ROCKRIDGE GEOTECHNICAL

Prepared for **Josh Smith**

FINAL REPORT
GEOTECHNICAL INVESTIGATION
PROPOSED NEW SINGLE-FAMILY RESIDENCE
445 VIRGINIA AVENUE
SAN MATEO, CALIFORNIA

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March 19, 2021
Project No. 20-1941

ROCKRIDGE GEOTECHNICAL

March 19, 2021
Project No. 20-1941

Mr. Josh Smith
445 Virginia Avenue
San Mateo, California

Subject: Final Report
Geotechnical Investigation
Proposed New Single-Family Residence
445 Virginia Avenue
San Mateo, California

Dear Mr. Smith,

We are pleased to present our final geotechnical investigation report, dated March 19, 2021, for the proposed new single-family residence to be constructed at 445 Virginia Avenue in San Mateo, California are presented in the attached report. Our geotechnical investigation was performed in accordance with our proposal dated October 27, 2020.

The subject property site is a trapezoidal-shaped, approximately8,605-square-foot lot with a width of about 60 feet at the front and about 72 feet at the rear and a length of about 130 feet. The ground surface slopes up gently to the south with ground surface elevations ranging from 104 feet at the front of the site to 129 feet at the rear. The site is currently occupied by a two-story single-family residence with a garage on the lower (basement/garage) level.

Plans are to demolish the existing residence and construct a new three-story residence in roughly the same footprint as the existing structure. The basement/garage level will be expanded to the south and west to accommodate three vehicles, as well as provide room for storage. The basement/garage level will be of reinforced concrete construction but will not occupy the entire building footprint. The upper two floors will be framed in wood or light metal gauge steel and will be constructed over a concrete slab that will cover the entire building footprint. There may be a crawl space beneath the ground floor concrete slab where it is not over the basement/garage.

Based on the results of our geotechnical investigation, we conclude the proposed residence can be constructed as planned, provided the recommendations presented in this report are incorporated into the project plans and specifications and implemented during construction. The primary geotechnical issues affecting the proposed improvements are providing adequate foundation support and the presence of moderately to highly expansive soil. We conclude the proposed residence can be supported on conventional spread footings bearing on bedrock.

The recommendations contained in our report are based on a limited subsurface investigation. Consequently, variations between expected and actual subsurface conditions may be found in localized areas during construction. Therefore, we should be engaged to observe site grading and fill placement and footing excavations, during which time we may make changes in our recommendations, if deemed necessary.

We appreciate the opportunity to provide our services to you on this project. If you have any questions, please call.

Sincerely yours,
ROCKRIDGE GEOTECHNICAL, INC.

REGISTERED PROFESSIONAL ENGINEER
CRAIG S. SHIELDS
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GEOTECHNICAL
STATE OF CALIFORNIA

Craig S. Shields, P.E., G.E.
Principal Geotechnical Engineer

Enclosure

ROCKRIDGE GEOTECHNICAL

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445 VIRGINIA AVENUE
San Mateo, California

1.0 INTRODUCTION

This report presents the results of the geotechnical investigation performed by Rockridge Geotechnical, Inc. for the proposed new single-family residence to be constructed at 445 Virginia Avenue in San Mateo, California. The project site is on the southern side of Virginia Avenue between Jackson Street and Harvard Road, as shown on the Site Location Map, Figure 1.

The subject property site is a trapezoidal-shaped, approximately8,605-square-foot lot with a width of about 60 feet at the front and about 72 feet at the rear and a length of about 130 feet. The ground surface slopes up gently to the south with ground surface elevations[1] ranging from 104 feet at the front of the site to 129 feet at the rear. The site is currently occupied by a two-story single-family residence with a garage on the lower (basement/garage) level.

Plans are to demolish the existing residence and construct a new three-story residence in roughly the same footprint as the existing structure. The basement/garage level will be expanded to the south and west to accommodate three vehicles, as well as provide room for storage. The basement/garage level will be of reinforced concrete construction but will not occupy the entire building footprint. The upper two floors will be framed in wood or light metal gauge steel and will be constructed over a concrete slab that will cover the entire building footprint. There may be a crawl space beneath the ground floor concrete slab where it is not over the basement/garage.

2.0 SCOPE OF SERVICES

Our geotechnical investigation was performed in accordance with our proposal dated October 27, 2020. Our scope of services consisted of reviewing available information, exploring subsurface conditions at the site by drilling four test borings, and performing engineering analyses to

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[1] Elevations are based on the plans entitled “Existing Site Plan”, dated September 17, 2020.

provide information about the soil and groundwater conditions at the site and our conclusions and recommendations regarding:

- the most appropriate foundation type for the proposed new residence
- design criteria for the recommended foundation type, including vertical and lateral capacities
- estimates of foundation settlement
- lateral earth pressures for basement wall design
- subgrade preparation for exterior flatwork
- site grading and excavation, including criteria for fill quality and compaction
- site seismicity and seismic hazards
- 2019 California Building Code (CBC) site class and design spectral response acceleration parameters
- shoring design
- allowable inclinations for temporary slopes
- soil corrosivity
- construction considerations.

3.0 FIELD INVESTIGATION AND LABORATORY TESTING

Subsurface conditions at the site were explored by drilling four test borings and performing laboratory testing on selected soil samples. Prior to performing the field exploration, we submitted a drilling notification form to the San Mateo County Environmental Health Services Division (SMCEHSD) in accordance with our annual drilling permit and contacted Underground Service Alert (USA) to notify them of our work, as required by law. Details of the field investigation and laboratory testing are described below.

3.1 Test Borings

The test borings were drilled on November 11, 2020 by Access Soil Drilling of San Mateo, California. The borings, designated as B-1 through B-4, were drilled to depths ranging from 4-1/2 to 8-1/2 feet below the existing ground surface (bgs) using limited-access drilling equipment.

During drilling, our field engineer logged the soil encountered and obtained representative samples for visual classification and laboratory testing. The approximate locations of the borings are shown on Figure 2. The logs of the borings are presented on Figures A-1 through A-4 in Appendix A. The soil and bedrock encountered in the borings were classified in accordance with the classification systems shown on Figure A-5 and Figure A-6, respectively.

Soil samples were obtained using the following samplers:

- Sprague and Henwood (S&H) split-barrel sampler with a 3.0-inch outside diameter and 2.5-inch inside diameter, lined with 2.43-inch inside diameter tubes.
- California (CA) split-barrel sampler with a 2.5-inch outside diameter and a 2.0-inch inside diameter, lined with 1.875-inch diameter liners.
- Standard Penetration Test (SPT) split-barrel sampler with a 2.0-inch outside and 1.5-inch inside diameter, without liners.

The samplers were driven with a 140-pound safety hammer falling about 30 inches per drop. The hammer was lifted and dropped using a rope-and-cathead system. The samplers were driven up to 18 inches and the hammer blows required to drive the samplers were recorded every six inches and are presented on the boring logs. A “blow count” is defined as the number of hammer blows per six inches of penetration or 50 blows for six inches or less of penetration. The blow counts required to drive the S&H, CA, and SPT sampler were converted to approximate Standard Penetration Test (SPT) N-values using factors of 0.7, 0.8, and 1.2, respectively, to account for sampler type and approximate hammer energy and the fact that the SPT sampler was used without liners. The blow counts used for this conversion were: (1) the second and third blow counts if the sampler was driven 24 inches, (2) the last two blow counts if the sampler was driven more than 12 inches but less than 18 inches, (3) the last one blow count if the sampler was driven more than six inches but less than 12 inches, and (4) the only blow count if the sampler was driven 6 inches or less. The converted SPT N-values are presented on the boring logs.

Upon completion of drilling, the boreholes were backfilled with cement grout in accordance with SMCEHSD requirements. The soil cuttings were spread in landscaped areas on site.

3.2 Laboratory Testing

We re-examined the soil samples obtained from our borings to confirm the field classifications and selected representative samples for laboratory testing. Soil samples were tested to measure moisture content, dry density, Atterberg limits, and corrosivity. The results of the laboratory tests are presented on the boring logs and in Appendix B.

4.0 SUBSURFACE CONDITIONS

A Regional Geologic Map (Figure 3) of the area indicates the site is mostly underlain by early Cretaceous and/or late Jurassic-aged Franciscan Complex sedimentary rock. The results of our investigation indicate the site is blanketed by about 3 to 5 feet of soil overlying bedrock consisting of moderately to deeply weathered mudstone and sandstone. The soil encountered above bedrock in our borings consists of medium dense clayey sand and stiff to hard clay with varying amounts of sand, except for one foot of topsoil encountered just below the ground surface at the Boring B-3 location and approximately 1-1/2 feet of medium stiff sandy clay encountered at the Boring B-4 location. It should be noted that Boring B-3 was drilled in an existing lawn area outside the proposed building footprint. Three Atterberg limits tests were performed on select samples of the near-surface sandy clay. The Atterberg limits tests performed on near-surface clay samples from Borings B-1, B-3, and B-4 resulted in plasticity indices (PIs) of 26, 28, and 15, respectively. These PI values indicate that the surficial clay is moderately to highly expansive[2].

Groundwater was not encountered in our borings; however, perched groundwater in the fractures of the bedrock may occur seasonally. Considering the site topography and the shallow depth to bedrock, we anticipate there may be seasonally perched groundwater on or near the surface of the bedrock.

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[2] Expansive soil undergoes volumetric changes with changes in moisture content (i.e. it shrinks when dried and swells when wetted).

5.0 SEISMIC CONSIDERATIONS

The San Francisco Bay Area is considered to be one of the more seismically active regions in the world. The results of our evaluation regarding seismic considerations for the project site are presented in the following sections.

5.1 Regional Seismicity and Faulting

The site is located in the Coast Ranges geomorphic province that is characterized by northwest-southeast trending valleys and ridges. These topographic features are controlled by folds and faults that resulted from the collision of the Farallon and North American plates and subsequent strike-slip faulting along the San Andreas Fault system. The San Andreas Fault is more than 600 miles long from Point Arena in the north to the Gulf of California in the south. The Coast Ranges province is bounded on the east by the Great Valley and on the west by the Pacific Ocean.

The major active faults in the area are the San Andreas, Hayward, and Monte Vista - Shannon faults. These and other faults are shown on Figure 4. For these and other active faults within a 50-kilometer radius of the site, the distance and direction from the site and characteristic moment magnitude[4] [Petersen et al. (2014) & Thompson et al. (2016)] are summarized in Table 1. These references are based on the Third Uniform California Earthquake Rupture Forecast (UCERF3), prepared by Field et al. (2013).

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

TABLE 1
Regional Faults and Seismicity

Fault Segment	Approximate Distance from Site (km)	Direction from Site	Maximum Magnitude
Total North San Andreas (SAO+SAN+SAP+SAS)	4.3	West	8.04
North San Andreas (Peninsula, SAP)	4.3	West	7.38
Monte Vista - Shannon	8.9	South	7.14
San Gregorio (North)	16	West	7.44
Total Hayward + Rodgers Creek (RC+HN+HS+HE)	25	East	7.58
Hayward (South, HS)	25	East	7.00
Butano	28	South	6.93
Hayward (North, HN)	29	Northeast	6.90
Total Calaveras (CN+CC+CS+CE)	38	East	7.43
Calaveras (North, CN)	38	East	6.86
Zayante-Vergeles (2011 CFM)	41	South	7.48
Mount Diablo Thrust North CFM	42	Northeast	6.72
Mount Diablo Thrust	44	Northeast	6.67
Mount Diablo Thrust South	44	East	6.50
Las Positas	46	East	6.50
Calaveras (Central, CC)	47	East	6.85
North San Andreas (North Coast, SAN)	48	Northwest	7.52
Concord	49	Northeast	6.45
Hayward (Extension, HE)	50	East	6.18

Since 1800, four major earthquakes have been recorded on the San Andreas Fault. In 1836, an earthquake with an estimated maximum intensity of VII on the Modified Mercalli (MM) scale occurred east of Monterey Bay on the San Andreas Fault (Toppozada and Borchardt 1998). The estimated Moment magnitude, M_w, for this earthquake is about 6.25. In 1838, an earthquake occurred with an estimated intensity of about VIII-IX (MM), corresponding to an M_w of about 7.5. The San Francisco Earthquake of 1906 caused the most significant damage in the history of the Bay Area in terms of loss of lives and property damage. This earthquake created a surface rupture along the San Andreas Fault from Shelter Cove to San Juan Bautista approximately 470 kilometers in length. It had a maximum intensity of XI (MM), an M_w of about 7.9, and was felt 560 kilometers away in Oregon, Nevada, and Los Angeles. The Loma Prieta Earthquake of October 17, 1989 had an M_w of 6.9 and occurred about 70 kilometers south of the site.

In 1868, an earthquake with an estimated maximum intensity of X on the MM scale occurred on the southern segment (between San Leandro and Fremont) of the Hayward Fault. The estimated M_w for the earthquake is 7.0. In 1861, an earthquake of unknown magnitude (probably an M_w of about 6.5) was reported on the Calaveras Fault. The most recent significant earthquake on this fault was the 1984 Morgan Hill earthquake ($M_w = 6.2$).

As part of the UCERF3 project, researchers estimated that the probability of at least one $M_w \geq 6.7$ earthquake occurring in the San Francisco Region during the next 30 years (starting from 2014) is 72 percent. The highest probabilities are assigned to the Hayward (South), Calaveras (Central), and the North San Andreas (Santa Cruz Mountains) faults. These probabilities are 25, 21, and 17 percent, respectively.

5.2 Geologic Hazards

Because the project site in in a seismically active region, we evaluated the potential for earthquake-induced geologic hazards, including ground shaking, ground surface rupture, liquefaction[5], lateral spreading[6] and cyclic densification.[7] We used the results of our field investigation to evaluate the potential of these phenomena occurring at the project site.

5.2.1 Ground Shaking

The seismicity of the site is governed by the activity of the San Andreas Fault, although ground shaking from future earthquakes on other faults will also be felt at the site. The intensity of earthquake ground motion at the site will depend upon the characteristics of the generating fault, distance to the earthquake epicenter, and magnitude and duration of the earthquake. We judge that strong to very strong ground shaking could occur at the site during a large earthquake on one of the nearby faults.

5.2.2 Ground Surface Rupture

Historically, ground surface displacements closely follow the trace of geologically young faults. The site is not within an Earthquake Fault Zone, as defined by the Alquist-Priolo Earthquake Fault Zoning Act, and no known active or potentially active faults exist on the site. We therefore conclude the risk of fault offset at the site from a known active fault is very low. In a seismically active area, the remote possibility exists for future faulting in areas where no faults previously existed; however, we conclude the risk of surface faulting and consequent secondary ground failure from previously unknown faults is also very low.

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5 Liquefaction is a phenomenon where loose, saturated, cohesionless soil experiences temporary reduction in strength during cyclic loading such as that produced by earthquakes.

6 Lateral spreading is a phenomenon in which surficial soil displaces along a shear zone that has formed within an underlying liquefied layer. Upon reaching mobilization, the surficial blocks are transported downslope or in the direction of a free face by earthquake and gravitational forces.

7 Cyclic densification is a phenomenon in which non-saturated, cohesionless soil is compacted by earthquake vibrations, causing ground-surface settlement.

5.2.3 Liquefaction and Associated Hazards

When a saturated, cohesionless soil liquefies, it experiences a temporary loss of shear strength created by a transient rise in excess pore pressure generated by strong ground motion. Soil susceptible to liquefaction includes loose to medium dense sand and gravel, low-plasticity silt, and some low-plasticity clay deposits. Flow failure, lateral spreading, differential settlement, loss of bearing strength, ground fissures and sand boils are evidence of excess pore pressure generation and liquefaction.

The CGS has prepared a map titled *State of California Seismic Hazard Zones, San Mateo Quadrangle, Official Map*, dated January 11, 2018 (Figure 5). This map was prepared in accordance with the Seismic Hazards Mapping Act of 1990. As shown on Figure 5, the project site is **not** within one of the designated liquefaction hazard zones. Considering that bedrock was encountered within five feet of the ground surface and is overlain by cohesive soil that is not susceptible to liquefaction, we conclude that the potential for liquefaction and associated hazards to occur is nil.

5.2.4 Cyclic Densification

Cyclic densification (also referred to as differential compaction) of non-saturated sand (sand above groundwater table) can occur during an earthquake, resulting in settlement of the ground surface and overlying improvements. The soil encountered above the groundwater table is not susceptible to cyclic densification because of its cohesion. Accordingly, we conclude the potential for ground surface settlement resulting from cyclic densification is nil.

6.0 DISCUSSION AND CONCLUSIONS

From a geotechnical standpoint, we conclude the site can be developed as planned, provided the recommendations presented in this report are incorporated into the project plans and specifications and implemented during construction. The primary geotechnical concerns affecting the proposed development are providing adequate foundation support and the presence of moderately to highly expansive near-surface soil.

6.1 Foundation Support and Settlement

Based on the results of our subsurface investigation, we anticipate the foundation level of the proposed structure will be underlain by a combination of stiff to very stiff sandy clay and bedrock. To provide uniform support for the proposed structure, we conclude it should be supported on conventional spread footings bearing on bedrock. To minimize potential for differential settlement across the proposed building, footings should be deepened where necessary to extend through the surficial to reach bedrock. We estimate total settlement of properly constructed spread footings designed using the recommendations presented in Section 7.2 of this report will be less than 1/2 inch and differential settlement will be on the order of 1/4 inch over a 30-foot horizontal distance.

6.2 Excavation Support

We estimate construction of the partially below-grade garage and the building foundations will require excavations up to about 10 feet in depth, accounting for slab thickness and minimum footing depth. Excavations that will be deeper than five feet and will be entered by workers should be sloped or shored in accordance with CAL-OSHA standards (29 CFR Part 1926).

Where space permits, the sides of the temporary excavation can be sloped. We recommend temporary slopes not exceed an inclination of 1:1 (horizontal:vertical) in stiff clay and 3/4:1 in bedrock. Where space does not permit sloping of the excavation perimeter, a shoring system will be required to support the sides of the proposed excavation.

We judge that a cantilevered soldier pile and lagging shoring system is appropriate for support of excavations that are less than 12 feet deep. A structural/civil engineer knowledgeable in this type of construction should be retained to design the shoring. The shoring designer should design the shoring system for lateral deformation of less than one inch. We should review the final shoring plans and calculations to check that they are consistent with the recommendations presented in this report.

6.3 Construction Considerations

Excavation of bedrock will be required for the construction of the garage and storage area and foundations. Where explored, the bedrock is moderately to deeply weathered with low to moderate hardness near the bedrock surface and grades harder and less weathered with depth. We anticipate the weathered rock can be excavation with conventional grading equipment (excavators and bull dozers); harder rock at depth may require the use of hydraulic breaking equipment (i.e. a hoe ram).

Based on our experience on projects situation at sites with shallow bedrock similar to the subject site, some seepage of groundwater into the proposed excavation should be expected during and within a few months following the rainy season. In most cases, we anticipate groundwater seepage, if any, would have a relatively low flow rate. Flow of groundwater into the excavation during construction could result in sloughing, slumping, or caving of the sides of the excavation and/or wet, difficult working conditions. Therefore, for planning purposes, it should be assumed measures will be required to protect open cuts during the rainy season. Further, rainwater and surface runoff should be immediately pumped out to avoid softening of the foundation subgrade. If it is not practical to remove standing water within a short period, then a rat slab consisting of two inches of unreinforced concrete should be placed at the bottom of footing excavations after they are checked for proper bearing and cleanout by a representative from our firm.

6.4 Soil Corrosivity

Laboratory testing was performed by Project X Corrosion Engineering of Murrieta, California on a sample of clayey sand obtained from Boring B-3 at a depth of 2.5 feet bgs. The results of the tests are presented in Appendix B of this report. The resistivity test results (6,700 ohm-cm) indicate the near-surface soil is “mildly corrosive” to buried metallic structures. Accordingly, all buried iron, steel, cast iron, ductile iron, galvanized steel and dielectric-coated steel or iron may need to be protected against corrosion depending upon the critical nature of the structure. If it is necessary to have metal in contact with soil, a corrosion engineer should be consulted to provide recommendations for corrosion protection. The results indicate that sulfate and chloride ion concentrations are sufficiently low such that they do not pose a threat to buried concrete. The results of the pH test indicate the near-surface soil has a pH of 8.0 and has a "negligible" impact to buried metal.

7.0 RECOMMENDATIONS

Our recommendations for site preparation and grading, foundation design, and other geotechnical aspects of the project are presented in this section.

7.1 Site Preparation and Grading

Any vegetation and organic topsoil should be stripped in areas to receive improvements (i.e. building, pavement or flatwork). Site demolition should include removal of all former foundation elements within the proposed building footprint. Voids resulting from demolition activities that extend below finish improvements should be properly backfilled with engineered fill under our observation and following the recommendations provided in this section.

Where highly expansive soil is exposed at the building pad subgrade elevation in areas where a concrete slab-on-grade floor will be constructed, the building pad should be overexcavated to accommodate 12 inches of non-expansive fill below the proposed slab-on-grade floor. Prior to placement of the non-expansive fill, the soil subgrade exposed should be scarified to a depth of at least eight inches, moisture-conditioned to at least three percent above optimum moisture content and compacted in accordance with the recommendation provided below in Table 2. Where bedrock is exposed at subgrade elevation, scarification and recompaction will not be required, although loose rock fragments resulting from excavation should be removed.

On-site soil may be used as general fill, provided the material is free of organic matter, contain no rocks or lumps larger than three inches in greatest dimension, and be approved by the geotechnical engineer. If material to be used as fill is imported to the site, it should meet the requirements for select fill provided below. A summary of the compaction requirements for the various types of fill that may be used at the site is presented in Table 2.

TABLE 2
Summary of Compaction Requirements

Location	Required Relative Compaction (percent)	Moisture Requirement
General fill – select fill	90+	Above optimum
General fill – moderately to highly expansive clay	88-92+	3+% above optimum
Building pad subgrade – low-plasticity	90+	Above optimum
Building pad subgrade – moderately to highly expansive clay	88-92	3+% above optimum
Exterior flatwork subgrade – low-plasticity	90+	Above optimum
Exterior flatwork subgrade – moderately to highly expansive clay	88-92+	3+% above optimum
Exterior flatwork – select fill	90+	Above optimum
Vehicular pavement subgrade - moderately to highly expansive clay	92+	2+% above optimum
Vehicular pavement subgrade – aggregate base	95+	Near optimum
Fill and backfill – low-plasticity	90+	Above optimum
Utility trench backfill – moderately to highly expansive clay	88-92+	3+% above optimum
Utility trench backfill - clean sand or gravel	95+	Near optimum

Note: Select fill is considered low-plasticity soil.

All fill should be placed in horizontal lifts not exceeding eight inches in loose thickness, moisture-conditioned, and compacted in accordance with the requirements provided in Table 2. Fill should consist of on-site soil or imported soil (select fill) that is free of organic matter, contains no rocks or lumps larger than four inches in greatest dimension, has a liquid limit of less than 40 and a plasticity index lower than 15, and is approved by the geotechnical engineer.

Samples of the proposed imported fill material should be submitted to the geotechnical engineer at least three business days prior to use at the site. The grading contractor should provide analytical test results or other suitable environmental documentation indicating the imported fill is free of hazardous materials at least three days before use at the site. If this data is not available, up to two weeks should be allowed to perform analytical testing on the proposed imported material. Crushed bedrock from the site can be used as backfill material, provided the requirements for fill are met (i.e. no rocks or lumps larger than four inches in greatest dimension).

If grading work is performed during the rainy season, the contractor may find the subgrade material too wet to compact to the recommended relative compaction and will have to be scarified and aerated to lower its moisture content so the specified compaction can be achieved. Material to be dried by aeration should be scarified to a depth of at least 12 inches; the scarified soil should be turned at least twice a day to promote uniform drying. Once the moisture content of the aerated soil has been reduced to acceptable levels, the soil should be compacted in accordance with our recommendations. Aeration typically is the least costly method used to stabilize the subgrade soil; however, it generally requires the most time to complete. Other soil stabilization alternatives include overexcavating and placing drier material, importing drier material, and chemical treatment.

It is also important that the moisture content of the clay subgrade soil is sufficiently high to reduce the expansion potential. If the grading work is performed during the dry season, moisture-conditioning to increase the moisture content of the soil may be required.

7.1.1 Exterior Concrete Flatwork

We recommend exterior concrete flatwork be underlain by a minimum of six inches of select, non-expansive fill (such as Class 2 AB). The soil subgrade and select fill should be moisture-conditioned and compacted in accordance with the requirements provided above in Table 2. The prepared subgrade should be kept moist until it is covered with select fill. We recommend thickening the edges of concrete flatwork where it is immediately adjacent to landscaped areas.

Even with six inches of select fill, exterior slabs may experience some cracking due to shrinking and swelling of the underlying expansive soil. Thickening the slab edges and adding additional reinforcement will control cracking to some degree. Where slabs are adjacent to landscaped areas, thickening the concrete edge to extend to the bottom of the select fill underlying the flatwork will help control water infiltration beneath the slabs. In addition, where slabs provide access to the building, it would be prudent to dowel the entrance to the building to permit rotation of the slab as the exterior ground shrinks and swells and the precent a vertical offset at the entries.

7.1.2 Utility Trench Backfill

Excavations for utility trenches can be made with a backhoe; however, where excavations extend into bedrock, contractors should be prepared to use equipment capable of excavating rock. All trenches should conform to the current CAL-OSHA requirements. To provide uniform support, pipes or conduits should be bedded on a minimum of four inches of sand or fine gravel. After the pipes and conduits are tested, inspected (if required) and approved, they should be covered to a depth of six inches with sand or fine gravel, which should be mechanically tamped. Backfill for utility trenches and other excavations is also considered fill and should be placed and compacted according to the recommendations previously presented. Jetting of trench backfill should not be permitted.

Where utility trenches enter the building pad, an impermeable plug consisting of CLSM, at least three feet in length, should be installed where the trenches enter the building footprint. The purpose of this recommendation is to reduce the potential for water to be trapped in trenches beneath the building. This trapped water can cause heaving of soils beneath slabs.

Foundations for the proposed buildings should be bottomed below an imaginary line extending up at a 1.5:1 (horizontal to vertical) inclination from the base of utility trenches running parallel to the foundation. Alternatively, the portion of the utility trench that is below the 1.5:1 line can be backfilled with CLSM (see section 7.1.1 for material requirements) or Class 2 aggregate base compacted to at least 95 percent relative compaction. If utility trenches are to be excavated below this zone-of-influence line after construction of the building foundations, the trench wall needs to be fully supported with shoring until CLSM is placed – compacted AB shall not be used in this scenario.

7.1.3 Drainage and Landscaping

Positive surface drainage should be provided around the building to direct surface water away from foundations and below-grade walls. To reduce the potential for water ponding adjacent to the building, we recommend the ground surface within a horizontal distance of five feet from the building slope down away from the building with a surface gradient of at least two percent in unpaved areas and one percent in paved areas. In addition, roof downspouts should be discharged into controlled drainage facilities (i.e., solid pipe) to keep the water away from the foundation and below-grade walls. The use of water-intensive landscaping or unlined bio-swales around the perimeter of the building should be avoided.

Considering the presence of a lawn at the rear of the residence, we recommend a perimeter subdrain be installed adjacent to the rear perimeter footing of the residence. The subdrain trench should be at least one foot wide and a minimum of 18 inches deep but should not extend below the bottom of the rear footing. The bottom of the trench should slope at a minimum inclination of one percent to one rear corner of the residence. A perforated four-inch-diameter Schedule 40 PVC pipe should be installed (with perforations facing down and at a gradient of at least one percent) on two inches of Class 2 permeable soil placed on the bottom of the trench. The slotted pipe should be connected to a solid pipe that connects to the roof downspout outlet pipe on the side or at the front of the residence. The trench should then be backfilled with Class 2 permeable soil to within six inches of the ground surface. The trench should be capped with at least six inches of low-permeability on-site soil or a concrete slab. A cleanout should be installed at the high end of the pipe to allow for flushing of the subdrain if necessary.

7.2 Footings

The proposed new residence may be supported on continuous and/or individual spread footings bottomed on bedrock. Based on our field investigation, we estimate the footing excavations along the eastern side of the building will need to be deepened by about 1 to 2 foot to reach bedrock. Where a portion of the footing is underlain by existing soil and a portion is underlain by bedrock, the portion of the excavation in the soil should be deepened so that the entire footing bears on bedrock. The deepened portion of the footing excavation may be filled with structural concrete or controlled low-strength material (CLSM) with a 28-day unconfined strength of at least 100 pounds per square inch (psi).

Perimeter footings should be embedded at least 24 inches below the lowest adjacent grade and interior footings should be bottomed at least 18 inches below the lowest adjacent soil subgrade. Where hard bedrock is encountered, the minimum embedment depth of the footing may be decreased by six inches. Footings may be designed using an allowable bearing pressure of 5,000 pounds per square foot (psf) for dead-plus-live loads; this value may be increased by one-third for total design loads, which include wind or seismic forces. The allowable design values for dead-plus-live and total design loads include factors of safety of at least 2.0 and 1.5, respectively.

Lateral loads may be resisted by a combination of passive pressure on the vertical faces of the footings and friction between the bottoms of the footings and the supporting bedrock. Assuming the average inclination of the ground surface within four feet of the footing does not exceed 4:1 (horizontal:vertical), passive pressure may be computed using an equivalent fluid weight of 260 pcf and 400 pcf in soil and bedrock, respectively; the upper foot of soil/bedrock should be ignored unless confined by a slab or pavement. Frictional resistance should be computed using a base friction coefficient of 0.45 in bedrock. The passive pressure and frictional resistance values include a factor of safety of at least 1.5 and may not be used in combination without reduction.

Footing excavations should be free of standing water, debris, and disturbed materials prior to placing concrete. Where weak or loose material is encountered at the bottom of footing excavations, the material should be removed to expose competent bedrock. We suggest a two-inch-thick CLSM "rat" slab be placed at the bottom of footing excavations if footings will be excavated during the rainy season. The bottoms and sides of the footing excavations should be maintained in a moist condition until concrete is placed. We should check footing excavations prior to placement of the rat slab and reinforcing steel.

7.3 Concrete Slab-on-Grade Floors

The soil subgrade for slab-on-grade floors should be prepared following the recommendations presented in Section 7.1.1. If water vapor transmission through the floor slab is undesirable, which is typically the case in spaces to receive floor coverings, spaces used for storage, and/or rooms with limited air circulation, we recommend a vapor retarder be placed between the bottom of the floor slab and the underlying subgrade. A capillary moisture break and vapor retarder are generally not required below parking slabs-on-grade because there is sufficient air circulation to limit condensation of moisture on the slab surface. When a capillary moisture break/vapor retarder is not used, we recommend six inches of Class 2 aggregate base compacted to at least 95 percent relative compaction be placed beneath the parking garage slab.

A capillary moisture break consists of at least four inches of clean, free-draining gravel or crushed rock. The particle size of the capillary break material should meet the gradation requirements presented in Table 3.

TABLE 3
Gradation Requirements for Capillary Moisture Break

Sieve Size	Percentage Passing Sieve
1 inch	90 – 100
3/4 inch	30 – 100
1/2 inch	5 – 25
3/8 inch	0 – 6

The vapor retarder should meet the requirements for Class B vapor retarders stated in ASTM E1745 and should be placed in accordance with the requirements of ASTM E1643. These requirements include overlapping seams by six inches, taping seams, and sealing penetrations in the vapor retarder.

Concrete slabs should be properly cured. Concrete mixes with high water/cement (w/c) ratios result in excess water in the concrete, which increases the cure time and can result in excessive vapor transmission through the floor slab. Therefore, concrete for the floor slab should have a low w/c ratio – less than 0.45 – and water should not be added in the field. If necessary, workability should be increased by adding plasticizers. Before floor coverings, if any, are placed, the contractor should check that the concrete surface and the moisture emission levels (if emission testing is required) meet the manufacturer's requirements.

7.4 Permanent Below-Grade Walls

Permanent below-grade walls, including basement walls, should be designed to resist lateral earth pressures imposed by the retained soil and bedrock, as well as surcharge pressures, and surcharges from adjacent foundations, where appropriate. We recommend restrained below-grade walls at the site be designed for the more critical of the following criteria:

- at-rest equivalent fluid weights of 56 pcf (triangular distribution) in soil (including wall backfill) and 30 pcf in bedrock, or
- an active equivalent fluid weight of 37 plus a seismic increment of 42 pcf (triangular distribution); a seismic increment is not required in bedrock.

Proposed below-grade walls should be designed for surcharge pressures if new foundations are founded above the zone-of-influence for the below-grade walls. This zone is defined as an imaginary line extending up from the bottom of the basement wall at an inclination of 1.5:1 (horizontal to vertical). The influence on a wall from a foundation that is founded within this zone of influence should be analyzed on an individual basis after the geometry has been determined.

The lateral earth pressures recommended are applicable to walls that are backdrained to prevent the buildup of hydrostatic pressure. One acceptable method for backdraining below-grade walls is to place a prefabricated drainage panel against the shoring or the back of the walls. The drainage panel should extend down to a four-inch-diameter perforated PVC collector pipe at the base of the walls. The pipe should be surrounded on all sides by at least four inches of Caltrans Class 2 permeable material or 3/4-inch drain rock wrapped in filter fabric (Mirafi 140NC or equivalent). Where shoring is installed and there is insufficient room to install a perforated pipe between the shoring and the back of the basement wall, the drainage panel should extend down to a proprietary, prefabricated collector drain system, such as Tremdrain Total drain or Hydrcudt Coil (or equivalent), designed to work in conjunction with the drainage panel may be used in lieu of the perforated pipe surrounded by gravel described above. The pipe should be connected to a suitable discharge point; a sump and pump system may be required to drain the collector pipes. We should check the manufacturer's specifications regarding the proposed prefabricated drainage panel material to verify it is appropriate for its intended use.

To protect against moisture migration, below-grade walls should be waterproofed and water stops should be placed at all construction joints. If backfill is required behind below-grade walls, it should be engineered. Placement of the engineered fill may impose unacceptable surcharged on the walls. The project structural engineer should determine when the concrete has sufficient strength to resist surcharges imposed by compaction equipment. Bracing may be used to mitigate construction-related surcharge pressure. We recommend that lightweight, hand-compaction equipment used, to minimize the potential for damage.

7.5 Seismic Design

For design in accordance with the 2019 CBC, we recommend Site Class C be used. The latitude and longitude of the site are 37.5550° and -122.3309°, respectively. Hence, in accordance with the 2019 CBC, we recommend the following:

- S_S = 2.024g, S_1 = 0.836g
- S_{MS} = 2.429g, S_{M1} = 1.170g

- S_{DS} = 1.619g, S_{D1} = 0.780g
- Seismic Design Category E for Risk Categories I, II, and III.

8.0 ADDITIONAL GEOTECHNICAL SERVICES

Prior to construction, Rockridge Geotechnical should review the project plans and specifications to verify that they conform to the intent of our recommendations. During construction, our field engineer should provide on-site observation and testing during site preparation, placement and compaction of fill, and installation of building foundations. These observations will allow us to compare actual with anticipated soil conditions and to verify that the contractor's work conforms to the geotechnical aspects of the plans and specifications.

9.0 LIMITATIONS

This geotechnical investigation has been conducted in accordance with the standard of care commonly used as state-of-practice in the profession. No other warranties are either expressed or implied. The recommendations made in this report are based on the assumption that the subsurface conditions do not deviate appreciably from those disclosed in the exploratory borings. If any variations or undesirable conditions are encountered during construction, we should be notified so that additional recommendations can be made. The foundation recommendations presented in this report are developed exclusively for the proposed development described in this report and are not valid for other locations and construction in the project vicinity.

REFERENCES

2019 California Building Code

Cao, T., Bryant, W.A., Rowshandel, B., Branum, D. and Wills, C.J. (2003). "The Revised 2002 California Probabilistic Seismic Hazard Maps".

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Ishihara, K. and Yoshimine, M., (1992), Evaluation of Settlements in Sand Deposits Following Liquefaction During Earthquakes, Soils and Foundations, Volume 23, No. 1., pp 173-188.

Jennings, C.W. (1994). Fault Activity Map of California and Adjacent Areas with Locations and Ages of Recent Volcanic Eruptions: California Division of Mines and Geology Geologic Data Map No. 6, scale 1: 750,000.

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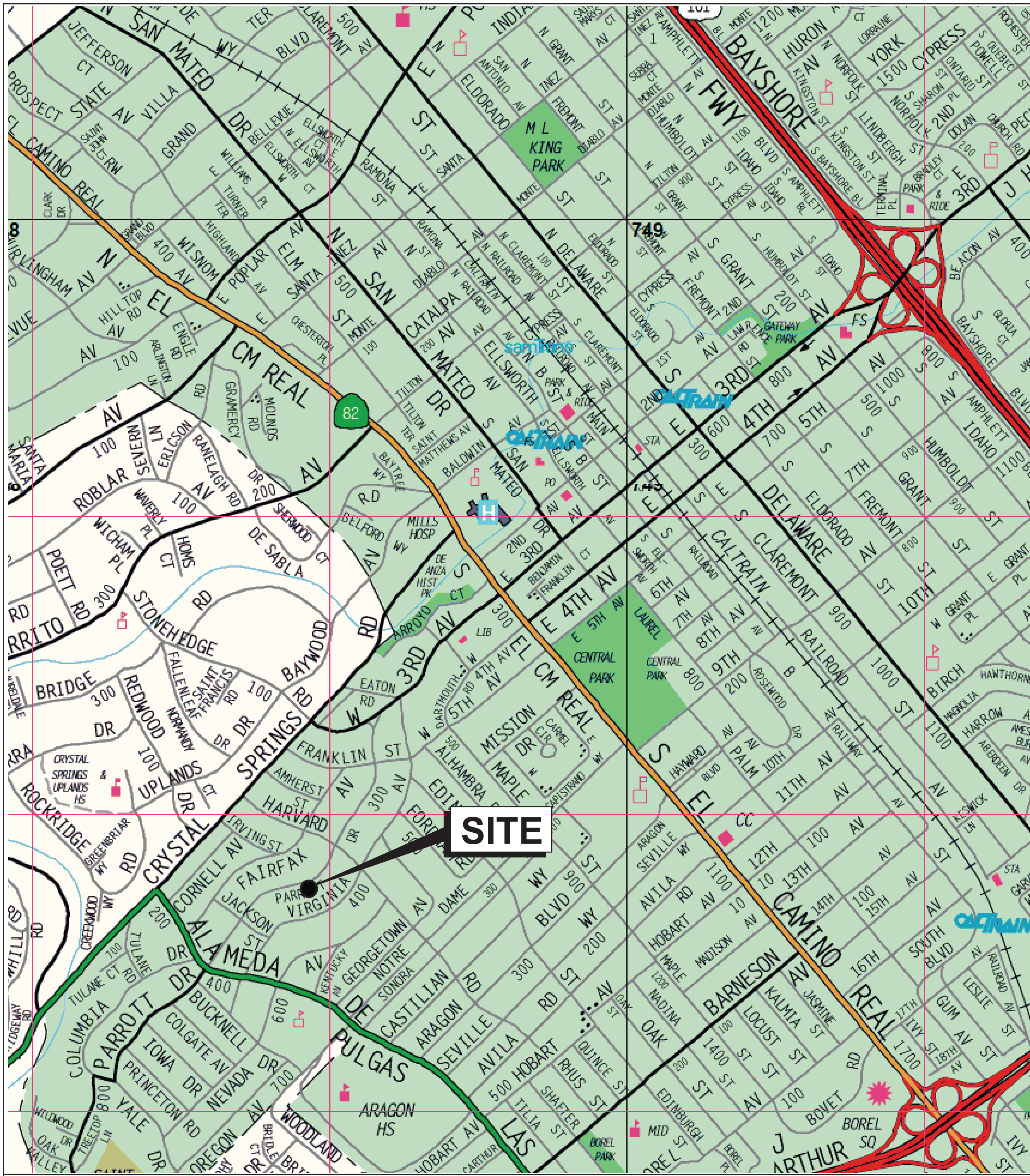
ROCKRIDGE GEOTECHNICAL

FIGURES



Base map: The Thomas Guide
San Mateo County
2002

0 1/4 1/2 Mile

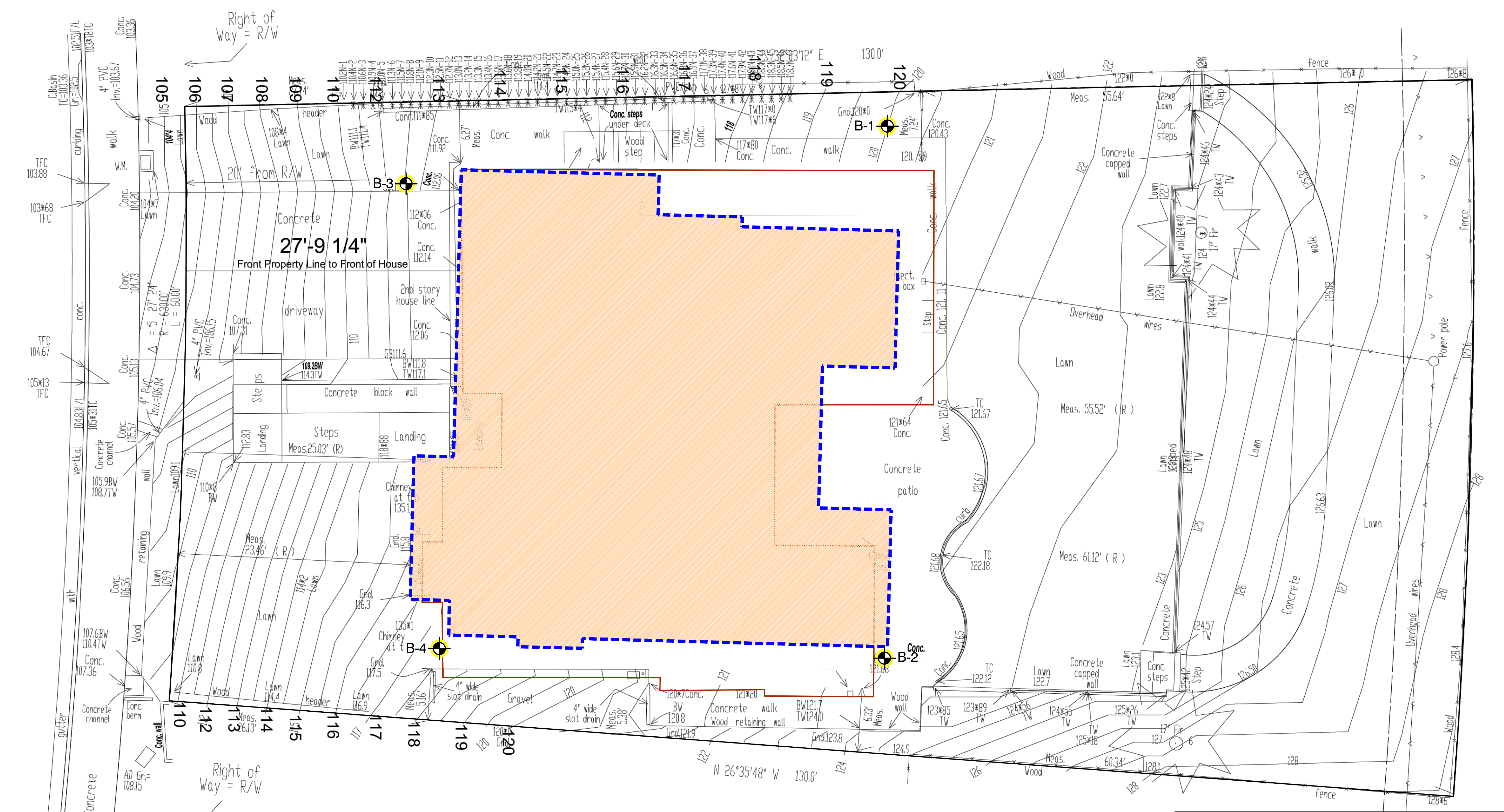
Approximate scale

445 VIRGINIA AVENUE
San Mateo, California

ROCKRIDGE GEOTECHNICAL

SITE LOCATION MAP

Date 12/02/20	Project No. 20-1941	Figure 1



EXPLANATION

B-1 Approximate location of boring by Rockridge Geotechnical Inc., November 11, 2020

Existing building footprint

Proposed building footprint

0 10 Feet

Approximate scale

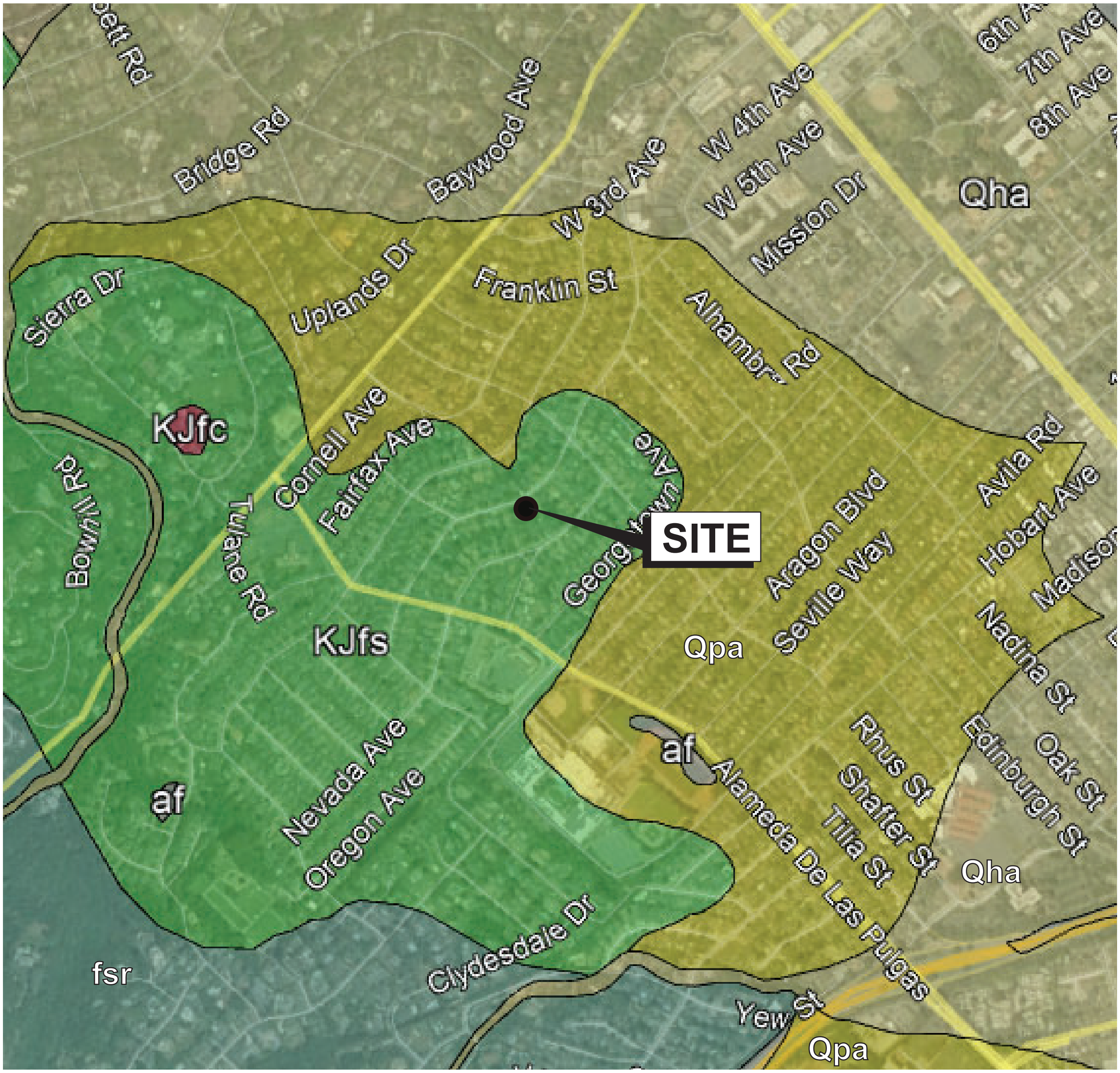
445 VIRGINIA AVENUE
San Mateo, California

SITE PLAN

Date 03/19/21	Project No. 20-1941	Figure 2

ROCKRIDGE GEOTECHNICAL

Reference: Base map from a drawing titled "Existing Site Plan", by unknown, dated September 17, 2020.



Base map: Google Earth with U.S. Geological Survey (USGS), San Mateo County, 2020.

EXPLANATION

af	Artificial Fill
Qha	Alluvium (Holocene)
Qpa	Alluvium (Pleistocene)
fsr	Franciscan Complex melange (Eocene, Paleocene, and (or) Late Cretaceous)
KJfs	Franciscan Complex sedimentary rocks (Early Cretaceous and (or) Late Jurassic)
KJfc	Franciscan Complex chert (Early Cretaceous and (or) Late Jurassic)

Geologic contact: dashed where approximate and dotted where concealed, queried where uncertain

0 1000 2000 Feet

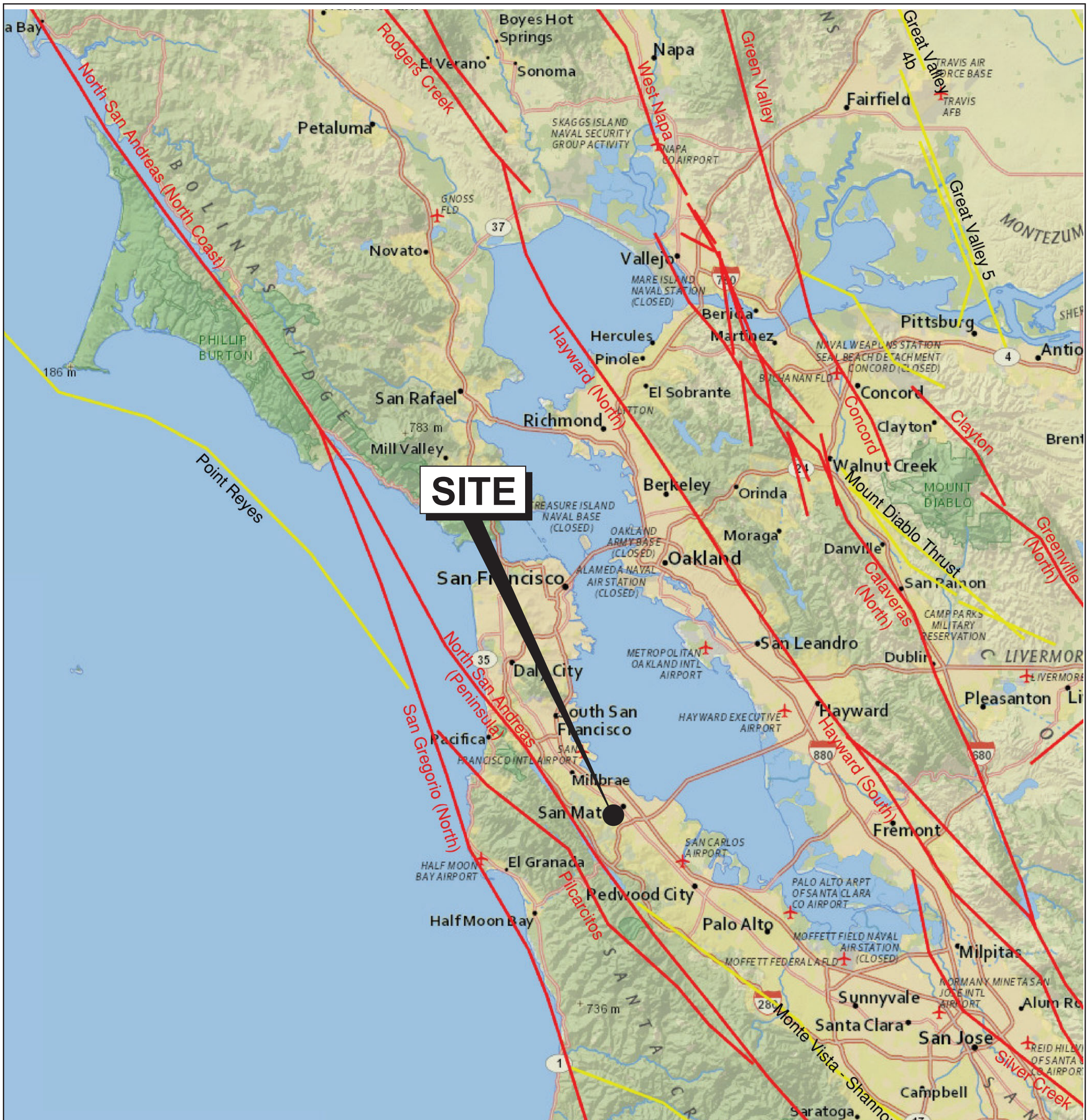
Approximate scale

445 VIRGINIA AVENUE
San Mateo, California

ROCKRIDGE GEOTECHNICAL

REGIONAL GEOLOGIC MAP

Date 12/02/20 | Project No. 20-1941 | Figure 3



Base Map: U.S. Geological Survey (USGS), National Seismic Hazards Maps - Fault Sources, 2014.

EXPLANATION

Strike slip

Thrust (Reverse)

0 5 10 Miles

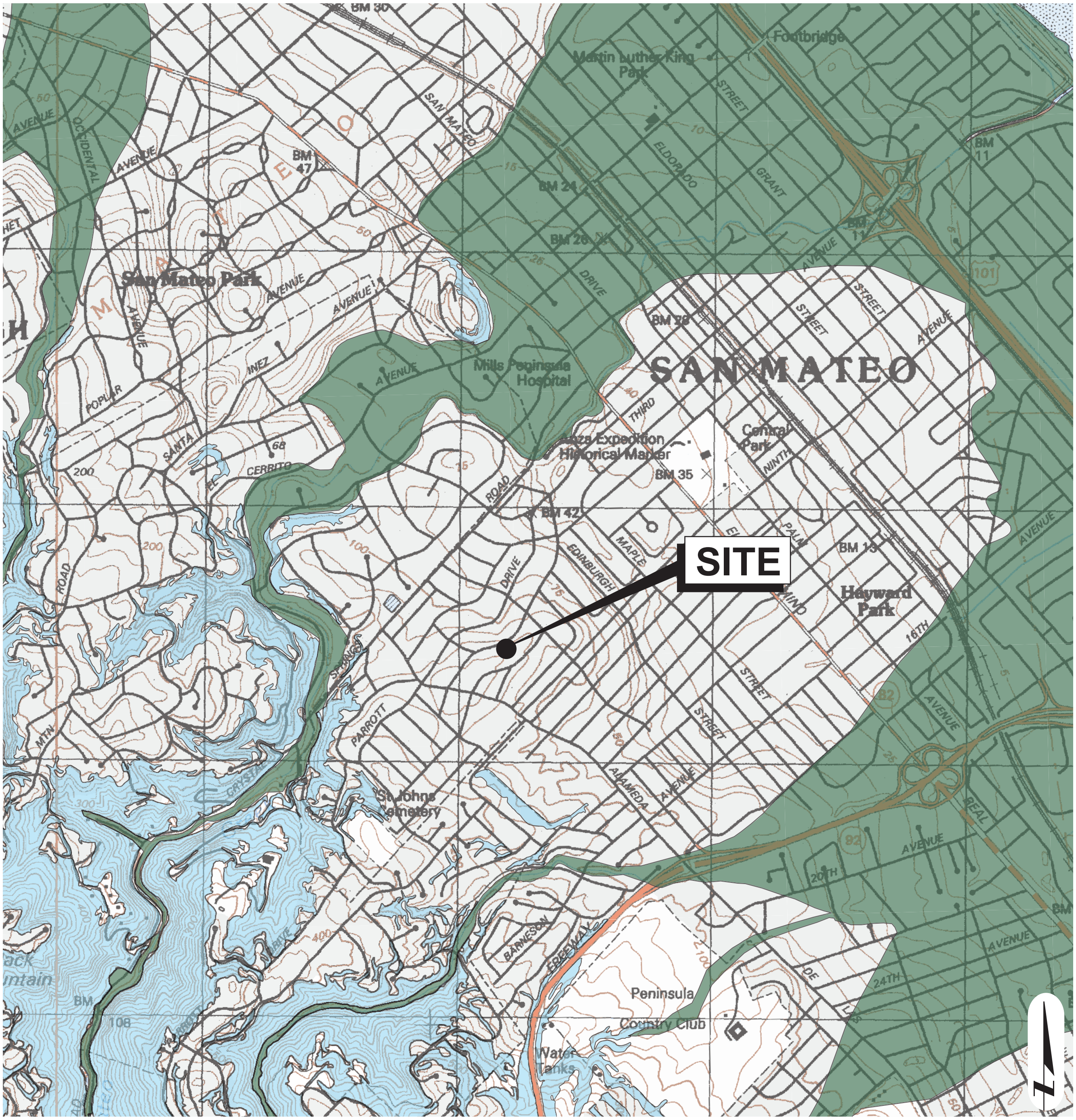
Approximate scale

445 VIRGINIA AVENUE
San Mateo, California

ROCKRIDGE GEOTECHNICAL

REGIONAL FAULT MAP

Date 12/02/20	Project No. 20-1941	Figure 4



Liquefaction Zones
Areas where historical occurrence of liquefaction, or local geological, geotechnical and ground water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

Earthquake-Induced Landslide Zones
Areas where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

Reference:
Earthquake Zones of Required Investigation
San Mateo Quadrangle
California Geological Survey
Released January 11, 2018

0 2,000 4,000 Feet
Approximate scale

445 VIRGINIA AVENUE
San Mateo, California

ROCKRIDGE GEOTECHNICAL

EARTHQUAKE ZONES OF REQUIRED INVESTIGATION MAP

Date 12/02/20	Project No. 20-1941	Figure 5

APPENDIX A
Logs of Borings

PROJECT: **445 VIRGINIA AVENUE**
San Mateo, California

Log of Boring B-1

Boring location: See Site Plan, Figure 2

Date started: 11/11/2020 | Date finished: 11/11/2020

Drilling method: solid-stem auger

Hammer weight/drop: 140 lbs./30 inches | Hammer type: Rope & Cathead

Sampler: Sprague & Henwood (S&H), Standard Penetration Test (SPT), California (CA)

Logged by: A. Limpert
Drilled by: Access Soil Drilling Inc.
Rig: Limited Access Equipment

DEPTH (feet)	Sampler Type	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
					SANDY CLAY (CL) red-brown to red, stiff to very stiff, dry to moist, fine sand						
1	S&H	7 8 13 17	15	CL	LL = 45, PI = 26; see Appendix B					12.5	103
2–3	S&H	25 21 33 50/ 5.5"	38		yellow, very stiff						
3–6.5					SANDSTONE yellow-brown to red-yellow, deeply weathered, moderately fractured, moist (BEDROCK)						
5	CA	49 39 35 50/5"	59								
6	SPT	50/4"	60/4"								
6.5	SPT	50/3"	60/3"								

Boring terminated at a depth of 6.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered during drilling.

[1] S&H, CA, and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.7, 0.8, and 1.2, respectively, to account for sampler type and hammer energy.

ROCKRIDGE GEOTECHNICAL

Project No.: 20-1941 | Figure: A-1

PROJECT: **445 VIRGINIA AVENUE**
San Mateo, California

Log of Boring B-2

Boring location: See Site Plan, Figure 2
Date started: 11/11/2020 Date finished: 11/11/2020
Drilling method: solid-stem auger
Hammer weight/drop: 140 lbs./30 inches Hammer type: Rope & Cathead
Sampler: Sprague & Henwood (S&H), Standard Penetration Test (SPT), California (CA)

Logged by: A. Limpert
Drilled by: Access Soil Drilling Inc.
Rig: Limited Access Equipment

DEPTH (feet)	SAMPLES: Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						4-inch concrete patio slab						
1	S&H		10 13 17 21	21	CL	CLAY with SAND (CL) brown mottled with black and light brown, very stiff, moist, increasing gravel in bottom 6 inches						
2	S&H		10 31 50/6"	57		hard						
3						SANDSTONE yellow-brown with yellow and white seams, deeply weathered, moderately fractured, weak (BEDROCK)						
4	CA		50/3"	40/3"								
	SPT		50/3"	60/3"								
	SPT		50/3"	60/3"								
5												
6												
7												
8												
9												
10												

Boring terminated at a depth of 4.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered during drilling.

S&H, CA, and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.7, 0.8, and 1.2, respectively, to account for sampler type and hammer energy.

ROCKRIDGE GEOTECHNICAL

Project No.: 20-1941 Figure: A-2

PROJECT:	445 VIRGINIA AVENUE San Mateo, California	Log of Boring B-3 PAGE 1 OF 1

Boring location: See Site Plan, Figure 2	Logged by: A. Limpert Drilled by: Access Soil Drilling Inc. Rig: Limited Access Equipment
Date started: 11/11/2020 — Date finished: 11/11/2020	
Drilling method: solid-stem auger	
Hammer weight/drop: 140 lbs./30 inches — Hammer type: Rope & Cathead	
Sampler: Sprague & Henwood (S&H), Standard Penetration Test (SPT), California (CA)	

DEPTH (feet)	SAMPLES: Sampler Type	Sample	Blows/ 6"	SPT N-Value[1]	LITHOLOGY	MATERIAL DESCRIPTION	LABORATORY TEST DATA: Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
						grass topsoil, roots/organics present						
1	HA				SC	CLAYEY SAND (SC) brown, medium dense, moist, fine sand						
	HA											
2						brown to yellow-brown, medium dense, fine to medium sand, less organics present						
3	S&H		19 17 21 25	27	SC	SANDY CLAY (CL) brown, very stiff, moist (RESIDUAL SOIL)						
						LL = 47, PI = 28; see Appendix B					17.2	112
4						hard						
5	S&H		18 20 32 27	36								
6	CA		21 35 50/4"	68/ 10"		SANDSTONE red-yellow mottled with brown and red-brown, intensely fractured, moderately hard, weak, moderately weathered (BEDROCK)						
7	SPT		30 50/5"	60/5"								
8	SPT		50/3"	60/5"								
9												
10												

Boring terminated at a depth of 8.5 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered during drilling.

[1] S&H, CA, and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.7, 0.8, and 1.2, respectively, to account for sampler type and hammer energy.

ROCKRIDGE GEOTECHNICAL

Project No.: 20-1941 | Figure: A-3

PROJECT: **445 VIRGINIA AVENUE**
San Mateo, California

Log of Boring B-4

Boring location: See Site Plan, Figure 2

Date started: 11/11/2020 Date finished: 11/11/2020

Drilling method: Solid-Stem Auger

Hammer weight/drop: 140 lbs./30 inches Hammer type: Rope & Cathead

Sampler: Sprague & Henwood (S&H), Standard Penetration Test (SPT), California (CA)

Logged by: A. Limpert
Drilled by: Access Soil Drilling Inc.
Rig: Limited Access Equipment

DEPTH (feet)	Sampler Type	Blows/ 6"	SPT N-Value [1]	LITHOLOGY	MATERIAL DESCRIPTION	Type of Strength Test	Confining Pressure Lbs/Sq Ft	Shear Strength Lbs/Sq Ft	Fines %	Natural Moisture Content, %	Dry Density Lbs/Cu Ft
0–2	S&H	5, 5, 6, 14	8	CL	SANDY CLAY (CL) brown with light brown, medium stiff, moist, roots/ organics present LL = 32, PI = 15; see Appendix B					13.6	94
2–3	S&H	26, 42, 30, 35	50	CL	dark brown with red-brown and red-yellow mottled with red, hard						
3–4.5					MUDSTONE dark brown mottled with red-brown, closely fractured, deeply weathered, friable						
4–5	CA	17, 48, 50/4"	78/ 10"								
4.5–6					SANDSTONE yellow to yellow-brown, deeply weathered, closely fractured, weak (BEDROCK)						
5.5	SPT	50/5"	60/4"								
5.8	SPT	50/3"	60/3"								

Boring terminated at a depth of 6 feet below ground surface.
Boring backfilled with cement grout.
Groundwater not encountered during drilling.

S&H, CA, and SPT blow counts for the last two increments were converted to SPT N-Values using factors of 0.7, 0.8, and 1.2, respectively, to account for sampler type and hammer energy.

ROCKRIDGE GEOTECHNICAL

Project No.: 20-1941 Figure: A-4

UNIFIED SOIL CLASSIFICATION SYSTEM

Major Divisions		Symbols	Typical Names
Coarse-Grained Soils (more than half of soil > no. 200 sieve size)	Gravels (More than half of coarse fraction > no. 4 sieve size)	**GW**	Well-graded gravels or gravel-sand mixtures, little or no fines
		GP	Poorly-graded gravels or gravel-sand mixtures, little or no fines
		GM	Silty gravels, gravel-sand-silt mixtures
		GC	Clayey gravels, gravel-sand-clay mixtures
	Sands (More than half of coarse fraction < no. 4 sieve size)	**SW**	Well-graded sands or gravelly sands, little or no fines
		SP	Poorly-graded sands or gravelly sands, little or no fines
		SM	Silty sands, sand-silt mixtures
		SC	Clayey sands, sand-clay mixtures
Fine -Grained Soils (more than half of soil < no. 200 sieve size)	Silts and Clays LL = < 50	**ML**	Inorganic silts and clayey silts of low plasticity, sandy silts, gravelly silts
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays
		OL	Organic silts and organic silt-clays of low plasticity
	Silts and Clays LL = > 50	**MH**	Inorganic silts of high plasticity
		CH	Inorganic clays of high plasticity, fat clays
		OH	Organic silts and clays of high plasticity
Highly Organic Soils		**PT**	Peat and other highly organic soils

GRAIN SIZE CHART

Classification	Range of Grain Sizes	
	U.S. Standard Sieve Size	**Grain Size in Millimeters**
Boulders	Above 12"	Above 305
Cobbles	12" to 3"	305 to 76.2
Gravel coarse fine	3" to No. 4 3" to 3/4" 3/4" to No. 4	76.2 to 4.76 76.2 to 19.1 19.1 to 4.76
Sand coarse medium fine	No. 4 to No. 200 No. 4 to No. 10 No. 10 to No. 40 No. 40 to No. 200	4.76 to 0.075 4.76 to 2.00 2.00 to 0.420 0.420 to 0.075
Silt and Clay	Below No. 200	Below 0.075

Unstabilized groundwater level

Stabilized groundwater level

SAMPLE DESIGNATIONS/SYMBOLS

Sample taken with split-barrel sampler. Darkened area indicates soil recovered

Classification sample taken with Standard Penetration Test sampler

Undisturbed sample taken with thin-walled tube

Disturbed sample

Sampling attempted with no recovery

Core sample

Analytical laboratory sample

Sample taken with Direct Push sampler

Sonic

SAMPLER TYPE

C	Core barrel
CA	California split-barrel sampler with 2.5-inch outside diameter and a 1.93-inch inside diameter
D&M	Dames & Moore piston sampler using 2.5-inch outside diameter, thin-walled tube
O	Osterberg piston sampler using 3.0-inch outside diameter, thin-walled Shelby tube
PT	Pitcher tube sampler using 3.0-inch outside diameter, thin-walled Shelby tube
S&H	Sprague & Henwood split-barrel sampler with a 3.0-inch outside diameter and a 2.43-inch inside diameter
SPT	Standard Penetration Test (SPT) split-barrel sampler with a 2.0-inch outside diameter and a 1.5-inch inside diameter
ST	Shelby Tube (3.0-inch outside diameter, thin-walled tube) advanced with hydraulic pressure

445 VIRGINIA AVENUE
San Mateo, California

ROCKRIDGE GEOTECHNICAL

CLASSIFICATION CHART

Date 12/04/20 | Project No. 20-1941 | Figure A-5

I FRACTURING

Intensity	Size of Pieces in Feet
Very little fractured	Greater than 4.0
Occasionally fractured	1.0 to 4.0
Moderately fractured	0.5 to 1.0
Closely fractured	0.1 to 0.5
Intensely fractured	0.05 to 0.1
Crushed	Less than 0.05

II HARDNESS

1. **Soft** - reserved for plastic material alone.
2. **Low hardness** - can be gouged deeply or carved easily with a knife blade.
3. **Moderately hard** - can be readily scratched by a knife blade; scratch leaves a heavy trace of dust and is readily visible after the powder has been blown away.
4. **Hard** - can be scratched with difficulty; scratch produced a little powder and is often faintly visible.
5. **Very hard** - cannot be scratched with knife blade; leaves a metallic streak.

III STRENGTH

1. **Plastic** or very low strength.
2. **Friable** - crumbles easily by rubbing with fingers.
3. **Weak** - an unfractured specimen of such material will crumble under light hammer blows.
4. **Moderately strong** - specimen will withstand a few heavy hammer blows before breaking.
5. **Strong** - specimen will withstand a few heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.
6. **Very strong** - specimen will resist heavy ringing hammer blows and will yield with difficulty only dust and small flying fragments.

IV WEATHERING - The physical and chemical disintegration and decomposition of rocks and minerals by natural processes such as oxidation, reduction, hydration, solution, carbonation, and freezing and thawing.

D. Deep - moderate to complete mineral decomposition; extensive disintegration; deep and thorough discoloration; many fractures, all extensively coated or filled with oxides, carbonates and/or clay or silt.

M. Moderate - slight change or partial decomposition of minerals; little disintegration; cementation little to unaffected. Moderate to occasionally intense discoloration. Moderately coated fractures.

L. Little - no megascopic decomposition of minerals; little of no effect on normal cementation. Slight and intermittent, or localized discoloration. Few stains on fracture surfaces.

F. Fresh - unaffected by weathering agents. No disintegration of discoloration. Fractures usually less numerous than joints.

ADDITIONAL COMMENTS:

V CONSOLIDATION OF SEDIMENTARY ROCKS: usually determined from unweathered samples. Largely dependent on cementation.

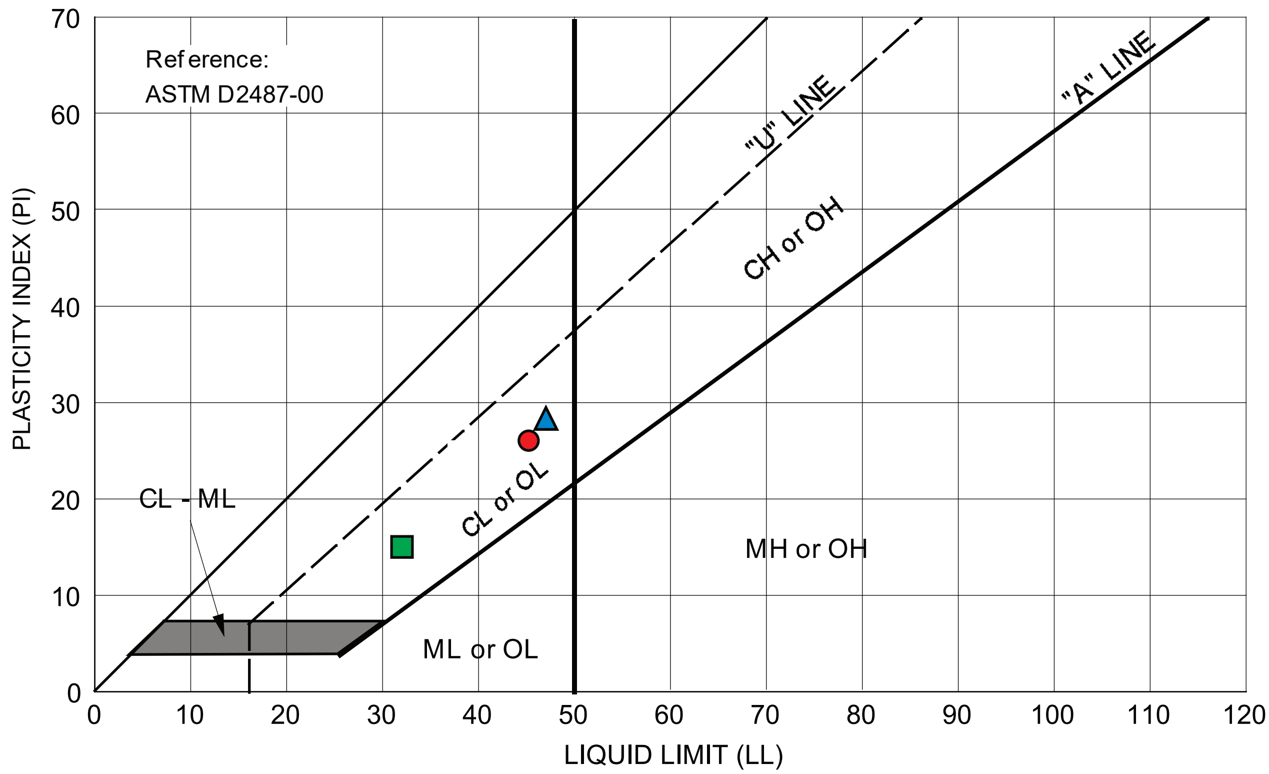
U = unconsolidated
P = poorly consolidated
M = moderately consolidated
W = well consolidated

VI BEDDING OF SEDIMENTARY ROCKS

Splitting Property	Thickness	Stratification
Massive	Greater than 4.0 ft.	very thick-bedded
Blocky	2.0 to 4.0 ft.	thick bedded
Slabby	0.2 to 2.0 ft.	thin bedded
Flaggy	0.05 to 0.2 ft.	very thin-bedded
Shaly or platy	0.01 to 0.05 ft.	laminated
Papery	less than 0.01	thinly laminated

ROCKRIDGE GEOTECHNICAL

APPENDIX B
Laboratory Test Results



Symbol	Source	Description and Classification	Natural M.C. (%)	Liquid Limit (%)	Plasticity Index (%)	% Passing #200 Sieve
●	B-1 at 1.0 feet	SANDY CLAY (CL), red-brown to red	12.5	45	26	--
▲	B-3 at 3.0 feet	SANDY CLAY (CL), brown	17.2	47	28	--
■	B-4 at 0.5 feet	SANDY CLAY (CL), brown with light brown	13.6	32	15	--

445 VIRGINIA AVENUE
San Mateo, California

ROCKRIDGE GEOTECHNICAL

PLASTICITY CHART

Date 12/04/20 | Project No. 20-1941 | Figure B-1

Results Only Soil Testing for 445 Virginia Avenue, San Mateo

November 25, 2020

Prepared for:
Devin Landkamer
Rockridge Geotechnical, Inc.
270 Grand Ave,
Oakland, CA 94610
dlandkamer@rockridgegeo.com

Project X Job#: S201120C
Client Job or PO#: 20-1941

Respectfully Submitted,

Eduardo Hernandez, M.Sc., P.E.
Sr. Corrosion Consultant
NACE Corrosion Technologist #16592
Professional Engineer
California No. M37102
ehernandez@projectxcorrosion.com

REGISTERED PROFESSIONAL ENGINEER
EDUARDO HERNANDEZ
No. M37102
MECHANICAL
STATE OF CALIFORNIA

Soil Analysis Lab Results

Client: Rockridge Geotechnical, Inc.
Job Name: 445 Virginia Avenue, San Mateo
Client Job Number: 20-1941
Project X Job Number: S201120C
November 25, 2020

	Method	ASTM D4327		ASTM D4327		ASTM G187		ASTM D4972	ASTM G200	SM 4500-S2-D	ASTM D4327	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D6919	ASTM D4327	ASTM D4327
Bore# / Description	**Depth**	**Sulfates** SO_4^{2-}		**Chlorides** Cl^-		**Resistivity**		**pH**	**Redox**	**Sulfide** S^{2-}	**Nitrate** NO_3^-	**Ammonium** NH_4^+	**Lithium** Li^+	**Sodium** Na^+	**Potassium** K^+	**Magnesium** Mg^{2+}	**Calcium** Ca^{2+}	**Fluoride** F_2^{--}	**Phosphate** PO_4^{3-}
						As Rec'd	**Minimum**												
	(ft)	**(mg/kg)**	**(wt%)**	**(mg/kg)**	**(wt%)**	**(Ohm-cm)**	**(Ohm-cm)**		**(mV)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**
B3 Clayey Sand (SC)	2.5	30.1	0.0030	14.2	0.0014	12,730	6,700	8.0	162	<0.01	0.2	n.a.	n.a.	60.7	0.1	30.3	37.8	11.3	1.7

Cations and Anions, except Sulfide and Bicarbonate, tested with Ion Chromatography
mg/kg = milligrams per kilogram (parts per million) of dry soil weight
ND = 0 = Not Detected | NT = Not Tested | Unk = Unknown
Chemical Analysis performed on 1:3 Soil-To-Water extract

Project X
Corrosion Engineering
Corrosion Control - Soil, Water, and Metallurgy Lab

Lab Request Sheet Chain of Custody
Phone: (213) 928-7213 · Fax (951) 226-1720 · www.projectxcorrosion.com
Ship Samples To: 29990 Technology Dr, Suite 13, Murrieta, CA 92563

Project X Job Number S201120C Rockridge 20-1941 San Mateo 1 Full

IMPORTANT: Please complete Project and Sample Identification Data as you would like it to appear in report & include this form with samples.

Company Name:	Rockridge Geotechnical	**Contact Name:**	Devin Landkamer
Phone No:	970-215-7740		
Mailing Address:	270 Grand Ave, Oakland CA	**Contact Email:**	dlandkamer@rockridgegeo.com
Accounting Contact:	Jarka Stepanek	**Invoice Email:**	invoices@rockridgegeo.com
Client Project No:	20-1941	**Project Name:**	445 Virgina Avenue, San Mateo
P.O. #:			

	3-5 Day Standard	3 Day Guarantee 50% mark-up	24 Hr RUSH 100% mark-up
(Business Days) Turn Around Time:	✓		

Results By: ☐ Phone ☐ Fax ☐ Email

Date & Received by : 11-20-2020

Special Instructions:
Groundwater measured at 16 to 17.5 feet after boring and tape drop measurement to 9 feet for CPT borings.

ANALYSIS REQUESTED (Please circle)

		Methods (Default Method last)
Soil Resistivity	Full Corrosion Series / Geo Quad	Caltrans CTM643; AASHTO T2888; ASTM G187
pH	Full Corrosion Series / Geo Quad	Caltrans CTM643; AASHTO T 289; ASTM G 51
Sulfate	Full Corrosion Series / Geo Quad	Caltrans CTM417; AASHTO T 290; ASTM D4327
Chloride	Full Corrosion Series / Geo Quad	Caltrans CTM422; AASHTO T 291; ASTM D4327
Redox Potential	Full Corrosion Series	SM 2580B; ASTM G200
Sulfide	Full Corrosion Series	SM 4500-S2
Ammonia	Full Corrosion Series	SM 4500-NH3; ASTM D4327
Nitrate	Full Corrosion Series	SM 4500-NO3; ASTM D4327
Flouride	Full Corrosion Series	SM 2320B
Phosphate	Full Corrosion Series	ASTM D4327
Lithium	Full Corrosion Series	ASTM D4327
Sodium	Full Corrosion Series	ASTM D4327
Potassium	Full Corrosion Series	ASTM D4327
Magnesium	Full Corrosion Series	ASTM D4327
Calcium	Full Corrosion Series	ASTM D4327
BiCarbonate	Full Corrosion Series	SM 2320B
Full Corrosion Series		
Soil Corrosivity Evaluation Report	Reports	*Req: Min. 3 Samples, site map, and groundwater info
Water Corrosivity Mini Report	Reports	*Req: Min. 3 Samples, site map, and groundwater info
Moisture Content		ASTM D2216
Total Alkalinity		SM 2520B
Thermal Resistivity		
Metallurgical Analysis		
Langelier Index		
Puckorius Index		
XRF Elemental Analysis		
Water Hardness		

		SAMPLE ID - BORE #	DESCRIPTION	DEPTH (ft)	DATE COLLECTED	Soil Resistivity	pH	Sulfate	Chloride	Redox Potential	Sulfide	Ammonia	Nitrate	Flouride	Phosphate	Lithium	Sodium	Potassium	Magnesium	Calcium	BiCarbonate	Full Corrosion Series	Soil Corrosivity Evaluation Report	Water Corrosivity Mini Report	Moisture Content	Total Alkalinity	Thermal Resistivity	Metallurgical Analysis	Langelier Index	Puckorius Index	XRF Elemental Analysis	Water Hardness
167	1	B3	Clayey Sand (SC)	2.5	11/11/20																	X										
	2																															
	3																															
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