Appendix E:
Geology and Soils Supporting Information

E.1 - Geotechnical Feasibility

MPEG MILLER PACIFIC ENGINEERING GROUP

GEOTECHNICAL FEASIBILITY EVALUATION
OAK HILL AT SAN QUENTIN MULTI-FAMILY RESIDENTIAL DEVELOPMENT
APN 018-152-12
SAN QUENTIN, CALIFORNIA

August 19, 2022

Project 1547.021

Prepared for:
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CERTIFICATION

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1.0 INTRODUCTION

This report summarizes Miller Pacific Engineering Group's (MPEG) Geotechnical Feasibility Evaluation for the proposed new Oak Hill at San Quentin multi-family residential development in San Quentin, California. As shown on Figure 1, the site is located along the north side of Sir Francis Drake Boulevard, just east of Drake's Cove Road.

Our services have been provided in accordance with our Agreement dated July 8, 2022. The purpose of our services is to investigate site geologic conditions, evaluate geologic hazards that may impact the site, and develop geotechnical recommendations and criteria for use in project planning, design, and construction.

In accordance with our proposal dated May 27, 2022, we are providing our geotechnical engineering services in four phases: 1) Preliminary Geotechnical Investigation, 2) Design-Level Geotechnical Investigation 3) Geotechnical Consultation and Plan Review, and 4) Geotechnical Observation and Testing during construction. As described in our proposal, the scope of our Preliminary Geotechnical Investigation includes the following:

- Review of published, readily-available geologic and geotechnical reference data from our in-house library and as supplied by the project team;

- Detailed site reconnaissance to observe and document existing conditions, map site surface geology, and evaluate apparent historic slope stability;

- Evaluation of relevant geologic hazards and development of conceptual mitigation measures;

- Development of preliminary geotechnical criteria, recommendations, and development guidelines for the work; and

- Preparation of this report summarizing our findings.

2.0 PROJECT DESCRIPTION

Based on our discussions with the project team and review of preliminary drawings, we understand the project generally includes development of an approximately six-acre, multi-story, multi-family residential complex. Although specific project details, including exact number of structures/stories, building footprints, limits of grading, and other items have not yet been finalized, we anticipate that grading, including new cuts and fills up to 30-feet or more, will be required for the project, and that retaining walls of similar height will be required to support excavations into the sloping terrain to support subterranean parking. Multi-story buildings are expected to generally impose moderate to heavy foundation loads. Ancillary improvements are expected to include exterior hardscape/flatwork and asphalt paving, new underground utilities, new site drainage, landscaping, and/or other "typical" residential items. No detailed structural information is available at this time. A Site Plan showing the conceptual extents of the planned improvements is presented on Figure 2.

3.0 SITE CONDITIONS

The project site occupies approximately 8-acres on the western portion of APN 018-152-12. A portion of the project site was formerly used as a shooting range associated with the nearby San Quentin State Prison. The site is generally located within a south-trending drainage and is flanked by relatively steep slopes to the north, east, and west that all slope down toward the center. Site elevations range from a minimum of about +22-feet along Sir Francis Drake Boulevard at the south end of the site to about +315-feet at the ridgeline to the north.

3.1 Regional Geology

The site is located within the Coast Range Geomorphic Province of California. The regional bedrock geology consists of complexly folded, faulted, sheared, and altered sedimentary, igneous, and metamorphic rock of the Jurassic-Cretaceous age (65 to 190 million years ago). The regional topography is characterized by northwest-southeast trending mountain ridges and intervening valleys that were formed as a result of tectonic activity between the North American Plate and the Pacific Plate. Extensive faulting during the Pliocene Age (1.8 to 7 million years ago) formed the uneven depression that is now the San Francisco Bay. The more recent tectonic activity within the Coast Range Geomorphic Province is concentrated along the San Andreas Fault zone, a complex group of generally parallel faults.

As shown on Figure 3, regional geologic mapping (Rice, S.J., et al., 1976) indicates the site is underlain by the debris field of extensive debris-flow landslides emanating from the slopes surrounding the site. The higher-elevation ridgelines surrounding the project site to the north, east, and west are mapped as Franciscan Mélange bedrock (Map Symbol, fm). Colluvial soil (Map Symbol, Qc) is mapped just south of the project site and artificial fill/Bay Mud (Map Symbol, Qaf/Qm) is mapped just south of Sir Francis Drake Boulevard, across from the project site.

Debris flow landslide deposits typically consist of unconsolidated and unsorted soil and rock debris that have moved downslope en masse or in increments by flow or creep processes. Franciscan Mélange is described as a tectonic mixture of resistance rock types, principally sandstone, chert, and metabasalt, embedded in a matrix of pervasively sheared shale. Colluvial soils consist of unconsolidated and unsorted soil material and weathered rock fragments that have accumulated on or at the base of slopes by natural gravitational or slope wash processes. Artificial fill is described as deposits of rock, soil, garbage and trash, or Bay Mud placed by man upon natural surfaces for engineering purposes, while Bay Mud consists of thick deposits of unconsolidated, low-density, highly compressible silty clay.

3.2 Seismicity

The project site is located within the seismically active San Francisco Bay Area and will therefore experience the effects of future earthquakes. Earthquakes are the product of the build-up and sudden release of strain along a “fault” or zone of weakness in the earth’s crust. Stored energy may be released as soon as it is generated, or it may be accumulated and stored for long periods of time. Individual releases may be so small that they are detected only by sensitive instruments, or they may be violent enough to cause destruction over vast areas.

Faults are seldom single cracks in the earth’s crust but are typically composed of localized shear zones which link together to form larger fault zones. Within the Bay Area, faults are concentrated along the San Andreas Fault zone. The movement between rock formations along either side of a fault may be horizontal, vertical, or a combination, and is radiated outward in the form of energy waves. The amplitude and frequency of earthquake ground motions partially depends on the material through which it is moving. The earthquake force is transmitted through hard rock in short, rapid vibrations, while this energy becomes a long, high-amplitude motion when moving through soft ground materials, such as Bay Mud.

3.2.1 Active Faults in the Region

The California Geological Survey (previously known as the California Division of Mines and Geology) defines a "Holocene-active fault" as one that has exhibited surface displacement within Holocene time (the last 11,700 years). CGS mapped various faults in the region as part of their Fault Activity Map of California (CGS, 2010). Many of these faults are shown in relation to the project site on the attached Active Fault Map, Figure 4. The nearest known Holocene-active faults are the San Andreas, San Gregorio, and Hayward Faults. The Hayward and San Andreas Faults are the nearest known active faults to the site and are located about 13.4-km northeast and 15.0-km southwest, respectively.

3.2.2 Historic Fault Activity

Numerous earthquakes have occurred in the region within historic times. The results of our USGS earthquake search catalogue indicates that at least 17 earthquakes with a Richter Magnitude of 5.0 or greater have occurred within 100 kilometers (62 miles) of the site between 1900 and 2022. Earthquakes (magnitude 5.0 and greater) that have occurred in the San Francisco Bay Area between 1830 to present day have been plotted on a map shown on Figure 5.

3.2.3 Probability of Future Earthquakes

The site will likely experience moderate to strong ground shaking from future earthquakes originating on any of several active faults in the San Francisco Bay region. The historical records do not directly indicate either the maximum credible earthquake or the probability of such a future event. To evaluate earthquake probabilities in California, the USGS has assembled a group of researchers into the "Working Group on California Earthquake Probabilities" (USGS, 2003, 2008; Field et al, 2015) to estimate the probabilities of earthquakes on active faults. These studies have been published cooperatively by the USGS, CGS, and Southern California Earthquake Center (SCEC) as the Uniform California Earthquake Rupture Forecast, Versions 1, 2, and 3. In these studies, potential seismic sources were analyzed considering fault geometry, geologic slip rates, geodetic strain rates, historic activity, micro-seismicity, and other factors to arrive at estimates of earthquakes of various magnitudes on a variety of faults in California.

The study specifically analyzed fault sources and earthquake probabilities for the seven major regional fault systems in the Bay Area region and the entire state of California and updated some of the analytical methods and models. The most recent 2015 study (UCERF3) further expanded the database of faults considered and allowed for consideration of multi-fault ruptures, among other improvements.

Conclusions from the most recent UCERF3 and USGS (Aagard et. Al., 2016) studies indicate there is a 72% probability of an earthquake with a magnitude greater than 6.7 originating on any of the active faults in the San Francisco Bay region by 2043. The Hayward and Rodgers Creek Faults are located approximately 13.4 kilometers and 25.3 kilometers northeast of the site, respectively, and are assigned a combined probability of 33 percent. The San Andreas Fault, located approximately 15.0 kilometers southwest of the site, is assigned a 22 percent probability of an earthquake with a magnitude greater than 6.7 by 2043. Additional studies by the USGS regarding the probability of large earthquakes in the Bay Area are ongoing. These current evaluations include data from additional active faults and updated geological data.

3.3 Review of Reference Documents

We reviewed several reference materials provided by the design team, each of which generally includes descriptions of subsurface exploration, laboratory testing, and site geologic conditions as interpreted by others. Materials we reviewed are discussed below, and the locations of relevant subsurface exploration data points are shown for reference on Figure 2.

- **Geotechnical Consultants, Inc., *Geotechnical Investigation, Central Marin Sanitation Agency, Wastewater Transport System*, Report ID SF80017, August 1981.**

  Subsurface exploration performed by Geotechnical Consulting Inc. (1981) for a then-proposed wastewater pipeline/tunnel system (currently existing force main) included rotary wash and rock core borings at various locations along a roughly northeast-southwest transect.

  Soil borings in the central and southern parts of the level, lower site area (Borings T-5, SP-1, and SP-2) generally encountered clayey to gravelly fills that range from about 6- to 20-feet thick, thickening to the south. Fills were underlain by a few feet of colluvial/residual soils and Franciscan bedrock.

  Borings performed at the north end of the graded area and along the ridgeline access road north of the site (Borings T-6 and T-1, respectively) each encountered Franciscan bedrock near the ground surface. No laboratory test results are shown on the logs, although some discussion of soil and rock materials properties is provided in the report and is stated to be based on laboratory testing.

- **AECOM, *Final Phase 1 Environmental Site Assessment, San Quentin Affordable Housing, San Quentin, California, Marin County APN 018-152-12*, Project No. 60631939, July 31, 2020.**

  AECOM's Phase 1 ESA includes a summary of historic topographic mapping spanning the time period between 1895 and 2012. All of the referenced topographic maps apparently show similar site conditions and generally indicate that, as of 1895, none of the site was inundated by San Pablo Bay. The report includes also copies of historical aerial photographs spanning the time period from 1946 to 2016. Photographs generally indicate relatively modest manmade development at the site over the years, limited primarily to development and later abandonment of a pistol shooting range and associated paths and roads. Notably, photographs indicate that the level shooting range areas in the central part of the site were apparently developed via excavation into the natural slope at the north edge of the lower site area and fill placement in the south-central part of the site.

- **AECOM, *Draft Limited Phase II Environmental Site Assessment Work Report, San Quentin Oak Hill Land Plot, San Quentin, California, APN 018-152-12,* April 11, 2022.**

  Subsurface exploration performed by AECOM for Phase II environmental work included advancement of eight relatively shallow direct-push borings to depths between about 5-

and 15-feet at the locations shown on Figure 2. Subsurface conditions generally consisted of silty to clayey fill and colluvial soils with minor sand and gravel. Borings SB3 and SB5, located along the west edge of the existing level pad, encountered bedrock at depths of 5-feet and 8-feet below ground surface, respectively.

3.4 Surface Conditions

We performed a detailed reconnaissance on July 12 and July 28, 2022 to observe and document current conditions and map site geology. While large portions of the site were overgrown and inaccessible, we observed artificially-made open drainage channels located near the westernmost drainage channel, and observed vegetation that suggests considerable amounts of water flow through the western region of the site. We also noted steep rill and gully erosion at the head of the westmost drainage channel which appeared to be the result of concentrated water flow from the access road above. The natural south- and west-facing slopes typically consist of 1- to 2-feet of loose, generally non-cohesive residual soils over shallow bedrock consisting of hard, highly weathered graywacke sandstone. Minor outcrops of meta-basalt (greenstone) and chert were observed, mainly within the eastern and southern areas of the site. The drainage channels appeared to be generally lined with exposed bedrock at the channel heads and we did not observe significant amounts of debris within the upslope portions of the channels. However, we were not able to observe any drainage channel in its entirety due to overgrowth. The density and general “in-place” nature of vegetation within the drainage channels suggest that soils have not moved significantly in recent times. Landslide deposits were observed at the south end of the project site (mapped on Figure 2) and appeared to be sourced from a small drainage channel just southeast of the existing paved lot.

3.5 Interpreted Subsurface Conditions

Based on previous subsurface exploration and site geologic mapping, the project site is underlain primarily by graywacke sandstone and shale bedrock of the Franciscan Complex. The graywacke is typically hard, strong, slightly to moderately weathered, and typically moderately fractured, although local zones of intensely fractured to crushed rock are indicated on reference boring logs. Shale is typically friable to weak and locally sheared.

While Franciscan rocks are exposed at or near the ground surface on slopes and ridgelines around the perimeter of the site, they are overlain by layers of artificial fill and native colluvium/residual soils that generally thicken to a maximum of about 26-feet near the south end of the site. Fill soils are predominantly clayey to gravelly, locally plastic, and are probably composed, at least in part, of Bay Mud. Colluvial and residual soils typically consist of clayey gravel that may locally be moderately plastic and expansive.

3.6 Groundwater

Subsurface exploration performed by AECOM (2020) does not indicate if groundwater was encountered in any of their borings.

Subsurface exploration performed by Geotechnical Consultants, Inc. (1981) indicated that borings TP-5 and SP-1, located within the southern half of the existing level pad area, had stabilized groundwater levels of 16-feet and 13-feet below ground surface, respectively. Boring SP-2, located near an area where we observed water ponding at the mouth of the western drainage gully, had a stabilized groundwater level of 2-feet below ground surface. Boring T-6 had a stabilized groundwater level of 3-feet below ground surface. Boring T-1 did not appear to encounter groundwater.

4.0 PRELIMINARY GEOLOGIC HAZARDS EVALUATION

The principal geologic hazards which could potentially affect the project site are strong seismic shaking from future earthquakes in the San Francisco Bay Region, slope instability/debris flow landsliding, differential settlement, and erosion. Other hazards, such as fault surface rupture, tsunami inundation, and others, are not considered significant at the site. More detailed discussion of each geologic hazard considered, their anticipated impacts, and recommended mitigation measures are discussed below.

4.1 Fault Surface Rupture

Under the Alquist-Priolo Earthquake Fault Zoning Act, the California Geological Survey (CDMG)/California Geologic Survey (CGS) (1972, 2000) produced 1:24,000 scale maps showing all known active faults and defining zones within which special fault studies are required. Based on currently available published geologic information, the project site is not located within an Alquist-Priolo Earthquake Fault Zone (CGS, 2018). The Hayward Fault is the nearest known active fault, located about 13.4-kilometers northeast. No evidence indicative of active or historic faulting was observed during our reconnaissance, either within or proximal to the site. Therefore, the potential for fault surface rupture on the campus is therefore considered to be low.

Evaluation:	*No significant impact.*
Recommendations:	*No special engineering measures are anticipated.*

4.2 Seismic Shaking

The site will likely experience seismic ground shaking from future earthquakes in the San Francisco Bay Area. Earthquakes along any of several active faults in the region, as shown on Figure 5, could cause moderate to strong ground shaking at the site.

4.2.1 Deterministic Seismic Hazard Analysis

Deterministic Seismic Hazard Analysis (DSHA) predicts the intensity of earthquake ground motions by analyzing the characteristics of nearby faults, distance to the faults and rupture zones, earthquake magnitudes, earthquake durations, and site-specific geologic conditions. Empirical relations (Abrahamson, Silva & Kamai, Boore, Stewart, Seyhan & Atkinson, Campbell & Borzognia, and Chiou & Youngs, (2014)) for the stiff soil subsurface conditions were utilized to provide approximate estimates of median peak site accelerations. A summary of the principal active faults affecting the site, their closest distance, moment magnitude of characteristic earthquake, probable median accelerations and plus one standard deviation ($+1\sigma$), peak ground accelerations (PGA) for earthquakes on faults near the site are shown in Table A.

TABLE A
DETERMINISTIC PEAK GROUND ACCELERATION
Oak Hill at San Quentin
Larkspur, California

Fault	Fault Distance[1]	Moment Magnitude[1]	Median PGA[1,2,3,4]	+1σ PGA[4]
Hayward	13.4 km	7.58	0.26 g	0.47 g
San Andreas	15.0 km	8.04	0.27 g	0.50 g
San Gregorio	16.6 km	7.44	0.21 g	0.38 g
Rodgers Creek	25.3 km	7.58	0.17 g	0.30 g
Calaveras FZ	30.9 km	7.43	0.13 g	0.23 g

Notes:

1. Values determined using Google Earth KML Files showing Quaternary Faults & Folds in the US obtained from USGS website August 1, 2022.
2. Values determined using USGS Earthquake Scenario Map (BSSC 2014), accessed 2022.
3. Values determined using V_{S30} = 760 m/s, for Site Class “C”.
4. Values determined using Pacific Earthquake Engineering Research Center (PEER) NGA-West2 Excel Spreadsheet, http://peer.berkeley.edu/ngawest2/databases/.

4.2.2 Probabilistic Seismic Hazard Analysis

Probabilistic Seismic Hazard Analysis (PSHA) analyzes all possible earthquake scenarios while incorporating the probability of each individual event to occur. The probability is determined in the form of the recurrence interval, which is the average time for a specific earthquake acceleration to be exceeded. The design earthquake is not solely dependent on the fault with the closest distance to the site and/or the largest magnitude, but rather the probability of given seismic events occurring on both known and unknown faults.

We calculated the PGA for two separate probabilistic conditions, the 2% chance of exceedance in 50 years (2,475-year statistical return period) and the 10% chance of exceedance in 50 years (475-year statistical return period), utilizing the online USGS Unified Hazard Tool (USGS, 2022). The results of the probabilistic analyses are presented below in Table B.

TABLE B
PROBABILISTIC SEISMIC HAZARD ANALYSES
Oak Hill at San Quentin
Larkspur, California

	Statistical Return Period	Magnitude	PGA
2% in 50 years	2,475 years	7.3	0.71 g
10% in 50 years	475 years	7.3	0.41 g

1. Reference: USGS Unified Hazard Tool accessed on August 1, 2022. Site Class C = 760 (m/sec)

The potential for strong seismic shaking at the project site is high. Due to its close proximity, the Hayward Fault (approximately 13.4-kilometers northeast of the site) presents the highest potential for strong ground shaking. The most significant adverse impact associated with strong seismic shaking is potential damage to structures and improvements.

Evaluation:	*Less than significant with special engineering measures.*
Recommendations:	*Minimum engineering measures should include designing the structures and foundations in accordance with the most recent version of the California Building Code (2019). Seismic design coefficients for the new improvements may vary across the site due to differing and gradational thicknesses of variable subsurface materials. Therefore, several different structural designs could be required for buildings underlain by materials of varying thickness or composition. Preliminary seismic design criteria are provided in Section 5 of this report. Once project plans are better-developed, final seismic design recommendations should be developed on the basis of final structure locations and interpreted subsurface conditions.*

4.3 Liquefaction Potential and Related Impacts

Liquefaction refers to the sudden, temporary loss of soil shear strength during strong ground shaking. Liquefaction-related phenomena include liquefaction-induced settlement, flow failure, and lateral spreading. These phenomena can occur where there are saturated, loose, granular deposits. Recent advances in liquefaction studies indicate that liquefaction can occur in granular materials with a high, 35 to 50%, fines content (soil particles that pass the #200 sieve), provided the fines exhibit a plasticity less than 7.

As shown on Figure 6, the project site lies within an area of "very low" liquefaction susceptibility (ABAG, 2022). Based on previous subsurface exploration by others, fill and colluvial soils underlying the central and southern parts of the site are predominantly fine-grained and probably not subject to liquefaction, while the remainder of the site is essentially underlain by non-liquefiable bedrock. Therefore, liquefaction and related phenomena are not anticipated to constitute a significant hazard at the project site.

Evaluation:	*Less than significant.*
Recommendations:	*No special engineering measures are anticipated.*

4.4 Seismically-Induced Ground Settlement

Seismic ground shaking can induce settlement of unsaturated, loose, granular soils. Settlement occurs as the loose soil particles rearrange into a denser configuration when subjected to seismic ground shaking. Previous subsurface exploration by others indicates that the relatively level portions of the site are underlain by predominately fine-grained, gravelly silt and clay fill/colluvial soils. Therefore, we judge seismically induced ground settlement is a low to moderate risk at the project site.

Evaluation: *Less than significant with special engineering measures.*
Recommendations: *Design foundations to extend through any loose/medium dense surface soil and gain support in stiff soil or rock.*

4.5 Lurching and Ground Cracking

Lurching and associated ground cracking can occur during strong ground shaking. The ground cracking generally occurs along the tops of slopes where stiff soils are underlain by soft deposits or along steep slopes or channel banks. In general, conditions conducive to lurching and ground cracking are not present throughout most of the development area, although some ground cracking may be anticipated along existing access roads on the upper surrounding slopes where over-steepened roadway fills exist.

Evaluation: *No significant impact.*
Recommendations: *No mitigation measures are anticipated.*

4.6 Erosion

Sandy soils on moderate slopes or clayey soils on steep slopes are susceptible to erosion when exposed to concentrated water runoff. The risk of erosion will be increased where established vegetation is removed by grading or construction activity.

During our reconnaissance, we noted that existing drainages on the northern and eastern sides of the development area are deeply-incised, with flanking slopes exposing relatively thin, silty to sandy soils over shallow bedrock. Given the combination of steeply-inclined slopes and relatively cohesionless soils, we judge there is a high risk of erosion in the sloping parts of the site.

Evaluation: *Less than significant with special engineering measures.*
Recommendations: *Mitigation measures include designing a site drainage system to collect surface water and discharging it into an established storm drainage system. The project Civil Engineer of Architect is responsible for designing the site drainage system and, an erosion control plan could be developed prior to construction per the current guidelines of the California Stormwater Quality Association's Best Management Practice Handbook (2015).*

4.7 Seiche and Tsunami

Seiche and tsunamis are short duration, earthquake-generated water waves in large, enclosed bodies of water and the open ocean, respectively. The extent and severity of a seiche or tsunami would be dependent upon ground motions and fault offset from nearby active faults. The project site is not mapped within a tsunami inundation zone (ABAG, 2022). Therefore, seiche and tsunami events are not considered significant geologic hazards at the site.

Evaluation:	*No significant impact.*
Recommendations:	*No special engineering measures are anticipated.*

4.8 Flooding

As shown in Figure 7, the project site is mapped within a FEMA 500-year flood zone (ABAG, 2022); therefore, large-scale flooding may be considered to present a moderated risk of damage.

Evaluation:	*Less than significant with special engineering measures.*
Recommendations:	*Special engineering measures should include designing finished floor elevations above County flood elevation minimums. Evaluation of potential long-term settlements should also be performed as part of a design-level investigation so that settlement estimates can be incorporated into finished floor elevation calculations. Careful consideration should be given to design of finished grades and site drainage to minimize the potential for damage due to flooding. Additional discussion and recommendations for site grading and drainage are provided in Section 5 of this report. The project Civil Engineer should design the site drainage system to accommodate anticipated runoff and should consider the potential for flooding and ponding of water during design of site finished grades.*

4.9 Dam Failure Inundation

Based on the Marin County Dam Inundation Map (Marin County GeoHub, 2022), the site is not located within a Dam Failure Inundation zone. Therefore, the risk of inundation due to dam failure is judged low.

Evaluation:	*No significant impact.*
Recommendations:	*No special engineering measures are anticipated.*

4.10 Expansive Soil

Expansive soils will shrink and swell with fluctuations in moisture content and are capable of exerting significant expansion pressures on building foundations, interior floor slabs, and exterior flatwork. Distress from expansive soil movement can include cracking of brittle wall coverings (stucco, plaster, drywall, etc.), racked door and/or window frames, and uneven floors and cracked slabs. Flatwork, pavements, and concrete slabs-on-grade are particularly vulnerable to distress due to their low bearing pressures.

Review of previous subsurface exploration by others indicates that much of the fill material underlying the southern and central parts of the site is composed in part of moderately- to highly-plastic clays, the risk of expansive soil affecting the proposed improvements appears low to moderate. Although we did not observe significant evidence of expansive native soils, we judge there is a moderate risk of damage where old Bay Mud or other expansive materials have been placed as fill.

Evaluation:	*Less than significant with special engineering measures.*
Recommendations:	*The potential for expansive soils should be addressed on the basis of subsurface exploration and laboratory testing performed as part of a design-level Investigation. It is anticipated that, if special engineering measures are required to reduce the effects of moderately-expansive soils, such measures could include localized removal and replacement with non-expansive materials, design of thicker and/or internally reinforced pavement and flatwork sections, use of void forms or heavier foundation elements, or other options depending on the extents/depths of expansive soil deposits and project grading plans.*

4.11 Settlement/Subsidence

Significant settlement can occur when new loads are placed at sites due to consolidation of soft compressible clays (i.e., Bay Mud) or compression of loose granular soils. Previous subsurface exploration by others indicates up to 15- to 26-feet of fill and colluvial/alluvial soils, consisting predominantly of gravelly clay and silt, underlie the relatively level central and southern portions of the site.

Based on review of historic air photos and previous exploration by others, we judge it is unlikely the site is underlain by Bay Mud. However, given the extents and apparent thickness of existing undocumented fills, we judge there is a moderate to high risk of “traditional” consolidation settlement under new loads. Additionally, we judge there is a high risk of differential settlement where structures will span the transition between material of varying support capacity, such as from bedrock to compacted fill.

Evaluation:	*Less than significant with special engineering measures.*
Recommendations:	*The potential for total and differential settlements should be evaluated on the basis of further plan development along with subsurface exploration, laboratory testing, and engineering analyses performed as part of a future design-level Investigation. Preliminary recommendations and discussion regarding probable foundation types and site grading considerations are presented in Section 5 of this report.*

4.12 Slope Instability/Landsliding

Slope instability generally occurs on relatively steep slopes and/or on slopes underlain by weak materials. Regional geologic mapping (Rice, S.J., et al., 1976) indicates that the site is underlain by the debris fields of large debris-flow landslides originating near the ridgelines north and east of the site. Notably, previous site-specific mapping from 1981 does not indicate any significant landslides.

During our reconnaissance, we observed that steeply-inclined slopes north, west, and east of the site are typically underlain by relatively thin layers of loose silty to sandy residual soils over relatively shallow Franciscan bedrock. We did not observe significant evidence of recent or incipient (developing) slope instability (such as fresh scarps, tension cracks, debris piles, toe bulges, etc.) during our site reconnaissance. We did observe one apparent older debris-flow landslide in the southeast corner of the site (shown on Figure 2), which appears to be a few feet deep and originate near a contact between chert and sandstone bedrock.

Based on our observations, the prominent gullies to the north of the site appear to be the result of downcutting and erosion along bedrock contacts or shear zones. We judge that, under static conditions, sloping portions of the site will likely be prone to localized shallow slumps and debris flows, especially during or following heavy rains. It is anticipated that a higher risk of more significant debris flows, possibly involving the upper few feet of sheared, weathered bedrock, under seismic conditions. We judge there is a moderate to high risk of damage to improvements due to slope instability.

In addition to instability of existing natural slopes, we understand that new permanent cut and fill slopes are planned around the site. We judge that, in general, there is a low risk of instability affecting these slopes provided they are designed in conformance with the recommendations in Section 5 of this report and any subsequent design-level recommendations.

Evaluation:	*Less than significant with special engineering measures.*
Recommendations:	*The potential for slope instability and attendant debris impact to new improvements should be carefully considered during project design. Preliminary plans indicate that, in most areas, new structures will be provided with some setback from the toe of surrounding slopes by planned access roads and landscaping areas, which we judge is appropriate. Engineering measures to reduce the risk of damage due to debris flows in the prominent gullies north of the site could consist of soldier-pile catchment walls or Geobrugg-type ring-net debris barriers. The potential for debris impact and need for structural protection should be evaluated in more detail as project design advances.*

4.13 Soil Corrosion

Corrosive soil can damage buried metallic structures, cause concrete spalling, and deteriorate rebar reinforcement. Bay Mud deposits and fill soils in areas immediately proximal to the saltwater body of San Francisco Bay are typically high in soluble salts. Elsewhere, colluvial/residual soils and Franciscan sandstone and shale bedrock are most often non- to slightly-corrosive. Therefore, we anticipate a low risk of damage to the proposed improvements by corrosive soils.

Evaluation:	*No significant impact.*
Recommendations:	*The potential for soil corrosion should be further evaluated on the basis of subsurface exploration and laboratory testing performed as part of a design-level Investigation. If corrosion is deemed a hazard, mitigation measures would typically consist of specifying construction materials for new improvements which are either corrosion-protected or non-corrosive.*

4.14 Radon-222 Gas

Radon-222 is a product of the radioactive decay of uranium-238 and raduim-226, which occur naturally in a variety of rock types, mainly phosphatic shales, but also in other igneous, metamorphic, and sedimentary rocks. While low levels of radon gas are common, very high levels, which are typically caused by a combination of poor ventilation and high concentrations of uranium and radium in the underlying geologic materials, can be hazardous to human health.

The project site is located in Marin County, California, which is mapped in radon gas Zone 3 by the United States Environmental Protection Agency (USEPA, 2022). Zone 3 is classified by the

EPA as exhibiting a "low" potential for Radon-222 gas with average predicted indoor screening levels less than 2 pCi/L. Therefore, the potential for hazardous levels of radon at the project site is low.

Evaluation: *No significant impact.*
Recommendations: *No mitigation measures are anticipated.*

4.15 Volcanic Eruption

Several active volcanoes with the potential for future eruptions exist within northern California, including Mount Shasta, Lassen Peak, and Medicine Lake in extreme northern California, the Mono Lake-Long Valley Caldera complex in east-central California, and the Clear Lake Volcanic Field, located in Lake County approximately 72 miles north of the project site. The most recent volcanic eruption in northern California was at Lassen Peak in 1917, while the most recent eruption at the nearest volcanic center to the project site, the Clear Lake Volcanic Field, was about 10,000 years ago. All of northern California's volcanic centers are currently listed under "normal" volcanic alert levels by the USGS California Volcano Observatory (USGS, 2022). While the aforementioned volcanic centers are considered "active" by the USGS, the likelihood of damage to the proposed improvements due to volcanic eruption is generally low.

Evaluation: *No significant impact.*
Recommendations: *No mitigation measures are anticipated.*

4.16 Naturally Occurring Asbestos (NOA)

Naturally occurring asbestos is commonly found in association with serpentinite and associated ultramafic rock types, including basalt, meta-basalt, greenstone, and derivative metamorphic rocks. These rocks are a major constituent of the Franciscan Complex, which underlies vast portions of the greater San Francisco Bay Area, including the project site (albeit at variable depths beneath local young soil deposits).

Based on our site reconnaissance and previous subsurface exploration by others, Franciscan materials underlying the site consist primarily of graywacke sandstone and shale, with lesser minor outcrops of greenstone/meta-basalt and chert. No occurrences of serpentinite are indicated on reference boring logs, and we did not observe evidence of serpentinite or associated asbestos during our reconnaissance. Although materials derivative of ultramafic rocks (greenstone) do appear to be locally present, we judge the likelihood that significant quantities of naturally-occurring asbestos are encountered at the site is generally low.

Evaluation: *No significant impact.*
Recommendations: *No special engineering measures are anticipated. The potential for NOA may be evaluated in more detail in the event serpentinite or related rocks are encountered during subsurface exploration performed as part of a future design-level Investigation.*

5.0 PRELIMINARY CONCLUSIONS AND RECOMMENDATIONS

Based on our experience with similar projects in the area, we conclude that the proposed improvements are feasible from a geotechnical perspective. The primary geotechnical issues to be considered during project design include providing adequate seismic design, providing adequate settlement mitigation and uniform foundation support, providing adequate and effective site drainage, and providing adequate protection from potential debris-flow landslides originating on surrounding slopes.

As previously noted, this report is preliminary in nature, and supplemental subsurface exploration, laboratory testing, and engineering analysis will be required to develop design-level criteria and recommendations for specific structures and improvements. Preliminary geotechnical recommendations and development guidelines to assist in project planning and preliminary design are provided in the following sections.

5.1 Preliminary Seismic Design

The project site is located within a seismically active area. Therefore, structures should be designed in conformance to the seismic provisions of the latest edition of the California Building Code (2019 CBC). However, since the goal of the building code is protection of life safety, some structural damage may still occur during strong ground shaking.

Based on interpreted subsurface conditions, most of the site likely will be designated Site Class "C". As such, we recommend the criteria shown in Table C for preliminary seismic design of new structures.

TABLE C
PRELIMINARY 2019 CBC FACTORS
Oak Hill at San Quentin
Larkspur, California

Factor Name	Coefficient	2019 CBC Site Specific Value
Site Class[1]	$S_{A,B,C,D,E,\text{ or }F}$	S_C
Spectral Acc. (short)	S_S	1.50 g
Spectral Acc. (1-sec)	S_1	0.60 g
Spectral Response (short)	SM_S	1.80 g
Spectral Response (1-sec)	SM_1	0.84 g
Design Spectral Response (short)	SD_S	1.20 g
Design Spectral Response (1-sec)	SD_1	0.56 g
MCE_G[2] PGA adjusted for Site Class	PGA_M	0.611 g
Seismic Design Category	A,B,C,D, or E	D

Notes:
1. Site Class C Description: "Very Dense Soil and Rock" profile with shear wave velocities between 1,200 and 2,500 ft/sec, Standard Penetration Test (SPT) blow counts greater than 50 blows per foot, and undrained shear strength greater than 2,000 psf.
2. Maximum Considered Earthquake Geometric Mean.

5.2 Probable Foundation Types

Where new structures are located around the perimeter of the development in areas underlain by Franciscan bedrock, shallow foundations are likely appropriate provided they bear directly and uniformly on weathered rock. Where new structures will span a cut/fill transition, deep foundations extending through the fill into underlying bedrock should be used. Where structures will be underlain entirely by undocumented fills, or where significant new fill/structural loads may require long-term settlement mitigation, then more careful consideration should be given to the interaction between site grading, foundations, and settlement.

There are several alternative approaches by which mitigation for total and differential settlements (both as a result of structural loading and liquefaction induced) and uniform foundation support for the structure may be provided. These alternatives include utilization of specialized ground-improvement techniques or a “zero net load” in conjunction with shallow foundations or construction of a deep foundation system. Each option is discussed in greater detail below:

Shallow Foundations with “Zero Net Loading”

To reduce total and differential settlement to acceptable levels, the weight of the structure may be effectively offset by over-excavating and removing an equivalent weight of soil by creating a deepened crawl space or basement. Alternatively, the building footprint could be over-excavated and backfilled with a low-density material such as Geofoam or lava rock. The depth of the required over-excavation would be dependent on the building weight and amount of soil removal needed to create a net “zero” load after the structure has been constructed.

Over-excavating and replacing with lightweight fill would reduce the total and differential settlement, but would not completely eliminate it. The columns and perimeter walls will create zones of higher pressure as compared to open interior areas. This uneven load distribution will result in some differential settlement. The amount of settlement is dependent on the rigidity of the mat slab and ability to spread and distribute the loads. The slab itself should also be capable of spanning areas of differential settlement and provide enough support to minimize structural damage.

Ground Improvement with Shallow Foundations

Another option for foundations and settlement mitigation is to couple subsurface improvements that increase soil bearing capacity with a shallow foundation system. Drill Displacement Columns (DDC) involve drilling to design depths and injecting Controlled Low Strength Material (CLSM) under pressure, which creates large diameter, well defined, compaction columns and effectively increases soil strength. DDC does not structurally connect to the foundation and therefore requires a subsequent shallow foundation. Other ground-improvements options include deep soil-cement mixing (DSCM), whereby Portland cement is mixed continuously with soil to create overlapping columns of increased strength, and “geopiers” or stone columns, where columns of dense aggregate are created by “vibro-replacement”, which reinforces soft native soils.

Deep Foundations

A deep foundation system which gains support in firm material beneath any compressible horizons should provide good long-term performance with minimal anticipated settlement. There are several alternative deep foundation systems which may be considered for the project, including traditional cast-in-drilled-hole (CIDH) concrete piers, auger-cast concrete piers (ACP), driven concrete or steel piles, and “torque-down” piles (TDP). While each system should provide comparable performance and settlement mitigation, variations in cost and constructability should be considered during selection of the “preferred” system.

Traditional CIDH piers will result in the need for offhaul and disposal or re-use of drilling spoils which, depending on the results of environmental testing performed for the project, may incur additional hazardous material testing, transport, and disposal costs. Auger-cast pile (ACP) construction avoids this complexity by effectively using the hollow drill auger as temporary casing and pumping concrete directly into the excavation as the auger is withdrawn, but requires the use of specialty equipment which is very large and costly to mobilize. While not as much as CIDH construction, ACP construction will still result in the need for some spoils offhaul.

Driven piles, which do not require spoils offhaul or stabilization of excavations, have been successfully utilized on nearby projects of similar scale. However, they may be difficult to acquire permits for given the site’s location in a central business/residential district and the noise, vibration, and general disturbance inherent to the pile-driving process. Additionally, driven piles require the use of specialty equipment which, like ACP equipment, will be very large and potentially cost-prohibitive for a project of this scale.

Of the options presented above, we judge torque-down piles (TDP) may be the most effective alternative from a level-of-cost and constructability standpoint. TDP consists of full-displacement large-diameter welded steel pipe fitted with a proprietary conical tip and helical auger flight. The pile is effectively “screwed” into the ground by a large drilling rig until such depth is reached that the required pile load capacity is achieved. Vertical capacity is achieved via a combination of skin friction and end bearing, while lateral capacity is gained through the bending moment of the pipe. Lateral capacity may be increased by filling the TDP with concrete upon installation. The main advantages of the system include the efficiency with which piles can be constructed, the avoidance of constructability considerations such as excavation casing and de-watering, minimization of ancillary labor and materials costs (including concrete and steel rebar placement and construction) the lack of required spoils offhaul, and the minimal disturbance to lands both on- and off-site.

5.3 Site Grading Considerations

Although much of the proposed work area is relatively level, we understand that extensive site grading, including new cuts and fills of up to 30-feet or more, may be required for the new development. In general, we expect the most significant cuts will occur around the northern perimeter of the project and involve deep excavation on relatively steep slopes, while fill placement will probably be concentrated in the central part of the site, possibly overlapping with the extents of existing undocumented fills.

Excavations in areas underlain by fill or colluvial soils, as shown on Figure 2, will likely encounter gravelly to clayey/silty soils, and can most likely be accomplished using “traditional” techniques and equipment, such as medium- to large-size dozers and excavators. Deeper excavations into Franciscan bedrock, either beneath the surface soils or where exposed around the site perimeter, could locally encounter zones of particularly hard rock that require special techniques or equipment, such as hoe-rams, heavy ripper shanks, or blasting, to excavate. If desired, rippability/excavation difficulty can be assessed on the basis of supplemental subsurface geophysical work or local deep rock core borings once planned excavation locations/depths are better-defined. Regardless, we recommend inclusion of a line item and clear definition for “hard rock excavation” in the eventual bid documents.

Excavations in areas underlain by undocumented fill soils will likely generate clayey to gravelly mixtures that could be suitable for re-use as fill, provided they can be processed to meet the preliminary criteria shown below. If and where old Bay Mud or other plastic or expansive clays exist they will not be suitable for re-use as fill and should be removed from the site. Excavations in bedrock may yield significant quantities of oversize material that require substantial processing for re-use as fill.

New fill slopes should be no steeper than 2:1 (horizontal:vertical) and should be founded on keyways and benches in accordance with the current standard of geotechnical practice. Fill slopes steeper than 2:1 need to be specifically evaluated and designed. Subdrains should be provided for benches and keyways, and the collected drainage conveyed in a “tight pipe” system to a safe discharge location. A schematic detail for hillside fill construction is shown on Figure 8.

Permanent cut slopes in soils and softer rock should be limited to 2:1. In harder rock, cut slopes may be steeper, but orientation of rock fractures and bedding must be considered in design-level investigations to reduce risks of “block” failures or other rockfall types.

5.4 Retaining Walls

New retaining walls will likely be required to retain new cuts and fills around the site. For new fills, gravity or mechanically-stabilized earth (MSE) walls (such as Versa-Lok, Keystone, or equivalent) are often the most cost-effective. For cut areas, reinforced concrete or shotcrete and soil nail/rock bolt are likely the most cost-efficient options.

Based on our review of preliminary plans, new improvements are planned in relatively close proximity to the mouths of the incised drainages at the north end of the site. In order to minimize the potential for debris flows to impact the development, we recommend a catchment structure be considered. A soldier-pile and timber-lagging wall is likely the most cost-effective structure, but if aesthetics or other considerations warrant the increased costs, other retaining or catchment structures, such as a soil nail and shotcrete wall, Geobrugg-type debris barrier, or Tecco mesh system could be considered. New catchment structures should be designed on the basis of debris volume and runout distance analyses performed as part of a future design-level Investigation.

All retaining walls over 3-feet high should be properly engineered and provided with back-of-wall drainage. A schematic detail for retaining wall backdrains is presented on Figure 9.

5.5 Site and Foundation Drainage

Although the site currently contains slopes that will drain, there is a possibility that new grading could result in adverse drainage patterns and water ponding around buildings. Careful consideration should therefore be given to design of finished grades at the site. We recommend that landscaped areas adjoining new structures be sloped downward at least 0.25 feet for 5 feet (5%) from the perimeter of building foundations. Where hard surfaces, such as concrete or asphalt adjoin foundations, slope these surfaces at least 0.10 feet in the first 5 feet (2%). Roof gutter downspouts may discharge onto the pavements but should not discharge onto any landscaped areas. Provide area drains for landscape planters adjacent to buildings and parking areas and collect downspout discharges into a nonperforated pipe collection system.

Subsurface drainage should be provided along the upslope side of new structures where no retaining wall and integral backdrain is planned, and should also be considered at the mouths of the prominent drainages where ponding water is evident or anticipated. All subsurface drainage should be designed as an independent system and not connected to any surface drainage element. All collected runoff should be discharged at a safe location unlikely to result in new erosion. In general, provided percolation rates allow, we judge that infiltration of stormwater runoff may be appropriate in the lower-lying, relatively level parts of the site. Specific details of site drainage should be designed by the project civil engineer.

6.0 SUPPLEMENTAL GEOTECHNICAL SERVICES

When project plans are more fully developed, a design-level geotechnical investigation will be required to further evaluate liquefaction and settlement as well as develop design-level recommendations and criteria for use in design and construction of the project. We expect that some consultation with the design team will be required to balance hazard mitigation with cost-effective design, and we should review project plans and specifications when they are nearing completion to ensure that the intent of our recommendations has been sufficiently incorporated.

7.0 LIMITATIONS

This report has been prepared in accordance with generally accepted geotechnical engineering practices in the San Francisco Bay Area at the time the report was prepared. This report has been prepared for the exclusive use of Education Housing Partners and/or its assignees specifically for this project. No other warranty, expressed or implied, is made. Our evaluations and recommendations are based on the data obtained during our subsurface exploration program and our experience with soil conditions in this geographic area.

Our approved scope of work did not include an environmental assessment of the site. Consequently, this report does not contain information regarding the presence or absence of toxic or hazardous wastes.

The evaluations and recommendations do not reflect variations in subsurface conditions that may exist between boring locations or in unexplored portions of the site. Should such variations become apparent during construction, the general recommendations contained within this report will not be considered valid unless MPEG is given the opportunity to review such variations and revise or modify our recommendations accordingly. No changes may be made to the general recommendations contained herein without the written consent of MPEG.

We recommend that this report, in its entirety, be made available to project team members, contractors, and subcontractors for informational purposes and discussion. We intend that the information presented in this report be interpreted only within the context of the report as a whole. No portion of this report should be separated from the rest of the information presented herein. No single portion of this report shall be considered valid unless it is presented with and as an integral part of the entire report.

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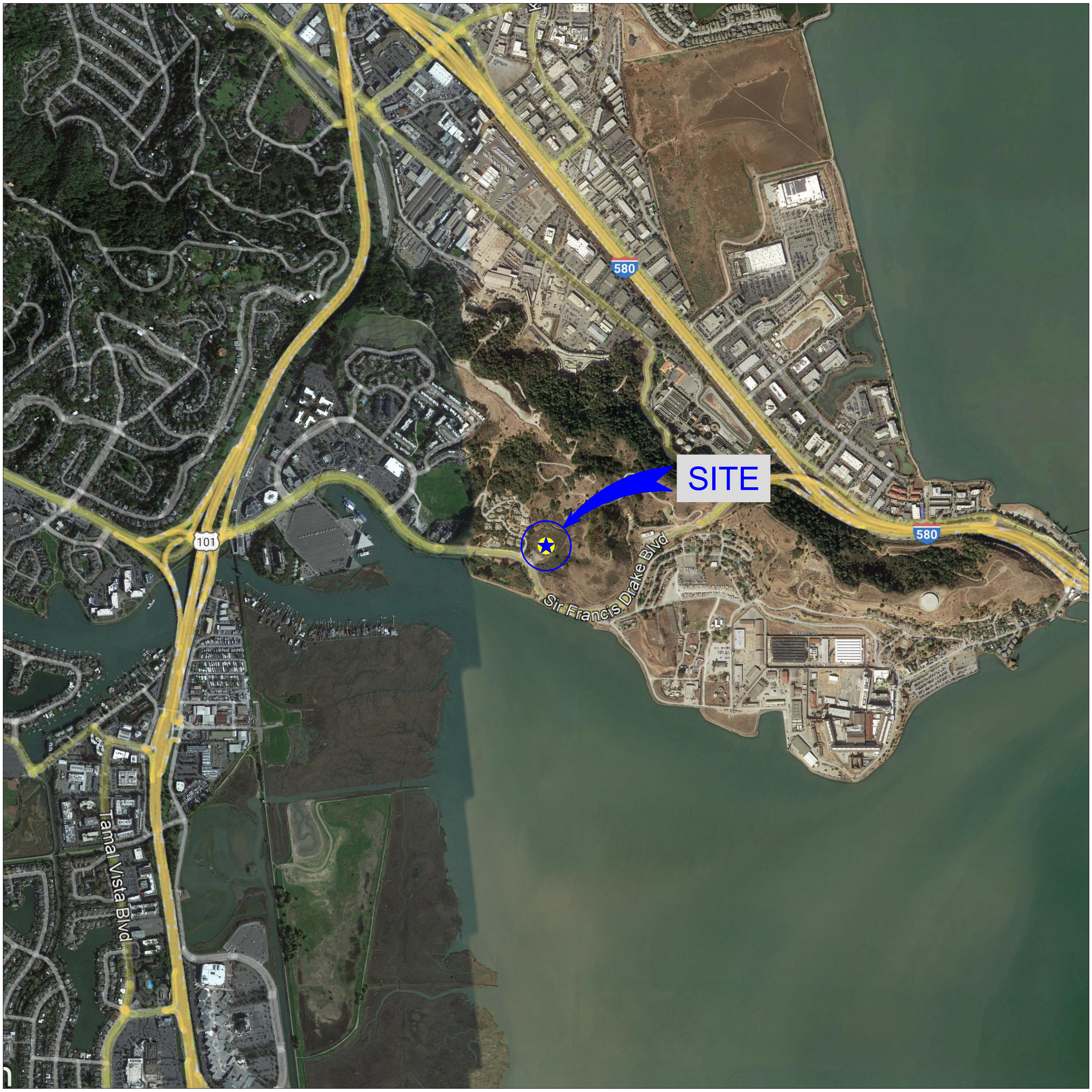

SITE COORDINATES
LAT. 37.94456°
LON. -122.50111°

SITE LOCATION

N.T.S.

NORTH

REFERENCE: Google Earth, 2022

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SITE LOCATION MAP

Oak Hill at San Quentin
Sir Francis Drake Boulevard
San Quentin, California

Project No. 1547.021
Date: 8/12/2022

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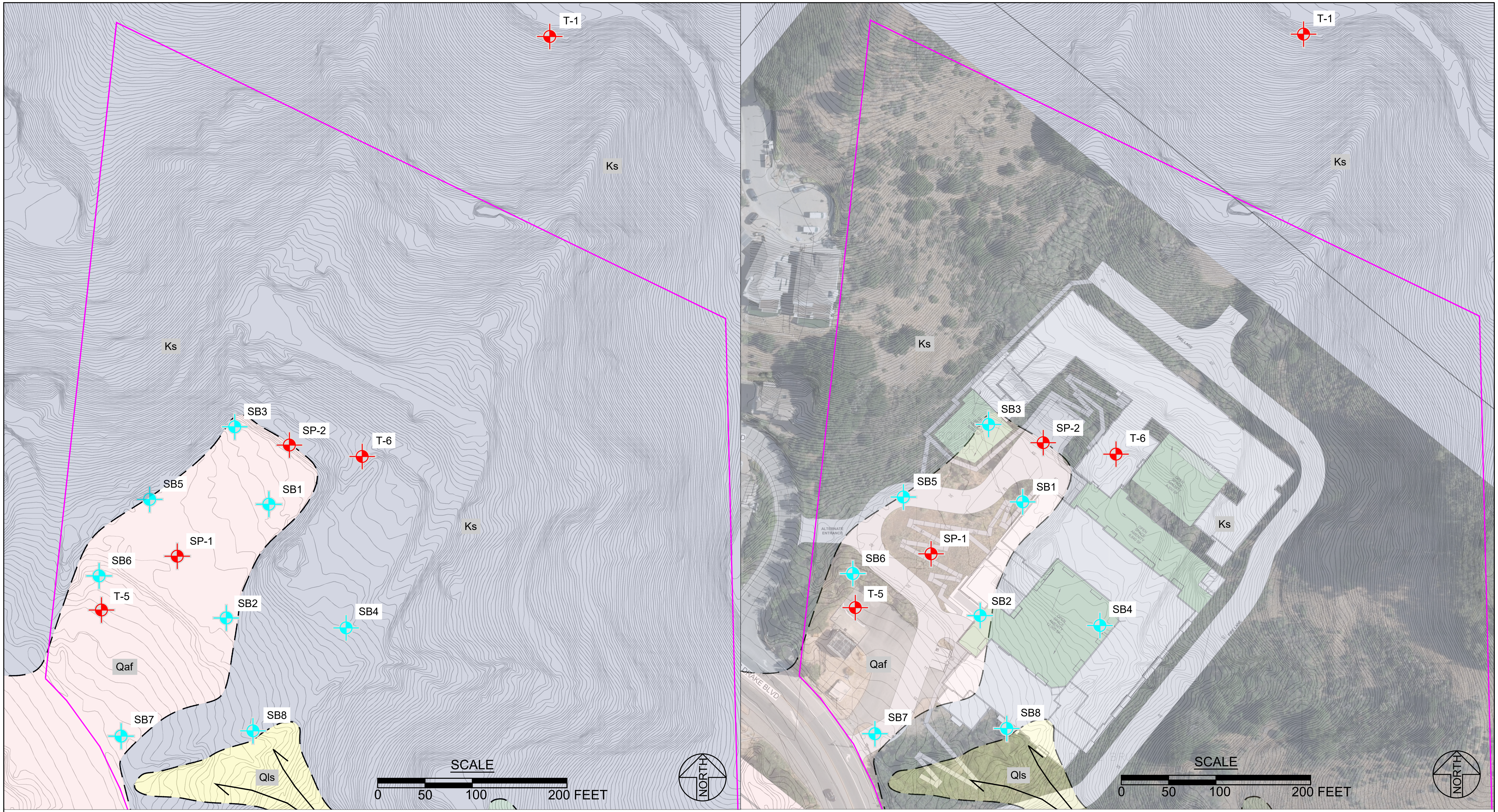
FIGURE



LEGEND

Qaf	**Artificial Fill** [Quaternary] - Deposits of rock, soil, garbage and trash, or bay mud placed by man upon natural surfaces, mostly for engineering purposes. Highly variable as to composition, degree of compaction, etc.
Qls	**Debris Flow Landslides** [Quaternary] - Predominately deposits of unconsolidated and unsorted soil and rock debris that have moved downslope en masse or in increments by flow or creep processes.
—	**Approx. Project Boundary**
Ks	**Sandstone and Shale** [Cretaceous] - Sandstone is mainly thick bedded, medium- to coarse-grained arkose and arkose-wacke, light gray where fresh, but buff to almost white in typical weathered exposures. Shale is gnerally well-bedded siltstone, dark gray where fresh, light gray, buff, or stained brown by iron oxides where weathered.
⊕	**Approx. location of borings completed by AECOM, 2022.**
⊕	**Approx. location of borings completed by Geotechnical Consultants, Inc., 1980.**

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SITE PLAN AND GEOLOGIC MAP

Oak Hill at San Quentin
Sir Francis Drake Boulevard
San Quentin, California

Project No. 1547.021
Date: 8/12/2022

Designed
Drawn EIC
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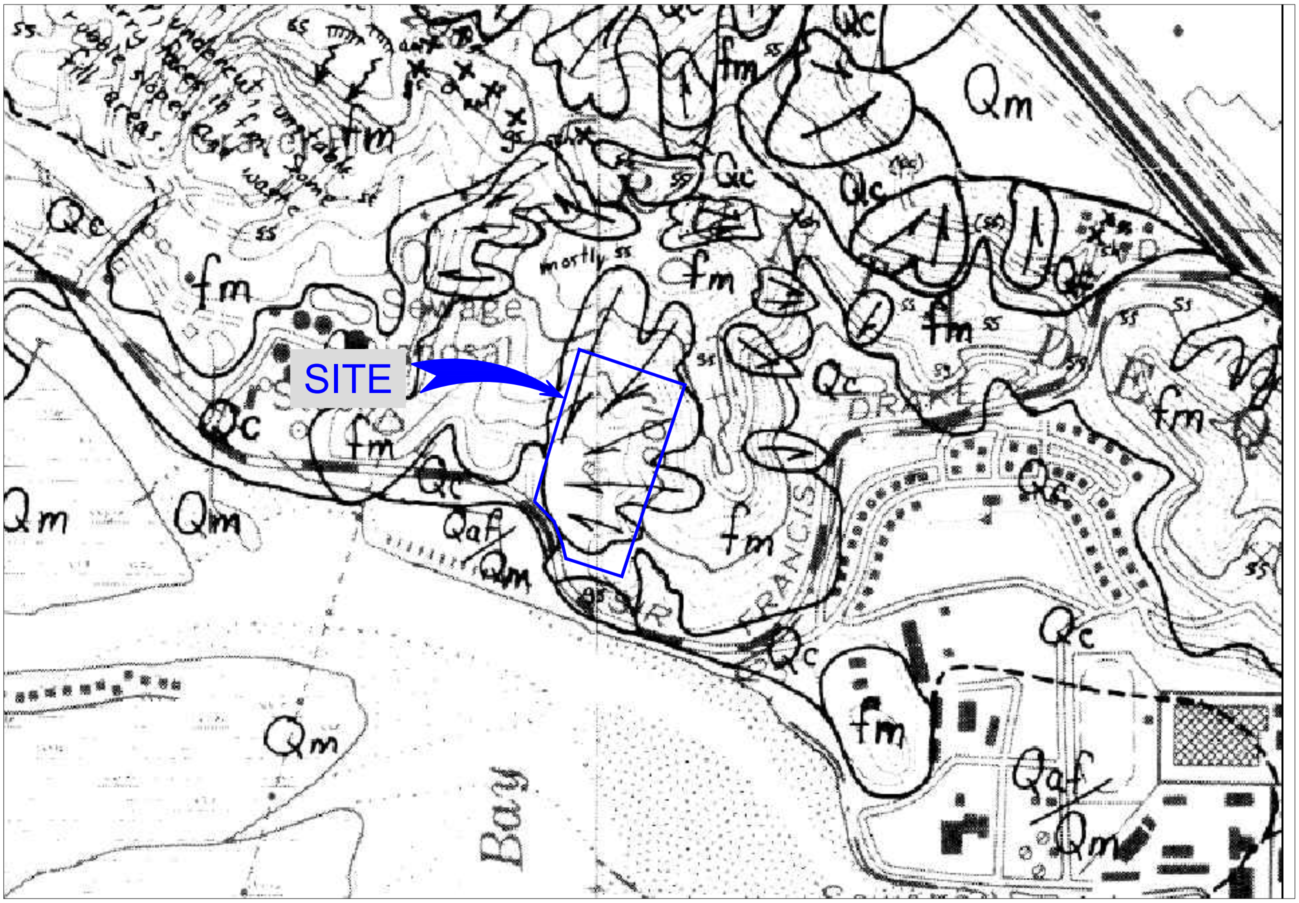
FIGURE



REGIONAL GEOLOGIC MAP

NORTH

LEGEND

Qaf **Artificial Fill** [Quaternary] - Deposits of rock, soil, garbage and trash, or bay mud placed by man upon natural surfaces, mostly for engineering purposes. Highly variable as to composition, degree of compaction, etc. **Qaf/Qm** indicates artificial fill placed on bay mud.

Debris Flow Landslides [Quaternary] - Predominately deposits of unconsolidated and unsorted soil and rock debris that have moved downslope en masse or in increments by flow or creep processes.

Block Slump Landslides [Quaternary] - Masses of relatively intact to highly disrupted bedrock that have moved downslope by rotational slip along deep concave slip planes, or rarely, by translational slip along planar surfaces.

Qm **Bay Mud** [Quaternary] - Thick deposits of unconsolidated, low-density, semi-fluid, highly compressible, highly impermeable silty clay. Contains lenses of peat and likely contains lenses of sand in many areas.

Qc **Colluvium** [Quaternary] - Unconsolidated and unsorted soil material and weathered rock fragments accumulated on or at the base of slopes by natural gravitational or slope wash processes. Derived by weathering and decomposition of bedrock materials underlying the slopes.

fm **Franciscan Melange** [Jurassic-Cretaceous] - A tectonic mixture consisting of small to large masses of resistant rock types, principally of sandstone (**ss**), greenstone (**gs**), chert (**ch**) and serpentine (**sp**), but including various exotic metamorphic rock types, embedded in a matrix of pervasively sheared or pulverized rock material.

REFERENCE: Rice, S.J., Strand, R.G., Smith, T.C., (1976) 'Geology of the Eastern Part of the San Rafael Area, Marin County, California', California Division of Mines and Geology, Open File Report 76-2 S.F., Plate 1C, Scale 1:24,000.

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REGIONAL GEOLOGIC MAP

Oak Hill at San Quentin
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Project No. 1547.021 Date: 8/12/2022

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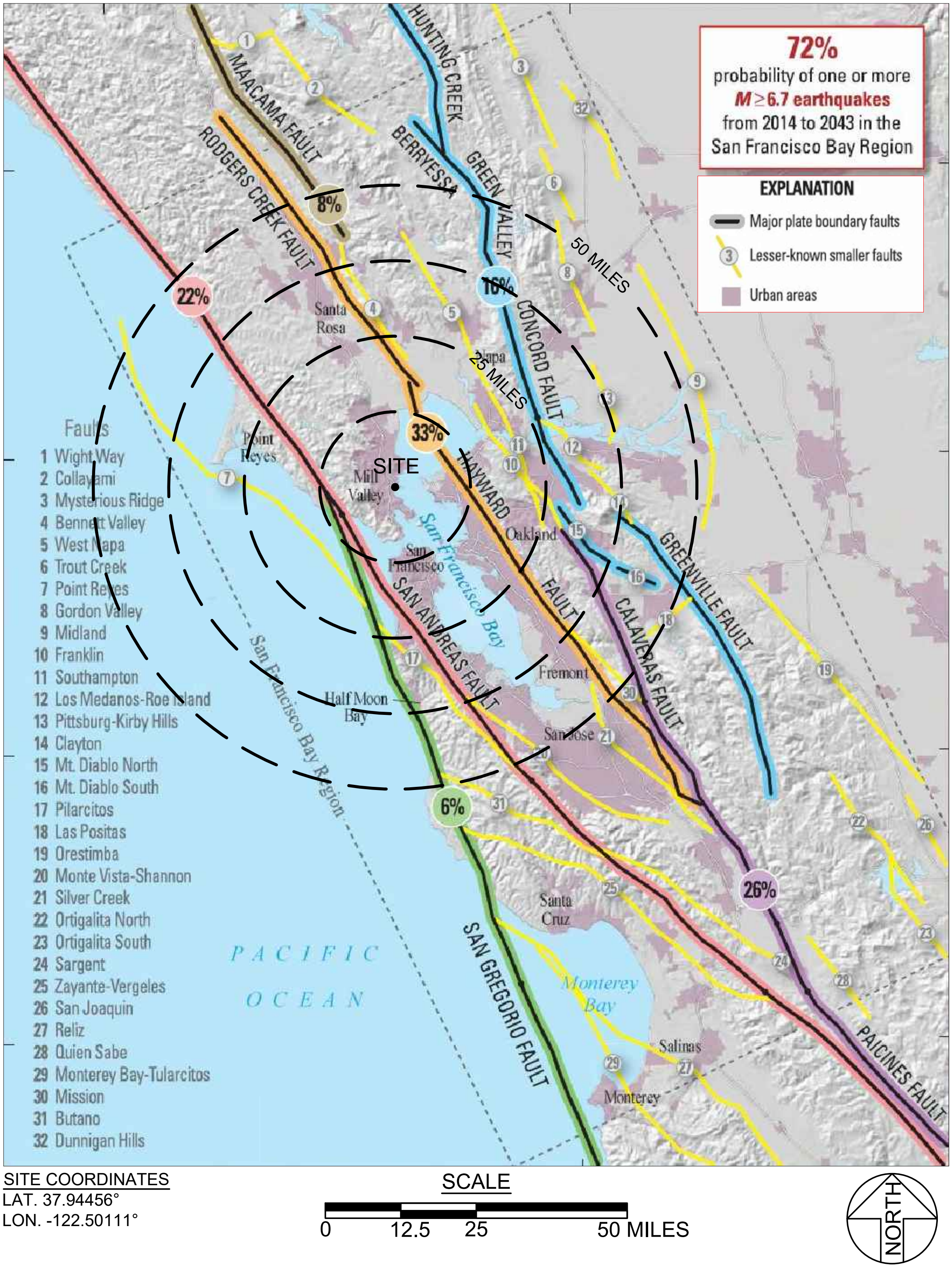
FIGURE



SITE COORDINATES

LAT. 37.94456°

LON. -122.50111°

DATA SOURCE:

1) U.S. Geological Survey, U.S. Department of the Interior, "Earthquake Outlook for the San Francisco Bay Region 2014-2043", Map of Known Active Faults in the San Francisco Bay Region, Fact Sheet 2016-3020, Revised August 2016 (ver. 1.1).

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ACTIVE FAULT MAP

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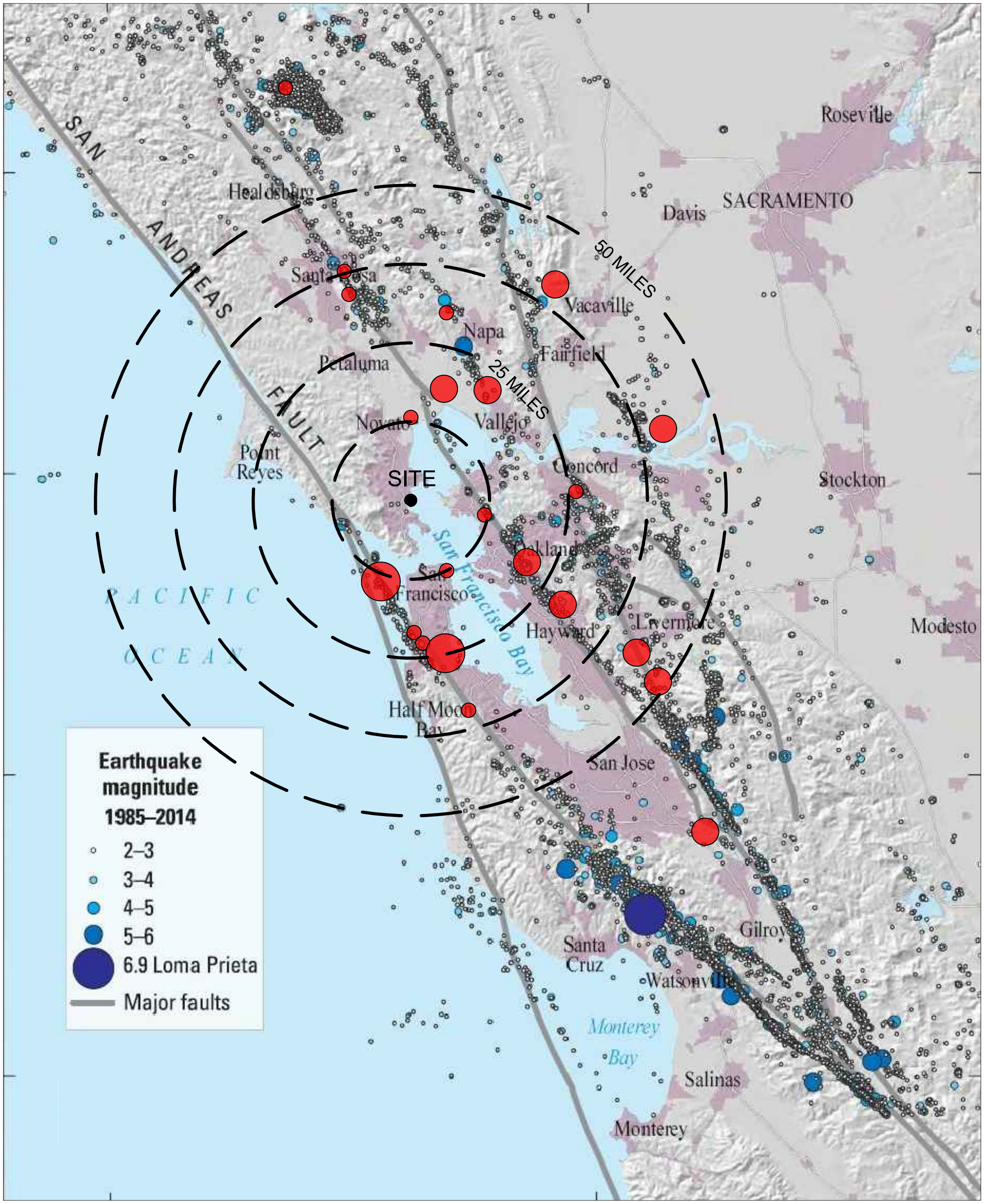

SITE COORDINATES
LAT. 37.94456°
LON. -122.50111°

SCALE
0 12.5 25 50 MILES

NORTH

LEGEND & DATA SOURCE:

● ● ● See legend above. U.S. Geological Survey, U.S. Department of the Interior, "Earthquake Outlook for the San Francisco Bay Region 2014-2043", Map of Known Active Faults in the San Francisco Bay Region, Fact Sheet 2016-3020, Revised August 2016 (ver. 1.1).

● ● ● Large circles indicate earthquakes M>7.0, medium circles indicate 6.0<M<7.0 and small circles indicate 5.0<M<6.0 .U.S. Geological Survey, Earthquake Catalog Search, https://earthquake.usgs.gov/earthquakes/search/. Earthquakes between 1830 and 2021.

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HISTORIC EARTHQUAKE MAP

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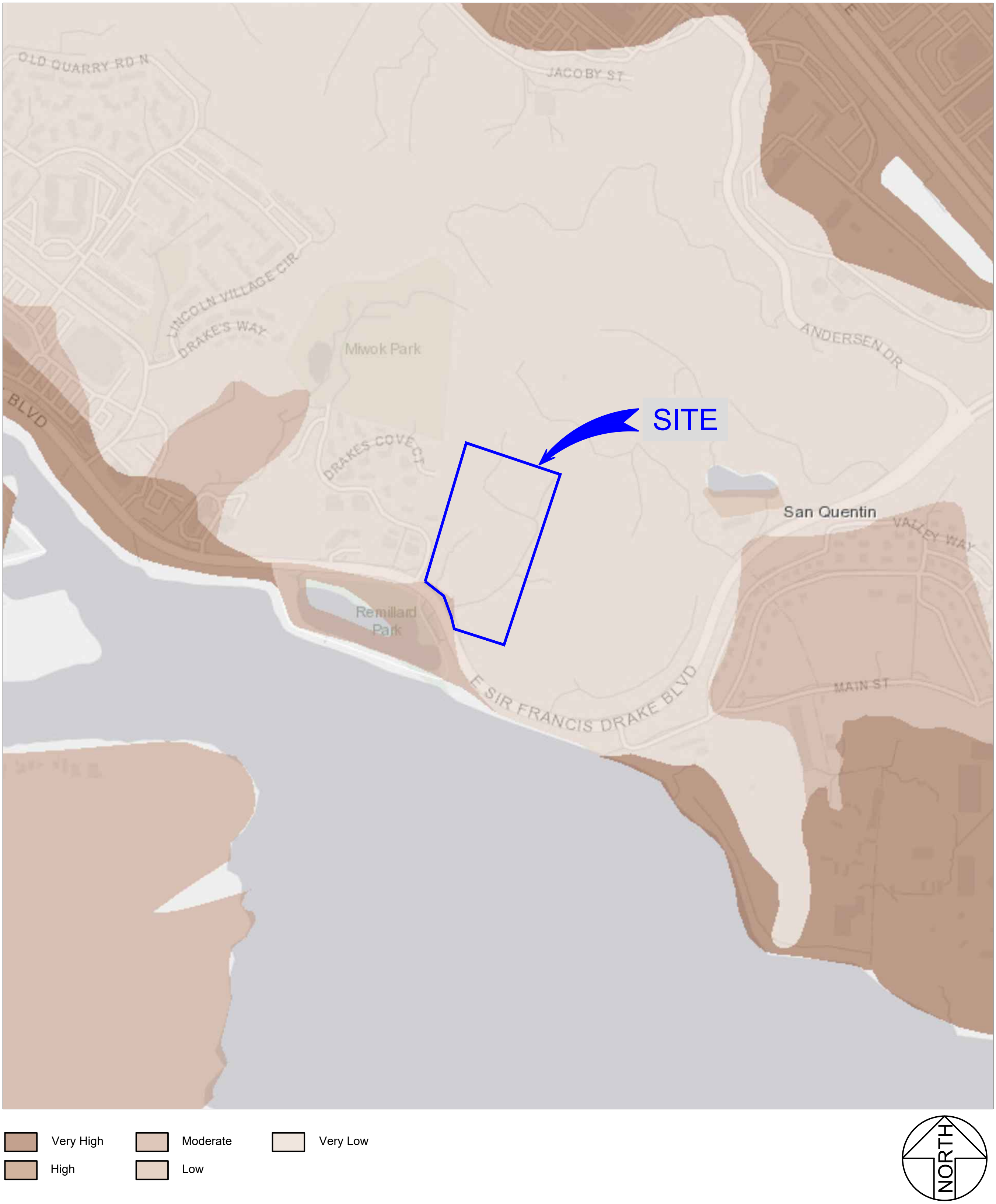

REFERENCE: ABAG Hazard Viewer, 2022

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LIQUEFACTION SUSCEPTIBILITY MAP

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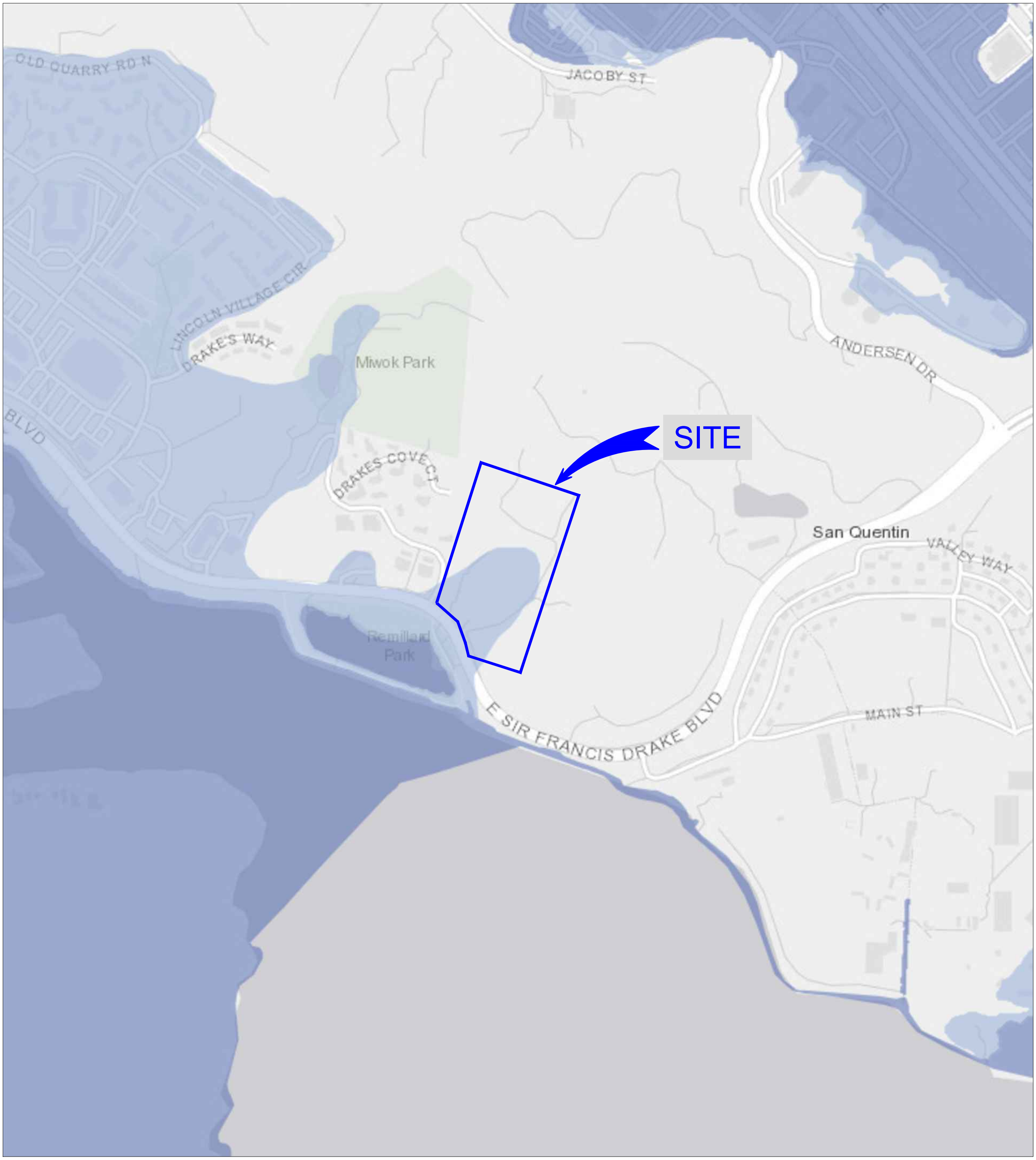
6
FIGURE



▨	Zone A- 100yr.
▨	Zone X - 500yr.

Zone A: This identifies an area inundated by 1% annual chance flooding.

Zone X 500yr: This identifies an area inundated by .02% annual chance flooding and area inundated by 1% annual chance of flooding with average depth of less than 1 foot of with drainage areas less than 1 square mile or an area protected by levees form 1% annual chance flooding.

NORTH

REFERENCE: ABAG Hazard Viewer, 2022

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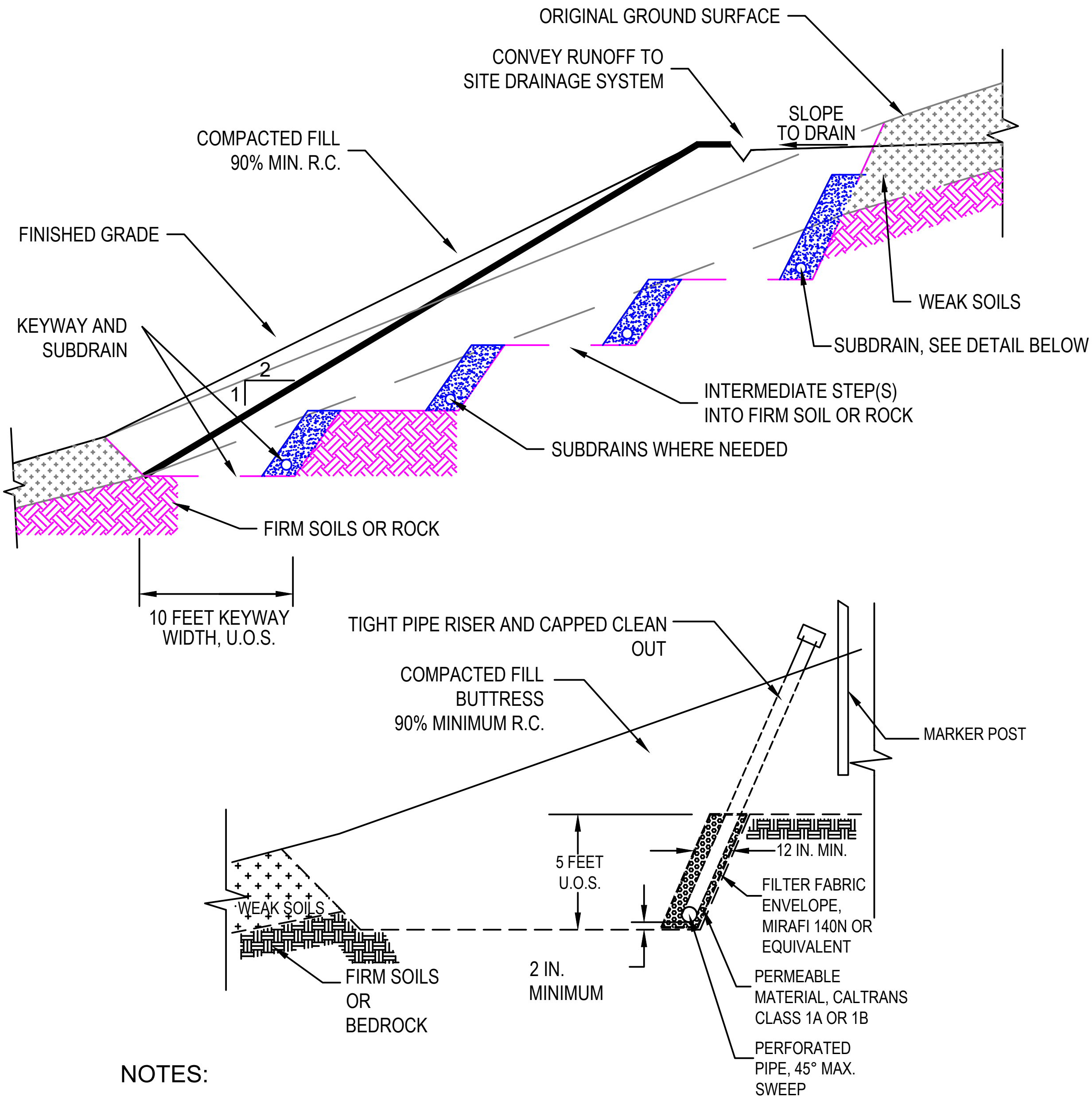
FEMA FLOOD MAP

Oak Hill at San Quentin
Sir Francis Drake Boulevard
San Quentin, California

Project No. 1547.021
Date: 8/12/2022

Drawn EIC
Checked

7
FIGURE



NOTES:

(1) NUMBER OF BENCHES AND WIDTH(S) MAY VARY
(2) PIPE TO BE 4-IN. DIAMETER SCHEDULE 40 PVC. PERFORATIONS DOWN, SLOPE 2% MIN., WITH TIGHT PIPE TO GRAVITY DISCHARGE.
(3) IF CALTRANS CLASS 2 PERMEABLE MATERIAL IS USED, THEN FILTER FABRIC IS NOT REQUIRED
(4) USE SWEEPS (45° MAX.) FOR ALL SUBDRAINS BENDS/ELBOWS
(5) R.C. = RELATIVE COMPACTION, ASTM D-1557.
(6) FOR FILLS HIGHER THAN 25', TERRACES WILL BE REQUIRED PER CBC

TYPICAL HILLSIDE FILL AND SUBDRAIN DETAIL

(NO SCALE)

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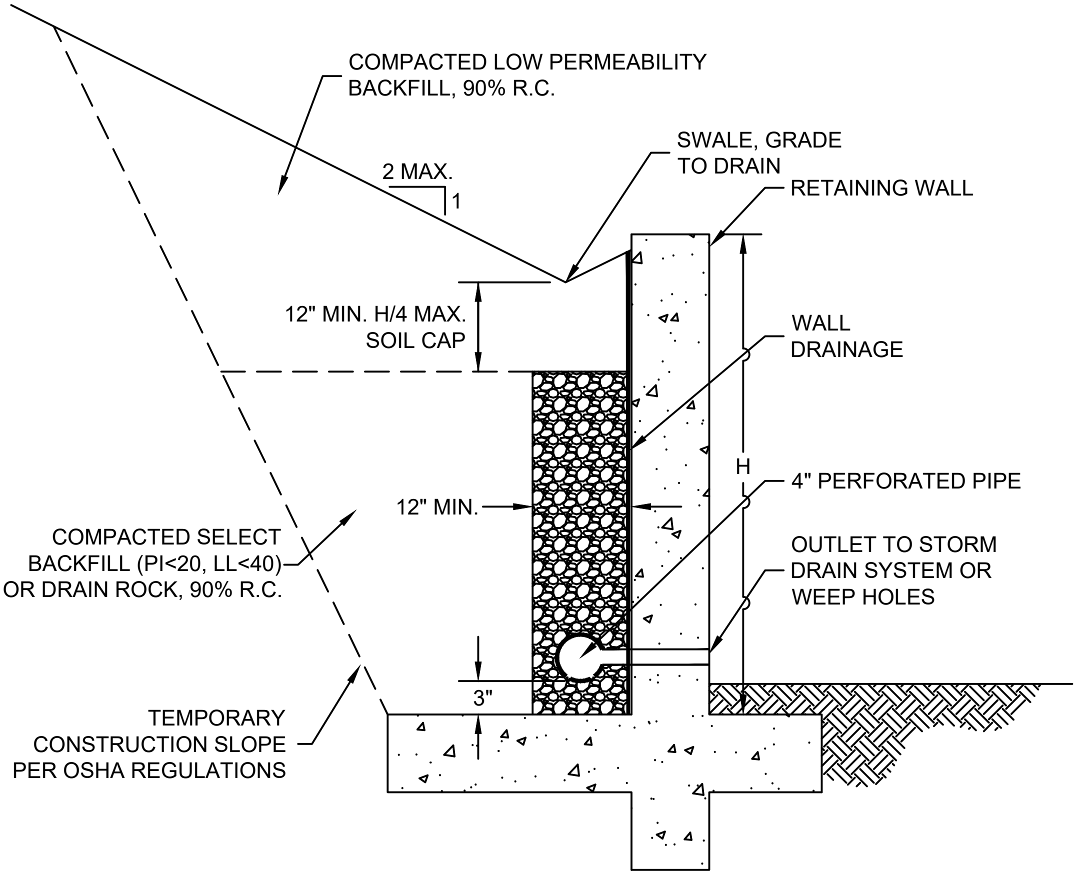
TYPICAL HILLSIDE FILL DETAIL

Oak Hill at San Quentin
Sir Francis Drake Boulevard
San Quentin, California

Project No. 1547.021
Date: 8/12/2022

Drawn EIC
Checked

8
FIGURE



NOTES:

1. Wall drainage should consist of clean, free draining 3/4 inch crushed rock (Class 1B Permeable Material) wrapped in filter fabric (Mirafi 140N or equivalent) or Class 2 Permeable Material. Alternatively, pre-fabricated drainage panels (Miradrain G100N or equivalent), installed per the manufacturers recommendations, may be used in lieu of drain rock and fabric.

2. All retaining walls adjacent to interior living spaces shall be water/vapor proofed as specified by the project architect or structural engineer.

3. Perforated pipe shall be SCH 40 or SDR 35 for depths less than 20 feet. Use SCH 80 or SDR 23.5 perforated pipe for depths greater than 20 feet. Place pipe perforations down and slope at 1% to a gravity outlet. Alternatively, drainage can be outlet through 3" diameter weep holes spaced approximately 20' apart.

4. Clean outs should be installed at the upslope end and at significant direction changes of the perforated pipe. Additionally, all angled connectors shall be long bend sweep connections.

5. During compaction, the contractor should use appropriate methods (such as temporary bracing and/or light compaction equipment) to avoid over-stressing the walls. Walls shall be completely backfilled prior to construction in front of or above the retaining wall.

6. Refer to the geotechnical report for lateral soil pressures.

7. All work and materials shall conform with Section 68, of the latest edition of the Caltrans Standard Specifications.

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TYPICAL RETAINING WALL BACKDRAIN

Oak Hill at San Quentin
Sir Francis Drake Boulevard
San Quentin, California

Project No. 1547.021
Date: 8/12/2022

Drawn EIC
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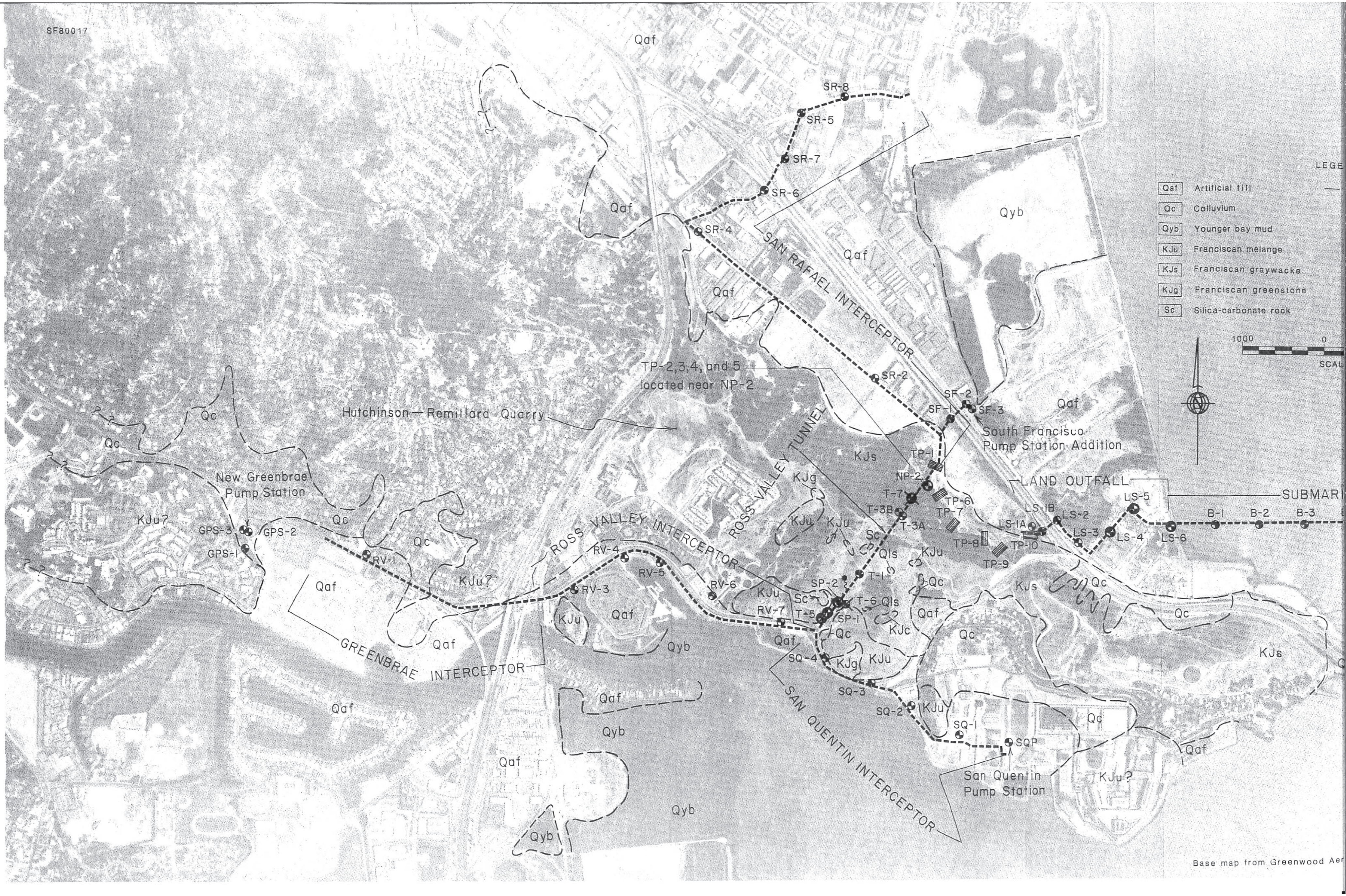
9
FIGURE

APPENDIX A
REFERENCE SUBSURFACE EXPLORATION


SF80017
LEGE
Qaf Artificial fill
Qc Colluvium
Qyb Younger bay mud
KJu Franciscan melange
KJs Franciscan graywacke
KJg Franciscan greenstone
Sc Silica-carbonate rock
1000
0
SCAL
SAN RAFAEL INTERCEPTOR
ROSS VALLEY TUNNEL
ROSS VALLEY INTERCEPTOR
GREENBRAE INTERCEPTOR
SAN QUENTIN INTERCEPTOR
LAND OUTFALL
SUBMARI
TP-2,3,4, and 5 located near NP-2
Hutchinson—Remillard Quarry
New Greenbrae Pump Station
South Francisco Pump Station Addition
San Quentin Pump Station
SR-8
SR-5
SR-7
SR-6
SR-4
SR-2
SF-2
SF-1
SF-3
TP-1
NP-2
T-7
TP-6
TP-7
T-3B
T-3A
TP-8
TP-10
TP-9
T-1
SP-2
SP-1
T-6
T-5
LS-1B
LS-1A
LS-2
LS-3
LS-4
LS-5
LS-6
B-1
B-2
B-3
GPS-3
GPS-2
GPS-1
RV-1
RV-3
RV-4
RV-5
RV-6
RV-7
SQ-4
SQ-3
SQ-2
SQ-1
SQP
Qaf
Qc
Qyb
KJs
KJg
KJu
KJu?
KJc
Sc
Qls
Base map from Greenwood Aer

LOG OF SOIL BORING

SHEET 1 OF 2

PROJECT: Central Marin Sanitation Agency
DRILLING METHOD: Rotary Wash, Coring
LOCATION: San Quentin Rifle Range
ELEVATION: 130.1 Feet
BORING NO.: SP-1
DRILLING DATE: 8/4 and 8/5/80
DATUM: CMSA Datum

ELEVATION (FEET)	DEPTH	DRILLING RATE (MINUTES/FEET) AND CASING 2 4 6 8	SAMPLE	SAMPLE NO	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	TORVANE (PSF)	ADDITIONAL TESTS
	0						PEAT (Pt), gray to black						
							"ARTIFICIAL FILL" GRAVELLY CLAY (CL), brown, sticky, plastic, gravel composed of angular to subangular graywacke up to 2 inches in size						
125		++++	S	1			drilling with tricone (0' to 25')						
	10	+++	S	2			angular, red chert fragments up to .25 inches in size ▽ water level on 11/3/80						
115		+++					"FRANCISCAN FORMATION" MELANGE, sheared graywacke and shale, gray to black, friable in hardness and strength, with calcite						
	20	+++	PT	3									
105							Rock encountered at a depth of 15 feet. Drill log continues on rock sheet.						
		++++											
		++++											
		++++											
		++++											
		++++											

PLATE A-1.37

LOG OF ROCK BORING

SHEET 2 OF 2

PROJECT: Central Marin Sanitation Agency
DRILLING METHOD: Rotary Wash, Coring
LOCATION: San Quentin Rifle Range
ELEVATION: 130.1 Feet
BORING NO.: SP-1
DRILLING DATE: 8/4 and 8/5/80
DATUM: CMSA Datum

						ROCK MATERIAL				BEDDING/JOINTING			
								STRENGTH					
ELEVATION (FEET)	DEPTH	10 20 30 40 DRILLING RATE (MINUTES/FEET) AND CASING	RUN	20 40 60 80 RECOVERY — RQD -----	GRAPHIC LOG	DESCRIPTION	2 3 4 WEATHERING	POINT LOAD (PSI)	UNCONFINED COMPRESSION (PSI)	FRACTURES/FT	NO. OF SETS	ORIENTATION	DESCRIPTION
105	30		1 2			"FRANCISCAN FORMATION" MELANGE, sheared graywacke and shale, gray to black, friable in hardness and strength, with calcite graywacke clasts 0.7 to 1.5 inches in size		43 pf 12 39 pf	1030 pf 300 940 pf	>50		random	intensely fractured, random orientation, fractures between 30° and vertical filled with barite, quartz, and pyrite, non-planar, irregular surfaces.
95	40		3 4			"FRANCISCAN FORMATION" GRAYWACKE, light gray, closely to moderately fractured, moderately hard, weak		44 83	1,052 1,995	4	2	60°	most fractures vertical, quartz or pyrite-filled, 60° set spaced 26 to 40mm apart; irregular fractures, open or filled with quartz, barite or pyrite.
	50					Bottom of hole at a depth of 40.5 feet. Piezometer pipe installed.							

PLATE A-1.37

LOG OF SOIL BORING

SHEET 1 OF 2

PROJECT: Central Marin Sanitation Agency
BORING NO.: SP-2
DRILLING METHOD: Rotary Wash and Coring
DRILLING DATE: 8/5 and 8/6/80
LOCATION: San Quentin Rifle Range
ELEVATION: 138.4 Feet
DATUM: CMSA Datum

ELEVATION (FEET) DEPTH	DRILLING RATE (MINUTES/FEET) AND CASING 2 4 6 8	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	TORVANE (PSF)	ADDITIONAL TESTS
0					▨	"ARTIFICIAL FILL" ∇ Water level on 11/3/80. GRAVEL (GP), orange-brown, contains rock fragments						
133	+ + + +				≡	"FRANCISCAN FORMATION" SHALE, dark gray, plastic, oil in drilling fluid softer harder						
10						Rock encountered at a depth of 6 feet. Drill log continues on rock sheet.						

LOG OF ROCK BORING

SHEET 2 OF 2

PROJECT: Central Marin Sanitation Agency
DRILLING METHOD: Rotary Wash Coring
LOCATION: San Quentin Rifle Range
ELEVATION: 138.4 Feet
BORING NO.: SP-2
DRILLING DATE: 9/5 to 9/6/80
DATUM: CMSA Datum

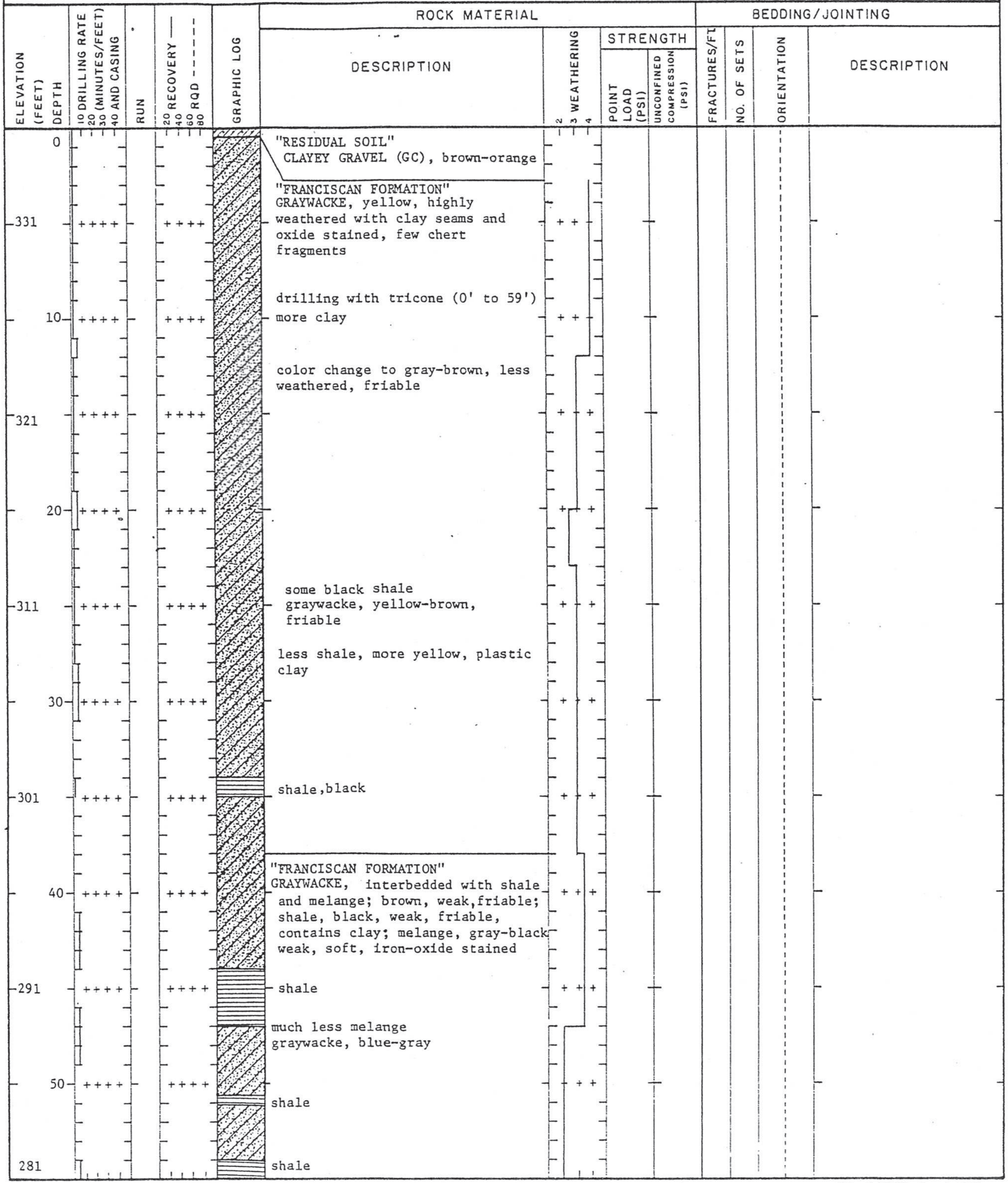
ELEVATION (FEET)	DEPTH	10 20 30 40 DRILLING RATE (MINUTES/FEET) AND CASING	RUN	20 40 60 80 RECOVERY —— RQD - - - -	GRAPHIC LOG	ROCK MATERIAL DESCRIPTION	2 3 4 WEATHERING	STRENGTH POINT LOAD (PSI)	STRENGTH UNCONFINED COMPRESSION (PSI)	BEDDING/JOINTING FRACTURES/FT	NO. OF SETS	ORIENTATION	BEDDING/JOINTING DESCRIPTION
	10					"FRANCISCAN FORMATION" SHALE, dark gray, plastic							irregular, undulating, unhealed, discontinuous most calcite-filled
						"FRANCISCAN FORMATION" GRAYWACKE, blue-gray, moderately strong to strong, hard				2	1	30°	
123			1					476	11,417				open fractures, irregular fractures filled with calcite, quartz, 1mm to 10mm spacing
								570	13,676				crushed
20			2			brecciated, dark gray crushed to highly fractured (19' to 21') brecciated, with clay		257	6,159				highly fractured crushed intensely fractured, irregular, calcite filled, some epidote
113			3										quartz and calcite-filled
								413	9,915				moderate to intense fracturing, most fractures filled
	30		4			lighter color, coarser grained						30°	
								19	451		1		
								113	2074				
103			5			brecciated, dark gray, with clay (34' to 36')						20°	intensely fractured to crushed, some open, some filled with clay
												20°	moderately fractured, 5-10 cm spacing,
	40		6							3	1		irregular, clay and calcite-filled
								544	13,070			20°	20° set, clay or gouge filled
						medium to coarse grained				3	3	80° Vert.	vertical set, clay-filled
93			7							2	3		80° set, gouge-filled
								651	15,624				
						clayey				4	2	35°	little to moderate fracturing, some calcite-filled
								144	3,455				
			8					382	9,164	5	1	25°	

Bottom of hole at a depth of 50 feet. Piezometer installed to a depth of 49.5 feet.

LOG OF ROCK BORING

SHEET 1 OF 5

PROJECT: Central Marin Sanitation Agency
DRILLING METHOD: Rotary Wash and Coring
LOCATION: Cemetery Road, San Quentin
ELEVATION: 335.8 Feet
BORING NO.: T-1
DRILLING DATE: 8/7 to 8/18/80
DATUM: CMSA Datum



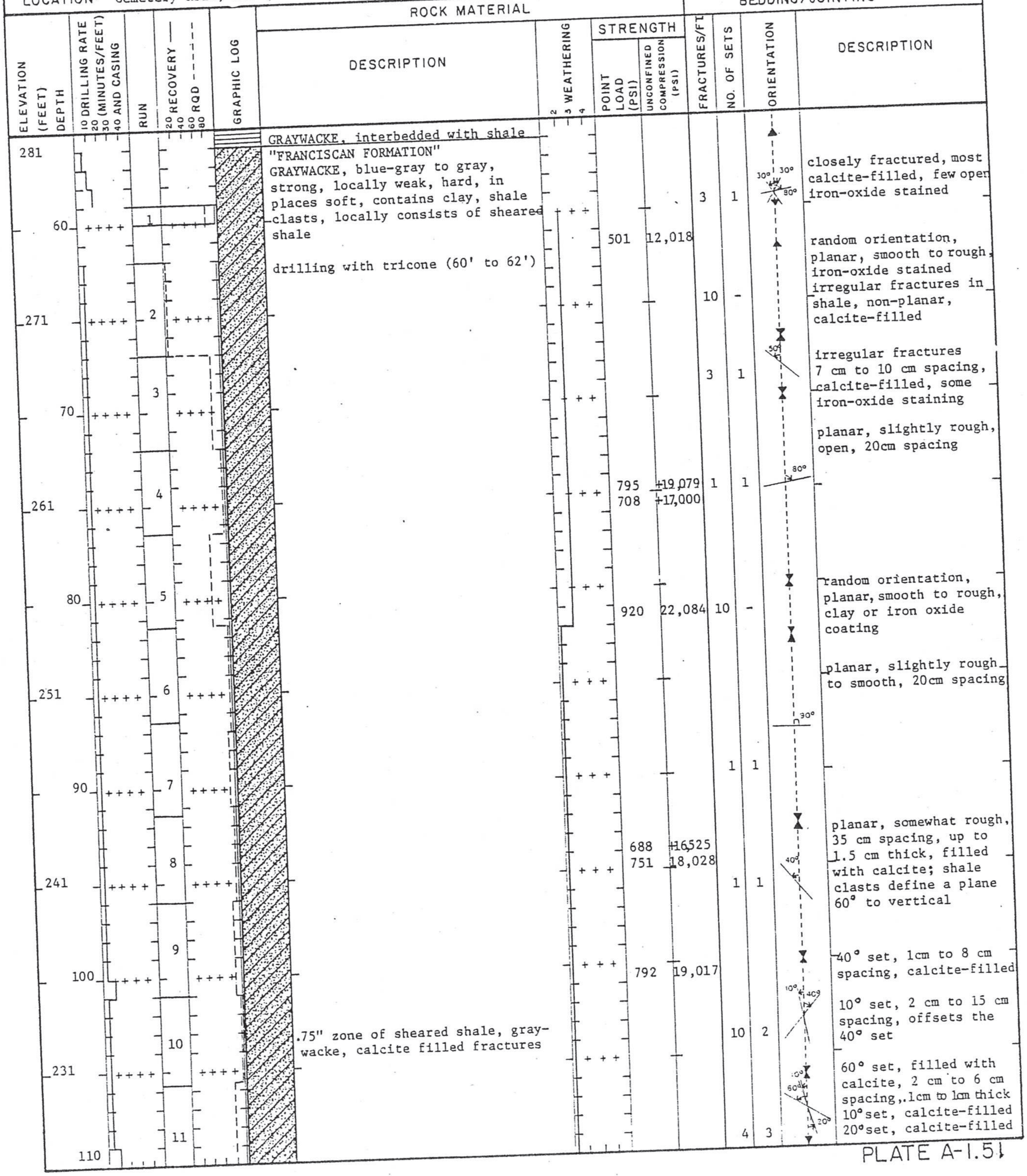
ELEVATION (FEET)	DEPTH	DESCRIPTION
	0	"RESIDUAL SOIL" CLAYEY GRAVEL (GC), brown-orange
		"FRANCISCAN FORMATION" GRAYWACKE, yellow, highly weathered with clay seams and oxide stained, few chert fragments
331		
		drilling with tricone (0' to 59')
	10	more clay
		color change to gray-brown, less weathered, friable
321		
	20	
		some black shale
311		graywacke, yellow-brown, friable
		less shale, more yellow, plastic clay
	30	
301		shale,black
		"FRANCISCAN FORMATION" GRAYWACKE, interbedded with shale and melange; brown, weak,friable; shale, black, weak, friable, contains clay; melange, gray-black weak, soft, iron-oxide stained
	40	
291		shale
		much less melange graywacke, blue-gray
	50	shale
281		shale

PLATE A-1.51

LOG OF ROCK BORING

SHEET 2 OF 5

PROJECT: Central Marin Sanitation Agency
DRILLING METHOD: Rotary Wash, Coring
LOCATION: Cemetery Road, San Quentin
ELEVATION: 335.8 Feet
BORING NO.: T-1
DRILLING DATE: 8/7 to 8/18/80
DATUM: CMSA Datum



ELEVATION (FEET)	DEPTH	DRILLING RATE (MINUTES/FEET) 10 20 30 40 AND CASING	RUN	RECOVERY 20 40 60 80 / RQD	ROCK MATERIAL DESCRIPTION	WEATHERING 2 3 4	STRENGTH POINT LOAD (PSI)	STRENGTH UNCONFINED COMPRESSION (PSI)	FRACTURES/FT	NO. OF SETS	BEDDING/JOINTING DESCRIPTION
281					GRAYWACKE, interbedded with shale "FRANCISCAN FORMATION" GRAYWACKE, blue-gray to gray, strong, locally weak, hard, in places soft, contains clay, shale clasts, locally consists of sheared shale				3	1	closely fractured, most calcite-filled, few open iron-oxide stained
	60	++++	1		drilling with tricone (60' to 62')	+ +	501	12,018			random orientation, planar, smooth to rough, iron-oxide stained irregular fractures in shale, non-planar, calcite-filled
271		++++	2	++++		+ +			10	-	
			3						3	1	irregular fractures 7 cm to 10 cm spacing, calcite-filled, some iron-oxide staining
	70	++++		++++		+ +					planar, slightly rough, open, 20cm spacing
261		++++	4	++++		+ +	795 708	+19,079 +17,000	1	1	
	80	++++	5	++++		+ +	920	22,084	10	-	random orientation, planar, smooth to rough, clay or iron oxide coating
251		++++	6	++++		+ + +					planar, slightly rough to smooth, 20cm spacing
	90	++++	7	++++		+ + +			1	1	
241		++++	8	++++		+ + +	688 751	+16,525 18,028	1	1	planar, somewhat rough, 35 cm spacing, up to 1.5 cm thick, filled with calcite; shale clasts define a plane 60° to vertical
	100	+++	9	+++		+ + +	792	19,017			40° set, 1cm to 8 cm spacing, calcite-filled
			10		.75" zone of sheared shale, graywacke, calcite filled fractures				10	2	10° set, 2 cm to 15 cm spacing, offsets the 40° set
231		++++		++++		+ + +					
			11						4	3	60° set, filled with calcite, 2 cm to 6 cm spacing, 1cm to 1cm thick 10° set, calcite-filled 20° set, calcite-filled
	110										

PLATE A-1.51

LOG OF ROCK BORING

SHEET 3 OF 5

PROJECT: Central Marin Sanitation Agency
DRILLING METHOD: Rotary Wash, Coring
LOCATION: Cemetery Road, San Quentin
ELEVATION: 335.8 Feet
BORING NO.: T-1
DRILLING DATE: 8/7 to 8/18/80
DATUM: CMSA Datum

ELEVATION (FEET)	DEPTH	10 DRILLING RATE 20 (MINUTES/FEET) 30 AND CASING 40	RUN	20 RECOVERY —— 40 RQD - - - - 60 80	ROCK MATERIAL DESCRIPTION	2 3 WEATHERING 4	STRENGTH POINT LOAD (PSI)	STRENGTH UNCONFINED COMPRESSION (PSI)	BEDDING/JOINTING FRACTURES/FT	NO. OF SETS	BEDDING/JOINTING DESCRIPTION
	110		12		"FRANCISCAN FORMATION" GRAYWACKE, blue-gray to gray, strong, locally weak, hard, soft in places, contains clay, shale clasts						90°set, offsets 10°set, calcite and clay-filled 30°sets, calcite and clay-filled 3cm to 5cm spacing, 0.1cm to 0.5cm thick
-221		++++	13	++++	increasing shaley material, dark gray to black, moderately strong, hard, finer grained graywacke	+ + +	810 780 178	19,452 18,729 4,282	6	4	20°set, calcite-filled, 5cm to 15cm spacing, 5°set, calcite filled or open 40°set, calcite filled
	120	+++	14	++++	shale clasts 0.25 inches to 0.67 inches	+ + +					
-211		++++	15	++++		+ + +			10	2	90°set, healed with calcite, 15mm to 80mm spacing, 0.2mm to 0.3mm thick
	130	++++	16	++++		+ + +	900	21,610			
-201		++++	17	++++		+ + +	845	20,281	1	2	50°set, planar, moderately rough, most calcite-filled a few open, up to 5mm thick 30°set, planar, filled with calcite, 1mm to 2mm thick
	140	++++	18	++++		+ + +			0	0	
-191		++++	19	++++		+ + +				1	planar, healed with calcite, 1.2cm to 5cm spacing, 3mm to 6mm thick
	150	++++	20	++++		+ + +	745	17,877	4	1	planar, rough, calcite filled 7.5cm spacing random orientations, open and closed, shale and calcite filled
-181		++++	21	+++		+ + +					open, shale and calcite filled closed, planar, some are calcite filled
	160	++++	22	+++	gouge zone, sheared graywacke, moderately strong, hard	+ + +					gouge zone
			23		color change to dark gray		75	1,803			most fractures are closed
	171		24						50+		

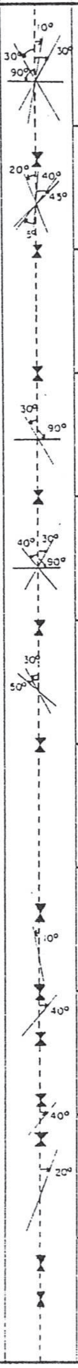


PLATE A-1.51

LOG OF ROCK BORING

SHEET 4 OF 5

PROJECT: Central Marin Sanitation Agency
DRILLING METHOD: Rotary Wash, Coring
LOCATION: Cemetery Road, San Quentin
ELEVATION: 335.8 Feet
BORING NO.: T-1
DRILLING DATE: 8/7 to 8/18/80
DATUM: CMSA Datum

ELEVATION (FEET) DEPTH	DRILLING RATE (MINUTES/FEET) 10 20 30 AND CASING 40	RUN	RECOVERY —— RQD - - - - 20 40 60 80	ROCK MATERIAL DESCRIPTION	WEATHERING 2 3 4	STRENGTH POINT LOAD (PSI)	STRENGTH UNCONFINED COMPRESSION (PSI)	FRACTURES/FT	NO. OF SETS	ORIENTATION	BEDDING/JOINTING DESCRIPTION
171		24		"FRANCISCAN FORMATION" GRAYWACKE, blue-gray to gray, strong, hard, contains clay, shale clasts					1	40°	open, planar, coated with shale and calcite
170	+++	25	+++		+ + +	908	21,783				
											massive, a few calcite and silica veins
161	++++	26	+++		+ + +	438	10,516				
								50+			crushed, some clay
180	+++	27	+++		+ + +						random orientations, planar, smooth, filled with clay, silica shaley gouge, or pyrite
				sheared shale, 0.5mm to 2mm thick layers, randomly oriented rock is hard, strong							
151	++++	28	++++		+ + +			1			
190	++++		++++	darker gray, finer grained	+ + +	419 563	10,065 13,521				
		29						3			
141	++++		+++		+ + +	720	17,276				
				1" shale layer, weak, soft							
		30						4	1	85°	planar, rough, open, 7.5 cm to 10 cm
200	++++		+++		+ + +						
131	++++	31	++++		+ + +				2	50° 40°	planar, rough, open, no filling
										30°	irregular
210	++++		+++		+ + +	845	20,281	2	2	60°	closed, fractures 1mm to 5mm spacing, 0.1mm to 0.5mm thick calcite filling
121	++++	32	+++		+ + +	751	18,028	1	1	40°	few open fractures, calcite or shale filled
220											

PLATE A-1.51

LOG OF ROCK BORING

SHEET 5 OF 5

PROJECT: Central Marin Sanitation Agency
DRILLING METHOD: Rotary Wash, Coring
LOCATION: Cemetery Road, San Quentin
ELEVATION: 335.8 Feet
BORING NO.: T-1
DRILLING DATE: 8/7 to 8/18/80
DATUM: CMSA Datum

ELEVATION (FEET)	DEPTH	10 DRILLING RATE 20 (MINUTES/FEET) 30 40 AND CASING	RUN	20 RECOVERY —— 40 60 RQD - - - 80	GRAPHIC LOG	ROCK MATERIAL DESCRIPTION	2 3 WEATHERING 4	STRENGTH POINT LOAD (PSI)	STRENGTH UNCONFINED COMPRESSION (PSI)	BEDDING/JOINTING FRACTURES/FT	NO. OF SETS	ORIENTATION	BEDDING/JOINTING DESCRIPTION
	220		32 33			"FRANCISCAN FORMATION" GRAYWACKE, blue-gray to gray, strong, hard		588	14,122			20°	planar, smooth, mullion structures, clay and calcite-filled
111		++++		++++			+++			1	1		intensely fractured, 2cm to 4cm spacing
			34					419	10,065	12	2	30° 80°	crushed, cavities, filled with silica and calcite, some fractures open, most filled with silica and calcite
	230	++++		++++			+++	213	5,108				
101		++++	35	++++		231' to 235' moderately weak zone	+						40° set, irregular to planar, most silica-filled, some open, 1.5 cm to 5.5 cm spacing crushed zone at 235'
	240	++++		++++			++	482	11,568			20° 40°	lightly fractured
										5	2	45°-60°	20° set, 8 cm spacing 45° set, 1-10mm spacing both are silica and pyrite filled
91		++++	36	++++			+++	570	13,671				
	250												
						Bottom of drill hole at a depth of 250 feet.							

PLATE A-1.51

LOG OF SOIL BORING

SHEET 1 OF 1

PROJECT: Central Marin Sanitation Agency
DRILLING METHOD: Rotary Wash
LOCATION: San Quentin Rifle Range
ELEVATION: 123.9 Feet
BORING NO.: T-5
DRILLING DATE: 8/18/80
DATUM: CMSA Datum

ELEVATION (FEET)	DEPTH	DRILLING RATE (MINUTES/FEET) AND CASING 2 4 6 8	SAMPLE	SAMPLE NO.	BLOW COUNT (BLOWS PER FOOT)	GRAPHIC LOG	GEOTECHNICAL DESCRIPTION AND CLASSIFICATION	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT (%)	ATTERBERG LIMITS PLASTIC LIMIT (%)	TORVANE (PSF)	ADDITIONAL TESTS
	0						"ARTIFICIAL FILL" GRAVELLY CLAY (CL), top one-half foot is crushed gravel, brown to red brown, sticky, slightly plastic clay with sand to gravel-size graywacke fragments less gravel						
119		+++	■	1			SANDY CLAY (CL), more sand, fine-grained fragments drilling with tricone (0' to 15')						
			S	*									
	10	+++		*			GRAVELLY CLAY (CL), less sand, gravel-size, siliceous rock, and gravel-size graywacke fragments						
109		+++	■	3			light-brown medium-fine to coarse-grained fragments drilling with fishtail (15'to 20') ∇ water level on 11/3/80						
			PT										
	20	++++	■				some tan clay drilling with tricone (20' to 30')						
			PT				"RESIDUAL SOIL" CLAYEY GRAVEL (GC), light brown, plastic clay, with gravel-size, highly weathered graywacke						
99		++++					less clay						
							"FRANCISCAN FORMATION" GRAYWACKE, brown, low hardness (highly weathered bedrock)						
	30						some gray-blue, unweathered graywacke						

Rock encountered at a depth of 26 feet.
Bottom of drill hole at a depth of 30 feet.
Piezometer installed to a depth of 30 feet, perforated between a depth of 5 and 25 feet.

* corrosion testing samples

PLATE A-1.54

LOG OF ROCK BORING

SHEET 1 OF 2

PROJECT: Central Marin Sanitation Agency
DRILLING METHOD: Rotary Wash and Coring
LOCATION: San Quentin Rifle Range

ELEVATION: 151.4 Feet

BORING NO.: T-6
DRILLING DATE: 9/5 and 9/6/80
DATUM: CMSA Datum

ELEVATION (FEET)	DEPTH	DRILLING RATE (MINUTES/FEET) 10 20 30 40 AND CASING	RUN	RECOVERY —— RQD ---- 20 40 60 80	GRAPHIC LOG	ROCK MATERIAL: DESCRIPTION	WEATHERING 2 3 4	STRENGTH: POINT LOAD (PSI)	STRENGTH: UNCONFINED COMPRESSION (PSI)	BEDDING/JOINTING: FRACTURES/FT	NO. OF SETS	ORIENTATION	DESCRIPTION
	0					SANDY SILT (ML), yellow brown, very stiff drilling with tricone (0' to 5') ▽ Water level on 11/3/80 "FRANCISCAN FORMATION"							
146		++++		++++		GRAYWACKE, gray, moderately strong, moderately hard, closely to intensely fractured, some oxide staining and few shale-clast inclusions	+ + +			10	2	30°	most fractures closed, filled with less than 1 mm calcite
			1							5	2	30° 40° 40°	fractures closed, filled with calcite
	10	++++		++++			+ + +	613	14,721	10	3	vert 10°	calcite-filled
			2							5	2	20° 30°	planar, closed fractures are calcite-filled, open fractures are oxide coated
136		++++		++++			+ + +					10°	
			3			more shale inclusions				4	2	40°	up to 5mm calcite filling, some silica-filled-veins
	20	++++		++++			+ + +	814	19,530			20°	
			4			intensely fractured zone, graywacke and silica with minor pyrite (21' to 23')					3	10° 90°	10° and 20° set are silica-filled
								864	20,732		1	40°	closely fractured, calcite-filled
126		++++		++++			+ + +						
			5					263	6,310	10			randomly oriented larger fractures rehealed with silica
	30	+++		++++		moderately to closely fractured moderately strong to strong	+ + +			2	1	20°	
										15	2	vert 30°	silica-filled
										10	2	60° 50°	closely fractured, most open
116		++++	6	++++			+ + +	206	4,957	5	1	40°	less than 1mm thick
										5	1	30°	average 1mm, up to 1cm thick, silica-filled few are calcite-filled
	40	++++		++++		stronger	+ + +	688	16,525				
								401	9,615	15	2	80° 70°	planar, rough, up to 1cm calcite-filling
106		++++	7	++++		closely fractured	+ + +						
										20	2	30° 50°	1mm to 1cm calcite or silica filling
	50	++++		++++			+ + +	444	10,666	30	2	30° 80°	most fractures at 80°, up to 1cm silica-filling, 30° set is calcite-filled
			8										
96													

PLATE A-1.55

LOG OF ROCK BORING

SHEET 2 OF 2

PROJECT: Central Marin Sanitation Agency
DRILLING METHOD: Rotary Wash, Coring
LOCATION: San Quentin Rifle Range
ELEVATION: 151.4 Feet
BORING NO.: T-6
DRILLING DATE: 9/5 to 9/6/80
DATUM: CMSA Datum

					ROCK MATERIAL				BEDDING/JOINTING			
							STRENGTH					
ELEVATION (FEET) DEPTH	10 20 30 40 DRILLING RATE (MINUTES/FEET) AND CASING	RUN	20 40 60 80 RECOVERY —— RQD - - - - -	GRAPHIC LOG	DESCRIPTION	2 3 4 WEATHERING	POINT LOAD (PSI)	UNCONFINED COMPRESSION (PSI)	FRACTURES/FT	NO. OF SETS	ORIENTATION	DESCRIPTION
96 60				▨	"FRANCISCAN FORMATION" GRAYWACKE, gray, moderately strong, moderately hard, fine-grained, few shale-clast inclusions, some iron-oxide staining		250 394 601	6,009 9,465 14,422	20	2	50° 80°	moderately to closely fractured, filled with silica, some calcite or clay, some open, 1mm to 5mm thick
					Bottom of drill hole at a depth of 60 feet.							

PLATE A-1.55

AECOM Oakland CA 4/11/2022 USER BivolaruL PATH Y:\Oakland-USOAK01\DCS\Projects\GIS\Projects\DGS_SanQuentin\02_Maps\02_Map_Production_and_Reports\Phase II ESA\Figure3 - Project Parcel Subdivision.mxd

Source: AECOM, 2020; DGS, 2020; ESRI, 2020; ESRI, 2016

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Department of General Services
San Quentin
PHASE I ESA

100 50 0 100

Scale in feet

FIGURE 3

Soil Boring Locations

Page 1 of 1

AECOM

Client Name:	Department of General Services CA	Boring/Well Name:	SB1
Job/Site Name:	San Quentin Limited Phase II	Utility Cleared to:	5
Location:	San Quentin	Total Depth:	10 ft bgs
Project Number:	60678478	Date(s) Drilled:	3/10/22
Driller:	Cascade Envorinmental	Screened Interval:	–
Drilling Method:	Hand Auger & DPT	Depth to water (first encountered):	–
Boring Diameter:	3 1/4" / 2 1/4"	Depth to water (static):	–
Logged By:	Dylan Bailey	Location:	middle of property
PG:		Misc. Notes:	

DEPTH/ SAMPLE INTERVAL	SAMPLE TIME	SAMPLE ID	P.I.D.	RECOVERY, %	USCS CLASS	GEOLOGIC DESCRIPTION AND FIELD NOTES	COLOR	Moisture	Stiffness/Density	ESTIMATED PERCENTAGES Clay	Silt	Sand	Gravel	ESTIMATED PLASTICITY
1						Top soil. ~~sand~~ silt w/ ~~silt~~ sand and gravel. very fine grains	light brown	[✓ d]/m/w	loose		20	[✓ f]/m/c 60	[✓ f]/c 20	[✓ N]/L/M/H
2.	0742	SB1-2	0.0			sand and silt w/ clay. very fine to fine grains	light brown	d/m/w	loose	15	30	f/m/c 50	f/[✓ c] 5	[✓ N]/L/M/H
3.						silt and clay w/ gravel fine grains	dark brow	[✓ d]/m/w	loose to M	30	50	[✓ f]/m/c 10	[✓ f]/c 20	N/[✓ L]/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
5	0756	SB1-5	0.1			silt w/ clay. some gravel. fine grains	dark brown	[✓ d]/m/w	M	60	30	f/m/c	f/[✓ c] 10	N/[✓ L]/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
7						silt w/ clay. some sand. small pebbles. fine to medium grains	dark light brwn	[✓ d]/m/w	M	50	25	[✓ f]/m/c 20	f/c 5	N/[✓ L]/M/H
						↳ more sand		d/m/w				f/m/c	f/c	N/L/M/H
10	0802	SB1-10	0.1			clay and silt w/ sand very fine grains. small pebbles	dark brown	[✓ d]/m/w	M to loose	20	25	f/m/c 50	f/c 5	N/[✓ L]/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H

AECOM

Client Name:	Department of General Services CA	Boring/Well Name:	SB2
Job/Site Name:	San Quentin Limited Phase II	Utility Cleared to:	5
Location:	San Quentin	Total Depth:	10 ft bgs
Project Number:	60678478	Date(s) Drilled:	3/10/22
Driller:	Cascade Envorinmental	Screened Interval:	—
Drilling Method:	Hand Auger & DPT	Depth to water (first encountered):	—
Boring Diameter:	3 1/4" / 2 1/4"	Depth to water (static):	—
Logged By:	Dylan Bailey	Location:	middle of property
PG:		Misc. Notes:	

DEPTH/ SAMPLE INTERVAL	SAMPLE TIME	SAMPLE ID	P.I.D.	RECOVERY, %	USCS CLASS	GEOLOGIC DESCRIPTION AND FIELD NOTES	COLOR	Moisture	Stiffness/Density	ESTIMATED PERCENTAGES				ESTIMATED PLASTICITY
										Clay	Silt	Sand	Gravel	
1						Top soil. silt w/sand. som gravel. very fine grains.	light brown	[✓ d]/m/w	loose		20	[✓ f]/m/c 60	[✓ f]/c 10	[✓ N]/L/M/H
2.	0827	SB2-2	0.2			silt and sand. some clay and gravel. very fine to fine	light brown	d/m/w	loose	10	40	[✓ f]/m/c 40	[✓ f]/c 10	[✓ N]/L/M/H
						more clay		d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
5.	0836	SB2-5	0.4			Native. silt w/ clay. some gravel. fine grains	dark brown	[✓ d]/m/w	M	60	20	f/m/c	[✓ f]/c 10	N/L/[✓ M]/H
						NOTE: Hit rock which stopped		d/m/w				f/m/c	f/c	N/L/M/H
						soil from enterin sleeve. 0% recovery after 5ft bgs.		d/m/w				f/m/c	f/c	N/L/M/H
						Step out 1 foot laterally.		d/m/w				f/m/c	f/c	N/L/M/H
8						silt w/clay. very fine grains	brown light red	[✓ d]/m/w	loose to M	80	20	f/m/c	f/c	N/[✓ L]/M/H
						more dense.		d/m/w				f/m/c	f/c	N/L/M/H
10	0904	SB2-10	1.8			silt w/ clay. fine grains.	dark brown	d/m/w	M	60	40	f/m/c	f/c	N/[✓ L]/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H

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Client Name:	Department of General Services CA	Boring/Well Name:	SB3
Job/Site Name:	San Quentin Limited Phase II	Utility Cleared to:	5
Location:	San Quentin	Total Depth:	
Project Number:	60678478	Date(s) Drilled:	3/9/22
Driller:	Cascade Envorinmental	Screened Interval:	—
Drilling Method:	Hand Auger & DPT	Depth to water (first encountered):	—
Boring Diameter:	3 1/4" / 2 1/4" OD	Depth to water (static):	—
Logged By:	Dylan Bailey	Location:	NW corner of property
PG:		Misc. Notes:	Refusal

DEPTH/ SAMPLE INTERVAL	SAMPLE TIME	SAMPLE ID	P.I.D.	RECOVERY, %	USCS CLASS	GEOLOGIC DESCRIPTION AND FIELD NOTES	COLOR	Moisture	Stiffness/Density	ESTIMATED PERCENTAGES Clay	Silt	Sand	Gravel	ESTIMATED PLASTICITY
1						Topsoil. sand and silt w/ gravel. very fine grains	light brown	[✓ d]/m/w	loose		30	[✓ f]/m/c 60	f/[✓ c] 10	[✓ N]/L/M/H
2	1257	SB3-2	0.4			sand and silt w/gravel very fine grains	dark brown	[✓ d]/m/w	loose		40	[✓ f]/m/c 50	[✓ f]/c 10	[✓ N]/L/M/H
						Refusal @ 2.5ft		d/m/w				f/m/c	f/c	N/L/M/H
						bgs. plastic pipe (possible		d/m/w				f/m/c	f/c	N/L/M/H
						(utility)		d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H

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Client Name:	Department of General Services CA	Boring/Well Name:	SB3
Job/Site Name:	San Quentin Limited Phase II	Utility Cleared to:	5
Location:	San Quentin	Total Depth:	
Project Number:	60678478	Date(s) Drilled:	3/9/22
Driller:	Cascade Envoronmental	Screened Interval:	—
Drilling Method:	Hand Auger & DPT	Depth to water (first encountered):	—
Boring Diameter:	3 1/4"/2 1/4"	Depth to water (static):	—
Logged By:	Dylan Bailey	Location:	NW back of property
PG:		Misc. Notes:	Step out location 5ft to the E.

DEPTH/ SAMPLE INTERVAL	SAMPLE TIME	SAMPLE ID	P.I.D.	RECOVERY, %	USCS CLASS	GEOLOGIC DESCRIPTION AND FIELD NOTES	COLOR	Moisture	Stiffness/Density	ESTIMATED PERCENTAGES				ESTIMATED PLASTICITY
										Clay	Silt	Sand	Gravel	
1						Top soil. sand and silt w/ gravel. very fine grains	light brown	[✓ d]/m/w	loose		40	[✓ f]/m/c 50	f/[✓ c] 10	[✓ N]/L/M/H
	1325	SB3-2	0.3					d/m/w				f/m/c	f/c	N/L/M/H
3	~~1325~~	~~SB3-2~~ DB				sand and silt w/ gravel. very fine grains	brown	[✓ d]/m/w			60	[✓ f]/m/c 30	f/c 10	[✓ N]/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
5	1402	SB3-5	0.1			Silt and gravel/ ~~granite~~ silt DB Hit Bedrock at	light	d/m/w			20	f/m/c	f/[✓ c] 80	N/L/M/[✓ H]
						5ft bgs. Refusal at 5ft bgs.	gray	[✓ d]/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H

AECOM

Client Name:	**Department of General Services CA**	**Boring/Well Name:**	SB4
Job/Site Name:	**San Quentin Limited Phase II**	**Utility Cleared to:**	5
Location:	**San Quentin**	**Total Depth:**	10 ft bgs
Project Number:	**60678478**	**Date(s) Drilled:**	3/10/22
Driller:	**Cascade Envorinmental**	**Screened Interval:**	—
Drilling Method:	**Hand Auger & DPT**	**Depth to water (first encountered):**	—
Boring Diameter:	3 1/4" / 2 1/4"	**Depth to water (static):**	—
Logged By:	Dylan Bailey	**Location:**	NE side of property
PG:		**Misc. Notes:**	

DEPTH/ SAMPLE INTERVAL	SAMPLE TIME	SAMPLE ID	P.I.D.	RECOVERY, %	USCS CLASS	GEOLOGIC DESCRIPTION AND FIELD NOTES	COLOR	Moisture	Stiffness/Density	ESTIMATED PERCENTAGES				ESTIMATED PLASTICITY
										Clay	Silt	Sand	Gravel	
1						Top soil. silt and sand. some gravel. very fine grains	light tan	[✓ d]/m/w	loose		60	30 [✓ f]/m/c	10 f/c	[✓ N]/L/M/H
2.	0945	SB4-2 DUP-2	0.4		DB	~~silt w/~~ sand w/silt. som gravel, small pebbles very fine grains.	light tan brown	[✓ d]/m/w	loose		60	25 f/m/c	5 f/c	[✓ N]/L/M/H
						more clay		d/m/w				f/m/c	f/c	N/[✓ L]/M/H
3						silt w/ clay. very fine to fine grains	light brown	[✓ d]/m/w	loose to M	60	40	f/m/c	f/c	N/L/M/H
						more clay, more dense		d/m/w				f/m/c	f/c	N/L/M/H
5	0955	SB4-5	0.5		no	~~clay w/silt.~~ silt w/ clay fine grains	light brown orange	d/[✓ m]/w	M	80	20	f/m/c	f/c	N/L/[✓ M]/H
								d/m/w				f/m/c	f/c	N/L/M/H
7						silt w/clay. fine grains.	Brown light orange	d/[✓ m]/w	M	80	20	f/m/c	f/c	N/L/[✓ M]/H
						more dense		d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
10	1008	SB4-10	0.7			silt w/ clay. fine to medium grains	light brown + orange	[✓ d]/m/w	M to dense	75	25	f/m/c	f/c	N/L/[✓ M]/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H

AECOM

Client Name:	Department of General Services CA	**Boring/Well Name:**	SBS
Job/Site Name:	San Quentin Limited Phase II	**Utility Cleared to:**	5
Location:	San Quentin	**Total Depth:**	10 ft bgs
Project Number:	60678478	**Date(s) Drilled:**	3/9/22
Driller:	Cascade Envorinmental	**Screened Interval:**	—
Drilling Method:	Hand Auger & DPT	**Depth to water (first encountered):**	—
Boring Diameter:	3 1/4" / 2 1/4"	**Depth to water (static):**	—
Logged By:	Dylan Bailey	**Location:**	NV edge of property
PG:		**Misc. Notes:**	Bullet found in soil at 1.5 ft bgs

DEPTH/ SAMPLE INTERVAL	SAMPLE TIME	SAMPLE ID	P.I.D.	RECOVERY, %	USCS CLASS	GEOLOGIC DESCRIPTION AND FIELD NOTES	COLOR	Moisture	Stiffness/Density	ESTIMATED PERCENTAGES				ESTIMATED PLASTICITY
										Clay	Silt	Sand	Gravel	
1						Top soil. Sand and silt w/clay, very fine grain	light brown	[✓ d]/m/w	loose	10	40	[✓ f]/m/c 40	f/[✓ c] 10	[✓ N]/L/M/H
2.	1106	SBS-2	0.7			DB ~~Clay~~ silt and gravel w/ ~~silt~~ clay DB some sand fine ~~to~~ grain.	light to dark brown	[✓ d]/m/w	loose to m	60	25	[✓ f]/m/c 15	f/c	N/[✓ L]/M/H
						Bullet found in soil at 1.5 ft bgs		d/m/w				f/m/c	f/c	N/L/M/H
4						clay w/ silt. some sand and gravel. Fin grain	dark brown	[✓ d]/m/w	m to dense	70	20	[✓ f]/m/c 5	[✓ f]/c 5	N/L/[✓ M]/H
5	1115	SBS-5	~~0.3~~ 0.5 DB			clay w/ silt. some gravel fine grain.	dark brown black	[✓ d]/m/w	dense	80	15	f/m/c	[✓ f]/c 5	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
7.5						silt w/ gravel and sand fine to medium grain	light gray	[✓ d]/m/w	loose to m		60	[✓ f]/m/c 10	f/[✓ c] 30	N/L/[✓ M]/H
								d/m/w				f/m/c	f/c	N/L/M/H
10	1140	SBS-10	0.3			Hit bedrock @ 8ft bgs silt and gravel. fine to medium grain. gravel/~~granite~~ silt DB	light gray	[✓ d]/m/w			40	f/m/c	f/[✓ c] 60	N/L/[✓ M]/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H

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AECOM

Client Name:	Department of General Services CA	Boring/Well Name:	SB6
Job/Site Name:	San Quentin Limited Phase II	Utility Cleared to:	5
Location:	San Quentin	Total Depth:	
Project Number:	60678478	Date(s) Drilled:	3/9/22
Driller:	Cascade Envoronmental	Screened Interval:	
Drilling Method:	Hand Auger & DPT	Depth to water (first encountered):	
Boring Diameter:	3 1/4" / 2 1/4"	Depth to water (static):	
Logged By:	Dylan Bailey	Location:	middle/front of property
PG:		Misc. Notes:	NW corner of pavement

DEPTH/ SAMPLE INTERVAL	SAMPLE TIME	SAMPLE ID	P.I.D.	RECOVERY, %	USCS CLASS	GEOLOGIC DESCRIPTION AND FIELD NOTES	COLOR	Moisture	Stiffness/Density	ESTIMATED PERCENTAGES				ESTIMATED PLASTICITY
										Clay	Silt	Sand	Gravel	
1						Topsoil. Sand w/ clay very fine grain.	light brown	[✓ d]/m/w	loose	20		[✓ f]/m/c 70	f/[✓ c] 10	[✓ N]/L/M/H
2	0950	SBG-2 DUP-1	0.7 ~~0.4~~ DB			Sand w/ clay. some gravel DB ~~fine~~ very fine to fine grain	light brown	[✓ d]/m/w	loose	20		[✓ f]/m/c 70	f/[✓ c] 10	[✓ N]/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
4						sand and clay w/ silt fine to medium grain.	light brown	[✓ d]/m/w	loose to m	45	10	[✓ f]/m/c 45	f/c	N/[✓ L]/M/H
5	1006	SBG-5	0.5			clay w/ sand and silt fine to medium grain.	light brown	[✓ d]/m/w	m to dense	70	10	[✓ f]/m/c 20	f/c	N/[✓ L]/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
8 DB ~~13~~						clay w/ sand very fine to fine grain	dark brown	[✓ d]/m/w	m to dense	80		[✓ f]/m/c 20	f/c	N/[✓ L]/M/H
10	1028	SBG-10	1.0			clay and sand w/ silt very fine to fine grain	light brown	[✓ d]/m/w	loose to m	50	10	[✓ f]/m/c 40	f/c	N/[✓ L]/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H

DB

AECOM

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Client Name:	Department of General Services CA	Boring/Well Name:	~~SB6~~ SB7
Job/Site Name:	San Quentin Limited Phase II	Utility Cleared to:	6 ft bgs
Location:	San Quentin	Total Depth:	15 ft bgs
Project Number:	60678478	Date(s) Drilled:	3/9/22
Driller:	Cascade Envorinmental	Screened Interval:	10-15
Drilling Method:	Hand Auger & DPT	Depth to water (first encountered):	14.81
Boring Diameter:	3 1/4" / 2 1/4"	Depth to water (static):	
Logged By:	Dylan Bailey	Location:	Front of property
PG:		Misc. Notes:	

DEPTH/ SAMPLE INTERVAL	SAMPLE TIME	SAMPLE ID	P.I.D.	RECOVERY, %	USCS CLASS	GEOLOGIC DESCRIPTION AND FIELD NOTES	COLOR	Moisture	Stiffness/Density	ESTIMATED PERCENTAGES				ESTIMATED PLASTICITY
										Clay	Silt	Sand	Gravel	
DB 1						Top soil, sand w/ gravel/silt Very fine grain, brown to light brown		[✓ d]/m/w	loose		10	[✓ f]/m/c 60	f/[✓ c] 30	[✓ N]/L/M/H
1	0820	DB ~~SB6-1.5~~ SB7-1.5	0.0			Asphalt/concrete @ 0.5 ft bgs		d/m/w				f/m/c	f/c	N/L/M/H
2.						Asphalt @ 2.0 ft bgs gravel/asphalt. Coarse grain	tan	[✓ d]/m/w				[✓ f]/m/c 10	f/[✓ c] 50	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
4						Native. Clay w/ sand/silt some gravel. fine to medium grain	dark brown	[✓ d]/m/w		65	15	f/[✓ m]/c 15	f/[✓ c] 5	N/[✓ L]/M/H
5	0833	DB ~~SB6-5~~ SB7-5	0.0			Native. clay w/ sand. some silt fine to medium grain.	dark brown	[✓ d]/m/w	medium	70	10	f/[✓ m]/c 20	f/c	N/[✓ L]/M/H
6						Clay w/ sand. and silt. Som gravel. fine to medium grain	dark brown	[✓ d]/m/w	M	60	15	[✓ f]/m/c 20	f/[✓ c] 5	N/[✓ L]/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
10	0850	SB7-10	0.1 ~~0.0~~ DB			clay w/ som sand ~~and~~ DB. fine to medium grain	dark brown	[✓ d]/m/w		80	5	[✓ f]/m/c 15	f/c	N/[✓ L]/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
15	0900	SB7-15	0.0			Cley w/ silt, some sand very fine grain, moist @ 13 ft	dark brown	d/[✓ m]/w	M	75	20	[✓ f]/m/c 5	f/c	N/[✓ L]/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H

AECOM

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Client Name:	Department of General Services CA	Boring/Well Name:	SB8
Job/Site Name:	San Quentin Limited Phase II	Utility Cleared to:	5
Location:	San Quentin	Total Depth:	
Project Number:	60678478	Date(s) Drilled:	3/10/22
Driller:	Cascade Envorinmental	Screened Interval:	—
Drilling Method:	Hand Auger & DPT	Depth to water (first encountered):	—
Boring Diameter:	3 1/4" / 2 1/4"	Depth to water (static):	—
Logged By:	Dylan Bailey	Location:	East side of property
PG:		Misc. Notes:	

DEPTH/ SAMPLE INTERVAL	SAMPLE TIME	SAMPLE ID	P.I.D.	RECOVERY, %	USCS CLASS	GEOLOGIC DESCRIPTION AND FIELD NOTES	COLOR	Moisture	Stiffness/Density	ESTIMATED PERCENTAGES				ESTIMATED PLASTICITY
										Clay	Silt	Sand	Gravel	
1						Topsoil. sand and silt. Some gravel. very fine grains	light tan	[✓ d]/m/w	loose		60	[✓ f]/m/c 30	f/[✓ c] 10	[✓ N]/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
2	1034	SB8-2	0.6			silt w/ clay. some sand and gravel, very fine to fine grains	light brown	[✓ d]/m/w	loose	25	50	[✓ f]/m/c 15	f/c 10	[✓ N]/L/M/H
3						silt w/ clay. some sand. fine grains	light brown	[✓ d]/m/w	loose to M	40	50	[✓ f]/m/c 10	f/c	N/L/M/H
						more sand silt.		d/m/w				f/m/c	f/c	N/L/M/H
5	1040	SB8-5	0.5			clay w/ silt. fine grains	light brown + orange	[✓ d]/m/w	loose	30	60	f/m/c 10	f/c	N/L/M/H
						more clay, more dense	pR	d/m/w				f/m/c	f/c	N/L/M/H
7.5						silt w/ clay. fine grains	~~light~~ brown	[✓ d]/m/w	M	70	30	f/m/c	f/c	N/L/M/H
							pR	d/m/w				f/m/c	f/c	N/L/M/H
						more clay, more dense	~~dark~~ brown	d/m/w				f/m/c	f/c	N/L/M/H
10	1055	SB8-10	0.6			silt w/ clay. fine grains	dark brown	[✓ d]/m/w		85	15	f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H
								d/m/w				f/m/c	f/c	N/L/M/H

E.2 - Paleontological Records Search

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Kenneth L. Finger, Ph.D.
Consulting Paleontologist

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August 6, 2021

Dana DePietro
FirstCarbon Solutions
1350 Treat Boulevard, Suite 380
Walnut Creek, CA 94597

Re: Paleontological Records Search for the Oak Hills Apartments Project (5566.0001), Larkspur, Marin County

Dear Dr. DePietro:

As per the request of Madelyn Dolan, I have performed a paleontological records search for the Oak Hills Apartments project in Larkspur. The project site is on a hillside east of Drakes Cove road and north of Sir Francis Drake Boulevard. Its PRS location is E½, SW¼ Sec. 11, T1N, R6W, San Rafael and San Quentin quadrangles (USGS 7.5-series topographic maps). The Applicant is proposing construction of a seven-story building containing 230 apartments on the lower and flatter portions of the 6.9-acre parcel. Its surrounding area will be developed with a community terrace, play area, lawn, fenced dog area, community garden, and trail connection to open space. Google Earth imagery shows a concrete utility structure at the southern end of the project site; otherwise, this parcel is undeveloped and covered by grass, bushes and trees.

Geologic Units

According to the part of the Blake et al. (2000) geologic map shown here, the entire project site (yellow outline) consists of Franciscan mélange (fsr), which abuts Holocene artificial fill over marine and marsh deposits (Qmf) at its southwestern end. Also in the half-mile search area (dashed outline) is another unit of artificial fill (Qaf).

Geologic Units Shown on Adjacent Map

Qaf	Artificial fill (Quaternary)
Qmf	Artificial fill over marine & marsh deposits (Quaternary)
fsr	Franciscan Complex Mélange (Jurassic–Cretaceous)

Artificial fill (Qmf) is disturbed sediment of historic age that has no paleontological potential or sensitivity, although underlying marine and marsh deposits could be as old as late Pleistocene. Vertebrate fossils are extremely rare in the Franciscan Complex, so it is ranked as having a very low paleontological potential and sensitivity. Its mélange (fsr) consists of sheared sandstone and shale characterized by its lack of continuous bedding, and it includes rock fragments of all sizes, including large blocks of various lithologies. Allochthonous blocks in mélange have the potential of containing fossils (e.g., Bradshaw, 1972), but that has not been observed in California.

Paleontological Records Search

The University of Museum of Paleontology (UCMP) database lists 35 vertebrate localities in Marin County: 5 Pleistocene, 8 Pliocene, and 22 Miocene. None are in Mesozoic rocks, such as those of the Franciscan Complex. The only significant paleontological resources recorded from the Franciscan are the type specimens of the Jurassic marine reptiles *Ichthyosaurus franciscanus* from San Joaquin County and *Plesiosaurus*? *hesternus* from San Luis Obispo County (Hilton, 2003). The composite late Pleistocene assemblage of 10 specimens from four localities includes Osteichthyes (boney fish), *Glossotherium harlani* (Harlan's ground sloth), *Equus* (horse), *Mammut americanum* (American mastodon), and *Mammuthus primigenius* (wooly mammoth); however, none of the Pleistocene localities is within ten miles of the project site.

Paleontological Assessment and Mitigation Recommendations

The proposed project site is situated on Franciscan mélange, which has very low paleontological sensitivity and potential in California overall. No significant paleontological resources are known from Franciscan rocks in Northern California. It does not appear that the project site extends into the artificial fill that overlies late Pleistocene? marine and marsh deposits. I therefore do not recommend any further paleontological mitigation for this project.

In the highly unlikely event that any earth-disturbing construction-related activities uncover any significant fossils (i.e., bones or teeth), those activities should to be diverted at least 15 feet away from the discovery until a professional paleontologist assesses the find for possible salvage. The construction crew should not attempt to remove such finds as they could be quite fragile, in which case they would require special treatment for their intact recovery.

Sincerely,

Ken Finger

References Cited

Blake, M.C., Graymer, R.W., Jones, D.L., and Soule, A., 2000. Geologic map and map database of parts of Marin and San Francisco, Alameda, Contra Costa, and Sonoma counties, California. USGS MF-2337.

Bradshaw, J.D., 1973. Allochthonous fossil localities in mélange within the Torlesse rocks of North Canterbury. Journal of the Royal Society of New Zealand 3(2): 161–167.

Hilton, R.P., 2003. Dinosaurs and other Mesozoic reptiles of California. University of California Press, 356 p.