CORNERSTONE EARTH GROUP

Type of Services	**Geotechnical Investigation**
Project Name	**Easton Addition, Ray Park and Neighborhood Sewer Rehabilitation Project**
Location	**Various Streets Burlingame, California**
Client	**Hatch Mott MacDonald**
Client Address	**181 Metro Drive, Suite 510 San Jose, California**
Project Number	**522-5-1**
Date	**April 14, 2016**

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CORNERSTONE EARTH GROUP

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APPENDIX A: FIELD INVESTIGATION
APPENDIX B: LABORATORY TEST PROGRAM

Type of Services	**Geotechnical Investigation**
Project Name	**Easton Addition, Ray Park and Neighborhood Sewer Rehabilitation Project**
Location	**Various Streets** **Burlingame, California**

SECTION 1: INTRODUCTION

This geotechnical report was prepared for the sole use of Hatch Mott MacDonald for the Easton Addition, Ray Park and Neighborhodd Sewer Rehabilitation Project in Burlingame, California. The location of the sewer rehabilitation project is shown on the Vicinity Map, Figure 1. For our use, we were provided with the following documents:

- A set of plans titled "Easton Addition, Ray Park and Neighborhood Sewer Rehabilitation Project Phase 1," Pages G-2, C-2, C-5, C-7, C-18, C-13, prepared by Hatch Mott MacDonald, dated February 23, 2016.

1.1 PROJECT DESCRIPTION

The project will consist of replacing and upsizing approximately 5,000 linear feet of existing sanitary sewer lines at various locations within the public right-of-way throughout the City of Burlingame. We understand the existing lines will be upsized from the existing 6- and 8-inch diameters to 8- and 10-inch diameter pipes, respectively. We assume the new lines will follow approximately the invert depths and locations of the existing lines, ranging from approximately 4 to 15 feet below surface grades. We understand that installation of the new pipes will consist of either pipe bursting or open cut methods.

1.2 SCOPE OF SERVICES

Our scope of services was presented in our proposal dated August 5, 2015 and consisted of field and laboratory programs to evaluate physical and engineering properties of the subsurface soils, engineering analysis to prepare information for your pipe design and construction, and preparation of this report. Brief descriptions of our exploration and laboratory programs are presented below.

1.3 EXPLORATION PROGRAM

Field exploration consisted of four borings drilled on March 10, 2016 with truck-mounted, hollow-stem auger drilling equipment. The borings were drilled to depths ranging from 14½ to 15 feet. The borings were backfilled with cement grout in accordance with local requirements; exploration permits were obtained as required by local jurisdictions.

All four borings were drilled adjacent to the existing sanitary sewer line alignments. The approximate locations of our exploratory borings are shown on the Site Plan and Geologic Map, Figure 2. Details regarding our field program are included in Appendix A.

1.4 LABORATORY TESTING PROGRAM

In addition to visual classification of samples, the laboratory program focused on obtaining data to classify the materials encountered. Testing included moisture contents, dry densities, and washed sieve analyses. Details regarding our laboratory program are included in Appendix B.

1.5 ENVIRONMENTAL SERVICES

Environmental services were not requested for this project. If environmental concerns are determined to be present during future evaluations, the project environmental consultant should review our geotechnical recommendations for compatibility with the environmental concerns.

SECTION 2: REGIONAL SETTING

2.1 GEOLOGICAL SETTING

2.1.1 Regional Geology

The San Francisco peninsula is a relatively narrow band of rock at the northern end of the Santa Cruz Mountains separating the Pacific Ocean from San Francisco Bay. This represents one mountain range in a series of northwesterly-aligned mountains forming the Coast Ranges geomorphic province of California that stretches from the Oregon border nearly to Point Conception. In the San Francisco Bay area, most of the Coast Ranges have developed on a basement of tectonically mixed Cretaceous- and Jurassic-age (70- to 200-million years old) rocks of the Franciscan Complex. Locally these basement rocks are capped by younger sedimentary and volcanic rocks. Most of the Coast Ranges are covered by still younger surficial deposits that reflect geologic conditions of the last million years or so.

Movement on the many splays within the San Andreas Fault system has produced the dominant northwest-oriented structural and topographic trend seen throughout the Coast Ranges today. This trend reflects the boundary between two of the Earth's major tectonic plates: the North American plate to the east and the Pacific plate to the west. The San Andreas Fault system is about 40 miles wide in the Bay area and extends from the San Gregorio Fault near the coastline to the Coast Ranges-Central Valley blind thrust at the western edge of the Great Central Valley as shown on the Regional Fault Map, Figure 3. The San Andreas Fault is the dominant

structure in the system, nearly spanning the length of California, and capable of producing the highest magnitude earthquakes. Many other sub-parallel or branch faults within the San Andreas system are equally active and nearly as capable of generating large earthquakes. Right-lateral movement dominates on these faults but an increasingly large amount of thrust faulting resulting from oblique compression across the fault system is now being identified also.

2.1.2 Local Geology

A regional scale published map covering the general area of the site is shown on Figure 4, Vicinity Geologic Map. This figure is from regional mapping by Pampeyan (1994). Pampeyan's map indicates the northern portion of the project traverses through an area underlain by Pliestocene Colma Formation (Qc). The southern end of the project consists of younger alluvial stream deposits overlying Quaternary and Tertiary sedimentary units. At depth sheared rock of the Franciscan Complex is overlain by the moderately consolidated sandstones to clayey sandstones of the upper Pliocene Merced Formation (Tme). Conformably overlying the Merced Formation lies the weakly consolidated well-graded clays, sands, and gravels of the Pliestocene Colma Formation. Both units are exposed at the surface except where overlain by Quaternary stream deposits (Qac, Qya). Fills (Qf2) derived from local sources were placed at the surface near the mid-century 20th Century. .

2.2 REGIONAL SEISMICITY

The San Francisco Bay area region is one of the most seismically active areas in the Country. While seismologists cannot predict earthquake events, the U.S. Geological Survey's Working Group on California Earthquake Probabilities 2015 revises earlier estimates from the Uniform California Earthquake Rupture Forecast Publication (UCERF, 2008). Compared to the previous assessment issued in 2008, the estimated rate of earthquakes around magnitude 6.7 (the size of the destructive 1994 Northridge earthquake) has gone down by about 30 percent. The expected frequency of such events statewide has dropped from an average of one per 4.8 years to about one per 6.3 years. However, in the new study, the estimate for the likelihood that California will experience a magnitude 8 or larger earthquake in the next 30 years has increased from about 4.7 for UCERF2 to about 7.0% for UCERF3.

UCERF3 estimates that each region of California will experience a magnitude 6.7 or larger earthquake in the next 30 years. Additionally, there is a 63 percent chance of at least one magnitude 6.7 or greater earthquake occurring in the Bay Area region between 2007 and 2036.

The faults considered capable of generating significant earthquakes are generally associated with the well-defined areas of crustal movement, which trend northwesterly. The table below presents the State-considered active faults within 25 kilometers of the site.

Table 1: Approximate Fault Distances

Fault Name	Distance	
	(miles)	(kilometers)
San Andreas (1906)	1.4	2.2
San Gregorio	7.5	12.1
Monte Vista-Shannon	12.6	20.2

A regional fault map is presented as Figure 3, illustrating the relative distances of the site to significant fault zones.

SECTION 3: SITE CONDITIONS

3.1 SURFACE DESCRIPTION

As stated earlier, our field investigation consisted of advancing four exploratory borings at various locations that were offset from the existing sewer line locations. Existing pavement sections consisted of about 1 to 12 inches of asphalt concrete over 0 to 8 inches of aggregate base. The pavements generally appear in poor to good condition with longitudinal/tranverse cracking throughout, with the exception of Boring EB-4, where no cracking was observed in the vicinity of the Boring.

Invert depths for the existing sanitary sewer line decrease from approximately 13 to 14 feet along Albemarle Way to approximately 4 to 5 feet at the intersection of Quesada Way and Davis Drive. Invert depths then increase from the intersection of Quesada Way and Davis Drive to approximately 9 to 10 feet at the intersection of Clarice Lane and Quesada Way.

3.2 SUBSURFACE CONDITIONS

Below the surface pavements, our explorations encountered up to 1½ feet of undocumented fill consisting of loose to medium dense poorly graded sand with clay and gravel in Borings EB-3 and EB-4. Beneath the surficial fill in Borings EB-3 and EB-4, and surface pavements in the remaining borings, our explorations generally encountered stiff to hard lean clays with varying amounts of sand to depths of 2 to 12 ½ feet, which were underlain by loose to very dense clayey sand with varying amounts of gravel to 15 feet, the maximum depth explored.

3.2.1 In-Situ Moisture Contents

Laboratory testing indicated that the in-situ moisture contents within the upper 15 feet range from approximately optimum to 10 percent over the estimated laboratory optimum moisture.

3.3 GROUND WATER

Ground water was not encountered in Borings EB-1 to EB-3. At Boring EB-4, ground water stabilized at 6 feet during drilling. This may be a localized perched condition as water was

initially encountered within a layer of sand at a depth of 10 feet but samples beneath this did not appear below the water table. These measurements were taken at the time of drilling and may not represent the stabilized levels that can be higher or lower than the initial levels encountered. Ground water levels are not currently mapped in the area; however, we anticipate ground water to be generally below the existing/proposed sanitary lines with the potential of perched ground water in isolated areas, as was found in Boring EB-4.

Fluctuations in ground water levels occur due to many factors including seasonal fluctuation, underground drainage patterns, regional fluctuations, and other factors.

SECTION 4: CONCLUSIONS AND DISCUSSION

4.1 POTENTIAL CONCERNS

As discussed, the existing sanitary sewer replacement is planned to be constructed by pipe bursting or open-cut methods. Due to the existing stiffness and density of the subsurface conditions encountered, pipe bursting methods may be difficult in some locations due to the dense conditions, and we recommend contractors review the subsurface conditions in our boring logs to confirm the compatibility of pipe bursting methods and equipment proposed for use. If pipe bursting methods are not feasible within various locations, open-cut methods could be performed. Descriptions and brief outlines of additional concerns to be addressed in the project design are listed below. Descriptions of each concern with brief outlines may be referenced below. Our general earthwork recommendations are provided in Section 5 following this section.

4.1.1 Residential Construction Areas

The project site is located within an area of residential development where there will be concerns about construction noise and vibrations. For these reasons, our judgement is that installing either steel H-piles or sheet piles using impact equipment has substantial risk of being a nuisance, and that braced sheeting or similar methods may be preferred.

4.1.2 Presence of Existing Utilities

Existing utilities appear to be in planned construction areas. An appropriate amount of clearance, discussed in more detail in Section 4.1.3, is desirable to reduce the risk of damaging the existing utilities where installing the new sanitary sewer line.

4.1.3 Ground Displacement and Cracking

The planned sewer pipe construction methods have the potential risk of causing ground displacements that may damage existing utilities.

For open-cut trenching, the shoring design and construction sequencing can address these potential risks.

For the pipe bursting sections, these potential risks can be addressed by following general pipe bursting guidelines such as maintaining a clearance of 2 to 3 times the new pipe diameter from adjacent or crossing utilities and structures or providing a clearance of at least 10 times the difference in diameters between the existing pipe and the new pipe. For example, where the existing pipe is 6 inch diameter and the new piper is 8 inch diameter, the difference in diameters is 2 inches and the clearance from other utilities and structures should be at least 20 inches. Paying close attention to and monitoring the pipe bursting procedure will also reduce potential risks; however, even with the above precautions, some risks of ground displacement, settling or cracking remain.

4.1.4 Perched Ground Water

As discussed earlier, perched ground water was encountered at a depth of 10 feet in Boring EB-4 and stabilized at 6 feet at the end of drilling. Static ground water levels are not mapped in the area and we generally anticipate seasonal static water levels to be below the proposed sanitary sewer lines; however, perched ground water may be encountered in isolated areas.

4.2 MANHOLE FOUNDATION SUPPORT

Manhole foundations bearing on undisturbed natural soils are capable of supporting maximum static bearing pressures of 3,000 psf. If wet conditions are encountered, it may be desirable to place 12 inches of crushed rock at the bottom of manhole excavations to stabilize and provide a better working surface.

4.3 OPEN-CUT TRENCHING SECTIONS

Excavations for open-cut trenching sections will be made adjacent to existing utilities and within City streets; therefore, the trenching will require temporary support in order to avoid damaging the adjacent streets, utilities, and other improvements. Excavation should be readily accomplished with standard backhoes and excavators during or after shoring installations.

The Contractor should be responsible for all temporary slopes and design of any required shoring. Shoring, bracing or temporary slopes should be performed by the Contractor in accordance with the strictest governing safety standards.

Vertical excavations may be temporarily shored using sheet piling or other shoring schemes, depending on the judgment of the shoring designer and Contractor. We recommend that the lateral soil pressures presented on Figures 5 and 6 be used in the design of temporary shoring. As indicated on the figures, the excavation shoring should be designed for additional surcharge loads due to normal street loads or other incidental surcharge loads. To prevent excessive surcharging of the walls from heavy construction vehicles, such as concrete trucks, we recommend that such vehicles be kept at least 15 feet from the top of the excavations. If this is not possible, the shoring must be designed to resist the additional lateral loads. In addition, all shoring schemes should be designed with sufficient rigidity to prevent detrimental displacements at the top of the shoring, particularly where excavations are completed adjacent to existing utilities, pavements or other improvements. Where excavations are supported with

temporary shoring, some settlement of the adjacent ground surface should be anticipated. If these shored excavations are placed in paved streets, some cracking and deflection of the adjacent pavements should be anticipated. Good design and construction techniques should greatly reduce these types of distress to improvements. The project specifications should require restoration of these damaged pavements, curbs, gutters, etc., to their preconstruction condition. A precondition survey of the area performed by the contractor prior to construction, including photos, should be considered.

In addition to anticipated deflection of the shoring system, other factors such as voids created by soil sloughing, and erosion of granular layers due to perched water conditions can create adverse ground subsidence and deflections. The contractor should attempt to cut the excavation as close to neat lines as possible; where voids are created they should be backfilled as soon as possible with sand, gravel, or grout. Prior approval of the proposed method should be received.

4.4 PIPE BURSTING SECTIONS

Pipe bursting is a well-established trenchless method that is widely used for the in-place replacement of deteriorated pipes with a new pipe of the same or larger diameter. Pipe bursting is an economic pipe replacement alternative that typically reduces the impact to residents when compared to open cut rehabilitation techniques. The success of pipe bursting will be significantly influenced by the size of the new pipe, the invert depths of the existing sanitary sewer, existing utilities and other improvements in close proximity to the existing sanitary sewer lines, and local subsurface conditions. As mentioned, due to the subsurface conditions encountered, the feasibility of pipe bursting should be evaluated by the contractor. If deemed feasible, excavation and earthwork associated with the pipe bursting sections should follow our general earthwork recommendations included in the following Section 5.

SECTION 5: GENERAL EARTHWORK

The earthwork anticipated for this project is likely to consist of excavations for lateral and cleanout replacements and lateral connections to main lines, clearing the open cuts and entry/exit pit areas of surface pavements, excavating the open cuts and entry/receiving pits, installation and removal of temporary shoring systems, backfilling of the open cuts and entry/receiving puts, and restoration of the surface pavement improvements. These are discussed in the following sections.

5.1 CLEARING AND SPOIL DISPOSAL

In the designated areas of the open cuts, the site should be cleared of all surface and subsurface deleterious materials designated for removal, including existing pavements, curb and gutter, buried utility lines, debris, designated trees, shrubs, and associated roots. All deleterious materials should be removed from the site and properly disposed of in accordance with regulatory requirements.

5.2 MATERIAL FOR FILL

All on-site soils below the stripped layer having an organic content of less than 3 percent by weight are suitable for re-use as fill at the site. In general, fill material should not contain rocks or lumps larger than 6 inches in greatest dimension, with no more than 15 percent larger than 2½ inches. Imported fill material should be predominantly granular with a Plasticity Index of 15 or less. To prevent significant caving during future trenching or excavations, imported material should have sufficient fines. Samples of potential import sources should be delivered to our office at least 10 days prior to the desired import start date. Information regarding the import source should be provided, such as any site geotechnical and environmental reports.

Environmental and soil corrosion characterization should also be considered by the project team prior to acceptance. Suitable environmental laboratory data to the planned import quantity should be provided to the project environmental consultant; additional laboratory testing may be required based on the project environmental consultant's review. The potential import source should also not be more corrosive than the on-site soils, based on pH, saturated resistivity, soluble sulfate, chloride, sulfates, and redox potential.

5.3 BACKFILL COMPACTION

All backfill should be compacted in accordance with the City of Burlingame requirements or the recommendations contained in this section, whichever is more stringent. Fill materials should be placed in lifts not exceeding 8 inches in uncompacted thickness and should be compacted to at least 90 percent relative compaction (ASTM D1557, latest edition) by mechanical means only. The aggregate base and pavement sections should be restored to their original thicknesses and grades or as required by the City of Burlingame. The upper 6 inches of subgrade in pavement areas and all aggregate base and asphalt concrete should be compacted to at least 95 percent relative compaction (ASTM D1557, latest edition). Aggregate base and all import soils should be compacted at a moisture content near the laboratory optimum.

5.4 PLANS AND SPECIFICATIONS REVIEW

We recommend that we be retained to review the geotechnical aspects of the project plans and specifications, allowing sufficient time to provide the design team with any comments prior to issuing the plans for construction.

5.5 CONSTRUCTION OBSERVATION

As site conditions may vary significantly between the small-diameter borings performed during this investigation, we also recommend that a Cornerstone representative be present to provide geotechnical observation and testing during earthwork and related construction activities. This will allow us to form an opinion and prepare a letter at the end of construction regarding contractor compliance with project plans and specifications, and with the recommendations in our report. We would also be allowed to evaluate any conditions differing from those encountered during our investigation, and provide supplemental recommendations as

necessary. Contractors should provide at least a 48-hour notice when scheduling our field personnel.

SECTION 6: LIMITATIONS

This report, an instrument of professional service, has been prepared for the sole use of Hatch Mott MacDonald specifically to support the design of the Easton Addition, Ray Park and Neighborhodd Sewer Rehabilitation Project in Burlingame, California. The opinions, conclusions, and recommendations presented in this report have been formulated in accordance with accepted geotechnical engineering practices that exist in Northern California at the time this report was prepared. No warranty, expressed or implied, is made or should be inferred.

Recommendations in this report are based upon the soil and ground water conditions encountered during our subsurface exploration. If variations or unsuitable conditions are encountered during construction, Cornerstone must be contacted to provide supplemental recommendations, as needed.

Hatch Mott MacDonald may have provided Cornerstone with plans, reports and other documents prepared by others. Hatch Mott MacDonald understands that Cornerstone reviewed and relied on the information presented in these documents and cannot be responsible for their accuracy.

Cornerstone prepared this report with the understanding that it is the responsibility of the owner or his representatives to see that the recommendations contained in this report are presented to other members of the design team and incorporated into the project plans and specifications, and that appropriate actions are taken to implement the geotechnical recommendations during construction.

Conclusions and recommendations presented in this report are valid as of the present time for the development as currently planned. Changes in the condition of the property or adjacent properties may occur with the passage of time, whether by natural processes or the acts of other persons. In addition, changes in applicable or appropriate standards may occur through legislation or the broadening of knowledge. Therefore, the conclusions and recommendations presented in this report may be invalidated, wholly or in part, by changes beyond Cornerstone's control. This report should be reviewed by Cornerstone after a period of three (3) years has elapsed from the date of this report. In addition, if the current project design is changed, then Cornerstone must review the proposed changes and provide supplemental recommendations, as needed.

An electronic transmission of this report may also have been issued. While Cornerstone has taken precautions to produce a complete and secure electronic transmission, please check the electronic transmission against the hard copy version for conformity.

Recommendations provided in this report are based on the assumption that Cornerstone will be retained to provide observation and testing services during construction to confirm that

conditions are similar to that assumed for design, and to form an opinion as to whether the work has been performed in accordance with the project plans and specifications. If we are not retained for these services, Cornerstone cannot assume any responsibility for any potential claims that may arise during or after construction as a result of misuse or misinterpretation of Cornerstone's report by others. Furthermore, Cornerstone will cease to be the Geotechnical-Engineer-of-Record if we are not retained for these services.

SECTION 7: REFERENCES

California Department of Conservation Division of Mines and Geology, 1998, Maps of Known Active Fault Near-Source Zones in California and Adjacent Portions of Nevada, International Conference of Building Officials, February, 1998.

Pampeyan, E. H., 1994, Geologic Map of the Montara Mountain and San Mateo 7.5-minute Quadrangles, San Mateo County, California, U. S. Geological Survey, Miscellaneous Investigation Series Map I-2390.

Working Group on California Earthquake Probabilities, 2015, The Third Uniform California Earthquake Rupture Forecast, Version 3 (UCERF), U.S. Geological Survey Open File Report 2013-1165 (CGS Special Report 228). KMZ files available at: www.scec.org/ucerf/images/ucerf3_timedep_30yr_probs.kmz

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Vicinity Map

Burlingame SS Improvements
Burlingame, CA

Project Number	522-5-1
Figure Number	Figure 1
Date	March 2016
Drawn By	RRN

Legend

Approximate location of exploratory boring (EB)

0 250 500

APPROXIMATE SCALE (FEET)

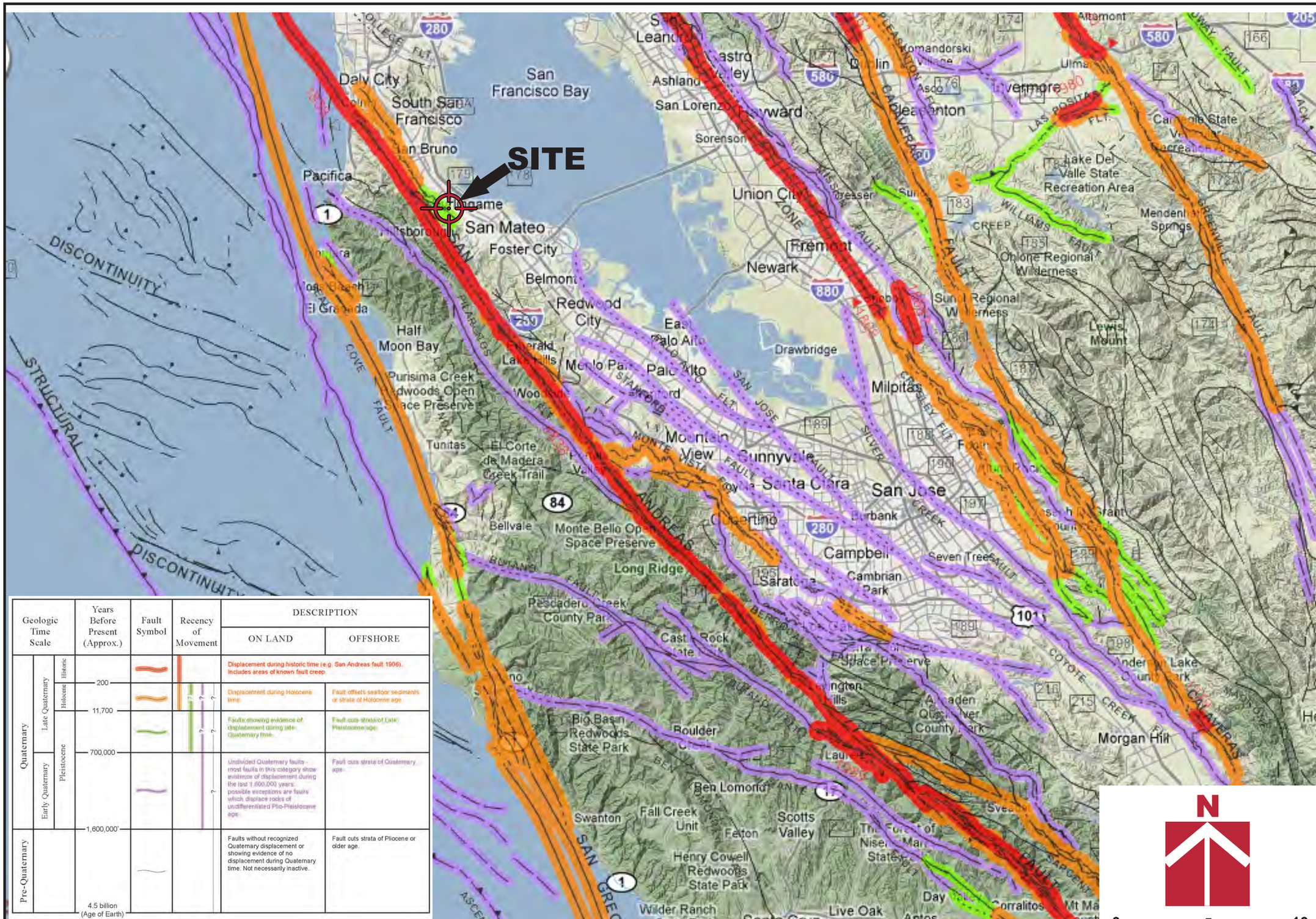
Base by Google Earth, dated 3/28/2015

Project Number	522-5-1
Figure Number	Figure 2
Date	March 2016
Drawn By	RRN

Site Plan

Burlingame SS Improvements
Burlingame, CA

CORNERSTONE EARTH GROUP



Geologic Time Scale			Years Before Present (Approx.)	Fault Symbol	Recency of Movement	DESCRIPTION: ON LAND	DESCRIPTION: OFFSHORE
Quaternary	Late Quaternary	Historic				Displacement during historic time (e.g. San Andreas fault 1906). Includes areas of known fault creep.	
		Holocene	200		? ?	Displacement during Holocene time.	Fault offsets seafloor sediments or strata of Holocene age.
			11,700		? ?	Faults showing evidence of displacement during late Quaternary time.	Fault cuts strata of Late Pleistocene age.
	Early Quaternary	Pleistocene	700,000		?	Undivided Quaternary faults - most faults in this category show evidence of displacement during the last 1,600,000 years; possible exceptions are faults which displace rocks of undifferentiated Plio-Pleistocene age.	Fault cuts strata of Quaternary age.
Pre-Quaternary			1,600,000			Faults without recognized Quaternary displacement or showing evidence of no displacement during Quaternary time. Not necessarily inactive.	Fault cuts strata of Pliocene or older age.
			4.5 billion (Age of Earth)				

Base by California Geological Survey - 2010 Fault Activity Map of California (Jennings and Bryant, 2010)

Project Number: 522-5-1

Figure Number: Figure 3

Drawn By: RRN

Date: March 2016

Regional Fault Map

Burlingame SS Improvements
Burlingame, CA

CORNERSTONE EARTH GROUP

Geologic Units

Qac	Coarse-grained alluvium (Holocene)
$Qf_{1\&2}$	Artificial fill (Holocene)
Qc	Colma Formation (Pleistocene)
Tme	Merced Formation (upper Pliocene)

Explanation

Contact- dashed where approximate, dotted where concealed

N

0 2000 4000

APPROXIMATE SCALE (FEET)

Base: USGS, Geologic Map of the Montara Mountain and San Mateo 7.5' Quadrangles, San Mateo County, California, by Pampeyan, dated 1994

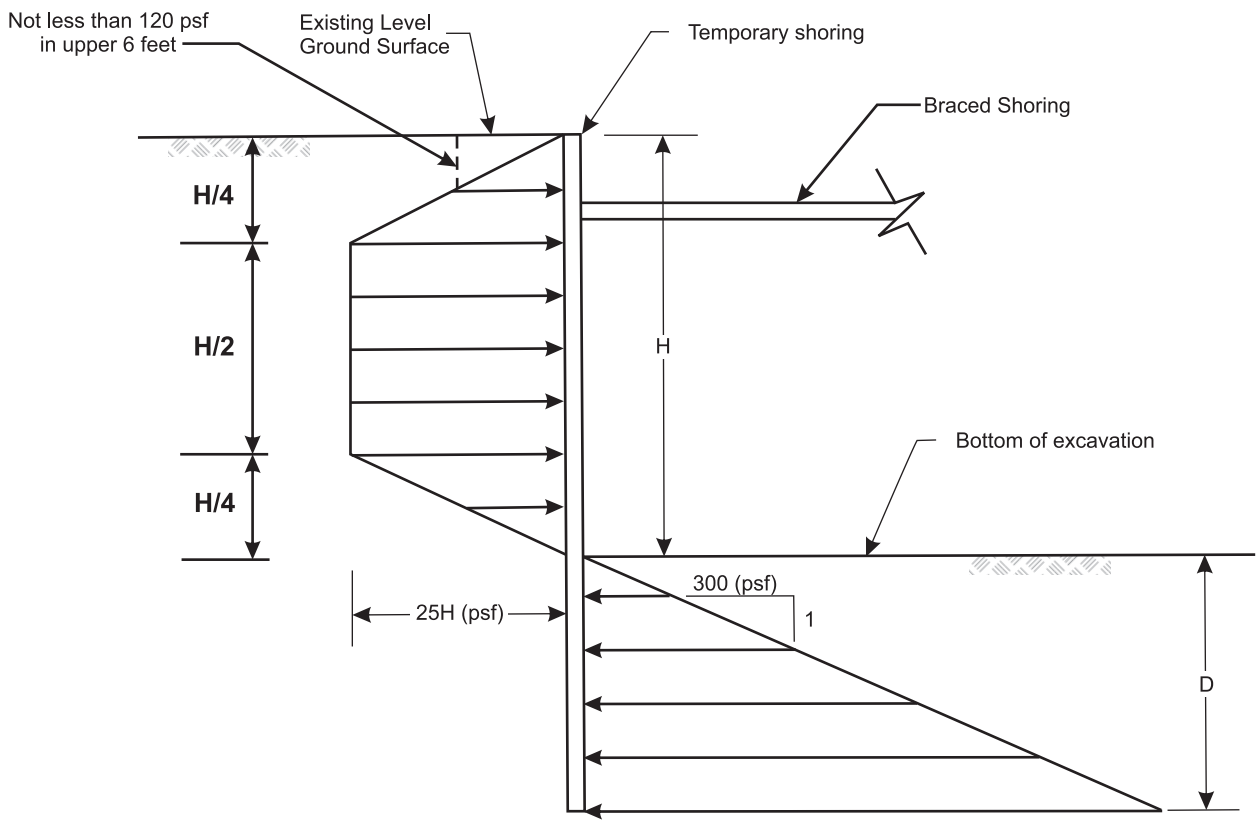
CORNERSTONE EARTH GROUP

Vicinity Geologic Map

Burlingame SS Improvements
Burlingame, CA

Project Number	522-5-1
Figure Number	Figure 4
Date	March 2016
Drawn By	RRN

Lateral Earth Pressures - Braced Shoring



H = Height of temporary shoring above the bottom of the excavation (feet)

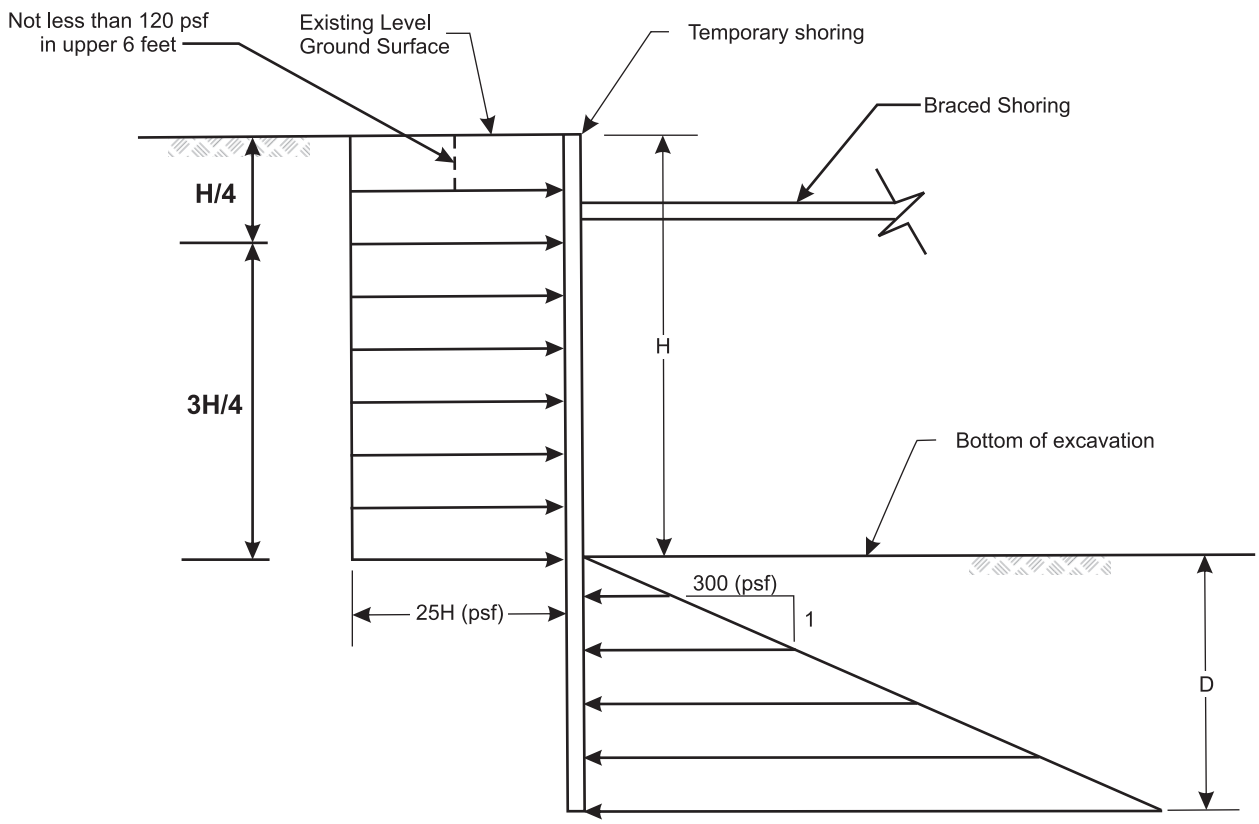
D = Depth of embedment of vertical members (feet)

Notes:

1. The above pressures are for walls with a level surface behind them; these pressures must be increased if the ground behind the temporary shoring slopes upward.
2. Passive pressure can be used over twice the projected area of the soldier pile.
3. The above pressures do not include surcharge loads. Walls should be designed to resist an additional uniform pressure equivalent ot one-half of any uniform surcharge loads.
4. Minimum earth pressure of 120 psf should be used in upper 6 feet to account for inadvertent surcharges.

CORNERSTONE EARTH GROUP	Lateral Earth Pressures - Clayey Soils	Project Number 522-5-1
	Burlingame SS Improvements Burlingame, CA	Figure Number Figure 5
		Date March 2016 / Drawn By MGV, RRN

Lateral Earth Pressures - Braced Shoring



H = Height of temporary shoring above the bottom of the excavation (feet)

D = Depth of embedment of vertical members (feet)

Notes:

1. The above pressures are for walls with a level surface behind them; these pressures must be increased if the ground behind the temporary shoring slopes upward.
2. Passive pressure can be used over twice the projected area of the soldier pile.
3. The above pressures do not include surcharge loads. Walls should be designed to resist an additional uniform pressure equivalent ot one-half of any uniform surcharge loads.
4. Minimum earth pressure of 120 psf should be used in upper 6 feet to account for inadvertent surcharges.

CORNERSTONE EARTH GROUP	Lateral Earth Pressures - Sandy Soils	Project Number 522-5-1
	Burlingame SS Improvements Burlingame, CA	Figure Number Figure 6
		Date March 2016 / Drawn By MGV, RRN

APPENDIX A: FIELD INVESTIGATION

The field investigation consisted of a surface reconnaissance and a subsurface exploration program using truck-mounted, hollow-stem auger drilling equipment. Four 8-inch-diameter exploratory borings were drilled on March 10, 2016 to depths of 14½ to 15 feet. The approximate locations of exploratory borings are shown on the Site Plan and Geologic Map, Figure 2. The soils encountered were continuously logged in the field by our representative and described in accordance with the Unified Soil Classification System (ASTM D2488). Boring logs, as well as a key to the classification of the soil and bedrock, are included as part of this appendix.

Boring locations were approximated using existing site boundaries, and other site features as references. Boring elevations were not determined. The locations of the borings should be considered accurate only to the degree implied by the method used.

Representative soil samples were obtained from the borings at selected depths. All samples were returned to our laboratory for evaluation and appropriate testing. The standard penetration resistance blow counts were obtained by dropping a 140-pound hammer through a 30-inch free fall. The 2-inch O.D. split-spoon sampler was driven 18 inches and the number of blows was recorded for each 6 inches of penetration (ASTM D1586). 2.5-inch I.D. samples were obtained using a Modified California Sampler driven into the soil with the 140-pound hammer previously described. Unless otherwise indicated, the blows per foot recorded on the boring log represent the accumulated number of blows required to drive the last 12 inches. The various samplers are denoted at the appropriate depth on the boring logs.

Field tests included an evaluation of the unconfined compressive strength of the soil samples using a pocket penetrometer device. The results of these tests are presented on the individual boring logs at the appropriate sample depths.

Attached boring logs and related information depict subsurface conditions at the locations indicated and on the date designated on the logs. Subsurface conditions at other locations may differ from conditions occurring at these boring locations. The passage of time may result in altered subsurface conditions due to environmental changes. In addition, any stratification lines on the logs represent the approximate boundary between soil types and the transition may be gradual.

UNIFIED SOIL CLASSIFICATION (ASTM D-2487-98)

MATERIAL TYPES	CRITERIA FOR ASSIGNING SOIL GROUP NAMES			GROUP SYMBOL	SOIL GROUP NAMES & LEGEND
COARSE-GRAINED SOILS >50% RETAINED ON NO. 200 SIEVE	GRAVELS >50% OF COARSE FRACTION RETAINED ON NO 4. SIEVE	CLEAN GRAVELS <5% FINES	Cu>4 AND 1<Cc<3	GW	WELL-GRADED GRAVEL
			Cu>4 AND 1>Cc>3	GP	POORLY-GRADED GRAVEL
		GRAVELS WITH FINES >12% FINES	FINES CLASSIFY AS ML OR CL	GM	SILTY GRAVEL
			FINES CLASSIFY AS CL OR CH	GC	CLAYEY GRAVEL
	SANDS >50% OF COARSE FRACTION PASSES ON NO 4. SIEVE	CLEAN SANDS <5% FINES	Cu>6 AND 1<Cc<3	SW	WELL-GRADED SAND
			Cu>6 AND 1>Cc>3	SP	POORLY-GRADED SAND
		SANDS AND FINES >12% FINES	FINES CLASSIFY AS ML OR CL	SM	SILTY SAND
			FINES CLASSIFY AS CL OR CH	SC	CLAYEY SAND
FINE-GRAINED SOILS >50% PASSES NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT<50	INORGANIC	PI>7 AND PLOTS>"A" LINE	CL	LEAN CLAY
			PI>4 AND PLOTS<"A" LINE	ML	SILT
		ORGANIC	LL (oven dried)/LL (not dried)<0.75	OL	ORGANIC CLAY OR SILT
	SILTS AND CLAYS LIQUID LIMIT>50	INORGANIC	PI PLOTS >"A" LINE	CH	FAT CLAY
			PI PLOTS <"A" LINE	MH	ELASTIC SILT
		ORGANIC	LL (oven dried)/LL (not dried)<0.75	OH	ORGANIC CLAY OR SILT
HIGHLY ORGANIC SOILS		PRIMARILY ORGANIC MATTER, DARK IN COLOR, AND ORGANIC ODOR		PT	PEAT

OTHER MATERIAL SYMBOLS

- Poorly-Graded Sand with Clay
- Clayey Sand
- Sandy Silt
- Artificial/Undocumented Fill
- Poorly-Graded Gravelly Sand
- Topsoil
- Well-Graded Gravel with Clay
- Well-Graded Gravel with Silt
- Sand
- Silt
- Well Graded Gravelly Sand
- Gravelly Silt
- Asphalt
- Boulders and Cobble

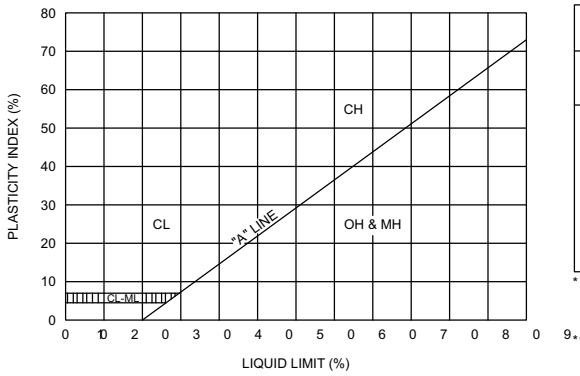
SAMPLER TYPES

- SPT
- Modified California (2.5" I.D.)
- Rock Core
- Shelby Tube
- No Recovery
- Grab Sample

ADDITIONAL TESTS

CA	-	CHEMICAL ANALYSIS (CORROSIVITY)	PI	-	PLASTICITY INDEX
CD	-	CONSOLIDATED DRAINED TRIAXIAL	SW		SWELL TEST
CN	-	CONSOLIDATION	TC	-	CYCLIC TRIAXIAL
CU	-	CONSOLIDATED UNDRAINED TRIAXIAL	TV	-	TORVANE SHEAR
DS	-	DIRECT SHEAR	UC	-	UNCONFINED COMPRESSION
PP	-	POCKET PENETROMETER (TSF)	(1.5)	-	(WITH SHEAR STRENGTH IN KSF)
(3.0)	-	(WITH SHEAR STRENGTH IN KSF)		-	
RV	-	R-VALUE	UU		UNCONSOLIDATED UNDRAINED TRIAXIAL
SA	-	SIEVE ANALYSIS: % PASSING #200 SIEVE		-	
	-	WATER LEVEL			

PLASTICITY CHART



PENETRATION RESISTANCE
(RECORDED AS BLOWS / FOOT)

SAND & GRAVEL		SILT & CLAY		
RELATIVE DENSITY	BLOWS/FOOT*	CONSISTENCY	BLOWS/FOOT*	STRENGTH** (KSF)
VERY LOOSE	0 - 4	VERY SOFT	0 - 2	0 - 0.25
LOOSE	4 - 10	SOFT	2 - 4	0.25 - 0.5
MEDIUM DENSE	10 - 30	MEDIUM STIFF	4 - 8	0.5 - 1.0
DENSE	30 - 50	STIFF	8 - 15	1.0 - 2.0
VERY DENSE	OVER 50	VERY STIFF	15 - 30	2.0 - 4.0
		HARD	OVER 30	OVER 4.0

* NUMBER OF BLOWS OF 140 LB HAMMER FALLING 30 INCHES TO DRIVE A 2 INCH O.D. (1-3/8 INCH I.D.) SPLIT-BARREL SAMPLER THE LAST 12 INCHES OF AN 18-INCH DRIVE (ASTM-1586 STANDARD PENETRATION TEST).

** UNDRAINED SHEAR STRENGTH IN KIPS/SQ. FT. AS DETERMINED BY LABORATORY TESTING OR APPROXIMATED BY THE STANDARD PENETRATION TEST, POCKET PENETROMETER, TORVANE, OR VISUAL OBSERVATION.

CORNERSTONE EARTH GROUP

LEGEND TO SOIL DESCRIPTIONS

Figure Number A-1

BORING NUMBER EB-1

CORNERSTONE EARTH GROUP

PROJECT NAME Burlingame SS Improvements
PROJECT NUMBER 522-5-1
PROJECT LOCATION Burlingame, CA

DATE STARTED 3/10/16 **DATE COMPLETED** 3/10/16
GROUND ELEVATION **BORING DEPTH** 15 ft.
DRILLING CONTRACTOR Exploration Geoservices Inc.
LATITUDE **LONGITUDE**
DRILLING METHOD Mobile B-56, 8 inch Hollow-Stem Auger
GROUND WATER LEVELS:
LOGGED BY MFR
AT TIME OF DRILLING Not Encountered
NOTES
AT END OF DRILLING Not Encountered

This log is a part of a report by Cornerstone Earth Group, and should not be used as a stand-alone document. This description applies only to the location of the exploration at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with time. The description presented is a simplification of actual conditions encountered. Transitions between soil types may be gradual.

ELEVATION (ft)	DEPTH (ft)	SYMBOL	DESCRIPTION	N-Value (uncorrected) blows per foot	SAMPLES TYPE AND NUMBER	DRY UNIT WEIGHT PCF	NATURAL MOISTURE CONTENT, %	PLASTICITY INDEX, %	PERCENT PASSING No. 200 SIEVE	UNDRAINED SHEAR STRENGTH, ksf (○ HAND PENETROMETER, △ TORVANE, ● UNCONFINED COMPRESSION, ▲ UNCONSOLIDATED-UNDRAINED TRIAXIAL; 1.0 2.0 3.0 4.0)
	0.0		12 inches asphalt concrete							
			Lean Clay with Sand (CL) very stiff, moist, gray with brown mottles, fine sand, moderate plasticity	20	MC-1B	110	16			○
	2.5		**Sandy Lean Clay (CL)** very stiff, moist, gray with reddish brown mottles, fine to medium sand, moderate plasticity							
	5.0		**Clayey Sand (SC)** medium dense, moist, light brown with gray mottles, fine to medium sand	21	MC-2B	99	18		32	
	7.5									
	10.0		**Clayey Sand with Gravel (SC)** dense, moist, brown with reddish brown mottles, fine to medium sand, fine to coarse subangular to subrounded gravel	65	MC-3B	121	10		14	
	12.5		**Clayey Sand (SC)** dense, moist, reddish brown with gray mottles, fine to medium sand	77	MC-4B	103	14			
	15.0		Bottom of Boring at 15.0 feet.							
	17.5									

CORNERSTONE EARTH GROUP2 - CORNERSTONE 0812.GDT - 3/15/16 13:12 - P:\DRAFTING\GINT FILES\522-5-1 BURLINGAME SS IMP.GPJ

BORING NUMBER EB-2

CORNERSTONE EARTH GROUP

PROJECT NAME Burlingame SS Improvements
PROJECT NUMBER 522-5-1
PROJECT LOCATION Burlingame, CA

DATE STARTED 3/10/16 **DATE COMPLETED** 3/10/16
GROUND ELEVATION **BORING DEPTH** 15 ft.
DRILLING CONTRACTOR Exploration Geoservices Inc.
LATITUDE **LONGITUDE**
DRILLING METHOD Mobile B-56, 8 inch Hollow-Stem Auger
GROUND WATER LEVELS:
LOGGED BY MFR
AT TIME OF DRILLING Not Encountered
NOTES
AT END OF DRILLING Not Encountered

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ELEVATION (ft)	DEPTH (ft)	SYMBOL	DESCRIPTION	N-Value (uncorrected) blows per foot	SAMPLES TYPE AND NUMBER	DRY UNIT WEIGHT PCF	NATURAL MOISTURE CONTENT, %	PLASTICITY INDEX, %	PERCENT PASSING No. 200 SIEVE	UNDRAINED SHEAR STRENGTH, ksf (○ HAND PENETROMETER, △ TORVANE, ● UNCONFINED COMPRESSION, ▲ UNCONSOLIDATED-UNDRAINED TRIAXIAL; 1.0 2.0 3.0 4.0)
	0.0		1 inch asphalt concrete over 6 inches aggregate base							
			Lean Clay (CL) stiff, moist, dark brown, some fine sand, moderate plasticity	12	MC-1B	99	22			○
	2.5									
			Sandy Lean Clay (CL) hard, moist, gray and brown mottled, fine to medium sand, some fine subangular to subrounded gravel, moderate plasticity							
	5.0			35	MC-2B	103	21			>4.5 ○
	7.5									
	10.0		**Lean Clay with Sand (CL)** hard, moist, brown, fine to medium sand, moderate plasticity	44	MC-3B	103	23			>4.5 ○
	12.5		**Clayey Sand with Gravel (SC)** medium dense, moist, brown with reddish brown mottles, fine to medium sand, fine to coarse subangular to subrounded gravel	58	MC-4B	112	19			
	15.0		Bottom of Boring at 15.0 feet.							
	17.5									

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BORING NUMBER EB-3

CORNERSTONE EARTH GROUP

PROJECT NAME Burlingame SS Improvements
PROJECT NUMBER 522-5-1
PROJECT LOCATION Burlingame, CA

DATE STARTED 3/10/16 **DATE COMPLETED** 3/10/16
GROUND ELEVATION **BORING DEPTH** 14.5 ft.
DRILLING CONTRACTOR Exploration Geoservices Inc.
LATITUDE **LONGITUDE**
DRILLING METHOD Mobile B-56, 8 inch Hollow-Stem Auger
GROUND WATER LEVELS:
LOGGED BY MFR
AT TIME OF DRILLING Not Encountered
NOTES
AT END OF DRILLING Not Encountered

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ELEVATION (ft)	DEPTH (ft)	SYMBOL	DESCRIPTION	N-Value (uncorrected) blows per foot	SAMPLES TYPE AND NUMBER	DRY UNIT WEIGHT PCF	NATURAL MOISTURE CONTENT, %	PLASTICITY INDEX, %	PERCENT PASSING No. 200 SIEVE	UNDRAINED SHEAR STRENGTH, ksf (○ HAND PENETROMETER, △ TORVANE, ● UNCONFINED COMPRESSION, ▲ UNCONSOLIDATED-UNDRAINED TRIAXIAL; 1.0 2.0 3.0 4.0)
	0.0		2½ inches asphalt concrete over 8 inches aggregate base							
			Poorly Graded Sand with Clay and Gravel (SP-SC) [Fill] medium dense, moist, brown, fine to medium sand	22	MC-1B	110	17			
	2.5		**Sandy Lean Clay (CL)** very stiff, moist, brown, fine to medium sand, some fine subangular to subrounded gravel, moderate plasticity							
			Clayey Sand (SC) medium dense, moist, light brown with gray mottles, fine to medium sand							
	5.0			60	MC-2B	103	11		18	
	7.5									
	10.0		becomes very dense	50/6"	MC-3B	110	10			
	12.5									
				50/6"	MC-4B	101	12			
	15.0		Bottom of Boring at 14.5 feet.							
	17.5									

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BORING NUMBER EB-4

CORNERSTONE EARTH GROUP

PROJECT NAME Burlingame SS Improvements
PROJECT NUMBER 522-5-1
PROJECT LOCATION Burlingame, CA

DATE STARTED 3/10/16 **DATE COMPLETED** 3/10/16
GROUND ELEVATION **BORING DEPTH** 15 ft.
DRILLING CONTRACTOR Exploration Geoservices Inc.
LATITUDE **LONGITUDE**
DRILLING METHOD Mobile B-56, 8 inch Hollow-Stem Auger
GROUND WATER LEVELS:
LOGGED BY MFR
AT TIME OF DRILLING 10 ft.
NOTES
AT END OF DRILLING 6 ft.

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ELEVATION (ft)	DEPTH (ft)	SYMBOL	DESCRIPTION	N-Value (uncorrected) blows per foot	SAMPLES TYPE AND NUMBER	DRY UNIT WEIGHT PCF	NATURAL MOISTURE CONTENT, %	PLASTICITY INDEX, %	PERCENT PASSING No. 200 SIEVE	UNDRAINED SHEAR STRENGTH, ksf (○ HAND PENETROMETER, △ TORVANE, ● UNCONFINED COMPRESSION, ▲ UNCONSOLIDATED-UNDRAINED TRIAXIAL; 1.0 2.0 3.0 4.0)
	0.0		4 inches asphalt concrete over 3½ inches aggregate base							
			Clayey Sand with Gravel (SC) [Fill] loose, moist, brown, fine to medium sand, fine to coarse subangular to subrounded gravel	6	MC-1B	107	19			○
	2.5		**Sandy Lean Clay (CL)** stiff, moist, brown, fine to medium sand, some fine subangular to subrounded gravel, moderate plasticity							
	5.0			14	MC-2B	113	16		44	
			Clayey Sand with Gravel (SC) loose, moist, brown, fine to medium sand, fine to coarse subangular to subrounded gravel							
	7.5		**Clayey Sand (SC)** medium dense, moist, light brown with gray mottles, fine to medium sand							
	10.0			56	MC-3B	110	15			
	12.5									
			becomes very dense	50/6"	MC-4B	108	14			
	15.0		Bottom of Boring at 15.0 feet.							
	17.5									

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APPENDIX B: LABORATORY TEST PROGRAM

The laboratory testing program was performed to evaluate the physical and mechanical properties of the soils retrieved from the site to aid in verifying soil classification.

Moisture Content: The natural water content was determined (ASTM D2216) on 16 samples of the materials recovered from the borings. These water contents are recorded on the boring logs at the appropriate sample depths.

Dry Densities: In place dry density determinations (ASTM D2937) were performed on 16 samples to measure the unit weight of the subsurface soils. Results of these tests are shown on the boring logs at the appropriate sample depths.

Washed Sieve Analyses: The percent soil fraction passing the No. 200 sieve (ASTM D1140) was determined on four samples of the subsurface soils to aid in the classification of these soils. Results of these tests are shown on the boring logs at the appropriate sample depths.