CORNERSTONE EARTH GROUP

TYPE OF SERVICES	Geotechnical Feasibility Study
PROJECT NAME	Well Station 20
LOCATION	800 Carlisle Way Sunnyvale, California
CLIENT	David J. Powers & Associates, Inc.
PROJECT NUMBER	118-144-2
DATE	December 9, 2022

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Type of Services	**Geotechnical Feasibility Evaluation**
Project Name	**Well Station 20**
Location	**800 Carlisle Way** **Sunnyvale, California**
Client	**David J. Powers & Associates**
Client Address	**1871 The Alameda, Suite 200** **San Jose, California**
Project Number	**118-144-2**
Date	**December 9, 2022**

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Project Name	**Well Station 20**
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SECTION 1: INTRODUCTION

This geotechnical feasibility evaluation was prepared for the sole use of David J. Powers & Associates for the groundwater well site (Station 20) project at 800 Carlisle Way in Sunnyvale, California. The location of the site is shown on the Vicinity Map and Site Plan, Figures 1 and 2. For our use, we were provided with the following documents:

- A project narrative memo prepared by the California Water Service (Cal Water), date and title unknown.
- A set of civil plans titled, "Los Altos Suburban – Station 20, 800 Carlisle Way," produced by California Water Service Engineering Department, dated January 4, 2022.

1.1 PROJECT DESCRIPTION

The site is located at 800 Carlisle Way in Sunnyvale, California. From our review of the project narrative memo, we understand California Water Service currently operates a groundwater well at the site and a chemical building, communication (SCADA) tower, and booster pump are currently present on site. We understand a 50,000-gallon steel bolted tank was previously onsite and removed in 2016.

The project scope consists of abandoning the existing groundwater well, demolishing the chemical buildings, booster pump, electrical control panel and associated water mains, and construction of a new domestic water well, an approximately 56,474-gallon steel-bolted tank, electrical and emergency panelboards, an emergency backup generator, a maintenance area, an emergency light post, and three 8-foot by 8-foot chemical sheds. We understand the project will be constructed in two-phases. The first phase will consist of demolition of the site, capping of the existing well, and drilling, construction and testing of the new well. The second phase will consist of constructing the above-mentioned site structures and fixtures including the new water tank and chemical sheds

Structural loads for the new structures have not been provided at this time; however, structural loads are expected to be typical for similar structures. Site grading with cuts and fills on the order of a few feet or less are anticipated.

1.2 SCOPE OF SERVICES

Our scope of services was presented in our proposal dated May 10, 2022 and consisted of review of available data in our files and published documents including the project narrative memo and civil plans, identification of potential geologic, seismic, and geotechnical impacts, and preparation of this feasibility report.

1.3 ENVIRONMENTAL SERVICES

Cornerstone Earth Group also provided environmental services for this project, including a Phase 1 site assessment; environmental findings and conclusions are provided under a separate cover.

SECTION 2: REGIONAL SETTING

2.1 GEOLOGICAL SETTING

The site is located within the Santa Clara Valley, which is a broad alluvial plane between the Santa Cruz Mountains to the southwest and west, and the Diablo Range to the northeast. The San Andreas Fault system, including the Monte Vista-Shannon Fault, exists within the Santa Cruz Mountains and the Hayward and Calaveras Fault systems exist within the Diablo Range. Alluvial soil thicknesses in the site vicinity range from about 200 to 300 feet (Rogers & Williams, 1974).

2.2 REGIONAL SEISMICITY

The San Francisco Bay area region is one of the most seismically active areas in the Country. 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)
Monte Vista-Shannon	4.0	6.5
San Andreas (1906)	7.5	12.0
Hayward (Southeast Extension)	10.2	16.4
Hayward (Total Length)	12.7	20.4
Calaveras	13.5	21.8
San Gregorio	15.1	24.3

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 site is located at 800 Carlisle Way in Sunnyvale, California. The site is bounded by Carlisle Way to the north, residential developments to the south and east, and Panama Park to the west. The site is currently occupied by an existing groundwater well, chemical buildings, communication (SCADA) tower, booster pump, electrical control panel, and associated water mains. The site appears to be generally unpaved with a gravel parking lot. Mature trees and medium dense vegetation are also present on-site. The site is relatively flat and generally level with the surrounding street, properties, and park.

We reviewed historical aerial imagery dating back to 1948 provided by Historic Aerials (www.historicaerials.com). Additionally, we reviewed the project background provided in the project narrative. A summary of the pertinent surface changes observed within the site vicinity is as follows:

- 1948: The site and surrounding area appear to be primarily used for agriculture purposes.
- 1953: Carlisle way appears to have been established and single-family homes have been constructed north of Carlisle Way.
- 1960: A water tank has been constructed within the site boundary.
- 2016: We understand the water tank was demolished in 2016. Smaller site fixtures were also constructed between 1960 and 2016 including chemical buildings, communication tower, and booster pump.

- 2020: The site appears to remain relatively unchanged and no pertinent surface changes are observed at the subject site.

3.2 ANTICIPATED SUBSURFACE CONDITIONS

Based on our experience at other sites in the vicinity, we anticipate the site is underlain by alluvial soils generally consisting of stiff to hard fine-grained soils (clays and silts) interbedded with generally medium dense to very dense sands. Plasticity index tests performed at nearby sites indicate the surficial clays may exhibit low to moderate expansion potential. Based on the previous site use, we anticipate encountering localized areas of undocumented fill.

3.3 GROUNDWATER

Historic high groundwater is mapped by the California Geological Survey (CGS, 2002) at a depth of about 50 feet below the ground surface. Additionally, we reviewed groundwater data available online from the GeoTracker website, geotracker.waterboards.ca.gov. Monitoring well data indicate groundwater has been measured at depths of about 38¼ to 55¾ feet below grades at wells located at 898 East Fremont Avenue (about ¼-mile northeast of the site) between February 2002 and November 2013. We recommend an initial groundwater depth of about 40 to 50 feet be considered during project planning.

Fluctuations in groundwater levels occur due to many factors including seasonal fluctuation, underground drainage patterns, regional fluctuations, and other factors. Groundwater should be further evaluated during the design-level geotechnical investigation

SECTION 4: GEOLOGIC HAZARDS

4.1 FAULT 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 or a Santa Clara County Fault Hazard Zone. No known surface expression of fault traces is thought to cross the site; therefore, fault rupture hazard is not a significant geologic hazard at the site.

4.2 STRONG 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.

Strong ground shaking should be considered in the design of the structures to meet current building codes and applicable requirements. Ground shaking should be further evaluated, and seismic design criteria provided during the design-level geotechnical investigation.

4.3 LIQUEFACTION POTENTIAL

The site is not currently mapped within a State-designated Liquefaction Hazard Zone (CGS, 2002) as well as a Santa Clara County Liquefaction Hazard Zone (Santa Clara County, 2002). The site is within a zone mapped as having a low liquefaction potential by the Association of Bay Area Governments (ABAG, 2021).

During strong seismic shaking, cyclically induced stresses can cause increased pore pressures within the soil matrix that can result in liquefaction triggering, soil softening due to shear stress loss, potentially significant ground deformation due to settlement within sandy liquefiable layers as pore pressures dissipate, and/or flow failures in sloping ground or where open faces are present (lateral spreading) (NCEER 1998). Limited field and laboratory data is available regarding ground deformation due to settlement; however, in clean sand layers settlement on the order of 2 to 4 percent of the liquefied layer thickness can occur. Soils most susceptible to liquefaction are loose, non-cohesive soils that are saturated and are bedded with poor drainage, such as sand and silt layers bedded with a cohesive cap.

Based on guidelines set forth in CGS Special Publication 117A (CGS, 2008), “screening investigation” could be used to determine whether a particular site has “obvious indicators” for potential failure as a result of liquefaction. Three of these indicators include soil type, soil density, and depth to groundwater. Based on previous investigations near the site, mapped soil conditions, mapped groundwater depth, in our opinion, the potential for liquefaction induced settlement is considered low. We recommend the potential for liquefaction be evaluated as part of the design-level geotechnical investigation.

4.4 GROUND DEFORMATION AND SURFICIAL CRACKING POTENTIAL

The methods used to estimate liquefaction settlements assume that there is a sufficient cap of non-liquefiable material to prevent ground deformation or sand boils. For ground deformation to occur, the pore water pressure within liquefiable soil layers will need to be great enough to break through the overlying non-liquefiable layer, which could cause significant ground deformation and settlement. Based on the anticipated depth to groundwater and the mapped low potential for liquefaction at the site, the potential for ground rupture at the site appears to be low.

4.5 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.

As the potential for liquefaction at the site is considered low and there are no open faces within a distance considered susceptible to lateral spreading, in our opinion, the potential for lateral spreading to affect the site is low.

4.6 SEISMIC SETTLEMENT/UNSATURATED SAND SHAKING

Loose to medium dense, unsaturated sandy soils can settle during strong seismic shaking. Based on our review of data from other sites within the vicinity, we anticipate the soils above the design groundwater are alluvial in nature and consist of clays, sands, and gravels. In our opinion, the potential for seismically induced settlement of the unsaturated sandy soils is likely moderate. 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.

4.7 LANDSLIDING

The site is not located within a California Seismic Hazard Zone for landsliding (CGS, 2002) or a Santa Clara County Landslide Hazard Zone (Santa Clara County, 2002). Due to the relatively flat topography, the potential for landsliding at the site is considered low.

4.8 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 study of tsunami inundation potential for the San Francisco Bay Area (Ritter and Dupre, 1972), 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 7 miles inland from the San Francisco Bay shoreline and is approximately 148 to 149 feet above mean sea level according to Google Earth (2022). Therefore, the potential for inundation due to tsunami or seiche is considered low.

4.9 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 “0.2% annual chance flood hazard, areas of 1% annual chance flood with average depths less than one foot or with drainage areas of less than one square mile." We recommend the project civil engineer be retained to confirm this information and verify the base flood elevation, if appropriate.

As required by California Water Code section 6161, the Department of Water Resources (DWR), Division of Safety of Dams (DSOD) reviews and approves inundation maps prepared by licensed civil engineers and submitted by dam owners for extremely high, high, and significant hazard dams and their critical appurtenant structures; 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 (DSOD, 2022).

SECTION 5: PRELIMINARY CONCLUSIONS

5.1 PRILIMINARY IMPACTS

Descriptions of our preliminary concerns follow the listed concerns.

- Strong ground shaking
- Potential for static and seismic settlements
- Potential presence of undocumented fill and re-development considerations
- Potential presence of moderately expansive soils

5.1.1 Strong Ground Shaking

Strong ground shaking is expected at this site, as with most sites in the Bay Area, during a major earthquake in the area. To mitigate the effects of strong ground shaking, all planned structures should be designed in accordance with the recommendations in a final design-level geotechnical report, and the most recent California Building Code.

5.1.2 Potential for Static and Seismic Settlements

As previously discussed, the site is underlain by alluvial soils likely consisting of clays, sands, and gravels. Based on our experience with sites in the vicinity of the project, the potential for static settlement from structure/tank loads and seismic settlement to impact the proposed development should be considered during the design-level geotechnical investigation.

5.1.3 Potential Presence of Undocumented Fill and Re-development Considerations

As discussed, it is likely that undocumented fill is present at the site due to previous site grading and existing site development. Undocumented fill, if not mitigated, could potentially settle, and cause distress to new structures and other improvements. Fill mitigation should consist of the removal of all undocumented fill materials. Provided the fill materials meet the requirements for engineered fill, they could be re-used on site as engineered fill. Otherwise, they could be stockpiled on site for future use in landscaping or non-structural fill areas or should be removed from the site. Additionally, as the site has existing development, demolition of existing improvements including structures and utilities will need to be address. Additional re-development recommendations and the presence/lateral extent of undocumented fill should be evaluated further during the design-level geotechnical investigation.

5.1.4 Potential for Presence of Moderately Expansive Soils

Moderately expansive surficial soils were encountered during previous investigations within the site vicinity and are common across the Bay Area. To reduce the potential for damage to the planned surface structures and other improvements, the expansive properties of the native soils should be considered in developing design recommendations for foundations, slabs-on-grade, exterior concrete flatwork, pavements, and other site improvements during the design-level geotechnical investigation. In addition, it is important to limit moisture changes in the surficial soils by using positive drainage away from the structures and other hardscaped areas, as well as limiting landscaping watering.

5.2 EARTHWORK

On a preliminary basis, we recommend that within the planned structures and tank areas any remnant foundations, slabs, and/or abandoned underground utilities from prior development be removed entirely, the ends capped, and the resulting excavations backfilled with engineered fill. All fills should be completely removed from within these areas and to a lateral distance of at least 5 feet beyond the structure's/tank's footprint or to a lateral distance equal to fill depth below the perimeter footing, whichever is greater.

Surface water runoff should not be allowed to pond adjacent to foundations, slabs-on-grade, or pavements. Hardscape surfaces should slope at least 2 percent towards suitable discharge facilities; landscape areas should slope at least 3 percent away from buildings. Bio-treatment basins should be kept at least 10 feet away from buildings and, where possible, at least 3 feet from pavements and flatwork.

5.3 POTENTIAL FOUNDATION ALTERNATIVES

Based on our understanding of the project and on estimated loading, we anticipate the tank and site structures will be able to be supported by conventional spread/continuous footings or mat foundations bearing entirely on competent native soils or engineered fill. However, if softer and compressible clays, loose sands or liquefiable soils, etc. are present, alternative foundations or ground improvement elements may be required to support the structure.

The feasibility of and recommendations for shallow spread footings, mat foundations, or deep foundation system should be evaluated further during the design-level geotechnical investigation.

5.4 DESIGN-LEVEL GEOTECHNICAL INVESTIGATION

The design considerations and feasibility recommendations contained in this report were based on limited preliminary site development information and review of available published information. No exploration was completed for this initial study. We recommend that we be retained to perform a design-level geotechnical investigation including exploration, laboratory testing, and analysis once detailed site development plans are available. The recommendations provided in this report should not be used for project design.

SECTION 6: CLOSURE AND LIMITATIONS

We hope this report provides the information needed at this time. This report, an instrument of professional service, has been prepared for the sole use of David J. Powers & Associates specifically to support the design of the Well Station 20 project in Sunnyvale, California. The opinions, conclusions, and preliminary 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.

Preliminary recommendations in this report are based upon literature review and professional experience. No subsurface exploration of this project area was performed for this study. Preparation of a design-level investigation is anticipated to provide additional information and refine the preliminary recommendations presented herein. If variations or unsuitable conditions are encountered during construction, Cornerstone should be contacted to provide supplemental recommendations, as needed.

David J. Powers & Associates may have provided Cornerstone with plans, reports and other documents prepared by others. David J. Powers & Associates 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 feasibility 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.

Preliminary 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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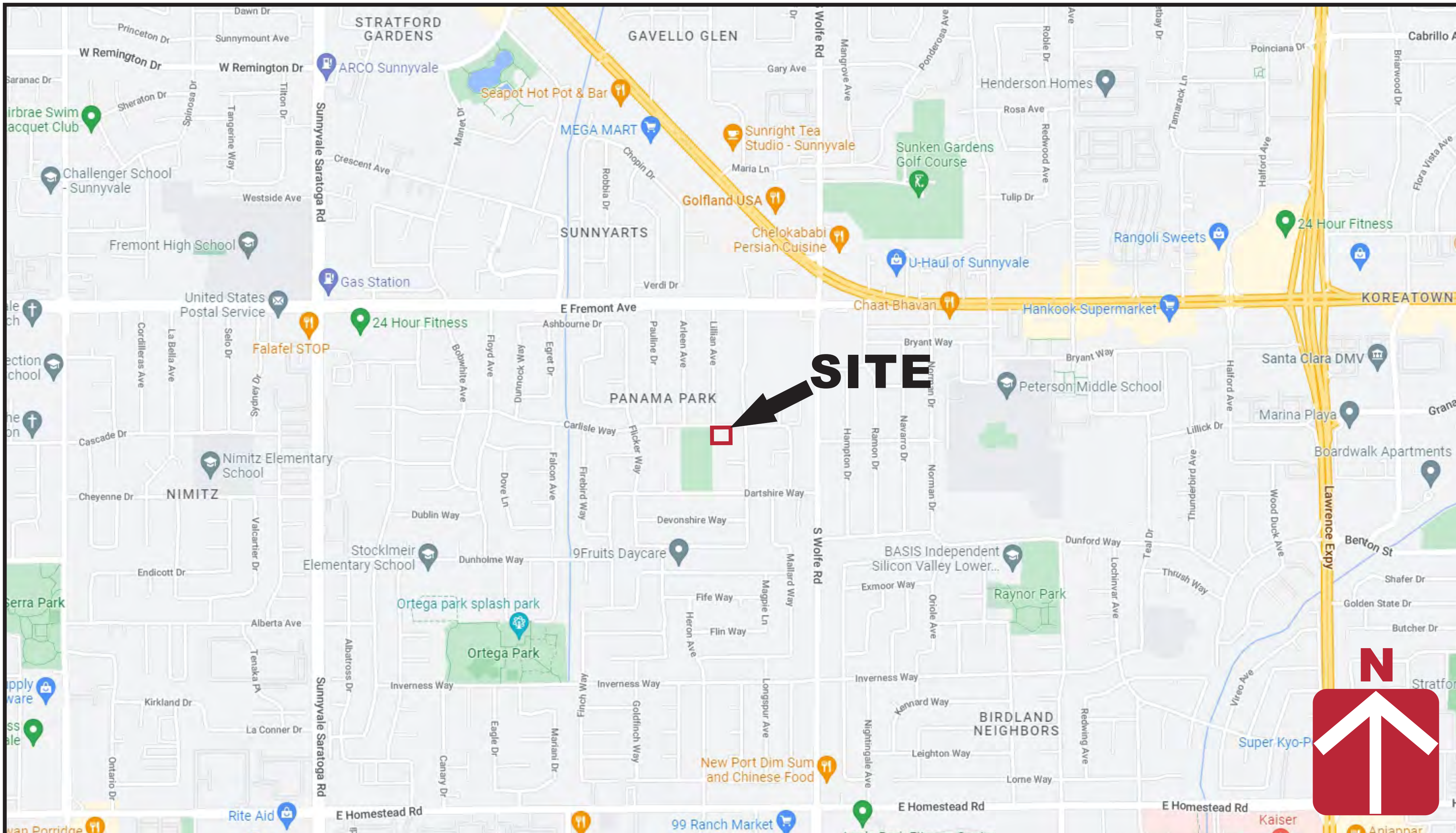
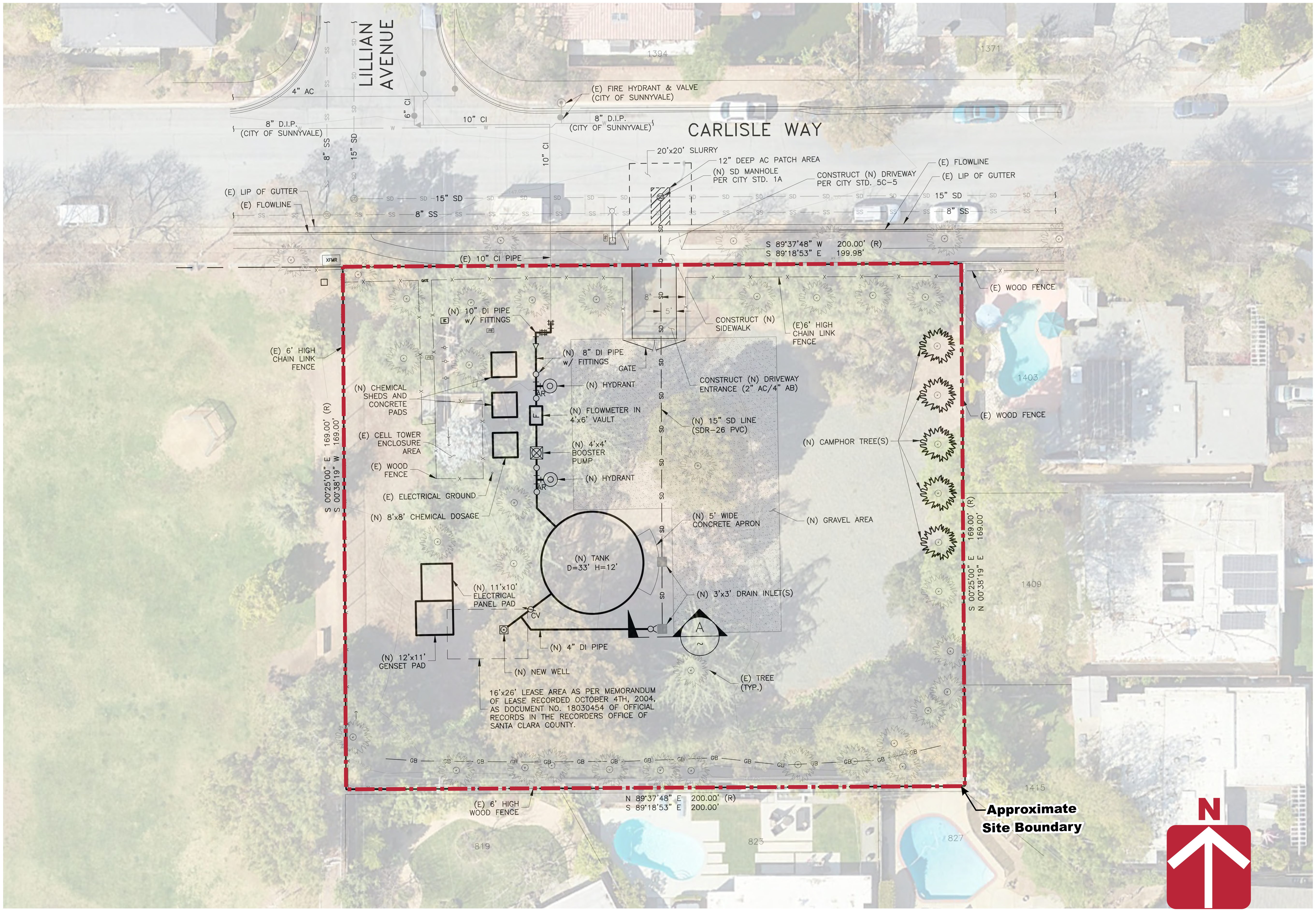


Vicinity Map

Well Station 20
800 Carlisle Way
Sunnyvale, CA

CORNERSTONE EARTH GROUP

Project Number	118-144-2
Figure Number	Figure 1
Date	December 2022
Drawn By	RRN



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APPROXIMATE SCALE (FEET)

Base by Google Earth, dated 03/10/2022
Overlay by California Water Service Engineering Department, Proposed Site Plan - Sheet 2, dated 01/04/2022

Project Number: 118-144-2

Figure Number: Figure 2

Date: December 2022

Drawn By: RRN

Site Plan

Well Station 20
800 Carlisle Way
Sunnyvale, CA

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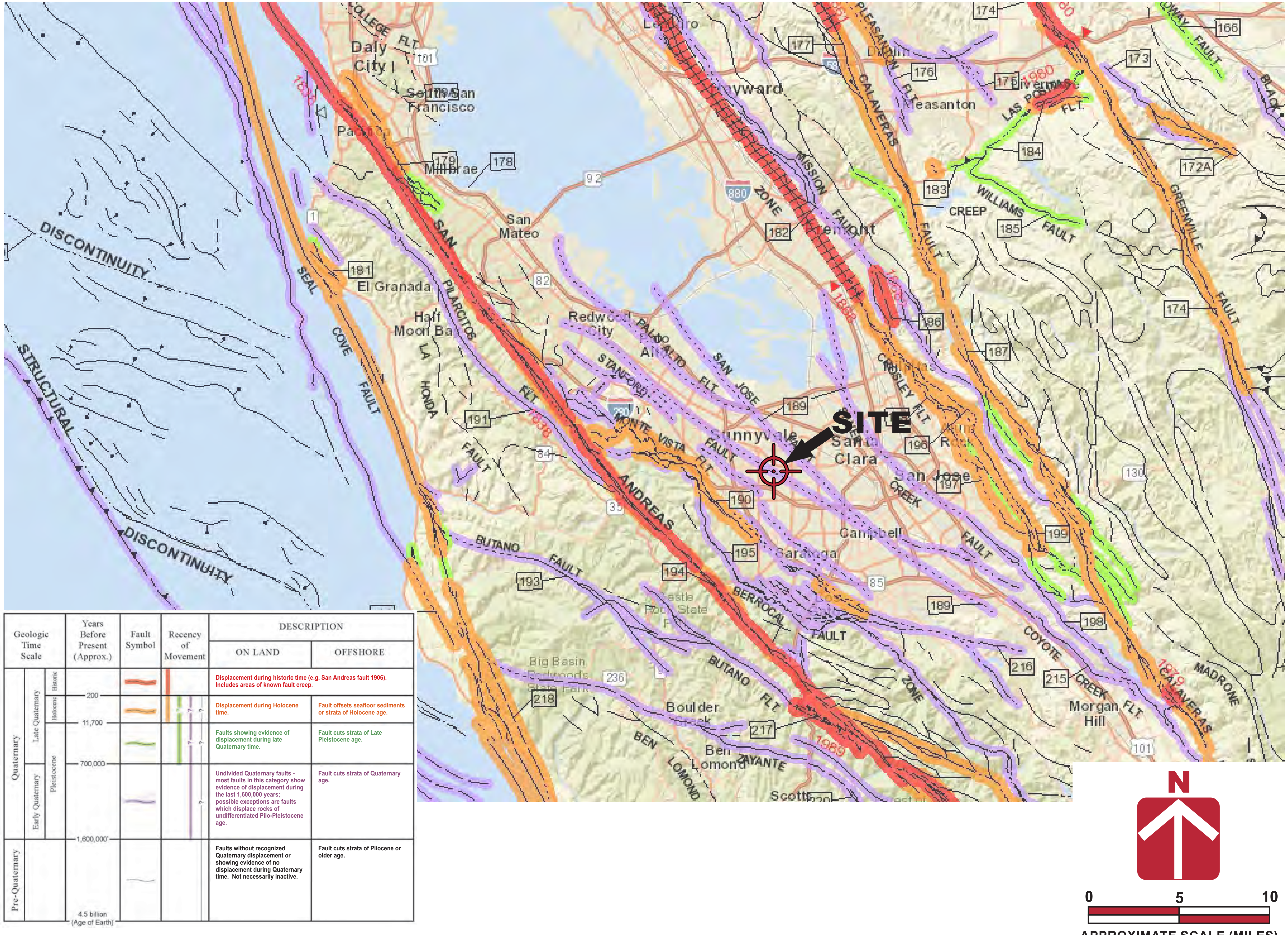

Geologic Time Scale			Years Before Present (Approx.)	Fault Symbol	Recency of Movement	DESCRIPTION: ON LAND	DESCRIPTION: OFFSHORE
Quaternary	Late Quaternary	Historic	200			Displacement during historic time (e.g. San Andreas fault 1906). Includes areas of known fault creep.	
		Holocene	11,700			Displacement during Holocene time.	Fault offsets seafloor sediments or strata of Holocene age.
		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)

Project Number 118-144-2

Figure Number Figure 3

Date December 2022

Drawn By RRN

Regional Fault Map

Well Station 20
800 Carlisle Way
Sunnyvale, CA

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