: December 28, 2023
DRILL RIG: SIMCO
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: A. Luna/S. Jensen

Vertical Depth	Sample Type			PENETRATION RESISTANCE (BLOWS/6"	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	**DESCRIPTION OF UNITS**
	Bulk	SPT	Mod. Calif.						
0									
		■		17/16/8	▦	SM			**ALLUVIUM:** Brown Silty fine Sand, some Clay, medium dense, damp
5		■		7/10/14	▨	CL			**ALLUVIUM:** Brown fine Sandy Lean Clay, very stiff, damp
10		■		7/9/13	▦	SM			**ALLUVIUM:** Brown to Orange Brown Silty fine Sand, little to some Clay, medium dense, damp
		■		7/12/17	▦				
15									**Total Depth: 15.0 feet** **No Groundwater Encountered**
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems

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BORING NO: B-7	DRILLING DATE: December 28, 2023
PROJECT NAME: Anthem Chapel	DRILL RIG: SIMCO
PROJECT NUMBER: 306481-001	DRILLING METHOD: Hollow-Stem Auger
BORING LOCATION: Per Plan	LOGGED BY: A. Luna/S. Jensen

Vertical Depth	Sample Type			PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
	Bulk	SPT	Mod. Calif.						
0					▨				
		■		3/4/5	▨	CL			**ALLUVIUM:** Brown fine Sandy Lean Clay, stiff, damp
5					▨				
		■		5/7/9	▨	CL			same as above
10					▨				
		■		5/4/8	▨	SC			**ALLUVIUM:** Brown Clayey fine Sand, medium dense, damp
15									**Total Depth: 15.0 feet** **No Groundwater Encountered**
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries
between soil and/or rock types and the transitions may be gradual.

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BORING NO: B-8
PROJECT NAME: Anthem Chapel
PROJECT NUMBER: 306481-001
BORING LOCATION: Per Plan

DRILLING DATE: December 28, 2023
DRILL RIG: SIMCO
DRILLING METHOD: Hollow-Stem Auger
LOGGED BY: A. Luna/S. Jensen

Vertical Depth	Sample Type Bulk	Sample Type SPT	Sample Type Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6"	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0					▨				
5		■		8/13/14	▨	SC			**ALLUVIUM:** Brown Clayey fine Sand, medium dense, damp
10		■		5/9/12	▦	SM			**ALLUVIUM:** Brown Silty fine Sand, some Clay, damp
15		■		5/11/13	▦				
20									**Total Depth: 16.5 feet** **No Groundwater Encountered**
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems

5917 Olivas Park Drive, Suite F, Ventura, CA
PHONE: (805) 642-6727 FAX: (805) 642-1325

BORING NO: B-9	DRILLING DATE: December 28, 2023
PROJECT NAME: Anthem Chapel	DRILL RIG: SIMCO
PROJECT NUMBER: 306481-001	DRILLING METHOD: Hollow-Stem Auger
BORING LOCATION: Per Plan	LOGGED BY: A. Luna/S. Jensen

Vertical Depth	Sample Type: Bulk	Sample Type: SPT	Sample Type: Mod. Calif.	PENETRATION RESISTANCE (BLOWS/6")	SYMBOL	USCS CLASS	UNIT DRY WT. (pcf)	MOISTURE CONTENT (%)	DESCRIPTION OF UNITS
0		◧		16/19/20	▒	SM			**ALLUVIUM:** Brown Silty fine Sand, medium dense, damp
5		◧		9/11/16	▨	SC			**ALLUVIUM:** Brown Clayey fine Sand, medium dense, damp
10		◧		9/10/15	▒	SM			**ALLUVIUM:** Brown Silty fine Sand, medium dense, damp
15									**Total Depth: 16.5 feet** **No Groundwater Encountered**
20									
25									
30									
35									

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

BORING LOG SYMBOLS

■	Modified California Split Barrel Sampler
⧅	Modified California Split Barrel Sampler - No Recovery
◨	Standard Penetration Test (SPT) Sampler
◫	Standard Penetration Test (SPT) Sampler - No Recovery
▽	Perched Water Level
▼	Water Level First Encountered
▼	Water Level After Drilling
⊙	Pocket Penetrometer (tsf)
⊕	Vane Shear (ksf)

1. The location of borings were approximately determined by pacing and/or siting from visible features. Elevations of borings are approximately determined by interpolating between plan contours. The location and elevation of the borings should be considered.

2. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

3. Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. This data has been reviewed and interpretations made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, tides, temperature, and other factors at the time measurements were made.

BORING LOG SYMBOLS

Earth Systems

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			*GRAPH SYMBOL*	*LETTER SYMBOL*	*TYPICAL DESCRIPTIONS*
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)	▨	**GW**	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
			▨	**GP**	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	▨	**GM**	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			▨	**GC**	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	CLEAN SAND (LITTLE OR NO FINES)	▨	**SW**	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			▨	**SP**	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNTOF FINES)	▨	**SM**	SILTY SANDS, SAND-SILT MIXTURES
			▨	**SC**	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50	▨	**ML**	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			▨	**CL**	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			▨	**OL**	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50	▨	**MH**	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
			▨	**CH**	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			▨	**OH**	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			▨	**PT**	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENT

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

UNIFIED SOIL CLASSIFICATION SYSTEM

Earth Systems

APPENDIX B

Laboratory Testing
Tabulated Laboratory Test Results
Individual Laboratory Test Results

LABORATORY TESTING

A. Samples were reviewed along with field logs to determine which would be analyzed further. Those chosen for laboratory analyses were considered representative of soils that would be exposed and/or used during grading, and those deemed to be within the influence of proposed structures. Test results are presented in graphic and tabular form in this Appendix.

B. In-situ moisture content and dry unit weight for the ring samples were determined in general accordance with ASTM D 2937.

C. A maximum density tests was performed to estimate the moisture-density relationship of a typical soil material. The test was performed in accordance with ASTM D 1557.

D. The relative strength characteristics of soils were determined from the results of a direct shear test on a remolded sample. The test specimens were placed in contact with water at least 24 hours before testing, and then sheared under normal loads ranging from 1 to 3 ksf in general accordance with ASTM D 3080.

E. An expansion index test was performed on a bulk soil sample in accordance with ASTM D 4829. The sample was surcharged under 144 pounds per square foot at moisture content of near 50 percent saturation. The sample was then submerged in water for 24 hours, and the amount of expansion was recorded with a dial indicator.

F. The gradation characteristics of various soils encountered were evaluated by hydrometer in accordance with ASTM D 7928 and sieve analysis procedures. The samples were soaked in water until individual soil particles were separated, then washed on the No. 200 mesh sieve, oven dried, weighed to calculate the percent passing the No. 200 sieve, and mechanically sieved. Additionally, hydrometer analyses were performed to assess the distribution of the particles that passed the No. 200 screen. The hydrometer portions of the tests were run using sodium hexametaphosphate as a dispersing agent.

G. Settlement characteristics were developed from the results of one-dimensional consolidation/hydrocollapse tests performed in general accordance with ASTM D 2435. The samples were incrementally loaded to their approximate overburden pressure and then flooded with water. After monitoring for collapse, the samples were incrementally loaded up to 8 ksf. The samples were allowed to consolidate under each load increment. Rebound was measured under reverse alternate loading. Compression was measured by dial gauges accurate to 0.0001 inch. Results of the consolidation tests are presented in this Appendix in the form of percent consolidation versus log of pressure curves.

H. A portion of bulk samples was sent to another laboratory for analyses of soil pH, resistivity, chloride contents, and sulfate contents. Soluble chloride and sulfate contents were determined on a dry weight basis. Resistivity testing was performed in accordance with California Test Method 424, wherein the ratio of soil to water was 1:3.

I. The Atterberg limits (liquid and plastic limits) and plasticity index were determined on one sample according to the ASTM D 4318 test method.

J. Two resistance (“R”) Value tests were performed in accordance with California Test Method 301 on bulk samples gathered between the depths of 0’ and 5’ of borings B-1 and B-2. Each of three test specimens from each sample at different moisture contents were tested, and the R-value at 300 psi exudation pressure was determined from the plotted results.

TABULATED LABORATORY TEST RESULTS

REMOLDED SAMPLES

BORING AND DEPTH	B-1 @ 0'-5'	B-2 @ 0’-5’
USCS	CL	--
MAXIMUM DRY DENSITY (pcf)	117.0	--
OPTIMUM MOISTURE (%)	13.0	--
PEAK FRICTION ANGLE	22°	--
PEAK COHESION (psf)	350	--
ULTIMATE FRICTION ANGLE	22°	--
ULTIMATE COHESION (psf)	320	--
EXPANSION INDEX	68	--
pH	6.6	--
RESISTIVITY (ohms-cm)	12,700	--
SOLUBLE CHLORIDES (mg/Kg)	13	--
SOLUBLE SULFATES (mg/Kg)	35	--
GRAIN SIZE DISTRIBUTION (%)		
GRAVEL	0.6	--
SAND	42.3	--
SILT	23.3	--
CLAY (2ųm to 5ųm)	7.4	--
CLAY (≤2ųm)	26.4	--
R-Value	32	45

GRAIN SIZE ANALYSES

BORING AND DEPTH	B-1 @ 15'	B-1 @ 25’
USCS	SM	CH
GRAVEL	4.4	0.0
SAND	79.8	9.5
SILT	5.9	28.0
CLAY (2ųm to 5ųm)	3.0	9.8
CLAY (≤2ųm)	6.9	52.7
Liquid Limit	--	78
Plastic Limit	--	25
Plasticity Index	--	53

Individual Laboratory Test Results

File Number: 306481-001 Lab Number: 098738

MAXIMUM DENSITY / OPTIMUM MOISTURE

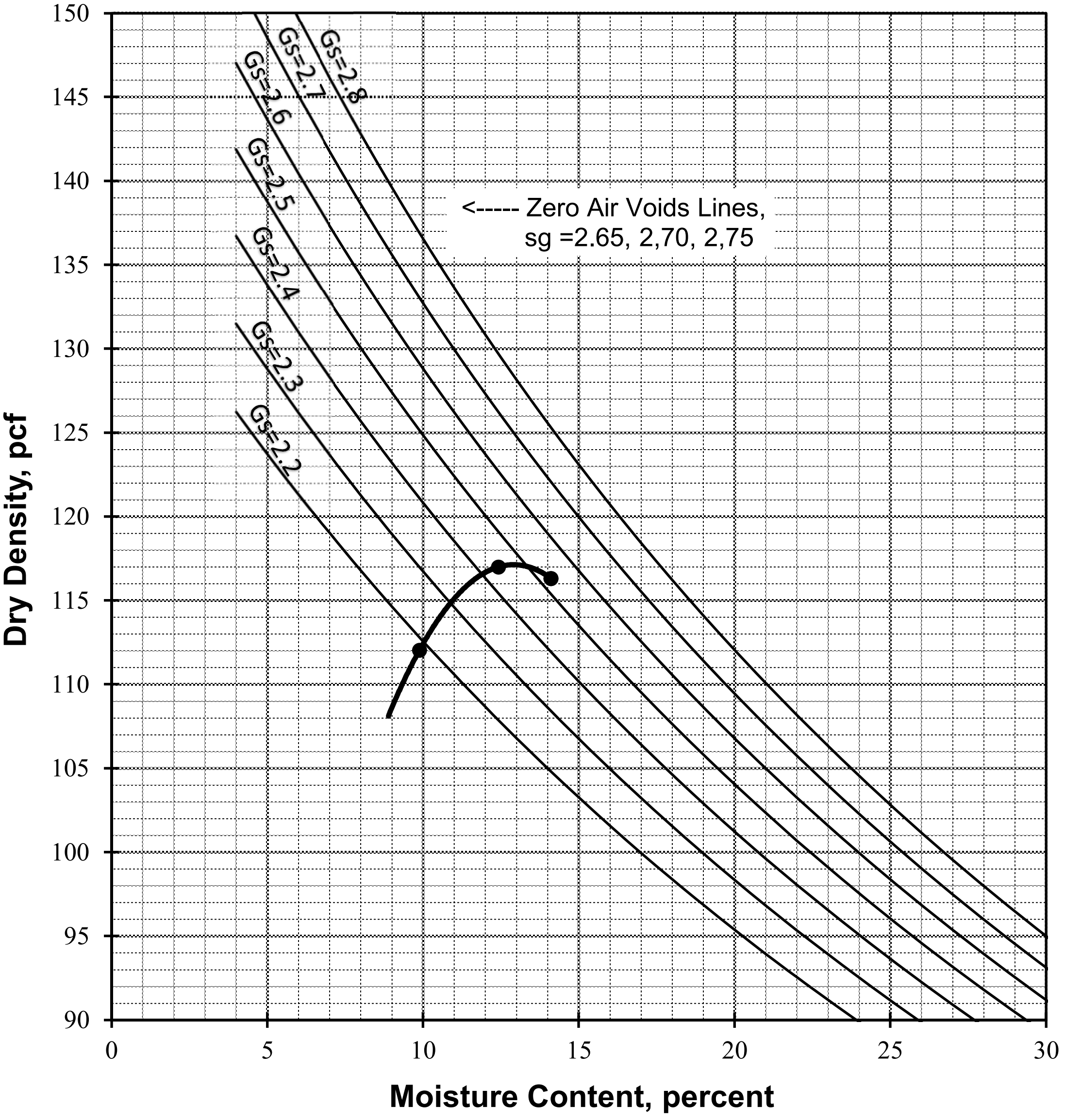
ASTM D 1557-12 (Modified)

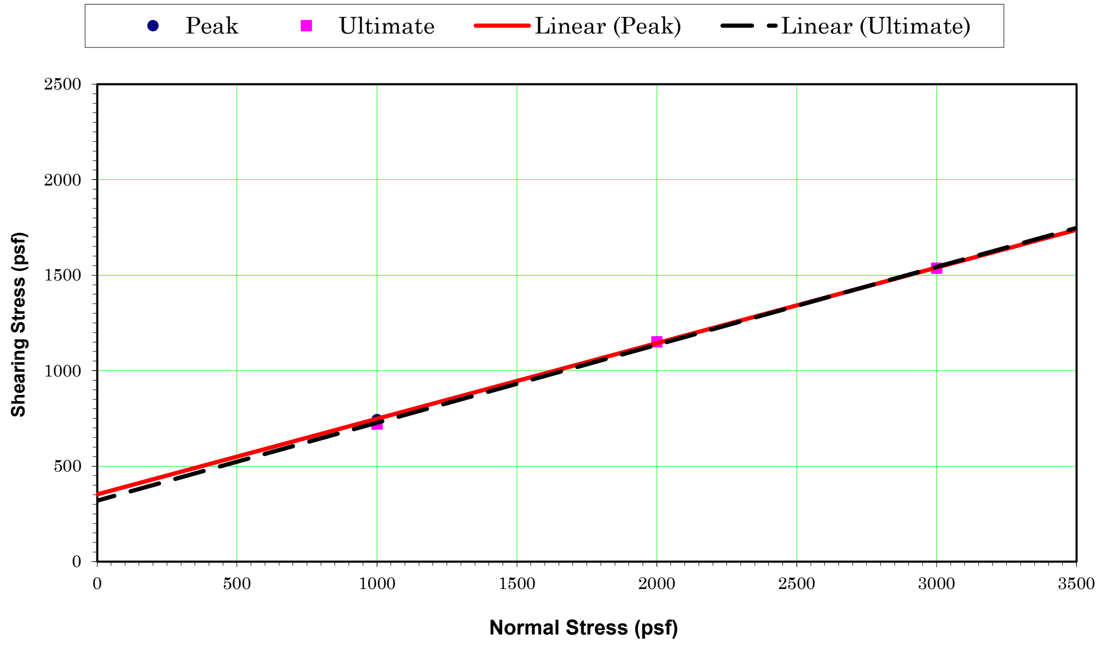
Job Name:	Anthem Chapel	Procedure Used: A
Sample ID:	B 1 @ 0-5'	Prep. Method: Moist
Date:	1/25/2024	Rammer Type: Automatic
Description:	Dark Brown Sandy Lean Clay	

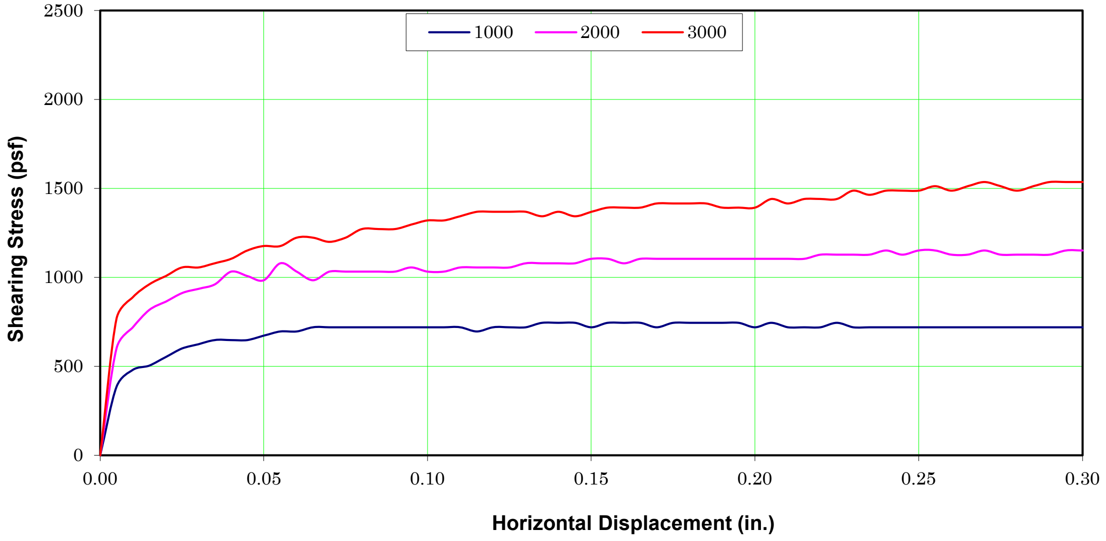
Maximum Density: **117 pcf**

Optimum Moisture: **13%**

Sieve Size	% Retained
3/4"	0.0
3/8"	0.0
#4	0.6







DIRECT SHEAR DATA*

Sample Location: B 1 @ 0-5'
Sample Description: Dark Brown Sandy Lean Clay
Dry Density (pcf): 104.8
Intial % Moisture: 12.9
Average Degree of Saturation: 100.0
Shear Rate (in/min): 0.005 in/min

Normal stress (psf)	1000	2000	3000
Peak stress (psf)	744	1152	1536
Ultimate stress (psf)	720	1152	1536

	Peak	Ultimate
ϕ Angle of Friction (degrees):	22	22
c Cohesive Strength (psf):	350	320

Test Type: Peak & Ultimate

* Test Method: ASTM D-3080

Note: Sample specimens were initially saturated before testing by partially immersing the specimens in water for about 24 hours while the specimens were restrained from swelling. Initial saturation was not performed in the direct shear machine, and is not prescribed by ASTM D 3080.

DIRECT SHEAR TEST

Anthem Chapel

Earth Systems

3/7/2024 306481-001

File No.: 306481-001

EXPANSION INDEX

ASTM D-4829, UBC 18-2

Job Name: Anthem Chapel
Sample ID: B 1 @ 0-5'
Soil Description: CL

Initial Moisture, %:	12.2
Initial Compacted Dry Density, pcf:	101.7
Initial Saturation, %:	50
Final Moisture, %:	28.2
Volumetric Swell, %:	6.8

Expansion Index: **68** **Medium**

EI	UBC Classification
0-20	Very Low
21-50	Low
51-90	Medium
91-130	High
130+	Very High

CAPCO
Analytical Services, Inc.
Environmental and Analytical Services-Since 1994
California State Accredited Laboratory in Accordance with ELAP Certificate # 2332

CERTIFICATE OF ANALYSIS

Client: Earth Systems Pacific
CAS LAB NO: 240148-01
Sample ID: B1@0-5' Anthem Chapel
Analyst: Gloria

Date Sampled: 01/23/24
Date Received: 01/25/24
Sample Matrix: Soil

WET CHEMISTRY SUMMARY

COMPOUND	RESULTS	UNITS	DF	PQL	METHOD	ANALYZED
pH (Corrosivity)**	6.6	S.U.	1	---	9045	01/29/24
Resistivity*	12700	Ohms-cm	1	---	SM 120.1M	01/29/24
Chloride	13	mg/Kg	1	0.3	300.0M	01/29/24
Sulfate	35	mg/Kg	1	0.9	300.0M	01/29/24

*Sample was extracted using a 1:3 ratio of soil and DI water.
**Sample was extracted using 1:1 ratio of soil and DI water.

DF: Dilution Factor
PQL: Practical Quantitation Limit
BQL: Below Quantitation Limit
mg/Kg: Milligrams/Kilograms(ppm)

MECHANICAL ANALYSIS

CTM 203-08

Job Name: Anthem Chapel
Job No.: 306481-001
Sample ID: **B 1 @ 0-5'**
Soil Description: **CL**
Hydrometer ID: 504229

Hydroscopic Moisture

Air Dry Wt, g: 100.0
Oven Dry Wt, g 100.0
% Moisture: 0.0

Air Dry Sample Wt., g: 547.5
Corrected Wt., g: 547.5

Sieve Analysis for +#10 Material

Sieve Size	Wt Ret	% Ret	% Passing
1/2 inch	0.0	0.00	100.00
3/8 inch	0.0	0.00	100.00
#4	3.5	0.64	99.36
#8	28.8	5.26	94.74
#10	30.2	5.52	94.48

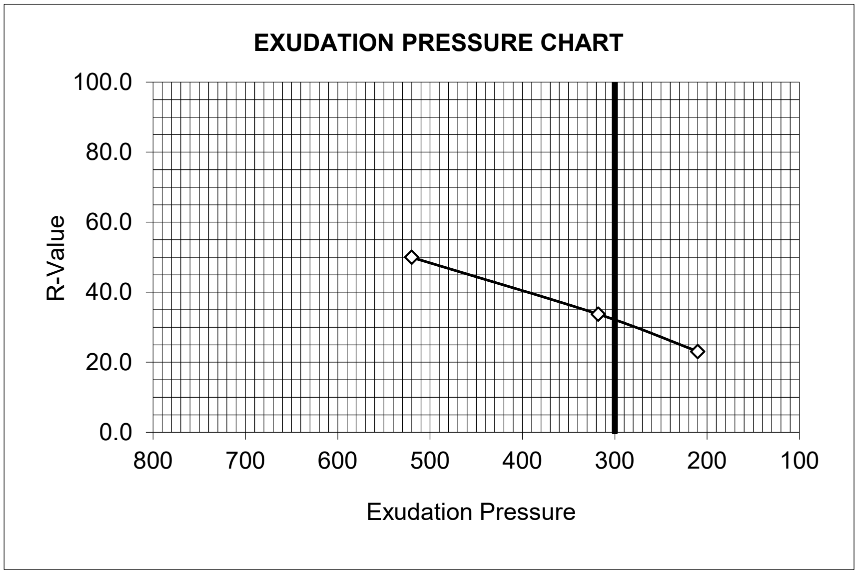
Air Dry Hydro Sample Wt., g: 64.9
Corrected Wt., g: 64.9
Calculation Factor 0.6869

Hydrometer Analysis for <#10 Material

Start time: 7:52:00 AM

Short Hydro	Time of Reading	Hydro Reading	Temp. at Reading, °C	Correction Factor	Corrected Hydro Reading
20 sec	7:52:20 AM	45	16	5.8	39.2
1 hour	8:52:00 AM	29	16	5.8	23.2
6 hour	1:52:00 PM	23	21	4.9	18.1

% Gravel:	0.6
% Sand(2mm - 74µm):	42.3
% Silt(74µm- 5µm):	23.3
% Clay(5µm - 2µm):	7.4
% Clay(≤2µm):	26.4

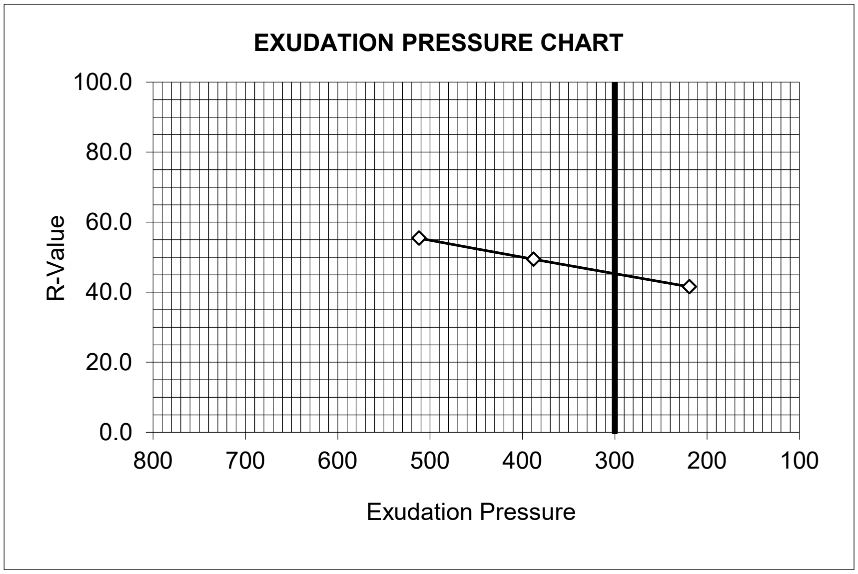


JOB NAME: Anthem Chapel
SAMPLE I. D.: B-1 @ 0-5
SOIL DESCRIPTION: Clayey Silt (ML)

SPECIMEN NUMBER	D	E	F
EXUDATION PRESSURE	520	318	210
RESISTANCE VALUE	50.0	33.8	23.1
EXPANSION DIAL(0.0001")	0	0	0
EXPANSION PRESSURE (PSF)	0.0	0.0	0.0
% MOISTURE AT TEST	10.9	11.7	12.3
DRY DENSITY AT TEST	125.8	124.5	123.6

R-VALUE @ 300 PSI EXUDATION **32**

**Based on Traffic Index = 8.00 & Gravel Factor = 1.34*



JOB NAME: Anthem Chapel
SAMPLE I. D.: B2 @ 0-5
SOIL DESCRIPTION: Clayey Silt

SPECIMEN NUMBER	D	E	F
EXUDATION PRESSURE	512	388	219
RESISTANCE VALUE	55.4	49.4	41.6
EXPANSION DIAL(0.0001")	0	0	0
EXPANSION PRESSURE (PSF)	0.0	0.0	0.0
% MOISTURE AT TEST	10.9	11.4	11.8
DRY DENSITY AT TEST	124.5	123.2	123.6

R-VALUE @ 300 PSI EXUDATION **45**

**Based on Traffic Index = 8.00 & Gravel Factor = 1.34*

MECHANICAL ANALYSIS

CTM 203-08

Job Name: Anthem Chapel
Job No.: 306481-001
Sample ID: **B 1 @ 15'**
Soil Description: **SM**
Hydrometer ID: 504229

Hydroscopic Moisture

Air Dry Wt, g: 100.0
Oven Dry Wt, g 100.0
% Moisture: 0.0

Air Dry Sample Wt., g: 533.3
Corrected Wt., g: 533.3

Sieve Analysis for +#10 Material

Sieve Size	Wt Ret	% Ret	% Passing
1/2 inch	4.4	0.83	99.17
3/8 inch	9.3	1.74	98.26
#4	23.2	4.35	95.65
#8	48.3	9.06	90.94
#10	51.6	9.68	90.32

Air Dry Hydro Sample Wt., g: 92.7
Corrected Wt., g: 92.7
Calculation Factor 1.0264

Hydrometer Analysis for <#10 Material

Start time: 7:44:00 AM

Short Hydro	Time of Reading	Hydro Reading	Temp. at Reading, °C	Correction Factor	Corrected Hydro Reading
20 sec	7:44:20 AM	22	16	5.8	16.2
1 hour	8:44:00 AM	16	16	5.8	10.2
6 hour	1:44:00 PM	12	21	4.9	7.1

% Gravel: 4.4
% Sand(2mm - 74µm): 79.8
% Silt(74µm- 5µm): 5.9
% Clay(5µm - 2µm): 3.0
% Clay(≤2µm): 6.9

MECHANICAL ANALYSIS

CTM 203-08

Job Name: Anthem Chapel
Job No.: 306481-001
Sample ID: **B 1 @ 25'**
Soil Description: **CH**
Hydrometer ID: 504229

Hydroscopic Moisture

Air Dry Wt, g: 100.0
Oven Dry Wt, g 100.0
% Moisture: 0.0

Air Dry Sample Wt., g: 513.8
Corrected Wt., g: 513.8

Sieve Analysis for +#10 Material

Sieve Size	Wt Ret	% Ret	% Passing
1/2 inch	0.0	0.00	100.00
3/8 inch	0.0	0.00	100.00
#4	0.0	0.00	100.00
#8	0.0	0.00	100.00
#10	0.0	0.00	100.00

Air Dry Hydro Sample Wt., g: 64.3
Corrected Wt., g: 64.3
Calculation Factor 0.6430

Hydrometer Analysis for <#10 Material

Start time: 6:35:00 AM

Short Hydro	Time of Reading	Hydro Reading	Temp. at Reading, °C	Correction Factor	Corrected Hydro Reading
20 sec	6:35:20 AM	64	16	5.8	58.2
1 hour	7:35:00 AM	46	16	5.8	40.2
6 hour	12:35:00 PM	39	20	5.1	33.9

% Gravel:	0.0
% Sand(2mm - 74µm):	9.5
% Silt(74µm- 5µm):	28.0
% Clay(5µm - 2µm):	9.8
% Clay(≤2µm):	52.7

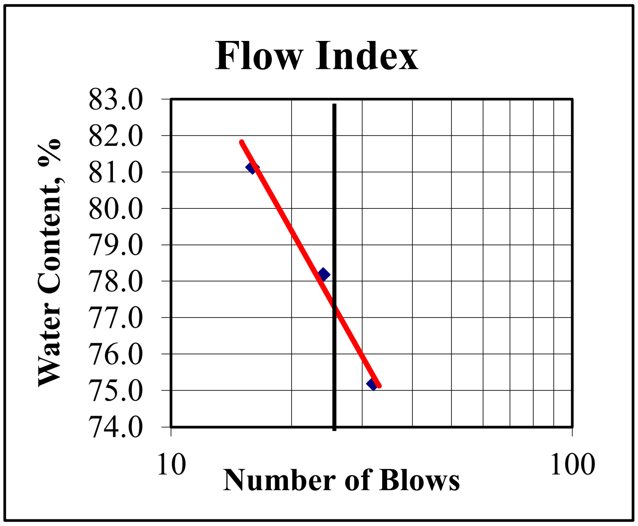
File No.: 306481-001 February 12, 2024

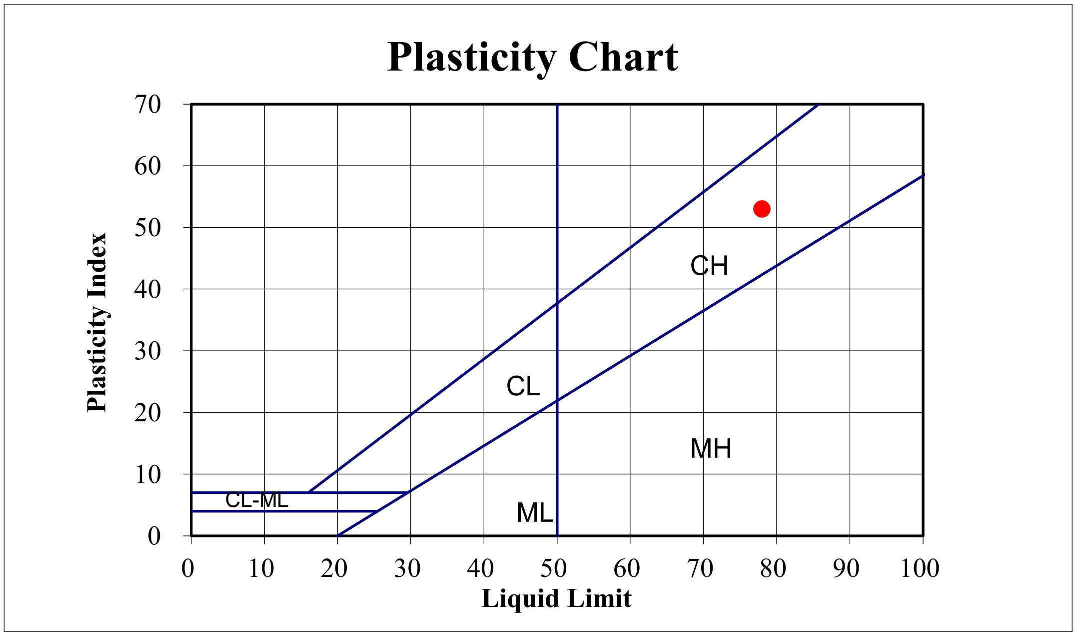
PLASTICITY INDEX

ASTM D-4318

Job Name: Anthem Chapel
Sample ID: B 1 @ 25'
Soil Description: CH

DATA SUMMARY				TEST RESULTS	
Number of Blows:	16	24	32	**LIQUID LIMIT**	**78**
Water Content, %	81.1	78.2	75.2	**PLASTIC LIMIT**	**25**
Plastic Limit:	25.1	25.2		**PLASTICITY INDEX**	**53**



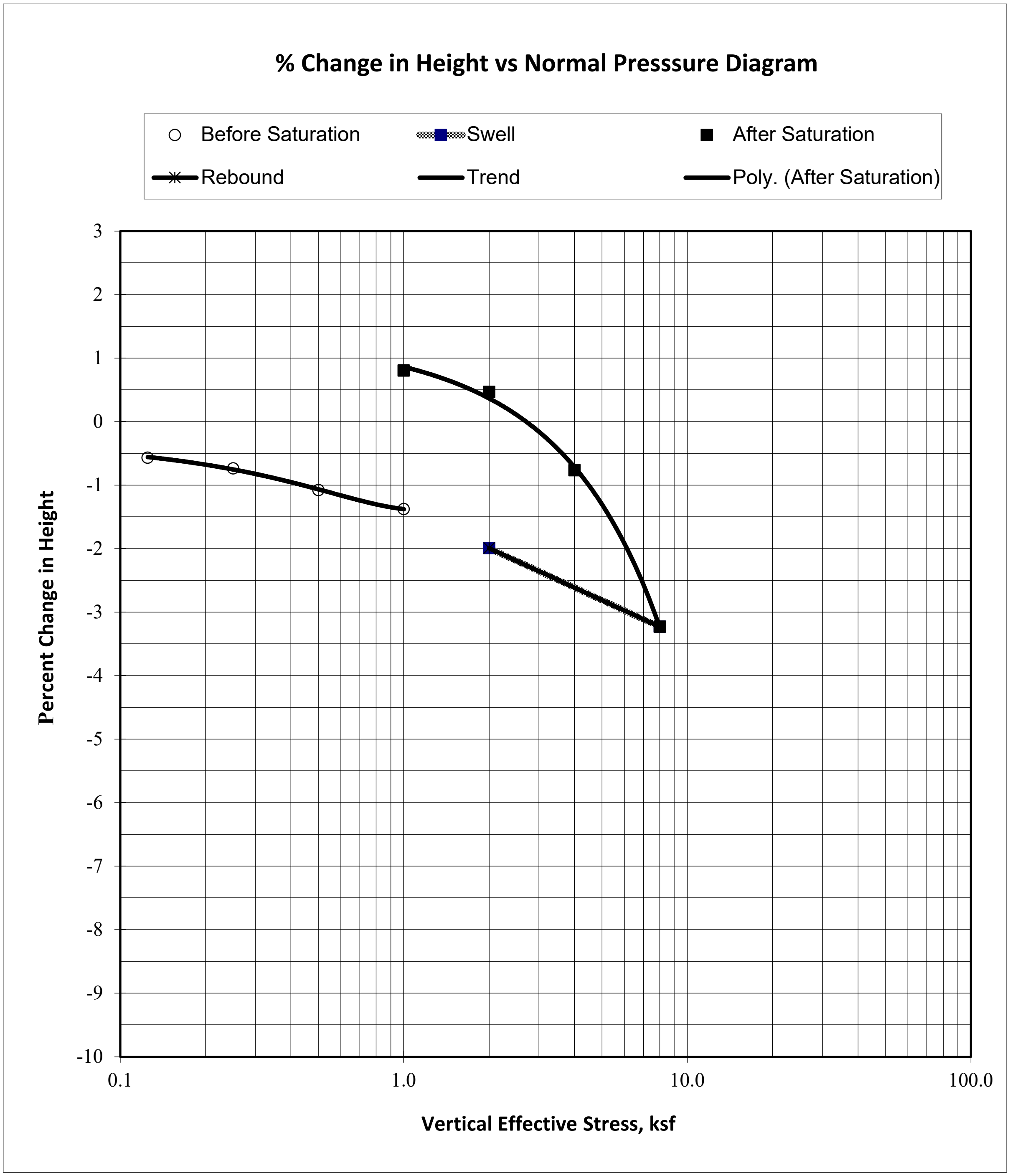


CONSOLIDATION TEST

ASTM D 2435-90

Anthem Chapel
B 1 @ 2.5'
CL
Ring Sample

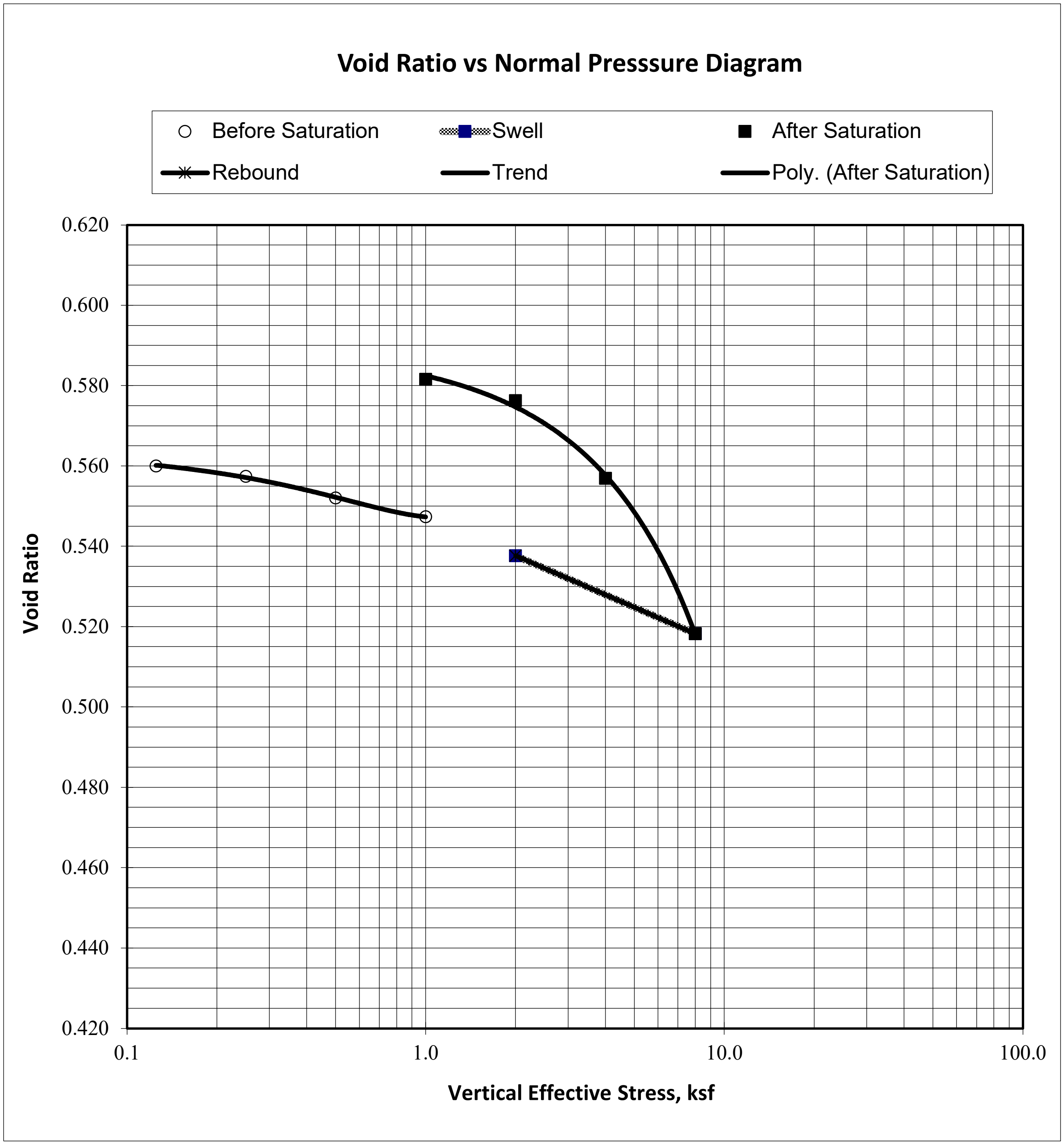
Initial Dry Density: 106.3 pcf
Initial Moisture, %: 20.2%
Specific Gravity: 2.67 (assume
Initial Void Ratio: 0.569



CONSOLIDATION TEST

ASTM D 2435-90

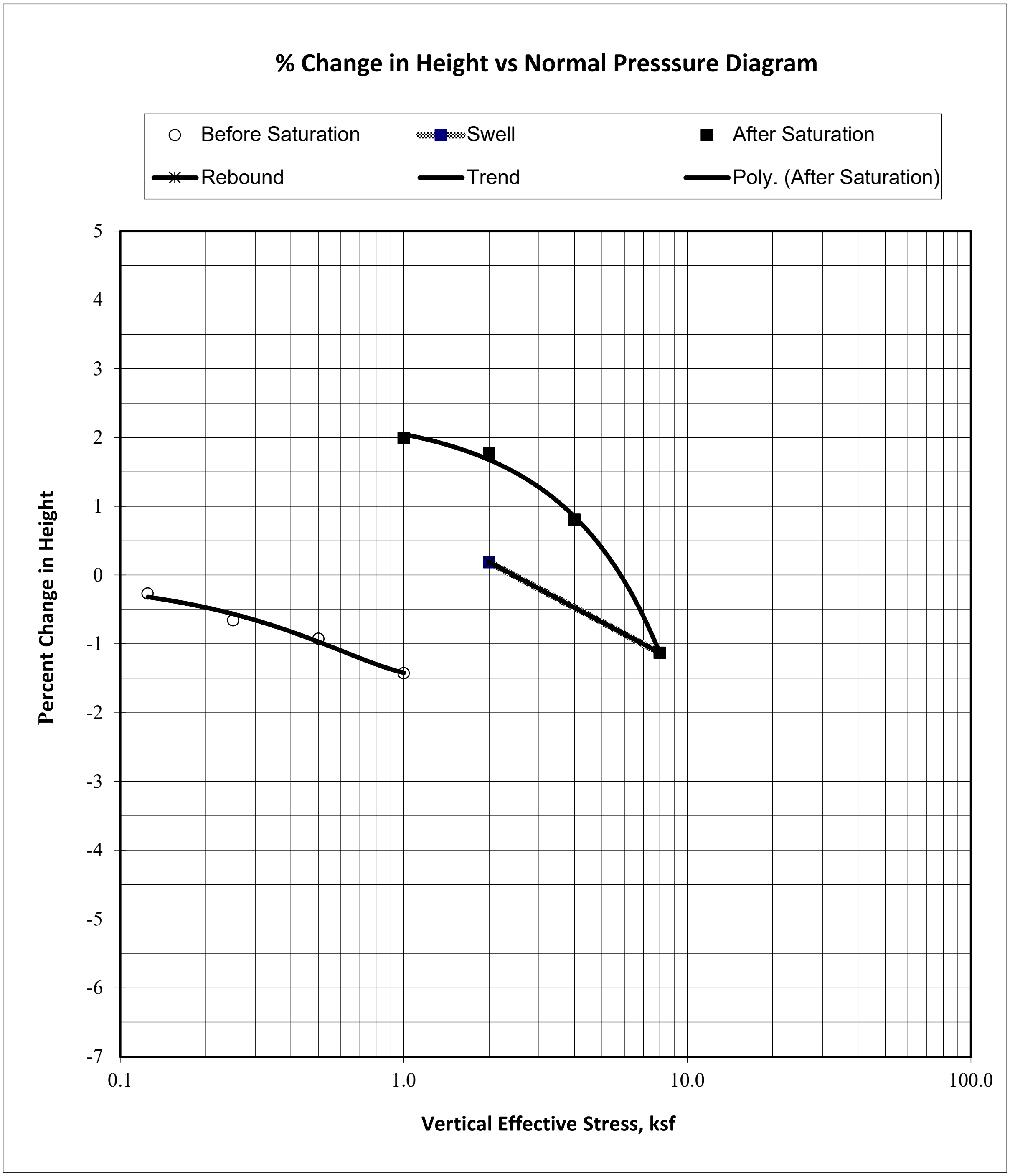
Anthem Chapel		Initial Dry Density:	106.3
B 1 @ 2.5'		Initial Moisture, %:	20.2
CL		Specific Gravity:	2.67 (assume
Ring Sample		Initial Void Ratio:	0.569



CONSOLIDATION TEST

ASTM D 2435-90

Anthem Chapel		Initial Dry Density:	112.0 pcf
B 2 @ 5'		Initial Moisture, %:	18.0%
CL		Specific Gravity:	2.67 (assume
Ring Sample		Initial Void Ratio:	0.488

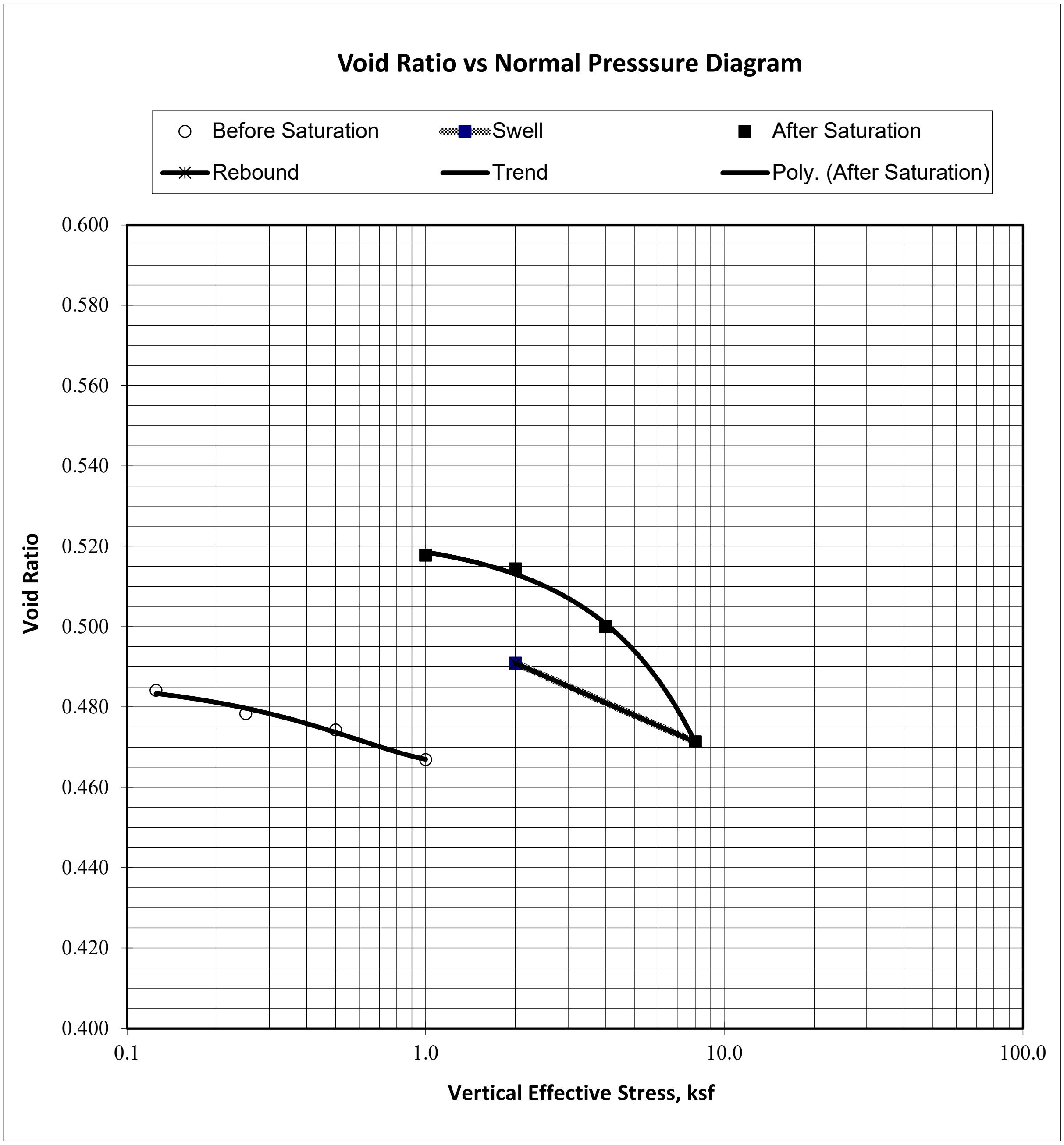


CONSOLIDATION TEST

ASTM D 2435-90

Anthem Chapel
B 2 @ 5'
CL
Ring Sample

Initial Dry Density:	112.0
Initial Moisture, %:	18.0
Specific Gravity:	2.67 (assume
Initial Void Ratio:	0.488



APPENDIX C

Minimum Foundation Design

MINIMUM FOUNDATION DESIGN

FOUNDATIONS FOR STUD BEARING WALLS – MINIMUM REQUIREMENTS

EXPANSION INDEX (E. I.)	FOUNDATIONS FOR SLAB AND RAISED FLOOR SYSTEM							CONCRETE SLAB 3-1/2" MINIMUM THICKNESS (4" WHEN OVER 51, E. I.)			
	NUMBER OF STORIES	STEM THICKNESS	FOOTING WIDTH	FOOTING THICKNESS	ALL PERIMETER FOOTINGS	INTERIOR FOOTINGS FOR SLAB AND RAISED FLOORS	REINFORCEMENT FOR FOUNDATIONS			PREMOISTENING CONTROLS FOR SOILS UNDER FOOTINGS, PEIRS AND SLABS	PIERS UNDER RAISED FLOORS
					DEPTH BELOW NATURAL SURFACE OF GROUND & FINISH GRADE			REINFORCEMENT	TOTAL THICKNESS OF SAND		
		INCHES									
0 -20 VERY LOW (NON-EXPANSIVE)	1	6	12	6	12	12	1 - #4 @ TOP AND BOTTOM	#3 @ 24" O.C. EACH WAY	2"	MOISTENING OF GROUND PRIOR TO PLACING CONCRETE IS RECOMMENDED	PIERS ALLOWED FOR SINGLE FLOOR LOADS ONLY
	2	8	15	7	18	18					
	3	10	18	8	24	24					
21-50 LOW	1	6	12	6	15	12	1 - #4 @ TOP AND BOTTOM	#3 @ 24" O.C. EACH WAY	4"	3% OVER OPTIMUM MOISTURE CONTENT TO A DEPTH OF 18" BELOW LOWEST ADJACENT GRADE TESTING REQ'D	PIERS ALLOWED FO SINGLE FLOOR LOADS ONLY
	2	8	15	7	18	18					
	3	10	18	8	24	24					
51-90 MEDIUM	1	6	12	6	21	12	1 - #4 @ TOP AND BOTTOM	#3 @ 24" O.C. EACH WAY	4"	3% OVER OPTIMUM MOISTURE CONTENT TO A DEPTH OF 18" BELOW LOWEST ADJ ACENT GRADE TESTING REQ'D	PIERS NOT ALLOWED
	2	8	15	8	21	18					
	3	10	18	8	24	24					
							#3 BARS @ 24" O.C. 12" INTO FOOTING AND BENT 3' INTO SLAB				
91-130 HIGH	1	6	12	8	27	12	2 - #4 @ TOP AND BOTTOM	#3 @ 24" O.C. EACH WAY	4"	3% OVER OPTIMUM MOISTURE CONTENT TO A DEPTH OF 24" BELOW LOWEST ADJACENT GRADE TESTING REQ'D	PIERS NOT ALLOWED
	2	8	15	8	27	18					
	3	10	18	8	27	24					
							#3 BARS @ 24" O.C. 12" INTO FOOTING AND BENT 3' INTO SLAB				
ABOVE 130 VERY HIGH	REQUIRES SPECIAL DESIGN BY A STATE LICENSED SOILS PROFESSIONAL										

APPENDIX D

SEAOC-OSHPD ASCE 7-16 and 2022 CBC Seismic Design Parameters
Fault Parameters

USGS web services were down for some period of time and as a result this tool wasn't operational, resulting in *timeout* error.
USGS web services are now operational so this tool should work as expected.

Anthem Chapel

Latitude, Longitude: 34.4437, -119.8536

Date	3/5/2024, 11:18:06 AM
Design Code Reference Document	ASCE7-16
Risk Category	III
Site Class	D - Stiff Soil

Type	Value	Description
S_S	2.263	MCE_R ground motion. (for 0.2 second period)
S_1	0.8	MCE_R ground motion. (for 1.0s period)
S_{MS}	2.263	Site-modified spectral acceleration value
S_{M1}	null -See Section 11.4.8	Site-modified spectral acceleration value
S_{DS}	1.509	Numeric seismic design value at 0.2 second SA
S_{D1}	null -See Section 11.4.8	Numeric seismic design value at 1.0 second SA

Type	Value	Description
SDC	null -See Section 11.4.8	Seismic design category
F_a	1	Site amplification factor at 0.2 second
F_v	null -See Section 11.4.8	Site amplification factor at 1.0 second
PGA	0.995	MCE_G peak ground acceleration
F_{PGA}	1.1	Site amplification factor at PGA
PGA_M	1.095	Site modified peak ground acceleration
T_L	8	Long-period transition period in seconds
SsRT	2.263	Probabilistic risk-targeted ground motion. (0.2 second)
SsUH	2.589	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration
SsD	3.166	Factored deterministic acceleration value. (0.2 second)
S1RT	0.8	Probabilistic risk-targeted ground motion. (1.0 second)
S1UH	0.914	Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration.
S1D	1.011	Factored deterministic acceleration value. (1.0 second)
PGAd	1.27	Factored deterministic acceleration value. (Peak Ground Acceleration)
PGA_{UH}	0.995	Uniform-hazard (2% probability of exceedance in 50 years) Peak Ground Acceleration
C_{RS}	0.874	Mapped value of the risk coefficient at short periods
C_{R1}	0.875	Mapped value of the risk coefficient at a period of 1 s
C_V	1.5	Vertical coefficient

Table E-1
Fault Parameters

Fault Section Name	Distance		Upper Seis. Depth	Lower Seis. Depth	Avg Dip Angle	Avg Dip Direction	Avg Rake	Trace Length	Fault Type	**Mean Mag**	Mean Return Interval	Slip Rate
	(miles)	(km)	(km)	(km)	(deg.)	(deg.)	(deg.)	(km)			(years)	(mm/yr)
Mission Ridge-Arroyo Parida-Santa Ana FM3.1, 3	1.1	1.8	0.0	7.6	70	176	90	69	B	**6.8**		0.4
Red Mountain FM3.1, 3.2	4.2	6.8	0.0	14.1	56	2	90	101	B	**7.4**		2
North Channel FM3.2	5.9	9.5	1.1	4.5	26	10	90	51	B	**6.7**		1
Pitas Point (Upper) FM3.2	7.3	11.7	1.4	10.0	42	15	90	35	B	**6.8**		1
Santa Ynez (West) FM3.1, 3.2	7.5	12.0	0.0	9.2	70	182	0	80	B	**6.9**		2
Santa Ynez River FM3.1, 3.2	7.8	12.6	0.0	12.0	70	na	na	73	B'	**7.1**		
Los Alamos extension FM3.1, 3.2	7.8	12.6	0.0	12.0	30	na	na	22	B'	**6.8**		
San Luis Range (So Margin) FM3.2	8.2	13.2	0.0	12.0	45	37	90	115	B	**7.1**		0.2
Oak Ridge (Offshore), west extension FM3.2	9.1	14.7	0.0	3.1	67	195	na	28	B'	**6.1**		
Pitas Point (Lower, West), FM 3.1	11.3	18.1	1.5	8.8	13	3	90	35	B	**7.2**		2.5
Channel Islands Western Deep Ramp FM3.1, 3.2	11.6	18.7	4.8	12.5	21	204	90	62	B'	**7.3**		
Santa Ynez (East) FM3.1, 3.2	13.0	20.9	0.0	13.3	70	172	0	68	B	**7.2**		2
Oak Ridge (Offshore) FM3.2	16.6	26.7	0.0	7.9	32	180	90	38	B	**6.9**		3
Ventura-Pitas Point FM3.1, 3.2	18.0	28.9	1.0	15.0	64	353	60	59	B	**6.9**		1
Los Alamos 2011 CFM FM3.1, 3.2	19.1	30.7	0.0	12.0	30	na	na	27	B'	**6.9**		
Pitas Point (Lower)-Montalvo, FM3.1	19.3	31.0	0.4	12.7	16	359	90	30	B	**7.3**		2.5
Lions Head 2011 CFM FM3.1, 3.2	20.0	32.3	0.0	12.0	75	29	90	65	B	**6.7**		0.02
Big Pine (West) FM3.1, 3.2	20.4	32.8	0.0	11.0	50	2	na	18	B'	**6.5**		
East Huasna 2011 CFM FM3.1, 3.2	25.3	40.6	0.0	15.0	90	na	na	74	B'	**7.2**		
San Luis Range 2011 CFM, FM3.1	26.4	42.5	0.0	12.0	52	na	na	79	B'	**7.2**		
Santa Cruz Island FM3.1, 3.2	26.9	43.3	0.0	13.3	90	188	30	69	B	**7.1**		1
Pine Mtn FM3.1, 3.2	28.7	46.1	0.0	16.3	45	5	na	62	B'	**7.3**		
Ozena FM3.1, 3.2	29.7	47.8	0.0	13.9	33	na	na	41	B'	**7.2**		
Santa Rosa Island FM3.1, 3.2	30.0	48.3	0.0	8.7	90	1	30	58	B	**6.8**		1
South Cuyama FM3.1, 3.2	31.7	51.0	0.0	13.9	33	210	na	83	B'	**7.5**		
Big Pine (Central) FM3.1, 3.2	32.2	51.9	0.0	6.6	76	167	na	23	B'	**6.3**		
Sisar FM3.1, 3.2	32.3	52.0	0.0	17.4	29	168	na	20	B'	**7.0**		
Channel Islands Thrust FM3.1, 3.2	32.4	52.2	5.0	12.3	20	354	90	59	B	**7.3**		1.5
Casmalia 2011 CFM	35.3	56.8	0.0	12.0	75	na	na	48	B'	**6.9**		
Morales (West) FM3.1, 3.2	37.4	60.2	0.0	8.6	32	49	na	28	B'	**6.8**		
Santa Cruz Catalina Ridge Alt2 FM3.2	37.9	61.1	0.0	11.0	90	38	na	137	B'	**7.3**		
Santa Cruz Catalina Ridge alt 1, FM3.1	37.9	61.1	0.0	11.0	90	na	na	114	B'	**7.2**		
Morales (East) FM3.1, 3.2	38.5	62.0	0.0	8.6	32	14	na	18	B'	**6.6**		
Oak Ridge (Onshore) FM3.1, 3.2	38.7	62.3	1.0	19.4	65	159	90	50	B	**7.2**		4
San Cayetano FM3.1, 3.2	39.5	63.6	0.0	16.0	42	3	90	42	B	**7.2**		6
Malibu Coast (Extension), alt 1, FM3.1	40.6	65.3	0.0	7.8	74	4	30	35	B'	**6.5**		
Malibu Coast (Extension), alt 2 FM3.2	40.6	65.3	0.0	16.6	74	4	30	35	B'	**6.9**		
Big Pine (East) FM3.1, 3.2	41.0	66.0	0.0	14.3	73	338	na	23	B'	**6.6**		
Oceanic-West Huasna FM3.1, 3.2	42.0	67.6	0.0	7.0	58	49	na	122	B'	**7.1**		
San Andreas (Big Bend) FM3.1, 3.2	42.9	69.0	0.0	15.1	90	198	180	50	A	**6.8**	89	3.5

Reference: USGS OFR 2013-1165 (CGS SP 228)

Based on Site Coordinates of 34.4437 Latitude, -119.8536 Longitude

Mean Magnitude for Type A Faults based on 0.1 weight for unsegmented section, 0.9 weight for segmented model (weighted by probability of each scenario with section listed as given on Table 3 of Appendix G in OFR 2008-1437). Mean magntude is average of Ellworths-B and Hanks & Bakun moment area relationship.

APPENDIX E

Liquefaction and Seismic-Induced Dry Sand Settlement Analyses

LIQUEFY-v2dot45.XLS - A SPREADSHEET FOR EMPIRICAL ANALYSIS OF LIQUEFACTION POTENTIAL AND INDUCED GROUND SUBSIDENCE

Coryright & Developed 2007 by Shelton L. Stringer, PE, GE, PG , EG - Earth Systems Southwest
(Modified by R. Beard to use 2/3's PGAm for Seismic Induced Settlement of Dry Sands)

Project: Anthem Chapel
Job No: 306481-001
Date: 2/28/2024
Boring: B1 Data Set: 1

Methods:
Journal of Geotechnical and Enviromental Engineering (JGEE), October 2001, Vol 127, No. 10, ASCE
Settlement Analysis from Tokimatsu and Seed (1987), JGEE,Vol 113, No.8, ASCE
Modified by Pradel, JGEE, Vol 124, No. 4, ASCE

EARTHQUAKE INFORMATION:
Magnitude: 7 7.5
PGA, g: 1.09 0.92
MSF: 1.19
GWT: 20.0 feet
Calc GWT: 13.5 feet
Remediate to: 0.0 feet

SPT N VALUE CORRECTIONS:
Energy Correction to N60 (C_E): 1.33 Automatic Hammer
Drive Rod Corr. (C_R): 1 Default
Rod Length above ground (feet): 3.0
Borehole Dia. Corr. (C_B): 1.00
Sampler Liner Correction for SPT?: 1.0 Yes
Cal Mod/ SPT Ratio: 0.63

Threshold Acceler., g: #N/A

Total (ft) Liquefied Thickness
0.0

Total (in.) Induced Subsidence
0.1

upper 50 ft

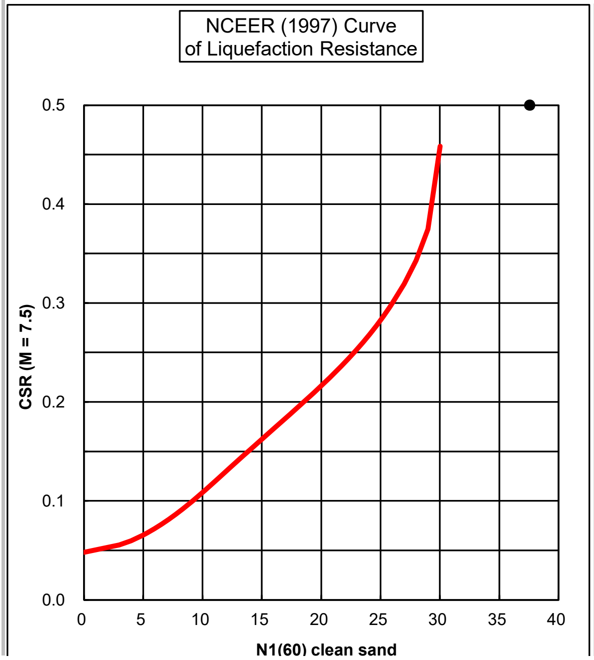
Required SF: 1.30
Minimum Calculated SF: #N/A

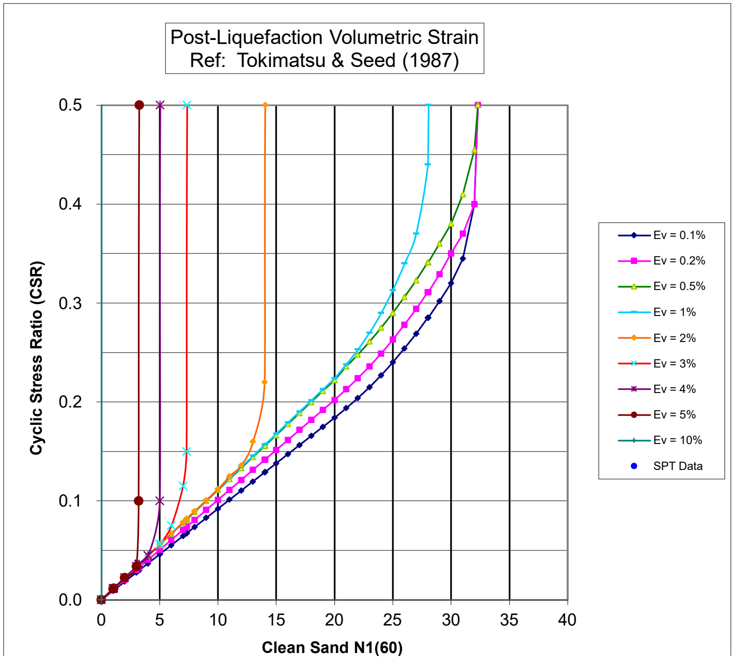
Base Depth (feet)	Cal Mod N	SPT N	Liquef. Suscept. (0 or 1)	Total Unit Wt. (pcf)	Fines Content (%)	Depth of SPT (feet)	Rod Length (feet)	Tot.Stress at SPT po (tsf)	Eff.Stress at SPT p'o (tsf)	rd	C_N	C_R	C_S	$N_{1(60)}$	Rel. Dens. Dr (%)	*Trigger FC Adj.* $\Delta N_{1(60)}$	*Equiv. Sand* $N_{1(60)CS}$	Kσ	M = 7.5 Available CRR	M =7.5 Induced CSR*	**Liquefac. Safety Factor**	*Post FC Adj.* $\Delta N_{1(60)}$	$N_{1(60)CS}$	Volumetric *Strain (%)*	**Induced Subsidence (in.)**
								0.000																	
4.5	15	**9**		125	5	3.5	6.5	0.219	0.219	0.99	1.00	0.75	1.00	9.4				1.00	Infin.	0.592	**Non-Liq.**		9.4	0.00	**0.00**
7.0	62	**39**	1	125	5	6.0	9.0	0.375	0.375	0.99	1.68	0.75	1.00	65.4	97	0.0	65.4	1.00	Infin.	0.589	**Non-Liq.**	0.0	65.4	0.02	**0.01**
9.5	58	**37**	1	125	5	8.5	11.5	0.531	0.531	0.98	1.41	0.75	1.00	51.4	86	0.0	51.4	1.00	Infin.	0.586	**Non-Liq.**	0.0	51.4	0.04	**0.01**
13.5	55	**35**	1	125	5	11.0	14.0	0.688	0.688	0.98	1.24	0.78	1.00	44.8	80	0.0	44.8	1.00	Infin.	0.582	**Non-Liq.**	0.0	44.8	0.07	**0.03**
18.5		**24**	1	125	5	16.0	19.0	1.000	1.000	0.97	1.03	0.88	1.30	37.6	73	0.0	37.6	1.00	Infin.	0.625	**Non-Liq.**	0.0	37.6	0.00	**0.00**
23.5		**35**	1	125	5	21.0	24.0	1.313	1.281	0.95	0.91	0.94	1.30	52.0	86	0.0	52.0	0.99	Infin.	0.698	**Non-Liq.**	0.0	52.0	0.00	**0.00**
27.5		**20**		125	5	26.0	29.0	1.625	1.438	0.94	1.00	0.99	1.30	34.3				0.97	Infin.	0.759	**Non-Liq.**		34.3	0.00	**0.00**
32.5		**25**		125	5	31.0	34.0	1.938	1.594	0.92	1.00	1.00	1.30	43.2				0.95	Infin.	0.803	**Non-Liq.**		43.2	0.00	**0.00**
37.5		**50**		125	5	36.0	39.0	2.250	1.751	0.88	1.00	1.00	1.30	86.5				0.93	Infin.	0.826	**Non-Liq.**		86.5	0.00	**0.00**
42.5		**89**	1	125	5	41.0	44.0	2.563	1.907	0.84	0.74	1.00	1.30	114.6	100	0.0	114.6	0.83	Infin.	0.913	**Non-Liq.**	0.0	114.6	0.00	**0.00**
47.5		**84**	1	125	5	46.0	49.0	2.875	2.064	0.79	0.72	1.00	1.30	104.0	100	0.0	104.0	0.80	Infin.	0.916	**Non-Liq.**	0.0	104.0	0.00	**0.00**
51.5		**70**	1	125	5	51.0	54.0	3.188	2.220	0.74	0.69	1.00	1.30	83.5	100	0.0	83.5	0.77	Infin.	0.905	**Non-Liq.**	0.0	83.5	0.00	**0.00**

SETTLEMENT (SUBSIDENCE) OF DRY SANDS

Nc = 10.8

Base Depth (feet)	p (tsf)	G_{max} (tsf)	τ_{av} (tsf)	Shear Strain γ	Strain E_{15}	Strain Enc	**Dry Sand Subsidence (in.)**
4.5	0.147						
7.0	0.251	903	0.176	5.7E-04	1.4E-04	1.2E-04	**0.01**
9.5	0.356	992	0.247	8.1E-04	2.6E-04	2.2E-04	**0.01**
13.5	0.461	1,077	0.318	1.0E-03	3.8E-04	3.3E-04	**0.03**
18.5	0.670	1,225	0.458	1.3E-03			
23.5	0.879	1,564	0.594	1.0E-03			
27.5	1.089						
32.5	1.298						
37.5	1.508						
42.5	1.717	2,845	1.023	6.1E-04			
47.5	1.926	2,917	1.082	6.1E-04			
51.5	2.136	2,856	1.122	6.6E-04			





$N_{1(60)} = C_N*C_E*C_B*C_R*C_S*N$

C_R = 0.75 for Rod lengths < 3m, 1.0 for > 10m
= $\min(1,\max(0.75,1.4666-2.556/(z(ft))^{0.5}))$

$C_N = (1\ atm/p'o)^{0.5}$, max 1.7

$C_S = \max(1.1,\min(1.3,1+N_{1(60)}/100))$ for SPT without liners

$MSF = 10^{2.24}/M^{2.56}$

z = Depth (m)

pa = 1 atm = 101 KPa = 1.058 tsf

p = 0.67*po

$\tau_{av} = 0.65*PGA*po*rd$

$G_{max} = 447*N_{1(60)CS}{}^{(1/3)}*p^{0.5}$

a = 0.0389*(p/1)+0.124

$b = 6400*(p/1)^{(-0.6)}$

$\gamma = [1+a*EXP(b*\tau_{av}/G_{max})]/[(1+a)*\tau_{av}/G_{max}]$

$E_{15} = \gamma*(N_{1(60)CS}/20)^{-1.2}$

$E_{nc} = (Nc/15)^{0.45}*E15$

$Nc = (MAG-4)^{2.17}$

$S = 2*H*E_{nc}$

rd = (1-0.4113*z^0.5+0.04052*z+0.001753*z^1.5)/(1-0.4177*z^0.5+0.05729*z-0.006205*z^1.5+0.00121*z^2))

$\Delta N_{1(60)}$ = min(10,IF(FC<35,exp(1.76-(190/FC^2)),5)+IF(FC<=5,1,IF(FC<35,0.99+(FC^1.5/1000),1.2))*N1(60) - N1(60)

$N_{1(60)CS} = N_{1(60)CS} + \Delta N_{1(60)}$

$K\sigma$ = min of 1.0 or $(p'o/1.058)^{(IF(Dr>0.7,0.6,IF(Dr<0.5,0.8,0.7))-1)}$

$Dr = (N_{1(60)}/70)^{0.5}$

CSReq = 0.65*PGA*(po/p'o)*rd
CSR* = CSReq/MSF/Kσ

$CRR_{7.5}$ = (0.048-0.004721*N+0.0006136*N^2-0.00001673*N^3)/(1-0.1248*N+0.009578*N^2-0.0003285*N^3+0.000003714*N^4))

$N = N_{1(60)CS}$

$SF = CRR_{7.5,1atm}/CSR*$