

PRELIMINARY GEOTECHNICAL INVESTIGATION

**PROPOSED MASTER PLAN
REDEVELOPMENT
TWELVE OAKS SENIOR LIVING FACILITY
2820 SYCAMORE AVENUE
GLENDALE, CALIFORNIA
APN: 5617-002-027**



GEOCON
WEST, INC.

GEOTECHNICAL
ENVIRONMENTAL
MATERIALS

PREPARED FOR

**TWELVE OAKS SENIOR LIVING
GLENDALE, CALIFORNIA**

PROJECT NO. W1582-06-01

AUGUST 4, 2022



Project No. W1582-06-01

August 4, 2022

Ms. Sharon Pewtress
2820 Sycamore Avenue
Glendale, CA 91214

Subject: PRELIMINARY GEOTECHNICAL INVESTIGATION
PROPOSED MASTER PLAN REDEVELOPMENT
TWELVE OAKS SENIOR LIVING FACILITY
2820 SYCAMORE AVENUE
GLENDALE, CALIFORNIA
APN: 5617-002-027

Dear Ms. Pewtress:

In accordance with your authorization of our proposal dated May 24, 2022, we have performed a preliminary geotechnical investigation for the proposed master plan redevelopment of the Twelve Oaks Senior Living Facility, located at 2820 Sycamore in the City of Glendale, California. The accompanying report presents the findings of our study and our conclusions and preliminary recommendations pertaining to the geotechnical aspects of proposed design and construction. Based on the results of our investigation, it is our opinion that the site can be developed as proposed, provided the recommendations of this report are followed and implemented during design and construction.

The primary intent of this report is to address the potential geologic hazards and geotechnical conditions that could impact site development and to provide preliminary recommendations. Additional analyses will be required in order to provide comprehensive geotechnical recommendations for design and construction when the scope of the proposed development has been established.

If you have any questions regarding this report, or if we may be of further service, please contact the undersigned.

Very truly yours,

GEOCON WEST, INC.

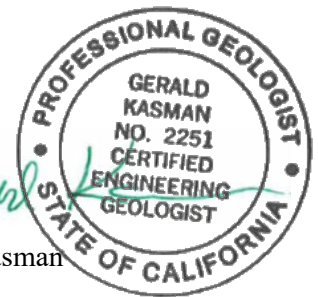


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PRELIMINARY GEOTECHNICAL INVESTIGATION

1. PURPOSE AND SCOPE

This report presents the results of a preliminary geotechnical investigation for the proposed master plan redevelopment of the Twelve Oaks Senior Living Facility located at 2820 Sycamore Avenue in the City of Glendale, California (see Vicinity Map, Figure 1). The purpose of the investigation was to evaluate subsurface soil and geologic conditions underlying the site and, based on conditions encountered, to provide conclusions and recommendations pertaining to the geotechnical aspects of design and construction. Due to the preliminary nature of the project at this time, the primary intent of this report is to address the potential geologic hazards and geotechnical conditions that could impact site development and to provide preliminary recommendations. Additional analyses will be required in order to provide comprehensive geotechnical recommendations for design and construction when the scope of the proposed development has been established.

The scope of this investigation included a site reconnaissance, field exploration, laboratory testing, engineering analysis, and the preparation of this report. The site was explored on June 27 and 28, 2022 by excavating four borings using a truck-mounted hollow stem auger drilling machine to depths between 10 and 41 feet below the existing ground surface. Additional excavations were performed up to 3 feet below the existing ground surface using hand tools. The approximate locations of the exploratory borings are depicted on the Site Plan (see Figure 2). A detailed discussion of the field investigation, including the boring logs, is presented in Appendix A.

Laboratory tests were performed on selected soil samples obtained during the investigation to determine pertinent physical and chemical soil properties. Appendix B presents a summary of the laboratory test results.

The recommendations presented herein are based on analysis of the data obtained during the investigation and our experience with similar soil and geologic conditions. References reviewed to prepare this report are provided in the *List of References* section.

If project details vary significantly from those described herein, Geocon should be contacted to determine the necessity for review and possible revision of this report.

2. SITE AND PROJECT DESCRIPTION

The subject site is located at 2820 Sycamore Avenue in the City of Glendale, California. The subject site is approximately 4.25 acres and is currently occupied by multiple one- and two-story structures with associated drive lanes, paved parking, and landscaping. The project property is bounded by single-family residential structures and Sycamore Avenue to the north, by single-family residential structures and the Crescenta Valley Water District pump station to the west, by La Crescenta Avenue to the east, and by single-family residential structures and Glenwood Avenue to the south. The southern portion of the property gently slopes downward approximately 7 feet to the south toward Glenwood Avenue. Surface water drainage is by sheet flow towards the city streets or into landscaping. Vegetation onsite consists of grass, trees, and shrubs confined to landscaping areas.

Based on the information provided by the Client, it is our understanding that the proposed development is currently in a preliminary phase, and the design recommendations in this report will be used for a master plan for future redevelopment. We understand that the proposed development will consist of a one-story structure located in the center of the property surrounded by parking and landscaping. Additionally, a CMU block wall is currently being proposed for construction along the southern property boundary. The existing structures and site conditions are shown on the Site Plan (see Figure 2).

Based on the preliminary nature of the design at this time, wall and column loads were not available. It is anticipated that column loads for the proposed structure will be up to 150 kips, and wall loads will be up to 2 kips per linear foot.

Once the design phase and foundation loading configuration proceeds to a more finalized plan, the recommendations within this report should be reviewed and revised, if necessary. Any changes in the design, location or elevation of any structure, as outlined in this report, should be reviewed by this office. Geocon should be contacted to determine the necessity for review and possible revision of this report.

3. GEOLOGIC SETTING

The site is situated at the foot of the northeast-facing slopes of the Verdugo Mountains, within a southeast trending alluvial valley following the Verdugo Wash. The sediments underlying the site are generally derived from the nearby Verdugo and San Gabriel Mountains. Regionally, the site is located in the southern portion of the Transverse Ranges geomorphic province. The Transverse Ranges geomorphic province is characterized by east-west trending geologic structures such as the nearby Sierra Madre and San Gabriel fault zones.

4. SOIL AND GEOLOGIC CONDITIONS

Based on our field investigation and published geologic maps of the area, the site is underlain by artificial fill and alluvial fan deposits, which are underlain at depth by alluvial channel deposits (CGS, 2012; Dibblee, 1989). Detailed stratigraphic profiles of the materials encountered at the site are provided on the boring logs in Appendix A.

4.1 Artificial Fill

Artificial fill was encountered in our explorations to a maximum depth of 4½ feet below existing ground surface. The artificial fill generally consists of light to moderate grayish brown or brown poorly graded sand with varying amounts of silt and gravel. The fill is generally characterized as loose to medium dense and dry to slightly moist. The fill is likely the result of past grading or construction activities at the site. Deeper fill may exist between excavations and in other portions of the site that were not directly explored.

4.2 Alluvial Fan Deposits

Alluvial fan deposits underlie the artificial fill and generally consist of light to reddish brown sand with varying amounts of silt, gravel, and cobbles. The alluvial fan deposits range from well graded to poorly graded in fining-upwards sequences. The alluvial fan soils are generally characterized as loose to dense and dry to slightly moist.

4.3 Alluvial Wash Deposits

Alluvial fan deposits are further underlain by alluvial wash deposits at a depth of between 24 and 31 feet below the existing ground surface. The alluvial wash deposits generally consist of light grayish brown to light brown sand with some gravel and cobbles present, up to 4 inches as encountered by our excavations. The alluvial wash soils are generally characterized as medium dense to very dense and dry.

5. GROUNDWATER

A review of the Seismic Hazard Zone Report for the Pasadena Quadrangle (California Division of Mines and Geology [CDMG], 1998) indicates the subject site has a historic high groundwater table of between 30 and 40 feet below the existing ground surface. Groundwater information presented in this document is generated from data collected in the early 1900's to the late 1990s. Based on current groundwater basin management practices, it is unlikely that groundwater levels will ever exceed the historic high levels.

Based on a review of data from the Los Angeles County Department of Public Works Groundwater Wells Maps (LADPW, 2022a), indicates that an active groundwater monitoring well (Well ID 5069F) is located approximately 500 feet to the north of the property, which has a historic high groundwater depth of 43.8 feet on April 27, 1984, and a current depth to groundwater of 128 feet below existing ground surface.

Groundwater was not encountered in our field explorations, excavated to a maximum depth of 41 feet below the existing ground surface. Based on the reported historic high groundwater levels in the site vicinity and the lack of groundwater in our borings, static groundwater is neither expected to be encountered during construction, nor have a detrimental effect on the project. However, it is not uncommon for groundwater levels to vary seasonally or for groundwater seepage conditions to develop where none previously existed, especially in impermeable fine-grained soils which are heavily irrigated or after seasonal rainfall. In addition, recent requirements for stormwater infiltration could result in shallower seepage conditions in the immediate site vicinity. Proper surface drainage of irrigation and precipitation will be critical for future performance of the project. Recommendations for drainage are provided in the *Surface Drainage* section of this report (see Section 7.15).

6. GEOLOGIC HAZARDS

6.1 Surface Fault Rupture

The numerous faults in Southern California include Holocene-active, pre-Holocene, and inactive faults. The criteria for these major groups are based on criteria developed by the California Geological Survey (CGS, formerly known as CDMG) for the Alquist-Priolo Earthquake Fault Zone Program (CGS, 2018). By definition, a Holocene-active fault is one that has had surface displacement within Holocene time (about the last 11,700 years). A pre-Holocene fault has demonstrated surface displacement during Quaternary time (approximately the last 1.6 million years) but has had no known Holocene movement. Faults that have not moved in the last 1.6 million years are considered inactive.

The site is not within a state-designated Alquist-Priolo Earthquake Fault Zone (CGS, 2022a; CGS, 2022b) for surface fault rupture hazards. No Holocene-active or pre-Holocene faults with the potential for surface fault rupture are known to pass directly beneath the site. Therefore, the potential for surface rupture due to faulting occurring beneath the site during the design life of the proposed development is considered low. However, the site is located in the seismically active Southern California region and could be subjected to moderate to strong ground shaking in the event of an earthquake on one of the many active Southern California faults. The faults in the vicinity of the site are shown in Figure 3, Regional Fault Map.

The closest surface trace of an active fault to the site is the Sierra Madre Fault Zone, located approximately 1.7 miles to the northeast (USGS, 2006). Other nearby active faults include the Verdugo Fault, the Raymond Fault, and the Hollywood Fault, located approximately 2.9 miles southwest, 6.3 miles south, and 6.7 miles south of the site, respectively. The active San Andreas Fault Zone is located approximately 24 miles northeast of the site (USGS, 2006; Ziony and Jones, 1989).

Several buried thrust faults, commonly referred to as blind thrusts, underlie the Los Angeles Basin at depth. These faults are not exposed at the ground surface and are typically identified at depths greater than 3.0 kilometers. The October 1, 1987, M_w 5.9 Whittier Narrows earthquake and the January 17, 1994, M_w 6.7 Northridge earthquake were a result of movement on the Puente Hills Blind Thrust and the Northridge Thrust, respectively. These thrust faults and others in the greater Los Angeles area are not exposed at the surface and do not present a potential surface fault rupture hazard at the site; however, these deep thrust faults are considered active features capable of generating future earthquakes that could result in moderate to significant ground shaking at the site.

6.2 Seismicity

As with all of Southern California, the site has experienced historic earthquakes from various regional faults. The seismicity of the region surrounding the site was formulated based on research of an electronic database of earthquake data. The epicenters of recorded earthquakes with magnitudes equal to or greater than 5.0 in the site vicinity are depicted on Figure 4, Regional Seismicity Map. A partial list of moderate to major magnitude earthquakes that have occurred in the Southern California area within the last 100 years is included in the following table.

LIST OF HISTORIC EARTHQUAKES

Earthquake (Oldest to Youngest)	Date of Earthquake	Magnitude	Distance to Epicenter (Miles)	Direction to Epicenter
Near Redlands	July 23, 1923	6.3	58	ESE
Long Beach	March 10, 1933	6.4	44	SSE
Tehachapi	July 21, 1952	7.5	70	NW
San Fernando	February 9, 1971	6.6	17	NW
Whittier Narrows	October 1, 1987	5.9	14	SE
Sierra Madre	June 28, 1991	5.8	14	ENE
Landers	June 28, 1992	7.3	103	E
Big Bear	June 28, 1992	6.4	81	E
Northridge	January 17, 1994	6.7	17	W
Hector Mine	October 16, 1999	7.1	116	ENE
Ridgecrest	July 5, 2019	7.1	113	NNE

The site could be subjected to strong ground shaking in the event of an earthquake. However, this hazard is common in Southern California and the effects of ground shaking can be mitigated if the proposed structures are designed and constructed in conformance with current building codes and engineering practices.

6.3 Seismic Design Criteria

The following table summarizes the site-specific design criteria obtained from the 2019 California Building Code (CBC; Based on the 2018 International Building Code [IBC] and ASCE 7-16), Chapter 16 Structural Design, Section 1613 Earthquake Loads. The data was calculated using the online application *Seismic Design Maps*, provided by OSHPD. The short spectral response uses a period of 0.2 second. We evaluated the Site Class based on the discussion in Section 1613.2.2 of the 2019 CBC and Table 20.3-1 of ASCE 7-16. The values presented below are for the risk-targeted maximum considered earthquake (MCE_R).

2019 CBC SEISMIC DESIGN PARAMETERS

	Value	2019 CBC Reference
Site Class	D	Section 1613.2.2
MCE_R Ground Motion Spectral Response Acceleration – Class B (short), S_s	1.989g	Figure 1613.2.1(1)
MCE_R Ground Motion Spectral Response Acceleration – Class B (1 sec), S_1	0.737g	Figure 1613.2.1(2)
Site Coefficient, F_A	1	Table 1613.2.3(1)
Site Coefficient, F_V	1.7*	Table 1613.2.3(2)
Site Class Modified MCE_R Spectral Response Acceleration (short), S_{MS}	1.989	Section 1613.2.3 (Eqn 16-36)
Site Class Modified MCE_R Spectral Response Acceleration – (1 sec), S_{M1}	1.253g*	Section 1613.2.3 (Eqn 16-37)
5% Damped Design Spectral Response Acceleration (short), S_{DS}	1.326g	Section 1613.2.4 (Eqn 16-38)
5% Damped Design Spectral Response Acceleration (1 sec), S_{D1}	0.835g*	Section 1613.2.4 (Eqn 16-39)
Note: *Per Section 11.4.8 of ASCE/SEI 7-16, a ground motion hazard analysis shall be performed for projects for Site Class “E” sites with S_s greater than or equal to 1.0g and for Site Class “D” and “E” sites with S_1 greater than 0.2g. Section 11.4.8 also provides exceptions which indicates that the ground motion hazard analysis may be waived provided the exceptions are followed. Using the code based values presented in the table above, in lieu of a performing a ground motion hazard analysis, requires the exceptions outlined in ASCE 7-16 Section 11.4.8 be followed.		

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

ASCE 7-16 PEAK GROUND ACCELERATION

Parameter	Value	ASCE 7-16 Reference
Mapped MCE_G Peak Ground Acceleration, PGA	0.847g	Figure 22-9
Site Coefficient, F_{PGA}	1.1	Table 11.8-1
Site Class Modified MCE_G Peak Ground Acceleration, PGA_M	0.932g	Section 11.8.3 (Eqn 11.8-1)

The Maximum Considered Earthquake Ground Motion (MCE) is the level of ground motion that has a 2 percent chance of exceedance in 50 years, with a statistical return period of 2,475 years. According to the 2019 California Building Code and ASCE 7-16, the MCE is to be utilized for the evaluation of liquefaction, lateral spreading, seismic settlements, and it is our understanding that the intent of the Building code is to maintain “Life Safety” during a MCE event. The Design Earthquake Ground Motion (DE) is the level of ground motion that has a 10 percent chance of exceedance in 50 years, with a statistical return period of 475 years.

Deaggregation of the MCE peak ground acceleration was performed using the USGS online Unified Hazard Tool, 2014 Conterminous U.S. Dynamic edition (v4.2.0). The result of the deaggregation analysis indicates that the mean earthquake contributing to the MCE peak ground acceleration is characterized as a 7.05 magnitude event occurring at a hypocentral distance of 10.34 kilometers from the site.

Deaggregation was also performed for the Design Earthquake (DE) peak ground acceleration, and the result of the analysis indicates that the mean earthquake contributing to the DE peak ground acceleration is characterized as a 6.91 magnitude occurring at a hypocentral distance of 14.47 kilometers from the site.

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

6.4 Liquefaction Potential

Liquefaction is a phenomenon in which loose, saturated, relatively cohesionless soil deposits lose shear strength during strong ground motions. Primary factors controlling liquefaction include intensity and duration of ground motion, gradation characteristics of the subsurface soils, in-situ stress conditions, and the depth to groundwater. Liquefaction is typified by a loss of shear strength in the liquefied layers due to rapid increases in pore water pressure generated by earthquake accelerations.

The current standard of practice, as outlined in the “Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction in California” and “Special Publication 117A, Guidelines for Evaluating and Mitigating Seismic Hazards in California” requires liquefaction analysis to a depth of 50 feet below the lowest portion of the proposed structure. Liquefaction typically occurs in areas where the soils below the water table are composed of poorly consolidated, fine- to medium-grained, primarily sandy soil. In addition to the requisite soil conditions, the ground acceleration and duration of the earthquake must also be of a sufficient level to induce liquefaction.

A review of the State of California Seismic Hazard Zone Map for the Pasadena Quadrangle (CDMG, 1999) indicates that the site is located in an area designated as having a potential for liquefaction.

Liquefaction analysis of the soils underlying the site was performed using an updated version of the spreadsheet template LIQ2_30.WQ1 developed by Thomas F. Blake (1996). This program utilizes the 1996 NCEER method of analysis. This semi-empirical method is based on a correlation between values of Standard Penetration Test (SPT) resistance and field performance data. In order to supplement the SPT blow count data, select California Modified Sampler blow count data were converted to equivalent SPT blow counts based on a correlation factor of 0.55 (Rogers, 2006).

The liquefaction analysis was performed for a Design Earthquake level by using a historic high groundwater table of 30 feet below the ground surface, a magnitude 6.91 earthquake, and a peak horizontal acceleration of 0.622g ($\frac{2}{3}$ PGA_M). The enclosed liquefaction analyses, included herein for borings B1 and B4, indicate that the alluvial soils below the historic high groundwater level could be susceptible up to approximately 0.3 inches of total settlement during Design Earthquake ground motion (see enclosed calculation sheets, Figures 5 through 8).

It is our understanding that the intent of the Building Code is to maintain “Life Safety” during Maximum Considered Earthquake level events. Therefore, additional analysis was performed to evaluate the potential for liquefaction during a MCE event. The structural engineer should evaluate the proposed structure for the anticipated MCE liquefaction induced settlements and verify that anticipated deformations would not cause the foundation system to lose the ability to support the gravity loads and/or cause collapse of the structure.

The liquefaction analysis was also performed for the Maximum Considered Earthquake level by using a historic high groundwater table of 30 feet below the ground surface, a magnitude 7.05 earthquake, and a peak horizontal acceleration of 0.932g (PGA_M). The enclosed liquefaction analyses, included herein for borings B1 and B4, indicate that the alluvial soils below the historic high groundwater level could be susceptible up to approximately 0.4 inches of total settlement during Maximum Considered ground motion (see enclosed calculation sheets, Figures 9 through 12).

6.5 Seismically Induced Settlement

Dynamic compaction of dry and loose sands may occur during a major earthquake. Typically, settlements occur in thick beds of such soils. The seismically-induced settlement calculations were performed in accordance with the American Society of Civil Engineers, Technical Engineering and Design Guides as adapted from the US Army Corps of Engineers, No. 9.

The calculations provided herein for borings B1 and B4 indicate that the alluvial soils above a historic high groundwater depth of 30 feet could be susceptible to approximately 0.31 and 0.12 inches, respectively, of seismically-induced dry settlement as a result of the Design Earthquake peak ground acceleration ($\frac{2}{3}PGA_M$).

The calculations provided herein for borings B1 and B4 indicate that the alluvial soils above a historic high groundwater depth of 30 feet could be susceptible to approximately 1.0 and 0.28 inches, respectively, of seismically-induced dry settlement as a result of the Maximum Considered Earthquake peak ground acceleration (PGA_M).

Calculations of the anticipated seismically-induced settlements are provided as Figures 13 through 16.

6.6 Slope Stability

The topography in the immediate site vicinity slopes gently to the southwest. The City of Glendale does not identify the site as being in an area with a potential for slope stability hazards (City of Glendale, 2003). Also, the State of California Seismic Hazard Zone Map for the Pasadena Quadrangle (CDMG, 1999) indicates that the site is not within an area identified as having a potential for seismic slope instability. There are no known landslides near the site, nor is the site in the path of any known or potential landslides. Therefore, the potential for slope stability hazards to adversely affect the proposed development is considered low.

6.7 Earthquake-Induced Flooding

Earthquake-induced flooding is inundation caused by failure of dams or other water-retaining structures due to earthquakes. The Los Angeles County Safety Element (Leighton, 1990) indicates that the site is not located within an inundation area. Therefore, the potential for inundation at the site as a result of an earthquake-induced dam failure is considered low.

6.8 Tsunamis, Seiches, and Flooding

The site is not located within a coastal area. Therefore, tsunamis are not considered a significant hazard at the site.

Seiches are large waves generated in enclosed bodies of water in response to ground shaking. No major water-retaining structures are located immediately up gradient from the project site. Therefore, flooding resulting from a seismically induced seiche is considered unlikely.

The site is within a Zone X as defined by the Federal Emergency Management Agency (LADPW, 2022b; FEMA, 2022). Sites within a Zone X have a minimal potential for flooding (FEMA, 2022).

6.9 Oil Fields & Methane Potential

Review of the California Geologic Energy Management Division (CalGEM) Well Finder Website indicates that the site is not located within the boundaries of an oil field. Additionally, no active or plugged oil or gas wells are located within the immediate site vicinity. However, due to the voluntary nature of record reporting by the oil well drilling companies, wells may be improperly located or not shown on the location map. Undocumented wells could be encountered during construction. Any wells encountered will need to be properly abandoned in accordance with the current requirements of the CalGEM.

Since the site is not located within the boundaries of a known oil field, the potential for the presence of methane or other volatile gases at the site is considered low. However, should it be determined that a methane study is required for the proposed development it is recommended that a qualified methane consultant be retained to perform the study and provide mitigation measures as necessary.

6.10 Subsidence

Subsidence occurs when a large portion of land is displaced vertically, usually due to the withdrawal of groundwater, oil, or natural gas. Soils that are particularly subject to subsidence include those with high silt or clay content. The site is not located within an area of known ground subsidence. No known large-scale extraction of groundwater, gas, oil, or geothermal energy is occurring or planned at the site or in the general site vicinity. Therefore, the potential for ground subsidence at the site, due to withdrawal of fluids or gases, is considered low.

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 General

- 7.1.1 It is our opinion that neither soil nor geologic conditions were encountered during the investigation that would preclude the construction of the proposed development provided the recommendations presented herein are followed and implemented during design and construction. This report should be considered “preliminary” and the geotechnical design parameters presented herein should be verified once the project progresses to a more finalized state.
- 7.1.2 Up to 4½ feet of existing artificial fill was encountered during the site investigation. The existing fill encountered is believed to be the result of past grading and construction activities at the site. Deeper fill may exist in other areas of the site that were not directly explored. Future demolition of the existing structures and improvements which occupy the site will likely disturb the upper few feet of existing site soils. It is our opinion that the existing fill, in its present condition, is not suitable for direct support of proposed foundations or slabs. The existing fill and site soils are considered suitable for re-use as engineered fill provided the recommendations in the *Grading* section of this report are followed (see Section 7.3).
- 7.1.3 Based on our observations onsite and our knowledge of the geologic setting, cobbles should be anticipated during earthwork at the subject site. Due to the presence of sand and cobbles, the contractor should be prepared for difficult excavation conditions as well as excessive caving. The contractor should be aware that formwork may be required to prevent caving of shallow spread foundation excavations. In addition, the contractor should be prepared to screen cobbles from the soils during earthwork operations. Generation and disposal of oversized material (greater than 6 inches) should be anticipated. The presence of these materials and their impact on construction methods and equipment selection should be considered by both the client and contractor prior to construction to minimize potential changes orders based on difficult excavation and earthwork conditions.
- 7.1.4 Please be aware that the use of hollow-stem auger drilling equipment utilized for this investigation does not allow for the identification of the size of rock or abundance of rock being encountered or the visual observation of caving conditions since the drilling method is a small diameter cased excavation. It is recommended that the contractors bidding on earthwork for this project perform their own excavations and test borings with the intended earthwork equipment to verify the presence, abundance, and size of buried rock (cobbles and boulders), and potential for caving.

- 7.1.5 The enclosed seismically-induced settlement analyses indicate that the site soils could be susceptible to approximately 0.42 inch of total settlement as a result of the Design Earthquake peak ground acceleration ($\frac{2}{3}PGA_M$). Differential settlement at the foundation level is anticipated to be less than 0.21 inch over a distance of 20 feet. The foundation design recommendations presented herein are intended to mitigate the effects of settlement on proposed improvements.
- 7.1.6 Based on these considerations, as a minimum it is recommended that the upper 5 feet of existing earth materials within the building footprint areas be excavated and properly compacted for foundation and slab support. Deeper excavations should be conducted as needed to remove any encountered soft soils as necessary at the direction of the Geotechnical Engineer (a representative of Geocon). Proposed building foundations should be underlain by a minimum of 3 feet of newly placed engineered fill. The excavation should extend laterally a minimum distance of 3 feet beyond the building footprint area, including building appurtenances, or a distance equal to the depth of fill below the foundation, whichever is greater. The limits of existing fill and/or soft soil removal will be verified by the Geocon representative during site grading activities. Recommendations for earthwork are provided in the *Grading* section of this report (see Section 7.3).
- 7.1.7 Subsequent to the recommended grading, the proposed structure may be supported on a conventional shallow spread foundation system deriving support in newly placed engineered fill. Recommendations for the design of a conventional foundation system are provided in Section 7.4.
- 7.1.8 All excavations must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon). Prior to placing any fill, the upper 12 inches of the excavation bottom must be scarified, moistened, and proof-rolled with heavy equipment in the presence of the Geotechnical Engineer (a representative of Geocon West, Inc.).
- 7.1.9 It is anticipated that stable excavations for the recommended grading associated with the proposed structure can be achieved with sloping measures. However, if excavations in close proximity to an adjacent property line and/or an existing structure are required, special excavation measures may be necessary in order to maintain lateral support of offsite improvements. Excavation recommendations are provided in the *Temporary Excavations* section of this report (Section 7.13).

- 7.1.10 Foundations for small outlying structures, such as block walls up to 6 feet in height, planter walls or trash enclosures, which will not be tied to the proposed structure, may be supported on conventional foundations deriving support on a minimum of 12 inches of newly placed engineered fill which extends laterally at least 12 inches beyond the foundation area. Where excavation and compaction cannot be performed, foundations may derive support directly in the undisturbed alluvial soils at and below a depth of 24 inches and should be deepened as necessary to maintain a minimum 12-inch embedment into the recommended bearing materials. If the soils exposed in the excavation bottom are soft or loose, compaction of the soils will be required prior to placing steel or concrete. Compaction of the foundation excavation bottom is typically accomplished with a compaction wheel or mechanical whacker and must be observed and approved by a Geocon representative.
- 7.1.11 Where new paving is to be placed, it is recommended that all existing fill and soft soils be excavated and properly compacted for paving support. The client should be aware that excavation and compaction of all existing fill and soft soils in the area of new paving is not required; however, paving constructed over existing uncertified fill or unsuitable soil may experience increased settlement and/or cracking, and may therefore have a shorter design life and increased maintenance costs. As a minimum, the upper 12 inches of subgrade soil should be scarified and properly compacted for paving support. Paving recommendations are provided in the *Preliminary Pavement Recommendations* section of this report (see Section 7.10).
- 7.1.12 Based on the results of percolation testing performed at the site, a stormwater infiltration system is considered feasible for this project. Recommendations for infiltration are provided in the *Stormwater Infiltration* section of this report (see Section 7.14).
- 7.1.13 Once the design and foundation loading configuration for the proposed structure proceeds to a more finalized plan, the recommendations within this report should be reviewed and revised, if necessary. Based on the final foundation loading configurations, the potential for settlement should be re-evaluated by this office.
- 7.1.14 Any changes in the design, location or elevation, as outlined in this report, should be reviewed by this office. Geocon should be contacted to determine the necessity for review and possible revision of this report.

7.2 Soil and Excavation Characteristics

- 7.2.1 Due to the presence of sand and cobbles, the contractor should be prepared for difficult excavation conditions as well as excessive caving. The contractor should be prepared to use formwork to prevent caving of shallow spread foundation excavations. In addition, the contractor should be prepared to screen cobbles from the soils during earthwork operations.
- 7.2.2 Please be aware that the use of hollow-stem auger drilling equipment utilized for this investigation does not allow for the identification of the size of rock or abundance of rock being encountered or the visual observation of caving conditions since the drilling method is a small diameter cased excavation. It is recommended that the contractors bidding on earthwork for this project perform their own excavations and test borings with the intended earthwork equipment to verify the presence, abundance, and size of buried rock (cobbles and boulders), and potential for caving.
- 7.2.3 It is the responsibility of the contractor to ensure that all excavations and trenches are properly sloped, shored, and maintained in accordance with applicable OSHA rules and regulations to maintain safety and maintain the stability of adjacent existing improvements.
- 7.2.4 All onsite excavations must be conducted in such a manner that potential surcharges from existing structures, construction equipment, and vehicle loads are resisted. The surcharge area may be defined by a 1:1 projection down and away from the bottom of an existing foundation or vehicle load. Penetrations below this 1:1 projection will require special excavation measures such as sloping and shoring. Excavation recommendations are provided in the *Temporary Excavations* section of this report (see Section 7.13).
- 7.2.5 The upper 5 feet of existing site soils encountered during this investigation are considered to have a “very low” expansive potential ($EI = 0$); and are classified as “non-expansive” based on the 2019 California Building Code (CBC) Section 1803.5.3. The recommendations presented herein assume that proposed foundations and slabs will derive support in these materials.

7.3 Grading

- 7.3.1 Grading is anticipated to include preparation of building pad, excavation of site soils for proposed foundations and slabs, utility trenches, and placement of backfill for utility trenches.
- 7.3.2 A preconstruction conference should be held at the site prior to the beginning of grading operations with the owner, contractor, civil engineer, geotechnical engineer, and building official in attendance. Special soil handling requirements can be discussed at that time.

- 7.3.3 Earthwork should be observed, and compacted fill tested by representatives of Geocon West, Inc. The existing fill and alluvial soil encountered during exploration is suitable for re-use as an engineered fill, provided any encountered oversized material (greater than 6 inches) and any encountered deleterious debris is removed. **The contractor should be prepared to screen cobbles from the soils during earthwork operations.** Generation and disposal of oversized material (greater than 6 inches) should be anticipated. Additionally, the site soils have little to no cohesion and are prone to excessive caving. The contractor should be prepared for difficult excavation conditions. The presence of these materials and their impact on construction methods and equipment selection should be considered by both the owner and contractor prior to construction.
- 7.3.4 Grading should commence with the removal of all existing vegetation and existing improvements from the area to be graded. Deleterious debris such as wood and root structures should be exported from the site and should not be mixed with the fill soils. Asphalt and concrete should not be mixed with the fill soils unless approved by the Geotechnical Engineer. All existing underground improvements planned for removal should be completely excavated and the resulting depressions properly backfilled in accordance with the procedures described herein. Once a clean excavation bottom has been established it must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.).
- 7.3.5 As a minimum, it is recommended that the upper 5 feet of existing earth within the proposed building footprint area be excavated and properly compacted for foundation and slab support. Deeper excavations should be conducted as necessary to remove deeper artificial fill or soft unsuitable soil at the direction of the Geotechnical Engineer (a representative of Geocon). Proposed building foundations should be underlain by a minimum of 3 feet of newly placed engineered fill. The excavation should extend laterally a minimum distance of 3 feet beyond the building footprint area, including building appurtenances, or a distance equal to the depth of fill below the foundation, whichever is greater. The limits of existing fill and/or soft fill soils removal will be verified by the Geocon representative during site grading activities.
- 7.3.6 Additional grading should be conducted as necessary to maintain the required 3 feet of newly placed engineered fill below foundations. The grading contractor should verify all bottoms of footing elevations prior to commencement of grading activities to ensure that grading is conducted deep enough to provide the required three feet of newly placed engineered fill below foundations.
- 7.3.7 Subsequent to the recommended grading, the proposed structure may be supported on conventional shallow spread foundations deriving support in newly placed engineered fill.

- 7.3.8 All excavations must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon). Prior to placing any fill, the upper 12 inches of the excavation bottom must be scarified, moistened to near optimum moisture, and proof-rolled with heavy equipment in the presence of the Geotechnical Engineer (a representative of Geocon West, Inc.).
- 7.3.9 All fill and backfill soils should be placed in horizontal loose layers approximately 6 to 8 inches thick, moisture conditioned to near optimum moisture content, and properly compacted to a minimum 90 percent of the maximum dry density in accordance with ASTM D 1557 (latest edition).
- 7.3.10. Where new paving is to be placed, it is recommended that all existing fill and soft alluvium be excavated and properly compacted for paving support. As a minimum, the upper 12 inches of soil should be scarified and properly compacted to at least 95 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition). Paving recommendations are provided in the *Preliminary Pavement Recommendations* section of this report (see Section 7.10).
- 7.3.11 It is anticipated that stable excavations for the recommended grading can be achieved with sloping measures. However, if excavations in close proximity to an adjacent property line and/or an existing structure are required, special excavation measures may be necessary in order to maintain lateral support of the existing offsite improvements. Excavation recommendations are provided in the *Temporary Excavations* section of this report (see Section 7.13).
- 7.3.12 Foundations for small outlying structures, such as block walls up to 6 feet high, planter walls or trash enclosures, which will not be tied to the proposed building, may be supported on conventional foundations deriving support on a minimum of 12 inches of newly placed engineered fill which extends laterally at least 12 inches beyond the foundation area. Where excavation and proper compaction cannot be performed, foundations may derive support directly in the undisturbed alluvial soils at and below a depth of 24 inches, and should be deepened as necessary to maintain a minimum 12-inch embedment into the recommended bearing materials. If the soils exposed in the excavation bottom are soft or loose, compaction of the soils will be required prior to placing steel or concrete. Compaction of the foundation excavation bottom is typically accomplished with a compaction wheel or mechanical whacker and must be observed and approved by a Geocon representative.

- 7.3.13 Utility trenches should be properly backfilled in accordance with the following requirements. The pipe should be bedded with clean sands (Sand Equivalent greater than 30) to a depth of at least 1 foot over the pipe, and the bedding material must be inspected and approved in writing by the Geotechnical Engineer (a representative of Geocon). The use of gravel is not acceptable unless used in conjunction with filter fabric to prevent the gravel from having direct contact with soil. The remainder of the trench backfill may be derived from onsite soil or approved import soil, compacted as necessary, until the required compaction is obtained. The use of minimum 2-sack slurry as backfill is also acceptable. Prior to placing any bedding materials or pipes, the excavation bottom must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon).
- 7.3.14 All imported fill shall be observed, tested, and approved by Geocon West, Inc. prior to bringing soil to the site. Rocks larger than 6 inches in diameter shall not be used in the fill. If necessary, import soils used as structural fill should have an expansion index less than 20 and corrosivity properties that are equally or less detrimental to that of the existing onsite soils. Import soils must be placed uniformly and at equal thickness or in a manner that is approved by the Geotechnical Engineer (a representative of Geocon).
- 7.3.15 All trench and foundation excavation bottoms must be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon), prior to placing bedding materials, fill, steel, gravel, or concrete.

7.4 Shrinkage

- 7.4.1 Shrinkage results when a volume of material removed at one density is compacted to a higher density. A shrinkage factor between 5 and 10 percent should be anticipated when excavating and compacting the artificial fill to an average relative compaction of 92 percent.
- 7.4.2 If import soils will be utilized in the building pad, the soils must be placed uniformly and at equal thickness at the direction of the Geotechnical Engineer (a representative of Geocon West, Inc.). In order to maintain uniformity in the building pad, soils can be borrowed from non-building pad areas and later replaced with imported soils.

7.5 Foundation Design

- 7.5.1 Subsequent to the recommended grading, the proposed structure may be supported on conventional shallow spread foundations deriving support in newly placed engineered fill. Proposed building foundations should be underlain by a minimum of 3 feet of newly placed engineered fill.

- 7.5.2 Continuous footings may be designed for an allowable bearing capacity of 2,250 pounds per square foot (psf), and should be a minimum of 12 inches in width, 18 inches in depth below the lowest adjacent grade, and 12 inches into the recommended bearing materials.
- 7.5.3 Isolated spread foundations may be designed for an allowable bearing capacity of 2,500 psf, and should be a minimum of 24 inches in width, 18 inches in depth below the lowest adjacent grade, and 12 inches into the recommended bearing materials.
- 7.5.4 The soil bearing pressures above may be increased by 250 psf and 500 psf for each additional foot of foundation width and depth, respectively, up to a maximum allowable soil bearing pressure of 4,000 psf.
- 7.5.5 The allowable bearing pressures may be increased by one-third for transient loads due to wind or seismic forces.
- 7.5.6 If depth increases are utilized for the exterior wall footings, this office should be provided a copy of the final construction plans so that the excavation recommendations presented herein could be properly reviewed and revised if necessary. Additional grading should be conducted as needed in order to maintain the recommended 3-foot-thick blanket of engineered fill below proposed foundations.
- 7.5.7 Continuous footings should be reinforced with four No. 4 steel reinforcing bars, two placed near the top of the footing and two near the bottom. Reinforcement for spread footings should be designed by the project structural engineer.
- 7.5.8 The above foundation dimensions and minimum reinforcement recommendations are based on soil conditions and building code requirements only, and are not intended to be used in lieu of those required for structural purposes.
- 7.5.9 No special subgrade presaturation is required prior to placement of concrete. However, the moisture in the foundation subgrade should be sprinkled as necessary to maintain a moist condition at the time of concrete placement.
- 7.5.10 Foundation excavations should be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to the placement of reinforcing steel and concrete to verify that the excavations and exposed soil conditions are consistent with those anticipated. If unanticipated soil conditions are encountered, foundation modifications may be required.
- 7.5.11 This office should be provided a copy of the final construction plans so that the excavation recommendations presented herein could be properly reviewed and revised if necessary.

7.6 Foundation Settlement

- 7.6.1 The enclosed seismically-induced settlement analyses indicate that the site soils could be susceptible to approximately 0.42 inch of total settlement as a result of the Design Earthquake peak ground acceleration ($\frac{2}{3}PGA_M$). Differential settlement at the foundation level is anticipated to be less than 0.21 inch over a distance of 20 feet. These settlements are in addition to the static settlements indicated below and must be considered in the structural design.
- 7.6.2 The maximum expected static settlement the proposed structure supported on conventional foundations deriving support in the recommended bearing materials and designed with a maximum bearing pressure of 4,000 psf is estimated to be less than 1 inch and occur below the heaviest loaded structural element. Settlement of the foundation system is expected to occur on initial application of loading. Differential settlement is not expected to exceed $\frac{1}{2}$ inch over a distance of 20 feet.
- 7.6.3 Based on seismic considerations, the proposed structure supported on a spread foundation system should be designed for a combined static and seismically induced differential settlement of $\frac{3}{4}$ inch over a distance of 20 feet.
- 7.6.4 Once the design and foundation loading configurations for the proposed structures proceeds to a more finalized plan, the estimated settlements presented in this report should be reviewed and revised, if necessary. If the final foundation loading configurations are greater than the assumed loading conditions, the potential for settlement should be reevaluated by this office.

7.7 Miscellaneous Foundations

- 7.7.1 Foundations for small outlying structures, such as block walls up to 6 feet in height, planter walls or trash enclosures which will not be tied to the proposed structure may be supported on conventional foundations bearing on a minimum of 12 inches of newly placed engineered fill which extends laterally at least 12 inches beyond the foundation area. Where excavation and compaction cannot be performed, such as adjacent to property lines, foundations may derive support in the undisturbed alluvial soils at and below a depth of 24 inches, and should be deepened as necessary to maintain a minimum 12-inch embedment into the recommended bearing materials. Recommendations for the design and construction of miscellaneous foundations should be reevaluated once formal plans are available.

7.7.2 If the soils exposed in the excavation bottom are soft, compaction of the soft soils will be required prior to placing steel or concrete. Compaction of the foundation excavation bottom is typically accomplished with a compaction wheel or mechanical whacker and must be observed and approved by a Geocon representative. Miscellaneous foundations may be designed for a bearing value of 1,500 psf, and should be a minimum of 12 inches in width, 18 inches in depth below the lowest adjacent grade, and 12 inches into the recommended bearing material. The allowable bearing pressure may be increased by up to one-third for transient loads due to wind or seismic forces.

7.7.3 Foundation excavations should be observed and approved in writing by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to the placement of reinforcing steel and concrete to verify that the excavations and exposed soil conditions are consistent with those anticipated.

7.8 Lateral Design

7.8.1 Resistance to lateral loading may be provided by friction acting at the base of foundations, slabs and by passive earth pressure. An allowable coefficient of friction of 0.4 may be used with the dead load forces in the newly placed engineered fill or undisturbed alluvial soils.

7.8.2 Passive earth pressure for the sides of foundations and slabs poured against newly placed engineered fill or undisturbed alluvial soils may be computed as an equivalent fluid having a density of 290 pounds per cubic foot (pcf) with a maximum earth pressure of 2,900 psf. When combining passive and friction for lateral resistance, the passive component should be reduced by one-third. A one-third increase in the passive value may be used for wind or seismic loads.

7.9 Concrete Slabs-on-Grade

7.9.1 Concrete slabs-on-grade subject to vehicle loading should be designed in accordance with the recommendations in the *Pavement Recommendations* section of this report (Section 7.10).

7.9.2 Subsequent to the recommended grading, concrete slabs-on-grade for structures, not subject to vehicle loading, should be a minimum of 4 inches thick and minimum slab reinforcement should consist of No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions. Steel reinforcing should be positioned vertically near the slab midpoint.

- 7.9.3 Slabs-on-grade at the ground surface that may receive moisture-sensitive floor coverings or may be used to store moisture-sensitive materials should be underlain by a vapor retarder placed directly beneath the slab. The vapor retarder and acceptable permeance should be specified by the project architect or developer based on the type of floor covering that will be installed. The vapor retarder design should be consistent with the guidelines presented in Section 9.3 of the American Concrete Institute's (ACI) Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials (ACI 302.2R-06) and should be installed in general conformance with ASTM E 1643 (latest edition) and the manufacturer's recommendations. A minimum thickness of 15 mils extruded polyolefin plastic is recommended; vapor retarders which contain recycled content or woven materials are not recommended. The vapor retarder should have a permeance of less than 0.01 perms demonstrated by testing before and after mandatory conditioning. The vapor retarder should be installed in direct contact with the concrete slab with proper perimeter seal. If the California Green Building Code requirements apply to this project, the vapor retarder should be underlain by 4 inches of clean aggregate. It is important that the vapor retarder be puncture resistant since it will be in direct contact with angular gravel. As an alternative to the clean aggregate suggested in the California Green Building Code, it is our opinion that the concrete slab-on-grade may be underlain by a vapor retarder over 4 inches of clean sand (sand equivalent greater than 30), since the sand will serve a capillary break and will minimize the potential for punctures and damage to the vapor barrier.
- 7.9.4 For seismic design purposes, a coefficient of friction of 0.4 may be utilized between concrete slabs and subgrade soils without a moisture barrier, and 0.15 for slabs underlain by a moisture barrier.
- 7.9.5 Exterior slabs for walkways or flatwork, not subject to traffic loads, should be at least 4 inches thick and reinforced with No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions, positioned near the slab midpoint. Prior to construction of slabs, the upper 12 inches of subgrade should be moistened to near optimum moisture content and properly compacted to at least 95 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition). Crack control joints should be spaced at intervals not greater than 10 feet and should be constructed using saw-cuts or other methods as soon as practical following concrete placement. Crack control joints should extend a minimum depth of one-fourth the slab thickness. The project structural engineer should design construction joints as necessary.

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

7.10 Preliminary Pavement Recommendations

- 7.10.1 Where new paving is to be placed, it is recommended that all existing fill and soft alluvial materials be excavated and properly compacted for paving support. The client should be aware that excavation and compaction of all existing artificial fill and soft alluvium in the area of new paving is not required; however, paving constructed over existing uncertified fill or unsuitable material may experience increased settlement and/or cracking, and may therefore have a shorter design life and increased maintenance costs. As a minimum, the upper 12 inches of paving subgrade should be scarified, moisture conditioned to near optimum moisture content, and properly compacted to at least 95 percent relative compaction, as determined by ASTM Test Method D 1557 (latest edition).
- 7.10.2 The following pavement sections are based on an assumed R-Value of 35. Once site grading activities are complete an R-Value should be obtained by laboratory testing to confirm the properties of the soils serving as paving subgrade, prior to placing pavement.
- 7.10.3 The Traffic Indices listed below are estimates. Geocon does not practice in the field of traffic engineering. The actual Traffic Index for each area should be determined by the project civil engineer. If pavement sections for Traffic Indices other than those listed below are required, Geocon should be contacted to provide additional recommendations. Pavement thicknesses were determined following procedures outlined in the *California Highway Design Manual* (Caltrans). It is anticipated that the majority of traffic will consist of automobile and large truck traffic.

PRELIMINARY PAVEMENT DESIGN SECTIONS

Location	Estimated Traffic Index (TI)	Asphalt Concrete (inches)	Class 2 Aggregate Base (inches)
Automobile Parking and Driveways	4.0	3.0	4.0
Trash Truck & Fire Lanes	7.0	4.0	9.0

- 7.10.4 Asphalt concrete should conform to Section 203-6 of the “*Standard Specifications for Public Works Construction*” (Green Book). Class 2 aggregate base materials should conform to Section 26-1.02A of the “*Standard Specifications of the State of California, Department of Transportation*” (Caltrans). The use of Crushed Miscellaneous Base (CMB) in lieu of Class 2 aggregate base is acceptable. Crushed Miscellaneous Base should conform to Section 200-2.4 of the “*Standard Specifications for Public Works Construction*” (Green Book).
- 7.10.5 Unless specifically designed and evaluated by the project structural engineer, where exterior concrete paving will be utilized for support of vehicles, it is recommended that the concrete be a minimum of 5 inches of concrete reinforced with No. 3 steel reinforcing bars placed 18 inches on center in both horizontal directions. Concrete paving supporting vehicular traffic should be underlain by a minimum of 4 inches of aggregate base and a properly compacted subgrade. The subgrade and base material should be compacted to 95 percent relative compaction as determined by ASTM Test Method D 1557 (latest edition).
- 7.10.6 The performance of pavements is highly dependent upon providing positive surface drainage away from the edge of pavements. Ponding of water on or adjacent to the pavement will likely result in saturation of the subgrade materials and subsequent cracking, subsidence and pavement distress. If planters are planned adjacent to paving, it is recommended that the perimeter curb be extended at least 12 inches below the bottom of the aggregate base to minimize the introduction of water beneath the paving.

7.11 Retaining Wall Design

- 7.11.1 The recommendations presented below are generally applicable to the design of rigid concrete or masonry retaining walls having a maximum height of 5 feet. In the event that walls significantly higher than 5 feet are planned, Geocon should be contacted for additional recommendations.
- 7.11.2 Retaining wall foundations may be designed in accordance with the recommendations provided in the *Foundation Design* section of this report (see Section 7.5).
- 7.11.3 Retaining walls with a level backfill surface that are not restrained at the top should be designed utilizing a triangular distribution of pressure (active pressure) of 30 pcf.
- 7.11.4 Restrained walls are those that are not allowed to rotate more than $0.001H$ (where H equals the height of the retaining portion of the wall in feet) at the top of the wall. Where walls are restrained from movement at the top, walls may be designed utilizing a triangular distribution of pressure (at-rest pressure) of 56 pcf.

- 7.11.5 The wall pressures provided above assume that the proposed retaining walls will support relatively undisturbed alluvial soils or engineered fill derived from onsite soils. If import soil will be used to backfill proposed retaining walls, revised earth pressures may be required to account for the geotechnical properties of the import soil used as engineered fill. This should be evaluated once the use of import soil is established. All imported fill shall be observed, tested, and approved by Geocon West, Inc. prior to bringing soil to the site.
- 7.11.6 The wall pressures provided above assume that the retaining wall will be properly drained preventing the buildup of hydrostatic pressure. If retaining wall drainage is not implemented, the equivalent fluid pressure to be used in design of undrained walls is 90 pcf. The value includes hydrostatic pressures plus buoyant lateral earth pressures.
- 7.11.7 Additional active pressure should be added for a surcharge condition due to sloping ground, vehicular traffic or adjacent structures and should be designed for each condition as the project progresses.
- 7.11.8 It is recommended that line-load surcharges from adjacent wall footings, use horizontal pressures generated from NAV-FAC DM 7.2. The governing equations are:

$$\text{For } x/H \leq 0.4$$

$$\sigma_H(z) = \frac{0.20 \times \left(\frac{z}{H}\right)}{\left[0.16 + \left(\frac{z}{H}\right)^2\right]^2} \times \frac{Q_L}{H}$$

and

$$\text{For } x/H > 0.4$$

$$\sigma_H(z) = \frac{1.28 \times \left(\frac{x}{H}\right)^2 \times \left(\frac{z}{H}\right)}{\left[\left(\frac{x}{H}\right)^2 + \left(\frac{z}{H}\right)^2\right]^2} \times \frac{Q_L}{H}$$

where x is the distance from the face of the excavation or wall to the vertical line-load, H is the distance from the bottom of the footing to the bottom of excavation or wall, z is the depth at which the horizontal pressure is desired, Q_L is the vertical line-load and $\sigma_H(z)$ is the horizontal pressure at depth z .

- 7.11.9 It is recommended that vertical point-loads, from construction equipment outriggers or adjacent building columns use horizontal pressures generated from NAV-FAC DM 7.2. The governing equations are:

$$\begin{aligned} &\text{For } x/H \leq 0.4 \\ &\sigma_H(z) = \frac{0.28 \times \left(\frac{z}{H}\right)^2}{\left[0.16 + \left(\frac{z}{H}\right)^2\right]^3} \times \frac{Q_P}{H^2} \\ &\text{and} \\ &\text{For } x/H > 0.4 \\ &\sigma_H(z) = \frac{1.77 \times \left(\frac{x}{H}\right)^2 \times \left(\frac{z}{H}\right)^2}{\left[\left(\frac{x}{H}\right)^2 + \left(\frac{z}{H}\right)^2\right]^3} \times \frac{Q_P}{H^2} \\ &\text{then} \\ &\sigma'_H(z) = \sigma_H(z) \cos^2(1.1\theta) \end{aligned}$$

where x is the distance from the face of the excavation/wall to the vertical point-load, H is distance from the outrigger/bottom of column footing to the bottom of excavation, z is the depth at which the horizontal pressure is desired, Q_P is the vertical point-load, $\sigma_H(z)$ is the horizontal pressure at depth z , θ is the angle between a line perpendicular to the excavation/wall and a line from the point-load to location on the excavation/wall where the surcharge is being evaluated, and $\sigma_H(z)$ is the horizontal pressure at depth z .

- 7.11.10 In addition to the recommended earth pressure, the upper 10 feet of the retaining wall adjacent to the street or driveway areas should be designed to resist a uniform lateral pressure of 100 psf, acting as a result of an assumed 300 psf surcharge behind the shoring due to normal street traffic. If the traffic is kept back at least 10 feet from the wall, the traffic surcharge may be neglected.
- 7.11.11 Seismic lateral forces will be required for any retaining walls in excess of 6 feet. Recommendations for seismic lateral forces will be provided under separate cover should they become necessary.

7.12 Retaining Wall Drainage

- 7.12.1 Retaining walls not designed for hydrostatic pressures should be provided with a drainage system extended at least two-thirds the height of the wall. At the base of the drain system, a subdrain covered with a minimum of 12 inches of gravel should be installed, and a compacted fill blanket or other seal placed at the surface (see Figure 17). The clean bottom and subdrain pipe, behind a retaining wall, should be observed by the Geotechnical Engineer (a representative of Geocon), prior to placement of gravel or compacting backfill.

- 7.12.2 As an alternative, a plastic drainage composite such as Miradrain or equivalent may be installed in continuous, 4-foot-wide columns along the entire back face of the wall, at 8 feet on center. The top of these drainage composite columns should terminate approximately 18 inches below the ground surface, where either hardscape or a minimum of 18 inches of relatively cohesive material should be placed as a cap (see Figure 18). These vertical columns of drainage material would then be connected at the bottom of the wall to a collection panel or a 1-cubic-foot rock pocket drained by a 4-inch subdrain pipe.
- 7.12.3 Subdrainage pipes at the base of the retaining wall drainage system should outlet to an acceptable location via controlled drainage structures.
- 7.12.4 Moisture affecting below grade walls is one of the most common post-construction complaints. Poorly applied or omitted waterproofing can lead to efflorescence or standing water. Particular care should be taken in the design and installation of waterproofing to avoid moisture problems, or actual water seepage into the structure through any normal shrinkage cracks which may develop in the concrete walls, floor slab, foundations and/or construction joints. The design and inspection of the waterproofing is not the responsibility of the geotechnical engineer. A waterproofing consultant should be retained in order to recommend a product or method, which would provide protection to subterranean walls, floor slabs and foundations.

7.13 Temporary Excavations

- 7.13.1 Excavations on the order of 5 feet in height may be required during grading and construction operations. The excavations are expected to expose fill and alluvial soils, which are subject to excessive caving. Due to the presence of cobbles, the contractor should be prepared for difficult excavation conditions. Vertical excavations up to 5 feet in height may be attempted where not surcharged; however, the contractor should be prepared for caving, sloughing, and raveling in open excavations. Due to the granular nature of soils and potential for caving, the contractor should also be prepared to form foundation excavations at the excavation bottom.
- 7.13.2 Vertical excavations greater than 5 feet or where surcharged by existing structures will require sloping or shoring measures in order to provide a stable excavation. It is anticipated that stable excavations for construction of the proposed improvements can be achieved and maintained with sloping measures. Where sufficient space is available, temporary unsurcharged embankments could be sloped back at a uniform 1½:1 (H:V) slope gradient or flatter up to a maximum height of 8 feet. A uniform slope does not have a vertical portion.

- 7.13.3 If excavations in close proximity to an adjacent property line and/or structure are required, special excavation measures such as slot-cutting or shoring may be necessary in order to maintain lateral support of offsite improvements. Recommendations for special temporary excavation measures can be provided under separate cover once the proposed building layout is established.
- 7.13.4 Where temporary construction slopes are utilized, the top of the slope should be barricaded to prevent vehicles and storage loads at the top of the slope within a horizontal distance equal to the height of the slope. If the temporary construction slopes are to be maintained during the rainy season, berms are suggested along the tops of the slopes where necessary to prevent runoff water from entering the excavation and eroding the slope faces. Geocon personnel should inspect the soils exposed in the cut slopes during excavation so that modifications of the slopes can be made if variations in the soil conditions occur. All excavations should be stabilized within 30 days of initial excavation.

7.14 Stormwater Infiltration

- 7.14.1 During the June 27, 2022 site exploration, borings B1 and B4 were utilized to perform percolation testing. The borings were excavated and subsequently backfilled and capped to the depths listed in the table below. Slotted casing was placed in the borings, and the annular space between the casing and excavation was filled with gravel. The borings were then filled with water to pre-saturate the soils. On June 28, 2022, the casings were refilled with water and percolation test readings were performed after repeated flooding of the cased excavation. Based on the test results, the measured infiltration rate and design infiltration rate, for the earth materials encountered, are provided in the following table. These values have been calculated in accordance with the Small Diameter Boring Infiltration Test Procedure in the County of Los Angeles Department of Public Works GMED *Guidelines for Geotechnical Investigation and Reporting, Low Impact Development Stormwater Infiltration* (June 2021). Percolation test field data and calculation of the measured infiltration rate and design infiltration rate are provided on Figures 19 and 20.

Boring	Soil Type	Infiltration Depth (ft)	Measured Percolation Rate (in / hour)	Design Infiltration Rate (in / hour)
B1	SP-SM	5 – 10	1.78	0.59
B4	SP	5 – 10	2.47	0.82

- 7.14.2 Based on the test method utilized (Small Diameter Boring), the reduction factor RF_t may be taken as 1.0 in the infiltration system design. Based on the number of tests performed and consistency of the soils throughout the site, it is suggested that the reduction factor RF_v be taken as 1.0. In addition, provided proper maintenance is performed to minimize long-term siltation and plugging, the reduction factor RF_s may be taken as 1.0. Additional reduction factors may be required and should be applied by the engineer in responsible charge of the design of the stormwater infiltration system and based on applicable guidelines.
- 7.14.3 The results of the percolation testing indicate that the soils at the depths in the above table are conducive to infiltration. It is our opinion that the soil zone encountered at the depth and location as listed in the table above are suitable for infiltration of stormwater.
- 7.14.4 It is our further opinion that infiltration of stormwater and will not induce excessive hydro-consolidation (see Figures B4 through B12), will not create a perched groundwater condition, will not affect soil structure interaction of existing or proposed foundations due to expansive soils, will not saturate soils supported by existing or proposed retaining walls, and will not increase the potential for liquefaction. Resulting settlements are anticipated to be less than $\frac{1}{4}$ inch, if any.
- 7.14.5 The infiltration system must be located such that the closest distance between an adjacent foundation is at least 15 feet in all directions from the zone of saturation. The zone of saturation may be assumed to project downward from the discharge of the infiltration facility at a gradient of 1:1. Additional property line or foundation setbacks may be required by the governing jurisdiction and should be incorporated into the stormwater infiltration system design as necessary.
- 7.14.6 Where the 15-foot horizontal setback cannot be maintained between the infiltration system and an adjacent footing, and the infiltration system penetrates below the foundation influence line, the proposed stormwater infiltration system must be designed to resist the surcharge from the adjacent foundation. The foundation surcharge line may be assumed to project down away from the bottom of the foundation at a 1:1 gradient. The stormwater infiltration system must still be sufficiently deep to maintain the 15-foot vertical offset between the bottom of the footing and the zone of saturation.
- 7.14.7 Subsequent to the placement of the infiltration system, it is acceptable to backfill the resulting void space between the excavation sidewalls and the infiltration system with minimum two-sack slurry provided the slurry is not placed in the infiltration zone. It is recommended that pea gravel be utilized adjacent to the infiltration zone so communication of water to the soil is not hindered.

- 7.14.8 Due to the preliminary nature of the project at this time, the type of stormwater infiltration system and location of the stormwater infiltration systems has not yet been determined. The design drawings should be reviewed and approved by the Geotechnical Engineer. The installation of the stormwater infiltration system should be observed and approved by the Geotechnical Engineer (a representative of Geocon).

7.15 Surface Drainage

- 7.15.1 Proper surface drainage is critical to the future performance of the project. Uncontrolled infiltration of irrigation excess and storm runoff into the soils can adversely affect the performance of the planned improvements. Saturation of a soil can cause it to lose internal shear strength and increase its compressibility, resulting in a change in the original designed engineering properties. Proper drainage should be maintained at all times.
- 7.15.2 All site drainage should be collected and controlled in non-erosive drainage devices. Drainage should not be allowed to pond anywhere on the site, and especially not against any foundation or retaining wall. The site should be graded and maintained such that surface drainage is directed away from structures in accordance with 2019 CBC 1804.4 or other applicable standards. In addition, drainage should not be allowed to flow uncontrolled over any descending slope. Discharge from downspouts, roof drains and scuppers are not recommended onto unprotected soils within 5 feet of the building perimeter. Planters which are located adjacent to foundations should be sealed to prevent moisture intrusion into the soils providing foundation support. Landscape irrigation is not recommended within 5 feet of the building perimeter footings except when enclosed in protected planters.
- 7.15.3 Positive site drainage should be provided away from structures, pavement, and the tops of slopes to swales or other controlled drainage structures.
- 7.15.4 Landscaping planters immediately adjacent to paved areas are not recommended due to the potential for surface or irrigation water to infiltrate the pavement's subgrade and base course. Either a subdrain, which collects excess irrigation water and transmits it to drainage structures, or impervious above-grade planter boxes should be used. In addition, where landscaping is planned adjacent to the pavement, it is recommended that consideration be given to providing a cutoff wall along the edge of the pavement that extends at least 12 inches below the base material.

7.16 Plan Review

- 7.16.1 Grading, foundation, and, if applicable, shoring plans should be reviewed by the Geotechnical Engineer (a representative of Geocon West, Inc.), prior to finalization to verify that the plans have been prepared in substantial conformance with the recommendations of this report and to provide additional analyses or recommendations.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

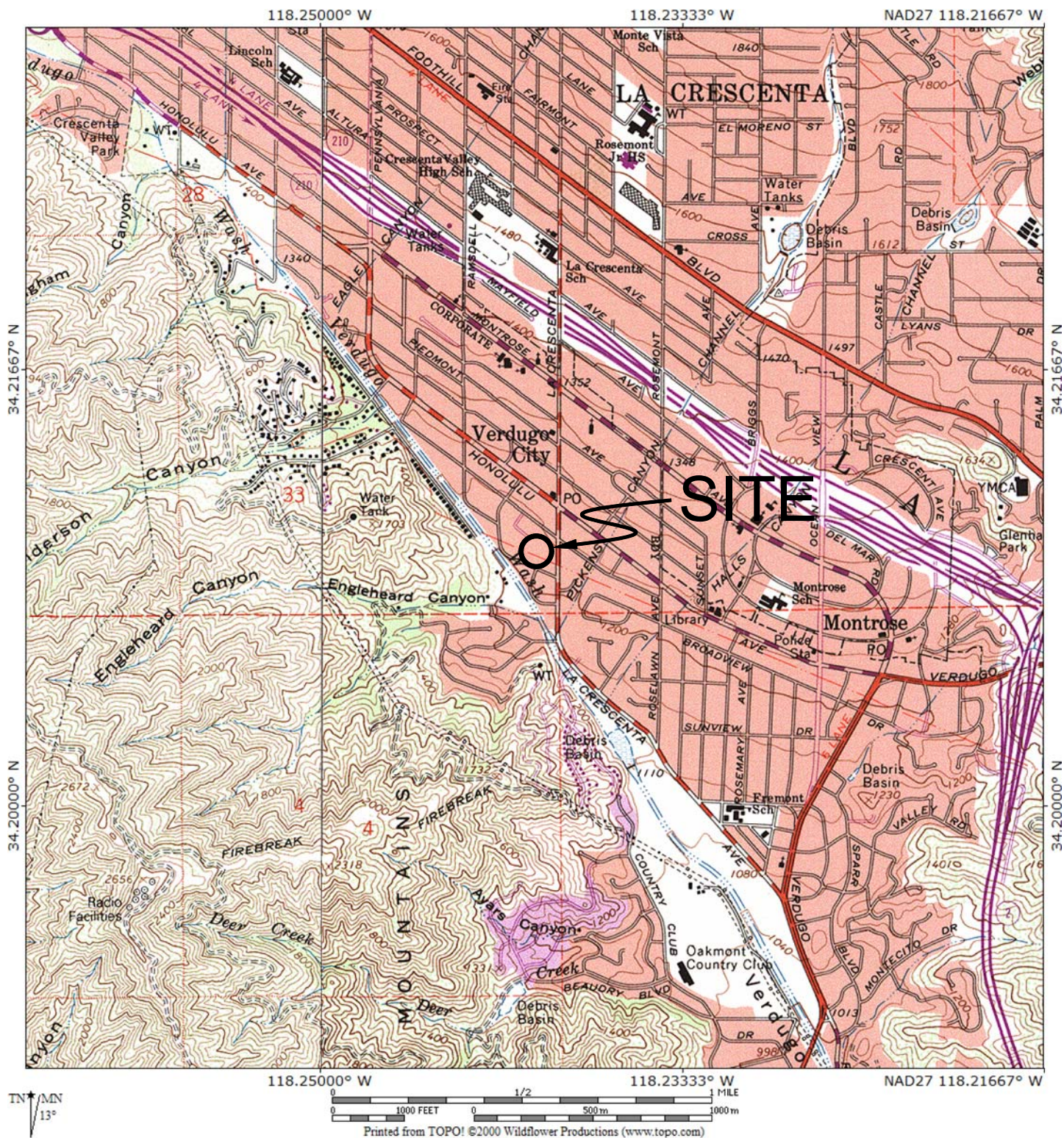
1. The recommendations of this report pertain only to the site investigated and are based upon the assumption that the soil conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Geocon West, Inc. should be notified so that supplemental recommendations can be given. The evaluation or identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by Geocon West, Inc.
2. 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 brought to the attention of the architect and engineer for the project and incorporated into the plans, and the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.
3. The findings of this report are valid as of the date of this report. However, changes in the conditions of a property can occur with the passage of time, whether they are due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.
4. The firm that performed the geotechnical investigation for the project should be retained to provide testing and observation services during construction to provide continuity of geotechnical interpretation and to check that the recommendations presented for geotechnical aspects of site development are incorporated during site grading, construction of improvements, and excavation of foundations. If another geotechnical firm is selected to perform the testing and observation services during construction operations, that firm should prepare a letter indicating their intent to assume the responsibilities of project geotechnical engineer of record. A copy of the letter should be provided to the regulatory agency for their records. In addition, that firm should provide revised recommendations concerning the geotechnical aspects of the proposed development, or a written acknowledgement of their concurrence with the recommendations presented in our report. They should also perform additional analyses deemed necessary to assume the role of Geotechnical Engineer of Record.

LIST OF REFERENCES

- California Division of Mines and Geology, 1999, *State of California Seismic Hazard Zones Map, Pasadena 7.5-Minute Quadrangle*, Official Map, Released: March 25, 1999.
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- California Geologic Energy Management Division, 2022, CalGEM Resources Well Finder, <http://maps.conservation.ca.gov.doggr/index.html#close>.
- California Geological Survey, 2022a, CGS Information Warehouse, Regulatory Map Portal, <http://maps.conservation.ca.gov/cgs/informationwarehouse/index.html?map=regulatorymaps>.
- California Geological Survey, 2022b, Earthquake Zones of Required Investigation, <https://maps.conservation.ca.gov/cgs/EQZApp/app/>.
- California Geological Survey, 2018, *Earthquake Fault Zones, A Guide for Government Agencies, Property Owners/Developers, and Geoscience Practitioners for Assessing Fault Rupture Hazards in California*, Special Publication 42, Revised 2018.
- California Geological Survey, 2012, *Geologic Compilation of Quaternary Surficial Deposits in Southern California, Los Angeles 30' X 60' Quadrangle*, compiled by Roffers, P.D. and Bedrosian, T.L., CGS Special Report 217, Plate 8.
- Earth Consultants International, 2003, *Technical Background Report to the Safety Element of the General Plan, City of Glendale, California*, dated July 2003.
- FEMA, 2022, Online Flood Hazard Maps, <http://www.esri.com/hazards/index.html>.
- Glendale, City of, 2003, *Safety Element of the General Plan*, dated August, 2003.
- Leighton and Associates, Inc., 1990, *Technical Appendix to the Safety Element of the Los Angeles County General Plan, Hazard Reduction in Los Angeles County*.
- Los Angeles County Department of Public Works, 2022a, Ground Water Wells Website, <http://dpw2.co.la.ca.us/website/wells/viewer.asp>.
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- Rogers, 2006, *Subsurface Exploration Using the Standard Penetration Test and Cone Penetrometer Test*, Environmental and Engineering Geoscience, V. 12, No. 2, P. 161-179.
- Toppozada, T., Branum, D., Petersen, M., Hallstrom, C., and Reichle, M., 2000, *Epicenters and Areas Damaged by M> 5 California Earthquakes, 1800 – 1999*, California Geological Survey, Map Sheet 49.
- U.S. Geological Survey and California Geological Survey, 2006, *Quaternary Fault and Fold Database for the United States*, accessed February 2, 2022, from USGS web site: <http://earthquake.usgs.gov/hazards/qfaults/>.

LIST OF REFERENCES (Continued)

Ziony, J. I., and Jones, L. M., 1989, *Map Showing Late Quaternary Faults and 1978–1984 Seismicity of the Los Angeles Region, California*, U.S. Geological Survey Miscellaneous Field Studies Map MF-1964.



U.S.G.S. TOPOGRAPHIC MAPS, 7.5 MINUTE SERIES, BURBANK AND PASADENA, CA QUADRANGLES

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DRAFTED BY: CB

CHECKED BY: GAK

VICINITY MAP

TWELVE OAKS SENIOR LIVING FACILITY
2820 SYCAMORE AVENUE
GLENDALE, CALIFORNIA

AUGUST 2022

PROJECT NO. W1582-06-01

FIG. 1

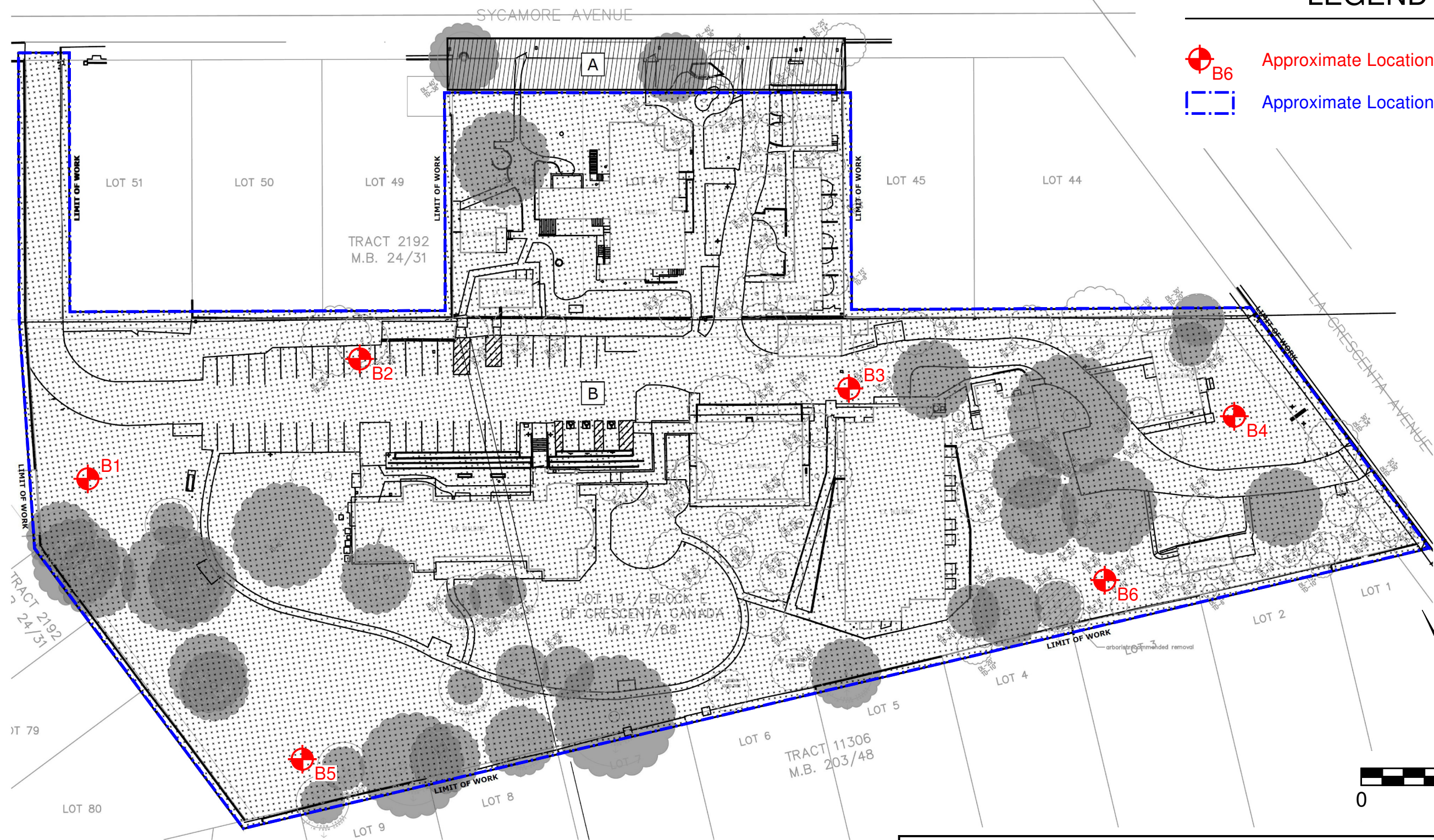
LEGEND



Approximate Location of Boring



Approximate Location of Property Line



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SITE PLAN

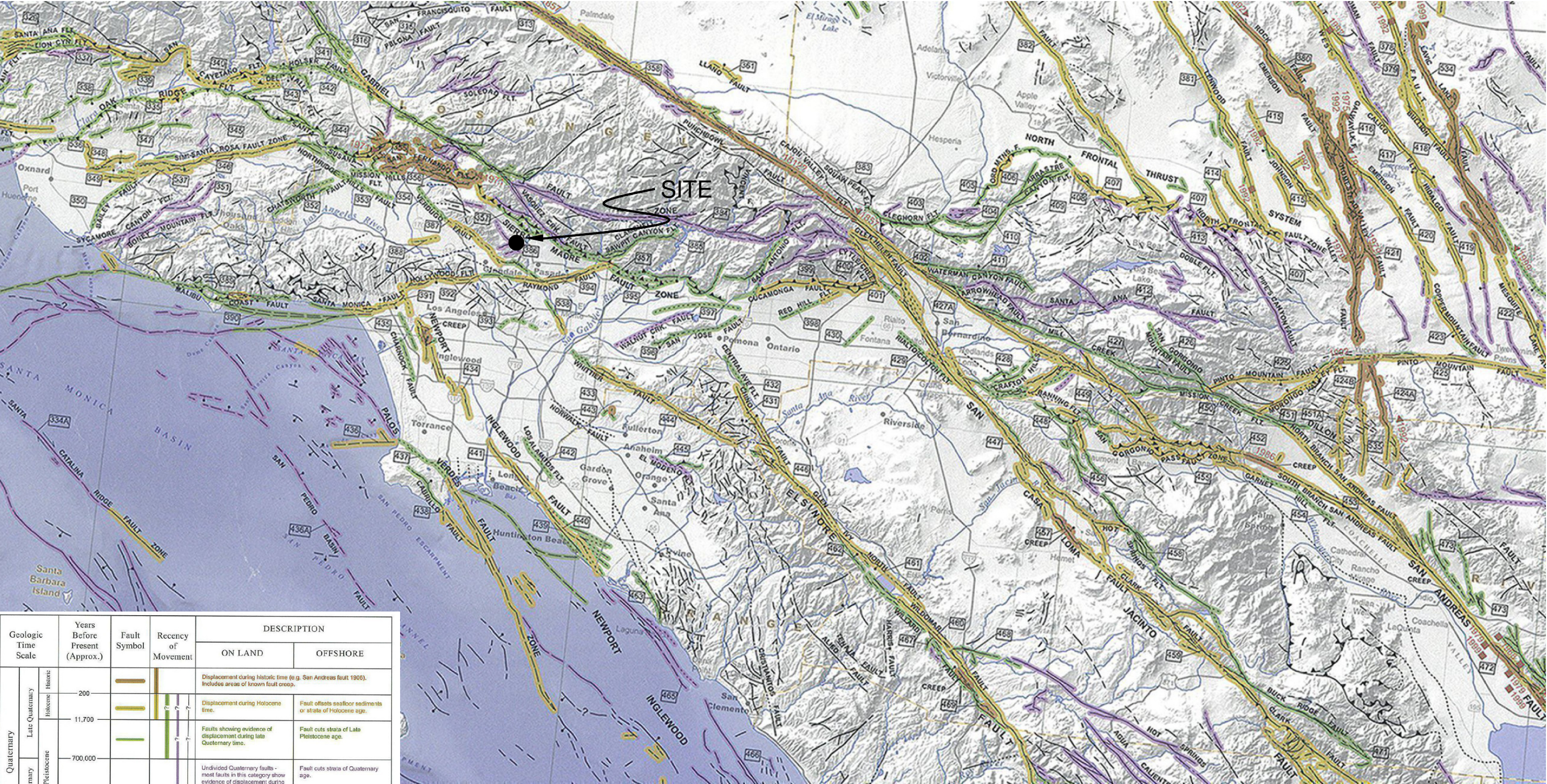
TWELVE OAKS SENIOR LIVING FACILITY
2820 SYCAMORE AVENUE
GLENDALE, CALIFORNIA

AUGUST 2022

PROJECT NO. W1582-06-01

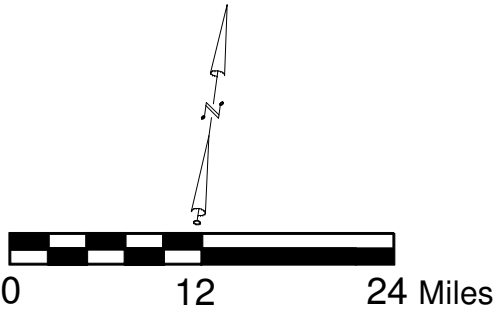
FIG. 2

Reference: Jennings, C.W. and Bryant, W. A., 2010, Fault Activity Map of California, California Geological Survey Geologic Data Map No. 6.



Geologic Time Scale	Years Before Present (Approx.)	Fault Symbol	Recency of Movement	DESCRIPTION	
				ON LAND	OFFSHORE
Quaternary	Late Quaternary Holocene	—	—	Displacement during historic time (e.g. San Andreas fault 1906). Includes areas of known fault creep.	
	11,700	—	—	Displacement during Holocene time.	Fault offsets seafloor sediments or strata of Holocene age.
	700,000	—	—	Faults showing evidence of displacement during late Quaternary time.	Fault cuts strata of Late Pleistocene age.
Pre-Quaternary	Early Quaternary Pleistocene	—	—	Undivided Quaternary faults - most faults in this category show evidence of displacement during the last 1,600,000 years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age.	Fault cuts strata of Quaternary age.
	1,600,000	—	—	Faults without recognized Quaternary displacement or showing evidence of no displacement during Quaternary time. Not necessarily inactive.	Fault cuts strata of Pliocene or older age.
	4.5 billion (Age of Earth)	—	—		

* Quaternary now recognized as extending to 2.6 Ma (Walker and Geissman, 2009). Quaternary faults in this map were established using the previous 1.6 Ma criterion.



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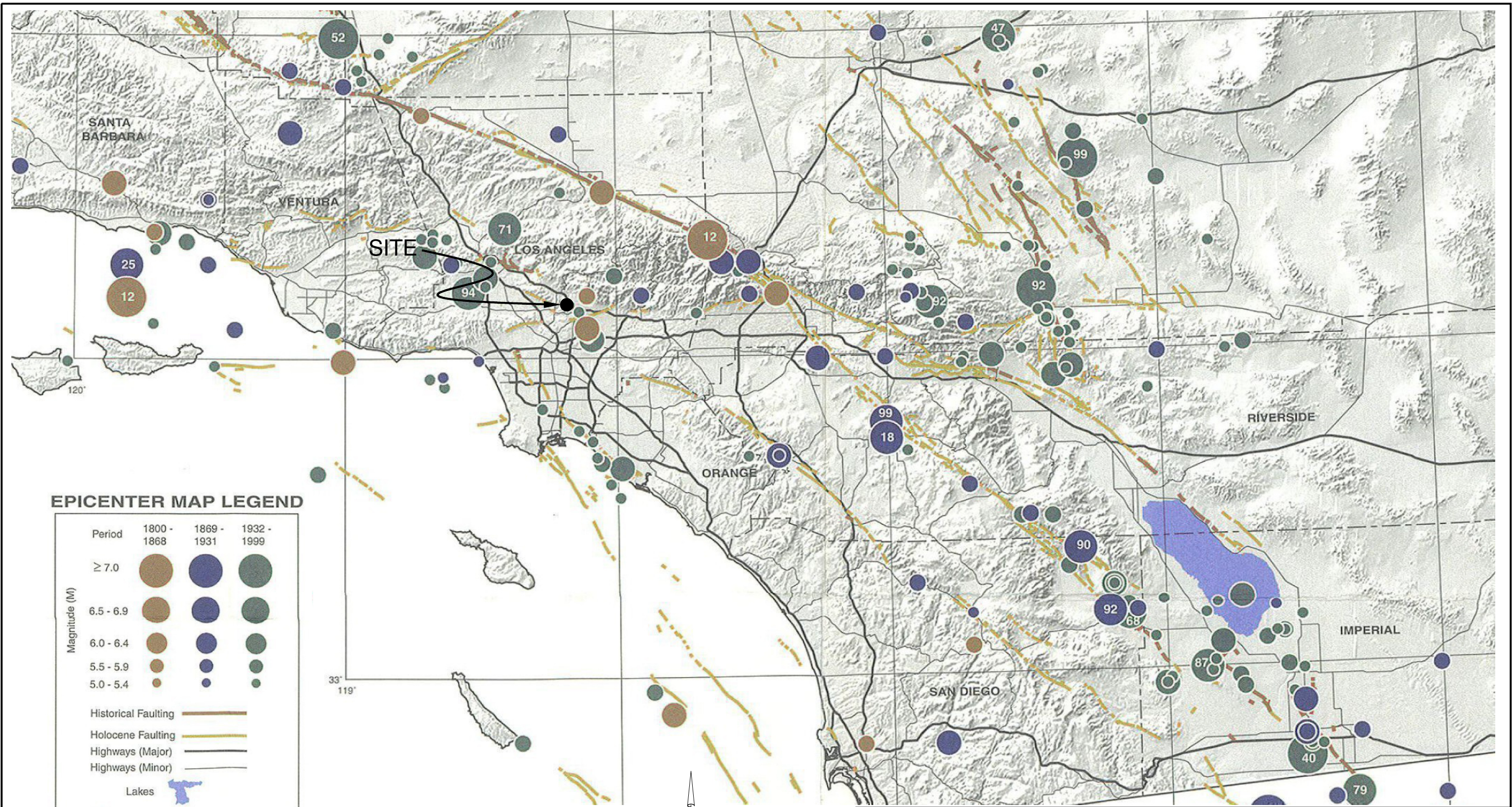
REGIONAL FAULT MAP

TWELVE OAKS SENIOR LIVING FACILITY
2820 SYCAMORE AVENUE
GLENDALE, CALIFORNIA

AUGUST 2022

PROJECT NO. W1582-06-01

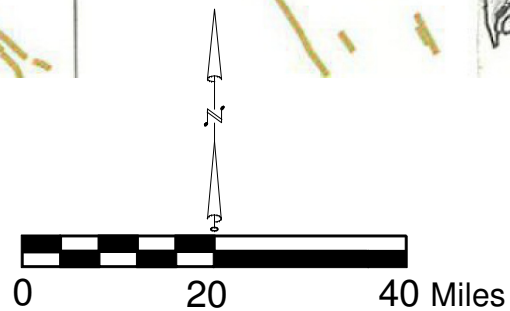
FIG. 3



EPICENTER MAP LEGEND

Period	1800 - 1868	1869 - 1931	1932 - 1999
≥ 7.0			
6.5 - 6.9			
6.0 - 6.4			
5.5 - 5.9			
5.0 - 5.4			
Historical Faulting			
Holocene Faulting			
Highways (Major)			
Highways (Minor)			
Lakes			
	Last two digits of M ≥ 6.5 earthquake year		

Reference: Toppozada, T., Branum, D., Petersen, M., Hallstrom, C., Cramer, C., and Reichle, M., 2000, Epicenters and Areas Damaged by M>5 California Earthquakes, 1800 - 1999, California Geological Survey, Map Sheet 49.



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CHECKED BY: GAK

REGIONAL SEISMICITY MAP

TWELVE OAKS SENIOR LIVING FACILITY
2820 SYCAMORE AVENUE
GLENDALE, CALIFORNIA

AUGUST 2022

PROJECT NO. W1582-06-01

FIG. 4



Project Name : 2820 Sycamore Ave, Glendale

Project No. : W1582-06-01

Boring : 1

EMPIRICAL ESTIMATION OF LIQUEFACTION POTENTIAL DESIGN EARTHQUAKE

NCEER (1996) METHOD

EARTHQUAKE INFORMATION:

Earthquake Magnitude:	6.91
Peak Horiz. Acceleration PGA_M (g):	0.932
2/3 PGA_M (g):	0.622
Calculated Mag.Wtg.Factor:	0.815
Historic High Groundwater:	30.0
Groundwater Depth During Exploration:	100.0

By Thomas F. Blake (1994-1996)

ENERGY & ROD CORRECTIONS:

Energy Correction (CE) for N60:	1.25
Rod Len.Corr.(CR)(0-no or 1-yes):	1.0
Bore Dia. Corr. (CB):	1.00
Sampler Corr. (CS):	1.20
Use Ksigma (0 or 1):	1.0

LIQUEFACTION CALCULATIONS:

Unit Wt. Water (pcf): 62.4

Depth to Base (ft)	Total Unit Wt. (pcf)	Water (0 or 1)	FIELD SPT (N)	Depth of SPT (ft)	Liq.Sus. (0 or 1)	-200 (%)	Est. Dr (%)	CN Factor	Corrected (N1)60	Eff. Unit Wt. (psf)	Resist. CRR	rd Factor	Induced CSR	Liquefac. Safe.Fact.
1.0	113.7	0	7.0	2.5	1		62	1.700	13.4	113.7	0.146	0.998	0.328	--
2.0	113.7	0	7.0	2.5	1		62	1.700	13.4	113.7	0.146	0.993	0.327	--
3.5	113.7	0	7.0	2.5	1		62	1.700	13.4	113.7	0.146	0.987	0.325	--
4.0	122.0	0	5.0	5.0	1	15	49	1.700	12.0	122.0	0.131	0.983	0.324	--
5.0	122.0	0	5.0	5.0	1	15	49	1.700	12.0	122.0	0.131	0.979	0.322	--
6.0	122.0	0	5.0	5.0	1	15	49	1.700	12.0	122.0	0.131	0.975	0.321	--
7.0	122.0	0	5.0	5.0	1	15	49	1.648	11.7	122.0	0.128	0.970	0.319	--
8.0	122.0	0	5.0	5.0	1	15	49	1.531	11.0	122.0	0.120	0.966	0.318	--
9.0	122.0	0	5.0	5.0	1	15	49	1.436	10.5	122.0	0.115	0.961	0.316	--
10.0	122.0	0	9.0	10.0	1	15	59	1.357	16.0	122.0	0.174	0.957	0.315	--
11.0	122.0	0	9.0	10.0	1	15	59	1.289	15.3	122.0	0.167	0.952	0.313	--
12.0	109.0	0	12.0	12.5	1		66	1.234	16.7	109.0	0.181	0.947	0.312	--
13.5	109.0	0	12.0	12.5	1		66	1.177	15.9	109.0	0.173	0.942	0.310	--
14.0	109.0	0	7.0	15.0	1	21	48	1.156	13.5	109.0	0.148	0.937	0.309	--
15.0	109.0	0	7.0	15.0	1	21	48	1.109	13.1	109.0	0.143	0.934	0.307	--
16.0	109.0	0	7.0	15.0	1	21	48	1.075	12.8	109.0	0.140	0.929	0.306	--
17.5	109.0	0	7.0	15.0	1	21	48	1.036	12.5	109.0	0.137	0.923	0.304	--
18.0	122.4	0	25.0	20.0	1	8	84	1.021	34.9	122.4	Inf.	0.919	0.302	--
19.0	122.4	0	25.0	20.0	1	8	84	0.984	33.7	122.4	Inf.	0.915	0.301	--
20.0	122.4	0	25.0	20.0	1	8	84	0.957	32.8	122.4	Inf.	0.911	0.300	--
21.0	122.4	0	25.0	20.0	1	8	84	0.933	32.0	122.4	Inf.	0.906	0.298	--
22.0	117.0	0	25.0	20.0	1	8	84	0.910	31.2	117.0	Inf.	0.902	0.297	--
23.0	117.0	0	25.0	20.0	1	8	84	0.890	30.5	117.0	Inf.	0.897	0.295	--
24.5	117.0	0	25.0	20.0	1	8	84	0.866	29.7	117.0	0.436	0.891	0.293	--
25.0	117.0	0	15.0	25.0	1	18	61	0.857	21.5	117.0	0.226	0.887	0.292	--
26.0	117.0	0	15.0	25.0	1	18	61	0.836	21.0	117.0	0.220	0.883	0.291	--
27.0	117.0	0	15.0	25.0	1	18	61	0.820	20.7	117.0	0.217	0.879	0.289	--
28.0	117.7	0	29.0	30.0	1	17	80	0.805	37.7	117.7	Inf.	0.874	0.288	--
29.0	117.7	0	29.0	30.0	1	17	80	0.791	37.1	117.7	Inf.	0.870	0.286	--
30.0	117.7	1	29.0	30.0	1	17	80	0.777	36.5	55.3	Inf.	0.865	0.287	Non-Liq.
31.0	117.7	1	29.0	30.0	1	17	80	0.764	36.0	55.3	Inf.	0.861	0.291	Non-Liq.
32.0	120.0	1	50.0	34.0	1	13	103	0.752	58.3	57.6	Inf.	0.856	0.294	Non-Liq.
33.0	120.0	1	50.0	34.0	1	13	103	0.740	57.5	57.6	Inf.	0.851	0.297	Non-Liq.
34.0	120.0	1	50.0	34.0	1	13	103	0.729	56.6	57.6	Inf.	0.847	0.300	Non-Liq.
35.0	120.0	1	50.0	34.0	1	13	103	0.718	55.8	57.6	Inf.	0.842	0.303	Non-Liq.
36.0	122.6	1	50.0	34.0	1	13	103	0.707	55.0	60.2	Inf.	0.838	0.305	Non-Liq.
37.0	122.6	1	50.0	34.0	1	13	103	0.697	54.2	60.2	Inf.	0.833	0.308	Non-Liq.
38.0	122.6	1	50.0	34.0	1	13	103	0.687	53.5	60.2	Inf.	0.829	0.310	Non-Liq.
39.0	122.6	1	50.0	39.0	1	20	101	0.678	54.4	60.2	Inf.	0.824	0.312	Non-Liq.
40.0	122.6	1	50.0	39.0	1	20	101	0.669	53.8	60.2	Inf.	0.819	0.314	Non-Liq.
41.0	122.6	1	50.0	39.0	1	20	101	0.660	53.1	60.2	Inf.	0.815	0.316	Non-Liq.
42.0	122.6	1	50.0	39.0	1	20	101	0.652	52.5	60.2	Inf.	0.810	0.317	Non-Liq.
43.0	122.6	1	50.0	39.0	1	20	101	0.644	51.9	60.2	Inf.	0.806	0.319	Non-Liq.
44.0	122.6	1	50.0	39.0	1	20	101	0.636	51.3	60.2	Inf.	0.801	0.320	Non-Liq.
45.0	122.6	1	50.0	39.0	1	20	101	0.629	50.8	60.2	Inf.	0.797	0.321	Non-Liq.
46.0	122.6	1	50.0	39.0	1	20	101	0.622	50.2	60.2	Inf.	0.792	0.322	Non-Liq.
47.0	122.6	1	50.0	39.0	1	20	101	0.615	49.7	60.2	Inf.	0.787	0.323	Non-Liq.
48.0	122.6	1	50.0	39.0	1	20	101	0.608	49.2	60.2	Inf.	0.783	0.324	Non-Liq.
49.0	122.6	1	50.0	39.0	1	20	101	0.602	48.7	60.2	Inf.	0.778	0.325	Non-Liq.
50.0	122.6	1	50.0	39.0	1	20	101	0.595	48.2	60.2	Inf.	0.774	0.325	Non-Liq.

Figure 5



Project Name : 2820 Sycamore Ave, Glendale
 Project No. : W1582-06-01
 Boring : 1

LIQUEFACTION SETTLEMENT ANALYSIS

DESIGN EARTHQUAKE

(SATURATED SAND AT INITIAL LIQUEFACTION CONDITION)

NCEER (1996) METHOD

EARTHQUAKE INFORMATION:

Earthquake Magnitude:	6.91
PGAM (g):	0.932
2/3 PGAM (g):	0.62
Calculated Mag.Wtg.Factor:	0.815
Historic High Groundwater:	30.0
Groundwater @ Exploration:	100.0

DEPTH TO BASE	BLOW COUNT N	WET DENSITY (PCF)	TOTAL STRESS O (TSF)	EFFECT STRESS O' (TSF)	REL. DEN. Dr (%)	ADJUST BLOWS (N1)60		LIQUEFACTION SAFETY FACTOR	Volumetric Strain [e ₁₅] (%)	EQ. SETTLE. Pe (in.)
							Tav/σ' _o			
1.0	7	113.7	0.028	0.028	62	13	0.404	--	0.00	0.00
2.0	7	113.7	0.085	0.085	62	13	0.404	--	0.00	0.00
3.5	7	113.7	0.156	0.156	62	13	0.404	--	0.00	0.00
4.0	5	122.0	0.186	0.186	49	12	0.404	--	0.00	0.00
5.0	5	122.0	0.262	0.262	49	12	0.404	--	0.00	0.00
6.0	5	122.0	0.323	0.323	49	12	0.404	--	0.00	0.00
7.0	5	122.0	0.384	0.384	49	12	0.404	--	0.00	0.00
8.0	5	122.0	0.445	0.445	49	11	0.404	--	0.00	0.00
9.0	5	122.0	0.506	0.506	49	10	0.404	--	0.00	0.00
10.0	9	122.0	0.567	0.567	59	16	0.404	--	0.00	0.00
11.0	9	122.0	0.628	0.628	59	15	0.404	--	0.00	0.00
12.0	12	109.0	0.686	0.686	66	17	0.404	--	0.00	0.00
13.5	12	109.0	0.754	0.754	66	16	0.404	--	0.00	0.00
14.0	7	109.0	0.781	0.781	48	14	0.404	--	0.00	0.00
15.0	7	109.0	0.850	0.850	48	13	0.404	--	0.00	0.00
16.0	7	109.0	0.904	0.904	48	13	0.404	--	0.00	0.00
17.5	7	109.0	0.972	0.972	48	13	0.404	--	0.00	0.00
18.0	25	122.4	1.001	1.001	84	35	0.404	--	0.00	0.00
19.0	25	122.4	1.078	1.078	84	34	0.404	--	0.00	0.00
20.0	25	122.4	1.139	1.139	84	33	0.404	--	0.00	0.00
21.0	25	122.4	1.200	1.200	84	32	0.404	--	0.00	0.00
22.0	25	117.0	1.260	1.260	84	31	0.404	--	0.00	0.00
23.0	25	117.0	1.318	1.318	84	31	0.404	--	0.00	0.00
24.5	25	117.0	1.391	1.391	84	30	0.404	--	0.00	0.00
25.0	15	117.0	1.421	1.421	61	21	0.404	--	0.00	0.00
26.0	15	117.0	1.494	1.494	61	21	0.404	--	0.00	0.00
27.0	15	117.0	1.552	1.552	61	21	0.404	--	0.00	0.00
28.0	29	117.7	1.611	1.611	80	38	0.404	--	0.00	0.00
29.0	29	117.7	1.670	1.670	80	37	0.404	--	0.00	0.00
30.0	29	117.7	1.729	1.713	80	37	0.408	Non-Liq.	0.00	0.00
31.0	29	117.7	1.788	1.741	80	36	0.415	Non-Liq.	0.00	0.00
32.0	50	120.0	1.847	1.769	103	58	0.422	Non-Liq.	0.00	0.00
33.0	50	120.0	1.907	1.798	103	57	0.429	Non-Liq.	0.00	0.00
34.0	50	120.0	1.967	1.827	103	57	0.435	Non-Liq.	0.00	0.00
35.0	50	120.0	2.027	1.855	103	56	0.441	Non-Liq.	0.00	0.00
36.0	50	122.6	2.088	1.885	103	55	0.448	Non-Liq.	0.00	0.00
37.0	50	122.6	2.149	1.915	103	54	0.453	Non-Liq.	0.00	0.00
38.0	50	122.6	2.210	1.945	103	54	0.459	Non-Liq.	0.00	0.00
39.0	50	122.6	2.272	1.975	101	54	0.465	Non-Liq.	0.00	0.00
40.0	50	122.6	2.333	2.005	101	54	0.470	Non-Liq.	0.00	0.00
41.0	50	122.6	2.394	2.035	101	53	0.475	Non-Liq.	0.00	0.00
42.0	50	122.6	2.455	2.065	101	52	0.480	Non-Liq.	0.00	0.00
43.0	50	122.6	2.517	2.095	101	52	0.485	Non-Liq.	0.00	0.00
44.0	50	122.6	2.578	2.126	101	51	0.490	Non-Liq.	0.00	0.00
45.0	50	122.6	2.639	2.156	101	51	0.495	Non-Liq.	0.00	0.00
46.0	50	122.6	2.701	2.186	101	50	0.499	Non-Liq.	0.00	0.00
47.0	50	122.6	2.762	2.216	101	50	0.504	Non-Liq.	0.00	0.00
48.0	50	122.6	2.823	2.246	101	49	0.508	Non-Liq.	0.00	0.00
49.0	50	122.6	2.884	2.276	101	49	0.512	Non-Liq.	0.00	0.00
50.0	50	122.6	2.946	2.306	101	48	0.516	Non-Liq.	0.00	0.00

TOTAL SETTLEMENT = 0.0 INCHES

Figure 6



Project Name : 2820 Sycamore Ave, Glendale

Project No. : W1582-06-01

Boring : 4

EMPIRICAL ESTIMATION OF LIQUEFACTION POTENTIAL DESIGN EARTHQUAKE

NCEER (1996) METHOD

EARTHQUAKE INFORMATION:

Earthquake Magnitude:	6.91
Peak Horiz. Acceleration PGA_M (g):	0.932
2/3 PGA_M (g):	0.622
Calculated Mag.Wtg.Factor:	0.815
Historic High Groundwater:	30.0
Groundwater Depth During Exploration:	100.0

By Thomas F. Blake (1994-1996)

ENERGY & ROD CORRECTIONS:

Energy Correction (CE) for N60:	1.25
Rod Len.Corr.(CR)(0-no or 1-yes):	1.0
Bore Dia. Corr. (CB):	1.00
Sampler Corr. (CS):	1.20
Use Ksigma (0 or 1):	1.0

LIQUEFACTION CALCULATIONS:

Unit Wt. Water (pcf): 62.4

Depth to Base (ft)	Total Unit Wt. (pcf)	Water (0 or 1)	FIELD SPT (N)	Depth of SPT (ft)	Liq.Sus. (0 or 1)	-200 (%)	Est. Dr (%)	CN Factor	Corrected (N1)60	Eff. Unit Wt. (psf)	Resist. CRR	rd Factor	Induced CSR	Liquefac. Safe.Fact.
1.0	110.4	0	20.0	2.5	1		103	1.700	38.3	110.4	Infin.	0.998	0.328	--
2.0	110.4	0	20.0	2.5	1		103	1.700	38.3	110.4	Infin.	0.993	0.327	--
3.0	110.4	0	20.0	2.5	1		103	1.700	38.3	110.4	Infin.	0.989	0.325	--
4.5	110.4	0	20.0	2.5	1		103	1.700	38.3	110.4	Infin.	0.983	0.324	--
5.0	115.3	0	21.0	5.0	1	5	101	1.700	40.2	115.3	Infin.	0.978	0.322	--
6.0	115.3	0	21.0	5.0	1	5	101	1.700	40.2	115.3	Infin.	0.975	0.321	--
7.0	115.3	0	21.0	5.0	1	5	101	1.691	40.0	115.3	Infin.	0.970	0.319	--
8.0	115.3	0	24.0	10.0	1	5	97	1.572	42.5	115.3	Infin.	0.966	0.318	--
9.0	115.3	0	24.0	10.0	1	5	97	1.474	39.9	115.3	Infin.	0.961	0.316	--
10.0	115.3	0	24.0	10.0	1	5	97	1.393	37.6	115.3	Infin.	0.957	0.315	--
11.0	115.3	0	24.0	10.0	1	5	97	1.324	35.7	115.3	Infin.	0.952	0.313	--
12.0	82.9	0	24.0	10.0	1	5	97	1.272	34.3	82.9	Infin.	0.947	0.312	--
13.0	82.9	0	24.0	10.0	1	5	97	1.233	33.3	82.9	Infin.	0.943	0.310	--
14.0	82.9	0	24.0	10.0	1	5	97	1.197	32.3	82.9	Infin.	0.938	0.309	--
15.0	129.3	0	10.0	15.0	1	11	58	1.156	15.4	129.3	0.167	0.934	0.307	--
16.0	129.3	0	10.0	15.0	1	11	58	1.111	14.8	129.3	0.162	0.929	0.306	--
17.0	129.3	0	55.0	20.0	1	11	126	1.071	80.4	129.3	Infin.	0.925	0.304	--
18.0	129.3	0	55.0	20.0	1	11	126	1.035	77.8	129.3	Infin.	0.920	0.303	--
19.0	129.3	0	55.0	20.0	1	11	126	1.002	75.4	129.3	Infin.	0.915	0.301	--
20.0	129.3	0	55.0	20.0	1	8	126	0.972	72.5	129.3	Infin.	0.911	0.300	--
21.0	129.3	0	55.0	20.0	1	8	126	0.945	70.5	129.3	Infin.	0.906	0.298	--
22.0	129.9	0	17.6	22.5	1	0	68	0.920	22.5	129.9	0.242	0.902	0.297	--
23.0	129.9	0	17.6	22.5	1	0	68	0.897	22.0	129.9	0.235	0.897	0.295	--
24.0	129.9	0	17.6	22.5	1	0	68	0.875	21.4	129.9	0.228	0.893	0.294	--
25.0	143.6	0	17.0	25.0	1	18	65	0.854	23.7	143.6	0.254	0.888	0.292	--
26.0	143.6	0	17.0	25.0	1	18	65	0.833	23.2	143.6	0.247	0.883	0.291	--
27.0	143.6	0	28.0	30.0	1	18	78	0.814	37.1	143.6	Infin.	0.879	0.289	--
28.0	143.6	0	28.0	30.0	1	18	78	0.796	36.3	143.6	Infin.	0.874	0.288	--
29.0	143.6	0	28.0	30.0	1	18	78	0.779	35.6	143.6	Infin.	0.870	0.286	--
30.0	143.6	1	28.0	30.0	1	16	78	0.763	34.6	81.2	Infin.	0.865	0.287	Non-Liq.
31.0	143.6	1	28.0	30.0	1	16	78	0.749	33.9	81.2	Infin.	0.861	0.291	Non-Liq.
32.0	130.4	1	28.0	30.0	1	16	78	0.735	33.4	68.0	Infin.	0.856	0.294	Non-Liq.
33.0	130.4	1	28.0	30.0	1	16	78	0.723	32.9	68.0	Infin.	0.851	0.297	Non-Liq.
34.0	130.4	1	28.0	30.0	1	16	78	0.712	32.4	68.0	Infin.	0.847	0.299	Non-Liq.
35.0	130.4	1	26.0	35.0	1	6	73	0.701	27.7	68.0	0.308	0.842	0.302	1.02
36.0	130.4	1	26.0	35.0	1	6	73	0.690	27.2	68.0	0.298	0.838	0.304	0.98
37.0	124.6	1	26.0	35.0	1	6	73	0.680	26.9	62.2	0.290	0.833	0.306	0.95
38.0	124.6	1	50.0	38.5	1	29	99	0.671	56.0	62.2	Infin.	0.829	0.308	Non-Liq.
39.0	124.6	1	50.0	38.5	1	29	99	0.662	55.3	62.2	Infin.	0.824	0.310	Non-Liq.
40.0	124.6	1	50.0	38.5	1	29	99	0.654	54.7	62.2	Infin.	0.819	0.312	Non-Liq.
41.0	124.6	1	50.0	38.5	1	29	99	0.646	54.1	62.2	Infin.	0.815	0.313	Non-Liq.
42.0	124.6	1	50.0	38.5	1	29	99	0.638	53.5	62.2	Infin.	0.810	0.315	Non-Liq.
43.0	124.6	1	50.0	38.5	1	29	99	0.630	52.9	62.2	Infin.	0.806	0.316	Non-Liq.
44.0	124.6	1	50.0	38.5	1	29	99	0.623	52.4	62.2	Infin.	0.801	0.317	Non-Liq.
45.0	124.6	1	50.0	38.5	1	29	99	0.616	51.8	62.2	Infin.	0.797	0.318	Non-Liq.
46.0	124.6	1	50.0	38.5	1	29	99	0.609	51.3	62.2	Infin.	0.792	0.319	Non-Liq.
47.0	124.6	1	50.0	38.5	1	29	99	0.602	50.8	62.2	Infin.	0.787	0.320	Non-Liq.
48.0	124.6	1	50.0	38.5	1	29	99	0.596	50.4	62.2	Infin.	0.783	0.321	Non-Liq.
49.0	124.6	1	50.0	38.5	1	29	99	0.590	49.9	62.2	Infin.	0.778	0.321	Non-Liq.
50.0	124.6	1	50.0	38.5	1	29	99	0.584	49.4	62.2	Infin.	0.774	0.322	Non-Liq.

Figure 7



Project Name : 2820 Sycamore Ave, Glendale
 Project No. : W1582-06-01
 Boring : 4

LIQUEFACTION SETTLEMENT ANALYSIS

DESIGN EARTHQUAKE

(SATURATED SAND AT INITIAL LIQUEFACTION CONDITION)

NCEER (1996) METHOD
 EARTHQUAKE INFORMATION:

Earthquake Magnitude:	6.91
PGAM (g):	0.932
2/3 PGAM (g):	0.62
Calculated Mag.Wtg.Factor:	0.815
Historic High Groundwater:	30.0
Groundwater @ Exploration:	100.0

DEPTH TO BASE	BLOW COUNT N	WET DENSITY (PCF)	TOTAL STRESS O (TSF)	EFFECT STRESS O' (TSF)	REL. DEN. Dr (%)	ADJUST BLOWS (N1)60		LIQUEFACTION SAFETY FACTOR	Volumetric Strain [e ₁₅] (%)	EQ. SETTLE. Pe (in.)
							Tav/σ' _o			
1.0	20	110.4	0.028	0.028	103	38	0.404	--	0.00	0.00
2.0	20	110.4	0.083	0.083	103	38	0.404	--	0.00	0.00
3.0	20	110.4	0.138	0.138	103	38	0.404	--	0.00	0.00
4.5	20	110.4	0.207	0.207	103	38	0.404	--	0.00	0.00
5.0	21	115.3	0.235	0.235	101	40	0.404	--	0.00	0.00
6.0	21	115.3	0.307	0.307	101	40	0.404	--	0.00	0.00
7.0	21	115.3	0.365	0.365	101	40	0.404	--	0.00	0.00
8.0	24	115.3	0.423	0.423	97	42	0.404	--	0.00	0.00
9.0	24	115.3	0.480	0.480	97	40	0.404	--	0.00	0.00
10.0	24	115.3	0.538	0.538	97	38	0.404	--	0.00	0.00
11.0	24	115.3	0.596	0.596	97	36	0.404	--	0.00	0.00
12.0	24	82.9	0.645	0.645	97	34	0.404	--	0.00	0.00
13.0	24	82.9	0.687	0.687	97	33	0.404	--	0.00	0.00
14.0	24	82.9	0.728	0.728	97	32	0.404	--	0.00	0.00
15.0	10	129.3	0.781	0.781	58	15	0.404	--	0.00	0.00
16.0	10	129.3	0.846	0.846	58	15	0.404	--	0.00	0.00
17.0	55	129.3	0.910	0.910	126	80	0.404	--	0.00	0.00
18.0	55	129.3	0.975	0.975	126	78	0.404	--	0.00	0.00
19.0	55	129.3	1.040	1.040	126	75	0.404	--	0.00	0.00
20.0	55	129.3	1.104	1.104	126	73	0.404	--	0.00	0.00
21.0	55	129.3	1.169	1.169	126	70	0.404	--	0.00	0.00
22.0	17.6	129.9	1.234	1.234	68	23	0.404	--	0.00	0.00
23.0	17.6	129.9	1.299	1.299	68	22	0.404	--	0.00	0.00
24.0	17.6	129.9	1.364	1.364	68	21	0.404	--	0.00	0.00
25.0	17	143.6	1.432	1.432	65	24	0.404	--	0.00	0.00
26.0	17	143.6	1.504	1.504	65	23	0.404	--	0.00	0.00
27.0	28	143.6	1.576	1.576	78	37	0.404	--	0.00	0.00
28.0	28	143.6	1.648	1.648	78	36	0.404	--	0.00	0.00
29.0	28	143.6	1.719	1.719	78	36	0.404	--	0.00	0.00
30.0	28	143.6	1.791	1.776	78	35	0.408	Non-Liq.	0.00	0.00
31.0	28	143.6	1.863	1.816	78	34	0.414	Non-Liq.	0.00	0.00
32.0	28	130.4	1.931	1.853	78	33	0.421	Non-Liq.	0.00	0.00
33.0	28	130.4	1.997	1.887	78	33	0.427	Non-Liq.	0.00	0.00
34.0	28	130.4	2.062	1.921	78	32	0.434	Non-Liq.	0.00	0.00
35.0	26	130.4	2.127	1.955	73	28	0.440	1.02	0.65	0.08
36.0	26	130.4	2.192	1.989	73	27	0.445	0.98	1.00	0.12
37.0	26	124.6	2.256	2.022	73	27	0.451	0.95	1.10	0.13
38.0	50	124.6	2.318	2.053	99	56	0.456	Non-Liq.	0.00	0.00
39.0	50	124.6	2.380	2.084	99	55	0.462	Non-Liq.	0.00	0.00
40.0	50	124.6	2.443	2.115	99	55	0.467	Non-Liq.	0.00	0.00
41.0	50	124.6	2.505	2.146	99	54	0.472	Non-Liq.	0.00	0.00
42.0	50	124.6	2.567	2.177	99	53	0.476	Non-Liq.	0.00	0.00
43.0	50	124.6	2.630	2.209	99	53	0.481	Non-Liq.	0.00	0.00
44.0	50	124.6	2.692	2.240	99	52	0.486	Non-Liq.	0.00	0.00
45.0	50	124.6	2.754	2.271	99	52	0.490	Non-Liq.	0.00	0.00
46.0	50	124.6	2.817	2.302	99	51	0.494	Non-Liq.	0.00	0.00
47.0	50	124.6	2.879	2.333	99	51	0.499	Non-Liq.	0.00	0.00
48.0	50	124.6	2.941	2.364	99	50	0.503	Non-Liq.	0.00	0.00
49.0	50	124.6	3.004	2.395	99	50	0.507	Non-Liq.	0.00	0.00
50.0	50	124.6	3.066	2.426	99	49	0.511	Non-Liq.	0.00	0.00

TOTAL SETTLEMENT = 0.3 INCHES

Figure 8



Project Name : 2820 Sycamore Ave, Glendale

Project No. : W1582-06-01

Boring : 1

EMPIRICAL ESTIMATION OF LIQUEFACTION POTENTIAL MAXIMUM CONSIDERED EARTHQUAKE

NCEER (1996) METHOD

EARTHQUAKE INFORMATION:

Earthquake Magnitude:	7.05
Peak Horiz. Acceleration PGA_M (g):	0.932
Calculated Mag.Wtg.Factor:	0.858
Historic High Groundwater:	30.0
Groundwater Depth During Exploration:	100.0

By Thomas F. Blake (1994-1996)

ENERGY & ROD CORRECTIONS:

Energy Correction (CE) for N60:	1.25
Rod Len.Corr.(CR)(0-no or 1-yes):	1.0
Bore Dia. Corr. (CB):	1.00
Sampler Corr. (CS):	1.20
Use Ksigma (0 or 1):	1.0

LIQUEFACTION CALCULATIONS:

Unit Wt. Water (pcf):		62.4												
Depth to Base (ft)	Total Unit Wt. (pcf)	Water (0 or 1)	FIELD SPT (N)	Depth of SPT (ft)	Liq.Sus. (0 or 1)	-200 (%)	Est. Dr (%)	CN Factor	Corrected (N1)60	Eff. Unit Wt. (psf)	Resist. CRR	rd Factor	Induced CSR	Liquefac. Safe.Fact.
1.0	113.7	0	7.0	2.5	1		62	1.700	13.4	113.7	0.146	0.998	0.518	--
2.0	113.7	0	7.0	2.5	1		62	1.700	13.4	113.7	0.146	0.993	0.516	--
3.5	113.7	0	7.0	2.5	1		62	1.700	13.4	113.7	0.146	0.987	0.513	--
4.0	122.0	0	5.0	5.0	1	15	49	1.700	12.0	122.0	0.131	0.983	0.511	--
5.0	122.0	0	5.0	5.0	1	15	49	1.700	12.0	122.0	0.131	0.979	0.509	--
6.0	122.0	0	5.0	5.0	1	15	49	1.700	12.0	122.0	0.131	0.975	0.507	--
7.0	122.0	0	5.0	5.0	1	15	49	1.648	11.7	122.0	0.128	0.970	0.504	--
8.0	122.0	0	5.0	5.0	1	15	49	1.531	11.0	122.0	0.120	0.966	0.502	--
9.0	122.0	0	5.0	5.0	1	15	49	1.436	10.5	122.0	0.115	0.961	0.499	--
10.0	122.0	0	9.0	10.0	1	15	59	1.357	16.0	122.0	0.174	0.957	0.497	--
11.0	122.0	0	9.0	10.0	1	15	59	1.289	15.3	122.0	0.167	0.952	0.495	--
12.0	109.0	0	12.0	12.5	1		66	1.234	16.7	109.0	0.181	0.947	0.492	--
13.5	109.0	0	12.0	12.5	1		66	1.177	15.9	109.0	0.173	0.942	0.489	--
14.0	109.0	0	7.0	15.0	1	21	48	1.156	13.5	109.0	0.148	0.937	0.487	--
15.0	109.0	0	7.0	15.0	1	21	48	1.109	13.1	109.0	0.143	0.934	0.485	--
16.0	109.0	0	7.0	15.0	1	21	48	1.075	12.8	109.0	0.140	0.929	0.483	--
17.5	109.0	0	7.0	15.0	1	21	48	1.036	12.5	109.0	0.137	0.923	0.480	--
18.0	122.4	0	25.0	20.0	1	8	84	1.021	34.9	122.4	Infin.	0.919	0.477	--
19.0	122.4	0	25.0	20.0	1	8	84	0.984	33.7	122.4	Infin.	0.915	0.476	--
20.0	122.4	0	25.0	20.0	1	8	84	0.957	32.8	122.4	Infin.	0.911	0.473	--
21.0	122.4	0	25.0	20.0	1	8	84	0.933	32.0	122.4	Infin.	0.906	0.471	--
22.0	117.0	0	25.0	20.0	1	8	84	0.910	31.2	117.0	Infin.	0.902	0.469	--
23.0	117.0	0	25.0	20.0	1	8	84	0.890	30.5	117.0	Infin.	0.897	0.466	--
24.5	117.0	0	25.0	20.0	1	8	84	0.866	29.7	117.0	0.436	0.891	0.463	--
25.0	117.0	0	15.0	25.0	1	18	61	0.857	21.5	117.0	0.226	0.887	0.461	--
26.0	117.0	0	15.0	25.0	1	18	61	0.836	21.0	117.0	0.220	0.883	0.459	--
27.0	117.0	0	15.0	25.0	1	18	61	0.820	20.7	117.0	0.217	0.879	0.457	--
28.0	117.7	0	29.0	30.0	1	17	80	0.805	37.7	117.7	Infin.	0.874	0.454	--
29.0	117.7	0	29.0	30.0	1	17	80	0.791	37.1	117.7	Infin.	0.870	0.452	--
30.0	117.7	1	29.0	30.0	1	17	80	0.777	36.5	55.3	Infin.	0.865	0.454	Non-Liq.
31.0	117.7	1	29.0	30.0	1	17	80	0.764	36.0	55.3	Infin.	0.861	0.459	Non-Liq.
32.0	120.0	1	50.0	34.0	1	13	103	0.752	58.3	57.6	Infin.	0.856	0.464	Non-Liq.
33.0	120.0	1	50.0	34.0	1	13	103	0.740	57.5	57.6	Infin.	0.851	0.469	Non-Liq.
34.0	120.0	1	50.0	34.0	1	13	103	0.729	56.6	57.6	Infin.	0.847	0.474	Non-Liq.
35.0	120.0	1	50.0	34.0	1	13	103	0.718	55.8	57.6	Infin.	0.842	0.478	Non-Liq.
36.0	122.6	1	50.0	34.0	1	13	103	0.707	55.0	60.2	Infin.	0.838	0.482	Non-Liq.
37.0	122.6	1	50.0	34.0	1	13	103	0.697	54.2	60.2	Infin.	0.833	0.486	Non-Liq.
38.0	122.6	1	50.0	34.0	1	13	103	0.687	53.5	60.2	Infin.	0.829	0.489	Non-Liq.
39.0	122.6	1	50.0	39.0	1	20	101	0.678	54.4	60.2	Infin.	0.824	0.492	Non-Liq.
40.0	122.6	1	50.0	39.0	1	20	101	0.669	53.8	60.2	Infin.	0.819	0.495	Non-Liq.
41.0	122.6	1	50.0	39.0	1	20	101	0.660	53.1	60.2	Infin.	0.815	0.498	Non-Liq.
42.0	122.6	1	50.0	39.0	1	20	101	0.652	52.5	60.2	Infin.	0.810	0.500	Non-Liq.
43.0	122.6	1	50.0	39.0	1	20	101	0.644	51.9	60.2	Infin.	0.806	0.503	Non-Liq.
44.0	122.6	1	50.0	39.0	1	20	101	0.636	51.3	60.2	Infin.	0.801	0.505	Non-Liq.
45.0	122.6	1	50.0	39.0	1	20	101	0.629	50.8	60.2	Infin.	0.797	0.507	Non-Liq.
46.0	122.6	1	50.0	39.0	1	20	101	0.622	50.2	60.2	Infin.	0.792	0.508	Non-Liq.
47.0	122.6	1	50.0	39.0	1	20	101	0.615	49.7	60.2	Infin.	0.787	0.510	Non-Liq.
48.0	122.6	1	50.0	39.0	1	20	101	0.608	49.2	60.2	Infin.	0.783	0.511	Non-Liq.
49.0	122.6	1	50.0	39.0	1	20	101	0.602	48.7	60.2	Infin.	0.778	0.512	Non-Liq.
50.0	122.6	1	50.0	39.0	1	20	101	0.595	48.2	60.2	Infin.	0.774	0.513	Non-Liq.

Figure 9



Project Name : 2820 Sycamore Ave, Glendale
Project No. : W1582-06-01
Boring : 1

LIQUEFACTION SETTLEMENT ANALYSIS MAXIMUM CONSIDERED EARTHQUAKE

(SATURATED SAND AT INITIAL LIQUEFACTION CONDITION)

NCEER (1996) METHOD
EARTHQUAKE INFORMATION:

Earthquake Magnitude:	7.05
PGA _M (g):	0.932
Calculated Mag.Wtg.Factor:	0.858
Historic High Groundwater:	30.0
Groundwater @ Exploration:	100.0

DEPTH TO BASE	BLOW COUNT N	WET DENSITY (PCF)	TOTAL STRESS O (TSF)	EFFECT STRESS O' (TSF)	REL. DEN. Dr (%)	ADJUST BLOWS (N1)60		LIQUEFACTION SAFETY FACTOR	Volumetric Strain [e ₁₅] (%)	EQ. SETTLE. Pe (in.)
							Tav/σ' _o			
1.0	7	113.7	0.028	0.028	62	13	0.606	--	0.00	0.00
2.0	7	113.7	0.085	0.085	62	13	0.606	--	0.00	0.00
3.5	7	113.7	0.156	0.156	62	13	0.606	--	0.00	0.00
4.0	5	122.0	0.186	0.186	49	12	0.606	--	0.00	0.00
5.0	5	122.0	0.262	0.262	49	12	0.606	--	0.00	0.00
6.0	5	122.0	0.323	0.323	49	12	0.606	--	0.00	0.00
7.0	5	122.0	0.384	0.384	49	12	0.606	--	0.00	0.00
8.0	5	122.0	0.445	0.445	49	11	0.606	--	0.00	0.00
9.0	5	122.0	0.506	0.506	49	10	0.606	--	0.00	0.00
10.0	9	122.0	0.567	0.567	59	16	0.606	--	0.00	0.00
11.0	9	122.0	0.628	0.628	59	15	0.606	--	0.00	0.00
12.0	12	109.0	0.686	0.686	66	17	0.606	--	0.00	0.00
13.5	12	109.0	0.754	0.754	66	16	0.606	--	0.00	0.00
14.0	7	109.0	0.781	0.781	48	14	0.606	--	0.00	0.00
15.0	7	109.0	0.850	0.850	48	13	0.606	--	0.00	0.00
16.0	7	109.0	0.904	0.904	48	13	0.606	--	0.00	0.00
17.5	7	109.0	0.972	0.972	48	13	0.606	--	0.00	0.00
18.0	25	122.4	1.001	1.001	84	35	0.606	--	0.00	0.00
19.0	25	122.4	1.078	1.078	84	34	0.606	--	0.00	0.00
20.0	25	122.4	1.139	1.139	84	33	0.606	--	0.00	0.00
21.0	25	122.4	1.200	1.200	84	32	0.606	--	0.00	0.00
22.0	25	117.0	1.260	1.260	84	31	0.606	--	0.00	0.00
23.0	25	117.0	1.318	1.318	84	31	0.606	--	0.00	0.00
24.5	25	117.0	1.391	1.391	84	30	0.606	--	0.00	0.00
25.0	15	117.0	1.421	1.421	61	21	0.606	--	0.00	0.00
26.0	15	117.0	1.494	1.494	61	21	0.606	--	0.00	0.00
27.0	15	117.0	1.552	1.552	61	21	0.606	--	0.00	0.00
28.0	29	117.7	1.611	1.611	80	38	0.606	--	0.00	0.00
29.0	29	117.7	1.670	1.670	80	37	0.606	--	0.00	0.00
30.0	29	117.7	1.729	1.713	80	37	0.611	Non-Liq.	0.00	0.00
31.0	29	117.7	1.788	1.741	80	36	0.622	Non-Liq.	0.00	0.00
32.0	50	120.0	1.847	1.769	103	58	0.633	Non-Liq.	0.00	0.00
33.0	50	120.0	1.907	1.798	103	57	0.643	Non-Liq.	0.00	0.00
34.0	50	120.0	1.967	1.827	103	57	0.652	Non-Liq.	0.00	0.00
35.0	50	120.0	2.027	1.855	103	56	0.662	Non-Liq.	0.00	0.00
36.0	50	122.6	2.088	1.885	103	55	0.671	Non-Liq.	0.00	0.00
37.0	50	122.6	2.149	1.915	103	54	0.680	Non-Liq.	0.00	0.00
38.0	50	122.6	2.210	1.945	103	54	0.688	Non-Liq.	0.00	0.00
39.0	50	122.6	2.272	1.975	101	54	0.697	Non-Liq.	0.00	0.00
40.0	50	122.6	2.333	2.005	101	54	0.705	Non-Liq.	0.00	0.00
41.0	50	122.6	2.394	2.035	101	53	0.713	Non-Liq.	0.00	0.00
42.0	50	122.6	2.455	2.065	101	52	0.720	Non-Liq.	0.00	0.00
43.0	50	122.6	2.517	2.095	101	52	0.728	Non-Liq.	0.00	0.00
44.0	50	122.6	2.578	2.126	101	51	0.735	Non-Liq.	0.00	0.00
45.0	50	122.6	2.639	2.156	101	51	0.742	Non-Liq.	0.00	0.00
46.0	50	122.6	2.701	2.186	101	50	0.748	Non-Liq.	0.00	0.00
47.0	50	122.6	2.762	2.216	101	50	0.755	Non-Liq.	0.00	0.00
48.0	50	122.6	2.823	2.246	101	49	0.761	Non-Liq.	0.00	0.00
49.0	50	122.6	2.884	2.276	101	49	0.768	Non-Liq.	0.00	0.00
50.0	50	122.6	2.946	2.306	101	48	0.774	Non-Liq.	0.00	0.00
TOTAL SETTLEMENT =									0.0 INCHES	

Figure 10



Project Name : 2820 Sycamore Ave, Glendale

Project No. : W1582-06-01

Boring : 4

EMPIRICAL ESTIMATION OF LIQUEFACTION POTENTIAL MAXIMUM CONSIDERED EARTHQUAKE

NCEER (1996) METHOD

EARTHQUAKE INFORMATION:

Earthquake Magnitude:	7.05
Peak Horiz. Acceleration PGA_M (g):	0.932
Calculated Mag.Wtg.Factor:	0.858
Historic High Groundwater:	30.0
Groundwater Depth During Exploration:	100.0

By Thomas F. Blake (1994-1996)

ENERGY & ROD CORRECTIONS:

Energy Correction (CE) for N60:	1.25
Rod Len.Corr.(CR)(0-no or 1-yes):	1.0
Bore Dia. Corr. (CB):	1.00
Sampler Corr. (CS):	1.20
Use Ksigma (0 or 1):	1.0

LIQUEFACTION CALCULATIONS:

Unit Wt. Water (pcf):		62.4												
Depth to Base (ft)	Total Unit Wt. (pcf)	Water (0 or 1)	FIELD SPT (N)	Depth of SPT (ft)	Liq.Sus. (0 or 1)	-200 (%)	Est. Dr (%)	CN Factor	Corrected (N1)60	Eff. Unit Wt. (psf)	Resist. CRR	rd Factor	Induced CSR	Liquefac. Safe.Fact.
1.0	110.4	0	20.0	2.5	1		103	1.700	38.3	110.4	Infin.	0.998	0.518	--
2.0	110.4	0	20.0	2.5	1		103	1.700	38.3	110.4	Infin.	0.993	0.516	--
3.0	110.4	0	20.0	2.5	1		103	1.700	38.3	110.4	Infin.	0.989	0.514	--
4.5	110.4	0	20.0	2.5	1		103	1.700	38.3	110.4	Infin.	0.983	0.511	--
5.0	115.3	0	21.0	5.0	1	5	101	1.700	40.2	115.3	Infin.	0.978	0.508	--
6.0	115.3	0	21.0	5.0	1	5	101	1.700	40.2	115.3	Infin.	0.975	0.507	--
7.0	115.3	0	21.0	5.0	1	5	101	1.691	40.0	115.3	Infin.	0.970	0.504	--
8.0	115.3	0	24.0	10.0	1	5	97	1.572	42.5	115.3	Infin.	0.966	0.502	--
9.0	115.3	0	24.0	10.0	1	5	97	1.474	39.9	115.3	Infin.	0.961	0.499	--
10.0	115.3	0	24.0	10.0	1	5	97	1.393	37.6	115.3	Infin.	0.957	0.497	--
11.0	115.3	0	24.0	10.0	1	5	97	1.324	35.7	115.3	Infin.	0.952	0.495	--
12.0	82.9	0	24.0	10.0	1	5	97	1.272	34.3	82.9	Infin.	0.947	0.492	--
13.0	82.9	0	24.0	10.0	1	5	97	1.233	33.3	82.9	Infin.	0.943	0.490	--
14.0	82.9	0	24.0	10.0	1	5	97	1.197	32.3	82.9	Infin.	0.938	0.488	--
15.0	129.3	0	10.0	15.0	1	11	58	1.156	15.4	129.3	0.167	0.934	0.485	--
16.0	129.3	0	10.0	15.0	1	11	58	1.111	14.8	129.3	0.162	0.929	0.483	--
17.0	129.3	0	55.0	20.0	1	11	126	1.071	80.4	129.3	Infin.	0.925	0.480	--
18.0	129.3	0	55.0	20.0	1	11	126	1.035	77.8	129.3	Infin.	0.920	0.478	--
19.0	129.3	0	55.0	20.0	1	11	126	1.002	75.4	129.3	Infin.	0.915	0.476	--
20.0	129.3	0	55.0	20.0	1	8	126	0.972	72.5	129.3	Infin.	0.911	0.473	--
21.0	129.3	0	55.0	20.0	1	8	126	0.945	70.5	129.3	Infin.	0.906	0.471	--
22.0	129.9	0	17.6	22.5	1		68	0.920	22.5	129.9	0.242	0.902	0.469	--
23.0	129.9	0	17.6	22.5	1		68	0.897	22.0	129.9	0.235	0.897	0.466	--
24.0	129.9	0	17.6	22.5	1		68	0.875	21.4	129.9	0.228	0.893	0.464	--
25.0	143.6	0	17.0	25.0	1	18	65	0.854	23.7	143.6	0.254	0.888	0.461	--
26.0	143.6	0	17.0	25.0	1	18	65	0.833	23.2	143.6	0.247	0.883	0.459	--
27.0	143.6	0	28.0	30.0	1	18	78	0.814	37.1	143.6	Infin.	0.879	0.457	--
28.0	143.6	0	28.0	30.0	1	18	78	0.796	36.3	143.6	Infin.	0.874	0.454	--
29.0	143.6	0	28.0	30.0	1	18	78	0.779	35.6	143.6	Infin.	0.870	0.452	--
30.0	143.6	1	28.0	30.0	1	16	78	0.763	34.6	81.2	Infin.	0.865	0.453	Non-Liq.
31.0	143.6	1	28.0	30.0	1	16	78	0.749	33.9	81.2	Infin.	0.861	0.459	Non-Liq.
32.0	130.4	1	28.0	30.0	1	16	78	0.735	33.4	68.0	Infin.	0.856	0.463	Non-Liq.
33.0	130.4	1	28.0	30.0	1	16	78	0.723	32.9	68.0	Infin.	0.851	0.468	Non-Liq.
34.0	130.4	1	28.0	30.0	1	16	78	0.712	32.4	68.0	Infin.	0.847	0.472	Non-Liq.
35.0	130.4	1	26.0	35.0	1	6	73	0.701	27.7	68.0	0.308	0.842	0.476	0.65
36.0	130.4	1	26.0	35.0	1	6	73	0.690	27.2	68.0	0.298	0.838	0.480	0.62
37.0	124.6	1	26.0	35.0	1	6	73	0.680	26.9	62.2	0.290	0.833	0.483	0.60
38.0	124.6	1	50.0	38.5	1	29	99	0.671	56.0	62.2	Infin.	0.829	0.486	Non-Liq.
39.0	124.6	1	50.0	38.5	1	29	99	0.662	55.3	62.2	Infin.	0.824	0.489	Non-Liq.
40.0	124.6	1	50.0	38.5	1	29	99	0.654	54.7	62.2	Infin.	0.819	0.492	Non-Liq.
41.0	124.6	1	50.0	38.5	1	29	99	0.646	54.1	62.2	Infin.	0.815	0.494	Non-Liq.
42.0	124.6	1	50.0	38.5	1	29	99	0.638	53.5	62.2	Infin.	0.810	0.496	Non-Liq.
43.0	124.6	1	50.0	38.5	1	29	99	0.630	52.9	62.2	Infin.	0.806	0.498	Non-Liq.
44.0	124.6	1	50.0	38.5	1	29	99	0.623	52.4	62.2	Infin.	0.801	0.500	Non-Liq.
45.0	124.6	1	50.0	38.5	1	29	99	0.616	51.8	62.2	Infin.	0.797	0.502	Non-Liq.
46.0	124.6	1	50.0	38.5	1	29	99	0.609	51.3	62.2	Infin.	0.792	0.504	Non-Liq.
47.0	124.6	1	50.0	38.5	1	29	99	0.602	50.8	62.2	Infin.	0.787	0.505	Non-Liq.
48.0	124.6	1	50.0	38.5	1	29	99	0.596	50.4	62.2	Infin.	0.783	0.506	Non-Liq.
49.0	124.6	1	50.0	38.5	1	29	99	0.590	49.9	62.2	Infin.	0.778	0.507	Non-Liq.
50.0	124.6	1	50.0	38.5	1	29	99	0.584	49.4	62.2	Infin.	0.774	0.508	Non-Liq.



Project Name : 2820 Sycamore Ave, Glendale
Project No. : W1582-06-01
Boring : 4

LIQUEFACTION SETTLEMENT ANALYSIS MAXIMUM CONSIDERED EARTHQUAKE

(SATURATED SAND AT INITIAL LIQUEFACTION CONDITION)

NCEER (1996) METHOD
EARTHQUAKE INFORMATION:

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Calculated Mag.Wtg.Factor:	0.858
Historic High Groundwater:	30.0
Groundwater @ Exploration:	100.0

DEPTH TO BASE	BLOW COUNT N	WET DENSITY (PCF)	TOTAL STRESS O (TSF)	EFFECT STRESS O' (TSF)	REL. DEN. Dr (%)	ADJUST BLOWS (N1)60		LIQUEFACTION SAFETY FACTOR	Volumetric Strain [e ₁₅] (%)	EQ. SETTLE. Pe (in.)
							Tav/σ' _o			
1.0	20	110.4	0.028	0.028	103	38	0.606	--	0.00	0.00
2.0	20	110.4	0.083	0.083	103	38	0.606	--	0.00	0.00
3.0	20	110.4	0.138	0.138	103	38	0.606	--	0.00	0.00
4.5	20	110.4	0.207	0.207	103	38	0.606	--	0.00	0.00
5.0	21	115.3	0.235	0.235	101	40	0.606	--	0.00	0.00
6.0	21	115.3	0.307	0.307	101	40	0.606	--	0.00	0.00
7.0	21	115.3	0.365	0.365	101	40	0.606	--	0.00	0.00
8.0	24	115.3	0.423	0.423	97	42	0.606	--	0.00	0.00
9.0	24	115.3	0.480	0.480	97	40	0.606	--	0.00	0.00
10.0	24	115.3	0.538	0.538	97	38	0.606	--	0.00	0.00
11.0	24	115.3	0.596	0.596	97	36	0.606	--	0.00	0.00
12.0	24	82.9	0.645	0.645	97	34	0.606	--	0.00	0.00
13.0	24	82.9	0.687	0.687	97	33	0.606	--	0.00	0.00
14.0	24	82.9	0.728	0.728	97	32	0.606	--	0.00	0.00
15.0	10	129.3	0.781	0.781	58	15	0.606	--	0.00	0.00
16.0	10	129.3	0.846	0.846	58	15	0.606	--	0.00	0.00
17.0	55	129.3	0.910	0.910	126	80	0.606	--	0.00	0.00
18.0	55	129.3	0.975	0.975	126	78	0.606	--	0.00	0.00
19.0	55	129.3	1.040	1.040	126	75	0.606	--	0.00	0.00
20.0	55	129.3	1.104	1.104	126	73	0.606	--	0.00	0.00
21.0	55	129.3	1.169	1.169	126	70	0.606	--	0.00	0.00
22.0	17.6	129.9	1.234	1.234	68	23	0.606	--	0.00	0.00
23.0	17.6	129.9	1.299	1.299	68	22	0.606	--	0.00	0.00
24.0	17.6	129.9	1.364	1.364	68	21	0.606	--	0.00	0.00
25.0	17	143.6	1.432	1.432	65	24	0.606	--	0.00	0.00
26.0	17	143.6	1.504	1.504	65	23	0.606	--	0.00	0.00
27.0	28	143.6	1.576	1.576	78	37	0.606	--	0.00	0.00
28.0	28	143.6	1.648	1.648	78	36	0.606	--	0.00	0.00
29.0	28	143.6	1.719	1.719	78	36	0.606	--	0.00	0.00
30.0	28	143.6	1.791	1.776	78	35	0.611	Non-Liq.	0.00	0.00
31.0	28	143.6	1.863	1.816	78	34	0.621	Non-Liq.	0.00	0.00
32.0	28	130.4	1.931	1.853	78	33	0.631	Non-Liq.	0.00	0.00
33.0	28	130.4	1.997	1.887	78	33	0.641	Non-Liq.	0.00	0.00
34.0	28	130.4	2.062	1.921	78	32	0.650	Non-Liq.	0.00	0.00
35.0	26	130.4	2.127	1.955	73	28	0.659	0.65	0.75	0.09
36.0	26	130.4	2.192	1.989	73	27	0.668	0.62	1.10	0.13
37.0	26	124.6	2.256	2.022	73	27	0.676	0.60	1.10	0.13
38.0	50	124.6	2.318	2.053	99	56	0.684	Non-Liq.	0.00	0.00
39.0	50	124.6	2.380	2.084	99	55	0.692	Non-Liq.	0.00	0.00
40.0	50	124.6	2.443	2.115	99	55	0.700	Non-Liq.	0.00	0.00
41.0	50	124.6	2.505	2.146	99	54	0.707	Non-Liq.	0.00	0.00
42.0	50	124.6	2.567	2.177	99	53	0.714	Non-Liq.	0.00	0.00
43.0	50	124.6	2.630	2.209	99	53	0.721	Non-Liq.	0.00	0.00
44.0	50	124.6	2.692	2.240	99	52	0.728	Non-Liq.	0.00	0.00
45.0	50	124.6	2.754	2.271	99	52	0.735	Non-Liq.	0.00	0.00
46.0	50	124.6	2.817	2.302	99	51	0.741	Non-Liq.	0.00	0.00
47.0	50	124.6	2.879	2.333	99	51	0.748	Non-Liq.	0.00	0.00
48.0	50	124.6	2.941	2.364	99	50	0.754	Non-Liq.	0.00	0.00
49.0	50	124.6	3.004	2.395	99	50	0.760	Non-Liq.	0.00	0.00
50.0	50	124.6	3.066	2.426	99	49	0.765	Non-Liq.	0.00	0.00
TOTAL SETTLEMENT =									0.4 INCHES	

Figure 12



TECHNICAL ENGINEERING AND DESIGN GUIDES AS ADAPTED FROM THE US ARMY CORPS OF ENGINEERS, NO. 9
EVALUATION OF EARTHQUAKE-INDUCED SETTLEMENTS IN DRY SANDY SOILS
DESIGN EARTHQUAKE

DE EARTHQUAKE INFORMATION:

Earthquake Magnitude:	6.91
Peak Horiz. Acceleration (g):	0.622

Fig 4.1 Fig 4.2

Fig 4.4

Depth of Base of Strata (ft)	Thickness of Layer (ft)	Depth of Mid-point of Layer (ft)	Soil Unit Weight (pcf)	Overburden Pressure at Mid-point (tsf)	Mean Effective Pressure at Mid-point (tsf)	Average Cyclic Shear Stress [Tav]	Field SPT [N]	Correction Factor [C _{er}]	Relative Density [D _r] (%)	Correction Factor [C _n]	Corrected [N1] ₆₀	rd Factor	Maximum Shear Mod. [G _{max}] (tsf)	[y _{eff}]*[G _{eff}] [G _{max}]	y _{eff} Shear Strain	[y _{eff}]*100%	Volumetric Strain M7.5 [E15] (%)	Number of Strain Cycles [N _c]	Corrected Vol. Strains [E _c]	Estimated Settlement [S] (inches)
1.0	1.0	0.5	113.7	0.03	0.02	0.011	7	1.25	62.4	1.7	13.4	1.0	146.504	7.77E-05	1.40E-04	0.014	2.27E-02	10.1542	1.90E-02	0.00
2.0	1.0	1.5	113.7	0.09	0.06	0.034	7	1.25	62.4	1.7	13.4	1.0	253.753	1.32E-04	2.30E-04	0.023	3.72E-02	10.1542	3.12E-02	0.00
3.5	1.5	2.8	113.7	0.16	0.10	0.063	7	1.25	62.4	1.7	13.4	1.0	343.583	1.74E-04	1.70E-04	0.017	2.75E-02	10.1542	2.31E-02	0.00
4.0	0.5	3.8	122.0	0.21	0.14	0.086	5	1.25	48.9	1.7	12.0	1.0	387.420	2.08E-04	8.10E-04	0.081	1.50E-01	10.1542	1.26E-01	0.00
5.0	1.0	4.5	122.0	0.26	0.17	0.105	5	1.25	48.9	1.7	12.0	1.0	426.786	2.25E-04	8.10E-04	0.081	1.50E-01	10.1542	1.26E-01	0.00
6.0	1.0	5.5	122.0	0.32	0.22	0.129	5	1.25	48.9	1.7	12.0	1.0	474.217	2.46E-04	4.50E-04	0.045	8.34E-02	10.1542	6.99E-02	0.02
7.0	1.0	6.5	122.0	0.38	0.26	0.154	5	1.25	48.9	1.6	11.7	1.0	513.105	2.65E-04	4.50E-04	0.045	8.58E-02	10.1542	7.20E-02	0.02
8.0	1.0	7.5	122.0	0.44	0.30	0.178	5	1.25	48.9	1.5	11.0	1.0	541.963	2.86E-04	4.50E-04	0.045	9.20E-02	10.1542	7.72E-02	0.02
9.0	1.0	8.5	122.0	0.50	0.34	0.202	5	1.25	48.9	1.4	10.5	1.0	568.546	3.04E-04	1.00E-03	0.100	2.17E-01	10.1542	1.82E-01	0.04
10.0	1.0	9.5	122.0	0.57	0.38	0.226	9	1.25	58.9	1.4	16.0	1.0	692.776	2.75E-04	4.50E-04	0.045	5.89E-02	10.1542	4.94E-02	0.01
11.0	1.0	10.5	122.0	0.63	0.42	0.250	9	1.25	58.9	1.3	15.3	1.0	718.656	2.88E-04	4.50E-04	0.045	6.21E-02	10.1542	5.21E-02	0.01
12.0	1.0	11.5	109.0	0.68	0.46	0.273	12	1.25	65.6	1.2	16.7	0.9	772.734	2.88E-04	4.50E-04	0.045	5.61E-02	10.1542	4.70E-02	0.01
13.5	1.5	12.8	109.0	0.75	0.50	0.299	12	1.25	65.6	1.2	15.9	0.9	797.618	3.00E-04	3.70E-04	0.037	4.88E-02	10.1542	4.09E-02	0.01
14.0	0.5	13.8	109.0	0.81	0.54	0.320	7	1.25	47.8	1.2	13.5	0.9	782.856	3.22E-04	7.10E-04	0.071	1.14E-01	10.1542	9.53E-02	0.01
15.0	1.0	14.5	109.0	0.85	0.57	0.335	7	1.25	47.8	1.1	13.1	0.9	794.440	3.29E-04	7.10E-04	0.071	1.18E-01	10.1542	9.88E-02	0.02
16.0	1.0	15.5	109.0	0.90	0.60	0.356	7	1.25	47.8	1.1	12.8	0.9	813.559	3.36E-04	7.10E-04	0.071	1.21E-01	10.1542	1.01E-01	0.02
17.5	1.5	16.8	109.0	0.97	0.65	0.381	7	1.25	47.8	1.0	12.5	0.9	836.548	3.44E-04	7.10E-04	0.071	1.25E-01	10.1542	1.05E-01	0.04
18.0	0.5	17.8	122.4	1.03	0.69	0.402	25	1.25	84.0	1.0	34.9	0.9	1211.587	2.47E-04	3.70E-04	0.037	1.90E-02	10.1542	1.59E-02	0.00
19.0	1.0	18.5	122.4	1.07	0.72	0.419	25	1.25	84.0	1.0	33.7	0.9	1223.564	2.52E-04	3.70E-04	0.037	1.98E-02	10.1542	1.66E-02	0.00
20.0	1.0	19.5	122.4	1.13	0.76	0.441	25	1.25	84.0	1.0	32.8	0.9	1246.696	2.57E-04	3.70E-04	0.037	2.04E-02	10.1542	1.72E-02	0.00
21.0	1.0	20.5	122.4	1.19	0.80	0.463	25	1.25	84.0	0.9	32.0	0.9	1269.018	2.62E-04	3.70E-04	0.037	2.11E-02	10.1542	1.77E-02	0.00
22.0	1.0	21.5	117.0	1.25	0.84	0.484	25	1.25	84.0	0.9	31.2	0.9	1290.131	2.66E-04	3.70E-04	0.037	2.17E-02	10.1542	1.82E-02	0.00
23.0	1.0	22.5	117.0	1.31	0.88	0.505	25	1.25	84.0	0.9	30.5	0.9	1310.137	2.70E-04	3.70E-04	0.037	2.23E-02	10.1542	1.87E-02	0.00
24.5	1.5	23.8	117.0	1.39	0.93	0.530	25	1.25	84.0	0.9	29.7	0.9	1334.335	2.74E-04	3.70E-04	0.037	2.30E-02	10.1542	1.93E-02	0.01
25.0	0.5	24.8	117.0	1.44	0.97	0.550	15	1.25	61.2	0.9	21.5	0.9	1222.463	3.07E-04	7.10E-04	0.071	6.52E-02	10.1542	5.47E-02	0.01
26.0	1.0	25.5	117.0	1.49	1.00	0.565	15	1.25	61.2	0.8	21.0	0.9	1232.035	3.10E-04	7.10E-04	0.071	6.69E-02	10.1542	5.61E-02	0.01
27.0	1.0	26.5	117.0	1.55	1.04	0.584	15	1.25	61.2	0.8	20.7	0.9	1249.171	3.13E-04	5.20E-04	0.052	4.99E-02	10.1542	4.19E-02	0.01
28.0	1.0	27.5	117.7	1.61	1.08	0.603	29	1.25	80.4	0.8	37.7	0.9	1555.226	2.57E-04	3.00E-04	0.030	1.40E-02	10.1542	1.17E-02	0.00
29.0	1.0	28.5	117.7	1.66	1.12	0.622	29	1.25	80.4	0.8	37.1	0.9	1574.721	2.59E-04	3.00E-04	0.030	1.43E-02	10.1542	1.20E-02	0.00
30.0	1.0	29.5	117.7	1.72	1.15	0.641	29	1.25	80.4	0.8	36.5	0.9	1593.780	2.61E-04	3.00E-04	0.030	1.46E-02	10.1542	1.22E-02	0.00
31.0	1.0	30.5	117.7	1.78	1.19	0.659	29	1.25	80.4	0.8	36.0	0.9	1612.427	2.62E-04	3.00E-04	0.030	1.48E-02	10.1542	1.24E-02	0.00
32.0	1.0	31.5	120.0	1.84	1.23	0.677	50	1.25	103.4	0.8	58.3	0.9	1925.815	2.23E-04	3.00E-04	0.030	8.30E-03	10.1542	6.96E-03	0.00
33.0	1.0	32.5	120.0	1.90	1.27	0.695	50	1.25	103.4	0.7	57.5	0.9	1946.889	2.25E-04	3.00E-04	0.030	8.46E-03	10.1542	7.09E-03	0.00
34.0	1.0	33.5	120.0	1.96	1.31	0.713	50	1.25	103.4	0.7	56.6	0.8	1967.532	2.26E-04	3.00E-04	0.030	8.61E-03	10.1542	7.22E-03	0.00
35.0	1.0	34.5	120.0	2.02	1.35	0.730	50	1.25	103.4	0.7	55.8	0.8	1987.766	2.27E-04	3.00E-04	0.030	8.76E-03	10.1542	7.35E-03	0.00
36.0	1.0	35.5	122.6	2.08	1.40	0.747	50	1.25	103.4	0.7	55.0	0.8	2007.822	2.28E-04	3.00E-04	0.030	8.91E-03	10.1542	7.48E-03	0.00
37.0	1.0	36.5	122.6	2.14	1.44	0.764	50	1.25	103.4	0.7	54.2	0.8	2027.706	2.29E-04	3.00E-04	0.030	9.06E-03	10.1542	7.60E-03	0.00
38.0	1.0	37.5	122.6	2.20	1.48	0.781	50	1.25	103.4	0.7	53.5	0.8	2047.222	2.30E-04	3.00E-04	0.030	9.21E-03	10.1542	7.73E-03	0.00
39.0	1.0	38.5	122.6	2.27	1.52	0.797	50	1.25	100.8	0.7	54.4	0.8	2087.476	2.29E-04	3.00E-04	0.030	9.02E-03	10.1542	7.57E-03	0.00
40.0	1.0	39.5	122.6	2.33	1.56	0.814	50	1.25	100.8	0.7	53.8	0.8	2106.770	2.29E-04	3.00E-04	0.030	9.16E-03	10.1542	7.68E-03	0.00
41.0	1.0	40.5	122.6	2.39	1.60	0.829	50	1.25	100.8	0.7	53.1	0.8	2125.740	2.30E-04	3.00E-04	0.030	9.29E-03	10.1542	7.79E-03	0.00
42.0	1.0	41.5	122.6	2.45	1.64	0.845	50	1.25	100.8	0.7	52.5	0.8	2144.401	2.31E-04	3.00E-04	0.030	9.42E-03	10.1542	7.91E-03	0.00
43.0	1.0	42.5	122.6	2.51	1.68	0.859	50	1.25	100.8	0.6	51.9	0.8	2162.766	2.31E-04	3.00E-04	0.030	9.55E-03	10.1542	8.02E-03	0.00
44.0	1.0	43.5	122.6	2.57	1.72	0.874	50	1.25	100.8	0.6	51.3	0.8	2180.845	2.31E-04	3.00E-04	0.030	9.68E-03			

Figure 13



TECHNICAL ENGINEERING AND DESIGN GUIDES AS ADAPTED FROM THE US ARMY CORPS OF ENGINEERS, NO. 9
EVALUATION OF EARTHQUAKE-INDUCED SETTLEMENTS IN DRY SANDY SOILS
DESIGN EARTHQUAKE

DE EARTHQUAKE INFORMATION:

Earthquake Magnitude:	6.91
Peak Horiz. Acceleration (g):	0.622

Fig 4.1 Fig 4.2

Fig 4.4

Depth of Base of Strata (ft)	Thickness of Layer (ft)	Depth of Mid-point of Layer (ft)	Soil Unit Weight (pcf)	Overburden Pressure at Mid-point (tsf)	Mean Effective Pressure at Mid-point (tsf)	Average Cyclic Shear Stress [Tav]	Field SPT [N]	Correction Factor [Cer]	Relative Density [Dr] (%)	Correction Factor [Cn]	Corrected [N1]60	rd Factor	Maximum Shear Mod. [Gmax] (tsf)	[yeff]*[Geff] [Gmax]	yeff Shear Strain	[yeff]*100%	Volumetric Strain M7.5 [E15] (%)	Number of Strain Cycles [Nc]	Corrected Vol. Strains [Ec]	Estimated Settlement [S] (inches)
1.0	1.0	0.5	110.4	0.03	0.02	0.011	20	1.25	103.0	1.7	38.3	1.0	204.843	5.39E-05	7.80E-05	0.008	3.58E-03	10.1542	3.01E-03	0.00
2.0	1.0	1.5	110.4	0.08	0.06	0.033	20	1.25	103.0	1.7	38.3	1.0	354.798	9.16E-05	1.90E-04	0.019	8.73E-03	10.1542	7.32E-03	0.00
3.0	1.0	2.5	110.4	0.14	0.09	0.056	20	1.25	103.0	1.7	38.3	1.0	458.042	1.16E-04	2.30E-04	0.023	1.06E-02	10.1542	8.86E-03	0.00
4.5	1.5	3.8	110.4	0.21	0.14	0.084	20	1.25	103.0	1.7	38.3	1.0	560.985	1.39E-04	1.70E-04	0.017	7.81E-03	10.1542	6.55E-03	0.00
5.0	0.5	4.8	115.3	0.26	0.18	0.106	21	1.25	101.3	1.7	40.2	1.0	642.711	1.51E-04	1.70E-04	0.017	7.35E-03	10.1542	6.17E-03	0.00
6.0	1.0	5.5	115.3	0.31	0.21	0.123	21	1.25	101.3	1.7	40.2	1.0	693.553	1.60E-04	1.50E-04	0.015	6.49E-03	10.1542	5.44E-03	0.00
7.0	1.0	6.5	115.3	0.36	0.24	0.146	21	1.25	101.3	1.7	40.0	1.0	754.739	1.72E-04	1.50E-04	0.015	6.53E-03	10.1542	5.48E-03	0.00
8.0	1.0	7.5	115.3	0.42	0.28	0.169	24	1.25	97.1	1.6	42.5	1.0	828.793	1.78E-04	1.50E-04	0.015	6.07E-03	10.1542	5.10E-03	0.00
9.0	1.0	8.5	115.3	0.48	0.32	0.192	24	1.25	97.1	1.5	39.9	1.0	865.052	1.90E-04	1.50E-04	0.015	6.56E-03	10.1542	5.50E-03	0.00
10.0	1.0	9.5	115.3	0.54	0.36	0.215	24	1.25	97.1	1.4	37.6	1.0	898.135	2.01E-04	4.50E-04	0.045	2.11E-02	10.1542	1.77E-02	0.00
11.0	1.0	10.5	115.3	0.59	0.40	0.238	24	1.25	97.1	1.3	35.7	1.0	929.238	2.12E-04	4.50E-04	0.045	2.24E-02	10.1542	1.88E-02	0.00
12.0	1.0	11.5	82.9	0.64	0.43	0.257	24	1.25	97.1	1.3	34.3	0.9	954.398	2.19E-04	4.50E-04	0.045	2.35E-02	10.1542	1.97E-02	0.00
13.0	1.0	12.5	82.9	0.69	0.46	0.273	24	1.25	97.1	1.2	33.3	0.9	974.471	2.25E-04	4.50E-04	0.045	2.44E-02	10.1542	2.05E-02	0.00
14.0	1.0	13.5	82.9	0.73	0.49	0.288	24	1.25	97.1	1.2	32.3	0.9	993.750	2.29E-04	4.50E-04	0.045	2.53E-02	10.1542	2.12E-02	0.01
15.0	1.0	14.5	129.3	0.78	0.52	0.309	10	1.25	58.2	1.2	15.4	0.9	803.267	2.99E-04	3.70E-04	0.037	5.08E-02	10.1542	4.26E-02	0.01
16.0	1.0	15.5	129.3	0.84	0.57	0.333	10	1.25	58.2	1.1	14.8	0.9	825.897	3.10E-04	7.10E-04	0.071	1.02E-01	10.1542	8.54E-02	0.02
17.0	1.0	16.5	129.3	0.91	0.61	0.358	55	1.25	125.7	1.1	80.4	0.9	1506.072	1.80E-04	1.60E-04	0.016	3.01E-03	10.1542	2.53E-03	0.00
18.0	1.0	17.5	129.3	0.97	0.65	0.382	55	1.25	125.7	1.0	77.8	0.9	1541.294	1.85E-04	1.60E-04	0.016	3.14E-03	10.1542	2.63E-03	0.00
19.0	1.0	18.5	129.3	1.04	0.70	0.406	55	1.25	125.7	1.0	75.4	0.9	1575.004	1.90E-04	1.60E-04	0.016	3.26E-03	10.1542	2.73E-03	0.00
20.0	1.0	19.5	129.3	1.10	0.74	0.429	55	1.25	125.7	1.0	72.5	0.9	1602.558	1.95E-04	1.60E-04	0.016	3.41E-03	10.1542	2.86E-03	0.00
21.0	1.0	20.5	129.3	1.17	0.78	0.453	55	1.25	125.7	0.9	70.5	0.9	1633.452	1.99E-04	1.60E-04	0.016	3.53E-03	10.1542	2.96E-03	0.00
22.0	1.0	21.5	129.9	1.23	0.83	0.476	17.6	1.25	68.0	0.9	22.5	0.9	1147.306	2.94E-04	3.70E-04	0.037	3.21E-02	10.1542	2.69E-02	0.01
23.0	1.0	22.5	129.9	1.30	0.87	0.499	17.6	1.25	68.0	0.9	22.0	0.9	1167.121	2.99E-04	3.70E-04	0.037	3.31E-02	10.1542	2.78E-02	0.01
24.0	1.0	23.5	129.9	1.36	0.91	0.522	17.6	1.25	68.0	0.9	21.4	0.9	1186.286	3.04E-04	7.10E-04	0.071	6.54E-02	10.1542	5.48E-02	0.01
25.0	1.0	24.5	143.6	1.43	0.96	0.545	17	1.25	65.0	0.9	23.7	0.9	1257.503	2.97E-04	3.70E-04	0.037	3.02E-02	10.1542	2.53E-02	0.01
26.0	1.0	25.5	143.6	1.50	1.01	0.570	17	1.25	65.0	0.8	23.2	0.9	1279.492	3.01E-04	5.20E-04	0.052	4.35E-02	10.1542	3.65E-02	0.01
27.0	1.0	26.5	143.6	1.57	1.05	0.594	28	1.25	78.1	0.8	37.1	0.9	1531.313	2.60E-04	3.00E-04	0.030	1.43E-02	10.1542	1.20E-02	0.00
28.0	1.0	27.5	143.6	1.65	1.10	0.618	28	1.25	78.1	0.8	36.3	0.9	1555.165	2.63E-04	3.00E-04	0.030	1.46E-02	10.1542	1.23E-02	0.00
29.0	1.0	28.5	143.6	1.72	1.15	0.642	28	1.25	78.1	0.8	35.6	0.9	1578.363	2.66E-04	3.00E-04	0.030	1.50E-02	10.1542	1.26E-02	0.00
30.0	1.0	29.5	143.6	1.79	1.20	0.665	28	1.25	78.1	0.8	34.6	0.9	1594.521	2.70E-04	3.00E-04	0.030	1.56E-02	10.1542	1.31E-02	0.00
31.0	1.0	30.5	143.6	1.86	1.25	0.688	28	1.25	78.1	0.7	33.9	0.9	1616.337	2.73E-04	3.00E-04	0.030	1.59E-02	10.1542	1.33E-02	0.00
32.0	1.0	31.5	130.4	1.93	1.29	0.710	28	1.25	78.1	0.7	33.4	0.9	1636.654	2.76E-04	3.00E-04	0.030	1.62E-02	10.1542	1.36E-02	0.00
33.0	1.0	32.5	130.4	2.00	1.34	0.729	28	1.25	78.1	0.7	32.9	0.9	1655.567	2.77E-04	3.00E-04	0.030	1.65E-02	10.1542	1.39E-02	0.00
34.0	1.0	33.5	130.4	2.06	1.38	0.749	28	1.25	78.1	0.7	32.4	0.8	1674.091	2.79E-04	3.00E-04	0.030	1.68E-02	10.1542	1.41E-02	0.00
35.0	1.0	34.5	130.4	2.13	1.42	0.768	26	1.25	72.9	0.7	27.7	0.8	1613.117	2.94E-04	3.00E-04	0.030	2.03E-02	10.1542	1.71E-02	0.00
36.0	1.0	35.5	130.4	2.19	1.47	0.786	26	1.25	72.9	0.7	27.2	0.8	1629.539	2.96E-04	3.00E-04	0.030	2.07E-02	10.1542	1.74E-02	0.00
37.0	1.0	36.5	124.6	2.25	1.51	0.804	26	1.25	72.9	0.7	26.9	0.8	1645.291	2.97E-04	3.00E-04	0.030	2.11E-02	10.1542	1.77E-02	0.00
38.0	1.0	37.5	124.6	2.32	1.55	0.821	50	1.25	99.0	0.7	56.0	0.8	2130.775	2.32E-04	3.00E-04	0.030	8.72E-03	10.1542	7.32E-03	0.00
39.0	1.0	38.5	124.6	2.38	1.59	0.837	50	1.25	99.0	0.7	55.3	0.8	2150.681	2.33E-04	3.00E-04	0.030	8.85E-03	10.1542	7.42E-03	0.00
40.0	1.0	39.5	124.6	2.44	1.64	0.853	50	1.25	99.0	0.7	54.7	0.8	2170.261	2.34E-04	3.00E-04	0.030	8.97E-03	10.1542	7.53E-03	0.00
41.0	1.0	40.5	124.6	2.50	1.68	0.869	50	1.25	99.0	0.6	54.1	0.8	2189.531	2.34E-04	3.00E-04	0.030	9.09E-03	10.1542	7.63E-03	0.00
42.0	1.0	41.5	124.6	2.57	1.72	0.885	50	1.25	99.0	0.6	53.5	0.8	2208.502	2.34E-04	3.00E-04	0.030	9.21E-03	10.1542	7.73E-03	0.00
43.0	1.0	42.5	124.6	2.63	1.76	0.900	50	1.25	99.0	0.6	52.9	0.8	2227.187	2.35E-04	3.00E-04	0.030	9.33E-03	10.1542	7.83E-03	0.00
44.0	1.0	43.5	124.6	2.69	1.80	0.914	50	1.25	99.0	0.6	52.4	0.8	2245.596	2.35E-04	3.00E-04	0.030	9.45E-03	10.1542	7.93E-03	0.00

Figure 14



TECHNICAL ENGINEERING AND DESIGN GUIDES AS ADAPTED FROM THE US ARMY CORPS OF ENGINEERS, NO. 9
EVALUATION OF EARTHQUAKE-INDUCED SETTLEMENTS IN DRY SANDY SOILS
MAXIMUM CONSIDERED EARTHQUAKE

MCE EARTHQUAKE INFORMATION:

Earthquake Magnitude:	7.05
Peak Horiz. Acceleration (g):	0.932

Fig 4.1 Fig 4.2

Fig 4.4

Depth of Base of Strata (ft)	Thickness of Layer (ft)	Depth of Mid-point of Layer (ft)	Soil Unit Weight (pcf)	Overburden Pressure at Mid-point (tsf)	Mean Effective Pressure at Mid-point (tsf)	Average Cyclic Shear Stress [Tav]	Field SPT [N]	Correction Factor [C _{er}]	Relative Density [D _r] (%)	Correction Factor [C _n]	Corrected [N1]60	rd Factor	Maximum Shear Mod. [G _{max}] (tsf)	[y _{eff}]*[G _{eff}] [G _{max}]	y _{eff} Shear Strain	[y _{eff}]*100%	Volumetric Strain M7.5 [E15] (%)	Number of Strain Cycles [N _c]	Corrected Vol. Strains [E _c]	Estimated Settlement [S] (inches)
1.0	1.0	0.5	113.7	0.03	0.02	0.017	7	1.25	62.4	1.7	13.4	1.0	146.504	1.16E-04	2.30E-04	0.023	3.72E-02	11.2443	3.27E-02	0.00
2.0	1.0	1.5	113.7	0.09	0.06	0.052	7	1.25	62.4	1.7	13.4	1.0	253.753	1.98E-04	2.30E-04	0.023	3.72E-02	11.2443	3.27E-02	0.00
3.5	1.5	2.8	113.7	0.16	0.10	0.095	7	1.25	62.4	1.7	13.4	1.0	343.583	2.61E-04	8.10E-04	0.081	1.31E-01	11.2443	1.15E-01	0.00
4.0	0.5	3.8	122.0	0.21	0.14	0.130	5	1.25	48.9	1.7	12.0	1.0	387.420	3.11E-04	5.00E-03	0.500	9.26E-01	11.2443	8.13E-01	0.00
5.0	1.0	4.5	122.0	0.26	0.17	0.157	5	1.25	48.9	1.7	12.0	1.0	426.786	3.38E-04	5.00E-03	0.500	9.26E-01	11.2443	8.13E-01	0.00
6.0	1.0	5.5	122.0	0.32	0.22	0.194	5	1.25	48.9	1.7	12.0	1.0	474.217	3.69E-04	1.00E-03	0.100	1.85E-01	11.2443	1.63E-01	0.04
7.0	1.0	6.5	122.0	0.38	0.26	0.231	5	1.25	48.9	1.6	11.7	1.0	513.105	3.98E-04	1.00E-03	0.100	1.91E-01	11.2443	1.68E-01	0.04
8.0	1.0	7.5	122.0	0.44	0.30	0.267	5	1.25	48.9	1.5	11.0	1.0	541.963	4.29E-04	2.70E-03	0.270	5.52E-01	11.2443	4.85E-01	0.12
9.0	1.0	8.5	122.0	0.50	0.34	0.303	5	1.25	48.9	1.4	10.5	1.0	568.546	4.56E-04	2.70E-03	0.270	5.86E-01	11.2443	5.15E-01	0.12
10.0	1.0	9.5	122.0	0.57	0.38	0.339	9	1.25	58.9	1.4	16.0	1.0	692.776	4.12E-04	2.70E-03	0.270	3.54E-01	11.2443	3.11E-01	0.07
11.0	1.0	10.5	122.0	0.63	0.42	0.375	9	1.25	58.9	1.3	15.3	1.0	718.656	4.32E-04	2.70E-03	0.270	3.73E-01	11.2443	3.27E-01	0.08
12.0	1.0	11.5	109.0	0.68	0.46	0.409	12	1.25	65.6	1.2	16.7	0.9	772.734	4.31E-04	2.70E-03	0.270	3.36E-01	11.2443	2.95E-01	0.07
13.5	1.5	12.8	109.0	0.75	0.50	0.448	12	1.25	65.6	1.2	15.9	0.9	797.618	4.49E-04	1.20E-03	0.120	1.58E-01	11.2443	1.39E-01	0.05
14.0	0.5	13.8	109.0	0.81	0.54	0.480	7	1.25	47.8	1.2	13.5	0.9	782.856	4.82E-04	1.20E-03	0.120	1.92E-01	11.2443	1.69E-01	0.02
15.0	1.0	14.5	109.0	0.85	0.57	0.503	7	1.25	47.8	1.1	13.1	0.9	794.440	4.93E-04	1.20E-03	0.120	1.99E-01	11.2443	1.75E-01	0.04
16.0	1.0	15.5	109.0	0.90	0.60	0.534	7	1.25	47.8	1.1	12.8	0.9	813.559	5.03E-04	2.20E-03	0.220	3.75E-01	11.2443	3.29E-01	0.08
17.5	1.5	16.8	109.0	0.97	0.65	0.572	7	1.25	47.8	1.0	12.5	0.9	836.548	5.15E-04	2.20E-03	0.220	3.86E-01	11.2443	3.39E-01	0.12
18.0	0.5	17.8	122.4	1.03	0.69	0.603	25	1.25	84.0	1.0	34.9	0.9	1211.587	3.70E-04	7.10E-04	0.071	3.64E-02	11.2443	3.19E-02	0.00
19.0	1.0	18.5	122.4	1.07	0.72	0.628	25	1.25	84.0	1.0	33.7	0.9	1223.564	3.78E-04	7.10E-04	0.071	3.80E-02	11.2443	3.34E-02	0.01
20.0	1.0	19.5	122.4	1.13	0.76	0.661	25	1.25	84.0	1.0	32.8	0.9	1246.696	3.86E-04	7.10E-04	0.071	3.92E-02	11.2443	3.45E-02	0.01
21.0	1.0	20.5	122.4	1.19	0.80	0.694	25	1.25	84.0	0.9	32.0	0.9	1269.018	3.93E-04	7.10E-04	0.071	4.05E-02	11.2443	3.55E-02	0.01
22.0	1.0	21.5	117.0	1.25	0.84	0.726	25	1.25	84.0	0.9	31.2	0.9	1290.131	3.99E-04	7.10E-04	0.071	4.16E-02	11.2443	3.66E-02	0.01
23.0	1.0	22.5	117.0	1.31	0.88	0.757	25	1.25	84.0	0.9	30.5	0.9	1310.137	4.05E-04	1.20E-03	0.120	7.23E-02	11.2443	6.35E-02	0.02
24.5	1.5	23.8	117.0	1.39	0.93	0.795	25	1.25	84.0	0.9	29.7	0.9	1334.335	4.11E-04	1.20E-03	0.120	7.46E-02	11.2443	6.55E-02	0.02
25.0	0.5	24.8	117.0	1.44	0.97	0.825	15	1.25	61.2	0.9	21.5	0.9	1222.463	4.60E-04	1.20E-03	0.120	1.10E-01	11.2443	9.67E-02	0.01
26.0	1.0	25.5	117.0	1.49	1.00	0.847	15	1.25	61.2	0.8	21.0	0.9	1232.035	4.65E-04	1.20E-03	0.120	1.13E-01	11.2443	9.93E-02	0.02
27.0	1.0	26.5	117.0	1.55	1.04	0.876	15	1.25	61.2	0.8	20.7	0.9	1249.171	4.69E-04	8.10E-04	0.081	7.78E-02	11.2443	6.83E-02	0.02
28.0	1.0	27.5	117.7	1.61	1.08	0.904	29	1.25	80.4	0.8	37.7	0.9	1555.226	3.85E-04	5.20E-04	0.052	2.43E-02	11.2443	2.13E-02	0.01
29.0	1.0	28.5	117.7	1.66	1.12	0.933	29	1.25	80.4	0.8	37.1	0.9	1574.721	3.88E-04	5.20E-04	0.052	2.48E-02	11.2443	2.17E-02	0.01
30.0	1.0	29.5	117.7	1.72	1.15	0.960	29	1.25	80.4	0.8	36.5	0.9	1593.780	3.91E-04	5.20E-04	0.052	2.52E-02	11.2443	2.22E-02	0.01
31.0	1.0	30.5	117.7	1.78	1.19	0.988	29	1.25	80.4	0.8	36.0	0.9	1612.427	3.93E-04	5.20E-04	0.052	2.57E-02	11.2443	2.26E-02	0.00
32.0	1.0	31.5	120.0	1.84	1.23	1.015	50	1.25	103.4	0.8	58.3	0.9	1925.815	3.35E-04	5.20E-04	0.052	1.44E-02	11.2443	1.26E-02	0.00
33.0	1.0	32.5	120.0	1.90	1.27	1.042	50	1.25	103.4	0.7	57.5	0.9	1946.889	3.37E-04	5.20E-04	0.052	1.47E-02	11.2443	1.29E-02	0.00
34.0	1.0	33.5	120.0	1.96	1.31	1.068	50	1.25	103.4	0.7	56.6	0.8	1967.532	3.39E-04	5.20E-04	0.052	1.49E-02	11.2443	1.31E-02	0.00
35.0	1.0	34.5	120.0	2.02	1.35	1.094	50	1.25	103.4	0.7	55.8	0.8	1987.766	3.41E-04	5.20E-04	0.052	1.52E-02	11.2443	1.33E-02	0.00
36.0	1.0	35.5	122.6	2.08	1.40	1.120	50	1.25	103.4	0.7	55.0	0.8	2007.822	3.42E-04	5.20E-04	0.052	1.54E-02	11.2443	1.36E-02	0.00
37.0	1.0	36.5	122.6	2.14	1.44	1.146	50	1.25	103.4	0.7	54.2	0.8	2027.706	3.44E-04	5.20E-04	0.052	1.57E-02	11.2443	1.38E-02	0.00
38.0	1.0	37.5	122.6	2.20	1.48	1.171	50	1.25	103.4	0.7	53.5	0.8	2047.222	3.45E-04	5.20E-04	0.052	1.60E-02	11.2443	1.40E-02	0.00
39.0	1.0	38.5	122.6	2.27	1.52	1.196	50	1.25	100.8	0.7	54.4	0.8	2087.476	3.43E-04	5.20E-04	0.052	1.56E-02	11.2443	1.37E-02	0.00
40.0	1.0	39.5	122.6	2.33	1.56	1.220	50	1.25	100.8	0.7	53.8	0.8	2106.770	3.44E-04	5.20E-04	0.052	1.59E-02	11.2443	1.39E-02	0.00
41.0	1.0	40.5	122.6	2.39	1.60	1.243	50	1.25	100.8	0.7	53.1	0.8	2125.740	3.45E-04	5.20E-04	0.052	1.61E-02	11.2443	1.41E-02	0.00
42.0	1.0	41.5	122.6	2.45	1.64	1.266	50	1.25	100.8	0.7	52.5	0.8	2144.401	3.46E-04	5.20E-04	0.052	1.63E-02	11.2443	1.43E-02	0.00
43.0	1.0	42.5	122.6	2.51	1.68	1.289	50	1.25	100.8	0.6	51.9	0.8	2162.766	3.46E-04	5.20E-04	0.052	1.66E-02	11.2443	1.45E-02	0.00
44.0	1.0	43.5	122.6	2.57	1.72	1.310	50	1.25	100.8	0.6	51.3	0.8	2180.845	3.47E-04	5.20E-04	0.052	1.68E-02	11.2443	1.47E-02	0.00
45.0	1.0	44.5	122.6	2.63	1.76	1.332	50	1.25	100.8	0.6	50.8	0.8	2198.651	3.48E-04	5.20E-04	0.052	1.70E-02	11.2443	1.49E-02	0.00
46.0	1.0	45.5	122.6	2.70	1.81	1.353	50	1.25	100.8	0.6	50.2	0.8	2216.194	3.48E-04	5.20E-04	0.052	1.72E-02	11.2443	1.51E-02	0.00
47.0	1.0	46.5	122.6	2.76	1.85	1.373	50	1.25	100.8	0.6	49.7	0.8	2233.484	3.48E-04	5.20E-04	0.052	1.74E-02	11.2443	1.53E-02	0.00
48.0	1.0	47.5	122.6	2.82	1.89	1.393	50	1.25	100.8	0.6	49.2	0.8	2250.530	3.49E-04	5.20E-04	0.052	1.77E-02	11.2443	1.55E-02	0.00
49.0	1.0	48.5	122.6	2.88	1.93	1.412	50	1.25	100.8	0.6	48.7	0.8	2267.340	3.49E-04	5.20E-04	0.052	1.79E-02	11.2443	1.57E-02	0.00
50.0	1.0	49.5	122.6	2.94	1.97	1.431	50	1.25	100.8	0.6	48.2	0.8	2283.924	3.49E-04	5.20E-04	0.052	1.81E-02	11.2443	1.59E-02	0.00
TOTAL SETTLEMENT =																				1.00

Figure 15

TECHNICAL ENGINEERING AND DESIGN GUIDES AS ADAPTED FROM THE US ARMY CORPS OF ENGINEERS, NO. 9 EVALUATION OF EARTHQUAKE-INDUCED SETTLEMENTS IN DRY SANDY SOILS MAXIMUM CONSIDERED EARTHQUAKE

MCE EARTHQUAKE INFORMATION:

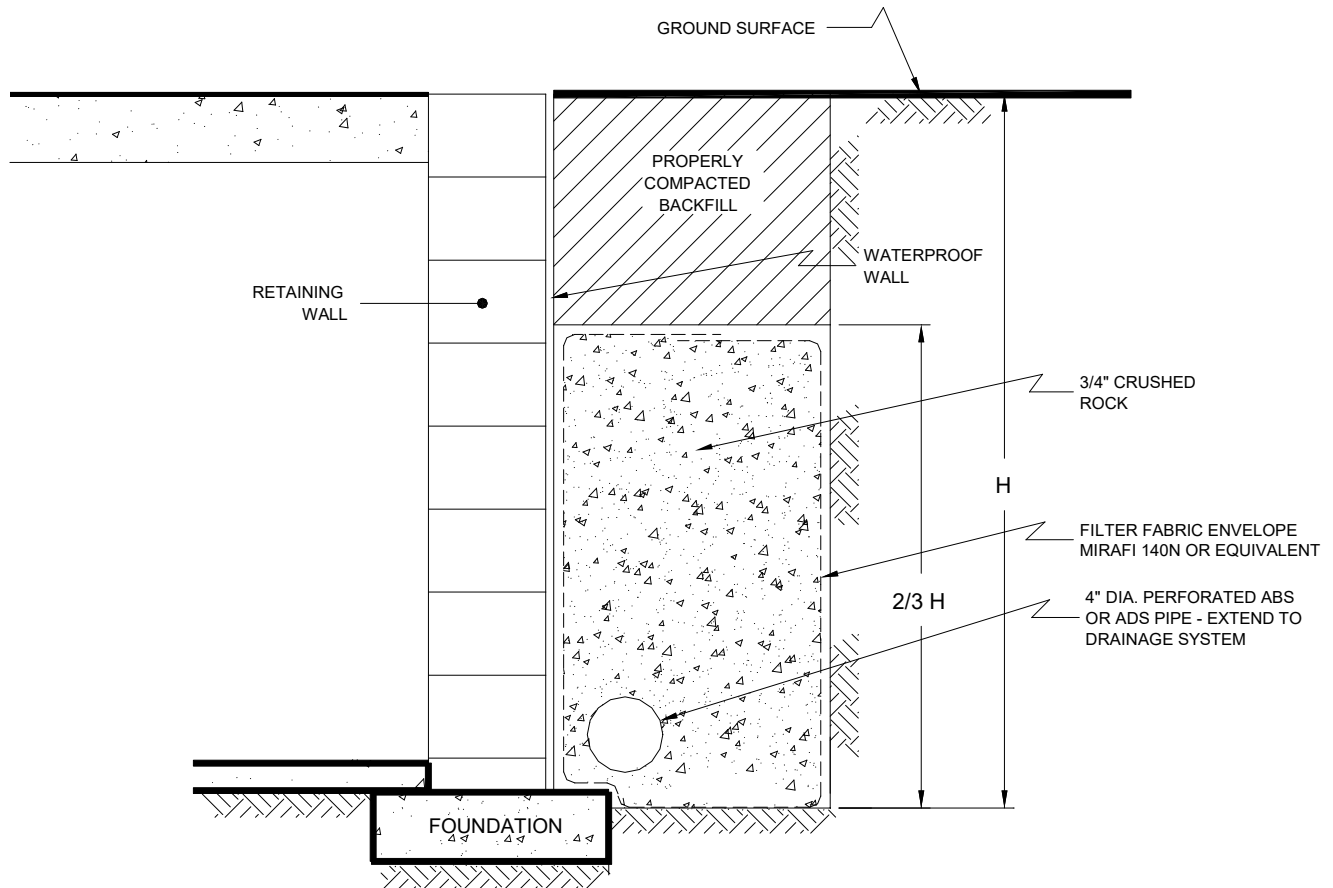
Earthquake Magnitude:	7.05
Peak Horiz. Acceleration (g):	0.932

Fig 4.1 Fig 4.2

Fig 4.4

Depth of Base of Strata (ft)	Thickness of Layer (ft)	Depth of Mid-point of Layer (ft)	Soil Unit Weight (pcf)	Overburden Pressure at Mid-point (tsf)	Mean Effective Pressure at Mid-point (tsf)	Average Cyclic Shear Stress [Tav]	Field SPT [N]	Correction Factor [Cer]	Relative Density [Dr] (%)	Correction Factor [Cn]	Corrected [N1]60	rd Factor	Maximum Shear Mod. [Gmax] (tsf)	[veff]*[Geff] [Gmax]	veff Shear Strain	[veff]*100%	Volumetric Strain M7.5 [E15] (%)	Number of Strain Cycles [Nc]	Corrected Vol. Strains [Ec]	Estimated Settlement [S] (inches)
1.0	1.0	0.5	110.4	0.03	0.02	0.017	20	1.25	103.0	1.7	38.3	1.0	204.843	8.08E-05	1.60E-04	0.016	7.35E-03	11.2443	6.45E-03	0.00
2.0	1.0	1.5	110.4	0.08	0.06	0.050	20	1.25	103.0	1.7	38.3	1.0	354.798	1.37E-04	2.30E-04	0.023	1.06E-02	11.2443	9.28E-03	0.00
3.0	1.0	2.5	110.4	0.14	0.09	0.084	20	1.25	103.0	1.7	38.3	1.0	458.042	1.74E-04	2.30E-04	0.023	1.06E-02	11.2443	9.28E-03	0.00
4.5	1.5	3.8	110.4	0.21	0.14	0.125	20	1.25	103.0	1.7	38.3	1.0	560.985	2.08E-04	8.10E-04	0.081	3.72E-02	11.2443	3.27E-02	0.00
5.0	0.5	4.8	115.3	0.26	0.18	0.159	21	1.25	101.3	1.7	40.2	1.0	642.711	2.26E-04	8.10E-04	0.081	3.50E-02	11.2443	3.08E-02	0.00
6.0	1.0	5.5	115.3	0.31	0.21	0.185	21	1.25	101.3	1.7	40.2	1.0	693.553	2.40E-04	4.50E-04	0.045	1.95E-02	11.2443	1.71E-02	0.00
7.0	1.0	6.5	115.3	0.36	0.24	0.219	21	1.25	101.3	1.7	40.0	1.0	754.739	2.57E-04	4.50E-04	0.045	1.96E-02	11.2443	1.72E-02	0.00
8.0	1.0	7.5	115.3	0.42	0.28	0.254	24	1.25	97.1	1.6	42.5	1.0	828.793	2.67E-04	4.50E-04	0.045	1.82E-02	11.2443	1.60E-02	0.00
9.0	1.0	8.5	115.3	0.48	0.32	0.288	24	1.25	97.1	1.5	39.9	1.0	865.052	2.85E-04	4.50E-04	0.045	1.97E-02	11.2443	1.73E-02	0.00
10.0	1.0	9.5	115.3	0.54	0.36	0.322	24	1.25	97.1	1.4	37.6	1.0	898.135	3.02E-04	1.00E-03	0.100	4.69E-02	11.2443	4.12E-02	0.01
11.0	1.0	10.5	115.3	0.59	0.40	0.356	24	1.25	97.1	1.3	35.7	1.0	929.238	3.17E-04	1.00E-03	0.100	4.98E-02	11.2443	4.38E-02	0.01
12.0	1.0	11.5	82.9	0.64	0.43	0.385	24	1.25	97.1	1.3	34.3	0.9	954.398	3.29E-04	1.00E-03	0.100	5.23E-02	11.2443	4.59E-02	0.01
13.0	1.0	12.5	82.9	0.69	0.46	0.409	24	1.25	97.1	1.2	33.3	0.9	974.471	3.37E-04	1.00E-03	0.100	5.43E-02	11.2443	4.77E-02	0.01
14.0	1.0	13.5	82.9	0.73	0.49	0.432	24	1.25	97.1	1.2	32.3	0.9	993.750	3.44E-04	1.00E-03	0.100	5.62E-02	11.2443	4.94E-02	0.01
15.0	1.0	14.5	129.3	0.78	0.52	0.463	10	1.25	58.2	1.2	15.4	0.9	803.267	4.49E-04	1.20E-03	0.120	1.65E-01	11.2443	1.45E-01	0.03
16.0	1.0	15.5	129.3	0.84	0.57	0.500	10	1.25	58.2	1.1	14.8	0.9	825.897	4.64E-04	1.20E-03	0.120	1.72E-01	11.2443	1.51E-01	0.04
17.0	1.0	16.5	129.3	0.91	0.61	0.536	55	1.25	125.7	1.1	80.4	0.9	1506.072	2.69E-04	3.70E-04	0.037	6.96E-03	11.2443	6.12E-03	0.00
18.0	1.0	17.5	129.3	0.97	0.65	0.572	55	1.25	125.7	1.0	77.8	0.9	1541.294	2.77E-04	3.70E-04	0.037	7.25E-03	11.2443	6.37E-03	0.00
19.0	1.0	18.5	129.3	1.04	0.70	0.608	55	1.25	125.7	1.0	75.4	0.9	1575.004	2.84E-04	3.70E-04	0.037	7.53E-03	11.2443	6.62E-03	0.00
20.0	1.0	19.5	129.3	1.10	0.74	0.644	55	1.25	125.7	1.0	72.5	0.9	1602.558	2.92E-04	3.70E-04	0.037	7.89E-03	11.2443	6.93E-03	0.00
21.0	1.0	20.5	129.3	1.17	0.78	0.679	55	1.25	125.7	0.9	70.5	0.9	1633.452	2.98E-04	3.70E-04	0.037	8.16E-03	11.2443	7.17E-03	0.00
22.0	1.0	21.5	129.9	1.23	0.83	0.714	17.6	1.25	68.0	0.9	22.5	0.9	1147.306	4.41E-04	1.20E-03	0.120	1.04E-01	11.2443	9.14E-02	0.02
23.0	1.0	22.5	129.9	1.30	0.87	0.748	17.6	1.25	68.0	0.9	22.0	0.9	1167.121	4.49E-04	1.20E-03	0.120	1.07E-01	11.2443	9.42E-02	0.02
24.0	1.0	23.5	129.9	1.36	0.91	0.782	17.6	1.25	68.0	0.9	21.4	0.9	1186.286	4.56E-04	1.20E-03	0.120	1.10E-01	11.2443	9.70E-02	0.02
25.0	1.0	24.5	143.6	1.43	0.96	0.818	17	1.25	65.0	0.9	23.7	0.9	1257.503	4.45E-04	1.20E-03	0.120	9.78E-02	11.2443	8.59E-02	0.02
26.0	1.0	25.5	143.6	1.50	1.01	0.855	17	1.25	65.0	0.8	23.2	0.9	1279.492	4.52E-04	8.10E-04	0.081	6.77E-02	11.2443	5.95E-02	0.01
27.0	1.0	26.5	143.6	1.57	1.05	0.891	28	1.25	78.1	0.8	37.1	0.9	1531.313	3.89E-04	5.20E-04	0.052	2.48E-02	11.2443	2.18E-02	0.01
28.0	1.0	27.5	143.6	1.65	1.10	0.927	28	1.25	78.1	0.8	36.3	0.9	1555.165	3.95E-04	5.20E-04	0.052	2.54E-02	11.2443	2.23E-02	0.01
29.0	1.0	28.5	143.6	1.72	1.15	0.963	28	1.25	78.1	0.8	35.6	0.9	1578.363	3.99E-04	5.20E-04	0.052	2.60E-02	11.2443	2.28E-02	0.01
30.0	1.0	29.5	143.6	1.79	1.20	0.998	28	1.25	78.1	0.8	34.6	0.9	1594.521	4.06E-04	8.10E-04	0.081	4.20E-02	11.2443	3.69E-02	0.01
31.0	1.0	30.5	143.6	1.86	1.25	1.032	28	1.25	78.1	0.7	33.9	0.9	1616.337	4.10E-04	8.10E-04	0.081	4.29E-02	11.2443	3.77E-02	0.00
32.0	1.0	31.5	130.4	1.93	1.29	1.064	28	1.25	78.1	0.7	33.4	0.9	1636.654	4.13E-04	8.10E-04	0.081	4.38E-02	11.2443	3.85E-02	0.00
33.0	1.0	32.5	130.4	2.00	1.34	1.093	28	1.25	78.1	0.7	32.9	0.9	1655.567	4.16E-04	8.10E-04	0.081	4.46E-02	11.2443	3.92E-02	0.00
34.0	1.0	33.5	130.4	2.06	1.38	1.122	28	1.25	78.1	0.7	32.4	0.8	1674.091	4.18E-04	8.10E-04	0.081	4.54E-02	11.2443	3.99E-02	0.00
35.0	1.0	34.5	130.4	2.13	1.42	1.151	26	1.25	72.9	0.7	27.7	0.8	1613.117	4.41E-04	8.10E-04	0.081	5.49E-02	11.2443	4.82E-02	0.00
36.0	1.0	35.5	130.4	2.19	1.47	1.179	26	1.25	72.9	0.7	27.2	0.8	1629.539	4.44E-04	8.10E-04	0.081	5.59E-02	11.2443	4.91E-02	0.00
37.0	1.0	36.5	124.6	2.25	1.51	1.205	26	1.25	72.9	0.7	26.9	0.8	1645.291	4.46E-04	8.10E-04	0.081	5.69E-02	11.2443	4.99E-02	0.00
38.0	1.0	37.5	124.6	2.32	1.55	1.231	50	1.25	99.0	0.7	56.0	0.8	2130.775	3.48E-04	5.20E-04	0.052	1.51E-02	11.2443	1.33E-02	0.00
39.0	1.0	38.5	124.6	2.38	1.59	1.255	50	1.25	99.0	0.7	55.3	0.8	2150.681	3.49E-04	5.20E-04	0.052	1.53E-02	11.2443	1.35E-02	0.00
40.0	1.0	39.5	124.6	2.44	1.64	1.279	50	1.25	99.0	0.7	54.7	0.8	2170.261	3.50E-04	5.20E-04	0.052	1.55E-02	11.2443	1.37E-02	0.00
41.0	1.0	40.5	124.6	2.50	1.68	1.303	50	1.25	99.0	0.6	54.1	0.8	2189.531	3.51E-04	5.20E-04	0.052	1.58E-02	11.2443	1.38E-02	0.00
42.0	1.0	41.5	124.6	2.57	1.72	1.326	50	1.25	99.0	0.6	53.5	0.8	2208.502	3.52E-04	5.20E-04	0.052	1.60E-02	11.2443	1.40E-02	0.00
43.0	1.0	42.5	124.6	2.63	1.76	1.349	50	1.25	99.0	0.6	52.9	0.8	2227.187	3.52E-04	5.20E-04	0.052	1.62E-02	11.2443	1.42E-02	0.00
44.0	1.0	43.5	124.6	2.69	1.80	1.371	50	1.25	99.0	0.6	52.4	0.8	2245.596	3.53E-04	5.20E-04	0.052	1.64E-02	11.2443	1.44E-02	0.00
45.0	1.0	44.5	124.6	2.75	1.84	1.392	50	1.25	99.0	0.6	51.8	0.8	2263.741	3.53E-04	5.20E-04	0.052	1.66E-02	11.2443	1.46E-02	0.00
46.0	1.0	45.5	124.6	2.82	1.89	1.413	50	1.25	99.0	0.6	51.3	0.8	2281.630	3.53E-04	5.20E-04	0.052	1.68E-02	11.2443	1.47E-02	0.00
47.0	1.0	46.5	124.6	2.88	1.93	1.433	50	1.25	99.0	0.6	50.8	0.8	2299.274	3.53E-04	5.20E-04	0.052	1.70E-02	11.2443	1.49E-02	0.00
48.0	1.0	47.5	124.6	2.94	1.97	1.453	50	1.25	99.0	0.6	50.4	0.8	2316.680	3.53E-04	5.20E-04	0.052	1.72E-02	11.2443	1.51E-02	0.00
49.0	1.0	48.5	124.6	3.00	2.01	1.472	50	1.25	99.0	0.6	49.9	0.8	2333.858	3.53E-04	1.00E-02	1.000	3.34E-01	11.2443	2.93E-01	0.00
50.0	1.0	49.5	124.6	3.06	2.05	1.491	50	1.25	99.0	0.6	49.4	0.8	2350.814	3.53E-04	1.00E-02	1.000	3.38E-01	11.2443	2.97E-01	0.00
TOTAL SETTLEMENT =																			0.28	

Figure 16



NO SCALE

GEOCON
WEST, INC.



ENVIRONMENTAL GEOTECHNICAL MATERIALS
3303 N. SAN FERNANDO BLVD. - SUITE 100 - BURBANK, CA 91504
PHONE (818) 841-8388 - FAX (818) 841-1704

DRAFTED BY: PZ

CHECKED BY: HHD

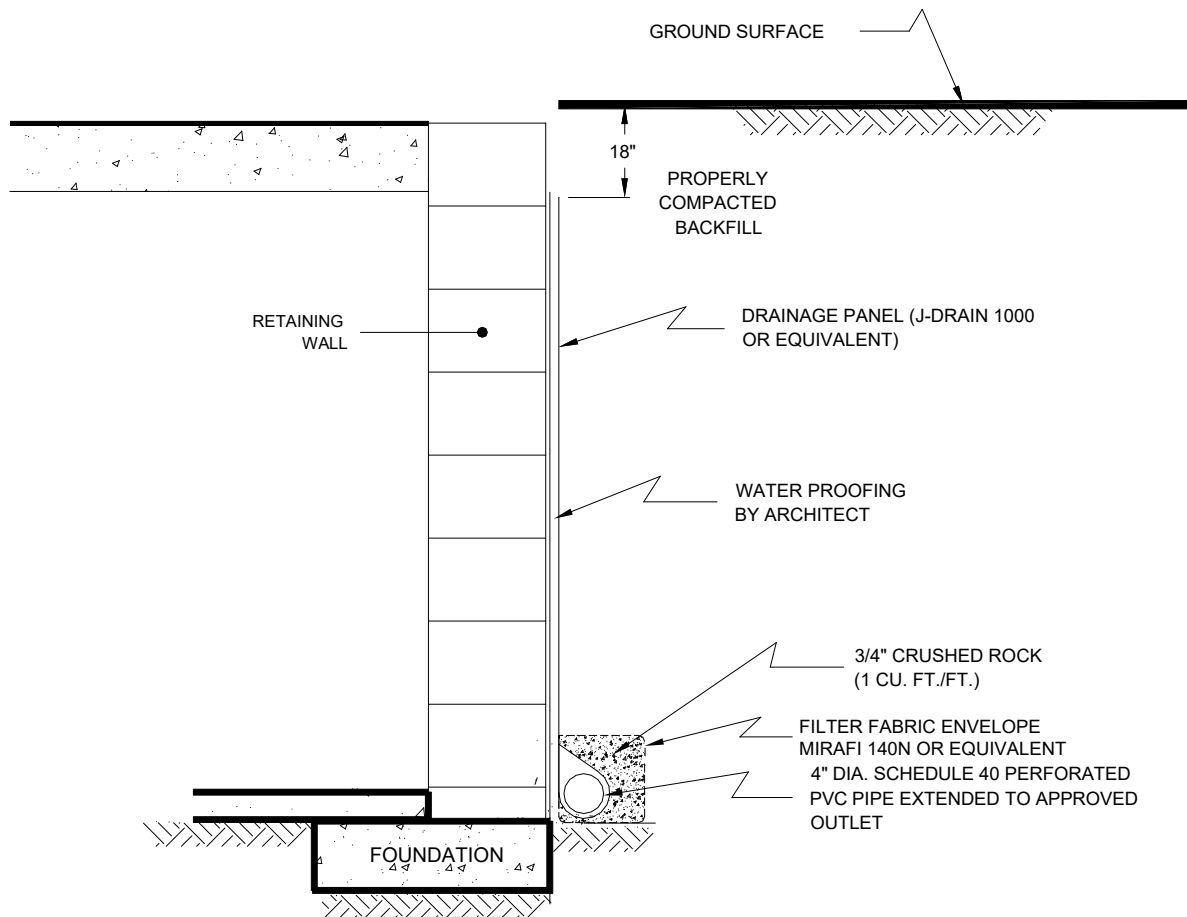
RETAINING WALL DRAIN DETAIL

TWELVE OAKS SENIOR LIVING FACILITY
2820 SYCAMORE AVENUE
GLENDALE, CALIFORNIA

AUGUST 2022

PROJECT NO. W1582-06-01

FIG. 17



NO SCALE

GEOCON
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ENVIRONMENTAL GEOTECHNICAL MATERIALS
3303 N. SAN FERNANDO BLVD. - SUITE 100 - BURBANK, CA 91504
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RETAINING WALL DRAIN DETAIL

TWELVE OAKS SENIOR LIVING FACILITY
2820 SYCAMORE AVENUE
GLENDALE, CALIFORNIA

AUGUST 2022

PROJECT NO. W1582-06-01

FIG. 18

BORING PERCOLATION TEST FIELD LOG					
Date: <u>6/28/2022</u> Project Number: <u>W1582-06-01</u> Project Location: <u>2820 Sycamore Ave, Glendale</u> Earth Description: <u>SP-SM</u> Tested By: <u>RP</u> Liquid Description: <u>Clear Clean Tap Water</u> Measurement Method: <u>Sounder</u>			Boring/Test Number: <u>B1</u> Diameter of Boring: <u>8</u> inches Diameter of Casing: <u>2</u> inches Depth of Boring: <u>10</u> feet Depth to Invert of BMP: <u>4</u> feet Depth to Water Table: <u>>80</u> feet Depth to Initial Water Depth (d ₁): <u>48</u> inches		
Start Time for Pre-Soak: <u>9:00 AM</u> Start Time for Standard: <u>10:00 AM</u>			Water Remaining in Boring (Y/N): <u>Yes</u> Standard Time Interval Between Readings: <u>30 min</u>		
Reading Number	Time Start (hh:mm)	Time End (hh:mm)	Elapsed Time Δtime (min)	Water Drop During Standard Time Interval, Δd (in)	Soil Description Notes Comments
1	10:05 AM	10:35 AM	30	34.2	
2	10:40 AM	11:10 AM	30	33.5	
3	11:15 AM	11:45 AM	30	32.4	
4	11:50 AM	12:20 PM	30	35.0	
5	12:25 PM	12:55 PM	30	33.7	
6	1:00 PM	1:30 PM	30	33.5	Stabilized Readings
7	1:35 AM	2:05 AM	30	33.0	Achieved with Readings
8	2:10 AM	2:40 AM	30	32.4	6, 7, and 8

MEASURED PERCOLATION RATE & DESIGN INFILTRATION RATE CALCULATIONS*					
* Calculations Below Based on Stabilized Readings Only					
Boring Radius, r: <u>4</u> inches		<i>Test Section Surface Area, A = 2πrh + πr²</i>			
Test Section Height, h: <u>72.0</u> inches		A = <u>1860</u> in ²			
<i>Discharged Water Volume, V = πr²Δd</i>		<i>Percolation Rate = (V/A) / ΔT</i>			
Reading 6	V = <u>1683</u> in ³	Percolation Rate =	<u>1.81</u>	inches/hour	
Reading 7	V = <u>1659</u> in ³	Percolation Rate =	<u>1.78</u>	inches/hour	
Reading 8	V = <u>1629</u> in ³	Percolation Rate =	<u>1.75</u>	inches/hour	
		Measured Percolation Rate =	<u><u>1.78</u></u> inches/hour		
Reduction Factors					
Small Diameter Boring, RF _t =		<u>1</u>			
Site Variability, RF _v =		<u>1</u>			
Long Term Siltation, RF _s =		<u>1</u>			
		<i>Total Reduction Factor, RF = RF_t + RF_v + RF_s</i>			
		Total Reduction Factor = <u>3</u>			
Design Infiltration Rate					
<i>Design Infiltration Rate = Measured Percolation Rate / RF</i>					
		Design Infiltration Rate =	<u><u>0.59</u></u> inches/hour		

FIGURE 19

BORING PERCOLATION TEST FIELD LOG					
Date: <u>6/28/2022</u> Project Number: <u>W1582-06-01</u> Project Location: <u>2820 Sycamore Ave, Glendale</u> Earth Description: <u>SP</u> Tested By: <u>RP</u> Liquid Description: <u>Clear Clean Tap Water</u> Measurement Method: <u>Sounder</u>			Boring/Test Number: <u>B4</u> Diameter of Boring: <u>8</u> inches Diameter of Casing: <u>2</u> inches Depth of Boring: <u>10</u> feet Depth to Invert of BMP: <u>5</u> feet Depth to Water Table: <u>> 80</u> feet Depth to Initial Water Depth (d ₁): <u>60</u> inches		
Start Time for Pre-Soak: <u>9:30 AM</u> Start Time for Standard: <u>10:30 AM</u>			Water Remaining in Boring (Y/N): <u>Yes</u> Standard Time Interval Between Readings: <u>30 min</u>		

Reading Number	Time Start (hh:mm)	Time End (hh:mm)	Elapsed Time Δtime (min)	Water Drop During Standard Time Interval, Δd (in)	Soil Description Notes Comments
1	10:35 AM	11:05 AM	30	37.2	
2	11:10 AM	11:40 AM	30	43.3	
3	11:45 AM	12:15 PM	30	38.5	
4	12:20 PM	12:50 PM	30	35.2	
5	12:55 PM	1:25 PM	30	42.2	
6	1:30 PM	2:00 PM	30	38.6	Stabilized Readings
7	2:05 PM	2:35 PM	30	38.4	Achieved with Readings
8	2:40 PM	3:10 PM	30	37.9	6, 7, and 8

MEASURED PERCOLATION RATE & DESIGN INFILTRATION RATE CALCULATIONS*					
* Calculations Below Based on Stabilized Readings Only					
Boring Radius, r: <u>4</u> inches		<i>Test Section Surface Area, A = 2πrh + πr²</i>			
Test Section Height, h: <u>60.0</u> inches		A = <u>1558</u> in ²			
<i>Discharged Water Volume, V = πr²Δd</i>		<i>Percolation Rate = (V/A) / ΔT</i>			
Reading 6	V = <u>1942</u> in ³	Percolation Rate =	<u>2.49</u>	inches/hour	
Reading 7	V = <u>1930</u> in ³	Percolation Rate =	<u>2.48</u>	inches/hour	
Reading 8	V = <u>1906</u> in ³	Percolation Rate =	<u>2.45</u>	inches/hour	
		Measured Percolation Rate =	<u><u>2.47</u></u> inches/hour		
Reduction Factors					
Small Diameter Boring, RF _t =		<u>1</u>			
Site Variability, RF _v =		<u>1</u>			
Long Term Siltation, RF _s =		<u>1</u>			
		<i>Total Reduction Factor, RF = RF_t + RF_v + RF_s</i>			
		Total Reduction Factor = <u>3</u>			
Design Infiltration Rate					
<i>Design Infiltration Rate = Measured Percolation Rate / RF</i>					
		Design Infiltration Rate = <u><u>0.82</u></u> inches/hour			

FIGURE 20

APPENDIX

A

APPENDIX A

FIELD INVESTIGATION

The scope of this investigation included a site reconnaissance, field exploration, laboratory testing, engineering analysis, and the preparation of this report. The site was explored on June 27 and 28, 2022 by excavating four borings using a truck-mounted hollow stem auger drilling machine to depths between 10 and 41 feet below the existing ground surface. Additional excavations were performed up to 3 feet below the existing ground surface using hand tools. Representative and relatively undisturbed samples were obtained by driving a 3-inch, O. D., California Modified Sampler into the “undisturbed” soil mass with blows from a 140-pound auto-hammer falling 30 inches as well as a slide hammer. The California Modified Sampler was equipped with 1-inch by 2³/₈-inch diameter brass sampler rings to facilitate soil removal and testing. Standard Penetration Tests were performed in borings B1 and B4. Bulk samples were also obtained.

The soil conditions encountered in the borings were visually examined, classified and logged in general accordance with the Unified Soil Classification System (USCS). The logs of the borings are presented on Figures A1 through A6. The logs depict the soil and geologic conditions encountered and the depth at which samples were obtained. The logs also include our interpretation of the conditions between sampling intervals. Therefore, the logs contain both observed and interpreted data. We determined the lines designating the interface between soil materials on the logs using visual observations, penetration rates, excavation characteristics and other factors. The transition between materials may be abrupt or gradual. Where applicable, the logs were revised based on subsequent laboratory testing. The location of the borings are shown on Figure 2.

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING 1 ELEV. (MSL.) -- DATE COMPLETED <u>06/27/2022</u> EQUIPMENT <u>HOLLOW STEM AUGER</u> BY: <u>CB</u>	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK 0-5'				MATERIAL DESCRIPTION			
2	B1@2.5'				ARTIFICIAL FILL Sand, well-graded, loose, dry, light grayish brown, fine- to coarse-grained. - some gravel	13	109.9	3.5
4	B1@5'			SP-SM	ALLUVIAL FAN DEPOSITS Sand with Silt, poorly graded, loose, slightly moist, brown, fine- to medium-grained. - cobble fragments (to 4")	5		
6								
8	B1@7.5'				- grades coarser	10	114.7	6.4
10	B1@10'					9		
12	B1@12.5'			SW	Sand, well-graded, medium dense, dry, light brown, fine- to coarse-grained.	23	104.2	4.6
14	B1@15'			SM	Silty Sand, loose, slightly moist, brown, fine-grained, some medium-grained.	7		
16								
18	B1@17.5'				Sand with Silt, well-graded, medium dense, slightly moist, reddish brown, fine- to coarse-grained.	24	115.9	5.6
20	B1@20'			SW-SM	- trace gravel (to 1")	25		
22								
24	B1@22.5'				- fragments (to 2")	38	110.6	5.8
26	B1@25'			SM	Silty Sand, medium dense, slightly moist, reddish brown, fine- to medium-grained, trace coarse-grained.	15		
28	B1@26.5'				- cobble	50 (5")	109.1	7.9
				SP-SM	Sand with Silt, medium dense, dry, light grayish brown, fine- to medium-grained, some coarse-grained, trace fine gravel.			

Figure A1,
Log of Boring 1, Page 1 of 2

W1582-06-01 BORING LOGS.GPJ

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

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

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING 1		PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					ELEV. (MSL.) -- DATE COMPLETED 06/27/2022	EQUIPMENT HOLLOW STEM AUGER BY: CB			
					MATERIAL DESCRIPTION				
30	B1@30'			SP-SM			29		
32	B1@32'		SW-SM	ALLUVIAL CHANNEL DEPOSITS Sand with Silt and Gravel, well-graded, very dense, dry, light grayish brown, gravel (to 2").		50 (5")	114.4	4.9	
34	B1@34'					50 (5")			
36	B1@36.5'					50 (5")	116.4	5.3	
38									
40	B1@39'				- increase in silt	50 (4")			
					Total depth of boring: 41 feet Fill to 3.5 feet. No groundwater encountered. Backfilled with soil cuttings and tamped. *Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.				

Figure A1,
Log of Boring 1, Page 2 of 2

W1582-06-01 BORING LOGS.GPJ

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

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

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING 2 ELEV. (MSL.) -- DATE COMPLETED <u>06/27/2022</u> EQUIPMENT <u>HOLLOW STEM AUGER</u> BY: <u>CB</u>	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					MATERIAL DESCRIPTION			
2	B2@2'	AC: 4" BASE: 3" ARTIFICIAL FILL			Sand, poorly graded, loose, dry, grayish brown, fine- to medium-grained, trace silt and fine gravel.	17	106.0	5.4
4	B2@5'	ALLUVIAL FAN DEPOSITS			Sand with Silt, poorly graded, medium dense, brown, fine-grained, some medium-grained, trace fine gravel.	19	114.2	4.0
6	B2@7'					38	115.3	3.8
8					- grades coarser			
10	B2@10'			SP-SM	- fine- to coarse-grained, cobble fragments (to 2")	31	107.2	2.2
12								
14								
16	B2@15'					26	108.7	6.6
18								
20	B2@19.5'				- cobble	50 (3")	113.5	7.9
Total depth of boring: 20 feet Fill to 4 feet. No groundwater encountered. Backfilled with soil cuttings and tamped. *Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.								

Figure A2,
Log of Boring 2, Page 1 of 1

W1582-06-01 BORING LOGS.GPJ

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

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

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING 3 ELEV. (MSL.) - - DATE COMPLETED <u>06/27/2022</u> EQUIPMENT <u>HOLLOW STEM AUGER</u> BY: <u>CB</u>	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					MATERIAL DESCRIPTION			
2					AC: 4.5" BASE: 4.5" ARTIFICIAL FILL Silty Sand, loose, dry, grayish brown, fine-grained, trace fine gravel.			
4								
6	B3@5'			SP	ALLUVIAL FAN DEPOSITS Sand, poorly graded, medium dense, dry, grayish brown, fine-grained, some gravel, trace cobbles (to 4").	30	148.5	1.1
8								
10	B3@9.5'				- cobble	50 (4")	123.2	2.1
Total depth of boring: 10 feet Fill to 4.5 feet. No groundwater encountered. Backfilled with soil cuttings and tamped. *Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.								

Figure A3,
Log of Boring 3, Page 1 of 1

W1582-06-01 BORING LOGS.GPJ

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

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

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING 4 ELEV. (MSL.) -- DATE COMPLETED <u>06/27/2022</u> EQUIPMENT <u>HOLLOW STEM AUGER</u> BY: <u>CB</u>	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0					MATERIAL DESCRIPTION			
2	B4@2.5'				ARTIFICIAL FILL Sand with Silt, well-graded, medium dense, dry, grayish brown, fine- to coarse-grained, some gravel (to 1").	37	108.7	1.6
4	B4@5'							
6	B4@7'				ALLUVIAL FAN DEPOSITS Sand, poorly graded, medium dense, slightly moist, brown, fine-grained, rootlets, trace gravel (to 2").	21		
8	B4@10'			SP	- cobble fragments	50 (3")	102.4	12.6
10	B4@11.5'				- fine- to medium-grained, some coarse-grained	24		
12	B4@15'					50 (3")	80.1	3.5
14	B4@17.5'				Sand with Silt, well-graded, loose, slightly moist, brown, fine- to coarse-grained.	10		
16	B4@20'			SW-SM	- dense, some gravel (to 2")	71	122.6	5.5
18	B4@22.5'					55		
20	B4@25'				Silty Sand, medium dense, slightly moist, brown, fine-grained, some medium-grained.			
22	B4@27.5'			SM		32	129.0	0.7
24					ALLUVIAL CHANNEL DEPOSITS Silty Sand, medium dense, dry, light brown, fine- to medium-grained.	17		
26				SM				
28					- grades coarser, trace gravel (to 3/4")	61	130.4	10.1

Figure A4,
Log of Boring 4, Page 1 of 2

W1582-06-01 BORING LOGS.GPJ

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

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

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING 4		PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
					ELEV. (MSL.)	DATE COMPLETED			
						06/27/2022			
					EQUIPMENT HOLLOW STEM AUGER BY: CB				
					MATERIAL DESCRIPTION				
30	B4@30'				- medium dense		28		
32	B4@32.5'						52	125.7	3.7
34	B4@35'			SM	- decrease in silt		26		
36									
38	B4@37.5'				- increase in silt - gravel (to 2")		88	118.8	4.9
	B4@38.5'				- cobble fragments		50 (4")		
					Total depth of boring: 39.5 feet Fill to 4.5 feet. No groundwater encountered. Backfilled with soil cuttings and tamped. *Penetration resistance for 140-pound hammer falling 30 inches by auto-hammer. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.				

Figure A4,
Log of Boring 4, Page 2 of 2

W1582-06-01 BORING LOGS.GPJ

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

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

DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING 5 ELEV. (MSL.) -- DATE COMPLETED <u>06/28/2022</u> EQUIPMENT <u>HAND TOOLS</u> BY: <u>CB</u>	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK 0-2.5'				MATERIAL DESCRIPTION ARTIFICIAL FILL Sand with Gravel, poorly graded, loose, dry, light grayish brown, fine- to medium-grained, trace silt, cobbles (to 4"), and roots.			
2	B5@2'			SW			107.4	2.8
					ALLUVIAL FAN DEPOSITS Sand with Gravel, well-graded, medium dense, dry, light brown, fine- to coarse-grained, some cobbles and gravel (to 3.5"). Total depth of boring: 2.5 feet Fill to 1.5 feet. No groundwater encountered. Backfilled with soil cuttings and tamped. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			

Figure A5,
Log of Boring 5, Page 1 of 1

W1582-06-01 BORING LOGS.GPJ

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

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

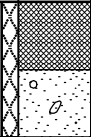
DEPTH IN FEET	SAMPLE NO.	LITHOLOGY	GROUNDWATER	SOIL CLASS (USCS)	BORING 6 ELEV. (MSL.) -- DATE COMPLETED <u>06/28/2022</u> EQUIPMENT <u>HAND TOOLS</u> BY: <u>CB</u>	PENETRATION RESISTANCE (BLOWS/FT*)	DRY DENSITY (P.C.F.)	MOISTURE CONTENT (%)
0	BULK 0-3'			SW	MATERIAL DESCRIPTION ARTIFICIAL FILL Sand with Gravel, poorly graded, medium dense, slightly moist, brown, fine- to medium-grained, some coarse-grained, silt, gravel (to 2"), and rootlets. ALLUVIAL FAN DEPOSITS Sand with Gravel, well-graded, loose, dry, gray, fine- to coarse-grained, some gravel (to 4"). Total depth of boring: 3 feet Fill to 1.5 feet. No groundwater encountered. Backfilled with soil cuttings and tamped. NOTE: The stratification lines presented herein represent the approximate boundary between earth types; the transitions may be gradual.			
2								

Figure A6,
Log of Boring 6, Page 1 of 1

W1582-06-01 BORING LOGS.GPJ

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

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

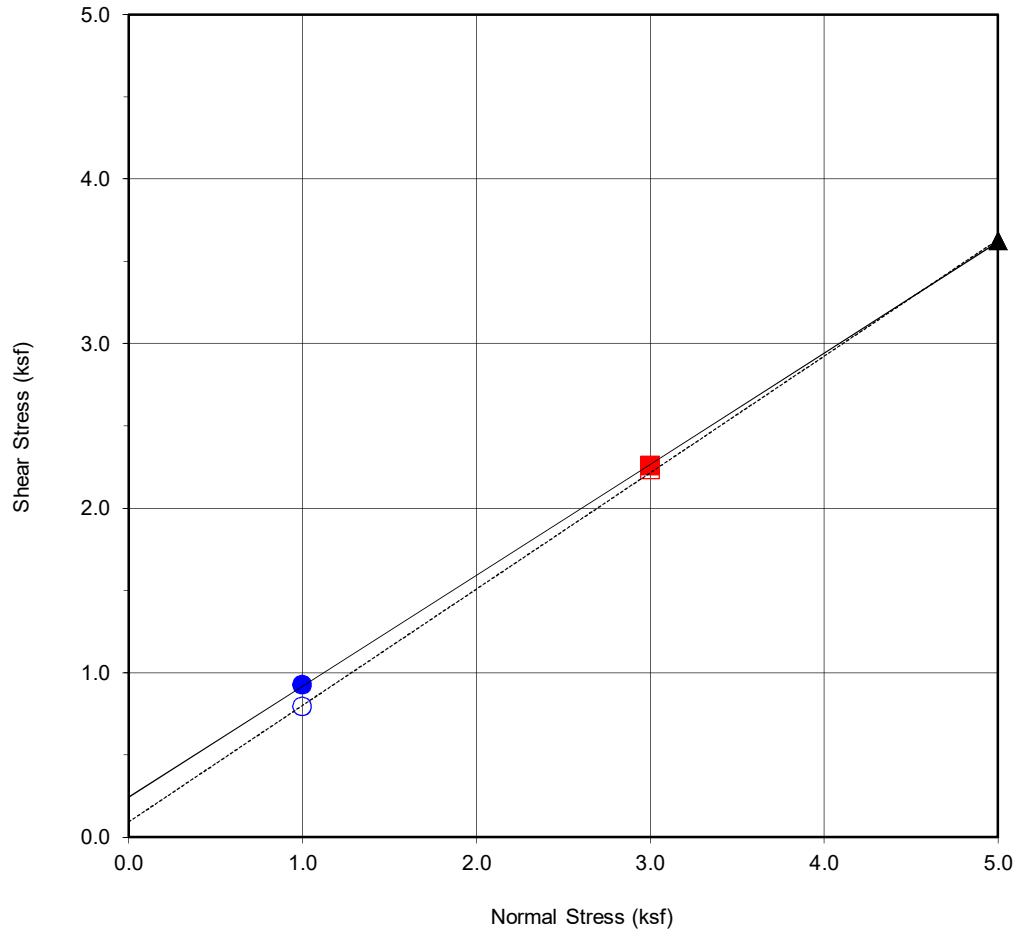
APPENDIX

B

APPENDIX B

LABORATORY TESTING

Laboratory tests were performed in accordance with generally accepted test methods of the International ASTM, or other suggested procedures. Selected samples were tested for direct shear strength, consolidation characteristics, grain-size, maximum dry density, in-place dry density and moisture content. The results of the laboratory tests are summarized in Figures B1 through B18. The in-place dry density and moisture content of the samples tested are presented on the boring logs, Appendix A.



Boring No.	B1
Sample No.	B1@0-5'
Depth (ft)	0-5'
<u>Sample Type:</u>	Bulk

<u>Soil Identification:</u>		
Well-Graded Sand (SW)		
Strength Parameters		
	C (psf)	ϕ ($^{\circ}$)
Peak	243	34.0
Ultimate	92	35.3

Normal Stress (kip/ft ²)	1	3	5
Peak Shear Stress (kip/ft ²)	● 0.92	■ 2.26	▲ 3.62
Shear Stress @ End of Test (ksf)	○ 0.79	□ 2.23	△ 3.62
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	8.9	8.6	8.6
Initial Dry Density (pcf)	116.0	116.0	116.0
Initial Degree of Saturation (%)	53.0	51.4	51.2
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	13.0	13.4	12.0



DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

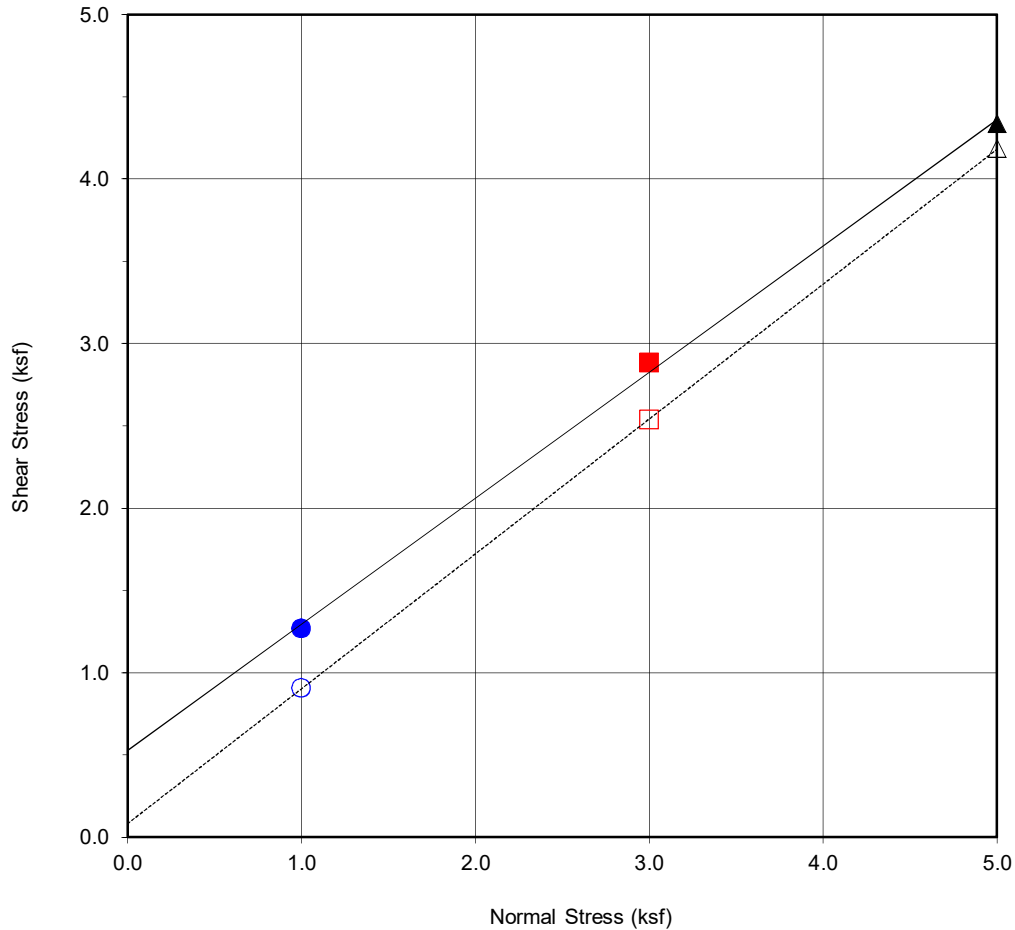
Checked by: PZ

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Glendale, California

August 2022

Figure B1



Boring No.	B5
Sample No.	B5@0-2.5'
Depth (ft)	0-2.5'
<u>Sample Type:</u>	Bulk

<u>Soil Identification:</u>		
Well-Graded Sand with Gravel (SW)		
Strength Parameters		
	C (psf)	ϕ ($^{\circ}$)
Peak	527	37.5
Ultimate	82	39.3

Normal Stress (kip/ft ²)	1	3	5
Peak Shear Stress (kip/ft ²)	● 1.27	■ 2.88	▲ 4.33
Shear Stress @ End of Test (ksf)	○ 0.91	□ 2.53	△ 4.19
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	11.5	11.3	11.4
Initial Dry Density (pcf)	97.0	97.0	97.0
Initial Degree of Saturation (%)	41.9	41.4	41.7
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	24.5	24.7	19.4



DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

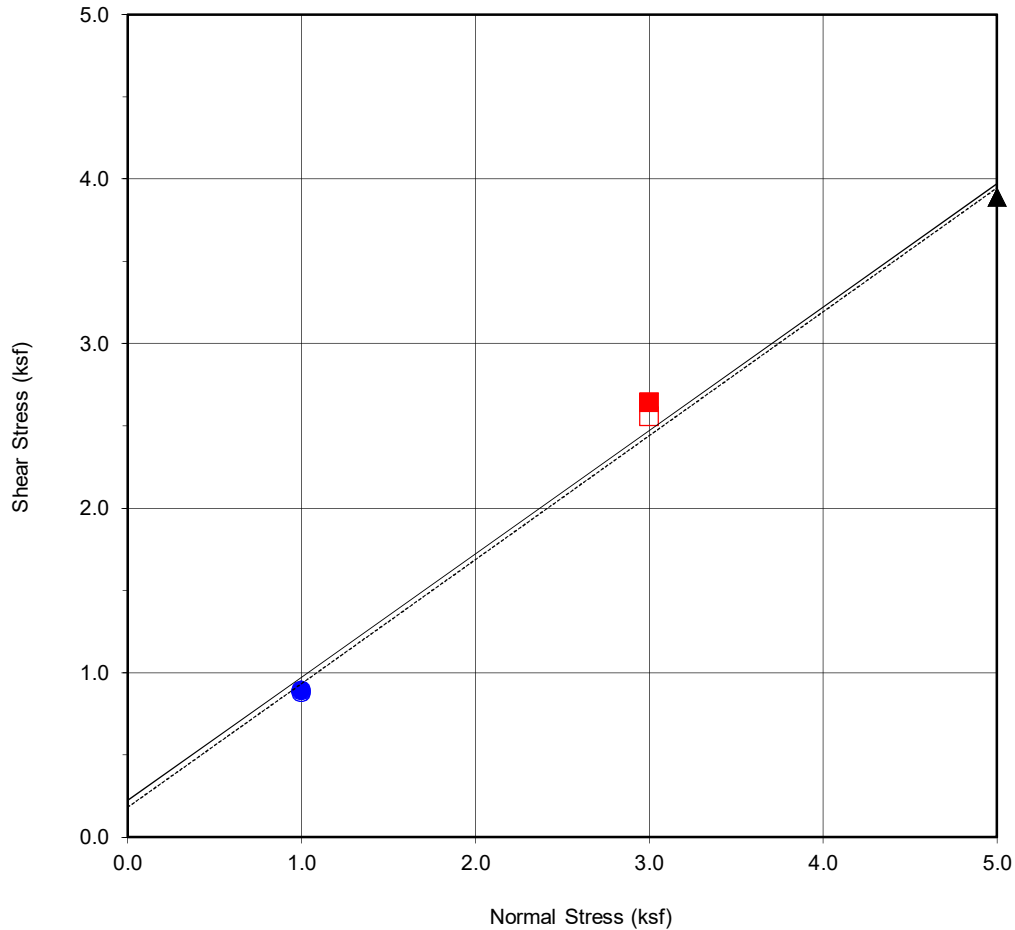
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August 2022

Figure B2



Boring No.	B2
Sample No.	B2@2'
Depth (ft)	2
<u>Sample Type:</u>	Ring

<u>Soil Identification:</u>		
Poorly Graded Sand (SP)		
Strength Parameters		
	C (psf)	ϕ ($^{\circ}$)
Peak	222	36.9
Ultimate	181	37.0

Normal Stress (kip/ft ²)	1	3	5
Peak Shear Stress (kip/ft ²)	● 0.89	■ 2.64	▲ 3.89
Shear Stress @ End of Test (ksf)	○ 0.88	□ 2.56	△ 3.89
Deformation Rate (in./min.)	0.05	0.05	0.05
Initial Sample Height (in.)	1.0	1.0	1.0
Ring Inside Diameter (in.)	2.375	2.375	2.375
Initial Moisture Content (%)	6.2	6.8	5.4
Initial Dry Density (pcf)	105.4	102.3	106.4
Initial Degree of Saturation (%)	27.7	28.3	25.0
Soil Height Before Shearing (in.)	1.2	1.2	1.2
Final Moisture Content (%)	16.3	14.3	15.6



DIRECT SHEAR TEST RESULTS

Consolidated Drained ASTM D-3080

Checked by: PZ

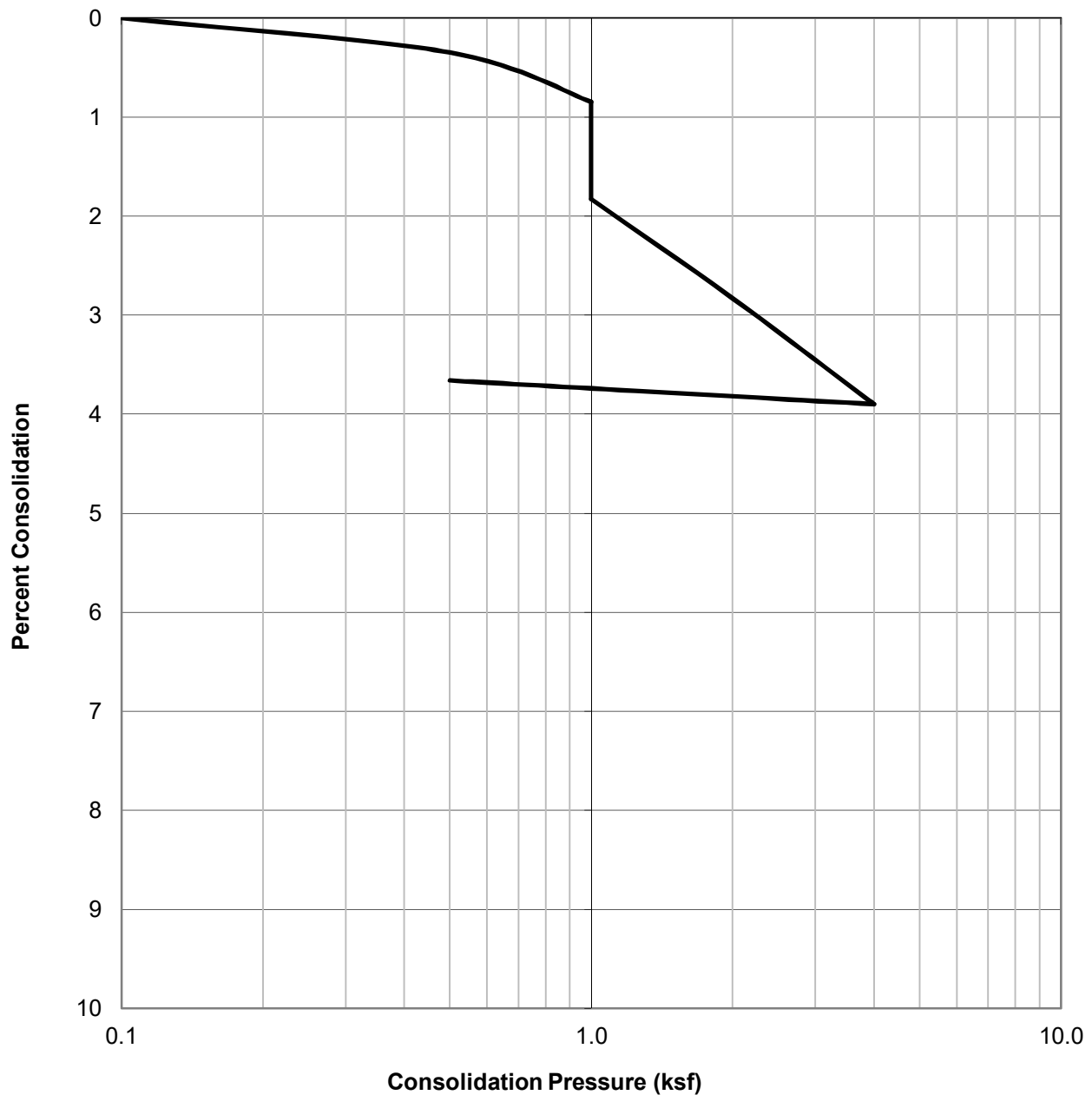
Project No.: W1582-06-01

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August 2022

Figure B3

WATER ADDED AT 1.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B3@5	Poorly Graded Sand (SP)	118.0	2.1	12.8



CONSOLIDATION TEST RESULTS

ASTM D-2435

Checked by: PZ

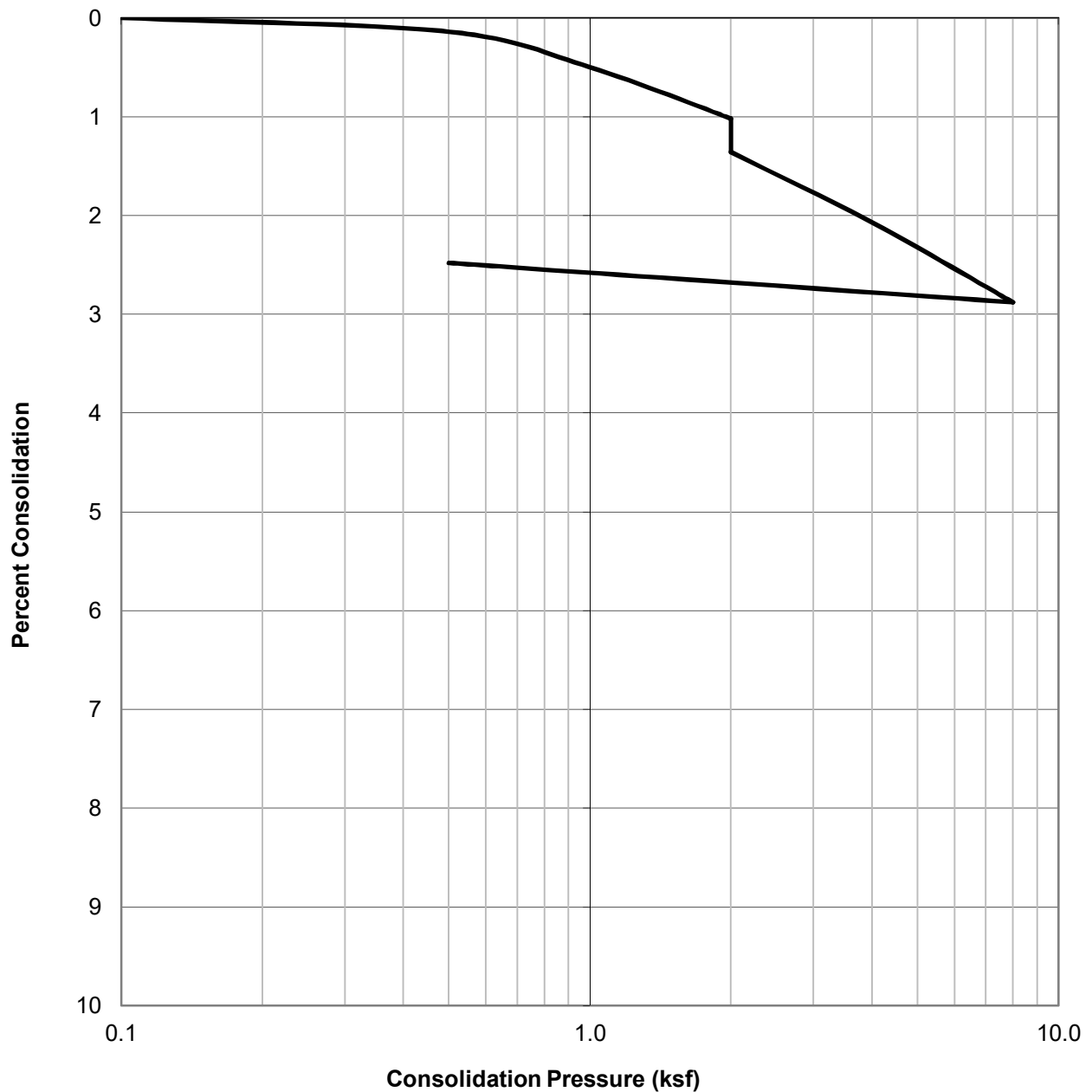
Project No.: W1582-06-01

Twelve Oaks Senior Living Facility
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Glendale, California

August 2022

Figure B4

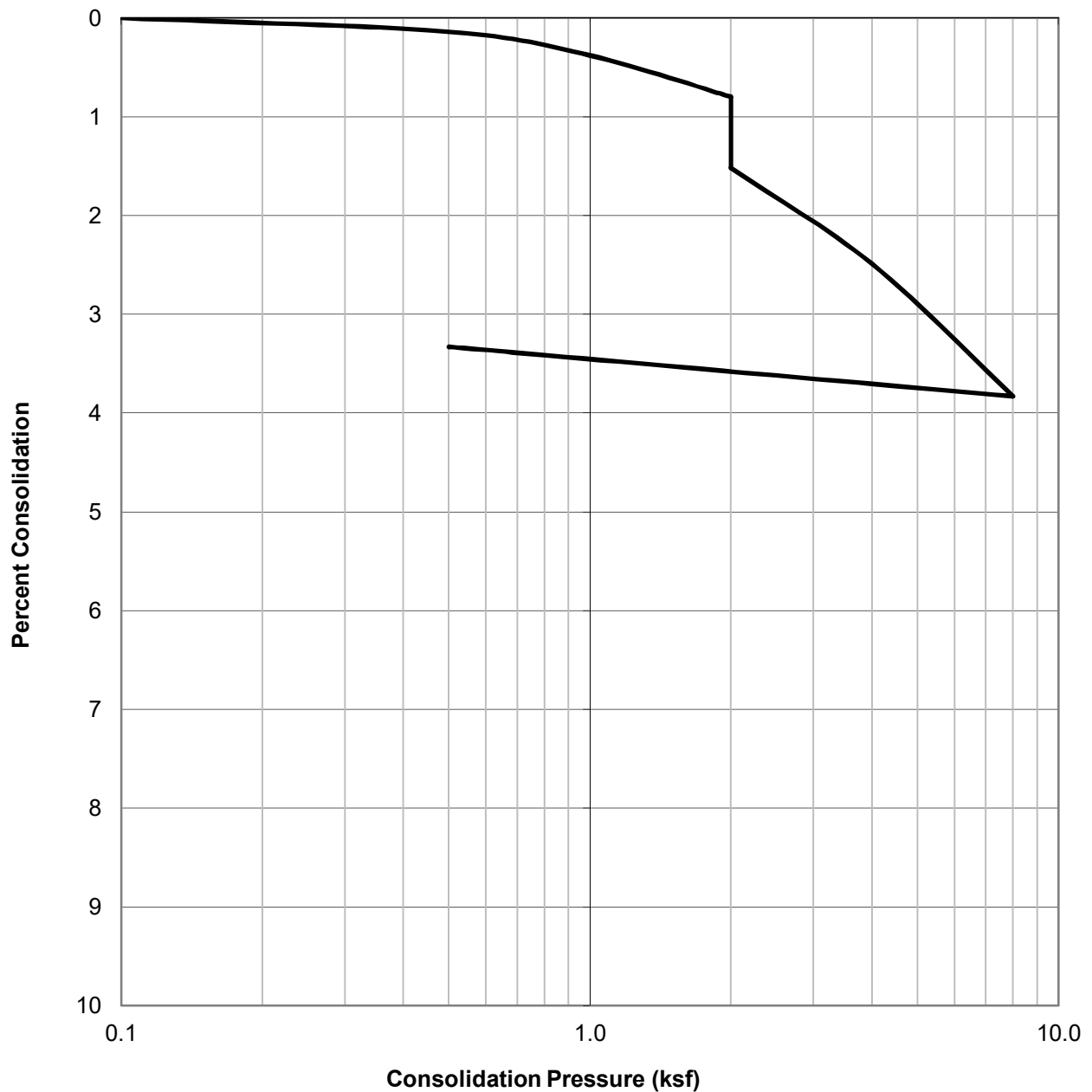
WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B4@7	Poorly Graded Sand (SP)	95.1	12.6	22.3

	CONSOLIDATION TEST RESULTS ASTM D-2435	Project No.:	W1582-06-01
		Twelve Oaks Senior Living Facility 2820 Sycamore Avenue Glendale, California	
	Checked by: PZ	August 2022	Figure B5

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B1@7.5	Poorly Graded Sand with Silt (SP-SM)	108.3	6.4	15.1



CONSOLIDATION TEST RESULTS

ASTM D-2435

Checked by: PZ

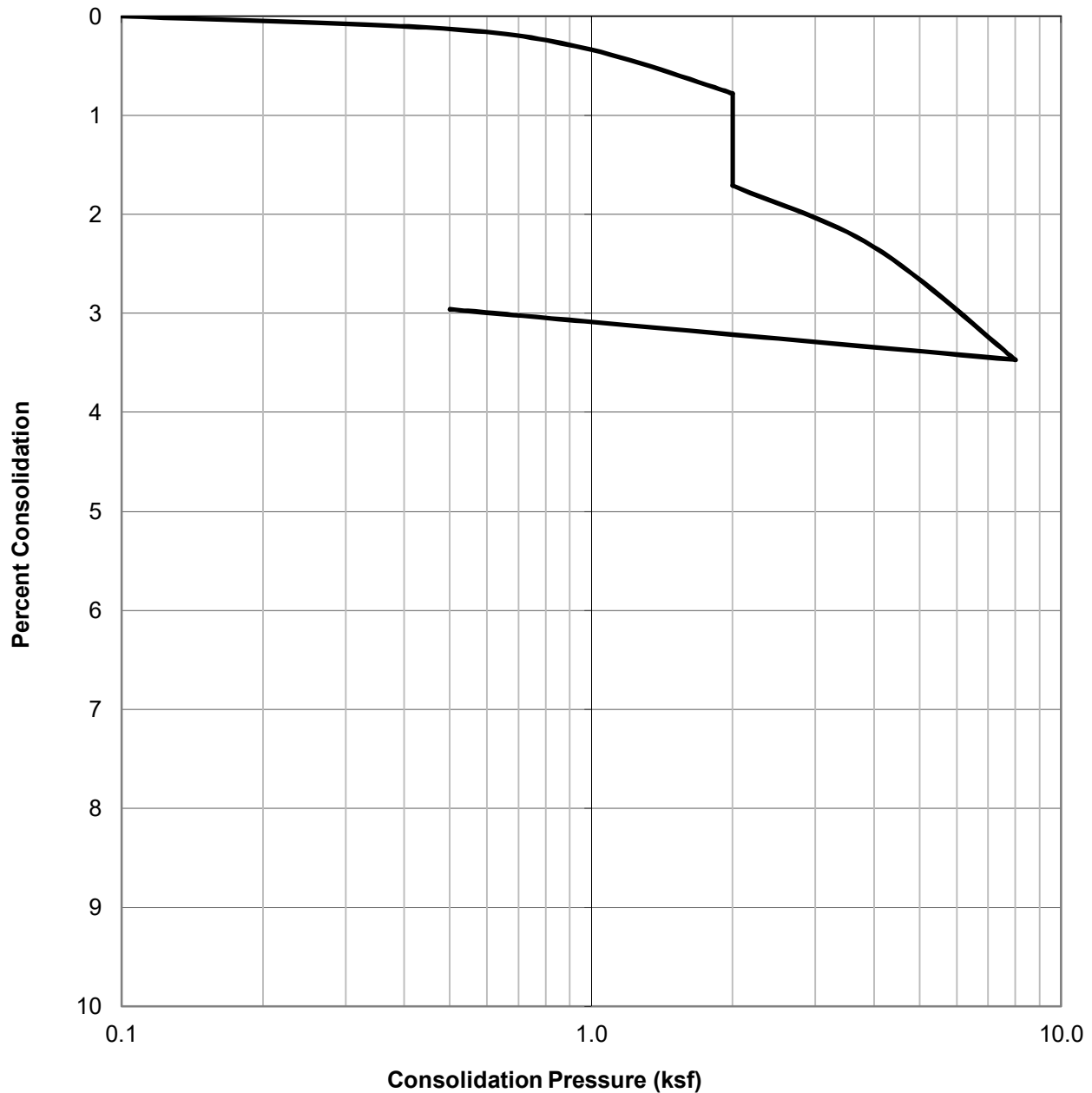
Project No.: W1582-06-01

Twelve Oaks Senior Living Facility
2820 Sycamore Avenue
Glendale, California

August 2022

Figure B6

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B4@11.5	Poorly Graded Sand (SP)	110.2	3.5	13.7



CONSOLIDATION TEST RESULTS

ASTM D-2435

Checked by: PZ

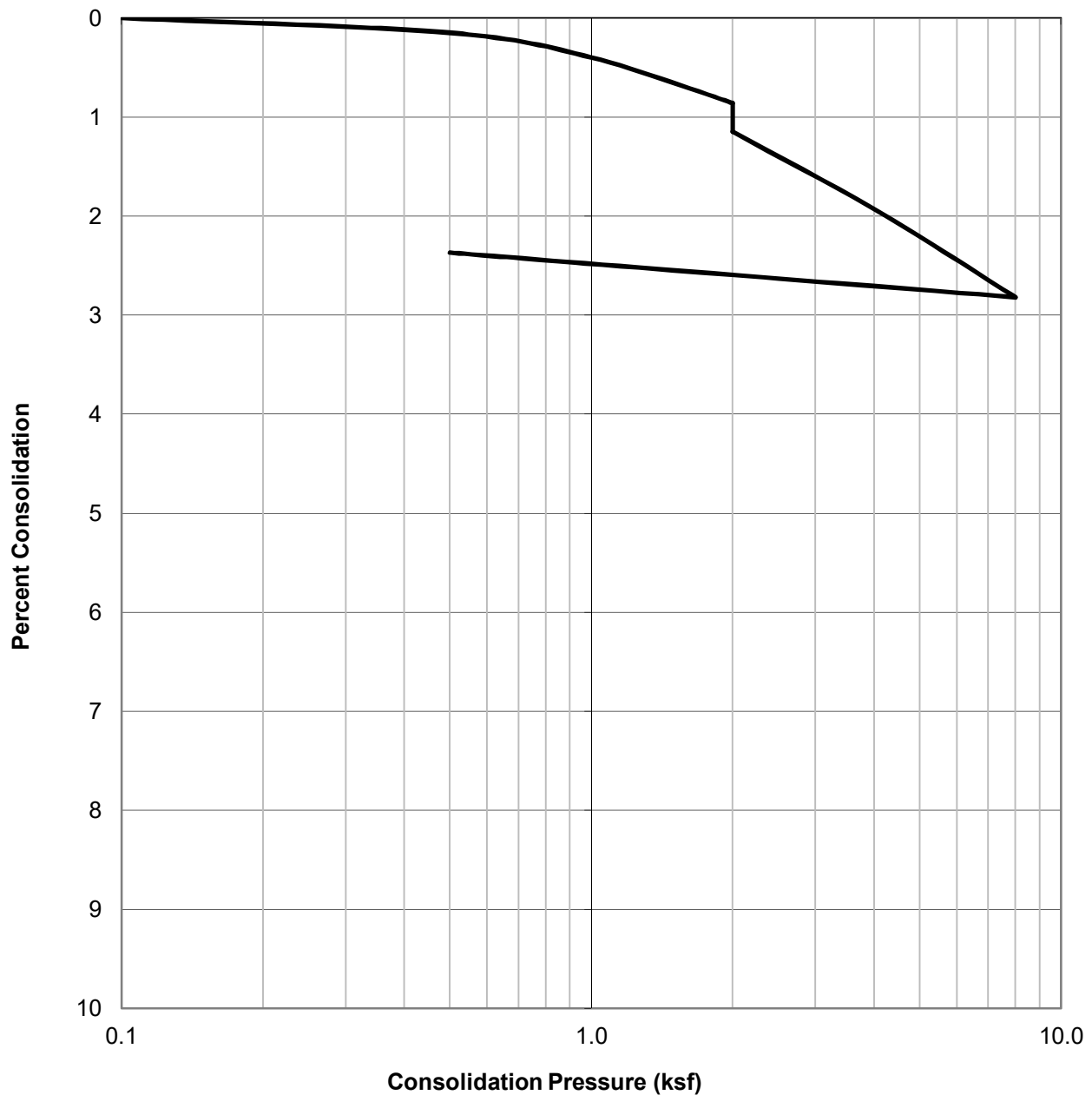
Project No.: W1582-06-01

Twelve Oaks Senior Living Facility
2820 Sycamore Avenue
Glendale, California

August 2022

Figure B7

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B1@12.5	Well-Graded Sand (SW)	102.1	4.6	20.9



CONSOLIDATION TEST RESULTS

ASTM D-2435

Checked by: PZ

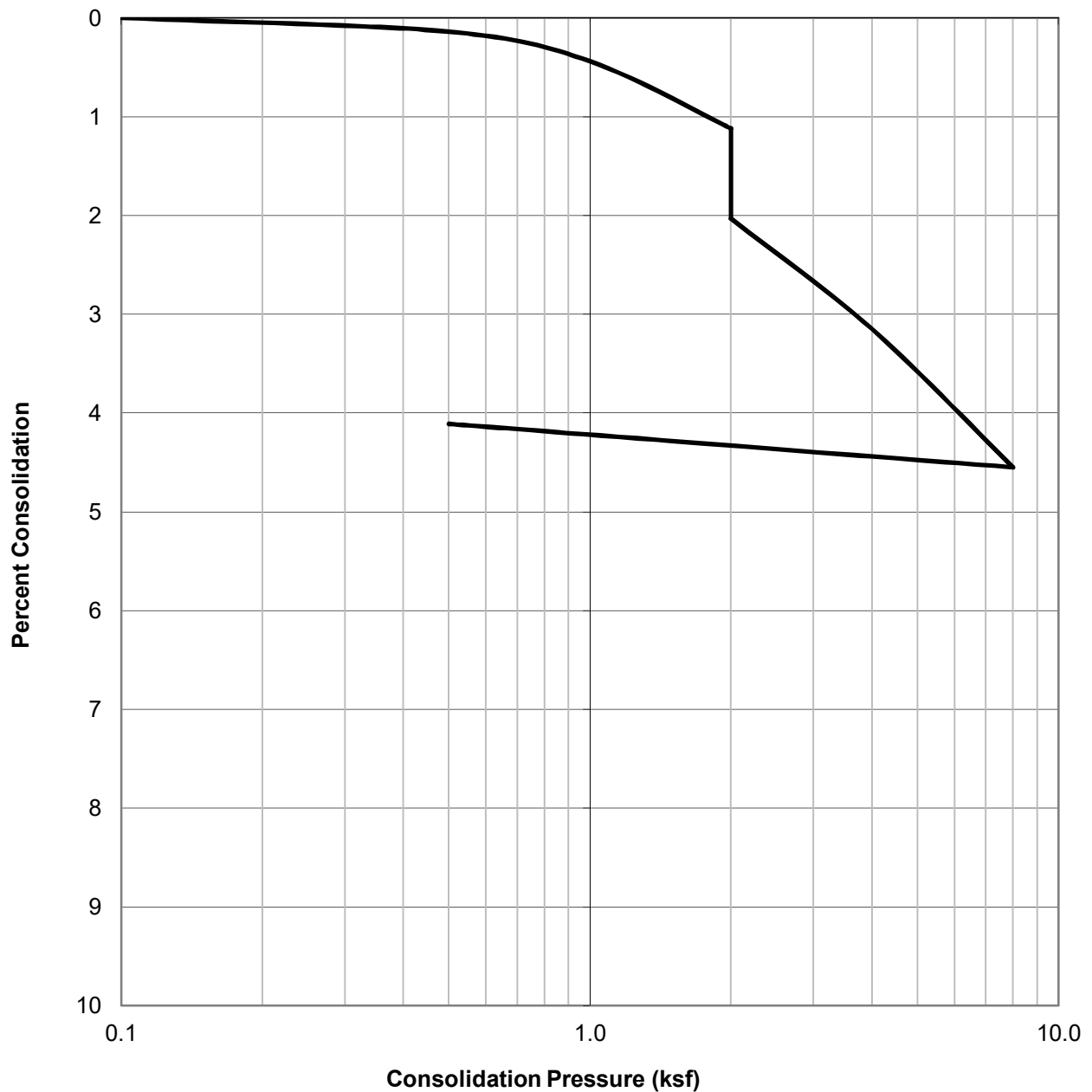
Project No.: W1582-06-01

Twelve Oaks Senior Living Facility
2820 Sycamore Avenue
Glendale, California

August 2022

Figure B8

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B1@17.5	Well-Graded Sand with Silt (SW-SM)	113.2	5.6	14.5

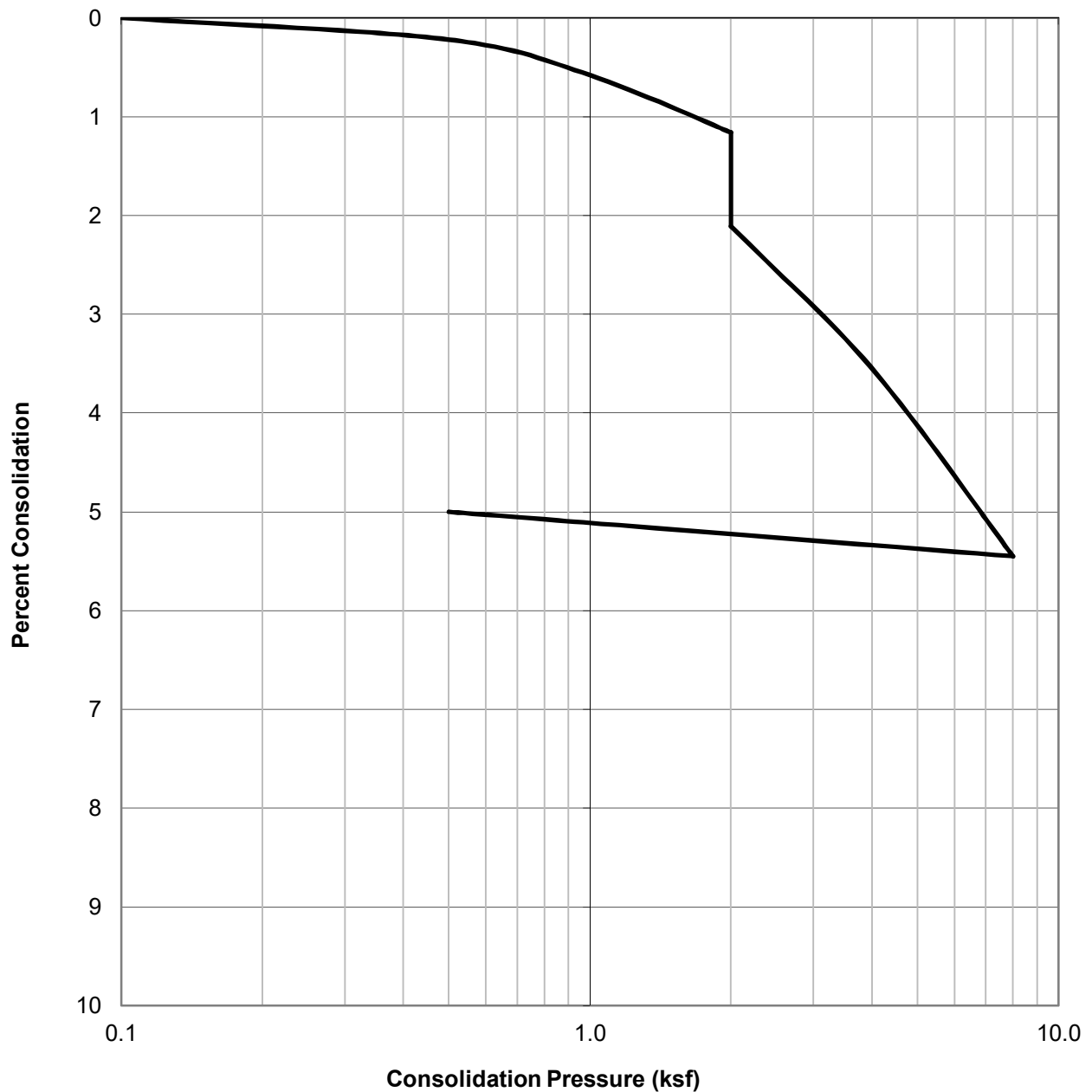


CONSOLIDATION TEST RESULTS
ASTM D-2435

Checked by: PZ

Project No.: W1582-06-01
Twelve Oaks Senior Living Facility
2820 Sycamore Avenue
Glendale, California
August 2022 Figure B9

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B4@17.5	Well-Graded Sand with Silt (SW-SM)	112.0	5.5	13.7



CONSOLIDATION TEST RESULTS

ASTM D-2435

Checked by: PZ

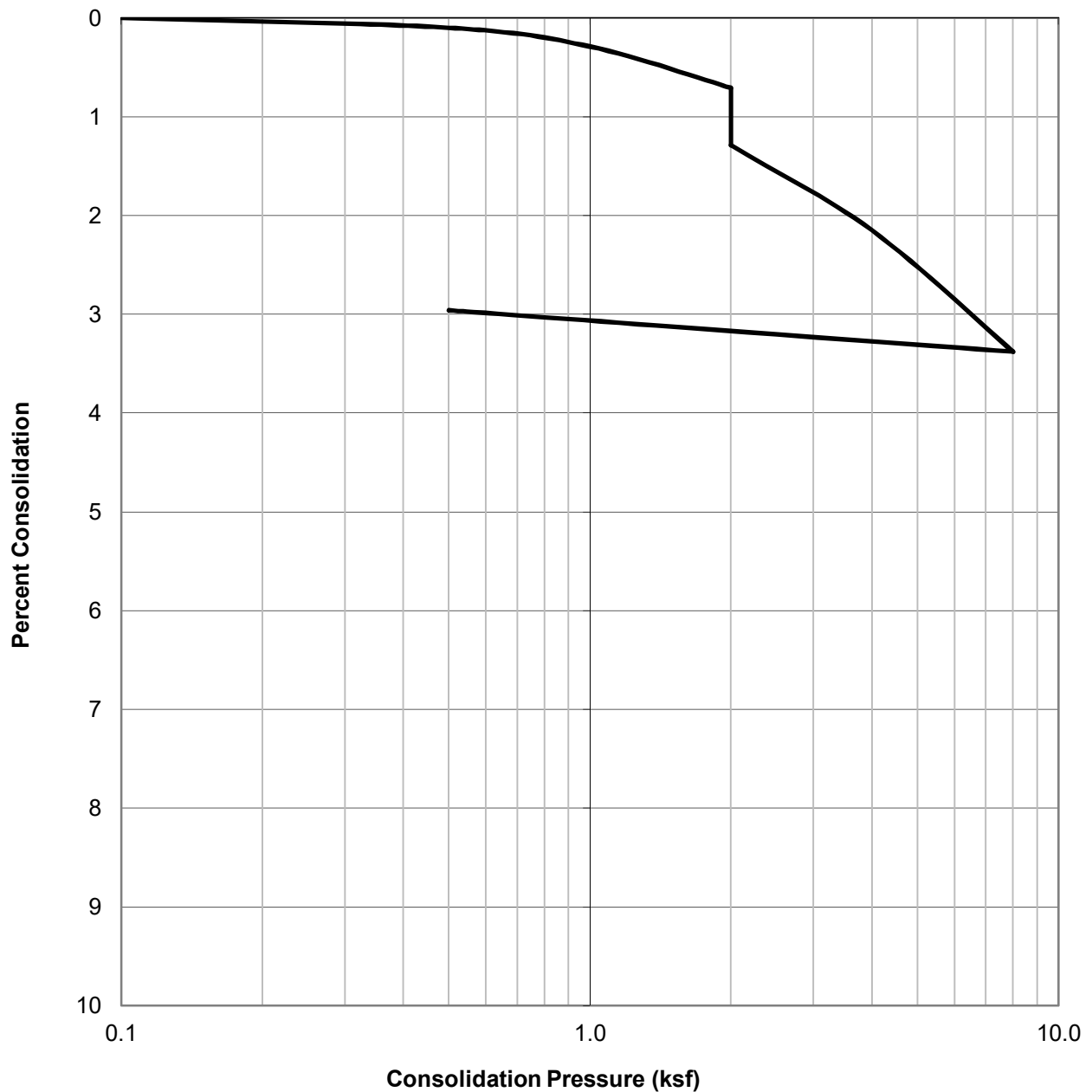
Project No.: W1582-06-01

Twelve Oaks Senior Living Facility
2820 Sycamore Avenue
Glendale, California

August 2022

Figure B10

WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B1@22.5	Well-Graded Sand with Silt (SW-SM)	106.0	5.8	17.7

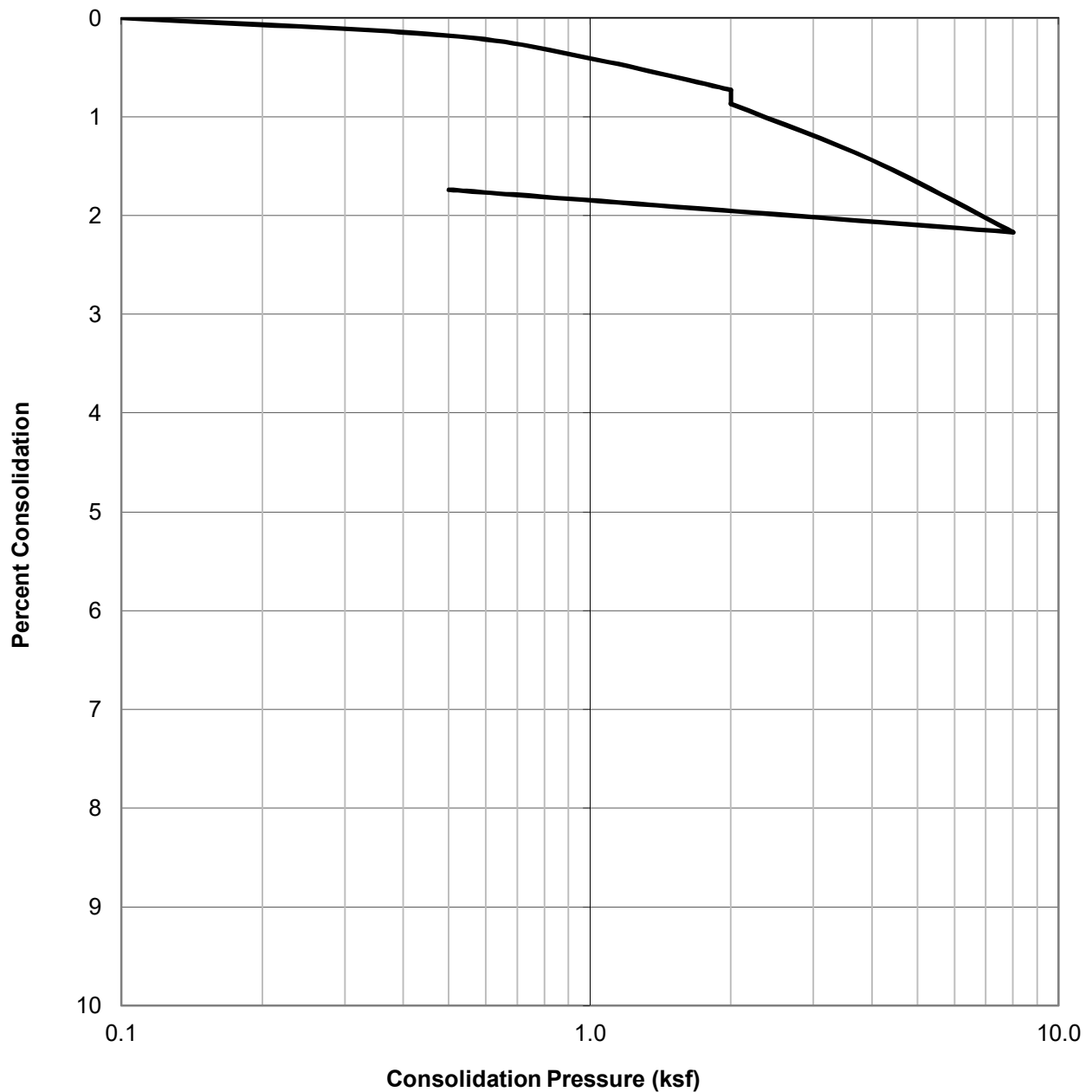


CONSOLIDATION TEST RESULTS
ASTM D-2435

Checked by: PZ

Project No.: W1582-06-01
Twelve Oaks Senior Living Facility
2820 Sycamore Avenue
Glendale, California
August 2022 Figure B11

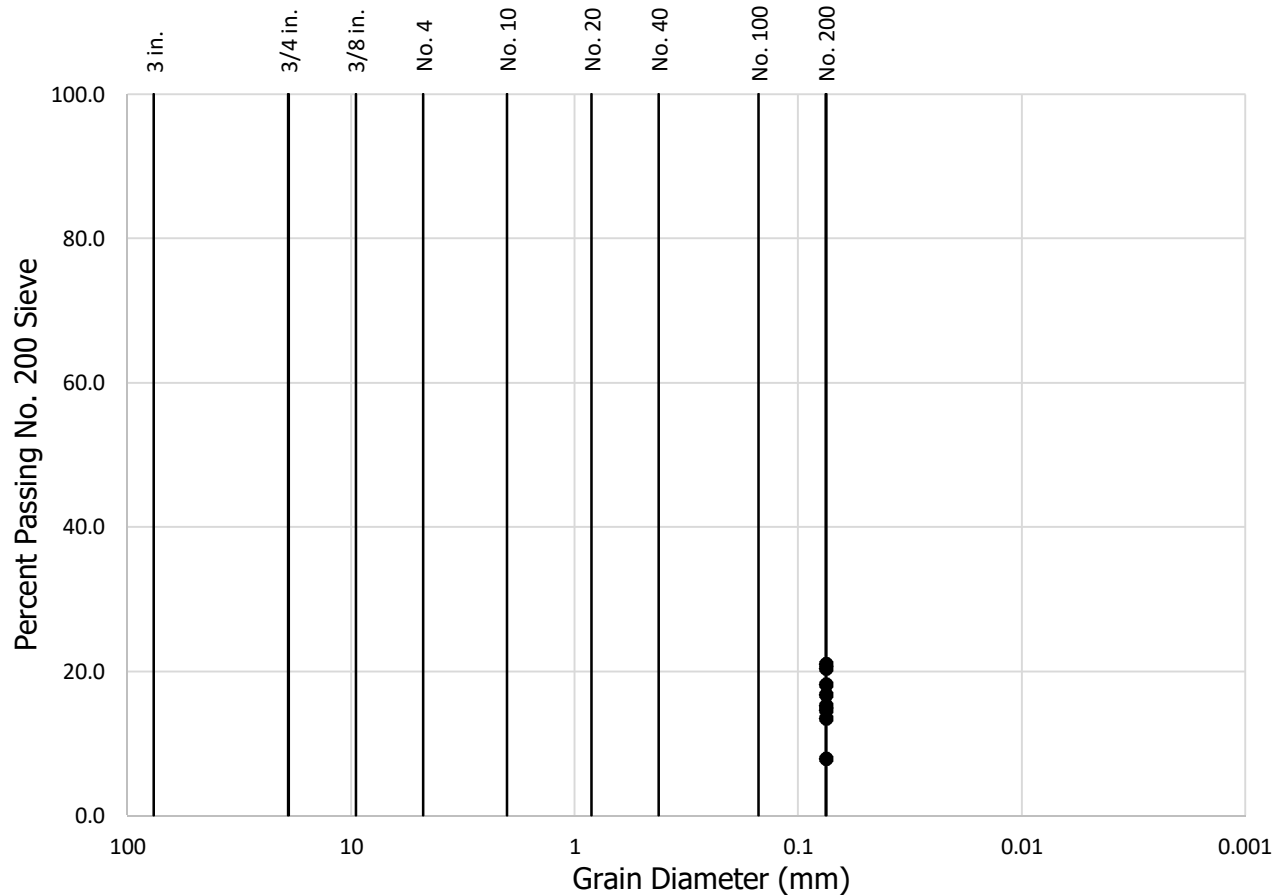
WATER ADDED AT 2.0 KSF



SAMPLE ID.	SOIL TYPE	DRY DENSITY (PCF)	INITIAL MOISTURE (%)	FINAL MOISTURE (%)
B4@22.5	Silty Sand (SM)	117.8	8.0	13.3

	CONSOLIDATION TEST RESULTS ASTM D-2435	Project No.: W1582-06-01	
		Twelve Oaks Senior Living Facility 2820 Sycamore Avenue Glendale, California	
	Checked by: PZ	August 2022	Figure B12

GRAVEL		SAND			SILT AND CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



Sample No.	Percent Passing No. 200 Sieve
B1 @ 5'	15.3
B1 @ 10'	14.6
B1 @ 15'	21.0
B1 @ 20'	7.8
B1 @ 25'	18.1
B1 @ 30'	16.7
B1 @ 34'	13.4
B1 @ 39'	20.4



GRAIN SIZE ANALYSIS

ASTM D-1140

Checked by: PZ

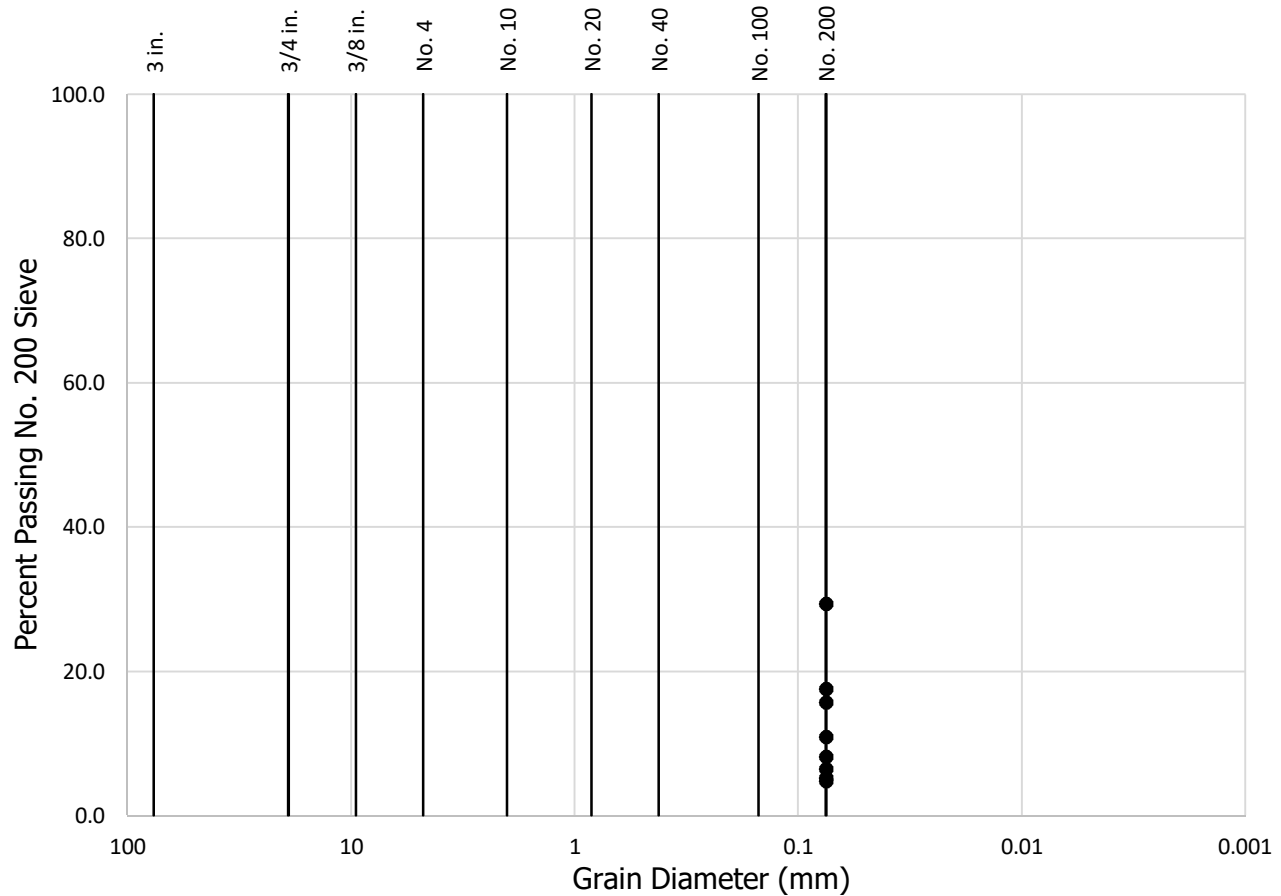
Project No.: W1582-06-01

Twelve Oaks Senior Living Facility
2820 Sycamore Avenue
Glendale, California

August 2022

Figure B13

GRAVEL		SAND			SILT AND CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	



Sample No.	Percent Passing No. 200 Sieve
B4 @ 5'	5.2
B4 @ 10'	4.7
B4 @ 15'	10.9
B4 @ 20'	8.1
B4 @ 25'	17.5
B4 @ 30'	15.7
B4 @ 35'	6.4
B4 @ 38.5'	29.3

B1@0-5'

MOLDED SPECIMEN		BEFORE TEST	AFTER TEST
Specimen Diameter	(in.)	4.0	4.0
Specimen Height	(in.)	1.0	1.0
Wt. Comp. Soil + Mold	(gm)	791.2	803.5
Wt. of Mold	(gm)	368.0	368.0
Specific Gravity	(Assumed)	2.7	2.7
Wet Wt. of Soil + Cont.	(gm)	487.4	803.5
Dry Wt. of Soil + Cont.	(gm)	466.2	393.3
Wt. of Container	(gm)	187.4	368.0
Moisture Content	(%)	7.6	10.7
Wet Density	(pcf)	127.7	131.2
Dry Density	(pcf)	118.6	118.5
Void Ratio		0.4	0.4
Total Porosity		0.3	0.3
Pore Volume	(cc)	61.3	60.8
Degree of Saturation	(%) [S_{meas}]	49.1	69.3

Date	Time	Pressure (psi)	Elapsed Time (min)	Dial Readings (in.)
6/30/2022	10:00	1.0	0	0.3215
6/30/2022	10:10	1.0	10	0.321
Add Distilled Water to the Specimen				
7/1/2022	10:00	1.0	1430	0.3185
7/1/2022	11:00	1.0	1490	0.3185

Expansion Index (EI meas) =	-2.5
Expansion Index (Report) =	0

Expansion Index, EI_{50}	CBC CLASSIFICATION *	UBC CLASSIFICATION **
0-20	Non-Expansive	Very Low
21-50	Expansive	Low
51-90	Expansive	Medium
91-130	Expansive	High
>130	Expansive	Very High

* Reference: 2019 California Building Code, Section 1803.5.3

** Reference: 1997 Uniform Building Code, Table 18-I-B.

	EXPANSION INDEX TEST RESULTS ASTM D-4829	Project No.:	W1582-06-01
		Twelve Oaks Senior Living Facility 2820 Sycamore Avenue Glendale, California	
	Checked by: PZ	August 2022	Figure B15

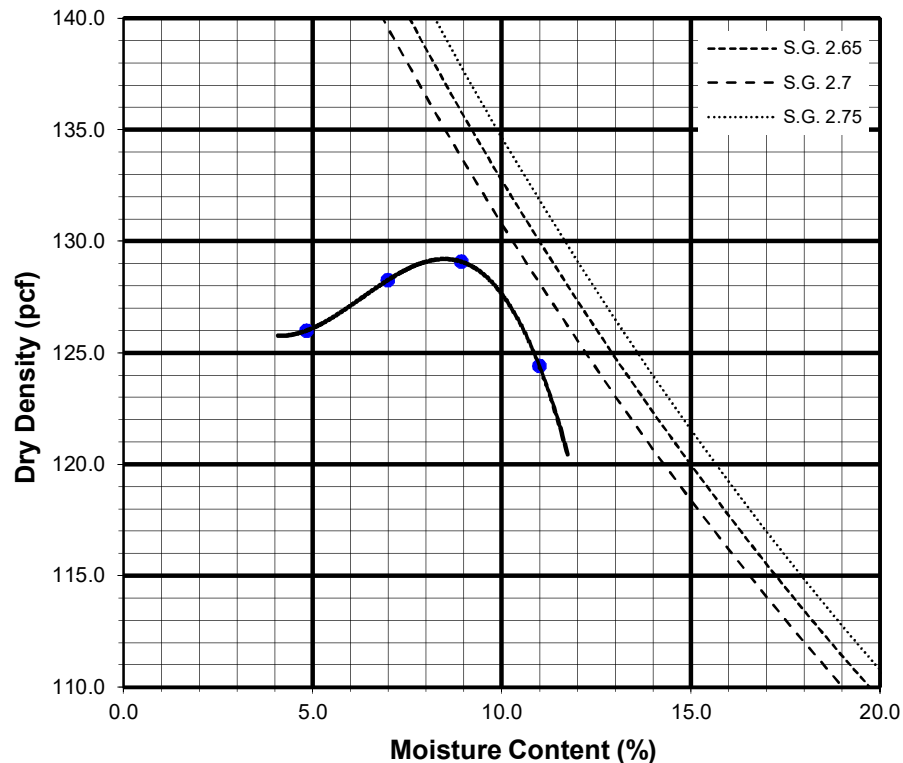
Sample No:

B1@0-5'	Well-Graded Sand (SW)
----------------	-----------------------

TEST NO.		1	2	3	4	5	6
Wt. Compacted Soil + Mold	(g)	6089	6166	6218	6179		
Weight of Mold	(g)	4100	4100	4100	4100		
Net Weight of Soil	(g)	1989	2066	2118	2079		
Wet Weight of Soil + Cont.	(g)	635.0	732.1	724.0	668.6		
Dry Weight of Soil + Cont.	(g)	612.5	693.3	676.7	615.0		
Weight of Container	(g)	146.8	137.5	146.9	127.4		
Moisture Content	(%)	4.8	7.0	8.9	11.0		
Wet Density	(pcf)	132.1	137.2	140.6	138.1		
Dry Density	(pcf)	126.0	128.2	129.1	124.4		

Maximum Dry Density (pcf)	129.0
Bulk Specific Gravity (dry)	2.65
Corrected Maximum Dry Density (pcf)	131.5

Optimum Moisture Content (%)	9.0
Oversized Fraction (%)	9.0
Corrected Moisture Content (%)	8.0



Preparation Method: A



**COMPACTION CHARACTERISTICS USING
MODIFIED EFFORT TEST RESULTS**
ASTM D-1557

Checked by: PZ

Project No.: W1582-06-01

Twelve Oaks Senior Living Facility
2820 Sycamore Avenue
Glendale, California

August 2022

Figure B16

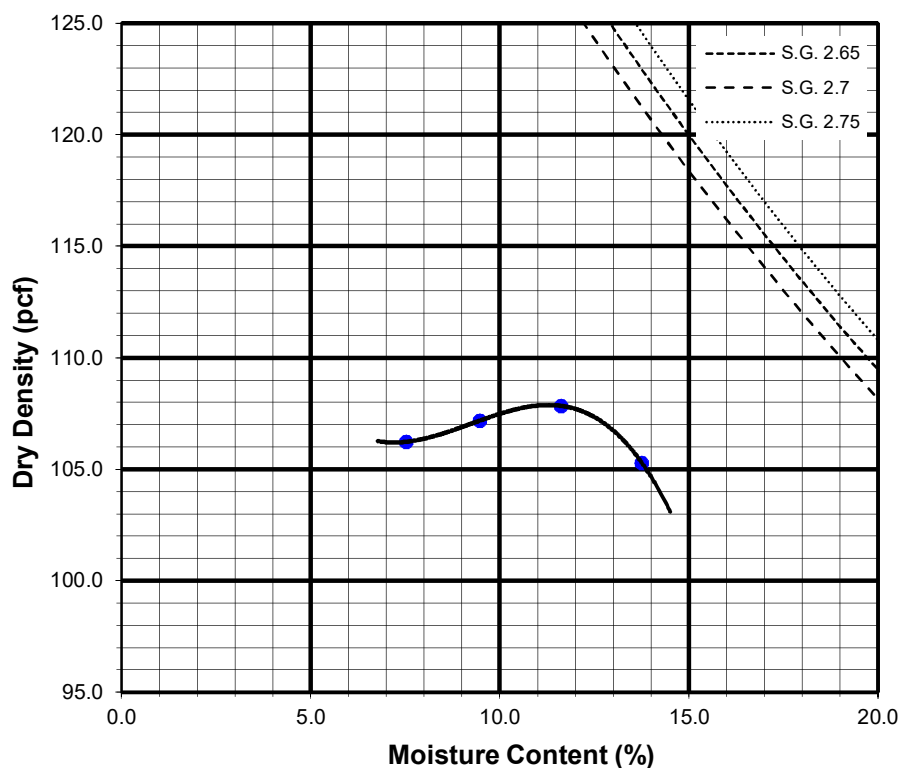
Sample No:

B5@0-2.5'	Well-Graded Sand with Gravel (SW)
------------------	-----------------------------------

TEST NO.		1	2	3	4	5	6
Wt. Compacted Soil + Mold	(g)	5820	5867	5913	5904		
Weight of Mold	(g)	4100	4100	4100	4100		
Net Weight of Soil	(g)	1720	1767	1813	1804		
Wet Weight of Soil + Cont.	(g)	630.8	629.3	620.6	632.2		
Dry Weight of Soil + Cont.	(g)	597.0	585.8	570.2	571.0		
Weight of Container	(g)	147.9	126.2	136.0	125.9		
Moisture Content	(%)	7.5	9.5	11.6	13.8		
Wet Density	(pcf)	114.2	117.3	120.4	119.8		
Dry Density	(pcf)	106.2	107.2	107.8	105.3		

Maximum Dry Density (pcf)	108.0
Bulk Specific Gravity (dry)	2.65
Corrected Maximum Dry Density (pcf)	115.5

Optimum Moisture Content (%)	11.5
Oversized Fraction (%)	19.0
Corrected Moisture Content (%)	9.5



Preparation Method: B



**COMPACTION CHARACTERISTICS USING
MODIFIED EFFORT TEST RESULTS**

ASTM D-1557

Checked by: PZ

Project No.: W1582-06-01

Twelve Oaks Senior Living Facility
2820 Sycamore Avenue
Glendale, California

August 2022

Figure B17

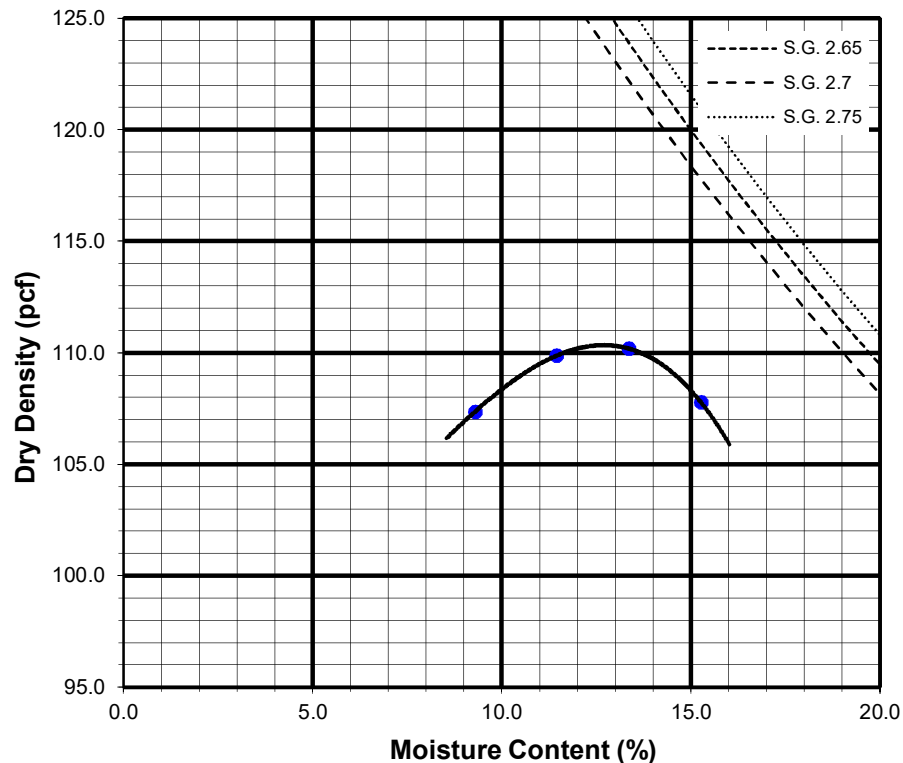
Sample No:

B6@0-3'	Poorly Graded Sand with Gravel (SP)
----------------	-------------------------------------

TEST NO.		1	2	3	4	5	6
Wt. Compacted Soil + Mold (g)		5867	5944	5981	5971		
Weight of Mold (g)		4100	4100	4100	4100		
Net Weight of Soil (g)		1767	1844	1881	1871		
Wet Weight of Soil + Cont. (g)		622.5	665.9	636.7	654.6		
Dry Weight of Soil + Cont. (g)		581.9	610.4	578.8	584.5		
Weight of Container (g)		145.0	125.6	145.4	125.4		
Moisture Content (%)		9.3	11.4	13.4	15.3		
Wet Density (pcf)		117.3	122.4	124.9	124.2		
Dry Density (pcf)		107.4	109.9	110.2	107.8		

Maximum Dry Density (pcf)	110.5
Bulk Specific Gravity (dry)	2.65
Corrected Maximum Dry Density (pcf)	116.5

Optimum Moisture Content (%)	13.0
Oversized Fraction (%)	15.0
Corrected Moisture Content (%)	11.0



Preparation Method: B



**COMPACTION CHARACTERISTICS USING
MODIFIED EFFORT TEST RESULTS**
ASTM D-1557

Checked by: PZ

Project No.: W1582-06-01

Twelve Oaks Senior Living Facility
2820 Sycamore Avenue
Glendale, California

August 2022

Figure B18