PARTNER

GEOTECHNICAL REPORT

Fallbrook Point
Roscoe Boulevard and Fallbrook Avenue
Los Angeles, California 91304

June 23, 2021
Partner Project Number: 20-285404.1

Prepared for:

Staley Point Capital
1801 Century Park East, Suite 1050
Los Angeles, California 90067

Engineers who understand your business

PARTNER

June 23, 2021

Daniel Jacobs
Staley Point Capital
1801 Century Park East, Suite 1050
Los Angeles, California 90067

Subject: **Geotechnical Report**
Fallbrook Point
Roscoe Boulevard and Fallbrook Avenue
Los Angeles, California 91304
Partner Project No. 20-285404.1

Dear Daniel Jacobs:

Partner Assessment Corporation (Partner) presents the following general opinion regarding the geotechnical conditions at the subject site, based on the information contained within this geotechnical report and our general experience with construction practices and geotechnical conditions on other sites. This statement does not constitute an engineering recommendation.

- *The geotechnical conditions on the site related to the planned construction are expected to be similar to more difficult in comparison with other similar sites*; given challenges associated with deep fill across the site.*

The descriptions and findings of our geotechnical report are presented for your use in this electronic format, for your use as shown in the hyperlinked outline below. To return to this page after clicking a hyperlink, hold "alt" and press the "left arrow key" on your keyboard.

We appreciate the opportunity to be of service during this phase of the work.

Sincerely,

PROFESSIONAL ENGINEER
MATTHEW MARCUS
GE 3156
EXP. 09/30/2021
GEOTECHNICAL
STATE OF CALIFORNIA

Matthew Marcus, GE, PG
Principal Geotechnical Engineer/Geologist

Yuri Kawashima, GIT
Project Geologist

** "similar sites" refers to sites with similar planned and current use, where we have recently performed similar work, and is a general statement not based on statistical analysis.*

1. GEOTECHNICAL EXECUTIVE SUMMARY

The executive summary is meant to consolidate information provided in more detail in the body of this report. This summary in no way replaces or overrides the detailed sections of the report.

Geologic Zones and Site Hazards:

The site is located in the West Hills neighborhood of the City of Los Angeles within the Peninsular Ranges geomorphic province of the state of California. Surficial geology at the site can be described as an artificial fill pad (about 10 to 12 feet thick) placed over alluvium sourced from nearby alluvial fans and stream channels. Alluvial deposits consist of sands, silts, and clays, with bedrock located at depth below the ground surface. The site grades are relatively flat, sloping down slightly to the south. The site is currently part of a paved parking lot for Thermo Fisher Scientific. The site may be impacted by existing buried foundations, utility lines, undocumented fills as well as other remnants of previous construction. This portion of the state is prone to ground shaking and the site is susceptible to less than 1 inch of liquefaction induced settlements.

Excavation Conditions

We anticipate excavations on the site to depths of up to 12 feet to remove undocumented fills from the new building areas. In general, the excavations can be sloped or stepped at 1:1, however, in some areas, we understand that support of excavation shoring may be needed. Parameters for this are provided in Section 5.2. Based on our boring data, conventional construction equipment in good working condition should be able to perform the planned excavations. Undocumented fills and remnants of previous construction on the site may be wet and could cave or be difficult to remove and require additional planning and equipment. We do not anticipate groundwater will impact the site excavations, though some areas of wet or saturated fill may be present due to overwatering of existing irrigation.

Foundation/Slab Support

Given the site challenges of a 12-ft thick pad of undocumented, wet fill we anticipate that the new structure may be supported on conventional spread foundations supported on a newly placed engineered fill pad. Alternatively, the buildings could be constructed with a structural grade beam slab (waffle slab) supported on deep foundations or a mat slab or waffle slab supported on a field of aggregate piers – recommendations can be provided for these upon request. Assuming that the undocumented fills are to be removed and replaced with an engineered fill pad, the base of over-excavation should be evaluated by the engineer, with additional removal of soft or deleterious material if needed and should then be compacted in-place prior to the placement of the new fill. The backfill of the over-excavation should be completed with fill more than 5 feet below finished grade compacted to 95% of its maximum dry density.

Soil Reuse

Based on our borings, site soils will generally be suitable for reuse though the moisture content at the time of exploration indicates that significant efforts to dry the material will be needed prior to reuse, which could include aeration or treatment with hydrated lime. Existing structural materials such as concrete, asphalt, crushed aggregate, or others could potentially be reused as site fills if processed to meet fill requirements on the site. Engineered fill on the site should be moisture conditioned and compacted to 90% of the Proctor determined maximum dry density, in accordance with Appendix C of this report.

Pavement Design:

Roadway Type	Subgrade Preparation	Pavement Section
Parking Area Drives	Proofrolled/Compacted Subgrade	3 in. asphalt / 8 in. aggregate base
Parking Area Heavy Duty (loading)	Proofrolled/Compacted Subgrade	8 in. concrete / 4 in. aggregate base

2. REPORT OVERVIEW & LIMITATIONS

2.1 Report Overview

To develop this report, Partner accessed existing information and obtained site specific data from our exploration program. Partner also used standard industry practices and our experience on previous projects to perform engineering analysis and provide recommendations for construction along with construction considerations to guide the methods of site development. The opinions on the cover letter of this report do not constitute engineering recommendations, and are only general, based on our recent anecdotal experiences and not statistical analysis. Section 1.0, Executive Geotechnical Summary, compiles data from each of the report sections, while each of sections in the report presents a detailed description of our work. The detailed descriptions in Section 5.0 and Appendix C constitute our engineering recommendations for the project, and they supersede the Executive Geotechnical Summary.

The report overview, including a description of the planned construction and a list of references, as well as an explanation of the report limitations is provided in Section 2.0. The findings of Partner's geologic review are included in Section 3.0 Geologic Conditions and Hazards. The descriptions of our methods of exploration and testing, as well as our findings are included in Section 4.0 Geotechnical Exploration and Laboratory Results. In addition, logs of our exploration excavations are included in Appendix A of the report, and laboratory testing is included in Appendix B of the report. Site Location and Site Plan maps are included as Figures in the report.

2.2 Assumed Construction

Partner's understanding of the planned construction was based on information provided by the project team. The proposed site plan is included as Figure 2 to this report. Partner's assumptions regarding the new construction are presented in the below table.

Property Data	
Property Use:	Commercial / Residential
Building footprint/height	Three, two-story buildings/ Building 1: 51,040 total sf, Buildings 2: 34,390 total sf, Building 3: 18,100 total sf
Land Acreage (Ac):	Approximately 7.01 acres
Number of Buildings:	3
Expected Cuts and Fills	Final grades within 2 feet of existing – roughly 10 to 12 ft over-ex
Type of Construction:	Unknown, assumed slab on grade with concrete tilt up or light weight wood framing
Foundations Type	Unknown, shallow/deep foundations
Anticipated Loads	Assumed 2,000 psf
Traffic Loading	Paved parking lot
Site Information Sources:	Psomas, Grading and Over-ex Study, dated 4/29/21

2.3 References

The following references were used to generate this report:

Federal Emergency Management Agency, FEMA Flood Map Service Center, accessed 9/24/20

Google Earth Pro (Online), accessed 9/24/20

Historic Aerials by NETR Online, accessed 9/24/20

United States Geological Survey, California Interactive Geologic Map accessed 9/24/20

United States Geological Survey, Lower 48 States 2014 Seismic Hazard Map, accessed online 9/24/20

National Geologic Map Database, Dibblee, T.W., and Ehrenspeck, H.E., ed., 1992, Geologic map of the Calabasas quadrangle, Los Angeles and Ventura Counties, California: Dibblee Geological Foundation, Dibblee Foundation Map DF-37, scale 1:24,000, accessed 9/24/20

United States Geologic Survey, Earthquake Hazards Program (Online), accessed 9/24/20

United States Department of Agriculture, Natural Resources Conservation Service, WebSoil Survey, accessed 9/24/20

Structural Engineers Association of California (SEAOC), and Office of Statewide Health Planning and Development (OSHPD) Seismic Design Maps, accessed 9/24/20

California State Water Resources Control Board, GeoTracker, accessed 9/24/20

2.4 Limitations

The conclusions, recommendations, and opinions in this report are based upon soil samples and data obtained in widely spaced locations that were accessible at the time of exploration and collected based on project information available at that time. Our findings are subject to field confirmation that the samples we obtained were representative of site conditions. If conditions on the site are different than what was encountered in our borings, the report recommendations should be reviewed by our office, and new recommendations should be provided based on the new information and possible additional exploration if needed. It should be noted that geotechnical subsurface evaluations are not capable of predicting all subsurface conditions, and that our evaluation was performed to industry standards at the time of the study, no other warranty or guarantee is made.

Likewise, our document review and geologic research study made a good-faith effort to review readily available documents that we could access and were aware of at the time, as listed in this letter. We are not able to guarantee that we have discovered, observed, and reviewed all relevant site documents and conditions. If new documents or studies are available following the completion of the report, the recommendations herein should be reviewed by our office, and new recommendations should be provided based on the new information and possible additional exploration if needed.

This report is intended for the use of the client in its entirety for the proposed project as described in the text. Information from this report is not to be used for other projects or for other sites. All of the report must be reviewed and applied to the project or else the report recommendations may no longer apply. If pertinent changes are made in the project plans or conditions are encountered during construction that appear to be different than indicated by this report, please contact this office for review. Significant variations may necessitate a re-evaluation of the recommendations presented in this report. The findings in this report are valid for one year from the date of the report. This report has been completed under specific Terms and Conditions relating to scope, relying parties, limitations of liability, indemnification, dispute resolution, and other factors relevant to any reliance on this report. Any parties relying on this report do so having accepted Partner's standard Terms and Conditions, a copy of which can be found at http: / www.partneresi.com/terms-and-conditions.php

If parties other than Partner are engaged to provide construction geotechnical services, they must be notified that they will be required to assume complete responsibility for the geotechnical phase of the project by concurring with the findings and recommendations in this report or providing alternate recommendations.

3. GEOLOGIC CONDITIONS & HAZARDS

This section presents the results of a geologic review performed by Partner, for the proposed new construction on site. The general location of the project is shown on Figure 1.

3.1 Site Location and Project Information

The planned construction will be situated on a lot currently developed with a Thermo Fisher Scientific facility within a mixed commercial/residential area of West Hills, California. The immediately surrounding properties consist of commercial or residential properties on all sides. Figure 2 presents the project site and the locations of our site exploration. Based on our review of available documents, the site has had the following previous uses:

Historical Use Information		
Period/Date	**Source**	**Description/Use**
1952	Aerial Photographs	Possible agricultural use
1959-1989	Aerial Photographs, Topographic Maps	Vacant Lot
1994	Aerial Photographs, Topographic Maps	Possible grass covered field
2002-Present	Aerial Photographs, Topographic Maps, Building Records	Current use

3.2 Geologic Setting

The subject property is situated within the City of Los Angeles, part of the Peninsular Ranges physiographic province of the state of California. The site is currently developed as a parking lot supported on a fill pad that is roughly 10 to 12 feet thick. The uppermost geologic formation underlying the fill soils at the subject property is Holocene to Pleistocene-age old alluvium deposits.

The subject property is mapped as Anacapa-Urban land complex, 0 to 2 percent slopes. An Urban land designation indicates that more than 85% of the original soils have been disturbed or covered by paved surfaces, buildings, or other structures. Due to the variability of the soil material, on-site investigation would be required to determine the specific soil composition at the subject property. Most areas are nearly level to gently sloping due to extensive grading and smoothing. Urban land is so modified by cuts and fills for works and structures that identification of the soil is not feasible. Soil materials underlying Urban land are ordinarily the same as the minor inclusions. The Anacapa series consist of mainly coarse-loamy, mixed alluvial soils derived from sandstone and shale.

A general summary of the geologic data compiled for this project is provided in the below table.

Geologic Data		
Parameter	**Value**	**Source**
Geomorphic Zone	Peninsular Ranges	CGS
Ground Elevation	850-860 feet above Mean Sea Level	USGS
Flood Elevation	Zone X (0.2% Flood Hazard)	FEMA
Seismic Hazard Zone	Low to Moderate	USGS

Geologic Data		
Parameter	**Value**	**Source**
Geologic Hazards	Liquefaction	CGS
Surface Cover	Asphalt	Partner Borings
Site Modifications	Previous agricultural use	Historical Aerials
Surficial Geology	Alluvium	USGS
Depth to Bedrock	Unknown	Partner Boring
Groundwater Depth	Not Encountered	Partner Boring Log

3.3 Geologic Hazards

California is tectonically active and contains numerous large, active faults. As a result, geologic hazards with the greatest potential to affect California include earthquakes and related hazards such as tsunamis, landslides, liquefaction, and ground shaking. The site was mapped within a zone of seismic hazard for liquefaction. According to the California Department of Conservation's Fault Activity Map of California, the three faults most relevant to the site are the Chatsworth fault (0.4 miles from the site), Northridge Hills fault (3.7 miles from the site), and Mission Hills fault zone (8.7 miles from the site.) Based on our evaluation, the site is susceptible to roughly 0.5 inches of liquefaction induced settlement. Ground shaking should be anticipated at the project site during the lifetime of the project.

3.4 Seismic Design Parameters

The site latitude and longitude are 34.220488 degrees N and -118.624461 degrees W respectively

Based on the recent edition of the American Society of Civil Engineers (ASCE), document 7-16, a site-specific ground motion hazard analysis (GMHA) is required for sites with:

- Structures on Site Class E with Ss greater than or equal to 1.0
- Structures on Site Class D and E sites with S_1 greater than or equal to 0.2.

However, exemptions are:

1) Structures on Site Class E sites with Ss greater than or equal to 1.0, provided the site coefficient F_a is taken as equal to that Site Class C.

2) Structures on Site Class D with S_1 greater than or equal to 0.2, provided the value of the seismic response coefficient Cs is determined by Eq. 12.8-2 for values of T <=1.5*Ts and taken as equal to 1.5 times the value computed in accordance with either: Eq. (12.8-3) for 1.5 Ts <=T <=TL or Eq.(12.8-4) for T>TL

3) Structures on Site Class E with S_1 greater than or equal to 0.2 provided that T is less than or equal to Ts and the equivalent static force procedure is used for design.

The site qualifies for exemption #1. Therefore, a site-specific ground motion hazard analysis is NOT needed for this site.

Based on boring logs and SPT N values, the site is determined to be Site Class E according to SEAOC (Structural Engineers Association of California) /OSHPD (Office of Statewide Health Planning and Development) Seismic Design Maps for ASCE 7-16.

The recommended MCE_R and design-level spectral response parameters for Site Class E conditions are tabulated below. Values were calculated using the ASCE 7-16 and the National Earthquake Hazards Reduction program (NEHRP) document, Recommended Seismic Provision for New Buildings and Other Structures. State, County, City, and other jurisdictions in seismically active areas update seismic standards on a regular basis. The design team should carefully evaluate all of the building requirements for the project.

Seismic Item	Value	Seismic Item	Value
Site Classification	E	Seismic Design Category	D
F_a	1.2	F_v	2.0
S_s	1.50g	S_1	0.60g
S_{MS}	1.80g	S_{M1}	1.20g
S_{DS}	1.20g	S_{D1}	0.80g
MCE_G PGA	0.588g	Design PGA (2/3 MCE_G)	0.392g

4. GEOTECHNICAL EXPLORATION & LABORATORY RESULTS

Our evaluation of soils on the site included field exploration and laboratory testing. The field exploration and laboratory testing programs are briefly described below. Data reports from the field exploration and laboratory testing are provided in Appendix A and Appendix B, respectively.

4.1 Soil Borings

The soil boring program was conducted on August 26, 27, and 28, 2020. Thirteen (13) borings and three (3) percolation tests were advanced by the use of a truck-mounted drill using hollow-stem auger drilling technique. The borings were made to depths of 20 to 50 feet in the building footprints (B1 to B11). The infiltration tests (P1 to P3) were conducted at 10 to 20 feet in the suggested infiltration areas. The approximate locations of the exploratory borings are shown on Figure 2.

Logs of subsurface conditions encountered in the borings were prepared in the field by a representative of Partner Engineering. Soil samples consisting of relatively undisturbed Standard Penetration Tests (SPT) samples were collected at approximately 2.5 and 5-foot depth intervals and were returned to the laboratory for testing. The SPTs were performed in accordance with ASTM D 1586. Typed boring logs were prepared from the field logs and are presented in Appendix A. A summary table description is provided below:

Surficial Geology		
Strata	**Depth to Bottom of Layer (bgs*)**	**Description**
Surface Cover	Up to 4 inches	Asphalt
Fill Material	Up to 12 feet	Clayey silty soils
Native Stratum 1	25 feet	Silty sandy soils
Native Stratum 2	51.5 feet	Silty sandy soils with clay lenses
Groundwater	Not Encountered	In boring
Bedrock	Unknown	Not observed

bgs – below ground surface

4.2 Groundwater/Soil Moisture:

Groundwater was not encountered in any borings advanced at the time of drilling. However, groundwater levels fluctuate over time and may be different at the time of construction and during the project life.

4.3 Laboratory Evaluation

Selected samples collected during drilling activities were tested in the laboratory to assist in evaluating engineering properties of subsurface materials at the site. Soil samples were submitted to a Los Angeles certified testing laboratory, Hamilton and Associates TA10199 during both soil boring programs. Letters from Hamilton and Associates approving the use of their results are attached in Appendix B. We have reviewed their laboratory data provided on May 16, 2019 and agree with the results. Tests performed included in-place moisture and density, sieve analysis, consolidation and Atterberg limits. The results of laboratory analyses are presented in the boring logs in Appendix A.

4.4 Infiltration Test Results:

Three infiltration tests were performed, as shown on Figure 2. The tests were performed at depths of 10 to 20 feet. The testing was performed using the borehole percolation test method. The measured infiltration rates are reported below and are unfactored. The civil engineer should apply the proper reduction factors or factors of safety based on the type of system used. Data is shown in Appendix B, and is summarized below:

Parameter	P1	P2	P3
Location	North Infiltration Area	Center Infiltration Area	Bldg 1 Area
Elevation of Tested Area	20 feet	10 feet	20 feet
Pre-soak Depth	14.27 feet	4.17 feet	18.08 feet
Test Start Depth	224.64 in.	86.16 in.	208.20 in.
Water Drop During Test	1.9 in.	1.3 in.	16.1 in.
Unfactored Infiltration Rate	**0.63 in./hr**	**0.24 in./hr**	**2.19 in./hr**

5. GEOTECHNICAL RECOMMENDATIONS & PARAMETERS

The following discussion of findings for the site is based on the assumed construction, geologic review, results of the field exploration, and laboratory testing programs. The recommendations of this report are contingent upon adherence to Appendix C of this report, General Geotechnical Design and Construction Considerations. For additional details on the below recommendations, please see Appendix C.

5.1 Geotechnical Recommendations

The proposed construction is generally feasible from a geotechnical perspective provided the recommendations and assumptions of this report are followed.

Geologic/General Site Considerations

- The site is located in the West Hills neighborhood of the City of Los Angeles within the Peninsular Ranges geomorphic province of the state of California. Surficial geology at the site can be described as an artificial fill pad (about 10 to 12 feet thick) placed over alluvium sourced from nearby alluvial fans and stream channels. Alluvial deposits consist of sands, silts, and clays, with bedrock located at depth below the ground surface. The site grades are relatively flat, sloping down slightly to the south. The site is currently part of a paved parking lot for Thermo Fisher Scientific. The site may be impacted by existing buried foundations, utility lines, undocumented fills as well as other remnants of previous construction. This portion of the state is prone to ground shaking and the site is susceptible to liquefaction induced settlements on the order of 1 inch or less as further described in Section 5.2 and Appendix D.
- Given the presence of the site in a seismically active area, ground shaking during earthquakes should be anticipate during the project life. State, County, City, and other jurisdictions in seismically active areas update seismic standards on a regular basis. The design team should carefully evaluate all of the building requirements for the project. As previously mentioned, this portion of the state is prone to ground shaking; however, the site is not mapped within a geologic hazard zone and no geologic hazards are known or suspected on the site.

Excavation Considerations

- We anticipate excavations on the site to depths of up to 12 feet to remove undocumented fills from the new building areas. In general site soil in the upper 12 feet is OSHA Class B and as such, the excavations can be sloped or stepped at 1:1. However, in some areas, given the depth of the planned excavation and the presence of nearby structures, a specially designed will be needed to establish over-excavation depths. Such a system would likely consist of a drilled soldier pile wall with lagging and soil anchors or rakers. The design of this system should be performed by the contractor performing the work and should consider the impacts of installing anchors and deflection of the soil behind the walls. These factors could result in damage to surrounding properties. The design can use soil data from section 5.2 of this report. Appendix C of this report contains a section regarding additional Excavation and Dewatering considerations.

- Based on our boring data, conventional construction equipment in good working condition should be able to perform the planned excavations. The top of excavation should be carefully planned and surveyed, with saw-cutting of existing asphalt and concrete and other measures put in to place to protect structures at the top of slopes. The slopes should be carefully monitored for safety purposes, and traffic, stockpiled materials, equipment etc. should be kept a safe distance away from the excavation to prevent falls and slope failures. Undocumented fills and remnants of previous construction on the site may be wet and could cave or be difficult to remove and require additional planning and equipment. We do not anticipate groundwater will impact the site excavations, though some areas of wet or saturated fill may be present due to overwatering of existing irrigation.
- Groundwater was not encountered during drilling. However, groundwater levels can fluctuate over time, and some areas of very wet to saturated soils were encountered due to overwatering. Excavations should be sloped and/or shored to protect worker safety and adjacent properties, per OSHA and local guidelines and the presence of existing utilities should be thoroughly and carefully checked prior to digging. Appendix C further discusses excavation recommendations in the following sections, which can be accessed by clicking hyperlinks: Earthwork, Underground Pipeline, Excavation De-Watering.

Remedial Fill Considerations

- Given the deep over-excavation for remedial grading on the site, benching of excavations will be needed as shown in the attached Grading Plans Cross Sections. We anticipate cuts and fills of 12 feet. City of Los Angeles requires fill over-excavation that extends laterally from the foundation edge a distance equal to the fill depth. However, given the depth of 12 feet of removal, and the Newmark solution of Bousinesq Equations (1935), stress from strip foundations is reduced to below 10% at a clear distance of 1.5 foundation widths laterally from the foundation edge. The furthest lateral extent of the stress bulb should occur at roughly approximately 7 ft below grade. As such, the 10 foot base of excavation with a 1:1 slope width is suitable to contain the foundation loads within the new engineered fill prism. In addition, the narrowest fill area, supported by shoring would provide a 7-foot clear distance from the new building to the shoring, which would also be adequate.
- We understand that a sewer line relocation is also planned along a part of the project. The line will be exposed at the base of the building over-excavation and will be re-routed outside of the zone of influence for new foundations. At the transitions between pipe sections left in-place and those to be newly installed and covered with new engineered fill, we recommend the use of flexible fittings. In addition, the pipes should be properly bedded and shaded to ½ the diameter on either side and covered to 1-foot above the top of pipe, with compacted roadway aggregate base or soil cement slurry. This can be done by re-exposing the pipe after mass fill or by the use of forms placed during mass fill operations or by other methods.
- Based on our boring data, conventional construction equipment in good working condition should be able to perform the planned excavations. The cut slopes will require benching and keying per California Building Code Appendix J specifications. Excavations should be sloped and/or shored to protect worker safety and adjacent properties, per OSHA and local guidelines. As previously stated, the site soil should be considered as OSHA Class B. Evaluation of the base of excavation, and

preparation for the placement of new fill should proceed per recommendations following in "On-Grade Construction Considerations", and "Soil Reuse Considerations" headers.

Foundations

- Given the site challenges of a 12-ft thick pad of undocumented wet fill, we anticipate that the new structure may be supported on conventional spread foundations supported on a newly placed engineered fill pad. The base of over-excavation should be evaluated by the engineer, with additional removal of soft or deleterious material if needed and should then be compacted in-place prior to the placement of the new fill pad. The backfill of the over-excavation should be completed with fill compacted to 95% of its maximum dry density for fills deeper than 5 feet below finished grade.
- We understand that an existing storm drainpipe passes below the building at a depth of roughly 10 feet below the strip foundation elevation at two locations. Assuming a maximum foundation width of 2 feet in that location, roughly 15% of the foundation load should be considered to impact the top of the pipe. We recommend that the top of the pipe be exposed during grading and be evaluated to verify the construction is adequate to function under the slightly elevated vertical stress due to the new fills and foundation.
- The base of excavation for new foundations should be evaluated by the engineer, with additional removal of soft or deleterious material if needed and should then be compacted in-place prior to the placement of new fills or foundations. Areas for new slabs on grade should be evaluated by proofrolling with soft, unstable areas removed and replaced with compacted fill.
- Section 5.2 of this report provides a table outlining the embedment depth, bearing capacity, settlement and other parameters for foundation design and construction.

On-Grade Construction Considerations

- In new structural areas of the site, all remnants of previous construction, vegetation and/or deleterious materials should be completely removed to exposed clean subgrade soil. In new fill, structural, and pavement areas, cleaned subgrade should be proofrolled and evaluated by the engineer with a loaded water truck (4,000 gallon) or equivalent rubber-tired equipment. In locations where proofrolling is not feasible, probing, dynamic cone penetration testing or other methods may be employed. Soft or unstable areas should be repaired per the direction of the engineer. Once approved, the subgrade soil should be scarified to a depth of 12 inches, moisture conditioned, and compacted as engineered fill. Improvements in these areas should extend laterally beyond the new structure limits 2 feet or a distance equal to or greater than the layer thickness, whichever is greater. This zone should extend vertically from the bearing grade elevation to the base of the fill. The thicknesses of the layer, settlement estimates, and modulus values are provided on the design tables in the next section.
- Based on our borings, we anticipate that some over-excavation will result from proofrolling operations due to wet soil. In areas where deep instability is encountered, we recommend test pits be excavated and an engineer be called to perform an evaluation of the issue and to propose a resolution. Such resolutions may include but are not limited to: the use of geotextiles, chemical

treatments (soil cement, hydrated lime, etc.) thickened slabs or pavements sections, lime-treated aggregate base, or others. Pavement sections provided in Section 5.2 are based on approved, compacted in-place soils being used in the subgrade. If subgrade conditions in the upper 3 feet of pavement areas vary or are improved, the pavement sections may be modified.

- Appendix C provides additional recommendations for earthwork and on-grade construction in the following sections: Cast-in-place Concrete, Foundations, Earthwork, Paving, Subgrade Preparation which can be accessed by clicking the hyperlinks.

Soil Reuse Considerations

- Based on our borings, site soils will generally be suitable for reuse though the moisture content at the time of exploration indicates that significant efforts to dry the material will be needed prior to reuse. If the material is to be dried and re-used, we anticipate a volume loss of roughly 20% during compaction, given the relatively low density of the site soil. If chemical treatment of the soil using dry quicklime, hydrated lime, cement kiln dust, or other product is performed, we recommend that a mix design be prepared by a geotechnical engineer. In general, we would expect that the goal of the treatment would be to lower the moisture content of the soil so that satisfactory compaction could be achieved. Given the moisture content, treatment using 10% by weight of material would be a reasonable starting assumption for budgeting purposes only. The actual amount needed could vary significantly.
- Existing structural materials such as concrete, asphalt, crushed aggregate, or others could potentially be reused as site fills if processed to meet fill requirements on the site. Engineered fill on the site should be moisture conditioned and compacted to 90% of the Proctor determined maximum dry density, in accordance with Appendix C of this report.
- Appendix C provides additional recommendations for soil reuse in the following sections: EARTHWORK, SUBGRADE PREPARATION which can be accessed by clicking the hyperlinks.

Geotechnical Concrete and Steel Construction Considerations

- Soil/rock may be corrosive to concrete. We recommend using corrosion resistant concrete (*e.g.* Type II/V Portland Cement, a fly ash mixture of 25 percent cement replacement, and a water/cement ratio of 0.45 or less) as directed by the producer, engineer or other qualified party based on their knowledge of the materials and site conditions. Concrete exposed to freezing weather should be air-entrained. Mix designs should be well-established and reviewed by the project engineers prior to placement, to verify the design is appropriate to meet the project needs and parameters provided in this report. Quality control testing should be performed to verify appropriate mixes are used and are properly handled and placed. Please refer to Appendix C, Cast In-Place Concrete for more details.
- Soil/rock may be corrosive to un-protected metallic elements such as pipes, poles, rebar, etc. We recommend the use of coatings and/or cathodic protection for metals in contact with the ground, as directed by the product manufacturer, engineer or other qualified party based on their knowledge of the materials to be used and site soil conditions.

Site Storm Water Considerations

- Based on our infiltration testing performed in the upper 5 to 10 feet of the site, near surface conditions are generally not favorable for storm-water infiltration. Surface drainage and landscaping design should be carefully planned to protect the new structures from erosion/undermining, and to maintain the site earthwork and structure subgrades in a relatively consistent moisture condition. Water should not flow towards or pond near to new structures, and high water-demand plants should not be planned near to structures. Appendix C provides additional recommendations for storm water management in the following sections: SITE GRADING AND DRAINAGE which can be accessed by clicking the hyperlinks.
- We recommend consulting with the landscape designer and civil engineer regarding management of site storm water and irrigation water, as changes in moisture content below the site after construction will lead to soil movement and potential distress to the building.

5.2 Geotechnical Parameters

Based on the findings of our field and laboratory testing, we recommend that design and construction proceed per industry accepted practices and procedures, as described in Appendix C, General Geotechnical Design and Construction Considerations (Considerations).

Prepared Subgrade Parameters – (hyperlink to Construction Considerations)

Prepared Subgrade Parameters				
Structure	**Design Values**	**Cover Depth**	**Bearing Surface** [a]	**Static Settlement** [d]
Slab on Grade	k=150 pci [b] q_{all} = 2.0 ksf[c] μ = 0.40	N/A	Engineered Fill Pad to compacted/approved native soil.	1 inch
Spread Foundations	q_{all} = 3.0 ksf[c] μ = 0.40	18 inches	Engineered Fill Pad to compacted/approved native soil.	1 inch
Mat Foundation or Grade Beam Foundation	q_{all} = 2 ksf[c] μ = 0.35	18 inches	Drilled Shafts or Aggregate Piers	1 inch

[a] Repairs in bearing *surface areas should be structural fill per the recommendation of the Earthwork section of Appendix C that is moisture conditioned to within 3 percent below to optimum moisture content and compacted to 95 percent or more of the soil maximum dry density per ASTM D1557. Expansive material should not be located within the upper* 3 feet of the soil subgrade.

[b] *Subgrade modulus value "k", assuming the grade slab is supported by aggregate layer roughly equal to slab thickness (minimum 4 inches), as required for capillary break*

[c] *Can be increased by 1/3 for temporary loading such as seismic and wind, allowable parameters, estimated FS of 2.5*

[d] *Differential settlement is expected to be half to ¾ of total settlement*

Pavement Design and Construction Recommendations

- In our experience we recommend that multiple different pavement sections be considered for the project for economic and performance reasons. For loading docks and trash enclosures we recommend that thickened reinforced concrete pavement be utilized. For heavily used and ADA parking spaces, etc., we recommend the use of thinner reinforced concrete pavement. For the main drives of the parking lot, we recommend a medium-duty asphalt pavement section, and thinner sections can be used in the parking field if any. We recommend concrete pavements consist of SCDOT, or otherwise jurisdictionally approved mixes, and that paving cross slopes, curbs, and other features conform to the applicable local standard specifications and details.
- Depending on the planned changes to site grading, and the availability of clean granular soil, different pavement sections would be appropriate. These can also be adjusted using treatment using soil cement. The following sections are provided for native soil subgrade conditions. If imported fill is used, the section may need to be adjusted. This information assumes that construction will proceed per the provided Construction Considerations, presented in Appendix C.

Paving Structural Sections – (hyperlink to Construction Considerations)

Pavement Sections		
Roadway Type	**Subgrade Preparation [a]**	**Pavement Section [b]**
Drive Aisles	Proof rolled/Compacted Subgrade	3 in. Asphalt / 8 in. Aggregate Base
Parking Spaces	Proof rolled/Compacted Subgrade	3 in. Asphalt / 4 in. Aggregate Base
ADA Parking Spaces	Proof rolled/Compacted Subgrade	6 in. Concrete/ 4 in. Aggregate Base
Trash Enclosure/ Dumpster Pad	Proof rolled/Compacted Subgrade	8 in. Concrete/ 4 in. Aggregate Base

[a] Repairs in proofrolled areas should be structural fill per the recommendation of the APPCEarthwork (hyperlink to Construction Considerations) that is moisture conditioned to within 3 percent above to optimum moisture content and compacted to 95 percent or more of the soil maximum dry density per ASTM D1557.

[b] 1 inch of pavement may be reduced if 6-in of lime or cement-treated soil is used with a 500 psi 28-day compressive strength. Soils with Plasticity Index of 10 or more are generally candidates for lime treatment, other soils are candidates for cement treatment, if any.

Liquefaction Analysis – (hyperlink to Appendix D)

The obtained data from geologic research, soil borings, and laboratory testing was entered into the Novoliq software program for liquefaction analysis. The SPT blow counts using the modified ring sampler were reduced in half, and the appropriate correction factors were used in the analysis. The historic high groundwater was not published on the California Department of Conservation website, so therefore we selected a depth of 40 feet bgs, though no groundwater was encountered in our borings to 50 feet. Our review of historic records indicates depths of more than 40 feet in all cases. The correction factors we applied to account for the hammer type, sampler type, borehole diameter, and rod length.

The analysis relied on the NCEER Workshop (1997) and the Boulanger Idriss (2014) for layer factors of safety, and Ishihara and Yoshimi (1992) for settlement calculations. The anticipated liquefaction settlement and differential settlement are shown below. In general, spread and deep foundations can tolerate a maximum of 0.75 inches differential settlement and mat foundations can tolerate 2 inches. The detailed analysis is presented in Appendix D.

Liquefaction and Static Settlement Estimates for Foundation Options				
Seismic Item	**Total Seismic Settlement (in)**	**Seismic Differential Settlement (in)**	**Total Static +Seismic Settlement (in)**	**Total Differential Settlement (in)**
Spread	0.5	0.25	1.5	0.75

Differential settlement is assumed to be half of total settlement

Laterally Loaded Structures Parameters– (hyperlink to Construction Considerations)

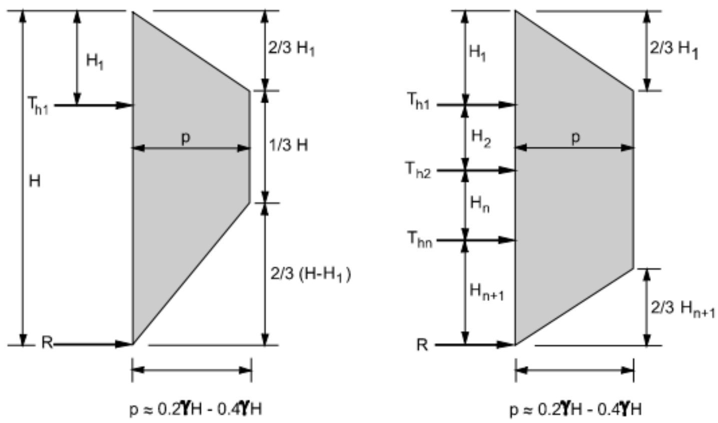
Lateral Earth Pressures [b*]				
Soil Type	**Coefficient of Friction (μ)**	**Static Fluid Pressure (pcf)**	**Active Fluid Pressure (pcf)**	**Passive Fluid Pressure (pcf)**
Undocumented Fill (Upper 10 feet)	0.35	60	45	175
Reworked Fill (Upper 10 ft)	0.35	55	40	225
Native Soil (10 to 20 ft)	0.40	50	35	250

[a] *Assumed GW table at 40 ft bgs, for underground structures where water is only on one side, the hydrostatic pressure of 62.4 psf should be added*

[b] *These loads should be modified by seismic and surcharge loads as shown in the below equations where k = 0.5:*

**Values provided in this table are UNFACTORED. The wall designer should select appropriate safety factors for their design*

The values on the table assume horizontal soil above top of the structure. The below diagram depicts the stress distributions around an anchored soldier pile wall to be used for support of excavation. Depending on the types of walls and soil types encountered, different distributions may be needed. The conditions of this diagram should be carefully considered prior to use, and values given are unfactored. We recommend that a specialty contractor with in-house engineering capability perform the design of temporary shoring.



(a) Walls with one level of ground anchors

(b) Walls with multiple levels of ground anchors

H_1 = Distance from ground surface to uppermost ground anchor

H_{n+1} = Distance from base of excavation to lowermost ground anchor

T_{hi} = Horizontal load in ground anchor i

R = Reaction force to be resisted by subgrade (i.e., below base of excavation)

p = Maximum ordinate of diagram

5.2.2.3 Traffic Surcharge Loading Equations

Table 1*

Equivalent Height of Soil for Vehicular Loading on Retaining Wall and Shoring Parallel to Traffic

Excavation/Wall Height (ft)	Distance from the edge of excavation (ft)	
	0.0 ft	1.0 ft or further
5.0	5.0	2.0
10.0	3.5	2.0
≥20.0	2.0	2.0

* From Table 3.11.6.4-2 of the AASHTO document referenced above.

$$q = k \times \gamma_s \times H_{eq}$$

Where:
- q = lateral surcharge pressure (psf) in rectangular distribution
- k = active or at-rest earth pressure coefficient from Soils Report
- γ_s = total unit weight of soil (pcf)
- H_{eq} = equivalent height of soil from "Table 1" above

5.2.2.4 Foundation Surcharge Equations

Resultant lateral force:

$$R = \frac{0.3Ph^2}{x^2 + h^2}$$

Location lateral resultant:

$$d = x\left[\left(\frac{x^2}{h^2}+1\right)\left(tan^{-1}\frac{h}{x}\right)-\left(\frac{x}{h}\right)\right]$$

WHERE:

R = resultant lateral force measured in pounds per foot (N/m) of wall width.

P = resultant surcharge loads of continuous or isolated footings measured in pounds per foot (N/m) of length parallel to the wall.

X = distance of resultant load from back face of wall measured in feet (mm).

h = depth below point of application of surcharge loading to top of wall footing measured in feet (mm).

d = depth of lateral resultant below point of application of surcharge loading measured in feet (mm).

$\tan^{-1} h/x$ = The angle in radians whose tangent is equal to *h/x*.

Loads applied within a horizontal distance equal to the wall stem height, measured from the back face of the wall, shall be considered as surcharge.

For isolated footings having a width parallel to the wall less than 3 feet (914 mm), "*R*" may be reduced to one-sixth the calculated value.

The resultant lateral force "*R*" shall be assumed to be uniform for the length of footing parallel to the wall and to diminish uniformly to zero at the distance "*x*" beyond the ends of the footing.

Vertical pressure due to surcharge applied to the top of the wall footing may be considered to spread uniformly within the limits of the stem and planes making an angle of 45 degrees with the vertical.

5.2.2.4 Seismic Surcharge Equations

Combined effect of static and seismic lateral force:
$P_{AE} = F_1 + F_2$

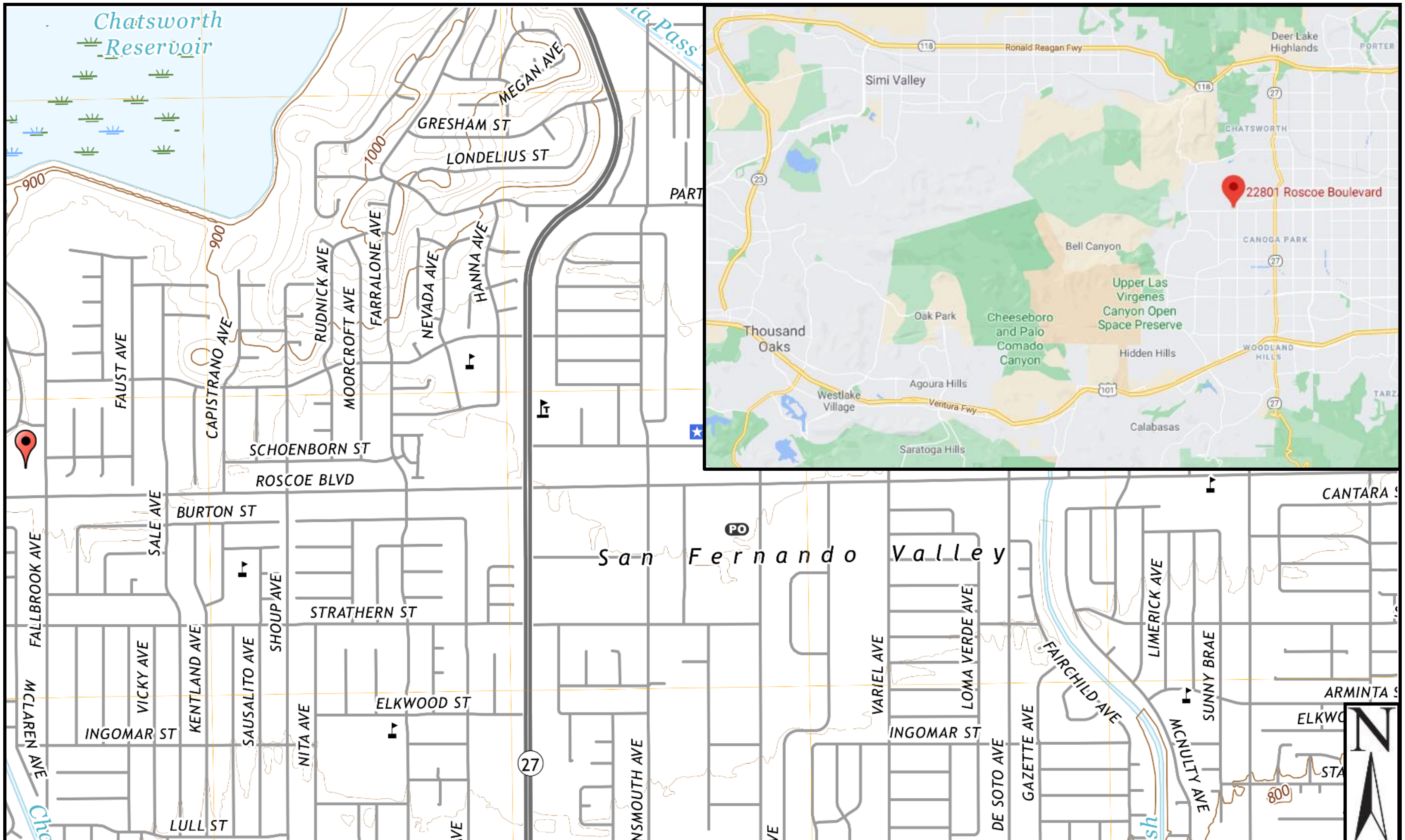
$F_1 = 1/2 * A * H^2$ Resultant acting at a distance of H/3 from base of wall
$F_2 = 3/8 * K_h * \gamma * H^2$ Resultant acting at a distance of (0.6*H) from base of wall

Where:
F_1 = Static Force (plf) based on active pressure
F_2 = Seismic Lateral Force (plf) based on seismic pressure
γ = 120 pcf
$K_h = S_{DS}/2.5$
A = Active Pressure (pcf)
H = Height of retained soil (ft)

FIGURES

- Site Location Map
- Site Exploration Map
- Geologic Map
- Geologic Hazards Map

PARTNER



Source: U.S. Geological Survey, USGS US Topo 7.5-minute map for Canoga Park, CA 2018: USGS - National Geospatial Technical Operations Center (NGTOC)

FIGURE 1 – SITE VICINITY PLAN

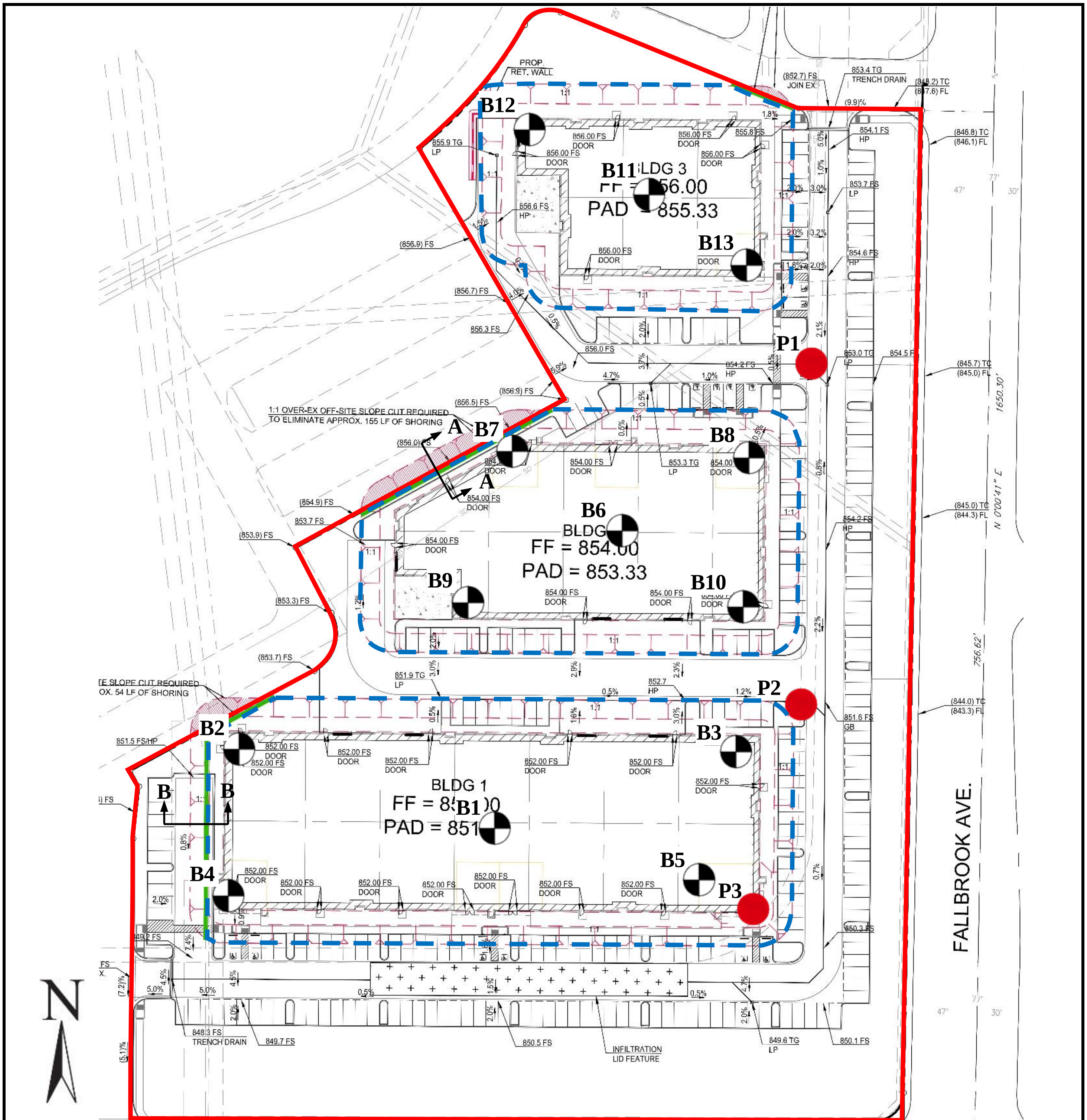
KEY

Approximate Site Location

Source: Google Earth Pro

FIGURE 2 – SITE PLAN

KEY Approximate Boring Locations Approximate Percolation Test Locations



Sources: Grading and Over-Ed Study, Fallbrook Point Project, 04/29/2021

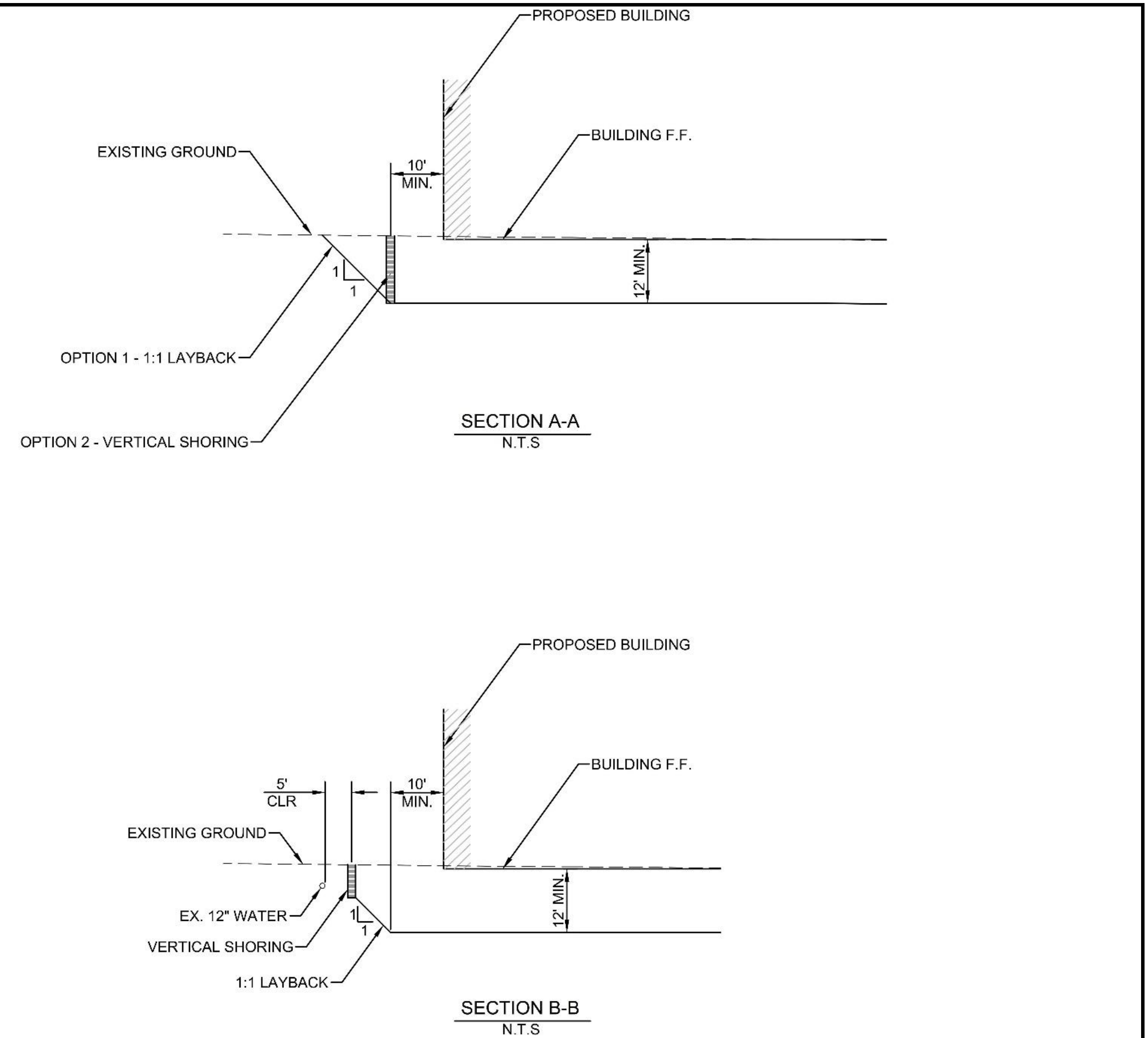
FIGURE 3 – SCALED BORING LOCATION PLAN

KEY

- Approximate Boring Location
- Approximate Infiltration Test Location
- Approximate Limits of Over Excavation
- Approximate Project Limits
- Proposed Shoring Location

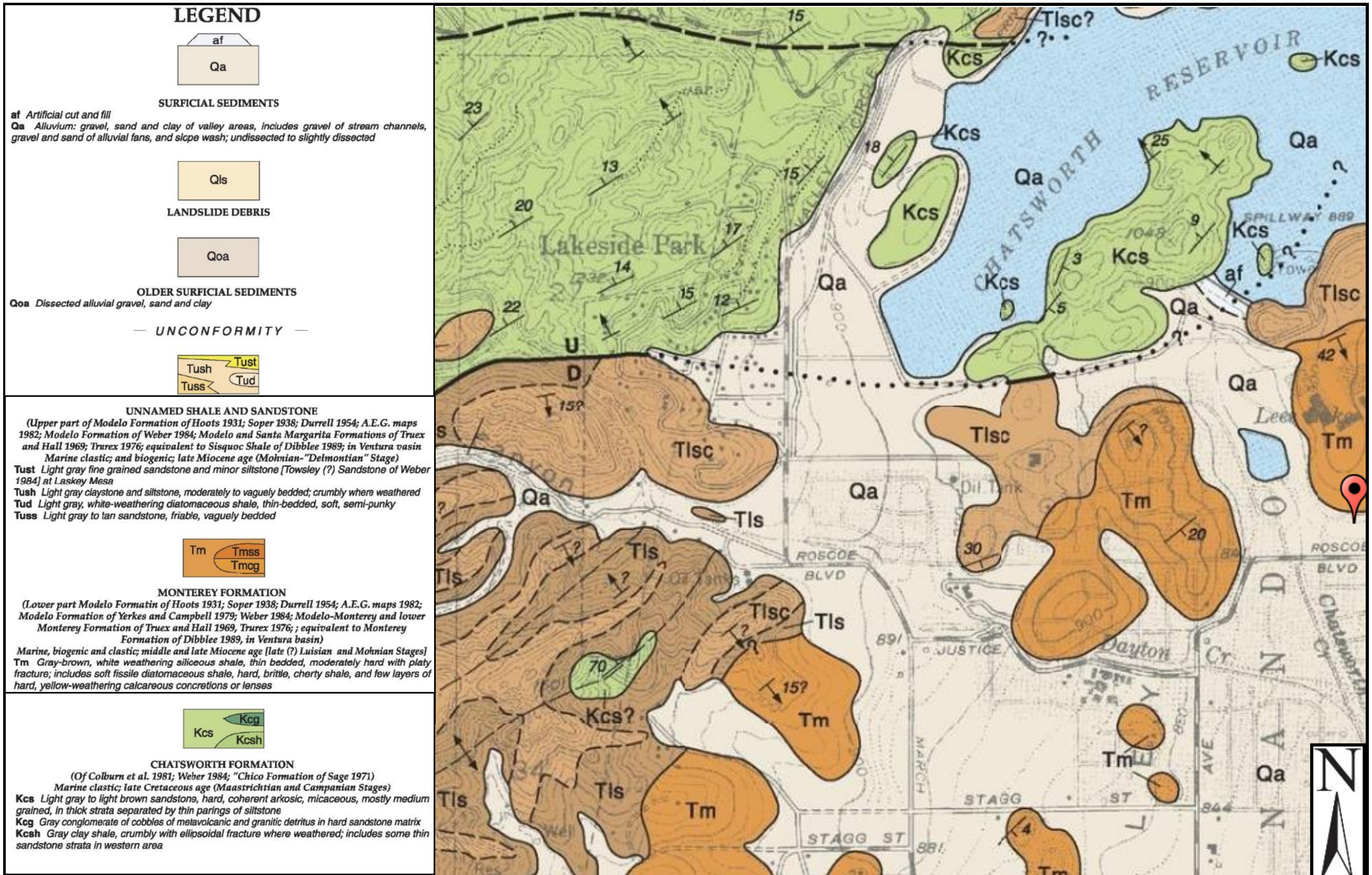
Scale
1 inch = 100 feet

0 100’ 200’ 300’ 400’



Source: Cross sections prepared by PSOMAS, received 05/27/2021

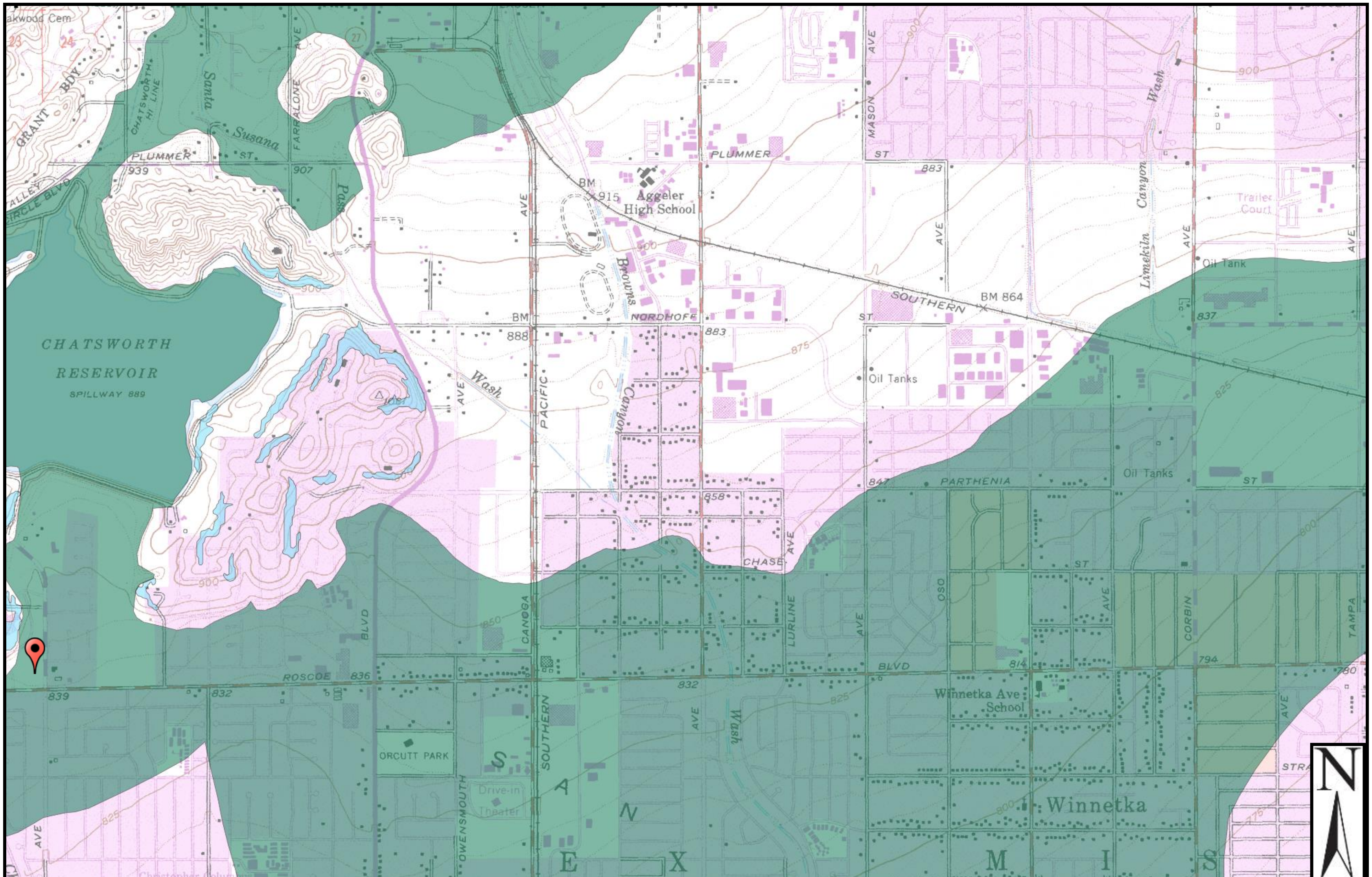
FIGURE 4 – GRADING PLANS CROSS SECTIONS



Source: Dibblee, T.W., and Ehrenspeck, H.E., ed., 1992, Geologic map of the Calabasas quadrangle, Los Angeles and Ventura Counties, California: Dibblee Geological Foundation, Dibblee Foundation Map DF-37, scale 1:24,000

FIGURE 5 – GEOLOGIC MAP

KEY Approximate Site Location



Source: California Geological Survey, 1998, Earthquake Zones of Required Investigation, Canoga Park Quadrangle, scale 1:24,000

FIGURE 5 – GEOLOGIC HAZARD MAP

KEY Approximate Site Location

APPENDIX A

Boring Logs

Percolation Test Logs

PARTNER

BORING LOG KEY - EXPLANATION OF TERMS

SURFACE COVER: General discription with thickness to the inch, ex. Topsoil, Concrete, Asphalt, etc,

FILL: General description with thickness to the 0.5 feet. Ex. Roots, Debris, Processed Materials (Pea Gravel, etc.)

NATIVE GEOLOGIC MATERIAL: Deposit type, 1.Color, 2.moisture, 3.density, 4.SOIL TYPE, other notes - Thickness to 0.5 feet

1. Color - Generalized

Light Brown (usually indicates dry soil, rock, caliche)
Brown (usually indicates moist soil)
Dark Brown (moist to wet soil, organics, clays)
Reddish (or other bright colors) Brown (moist, indicates some soil development/or residual soil)
Greyish Brown (Marine, sub groundwater - not the same as light brown above)
Mottled (brown and gray, indicates groundwater fluctuations)

2. Moisture

dry - only use for wind-blown silts in the desert
damp - soil with little moisture content
moist - near optimum, has some cohesion and stickyness
wet - beyond the plastic limit for clayey soils, and feels wet to the touch for non clays
saturated - Soil below the groundwater table, sampler is wet on outside

3A. Relative Density for Granular Soils

Relative Density	Ring	SPT
very loose	0-7	0-4
loose	7-14	4-10
medium dense	14-28	10-30
dense	28-100	30-50
very dense	100+	Over 50

3B. Consistency of Fine-Grained Cohesive Soils

Consistnecy	SPT	Undrained Shear Strength, tsf
very soft	0-2	less than 0.125
soft	2-4	0.125 - 0.25
medium stiff	4-8	0.25 - 0.50
stiff	8-15	0.50 - 1.0
very stiff	15-30	1.0 - 2.0
hard	Over 30	Over 2.0

4. Classification

Determine percent Gravel (Material larger than the No. 4 Sieve)
Determine percent fines (Material passing the No. 200 Sieve)
Determine percent sand (Passing the No. 4 and retained on the No. 200 Sieve)
Determine if clayey (make soil moist, if it easily roll into a snake it is clayey)

Coarse Grained Soils (Less than 50% Passing the No. 200 Sieve)

GP	SP	Mostly sand and gravel, with less than 5 % fines	sandy GRAVEL	SAND
GP-GM	SP-SM	Mostly sand and gravel 5-12% fines, non-clayey	sandy GRAVEL with silt	SAND with Silt
GP-GC	SP-SC	Mostly sand and gravel 5-12% fines, clayey	sandy GRAVEL with clay	SAND with clay
GC	SC	Mostly sand and gravel >12% fines clayey	clayey GRAVEL	clayey SAND
GM	SM	Mostly sand and gravel >12% fines non-clayey	silty GRAVEL	silty SAND

Fine Grained Soils (50% or more passes the No. 200 Sieve)

ML	Soft, non clayey	SILT with sand
MH	Very rare, holds a lot of water, and is pliable with very low strength	high plasticity SILT
CL	If sandy can be hard when dry, will be stiff/plastic when wet	CLAY with sand/silt
CH	Hard and resiliant when dry, very strong/sticky when wet (may have sand in it)	FAT CLAY

H = Liquid limit over 50%, L - LL under 50%
C = Clay
M = Silt

Samplers

S = Standard split spoon (SPT)
R = Modified ring
Bulk = Excavation spoils
ST = Shelby tube
C = Rock core

Boring Number:	B1	Boring Log Page 1 of 3	
Location:	Center Building 1	Date Started:	8/26/2020
Site Address:	Roscoe Blvd. & Fallbrook Ave.	Date Completed:	8/26/2020
	Canoga Park, CA 91304	Depth to Groundwater:	N/A
Project Number:	20-285404.1	Field Technician:	YK
Drill Rig Type:	SIMCO 2800	Partner Engineering and Science	
Sampling Equipment:	Hollowstem auger drilling with SPT & Rings	2154 Torrance Blvd., Suite 201	
Borehole Diameter:	8"	Torrance, CA 90501	

Depth, FT	Sample	N-Value	USCS	Description
0				**<u>SURFACE COVER:</u>** asphalt (2.5") / base (8")
0.5				
1			ML	**<u>FILL:</u>** Tan, moist, clayey SILT with calcification
1.5				
2				
2.5	S	13		Stiff
3				
3.5				
4				
4.5				
5	S	11		
5.5				
6				
6.5				
7	S	11		sandy SILT
7.5				
8				
8.5				
9				
9.5				
10	R	64		Hard
10.5				
11			SM	**<u>NATIVE:</u>** Brown, damp, silty SAND
11.5				
12				
12.5	S	5		Loose
13				
13.5				
14				
14.5				
15	S	6		
15.5				
16				
16.5				
17				
17.5				
18				
18.5				
19				
19.5				
20	S			
				(Continued on next page)

Boring Number:	B1	Boring Log Page 2 of 3	
Location:	Center Building 1	Date Started:	8/26/2020
Site Address:	Roscoe Blvd. & Fallbrook Ave.	Date Completed:	8/26/2020
	Canoga Park, CA 91304	Depth to Groundwater:	N/A
Project Number:	20-285404.1	Field Technician:	YK
Drill Rig Type:	SIMCO 2800	Partner Engineering and Science	
Sampling Equipment:	Hollowstem auger drilling with SPT & Rings	2154 Torrance Blvd., Suite 201	
Borehole Diameter:	8"	Torrance, CA 90501	

Depth, FT	Sample	N-Value	USCS	Description
20	S	5	SM	Brown, damp, loose, silty SAND
20.5				
21				
21.5				
22				
22.5				
23				
23.5				
24				
24.5				
25	S	8		
25.5				
26				
26.5				
27				
27.5				
28				
28.5				
29				
29.5				
30	S	5	CL	Dark brown, moist, medium stiff, sandy CLAY (Moisture Content: 19.7%)
30.5				
31				
31.5				
32				
32.5				
33				
33.5				
34				
34.5				
35	S	23	SC	Dark brown, moist, dense, clayey SAND
35.5				
36				
36.5				
37				
37.5				
38				
38.5				
39				
39.5				
40	S			
				(Continued on next page)

Boring Number:	B1 (Continued)	Boring Log Page 3 of 3	
Location:	Center Building 1	Date Started:	8/26/2020
Site Address:	Roscoe Blvd. & Fallbrook Ave.	Date Completed:	8/26/2020
	Canoga Park, CA 91304	Depth to Groundwater:	N/A
Project Number:	20-285404.1	Field Technician:	YK
Drill Rig Type:	SIMCO 2800	Partner Engineering and Science	
Sampling Equipment:	Hollowstem auger drilling with SPT & Rings	2154 Torrance Blvd., Suite 201	
Borehole Diameter:	8"	Torrance, CA 90501	

Depth, FT	Sample	N-Value	USCS	Description
40	S	24	ML	Light tan, damp, very stiff, sandy SILT
40.5				
41				
41.5				
42				
42.5				
43				
43.5				
44				
44.5				
45	S	13		Mottled brown/orange brown/tan, moist
45.5				
46				
46.5				
47				
47.5				
48				
48.5				
49				
49.5				
50	S	11		(Moisture Content: 44.8%)
50.5				
51				
51.5				
52				Boring terminated at 51.5' below existing surface
52.5				Groundwater not encountered
53				Boring grouted and patched with asphalt upon completion
53.5				
54				
54.5				
55				
55.5				
56				
56.5				
57				
57.5				
58				
58.5				
59				
59.5				
60				

Boring Number:	B2	Boring Log Page 1 of 2	
Location:	NWC Building 1	Date Started:	8/27/2020
Site Address:	Roscoe Blvd. & Fallbrook Ave.	Date Completed:	8/27/2020
	Canoga Park, CA 91304	Depth to Groundwater:	N/A
Project Number:	20-285404.1	Field Technician:	YK
Drill Rig Type:	SIMCO 2800	Partner Engineering and Science	
Sampling Equipment:	Hollowstem auger drilling with SPT & Rings	2154 Torrance Blvd., Suite 201	
Borehole Diameter:	8"	Torrance, CA 90501	

Depth, FT	Sample	N-Value	USCS	Description
0				**<u>SURFACE COVER:</u>** asphalt (3") / base (5")
0.5				
1			ML	**<u>FILL:</u>** Light tan/grey, damp, clayey SILT with calcification
1.5				
2				
2.5	S	13		Stiff
3				
3.5				
4				
4.5				
5	S	12		
5.5				
6				
6.5				
7	S	9		
7.5				
8				
8.5				
9				
9.5				
10	S	10		
10.5				
11			SM	**<u>NATIVE:</u>** Brown, damp, silty SAND
11.5				
12				
12.5	R	18		Medium dense (Dry Density: 83.2 pcf, Moisture Content: 43.8%)
13				
13.5				
14				
14.5				
15	S	5		
15.5				
16				
16.5				
17				
17.5				
18				
18.5				
19				
19.5				
20	S			
20.5				(Continued on next page)
21				
21.5				

Boring Number:	B2 (Continued)		Boring Log Page 2 of 2		
Location:	NWC Building 1		Date Started:	8/27/2020	
Site Address:	Roscoe Blvd. & Fallbrook Ave.		Date Completed:	8/27/2020	
	Canoga Park, CA 91304		Depth to Groundwater:	N/A	
Project Number:	20-285404.1		Field Technician:	YK	
Drill Rig Type:	SIMCO 2800		Partner Engineering and Science		
Sampling Equipment:	Hollowstem auger drilling with SPT & Rings		2154 Torrance Blvd., Suite 201		
Borehole Diameter:	8"		Torrance, CA 90501		

Depth, FT	Sample	N-Value	USCS	Description
20	S	6	SC	Brown, damp, loose, clayey SAND
20.5				
21				
21.5				
22				Boring terminated at 21.5' below existing surface
22.5				Groundwater not encountered
23				Boring grouted and patched with asphalt upon completion
23.5				
24				
24.5				
25				
25.5				
26				
26.5				
27				
27.5				
28				
28.5				
29				
29.5				
30				
30.5				
31				
31.5				
32				
32.5				
33				
33.5				
34				
34.5				
35				
35.5				
36				
36.5				
37				
37.5				
38				
38.5				
39				
39.5				
40				
40.5				
41				
41.5				

Boring Number:	B3	Boring Log Page 1 of 2	
Location:	NEC Building 1	Date Started:	8/26/2020
Site Address:	Roscoe Blvd. & Fallbrook Ave.	Date Completed:	8/26/2020
	Canoga Park, CA 91304	Depth to Groundwater:	N/A
Project Number:	20-285404.1	Field Technician:	YK
Drill Rig Type:	SIMCO 2800	Partner Engineering and Science	
Sampling Equipment:	Hollowstem auger drilling with SPT	2154 Torrance Blvd., Suite 201	
Borehole Diameter:	8"	Torrance, CA 90501	

Depth, FT	Sample	N-Value	USCS	Description
0				**SURFACE COVER:** asphalt (4") / base (6")
0.5				
1			ML	**FILL:** Light tan/grey, moist, clayey SILT with calcification
1.5				
2				
2.5	S	9		Medium stiff
3				
3.5				
4				
4.5				
5	S	19		Very stiff
5.5				
6				
6.5				
7	S	10		Stiff
7.5				
8				
8.5				
9				
9.5				
10	S	25		Very stiff
10.5				
11			SM	**NATIVE:** Brown, damp, silty SAND
11.5				
12				
12.5	S	6		Loose
13				
13.5				
14				
14.5				
15	S	8		
15.5				
16				
16.5				
17				
17.5				
18				
18.5				
19				
19.5				
20	S			
20.5				(Continued on next page)
21				
21.5				

Boring Number:	B3 (Continued)		Boring Log Page 2 of 2	
Location:	NEC Building 1		Date Started:	8/26/2020
Site Address:	Roscoe Blvd. & Fallbrook Ave.		Date Completed:	8/26/2020
	Canoga Park, CA 91304		Depth to Groundwater:	N/A
Project Number:	20-285404.1		Field Technician:	YK
Drill Rig Type:	SIMCO 2800		Partner Engineering and Science	
Sampling Equipment:	Hollowstem auger drilling with SPT & Rings		2154 Torrance Blvd., Suite 201	
Borehole Diameter:	8"		Torrance, CA 90501	

Depth, FT	Sample	N-Value	USCS	Description
20	S	6	SM	Brown, damp, loose, silty SAND
20.5				
21				
21.5				
22				Boring terminated at 21.5' below existing surface
22.5				Groundwater not encountered
23				Boring grouted and patched with asphalt upon completion
23.5				
24				
24.5				
25				
25.5				
26				
26.5				
27				
27.5				
28				
28.5				
29				
29.5				
30				
30.5				
31				
31.5				
32				
32.5				
33				
33.5				
34				
34.5				
35				
35.5				
36				
36.5				
37				
37.5				
38				
38.5				
39				
39.5				
40				
40.5				
41				
41.5				

Boring Number:	B4	Boring Log Page 1 of 2	
Location:	SWC Building 1	Date Started:	8/26/2020
Site Address:	Roscoe Blvd. & Fallbrook Ave.	Date Completed:	8/26/2020
	Canoga Park, CA 91304	Depth to Groundwater:	N/A
Project Number:	20-285404.1	Field Technician:	YK
Drill Rig Type:	SIMCO 2800	Partner Engineering and Science	
Sampling Equipment:	Hollowstem auger drilling with SPT	2154 Torrance Blvd., Suite 201	
Borehole Diameter:	8"	Torrance, CA 90501	

Depth, FT	Sample	N-Value	USCS	Description
0				**SURFACE COVER:** asphalt (4") / base (6")
0.5				
1			ML	**FILL:** Light tan/grey, moist, SILT with calcification
1.5				
2				
2.5	S	7		Medium stiff
3				
3.5				
4				
4.5				
5	S	6		
5.5				
6				
6.5				
7	S	7		
7.5				
8				
8.5				
9				
9.5				
10	S	17		Very stiff
10.5				
11			SM	**NATIVE:** Brown, damp, silty SAND
11.5				
12				
12.5	S	5		Loose
13				
13.5				
14				
14.5				
15	S	6		
15.5				
16				
16.5				
17				
17.5				
18				
18.5				
19				
19.5				
20	S			
20.5				(Continued on next page)
21				
21.5				

Boring Number:	B4 (Continued)			Boring Log Page 2 of 2	
Location:	SWC Building 1			Date Started:	8/26/2020
Site Address:	Roscoe Blvd. & Fallbrook Ave.			Date Completed:	8/26/2020
	Canoga Park, CA 91304			Depth to Groundwater:	N/A
Project Number:	20-285404.1			Field Technician:	YK
Drill Rig Type:	SIMCO 2800			Partner Engineering and Science	
Sampling Equipment:	Hollowstem auger drilling with SPT			2154 Torrance Blvd., Suite 201	
Borehole Diameter:	8"			Torrance, CA 90501	

Depth, FT	Sample	N-Value	USCS	Description
20	S	6	SM	Brown, damp, loose, silty SAND
20.5				
21				
21.5				
22				Boring terminated at 21.5' below existing surface
22.5				Groundwater not encountered
23				Boring grouted and patched with asphalt upon completion
23.5				
24				
24.5				
25				
25.5				
26				
26.5				
27				
27.5				
28				
28.5				
29				
29.5				
30				
30.5				
31				
31.5				
32				
32.5				
33				
33.5				
34				
34.5				
35				
35.5				
36				
36.5				
37				
37.5				
38				
38.5				
39				
39.5				
40				
40.5				
41				
41.5				

Boring Number:	B5	Boring Log Page 1 of 2	
Location:	SEC Building 1	Date Started:	8/26/2020
Site Address:	Roscoe Blvd. & Fallbrook Ave.	Date Completed:	8/26/2020
	Canoga Park, CA 91304	Depth to Groundwater:	N/A
Project Number:	20-285404.1	Field Technician:	YK
Drill Rig Type:	SIMCO 2800	Partner Engineering and Science	
Sampling Equipment:	Hollowstem auger drilling with SPT	2154 Torrance Blvd., Suite 201	
Borehole Diameter:	8"	Torrance, CA 90501	

Depth, FT	Sample	N-Value	USCS	Description
0				**SURFACE COVER:** asphalt (3") / base (6")
0.5				
1			ML	**FILL:** Light tan/grey, damp, sandy SILT with calcification
1.5				
2				
2.5	S	7		Medium stiff
3				
3.5				
4				
4.5				
5	S	8		Stiff
5.5				
6				
6.5				
7	S	10		
7.5				
8				
8.5				
9				
9.5				
10	S	9		Very stiff
10.5				
11			SM	**NATIVE:** Brown, damp, silty SAND
11.5				
12				
12.5	S	9		Loose
13				
13.5				
14				
14.5				
15	S	9		with gravel
15.5				
16				
16.5				
17				
17.5				
18				
18.5				
19				
19.5				
20	S			
20.5				(Continued on next page)
21				
21.5				

Boring Number:	B5 (Continued)	Boring Log Page 2 of 2	
Location:	SEC Building 1	Date Started:	8/26/2020
Site Address:	Roscoe Blvd. & Fallbrook Ave.	Date Completed:	8/26/2020
	Canoga Park, CA 91304	Depth to Groundwater:	N/A
Project Number:	20-285404.1	Field Technician:	YK
Drill Rig Type:	SIMCO 2800	Partner Engineering and Science	
Sampling Equipment:	Hollowstem auger drilling with SPT	2154 Torrance Blvd., Suite 201	
Borehole Diameter:	8"	Torrance, CA 90501	

Depth, FT	Sample	N-Value	USCS	Description
20	S	6	SM	Brown, damp, loose, silty SAND
20.5				(increase in silt)
21				
21.5				
22				Boring terminated at 21.5' below existing surface
22.5				Groundwater not encountered
23				Boring grouted and patched with asphalt upon completion
23.5				
24				
24.5				
25				
25.5				
26				
26.5				
27				
27.5				
28				
28.5				
29				
29.5				
30				
30.5				
31				
31.5				
32				
32.5				
33				
33.5				
34				
34.5				
35				
35.5				
36				
36.5				
37				
37.5				
38				
38.5				
39				
39.5				
40				
40.5				
41				
41.5				

Boring Number:	B6		Boring Log Page 1 of 3
Location:	Center Building 2	Date Started:	8/27/2020
Site Address:	Roscoe Blvd. & Fallbrook Ave.	Date Completed:	8/27/2020
	Canoga Park, CA 91304	Depth to Groundwater:	N/A
Project Number:	20-285404.1	Field Technician:	YK
Drill Rig Type:	SIMCO 2800	Partner Engineering and Science	
Sampling Equipment:	Hollowstem auger drilling with SPT & Rings	2154 Torrance Blvd., Suite 201	
Borehole Diameter:	8"	Torrance, CA 90501	

Depth, FT	Sample	N-Value	USCS	Description
0				**SURFACE COVER:** asphalt (3") / base (7")
0.5				
1			ML	**FILL:** Tan to grey, moist, SILT with calcification
1.5				
2				
2.5	S	12		Stiff
3				
3.5				
4				
4.5				
5	R	42		Hard (Dry Density: 83.5 pcf, Moisture Content: 31.4%)
5.5				
6				
6.5				
7	S	11		Stiff
7.5				
8				
8.5				
9				
9.5				
10	R	42		Hard
10.5				
11			SM	**NATIVE:** Brown, moist, dense, silty SAND
11.5				
12				
12.5	S	7		Loose
13				
13.5				
14				
14.5				
15	S	12		With gravel
15.5				
16				
16.5				
17				
17.5				
18				
18.5				
19				
19.5				
20	S			
				(Continued on next page)

Boring Number:	B6	Boring Log Page 2 of 3	
Location:	Center Building 2	Date Started:	8/27/2020
Site Address:	Roscoe Blvd. & Fallbrook Ave.	Date Completed:	8/27/2020
	Canoga Park, CA 91304	Depth to Groundwater:	N/A
Project Number:	20-285404.1	Field Technician:	YK
Drill Rig Type:	SIMCO 2800	Partner Engineering and Science	
Sampling Equipment:	Hollowstem auger drilling with SPT & Rings	2154 Torrance Blvd., Suite 201	
Borehole Diameter:	8"	Torrance, CA 90501	

Depth, FT	Sample	N-Value	USCS	Description
20	S	5	SM	Brown, damp, loose, silty SAND
20.5				
21				
21.5				
22				
22.5				
23				
23.5				
24				
24.5				
25	S	5	ML	Brown, moist, medium stiff, sandy SILT
25.5				
26				
26.5				
27				
27.5				
28				
28.5				
29				
29.5				
30	S	9		Stiff
30.5				
31				
31.5				
32				
32.5				
33				
33.5				
34				
34.5				
35	S	18	CL	Dark brown, moist, stiff, CLAY
35.5				
36				
36.5				
37				
37.5				
38			ML	Mottled tan/orange brown, moist, SILT
38.5				
39				
39.5				
40	S	13		Stiff
				(Continued on next page)

Boring Number:	B6 (Continued)	Boring Log Page 3 of 3		
Location:	Center Building 1	Date Started:	8/27/2020	
Site Address:	Roscoe Blvd. & Fallbrook Ave.	Date Completed:	8/27/2020	
	Canoga Park, CA 91304	Depth to Groundwater:	N/A	
Project Number:	20-285404.1	Field Technician:	YK	
Drill Rig Type:	SIMCO 2800	Partner Engineering and Science		
Sampling Equipment:	Hollowstem auger drilling with SPT & Rings	2154 Torrance Blvd., Suite 201		
Borehole Diameter:	8"	Torrance, CA 90501		

Depth, FT	Sample	N-Value	USCS	Description
40	S	13	ML	Mottled tan/orange brown, moist, stiff, SILT
40.5				
41				
41.5				
42				
42.5				
43				
43.5				
44				
44.5				
45	S	12		
45.5				
46				
46.5				
47				
47.5				
48				
48.5				
49				
49.5				
50	S	22		Very stiff, clayey SILT
50.5				
51				
51.5				
52				Boring terminated at 51.5' below existing surface
52.5				Groundwater not encountered
53				Boring grouted and patched with asphalt upon completion
53.5				
54				
54.5				
55				
55.5				
56				
56.5				
57				
57.5				
58				
58.5				
59				
59.5				
60				

Boring Number:	B7		Boring Log Page 1 of 2
Location:	NWC Building 2	Date Started:	8/27/2020
Site Address:	Roscoe Blvd. & Fallbrook Ave.	Date Completed:	8/27/2020
	Canoga Park, CA 91304	Depth to Groundwater:	N/A
Project Number:	20-285404.1	Field Technician:	YK
Drill Rig Type:	SIMCO 2800	Partner Engineering and Science	
Sampling Equipment:	Hollowstem auger drilling with SPT & Rings	2154 Torrance Blvd., Suite 201	
Borehole Diameter:	8"	Torrance, CA 90501	

Depth, FT	Sample	N-Value	USCS	Description
0				**SURFACE COVER:** asphalt (4") / base (7")
0.5				
1			ML	**FILL:** Light tan/grey, moist, clayey SILT with calcification
1.5				
2				
2.5	S	11		Stiff
3				
3.5				
4				
4.5				
5	S	29		Very stiff
5.5				
6				
6.5				
7	S	10		Stiff
7.5				
8				
8.5				
9				
9.5				
10	S	12	SM	**NATIVE:** Brown, damp, medium dense, silty SAND
10.5				
11				
11.5				
12				
12.5	S	21		Dense
13				
13.5				
14				
14.5				
15	S	4		with gravel
15.5				
16				
16.5				
17				
17.5				
18				
18.5				
19				
19.5				
20	S			
20.5				(Continued on next page)
21				
21.5				

Boring Number:	B7 (Continued)	Boring Log Page 2 of 2	
Location:	NWC Building 2	Date Started:	8/27/2020
Site Address:	Roscoe Blvd. & Fallbrook Ave.	Date Completed:	8/27/2020
	Canoga Park, CA 91304	Depth to Groundwater:	N/A
Project Number:	20-285404.1	Field Technician:	YK
Drill Rig Type:	SIMCO 2800	Partner Engineering and Science	
Sampling Equipment:	Hollowstem auger drilling with SPT & Rings	2154 Torrance Blvd., Suite 201	
Borehole Diameter:	8"	Torrance, CA 90501	

Depth, FT	Sample	N-Value	USCS	Description
20	S	6	SM	Brown, damp, loose, silty SAND
20.5				
21				
21.5				
22				Boring terminated at 21.5' below existing surface
22.5				Groundwater not encountered
23				Boring grouted and patched with asphalt upon completion
23.5				
24				
24.5				
25				
25.5				
26				
26.5				
27				
27.5				
28				
28.5				
29				
29.5				
30				
30.5				
31				
31.5				
32				
32.5				
33				
33.5				
34				
34.5				
35				
35.5				
36				
36.5				
37				
37.5				
38				
38.5				
39				
39.5				
40				
40.5				
41				
41.5				

Boring Number:	B8		Boring Log Page 1 of 2
Location:	NEC Building 2	Date Started:	8/26/2020
Site Address:	Roscoe Blvd. & Fallbrook Ave.	Date Completed:	8/26/2020
	Canoga Park, CA 91304	Depth to Groundwater:	N/A
Project Number:	20-285404.1	Field Technician:	YK
Drill Rig Type:	SIMCO 2800	Partner Engineering and Science	
Sampling Equipment:	Hollowstem auger drilling with SPT & Rings	2154 Torrance Blvd., Suite 201	
Borehole Diameter:	8"	Torrance, CA 90501	

Depth, FT	Sample	N-Value	USCS	Description
0				**SURFACE COVER:** asphalt (4") / base (7")
0.5				
1			ML	**FILL:** Light tan/grey, damp, clayey SILT with calcification
1.5				
2				
2.5	S	11		Stiff
3				
3.5				
4				
4.5				
5	R	32		Hard (Dry DensitY: 68.8 pcf, Moisture Content: 46.2%)
5.5				
6				
6.5				
7	S	12		Stiff
7.5				
8				
8.5				
9				
9.5				
10	S	7		Medium stiff
10.5			SM	**NATIVE:** Brown, damp, loose, silty SAND
11				
11.5				
12				
12.5	S	4		Loose
13				
13.5				
14				
14.5				
15	S	4		
15.5				
16				
16.5				
17				
17.5				
18				
18.5				
19				
19.5				
20	S			
20.5				(Continued on next page)
21				
21.5				

Boring Number:	B8 (Continued)		Boring Log Page 2 of 2
Location:	NEC Building 2	Date Started:	8/26/2020
Site Address:	Roscoe Blvd. & Fallbrook Ave.	Date Completed:	8/26/2020
	Canoga Park, CA 91304	Depth to Groundwater:	N/A
Project Number:	20-285404.1	Field Technician:	YK
Drill Rig Type:	SIMCO 2800	Partner Engineering and Science	
Sampling Equipment:	Hollowstem auger drilling with SPT & Rings	2154 Torrance Blvd., Suite 201	
Borehole Diameter:	8"	Torrance, CA 90501	

Depth, FT	Sample	N-Value	USCS	Description
20	S	5	SM	Brown, damp, loose, silty SAND
20.5				
21				
21.5				
22				Boring terminated at 21.5' below existing surface
22.5				Groundwater not encountered
23				Boring grouted and patched with asphalt upon completion
23.5				
24				
24.5				
25				
25.5				
26				
26.5				
27				
27.5				
28				
28.5				
29				
29.5				
30				
30.5				
31				
31.5				
32				
32.5				
33				
33.5				
34				
34.5				
35				
35.5				
36				
36.5				
37				
37.5				
38				
38.5				
39				
39.5				
40				
40.5				
41				
41.5				

Boring Number:	B9	Boring Log Page 1 of 2	
Location:	SWC Building 2	Date Started:	8/26/2020
Site Address:	Roscoe Blvd. & Fallbrook Ave.	Date Completed:	8/26/2020
	Canoga Park, CA 91304	Depth to Groundwater:	N/A
Project Number:	20-285404.1	Field Technician:	YK
Drill Rig Type:	SIMCO 2800	Partner Engineering and Science	
Sampling Equipment:	Hollowstem auger drilling with SPT	2154 Torrance Blvd., Suite 201	
Borehole Diameter:	8"	Torrance, CA 90501	

Depth, FT	Sample	N-Value	USCS	Description
0				**SURFACE COVER:** asphalt (4") / base (7")
0.5				
1			ML	**FILL:** Light tan/grey, damp, clayey SILT with calcification
1.5				
2				
2.5	S	9		Stiff
3				
3.5				
4				
4.5				
5	S	9		
5.5				
6				
6.5				
7	S	6		Moist
7.5				
8				
8.5				
9				
9.5				
10	S	14		Stiff
10.5				
11				
11.5				
12			SM	**NATIVE:** Brown, damp, medium dense, silty SAND
12.5	S	7		Loose
13				
13.5				
14				
14.5				
15	S	4		
15.5				
16				
16.5				
17				
17.5				
18				
18.5				
19				
19.5				
20	S			
20.5				(Continued on next page)
21				
21.5				

Boring Number:	B9 (Continued)		Boring Log Page 2 of 2
Location:	SWC Building 2	Date Started:	8/26/2020
Site Address:	Roscoe Blvd. & Fallbrook Ave.	Date Completed:	8/26/2020
	Canoga Park, CA 91304	Depth to Groundwater:	N/A
Project Number:	20-285404.1	Field Technician:	YK
Drill Rig Type:	SIMCO 2800	Partner Engineering and Science	
Sampling Equipment:	Hollowstem auger drilling with SPT	2154 Torrance Blvd., Suite 201	
Borehole Diameter:	8"	Torrance, CA 90501	

Depth, FT	Sample	N-Value	USCS	Description
20	S	6	SM	Brown, damp, loose, silty SAND
20.5				
21				
21.5				
22				Boring terminated at 21.5' below existing surface
22.5				Groundwater not encountered
23				Boring grouted and patched with asphalt upon completion
23.5				
24				
24.5				
25				
25.5				
26				
26.5				
27				
27.5				
28				
28.5				
29				
29.5				
30				
30.5				
31				
31.5				
32				
32.5				
33				
33.5				
34				
34.5				
35				
35.5				
36				
36.5				
37				
37.5				
38				
38.5				
39				
39.5				
40				
40.5				
41				
41.5				

Boring Number:	B10	Boring Log Page 1 of 2	
Location:	SEC Building 2	Date Started:	8/26/2020
Site Address:	Roscoe Blvd. & Fallbrook Ave.	Date Completed:	8/26/2020
	Canoga Park, CA 91304	Depth to Groundwater:	N/A
Project Number:	20-285404.1	Field Technician:	YK
Drill Rig Type:	SIMCO 2800	Partner Engineering and Science	
Sampling Equipment:	Hollowstem auger drilling with SPT & Rings	2154 Torrance Blvd., Suite 201	
Borehole Diameter:	8"	Torrance, CA 90501	

Depth, FT	Sample	N-Value	USCS	Description
0				**SURFACE COVER:** asphalt (3") / base (6")
0.5				
1			ML	**FILL:** Light tan/grey, damp, clayey SILT with calcification
1.5				
2				
2.5	S	14		Stiff
3				
3.5				
4				
4.5				
5	S	10		
5.5				
6				
6.5				
7	S	17		Very stiff
7.5				
8				
8.5				
9				
9.5				
10	R	64		Stiff (Dry Density: 112.1 pcf, Moisture Content: 20.5%)
10.5			SM	**NATIVE:** Brown, damp, dense, silty SAND
11				
11.5				
12				
12.5				
13				
13.5				
14				
14.5				
15	S	17		Light brown, medium dense
15.5				
16				
16.5				
17				
17.5				
18				
18.5				
19				
19.5				
20	S			
20.5				(Continued on next page)
21				
21.5				

Boring Number:	B10 (Continued)		Boring Log Page 2 of 2	
Location:	SEC Building 2		Date Started:	8/26/2020
Site Address:	Roscoe Blvd. & Fallbrook Ave.		Date Completed:	8/26/2020
	Canoga Park, CA 91304		Depth to Groundwater:	N/A
Project Number:	20-285404.1		Field Technician:	YK
Drill Rig Type:	SIMCO 2800		Partner Engineering and Science	
Sampling Equipment:	Hollowstem auger drilling with SPT		2154 Torrance Blvd., Suite 201	
Borehole Diameter:	8"		Torrance, CA 90501	

Depth, FT	Sample	N-Value	USCS	Description
20	S	5	SM	Brown, damp, loose, silty SAND
20.5				
21				
21.5				
22				Boring terminated at 21.5' below existing surface
22.5				Groundwater not encountered
23				Boring grouted and patched with asphalt upon completion
23.5				
24				
24.5				
25				
25.5				
26				
26.5				
27				
27.5				
28				
28.5				
29				
29.5				
30				
30.5				
31				
31.5				
32				
32.5				
33				
33.5				
34				
34.5				
35				
35.5				
36				
36.5				
37				
37.5				
38				
38.5				
39				
39.5				
40				
40.5				
41				
41.5				

Boring Number:	B11	Boring Log Page 1 of 3	
Location:	Center Building 3	Date Started:	8/28/2020
Site Address:	Roscoe Blvd. & Fallbrook Ave.	Date Completed:	8/28/2020
	Canoga Park, CA 91304	Depth to Groundwater:	N/A
Project Number:	20-285404.1	Field Technician:	YK
Drill Rig Type:	SIMCO 2800	Partner Engineering and Science	
Sampling Equipment:	Hollowstem auger drilling with SPT & Rings	2154 Torrance Blvd., Suite 201	
Borehole Diameter:	8"	Torrance, CA 90501	

Depth, FT	Sample	N-Value	USCS	Description
0				**SURFACE COVER:** asphalt (3") / base (10")
0.5				
1			CL/ML	**FILL:** Tan to grey, moist, stiff, clayey SILT/silty CLAY with calcification
1.5				
2				
2.5	R	29		Very stiff (Dry Density: 80.6 pcf, Moisture Content: 41.8%)
3				
3.5				
4				
4.5				
5	S	15		
5.5				
6				
6.5				
7	S	11		Stiff
7.5				
8				
8.5				
9				
9.5				
10	R	30		Very stiff (Dry Density: 92.4 pcf, Moisture Content: 38.9%)
10.5				
11			SM	**NATIVE:** Brown, damp to moist, dense, silty SAND
11.5				
12				
12.5	S	4		Loose
13				
13.5				
14				
14.5				
15	S	4		
15.5				
16				
16.5				
17				
17.5				
18				
18.5				
19				
19.5				
20	S			
				(Continued on next page)

Boring Number:	B11 (Continued)		Boring Log Page 2 of 3
Location:	Center Building 3	Date Started:	8/28/2020
Site Address:	Roscoe Blvd. & Fallbrook Ave.	Date Completed:	8/28/2020
	Canoga Park, CA 91304	Depth to Groundwater:	N/A
Project Number:	20-285404.1	Field Technician:	YK
Drill Rig Type:	SIMCO 2800	Partner Engineering and Science	
Sampling Equipment:	Hollowstem auger drilling with SPT & Rings	2154 Torrance Blvd., Suite 201	
Borehole Diameter:	8"	Torrance, CA 90501	

Depth, FT	Sample	N-Value	USCS	Description
20	S	8	SM	Brown, damp to moist, loose, silty SAND
20.5				
21				
21.5				
22				
22.5				
23				
23.5				
24				
24.5				
25	S	9	CL	Dark brown, damp, stiff, silty CLAY
25.5				
26				
26.5				
27				
27.5				
28				
28.5				
29				
29.5				
30	S	19	ML	Mottled brown/orange brown, damp, very stiff, sandy SILT with calcification
30.5				
31				
31.5				
32				
32.5				
33				
33.5				
34				
34.5				
35	S	26		Tan
35.5				
36				
36.5				
37				
37.5				
38			ML	Mottled tan/orange brown, moist, SILT
38.5				
39				
39.5				
40	S			
				(Continued on next page)

Boring Number:	B11 (Continued)		Boring Log Page 3 of 3
Location:	Center Building 3	Date Started:	8/28/2020
Site Address:	Roscoe Blvd. & Fallbrook Ave.	Date Completed:	8/28/2020
	Canoga Park, CA 91304	Depth to Groundwater:	N/A
Project Number:	20-285404.1	Field Technician:	YK
Drill Rig Type:	SIMCO 2800	Partner Engineering and Science	
Sampling Equipment:	Hollowstem auger drilling with SPT & Rings	2154 Torrance Blvd., Suite 201	
Borehole Diameter:	8"	Torrance, CA 90501	

Depth, FT	Sample	N-Value	USCS	Description
40	S	26	ML	Mottled tan/orange brown, moist, very stiff, SILT
40.5				(Moisture Content: 45.5%)
41				
41.5				
42				
42.5				
43				
43.5				
44				
44.5				
45	S	21		
45.5				
46				
46.5				
47				
47.5				
48				
48.5				
49				
49.5				
50	S	26		Tan/brown
50.5				
51				
51.5				
52				Boring terminated at 51.5' below existing surface
52.5				Groundwater not encountered
53				Boring grouted and patched with asphalt upon completion
53.5				
54				
54.5				
55				
55.5				
56				
56.5				
57				
57.5				
58				
58.5				
59				
59.5				
60				

Boring Number:	B12	Boring Log Page 1 of 2	
Location:	NWC Building 3	Date Started:	8/27/2020
Site Address:	Roscoe Blvd. & Fallbrook Ave.	Date Completed:	8/27/2020
	Canoga Park, CA 91304	Depth to Groundwater:	N/A
Project Number:	20-285404.1	Field Technician:	YK
Drill Rig Type:	SIMCO 2800	Partner Engineering and Science	
Sampling Equipment:	Hollowstem auger drilling with SPT & Rings	2154 Torrance Blvd., Suite 201	
Borehole Diameter:	8"	Torrance, CA 90501	

Depth, FT	Sample	N-Value	USCS	Description
0				**SURFACE COVER:** asphalt (4") / base (6.5")
0.5				
1			ML	**FILL:** Light tan, damp, stiff, SILT with calcification
1.5				
2				
2.5	S	13		Stiff
3				
3.5				
4				
4.5				
5	R	30		Very stiff
5.5				
6				
6.5				
7	S	11		Stiff
7.5				
8				
8.5				
9				
9.5				
10	S	8		
10.5				
11				
11.5			SM	**NATIVE:** Brown, damp, silty SAND
12				
12.5		10		Medium dense
13				
13.5				
14				
14.5				
15	S	13	ML	Dark brown, moist, stiff, sandy SILT
15.5				
16				
16.5				
17				
17.5				
18				
18.5				
19				
19.5				
20	S			
20.5				(Continued on next page)
21				
21.5				

Boring Number:	B12 (Continued)	Boring Log Page 2 of 2	
Location:	NWC Building 3	Date Started:	8/27/2020
Site Address:	Roscoe Blvd. & Fallbrook Ave.	Date Completed:	8/27/2020
	Canoga Park, CA 91304	Depth to Groundwater:	N/A
Project Number:	20-285404.1	Field Technician:	YK
Drill Rig Type:	SIMCO 2800	Partner Engineering and Science	
Sampling Equipment:	Hollowstem auger drilling with SPT	2154 Torrance Blvd., Suite 201	
Borehole Diameter:	8"	Torrance, CA 90501	

Depth, FT	Sample	N-Value	USCS	Description
20	S	20	ML	Light tan, damp, very stiff, SILT
20.5				
21				
21.5				
22				Boring terminated at 21.5' below existing surface
22.5				Groundwater not encountered
23				Boring grouted and patched with asphalt upon completion
23.5				
24				
24.5				
25				
25.5				
26				
26.5				
27				
27.5				
28				
28.5				
29				
29.5				
30				
30.5				
31				
31.5				
32				
32.5				
33				
33.5				
34				
34.5				
35				
35.5				
36				
36.5				
37				
37.5				
38				
38.5				
39				
39.5				
40				
40.5				
41				
41.5				

Boring Number:	B13	Boring Log Page 1 of 2	
Location:	SEC Building 3	Date Started:	8/27/2020
Site Address:	Roscoe Blvd. & Fallbrook Ave.	Date Completed:	8/27/2020
	Canoga Park, CA 91304	Depth to Groundwater:	N/A
Project Number:	20-285404.1	Field Technician:	YK
Drill Rig Type:	SIMCO 2800	Partner Engineering and Science	
Sampling Equipment:	Hollowstem auger drilling with SPT & Rings	2154 Torrance Blvd., Suite 201	
Borehole Diameter:	8"	Torrance, CA 90501	

Depth, FT	Sample	N-Value	USCS	Description
0				**SURFACE COVER:** asphalt (4") / base (10")
0.5				
1			ML	**FILL:** Tan/grey, damp, clayey SILT with calcification
1.5				
2				
2.5	S	11		Stiff
3				
3.5				
4				
4.5				
5	R	26		Very stiff (Dry Density: 70.2 pcf, Moisture Content: 46.0%)
5.5				
6				
6.5				
7	R	11		Stiff
7.5				
8				
8.5				
9				
9.5				
10	S	5		Medium stiff
10.5				
11			SM	**NATIVE:** Brown, damp, silty SAND
11.5				
12				
12.5		17		Medium dense (Dry Density: 101.2 pcf, Moisture Content: 12.7%)
13				
13.5				
14				
14.5				
15	S	3		Very loose
15.5				
16				
16.5				
17				
17.5				
18				
18.5				
19				
19.5				
20	S			
20.5				(Continued on next page)
21				
21.5				

Boring Number:	B13 (Continued)		Boring Log Page 2 of 2	
Location:	SEC Building 3		Date Started:	8/27/2020
Site Address:	Roscoe Blvd. & Fallbrook Ave.		Date Completed:	8/27/2020
	Canoga Park, CA 91304		Depth to Groundwater:	N/A
Project Number:	20-285404.1		Field Technician:	YK
Drill Rig Type:	SIMCO 2800		Partner Engineering and Science	
Sampling Equipment:	Hollowstem auger drilling with SPT & Rings		2154 Torrance Blvd., Suite 201	
Borehole Diameter:	8"		Torrance, CA 90501	

Depth, FT	Sample	N-Value	USCS	Description
20	S	5	SM	Brown, damp, loose, silty SAND
20.5				
21				
21.5				
22				Boring terminated at 21.5' below existing surface
22.5				Groundwater not encountered
23				Boring grouted and patched with asphalt upon completion
23.5				
24				
24.5				
25				
25.5				
26				
26.5				
27				
27.5				
28				
28.5				
29				
29.5				
30				
30.5				
31				
31.5				
32				
32.5				
33				
33.5				
34				
34.5				
35				
35.5				
36				
36.5				
37				
37.5				
38				
38.5				
39				
39.5				
40				
40.5				
41				
41.5				

APPENDIX B

Lab Data

PARTNER

Moisture and Density Data

Soil Sample	Dry Density	Moisture Content (%)
B1 @ 30 feet	-	19.7
B1 @ 50 feet	-	44.8
B2 @ 12.5 feet	83.2	43.8
B6 @ 5 feet	83.5	31.4
B8 @ 5 feet	68.8	46.2
B10 @ 10 feet	112.1	20.5
B11 @ 2 feet	80.6	41.8
B11 @ 10 feet	92.4	38.9
B11 @ 40 feet	-	45.5
B13 @ 5 feet	70.2	46.0
B13 @ 12.5 feet	101.2	12.7

HAMILTON
& Associates

1641 Border Avenue • Torrance, CA 90501 T 310.618.2190 888.618.2190 F 310.618.2191 W hamilton-associates.net

October 1, 2020
H&A Project No. 20-2822
Partner Project No. 20-285404.1

Partner Engineering and Science, Inc.
4518 N.12 Street Suite 201
Phoenix AZ, 85016

Attention: Mr. Matthew Marcus, Technical Director- Geotechnical Engineering

Subject: Laboratory Testing of Soil Samples, Partner (Canoga Park)
22801 Roscoe Boulevard, Los Angeles, California

Dear Mr. Marcus:

We have completed the laboratory tests on the samples provided for the subject project. Enclosed is a summary of laboratory test results.

We thank you for the opportunity to provide laboratory testing services. If there are any questions, please do not hesitate to contact the undersigned.

Respectfully submitted,
HAMILTON & ASSOCIATES, INC.

Rosa E. Murrieta
Laboratory Supervisor | Staff Geologist

David T. Hamilton, PE, GE
President

Distribution: (1) Matthew Marcus
mmarcus@partneresi.com
(2) Brett Bova
bbova@partneresi.com

MOISTURE CONTENT AND DENSITY TESTS
Relatively undisturbed soil retained within the rings of the Modified California barrel sampler was tested in the laboratory to determine in-place dry density and moisture content. Test results are presented in Table 1.

NO. 200 SIEVE (WASH)
No. 200 Sieves (Wash) were performed on selected samples to determine the fines content. The results of these tests are shown on Table 1.

MAXIMUM DENSITY TEST
Maximum density test was conducted in accordance with ASTM D1557-12, Method A, using 5 equal layers, 25 blows each layer, 10-pound hammer, 18-inch drop in a 1/30 cubic foot mold. The results are shown in Table 1.

RESISTANCE *R*-VALUE TESTS
"R" Value Stabilometer results were obtained in accordance with California 301-G test to measure potential strength of subgrade, subbase, and base course materials for road and airfield pavements. Results were performed on a select sample of site soils by Associated Soils Engineering, Inc., and are presented in Table 2.

CONSOLIDATION TESTS
Consolidation (ASTM D-2435) tests were performed on selected relatively undisturbed samples or remolded samples to determine the settlement characteristics of various soil samples, respectively. The results of this test are shown graphically on the appended ‘C’ Plates.

DIRECT SHEAR TESTS
Direct shear (ASTM D3080) tests were performed on selected relatively undisturbed samples to determine the shear strength parameters of various soil samples, respectively. The results of these tests are shown graphically on the appended “D” Plates.

ATTERBERG LIMITS
Atterberg Limits (ASTM D-4318) tests were performed on selected samples to determine the liquid limit, plastic limit, and the plasticity index of soils. The results of these tests are shown on the appended “E” Plates.

HAMILTON & Associates

TABLE 1 - LABORATORY RESULTS

JOB TITLE: Partner (Canoga Park)
ADDRESS: 22801 Roscoe Blvd
Los Angeles, CA
H&A PROJECT NO. 20-2822
SHEET: 1 OF 1

Test Pit/ Boring No.	Depth (ft)	Sampler /No. Rings	Field Dry Density (pcf)	Field Moisture (%)	Atterberg Limits	Consolidation	Corrosivity Suite	Direct Shear	Expansion Index	Fines Fraction (No. 200 Wash)	Hydraulic Conductivity	Maximum Density (lbs/ft³) / Optimum Moisture (%)	Particle Size (No. 200 Wash & Grain Size Analysis)	Particle Size w/ Hydrometer	R-Value	Reshear (4/7 passes)	Sand Equivalent	Specific Gravity	Sulfate	Triaxial (UU)	Triaxial (CU)	Unconfined Compression	Other	Other	Remarks
N/A	0-11	BULK			X					47.6		92.5/24			22										
B-1	10	R	49.9	131.3																					
	30	SPT		19.7	X					60.3															
	50	SPT		44.8	X					69.7															
B-2	12.5	R	83.2	43.8				X																	
B-6	5	R	83.5	31.4																					
	10	R	54.0	105.7																					
B-7	5	R																							
B-8	5	R	68.8	46.2																					
B-10	10	R	112.1	20.5		X		X																	
B-11	2	R	80.6	41.8																					
	10	R	92.4	38.9																					
	40	SPT		45.5		X				76.4															
B-12	5	R	55.3	72.8				X																	
B-14	5	R	70.2	46.0																					
	12.5	R	101.2	12.7				X																	

SPECIAL INSTRUCTIONS:

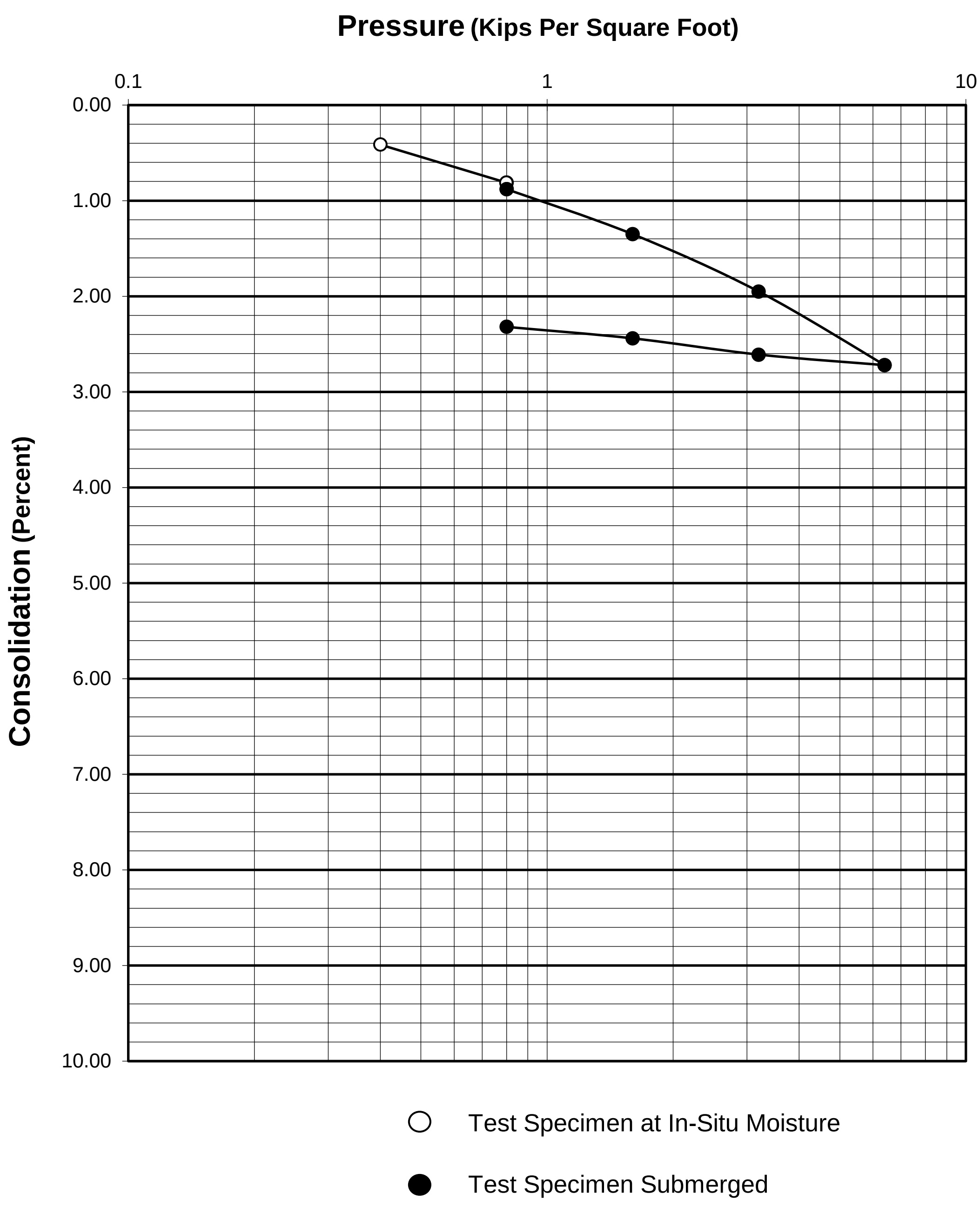
"R" VALUE ANALYSIS

The following "R" Value Stabilometer results were obtained in accordance with California 301-G test procedures.

TABLE 2			
Stabilometer Results	**Trial #1**	**Trial #2**	**Trial #3**
Dry Density as molded, pcf	89.6	88.5	87.9
Moisture content as molded, %	28.9	30.5	31.7
Expansion Pressure, dial reading 10^4	160	68	30
Exudation Pressure, psi	435	215	105
Stabilometer "R" Value	34	17	10
"R" Value equilibrium (300 psi Exudation Pressure) = 22			
Sampled From: Bulk 0-11			
Classification: Olive Bordering Gray Brown Silty Clay with Cale, Conc's			
Source & H&A Job No.: Partner (Canoga Park), 20-2822			

CONSOLIDATION TEST RESULTS

B-1 at 10 Feet

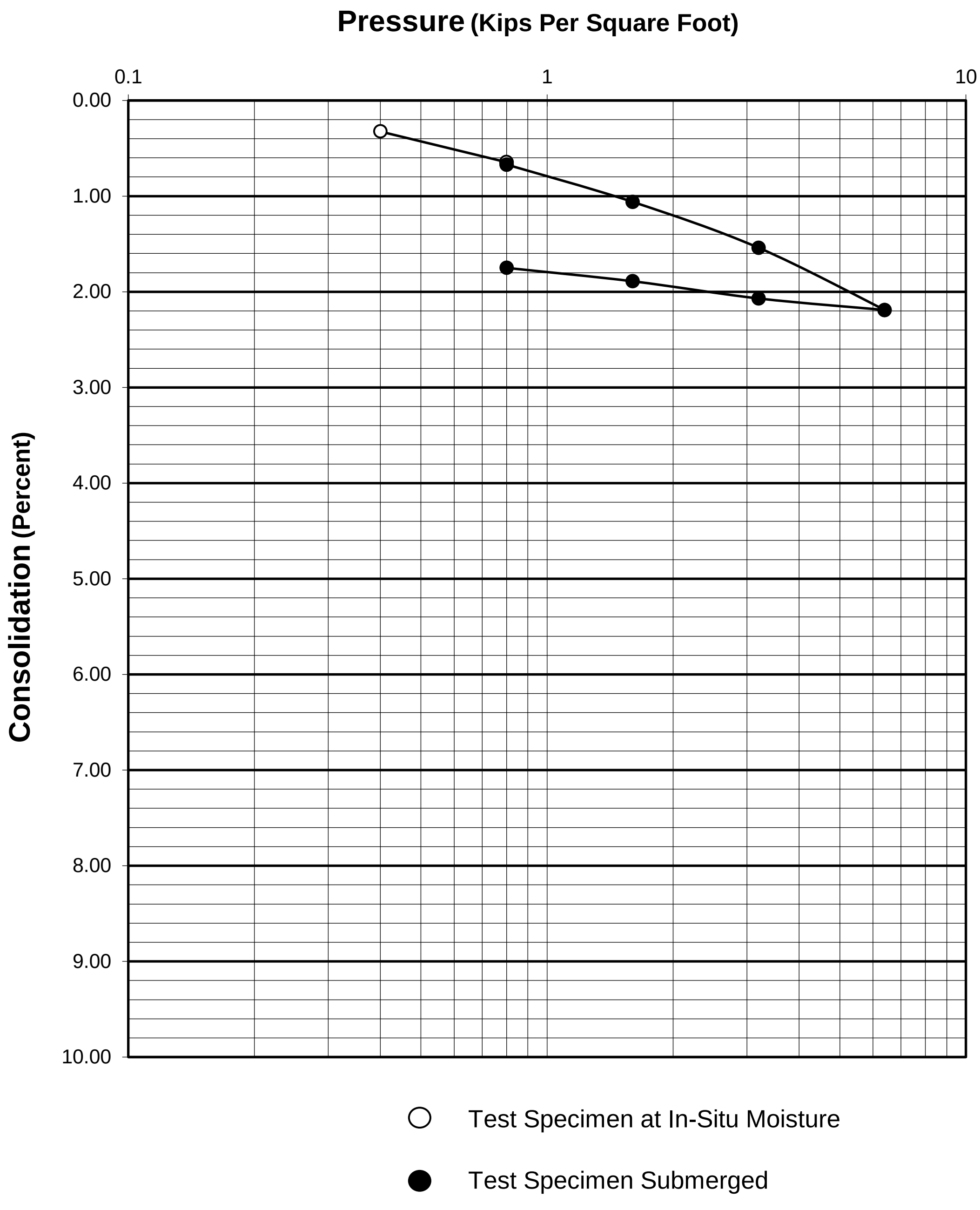


Geotechnical Engineering Investigation 22801 Roscoe Boulevard Los Angeles, California	Project No.	20-2822
	Plate	C-1

HAMILTON & ASSOCIATES, INC.

CONSOLIDATION TEST RESULTS

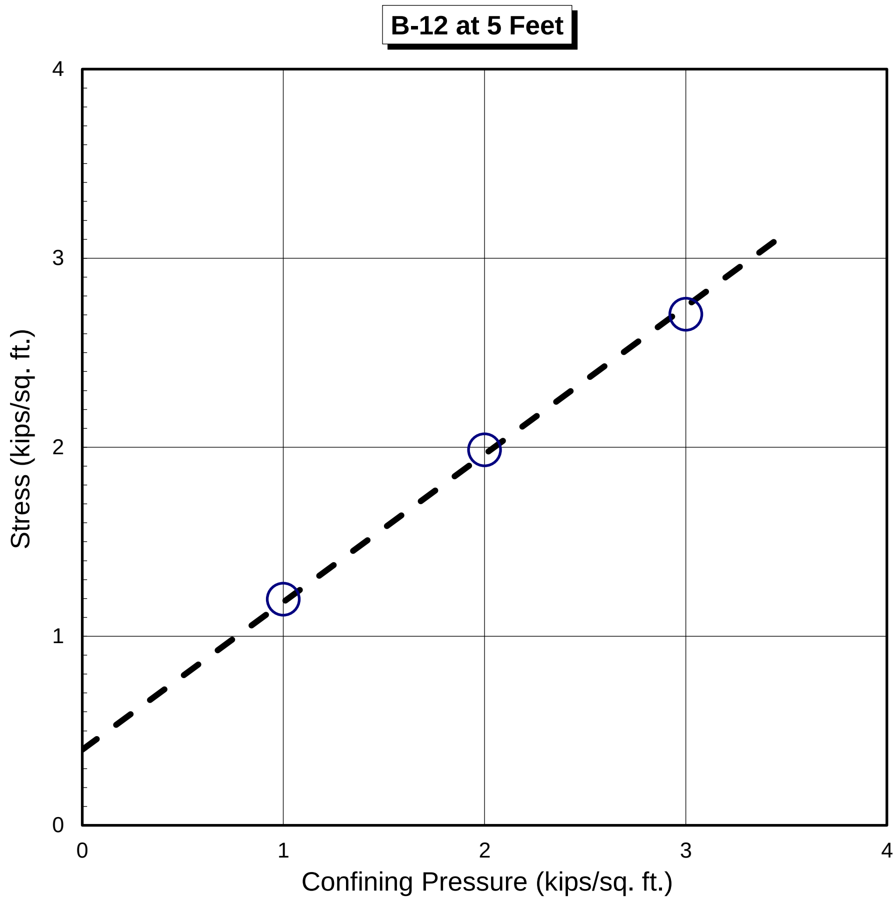
B-10 at 10 Feet

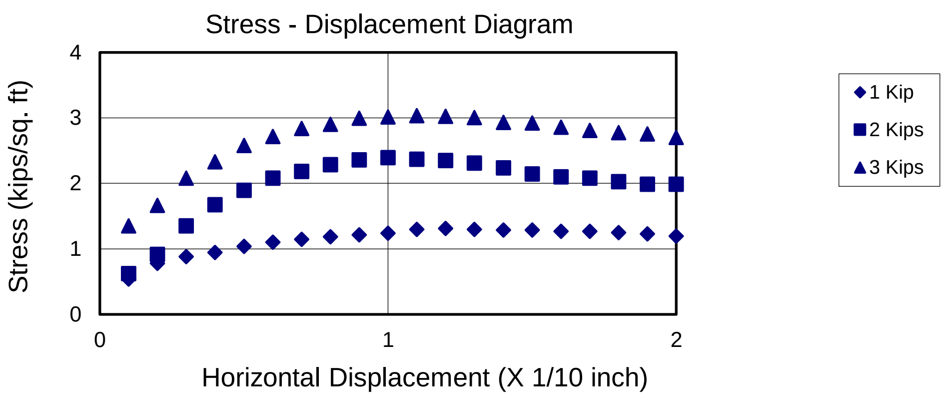


Geotechnical Engineering Investigation 22801 Roscoe Boulevard Los Angeles, California	Project No.	20-2822
	Plate	C-3

HAMILTON & ASSOCIATES, INC.

SHEAR TEST RESULTS





Samples were submerged for at least 24 hours.

The samples had a density of 55.3 lbs./cu.ft. and a moisture content of 72.8 %

Cohesion = 400 psf

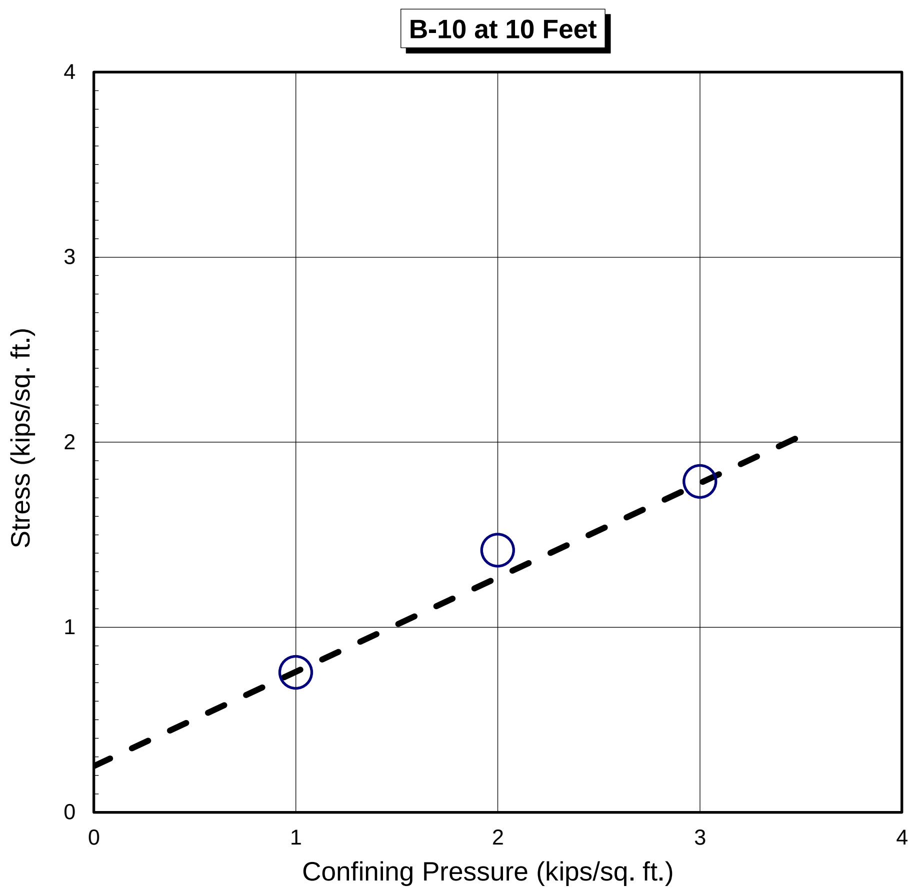
Friction Angle = 38 degrees

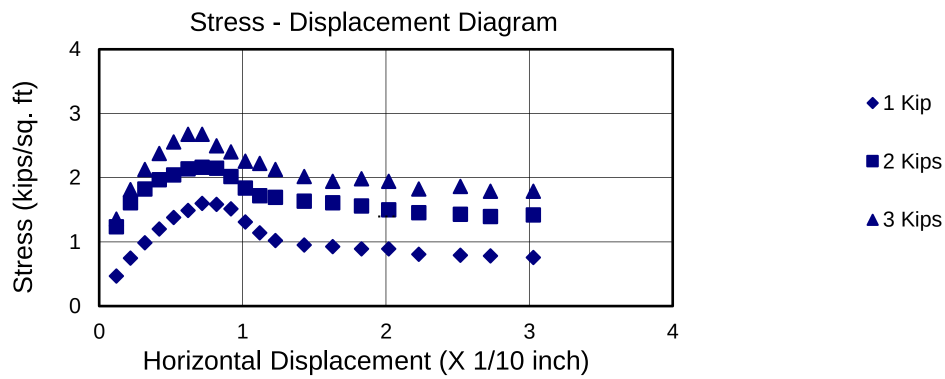
Based on Ultimate Strength

Geotechnical Engineering Investigation 22801 Roscoe Boulevard Los Angeles, California	Project No.	20-2822
	Plate	D-1

HAMILTON & ASSOCIATES

SHEAR TEST RESULTS





Samples were submerged for at least 24 hours.

The samples had a density of 112.1 lbs./cu.ft. and a moisture content of 20.5 %

Cohesion = 250 psf

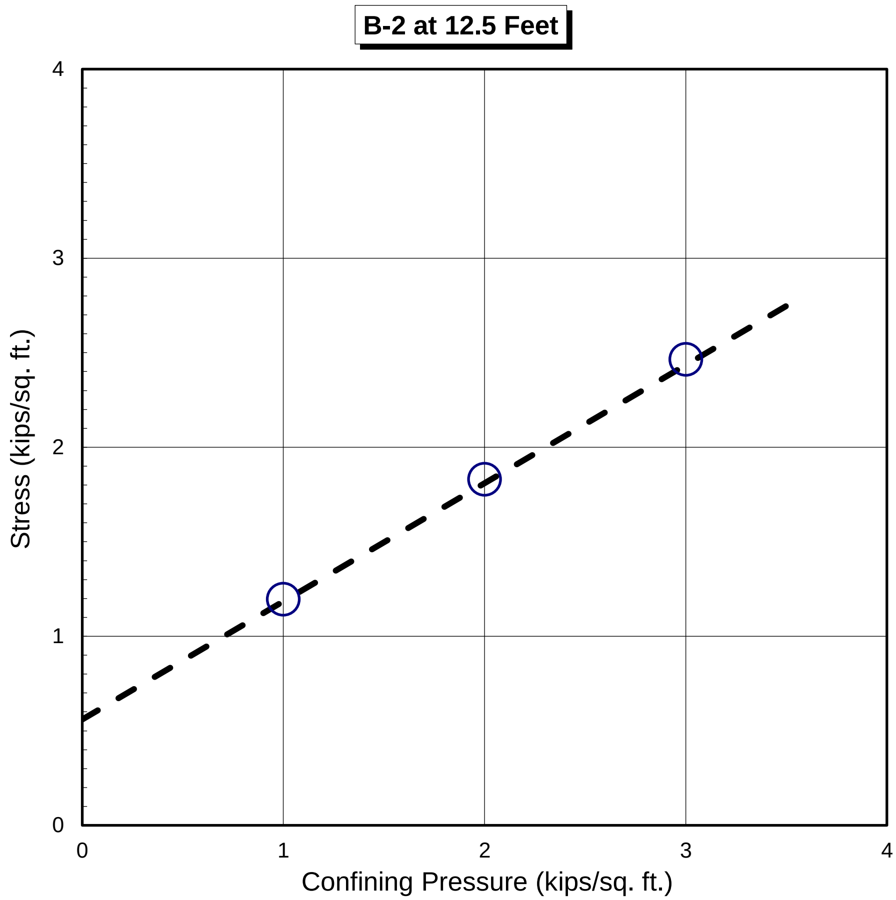
Friction Angle = 27 degrees

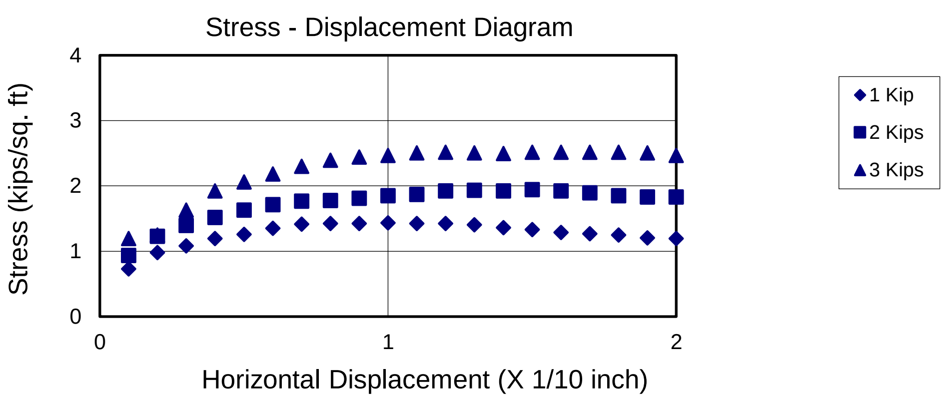
Based on Ultimate Strength

Geotechnical Engineering Investigation 22801 Roscoe Boulevard Los Angeles, California	Project No.	20-2822
	Plate	D-2

HAMILTON & ASSOCIATES

SHEAR TEST RESULTS





Samples were submerged for at least 24 hours.

The samples had a density of 83.2 lbs./cu.ft. and a moisture content of 43.8 %

Cohesion = 560 psf

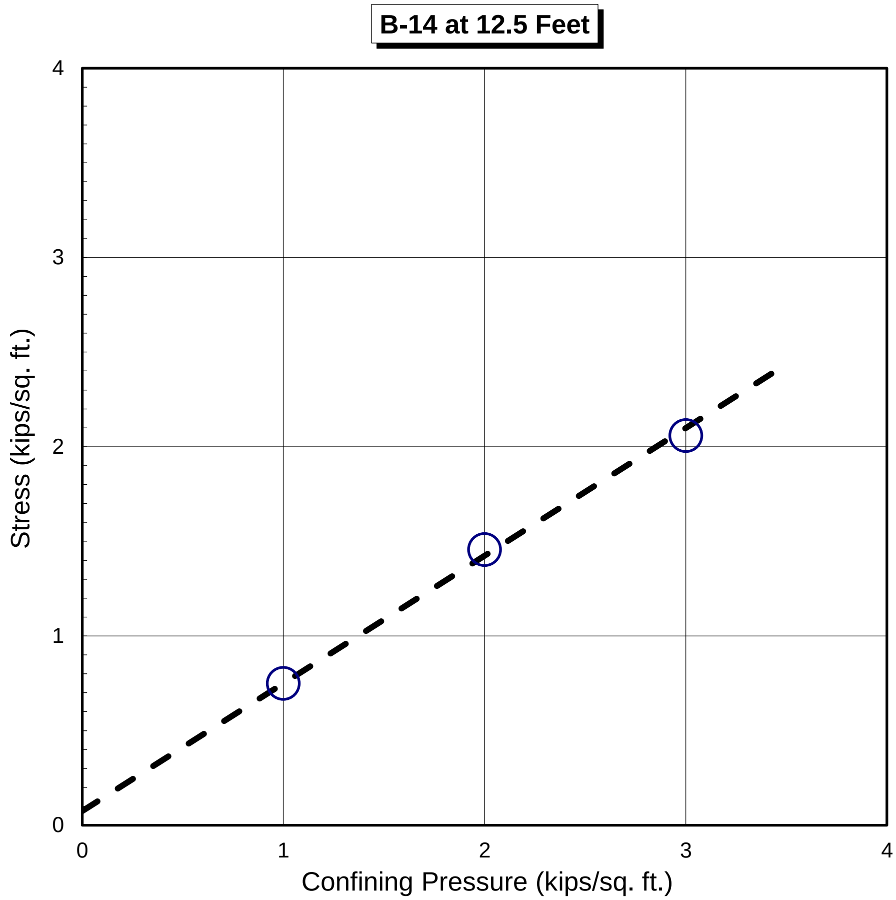
Friction Angle = 32 degrees

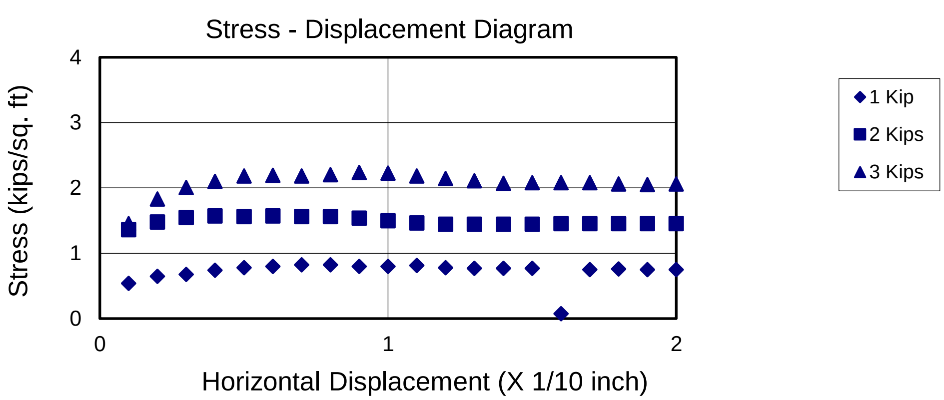
Based on Ultimate Strength

Geotechnical Engineering Investigation 22801 Roscoe Boulevard Los Angeles, California	Project No.	20-2822
	Plate	D-3

HAMILTON & ASSOCIATES

SHEAR TEST RESULTS





Samples were submerged for at least 24 hours.

The samples had a density of 101.2 lbs./cu.ft. and a moisture content of 12.7 %

Cohesion = 75 psf

Friction Angle = 34 degrees

Based on Ultimate Strength

Geotechnical Engineering Investigation 22801 Roscoe Boulevard Los Angeles, California	Project No.	20-2822
	Plate	D-4

HAMILTON & ASSOCIATES

ATTERBERG LIMITS
ASTM D4318

HAMILTON & Associates

Project Name: Partner (Canoga Park)
Project No. : 20-2822
Boring No. : Bulk
Sample No. : N/A

Tested By: BB
Checked By: RM
Depth (ft.): 0-11'
Date: 9/30/2020

Visual Sample Description: Beige silty clay/clayey silt

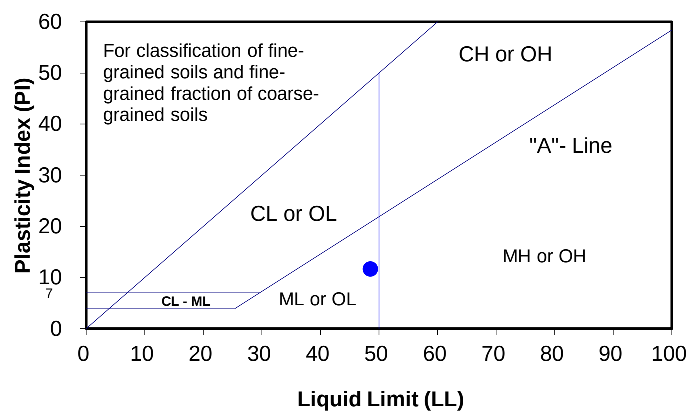
	PLASTIC LIMIT		LIQUID LIMIT			
	1	2	1	2	3	4
Number of Blows [N]:			32	26	20	
Tare No.:	J-3	P-9	P-6	P-2	P-1	
Wt. of Tare (gm):	15.80	15.60	15.10	15.60	15.60	
Wet Wt. of Soil + Tare (gm):	21.00	20.80	46.10	45.90	46.00	
Dry Wt. of Soil + Tare (gm):	19.60	19.40	36.20	36.10	35.80	
Moisture Content (%) [Wn]:	36.84	36.84	46.92	47.80	50.50	

Liquid Limit	**49**
Plastic Limit	**37**
Plasticity Index	**12**
USCS Classification	**ML**

PI at "A" - Line = 0.73(LL-20) = 20.8109

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

☐ Wet Preparation
Multipoint - Wet

☒ Dry Preparation
Multipoint - Dry

☒ Procedure A
Multipoint Test

☐ Procedure B
One-point Test

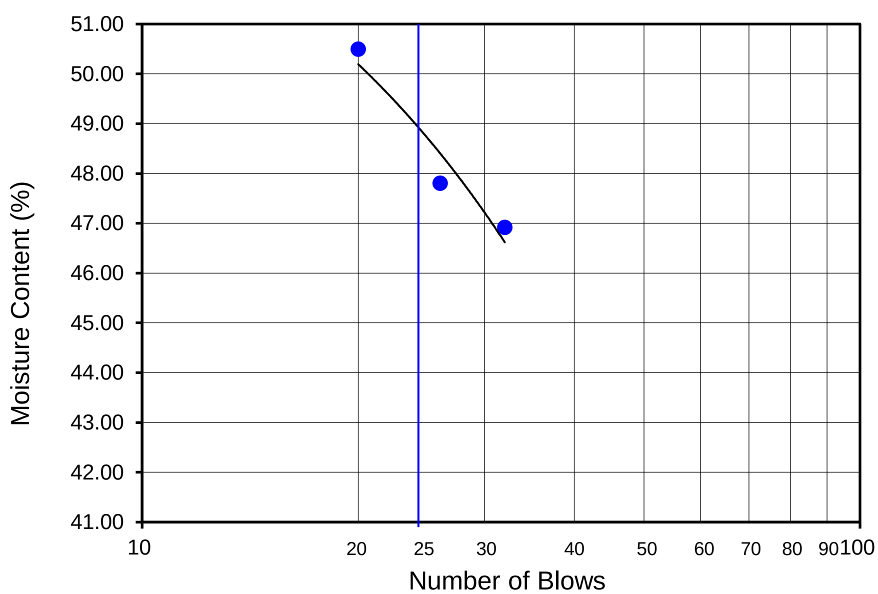


Plate E-1

ATTERBERG LIMITS
ASTM D4318

HAMILTON & Associates

Project Name: Partner (Canoga Park)
Project No. : 20-2822
Boring No. : B-1
Sample No. : N/A

Tested By: BB
Checked By: RM
Depth (ft.): 30'
Date: 9/30/2020

Visual Sample Description: Tan/beige fine sandy clay/sandy silt

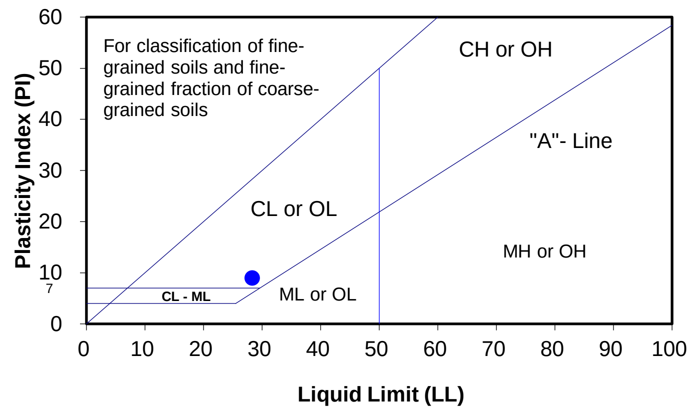
	PLASTIC LIMIT		LIQUID LIMIT			
	1	2	1	2	3	4
Number of Blows [N]:			33	26	21	
Tare No.:	J-3	P-9	P-2	P-5	P-7	
Wt. of Tare (gm):	15.80	15.60	15.60	15.70	15.90	
Wet Wt. of Soil + Tare (gm):	21.20	20.70	46.00	46.10	46.60	
Dry Wt. of Soil + Tare (gm):	20.30	19.90	39.60	39.40	39.60	
Moisture Content (%) [Wn]:	20.00	18.60	26.67	28.27	29.54	

Liquid Limit	**28**
Plastic Limit	**19**
Plasticity Index	**9**
USCS Classification	**CL**

PI at "A" - Line = 0.73(LL-20) = 6.059368

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

- [ ] Wet Preparation Multipoint - Wet
- [X] Dry Preparation Multipoint - Dry
- [X] Procedure A Multipoint Test
- [ ] Procedure B One-point Test

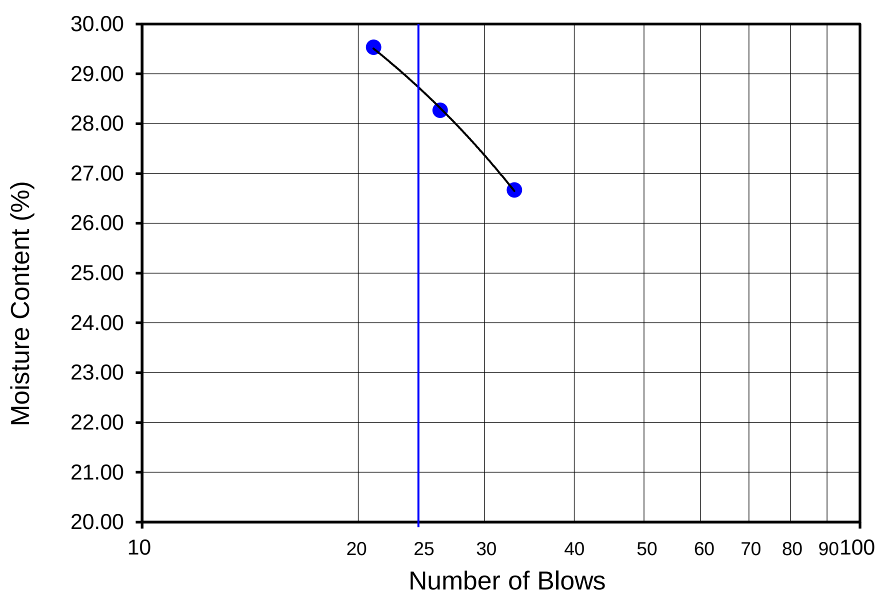


Plate E-2

ATTERBERG LIMITS
ASTM D4318

HAMILTON & Associates

Project Name: Partner (Canoga Park)
Project No. : 20-2822
Boring No. : B-11
Sample No. : N/A

Tested By: BB
Checked By: RM
Depth (ft.): 40'
Date: 9/30/2020

Visual Sample Description: Beige/tan sandy silt

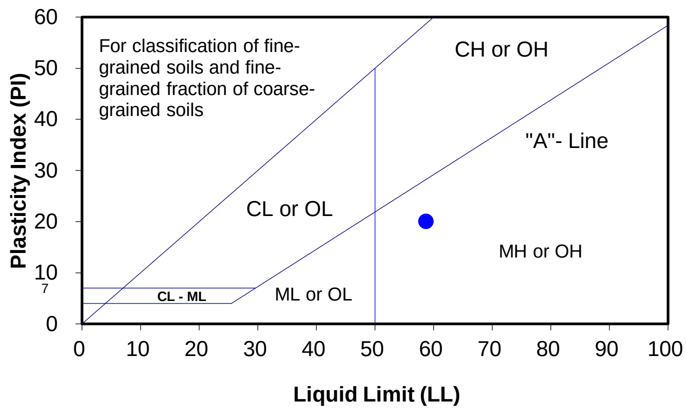
	PLASTIC LIMIT		LIQUID LIMIT			
	1	2	1	2	3	4
Number of Blows [N]:			31	23	17	
Tare No.:	MB-7	GM-12	AM-13	1000	C-10	
Wt. of Tare (gm):	3.40	3.50	3.70	3.60	3.80	
Wet Wt. of Soil + Tare (gm):	8.70	8.60	34.90	34.70	34.20	
Dry Wt. of Soil + Tare (gm):	7.20	7.20	23.50	23.10	22.70	
Moisture Content (%) [Wn]:	39.47	37.84	57.58	59.49	60.85	

Liquid Limit	**59**
Plastic Limit	**39**
Plasticity Index	**20**
USCS Classification	**MH**

PI at "A" - Line = 0.73(LL-20) = 28.2404

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



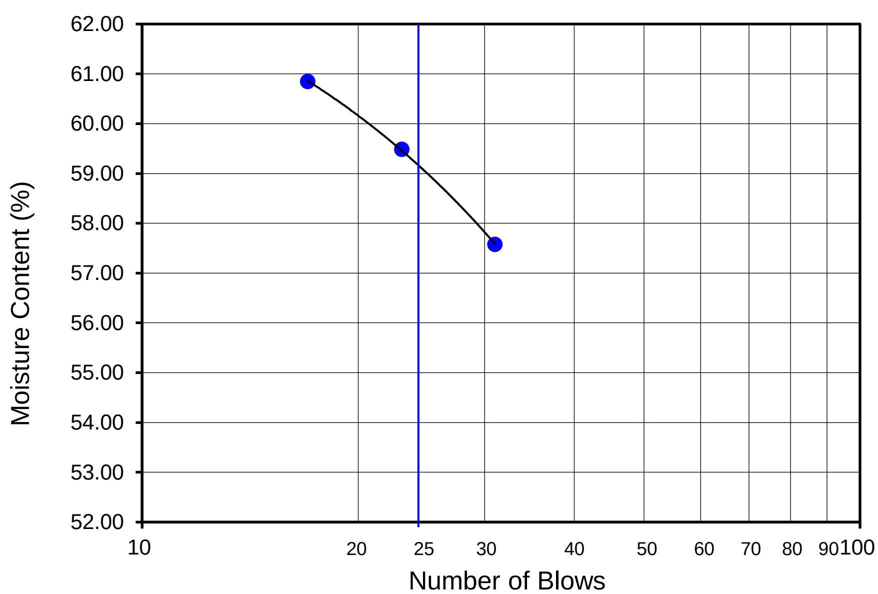
PROCEDURES USED

☐ Wet Preparation
Multipoint - Wet

☒ Dry Preparation
Multipoint - Dry

☒ Procedure A
Multipoint Test

☐ Procedure B
One-point Test



HAMILTON & Associates

ATTERBERG LIMITS
ASTM D4318

Project Name: Partner (Canoga Park)
Project No. : 20-2822
Boring No. : B-1
Sample No. : N-A

Tested By: BB
Checked By: RM
Depth (ft.): 50'
Date: 9/30/2020

Visual Sample Description: Beige/tan sandy silt

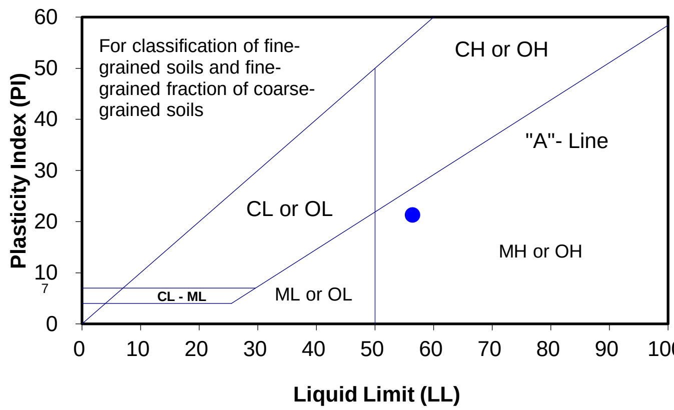
	PLASTIC LIMIT		LIQUID LIMIT			
	1	2	1	2	3	4
Number of Blows [N]:			27	23	18	
Tare No.:	J-2	P-7	P-8	J-1	P-5	
Wt. of Tare (gm):	15.60	15.90	15.00	15.60	15.60	
Wet Wt. of Soil + Tare (gm):	20.90	21.00	45.80	46.90	47.00	
Dry Wt. of Soil + Tare (gm):	19.50	19.70	34.70	35.50	35.50	
Moisture Content (%) [Wn]:	35.90	34.21	56.35	57.29	57.79	

Liquid Limit	**56**
Plastic Limit	**35**
Plasticity Index	**21**
USCS Classification	**MH**

PI at "A" - Line = 0.73(LL-20) = 26.55269

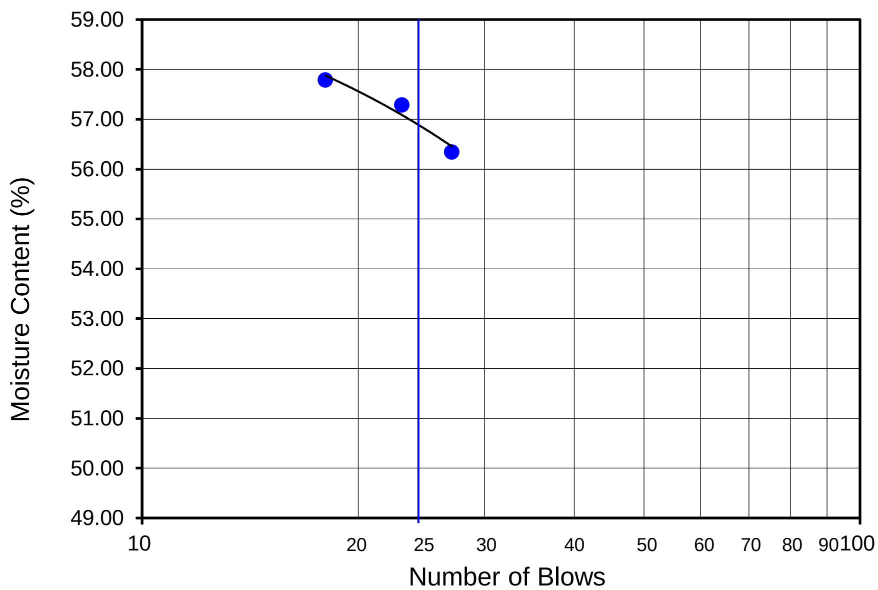
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.121}$



PROCEDURES USED

- [ ] Wet Preparation
  Multipoint - Wet
- [X] Dry Preparation
  Multipoint - Dry
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



APPENDIX C

General Geotechnical Design and Construction Considerations

SUBGRADE PREPARATION

1. In general, construction should proceed per the project specifications and contract documents, as well as governing jurisdictional guidelines for the project site, including but not limited to the applicable State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Subgrade preparation in this section is considered to apply to the initial modifications to existing site conditions to prepare for new planned construction.
3. Prior to the start of subgrade preparation, a detailed conflict study including as-builts, utility locating, and potholing should be conducted. Existing features that are to be demolished should also be identified and the geotechnical study should be referenced to determine the need for subgrade preparation, such as over-excavation, scarification and compaction, moisture conditioning, and/or other activities below planned new structural fills, slabs on grade, pavements, foundations, and other structures.
4. The site conflicts, planned demolitions, and subgrade preparation requirements should be discussed in a pre-construction meeting with the pertinent parties, including the geotechnical engineer, inspector, contractors, testing laboratory, surveyor, and others.
5. In the event of preparations that will require work near to existing structures to remain in-place, protection of the existing structures should be considered. This also includes a geotechnical review of excavations near to existing structures and utilities and other concerns discussed in General Geotechnical Design and Construction Considerations, EARTHWORK and UNDERGROUND PIPELINE INSTALLATION.
6. Features to be demolished should be completely removed and disposed of per jurisdictional requirements and/or other conditions set forth as a part of the project. Resulting excavations or voids should be backfilled per the recommendations in the General Geotechnical Design and Construction Considerations, EARTHWORK section.
7. Vegetation, roots, soils containing organic materials, debris and/or other deleterious materials on the site should be removed from structural areas and should be disposed of as above. Replacement of such materials should be in accordance with the recommendations in the General Geotechnical Design and Construction Considerations, EARTHWORK section
8. Subgrade preparation required by the geotechnical report may also call for as over-excavation, scarification and compaction, moisture conditioning, and/or other activities below planned structural fills, slabs on grade, pavements, foundations, and other structures. These requirements should be provided within the geotechnical report. The execution of this work should be observed by the geotechnical engineering representative or inspector for the site. Testing of the subgrade preparation should be performed per the recommendations in the General Geotechnical Design and Construction Considerations, EARTHWORK section.

9. Subgrade Preparation cannot be completed on frozen ground or on ground that is not at a proper moisture condition. Wet subgrades may be dried under favorable weather if they are disked and/or actively worked during hot, dry, weather, when exposed to wind and sunlight. Frozen ground or wet material can be removed and replaced with suitable material. Dry material can be pre-soaked, or can have water added and worked in with appropriate equipment. The soil conditions should be monitored by the geotechnical engineer prior to compaction. Following this type of work, approved subgrades should be protected by direction of surface water, covering, or other methods, otherwise, re-work may be needed.

EARTHWORK – STRUCTURAL FILL

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Earthwork in this section is considered to apply to the re-shaping and grading of soil, rock, and aggregate materials for the purpose of supporting man-made structures. Where earthwork is needed to raise the elevation of the site for the purpose of supporting structures or forming slopes, this is referred to as the placement of structural fill. Where lowering of site elevations is needed prior to the installation of new structures, this is referred to as earthwork excavations.
3. Prior to the start of earthwork operations, the geotechnical study should be referenced to determine the need for subgrade preparation, such as over-excavation or scarification and compaction of unsuitable soils below planned structural fills, slabs on grade, pavements, foundations, and other structures. These required preparations should be discussed in a pre-construction meeting with the pertinent parties, including the geotechnical engineer, inspector, contractors, testing laboratory, surveyor, and others. The preparations should be observed by the inspector or geotechnical engineer representative, and following such subgrade preparation, the geotechnical engineer should observe the prepared subgrade to approve it for the placement of earthwork fills or new structures.
4. Structural fill materials should be relatively free of organic materials, man-made debris, environmentally hazardous materials, and brittle, non-durable aggregate, frozen soil, soil clods or rocks and/or any other materials that can break down and degrade over time.
5. In deeper structural fill zones, expansive soils (greater than 1.5 percent swell at 100 pounds per square foot surcharge) and rock fills (fills containing particles larger than 4 inches and/or containing more than 35 percent gravel larger than ¾-inch diameter or more than 50 percent gravel) may be used with the approval and guidance of the geotechnical report or geotechnical engineer. This may require the placement of geotextiles or other added costs and/or conditions. These conditions may also apply to corrosive soils (less than 2,000 ohm-cm resistivity, more than 50 ppm chloride content, more than 0.1 percent sulfates)
6. For structural fill zones that are closer in depth below planed structures, low expansive materials, and materials with smaller particle size are generally recommended, as directed by the geotechnical report (see criteria above in 5). This may also apply to corrosive soils.
7. For structural fill materials, in general the compaction equipment should be appropriate for the thickness of the loose lift being placed, and the thickness of the loose lift being placed should be at least two times the maximum particle size incorporated in the fill.
8. Fill lift thickness (including bedding) should generally be proportioned to achieve 95 percent or more of a standard proctor (ASTM D689) maximum dry density (MDD) or 90 percent or more of a modified proctor (ASTM D1557) MDD, depending on the state practices. For subgrades below

roadways, the general requirement for soil compaction is usually increased to 100 percent or more of the standard proctor MDD and 95 percent or more of the modified proctor MDD.

9. Soil compaction should be performed at a moisture content generally near optimum moisture content determined by either standard or modified proctor, and ideally within 3 percent below to 1 percent over the optimum for a standard proctor, and from 2 percent below to 2 percent above optimum for a modified proctor.

10. In some instances fill areas are difficult to access. In such cases a low-strength soil-cement slurry can be used in the place of compacted fill soil. In general such fills should be rated to have a 28-day strength of 75 to 125 psi, which in some areas is referred to as a “1-sack” slurry. It should be noted that these materials are wet during placement, and require a period of 2 days (24 hours) to cure before additional fill can be placed above them. Testing of this material can be done using concrete cylinder compression strength testing equipment, but care is needed in removing the test specimens from the molds. Field testing using the ball method, and spread or flow testing is also acceptable.

11. For fills to be placed on slopes, benching of fill lifts is recommended, which may require cutting into existing slopes to create a bench perpendicular to the slope where soil can be placed in a relatively horizontal orientation. For the construction of slopes, the slopes should be over-built and cut back to grade, as the material in the outer portion of the slope may not be well compacted.

12. For subgrade below roadways, runways, railways or other areas to receive dynamic loading, a proofroll of the finished, compacted subgrade should be performed by the geotechnical engineer or inspector prior to the placement of structural aggregate, asphalt or concrete. Proofrolling consists of observing the performance of the subgrade under heavy-loaded equipment, such as full, 4,000 Gallon water truck, loaded tandem-axel dump truck or similar. Areas that exhibit instability during proofroll should be marked for additional work prior to approval of the subgrade for the next stage of construction.

13. Quality control testing should be provided on earthwork. Proctor testing should be performed on each soil type, and one-point field proctors should be used to verify the soil types during compaction testing. If compaction testing is performed with a nuclear density gauge, it should be periodically correlated with a sand cone test for each soil type. Density testing should be performed per project specifications and or jurisdictional requirements, but not less than once per 12 inches elevation of any fill area, with additional tests per 12-inch fill area for each additional 7,500 square-foot section or portion thereof.

14. For earthwork excavations, OSHA guidelines should be referenced for sloping and shoring. Excavations over a depth of 20 feet require a shoring design. In the event excavations are planned near to existing structures, the geotechnical engineer should be consulted to evaluate whether such excavation will call for shoring or underpinning the adjacent structure. Pre-construction and post-construction condition surveys and vibration monitoring might also be helpful to evaluate any potential damage to surrounding structures.

15. Excavations into rock, partially weathered rock, cemented soils, boulders and cobbles, and other hard soil or ”hard-pan” materials, may result in slower excavation rates, larger equipment with specialized digging tools, and even blasting. It is also not unusual in these situations for screening

and or crushing of rock to be called for. Blasting, hard excavating, and material processing equipment have special safety concerns and are more costly than the use of soil excavation equipment. Additionally, this type of excavation, especially blasting, is known to cause vibrations that should be monitored at nearby structures. As above, a pre-blast and post-blast conditions assessment might also be warranted.

UNDERGROUND PIPELINE – STRUCTURAL BACKFILL

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable State Department of Transportation, the State Department of Environmental Quality, the US Environmental Protection Agency, City and/or County Public Works, Occupational Safety and Health Administration (OSHA), Private Utility Companies, and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered, and in some cases work may take place to multiple different standards. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Underground pipeline in this section is considered to apply to the installation of underground conduits for water, storm water, irrigation water, sewage, electricity, telecommunications, gas, etc. Structural backfill refers to the activity of restoring the grade or establishing a new grade in the area where excavations were needed for the underground pipeline installation.
3. Prior to the start of underground pipeline installation, a detailed conflict study including as-builts, utility locating, and potholing should be conducted. The geotechnical study should be referenced to determine subsurface conditions such as caving soils, unsuitable soils, shallow groundwater, shallow rock and others. In addition, the utility company responsible for the line also will have requirements for pipe bedding and support as well as other special requirements. Also, if the underground pipeline traverses other properties, rights-of-way, and/or easements etc. (for roads, waterways, dams, railways, other utility corridors, etc.) those owners may have additional requirements for construction.
4. The required preparations above should be discussed in a pre-construction meeting with the pertinent parties, including the geotechnical engineer, inspector, contractors, testing laboratory, surveyor, and other stake holders.
5. For pipeline excavations, OSHA guidelines should be referenced for sloping and shoring. Excavations over a depth of 20 feet require a shoring design. In the event excavations are planned near to existing structures or pipelines, the geotechnical engineer should be consulted to evaluate whether such excavation will call for shoring or supporting the adjacent structure or pipeline. A pre-construction and post-construction condition survey and vibration monitoring might also be helpful to evaluate any potential damage to surrounding structures.
6. Excavations into rock, partially weathered rock, cemented soils, boulders and cobbles, and other hard soil or "hard-pan" materials, may result in slower excavation rates, larger equipment with specialized digging tools, and even blasting. It is also not unusual in these situations for screening and or crushing of rock to be called for. Blasting, hard excavating and material processing equipment have special safety concerns and are more costly than the use soil excavation equipment. Additionally, this type of excavation, especially blasting, is known to cause vibrations that should be monitored at nearby structures. As above, a pre-blast and post-blast conditions assessment might also be warranted.
7. Bedding material requirements vary between utility companies and might depend of the type of pipe material and availability of different types of aggregates in different locations. In general,

bedding refers to the material that supports the bottom of the pipe, and extends to 1 foot above the top of the pipe. In general the use of aggregate base for larger diameter pipes (6-inch diameter or more) is recommended lacking a jurisdictionally specified bedding material. Gas lines and smaller diameter lines are often backfilled with fine aggregate meeting the ASTM requirements for concrete sand. In all cases bedding with less than 2,000 ohm-cm resistivity, more than 50 ppm chloride content or more than 0.1 percent sulfates should not be used.

8. Structural backfill materials above the bedding should be relatively free of organic materials, man-made debris, environmentally hazardous materials, frozen material, and brittle, non-durable aggregate, soil clods or rocks and/or any other materials that can break down and degrade over time.
9. In general the backfill soil requirements will depend on the future use of the land above the buried line, but in most cases, excessive settlement of the pipe trench is not considered advisable or acceptable. As such, the structural backfill compaction equipment should be appropriate for the thickness of the loose lift being placed. The thickness of the loose lift being placed should be at least two times the maximum particle size incorporated in the fill. Care should be taken not to damage the pipe during compaction or compaction testing.
10. Fill lift thickness (including bedding) should generally be proportioned to achieve 95 percent or more of a standard proctor (ASTM D689) maximum dry density (MDD) or 90 percent or more of a modified proctor (ASTM D1557) MDD, depending on the state practices (in general the modified proctor is required in California and for projects in the jurisdiction of the Army Corps of Engineers). For backfills within the upper poritons of roadway subgrades, the general requirement for soil compaction is usually increased to 100 percent or more of the standard proctor MDD and 95 percent or more of the modified proctor MDD.
11. Soil compaction should be performed at a moisture content generally near optimum moisture content determined by either standard or modified proctor, and ideally within 3 percent below to 1 percent over the optimum for a standard proctor, and from 2 percent below to 2 percent above optimum for a modified proctor.
12. In some instances fill areas are difficult to access. In such cases a low-strength soil-cement slurry can be used in the place of compacted fill soil. In general such fills should be rated to have a 28-day strength of 75 to 125 psi, which in some areas is referred to as a "1-sack" slurry. It should be noted that these materials are wet, and require a period of 2 days (24 hours) to cure before additional fill can be placed above it. Testing of this material can be done using concrete cylinder compression strength testing equipment, but care is needed in removing the test specimens from the molds. Field testing using the ball method, and spread or flow testing is also acceptable.
13. Quality control testing should be provided on structural backfill to assist the contractor in meeting project specifications. Proctor testing should be performed on each soil type, and one-point field proctors should be used to verify the soil types during compaction testing. If compaction testing is performed with a nuclear density gauge, it should be periodically correlated with a sand cone test for each soil type.

14. Density testing should be performed on structural backfill per project specifications and or jurisdictional requirements, but not less than once per 12 inches elevation in each area, and additional tests for each additional 500 linear-foot section or portion thereof.

CAST-IN-PLACE CONCRETE

SLABS-ON-GRADE/STRUCTURES/PAVEMENTS

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Cast-in-place concrete (concrete) in this section is considered to apply to the installation of cast-in-place concrete slabs on grade, including reinforced and non-reinforced slabs, structures, and pavements.
3. In areas where concrete is bearing on prepared subgrade or structural fill soils, testing and approval of this work should be completed prior to the beginning of concrete construction.
4. In locations where a concrete is approved to bear on in-place (native) soil or in locations where approved documented fills have been exposed to weather conditions after approval, a concrete subgrade evaluation should be performed prior to the placement of reinforcing steel and or concrete. This can consist of probing with a "t"-handled rod, borings, penetrometer testing, dynamic cone penetration testing and/or other methods requested by the geotechnical engineer and/or inspector. Where unsuitable, wet, or frozen bearing material is encountered, the geotechnical engineer should be consulted for additional recommendations.
5. Slabs on grade should be placed on a 4-inch thick or more capillary barrier consisting of non-corrosive (more than 2,000 ohm-cm resistivity, less than 50 ppm chloride content and less than 0.1 percent sulfates) aggregate base or open-graded aggregate material. This material should be compacted or consolidated per the recommendations of the structural engineer or otherwise would be covered by the General Considerations for EARTHWORK.
6. Depending on the site conditions and climate, vapor barriers may be required below in-door grade-slabs to receive flooring. This reduces the opportunity for moisture vapor to accumulate in the slab, which could degrade flooring adhesive and result in mold or other problems. Vapor barriers should be specified by the structural engineer and/or architect. The installation of the barrier should be inspected to evaluate the correct product and thickness is used, and that it has not been damaged or degraded.
7. At times when rainfall is predicted during construction, a mud-mat or a thin concrete layer can be placed on prepared and approved subgrades prior to the placement of reinforcing steel or tendons. This serves the purpose of protecting the subgrades from damage once the reinforcement placement has begun.
8. Prior to the placement of concrete, exposed subgrade or base material and forms should be wetted, and form release compounds should be applied. Reinforcement support stands or ties should be checked. Concrete bases or subgrades should not be so wet that they are softened or have standing water.

9. For a cast-in-place concrete, the form dimensions, reinforcement placement and cover, concrete mix design, and other code requirements should be carefully checked by an inspector before and during placement. The reinforcement should be specified by the structural engineering drawings and calculations.
10. For post-tension concrete, an additional check of the tendons is needed, and a tensioning inspection form should be prepared prior to placement of concrete.
11. For Portland cement pavements, forms an additional check of reinforcing dowels should performed per the design drawings.
12. During placement, concrete should be tested, and should meet the ACI and jurisdictional requirements and mix design targets for slump, air entrainment, unit weight, compressive strength, flexural strength (pavements), and any other specified properties. In general concrete should be placed within 90 minutes of batching at a temperature of less than 90 degrees Fahrenheit. Adding of water to the truck on the jobsite is generally not encouraged.
13. Concrete mix designs should be created by the accredited and jurisdictionally approved supplier to meet the requirements of the structural engineer. In general a water/cement ratio of 0.45 or less is advisable, and aggregates, cement, flyash, and other constituents should be tested to meet ASTM C-33 standards, including Alkali Silica Reaction (ASR). To further mitigate the possibility of concrete degradation from corrosion and ASR, Type II or V Portland Cement should be used, and fly ash replacement of 25 percent is also recommended. Air entrained concrete should be used in areas where concrete will be exposed to frozen ground or ambient temperatures below freezing.
14. Control joints are recommended to improve the aesthetics of the finished concrete by allowing for cracking within partially cut or grooved joints. The control joints are generally made to depths of about 1/4 of the slab thickness and are generally completed within the first day of construction. The spacing should be laid out by the structural engineer, and is often in a square pattern. Joint spacing is generally 5 to 15 feet on-center but this can vary and should be decided by the structural engineer. For pavements, construction joints are generally considered to function as control joints. Post-tensioned slabs generally do not have control joints.
15. Some slabs are expected to meet flatness and levelness requirements. In those cases, testing for flatness and levelness should be completed as soon as possible, usually the same day as concrete placement, and before cutting of control joints if possible. Roadway smoothness can also be measured, and is usually specified by the jurisdictional owner if is required.
16. Prior to tensioning of post-tension structures, placement of soil backfills or continuation of building on newly-placed concrete, a strength requirement is generally required, which should be specified by the structural engineer. The strength progress can be evaluated by the use of concrete compressive strength cylinders or maturity monitoring in some jurisdictions. Advancing with backfill, additional concrete work or post-tensioning without reaching strength benchmarks could result in damage and failure of the concrete, which could result in danger and harm to nearby people and property.
17. In general, concrete should not be exposed to freezing temperatures in the first 7 days after placement, which may require insulation or heating. Additionally, in hot or dry, windy weather,

misting, covering with wet burlap or the use of curing compounds may be called for to reduce shrinkage cracking and curling during the first 7 days.

FOUNDATIONS

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Foundations in this section are considered to apply to the construction of structural supports which directly transfer loads from man-made structures into the earth. In general, these include shallow foundations and deep foundations. Shallow foundations are generally constructed for the purpose of distributing the structural loads horizontally over a larger area of earth. Some types of shallow foundations (or footings) are spread footings, continuous footings, mat foundations, and reinforced slabs-on-grade. Deep foundations are generally designed for the purpose of distributing the structural loads vertically deeper into the soil by the use of end bearing and side friction. Some types of deep foundations are driven piles, auger-cast piles, drilled shafts, caissons, helical piers, and micro-piles.
3. For shallow foundations, the minimum bearing depth considered should be greater than the maximum design frost depth for the location of construction. This can be found on frost depth maps (ICC), but the standard of practice in the city and/or county should also be consulted. In general the bearing depth should never be less than 18 inches below planned finished grades.
4. Shallow continuous foundations should be sized with a minimum width of 18 inches and isolated spread footings should be a minimum of 24 inches in each direction. Foundation sizing, spacing, and reinforcing steel design should be performed by a qualified structural engineer.
5. The geotechnical engineer will provide an estimated bearing capacity and settlement values for the project based on soil conditions and estimated loads provided by the structural engineer. It is assumed that appropriate safety factors will be applied by the structural engineer.
6. In areas where shallow foundations are bearing on prepared subgrade or structural fill soils, testing and approval of this work should be completed prior to the beginning of foundation construction.
7. In locations where the shallow foundations are approved to bear on in-place (native) soil or in locations where approved documented fills have been exposed to weather conditions after approval, a foundation subgrade evaluation should be performed prior to the placement of reinforcing steel. This can consist of probing with a "t"-handled rod, borings, penetrometer testing, dynamic cone penetration testing and/or other methods requested by the geotechnical engineer and/or inspector. Where unsuitable foundation bearing material is encountered, the geotechnical engineer should be consulted for additional recommendations.
8. For shallow foundations to bear on rock, partially weathered rock, hard cemented soils, and/or boulders, the entire foundation system should bear directly on such material. In this case, the rock surface should be prepared so that it is clean, competent, and formed into a roughly horizontal, stepped base. If that is not possible, then the entire structure should be underlain by a zone of

structural fill. This may require the over-excavation in areas of rock removal and/or hard dig. In general this zone can vary in thickness but it should be a minimum of 1 foot thick. The geotechnical engineer should be consulted in this instance.

9. At times when rainfall is predicted during construction, a mud-mat or a thin concrete layer can be placed on prepared and approved subgrades prior to the placement of reinforcing steel. This serves the purpose of protecting the subgrades from damage once the reinforcing steel placement has begun.
10. For cast-in-place concrete foundations, the excavations dimensions, reinforcing steel placement and cover, structural fill compaction, concrete mix design, and other code requirements should be carefully checked by an inspector before and during placement.

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11. For deep foundations, the geotechnical engineer will generally provide design charts that provide foundations axial capacity and uplift resistance at various depths given certain-sized foundations. These charts may be based on blow count data from drilling and or laboratory testing. In general safety factors are included in these design charts by the geotechnical engineer.
12. In addition, the geotechnical engineer may provide other soil parameters for use in the lateral resistance analysis. These parameters are usually raw data, and safety factors should be provided by the shaft designer. Sometimes, direct shear and or tri-axial testing is performed for this analysis.
13. In general the spacing of deep foundations is expected to be 6 shaft diameters or more. If that spacing is reduced, a group reduction factor should be applied by the structural engineer to the foundation capacities per FHWA guidelines. The spacing should not be less than 2.5 shaft diameters.
14. For deep foundations, a representative of the geotechnical engineer should be on-site to observe the excavations (if any) to evaluate that the soil conditions are consistent with the findings of the geotechnical report. Soil/rock stratigraphy will vary at times, and this may result in a change in the planned construction. This may require the use of fall protection equipment to perform observations close to an open excavation.
15. For driven foundations, a representative of the geotechnical engineer should be on-site to observe the driving process and to evaluate that the resistance of driving is consistent with the design assumptions. Soil/rock stratigraphy will vary at times and may this may result in a change in the planned construction.
16. For deep foundations, the size, depth, and ground conditions should be verified during construction by the geotechnical engineer and/or inspector responsible. Open excavations should be clean, with any areas of caving and groundwater seepage noted. In areas below the groundwater table, or areas where slurry is used to keep the trench open, non-destructive testing techniques should be used as outlined below.
17. Steel members including structural steel piles, reinforcing steel, bolts, threaded steel rods, etc. should be evaluated for design and code compliance prior to pick-up and placement in the foundation. This includes verification of size, weight, layout, cleanliness, lap-splices, etc. In addition, if non-destructive testing such as crosshole sonic logging or gamma-gamma logging is required, access tubes should be attached to the steel reinforcement prior to placement, and should be

relatively straight, capped at the bottom, and generally kept in-round. These tubes must be filled with water prior to the placement of concrete.

18. In cases where steel welding is required, this should be observed by a certified welding inspector.
19. In many cases, a crane will be used to lower steel members into the deep foundations. Crane picks should be carefully planned, including the ground conditions at placement of outriggers, wind conditions, and other factors. These are not generally provided in the geotechnical report, but can usually be provided upon request.
20. Cast-in-place concrete, grout or other cementations materials should be pumped or distributed to the bottom of the excavation using a tremmie pipe or hollow stem auger pipe. Depending on the construction type, different mix slumps will be used. This should be carefully checked in the field during placement, and consolidation of the material should be considered. Use of a vibrator may be called for.
21. For work in a wet excavation (slurry), the concrete placed at the bottom of the excavation will displace the slurry as it comes up. The upper layer of concrete that has interacted with the slurry should be removed and not be a part of the final product.
22. Bolts or other connections to be set in the top after the placement is complete should be done immediately after final concrete placement, and prior to the on-set of curing.
23. For shafts requiring crosshole sonic logging or gamma-gamma testing, this should be performed within the first week after placement, but not before a 2 day curing period. The testing company and equipment manufacturer should provide more details on the requirements of the testing.
24. Load testing of deep foundations is recommended, and it is often a project requirement. In some cases, if test piles are constructed and tested, it can result in a significant reduction of the amount of needed foundations. The load testing frame and equipment should be sized appropriately for the test to be performed, and should be observed by the geotechnical engineer or inspector as it is performed. The results are provided to the structural engineer for approval.

LATERALLY LOADED STRUCTURES - RETAINING WALLS/SLOPES/DEEP FOUNDATIONS/MISCELLANEOUS

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Laterally loaded structures for this section are generally meant to describe structures that are subjected to loading roughly horizontal to the ground surface. Such structures include retaining walls, slopes, deep foundations, tall buildings, box culverts, and other buried or partially buried structures.
3. The recommendations put forth in General Geotechnical Design and Construction Considerations for FOUNDATIONS, CAST-IN-PLACE CONCRETE, EARTHWORK, and SUBGRADE PREPARATION should be reviewed, as they are not all repeated in this section, but many of them will apply to the work. Those recommendations are incorporated by reference herein.
4. Laterally loaded structures are generally affected by overburden pressure, water pressure, surcharges, and other static loads, as well as traffic, seismic, wind, and other dynamic loads. The structural engineer must account for these loads. In addition, eccentric loading of the foundation should be evaluated and accounted for by the structural engineer. The structural engineer is also responsible for applying the appropriate factors of safety to the raw data provided by the geotechnical engineer.
5. The geotechnical report should provide data regarding soil lateral earth pressures, seismic design parameters, and groundwater levels. In the report the pressures are usually reported as raw data in the form of equivalent fluid pressures for three cases. 1. Static is for soil pressure against a structure that is fixed at top and bottom, like a basement wall or box culvert. 2. Active is for soil pressure against a wall that is free to move at the top, like a retaining wall. 3. Passive is for soil that is resisting the movement of the structure, usually at the toe of the wall where the foundation and embedded section are located. The structural engineer is responsible for deciding on safety factors for design parameters and groundwater elevations based on the raw data in the geotechnical report.
6. Generally speaking, direct shear or tri-axial shear testing should be performed for this evaluation in cases of soil slopes or unrestrained soil retaining walls over 6 feet in height or in lower walls in some cases based on the engineer's judgment. For deep foundations and completely buried structures, this testing will be required per the discretion of the structural engineer.
7. For non-confined retaining walls (walls that are not attached at the top) and slopes, a geotechnical engineer should perform overall stability analysis for sliding, overturning, and global stability. For walls that are structurally restrained at the top, the geotechnical engineer does not generally perform this analysis. Internal wall stability should be designed by the structural engineer.

8. Cut slopes into rock should be evaluated by an engineering geologist, and rock coring to identify the orientation of fracture plans, faults, bedding planes, and other features should be performed. An analysis of this data will be provided by the engineering geologist to identify modes of failure including sliding, wedge, and overturning, and to provide design and construction recommendations.
9. For laterally loaded deep foundations that support towers, bridges or other structures with high lateral loads, geotechnical reports generally provide parameters for design analysis which is performed by the structural engineer. The structural engineer is responsible for applying appropriate safety factors to the raw data from the geotechnical engineer.
10. Construction recommendations for deep foundations can be found in the General Geotechnical Design and Construction Considerations-FOUNDATIONS section.
11. Construction of retaining walls often requires temporary slope excavations and shoring, including soil nails, soldier piles and lagging or laid-back slopes. This should be done per OSHA requirements and may require specialty design and contracting.
12. In general, surface water should not be directed over a slope or retaining wall, but should be captured in a drainage feature trending parallel to the slope, with an erosion protected outlet to the base of the wall or slope.
13. Waterproofing for retaining walls is generally required on the backfilled side, and they should be backfilled with an 18-inch zone of open graded aggregate wrapped in filter fabric or a synthetic draining product, which outlets to weep holes or a drain at the base of the wall. The purpose of this zone, which is immediately behind the wall is to relieve water pressures from building behind the wall.
14. Backfill compaction around retaining walls and slopes requires special care. Lighter equipment should be considered, and consideration to curing of cementitious materials used during construction will be called for. Additionally, if mechanically stabilized earth walls are being constructed, or if tie-backs are being utilized, additional care will be necessary to avoid damaging or displacing the materials. Use of heavy or large equipment, and/or beginning of backfill prior to concrete strength verification can create dangers to construction and human safety. Please refer to the General Geotechnical Design and Construction Considerations-CAST-IN-PLACE CONCRETE section. These concerns will also apply to the curing of cell grouting within reinforced masonry walls.
15. Usually safety features such as handrails are designed to be installed at the top of retaining walls and slopes. Prior to their installation, workers in those areas will need to be equipped with appropriate fall protection equipment.

EXCAVATION AND DEWATERING

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Excavation and Dewatering for this section are generally meant to describe structures that are intended to create stable, excavations for the construction of infrastructure near to existing development and below the groundwater table.
3. The recommendations put forth in General Geotechnical Design and Construction Considerations for LATERALLY LOADED STRUCTURES, FOUNDATIONS, CAST-IN-PLACE CONCRETE, EARTHWORK, and SUBGRADE PREPARATION should be reviewed, as they are not all repeated in this section, but many of them will apply to the work. Those recommendations are incorporated by reference herein.
4. The site excavations will generally be affected by overburden pressure, water pressure, surcharges, and other static loads, as well as traffic, seismic, wind, and other dynamic loads. The structural engineer must account for these loads as described in Section 5.2 of this report. In addition, eccentric loading of the foundation should be evaluated and accounted for by the structural engineer. The structural engineer is also responsible for applying the appropriate factors of safety to the raw data provided by the geotechnical engineer.
5. The geotechnical report should provide data regarding soil lateral earth pressures, seismic design parameters, and groundwater levels. In the report the pressures are usually reported as raw data in the form of equivalent fluid pressures for three cases. 1. Static is for soil pressure against a structure that is fixed at top and bottom, like a basement wall or box culvert. 2. Active is for soil pressure against a wall that is free to move at the top, like a retaining wall. 3. Passive is for soil that is resisting the movement of the structure, usually at the toe of the wall where the foundation and embedded section are located. The structural engineer is responsible for deciding on safety factors for design parameters and groundwater elevations based on the raw data in the geotechnical report.
6. The parameters provided above are based on laboratory testing and engineering judgement. Since numerous soil layers with different properties will be encountered in a large excavation, assumptions and judgement are used to generate the equivalent fluid pressures to be used in design. Factors of safety are not included in those numbers and should be evaluated prior to design.
7. Groundwater, if encountered will dramatically change the stability of the excavation. In addition, pumping of groundwater from the bottom of the excavation can be difficult and costly, and it can result in potential damage to nearby structures if groundwater drawdown occurs. As such, we recommend that groundwater monitoring be performed across the site during design and prior to construction to assist in the excavation design and planning.
8. Groundwater pumping tests should be performed if groundwater pumping will be needed during construction. The pumping tests can be used to estimate drawdown at nearby properties, and also

will be needed to determine the hydraulic conductivity of the soil for the design of the dewatering system.

9. For excavation stabilization in granular and dense soil, the use of soldier piles and lagging is recommended. The soldier pile spacing and size should be determined by the structural engineer based on the lateral loads provided in the report. In general, the spacing should be more than two pile diameters, and less than 8 feet. Soldier piles should be advanced 5 feet or more below the base of the excavation. Passive pressures from Section 5.2 can be used in the design of soldier piles for the portions of the piles below the excavation.
10. If the piles are drilled, they should be grouted in-place. If below the groundwater table, the grouting should be accomplished by tremmie pipe, and the concrete should be a mix intended for placement below the groundwater table. For work in a wet excavation, the concrete placed at the bottom of the excavation will displace the water as it comes up. The upper layer of concrete that has interacted with the water should be removed and not be a part of the final product. Lagging should be specially designed timber or other lagging. The temporary excavation will need to account for seepage pressures at the toe of the wall as well as hydrostatic forces behind the wall.
11. Depending on the loading, rakers, tie back anchors, and/or soil nails may be needed. These should be installed beyond the failure envelope of the wall. This would be a plane that is rotated upward 45 degrees + half the friction angle ($45º + \phi'/2$) from horizontal. The strength of the anchors behind this plane should be considered, and bond strength inside the plane should be ignored. If friction anchors are used, they should extend 10 feet or more beyond the failure envelope. Evaluation of the anchor length and encroachment onto other properties, and possible conflicts with underground utilities should be carefully considered. Anchors are typically installed 25 to 40 degrees below horizontal. The capacity of the anchors should be checked on 10% of locations by loading to 200% of the design strength. All should be loaded to 120% of design strength, and should be locked off at 80%
12. The shoring and tie backs should be designed to allow less than ½ inch of deflection at the top of the excavation wall, where the wall is within an imaginary 1:1 line extending downward from the base of surrounding structures. This can be expanded to 1 inch of deflection if there is no nearby structure inside that plane. An analysis of nearby structures to locate their depth and horizontal position should be conducted prior to shored excavation design.
13. Assuming that the excavations will encroach below the groundwater table, allowances for drainage behind and through the lagging should be made. The drainage can be accomplished by using an open-graded gravel material that is wrapped in geotextile fabric. The lagging should allow for the collected water to pass through the wall at select locations into drainage trenches below the excavation base. These trenches should be considered as sump areas where groundwater can be pumped out of the excavation.
14. The pumped groundwater needs to be handled properly per jurisdictional guidelines.
15. In general, surface water should not be directed over a slope or retaining wall, but should be captured in a drainage feature trending parallel to the slope, with an erosion protected outlet to the base of the wall or slope.

16. Safety features such as handrails or barriers are to be designed to be installed at the top of retaining walls and slopes. Prior to their installation, workers in those areas will need to be equipped with appropriate fall protection equipment.

CHEMICAL TREATMENT OF SOIL

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, State Department of Environmental Quality, the US Environmental Protection Agency, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Chemical treatment of soil for this section is generally meant to describe the process of improving soil properties for a specific purpose, using cement or chemical lime.
3. A mix design should be performed by the geotechnical engineer to help it meet the specific strength, plasticity index, durability, and/or other desired properties. The mix design should be performed using the proposed chemical lime or cement proposed for use by the contractor, along with samples of the site soil that are taken from the material to be used in the process.
4. For the mix design the geotechnical engineer should perform proctor testing to determine optimum moisture content of the soil, and then mix samples of the soil at 3 percent above optimum moisture content with varying concentrations of lime or cement. The samples will be prepared and cured per ASTM standards, and then after 7-days for curing, they will be tested for compression strength. Durability testing goes on for 28 days.
5. Following this testing, the geotechnical engineer will provide a recommended mix ratio of cement or chemical lime in the geotechnical report for use by the contractor. The geotechnical engineer will generally specify a design ratio of 2 percent more than the minimum to account for some error during construction.
6. Prior to treatment, the in-place soil moisture should be measured so that the correct amount of water can be used during construction. Work should not be performed on frozen ground.
7. During construction, special considerations for construction of treated soils should be followed. The application process should be conducted to prevent the loss of the treatment material to wind which might transport the materials off site, and workers should be provided with personal protective equipment for dust generated in the process.
8. The treatment should be applied evenly over the surface, and this can be monitored by use of a pan placed on the subgrade. This can also be tested by preparing test specimens from the in-place mixture for laboratory testing.
9. Often, after or during the chemical application, additional water may be needed to activate the chemical reaction. In general, it should be maintained at about 3 percent or more above optimum moisture. Following this, mixing of the applied material is generally performed using specialized equipment.
10. The total amount of chemical provided can be verified by collecting batch tickets from the delivery trucks, and the depth of the treatment can be verified by digging of test pits, and the use of reagents that react with lime and or cement.

11. For the use of lime treatment, compaction should be performed after a specified amount of time has passed following mixing and re-grading. For concrete, compaction should be performed immediately after mixing and re-grading. In both cases, some swelling of the surface should be expected. Final grading should be performed the following day of the initial work for lime treatment, and within 2 to 4 hours for soil cement.
12. Quality control testing of compacted treated subgrades should be performed per the recommendations of the geotechnical report, and generally in accordance with General Geotechnical Design and Construction Considerations - EARTHWORK

PAVING

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Paving for this section is generally meant to describe the placement of surface treatments on travel-ways to be used by rubber-tired vehicles, such as roadways, runways, parking lots, etc.
3. The geotechnical engineer is generally responsible for providing structural analysis to recommend the thickness of pavement sections, which can include asphalt, concrete pavements, aggregate base, cement or lime treated aggregate base, and cement or lime treated subgrades.
4. The civil engineer is generally responsible for determining which surface finishes and mixes are appropriate, and often the owner, general contractor and/or other party will decide on lift thickness, the use of tack coats and surface treatments, etc.
5. The geotechnical engineer will generally be provided with the planned traffic loading, as well as reliability, design life, and serviceability factors by the jurisdiction, traffic engineer, designer, and/or owner. The geotechnical study will provide data regarding soil resiliency and strength. A pavement modeling software is generally used to perform the analysis for design, however, jurisdictional minimum sections also must be considered, as well as construction considerations and other factors.
6. The geotechnical report report will generally provide pavement section thicknesses if requested.
7. For construction of overlays, where new pavement is being placed on old pavement, an evaluation of the existing pavement is needed, which should include coring the pavement, evaluation of the overall condition and thickness of the pavement, and evaluation of the pavement base and subgrade materials.
8. In general, the existing pavement is milled and treated with a tack coat prior to the placement of new pavement for the purpose of creating a stronger bond between the old and new material. This is also a way of removing aged asphalt and helping to maintain finished grades closer to existing conditions grading and drainage considerations.
9. If milling is performed, a minimum of 2 inches of existing asphalt should be left in-place to reduce the likelihood of equipment breaking through the asphalt layer and destroying its integrity. After milling and before the placement of tack coat, the surface should be evaluated for cracking or degradation. Cracked or degraded asphalt should be removed, spanned with geosynthetic reinforcement, or be otherwise repaired per the direction of the civil and or geotechnical engineer prior to continuing construction. Proofrolling may be requested.
10. For pavements to be placed on subgrade or base materials, the subgrade and base materials should be prepared per the General Geotechnical Design and Construction Considerations – EARTHWORK section.

11. Following the proofrolling as described in the General Geotechnical Design and Construction Considerations – EARTHWORK section, the application of subgrade treatment, base material, and paving materials can proceed per the recommendations in the geotechnical report and/or project plans. The placement of pavement materials or structural fills cannot take place on frozen ground.
12. The placement of aggregate base material should conform to the jurisdictional guidelines. In general the materials should be provided by an accredited supplier, and the material should meet the standards of ASTM C-33. Material that has been stockpiled and exposed to weather including wind and rain should be retested for compliance since fines could be lost. Frozen material cannot be used.
13. The placement of asphalt material should conform to the jurisdictional guidelines. In general the materials should be provided by an accredited supplier, and the material should meet the standards of ASTM C-33. The material can be placed in a screed by end-dumping, or it can be placed directly on the paving surface. The temperature of the mix at placement should generally be on the order of 300 degrees Fahrenheit at time of placement and screeding.
14. Compaction of the screeded asphalt should begin as soon as practical after placement, and initial rolling should be performed before the asphalt has cooled significantly. Compaction equipment should have vibratory capabilities, and should be of appropriate size and weight given the thickness of the lift being placed and the sloping of the ground surface.
15. In cold and/or windy weather, the cooling of the screeded asphalt is a quality issue, so preparations should be made to perform screeding immediately after placement, and compaction immediately after screeding.
16. Quality control testing of the asphalt should be performed during placement to verify compaction and mix design properties are being met and that delivery temperatures are correct. Results of testing data from asphalt laboratory testing should be provided within 24 hours of the paving.

SITE GRADING AND DRAINAGE

1. In general, construction should proceed per the governing jurisdictional guidelines for the project site, including but not limited to the applicable American Concrete Institute (ACI), International Code Council (ICC), State Department of Transportation, State Department of Environmental Quality, the US Environmental Protection Agency, City and/or County, Army Corps of Engineers, Federal Aviation, Occupational Safety and Health Administration (OSHA), and any other governing standard details and specifications. In areas where multiple standards are applicable the more stringent should be considered. Work should be performed by qualified, licensed contractors with experience in the specific type of work in the area of the site.
2. Site grading and drainage for this section is generally meant to describe the effect of new construction on surface hydrology, which impacts the flow of rainfall or other water running across, onto or off-of, a newly constructed or modified development.
3. This section does not apply to the construction of site grading and drainage features. Recommendations for the construction of such features are covered in General Geotechnical Design and Construction Considerations for Earthwork – Structural Fills section and Underground Pipeline Installation – Backfill section.
4. In general, surface water flows should be directed towards storm drains, natural channels, retention or detention basins, swales, and/or other features specifically designed to capture, store, and or transmit them to specific off-site outfalls.
5. The surface water flow design is generally performed by a site civil engineer, and it can be impacted by hydrology, roof lines, and other site structures that do not allow for water to infiltrate into the soil, and that modify the topography of the site.
6. Soil permeability, density, and strength properties are relevant to the design of storm drain systems, including dry wells, retention basins, swales, and others. These properties are usually only provided in a geotechnical report if specifically requested, and recommendations will be provided in the geotechnical report in those cases.
7. Structures or site features that are not a part of the surface water drainage system should not be exposed to surface water flows, standing water or water infiltration. In general, roof drains and scuppers, exterior slabs, pavements, landscaping, etc. should be constructed to drain water away from structures and foundations. The purpose of this is to reduce the opportunity for water damage, erosion, and/or altering of structural soil properties by wetting. In general, a 5 percent or more slope away from foundations, structural fills, slopes, structures, etc. should be maintained.
8. Special considerations should be used for slopes and retaining walls, as described in the General Geotechnical Design and Construction Considerations - LATERALLY LOADED STRUCTURES section.
9. Additionally, landscaping features including irrigation emitters and plants that require large amounts of water should not be placed near to new structures, as they have the potential to alter soil moisture states. Changing of the moisture state of soil that provides structural support can lead to damage to the supported structures.

APPENDIX D

Liquefaction Analysis

PARTNER

Soil Liquefaction Analysis Report

PARTNER Engineering and Science, Inc.

Partner Engineering and Science, Inc.

Project : West Hills
Project No. : 1
Client : Staley
Site Address : Canoga Park

Borehole : B6
Total Depth : 50 ft
Water Level : 30 ft
Calculated By :
Reviewed By : Marcus

Table i : Input Data and Assumptions

Input Assumption	Setting
Field Test Type :	Standard Penetration Test (SPT)
Apply All Corrections to SPT?	False
Groundwater Level (ft) =	30
Earthquake Magnitude M =	7
Magnitude Scaling Factor (MSF) :	1.19 (Idriss, 1997 -NCEER)
Fines Content Correction :	(according to user settings)
Depth Reduction Factor (Rd) :	Idriss 1999, Golesorkhi 1989
Relative Density (Dr) Estimation :	Idriss & Boulanger, 2003
Site Topography :	Free Face H/L = 0.1
Ground Improvement Feature :	None
Peak Ground Acceleration PGA (g) =	0.588

Table ii : CRR Calculation Methods

CRR Formula	Selected?
NCEER Workshop (1997)	True
Boulanger & Idriss (2014)	True
Vancouver Task Force (2007)	False
Cetin et al. (2004)	False
Chinese Code	False
Seed et al. (1983)	False
Japanese Highway Bridge Code	False
Tokimatsu & Yoshimi (1983)	False
Shibata (1981)	False
Kokusho et al. (1983)	False

Table iv : Field Tests

Depth (ft)	SPT Blow Counts (N)
5	46
10	39
15	19
20	8
25	7
30	13
35	24
40	17
45	15
50	26

Table iii : Subsurface Soil Layers

Layer Thickness (ft)	Soil Type	Unit Weight (lb/ft3)	Fines Content (%)	D50 (mm)	Check Liquefaction/ Sei	Su (ksf)
11	Silt	95	60	0.02	True	0
19	Sand	100	20	2	True	0
5	Clay	90	60	0.002	True	0
5	Sand	100	20	2	True	0
10	Silt	95	60	0.02	False	0

Table v : Post-Liquefaction Displacements

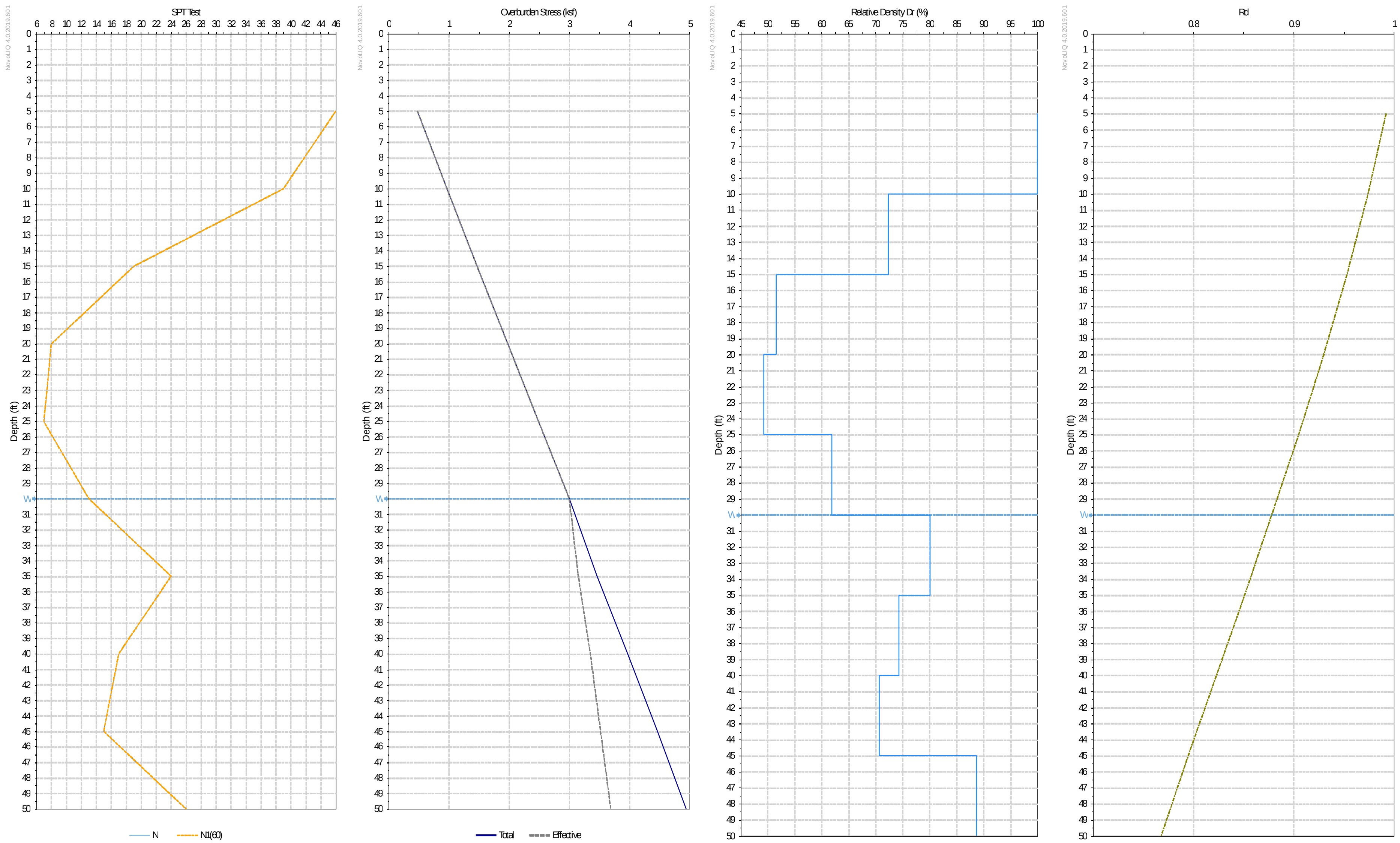
Type	Method	Movement (inch)
Lateral Spreading	Zhang, Robertson and Brachman, 2004	1
Lateral Spreading	Faris, 2006	1
Lateral Spreading	Youd et al., 2002	9
Lateral Spreading	Barlett and Youd, 1992	30
Lateral Spreading	Hamada et al., 1986	77
Lateral Spreading	Youd and Perkins, 1987	LSI ~33 see details for LSI=30
Vertical Settlement	Ishihara and Yoshimine, 1992	0

Soil Liquefaction Analysis Report

Partner Engineering and Science, Inc.

Project : West Hills
Project No. : 1
Client : Staley
Site Address : Canoga Park

Borehole : B6
Total Depth : 50 ft
Water Level : 30 ft
Calculated By :
Reviewed By : Marcus



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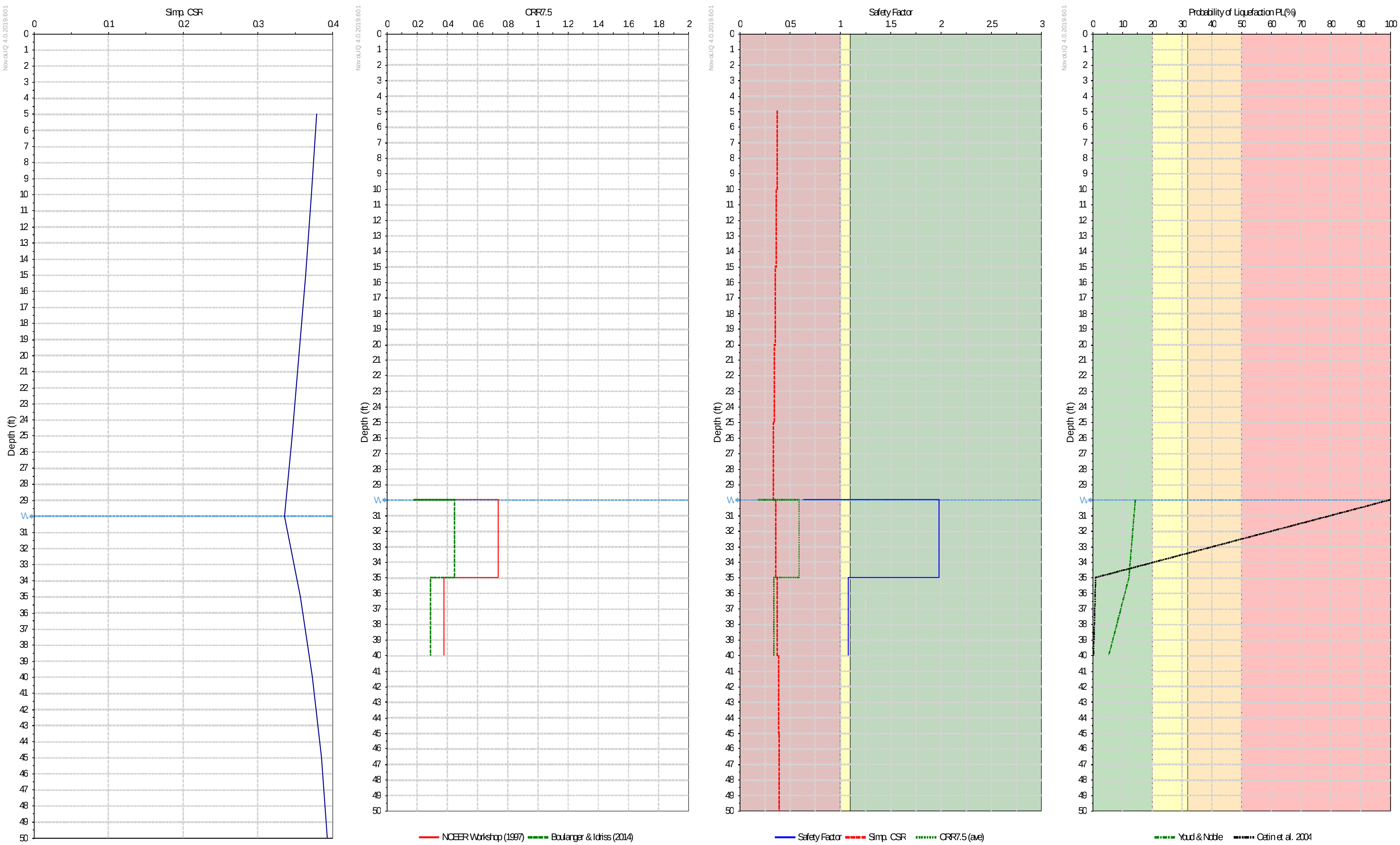

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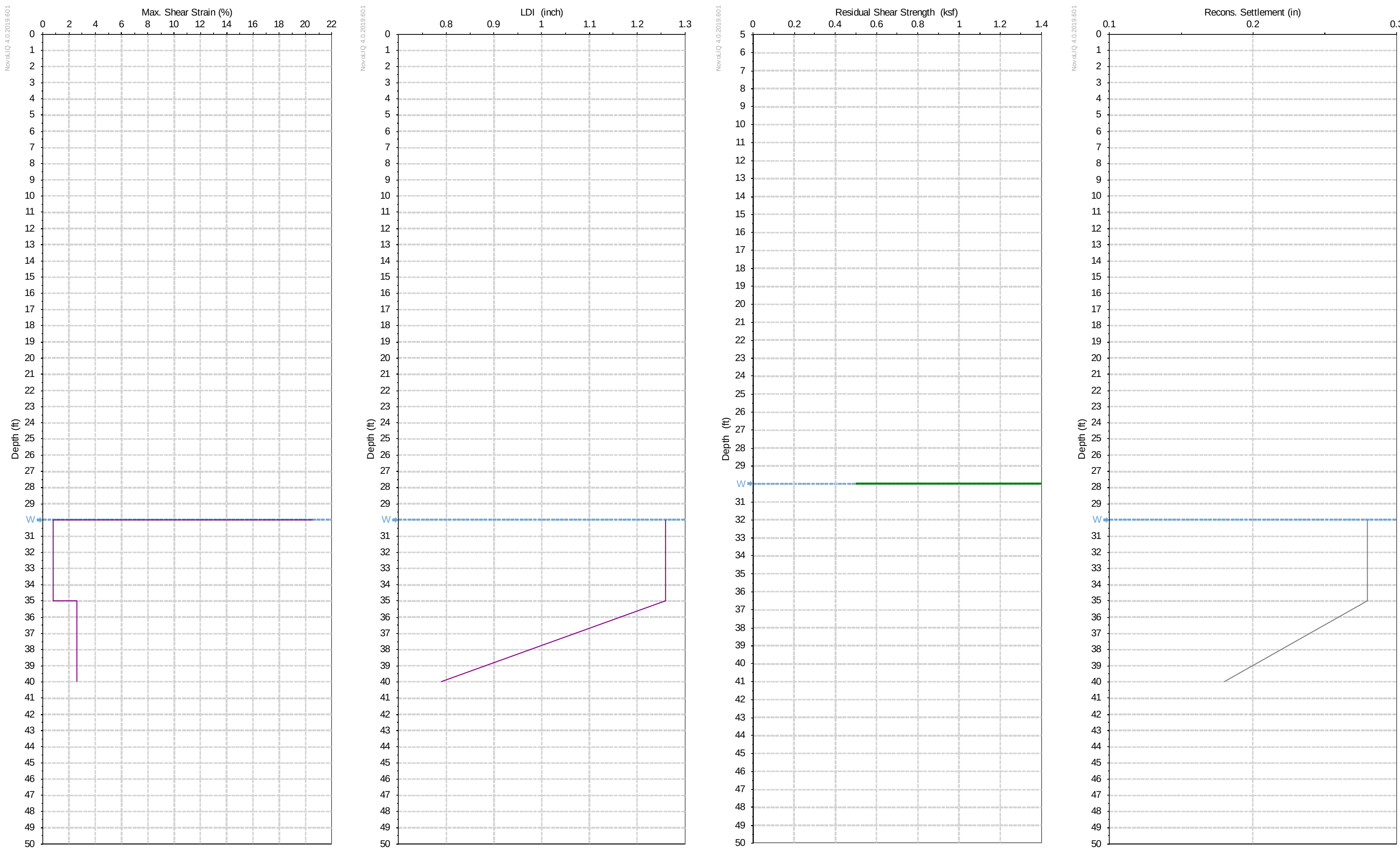


Soil Liquefaction Analysis Report

PARTNER Engineering and Science, Inc.

Partner Engineering and Science, Inc.

Project : West Hills
Project No. : 1
Client : Staley
Site Address : Canoga Park

Borehole : BH-1
Total Depth : 0 ft
Water Level : 40 ft
Calculated By :
Reviewed By : Marcus

Table i : Input Data and Assumptions

Input Assumption	Setting
Field Test Type :	Standard Penetration Test (SPT)
Apply All Corrections to SPT?	True
Groundwater Level (ft) =	30
Earthquake Magnitude M =	7
Magnitude Scaling Factor (MSF) :	1.19 (Idriss, 1997 -NCEER)
Fines Content Correction :	(according to user settings)
Depth Reduction Factor (Rd) :	Idriss 1999, Golesorkhi 1989
Relative Density (Dr) Estimation :	Idriss & Boulanger, 2003
Site Topography :	Free Face H/L = 0.1
Ground Improvement Feature :	None
Peak Ground Acceleration PGA (g) =	0.588

Table ii : CRR Calculation Methods

CRR Formula	Selected?
NCEER Workshop (1997)	True
Boulanger & Idriss (2014)	True
Vancouver Task Force (2007)	False
Cetin et al. (2004)	False
Chinese Code	False
Seed et al. (1983)	False
Japanese Highway Bridge Code	False
Tokimatsu & Yoshimi (1983)	False
Shibata (1981)	False
Kokusho et al. (1983)	False

Table iv : Field Tests

Depth (ft)	SPT Blow Counts (N)
5	11
10	32
15	6
20	5
25	8
30	5
35	23
40	24
45	13
50	11

Table iii : Subsurface Soil Layers

Layer Thickness (ft)	Soil Type	Unit Weight (lb/ft3)	Fines Content (%)	D50 (mm)	Check Liquefaction/ Sei	Su (ksf)
11	Silt	95	60	0.02	True	0
19	Sand	100	20	2	True	0
5	Clay	90	60	0.002	True	0
5	Sand	100	20	2	True	0
10	Silt	95	60	0.02	False	0

Table v : Post-Liquefaction Displacements

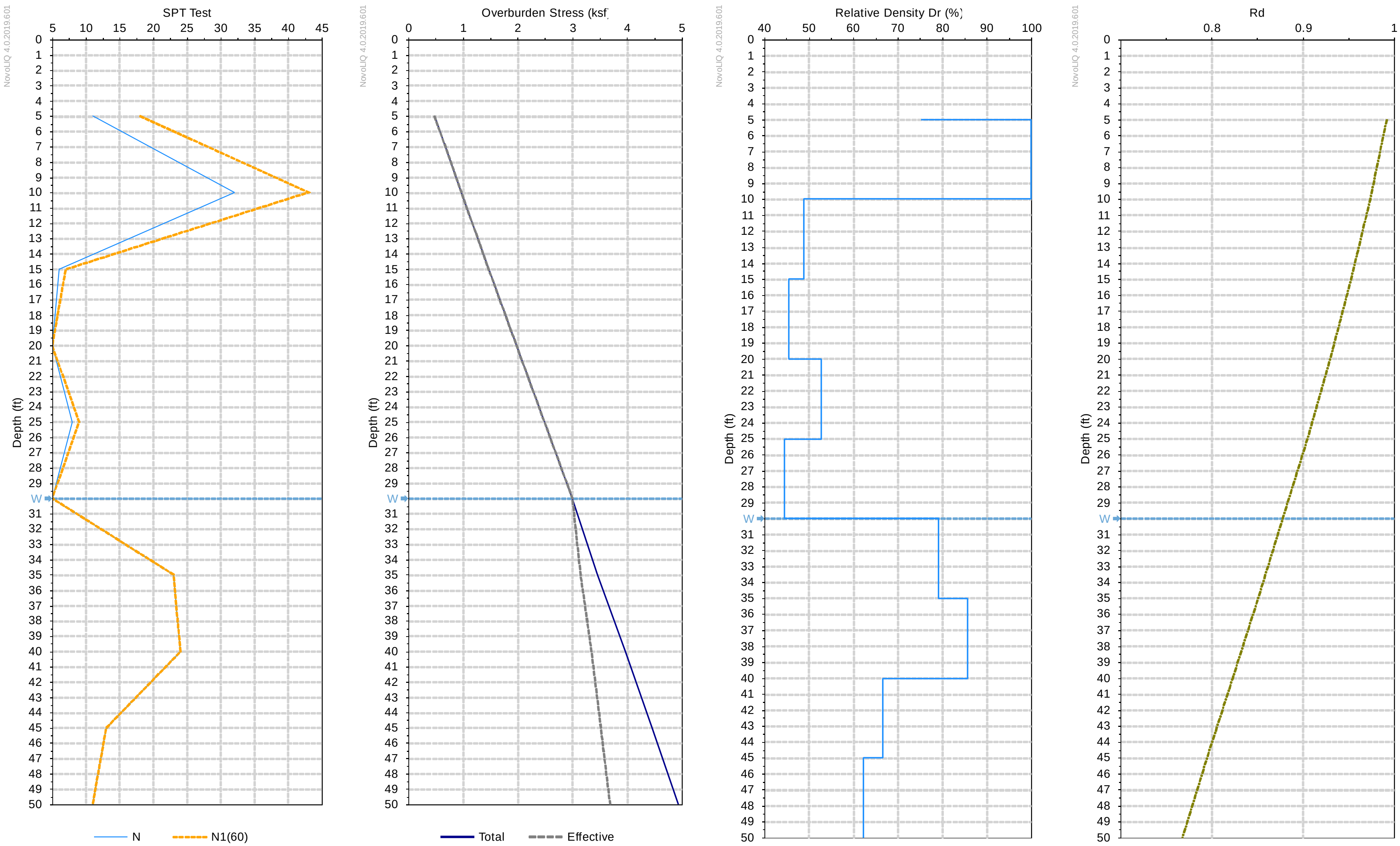
Type	Method	Movement (inch)
Lateral Spreading	Zhang, Robertson and Brachman, 2004	0
Lateral Spreading	Faris, 2006	0
Lateral Spreading	Youd et al., 2002	12
Lateral Spreading	Barlett and Youd, 1992	39
Lateral Spreading	Hamada et al., 1986	77
Lateral Spreading	Youd and Perkins, 1987	LSI ~33 see details for LSI=30
Vertical Settlement	Ishihara and Yoshimine, 1992	0

Soil Liquefaction Analysis Report

Partner Engineering and Science, Inc.

Project : West Hills
Project No. : 1
Client : Staley
Site Address : Canoga Park

Borehole : BH-1
Total Depth : 0 ft
Water Level : 40 ft
Calculated By :
Reviewed By : Marcus



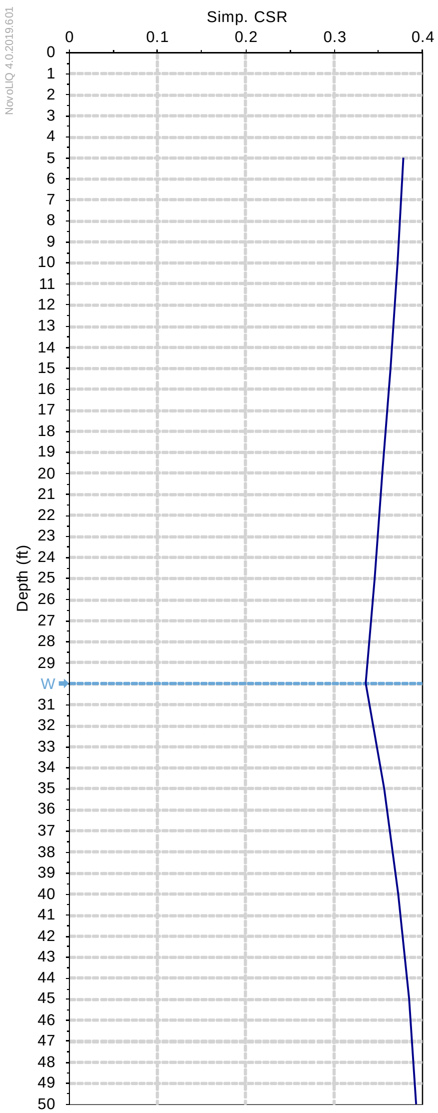
PARTNER
Engineering and Science, Inc.

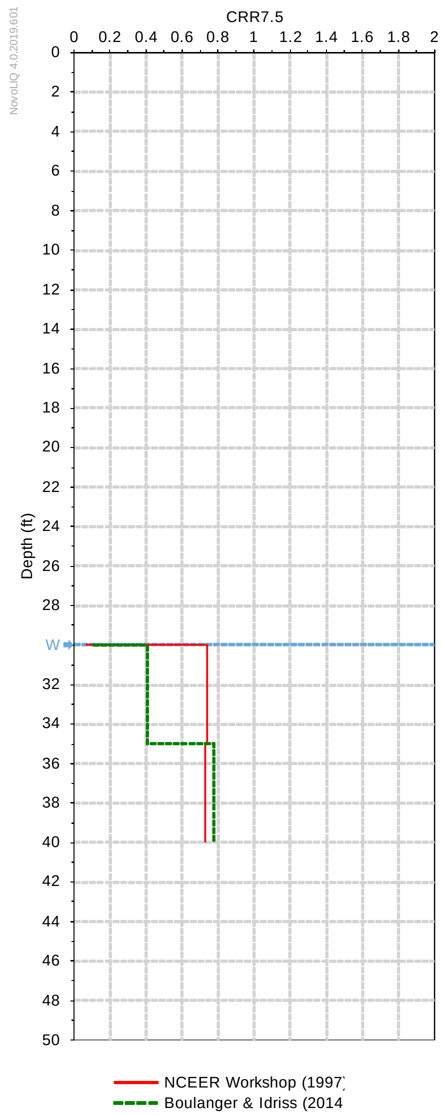
Soil Liquefaction Analysis Report

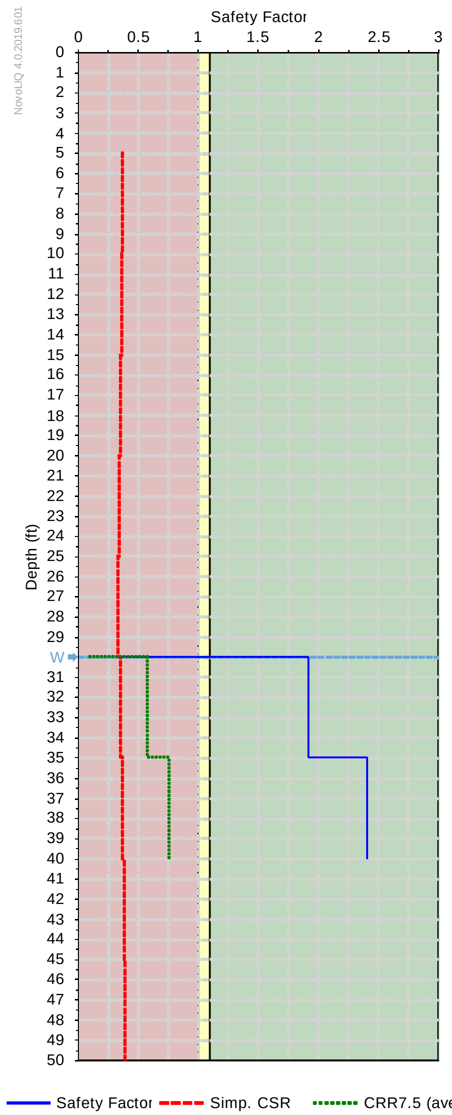
Partner Engineering and Science, Inc.

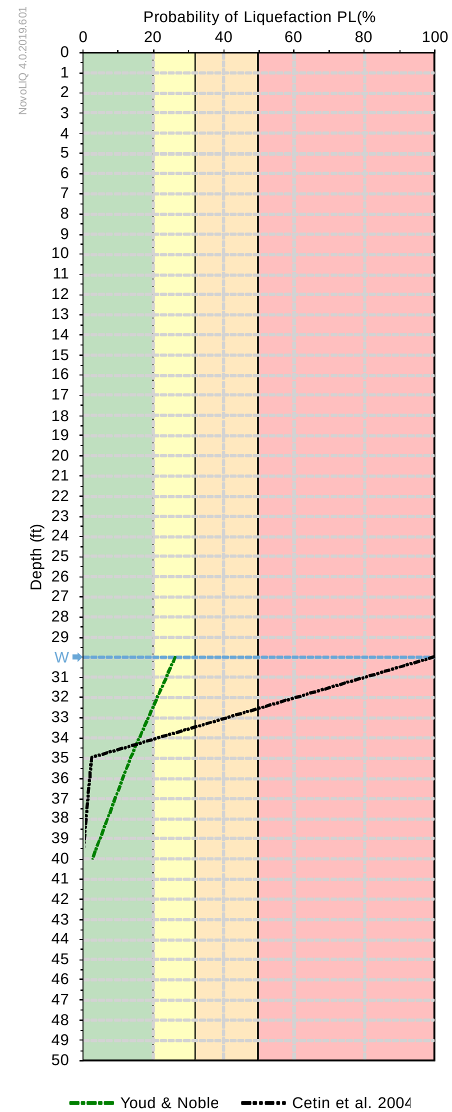
Project : West Hills
Project No. : 1
Client : Staley
Site Address : Canoga Park

Borehole : BH-1
Total Depth : 0 ft
Water Level : 40 ft
Calculated By :
Reviewed By : Marcus









Soil Liquefaction Analysis Report

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Borehole : BH-1
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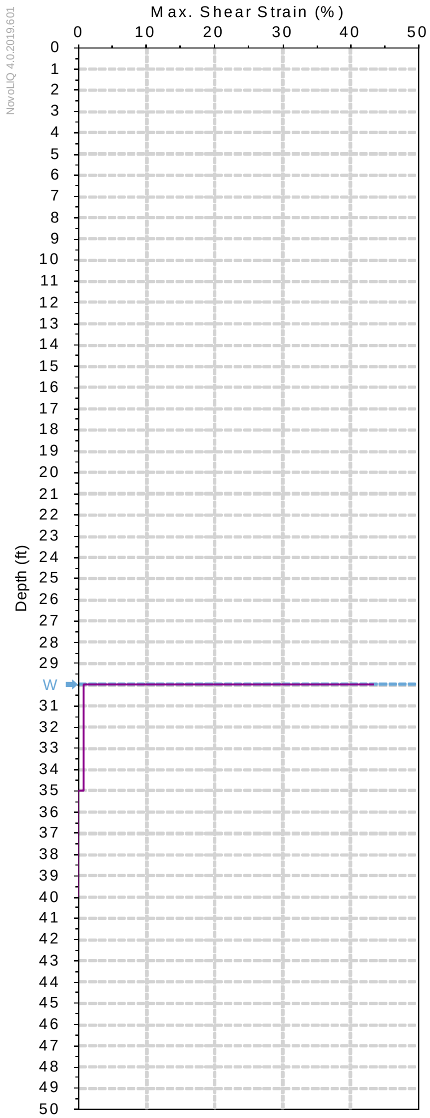
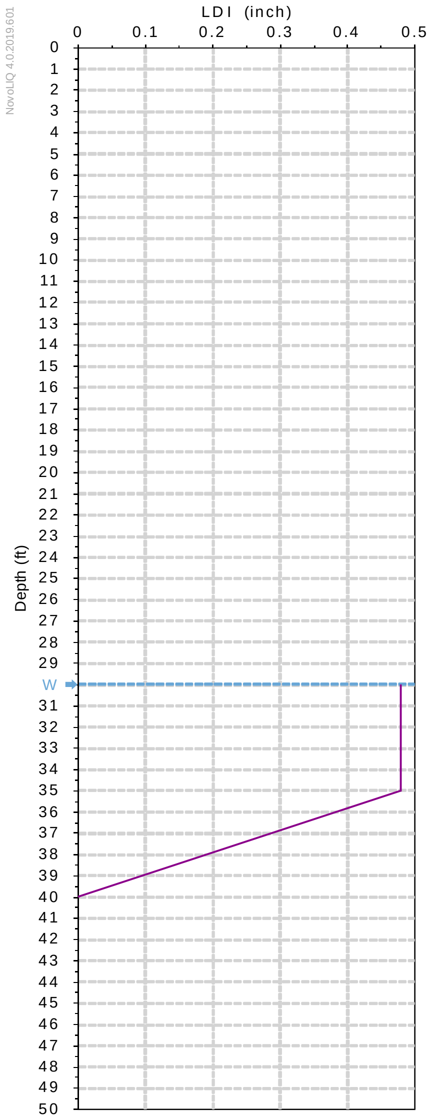
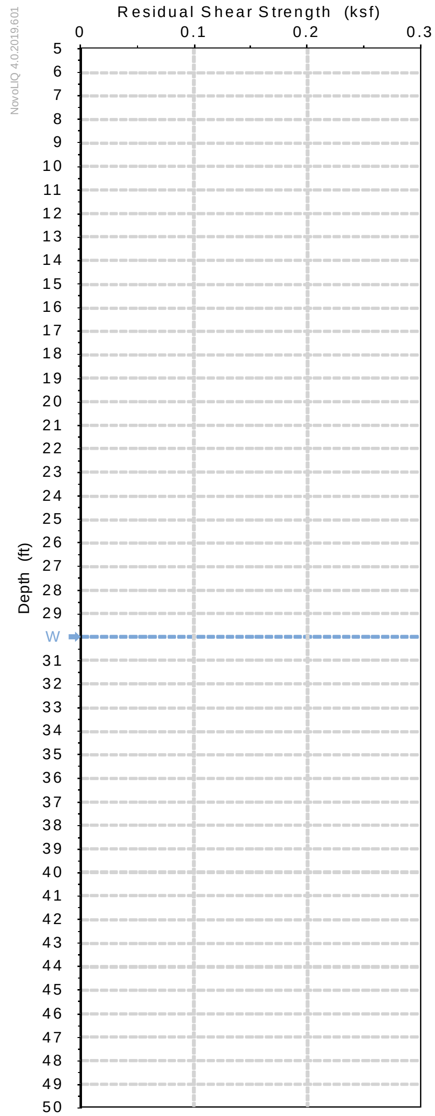
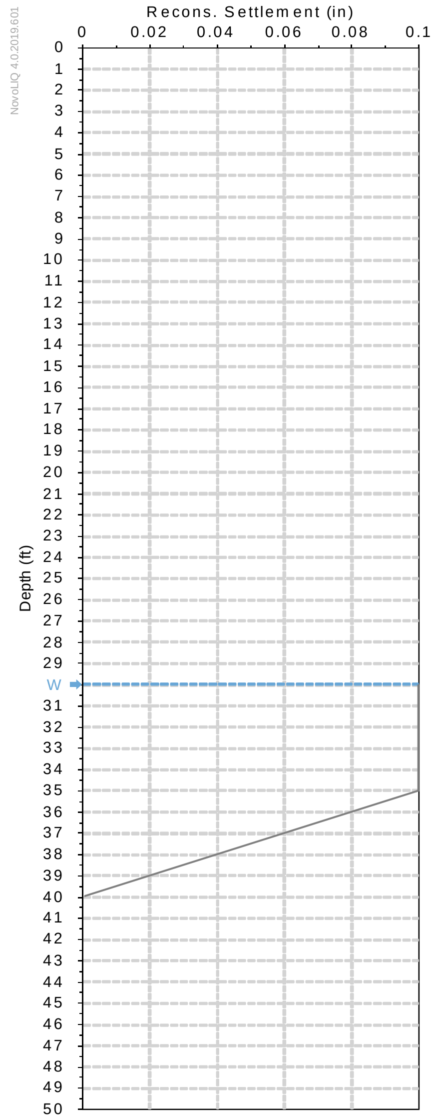
Calculated By :
Reviewed By : Marcus









Layer Thickness (ft)	Soil Type	Unit Weight (lb/ft3)	Fines Content	D50 (mm)	Check Liquefaction/	Su (ksf)
11	Silt	95	60	0.02	☑	0
19	Sand	100	20	2	☑	0
5	Clay	90	60	0.002	☑	0
5	Sand	100	20	2	☑	0
10	Silt	95	60	0.02	☐	0
					☐	

Depth (ft)	SPT Blow Counts (N)
5	11
10	32
15	6
20	5
25	8
30	5
35	23
40	24
45	13
50	11

Depth (ft)	Rd	Rd_I&B	Overburden Stress (ksf)		Fines Content (%)	SPT Test				Relative Density Dr (%)	Simp. CSR	CSR_I&B	CRR7.5		CRR7.5 (ave)
			Total	Effective		N	Co	Cn	N1(60)				NCEER Workshop	Boulanger & Idriss	
5	0.992	0.992	0.48	0.48	60	11	0.94	1.7	18	75.2	0.379	0.379	-	-	-
10	0.974	0.974	0.97	0.97	60	32	0.99	1.36	43	100	0.372	0.372	-	-	-
15	0.953	0.953	1.47	1.47	20	6	1.13	1.01	7	48.9	0.364	0.364	-	-	-
20	0.93	0.93	1.98	1.98	20	5	1.16	0.94	5	45.5	0.355	0.355	-	-	-
25	0.905	0.905	2.49	2.49	20	8	1.2	0.89	9	52.8	0.346	0.346	-	-	-
30	0.878	0.878	3	3	20	5	1.21	0.84	5	44.5	0.336	0.336	0.07	0.11	0.09
35	0.851	0.851	3.46	3.15	20	23	1.23	0.83	23	79.2	0.357	0.357	0.74	0.41	0.58
40	0.823	0.823	3.97	3.35	60	24	1.23	0.81	24	85.7	0.373	0.373	0.73	0.78	0.76
45	0.795	0.795	4.46	3.52	60	13	1.24	0.8	13	66.6	0.385	0.385	-	-	-
50	0.768	0.768	4.94	3.69	60	11	1.24	0.78	11	62.3	0.393	0.393	-	-	-

Depth (ft)	Safety Factor		Safety Factor	Probability of Liquefaction PL(%)	
	NCEER Worksho	Boulange r & Idriss		Youd & Noble	Cetin et al. 2004
5	-	-	-	-	-
10	-	-	-	-	-
15	-	-	-	-	-
20	-	-	-	-	-
25	-	-	-	-	-
30	0.27	0.39	0.33	26.4	100
35	2.47	1.37	1.92	13.7	2.6
40	2.33	2.49	2.41	2.8	0
45	-	-	-	-	-
50	-	-	-	-	-

Depth (ft)	Zt (in)	Zb (in)	dZ (in)	Lateral Spreading Indexes (in)			Recons. Settlement (in)			Residual Strength Sr (ksf)	
				Max. Shear Strain (%)	delta LDI	LDI	Vol. Strain (%)	delta S	S	Lower limit	Upper limit
5			-	-	-	-	-	-	-	-	-
10			-	-	-	-	-	-	-	-	-
15			-	-	-	-	-	-	-	-	-
20			-	-	-	-	-	-	-	-	-
25			-	-	-	-	-	-	-	-	-
30	360	360	0	43.5	0	0.48	3.9	0	0.1	0.3	0.3
35	420	480	60	0.8	0.48	0.48	0.2	0.1	0.1	-	-
40	480	510	30	0	0	0	0	0	0	-	-
45			-	-	-	-	-	-	-	-	-
50			-	-	-	-	-	-	-	-	-

Type	Method	Movement (inch)
Lateral Spreading	Zhang, Robertson and Brachman, 2004	0
	Faris, 2006	0
	Youd et al., 2002	12
	Barlett and Youd, 1992	39
	Hamada et al., 1986	77
	Youd and Perkins, 1987	LSI ~33 see details for
Vertical Settlement	Ishihara and Yoshimine, 1992	0

B1 SPT Data Correction Factors (GW Depth 50 feet as encountered in borings)

Depth	Field N-Values	Ce	Cr	Cs	Cb	Co	Cn	Cn	N160
5	11	1.25	0.75	1.2	1.15	1.29	1.7	1.70	24
10	32	1.25	0.79	1.2	1.15	1.36	1.36	1.23	54
15	6	1.25	0.9	1.2	1.15	1.55	1.01	0.98	9
20	5	1.25	0.93	1.2	1.15	1.60	0.94	0.91	7
25	8	1.25	0.96	1.2	1.15	1.66	0.89	0.86	11
30	5	1.25	0.97	1.2	1.15	1.67	0.84	0.82	7
35	23	1.25	0.98	1.2	1.15	1.69	0.8	0.77	30
40	24	1.25	0.98	1.2	1.15	1.69	0.76	0.74	30
45	13	1.25	0.99	1.2	1.15	1.71	0.73	0.73	16
50	11	1.25	0.99	1.2	1.15	1.71	0.7	0.71	13

B6 SPT Data Correction Factors (GW Depth below 50 feet as encountered in borings)

Depth	Field N-Values	Ce	Cr	Cs	Cb	Co	Cn	N160
5	21	1.25	0.75	1.2	1.15	1.29	1.70	46
10	21	1.25	0.79	1.2	1.15	1.36	1.36	39
15	12	1.25	0.9	1.2	1.15	1.55	1.01	19
20	5	1.25	0.93	1.2	1.15	1.60	0.94	8
25	5	1.25	0.96	1.2	1.15	1.66	0.89	7
30	9	1.25	0.97	1.2	1.15	1.67	0.84	13
35	18	1.25	0.98	1.2	1.15	1.69	0.80	24
40	13	1.25	0.98	1.2	1.15	1.69	0.76	17
45	12	1.25	0.99	1.2	1.15	1.71	0.73	15
50	22	1.25	0.99	1.2	1.15	1.71	0.70	26