

**GEOTECHNICAL ENGINEERING
AND GEOLOGIC HAZARDS STUDY**

Junipero Serra Elementary School
Construction of New Modular Classroom Building
151 Victoria Street
Daly City, California 94015

Prepared for:

South San Francisco Unified School District
Measure J Bond Program
Facility Building, 398 B Street
South San Francisco, California 94080

Prepared by:

GEOSPHERE CONSULTANTS, INC
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Project No. 91-02821-A



Geosphere Consultants, Inc.

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Environmental Management • Water Resources

May 24, 2012

South San Francisco Unified School District
Measure J Bond Program
Facility Building, 398 B Street
South San Francisco, California 94080

Attention: Mr. Bob Collins, Program Manager

Subject: **Geotechnical Engineering and Geologic Hazards Study**
Junipero Serra Elementary School
Construction of New Modular Classroom Buildings
151 Victoria Street, Daly City, California 94015
Geosphere Project No. 91-02821-A

Dear Mr. Collins:

In accordance with your authorization, Geosphere Consultants, Inc. (Geosphere) has completed a Geotechnical Engineering and Geologic Hazards Study for the proposed New Modular Building at Junipero Serra Elementary School in Daly City, San Mateo County, California. This report has been prepared in accordance with the requirements set forth in California Geological Survey Note 48 and the California Building Code, 2010. Transmitted herewith are the results of our findings, conclusions, and recommendations for the design and construction of proposed foundations, interior and exterior concrete slabs, site grading and drainage, temporary trench slope stability, and utility trench backfilling. In general, the proposed improvements at the site are considered to be geotechnically and geologically feasible provided the recommendations of this report are implemented in the design and construction of the project.

Should you or members of the design team have questions or need additional information, please contact the undersigned by email: gh@geosphereinc.net or rshrestha@geosphereinc.net or at (925) 314-7180. The opportunity to be of service to South San Francisco Unified School District and to be involved in the design of this project is appreciated.

Sincerely,
GEOSPHERE CONSULTANTS, INC.

Raghubar Shrestha, Ph.D., P.E.
Senior Engineer



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GEOTECHNICAL ENGINEERING AND GEOLOGIC HAZARDS STUDY

Project: Construction of New Classroom Buildings
Junipero Serra Elementary School
Daly City, California

Client: South San Francisco Unified School District
Measure J Bond Program
South San Francisco, San Mateo County, California

1.0 INTRODUCTION

1.1 Purpose and Scope

The purposes of this study were to evaluate the geologic hazards and the subsurface conditions at the site and prepare geotechnical recommendations for the proposed new developments. The new development includes construction of new modular classroom buildings and minor site improvements. This study provides recommendations for the design and construction of new proposed foundations, interior and exterior concrete slabs, site grading and drainage, temporary trench slope stability, and utility trench backfill. This study was performed in accordance with the scope of work outlined in our proposal dated February 8, 2012 and the Professional Services Agreement signed by representatives of the South San Francisco Unified School District and Geosphere Consultants Inc., dated March 23, 2012.

The scope of this study included the review of pertinent published and unpublished documents related to the site, a field exploration, laboratory testing, engineering analysis of the accumulated data, and preparation of this report. The conclusions and recommendations presented in this report are based on the data acquired and analyzed during this study, and on prudent engineering judgment and experience. This study did not include an in-depth assessment of potentially toxic or hazardous materials that may be present on or beneath the site.

1.2 Site Description

The proposed project site is located at 151 Victoria Street in Daly City, San Mateo County in California, as shown on the attached Figure 1 – Site Location Map. The project site consists of existing modular classroom buildings and a storage/service building. The proposed project sites are located at the northwest corner and northeast corner of the school campus and in the south of Victoria Street. The school campus is surrounded by Victoria Street in the north, Gellert Boulevard in the east, Simpson Drive in the west, and residential developments in the south. The proposed project improvement areas are being used by the school as classrooms and service/storage building. The proposed



improvement areas are relatively flat. The geographic coordinates of the site improvements are approximately 37.660779 degrees north latitude and 122.470003 degrees west longitude. The site is at an average approximate elevation of 408 feet above mean sea level (Source: Latitude, Longitude and Elevation were recorded from Google Earth).

1.3 Proposed Development

We understand, based on the preliminary construction plan provided by the Client, the proposed construction work includes the demolition of the existing classroom buildings and other structures and construction of new modular classroom buildings. We anticipate that the proposed buildings will be light structures. We anticipate the areas of the footprint of buildings will be approximately 6500 sq ft based on the provided proposed plans. This may vary depending upon the final plan. Foundation design plans and finished level of different structures/amenities have not been provided at the time of this report preparation. Attached Figure 2 shows the proposed general improvement layout plan.



2.0 PROCEDURES AND RESULTS

2.1 Literature Review

Pertinent geologic and geotechnical literature pertaining to the site area was reviewed. These included various USGS, CGS, and other government publications and maps, as listed in the References section.

2.2 Aerial Photograph Review

Aerial photographs were reviewed at the U.S. Geological Survey in Menlo Park, California in order to observe site history and pre-development conditions. The following stereo-paired aerial photographs were reviewed:

Photo Nos. 3567-2-016 and -017, BW, dated 4/22/73 at a scale of 1:12,000

Photo Nos. DDB-2B-182 and -183, BW, dated 10-11-43, at a scale of 1:20,000

The 1973 photos show the current classroom wings, administration building and multi-purpose building in existence, along with four small buildings to the west.

The 1943 photos show rangeland/farmland, with no school or residences yet constructed. The site is in an area of low hills and valleys. There are strongly NW/SE –trending ridges and valleys observable several hundred feet to the west in the San Andreas Fault rift zone.

2.3 Field Exploration

A total of four borings were drilled at the site on April 5th, 2012. The borings were drilled up to approximately 50 feet below the existing ground level within the proposed construction site by a truck mounted drill rig equipped with eight-inch hollow-stem auger. All borings were drilled within the proposed new construction areas.

A Geosphere Registered Professional Engineer visually classified the materials encountered in the borings according to the Unified Soil Classification System as the borings were advanced. Relatively undisturbed soil samples were recovered at selected intervals using a three-inch outside diameter Modified California split spoon sampler containing six-inch long brass liners. A two-inch outside diameter Standard Penetration Test (SPT) sampler was used to obtain SPT blow counts and obtain disturbed soil samples. The samplers were driven by using a mechanical-trip, 140-pound hammer with an approximate 30-inch fall utilizing N-rods as necessary. Resistance to penetration was recorded as the number of hammer blows required to drive the sampler the final foot of an 18-inch drive. All of the



blow counts recorded using Modified California split spoon samplers in the field were converted to equivalent SPT blow counts using appropriate modification factors suggested by Burmister (1948), i.e. a factor of 0.65 with inner diameter of 2.5 inches. Therefore, the boring logs reported in this report are all equivalent SPT blow counts. Bulk samples were obtained in the upper few feet of the borings from the auger cuttings as needed.

The boring logs with descriptions of the various materials encountered in each boring, the penetration resistance values, and some of the laboratory test results are presented in Appendix A. The ground surface elevations indicated on the soil boring logs are approximate (rounded to the nearest ½ foot) and were estimated from Google Earth. True surface elevations at the boring locations could differ. The locations and elevations of the borings should only be considered accurate to the degree implied by the means and methods used to define them. The approximate locations of the borings are shown on the Site Plan, Figure 2.

2.4 Laboratory Testing

Laboratory tests were performed on selected samples to determine some of the physical and engineering properties of the subsurface soils. The results of the laboratory testing are presented on the boring logs, and are included in the appendices. The following soil tests were performed for this study:

Dry Density and Moisture Content (ASTM D2937 and D2216) – In-situ density and moisture tests are conducted to determine the in-place dry density and moisture content of the subsurface materials. These properties provide information for evaluating the physical characteristics of the subsurface soil.

Atterberg Limits (ASTM D4318 and CT204) - Liquid Limit, Plastic Limit, and Plasticity Index are useful in the classification and characterization of the engineering properties of soil, helps evaluate the expansive characteristics of the soil, and for determining the soil type according to the USCS.

Particle Size Analysis (Wet and Dry Sieve) and Hydrometer (ASTM D422, D1140, and CT202) - Sieve analysis testing is conducted on selected samples to determine the soil particle size distribution. This information is useful for the evaluation of liquefaction potential and characterizing the soil type according to USCS.

Direct Shear (modified ASTM D3080) - Direct shear testing is performed on samples to determine the angle of internal friction and cohesion of soil or rock materials. This data can be utilized in determining allowable bearing capacity, retaining wall design parameters, and strength characteristics of the materials. Direct shear specimens are saturated under a 100-psf surcharge for a period of 24 hours prior to testing.



Soil Corrosivity - Soil corrosivity testing performed by Cooper Testing Laboratory is performed to determine the effects of constituents in the soil on buried steel and concrete. Water-soluble sulfate testing is required by the UBC, CBC, and IBC.



3.0 GEOLOGIC OVERVIEW

3.1 Regional Geologic Setting

The site is located within the Coast Range Geomorphic province of California. The Coast Range extends from the southern and western edge of the Klamath Mountains near the Oregon border, to the Transverse Ranges in southern California, a distance of more than 1000 km; in addition, the geology found in the Coast Ranges continues as basement through the western Transverse Ranges, then offshore from the Peninsula Ranges and Baja California.

The basement rocks of the Coast Ranges Province consist of three linear belts, the eastern Franciscan Assemblage, central Great Valley, and western Franciscan Assemblage. The Franciscan Assemblages consists of graywacke and shale in coherent units, often metamorphosed to blueschist facies, together with melanges composed not only of sheared shale and graywacke blocks but also exotic blocks including, serpentine, chert, greenstone, eclogite, and blueschist, overlain by the Jurassic Coast Range ophiolite, which is in turn depositionally overlain by the Jurassic to Cretaceous Great Valley Sequence of turbidites and fan deposits; The Great Valley sequence is a belt composed of Mesozoic plutons that had intruded metamorphic basement rocks, overlain by younger sediments, and called the Salinian Block. The three belts are separated by major faults, the eastern belt from the Salinian Block by the active San Andreas strike-slip system, and the Salinian Block from the western belt by the Sur-Nacimiento fault system, a complex system of apparent strike-slip faults.

3.2 Local Geologic Setting

The basement rocks of the San Francisco Peninsula consist primarily of Franciscan Assemblage rocks. Overlying the Franciscan in depositional contact are the relatively young Cenozoic formations of the Merced and Colma Formations. The Merced and Colma Formations are young (<1.5 MYA old) sediments that are predominately non-marine in origin with occasional marine interbeds. The sediments are granular uncemented deposits that have been uplifted into highland areas by the active tectonics of the nearby San Andreas Fault. As a rock, they are weak and uncemented. Described as a soil, they are considered dense to very dense and have generally very favorable engineering characteristics for shallow foundation structures. The mapped geologic units at the site are shown on the Site Vicinity Geologic Map - Figure 3, and Site Plan and Site Geologic Map – Figure 2. A contact between the Merced Formation and hill slope deposits is shown trending through the project area.



4.0 FIELD AND LABORATORY FINDINGS

4.1 Subsurface Conditions

The subsurface conditions of the project site generally consist of sandy clay, clayey sand, and claystone to depths of at least 50 feet below ground level. The upper approximately 2½ to 4 feet of soils in Borings B-1 and B-2 appeared to be engineered fill (stiff to very stiff sandy clay) placed during the past development. The soils in the upper 30 feet were generally stiff to very stiff sandy clay and medium dense to very dense clayey to silty sand. Boring B-2 encountered claystone extending from about 30 feet down to the bottom of borehole at 50 feet. The soil was generally damp to moist, with the exception of an anomalous wet zone starting at 17 ½ feet bgs in Boring B-2, which is discussed below. Details of soils encountered in the exploratory boring are included in the boring logs in the appendices. Figures 4a and 4b show the geological cross sections of the proposed development site.

4.2 Groundwater

The historic groundwater table in the project site was not determined during our research of records (DWR, Gregg). We encountered groundwater in Boring B-2 at depth of 17.5 feet respectively below the ground level measured immediately after completion of drilling operation. However no groundwater was encountered in other borings. This indicates that the water encountered in that boring is possible perched water. The perched water/groundwater levels can vary in response to time of year, variations in seasonal rainfall, tidal influence, well pumping, irrigation, and alterations to site drainage.

4.3 Laboratory Test Results

Selected representative samples of soils collected from the project site were tested for index properties and strength parameter. Laboratory test results are included in Appendix B of this report.

5.0 CORROSIVITY

5.1 Corrosion Test

Corrosion test results of soil samples obtained from the site from the upper two to three feet below existing ground level were evaluated based on ASTM A888 methods. Table X2.1, Soil-Test Evaluation, from the ASTM procedure is presented below. If the summed points are equal to 10, the soil should be considered corrosive to cast iron pipe. If sulfides are present and low or negative redox potential results are obtained, 3 points shall be given for this range.

Table 1: Corrosion Evaluation Criteria

Soil Characteristics	Points	Soil Characteristics	Points
Resistivity, ohm-cm, based on single probe or water-saturated soil box.		Redox Potential, mV	
<700	10	>+100	0
700-1,000	8	+50 to +100	3.5
1,000-1,200	5	0 to 50	4
1,200-1,500	2	Negative	5
1,500-2,000	1	Sulfides	
>2,000	0	Positive	3.5
PH		Trace	2
0-2	5	Negative	0
2-4	3	Moisture	
4-6.5	0	Poor drainage, continuously wet	2
6.5-7.5	0	Fair drainage, generally moist	1
7.5-8.5	0	Good drainage, generally dry	0
>8.5	5		

The bulk sample collected from Borings B-2 and B-5 at a depth between two to four feet had a redox of 305 mV, a pH of 6.2, a resistivity of 1,143 ohms-cm, and negative sulfides. The total points for this sample, considering the generally moist condition of the soil, is 6 which is considered to be soil with a low to moderate corrosive potential.

These results are preliminary, and provide information on the specific soils sampled and tested. Other soil at the site may be more or less corrosive. Providing a detailed assessment of the corrosion potential of the site soils is not within our scope of work. Appropriate corrosion specialists should be contacted if a detailed evaluation is required.



5.2 Water-Soluble Sulfates

Water-soluble sulfate can affect the concrete mix design for concrete in contact with the ground, such as shallow foundations, piles, piers, and concrete slabs. The UBC, CBC, and IBC provide the following evaluation criteria:

Table 2: Sulfate Evaluation Criteria

Sulfate Exposure	Water-Soluble Sulfate in Soil, Percentage by Weight or (mg/kg)	Sulfate in Water, ppm	Cement Type	Max. Water Cementitious Ratio by Weight	Min. Unconfined Compressive Strength, psi
Negligible	0.00-0.10 (0-1,000)	0-150	NA	NA	NA
Moderate	0.10-0.20 (1,000-2,000)	150-1,500	II, IP (MS), IS (MS)	0.50	4,000
Severe	0.20-2.00 (2,000-20,000)	1,500- 10,000	V	0.45	4,500
Very Severe	Over 2.00 (20,000)	Over 10,000	V plus pozzolan	0.45	4,500

The test results contained 514 mg/kg water-soluble sulfate. Hence, the water-soluble sulfate content in the site soil should have a moderate impact on buried concrete at the site. However, it should be pointed out that the water-soluble sulfate concentrations can vary due to the addition of fertilizer, irrigation, and other possible development activities. An appropriate expert should be contacted if a detailed evaluation is required.



6.0 GEOLOGIC HAZARDS

6.1 Seismic Induced Hazards

Seismic hazards resulting from the effects of an earthquake generally include ground shaking, liquefaction, lateral spreading, dynamic settlement, fault ground rupture and fault creep, dam inundation, and tsunamis and seiches. The site is not necessarily impacted by all of these potential seismic hazards. Nonetheless, potential seismic hazards are discussed and evaluated in the following sections in relation to the planned construction.

6.1.1 Ground Shaking

The site will likely experience severe ground shaking from a major earthquake originating from the major Bay Area faults, particularly the nearby San Andreas Fault (approximately 0.5 miles from the site) or Hayward-Rodgers Creek Fault (approximately 18 miles from the site).

6.1.2 Liquefaction Induced Phenomena

Research and historical data indicate that soil liquefaction generally occurs in saturated, loose granular soil (primarily fine to medium-grained, clean sand deposits) during or after strong seismic ground shaking and is typified by a loss of shear strength in the affected soil layer, thereby causing the soil to flow as a liquid. However, because of the higher inter-granular pressure of the soil at greater depths, the potential for liquefaction is generally limited to the upper 40 feet of the soil. Potential hazards associated with soil liquefaction below or near a structure include loss of foundation support, lateral spreading, sand boils, and areal and differential settlement.

Lateral spreading is lateral ground movement, with some vertical component, as a result of liquefaction. The soil literally rides on top of the liquefied layer. Lateral spreading can occur on relatively flat sites with slopes less than two percent under certain circumstances. Lateral spreading can cause ground cracking and settlement.

The site is mapped by the USGS and William Lettis & Associates as being located within a zone of very low liquefaction potential (see attached Figure 5). The site is generally underlain by stiff to very stiff sandy clay (CL) and medium dense to very dense clayey sand (SC) and clayey silty sand (SM). The perched groundwater was encountered in Boring B-2 at a depth of 17.5 feet below the ground surface level (bgs). Due to the presence of a layer of medium dense clayey silty sand at the depths between 7 feet to 12 feet in Boring B-3, we ran Liquefy-Pro software to analyze a potential for the liquefaction settlement. For this analysis we considered the water table as five feet below ground surface, seismic coefficient of 0.6g, and earthquake magnitude of 7.1. Based on the information collected during the



field investigation, laboratory test results, types of soils encountered in the borings within the project site and liquefaction analysis, we determined the maximum settlement of 0.17 inches with a safety factor of 1.3, which is considered to be low. Therefore potential for liquefaction settlement within the project site is low and insignificant to cause damage to the proposed structures.

6.1.3 Consolidation Settlement

Consolidation is the densification of soil into a more dense arrangement from additional loading, such as new fills or foundations. Consolidation of clayey soils is usually a long-term process, whereby the water is squeezed out of the soil matrix with time. Sandy soils consolidate relatively rapidly with an introduction of a load. Consolidation of soft and loose soil layers and lenses can cause settlement of the ground surface or buildings. Based on testing in the field, laboratory testing, and type of soils and depth of groundwater level, the surficial soil is considered to have a low potential for consolidation.

6.1.4 Dynamic Compaction (Settlement)

Dynamic compaction is a phenomenon where loose, sandy soil located above the water table densified from vibratory loading, typically from seismic shaking or vibratory equipment. The site is generally underlain by stiff to very stiff sandy clay, and medium dense to very dense clayey silty sands. The soil is sufficiently strong and therefore not likely to be subject to dry sand densification. Thus, the site should not be susceptible to dynamic compaction phenomena.

6.1.5 Fault Ground Rupture and Fault Creep

The State of California adopted the Alquist-Priolo Earthquake Fault Zone Act of 1972 (Chapter 7.5, Division 2, Sections 2621 – 2630, California Public Resources Code), which regulates development near active faults for the purpose of preventing surface fault rupture hazards to structures for human occupancy. In accordance with the Alquist-Priolo Act, the California Geological Survey established boundary zones or Earthquake Fault Zones surrounding faults or fault segments judged to be sufficiently active, well-defined, and mapped for some distance. Structures for human occupancy within designated Earthquake Fault Zone boundaries are not permitted unless surface fault rupture and fault creep hazards are adequately addressed in a site-specific evaluation of the development site.



The site is not currently within a designated Earthquake Fault Zone as defined by the State (Hart and Bryant, 1997). The closest Earthquake Fault Zone is associated with San Andreas Fault, located about 0.5 miles from the site (see Regional Fault Map, Figure 6). Since the site is not within an Earthquake Fault Zone, the potential for fault ground rupture and fault creep hazards are judged to be very low.

6.2 Other Hazards

Potential geologic hazards other than those caused by a seismic event generally include ground failure and subsidence, landslides, expansive and collapsible soils, flooding, and soil erosion. These are discussed and evaluated in the following sections.

6.2.1 Ground Cracking and Subsidence

Withdrawal of groundwater and other fluids (i.e. petroleum and the extraction of natural gas) from beneath the surface has been linked to large-scale land subsidence and associated cracking on the ground surface. Other causes for ground cracking and subsidence include the oxidation and resultant compaction of peat beds, the decline of groundwater levels and consequent compaction of aquifers, hydrocompaction and subsequent settlement of alluvial deposits above the water table from irrigation, or a combination of any of these causes. Due to the absence of any of these factors, the potential for subsidence or related ground cracking is considered low.

6.2.2 Landsliding

The site is not yet evaluated by CGS sources as being located within an existing landslide or potential landslide area. Based on the USGS rainfall induced landslide map and surrounding topography, the site is not considered prone to potential landslide. See attached USGS Landslide Map, Figure 7.

6.2.3 Expansive and Collapsible Soils

The result of the laboratory testing performed on representative sample of the near-surface soils (less than 10-feet deep) indicated Plasticity Index of 15 which is considered as low-plasticity soil. Hence, mitigation for expansive soil conditions is not required for this site.

The subsurface deposits encountered during the drilling program generally consisted of medium stiff to very stiff sandy clay and medium dense to very dense clayey sand and clayey silty sand. Collapsible soils are fine sandy and silty soils that have been laid down by the action of flowing water, usually in alluvial fan deposits. Terrace deposits

and fluvial deposits can also contain collapsible soil deposits. The soil particles are usually bound together with a mineral precipitate. The loose structure is maintained in the soil until a load is imposed on the soil and water is introduced. The water breaks down the inter-particle bonds and the newly imposed loading densifies the soil. The potential for collapsible soils underlying the site is considered to be low for this project site based on the soils which were encountered in the borings.

6.2.4 Flooding

It is noted by FEMA (2011) in the "Flood Insurance Study-San Mateo County and incorporated areas" that "There are no known principal flood problems within the City of Daly City." The site is located in an area which has not been mapped on the FIRM plots. Determining the flood hazard of the site is beyond the scope of this study or our expertise, and a flood specialist should be contacted if a more in-depth flooding analysis is desired.

6.2.5 Soil Erosion

Present construction techniques and agency requirements have provisions to limit soil erosion and resultant siltation during construction. These measures will reduce the potential for soil erosion at the site during the various construction phases. Long-term erosion at the site will be reduced by landscaping and hardscape areas, such as parking lots and walkways, designed with appropriate surface drainage facilities.

6.2.6 Naturally Occurring Asbestos (NOA)

The geologic mapping of the area does not include any formations which are a concern for potential asbestos hazard. Therefore, the asbestos hazard potential at the site is anticipated to be low.

6.2.7 Other Geologic Hazards

Due to the sites location, subsurface soil conditions, groundwater levels and land use factors, the site is not subject to the potential geologic hazards of loss of mineral resources, volcanism, tsunamis, seiches, dam failure inundation, cyclic softening of soils or loss of unique geologic features.



7.0 SEISMIC SETTING

7.1 Regional Faulting and Tectonics

Regional transpression has caused uplift and folding of the bedrock units within the Coast Ranges. This structural deformation occurred during periods of tectonic activity that began in the Pliocene and continues today. The site is located in a seismically active region that has experienced periodic, large magnitude earthquakes during historic times. This seismic activity appears to be largely controlled by displacement between the Pacific and North American crustal plates, separated by the San Andreas Fault zone, located approximately 0.5 miles west of the site. This plate displacement produced regional strain that is concentrated along major faults of the San Andreas Fault System including the San Andreas and Hayward faults in this area. Major faults include the San Andreas Fault located approximately 0.5 miles southwest of the site and Hayward-Rodgers Creek Fault located approximately 18.0 miles east of the site.

7.1.1 San Andreas Fault

The northwest-trending San Andreas Fault runs along the western coast of California extending approximately 625 miles from the north near Point Arena to the Salton Sea area in Southern California (Jennings, 1994). The fault zone has been divided into 11 segments. The site is located approximately 0.5 miles east of the San Francisco Bay Peninsula segment. The slip rate on the nearest segment of the San Andreas Fault is estimated to be about 17 mm/year and has been assigned a moment magnitude (M_{max}) of 7.1 (CGS, 2003). The Working Group on California Earthquake Probabilities (WG99) has estimated that there is a 15 percent probability of at least one magnitude 6.7 or greater earthquake before 2030 along the Bay Area segment of the San Andreas Fault (USGS, 1999).

7.1.2 Hayward –Rodgers Creek Fault

The Hayward –Rodgers Creek Fault trends northwesterly from the Milpitas area via Richmond to the Santa Rosa area. The site is located approximately 18 miles from the segment of the Hayward-Rodgers Creek Fault. The slip rate on this segment of the Hayward Fault is estimated to be about nine mm/year and has been assigned a moment magnitude (M_{max}) of 6.7 (CGS, 2003). The Working Group on California Earthquake Probabilities (WG99) has estimated that there is a 27 percent probability of at least one magnitude 6.7 or greater earthquake before 2030 along the Southern segment of the Hayward-Rodgers Creek Fault (USGS, 2003).



7.2 Historic Seismicity

As discussed above, the San Francisco Bay Area is subject to a high level of seismic activity. Within the period of 1800 to 2000 there were an estimated 19 earthquakes exceeding a Richter magnitude of 6.0 within a 100 mile radius of the site, seven exceeding 6.5, four exceeding 7.0, one exceeding 7.5, and one exceeding 8.0.

Of the major earthquakes known to have affected the site, the 1906 San Francisco earthquake caused the highest level of strong ground shaking. However, the City was semi-rural then, sparsely populated, and had no major buildings. The 1957 Daly City earthquake (5.3 magnitude) caused significant amounts of property damage and one death. The 1989 Loma Prieta earthquake caused only very minor damage in Daly City and no fatalities or injuries were reported.



8.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations are based upon the analysis of the information gathered during the course of this study and our understanding of the proposed improvements.

8.1 Conclusions

The site is considered suitable from a geotechnical and geologic perspective for the proposed improvements provided the recommendations of this report are incorporated into the design and implemented during construction. The predominant geotechnical and geological issues that will need to be addressed at this site are summarized below.

Seismic Considerations – The site is located within a seismically active region and should be designed to account for earthquake ground motions, as described in this report.

Expansive Soils – The near-surface soils at the site appear to have a moderately low to low expansion potential. Moisture conditioning of the fill and upper processed cut surfaces should be performed as a precautionary means and import fill should be non-expansive.

Demolition – The proposed developments consist of demolition of existing modular structures. Complete removal of buried utilities and foundations should be carried out. Demolition excavations should be backfilled with engineered fill.

Utility Connections – It is recommended that utility connections at building perimeters be designed for one inch of potential movement in any direction where the utility enters the buildings. This should accommodate potential differential movement during a seismic event.

Groundwater – Groundwater should not be problematic with placement of the anticipated shallow conventional foundations and utility trenches.

Winter Construction – If grading occurs in the winter rainy season, appropriate erosion control measures will be required and weatherproofing of the building pads, foundation excavations, and/or pavement areas should be considered. Winter rains will also impact foundation excavations and underground utilities.

8.2 Seismic Parameters

8.2.1 Seismic Considerations

The site is located within a seismically active region and should be designed to account for earthquake ground motions, as described in this report. For seismic analysis of the proposed site in accordance with the seismic provisions of the CBC 2010, we recommend the following:

Table 3: Seismic Design Parameters Based on 2010 CBC (2009 IBC)

Item	Value	Location
Site Class	D	Table 1613.5.2 ^{R1}
Mapped Spectral Response Accelerations		USGS ^{R2}
Short Period, S_s	2.252 g	
1-second Period, S_1	1.294 g	
Site Coefficient, F_a	1.0	Table 1613.5.3(1) ^{R1}
Site Coefficient, F_v	1.5	Table 1613.5.3(2) ^{R1}
MCE (S_{MS})	2.252 g	
MCE (S_{M1})	1.941 g	
Design Spectral Response Acceleration		
Short Period, S_{DS}	1.501 g	
1-second Period, S_{D1}	1.294 g	

R1 California Building Standards Commission (CBSC), "California Building Code," 2010 Edition.

R2 U.S. Seismic "Design Maps" Web Application, <https://geohazards.usgs.gov/secure/designmaps/us/application.php>

8.3 Site Grading

8.3.1 Site Preparation and Demolition

Site grading should be performed in accordance with these recommendations. A pre-construction conference should be held at the jobsite with representatives from the owner, general contractor, grading contractor, and Geosphere prior to starting the stripping and demolition operations at the site.

The proposed construction work includes demolition of existing modular buildings and removal of asphalt pavement. The site should be cleared of any foundation remains, concrete, asphalt, vegetation, organic topsoil, debris, and other deleterious materials within the proposed development areas. The grading contractor should be aware that there is a potential for encountering buried objects and underground utilities at the site.

Buried objects and debris should be removed from the site. The resulting excavations should be backfilled with properly compacted fill or other material approved by the Geotechnical Engineer. The selected soil from the over-

excavation areas can be stockpiled and utilized for fill at the site if the material is non-expansive and meets the requirements of backfill materials.

Existing underground utilities to be abandoned at the site should be properly grouted closed or removed as needed. If the utilities are removed, the excavations should be backfilled with properly compacted fill or other material approved by the Geotechnical Engineer.

8.3.2 Project Compaction Recommendations

The following table provides the recommended minimum compaction requirement for this project. Not all soils, aggregates, and scenarios listed below may be applicable for this project. Specific grading recommendations will be discussed individually within applicable sections of this report.

Table 4: Project Compaction Requirements

Description	Percent Relative Compaction	Optimum Moisture Content
Building Pads, Onsite Soil	90	+ 3
Building Pads, Subgrade Soil	90	+ 3
Building Pads, Class 2 Baserock	90	± 2
Concrete Hardscape, Subgrade Soil	90	+ 3
AC and Concrete Pavement, Subgrade Soil	95	+ 3
AC and Concrete Pavement, Class 2 Baserock	95	± 2
Underground Utility Backfill, 5-Feet and Deeper	90	+ 3
Underground Utility Backfill, Upper 5-Feet	95	+ 3

8.3.3 General Grading

Site grading is anticipated to consist of minimum cuts and fills depending upon the preliminary planned finished floor levels. No final grading plans were available at the time this report was prepared. On site soils are generally stiff to very stiff and medium dense to dense on the upper five feet. If loose or soft soils are encountered these soils should be replaced with suitable engineered/import fills. Imported soil should be non-expansive, having a Plasticity Index of 15 or less, an R-Value greater than 40, and contain at least 10 percent fines so the soil can bind together. Imported materials should be free of organic materials and debris, and should not contain rocks or lumps greater than three inches in maximum size. Import fill materials should be approved by the Geotechnical Engineer prior to use on site.



Final grading should be designed to provide positive drainage away from structures. Soil areas within 10 feet of proposed structures should slope at a minimum of five percent away from the buildings. Roof leaders and downspouts should discharge onto paved surfaces sloping away from the structure or into a closed pipe system channeled away from the structure to an approved collector or outfall.

8.3.4 Building Pad Grading/Preparation

Following demolition and general grading the entire area of the building should be over-excavated at least eight inches, properly moisture conditioned, and compacted to a minimum of 90 % relative compaction per ASTM D 1557. If loose or soft soil is encountered, these should be removed to expose firm soil and backfilled with Select fill. The fill should be thoroughly mixed during placement to provide uniformity in each layer.

8.3.5 Grading Hardscape Areas

Areas to receive concrete hardscapes should be scarified to a depth of eight inches below existing grade or final subgrade whichever is lower. Scarified areas should be moisture conditioned and compacted. Engineered fill should be placed to reach subgrade elevation as needed.

8.3.6 Site Winterization and Unstable Subgrade Conditions

If grading occurs in the winter rainy season, unstable and unworkable subgrade conditions may be present and compaction of on-site soils may not be feasible. These conditions may be remedied using appropriate soil admixtures, such as cement/lime or other admixtures. More detailed recommendations can be provided during construction. Stabilizing subgrade in small, isolated areas can be accomplished with the approval of the Geotechnical Engineer by over-excavating one foot, placing Tensar BX1100/TriAx geogrid or equivalent geogrid on the soil, and then placing 12-inches of Class 2 baserock on the geogrid. The upper six inches of the baserock should be compacted to at least 95 percent relative compaction.

8.4 Utility Trench Construction

Utility trenches may be backfilled with approved native soil above the utility bedding and shading materials. If rocks larger than four inches in maximum size are encountered, these should be removed from the fill prior to placement in the utility trenches. Utility bedding and shading compaction requirements should be in conformance with the requirements of the local agencies having jurisdiction and as recommended by the pipe manufacturers. Jetting of trench backfill is not recommended.



Pea gravel, rod mill (pea gravel with sand), or other similar self-compacting material should NOT be utilized at the site. This material may act as a conduit for subsurface moisture migration. Utility trenches should be sealed with concrete, clayey soil, sand-cement slurry, or controlled density fill (CDF) where the utility enters the building under the perimeter foundation. This would reduce the potential for migration of water beneath the building through the shading material in the utility trench.

If rain is expected and the trench will remain open, the bottom of the trench may be lined with one to two inches of gravel. This would provide a working surface in the trench bottom. The trench bottom may have to be sloped to a low point to pump the water out of the trench.

8.5 Temporary Excavations

The contractor should utilize proper Cal OSHA methods during construction. Excavations in soil more than five feet deep and less than 20 feet deep should have side slopes constructed at 1.5H: 1V (horizontal to vertical). The grading contractor should make selection of temporary side slopes based upon the materials encountered during the excavation. Maximum slope ratios provided above are assumed to be uniform from top to toe of the slope. Adequate provisions should be made to prevent water from ponding on top of the slope and from flowing over the slope face. Surcharge loads should not be permitted within 10 feet of the top of the slope. Desiccation or excessive moisture in the excavation could reduce stability and require shoring or laying back side slopes.

8.6 Building Foundations

8.6.1 Shallow Foundations

The proposed new buildings can be constructed on shallow foundations founded at least 24 inches below final exterior grade for perimeter footings and 18 inches below the lowest adjacent finished grade for interior footings. For the design of footings bearing within tested and approved new fill or deeper perimeter footings on stiff/dense native soil, we recommend using an allowable bearing pressure of 2500 psf for dead plus live loads. A one-third increase in allowable dead plus live load bearing pressure may be used when considering the effects of temporary wind or seismic forces. These recommendations are based on the assumptions that the buildings are light structures and anticipated isolated footing load of 35 kips or less, and three to five kips/ft for continuous footing. If structural loads are expected to be heavier than above indicated footings load, a Geosphere Engineer should be consulted for most economic and appropriate allowable bearing capacity and settlements during design phase.



Resistance to lateral loads may be developed by friction acting at the base of footings and passive earth pressure developed on the sides of footings below grade. Passive earth pressure and friction may be used in combination, without reduction, in evaluating total resistance to lateral loads. An allowable coefficient of friction of 0.30 may be used for dead load forces for footings cast directly against approved compacted fill. An allowable passive pressure of 200 pounds per square foot per linear foot of footing embedment may be used for the sides of footings, provided the footings are poured tight against approved compacted fill or competent natural soils.

Geosphere personnel should be retained to observe and evaluate that footing excavations terminate in soils suitable for the design bearing pressure. If unsuitable soil is present, the excavation should be extended until suitable material is encountered. Unsuitable soil or fill removal should also extend at least eight inches beyond the foundation edge for each 12-inch thickness of unsuitable soil being removed. The material removed should be replaced with an approved granular soil, placed and compacted.

If site preparation and foundation observation services are conducted as outlined in this report, long-term settlement is expected to be less than one inch for footings bearing within the materials described above. Differential settlement across the structure is not expected to exceed about $\frac{1}{2}$ this value.

Continuous footings should have a minimum width of at least 18 inches, and isolated column footings should have a minimum width of at least 24 inches. For continuous footings, we recommend minimum reinforcement of two #4 rebars, at the top and bottom of the footing be used. For isolated footings, we recommend minimum reinforcement of #4 rebars 12-inches on center be used. Actual required footing reinforcement should be determined by the project Structural Engineer.

To reduce moisture changes beneath the footing soils, we recommend that perimeter footings bear at least 24 inches below final exterior grade. Interior footings may be placed at shallower depths. Care should be taken to prevent wetting or drying of the bearing materials during construction. Any extremely wet or dry material or any loose or disturbed material in the bottom of the footing excavations should be removed prior to placing concrete.

8.7 Floor Slab Subgrade

8.7.1 General Recommendations

After stripping the site, the building area should be scarified and re-compacted to a minimum depth of eight inches below the bottom of the proposed floor slab subgrade. We recommend minimum thickness of the slab be five

inches. The actual required slab thickness and reinforcement should be determined by the project Structural Engineer.

Care should be taken to maintain the minimum recommended moisture content in the subgrade until floor slabs and/or Engineer Fills are constructed. Positive drainage should also be developed away from the building to prevent water from ponding along the perimeter and affecting future floor slab performance. We recommend a positive cutoff in utility trenches at the building lines to reduce the potential for water migrating through the utility trench backfill to areas under the building.

8.7.2 Interior Concrete Slabs

Floors with moisture sensitive floor coverings should be underlain by a high quality vapor retarder meeting ASTM E1745 Class C requirements, such as 15-mil StegoWrap, Griffolyn Type 65, Griffolyn VaporGaurd, Moistop Ultra C, or equivalent. The vapor retarder can be placed directly on the prepared subgrade soil. ASTM E1643 should be utilized as a guideline for the installation of the vapor retarder. A capillary rock layer or rock cushion is not required beneath the floor slab and a sand layer is not required over the vapor retarder. If sand on top of the vapor retarder is required by the design engineers, the thickness should be minimized to less than one-inch. If construction occurs in the winter months, water may pond within the sand layer since the vapor retarder may prevent the vertical percolation of rainwater.

8.7.3 Exterior Concrete Flatwork

Exterior concrete flatwork with pedestrian traffic should be at least five-inches thick and should be underlain by at least four-inches of Class II AB. The flatwork should be reinforced to reduce potential tripping hazards; welded wire mesh should not be utilized. The flatwork should be doveled into the building foundation adjacent to doorways and into curbs to prevent possible tripping hazards.

If possible, the building should have a concrete apron around the building to reduce the potential for surface water percolating down through the soil adjacent to the buildings. Landscaping adjacent to the building should be avoided if possible. Typically, landscape areas adjacent to buildings are surrounded by concrete flatwork, which keeps irrigation and rainwater from flowing away from the building. The ponded water trapped by the surrounding flatwork could percolate down or possibly laterally through perimeter foundation construction joints or pipe sleeves



and travel beneath the floor slab. Drainage can be provided in these landscape areas, but the top of the drains should be located below the building pad subgrade elevation.

8.8 Plan Review

It is recommended that Geosphere be provided the opportunity to review the foundation, grading, and drainage plans prior to construction. The purpose of this review is to assess the general compliance of the plans with the recommendations provided in this report and the incorporation of these recommendations into the project plans and specifications.

8.9 Observation and Testing During Construction

It is recommended that Geosphere/CEL be retained to provide observation and testing services during site preparation, site grading, utility construction, foundation excavation, pavement section preparation and to observe final site drainage. This is to observe compliance with the design concepts, specifications and recommendations, and to allow for possible changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

8.10 Validity of Report

This report is valid for three years after publication. If construction begins after this time period, Geosphere should be contacted to confirm that the site conditions have not changed significantly. If the proposed development differs considerably from that described above, Geosphere should be notified to determine if additional recommendations are required. Additionally, if Geosphere is not involved during the geotechnical aspects of construction, this report may become wholly or in part invalid since Geosphere's geotechnical personnel need to verify that the subsurface conditions anticipated preparing this report are similar to the subsurface conditions revealed during construction. Geosphere's involvement should include foundation and grading plan review; observation of foundation excavations; grading observation and testing; testing of utility trench backfill and retaining wall backfill; subgrade preparation in hardscape areas and pavement section preparation.



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U.S. Geological Survey, Geologic Map of San Francisco Bay Region, USGS Scientific Investigation Map 2918

LIMITATIONS AND UNIFORMITY OF CONDITIONS

The recommendations of this report are based upon the soil and conditions encountered in the borings. If variations or undesirable conditions are encountered during construction, Geosphere/CEL should be contacted so that supplemental recommendations may be provided.

This report is issued with the understanding that it is the responsibility of the owner or his representatives to see that the information and recommendations contained herein are called to the attention of the other members of the design team and incorporated into the plans and specifications, and that the necessary steps are taken to see that the recommendations are implemented during construction.

The findings and recommendations presented in this report are valid as of the present time for the development as currently proposed. However, changes in the conditions 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. Accordingly the findings and recommendations presented in this report may be invalidated, wholly or in part, by changes outside our control. Therefore, this report is subject to review by Geosphere/CEL after a period of three (3) years has elapsed from the date of issuance of this report. In addition, if the currently proposed design scheme as noted in this report is altered, Geosphere/CEL should be provided the opportunity to review the changed design and provide supplemental recommendations as needed.

Recommendations are presented in this report which specifically request that Geosphere/CEL be provided the opportunity to review the project plans prior to construction and that we be retained to provide observation and testing services during construction. The validity of the recommendations of this report assumes that Geosphere/CEL will be retained to provide these services.

This report was prepared upon your request for our services, and in accordance with currently accepted geotechnical engineering practice. No warranty based on the contents of this report is intended, and none shall be inferred from the statements or opinions expressed herein.

The scope of our services for this report did not include an environmental assessment or investigation for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater or air, on,



below or around this site. Any statements within this report or on the attached figures, logs or records regarding odors noted or other items or conditions observed are for the information of our client only.

FIGURES

Figure 1 – Site Vicinity Map

Figure 2 – Site Plan and Site Geologic Map

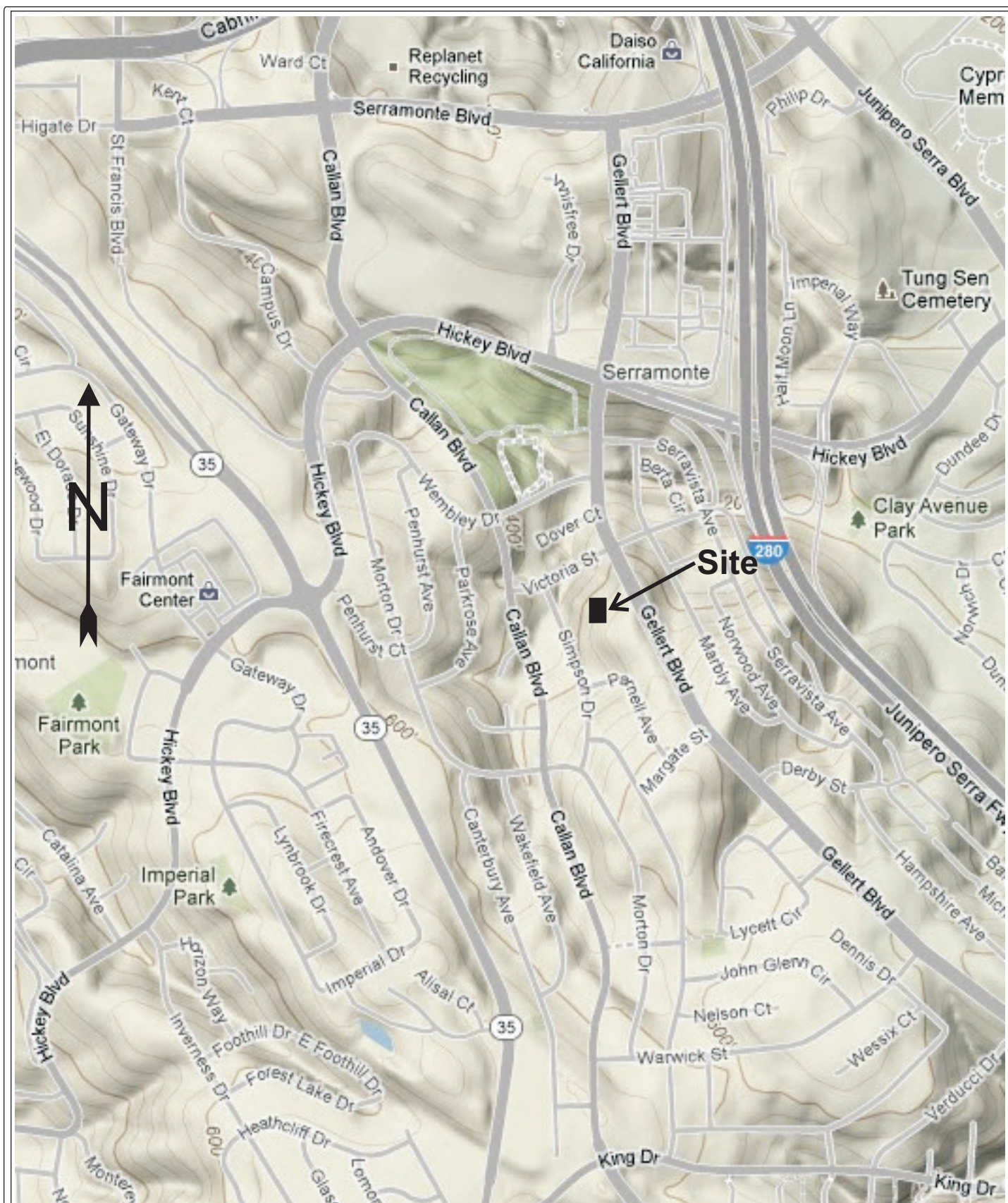
Figure 3 – Site Vicinity Geologic Map

Figures 4a and 4b – Schematic Geologic Cross Sections A-A' and B-B'

Figure 5 – Liquefaction Susceptibility Map

Figure 6 – Regional Fault Map

Figure 7 – Existing Landslide Map



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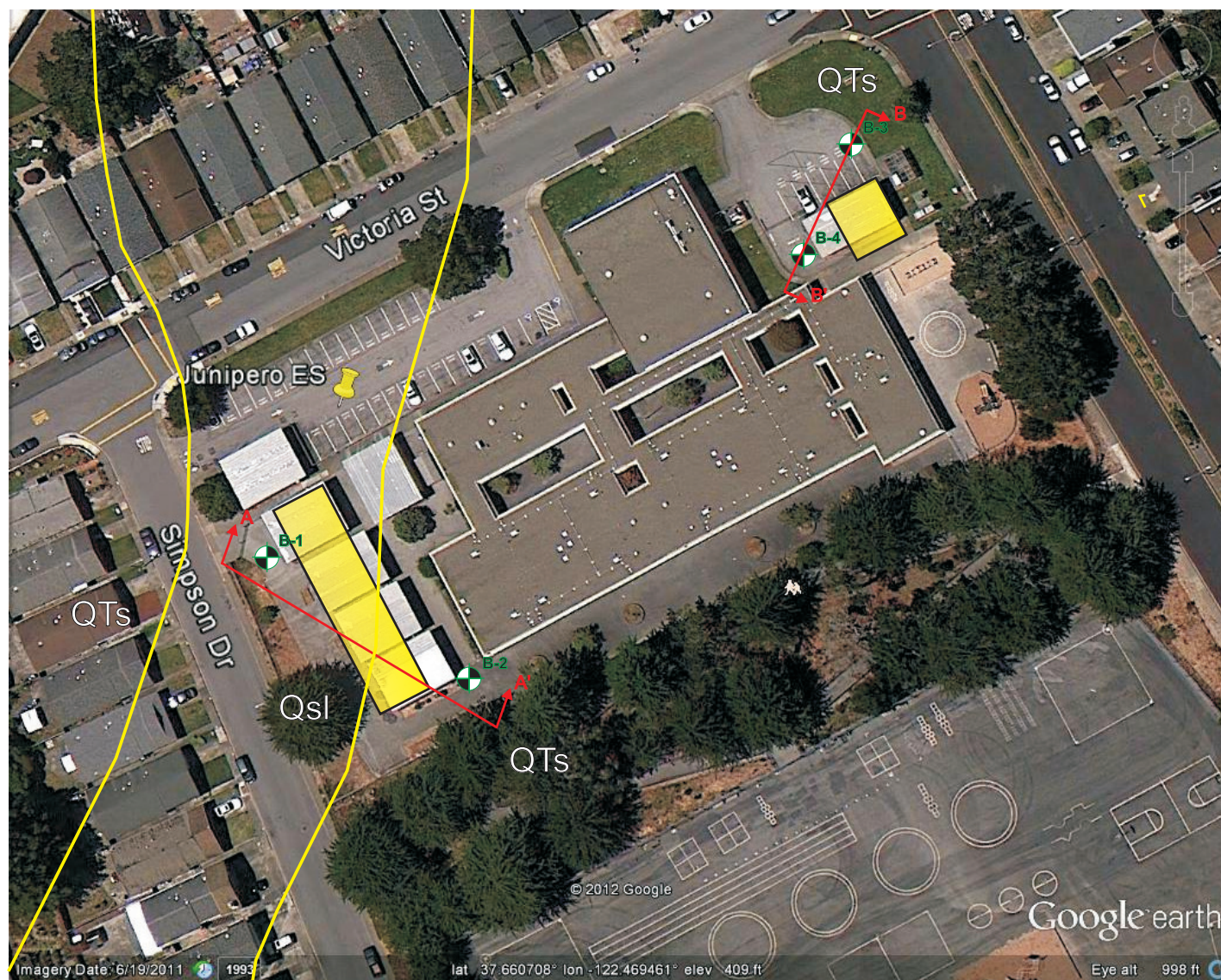
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Site Vicinity Map

Figure 1



-  - Proposed Building
-  - Geologic Cross Section
-  - Geologic Contact
-  - Approximate Boring Location
- Qsl** - Hillslope Deposits, Quaternary
- QTs** - Sediments, early Pleistocene and (or) Pliocene

 - Approximate Scale
0 90 ft

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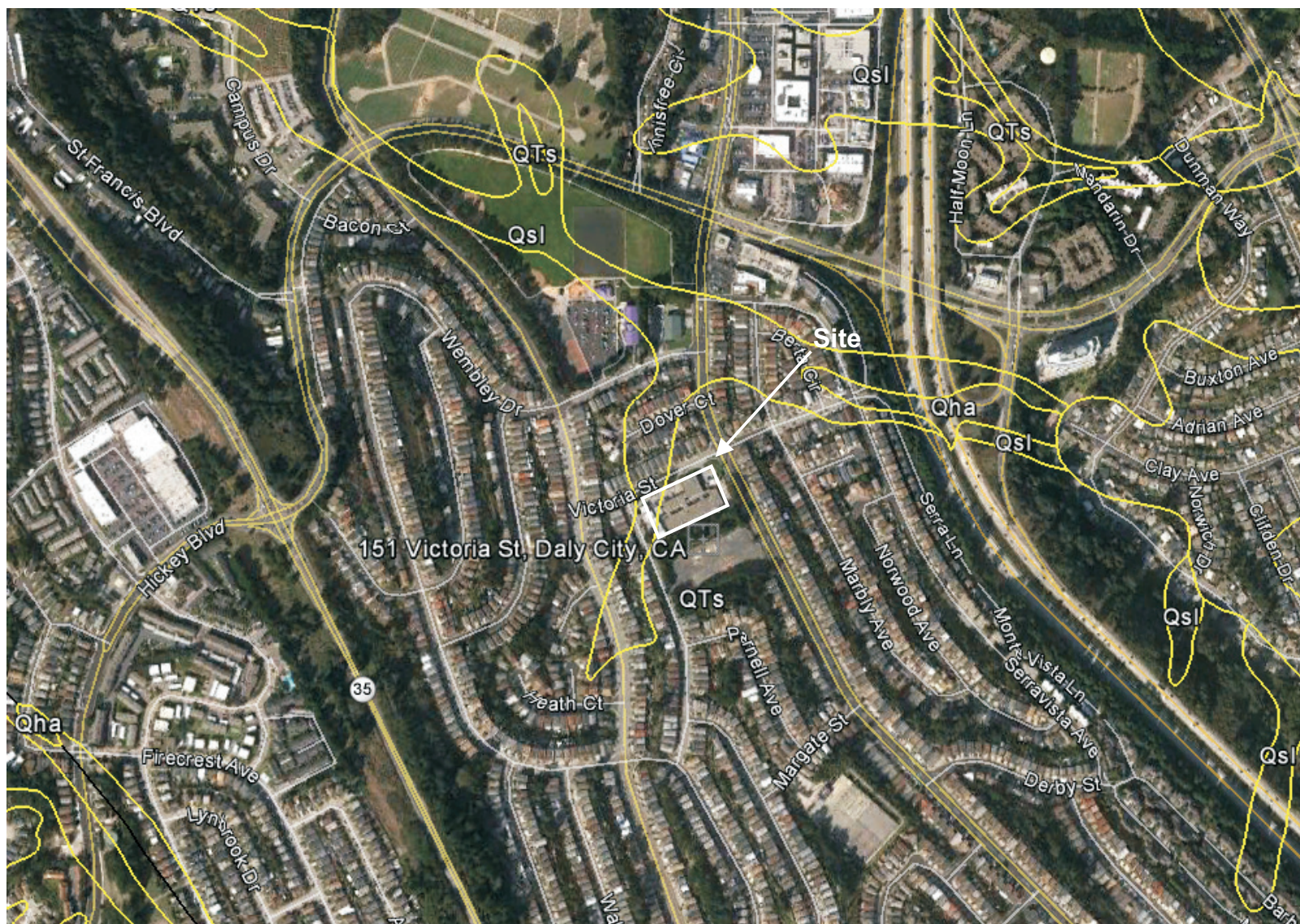
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Site Plan and Site
Geology Map

Figure 2



QTs - Merced Sand Formation, Quaternary
Qsl - Hillslope Deposits, Quaternary
Qha - Alluvium, Holocene

— Geologic contacts

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Site Vicinity Geologic
Map

Figure 3



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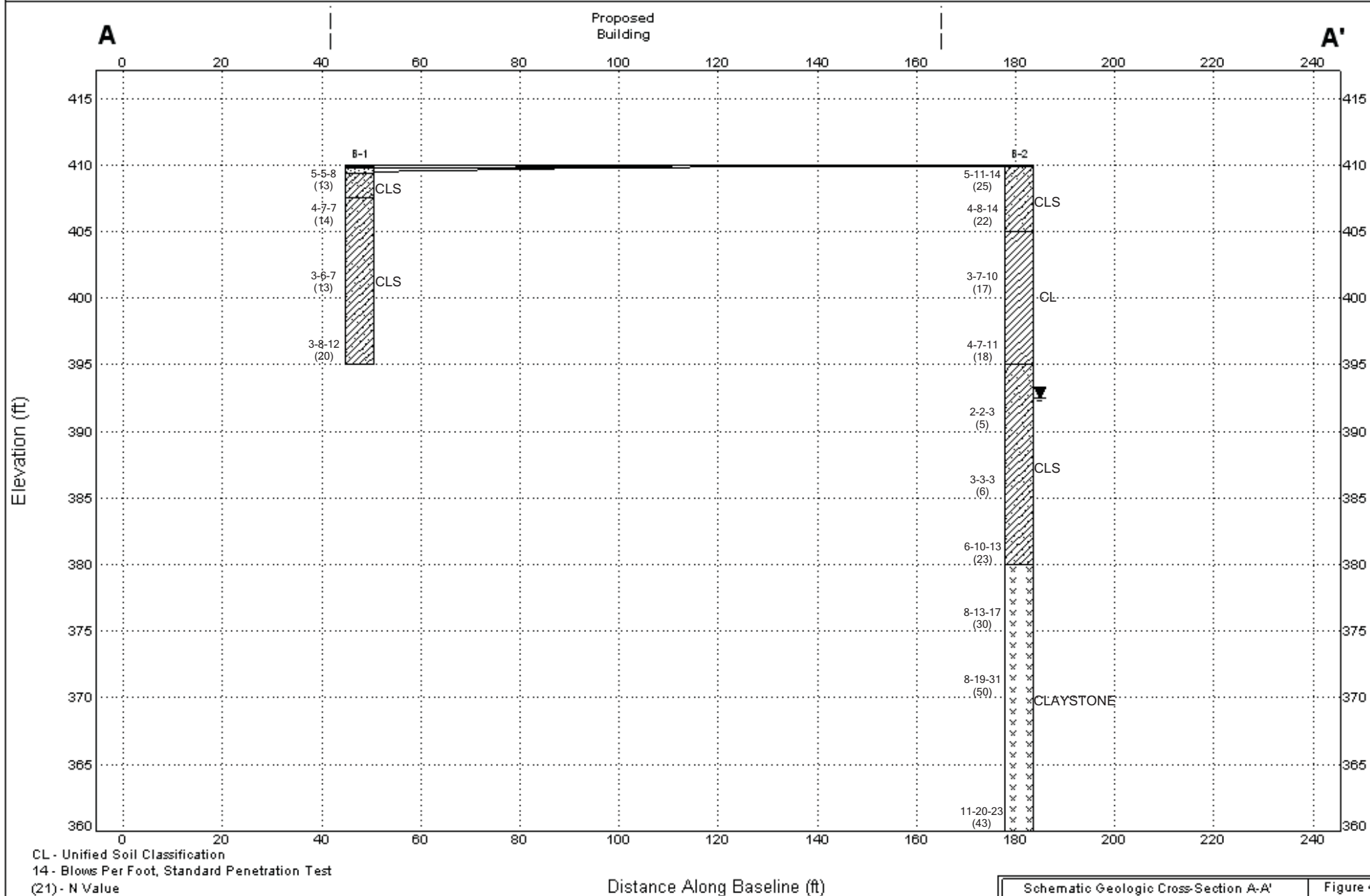
SUBSURFACE DIAGRAM

CLIENT South San Francisco Unified School District

PROJECT NAME Junipero Serra Elementary School

PROJECT NUMBER 91-02821-A

PROJECT LOCATION 151 Victoria Street, Daly City, CA





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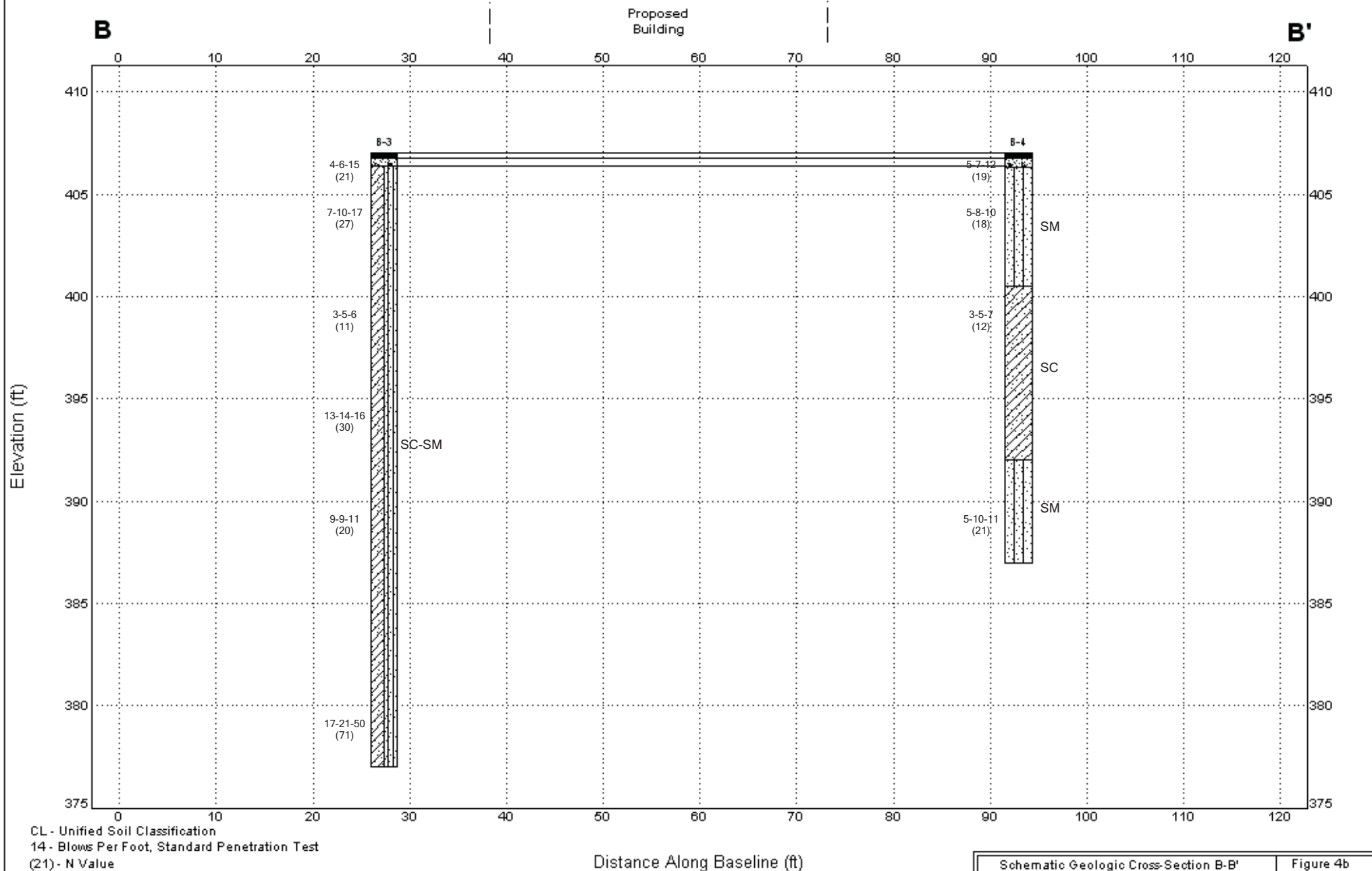
SUBSURFACE DIAGRAM

CLIENT South San Francisco Unified School District

PROJECT NAME Junipero Serra Elementary School

PROJECT NUMBER 91-02821-A

PROJECT LOCATION 151 Victoria Street, Daly City, CA



Liquefaction Susceptibility Map

Susceptibility Level

- Very High
- High
- Moderate
- Low
- Very Low

- Major Roads
- Local Roads



This map is intended for planning use only and is not intended to be site-specific. Rather, it depicts the general hazard level of a neighborhood and the relative hazard levels from community to community. Hazard levels are less likely to be accurate if your neighborhood is on or near the border between two zones. This information is not a substitute for a site-specific investigation by a licensed professional.

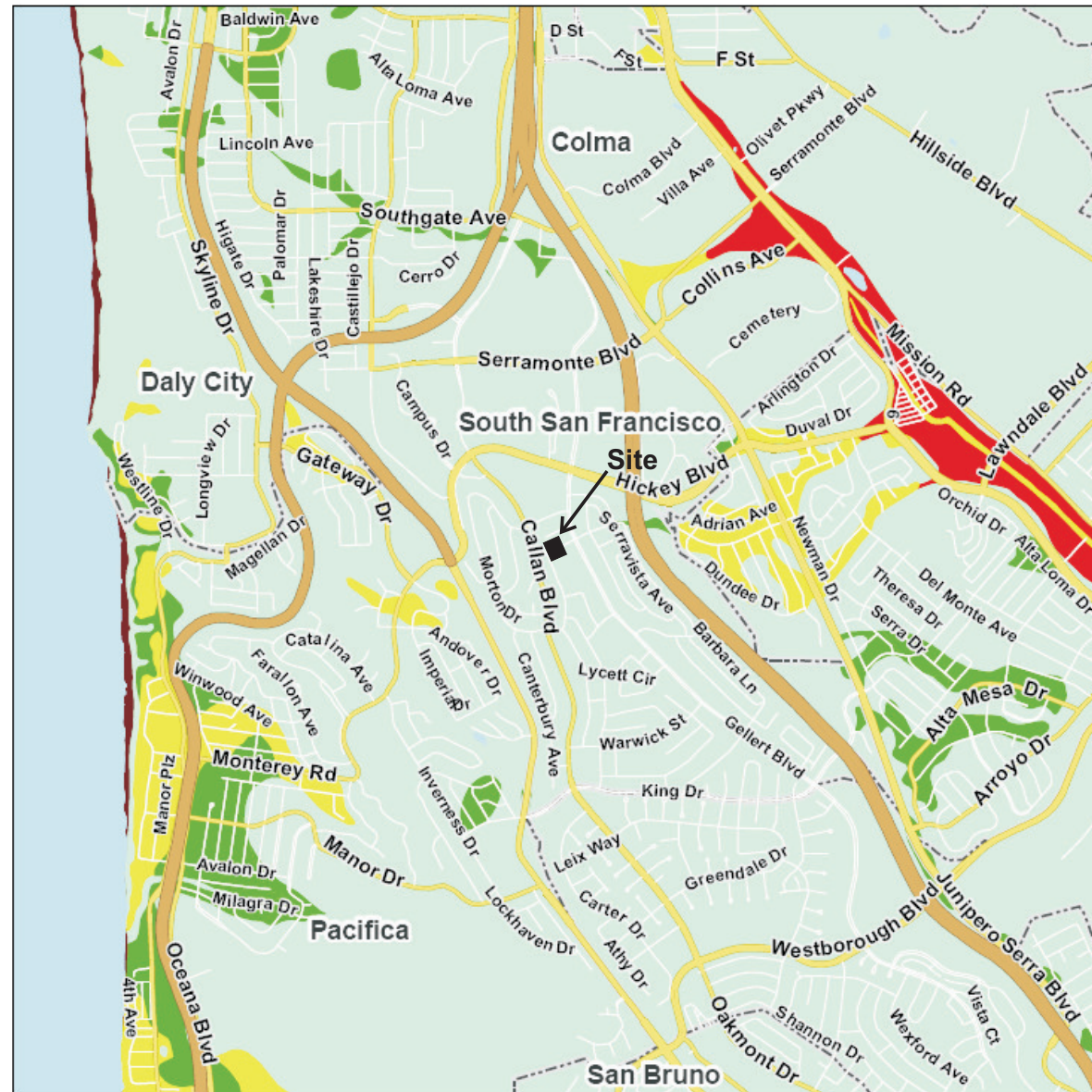
This map is available at
<http://quake.abag.ca.gov>

Sources:

This map is based on work by William Lettis & Associates, Inc. and USGS.
 USGS Open-File Report 00-444, Knudsen & others, 2000 and
 USGS Open-File Report 2006-1037, Witter & others, 2006

For more information visit:
<http://pubs.usgs.gov/of/2000/of00-444/>
<http://pubs.usgs.gov/of/2006/1037/>

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Liquefaction
 Susceptibility Map

Figure 5

Alquist-Priolo Earthquake Fault Zones

Earthquake Fault Zones

- San Andreas-North Golden Gate
- San Andreas -- Peninsula
- San Andreas -- Santa Cruz
- Rodgers Creek
- North Hayward
- South Hayward
- Northern Calaveras
- Central Calaveras
- Sargent
- Maacama
- West Napa
- Concord/Green Valley
- Greenville
- Northern San Gregorio

Major Roads

Local Roads

Water

Scale: 1 inch = 3.33 miles

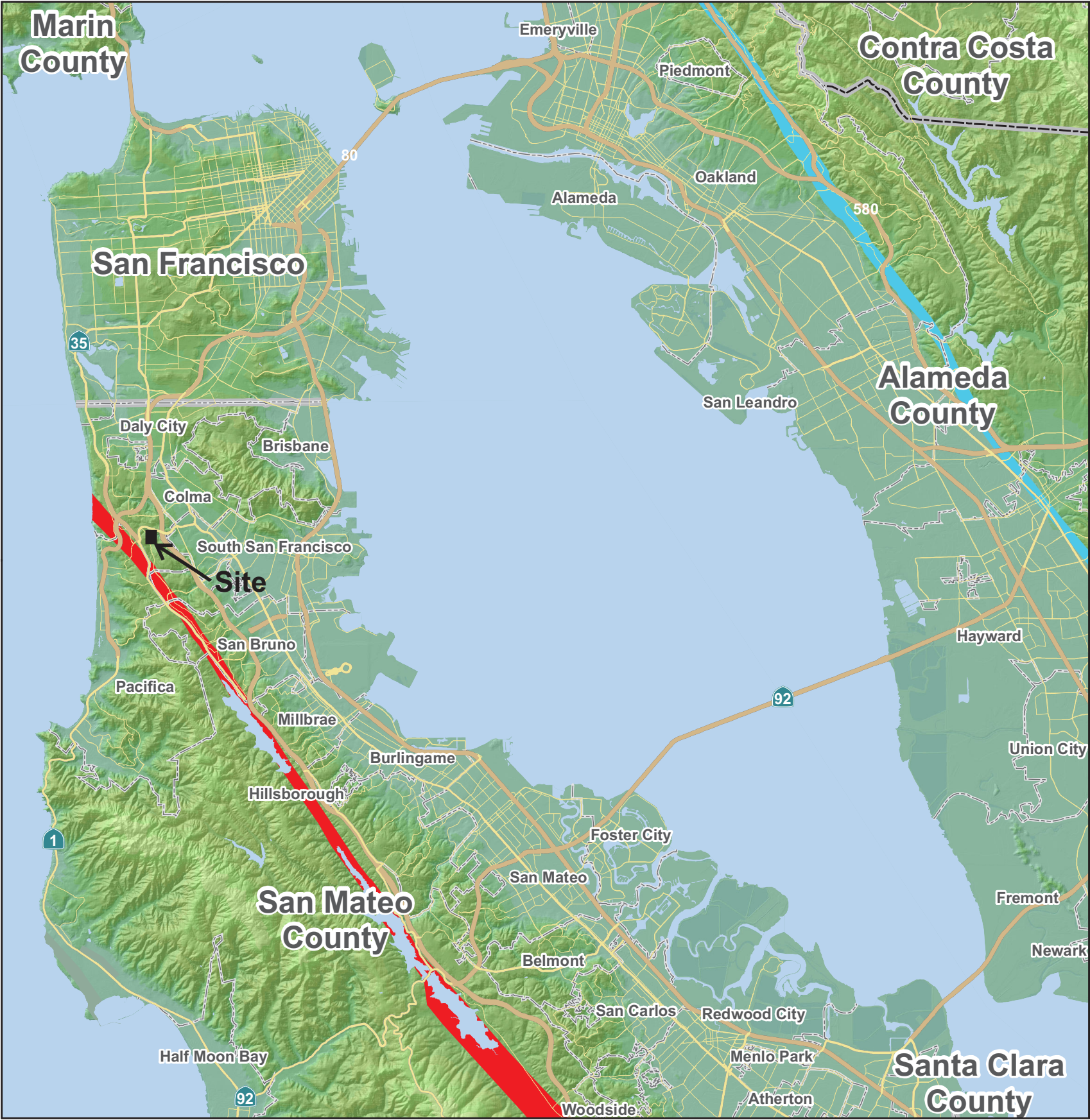
Reproduced with permission, California Geological Survey from CD-ROM 2001-04 (2001), Official Map of Alquist-Priolo Earthquake Fault Zones

This interactive map was created using digital files of AP EFZ quadrangles and is considered an electronic facsimile of the Official Alquist-Priolo Earthquake Fault Zone map. If there is any doubt or conflict with respect to the location of EFZ boundaries, the original clear-film overlay compiled by and on file with CGS is the official version of the map. Fault information in these digital files is not sufficient to serve as a substitute for the geological site studies required under Chapter 7.5 of Division 2 of the California Public Resources Code.

For more information visit:
<http://www.consrv.ca.gov/CGS/rghm/ap/>

This map is available at:
<http://quake.abag.ca.gov/>

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Junipero Sierra Elementary School Daly City, California	91-02821-A	May 2012
<p>Geosphere Consultants, Inc. AN ETS COMPANY Geotechnical Engineering • Engineering Geology Environmental Management • Water Resources</p>	Regional Fault Map	Figure 6

Summary Distribution of Slides and Earth Flows in the San Francisco Bay Region

- Mostly Landslides
- Many Landslides
- Flatland
- Few Landslides
- Very Few Landslides



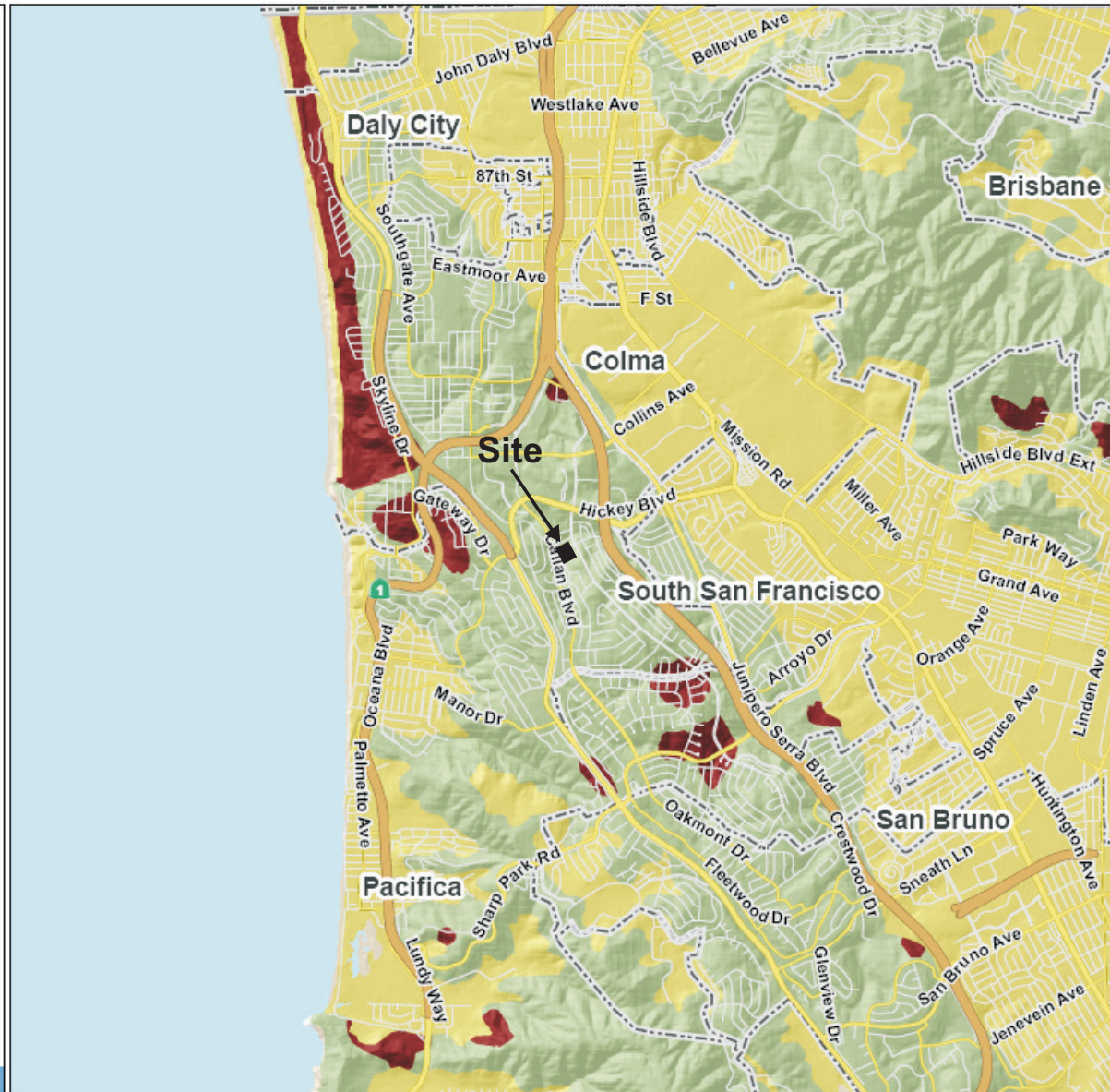
This map is intended for planning use only, and is not intended to be site-specific. Rather, it depicts the general risk within neighborhoods and the relative risk from community to community.

This map is available at <http://quake.abag.ca.gov>

For more detailed information regarding this map, please visit the USGS website at <http://wrgis.wr.usgs.gov/open-file/cf97-745/>

Source:
USGS Open File Report 97-745 E, 1997

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Existing Landslide
Map

Figure 7

APPENDIX A

Boring Logs



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BORING NUMBER B-1

PAGE 1 OF 1

CLIENT South San Francisco Unified School District	PROJECT NAME Junipero Serra Elementary School
PROJECT NUMBER 91-02821-A	PROJECT LOCATION 151 Victoria Street, Daly City, CA
DATE STARTED 4/5/12 COMPLETED 4/5/12	GROUND ELEVATION 410 ft HOLE SIZE 8"
DRILLING CONTRACTOR Exp Geoservices	GROUND WATER LEVELS:
DRILLING METHOD HSA	AT TIME OF DRILLING ---
LOGGED BY RW CHECKED BY GH	AT END OF DRILLING --- No water was observed
NOTES	AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
									LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0		3" THICK ASPHALT CONCRETE:										
		4" THICK AGGREGATE BASE:										
		(CL) SANDY CLAY (Possible Fill): gray/orange/brown, moist, stiff. C=116 psf, Phi=28.5 degrees.	MC 1		5-5-8 (13)		91	27	40	25	15	
		(CL) SANDY CLAY: gray/orange/brown, moist, stiff.										
5			MC 2		4-7-7 (14)		92	25				
10		increase in SAND, very moist, stiff, w/ bedrock fragments.	MC 3		3-6-7 (13)		91	25				
15		very moist, very stiff.	MC 4		3-8-12 (20)		109	18				

Bottom of borehole at 15.0 feet.

GEOTECH BH COLUMNS - STANDARD TEMP.GDT - 5/17/12 15:38 - R:\GEOTECH PROJECTS BY NUMBER\2800-2899\91-02821-A TO 91-02829-A SSFUSD PHASE II\91-02821-A JUNIPERO SERRA ES\JUNIPERO SERRA ES.GPJ



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BORING NUMBER B-2

PAGE 1 OF 2

CLIENT South San Francisco Unified School District	PROJECT NAME Junipero Serra Elementary School
PROJECT NUMBER 91-02821-A	PROJECT LOCATION 151 Victoria Street, Daly City, CA
DATE STARTED 4/5/12 COMPLETED 4/5/12	GROUND ELEVATION 410 ft HOLE SIZE 8"
DRILLING CONTRACTOR Exp Geoservices	GROUND WATER LEVELS:
DRILLING METHOD HSA	AT TIME OF DRILLING ---
LOGGED BY RW CHECKED BY GH	AT END OF DRILLING 17.50 ft / Elev 392.50 ft
NOTES	AFTER DRILLING ---

GEOTECH BH COLUMNS - STANDARD TEMP.GDT - 5/17/12 15:38 - R:\GEOTECH PROJECTS BY NUMBER\2800-2899\91-02821-A TO 91-02829-A SSFUSD PHASE II\91-02821-A JUNIPERO SERRA ES\JUNIPERO SERRA ES.GPJ

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
									LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0		1.5" THICK ASPHALT CONCRETE:										
		(CL) SANDY CLAY (Possible Fill): dark gray/orange/brown, very moist, very stiff, low plasticity, w/ some angular gravels.	MC 1		5-11-14 (25)							
5		increase in SAND, very stiff.	MC 2		4-8-14 (22)		103	22				
		(CL) SANDY CLAY: dark grayish brown, moist, very stiff, low plasticity.										
10		becomes gray	MC 3		3-7-10 (17)							
15		(CL) SANDY SILTY CLAY: gray, moist, and medium stiff	MC 4		4-7-11 (18)							
20			SPT 5		2-2-3 (5)							66
25			SPT 6		3-3-3 (6)							
30		becomes orangish brown, very moist, and very stiff.	SPT 7		6-10-13 (23)							74

(Continued Next Page)



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BORING NUMBER B-2

PAGE 2 OF 2

CLIENT South San Francisco Unified School District

PROJECT NAME Junipero Serra Elementary School

PROJECT NUMBER 91-02821-A

PROJECT LOCATION 151 Victoria Street, Daly City, CA

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
									LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
30	XXXXXX	(CL-ML) CEMENTED CLAYSTONE: orangish brown, moist, medium dense to dense.										
35	XXXXXX		X SPT 8		8-13-17 (30)							
40	XXXXXX	becomes dense to very dense.	X SPT 9		8-19-31 (50)							
45	XXXXXX											
50	XXXXXX		X SPT 10		11-20-23 (43)							
Bottom of borehole at 50.0 feet.												

GEOTECH BH COLUMNS - STANDARD TEMP.GDT - 5/17/12 15:38 - R:\GEOTECH PROJECTS BY NUMBER\2800-2899\91-02821-A TO 91-02829-A SSFUSD PHASE II\91-02821-A JUNIPERO SERRA ES\JUNIPERO SERRA ES.GPJ



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BORING NUMBER B-3

PAGE 1 OF 1

CLIENT South San Francisco Unified School District	PROJECT NAME Junipero Serra Elementary School
PROJECT NUMBER 91-02821-A	PROJECT LOCATION 151 Victoria Street, Daly City, CA
DATE STARTED 4/5/12 COMPLETED 4/5/12	GROUND ELEVATION 407 ft HOLE SIZE 8"
DRILLING CONTRACTOR Exp Geoservices	GROUND WATER LEVELS:
DRILLING METHOD HSA	AT TIME OF DRILLING ---
LOGGED BY RS CHECKED BY GH	AT END OF DRILLING --- No water was observed
NOTES	AFTER DRILLING ---

GEOTECH BH COLUMNS - STANDARD TEMP.GDT - 5/17/12 15:38 - R:\GEOTECH PROJECTS BY NUMBER\2800-2899\91-02821-A TO 91-02829-A SSFUSD PHASE II\91-02821-A JUNIPERO SERRA ES\JUNIPERO SERRA ES.GPJ

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
									LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0		4" THICK ASPHALT CONCRETE: 5" THICK AGGREGATE BASE:										
		(SC-SM) CLAYEY SAND: yellowish gray, moist, medium dense.	MC 1		4-6-15 (21)		99	24				
5		(SC-SM) CLAYEY SILTY SAND: yellowish gray, moist, medium dense.	MC 2		7-10-17 (27)		97	21				
10		(SC-SM) CLAYEY SILTY SAND: yellowish gray, moist, medium dense.	MC 3		3-5-6 (11)							
15		(SC-SM) SILTY SAND w/ CLAY: yellowish gray, moist, medium dense to dense.	SPT 4		13-14-16 (30)							
20		(SC-SM) becomes moist, medium dense.	SPT 5		9-9-11 (20)							
25												
30		(SM) SILTY SAND: grayish brown mottled, damp, very dense.	SPT 6		17-21-50 (71)							

Bottom of borehole at 30.0 feet.



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BORING NUMBER B-4

PAGE 1 OF 1

CLIENT South San Francisco Unified School District	PROJECT NAME Junipero Serra Elementary School
PROJECT NUMBER 91-02821-A	PROJECT LOCATION 151 Victoria Street, Daly City, CA
DATE STARTED 4/5/12 COMPLETED 4/5/12	GROUND ELEVATION 407 ft HOLE SIZE 8"
DRILLING CONTRACTOR Exp Geoservices	GROUND WATER LEVELS:
DRILLING METHOD HSA	AT TIME OF DRILLING ---
LOGGED BY RW CHECKED BY GH	AT END OF DRILLING --- No water was observed
NOTES	AFTER DRILLING ---

GEOTECH BH COLUMNS - STANDARD TEMP.GDT - 5/17/12 15:38 - R:\GEOTECH PROJECTS BY NUMBER\2800-2899\91-02821-A TO 91-02829-A SSFUSD PHASE II\91-02821-A JUNIPERO SERRA ES\JUNIPERO SERRA ES.GPJ

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS			FINES CONTENT (%)
									LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	
0		4" THICK ASPHALT CONCRETE: 5" THICK AGGREGATE BASE: (SM) SILTY SAND: gray/orange/brown, moist, dense, w/ trace of clay and bedrock fragments.	MC 1		5-7-12 (19)		101	19				
5			MC 2		5-8-10 (18)							
10		(SC) CLAYEY SAND: gray/orange/brown, moist, and medium dense.	MC 3		3-5-7 (12)		98	24				
15		increase in sand.										
20		(SM) SILTY SAND: gray, very moist, medium dense to dense, fine grained.	SPT 4		5-10-11 (21)							

Bottom of borehole at 20.0 feet.

APPENDIX B

LABORATORY TEST RESULTS

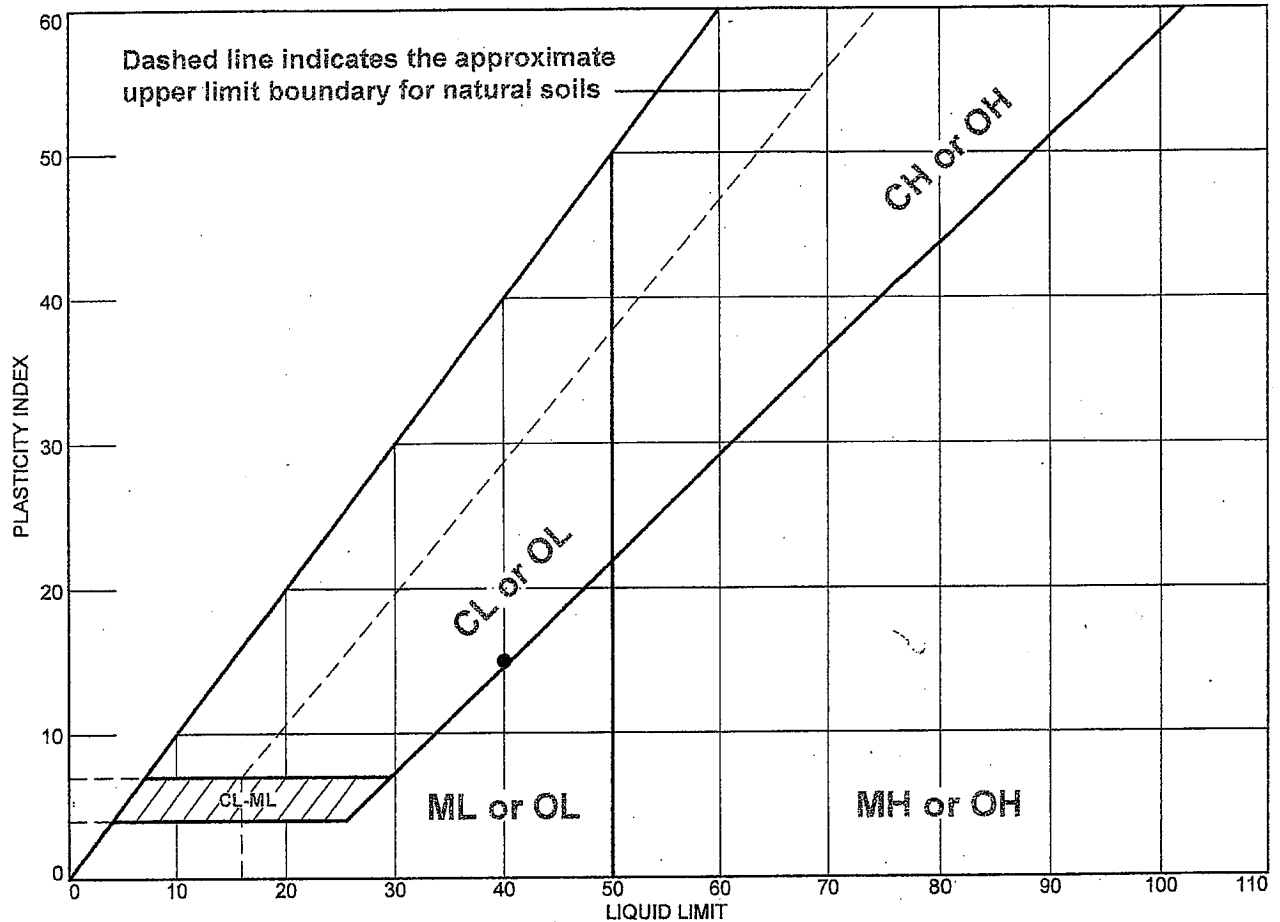
Atterberg Limits

Sieve Analysis

Direct Shear

Corrosion

LIQUID AND PLASTIC LIMITS TEST REPORT



MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
• Med.stiff,dark brown sandy CLAY(CL) with black organic lenses.	40	25	15			CL

Project No. 91-02821-A Client: Geosphere Consultants,Inc.

Project: Junipero Serra ES

• Location: B-1 Depth: 2-2.5' Sample Number: 1-1

Remarks:

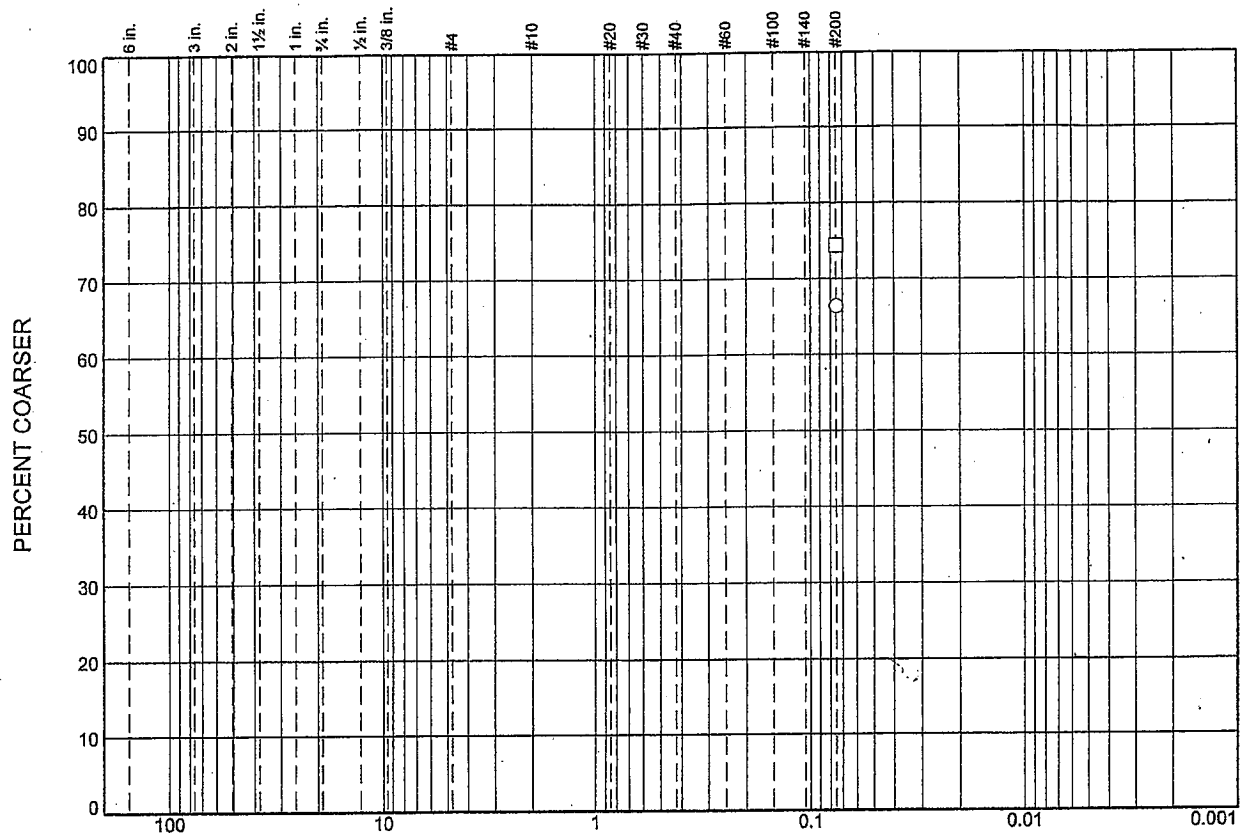
Soil Mechanics Lab

Oakland, California

Figure

Tested By: MA _____

Particle Size Distribution Report



GRAIN SIZE - mm.

	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○							66.4	
□							74.4	

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○		B2-5	19.5-20'	Very dark grey sandy CLAY.	CL
□		B2-7	29.5-30'	Dark brown sandy CLAY with fine gravel.	CL

Soil Mechanics Lab

Oakland, California

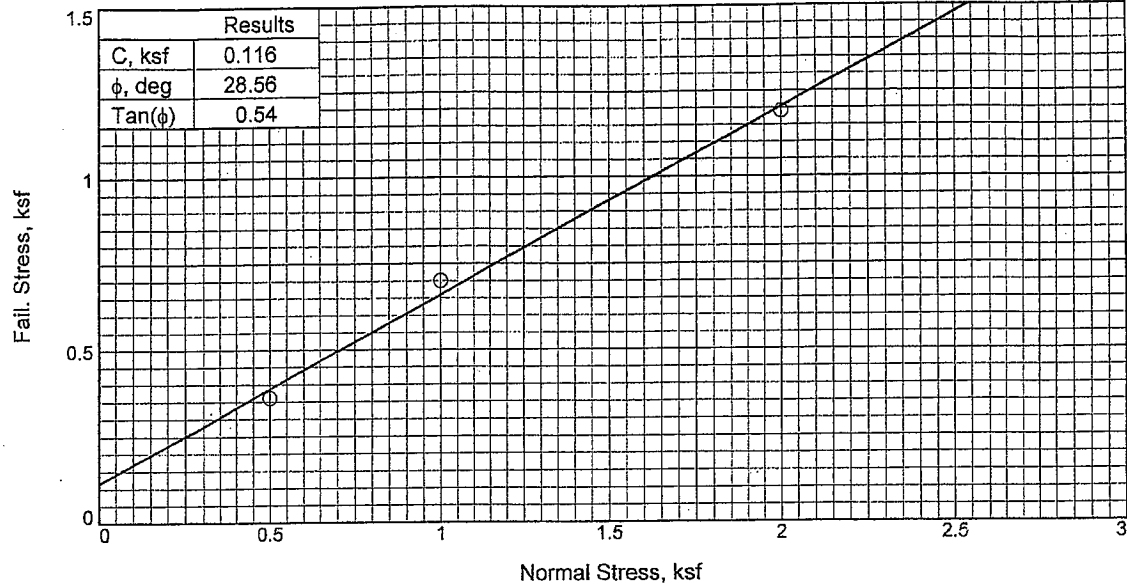
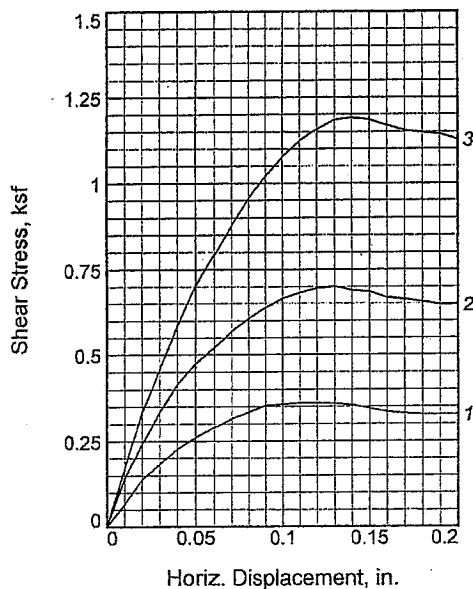
Client: Geosphere Consultants, Inc.

Project: Junipero Serra ES

Project No.: 91-02821-A

Figure

Tested By: MA



Sample No.		1	2	3
Initial	Water Content, %	27.0	27.0	27.0
	Dry Density, pcf	91.2	90.9	90.8
	Saturation, %	86.1	85.5	85.3
	Void Ratio	0.8484	0.8540	0.8567
	Diameter, in.	2.42	2.42	2.42
	Height, in.	5.20	1.00	1.00
At Test	Water Content, %	28.4	28.8	28.8
	Dry Density, pcf	91.2	91.0	90.9
	Saturation, %	90.6	91.3	90.9
	Void Ratio	0.8480	0.8520	0.8543
	Diameter, in.	2.42	2.42	2.42
	Height, in.	5.20	1.00	1.00
Normal Stress, ksf		0.500	1.000	2.000
Fail. Stress, ksf		0.361	0.701	1.191
Displacement, in.		0.11	0.13	0.14
Ult. Stress, ksf				
Displacement, in.				
Strain rate, in./min.		0.02	0.02	0.02

Sample Type: Mod.Cal.

Description: Med.stiff, dark brown sandy
CLAY(CL) with black organic lenses.

LL= 40 PL= 25 PI= 15

Assumed Specific Gravity= 2.70

Remarks:

Client: Geosphere Consultants, Inc.

Project: Junipero Serra ES

Location: B-1

Sample Number: 1-1

Depth: 2-2.5'

Proj. No.: 91-02821-A

Date Sampled:

DIRECT SHEAR TEST REPORT

Soil Mechanics Lab
Oakland, California

Figure _____

Tested By: MA **Checked By:** _____

[illegible]

APPENDIX C

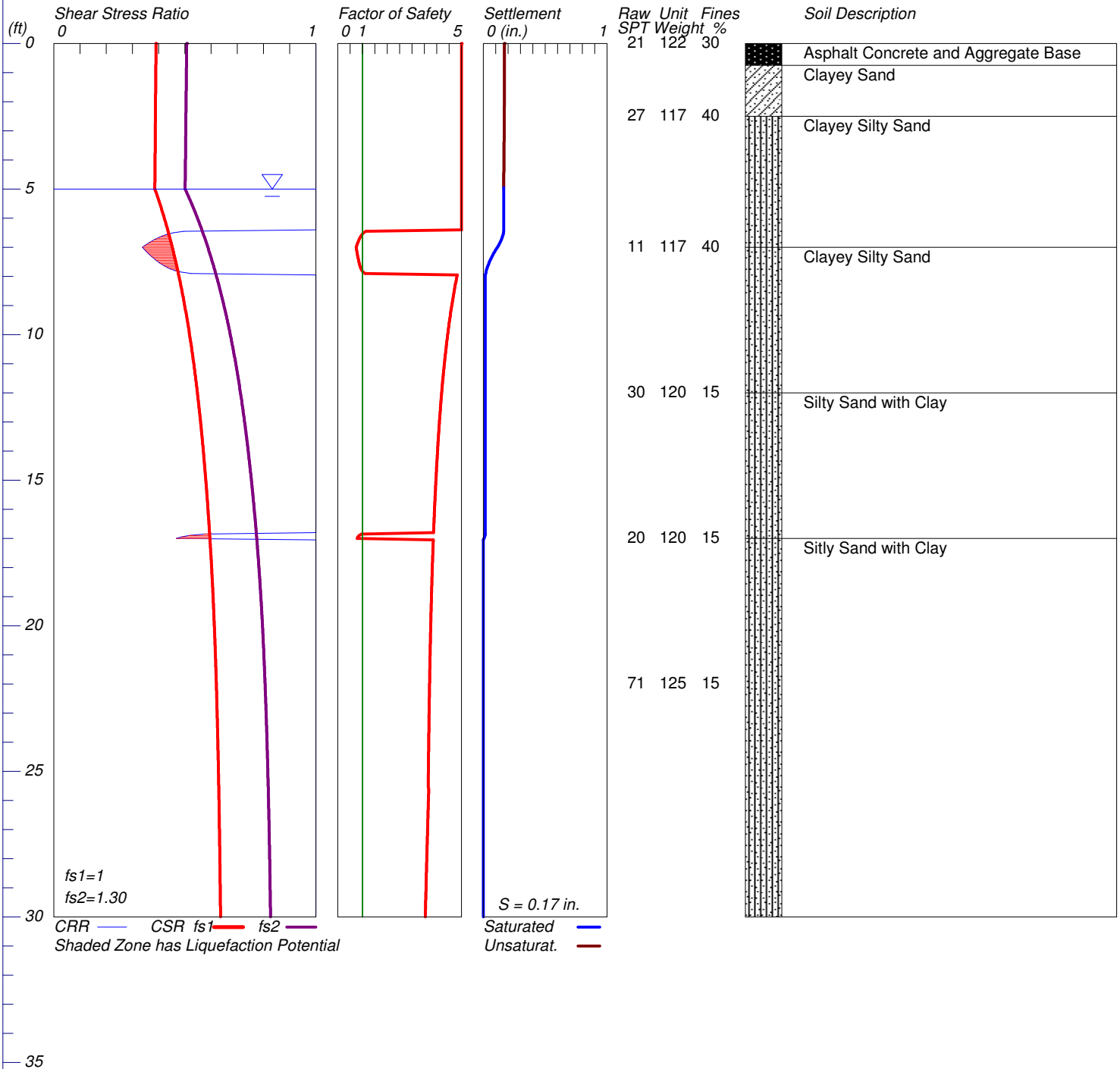
Liquefaction Analyses

LIQUEFACTION ANALYSIS

Junipero Serra Elementary School

Hole No.=B-3 Water Depth=5 ft Surface Elev.=407

Magnitude=7.1
Acceleration=0.6g



Liq Aanalysis - B-3

LIQUEFACTION ANALYSIS CALCULATION SHEET

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Input File Name: R:\Geotech Projects by Number\2800-2899\91-02821-A to
91-02829-A SSFUSD Phase II\91-02821-A Junipero Serra ES\Liquefaction Analysis\Liq
Aanalysis - B-3.liq
Title: Junipero Serra Elementary School
Subtitle: SSFUSD

Surface Elev.=407
Hole No.=B-3
Depth of Hole= 30.0 ft
Water Table during Earthquake= 5.0 ft
Water Table during In-Situ Testing= 30.0 ft
Max. Acceleration= 0.6 g
Earthquake Magnitude= 7.1

Input Data:

Surface Elev.=407
Hole No.=B-3
Depth of Hole=30.0 ft
Water Table during Earthquake= 5.0 ft
Water Table during In-Situ Testing= 30.0 ft
Max. Acceleration=0.6 g
Earthquake Magnitude=7.1

1. SPT or BPT Calculation.
2. Settlement Analysis Method: Ishihara / Yoshimine*
3. Fines Correction for Liquefaction: Stark/Olson et al.*
4. Fine Correction for Settlement: During Liquefaction*
5. Settlement Calculation in: All zones*
6. Hammer Energy Ratio, Ce = 1.25
7. Borehole Diameter, Cb= 1.15
8. Sampling Method, Cs= 1
9. User request factor of safety (apply to CSR) , User= 1.3
Plot two CSR (fs1=1, fs2=User)
10. Use Curve Smoothing: Yes*

* Recommended Options

In-Situ Test Data:

Depth ft	SPT	gamma pcf	Fines %
0.0	21.0	122.0	30.0
2.5	27.0	117.0	40.0
7.0	11.0	117.0	40.0
12.0	30.0	120.0	15.0
17.0	20.0	120.0	15.0
22.0	71.0	125.0	15.0
30.0	71.0	125.0	15.0

Liq Aanalysis - B-3

Output Results:

Settlement of Saturated Sands=0.16 in.
Settlement of Unsaturated Sands=0.01 in.
Total Settlement of Saturated and Unsaturated Sands=0.17 in.
Differential Settlement=0.086 to 0.113 in.

Depth ft	CRRm	CSRsf	F.S.	S_sat. in.	S_dry in.	S_all in.
0.00	2.30	0.39	5.00	0.16	0.01	0.17
0.05	2.30	0.39	5.00	0.16	0.01	0.17
0.10	2.30	0.39	5.00	0.16	0.01	0.17
0.15	2.30	0.39	5.00	0.16	0.01	0.17
0.20	2.30	0.39	5.00	0.16	0.01	0.17
0.25	2.30	0.39	5.00	0.16	0.01	0.17
0.30	2.30	0.39	5.00	0.16	0.01	0.17
0.35	2.30	0.39	5.00	0.16	0.01	0.17
0.40	2.30	0.39	5.00	0.16	0.01	0.17
0.45	2.30	0.39	5.00	0.16	0.01	0.17
0.50	2.30	0.39	5.00	0.16	0.01	0.17
0.55	2.30	0.39	5.00	0.16	0.01	0.17
0.60	2.30	0.39	5.00	0.16	0.01	0.17
0.65	2.30	0.39	5.00	0.16	0.01	0.17
0.70	2.30	0.39	5.00	0.16	0.01	0.17
0.75	2.30	0.39	5.00	0.16	0.01	0.17
0.80	2.30	0.39	5.00	0.16	0.01	0.17
0.85	2.30	0.39	5.00	0.16	0.01	0.17
0.90	2.30	0.39	5.00	0.16	0.01	0.17
0.95	2.30	0.39	5.00	0.16	0.01	0.17
1.00	2.30	0.39	5.00	0.16	0.01	0.17
1.05	2.30	0.39	5.00	0.16	0.01	0.17
1.10	2.30	0.39	5.00	0.16	0.01	0.17
1.15	2.30	0.39	5.00	0.16	0.01	0.17
1.20	2.30	0.39	5.00	0.16	0.01	0.17
1.25	2.30	0.39	5.00	0.16	0.01	0.17
1.30	2.30	0.39	5.00	0.16	0.01	0.17
1.35	2.30	0.39	5.00	0.16	0.01	0.17
1.40	2.30	0.39	5.00	0.16	0.01	0.17
1.45	2.30	0.39	5.00	0.16	0.01	0.17
1.50	2.30	0.39	5.00	0.16	0.01	0.17
1.55	2.30	0.39	5.00	0.16	0.01	0.17
1.60	2.30	0.39	5.00	0.16	0.01	0.17
1.65	2.30	0.39	5.00	0.16	0.01	0.17
1.70	2.30	0.39	5.00	0.16	0.01	0.17
1.75	2.30	0.39	5.00	0.16	0.01	0.17
1.80	2.30	0.39	5.00	0.16	0.01	0.17
1.85	2.30	0.39	5.00	0.16	0.01	0.17
1.90	2.30	0.39	5.00	0.16	0.01	0.17
1.95	2.30	0.39	5.00	0.16	0.01	0.17
2.00	2.30	0.39	5.00	0.16	0.01	0.17
2.05	2.30	0.39	5.00	0.16	0.01	0.17
2.10	2.30	0.39	5.00	0.16	0.01	0.17
2.15	2.30	0.39	5.00	0.16	0.01	0.17
2.20	2.30	0.39	5.00	0.16	0.01	0.17
2.25	2.30	0.39	5.00	0.16	0.01	0.17
2.30	2.30	0.39	5.00	0.16	0.01	0.17
2.35	2.30	0.39	5.00	0.16	0.00	0.17
2.40	2.30	0.39	5.00	0.16	0.00	0.17
2.45	2.30	0.39	5.00	0.16	0.00	0.17
2.50	2.30	0.39	5.00	0.16	0.00	0.17
2.55	2.30	0.39	5.00	0.16	0.00	0.17
2.60	2.30	0.39	5.00	0.16	0.00	0.17
2.65	2.30	0.39	5.00	0.16	0.00	0.17

Liq Aanalysis - B-3						
27.90	2.28	0.63	3.60	0.00	0.00	0.00
27.95	2.28	0.63	3.60	0.00	0.00	0.00
28.00	2.28	0.63	3.60	0.00	0.00	0.00
28.05	2.28	0.63	3.60	0.00	0.00	0.00
28.10	2.28	0.63	3.59	0.00	0.00	0.00
28.15	2.28	0.63	3.59	0.00	0.00	0.00
28.20	2.28	0.63	3.59	0.00	0.00	0.00
28.25	2.28	0.63	3.59	0.00	0.00	0.00
28.30	2.27	0.63	3.59	0.00	0.00	0.00
28.35	2.27	0.63	3.59	0.00	0.00	0.00
28.40	2.27	0.63	3.59	0.00	0.00	0.00
28.45	2.27	0.63	3.58	0.00	0.00	0.00
28.50	2.27	0.63	3.58	0.00	0.00	0.00
28.55	2.27	0.63	3.58	0.00	0.00	0.00
28.60	2.27	0.63	3.58	0.00	0.00	0.00
28.65	2.27	0.63	3.58	0.00	0.00	0.00
28.70	2.27	0.63	3.58	0.00	0.00	0.00
28.75	2.27	0.63	3.57	0.00	0.00	0.00
28.80	2.27	0.63	3.57	0.00	0.00	0.00
28.85	2.27	0.63	3.57	0.00	0.00	0.00
28.90	2.27	0.63	3.57	0.00	0.00	0.00
28.95	2.27	0.63	3.57	0.00	0.00	0.00
29.00	2.26	0.63	3.57	0.00	0.00	0.00
29.05	2.26	0.63	3.57	0.00	0.00	0.00
29.10	2.26	0.64	3.56	0.00	0.00	0.00
29.15	2.26	0.64	3.56	0.00	0.00	0.00
29.20	2.26	0.64	3.56	0.00	0.00	0.00
29.25	2.26	0.64	3.56	0.00	0.00	0.00
29.30	2.26	0.64	3.56	0.00	0.00	0.00
29.35	2.26	0.64	3.56	0.00	0.00	0.00
29.40	2.26	0.64	3.56	0.00	0.00	0.00
29.45	2.26	0.64	3.55	0.00	0.00	0.00
29.50	2.26	0.64	3.55	0.00	0.00	0.00
29.55	2.26	0.64	3.55	0.00	0.00	0.00
29.60	2.26	0.64	3.55	0.00	0.00	0.00
29.65	2.26	0.64	3.55	0.00	0.00	0.00
29.70	2.25	0.64	3.55	0.00	0.00	0.00
29.75	2.25	0.64	3.55	0.00	0.00	0.00
29.80	2.25	0.64	3.54	0.00	0.00	0.00
29.85	2.25	0.64	3.54	0.00	0.00	0.00
29.90	2.25	0.64	3.54	0.00	0.00	0.00
29.95	2.25	0.64	3.54	0.00	0.00	0.00
30.00	2.25	0.64	3.54	0.00	0.00	0.00

* F.S.<1, Liquefaction Potential Zone
(F.S. is limited to 5, CRR is limited to 2, CSR is limited to 2)

Units Depth = ft, Stress or Pressure = tsf (atm), Unit Weight =
pcf, Settlement = in.

CRRm	Cyclic resistance ratio from soils
CSRsf	Cyclic stress ratio induced by a given earthquake (with user
request factor of safety)	
F.S.	Factor of Safety against liquefaction, F.S.=CRRm/CSRsf
S_sat	Settlement from saturated sands
S_dry	Settlement from Unsaturated Sands
S_all	Total Settlement from Saturated and Unsaturated Sands
NoLiq	No-Liquefy Soils