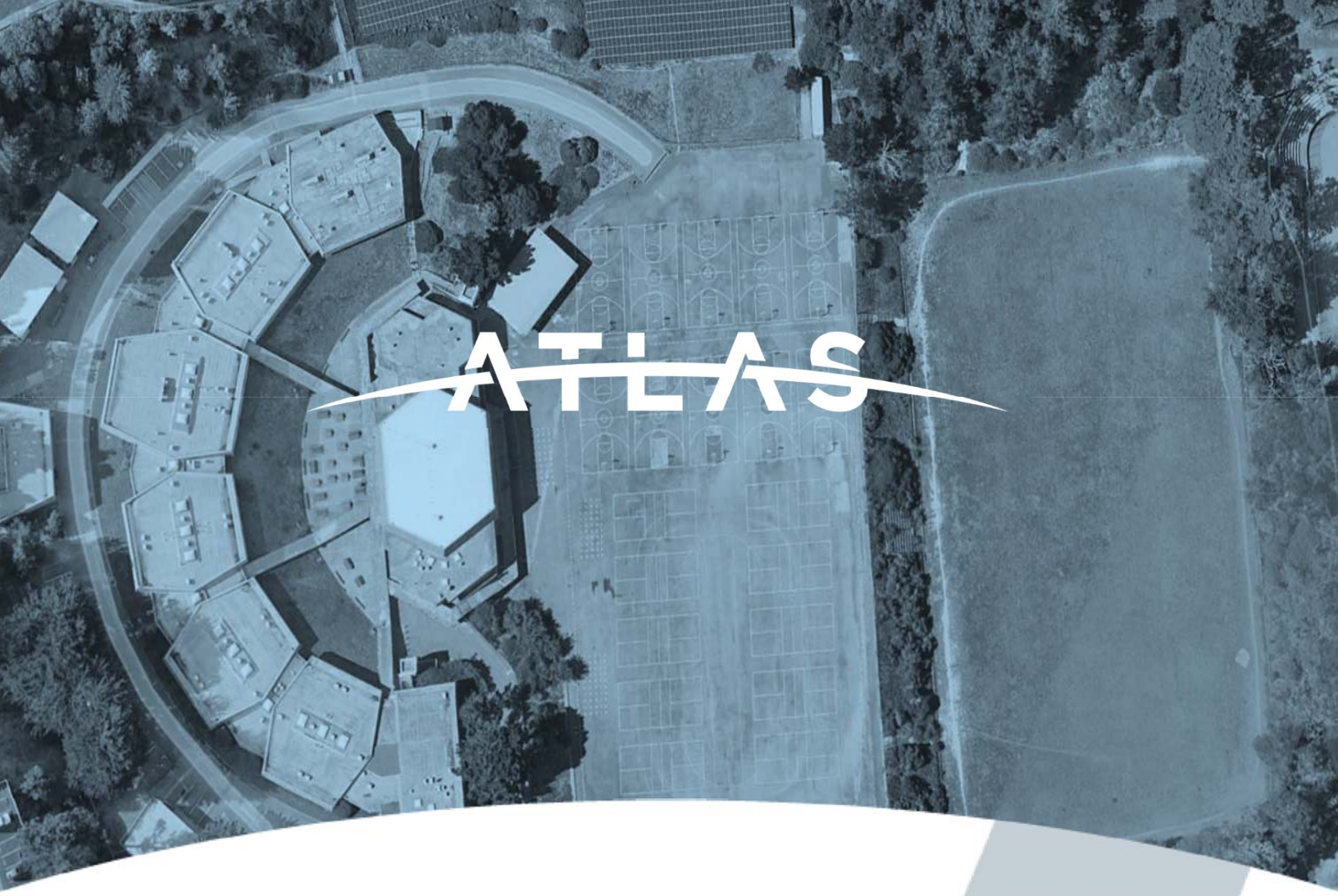


GEOTECHNICAL ENGINEERING STUDY

WESTBOROUGH MIDDLE SCHOOL – TURF FIELD AND SITE IMPROVEMENTS
2570 WESTBOROUGH BOULEVARD
SOUTH SAN FRANCISCO, CALIFORNIA 94080

PREPARED FOR:

Ms. Lori Shelton
South San Francisco Unified School District
398 B Street
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PREPARED BY:

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May 16, 2024

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May 16, 2024

Atlas No. 91-67787-PW

Ms. Lori Shelton | Director of Bond Program
SOUTH SAN FRANCISCO UNIFIED SCHOOL DISTRICT
398 B Street
South San Francisco, California 94080

Subject: **Geotechnical Engineering Study**
Westborough Middle School – Turf Field and Site Improvements
2570 Westborough Boulevard
South San Francisco, California 94080

Dear Ms. Shelton:

Atlas Technical Consultants (Atlas) has completed this Geotechnical Engineering Study for the proposed Westborough Middle School Turf Field and Site Improvements project in South San Francisco, California. Transmitted herewith are the results of our findings, conclusions, and recommendations regarding the proposed project. In general, the proposed improvements at the site are considered feasible from a geotechnical standpoint provided the recommendations of this report are implemented in the design and construction of the project.

Should you or members of the design team have questions or need additional information, please contact Mr. Manuel E. Zea at manuel.zea@oneatlas.com. We greatly appreciate the opportunity to be of service to you, and to be involved in the design of this project.

Respectfully submitted,

Atlas Technical Consultants LLC

Manuel E. Zea, PE
Senior Project Manager

Nick Anastasio, PE
Project Manager



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MEZ/NA:pmf

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GEOTECHNICAL ENGINEERING STUDY

1. INTRODUCTION

1.1 Purpose and Scope

The purposes of this study were to evaluate the subsurface conditions at the site and prepare geotechnical recommendations for the proposed improvements. This report provides recommendations for foundations, exterior concrete slabs, site preparation, grading, drainage, utility trench backfilling, and pavements. The investigation was performed in accordance with the scope of work outlined in our proposal dated January 24, 2024 (Revised February 28, 2024).

The scope of this study included field exploration, laboratory testing of selected samples, engineering analysis, and preparation of this report. The conclusions and recommendations presented in this report are based on the data acquired and analyzed during this study and on prudent engineering judgment, and experience. This study did not include an assessment of potentially toxic or hazardous materials that may be present on or beneath the site.

1.2 Site Description

The Westborough Middle School campus is located at the general address of 2570 Westborough Boulevard in South San Francisco, California, as shown on Plate 1. Specifically, the site for the proposed improvements is located within the existing grass-covered field at the lower, eastern edge of the school property that is currently not being used, as shown on Plate 2. At the time of our site visit, the grass was overgrown. The project also includes improvements to the existing asphalt-paved play yard in the central portion of the school property.

The site generally slopes downward towards the east with site elevations ranging between about +452 and +482 feet, based on the Google Earth Pro 3D software application. The elevation difference between the courts and the field is about 17 feet. The average geographic coordinates of the project site used for analysis were 37.6443 degrees north latitude and 122.4599 degrees west longitude.

1.3 Proposed Development

We understand the proposed project consists primarily of installing new synthetic turf for the existing field and associated grading and drainage improvements. The project also includes improvements to the existing asphalt-paved recreation area to also function as a drop-off and pick-up travelway for parent vehicles, requiring that the pavement be engineered for vehicle traffic. In addition, we understand that a potential future driveway extension could be constructed on the school property adjacent to Westborough Boulevard within a current landscape and asphalt pathway area with an adjacent parking lot entrance to increase space for queued vehicles to reduce the backup impact on Westborough Boulevard traffic. Construction of the driveway extension will require moderate cut and fill grading to be performed.

Related site improvements would also include the construction of new retaining walls at the top of a descending, approximately 17-foot-high slope separating the paved and grass field play areas.

Other planned upgrades include goalposts, pedestrian lights, below-grade walls, and pavement areas for pedestrians and vehicles. We anticipate that the goalposts and pedestrian lights will be supported on drilled pier foundations.

1.4 Validity of Report

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

2. PROCEDURES AND RESULTS

2.1 Literature Review

Pertinent geologic and geotechnical literature pertaining to the site area was reviewed. These included various publications and maps issued by the United States Geological Survey (USGS), California

Geological Survey (CGS), California Division of Mines and Geology (CDMG), and other government agencies, as listed in the References section.

2.2 Field Exploration

In order to characterize the subsurface conditions beneath the proposed improvement area, a field exploration program was conducted, which consisted of drilling seven test borings, designated as B-1 through B-7, on April 1, 2024, under the responsible charge of a California-registered Geotechnical Engineer. The location of the borings relative to the proposed improvements are shown on Plate 2.

The borings were drilled to total depths ranging from 5 to 15 feet below the existing surface using a truck mounted, B-24 drill rig equipped with 4-inch diameter solid flight augers. Following completion of drilling, the boreholes were backfilled using a cement grout mix.

An Atlas representative visually classified the materials encountered in the borings according to the Unified Soil Classification System as the borings were advanced. Relatively undisturbed soil samples were recovered at selected intervals using a 2-inch outside diameter Standard Penetration Test (SPT) sampler. The samplers were driven using a 140-pound automatic trip hammer with an approximate 30-inch fall. Resistance to penetration was recorded as the number of hammer blows required to drive the sampler the final 12-inches of an 18-inch drive.

The boring logs with descriptions of the various materials encountered in each boring, a key to the boring symbols, and select laboratory test results are included in Appendix A. Ground surface elevations indicated on the soil boring logs were estimated to the nearest foot using Google Earth Pro.

2.3 Laboratory Testing

Laboratory tests were performed on select samples to determine some of the physical and engineering properties of the subsurface soils. The results of the laboratory testing are presented in Appendix B. The following soil tests were performed for this study:

Dry Density and Moisture Content (ASTM D2216 and ASTM 2937) – In-situ dry density and/or moisture tests were conducted on select samples to measure the in-place dry density and moisture content of the subsurface materials.

Atterberg Limits (ASTM D4318 and CT204) - Atterberg Limits tests were performed on select samples of cohesive soils.

Particle Size Analysis & Percent Passing USCS No. 200 Sieve (Wet and Dry Sieve, ASTM D6913, D1140, & CT202) - Sieve analysis testing was conducted on select samples to measure the soil particle size distribution and/or the total percentage of fines (i.e., percent passing the USCS No. 200 sieve).

R-Value Test (ASTM D2844 and CT301) – An R-Value test was conducted on bulk composite samples of the near-surface materials collected from cuttings generated from the borings. This test provides data on prospective subgrade materials for pavement design.

3. GEOLOGIC AND SEISMIC OVERVIEW

3.1 Geologic Setting

The site is in the central portion of the Coast Ranges geomorphic province of California, flanked on the east by the Great Valley geomorphic province (CGS Note 36, 2002). The Coast Ranges extend from the Transverse Ranges in southern California to the Oregon border and are comprised of a northwest-trending series of mountain ranges and intervening valleys that reflect the overall structural grain of the province. The ranges consist of a variably thick mantle of easterly-dipping Cenozoic volcanic and sedimentary deposits overlying Mesozoic Franciscan basement rock composed of a complex, tectonically-deformed assemblage of sedimentary, mafic metamorphic, and igneous Franciscan Complex and widespread marine and non-marine sedimentary rocks of the Jurassic to early Paleocene Great Valley sequence (Bartow and Nilsen, 1990).

The basement rocks of the San Francisco Peninsula consist primarily of Franciscan Assemblage rocks. Overlying the Franciscan in depositional contact are the relatively young Cenozoic formations consisting of the Merced and Colma Formations. The Merced and Colma Formations are young (<1.5 MYA old) sediments that are predominately non-marine in origin with occasional marine interbeds. The sediments are granular uncemented deposits that have been uplifted into highland areas by the active tectonics of the nearby San Andreas Fault. As a rock, they are weak and uncemented. Described as soil, they are considered dense to very dense and have generally very favorable engineering characteristics for shallow foundation structures.

More specifically, the site is underlain by Pleistocene and Pliocene-epoch Merced Formation (Qtm), consisting of medium gray to yellowish orange, friable to firm sand, silt, and clay; with minor amounts of gravel, lignite, and volcanic ash. The mapped geologic units in the site vicinity are shown on Plate 3.

3.2 Regional Faulting and Tectonics

The site is in a seismically active region. Major active faults include the San Andreas Fault, located approximately 0.19 miles southwest of the site and the Seal Cove - San Gregorio Fault, located approximately 8 miles southwest of the site. In addition, active or potentially active faults include the Serra Fault, located approximately 0.9 miles northeast of the site. The site location relative to these and other active and potentially active faults in the southern San Francisco Bay Area is shown on Plate 5.

3.3 Historic Seismicity

The San Francisco Bay Area is subject to a high level of seismic activity. Within the period of 1800 to 2000 there were an estimated 20 earthquakes exceeding a Richter magnitude of 6.0 within a 100-mile radius of the site, seven exceeding 6.5, four exceeding 7.0 and one exceeding 7.5. There have been six major Bay Area earthquakes since 1800. Those were in 1836 and 1868 on the Hayward-Rodgers Creek Fault, in 1861 on the Calaveras Fault, and in 1838, 1906, and 1989 on the San Andreas Fault (CGS, 2024).

The site is reported to have experienced shaking from approximately 57 earthquakes of magnitude 5.5 or greater during the period of 1800 to 2000, occurring at various distances away from the site. Of those, 17 were greater than Magnitude 6.0, seven exceeded 6.5, four exceeded 7.0 and one was greater than 7.5. The most significant known ground shaking affecting the site since 1900 is likely the 1906 San Francisco earthquake, as well as the 1989 Loma Prieta earthquake.

4. FIELD AND LABORATORY FINDINGS

Subsurface conditions below the project site were interpreted based on the results of the test borings performed for this study, as well as the results of our laboratory testing. Detailed descriptions of the various subsurface soil units encountered during subsurface explorations are described in the following paragraphs.

4.1 Subsurface Soil Conditions

During our subsurface exploration program, we investigated the subsurface soils and evaluated soil conditions to a maximum depth of about 15 feet below the existing ground. Based on our collected data, the area of the proposed new construction is generally underlain by Merced Formation soils consisting of interbedded layers of clay with varying amounts of sand, and sand with varying amounts of silt and clay to the maximum depth explored. Borings B-2 and B-4 encountered possible fill consisting of re-

worked, native sandy clay/clayey sand soils, possibly associated with grading activities approximately 1½ and 5 feet bgs, respectively.

Atterberg Limit tests results of surficial soil samples recovered within the upper 5 feet in Borings B-1 and B-3 resulted in measured Liquid Limits of 34 and 30 percent, and corresponding Plasticity Indices of 8 and 9 percent, respectively. Based on these results, the near-surface soils are considered to have a low plasticity and a low expansion (shrink/swell) potential.

4.2 Groundwater Conditions

Free groundwater was not encountered in borings during our subsurface exploration. We note that the borings may not have been left open for a sufficient period of time to establish equilibrium groundwater conditions. Groundwater levels can vary in response to seasonal rainfall as well as time of year; well pumping, irrigation, and alterations to site drainage. A detailed investigation of local groundwater conditions was not performed and is beyond the scope of this study.

4.3 Field Percolation Testing

Two field percolation tests were performed at the site at Boring locations B-1 and B-2. The tests were conducted within a drilled 8-inch diameter hole and saturated overnight before the tests were conducted the following day. After drilling and removal of drill cuttings, the test installations were constructed using a 4-inch diameter perforated PVC casing inserted into the hole and backfilled around and below the casing with crushed rock to prevent scouring of the native materials when water was added. The hole was then saturated overnight with water before the test was conducted.

The estimated vertical infiltration rate of the soil was calculated from the field percolation rate adjusted with a correction formula according to the Porchet Method, which accounts for percolation occurring out the sides of the hole. Following the performance of the test, the hole was backfilled with auger soil cuttings. Final results of the tests are presented in Table 1.

Table 1: Percolation Test Results

Hole No.	Test Hole Depth (feet)	Measured Percolation Rate (min./in)	Calculated Infiltration Rate (Inches/Hour)
B-1	10.0	1.1	0.90
B-2	10.0	4.7	0.17

5. CONCLUSIONS AND RECOMMENDATIONS

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

5.1 Conclusions

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

Undocumented Fill Soils - Near-surface soils encountered in two borings at the site appear to be underlain by possible fill which may have been placed without engineering controls (e.g., material composition, placement and compaction requirements) and therefore may vary in material composition and foundation/load support qualities. In order to prevent potential variable support quality from affecting the performance of the synthetic field section, chemical stabilization, with its associated strengthening of the subgrade soils, should help provide more consistent support for the field section as well as enable field construction in the event the exposed subgrade proves to be unstable under construction equipment loads when exposed (see below).

Potentially Unstable Subgrades – After removal of the existing natural turf section and existing asphalt pavement section, the potential exists for the exposed subgrade to be unstable under the weight of construction equipment loads. As noted, this potential condition can be addressed by use of chemical stabilization.

Seismic Ground Shaking – The site is located within a seismically active region, and subject to potentially very strong ground shaking during the life of the project. As a minimum, any structures requiring seismic design per the California Building Code (CBC) should be designed per the applicable CBC requirements.

Groundwater – Groundwater was not encountered during our field investigation in any of the borings. Therefore, with the exception of unanticipated shallow seepage, groundwater should not be problematic for near-surface construction. However, groundwater may impact relatively deep utility trenches, if any, and conventional drilled pier foundations, which, if used in support of the goal posts and pedestrian lights, would require groundwater removal during construction.

Winter Construction – If grading occurs in the winter rainy season, appropriate erosion control measures may be required. Winter rains may also impact foundation excavations and underground utilities.

5.2 Seismic Design Parameters

Project structures, where applicable, should be designed to resist the seismic forces generated by earthquake shaking in accordance with the provisions of the 2022 California Building Code (CBC) and local design practice.

The proposed project should be designed to resist the seismic forces generated by earthquake shaking in accordance with the provisions of the 2022 California Building Code (CBC) and local design practice. Based on the subsurface conditions encountered in the borings, our evaluation of the geology of the site, and extrapolating the site conditions to 100 feet, we judge Site Class D – Stiff Soil, is appropriate for characterizing potential earthquake ground shaking conditions and seismic design considerations for the site, per ASCE/SEI 7-16 (Chapter 20). The geographic coordinates of the site improvements used for analysis were 37.6443 degrees north latitude and 122.4599 degrees west longitude.

We understand no new structural improvements are proposed for this project, which consists of the construction of a new synthetic turf field and adjacent site work. However, should new structural improvements ultimately be utilized at this site, they should be designed in accordance with local design practice to resist the lateral forces generated by ground shaking associated with a major earthquake occurring in Northern California.

Based on ASCE 7-16, Section 11.4.8, a ground motion hazard analysis is required for structures on Site Class “D” with S_1 greater than or equal to 0.2 (unless Exceptions are taken). Since the project site is mapped as S_1 equal to 1.035, a site-specific ground motion analysis in accordance with CBC 2022 and ASCE 7-16, Section 21.2.1.2, is required for the site. However, we assume that the exception to Section 11.4.8, Item 1 will be taken by the project structural engineer in accordance with ASCE 7-16 Supplement 3.

The values were obtained from the SEOC/OSHPD seismic hazard mapping web site based on the ASCE/SEI 7-16 Standard, as required by the 2022 CBC. If a site-specific ground motion analysis is desired by the structural engineer or by a reviewing agency such as the California Geological Survey (CGS), we should be contacted to provide such additional services. Also, in accordance with ASCE 7-16, Section 11.6, since the design spectral response acceleration parameter for S_1 is greater than 0.75

g, the Seismic Design Category for this site should be classified as “E” for Risk Categories I through III.

Table 2: Seismic Coefficients Based on 2022 CBC (per ASCE 7-16)

Item	Value	2019 CBC Source[R1]	ASCE 7-16 Table/Figure[R2]
Site Class	D	Table 1613.3.2	Table 20.3-1
Mapped Spectral Response Accelerations Short Period, S_S 1-second Period, S_1	 2.470 g 1.035 g		 Figure 22-1 Figure 22-2
Site Coefficient, F_a	1.0	Table 1613.3.3(1)	Table 11.4-1
Site Coefficient, F_V	1.7	Table 1613.3.3(2)	Table 11.4-2
MCE (S_{MS})	2.470 g	Equation 16-37	Equation 11.4-1
MCE (S_{M1}) [R3]	2.639 g	Equation 16-38	Equation 11.4-2
Design Spectral Response Acceleration Short Period, S_{DS} 1-second Period, S_{D1} [R3]	 1.647 g 1.173 g	 Equation 16-39 Equation 16-40	 Equation 11.4-3 Equation 11.4-4
Peak Ground Acceleration, PGA_M	1.742 g		Equation 11.8-1

R1 California Building Standards Commission (CBSC), “California Building Code,” 2022 Edition.
R2 U.S. Seismic “Design Maps” Web Application, https://seismicmaps.org
R3 Values increased by 50% in accordance with ASCE 7-16, Supplement 3, effective 11-5-21.

5.3 Site Grading and Site Preparation

5.3.1 General Grading Notes

Site grading should be performed in accordance with these recommendations. A pre-construction conference should be held at the jobsite with representatives from the owner, general contractor, grading contractor, and Atlas prior to starting the clearing and demolition operations at the site, at which time geotechnical considerations affecting grading should be discussed. Site grading is expected to consist of required grading to prepare and construct the synthetic field and pavement subgrade surface, any excavations and backfills required to establish other site grades if required, utility trench excavation and backfills, and preparation of supporting subgrades for new flatwork, if any.

5.3.2 Site Preparation

The project site should be cleared of any existing vegetation, including the existing turf; debris, undocumented loose or soft fill, exiting pavement sections, and other deleterious materials within the proposed development areas. The grading contractor should be aware of potential buried objects and underground utilities at the site which are to be removed or abandoned appropriately. Holes resulting from the removal of any underground obstructions or root balls that would extend below the proposed

finish grade should be cleaned down to firm soil as approved by the Geotechnical Engineer and backfilled with properly compacted engineered fill or other material approved by the Geotechnical Engineer. If loose or soft soil or unsuitable fill soil is encountered, these soils should be removed to expose firm soil and backfilled with engineered fill. Removed fill soil may be evaluated by the Geotechnical Engineer for possible reuse and placement as engineered fill. The Geotechnical Engineer's representative should observe and confirm the adequacy of site clearing operations during construction prior to engineered fill placement and observe and confirm all backfilling operations for any excavations to remove deleterious material.

Excavations resulting from the removal of any underground obstructions that would extend below the proposed finish grade should be excavated down to firm soil and backfilled with engineered fill in accordance with the grading sections of this report. The Geotechnical Engineer's representative should verify the adequacy of site clearing operations during construction prior to placement of engineered fill.

5.3.3 Engineered Fill Materials and Placement

The geotechnical engineer should receive samples of and approve all proposed import fill materials prior to use on site. Soil proposed for use as import-engineered fill shall be selected (i.e., non-expansive) fill and should meet the requirements established in Table 3.

Table 3: Import Non-Expansive Engineered Fill Requirements

Fill Requirement		Test Procedures	
Gradation		**ASTM[1]**	**Caltrans[2]**
Sieve Size	Percent Passing		
6 inch[3]	100	C136	202
¾ inch	70-100	C136	202
No. 4	50-100	C136	202
No. 200	5-12	C136	202
Plasticity			
Liquid Limit	Plasticity Index		
<30	<15	D4318	204
Organic Content			
Less than 3%	---	D2974	---
Expansion Index			
Less than 20	---	D4829	---

[1]ASTM International Standards (latest edition)
[2]State of California, Department of Transportation, Standard Test Methods (latest edition)
[3]Trench backfill should have a maximum particle size of 3 inches.

In general, on-site soils having an organic content of less than 3 percent by weight and meeting the size requirements for engineered fill in Table 3 can be reused as general (i.e., non-select) engineered fill as

approved by the Geotechnical Engineer. Reuse of highly expansive (i.e., Plasticity Index of 25 or greater) onsite soils -- if encountered -- as structural engineered fill may be restricted or not otherwise allowed by the Geotechnical Engineer.

Following excavation to the required grades, subgrades in areas to receive engineered fill, as well as for slabs-on-grade or flatwork, should be scarified to a depth of at least 8 inches; moisture conditioned, and compacted to the requirements for engineered fill presented in Section 5.3.4. Engineered fill should be moisture-conditioned and thoroughly mixed during placement to provide uniformity in each layer. To achieve satisfactory compaction of the subgrade and engineered fill materials, it may be necessary to adjust the water content at the time of construction. This may require that water be added to soils that are too dry, or that scarification and aeration be performed for any soils too wet.

The fill material should be evenly spread and compacted in relatively uniform lifts not exceeding 8 inches in pre-compacted (i.e., loose lift) thickness. Smaller lifts may be necessary to achieve the minimum required compaction using lighter weight compaction equipment. Moisture conditioning may be more difficult to achieve during cold, wet periods of the year, or during extreme temperatures and after precipitation events. The final compacted surface should be firm and unyielding and should be protected from damage caused by traffic or weather. Soil subgrades should be kept moist during construction.

In areas where space limitations preclude performing mechanical compaction, a flowable sand-cement slurry or other approved Controlled Density Fill (CDF; also known as Controlled Low Strength Material, or CLSM) may be used in place of soil. Required compressive strength of CLSM would depend on whether future excavatability would be required. In general, excavatable CLSM should have a 28-day unconfined compressive strength on the order of 50 to 150 pounds per square inch (psi). CLSM may also be used as an over-excavation backfill below footing excavations as well as for over-excavated winterized footing excavations for bottom protection prior to concrete pour (i.e., rat slabs).

5.3.4 Project Compaction Recommendations

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

Table 4: Project Compaction Requirements

Description	Min. Percent Relative Compaction (per ASTM D1557)	Recommended Minimum Percent Above or Below Optimum Moisture Content
Artificial Turf Subgrade, Chemically Treated	90	2
Fill Areas, Engineered Fill, Onsite Soil	90	2
Fill Areas, Engineered Fill, Select Fill	90	2
Concrete Flatwork and Non-Vehicular Pavement, Subgrade Soil	90	2
Concrete Flatwork and Non-Vehicular Pavement, Baserock	90	2
Asphalt Concrete Pavement (Vehicular), Subgrade, Upper 8”	95	2
Asphalt Concrete, Baserock	95	2
Underground Utility Backfill	90	2
Underground Utility Trench Backfill, Upper 3’ Feet below Pavement Sections	95	2
Retaining Wall Backfill	90	2

5.3.5 Synthetic Turf Field Preparation

After completion of site clearing and stripping, the exposed subgrade for the proposed synthetic turf field or subgrades to receive engineered fill should be scarified to a depth of 8 inches below existing grade or final subgrade, whichever is lower. In addition, loose soil or undocumented fills, where encountered during construction should be over-excavated and replaced by engineered fill. Scarified areas should be moisture conditioned and compacted to the requirements indicated in Table 4. The subgrade should be kept moist by watering until the fill is placed. Where recommended or required, engineered fill should be placed and compacted to reach design subgrade elevation.

Aggregate base (i.e., baserock such as Caltrans Class 2 aggregate base), if used below the turf section, should be moisture conditioned and compacted to a minimum 90% relative compaction. For compacted aggregate base or permeable base directly overlying lime treated subgrade, a woven stabilization fabric (e.g., Mirafi 500X or 600X) is not required from a stabilization standpoint.

5.3.6 Grading Pavement and Flatwork Areas

Pavement and flatwork subgrade exposed after cut excavation, or subgrades to receive engineered fill should be scarified to a depth of 8 inches below existing grade or final subgrade, whichever is lower. In addition, loose undocumented fills, where encountered during construction should be over-excavated and replaced by engineered fill. Scarified areas should be moisture conditioned and compacted to the

requirements indicated in Table 4. The subgrade should be kept moist by watering until the fill is placed. Where recommended or required, engineered fill should be placed and compacted to reach design subgrade elevation.

5.3.7 Site Winterization and Unstable Subgrade Conditions

If grading occurs in the winter rainy season, unstable and unworkable subgrade conditions may be locally present, and compaction of onsite soils may not be feasible. In addition, unstable subgrade conditions may be encountered in areas where existing pavements have been freshly removed, and underlying subgrade materials have not had adequate time to be reworked and dry out. These conditions may be remedied using soil admixtures, such as quicklime. A 5 percent mixture of quicklime based on a dry soil unit weight of 100 pcf is recommended for planning purposes. Treatment may vary between 12 to 18 inches, depending on the severity of the instability and the anticipated construction equipment loads. More detailed and final recommendations can be provided during construction if needed, after reviewing exposed unstable areas if encountered.

Stabilizing subgrade in small, isolated areas can generally be accomplished with the approval of the Geotechnical Engineer by over-excavating at least 12 inches, placing either (1) Tensar TriAx TX-140 or equivalent geogrid on the soil or (2) a high-modulus, woven stabilization geotextile such as Mirafi RS580i on the soil, and then backfilling with Class 2 baserock on the geogrid or geotextile. The upper 6 inches of the baserock should be compacted to at least 90% relative compaction (95% for pavement subgrades). Alternatively, a woven stabilization geotextile such as Mirafi 500X may be substituted for geogrid provided the over-excavation depth is increased to at least 18 inches below subgrade.

5.3.8 Site Drainage

Final grading should be designed to provide drainage away from new improvements. Exposed and covered soil areas within 10 feet of the proposed improvements or as applicable from the site conditions should slope at a minimum of 5 percent away from any structure. Adjacent concrete flatwork should slope a minimum 2 percent away from any structure.

5.4 Utility Trench Construction

5.4.1 Trench Backfilling

Utility trenches may be backfilled with onsite selected soil above the utility bedding and shading materials. If rocks or concrete larger than 4 inches in maximum size are encountered, they should be removed from

the fill material prior to placement in the utility trenches. Utility bedding and shading compaction requirements should be in conformance with the requirements of the local agencies having jurisdiction and as recommended by the pipe manufacturers. Jetting of trench backfill is not recommended. Compaction recommendations are presented in Table 2. Backfill should be generally placed in loose lifts of 12 inches or less; however, thicker lifts may be permitted if the specified minimum compaction can be demonstrated based on our field observation combined with confirmation testing.

If rain is expected and the trench will remain open, the bottom of the trench may be lined with 1 to 2 inches of gravel. This would provide a working surface in the trench bottom. The trench bottom may have to be sloped to a low point to pump the water out of the trench.

5.5 Temporary Excavation Slopes and Shoring

Where temporary excavation slopes are required, the Contractor should incorporate all appropriate requirements of OSHA/ Cal OSHA into the design of any temporary construction slopes used during construction. Excavation safety regulations are provided in the OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, Subpart P, and apply to excavations greater than 5 feet in depth.

The Contractor, or his specialty subcontractor, should design temporary construction slopes to conform to the OSHA regulations and should determine actual temporary slope inclinations based on the subsurface conditions exposed at the time of construction. For pre-construction planning purposes, the subsurface materials in the areas of the site where excavation may take place may be assumed to consist of stiff cohesive materials categorized as OSHA Type B with temporary slope inclination of no steeper than 1:1 (horizontal to vertical). This maximum slope ratio is assumed to be uniform from top to toe of the slope. The type of slope material and actual temporary construction slopes should be confirmed or adjusted during construction by a person who is trained as a “competent person” as designated by OSHA and directly responsible to the grading contractor.

If temporary slopes are left open for extended periods of time, exposure to weather and rain could have detrimental effects such as sloughing and erosion on surficial soils exposed in the excavations. We recommend that all vehicles and other surcharge loads be kept at least 10 feet away from the top of temporary slopes, and that such temporary slopes are protected from excessive drying or saturation during construction. In addition, adequate provisions should be made to prevent water from ponding on top of the slope and from flowing over the slope face. Desiccation or excessive moisture in the excavation could reduce stability and require shoring or laying back side slopes.

5.6 Foundation Recommendations

5.6.1 Drilled Pier Foundations

The proposed goal post and pedestrian light structures may be supported on deep foundation systems consisting of cast-in-drilled-hole (CIDH) piles, commonly known as drilled piers. Based on the soil conditions encountered, the following values may be used for CIDH pier foundation design, based on a factor of safety of 2.0:

Table 5: Recommended Design Parameters for CIDH Pier Foundations

Design Parameter	Recommended Design Value
Allowable Downward Skin Friction (Adhesion)*	350 psf
Allowable Uplift Skin Friction	230 psf
Allowable Axial End Bearing Capacity (if used)	4,500 psf
Allowable Lateral Passive Pressure	350 psf/foot (Equivalent Fluid Pressure)

* ignore contribution of uppermost 3 feet of shaft.

In order to fully mobilize the allowable skin friction, a pier settlement less than ¼ inch would be required. As an alternative to skin friction, end bearing resistance can be used provided the bottom of the pier hole is thoroughly cleaned of slough and other loose material. In order to mobilize the given allowable bearing capacity for end bearing, a settlement on the order of ½ to 1 inch may be required. End bearing and skin friction should not be used in combination for the pier design.

Lateral resistance for pier foundations, as shown on Table 5, may be assumed to act against the sides of foundations perpendicular to the direction of loading where the foundation is poured neat against undisturbed material (i.e., native soils or engineered fills). The contribution of the top foot of passive resistance for pier foundations not adjacent to and confined by flatwork or pavement should be neglected. For pier foundations, passive pressure can be assumed to act across two times the pier diameter. Settlement of pier foundations designed using the aforementioned design parameters and to the maximum supporting capacities is expected to be less than ½ inch.

5.7 Retaining Walls

5.7.1 Lateral Earth Pressure

Retaining walls should be designed to resist loading resulting from lateral earth pressures (static and seismic) and any additional lateral loads caused by surcharge loads on the adjoining ground surface. We

recommend walls be designed to resist the lateral earth pressures (expressed in terms of equivalent fluid weight) indicated in the tables below. The appropriate design values should be chosen based on the condition of the wall (restrained or unrestrained). Unrestrained wall pressures should only be considered applicable where the top of the wall is free to laterally deflect at least 0.2 percent of the wall height. Restrained wall pressures should be used for retaining walls whose tops are restrained from laterally deflecting.

Table 6: Static Lateral Earth Pressures (pcf)

Wall Condition	Slope Inclination (horizontal: vertical)	
	2:1	4:1 or flatter
Unrestrained	65	45
Restrained	85	65

Linear interpolation should be used to determine design values for retaining walls where the slope behind the wall is between 4:1 and 2:1. Where walls are to be designed for seismic loading (generally for structural walls retaining greater than 6 feet), unrestrained walls and restrained walls with level backfill should be designed to resist an additional uniform load equal to 8H psf, where H equals the height of soil retained by the wall in feet. The seismic load should be added to the unrestrained condition in both cases.

For surcharge loads, increase the design pressures behind the wall by an additional uniform pressure equivalent to one-half (for restrained conditions) or one-third (for unrestrained conditions) of the maximum anticipated surcharge load applied to the surface behind the wall.

5.7.2 Wall Foundations

Below grade walls can be supported on conventional continuous and isolated spread footings bearing on existing undisturbed fill soil, native soil, or properly compacted engineered fill. Footings should be founded a minimum of 24 inches below lowest adjacent finished grade subgrade elevation, as applicable. This value may be increased by one-third for transient loads.

Continuous footings should have a minimum width of at least 18 inches, and isolated column footings should have a minimum width of at least 24 inches. In addition, footings located adjacent to other footings or parallel utility trenches should bear below an imaginary 1.5:1 (horizontal to vertical) plane projected upward from the bottom edge of the adjacent footings or utility trenches. Footing reinforcement should be determined by the project Structural Engineer.

If Allowable Stress Design (ASD) is used by the structural engineer, the allowable bearing pressure for all loads (including seismic) shall be limited to our recommended ultimate bearing capacity (i.e., 6,000 psf) divided by the applicable overstrength factor Ω_0. Otherwise, footings should be designed for the following allowable bearing pressures, assuming design Factors-of-Safety of 3.0, 2.0 and 1.5 for dead loads, dead plus live loads and total loads, respectively, from the recommended ultimate bearing pressure.

Table 7: Allowable Bearing Pressures for Wall Foundations

Load Condition	Allowable Net Bearing Pressure (psf)
Dead Load	2,000
Dead plus Live Loads	3,000
Total Loads (including wind or seismic)	4,000

The above pressures are net values as the weight of the footing may be neglected for the portion of the footing extending below grade. Assuming site preparation and foundation observation services are conducted as outlined in the report, static vertical settlement is expected to be approximately 1 inch or less for footings bearing within the materials described in the report and designed to the aforementioned maximum allowable bearing pressures. Differential settlement across the structure would likely be in the range of ½ to ⅔ the estimated total settlement.

Atlas personnel should be retained to observe and confirm that footing excavations prior to formwork and reinforcing steel placement bear in engineered fill soils suitable for the recommended maximum design bearing pressure. If unsuitable bottom soil such as undocumented fill is present, the excavation should be deepened until suitable supporting material is encountered. The over excavation should be backfilled using engineered soil or lean concrete (or a sand-cement slurry mix acceptable to the Geotechnical Engineer) up to the bottom of the footing concrete.

Footing excavations should have firm bottoms and be free from excessive slough prior to concrete or reinforcing steel placement. Care should also be taken to prevent excessive wetting or drying of the bearing materials during construction. Extremely wet or dry or any loose or disturbed material in the bottom of the footing excavations should be removed prior to placing concrete. If construction occurs during the winter months, a thin layer of concrete (sometimes referred to as a rat slab) could be placed at the bottom of the footing excavations. This will protect the bearing soil and facilitate removal of water and slough if rainwater fills the excavations.

5.7.3 Lateral Resistance

Foundation elements can resist lateral loads with a combination of bottom friction and passive resistance. An allowable coefficient of friction of 0.35 between the base of the foundation elements and underlying material is recommended. In addition, an allowable passive resistance equal to an equivalent fluid weighing 350 pcf acting against the foundation may be used for lateral load resistance against the sides of footings perpendicular to the direction of loading where the footing is poured neat against undisturbed material (i.e., native soils or engineered fills).

In order to fully mobilize this passive resistance, a lateral footing deflection on the order of 1 to 2 percent of the embedment of the footing is required. If it is desired to limit the amount of lateral deflection to mobilize the passive resistance, a proportional safety factor should be applied. Alternatively, ultimate passive resistance may be reduced by one-third for allowable (SF = 1.5) or in accordance with pertinent code. The two modes of resistance should not be added unless the frictional component is reduced by 50%, since full mobilization of the passive resistance requires some horizontal movement, which significantly diminishes the frictional resistance. The friction between the bottom of a slab-on-grade floor and the underlying soil should not be utilized to resist lateral forces.

5.7.4 Retaining Wall Drainage

The aforementioned recommended lateral pressures assume that retaining walls are fully back drained to prevent the build-up of hydrostatic pressures. If a retaining wall drainage system is desired, it should consist of a minimum 12-inch width of free-draining granular soils containing less than 5 percent fines (by weight) passing a No. 200 sieve placed adjacent to the wall. The free-draining granular material should be graded to prevent the intrusion of fines (e.g., a Caltrans Class 2 permeable material) or encapsulated in a suitable filter fabric. A drainage system consisting of either weep holes or perforated drain lines (placed near the base of the wall) should be used to intercept and discharge water, which would tend to saturate the backfill. Where used, drain lines should be embedded in a uniformly graded filter material and provided with adequate clean-outs for periodic maintenance if desired. An impervious soil should be used in the upper layer of backfill to reduce the potential for water infiltration. As an alternative, a prefabricated drainage structure such as a geocomposite drain (e.g., MiraDRAIN 6000) may be used as a substitute for the granular backfill adjacent to the wall. Collector pipes for wall drainage should be sloped to discharge by gravity to an adjacent storm drain system or other appropriate facility.

If drainage is not provided behind the walls and hydrostatic pressure is expected to occur, the lateral earth pressures provided in Table 6 should be halved and hydrostatic pressure should be added for depths below the maximum expected water level.

5.8 Synthetic Turf Field Subdrainage

Due to the relative impermeability of the onsite subgrade soils, use of a subdrain system to provide drainage under the synthetic turf to an offsite dispersal system (e.g., storm drain) is warranted. Synthetic turf subdrainage layer and trench subdrain materials may consist of Caltrans Class 2 permeable material or a crushed or rounded open-graded drain rock, at the designer's option. If an open-graded material is used, subdrain trenches should be lined with a non-woven geotextile fabric such as Mirafi 140N or approved equivalent to separate the drain rock and the clayey native soils. Drainage material should be compacted to a firm, unyielding condition. Use of a finer leveling material such as ¼ - ⅝" washed chip on top of coarser crushed drain rock material in the subdrain without a separating geotextile fabric is acceptable from a geotechnical standpoint provided the designer does not have an issue with minor infiltration of the leveling material into voids at the top of the drain rock during initial chip placement.

5.9 Exterior Concrete Flatwork (Non-Vehicular)

Exterior concrete flatwork with pedestrian traffic should be at least 4 inches thick and supported on either compacted native subgrade or a baserock layer constructed in accordance with Sections 5.3.3 and 5.3.4.

Control joints should be constructed in accordance with ACI 224 "Control of Cracking in Concrete Structures". In general, for typical flatwork, joints would be required every 24 to 36 times the concrete thickness.

5.10 Pavement Design

5.10.1 Asphalt Concrete (Flexible) Pavements

Recommendations for the design of asphalt concrete pavement sections for vehicular traffic were developed in accordance with the procedures outlined in the latest edition of the Caltrans Highway Design Manual. The Caltrans design method uses Traffic Indices (TI) to represent anticipated wheel loads and frequency of usage for a given design life. A design life of 20 years is typically used in California. Factors such as surface and subsurface drainage have an effect on the overall life of a pavement section.

Two R-values of 14 and 28 were obtained from laboratory test on samples of typical near-surface onsite materials. To account for potential variation in the clay and silt content of these soils, an R-value of 10 was used for determining the design sections. Traffic Indices (TI) of 4.0, 5.0 and 6.0 were considered for car only parking areas, vehicle traffic lanes, and fire truck/ tanker lanes, respectively. Based on assumed condition and data analysis, the following are recommended minimum structural thicknesses for onsite asphalt concrete (AC) pavement sections.

Table 8: Recommended Minimum Pavement Design Sections

Traffic Type and (TI)	Asphalt Concrete (in)	Class 2 AB (in)	Total Section (in)
Parking Area for Passenger Cars (4.0)	2.5	7.0	9.5
Access Road, Passenger Cars and Light to Medium Load Trucks (5.0)	3.0	6.0*	9.0
Fire Lane Access (where applicable; 6.0)	3.5	6.0*	9.5

*Minimum AB section.

If the lighter pavements (TI = 4.5) are planned to be placed prior to, or during construction, the traffic indices and pavement sections may not be adequate for support of what is typically more frequent and heavier construction traffic. Therefore, if the pavement sections will be used for construction access, the heavier pavement section should be considered, or the asphalt concrete should be placed in phases (e.g., placement of final lift of AC after building construction is substantially completed) to minimize pavement damage caused by construction traffic. Design based on the aforementioned traffic indices should provide the design pavement life with only a normal amount of pavement maintenance.

In areas where pavements will abut planted areas, the pavement aggregate base layer, pavement section subgrade soils and trench backfill should be protected against saturation. Planned concrete curbs should extend at least to the bottom of the aggregate base layer, forming a concrete barrier between the landscaped areas and the pavement section. In addition, water should never be allowed to pond behind the curb and gutter during or after the completion of construction.

AB for use in flexible pavements should conform to Caltrans Standard Specification Sections 26-1.02A and 26-1.02B (2010) for Class 2 AB. AB from recycled sources offered by AB suppliers as well as AC grindings mixed with existing baserock and meeting Class 2 specifications can be utilized in lieu of virgin Class 2 AB upon approval of the Geotechnical Engineer. AB used in pavement sections should be compacted to a minimum 95 percent relative compaction (ASTM D1557) and should be firm and unyielding at the time of asphalt concrete placement.

Assuming AC pavement is compacted per commonly accepted Caltrans specifications for Hot Mix Asphalt (HMA), HMA sections should be compacted to a relative compaction value of 91% to 97% of maximum theoretical density determined through ASTM Test Method D2041, latest edition.

5.10.2 Rigid Pavements (Vehicular)

As an alternative to flexible pavement sections, new pavement areas may consist of rigid Portland Cement Concrete (PCC) pavement, which in addition to our subgrade preparation recommendations presented for slabs-on-grade, should be designed and constructed in accordance with American Concrete Institute (ACI) 330R-08 – *Guide for Design and Construction of Concrete Parking Lots*.

Based on an assumed 6-inch-thick aggregate base layer underlying the rigid pavement, a subgrade-subbase support strength value of 100 pci was assumed in our analysis. In addition, our design assumes that rigid pavements would be restrained laterally by concrete walls or curbs, and that the concrete will have a compressive strength of at least 4,000 psi.

Based on these assumptions, the table below shows minimum rigid pavement sections for a 20-year pavement life and maximum spacing between joints, for vehicle parking areas, with the design loading condition to be selected by the designing civil engineer.

Table 9: Recommended Rigid Minimum Pavement Design Sections

Traffic Categories	Design ADTT*	Pavement Components		Total Thickness (inches)	Contraction Joints Maximum Spacing (feet)
		Portland Cement Concrete (inches)	Caltrans Class 2 Aggregate Base (inches)		
Vehicle Parking Areas	1	4.0	6.0	10.0	10
Single-Unit Truck Lanes and Parking Areas	25	5.5	6.0	11.5	12.5

*ADTT = Average daily truck traffic in both directions (vehicles with at least six wheels; excludes panel trucks, pickup trucks, and other four-wheel vehicles).

Reinforcing steel or fiber mesh may be used for shrinkage crack control, if desired. In addition, maximum spacing should be provided between contraction joints on both directions.

5.10.3 Asphalt Concrete Pavements (Non-Vehicular)

Asphalt pavements not intended to be used for vehicular traffic such as pedestrian pathways, play areas or subgrade for track surfaces not intended for regular vehicular traffic should be at least 1½ inches thick and may optionally be underlain by a layer of aggregate baserock.

5.11 Stormwater Infiltration Design Considerations

If the requirements of Provision C.3 of the Bay Area Municipal Regional Stormwater Permit (MRP) apply to the project, post-construction stormwater controls may be required. Stormwater infiltration treatment systems utilizing measures such as biofiltration swales or planters, or pervious pavements or pavers should be designed considering the typical infiltration rates characteristic of the onsite surficial soils. The near-surface soils at the site were found to consist of low plasticity sandy silts and clays of relatively low infiltration potential (i.e., measured field percolation rates of near zero) and would likely be categorized as Hydrologic Soil Group “C” soils (USDA, 2007). In this case, the infiltration rates may be too low to accommodate infiltration of collected stormwater into the underlying soils, and the use of a subdrainage layer consisting of an appropriate permeable material may be required.

In general, biofiltration swales or basins should not be placed directly adjacent to building perimeters in order to minimize impact on the long-term performance of foundations. If such features must be constructed adjacent to foundations, the filter material should not be located within the footing zone of influence, considered to be the zone below an imaginary 1.5:1 (horizontal to vertical) plane projected downward from the bottom edge of the adjacent building footing. In addition, the bottom of the bioswale or biofiltration area should include a perforated subdrain pipe to carry collected infiltration water away from the foundations.

Biofiltration swales should generally be placed a minimum of 5 feet away from pavements or exterior flatwork in order to reduce potential impacts on these features such as settlement or lateral movement. Where concrete curbs are located adjacent to bioswale or other filtration features, the loose biofiltration material should not be located within a zone below an imaginary 1:1 (horizontal to vertical) plane projected downward from the bottom edge of the adjacent curb. Curbs adjacent to deeper biofiltration features may also be designed as retaining walls with the bottom of the wall deriving passive resistance from soils below the adjacent biofiltration medium and also assuming an ultimate lateral active pressure of 35 pcf EFP may be used.

5.12 Plan Review

We recommend that Atlas be provided the opportunity to review the final project plans prior to construction. The purpose of this review is to assess the general compliance of the plans with the recommendations provided in this report and confirm the incorporation of these recommendations into the project plans and specifications.

5.13 Observations and Testing During Construction

We recommend that Atlas be retained to provide observation and testing services during site preparation, mass and finish grading, underground utility construction, foundation excavation, and to observe final site drainage. This is to observe compliance with the design concepts, specifications, and recommendations, and to allow for possible changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

6. LIMITATIONS AND UNIFORMITY OF CONDITIONS

The recommendations of this report are based upon the soil and conditions encountered in the borings and subsurface data from previous studies at the project site. If variations or undesirable conditions are encountered during construction, Atlas should be contacted so that supplemental recommendations may be provided.

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

The findings and recommendations presented in this report are valid as of the present time for the development as currently proposed. However, changes in the conditions of the property or adjacent properties may occur with the passage of time, whether by natural processes or the acts of other persons. In addition, changes in applicable or appropriate standards may occur through legislation or the broadening of knowledge. Accordingly, the findings and recommendations presented in this report may be invalidated, wholly or in part, by changes outside our control. Therefore, this report is subject to review by Atlas after a period of three (3) years has elapsed from the date of issuance of this report. In addition, if the currently proposed design scheme as noted in this report is altered Atlas should be provided the opportunity to review the changed design and provide supplemental recommendations as needed.

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

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

The scope of our services for this report did not include an environmental assessment or investigation for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater or air, on, below or around this site. Any statements within this report or on the attached Plates, logs or records regarding odors noted or other items or conditions observed are for the information of our client only.

7. REFERENCES

American Concrete Institute, 2008, Guide for Design and Construction of Concrete Parking Lots: ACI Publication 330R-08.

American Society of Civil Engineers, 2017, Minimum Design Loads for Buildings and Other Structures; ASCE/SEI Standard 7-16.

Brabb, E.E. and Pampeyan, E.H., 1983, Geologic Map of San Mateo County, California, U.S. Geological Survey, Miscellaneous Investigations, Series Map I-1257-A ; 1:62,500 scale.

Burmister, D.M., 1948, "The importance and practical use of relative density in soil mechanics," Proceedings of ASTM, Vol. 48, 1249-1268.

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California Division of Mines and Geology (CDMG), Digital Images of Official Maps of Alquist-Priolo Earthquake Fault Zones of California, Central Coast Region, DMG CD 2000-004, 2000.

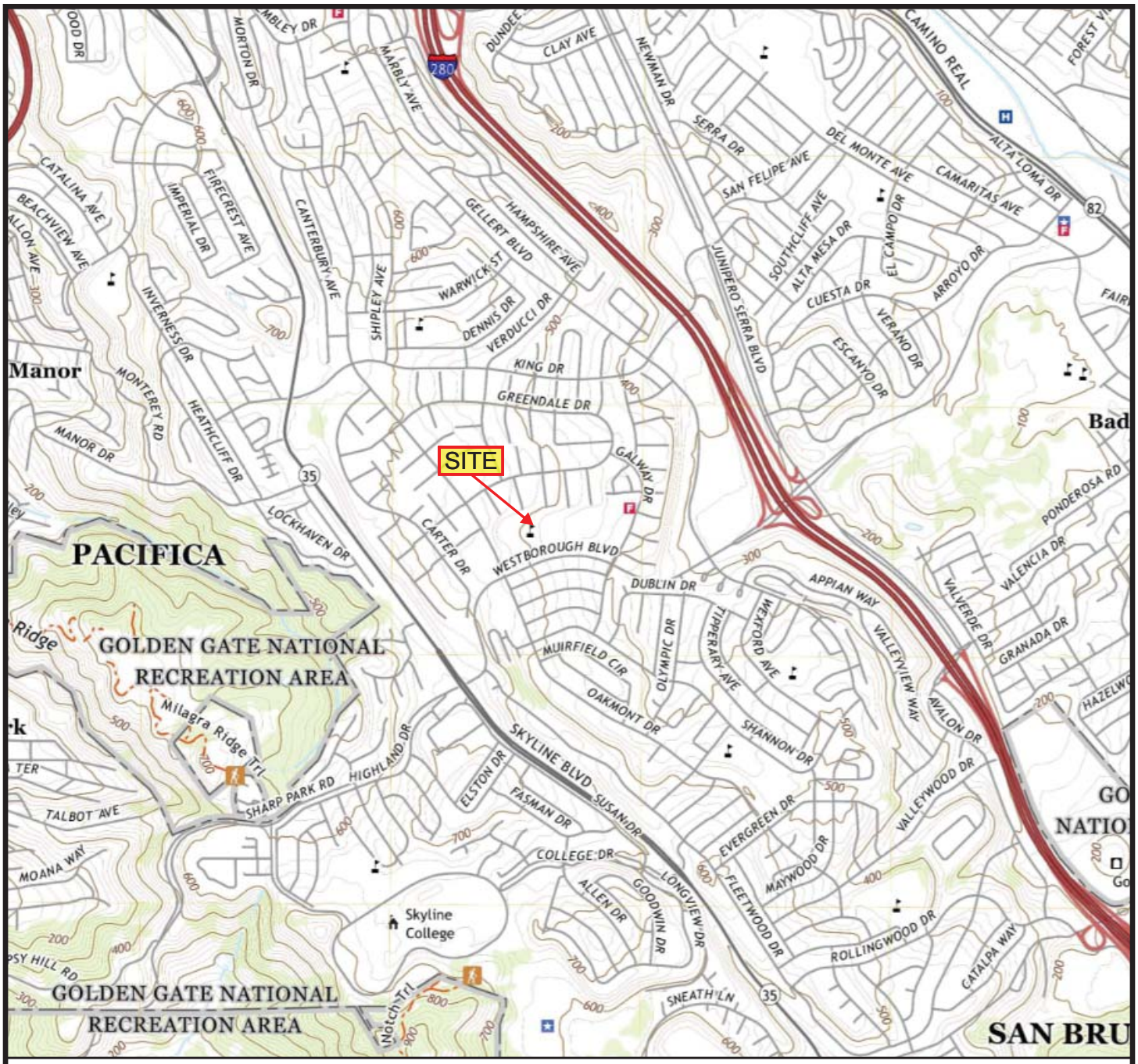
Hart, E.W., and Bryant, W.A., 1997, Fault-rupture hazard zones in California: California Geological Survey Special Publication 42, revised 1997 with Supplements 1 and 2 added 1999, 38 p.

U. S. Geological Survey Earthquake Information Center, 2012, website, earthquake.usgs.gov.

U. S. Geological Survey, Earthquake Hazards Program website, eqhazmaps.usgs.gov.

Publications may have been used as general reference and not specifically cited in the report text.

PLATES



N

2000 ft.
Scale

Contour Interval 20 ft.

San Francisco South Quadrangle (USGS, 2021)

ATLAS	**Job No.:** 91-67787-PW **Approved:** MZ **Date:** 05.09.2024	**VICINITY MAP** South San Francisco Unified School District Westborough Middle School – Turf Field and Site Improvements 2570 Westborough Boulevard, South San Francisco, California 94080	**Plate** 1



EXPLANATION

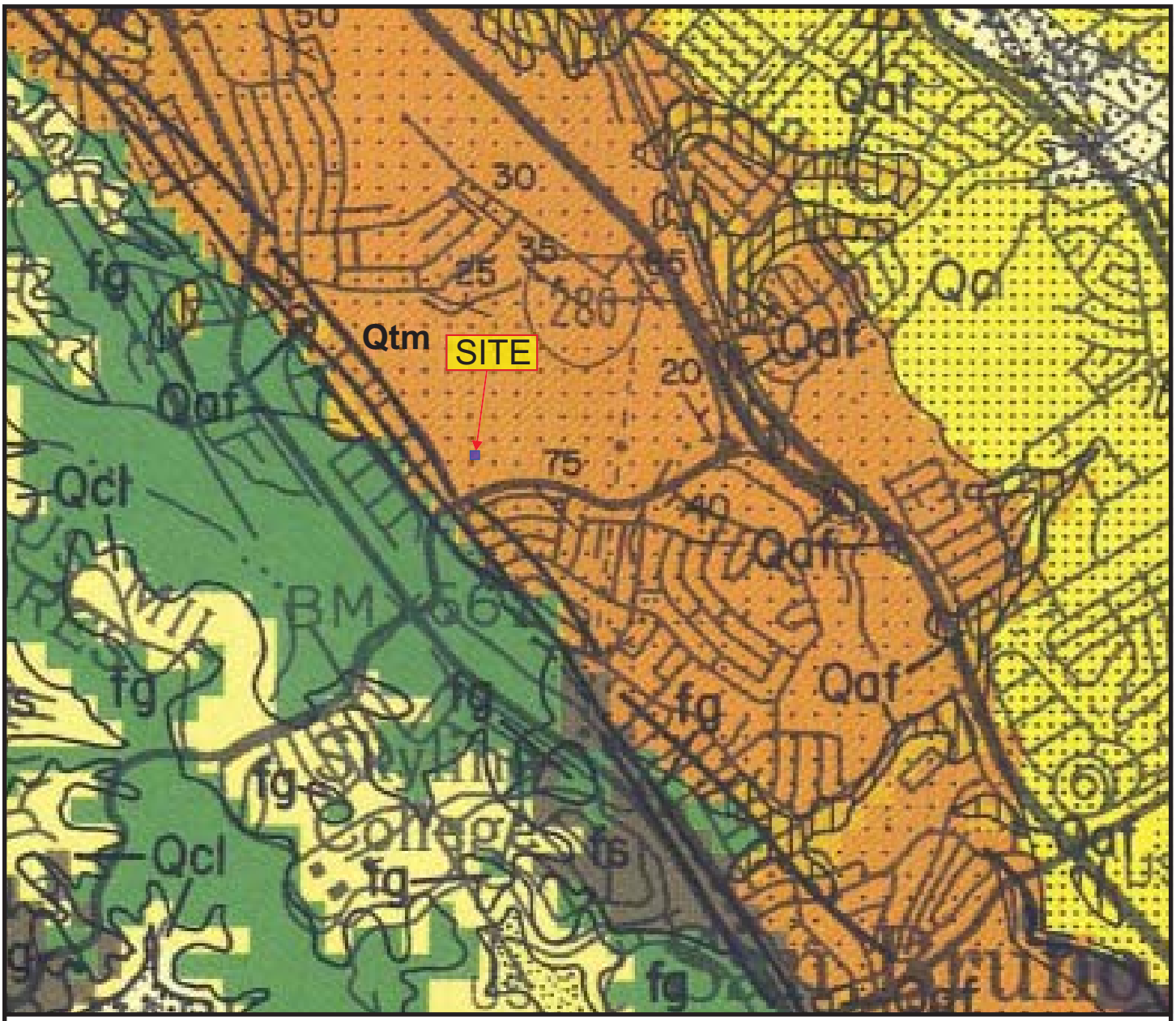
B-1 - Approximate Boring Location

N

70 ft.
Scale

Google Map Data (2022)

ATLAS	**Job No.:** 91-67787-PW **Approved:** MZ **Date:** 05.09.2024	**SITE PLAN** South San Francisco Unified School District Westborough Middle School – Turf Field and Site Improvements 2570 Westborough Boulevard, South San Francisco, California 94080	**Plate** 2



EXPLANATION

Units

Qtm Merced Formation: Friable to firm sand, silt, and clay; minor amounts of gravel, lignite, and volcanic ash, medium gray to yellowish orange.

Qc Colma Formation: Friable to loose, fine to medium grained sand with subordinate amount of gravel silt and clay (Pleistocene).

Qaf Artificial Fill: Loose to very well consolidated gravel, sand, silt, clay, rock fragments, organic matter and manmade debris in various Thickness is variable and may exceed 30 m in places.

Qcl Colluvium: Loose to firm, friable sand, silt, clay, gravel, rock debris, and organic material in varying proportions(Holocene)

fg Greenstone: Basaltic rocks, including flows, pillow lavas, breccias, tuff breccias, tuffs, and minor related intrusive rocks, in unknown proportions.

fs Sandstone: Greenish-gray to buff colored fine to coarse-grained sandstone (graywacke), with interbedded siltstone and shale.

Symbols

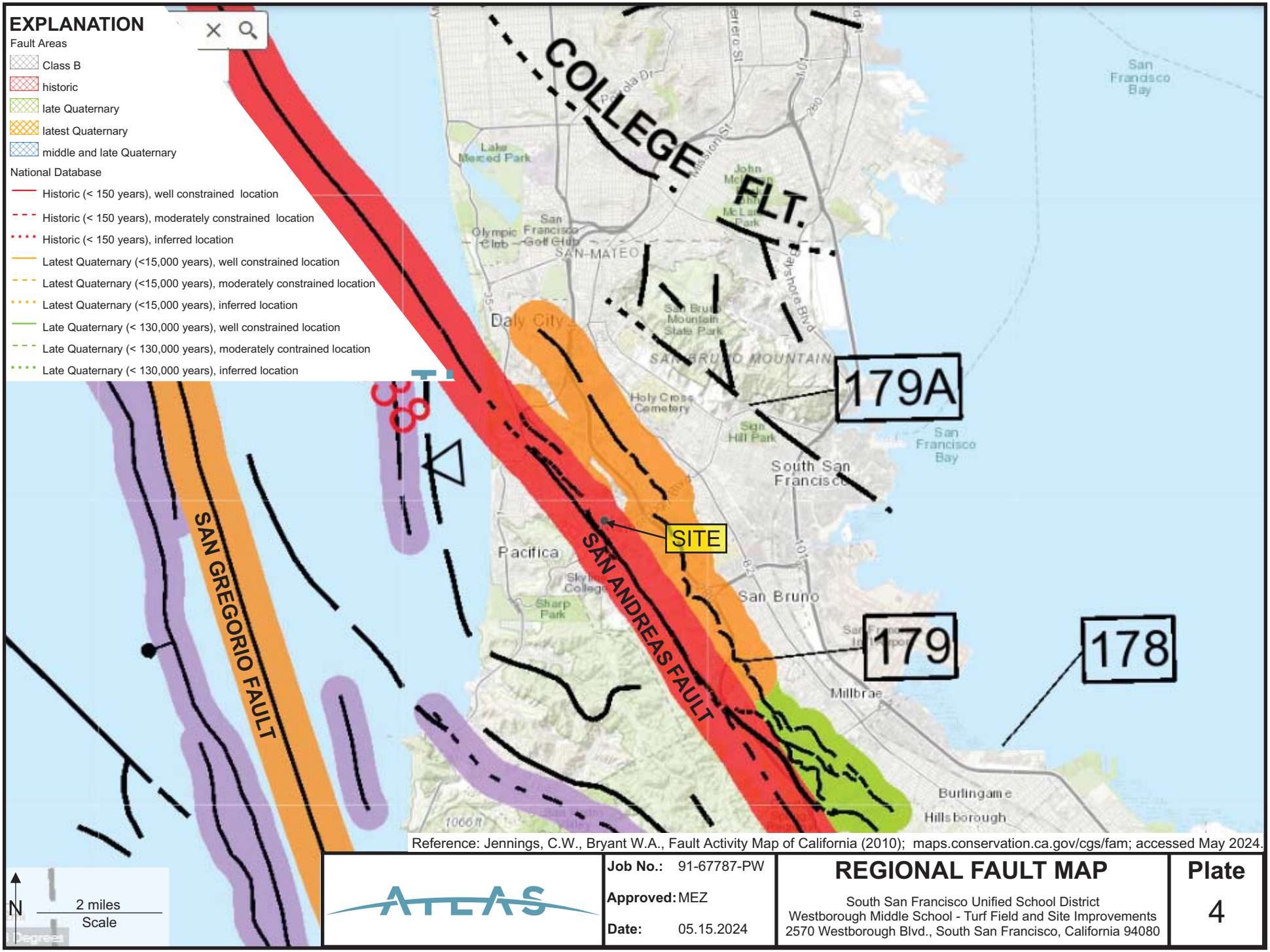
— — — ·····? Fault - dashed where approximately located, dotted where concealed or inferred.

N

2000 feet
Scale

Source: Brabb and Pampeyan (1983)

ATLAS	**Job No.:** 91-67783-PW **Approved:** MZ **Date:** 05.16.2024	**REGIONAL GEOLOGIC MAP** South San Francisco Unified School District Westborough Middle School – Turf Field and Site Improvements 2570 Westborough Boulevard, South San Francisco, California 94080	**Plate** 3



Reference: Jennings, C.W., Bryant W.A., Fault Activity Map of California (2010); maps.conservation.ca.gov/cgs/fam; accessed May 2024.

ATLAS

Job No.: 91-67787-PW

Approved: MEZ

Date: 05.15.2024

REGIONAL FAULT MAP

South San Francisco Unified School District
Westborough Middle School - Turf Field and Site Improvements
2570 Westborough Blvd., South San Francisco, California 94080

Plate

4

APPENDIX A

FIELD EXPLORATION

KEY TO BORINGS
BORING LOGS

UNIFIED SOIL CLASSIFICATION (ASTM D-2487)

Material Types	Criteria for Assigning Soil Group Names			Group Symbol	Soil Group Names	Legend
Coarse Grained Soils	Gravels >50% of Coarse Fraction Retained on No. 4 Sieve	Clean Gravels <5% Fines	Cu≥4 and 1≤Cc≤3	GW	Well-Graded Gravel	
			Cu<4 and/or [Cc<1 or Cc>3]	GP	Poorly-Graded Gravel	
		Gravels with Fines >12% Fines	Fines Classify as ML or MH	GM	Silty Gravel	
			Fines Classify as CL or CH	GC	Clayey Gravel	
>50% Retained on No. 200 Sieve	Sands ≥50% of Coarse Fraction Passes on No. 4 Sieve	Clean Sands <5% Fines	Cu≥6 and 1≤Cc≤3	SW	Well-Graded Sand	
			Cu<6 and/or [Cc<1 or Cc>3]	SP	Poorly-Graded Sand	
		Sands and Fines >12% Fines	Fines Classify as ML or MH	SM	Silty Sand	
			Fines Classify as CL or CH	SC	Clayey Sand	
Fine Grained Soils	Silts and Clays Liquid Limits<50	Inorganic	PI>7 and Plots≥"A" Line	CL	Lean Clay	
			PI>4 and Plots<"A" Line	ML	Silt	
		Organic	LL (Oven Dried)/LL(not Dried <0.75)	OL	Organic Silt	
≥50% Passes No. 200 Sieve	Silts and Clays Liquid Limits≥50	Inorganic	PI Plots≥"A" Line	CH	Fat Clay	
			PI Plots<"A" Line	MH	Elastic Silt	
		Organic	LL (Oven Dried)/LL(Not Dried <0.75)	OH	Organic Clay	
Highly Organic Soils		Primarily Organic Matter, Dark in Color and Organic Odor		PT	Peat	

PENETRATION RESISTANCE (RECORDED AS BLOWS/0.5 FEET)

SAND AND GRAVEL		SILT AND CLAY		
RELATIVE DENSITY	N-VALUE (BLOWS/FOOT)*	CONSISTENCY	N-VALUE (BLOWS/FOOT)*	COMPRESSIVE STRENGTH
Very Loose	0 - 3	Very Soft	0 - 1	0 - 0.25
Loose	4 - 10	Soft	2 - 4	0.25 - 0.50
Medium Dense	11 - 29	Medium Stiff	5 - 7	0.50 - 1.0
Dense	30 - 49	Stiff	8 - 14	1.0 - 2.0
Very Dense	50+	Very Stiff	15 - 29	2.0 - 4.0
		Hard	30+	Over 4.0

SOIL MOISTURE

DESCRIPTOR	DESCRIPTION
Dry	Dry of Standard Proctor Optimum
Damp	Sand Dry
Moist	Near Standard Proctor Optimum
Wet	Wet of Standard Proctor Optimum
Saturated	Free Water in Sample

PARTICLES SIZES

COMPONENTS		SIZE OR SIEVE NUMBER
Boulders		Over 12 Inches
Cobbles		3 to 12 inches
Gravels	-Coarse	3/4 to 3 Inches
	-Fine	Number 4 to 3/4 Inch
Sand	-Coarse	Number 10 to Number 4
	-Medium	Number 40 to Number 10
	-Fine	Number 200 to Number 40
Fines (Silt and Clay)		Below Number 200

Grab Bulk Sample

Standard Penetration Test

2.5 Inch Modified California

Rock Core

Shelby Tube

Initial Water Level Reading

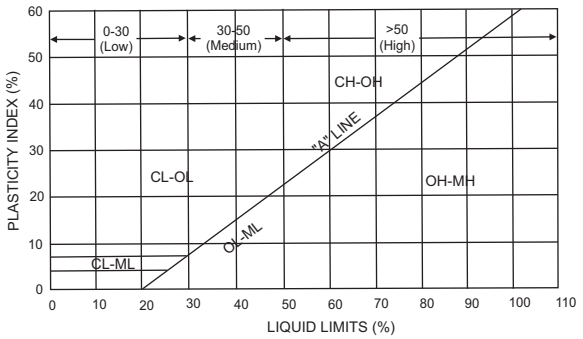
Final Water Level Reading

Blow Count
The number of blows of the sampling hammer required to drive the sampler through each of three 6-inch increments. Less than three increments may be reported if more than 50 blows are counted for any increment. The notation 50/5" indicates 50 blows recorded for 5 inches of penetration.

N-Value
Number of blows 140 LB hammer falling 30 inches to drive a 2 inch outside diameter (1-3/8 inch I.D) split barrel sampler the last 12 inches of an 18 inch drive (ASTM-1586 Standard Penetration Test)

CU -Consolidated Undrained triaxial test completed. Refer to laboratory results
DS - Results of Direct Shear test in terms of total cohesion (C, KSF) or effective cohesion and friction angles (C', KSF and degrees)
LL - Liquid Limit
PI - Plasticity Index
PP - Pocket Penetrometer test
TV - Torvane Shear Test results in terms of undrained shear strength (KSF)
UC - Unconfined Compression test results in terms of undrained shear strength (KSF)
#200 - Percent passing number 200 sieve
Cu - Coefficient of Uniformity
Cc - Coefficient of Concavity

PLASTICITY CHART



General Notes

1. The boring locations were determined by pacing, sighting and/or measuring from site features. Locations are approximate. Elevations of borings (if included) were determined by interpolation between plan contours or from another source that will be identified in the report or on the project site plan. The location and elevation of borings should be considered accurate only to the degree implied by the method used.

2. The stratification lines represent the approximate boundary between soil types. The transition may be gradual.

3. Water level readings in the drill holes were recorded at time and under conditions stated on the boring logs. This data has been reviewed and interpretations have been made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, tides, temperature and other factors at the time measurements were made.

4. The boring logs and attached data should only be used in accordance with the report.

ATLAS

KEY TO EXPLORATORY BORING LOGS

BORING NUMBER B-1

CLIENT South San Francisco Unified School District
PROJECT NAME Westborough MS - Turf Field and Site Improvements
PROJECT NUMBER 91-67787-PW
PROJECT LOCATION 2570 Westborough Boulevard, South San Francisco, Ca
DATE STARTED 4/1/24 **COMPLETED** 4/1/24
GROUND ELEVATION 461 ft **HOLE SIZE** 4"
DRILLING CONTRACTOR California Geotechnical Services
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight
AT TIME OF DRILLING --- No Ground Water Encountered
LOGGED BY JL **CHECKED BY** MZ
AT END OF DRILLING --- No Ground Water Encountered
NOTES Elevations based on Google Earth (2022)
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	Penetration Rate (sec./ft.)	SPT BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0	(CL) **SANDY CLAY** : Dark brown, stiff, wet.										
		MC 1-1		2-3-5 (8)	3.0						
	(SM) **SILTY SAND** : Light brown, loose, wet.					83	29	34	26	8	
2.5											
		MC 1-2		2-3-5 (8)							
5.0	Becomes medium dense.										
		MC 1-3		7-8-9 (17)		101	13				46
7.5											
	Becomes dense.										
		MC 1-4		10-16-24 (40)							
10.0	Bottom of borehole at 10.0 feet.										

BORING NUMBER B-2

CLIENT South San Francisco Unified School District
PROJECT NAME Westborough MS - Turf Field and Site Improvements
PROJECT NUMBER 91-67787-PW
PROJECT LOCATION 2570 Westborough Boulevard, South San Francisco, Ca
DATE STARTED 4/1/24 **COMPLETED** 4/1/24
GROUND ELEVATION 461 ft **HOLE SIZE** 4"
DRILLING CONTRACTOR California Geotechnical Services
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight
AT TIME OF DRILLING --- No Ground Water Encountered
LOGGED BY JL **CHECKED BY** MZ
AT END OF DRILLING --- No Ground Water Encountered
NOTES Elevations based on Google Earth (2022)
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	Penetration Rate (sec./ft.)	SPT BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0	(SC) **FILL: CLAYEY SAND** : Brown, medium dense, wet										
	(CL) **SANDY CLAY** : Greyey brown, very stiff, moist.	MC 2-1		4-9-16 (25)							
2.5											
		MC 2-2		9-10-15 (25)		101	22				77
5.0	Becomes grey and hard.										
		MC 2-3		7-17-18 (35)							
	(SM) **SILTY SAND** : Light brown, medium dense, moist.										
7.5											
		MC 2-4		7-10-14 (24)							
10.0	Bottom of borehole at 10.0 feet.										

BORING NUMBER B-3

CLIENT South San Francisco Unified School District
PROJECT NAME Westborough MS - Turf Field and Site Improvements
PROJECT NUMBER 91-67787-PW
PROJECT LOCATION 2570 Westborough Boulevard, South San Francisco, Ca
DATE STARTED 4/1/24 **COMPLETED** 4/1/24
GROUND ELEVATION 460 ft **HOLE SIZE** 4"
DRILLING CONTRACTOR California Geotechnical Services
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight
AT TIME OF DRILLING --- No Ground Water Encountered
LOGGED BY JL **CHECKED BY** MZ
AT END OF DRILLING --- No Ground Water Encountered
NOTES Elevations based on Google Earth (2022)
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	Penetration Rate (sec./ft.)	SPT BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		(CL) **SANDY CLAY** : Dark brown, medium stiff, wet	MC 3-1		2-3-3 (6)							
2.5		Becomes grey and greyish brown, and very stiff.	MC 3-2		7-9-14 (23)		107	19	30	21	9	
5.0			MC 3-3		8-8-10 (18)							
7.5			SPT 3-4		4-7-12 (19)							
10.0												
12.5		Becomes hard.	SPT 3-5		10-14-19 (33)							
15.0												

Bottom of borehole at 15.0 feet.

BORING NUMBER B-4

CLIENT South San Francisco Unified School District
PROJECT NAME Westborough MS - Turf Field and Site Improvements
PROJECT NUMBER 91-67787-PW
PROJECT LOCATION 2570 Westborough Boulevard, South San Francisco, Ca
DATE STARTED 4/1/24 **COMPLETED** 4/1/24
GROUND ELEVATION 478 ft **HOLE SIZE** 4"
DRILLING CONTRACTOR California Geotechnical Services
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight
AT TIME OF DRILLING --- No Ground Water Encountered
LOGGED BY JL **CHECKED BY** MZ
AT END OF DRILLING --- No Ground Water Encountered
NOTES Elevations based on Google Earth (2022)
AFTER DRILLING ---

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	Penetration Rate (sec./ft.)	SPT BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0	**AC 1"** : **AB 4"** : (CL) **FILL: SANDY CLAY** : Brown, very stiff, wet	MC 4-1		6-7-10 (17)	>4.5	105	20				
2.5	(SC) **FILL: CLAYEY SAND** : Brown and yellow brown, medium dense, wet	MC 4-2		7-9-18 (27)							
5.0	(CL) **SANDY CLAY** : Brown and yellow brown, very stiff, wet	MC 4-3		5-8-12 (20)		99	23				84
7.5		MC 4-4		8-12-15 (27)							
10.0											
12.5											
15.0		SPT 4-5		6-6-10 (16)							

Bottom of borehole at 15.0 feet.

BORING NUMBER B-5

CLIENT South San Francisco Unified School District
PROJECT NAME Westborough MS - Turf Field and Site Improvements
PROJECT NUMBER 91-67787-PW
PROJECT LOCATION 2570 Westborough Boulevard, South San Francisco, Ca
DATE STARTED 4/1/24 **COMPLETED** 4/1/24
GROUND ELEVATION 480 ft **HOLE SIZE** 4"
DRILLING CONTRACTOR California Geotechnical Services
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight
AT TIME OF DRILLING --- No Ground Water Encountered
LOGGED BY JL **CHECKED BY** MZ
AT END OF DRILLING --- No Ground Water Encountered
NOTES Elevations based on Google Earth (2022)
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	Penetration Rate (sec./ft.)	SPT BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		**AC 2"** : **AB 6"** : (CL) **LEAN CLAY** : Brown, very stiff, moist, with sand.										
			MC 5-1		5-7-9 (16)							
2.5												
			MC 5-2		7-10-14 (24)		109	17				85
5.0												
			MC 5-3		7-8-14 (22)							
7.5												
			MC 5-4		6-10-15 (25)							
10.0		Becomes grey.										

Bottom of borehole at 10.0 feet.

BORING NUMBER B-6

CLIENT South San Francisco Unified School District
PROJECT NAME Westborough MS - Turf Field and Site Improvements
PROJECT NUMBER 91-67787-PW
PROJECT LOCATION 2570 Westborough Boulevard, South San Francisco, Ca
DATE STARTED 4/1/24 **COMPLETED** 4/1/24
GROUND ELEVATION 482 ft **HOLE SIZE** 4"
DRILLING CONTRACTOR California Geotechnical Services
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight
AT TIME OF DRILLING --- No Ground Water Encountered
LOGGED BY JL **CHECKED BY** MZ
AT END OF DRILLING --- No Ground Water Encountered
NOTES Elevations based on Google Earth (2022)
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	Penetration Rate (sec./ft.)	SPT BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		**AC 2"** : **AB 4"** : (CL) **SANDY CLAY** : Greyish brown, stiff, wet.										
			MC 6-1		3-6-7 (13)	2.0	97	20				
2.5		(SC) **CLAYEY SAND** : Grey, medium dense, wet										
			MC 6-2		6-7-10 (17)							
5.0		Bottom of borehole at 5.0 feet.										

BORING NUMBER B-7

CLIENT South San Francisco Unified School District
PROJECT NAME Westborough MS - Turf Field and Site Improvements
PROJECT NUMBER 91-67787-PW
PROJECT LOCATION 2570 Westborough Boulevard, South San Francisco, Ca
DATE STARTED 4/1/24 **COMPLETED** 4/1/24
GROUND ELEVATION 479 ft **HOLE SIZE** 4"
DRILLING CONTRACTOR California Geotechnical Services
GROUND WATER LEVELS:
DRILLING METHOD Solid Flight
AT TIME OF DRILLING --- No Ground Water Encountered
LOGGED BY JL **CHECKED BY** MZ
AT END OF DRILLING --- No Ground Water Encountered
NOTES Elevations based on Google Earth (2022)
AFTER DRILLING ---

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	Penetration Rate (sec./ft.)	SPT BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT	ATTERBERG LIMITS: PLASTIC LIMIT	ATTERBERG LIMITS: PLASTICITY INDEX	FINES CONTENT (%)
0.0		**AC 1.5"** : **AB 5"** : (SC) **CLAYEY SAND** : Brown, medium dense, moist.										
			MC		6-7-8 (15)							
2.5												
			MC		7-7-10 (17)		104	19				
5.0		Bottom of borehole at 5.0 feet.										

APPENDIX B

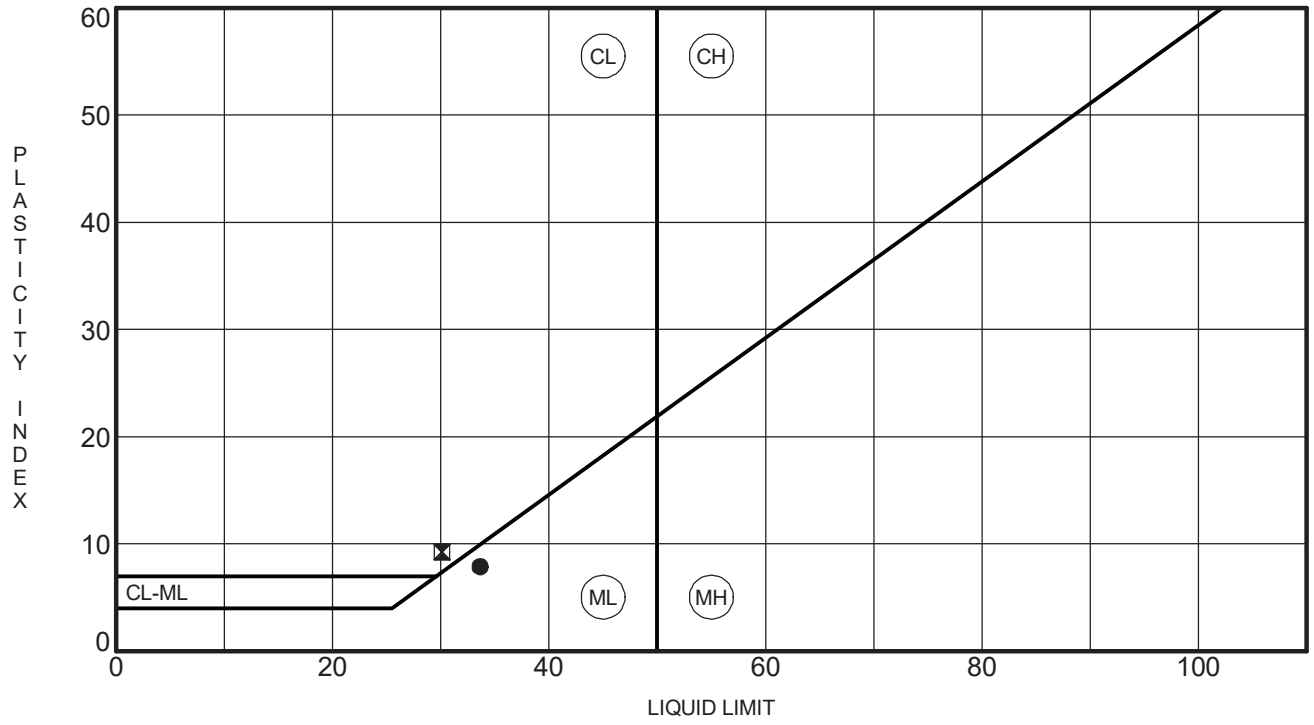
LABORATORY TEST RESULTS

Atterberg Limits Test Report
Particle Size Distribution
R-Value Test Report (2)

ATTERBERG LIMITS RESULTS

CLIENT South San Francisco Unified School District **PROJECT NAME** Westborough MS - Turf Field and Site Improvements

PROJECT NUMBER 91-67787-PW **PROJECT LOCATION** 2570 Westborough Boulevard, South San Francisco, Ca

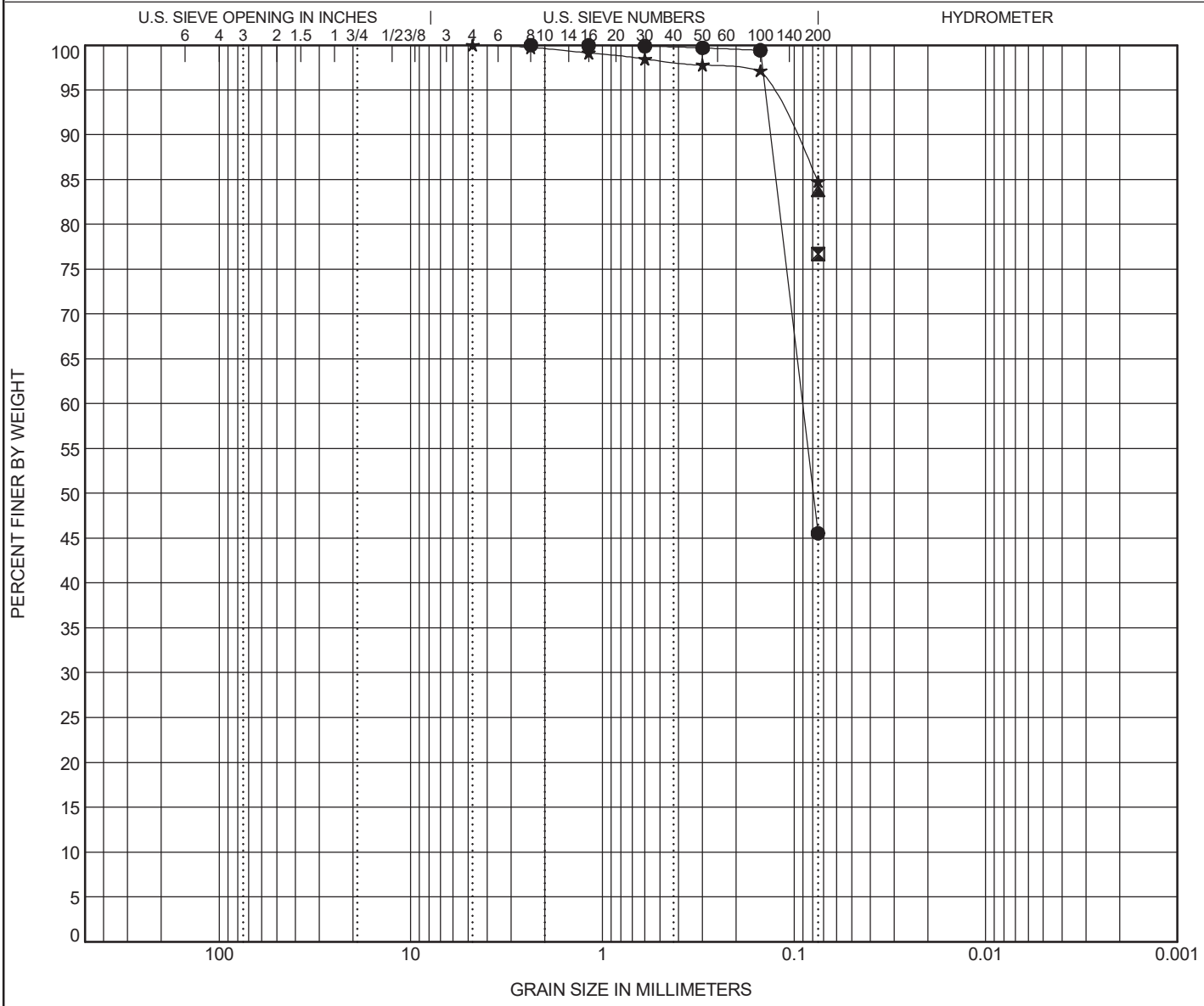


	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B-1**	**6.0**	**34**	**26**	**8**	**46**	**SILTY SAND (SM)**
⊠	**B-3**	**4.0**	**30**	**21**	**9**		**SANDY CLAY (CL)**

GRAIN SIZE DISTRIBUTION

CLIENT South San Francisco Unified School District **PROJECT NAME** Westborough MS - Turf Field and Site Improvements

PROJECT NUMBER 91-67787-PW **PROJECT LOCATION** 2570 Westborough Boulevard, South San Francisco, Ca

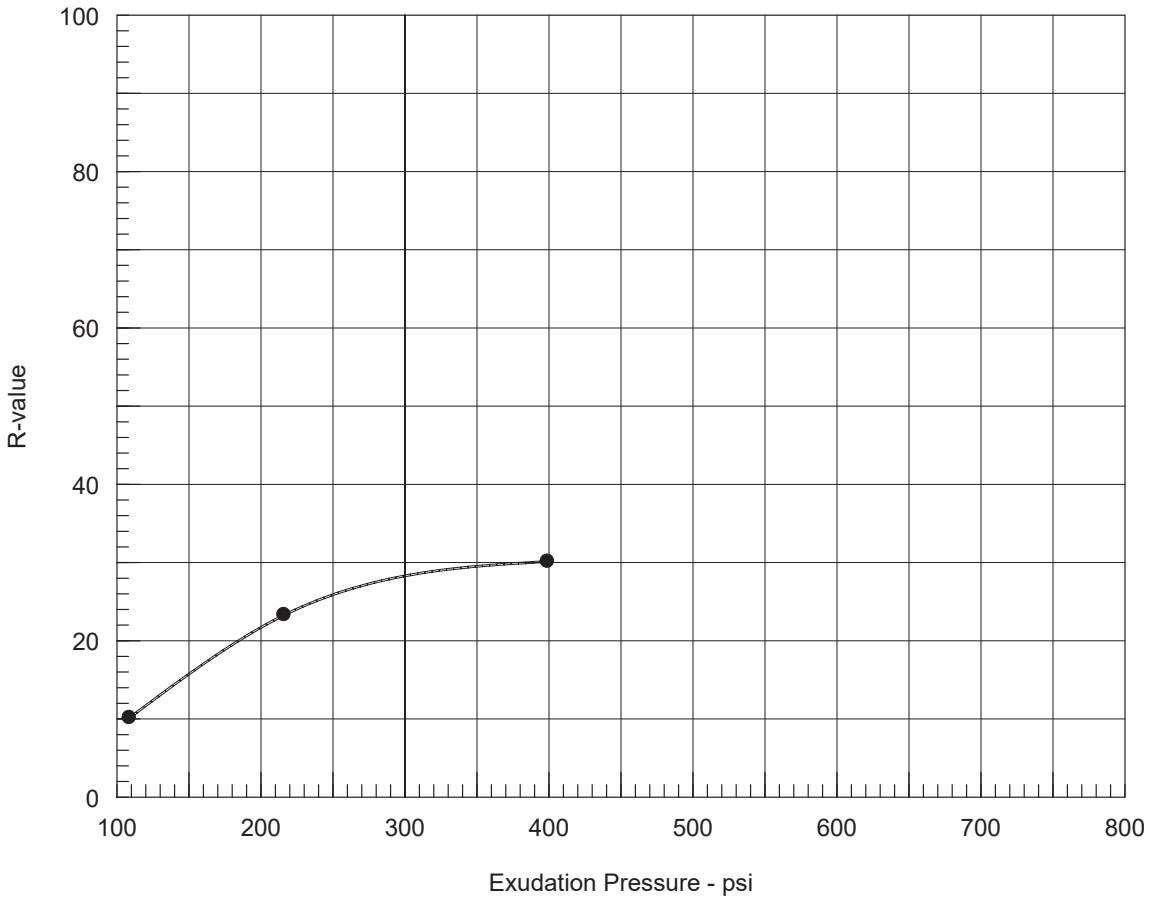


COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	LL	PL	PI	Cc	Cu
●	B-1	6.0	SILTY SAND (SM)	34	26	8		
⊠	B-2	4.0	SANDY CLAY (CL)					
▲	B-4	7.0	SANDY CLAY (CL)					
★	B-5	4.0	LEAN CLAY (CL)					

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	B-1	6.0	2.36	0.09			0.0	54.5	45.5	
⊠	B-2	4.0	0.075						76.7	
▲	B-4	7.0	0.075						83.7	
★	B-5	4.0	4.75				0.0	15.2	84.8	

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - ASTM D2844

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	70	120.5	7.0	0.21	94	2.36	216	26	23
2	50	117.1	7.6	0.27	127	2.37	109	11	10
3	88	119.7	8.9	0.45	82	2.35	399	33	30

Test Results	Material Description
R-value at 300 psi exudation pressure = 28	Yellowish Brown Sandy Clay Sampled by J.Li on 04/01/2024

Project No.: 9167787PW

Project: SSFUSD Westbrough MS-Turf Field & Site Improvement

Location: Onsite/B-4

Sample Number: 10S240426-3

Date: 4/26/2024

Tested by: AL

Checked by: YH

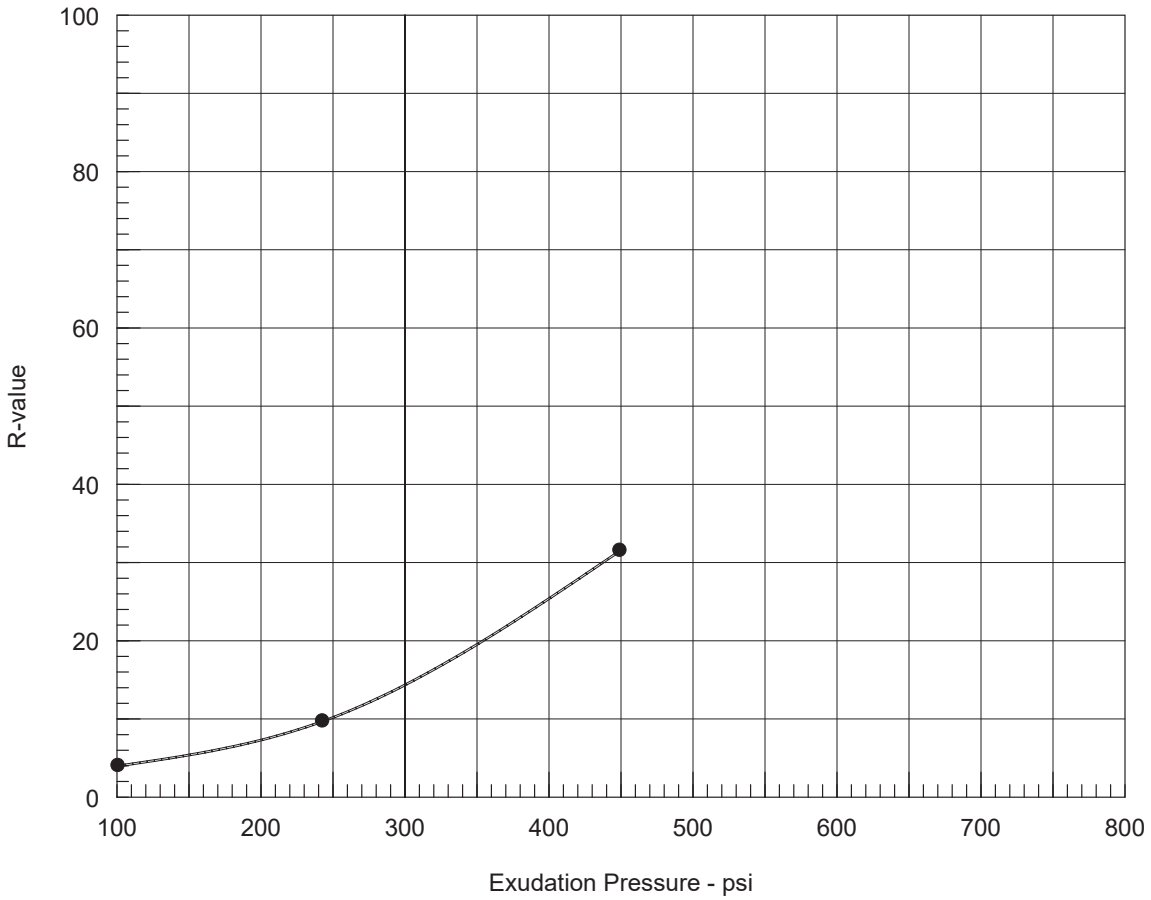
Remarks:

R-VALUE TEST REPORT

CONSOLIDATED ENGINEERING LABORATORIES

Figure 10S240426-3

R-VALUE TEST REPORT



Resistance R-Value and Expansion Pressure - ASTM D2844

No.	Compact. Pressure psi	Density pcf	Moist. %	Expansion Pressure psi	Horizontal Press. psi @ 160 psi	Sample Height in.	Exud. Pressure psi	R Value	R Value Corr.
1	70	119.2	6.7	0.06	145	2.34	101	4	4
2	80	120.1	7.8	0.09	134	2.55	243	10	10
3	90	118.0	9.5	0.33	85	2.40	450	34	32

Test Results	Material Description
R-value at 300 psi exudation pressure = 14	Dark Brown Sandy Clay Sampled by J.Li on 04/01/2024

Project No.: 9167787PW

Project: SSFUSD Westbrough MS-Turf Field & Site Improvement

Location: Onsite/B-6 & B-7

Sample Number: 10S240426-2

Date: 4/26/2024

Tested by: AL

Checked by: YH

Remarks:

R-VALUE TEST REPORT

CONSOLIDATED ENGINEERING LABORATORIES

Figure 10S240426-2