CORNERSTONE EARTH GROUP

TYPE OF SERVICES	Geotechnical Feasibility Study
PROJECT NAME	Bertolucci Parcel
LOCATION	421 Cypress Avenue 209 and 213 Lux Avenue South San Francisco, California
CLIENT	Peter Sodini
PROJECT NUMBER	1350-1-1
DATE	April 7, 2022

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Prepared by

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TABLE OF CONTENTS

CORNERSTONE EARTH GROUP

Type of Services	**Geotechnical Feasibility Study**
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SECTION 1: INTRODUCTION

This geotechnical report was prepared for the sole use of Peter Sodini for the Bertolucci Parcel site in South San Francisco, California. The purpose of this study was to evaluate the existing subsurface conditions and develop preliminary geotechnical concerns that could impact the proposed development. The preliminary geotechnical recommendations contained in this report are for your forward planning, cost estimating, and preliminary project design. The location of the site is shown on the Vicinity Map, Figure 1. For our use, we were provided with the following documents:

- A set of plans titled "Formal Planning Application #3, Bertolucci Parcel, 209, 213 Lux Ave & 421 Cypress Ave," dated August 6, 2021, prepared by Studio T Square.

1.1 PROJECT DESCRIPTION

We understand the project is still in the early planning stages. Based on the conceptual plans and information provided, the project will include redeveloping the approximately 0.58-acre site for a new mixed-use development. The proposed development currently includes six levels of multi-family housing over ground floor parking and retail. The first floor includes a 1,500 square foot restaurant space at the corner of Lux and Cypress Avenue. Ground floor and podium level leasing and lounge areas are included in the project amenities.

1.2 SCOPE OF SERVICES

Our scope of services was presented in our proposal dated February 23, 2022 and consisted of review of available data in our files and published documents including conceptual development plans, a site visit, and preparation of this report.

1.3 ENVIRONMENTAL SERVICES

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

SECTION 2: REGIONAL SETTING

2.1 GEOLOGICAL SETTING

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

Movement on the many splays within the San Andreas Fault system has produced the dominant northwest-oriented structural and topographic trend seen throughout the Coast Ranges today. This trend reflects the boundary between two of the Earth's major tectonic plates: the North American plate to the east and the Pacific plate to the west. The San Andreas Fault system is about 40 miles wide in the Bay area and extends from the San Gregorio Fault near the coastline to the Coast Ranges-Central Valley blind thrust at the western edge of the Great Central Valley as shown on the Regional Fault Map, Figure 3. The San Andreas Fault is the dominant structure in the system, nearly spanning the length of California, and capable of producing the highest magnitude earthquakes. Many other sub-parallel or branch faults within the San Andreas system are equally active and nearly as capable of generating large earthquakes. Right-lateral movement dominates on these faults but an increasingly large amount of thrust faulting resulting from oblique compression across the fault system is now being identified also.

The published geologic map of the San Francisco south 7.5-minute quadrangle by Bonila (1998) suggest the majority of the site is underlain by the Colma Formation (mapping symbol "Qc") with a small portion along the eastern edge of the site mapped as Slope Debris and Ravine Fill (mapping symbol "Qsr").

2.2 REGIONAL SEISMICITY

While seismologists cannot predict earthquake events, geologists from the U.S. Geological Survey have recently updated (in 2015) earlier estimates from their 2014 Uniform California Earthquake Rupture Forecast (Version 3; UCERF3) publication. The estimated probability of one or more magnitude 6.7 earthquakes (the size of the destructive 1994 Northridge earthquake) expected to occur somewhere in the San Francisco Bay Area has been revised (increased) to 72 percent for the period 2014 to 2043 (Aagaard et al., 2016). The faults in the

region with the highest estimated probability of generating damaging earthquakes between 2014 and 2043 are the Hayward (33%), Calaveras (26%), and San Andreas Faults (22%). In this 30-year period, the probability of an earthquake of magnitude 6.7 or larger occurring is 22 percent along the San Andreas Fault and 33 percent for the Hayward Fault.

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

Table 1: Approximate Fault Distances

Fault Name	Distance	
	(miles)	(kilometers)
San Andreas (1906)	3.1	5.0
San Gregorio	8.0	12.8

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

SECTION 3: SITE CONDITIONS

3.1 SURFACE DESCRIPTION

The approximately 0.58-acre site is located at 209 and 213 Lux Avenue and 421 Cypress Avenue in South San Francisco, California. The site is bounded by Lux Avenue to the north, Cypress Avenue to the east, Tamarack Lane to the south, and residential and commercial development to the west.

The site is currently occupied by an existing one to two story building and an at-grade parking lot. The southeast portion of the building is one story and was previously occupied by Bertolucci's Restaurant (currently closed). The northeast portion of the building is two story and occupied by residential apartments. Behind the building (western half of the site) consists of an at-grade asphalt concrete parking lot, minor landscaping, and a chain link fence.

Based on visual observations, the existing pavements are in moderate to poor conditions with areas of significant alligator cracking.

3.2 ANTICIPATED SUBSURFACE CONDITIONS

Based on our experience at other sites in the vicinity, we anticipate the site is underlain by generally medium stiff to hard fine-grained soils (clays and silts) interbedded with generally medium dense to dense sands of the Colma Formation. However, as discussed above, the eastern edge of the site may be underlain by slope debris and ravine fill which is described by Bonilla (1998) as "Stony silty to sandy clay; locally silty to clayey sand or gravel; yellowish-

orange to medium gray, unstratified or poorly stratified. Where it overlies the Merced or Colma Formation it is commonly a silty to clayey sand, or gravel."

Based on previous site use, we anticipate encountering localized areas of undocumented fill. Undocumented fill and potential mitigation measures are discussed in the "Undocumented Fill and Re-Development" section of this report.

3.3 GROUNDWATER

Historic high groundwater levels are mapped by the State of California at a depth of about 10 feet, or less (CGS, South San Francisco, 2021). We also reviewed groundwater data available online from the website GeoTracker, https://geotracker.waterboards.ca.gov/. Nearby monitoring well data indicates that groundwater has been measured at depths of approximately less than 1 foot to 6 feet at wells located to the east of the site at 190 East Grand Avenue, at depths of approximately 5 to 10 feet at wells located to the north of the site at 600 Linden Avenue, and at depths of approximately 11 to 14 feet at wells located to the south of the site at 401 Linden Avenue.

On a preliminary basis, we anticipate high groundwater depths of approximately 5 to 10 feet below the existing ground surface. Fluctuations in groundwater levels occur due to many factors including seasonal fluctuation, underground drainage patterns, regional fluctuations, and other factors.

SECTION 4: GEOLOGIC HAZARDS

4.1 FAULT SURFACE RUPTURE

As discussed above several significant faults are located within 25 kilometers of the site. The site is not located within a State-designated Alquist Priolo Earthquake Fault Zone. As shown in Figure 3, no known surface expression of fault traces is thought to cross the site; therefore, fault surface rupture hazard is not a significant geologic hazard at the site.

4.2 ESTIMATED GROUND SHAKING

Moderate to severe (design-level) earthquakes can cause strong ground shaking, which is the case for most sites within the Bay Area. While a seismic hazard analysis has not been prepared for this feasibility study, strong ground shaking can be expected at the site during the life of the project.

Mitigation of strong ground shaking includes designing new structures to meet current building codes and applicable requirements based on a design-level geotechnical investigation.

4.3 LIQUEFACTION POTENTIAL

The site is not located within a State-designated Liquefaction Hazard Zone (CGS, South San Francisco Quadrangle, 2021). As previously discussed, high groundwater in the area is

anticipated to be on the order of 5 to 10 feet. In addition, the site is expected to be underlain by alluvial deposits consisting of clayey, silty, and sandy soils. The granular materials, including sandy soils, are anticipated to be medium dense to dense in consistency. As a result, there may be the potential for liquefaction to impact site development. However, based on our experience in the area, we anticipate the potential for liquefaction potential to be low and consistent with CGS mapping in the Colma Formation but could have low to moderate potential in the slope debris and ravine fill (Qrs). We recommend the potential for liquefaction be further evaluated during the design-level geotechnical investigation once the project plans are finalized.

4.4 LATERAL SPREADING

Lateral spreading is horizontal/lateral ground movement of relatively flat-lying soil deposits towards a free face such as an excavation, channel, or open body of water; typically, lateral spreading is associated with liquefaction of one or more subsurface layers near the bottom of the exposed slope. As failure tends to propagate as block failures, it is difficult to analyze and estimate where the first tension crack will form.

There are no open faces within a distance considered susceptible to lateral spreading and we anticipate the potential for liquefaction to be low; therefore, in our opinion, the potential for lateral spreading to affect the site is low.

4.5 SEISMIC SETTLEMENT/UNSATURATED SAND SHAKING

Loose unsaturated sandy soils can settle during strong seismic shaking. Based on our review of data from other site within the vicinity, we anticipate the soils above the design groundwater depth to be clayey and/or medium dense to dense sands with low potential for seismic settlement. However, based on our experience in the area, we anticipate the potential for localized existing fills that may be susceptible to seismic settlement following strong ground shaking. We recommend the potential for seismic settlement at the site be further evaluated during the design-level geotechnical investigation once the project plans are finalized.

4.6 TSUNAMI/SEICHE

The terms tsunami or seiche are described as ocean waves or similar waves usually created by undersea fault movement or by a coastal or submerged landslide. Tsunamis may be generated at great distance from shore (far field events) or nearby (near field events). Waves are formed, as the displaced water moves to regain equilibrium, and radiates across the open water, similar to ripples from a rock being thrown into a pond. When the waveform reaches the coastline, it quickly raises the water level, with water velocities as high as 15 to 20 knots. The water mass, as well as vessels, vehicles, or other objects in its path create tremendous forces as they impact coastal structures.

Tsunamis have affected the coastline along the Pacific Northwest during historic times. The Fort Point tide gauge in San Francisco recorded approximately 21 tsunamis between 1854 and 1964. The 1964 Alaska earthquake generated a recorded wave height of 7.4 feet and drowned eleven people in Crescent City, California. For the case of a far-field event, the Bay area would

have hours of warning; for a near field event, there may be only a few minutes of warning, if any.

A tsunami or seiche originating in the Pacific Ocean would lose much of its energy passing through San Francisco Bay. Based on the mapping of tsunami inundation potential for the San Francisco Bay Area by CGS (conservation.ca.gov/cgs/tsunami/maps), areas most likely to be inundated are marshlands, tidal flats, and former bay margin lands that are now artificially filled, but are still at or below sea level, and are generally within 1½ miles of the shoreline. The site is approximately 1 mile inland from the San Francisco Bay shoreline and is approximately 25 to 30 feet above mean sea level. Additionally, the site is mapped by CGS as not being within a tsunami hazard area. Therefore, the potential for inundation due to tsunami or seiche is considered low.

4.7 FLOODING

Based on our internet search of the Federal Emergency Management Agency (FEMA) flood map public database, the site is located within Zone X, described as "Areas determined to be outside the 0.2% annual chance floodplain." We recommend the project civil engineer be retained to confirm this information and verify the base flood elevation, if appropriate.

The Department of Water Resources (DWR), Division of Safety of Dams (DSOD) compiled a database of Dam Failure Inundation Hazard Maps (DSOD, 2015). The generalized hazard maps were prepared by dam owners as required by the State Office of Emergency Services; they are intended for planning purposes only. Based on our review of these maps, the site is not located within a dam failure inundation area.

SECTION 5: CONCLUSIONS

5.1 SUMMARY

From a geotechnical viewpoint, the project is feasible provided the concerns listed below are addressed in the project design. The preliminary recommendations that follow are intended for conceptual planning and preliminary design. A design-level geotechnical investigation should be performed once site development plans are prepared. The design-level investigation findings will be used to confirm the preliminary recommendations and develop detailed recommendations for design and construction. Descriptions of each geotechnical concern with brief outlines of our preliminary recommendations follow the listed concerns.

- Potential for liquefaction-induced settlements
- Potential for static settlements
- Shallow groundwater
- Presence of expansive soils
- Differential movement at on-grade to on-structure transitions
- Presence of undocumented fill and re-development considerations

5.1.1 Potential for Liquefaction-Induced Settlements

Liquefaction is a phenomenon where soils lose strength and stiffness during strong ground shaking. Liquefaction can result in ground failure (fissures, sand boils, etc.), foundation bearing failure, and settlement of the ground surface. Soils most susceptible to liquefaction are loose, non-cohesive soils that are saturated and bedded with poor drainage, such as sand and silt layers bedded with a cohesive cap. Depending on the liquefiable layer thickness and depth, liquefaction-induced settlements can range from less than an inch to several inches and potentially larger if surface rupture occurs. The site is not located within a State-designated Liquefaction Hazard Zone (CGS, South San Francisco Quadrangle, 2021). Based on our review of geologic mapping and sites in the vicinity, we do not anticipate significant liquefaction settlements will be present at the site in the Colma Formation; however, the slope debris and ravine fill may have low to moderate potential for liquefaction. The potential for liquefaction settlements should be evaluated further as part of the design-level geotechnical investigation.

5.1.2 Potential for Static Settlements

The compressibility and stiffness of clays, the density of sands, the actual groundwater conditions beneath the site, and building loads will all dictate the total estimated static settlements building foundations may experience. As the proposed development plans are still in the conceptual phase and no anticipated building loads were provided to us, it is difficult to evaluate the potential magnitude of static settlements at the site. Based on general subsurface conditions in the site area, static settlements may be moderate to significant for the planned seven-story structure. Additional site-specific subsurface explorations and laboratory testing should be performed and settlement estimates should be made and evaluated during a design-level geotechnical investigation once specific project details are available. If settlements are large, they can be mitigated with deep foundations or ground improvement.

5.1.3 Shallow Groundwater

As discussed, we anticipate high groundwater to be on the order of 5 to 10 feet below the ground surface. Groundwater could potentially be encountered in any below grade excavations and deeper excavations for utilities, elevators, or other deep excavations. Impacts associated with high groundwater typically consist of potentially we and unstable subgrade, difficulty achieving compaction, and difficult underground utility installation. Dewatering and shoring of the deeper excavations including utility trenches may be required. More detailed recommendations and an evaluation of the depth of groundwater should be evaluated further as part of a design-level geotechnical investigation.

5.1.4 Presence of Expansive Soils

Based on our review of data from other sites within the vicinity, we anticipate that the surficial soils may be moderately expansive; this should be evaluated as part of the design-level geotechnical investigation. Expansive soils can undergo significant volume change with change in moisture content. They shrink and harden when dried and expand and soften when wetted.

Potential measures to reduce the potential for damage to any at-grade improvement and/or at-grade structures, foundations, and slabs-on-grade that may be proposed, may include:

- Employing grading and compaction methods to reduce potential volume change,
- Providing sufficient reinforcement and footing embedment to resist expansive soil forces, and
- Supporting slabs on a layer of non-expansive fill.

At-grade foundations should be designed to extend below the zone of seasonal moisture fluctuation. In addition, it is important to limit moisture changes in the surficial soils by using positive drainage away from the building as well as limiting landscaping watering.

5.1.5 Undocumented Fill and Redevelopment Considerations

The site is currently developed, and undocumented fill may be present based on existing site development. Potential issues that are often associated with redeveloping sites include demolition of existing improvements, abandonment of existing utilities, mitigation of undocumented fill, and mitigation of compressible soils (tidal flat deposits and loose surficial soils). Typically for mitigation of undocumented fills, all fills and existing improvements are encountered and extend within the areas of future at-grade improvements, the fills and improvements not to remain should be removed and replaced as engineered fill. Mitigation of compressible soils may include ground improvement or deep foundations. Recommendations are presented in the design-level geotechnical report.

5.2 DESIGN-LEVEL GEOTECHNICAL INVESTIGATION

The design considerations and preliminary recommendations contained in this report were based on limited site development information, review of geotechnical data in our files, available published information, and our experience in the area with similar projects. We recommend Cornerstone Earth Group be retained to perform a design-level geotechnical investigation once detailed site development plans are finalized. The recommendations provided in this report should not be used for project design.

SECTION 6: LIMITATIONS

This report, an instrument of professional service, has been prepared for the sole use of Peter Sodini specifically to support the design of the Bertolucci Parcel Geotechnical Feasibility Study project in South San Francisco, California. The opinions, conclusions, and recommendations presented in this report have been formulated in accordance with accepted geotechnical engineering practices that exist in Northern California at the time this report was prepared. No warranty, expressed or implied, is made or should be inferred.

Recommendations in this report are based upon the soil and groundwater conditions encountered during our subsurface exploration. If variations or unsuitable conditions are

encountered during construction, Cornerstone must be contacted to provide supplemental recommendations, as needed.

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

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

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

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

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

SECTION 7: REFERENCES

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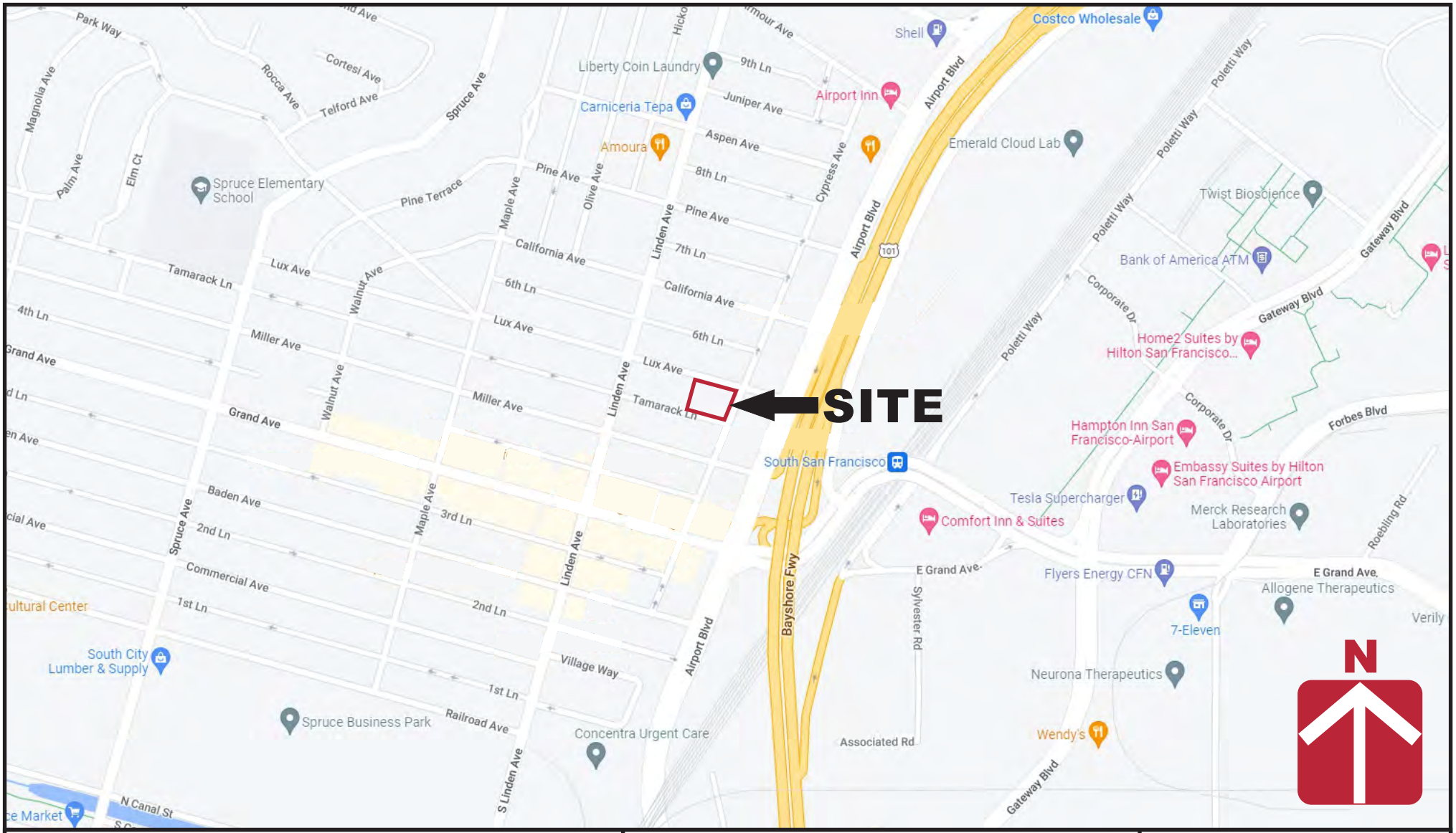

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Vicinity Map

Cypress and Lux Avenue Feasibility
South San Francisco, CA

Project Number	1350-1-1
Figure Number	Figure 1
Date	March 2022
Drawn By	RRN

Base by Google Earth, dated 09/26/2020

0 25 50
APPROXIMATE SCALE (FEET)

Project Number 1350-1-1

Figure Number Figure 2

Drawn By RRN

Date March 2022

Site Plan

Cypress and Lux Avenue Feasibility
South San Francisco, CA

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SITE

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

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

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0 5 10

APPROXIMATE SCALE (MILES)

Project Number	1350-1-1
Figure Number	Figure 3
Date	March 2022
Drawn By	RRN

Regional Fault Map

Cypress and Lux Avenue Feasibility Study
South San Francisco, CA

CORNERSTONE EARTH GROUP