GEOTECHNICAL EXPLORATION

VETERAN'S ADMINISTRATION MEDICAL CENTER
BUILDING 22

SAN FRANCISCO, CALIFORNIA

SUBMITTED

TO

VETERAN'S ADMINISTRATION MEDICAL CENTER

SAN FRANCISCO, CALIFORNIA

PREPARED

BY

ENGEO INCORPORATED

PROJECT NO. 7344.100.103

MAY 27, 2008

Project No.
7344.100.103

May 27, 2008

Mr. John Pechman
Veteran's Administration Medical Center
4150 Clement Street
San Francisco, CA 94121

Subject: Veteran's Administration Hospital
Building 22
San Francisco, California

GEOTECHNICAL EXPLORATION

Dear Mr. Pechman:

ENGEO Incorporated prepared this Geotechnical Exploration report for the proposed Building 22 at the Veteran's Administration Hospital as outlined in our proposal revised March 21, 2008. We characterized the subsurface conditions at the site in order to provide the enclosed geotechnical recommendations for design.

Our experience and that of our profession clearly indicates that the risk of costly design, construction, and maintenance problems can be significantly lowered by retaining the design geotechnical engineering firm to review the project plans and specifications and provide geotechnical observation and testing services during construction. Please let us know when working drawings are nearing completion, and we will be glad to discuss these additional services with you.

If you have any questions or comments regarding this report, please call and we will be glad to discuss them with you.

Very truly yours,

ENGEO Incorporated

Douglas Wahl
dw/smc

Donald Bruggers, GE

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GEOTECHNICAL
STATE OF CALIFORNIA

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INTRODUCTION

Purpose and Scope

ENGEO Incorporated prepared this geotechnical report for design of the proposed Building 22 at the Veteran's Administration Medical Center in San Francisco, California. We received several site plans, structural plans for adjacent buildings, and foundation plans for the adjacent buildings. These were provided by the Veteran's Administration, HGA Architects, and Degenkolb.

The proposed building will be located adjacent to Building 9 and Building 10 on the grounds of the Veteran's Administration Hospital Complex. The site is located to the east of the two buildings just inside the property line at the northeast corner of the Medical Center complex. The footprint of the new building is approximately 150 feet on the long edge, and 50 feet on the shorter edge and is located in an area containing sidewalks, some landscaping areas, and open air equipment storage.

ENGEO prepared this report as outlined in our agreement revised March 21, 2008. Our scope of services, as outlined in our proposal, consisted of exploring the subsurface conditions at the site and performing laboratory tests and engineering analyses, to develop conclusions and recommendations regarding:

- Soil and groundwater conditions at the site.
- Design criteria for the new foundations.
- Site seismicity and seismic hazards, including the potential for liquefaction, lateral spreading, cyclic densification, and estimated seismically induced settlement, if any.
- Measures to mitigate seismic hazards, if appropriate.
- Site grading and subgrade preparation, including fill quality and compaction requirements.

- 2007 CBC soil profile type and seismic design criteria.

This report was prepared for the exclusive use of the Veteran's Administration and its design team consultants. In the event that any changes are made in the character, design, or layout of the development, the conclusions and recommendations contained in this report must be reviewed by ENGEO to determine whether modifications to the report are necessary. This document may not be reproduced in whole or in part by any means whatsoever, nor may it be quoted or excerpted by any party without the express written consent of ENGEO.

Site Location and Description

Figure 1 displays a Site Vicinity Map. The Veteran's Administration Hospital is located at the cross streets of 4150 Clement Street in San Francisco, California. Figure 2, the Site Plan, shows the project site boundaries, existing buildings, the proposed building area, and our exploratory locations. The project site is bounded on the west by Buildings 9 and 10, and on the east by the property line. To the south are walkways, landscaping, paving and storage structures; the property line closes the site to the north.

Proposed Development

Based on our discussions with Mr. John Pechman of the Veteran's Administration and review of the information provided, we understand that the project will consist of construction of an approximately 4,000-square-foot footprint outpatient hoptel-type housing facility. The building is expected to consist of three stories of above-grade construction with one partially below grade basement level.

According to a scoping document from the Structural Engineer, Degenkolb, the design column loads are approximately 100 kips for dead loads, 200 kips for dead plus live load combinations and 300 kips for all loads.

GEOLOGY

Regional and Site Geology

The project site is situated on the northwestern corner of the San Francisco Peninsula in the San Francisco North Quadrangle. Review of the geologic map of San Francisco North prepared by Schlocker (1958) found that the property is underlain by intensely sheared rocks of the Franciscan formation. This mapped unit generally includes rock fragments rounded by shearing and embedded in a soft matrix. The site is also adjacent to deposits of Quaternary-age dune sand and weathered Franciscan bedrock. This formation generally consists of clean, well-sorted, fine- to medium-grained sand, underlain by weathered Franciscan bedrock.

In addition, there are three visible faults in the vicinity of the site and two mapped landslide scarps to the north of the site. Two of the faults run on either side of the site; however, the site is not in a mapped Alquist-Priolo Fault Zone. The mapped landslides appear to be well outside the site and do not pose a risk to the proposed structure.

Site Seismicity

The project area lies within a region of active faulting and high seismicity associated with the San Andreas Fault system. The San Andreas Fault system comprises a zone of major, northwest-trending active strike-slip faults that includes from east to west, the Calaveras, Hayward, San Andreas, and San Gregorio-Hosgri faults (Figure 1). The San Andreas Fault system has been the source of numerous moderate to large magnitude historical earthquakes that caused strong ground shaking in the project area, including the 1906 San Francisco earthquake and the 1989 Loma Prieta earthquake. Future strong ground shaking from nearby large magnitude earthquakes is a virtual certainty and should be a consideration in the design of the new project facilities and components.

At its closest point relative to the project area, the San Andreas Fault lies approximately 5.4 kilometers to the southwest. Several other active and potentially active faults occur within the project limits which include the San Gregorio, Hayward, Point Reyes, Rodgers Creek, Calaveras, and others. The distance from the site and estimated maximum Moment magnitude[1,2] for these and other active[3] or potentially active[4] faults of the region (within 100 kilometers) are summarized in Table 1.

TABLE 1
Regional Faults and Seismicity

Fault Name	Distance (km)	Direction from Site	Maximum Moment Magnitude
San Andreas - 1906 Rupture	5.6	Southwest	7.9
San Andreas - Peninsula	5.6	Southwest	7.2
San Andreas - North Coast South	8.8	West	7.5
San Gregorio North	9.8	West	7.3
Hayward - Total	23.8	Northeast	7.1
Northern Hayward	23.8	Northeast	6.6
Southern Hayward	28.4	East	6.9
Point Reyes	34.0	Northwest	6.8
Rodgers Creek	36.8	Northeast	7.1
Mount Diablo Thrust	41.7	East	6.7
Northern Calaveras	42.0	East	7.0
Monte Vista	44.4	Southeast	6.8

1 Maximum Magnitude Earthquake (Moment magnitude), from *Probabilistic Seismic Hazard Assessment for the State of California* by the California Department of Conservation, Division of Mines and Geology, Open File Report 96-08.

2 Moment magnitude is an energy-based scale and provides a physically meaningful measure of the size of a faulting event. Moment magnitude is directly related to average slip and fault rupture area.

3 Active faults are defined as those exhibiting either surface ruptures, topographic features created by faulting, surface displacements of geologically Recent (younger than about 11,000 years old) deposits, tectonic creep along fault lines, and/or close proximity to linear concentrations or trends of earthquake epicenters.

4 Potentially active faults are those that have evidence of displacement of deposits of Quaternary age (the last 2 million years).

Fault Name	Distance (km)	Direction from Site	Maximum Moment Magnitude
Concord	46.2	Northeast	6.5
Southern Green Valley	47.4	Northeast	6.5
West Napa	48.0	Northeast	6.5
Northern Greenville	53.4	Northeast	6.6
Great Valley - 6	59.4	Northeast	6.7
Central Greenville	61.5	East	6.7
Northern Green Valley	62.1	Northeast	6.3
Hayward - South East Extension	64.0	Southeast	6.4
Great Valley - 5	64.1	Northeast	6.5
Great Valley - 4	69.5	Northeast	6.6
Central Calaveras	71.9	Southeast	6.6
Southern Greenville	73.9	East	6.9
Hunting Creek - Berryessa	79.0	North	6.9
Great Valley - 7	80.3	East	6.7
San Andreas - Santa Cruz Mnts.	80.6	Southeast	7.2
Sargent	87.1	Southeast	6.8
Maacama - South	89.5	North	6.9
Zayante-Vergeles	90.3	Southeast	6.8

For seismic design, the site can be classified as a Type C in accordance with the California Building Code, 2007. The seismic design should be completed using the 2007 CBC or similar criteria appropriate for the site and project. The site does not lie within an Alquist-Priolo Earthquake Fault Hazard Zone.

FIELD EXPLORATION

Field Exploration

The field exploration for this study was conducted on May 7, 2008, and consisted of drilling three exploratory borings to a maximum depth of approximately 50 feet. The approximate locations of the borings are shown on Figure 2. The borings were roughly located by pacing from existing features and should be considered accurate only to the degree implied by the method used.

The exploratory borings were drilled with a truck-mounted drill rig equipped with 8-inch-diameter hollow stem augers. An ENGEO Engineer logged the borings in the field and collected soil samples using either a 3-inch O.D. California-type split-spoon sampler fitted with 6-inch-long brass liners, or a 2.5-inch O.D. Standard Penetrometer sampler. The samplers were advanced with a 140-pound hammer with a 30-inch drop, employing an automatic trip hammer system. The penetration of the sampler into the native materials was field recorded as the number of blows needed to drive the sampler 18 inches in 6-inch increments. Blow count results on the boring logs are recorded as the number of blows required for the last one foot of penetration. The field logs were used to develop the report boring logs, which are presented in Appendix A.

Laboratory Testing

We performed laboratory tests on selected soil and rock samples to determine their engineering properties. The methods performed included moisture, density, and percent fines testing on samples recovered from our explorations. Appendix B contains the laboratory test data. Select samples recovered were tested to determine the following soil characteristics:

Soil Characteristic	ASTM Method	Location of Results
Percent Passing #200 Sieve	ASTM D-1140	Appendix B
Natural Unit Weights and Moisture Contents	ASTM D-2216	Appendix A

Soil Stratigraphy and Bedrock

In general, the borings encountered 3 to 4 feet of medium dense sand fill, underlain by medium stiff sandy clay, and in turn, underlain by bedrock. The bedrock encountered locally at the site consists of friable to moderately strong sandstone and claystone. Bedrock encountered at the site was closely fractured to crushed and highly to fully weathered. The geotechnical properties of the bedrock are discussed in our foundation recommendations.

Please consult the Site Plan and boring logs for specific soil, rock, and groundwater conditions at each location. The logs for Borings 1 through 4 are provided in Appendix A. The logs contain the soil/rock type, color, consistency, and visual classification in general accordance with the Unified Soil Classification System.

Groundwater Conditions

Groundwater was not encountered in the borings during our field exploration. It is possible that the groundwater levels had not fully stabilized at the time of our measurements. In addition, fluctuations in groundwater levels may occur seasonally and over a period of years because of precipitation, changes in drainage patterns, irrigation, and other factors.

CONCLUSIONS

General

Based on the findings from the subsurface exploration, laboratory test results, and analyses, we conclude that the proposed development is feasible from a geotechnical standpoint provided that the recommendations included in this report, along with sound engineering practices, are incorporated in the design and construction of the project. Potential seismic hazards and other foundation issues are addressed in the following sections.

Seismic Hazards

Seismic hazards can generally be classified as primary and secondary. The primary effect is ground rupture, also called surface faulting. Common secondary seismic hazards include ground shaking, lurch cracking, soil liquefaction, lateral spreading, landslides, and tsunamis and seiches. The risk of regional subsidence/uplift or tsunamis or seiches is considered remote at the site. The risk of earthquake-induced ground rupture, landslides, liquefaction, densification, lateral spreading, and lurching are discussed below.

Ground Rupture. Historically, ground surface displacements closely follow the trace of geologically young faults. According to geologic maps, three unnamed faults exist near the site with one fault running nearly adjacent to the proposed building site; however, the project is not within an Earthquake Fault Zone, as defined by the Alquist-Priolo Earthquake Fault Zoning Act. Additionally, these faults are not quaternary age and are not considered active. In a seismically active area, the possibility exists for future faulting in areas where no faults previously existed; however, we conclude the risk of surface faulting and consequent secondary ground failure is low.

Ground Shaking. An earthquake of moderate to high magnitude generated within the San Francisco Bay Region could cause considerable ground shaking at the site. To mitigate the shaking effects, all structures should be designed using sound engineering judgment and the latest building code requirements as a minimum. Seismic design parameters are presented below:

2007 CBC Seismic Parameters

ITEM	DESIGN VALUE
Site Class	C
0.2 second Spectral response Acceleration, S_s	1.81
1.0 second Spectral response Acceleration, S_1	0.93
Site Coefficient, F_a	1.0
Site Coefficient, F_V	1.3
Maximum considered earthquake spectral response accelerations for short periods, S_{MS}	1.81
Maximum considered earthquake spectral response accelerations for 1-second periods, S_{M1}	1.21
Design spectral response acceleration at short periods, S_{DS}	1.21
Design spectral response acceleration at 1-second periods, S_{D1}	0.81
Long-period Transition Period, T_L	12 seconds

The seismic design should be completed using the 2007 CBC or similar criteria appropriate for the site and project.

Lurching. Ground lurching is a result of the rolling motion imparted to the ground surface during energy released by an earthquake. Such rolling motion can cause ground cracks to form. The potential for the formation of these cracks is considered greater at contacts between deep alluvium and bedrock. The absence of deep alluvial deposits implies that the risk of lurching at this site is low.

Liquefaction. Liquefaction is a phenomenon in which saturated cohesionless soils are subject to a temporary, but essentially total, loss of shear strength because of pore pressure build-up under the reversing cyclic shear stresses associated with earthquakes. We did not encounter groundwater during our exploration and the anticipated subsurface conditions beneath the proposed building footprint consist of weathered bedrock which is dense to very dense. As a result, it is our opinion that the general hazard of liquefaction on the property is negligible.

Lateral Spreading. Lateral spreading is a failure within a nearly horizontal soil zone (possibly due to liquefaction) that causes the overlying soil mass to move toward a free face or down a gentle slope. Lateral spreading at the site is unlikely since there is no liquefaction hazard present at the site.

Earthquake-Induced Densification. Densification of loose sand above the groundwater level during earthquake shaking could cause settlement of the ground surface. In addition, densification of liquefiable soils below the groundwater level can cause detrimental settlement at the ground surface. The sands encountered at the site are generally dense to very dense. Therefore we judge that the potential for earthquake-induced densification is very low.

Foundation Support

The proposed hoptel building may be supported on conventional shallow foundations bearing on competent in-place native soil or on compacted structural fill placed as described in the previous section.

Slab-on-Grade Floors

Slab-on-grade floors can be used for the ground floor of the new building; however, due to the presence of non-uniform fill material in the upper several feet of soils at the site, the slab-on-grade floors should be supported on a minimum of 18 inches of compacted engineered fill.

RECOMMENDATIONS

Demolition, Stripping and Overexcavation

Site development will commence with the removal of asphalt paving, vegetation, debris, loose soil, and soft compressible materials in any location to be graded. The site should be excavated to accommodate the placement of at least 18 inches of compacted fill below slab-on-grade floors.

Any soft, compressible soils should be removed from areas to receive fill or structures. Subject to approval by the Landscape Architect, strippings and organically contaminated soils can be used in landscape areas. Any topsoil that will be retained for future use in landscape areas should be stockpiled in areas where it will not interfere with grading operations.

All excavations from demolition and stripping below design grades should be cleaned to a firm undisturbed soil surface as determined by the Geotechnical Engineer. This surface should then be scarified, moisture conditioned, and backfilled with compacted engineered fill. The requirements for backfill materials and placement operations are the same as for engineered fill. No loose or uncontrolled backfilling of depressions resulting from demolition and stripping should be permitted.

Selection of Materials

With the exception of any organically contaminated materials (soil which contains more than 3 percent organics), the site soils are suitable for use as engineered fill. Bedrock materials should be processed to break down any large masses to pieces no larger than three inches in greatest dimension. In addition, processed bedrock material should be moisture conditioned prior to placement as fill.

The Geotechnical Engineer should be informed when import materials are planned for the site. Import fill should consist of soil that is free of organic matter, contain no rocks or lumps larger than three inches in greatest dimension, and have a liquid limit less than 40 and plasticity index less than 12. Import materials should be submitted to and approved by the Geotechnical Engineer prior to delivery at the site.

It is important that all site preparation, including demolition and stripping, is done under the observation of the Geotechnical Engineer or his/her qualified field representative and should be carried out according to the requirements contained herein. The final grading plans should be submitted to the Geotechnical Engineer for review.

Placement of Fill

After removal of seasonal vegetation, soft soils, loose fill, and overexcavation to accommodate the placement of 18 inches of compacted fill below slabs, the exposed non-yielding surface should be scarified to a depth of 12 inches, moisture conditioned, and recompacted. All fills should be placed in thin lifts. The lift thickness should not exceed 8 inches or the depth of penetration of the compaction equipment used, whichever is less. Fill should be compacted to at least 90 percent relative compaction.

Monitoring and Testing

The Geotechnical Engineer or his/her qualified representative should be present during all phases of grading operations to observe demolition, site preparation, and grading operations. General fill should be moisture conditioned to at least 2 percentage points over optimum moisture content and compacted to not less than 90 percent relative compaction.

Relative compaction refers to in-place dry density of the fill material expressed as a percentage of the maximum dry density as determined by ASTM D-1557-91. Optimum moisture is the moisture content corresponding to the maximum dry density.

Building Foundation Design – Shallow Footings

The new hoptel building can be supported on conventional spread footing foundations. Spread footings should bear upon undisturbed native soil or engineered backfill (compacted to at least 90 percent relative compaction). The maximum allowable bearing pressures that should be exerted by the spread footings are presented below.

Load Type	Allowable Bearing Capacity (pounds per square foot)
Dead Load	4,000
Dead plus Live Load	5,000
Total Loads including wind or seismic	6,000

Wall and column footings should have minimum dimensions of at least 12 and 18 inches, respectively. The footings should be bottomed at least 18 inches below the lowest adjacent finished grade. To avoid surcharging basement walls, new spread footing foundations should be located below an imaginary plane extending upward at an inclination of 1:1 (horizontal:vertical) from the bottom of the existing basement wall.

Resistance to lateral loads can be provided by friction along the base of foundations and by passive pressures developing on the sides of foundations. A friction coefficient of 0.4 times the dead load should be used to evaluate frictional resistance along the bottom of foundations. An equivalent fluid weight of 350 pounds per cubic foot (pcf) should be used to evaluate passive pressures. Foundation excavations should be cleaned of loose soil prior to concrete placement. ENGEO should observe all foundation excavations to check for adequate bearing and cleanout.

The Geotechnical Engineer should review foundation plans when they become available. Footing trenches and pier holes should be cleared of all loose materials. The Geotechnical Engineer or his/her field representative should observe the footing trenches and pier drilling prior to concrete placement.

Slab Moisture Vapor Reduction.

When buildings are constructed with concrete slabs-on-grade, water vapor from beneath the slab will migrate through the slab and into the building. This water vapor can be reduced but not stopped. Vapor transmission can negatively affect floor coverings and lead to increased moisture within a building. When water vapor migrating through the slab would be undesirable, we recommend the following to reduce, but not stop, water vapor transmission upward through the slab on grade.

1. Install a vapor retarder membrane directly beneath the slab. Seal the vapor retarder at all seams and pipe penetrations. Vapor retarders shall be Class A vapor retarder in accordance with ASTM E 1745 “Standard Specification for Plastic Water Vapor Retarders used in Contact with Soil or Granular Fill under Concrete Slabs.” Vapor retarders should be installed and sealed as recommended by the manufacturer and at all seams and pipe penetrations.

2. Concrete shall have a concrete water-cement ratio of no more than 0.5.

3. Provide inspection and testing during concrete placement to check that the proper concrete and water cement ratio are used.

4. Consider moist cure slabs for a minimum of 3 days.

The Structural Engineer should be consulted as to the use of a layer of clean sand (less than 5 percent passing the U.S. Standard No. 200 Sieve) placed on top of the vapor retarder membrane to assist in concrete curing. In our past experience, we have observed that concrete slabs retain moisture and may take several months to fully hydrate. Provide sufficient time to air dry floor slabs before floor covering application, such as vinyl floor tile and wood flooring placement. Alternatively, apply a floor sealant over the concrete to minimize moisture from accumulating under the flooring. Also, the use of a lower water/cement ratio and higher strength concrete will reduce the amount of water in the slab and help expedite the hydration time.

Secondary Slab-on-Grade Construction

This section provides guidelines for secondary slabs such as exterior slabs, walkways, driveways, and steps. Secondary slabs-on-grade should be constructed structurally independent of the foundation system. This allows slab movement to occur with a minimum of foundation distress.

Slabs-on-grade should be designed specifically for their intended use and loading requirements. As a minimum requirement, slabs-on-grade should be reinforced for control of cracking. Slab reinforcement should be designed by the Structural Engineer. In our experience, welded wire mesh is generally not sufficient to control slab cracking. Therefore, we recommend the Structural Engineer consider using a minimum of No. 3 bars for design of the slab reinforcement.

Slabs-on-grade should have a minimum thickness of 4 inches with a thickened edge extending at least 6 inches into compacted soil to minimize water infiltration. A 4-inch-thick layer of clean crushed rock or gravel should be placed under sidewalk and driveway slabs. As an alternative to providing a 6-inch-thick edge, a minimum 5½-inch-thick slab could be placed over 4 inches of clean crushed rock or gravel.

Retaining and Basement Walls

Retaining walls must be designed to resist both lateral earth pressures and any additional lateral loads caused by surcharging. We recommend that unrestrained walls be designed to resist lateral earth pressures of 40 pounds per cubic foot (pcf). Restrained basement walls should be designed to resist lateral earth pressures of 60 pcf. Walls subject to surcharging from either vehicle loads, or loads on the slabs behind the walls should be designed for an additional uniform lateral pressure equal to one-third or one-half the anticipated surcharge load for unrestrained and restrained walls, respectively. The design of walls greater than 10 feet tall should be checked under seismic conditions for an additional seismic load increment equal to a uniform pressure of 12H in psf. Unrestrained walls should be able to move outward at least one percent of their height. The walls may be supported on spread footing foundations designed in accordance with the recommendations presented above.

The recommended lateral pressures assume walls are fully back drained to prevent the buildup of hydrostatic pressures. Adequate drainage could be provided by means of a blanket of permeable materials installed behind the walls with a perforated pipe installed at the bottom of the material and conveying to an appropriate outlet. The blanket should consist of well-graded granular material meeting the requirements of Caltrans Class 2 Permeable Material that extends at least 12 inches from the rear of the wall. Alternatively, prefabricated filter fabric drainage panels may be used. Additionally, basement walls should be waterproofed to inhibit the movement of water through the wall. The waterproofing should be designed by a consultant that specializes in the design and construction of waterproofing systems.

Retaining wall backfill should be compacted in accordance with the recommendations presented for placement of fill. If heavy compaction equipment is used, the walls should be designed to withstand loads exerted by the equipment, or should be temporarily braced.

Preliminary Pavement Design

Based on our field explorations and laboratory testing, we estimate that site soils will have a resistance ("R") value of 5. The following preliminary pavement sections have been determined for Traffic Indices of 4.5, 5, 6, and 7 based on an assumed R-value of 5 according to the method contained in Topic 608 of Highway Design Manual by CALTRANS.

Traffic Index	Alternative I		Alternative II		
	AC in.	AB in.	AC in.	AB in.	ASB* in.
4.5	3.0	8.0	---	---	---
5.0	3.0	10.0	3.0	6.0	5.0
6.0	3.5	13.0	3.5	6.0	8.0
7.0	4.0	16.0	4.0	7.0	10.0

Notes: AC is asphaltic concrete
AB is aggregate base Class 2 Material with minimum R-value = 78
ASB is aggregate subbase with minimum R-value = 50
* A minimum 12-inch-thick section of lime treated subgrade can be substituted for ASB provided equivalent R-values can be obtained

The Traffic Index should be determined by the Civil Engineer or appropriate public agency. These sections are for estimating purposes only. We recommend R-value testing be performed following site grading to determine the as-built pavement subgrade characteristics for final pavement section evaluation. Pavement construction and all materials should comply with the requirements of the Standard Specifications of the State of California Division of Highways, County requirements and the following minimum requirements:

- All pavement subgrades should be scarified to a depth of 12 inches below finished subgrade elevation, moisture conditioned to 2 percentage points above optimum, and compacted to at least 90 percent relative compaction and in accordance with applicable City and County requirements. These specifications may be modified depending on the materials actually exposed at roadway subgrade levels.

- Subgrade soils should be in a stable, non-pumping condition at the time aggregate baserock materials are placed and compacted.

- Adequate provisions must be made such that the subgrade soils and aggregate baserock materials are not allowed to become saturated.

- Aggregate baserock materials should meet current Caltrans specifications for Class 2 aggregate baserock and should be compacted to at least 95 percent of maximum dry density at a minimum moisture content of optimum.

- Asphalt paving materials should meet current Caltrans specifications for asphalt concrete.

- All concrete curbs separating pavement and irrigated landscaped areas should extend into the subgrade and below the bottom of adjacent aggregate baserock materials.

Drainage

The subject site must be positively graded at all times to provide for rapid removal of surface water runoff from the foundation system and to prevent ponding of water under floors or seepage toward the foundation systems at any time during or after construction. Ponding of stormwater should not be permitted adjacent to the building during prolonged periods of inclement weather. As a minimum requirement, finished grades should have slopes of at least 3 to 5 percent (2 percent for paved areas) within 5 feet of the exterior walls and at right angles to them to allow surface water to drain positively away from the structure. All surface water should be collected and discharged into the storm drain system. Landscape mounds must not interfere with this requirement. All roof stormwater should be collected and directed to downspouts. Stormwater from roof downspouts should be directed to a solid pipe that discharges to the street or storm drain system.

Utilities

It is recommended that utility trench backfilling be done under the observation of a Geotechnical Engineer. Pipe zone backfill (i.e. material beneath and immediately surrounding the pipe) may consist of a well-graded import or native material less than ¾ inch in maximum dimension compacted in accordance with recommendations provided above for engineered fill. Trench zone backfill (i.e. material placed between the pipe zone backfill and the ground surface) may consist of native soil or processed bedrock compacted in accordance with recommendations for engineered fill.

Where import material is used for pipe zone backfill, we recommend it consist of fine- to medium-grained sand or a well-graded mixture of sand and gravel, and that this material not be used within 2 feet of finish grade. In general, uniformly graded gravel should not be used for pipe or trench zone backfill due to the potential for migration of soil into the relatively large void spaces present in this type of material, and water along trenches backfilled with this type of material.

Care should be exercised where utility trenches are located beside foundation areas. Utility trenches constructed parallel to foundations should be located entirely above a plane extending down from the lower edge of the footing at an angle of 45 degrees. Utility trenches in areas to be paved should be constructed using the recommendations for compaction under paved areas.

LIMITATIONS AND UNIFORMITY OF CONDITIONS

This report is issued with the understanding that it is the responsibility of the owner to transmit the information and recommendations of this report to the owner, contractors, architects, engineers, and designers for the project so that the necessary steps can be taken by the contractors and subcontractors to carry out such recommendations in the field. The conclusions and recommendations contained in this report are solely professional opinions.

ENGEO Incorporated strives to perform its services in a proper and professional manner with reasonable care and competence but is not infallible. There are risks of earth movement and property damages inherent in land development. We are unable to eliminate all risks or provide insurance; therefore, we are unable to guarantee or warrant the results of our work.

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LIST OF FIGURES

BASE MAP SOURCE: MS STREETS AND TRIPS

ENGEO INCORPORATED EXCELLENT SERVICE SINCE 1971	VICINITY MAP VA HOSPITAL - BUILDING 22 SAN FRANCISCO, CALIFORNIA	PROJECT NO.: 7344.100.103 DATE: MAY 2008 DRAWN BY: SRP CHECKED BY: DB	FIGURE NO. 1

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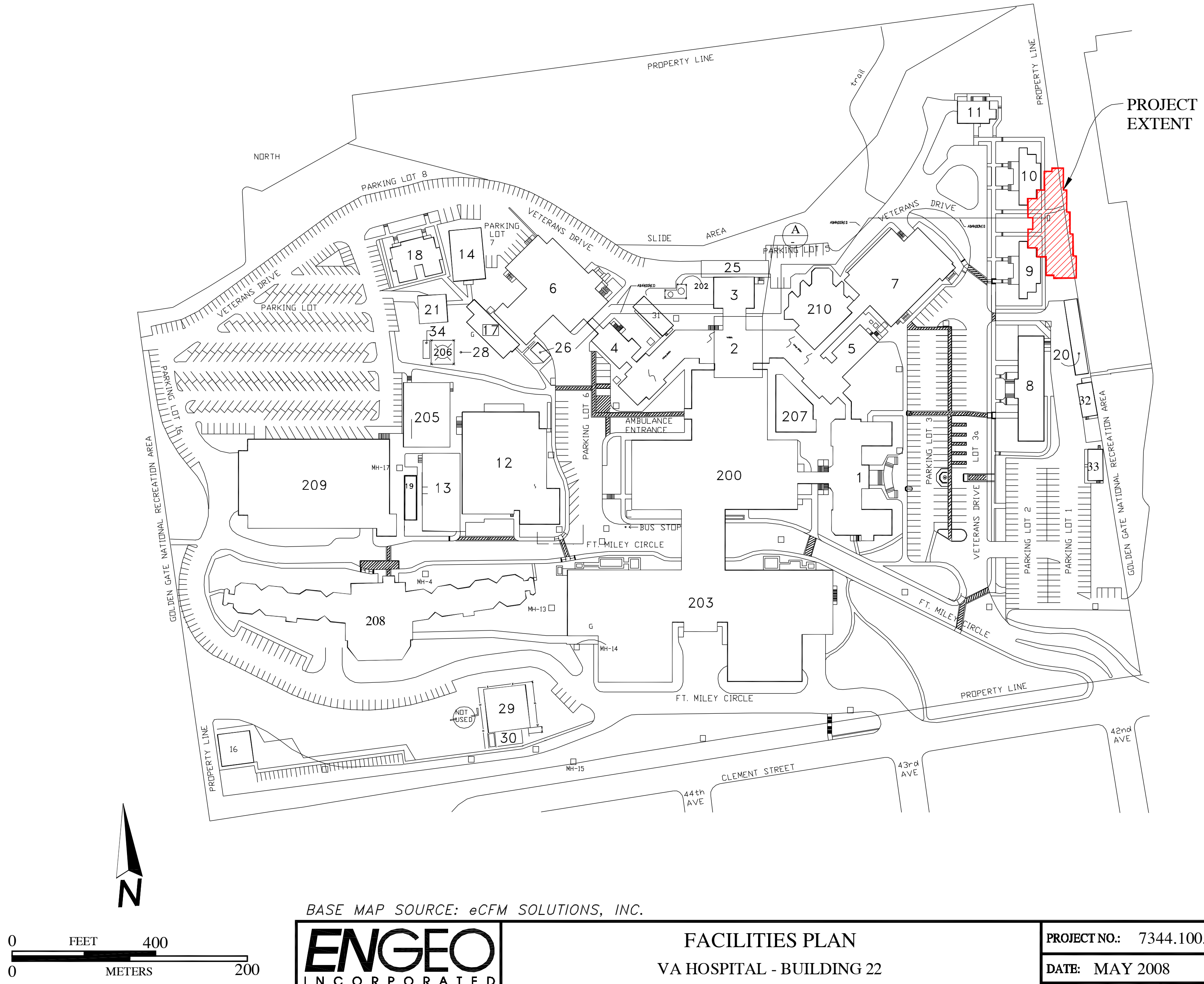

BASE MAP SOURCE: eCFM SOLUTIONS, INC.

ENGEO INCORPORATED
EXCELLENT SERVICE SINCE 1971

FACILITIES PLAN VA HOSPITAL - BUILDING 22 SAN FRANCISCO, CALIFORNIA	
PROJECT NO.: 7344.100.103	FIGURE NO. 2
DATE: MAY 2008	
DRAWN BY: SRP	CHECKED BY: DB

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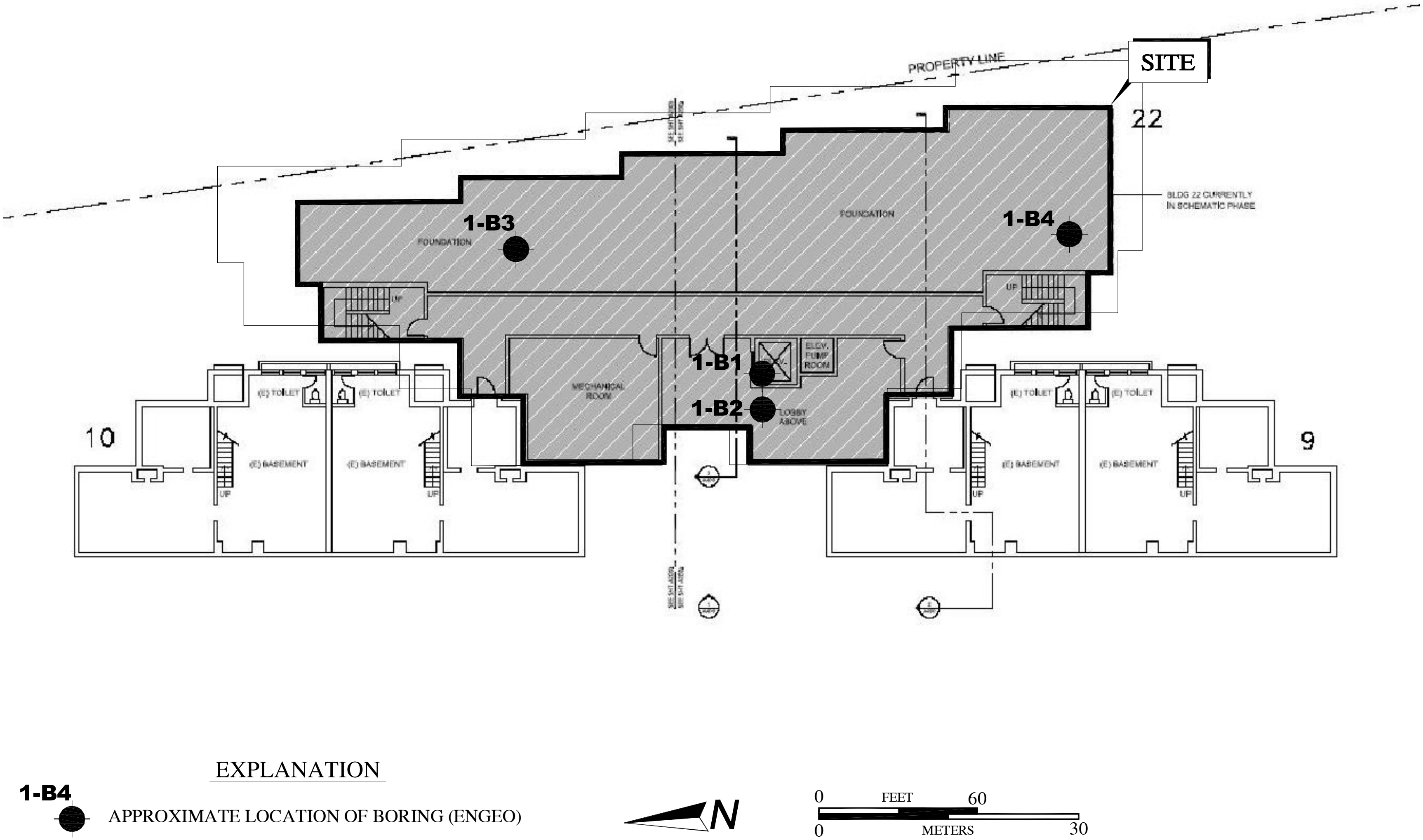
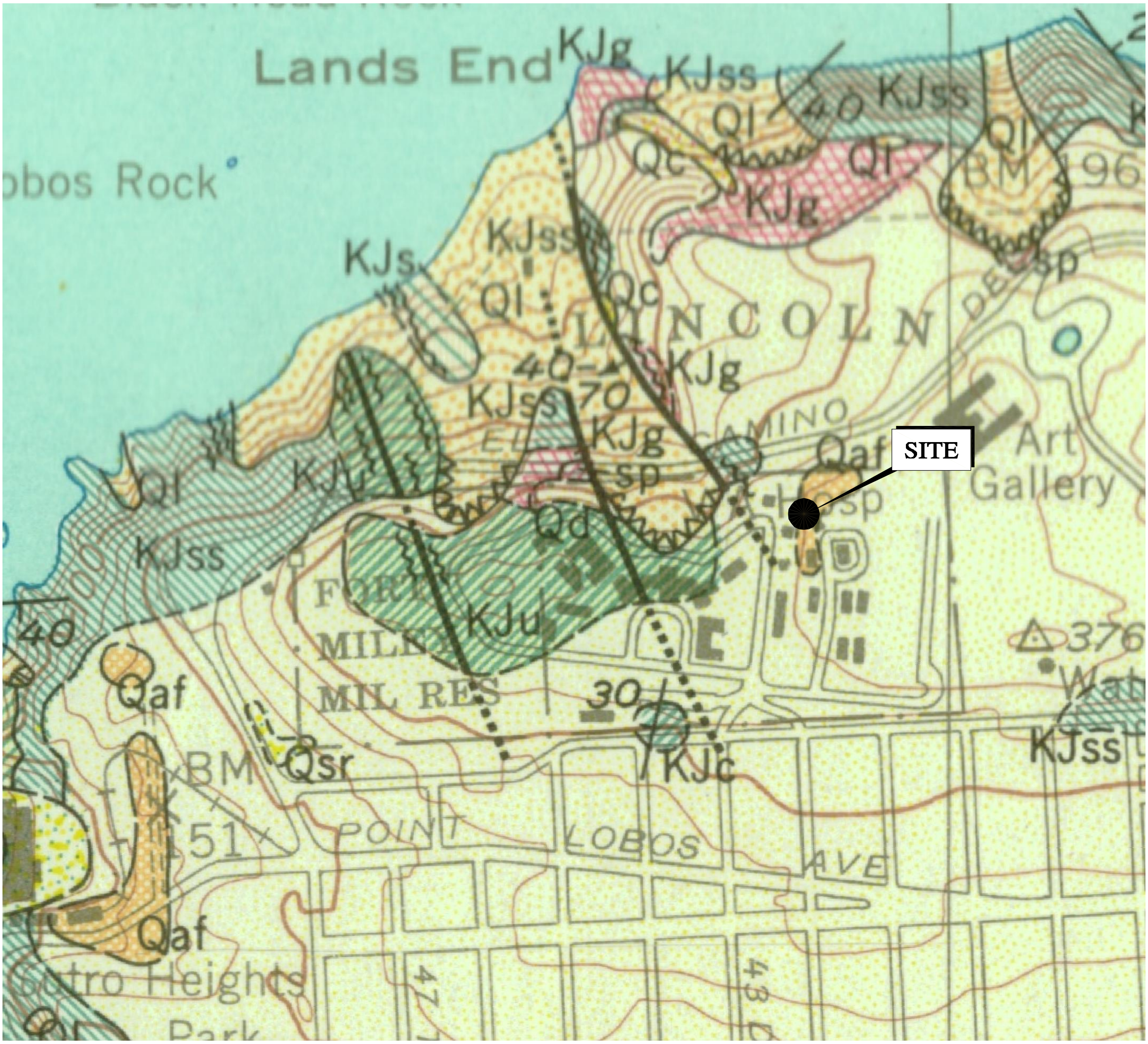


BASE MAP SOURCE: HGA

ENGEO INCORPORATED
EXCELLENT SERVICE SINCE 1971

SITE MAP
VA HOSPITAL - BUILDING 22
SAN FRANCISCO, CALIFORNIA

PROJECT NO.: 7344.100.103	FIGURE NO. 3
DATE: MAY 2008	
DRAWN BY: SRP	CHECKED BY: DB



EXPLANATION

Qaf	ARTIFICAL FILL	KJs	SANDSTONE AND SHALE
Ql	LANDSLIDE	KJg	GREENSTONE
Qc	COLMA FORMATION	sp	SERPENTINE
Qsr	SLOPE DEBRIS AND RAVINE FILL		FAULT-DASHED WHERE APPROXIMATELY LOCATED; SHORT DASHES WHERE INFERRED. DOTTED WHERE CONCEALED, QUERY INDICATES GREATER UNCERTAINTY AS TO THE EXISTENCE OF FAULT THAN DOES DASHED LINE.
Qd	DUNE SAND		
KJc	RADIOLARIAN CHERT AND SHALE		
KJu	SHEARED ROCKS		
KJss	SANDSTONE	40	STRIKE AND DIP OF BEDDING

N

0 MILES 600

0 KILOMETERS 300

BASE MAP SOURCE: SCHLOCKER, 1958

ENGEO INCORPORATED
EXCELLENT SERVICE SINCE 1971

REGIONAL GEOLOGY MAP
VA HOSPITAL - BUILDING 22
SAN FRANCISCO, CALIFORNIA

PROJECT NO.:	7344.100.103		FIGURE NO.
DATE:	MAY 2008		4
DRAWN BY: SRP		CHECKED BY: DB	

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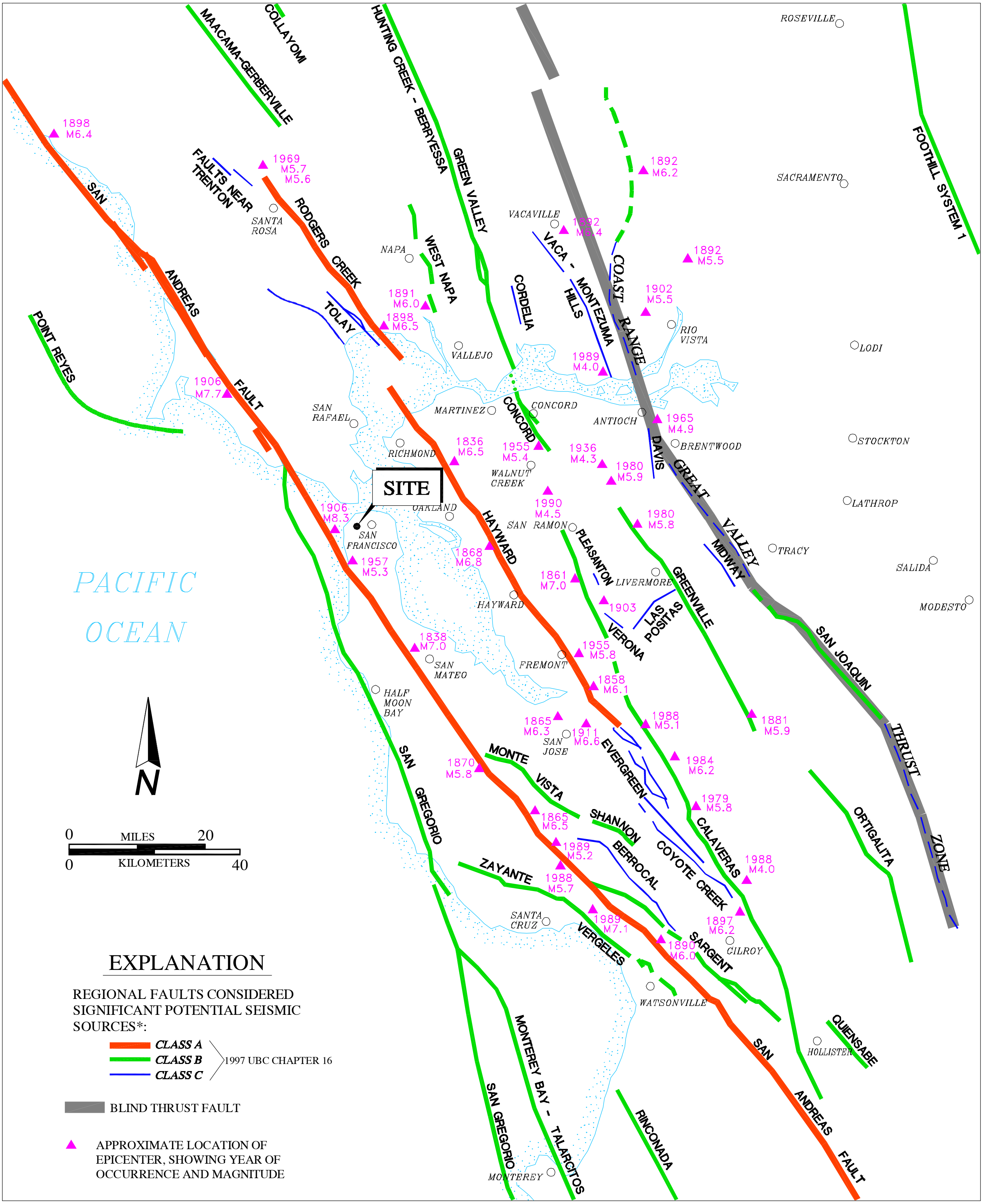
ORIGINAL FIGURE PRINTED IN COLOR



*BASED ON USGS OPEN FILE 96-706

ENGEO INCORPORATED
EXCELLENT SERVICE SINCE 1971

REGIONAL FAULTING AND SEISMICITY

VA HOSPITAL - BUILDING 22

SAN FRANCISCO, CALIFORNIA

PROJECT NO.:	7344.100.103
DATE:	MAY 2008
DRAWN BY: SRP	CHECKED BY: DB
FIGURE NO.	5

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ORIGINAL FIGURE PRINTED IN COLOR

APPENDIX A

Boring Logs

KEY TO BORING LOGS

MAJOR TYPES			DESCRIPTION
COARSE-GRAINED SOILS MORE THAN HALF OF MAT'L LARGER THAN #200 SIEVE	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW - Well graded gravels or gravel-sand mixtures GP - Poorly graded gravels or gravel-sand mixtures
		GRAVELS WITH OVER 12 % FINES	GM - Silty gravels, gravel-sand and silt mixtures GC - Clayey gravels, gravel-sand and clay mixtures
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDS WITH LITTLE OR NO FINES	SW - Well graded sands, or gravelly sand mixtures SP - Poorly graded sands or gravelly sand mixtures
		SANDS WITH OVER 12 % FINES	SM - Silty sand, sand-silt mixtures SC - Clayey sand, sand-clay mixtures
FINE-GRAINED SOILS MORE THAN HALF OF MAT'L SMALLER THAN #200 SIEVE	SILTS AND CLAYS LIQUID LIMIT 50 % OR LESS		ML - Inorganic silt with low to medium plasticity CL - Inorganic clay with low to medium plasticity OL - Low plasticity organic silts and clays
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50 %		MH - Inorganic silt with high plasticity CH - Inorganic clay with high plasticity OH - Highly plastic organic silts and clays
	HIGHLY ORGANIC SOILS		PT - Peat and other highly organic soils

GRAIN SIZES

U.S. STANDARD SERIES SIEVE SIZE: 200, 40, 10, 4
CLEAR SQUARE SIEVE OPENINGS: 3/4 ", 3", 12"

SILTS AND CLAYS	SAND			GRAVEL		COBBLES	BOULDERS
	FINE	MEDIUM	COARSE	FINE	COARSE		

RELATIVE DENSITY

SANDS AND GRAVELS	BLOWS/FOOT (S.P.T.)
VERY LOOSE	0-4
LOOSE	4-10
MEDIUM DENSE	10-30
DENSE	30-50
VERY DENSE	OVER 50

CONSISTENCY

SILTS AND CLAYS	STRENGTH*	BLOWS/FOOT (S.P.T.)
VERY SOFT	0-1/4	0-2
SOFT	1/4-1/2	2-4
MEDIUM STIFF	1/2-1	4-8
STIFF	1-2	8-15
VERY STIFF	2-4	15-30
HARD	OVER 4	OVER 30

MOISTURE CONDITION

DRY	Absence of moisture, dusty, dry to touch
MOIST	Damp but no visible water
WET	Visible freewater
SATURATED	Below the water table

MINOR CONSTITUENT QUANTITIES (BY WEIGHT)

TRACE	Particles are present, but estimated to the less than 5%
SOME	5 to 15%
WITH	15 to 30%
........Y	30 to 50%

SAMPLER SYMBOLS

- Modified California (3" O.D.) sampler
- California (2.5" O.D.) sampler
- S.P.T. - Split spoon sampler
- Shelby Tube
- Continuous Core
- Bag Samples
- Grab Samples
- NR No Recovery

LINE TYPES

- Solid - Layer Break
- Dashed - Gradational or approximate layer break

GROUND-WATER SYMBOLS

- Groundwater level during drilling
- Stabilized groundwater level

ENGEO INCORPORATED
EXCELLENT SERVICE SINCE 1971

(S.P.T.) Number of blows of 140 lb. hammer falling 30" to drive a 2-inch O.D. (1-3/8 inch I.D.) sampler

* Unconfined compressive strength in tons/sq. ft., asterisk on log means determined by pocket penetrometer

LOG OF BORING 1-B1

Geotechnical Exploration
VAMC - Building 22
San Francisco, CA
7344.100.103

DATE DRILLED: 5/8/2008
HOLE DEPTH: Approx. 7½ ft.
HOLE DIAMETER: 6.0 in.
SURF ELEV (MSL): Approx. 354 ft.

LOGGED / REVIEWED BY: A. Hargrove / DEB
DRILLING CONTRACTOR: Britton Exploration
DRILLING METHOD: Hollow Stem Auger
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
	1		SANDY CLAY (CL), brown mottled with tannish orange, medium stiff, moist, with gravel, (FILL)			16				16	11.6	112.8	
5			CLAYSTONE, dark red, weak, moderately weathered, fine-grained			50/6"							
	2		No Recovery			50/4"							
			Boring terminated due to suspected boulder at approximately 7.5' below ground surface. No groundwater encountered.										

ENGEO
Expect Excellence

LOG OF BORING 1-B2

Geotechnical Exploration
VAMC - Building 22
San Francisco, CA
7344.100.103

DATE DRILLED: 5/8/2008
HOLE DEPTH: Approx. 9½ ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (MSL): Approx. 354 ft.

LOGGED / REVIEWED BY: A. Hargrove / DEB
DRILLING CONTRACTOR: Britton Exploration
DRILLING METHOD: Solid Flight Auger
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
			SANDY CLAY (CL), brown with tannish orange, medium stiff, moist, (FILL)										
	1		SILTY CLAY (CH), tan to orange, hard, moist Driller added water at ~3.5'			50/2"							
5	2					50/2.5"					17.2		
						50/1"							
			Driller added water at ~8.5'. Refusal at ~9.5'. No recovery. Boring terminated at approximately 9.5' below ground surface. No groundwater encountered.										

LOG OF BORING 1-B3

ENGEO Expect Excellence

Geotechnical Exploration
VAMC - Building 22
San Francisco, CA
7344.100.103

DATE DRILLED: 5/8/2008
HOLE DEPTH: Approx. 21 ft.
HOLE DIAMETER: 4.0 in.
SURF ELEV (MSL): Approx. 354 ft.

LOGGED / REVIEWED BY: A. Hargrove / DEB
DRILLING CONTRACTOR: Britton Exploration
DRILLING METHOD: Solid Flight Auger
HAMMER TYPE: 140 lb. Auto Trip

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
			CLAYEY SAND (SC), brown with tannish orange, very dense to medium dense, moist, (weathered sandstone)										
	1					51	24	18	6	52	7.6 10.9	127.9 123.1	
5						52							
							25	16	9	48	12.9	126.6	
	2		SO4 = 16 mg/kg.			50/5.5"					8.1	114	
			SANDSTONE, light tan Cuttings change to light tan at ~9'.										
10	3					50/2.5"							
	4												
15						50/2.5"							
	5		CLAYSTONE, dark brown Cuttings changed to brown at ~16'.										
20	6					50/1"				37	12.2		
			Boring terminated at approximately 21' below ground surface. No groundwater encountered.										

ENGEO
Expect Excellence

LOG OF BORING 1-B4

Geotechnical Exploration
VAMC - Building 22
San Francisco, CA
7344.100.103

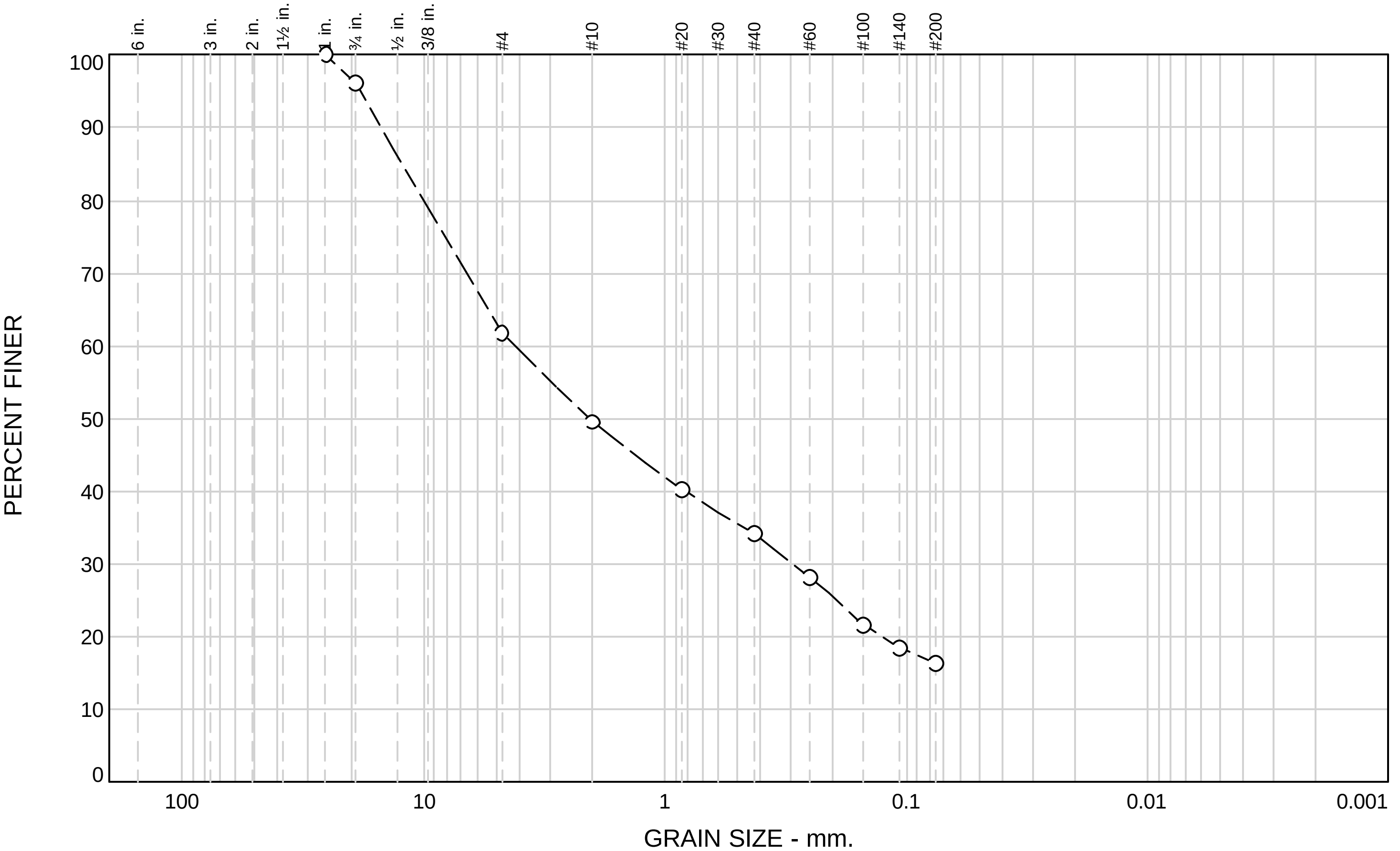
DATE DRILLED:	5/8/2008	LOGGED / REVIEWED BY:	A. Hargrove / DEB
HOLE DEPTH:	Approx. 15½ ft.	DRILLING CONTRACTOR:	Britton Exploration
HOLE DIAMETER:	4.0 in.	DRILLING METHOD:	Solid Flight Auger
SURF ELEV (MSL):	Approx. 358 ft.	HAMMER TYPE:	140 lb. Auto Trip

Depth in Feet	Depth in Meters	Sample Type	DESCRIPTION	Log Symbol	Water Level	Blow Count/Foot	Atterberg Limits: Liquid Limit	Atterberg Limits: Plastic Limit	Atterberg Limits: Plasticity Index	Fines Content (% passing #200 sieve)	Moisture Content (% dry weight)	Dry Unit Weight (pcf)	Unconfined Strength (tsf) *field approx
			SILTY CLAY (CL), brown, hard, moist, gravel, Orangish gravel in sample. Driller added water at ~3'.			50/4"							
5	1		CLAYSTONE, dark red to orange, friable to weak, fine-grained, damp Driller added water at ~5.5'. Recovery at 7' appears to be all slough.			71					6.3		
	2		pH = 6.3			48				47	7		
10	3		SANDSTONE, tan Cuttings change to tan at ~10'. Driller added water at ~10.5' and ~15.5'. Recovery at 10' and 15' appears to be all slough.			50/3"							
15	4					50/3"							
			Boring terminated at approximately 15.5' below ground surface. No groundwater encountered.										

APPENDIX B

Laboratory Test Results

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	3.9	34.4	12.1	15.5	17.7	16.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
3/4	96.1		
#4	61.7		
#10	49.6		
#20	40.3		
#40	34.1		
#60	28.1		
#100	21.6		
#140	18.5		
#200	16.4		

* (no specification provided)

Material Description

Mottled Olive brown, very dark gray and reddish brown silty SAND and SANDSTONE fragments.

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 12.1535 D_{60}= 4.1949 D_{50}= 2.0600
D_{30}= 0.2946 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

Sample Number: B1 @ 3 **Depth:** 3 ft. **Date:** 5/20/08

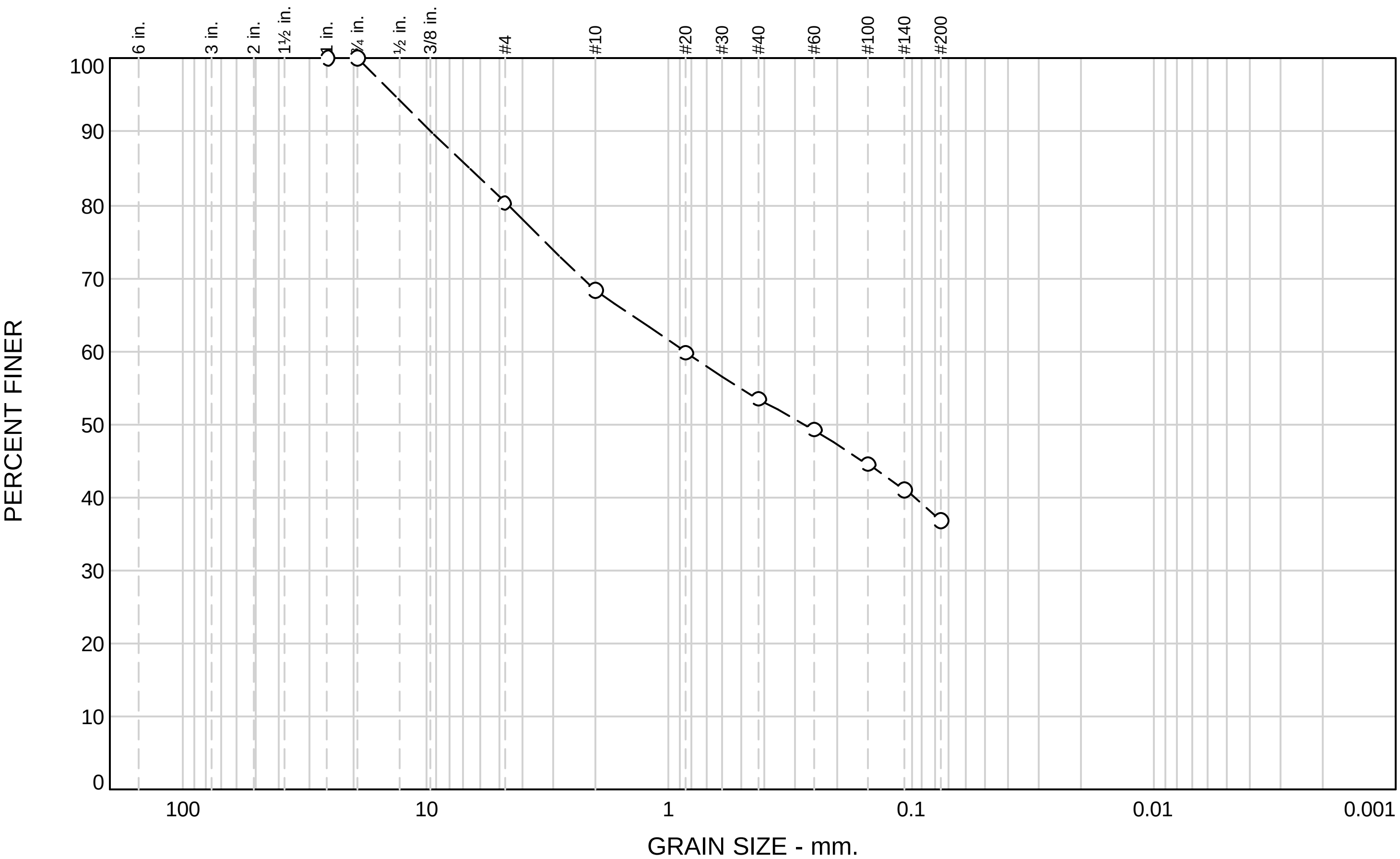
ENGEO INCORPORATED GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS MATERIALS TESTING

Client:

Project: VA Medical Center. 4150 Clement Street. San Francisco, CA

Project No: 7344.100.103

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	19.7	12.0	14.8	16.7	36.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1	100.0		
3/4	100.0		
#4	80.3		
#10	68.3		
#20	59.8		
#40	53.5		
#60	49.3		
#100	44.6		
#140	41.0		
#200	36.8		

* (no specification provided)

Material Description

Dark grayish brown silty SAND with sandstone fragments

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= 6.6240 D_{60}= 0.8644 D_{50}= 0.2738
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO=

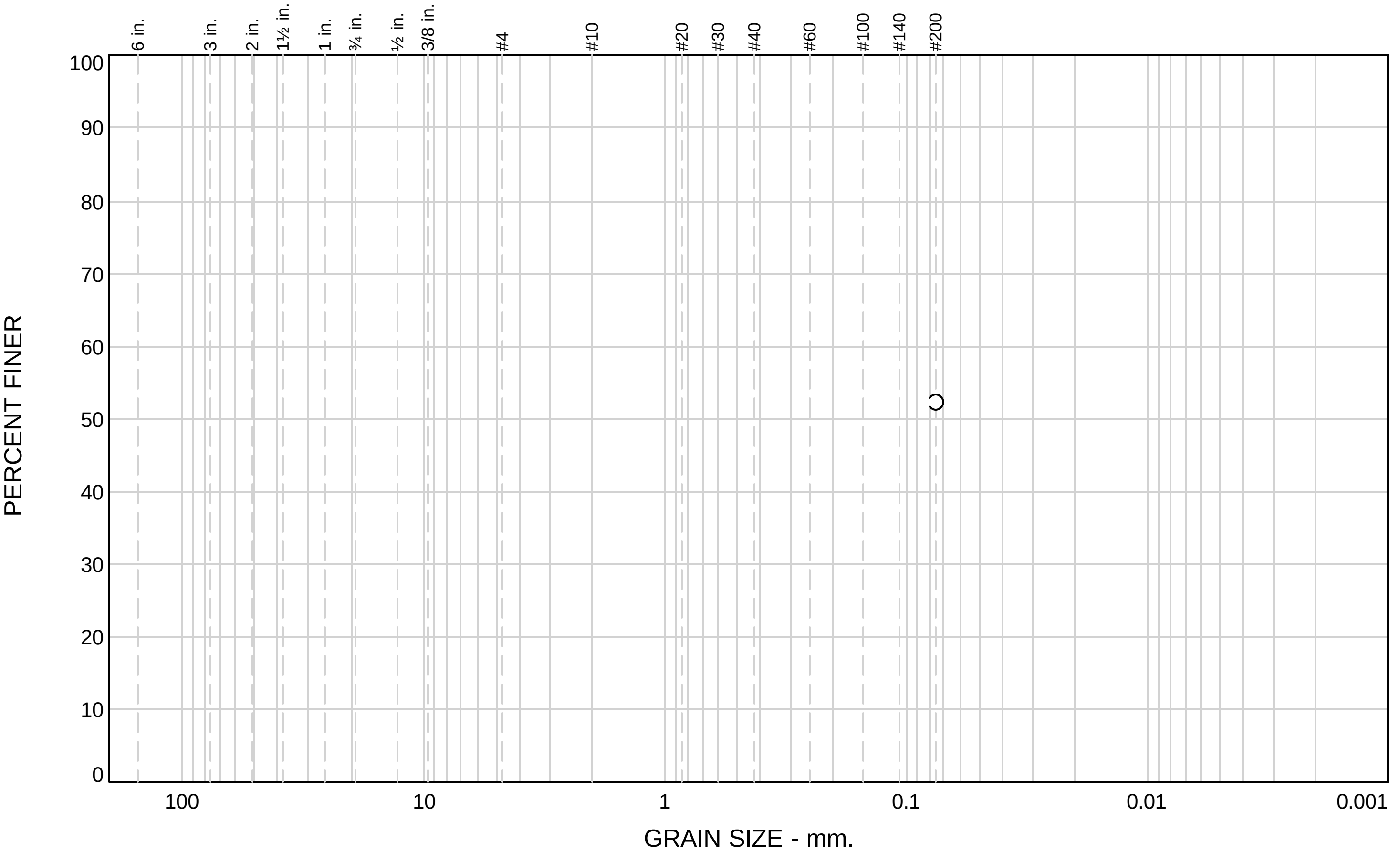
Remarks

Sample Number: B3 @ 20 **Depth:** 20 ft. **Date:** 5/20/08

ENGEO INCORPORATED
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
MATERIALS TESTING

Client:
Project: VA Medical Center. 4150 Clement Street. San Francisco, CA
Project No: 7344.100.103

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						52.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	52.4		

* (no specification provided)

Material Description

Dark yellowish brown sandy SILT with sandstone fragments.

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= ML AASHTO=

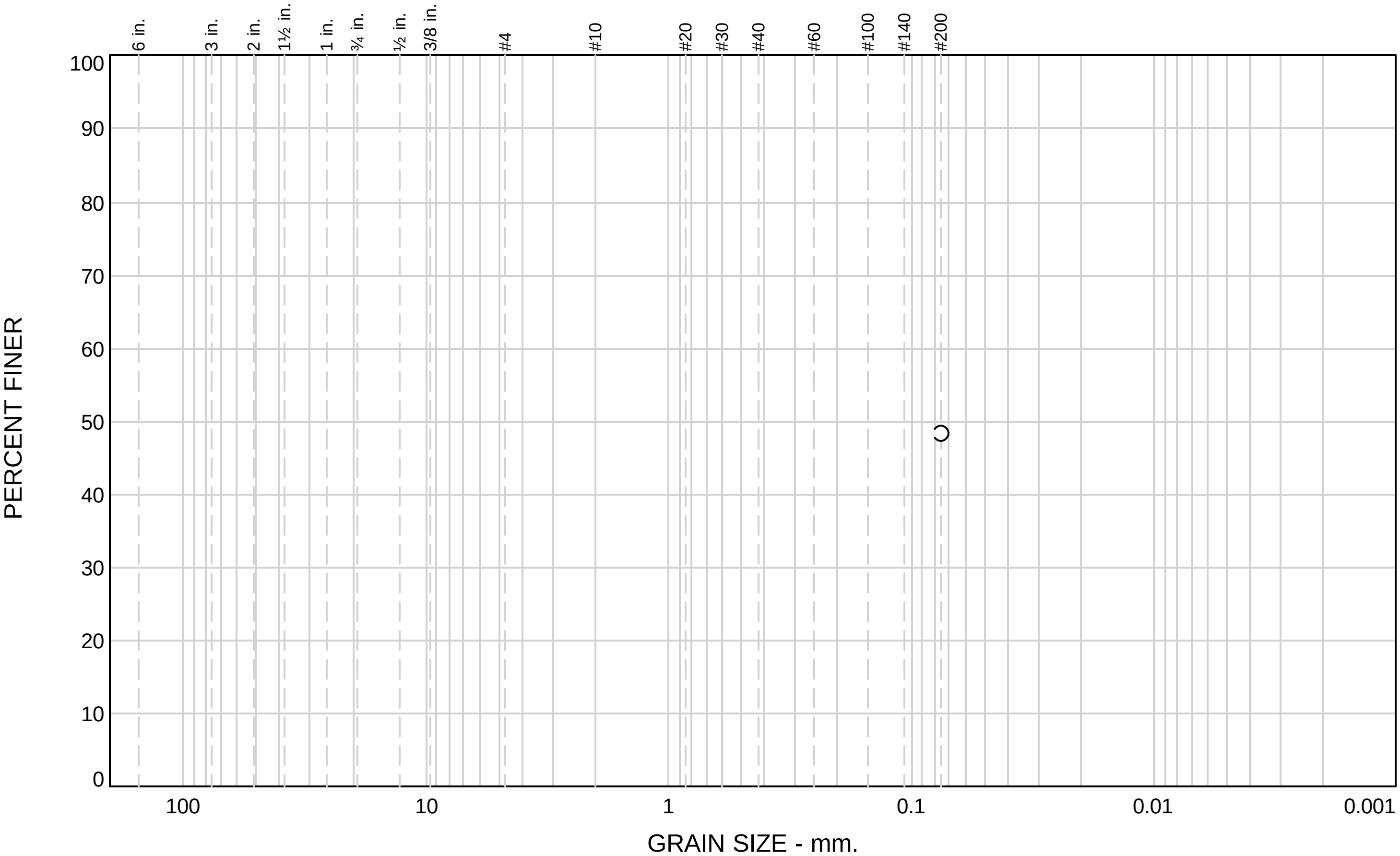
Remarks

Sample Number: B3 @ 3 **Depth:** 3 ft. **Date:** 5/20/08

ENGEO INCORPORATED
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
MATERIALS TESTING

Client:
Project: VA Medical Center. 4150 Clement Street. San Francisco, CA
Project No: 7344.100.103

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						48.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	48.4		

* (no specification provided)

Material Description

Mottled yellowish brown and olive gray clayey SAND with weathered sandstone fragments

Atterberg Limits

PL= 16 LL= 25 PI= 9

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SC AASHTO=

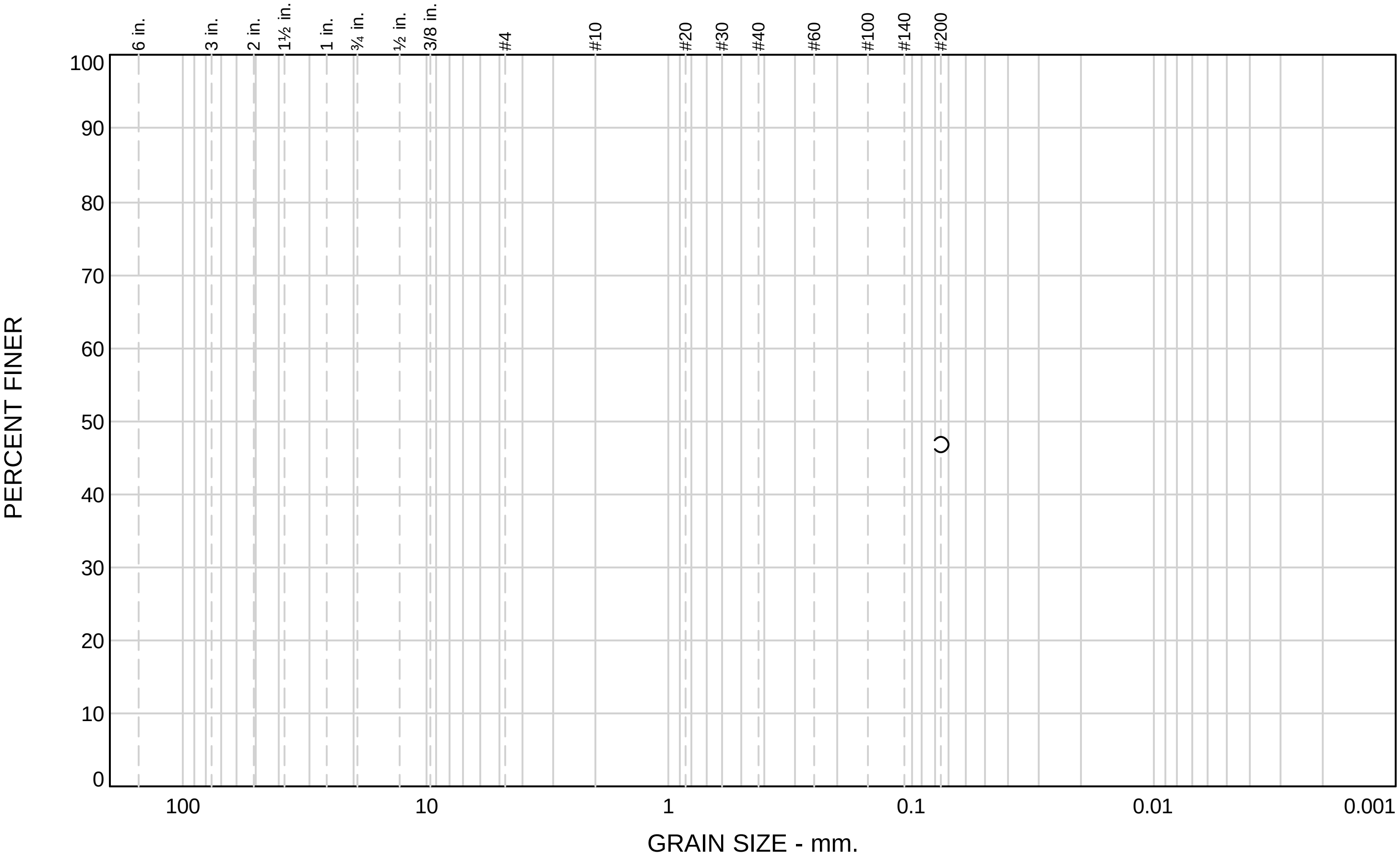
Remarks

Sample Number: B3 @ 5.5 **Depth:** 5.5 ft. **Date:** 5/20/08

ENGEO INCORPORATED
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS
MATERIALS TESTING

Client:
Project: VA Medical Center. 4150 Clement Street. San Francisco, CA
Project No: 7344.100.103

Particle Size Distribution Report



% Cobbles	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
						46.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	46.9		

* (no specification provided)

Material Description

Dark grayish brown silty SAND with sandstone fragments.

Atterberg Limits

PL= LL= PI=

Coefficients

D_{85}= D_{60}= D_{50}=
D_{30}= D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= SM AASHTO=

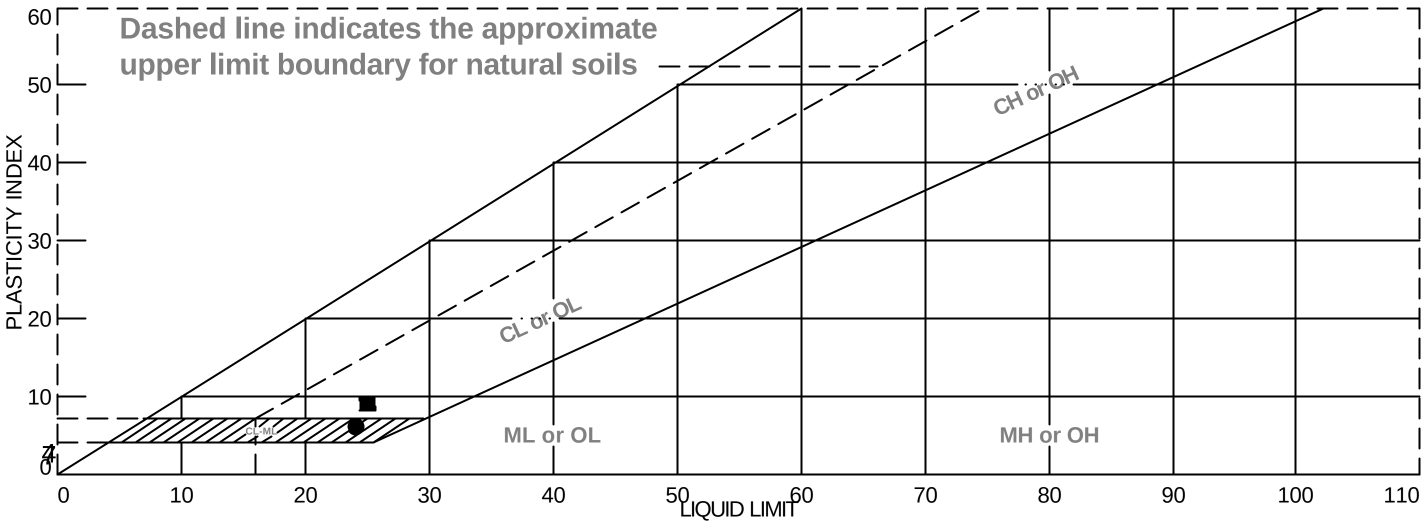
Remarks

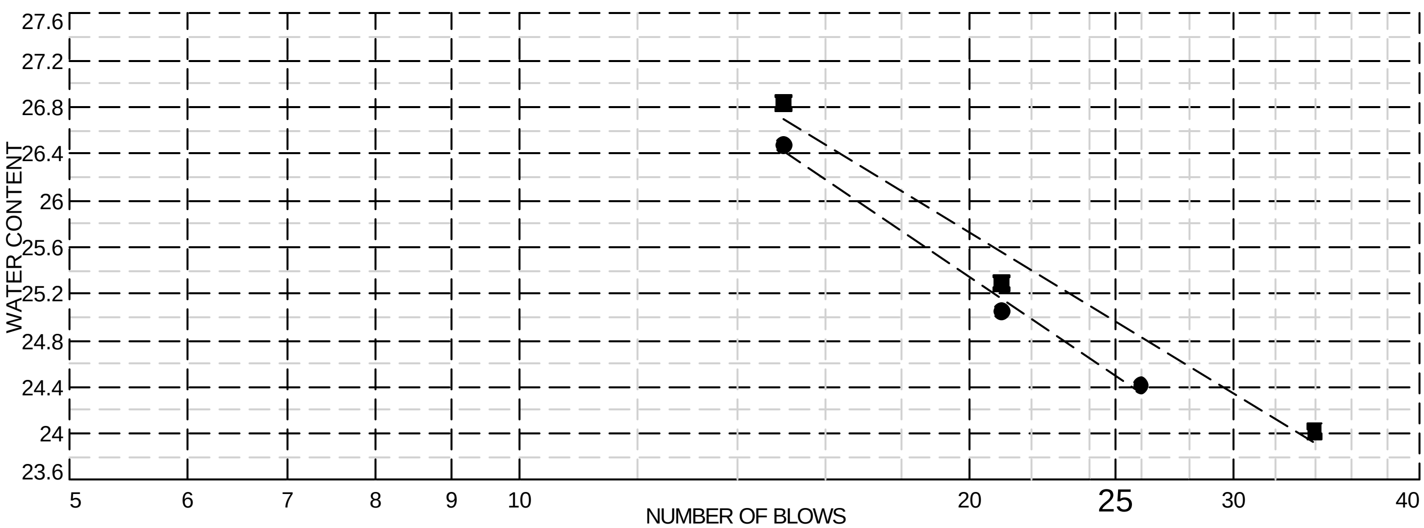
Sample Number: B4 @ 8 **Depth:** 8 ft. **Date:** 5/20/08

ENGEO INCORPORATED — GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS — MATERIALS TESTING

Client:
Project: VA Medical Center. 4150 Clement Street. San Francisco, CA
Project No: 7344.100.103

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Light olive brown silty SANDSTONE	24	18	6			SM
■	Mottled yellowish brown and olive gray clayey SAND with weathered sandstone fragments	25	16	9		48.4	SC

Project No. 7344.100.103 **Client:**

Project: VA Medical Center. 4150 Clement Street. San Francisco, CA

● **Sample Number:** B3 @ 2.5

■ **Sample Number:** B3 @ 5.5

Remarks:

● B3@2.5'

■ B3@5.5'

ENGEO INCORPORATED

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS MATERIALS TESTING

ENGEO INCORPORATED

STANDARD pH OF SOILS

ASTM D 4972-89

Project name: VA Medical Center. San Francisco, CA **Date:** 5/20/2008

Project number: 7344.100.103 **Tested by:** RC

Sample	Description	Location/Source/Date	pH
B4@8'	Dark grayish brown silty SAND	VA Medical Center/B4/5/18/08	6.30

EN GEO Incorporated

SULFATE TEST RESULTS

CALTRANS Test Method 417

Project Name: VA Medical Center   Project Number: 7344.100.103

Tested By: RC   Date: May 20, 2008

Measurements less than 15 mg/kg are reported as Not Detectable (ND)

Sample Number	Sample Location	Matrix	Water Soluble Sulfate (SO_4) in Soil	
			mg/kg	% by Weight
1	B3@7'	Soil	16	0.002