APPENDIX E.1

Geotechnical Report

GEOTECHNICAL INVESTIGATION

FAIRMOUNT AVENUE FIRE STATION

47th Street &
Fairmount Avenue
San Diego, California

Prepared By:
SCST, LLC
6280 Riverdale Street
San Diego, California 92120

Prepared For:
Michael Scott
RRM Design Group
3765 S. Higuera Suite 102
San Luis Obispo, CA 93401

Providing Professional Engineering Services Since 1959

SCST
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GEOTECHNICAL INVESTIGATION

March 15, 2019

SCST No. 170446P4.1
Report No. 1

Michael Scott
RRM Design Group
3765 S. Higuera Suite 102
San Luis Obispo, CA 93401

Subject: GEOTECHNICAL INVESTIGATION
FAIRMOUNT AVENUE FIRE STATION
47TH STREET AND FAIRMOUNT AVENUE
SAN DIEGO, CALIFORNIA

Dear Mr. Scott:

SCST, LLC (SCST) is pleased to present our report describing the geotechnical investigation performed for the construction of the new Fairmount Avenue Fire Station project. Based on the results of our investigation, we consider the planned construction feasible from a geotechnical standpoint provided the recommendations of this report are followed. If you have questions, please call us at (619) 280-4321.

Respectfully submitted,
SCST, LLC

DANIEL J. RICHARDSON
C 89379
Exp. 12/31/20
CIVIL

JONATHAN C. GOODMACHER
Exp 10/2019
No. 2136
CERTIFIED ENGINEERING GEOLOGIST

Daniel J. Richardson, PE C89379
Project Engineer

Jonathan Goodmacher PG, CEG, CHG 2136
Principal Geologist

GILLIAN L. CARZZARELLA
No. C87787

Gillian Carzzarella

Gillian Carzzarella, PE C87787
Project Engineer

GC:DR:JG:ER:hu

(1) Addressee via email at MLScott@rrmdesign.com

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EXECUTIVE SUMMARY

This report presents the results of the geotechnical and fault trench rupture hazard investigation SCST, LLC (SCST) performed for the subject project. We understand that the project will consist of the construction of the new Fairmount Avenue Fire Station at the site. The planned construction will consist of a three-story building, retaining walls, and pavements for site access, drop-off, and parking. The purpose of our work is to provide conclusions and recommendations regarding the geotechnical aspects of the project and to assess the site for the potential presence of an active fault capable of surface rupture.

We explored the subsurface conditions by excavating five test pits to depths between about 6 and 12½ feet below the existing ground surface. An approximately 100-foot-long fault trench was also excavated across the site to a depth of 8 feet. The test pits and trenches were dug using a track-mounted excavator. An SCST engineer and geologist logged the test pits and fault trench and collected samples of the materials encountered for geotechnical laboratory testing. SCST tested select samples from the test pits and fault trench to evaluate pertinent soil classification and engineering properties and to assist in developing geotechnical conclusions and recommendations.

The materials encountered in the test pits and fault trench consisted of fill, alluvium, and San Diego Formation. The fill and alluvium extended to depths up to about 12½ feet below the existing ground surface. They consisted of a mix of sand, silt, and gravel with organics and are considered unacceptable in their current condition for support of structures or structural fill. The San Diego Formation consists of weakly to strongly cemented, silty sandstone and is considered acceptable for support of structures or structural fill. Groundwater was not encountered in the test pits.

The main geotechnical considerations affecting the planned development are the presence of potentially compressible material (fill and alluvium) and transitions between cut and fill areas. To reduce the potential for settlement, the existing fill and alluvium should be excavated below the planned structures, settlement sensitive improvements and new fill. Additionally, the planned buildings should not be underlain by cut/fill transitions or transitions from shallow fill to deep fill. Building footings and concrete slabs should be underlain by at least 2 feet of material with an expansion index of 20 or less. The planned buildings can be supported on shallow spread footings with bottom levels on compacted fill. The grading and foundation recommendations presented herein may need to be updated once final plans are developed.

1. INTRODUCTION

This report presents the results of the geotechnical and fault rupture hazard investigation SCST, LLC (SCST) performed for the subject project. We understand that the project will consist of the construction of the new Fairmount Avenue Fire Station at the site. The planned construction will consist of a three-story building, retaining walls, and pavements for site access, drop-off, and parking. The purpose of our work is to provide conclusions and recommendations regarding the geotechnical aspects of the project. Figure 1 is a site vicinity map.

2. SCOPE OF WORK

2.1 FIELD INVESTIGATIONS

Our field investigation was limited by environmental constraints. We explored the subsurface conditions by excavating five test pits to depths between about 6 and 12½ feet below the existing ground surface. An approximately 100-foot-long fault trench was also excavated across the site to a depth of 8 feet. The test pits and trenches were dug out using a track-mounted excavator. An SCST engineer and geologist logged the test pits and fault trench and collected samples of the materials encountered for geotechnical laboratory testing. SCST tested select samples from the test pits and fault trench to evaluate pertinent soil classification and engineering properties and to assist in developing geotechnical conclusions and recommendations. Figure 2 shows the approximate locations of explorations. Logs of the explorations are presented in Appendix I. Soils are classified according to the Unified Soil Classification System illustrated on Figure I-1.

2.2 GEOTECHNICAL LABORATORY TESTING

Selected samples obtained from the test pits and the fault trench were tested to evaluate pertinent soil classification and engineering properties and enable development of geotechnical conclusions and recommendations. The laboratory tests consisted of particle-size distribution, sand equivalent, maximum density, expansion index, corrosivity, direct shear, and organic matter. The results of the laboratory tests and brief explanations of the test procedures are presented in Appendix II.

The results of the field and laboratory tests were evaluated to develop conclusions and recommendations regarding:

- Subsurface conditions beneath the site
- Potential geologic hazards
- Criteria for seismic design in accordance with the 2016 California Building Code (CBC)
- Site preparation and grading

- Appropriate alternatives for foundation support along with geotechnical engineering criteria for design of the foundations
- Estimated foundation settlements
- Support for concrete slabs-on-grade
- Lateral pressures for the design of retaining walls
- Pavement sections
- Soil corrosivity

3. SITE DESCRIPTION

The site is located north of the intersection of Fairmount Avenue and 47th Street in San Diego, California. Chollas Creek is approximately 400 feet north of the proposed development. Currently, the site consists of vacant land covered in vegetation. Outcrops of the San Diego Formation are exposed at the eastern portion of the site, adjacent to 47th Street.

The southern portion of the site generally slopes downward towards the north and west. Site elevations range from about 150 feet at the northern portion of the site to about 200 feet at the southeastern portion of the site.

4. GEOLOGY AND SUBSURFACE CONDITIONS

The site is located within the Peninsular Ranges Geomorphic Province of California, which stretches from the Los Angeles basin to the tip of Baja California. This province is characterized as a series of northwest-trending mountain ranges separated by subparallel fault zones and a coastal plain of subdued landforms. The mountain ranges are underlain primarily by Mesozoic metamorphic rocks that were intruded by plutonic rocks of the southern California batholith, while the coastal plain is underlain by subsequently deposited marine and non-marine sedimentary formations.

The site is located in the coastal plain portion of the province and, per published mapping, is underlain by the Plio-Pleistocene-age San Diego Formation (Kennedy and Tan, 2008). However, based on our explorations, site soils consist of fill, alluvium, and Plio-Pleistocene-age San Diego Formation. Figure 3 presents a geologic cross section. Figure 4 presents the regional geology.

For purposes of this report, the fill and alluvium are described together and are shown undifferentiated on the logs. The fill and alluvium extended to depths up to about 12 feet below the existing ground surface. They consisted of a mix of sand, silt, and gravel with organics. The San Diego Formation consisted of weakly to strongly cemented, silty sandstone.

Groundwater was not encountered in our explorations; however, water seepage was encountered in TP-1 at a depth of about 5½ feet. The groundwater table is expected to be below a depth that will influence planned construction. However, groundwater levels may fluctuate in the future due to rainfall, irrigation, broken pipes, or changes in site drainage. Because groundwater rise or seepage is difficult to predict, such conditions are typically mitigated if and when they occur.

5. GEOLOGIC HAZARDS

5.1 CITY OF SAN DIEGO SEISMIC SAFETY MAP

Figure 5 shows the site location on the City of San Diego Seismic Safety Study map (2008). The site is located within or adjacent to areas designated by the city as having Geologic Hazard Categories 12, 32, and 52. Geologic Hazard Category 12 is defined as faults that are potentially active, presumed inactive, or activity unknown. Category 32 is defined as areas with a low liquefaction potential with fluctuating groundwater and minor drainages. Geologic Hazard Category 52 is defined as level or sloping areas with favorable geologic structure and low risk.

5.2 FAULTING AND SURFACE RUPTURE

Figure 6 shows the site in relation to known active faults in the region. The closest known active fault is the Newport-Inglewood Rose Canyon (Offshore) fault zone located about 3.9 miles (5.0 kilometers) west of the site. The site is not located in an Alquist-Priolo Earthquake Fault Zone. No active faults are known to underlie or project toward the site.

5.3 CBC SEISMIC DESIGN PARAMETERS

A geologic hazard likely to affect the project is ground shaking as a result of movement along an active fault zone in the vicinity of the subject site. A web-based application was used to develop the seismic design parameters (SEAOC/OSHPOD, 2019). The site coefficients and adjusted maximum considered earthquake spectral response accelerations in accordance with the 2016 CBC are presented below:

Site Coordinates: Latitude 32.72472°
Longitude -117.09388°
Site Class: D
Site Coefficients, $F_a = 1.110$
$F_v = 1.640$
Mapped Spectral Response Acceleration at Short Period, $S_s = 0.999$g
Mapped Spectral Response Acceleration at 1-Second Period, $S_1 = 0.380$g

Design Spectral Acceleration at Short Period, S_{DS} = 0.733g
Design Spectral Acceleration at 1-Second Period, S_{D1} = 0.415g
Site Peak Ground Acceleration, PGA_M = 0.452g

5.4 LANDSLIDES AND SLOPE STABILITY

Evidence of landslides or slope instabilities was not observed or shown on the referenced geologic map.

5.5 LIQUEFACTION AND DYNAMIC SETTLEMENT

Liquefaction occurs when loose, saturated, generally fine sands and silts are subjected to strong ground shaking. The soils lose shear strength and become liquid; potentially resulting in large total and differential ground surface settlements as well as possible lateral spreading during an earthquake. Provided the remedial grading recommendations of this report are followed, and given the relatively dense formational materials underlying the site and the lack of shallow groundwater, the potential for liquefaction and dynamic settlement to occur is considered low.

5.6 TSUNAMIS, SEICHES, AND FLOODING

The site is not located within a mapped area on the State of California Tsunami Inundation Maps (CalEMA, 2009); therefore, damage due to tsunamis is considered negligible. Seiches are periodic oscillations in large bodies of water such as lakes, harbors, bays, or reservoirs. The site is not located adjacent to lakes or confined bodies of water; therefore, the potential for a seiche to affect the site is low.

We reviewed the Flood Insurance Rate Maps via the Federal Emergency Management Agency (FEMA) Flood Hazard Map online database to determine if the subject site location is located within an area susceptible to flooding. A portion of the project site is mapped as being within a special flood hazard area designated as a Zone AE. Zone AE designates a regulatory floodway area. The mapped base flood elevation (BFE) of the site is approximately 138 feet MSL.

5.7 HYDRO-CONSOLIDATION

Hydro-consolidation can occur in recently deposited (less than 10,000 years old) sediments that were deposited in a semi-arid environment. Examples of such sediments are aeolian sands, alluvial fan deposits, and mudflow sediments deposited during flash floods. The pore space between particle grains can re-adjust when inundated by groundwater causing the material to consolidate. The alluvium at the project site is highly susceptible to hydro-consolidation. However, the recommendations within this report mitigate this geologic hazard. The relatively dense formational materials underlying the site are not susceptible to hydro-consolidation.

6. CONCLUSIONS

The main geotechnical considerations affecting the proposed development are the presence of potentially compressible soils (fill and alluvium) and cut/fill transitions. Remedial grading will need to be performed to reduce the potential for adverse settlement and distress to the planned structures and improvements. Remedial grading recommendations are provided below. The planned buildings can be supported on shallow spread footings with bottom levels on compacted fill.

7. RECOMMENDATIONS

7.1 SITE PREPARATION AND GRADING

7.1.1 Site Preparation

Site preparation should begin with the removal of existing improvements, topsoil, vegetation, and debris. Subsurface improvements that are to be abandoned should be removed, and the resulting excavations should be backfilled and compacted in accordance with the recommendations of this report. Pipeline abandonment can consist of capping or rerouting at the project perimeter and removal within the project perimeter. If appropriate, abandoned pipelines can be filled with grout or slurry as recommended by and observed by the geotechnical consultant.

7.1.2 Compressible Soils

The existing fill and alluvium should be excavated beneath the planned structures, settlement-sensitive improvements, and new fills. Based on the initial site plan for improvements indicating finished pad elevations, excavations up to 25 feet deep are anticipated. Horizontally, the excavations should extend at least 10 feet outside the planned perimeter foundations, at least 2 feet outside the planned hardscape and pavements, or up to existing improvements, whichever is less. An SCST representative should observe conditions exposed in the bottom of excavations to determine if additional removals are required.

7.1.3 Cut/Fill Transitions

The planned buildings should not be underlain by cut/fill transitions or transitions from shallow fill to deep fill. Where such transitions are encountered, the San Diego

Formation should be over-excavated and replaced with compacted fill to provide a relatively uniform thickness of compacted fill beneath the building and reduce the potential for differential settlement. The over-excavation depth should be at least 3 feet below the planned finished pad elevation, at least 2 feet below the deepest planned footing bottom elevation, or to a depth of H/2, whichever is deeper, where H is the greatest depth of fill beneath the structure. Horizontally, the over-excavation should extend at least 10 feet outside the planned footing perimeter or up to existing improvements, whichever is less. Where practical, the bottom of excavations should be sloped toward the fill portion of the site and away from its center. An SCST representative should observe the conditions exposed in the bottom of excavations to evaluate if additional excavation is recommended.

7.1.4 Compacted Fill

Material with an expansion index of 20 or less determined in accordance with ASTM D4829 should be placed and compacted from 2 feet below the deepest planned footing bottom level to finished pad grade elevation. Concrete slabs should be underlain by at least 2 feet of material with an expansion index of 20 or less. Based on the limited geotechnical laboratory testing performed, we expect that the on-site materials may meet the expansion index criteria. Fill should be moisture conditioned to near optimum moisture content and compacted to at least 90% relative compaction. Fill should be placed in horizontal lifts at a thickness appropriate for the equipment spreading, mixing, and compacting the material, but generally should not exceed 8 inches in loose thickness. The maximum dry density and optimum moisture content for evaluating relative compaction should be determined in accordance with ASTM D 1557. Utility trench backfill beneath structures, pavements, and hardscape should be compacted to at least 90% relative compaction. The top 12 inches of subgrade beneath pavements should be compacted to at least 95%.

7.1.5 Imported Soil

Imported soil should consist of predominately granular soil free of organic matter and rocks greater than 6 inches. Imported soil should have an expansion index of 20 or less and should be inspected and, if appropriate, tested by SCST prior to transport to the site.

7.1.6 Excavation Characteristics

It is anticipated that excavations can be achieved with conventional earthwork equipment in good working order. However, difficult excavation should be anticipated within the alluvium due to the presence of cobbles and boulders, as well as in the cemented San Diego Formation. Caving was encountered during our explorations and should be expected. Contract documents should specify that the contractor mobilize equipment capable of excavating and compacting oversized and strongly cemented materials.

7.1.7 Temporary Excavations

Temporary excavations 3 feet deep or less can be made vertically. Deeper temporary excavations in fill or alluvium should be laid back no steeper than 1:1 (horizontal:vertical) and in formational material no steeper than ¾:1 (horizontal:vertical). The faces of temporary slopes should be inspected daily by the contractor's Competent Person before personnel are allowed to enter the excavation. Zones of potential instability, sloughing, or raveling should be brought to the attention of the Engineer and corrective action implemented before personnel begin working in the excavation. Excavated soils should not be stockpiled behind temporary excavations within a distance equal to the depth of the excavation. SCST should be notified if other surcharge loads are anticipated so that lateral load criteria can be developed for the specific situation. If temporary slopes are to be maintained during the rainy season, berms are recommended along the tops of slopes to prevent runoff water from entering the excavation and eroding the slope faces. Slopes steeper than those described above will require shoring. Additionally, temporary excavations that extend below a plane inclined at 1½:1 (horizontal:vertical) downward from the outside bottom edge of existing structures or improvements will require shoring. A shoring system consisting of soldier piles and lagging can be used.

7.1.8 Temporary Shoring

For design of cantilevered shoring, an active soil pressure equal to a fluid weighing 40 pcf can be used for level retained ground or 65 pcf for 2:1 (horizontal:vertical) sloping ground. The surcharge loads on shoring from traffic and construction equipment adjacent to the excavation can be modeled by assuming an additional 2 feet of soil behind the shoring. For design of soldier piles, an allowable passive pressure of 350 psf per foot of embedment over twice the pile diameter up to a maximum of 5,000 psf can be used. Soldier piles should be spaced at least three pile diameters, center to center. Continuous lagging will be required throughout. The soldier piles should be designed for the full anticipated lateral pressure; however, the pressure on the lagging will be less due to arching in the soils. For design of lagging, the earth pressure can be limited to a maximum value of 400 psf.

7.1.9 Temporary Dewatering

Groundwater seepage was found in TP-1 at about 5½ feet and may occur locally due to broken pipes, local irrigation, or following heavy rain. Groundwater should be anticipated in the planned excavations.

7.1.10 Oversized Material

Excavations may generate oversized material. Oversized material is defined as rocks or cemented clasts greater than 6 inches in largest dimension. Oversized material should be broken down to no greater than 6 inches in largest dimension for use in fill, used as landscape material, or disposed offsite.

7.1.11 Slopes

Permanent slopes should be constructed no steeper than 2:1 (horizontal:vertical). Faces of fill slopes should be compacted either by rolling with a sheepsfoot roller or other suitable equipment or by overfilling and cutting back to design grade. Fills should be benched into sloping ground inclined steeper than 5:1 (horizontal:vertical). It is our opinion that cut slopes constructed no steeper than 2:1 (horizontal:vertical) will possess an adequate factor of safety against instability. An engineering geologist should observe cut slopes during grading to ascertain that no unforeseen adverse geologic conditions are encountered that need revised recommendations. Slopes are susceptible to surficial slope failure and erosion. Water should not be allowed to flow over the top of slope. Additionally, slopes should be planted with vegetation that will reduce the potential for erosion.

7.1.12 Surface Drainage

Final surface grades around structures should be designed to collect and direct surface water away from the structure and toward appropriate drainage facilities. The ground around the structure should be graded so that surface water flows rapidly away from the structure without ponding. In general, we recommend that the ground adjacent to the structure slope away at a gradient of at least 2%. Densely vegetated areas where runoff can be impaired should have a minimum gradient of at least 5% within the first 5 feet from the structure. Roof gutters with downspouts that discharge directly into a closed drainage system are recommended on structures. Drainage patterns established at the time of fine grading should be maintained throughout the life of the proposed structures. Site irrigation should be limited to the minimum necessary to sustain landscape growth.

Should excessive irrigation, impaired drainage, or unusually high rainfall occur, saturated zones of perched groundwater can develop.

7.1.13 Grading Plan Review

SCST should review the grading plans and earthwork specifications to ascertain whether the intent of the recommendations contained in this report have been implemented and that no revised recommendations are needed due to changes in the development scheme.

7.2 FOUNDATIONS

7.2.1 Shallow Spread Footings

The planned buildings can be supported on shallow spread footings with bottom levels on compacted fill. Footings should extend at least 18 inches below lowest adjacent finished grade. Continuous footings should be at least 12 inches wide. Isolated or retaining wall footings should be at least 24 inches wide. An allowable bearing capacity of 2,500 psf can be used. The bearing capacity can be increased by 500 psf for each foot of depth below the minimum and 250 psf for each foot of width beyond the minimum up to a maximum of 5,000 psf. The bearing value can be increased by ⅓ when considering the total of all loads, including wind or seismic forces. Footings located adjacent to or within slopes should be extended to a depth such that a minimum horizontal distance of 7 feet exists between the lower outside footing edge and the face of the slope.

Lateral loads will be resisted by friction between the bottoms of footings and passive pressure on the faces of footings and other structural elements below grade. An allowable coefficient of friction of 0.35 can be used. Passive pressure can be computed using an allowable lateral pressure of 350 psf per foot of depth below the ground surface for level ground conditions. Reductions for sloping ground should be made. The passive pressure can be increased by ⅓ when considering the total of all loads, including wind or seismic forces. The upper 1 foot of soil should not be relied on for passive support unless the ground is covered with pavements or slabs.

7.2.2 Settlement Characteristics

Total foundation settlements are estimated to be less than 1 inch. Differential settlements between adjacent columns and across continuous footings are estimated to be less than ¾ inch over a distance of 40 feet. Settlements should be completed shortly after structural loads are applied.

7.2.3 Foundation Plan Review

SCST should review the foundation plans to ascertain that the intent of the recommendations in this report has been implemented and that revised recommendations are not necessary as a result of changes after this report was completed.

7.2.4 Foundation Excavation Observations

A representative from SCST should observe the foundation excavations prior to forming or placing reinforcing steel.

7.3 SLABS-ON-GRADE

7.3.1 Interior Slabs-on-Grade

The project structural engineer should design the interior concrete slabs-on-grade floor. However, we recommend that building slabs be at least five inches thick and reinforced with at least No. 4 bars at 18 inches on center each way.

Special consideration should be given to interior slabs on grade which will be used for fire truck parking and/or heavy equipment storage. We recommend that these slabs be at least 7½ inches thick. Reinforcement details shall be designed by the project structural or civil engineer.

Moisture protection should be installed beneath slabs where moisture sensitive floor coverings will be used. The project architect should review the tolerable moisture transmission rate of the proposed floor covering and specify an appropriate moisture protection system. Typically, a plastic vapor barrier is used. Minimum 10-mil plastic is recommended. The plastic should comply with ASTM E1745. The vapor barrier installation should comply with ASTM E1643. Construction practice often includes placement of a 2-inch-thick sand cushion between the bottom of the concrete slab and the moisture vapor retarder/barrier. This cushion can provide some protection to the vapor retarder/barrier during construction and may assist in reducing the potential for edge curling in the slab during curing. However, the sand layer also provides a source of moisture to the underside of the slab that can increase the time required to reduce vapor emissions to limits acceptable for the type of floor covering placed on top of the slab. The slab can be placed directly on the vapor retarder/barrier.

7.3.2 Exterior Slabs-on-Grade

Exterior slabs should be at least 4 inches thick and reinforced with at least No. 3 bars at 18 inches on center each way. Slabs should be provided with weakened plane joints. Joints should be placed in accordance with the American Concrete Institute (ACI) guidelines. The project architect should select the final joint patterns. A 1-inch maximum size aggregate mix is recommended for concrete for exterior slabs. The corrosion potential of on-site soils with respect to reinforced concrete will need to be taken into account in concrete mix design. Coarse and fine aggregate in concrete should conform to the “Greenbook” Standard Specifications for Public Works Construction.

7.4 CONVENTIONAL RETAINING WALLS

7.4.1 Foundations

The recommendations provided in the foundation section of this report are also applicable to conventional retaining walls.

7.4.2 Lateral Earth Pressures

The active earth pressure for the design of unrestrained retaining walls with level backfill can be taken as equivalent to the pressure of a fluid weighing 40 pcf. The at-rest earth pressure for the design of restrained retaining walls with level backfills can be taken as equivalent to the pressure of a fluid weighing 60 pcf. These values assume a granular and drained backfill condition. Higher lateral earth pressures would apply if walls retain expansive clay soils. An additional 20 pcf should be added to these values for walls with a 2:1 (horizontal:vertical) sloping backfill. An increase in earth pressure equivalent to an additional 2 feet of retained soil can be used to account for surcharge loads from light traffic. The above values do not include a factor of safety. Appropriate factors of safety should be incorporated into the design. If other surcharge loads are anticipated, SCST should be contacted for the necessary increase in soil pressure.

Retaining walls should be designed to resist hydrostatic pressures or be provided with a backdrain to reduce the accumulation of hydrostatic pressures. Backdrains may consist of a 2-foot-wide zone of ¾-inch crushed rock. The backdrain should be separated from the adjacent soils using a non-woven filter fabric, such as Mirafi 140N or equivalent. Weep holes should be provided, or a perforated pipe should be installed at the base of the backdrain and sloped to discharge to a suitable storm drain facility. As an alternative, a geocomposite drainage system such as Miradrain 6000 or equivalent placed behind the wall and connected to a suitable storm drain facility can be used. The project architect should provide waterproofing specifications and details. Figure 7 presents typical conventional retaining wall backdrain details.

7.4.3 Seismic Earth Pressure

If required, the seismic earth pressure can be taken as equivalent to the pressure of a fluid weighing 18 pcf. This value is for level backfill and does not include a factor of safety. Appropriate factors of safety should be incorporated into the design. This pressure is in addition to the un-factored, static active earth pressure. The passive pressure and bearing capacity can be increased by ⅓ in determining the seismic stability of the wall.

7.4.4 Backfill

Wall backfill should consist of granular, free-draining material. Expansive or clayey soil should not be used. Additionally, backfill within 3 feet from the back of the wall should not contain rocks greater than 3 inches in dimension. We anticipate that a portion of the on-site soils will be suitable for wall backfill. Backfill should be compacted to at least 90% relative compaction. Backfill should not be placed until walls have achieved adequate structural strength. Compaction of wall backfill will be necessary to minimize settlement of the backfill and overlying settlement sensitive improvements. However, some settlement should still be anticipated. Provisions should be made for some settlement of concrete slabs and pavements supported on backfill. Additionally, utilities supported on backfill should be designed to tolerate differential settlement.

7.5 MECHANICALLY STABILIZED EARTH RETAINING WALLS

The following soil parameters can be used for design of mechanically stabilized earth (MSE) retaining walls.

MSE Wall Design Parameters

Soil Parameter	Reinforced Soil	Retained Soil	Foundation Soil
Internal Friction Angle	30°	30°	30°
Cohesion	0	0	0
Moist Unit Weight	120 pcf	120 pcf	120 pcf

The reinforced soil should consist of granular, free-draining material with a sand equivalent of 20 or more. The bottom of MSE walls should extend to such a depth that a total of 5 feet exists between the bottom of the wall and the face of the slope. Figure 7 presents a typical retaining wall backdrain detail. MSE retaining walls may experience lateral movement over time. The wall engineer should review the configuration of proposed improvements adjacent to the wall and provide measures to help reduce the potential for distress to these improvements from lateral movement.

7.6 PIPELINES

7.6.1 Thrust Blocks

For level ground conditions, a passive earth pressure of 350 psf per foot of depth below the lowest adjacent final grade can be used to compute allowable thrust block resistance. A value of 150 psf per foot should be used below groundwater level, if encountered.

7.6.2 Modulus of Soil Reaction

A modulus of soil reaction (E') of 1,400 psi can be used to evaluate the deflection of buried flexible pipelines. This value assumes that granular bedding material is placed adjacent to the pipe and is compacted to at least 90% relative compaction.

7.6.3 Pipe Bedding

Pipe bedding as specified in the “Greenbook” Standard Specifications for Public Works Construction can be used. Bedding material should consist of clean sand having a sand equivalent not less than 30 and should extend to at least 12 inches above the top of pipe. Alternative materials meeting the intent of the bedding specifications are also acceptable. Samples of materials proposed for use as bedding should be provided to the engineer for inspection and testing before the material is imported for use on the project. The on-site materials are not expected to meet “Greenbook” bedding specifications. The pipe bedding material should be placed over the full width of the trench. After placement of the pipe, the bedding should be brought up uniformly on both sides of the pipe to reduce the potential for unbalanced loads. No voids or uncompacted areas should be left beneath the pipe haunches. Ponding or jetting the pipe bedding should not be allowed.

7.6.4 Cutoff Walls

Where pipeline inclinations exceed 15 percent, cutoff walls may be necessary in trench excavations. Additionally, we do not recommend that open graded rock be used for pipe bedding or backfill because of the potential for piping erosion. The recommended bedding is clean sand having a sand equivalent not less than 30. Alternatively, 2-sack sand-cement slurry can be used for the pipe bedding. If sand-cement slurry is used for pipe bedding to at least 1 foot over the top of the pipe, cutoff walls are not considered necessary. The need for cutoff walls should be further evaluated by the project civil engineer designing the pipeline.

7.6.5 Backfill

Excavated material free of organic debris and rocks greater than 6 inches in dimension are generally expected to be suitable for use as pipe backfill. Imported material should not contain rocks greater than 4 inches in dimension or organic debris. Imported material should have an expansion index of 20 or less. SCST should observe and, if appropriate, test proposed imported materials before they are delivered to the site. Backfill should be placed in lifts 8 inches or less in loose thickness, moisture conditioned to optimum moisture content or slightly above, and compacted to at least 90% relative compaction. The top 12 inches of soil beneath pavement subgrade should be compacted to at least 95% relative compaction.

7.7 PAVEMENT SECTION RECOMMENDATIONS

Due to anticipated grading and importing of materials at the project site, on-site soils were not evaluated for pavement support characteristics. An R-value of 30 was assumed for design of preliminary pavement sections. The actual R-value of the subgrade soils should be determined after grading and final pavement sections are provided. Based on an R-value of 30, the following pavement structural sections are recommended for the assumed Traffic Indices.

Flexible Pavement Sections

Traffic Type	Traffic Index	Asphalt Concrete (inches)	Aggregate Base (inches)
Parking Stalls	4.5	3	5
Drive Lanes	6.0	4	7
Fire Lanes	7.0	5	8

Portland Cement Concrete Pavement Sections

Traffic Type	Traffic Index	Full-Depth PCC Pavement (inches)
Parking Stalls	4.5	6
Drive Lanes	6.0	7½
Fire Lanes	7.0	7½

The top 12 inches of subgrade should be scarified, moisture conditioned to near optimum moisture content, and compacted to at least 95% relative compaction. All soft or yielding areas should be removed and replaced with compacted fill or aggregate base. Aggregate base and asphalt concrete should conform to the Caltrans Standard Specifications or the "Greenbook" and should be compacted to at least 95% relative compaction. Aggregate base should have an R-value of not less than 78. All materials and methods of construction should conform to good engineering practices.

7.8 PERVIOUS PAVEMENT SECTION RECOMMENDATIONS

Pervious pavement section recommendations are based on Caltrans (2014) pavement structural design guidelines. The pavement sections below are based on the strength of the materials. However, the actual thickness of the sections may be controlled by the reservoir layer design, which the project civil engineer should determine.

Due to anticipated grading and importing of materials at the project site, on-site soils were not evaluated for pavement support characteristics. An R-value of 30 was assumed for design of preliminary pavement sections. The actual R-value of the subgrade soils should be determined after grading and final pavement sections are provided.

Pervious Asphalt Pavement

Traffic Type	Category	*Asphalt Treated Permeable Base (ATPB) (inches)	Class 4 Aggregate Base (inches)
Parking Stalls	B	6¾	6
Drive Lanes	B	8½	6

***1¼ inches of an open-graded friction course (OGFC) should be placed on top of the ATPB.**

Pervious Concrete Pavement

Traffic Type	Category	Pervious Concrete (inches)	Class 4 Aggregate Base (inches)
Parking Stalls	B	5½	6
Drive Lanes	B	6	6

Permeable Interlocking Concrete Pavers (PICP)

Traffic Type	Category	PICP (inches)	Class 3 Permeable (inches)	Class 4 Aggregate Base (inches)
Parking Stalls	B	3⅛	4¼	6
Drive Lanes	B	3⅛	4¼	8¾

The top 12 inches of subgrade should be scarified, moisture conditioned to near optimum moisture content, and compacted to at least 95% relative compaction. All soft or yielding subgrade areas should be removed and replaced with compacted fill or permeable base. All materials and methods of construction should conform to good engineering practices and the minimum local standards.

We recommend installing deepened curbs or vertical cutoff membranes consisting of 30 mil HDPE or PVC at the edges of pervious pavements to reduce the potential for water-related distress to adjacent structures or improvements. The membrane should extend below the reservoir section. If infiltration is not used, the membrane should also be placed between the subgrade and pervious base, and a suitable subdrain system should be installed.

7.9 SOIL CORROSIVITY

Representative samples of the on-site soils were tested to evaluate corrosion potential. The test results are presented in Appendix II. The project design engineer can use the sulfate results in conjunction with ACI 318 to specify the water/cement ratio, compressive strength and cementitious material types for concrete exposed to soil. A corrosion engineer should be contacted to provide specific corrosion control recommendations.

7.10 PRELIMINARY INFILTRATION

Infiltration testing was not performed as part of our investigation. The infiltration rate of the actual soils that will be encountered at the bottom of stormwater retention basins could vary significantly subsequent to grading. Therefore, basin-specific testing is recommended for design purposes. An adequate safety factor should be applied to the infiltration rate during design of the proposed infiltration facilities. Site characteristics such as excessive slope of the drainage area, fine-grained soil types, and proximate location of the water table may preclude the use of an infiltration basin. Generally, infiltration basins are not suitable for areas with relatively impermeable soils containing clay and silt or in areas with fill. Further observation of the actual basin subgrade soils is recommended following grading. Additionally, infiltration basins will require periodic maintenance to function as intended.

8. GEOTECHNICAL ENGINEERING DURING CONSTRUCTION

The geotechnical engineer should review project plans and specifications prior to bidding and construction to check that the intent of the recommendations in this report has been incorporated. Observations and tests should be performed during construction. If the conditions encountered during construction differ from those anticipated based on the subsurface exploration program, the presence of the geotechnical engineer during construction will enable an evaluation of the exposed conditions and modifications of the recommendations in this report or development of additional recommendations in a timely manner.

9. CLOSURE

SCST should be advised of changes in the project scope so that the recommendations contained in this report can be evaluated with respect to the revised plans. Changes in recommendations will be verified in writing. The findings in this report are valid as of the date of this report. Changes in the condition of the site can, however, occur with the passage of time, whether they are due to natural processes or work on this or adjacent areas. In addition, changes in the standards of practice and government regulations can occur. Thus, the findings in this report may be invalidated wholly or in part by changes beyond our control. This report should not be relied upon after a period of two years without a review by us verifying the suitability of the conclusions and recommendations to site conditions at that time.

In the performance of our professional services, we comply with that level of care and skill ordinarily exercised by members of our profession currently practicing under similar conditions and in the same locality. The client recognizes that subsurface conditions may vary from those encountered at the boring locations and that our data, interpretations, and recommendations are based solely on the information obtained by us. We will be responsible for those data, interpretations, and recommendations, but shall not be responsible for interpretations by others of the information developed. Our services consist of professional consultation and observation only, and no warranty of kind whatsoever, express or implied, is made or intended in connection with the work performed or to be performed by us, or by our proposal for consulting or other services, or by our furnishing of oral or written reports or findings.

10. REFERENCES

American Concrete Institute (ACI) (2014), Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary.

California Department of Transportation, Division of Design, Office of Stormwater Management (2014), Pervious Pavement Design Guidance, August.

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City of San Diego Developmental Services Department (2008), Seismic Safety Study, Geologic Hazards and Faults, Grid Tile: 17 and 18, Scale 1:800, April 3.

International Code Council (2015), 2016 California Building Code, California Code of Regulations, Title 24, Part 2, Volume 2 of 2, Based on the 2015 International Existing Building Code, Effective Date: January 1, 2017.

Jennings, C.W., Bryant W.A., ESRI, HERE, Garmin, FAO, NOAA, USGS, EPA (2010), Fault Activity Map of California.

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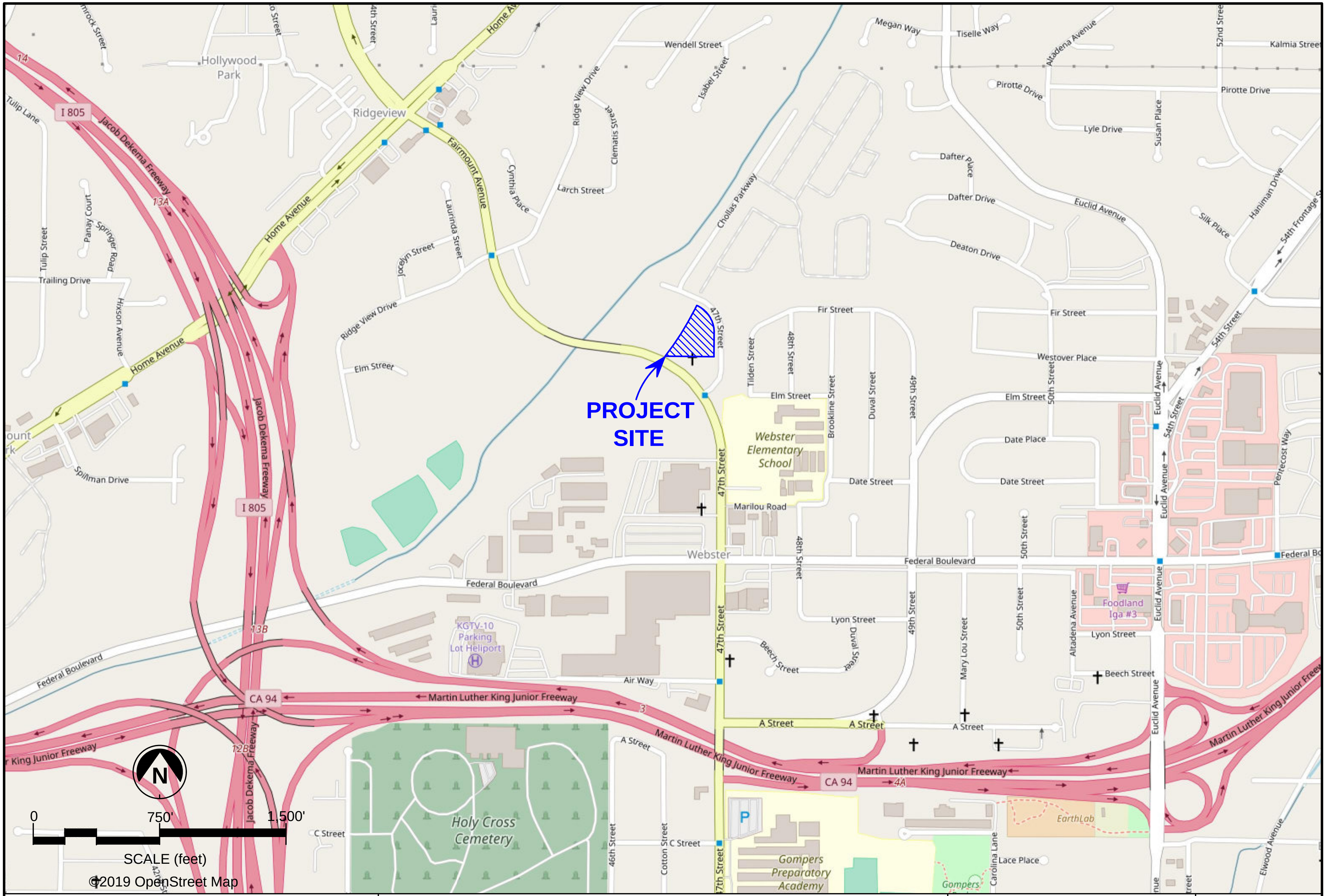


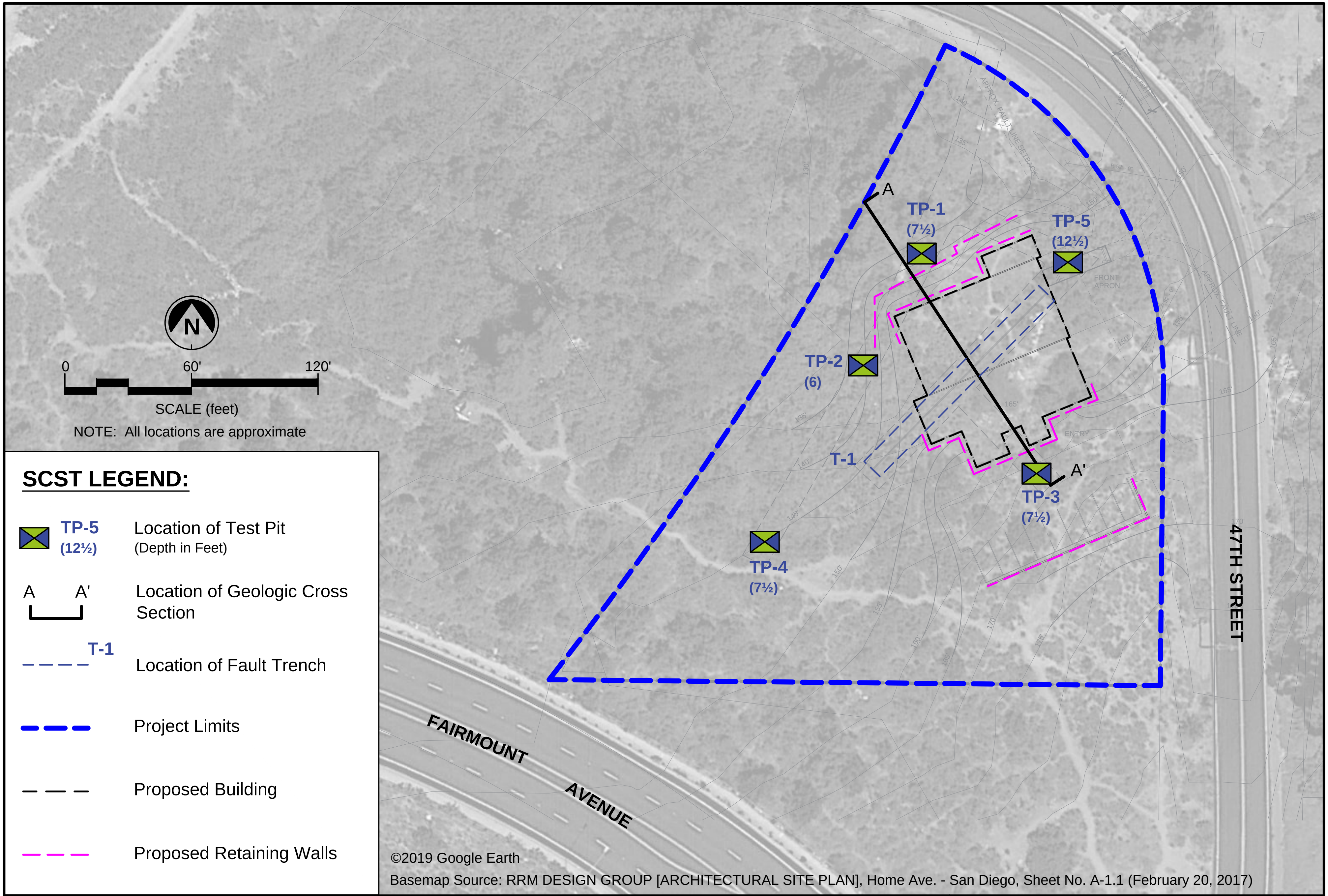
SCST, LLC

SITE VICINITY MAP

Fairmount Avenue Fire Station
San Diego, California

Date:	March, 2019
By:	NNW
Job No.:	170446P4-1

Figure:
1



©2019 Google Earth

Basemap Source: RRM DESIGN GROUP [ARCHITECTURAL SITE PLAN], Home Ave. - San Diego, Sheet No. A-1.1 (February 20, 2017)

SCST LEGEND:

☒ TP-5 (12½)	Location of Test Pit (Depth in Feet)
A A'	Location of Geologic Cross Section
T-1 – – – –	Location of Fault Trench
▬ ▬ ▬	Project Limits
— — —	Proposed Building
– – –	Proposed Retaining Walls

SCST, LLC

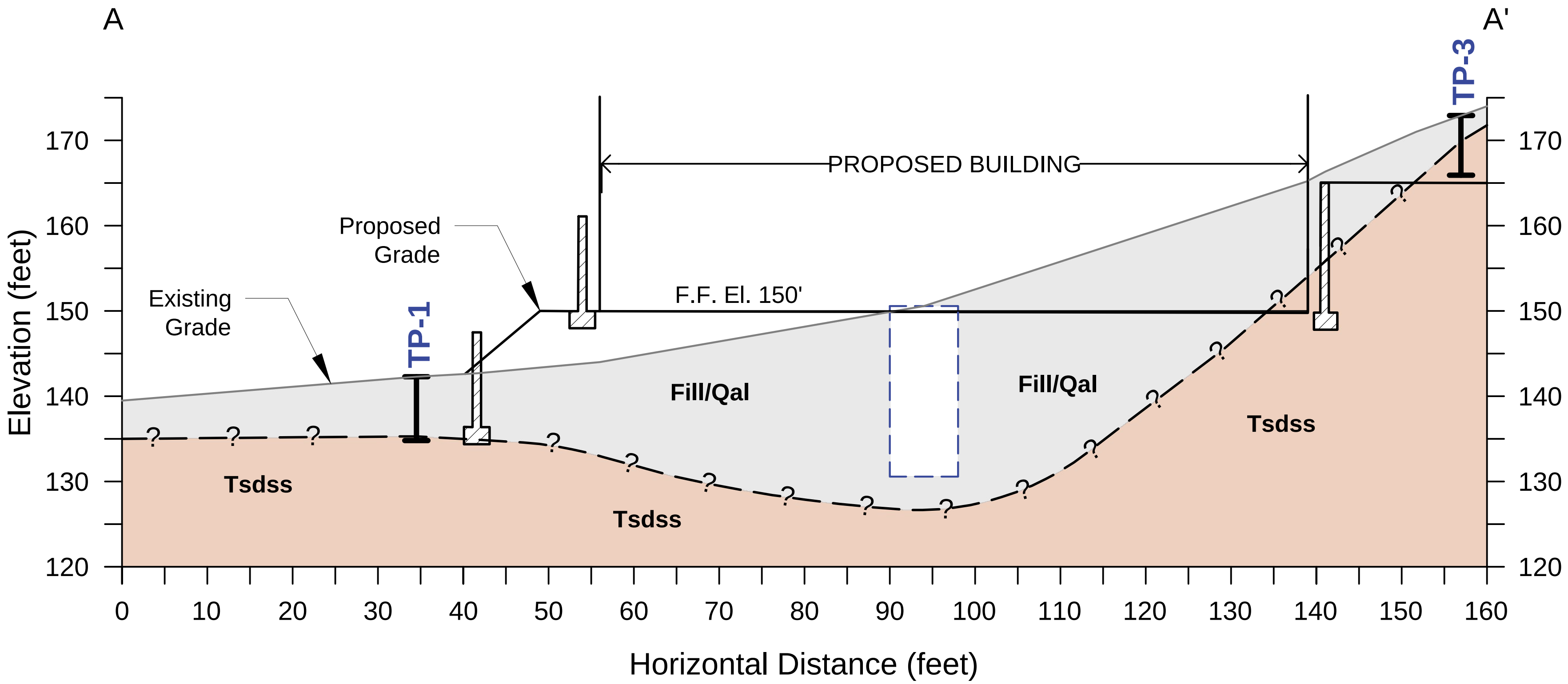
AN ATLAS COMPANY

SUBSURFACE EXPLORATION MAP

Fairmount Avenue Fire Station
San Diego, California

Date: March, 2019
By: NNW
Job No.: 170446P4-1

Figure:
2



SCST LEGEND:

TP-3 Location of Boring

Location of Proposed Retaining Wall

Fill/Qal Fill/ alluvium

Tsdss San Diego Formation, marine sandstone

▭ Fault Trench

—?—?— Geologic Contact, Queried Where Uncertain

SCALE
AS SHOWN

NOTE: All locations and depths are approximate.

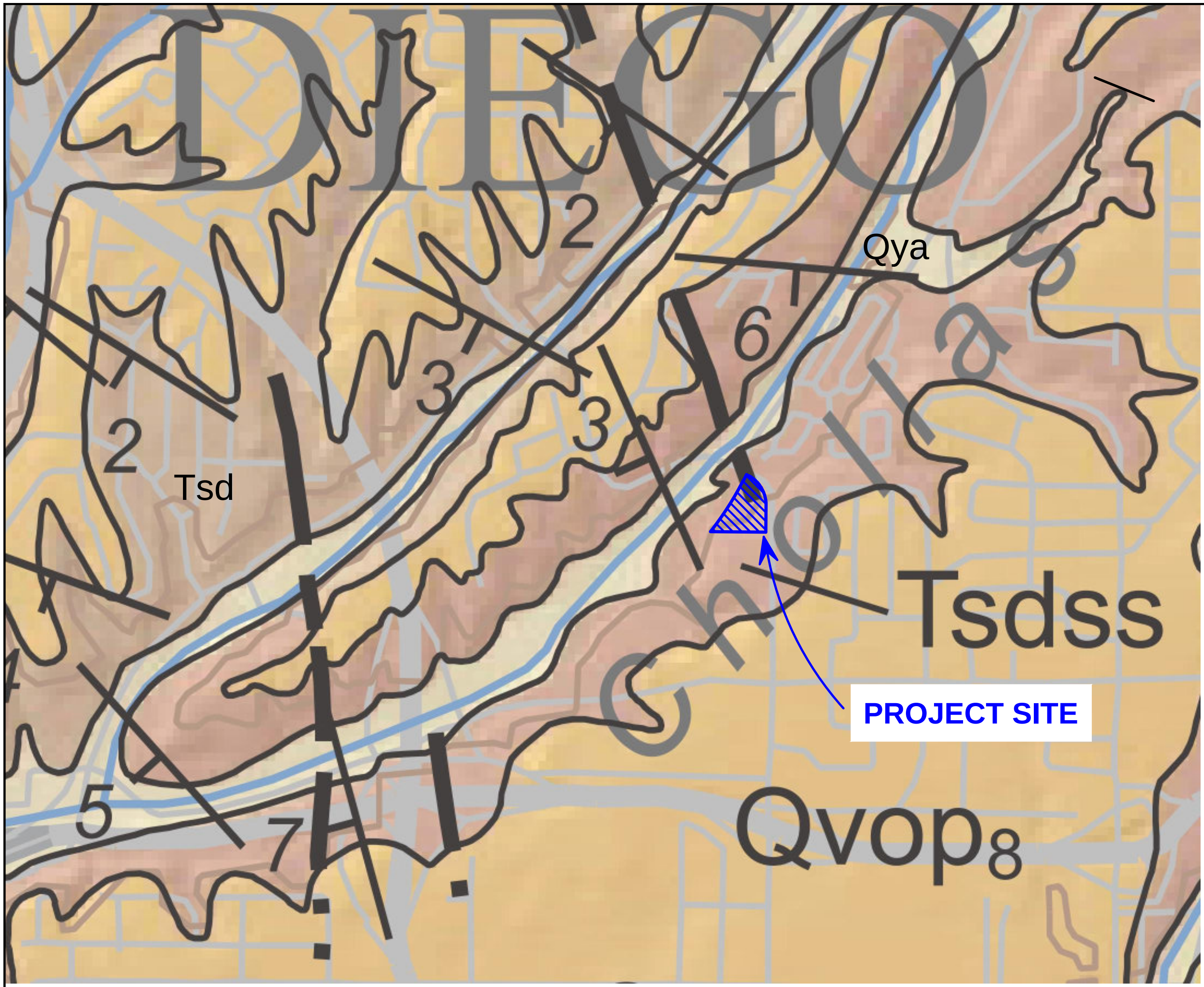
SCST, LLC

AN ATLAS COMPANY

GEOLOGIC CROSS SECTION
Fairmount Avenue Fire Station
San Diego, California

Date: March, 2019
By: MAW/NNW
Job No.: 170446P4-1

Figure:
3

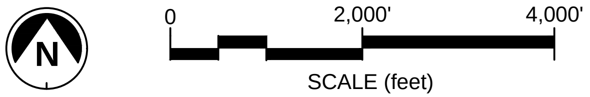


EXPLANATION:

Qya	Young alluvial flood-plain deposits
Qvop$_8$	Very old paralic deposits, various
Tsd	San Diego Formation, undivided
Tsdss	San Diego Formation, marine sandstone

4 **Strike** and **dip** of beds

70 U D **Fault** - Solid where accurately located; dashed where approximately located; dotted where concealed. U = upthrown block, D = downthrown block. Arrow and number indicate direction and angle of dip of fault plane.



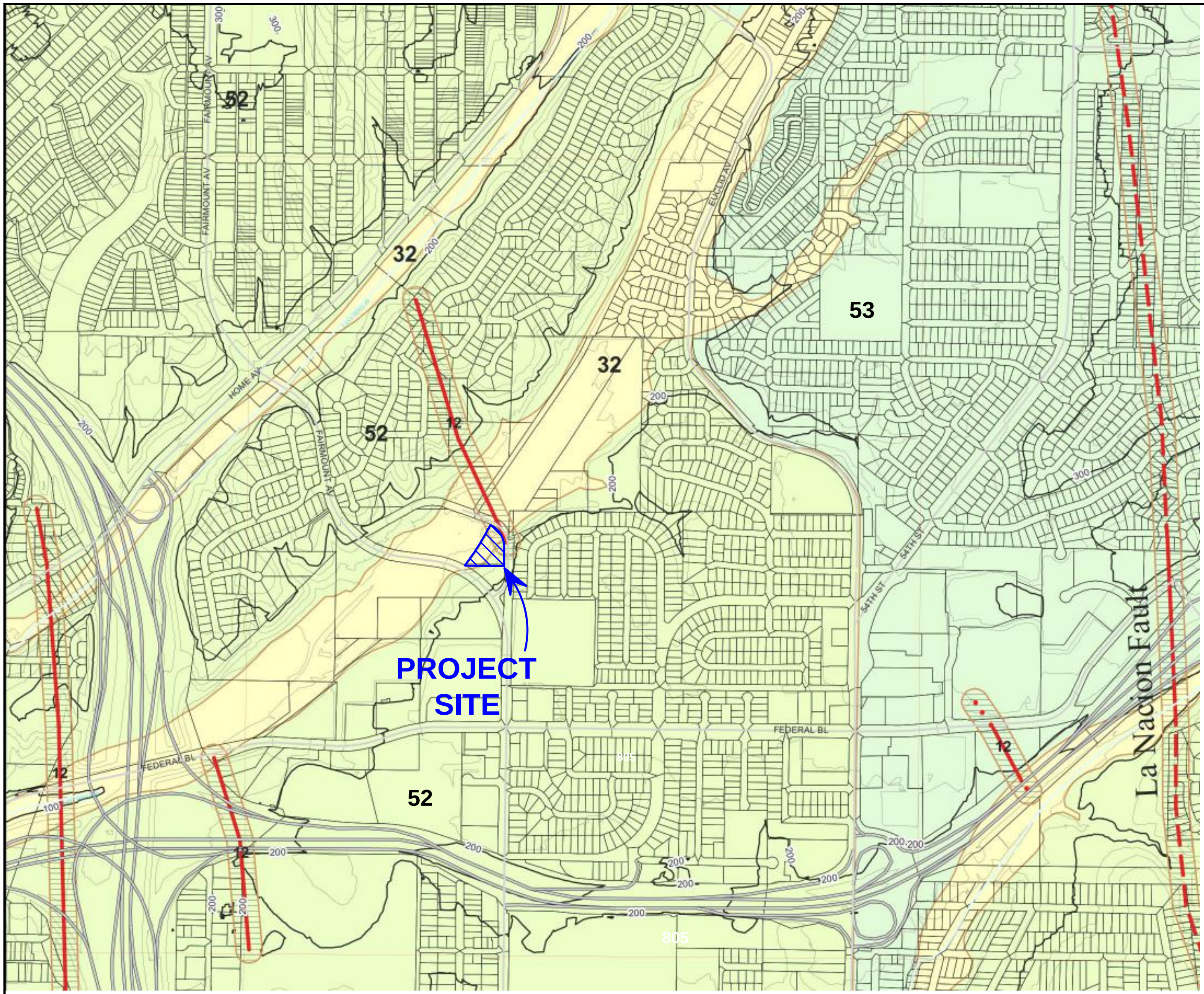
Reference:
Kennedy, M.P. and Tan, S.S. (2008), Geologic Map of the San Diego 30' x 60' Quadrangle, California, California Geological Survey, Scale 1:100,000

SCST, LLC
AN ATLAS COMPANY

REGIONAL GEOLOGY MAP
Fairmount Avenue Fire Station
San Diego, California

Date: March, 2019
By: NDK/NNW
Job No.: 170446P4-1

Figure:
4



EXPLANATION:

FAULT ZONES

12	Potentially Active, Inactive, Presumed Inactive, or Activity Unknown

SLIDE-PRONE FORMATIONS

27	Otay, Sweetwater, and others

LIQUEFACTION

32	Low Potential -- fluctuating groundwater; minor drainages

OTHER TERRAIN

52	Other level areas, gently sloping to steep terrain, favorable geologic structure; Low risk
53	Level or sloping terrain, unfavorable geologic structure; Low to moderate risk

FAULTS

Fault

Inferred Fault

Concealed Fault

Shear Zone

N

0 1,250' 2,500'

SCALE (feet)

Reference:
City of San Diego (2008), Seismic Safety Study, Geologic Hazards and Faults,
Grid Tile: 18, Development Services Department, April 3, Scale 1:800.

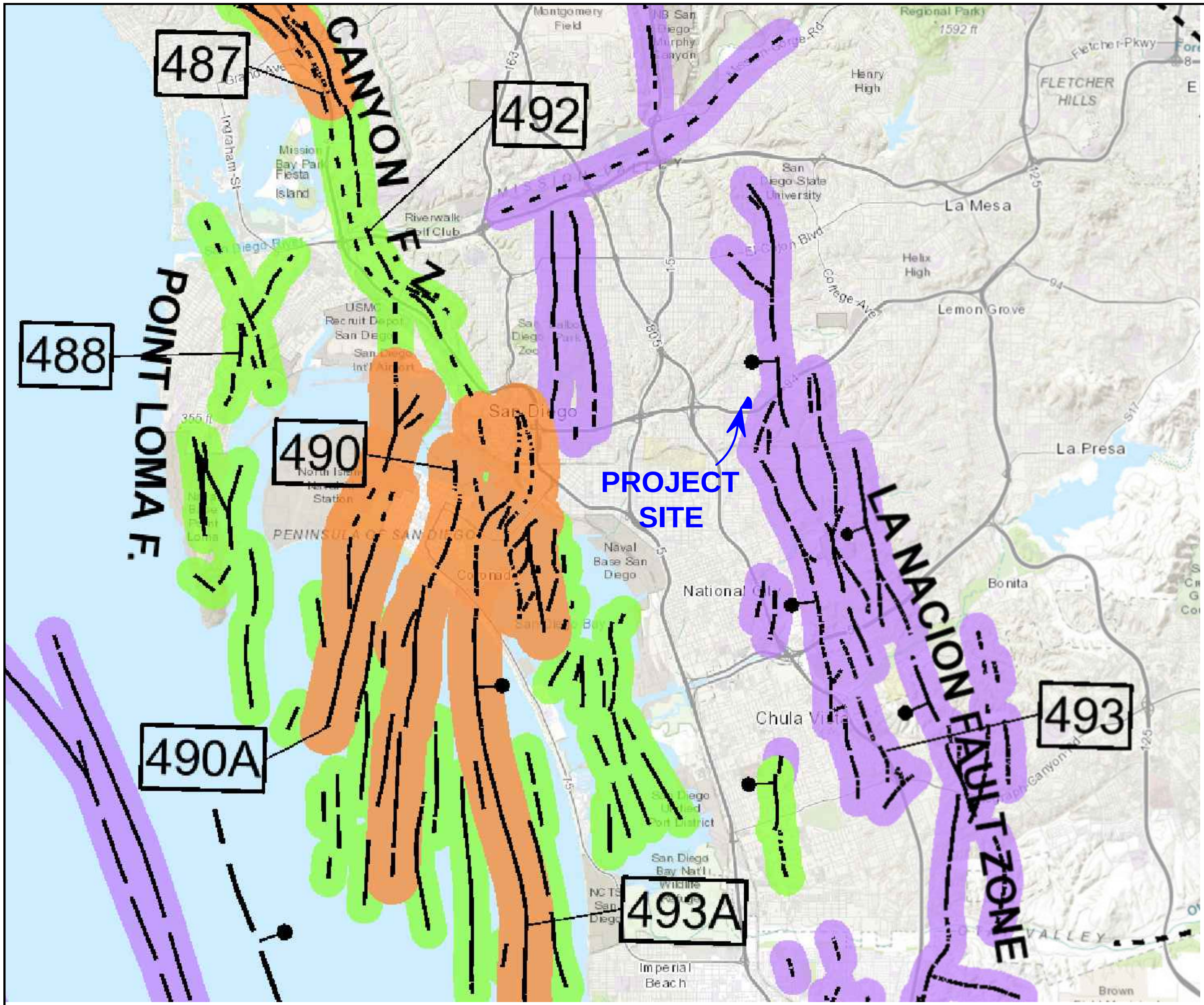
SCST, LLC

CITY OF SAN DIEGO SEISMIC SAFETY MAP

Fairmount Avenue Fire Station
San Diego, California

Date:	March, 2019
By:	NDK/NNW
Job No.:	170446P4-1

Figure:
5



N

0 15,000' 30,000'
SCALE (feet)

Reference:
Jennings, C.W., Bryant W.A., Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, Fault Activity Map or California (2010)

EXPLANATION:

Holocene fault displacement (during past 11,700 years) without historic record.

Late Quaternary fault displacement (during past 700,000 years).

Quaternary fault (age undifferentiated).

Pre-Quaternary fault (older than 1.6 million years) or fault without recognized Quaternary displacement.

Bar and ball on downthrown side (relative or apparent).

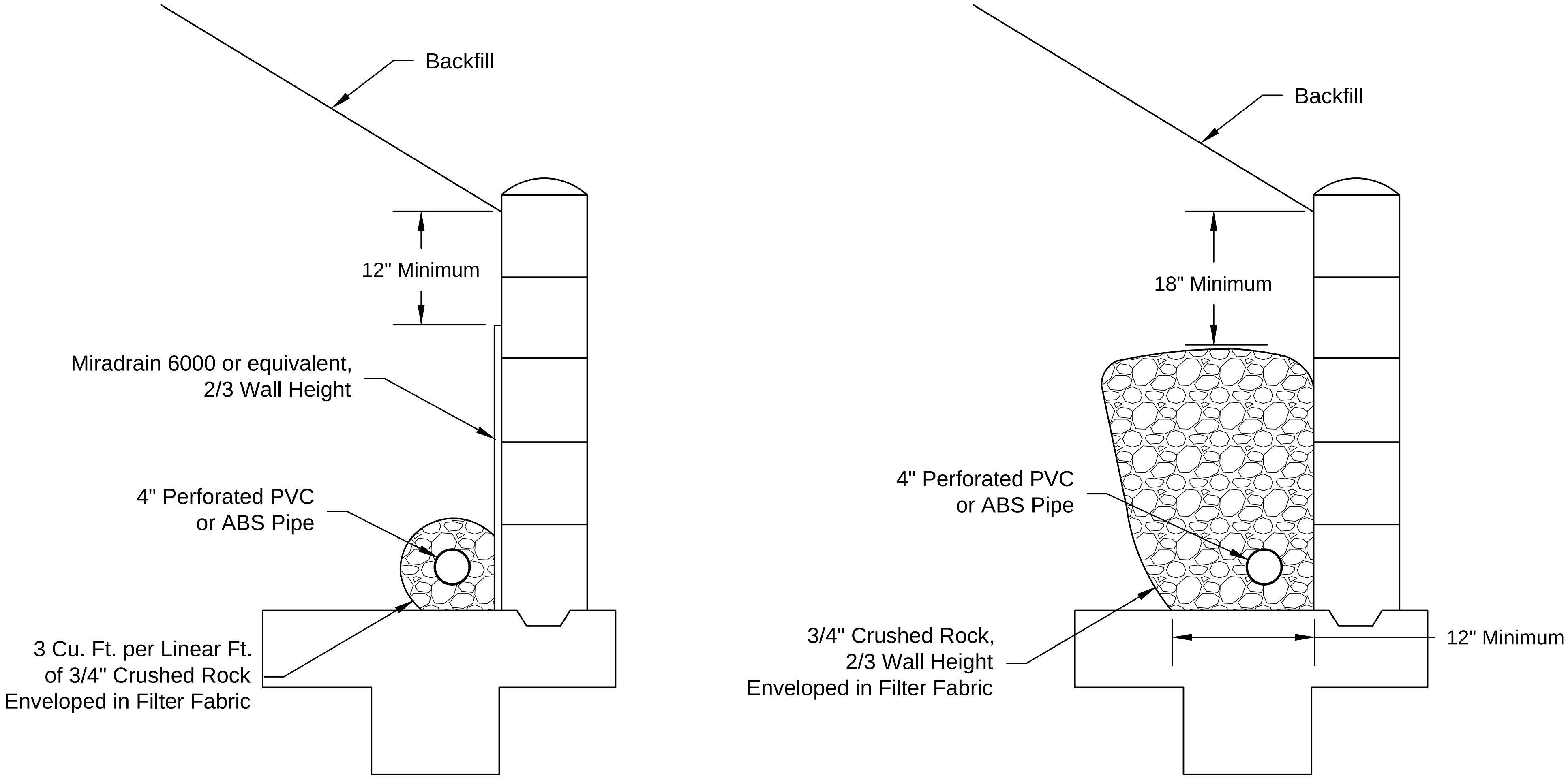
487	Mission Bay Fault (concealed)
488	Point Loma Fault (certain)
490	Coronado Fault (certain)
490A	Spanish Bight Fault (certain)
492	Old Town Fault (concealed)
493	Sweetwater Fault (approximately located)
493A	Silver Strand Fault (certain)

SCST, LLC

FAULT MAP
Fairmount Avenue Fire Station
San Diego, California

Date: March, 2019
By: NDK/NNW
Job No.: 170446P4-1

Figure:
6



NOT TO SCALE

NOTES:

1) Dampproof or waterproof back of wall following architect's specifications.
2) 4" minimum perforated pipe, SDR35 or equivalent, holes down, 1% fall to outlet. Provide solid outlet pipe at suitable locations.
3) Drain installation and outlet connection should be observed by the geotechnical consultant.

SCST, LLC	**TYPICAL RETAINING WALL BACKDRAIN DETAILS** Fairmount Avenue Fire Station San Diego, California	Date: March, 2019 By: NNW Job No.: 170446P4-1	Figure: 7

APPENDIX I
FIELD INVESTIGATION

The subsurface conditions were explored by excavating five test pits to depths between about 6 and 12½ feet below the existing ground surface. An approximately 100-foot-long fault trench was excavated across the site to a depth of 8 feet. An SCST engineer and geologist logged the test pits and fault trench and collected samples of the materials encountered for geotechnical laboratory testing. SCST tested select samples from the test pits and fault trench to evaluate pertinent soil classification and engineering properties and to assist in developing geotechnical conclusions and recommendations.

The soils are classified in accordance with the Unified Soil Classification System as illustrated on Figure I-1. Logs of the borings and test holes are presented on Figures I-2 through I-28.

SUBSURFACE EXPLORATION LEGEND

UNIFIED SOIL CLASSIFICATION CHART

SOIL DESCRIPTION		GROUP SYMBOL	TYPICAL NAMES
I. COARSE GRAINED, more than 50% of material is larger than No. 200 sieve size.			
GRAVELS More than half of coarse fraction is larger than No. 4 sieve size but smaller than 3".	CLEAN GRAVELS	GW	Well graded gravels, gravel-sand mixtures, little or no fines
		GP	Poorly graded gravels, gravel sand mixtures, little or no fines.
	GRAVELS WITH FINES (Appreciable amount of fines)	GM	Silty gravels, poorly graded gravel-sand-silt mixtures.
		GC	Clayey gravels, poorly graded gravel-sand, clay mixtures.
SANDS More than half of coarse fraction is smaller than No. 4 sieve size.	CLEAN SANDS	SW	Well graded sand, gravelly sands, little or no fines.
		SP	Poorly graded sands, gravelly sands, little or no fines.
		SM	Silty sands, poorly graded sand and silty mixtures.
		SC	Clayey sands, poorly graded sand and clay mixtures.
II. FINE GRAINED, more than 50% of material is smaller than No. 200 sieve size.			
	SILTS AND CLAYS (Liquid Limit less than 50)	ML	Inorganic silts and very fine sands, rock flour, sandy silt or clayey-silt-sand mixtures with slight plasticity.
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
		OL	Organic silts and organic silty clays or low plasticity.
	SILTS AND CLAYS (Liquid Limit greater than 50)	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
		CH	Inorganic clays of high plasticity, fat clays.
		OH	Organic clays of medium to high plasticity.
III. HIGHLY ORGANIC SOILS		PT	Peat and other highly organic soils.

SAMPLE SYMBOLS

☒ - Bulk Sample
CAL - Modified California Sampler
CK - Undisturbed Chunk sample
MS - Maximum Size of Particle
ST - Shelby Tube
SPT - Standard Penetration Test sampler

GROUNDWATER SYMBOLS

▽ - Water level at time of excavation or as indicated

≀≀ - Water seepage at time of excavation or as indicated

LABORATORY TEST SYMBOLS

AL - Atterberg Limits
CON - Consolidation
COR - Corrosivity Tests
(Resistivity, pH, Chloride, Sulfate)
DS - Direct Shear
EI - Expansion Index
MAX - Maximum Density
RV - R-Value
SA - Sieve Analysis

SCST, LLC	Fairmount Avenue Fire Station San Diego, California			
	By:	PFL	Date:	March, 2019
	Job Number:	170446N-1	Figure:	I-1

LOG OF BORING TP-1

Date Drilled: 1/29/2019
Equipment: Excavator
Elevation (ft): 142

Logged by: DJR
Reviewed by: JG
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES DRIVEN	SAMPLES BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pc	LABORATORY TESTS
	SM	**FILL (Qf) / ALLUVIUM (Qal):** SILTY SAND, loose, dark brown, moist, fine to medium grained.							
1									
2		Light brown.							
3		Dark brown, organic rich, few coarse gravel.							
	SP	**ALLUVIUM (Qal):** POORLY GRADED SAND, light brown, moist, fine to coarse grained.							
4									
5									
6									
7		**SAN DIEGO FORMATION (Tsdss):** SILTY SANDSTONE, gray, moist to wet, strongly cemented.							
8		**TEST PIT TERMINATED AT 7½ FEET, SIDEWALLS COLLAPSED.**							
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

SCST, LLC

Fairmount Avenue Fire Station
San Diego, California

By:	PFL	Date:	March, 2019
Job Number:	170446N-1	Figure:	I-2

LOG OF BORING TP-2

Date Drilled: 1/29/2019
Equipment: Excavator
Elevation (ft): 143

Logged by: DJR
Reviewed by: JG
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES DRIVEN	SAMPLES BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf)	LABORATORY TESTS
	SM	**<u>FILL (Qf) / ALLUVIUM (Qal)</u>:** SILTY SAND with GRAVEL, loose, brown, moist, organics, fine to coarse grained, some cobble. Dark brown, mostly cobble.							
1									
2									
3									
4		Medium dense, light brown.							
5									
6		**<u>SAN DIEGO FORMATION (Tsdss)</u>:** SILTY SANDSTONE, light brown and gray, wet, moderately cemented.							
7		**TEST PIT TERMINATED AT 6 FEET.**							
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

SCST, LLC

Fairmount Avenue Fire Station
San Diego, California

By: PFL
Date: March, 2019
Job Number: 170446N-1
Figure: I-3

LOG OF BORING TP-3

Date Drilled: 1/29/2019
Equipment: Excavator
Elevation (ft): 173

Logged by: KH
Reviewed by: JG
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES		DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf	LABORATORY TESTS
			DRIVEN	BULK					
	SC-SM	**FILL (Qf) / ALLUVIUM (Qal):** SILTY, CLAYEY SAND, loose, dark brown, moist, fine to coarse grained, organic rich, few cobbles.							
1									
2	SM	SILTY SAND, loose, light brown, moist, fine to coarse grained.							
3		**SAN DIEGO FORMATION (Tsdss):** SILTY SANDSTONE, light brown, moist, fine to coarse grained, weakly cemented.							
4									
5		Moderately cemented.							
6		Few cobbles.							
7		Light gray.							
8		**TEST PIT TERMINATED AT 7½ FEET.**							
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

SCST, LLC

Fairmount Avenue Fire Station
San Diego, California

By:	PFL	Date:	March, 2019
Job Number:	170446N-1	Figure:	I-4

LOG OF BORING TP-4

Date Drilled: 1/29/2019
Equipment: Excavator
Elevation (ft): 154

Logged by: KH
Reviewed by: JG
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES DRIVEN	 BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pcf	LABORATORY TESTS
1	SM	**FILL(Qf) / ALLUVIUM (Qal):** SILTY SAND, loose, dark brown, moist, fine to coarse grained.							
2									
3	GM	SILTY GRAVEL with SAND, brown, moist, medium to coarse grained, some cobbles.							
4									
5									
6									
7		**SAN DIEGO FORMATION (Tsdss):** SILTY SANDSTONE, light brown and gray, moist, moderately cemented.							
8		**TEST PIT TERMINATED AT 7½ FEET.**							
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									

SCST, LLC

Fairmount Avenue Fire Station
San Diego, California

By:	PFL	Date:	March, 2019
Job Number:	170446N-1	Figure:	I-5

LOG OF BORING TP-5

Date Drilled: 1/29/2019
Equipment: Excavator
Elevation (ft): 153

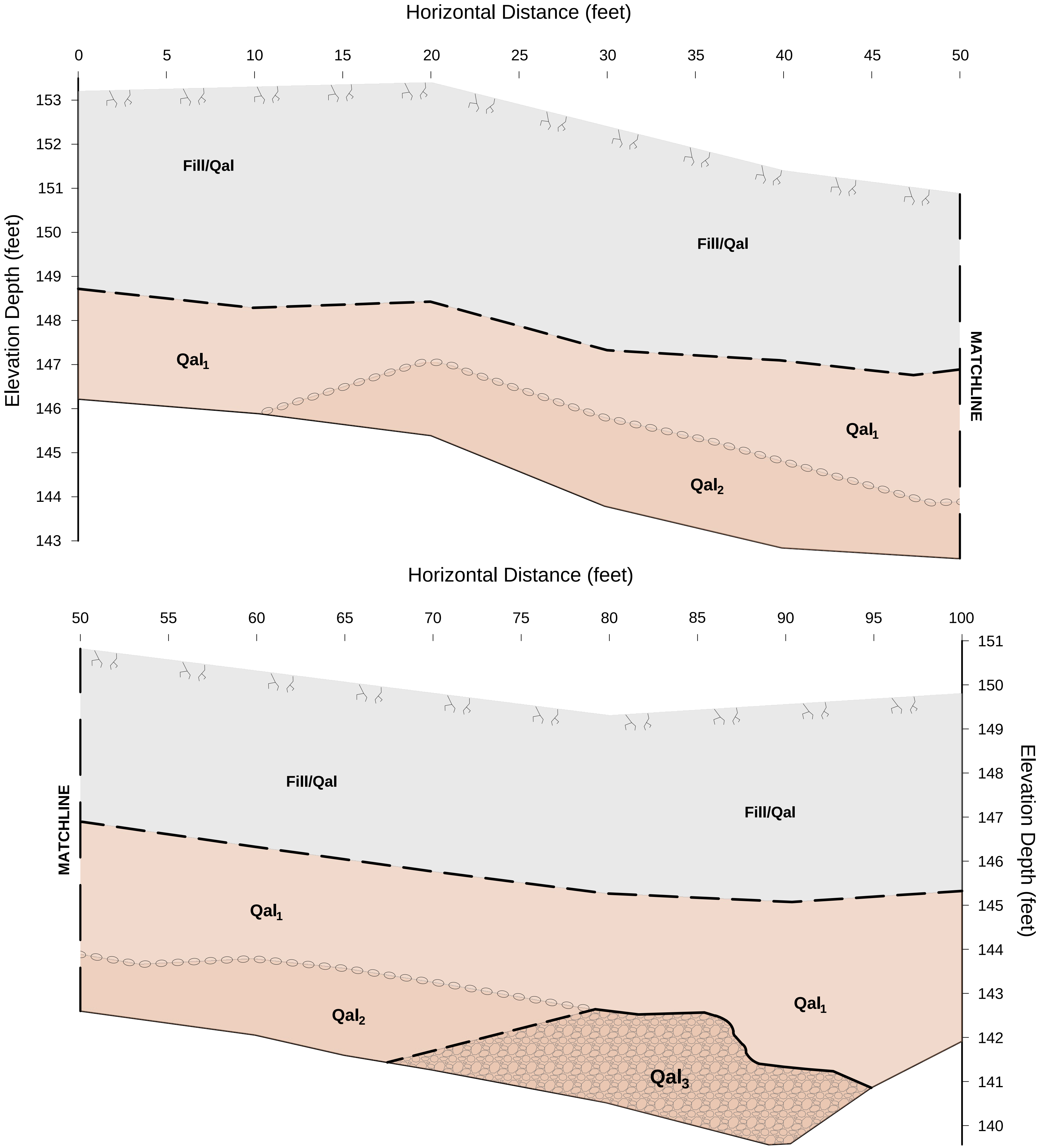
Logged by: DJR
Reviewed by: JG
Depth to Groundwater (ft): Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES DRIVEN	SAMPLES BULK	DRIVING RESISTANCE (blows/ft of drive)	N_{60}	MOISTURE CONTENT (%)	DRY UNIT WEIGHT (pc	LABORATORY TESTS
	SM	**FILL (Qf):** SILTY SAND, loose, brown to light brown, moist, fine to medium grained, some roots (to 2 inches).							
1									
2									
3		Loose to medium dense, dark brown, moist, medium grained, few organics.							
4									
5	GM	SILTY GRAVEL with SAND, loose, medium brown, moist, medium grained, mostly cobbles.							
6									
7									
8									
9									
10									
11									
12		**SAN DIEGO FORMATION (Tsdss):** SILTY SANDSTONE, light brown and gray, moist, moderately cemented.							
13		**TEST PIT TERMINATED AT 12½ FEET.**							
14									
15									
16									
17									
18									
19									
20									

SCST, LLC

Fairmount Avenue Fire Station
San Diego, California

By:	PFL	Date:	March, 2019
Job Number:	170446N-1	Figure:	I-6



SCST LEGEND:

—?—	Geologic Contact, Queried Where Uncertain
○ ○ ○	Cobbles or Boulders
⅄ ⅄	Roots
Fill/Qal	SILTY SAND, loose, brown, moist, fine to coarse grained, abundant organics including roots, few debris (glass, trash, etc.). Locally abundant cobbles (as shown).
Qal$_1$	SILTY SAND, loose to medium dense, dark brown, moist, fine to medium grained, fewer organics (roots), few coarse gravel
Qal$_2$	SILTY SAND, medium dense, moist, light brown, moist, fine to medium grained.
Qal$_3$	SILTY GRAVEL with SAND, medium dense, brown, moist, fine to coarse grained.

SCALE

AS SHOWN

Date: March, 2019
By: NNW
Job No.: 170446P4-1

FAULT TRENCH LOG
Fairmount Avenue Fire Station
San Diego, California

SCST, LLC

Figure:
I-7

APPENDIX II
LABORATORY TESTING

Laboratory tests were performed to provide geotechnical parameters for engineering analyses. The following tests were performed:

- **CLASSIFICATION:** Field classifications were verified in the laboratory by visual examination. The final soil classifications are in accordance with the Unified Soil Classification System.

- **PARTICLE-SIZE DISTRIBUTION:** The particle-size distribution was determined on four samples in accordance with ASTM D422.

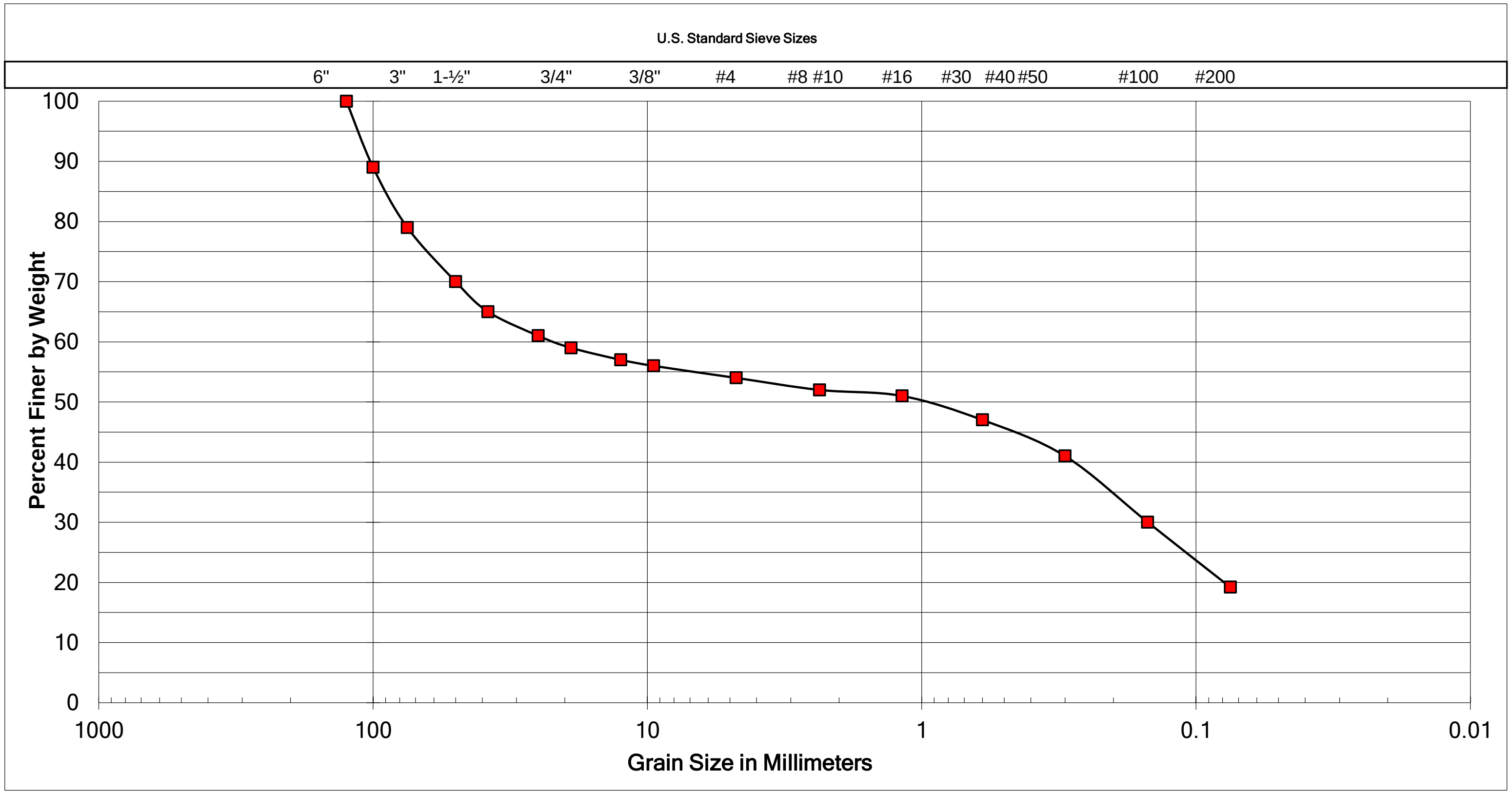
- **EXPANSION INDEX:** The expansion index was determined on one sample in accordance with ASTM D4829.

- **CORROSIVITY**: Corrosivity tests were performed on two samples. The pH and minimum resistivity were determined in general accordance with California Test 643. The soluble sulfate content was determined in accordance with California Test 417. The total chloride ion content was determined in accordance with California Test 422.

- **MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE**: The maximum dry density and optimum moisture content were determined on one soil sample in accordance with ASTM D1557.

- **DIRECT SHEAR:** Direct shear testing was performed on two samples in accordance with ASTM D3080. One was remolded to 90% relative compaction and the other was tested on a chunk sample. The shear stress was applied at a constant rate of strain of 0.003 inch per minute. Soil samples not tested are now stored in our laboratory for future reference and analysis, if needed.

Unless notified to the contrary, all samples will be disposed of 30 days.



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
FT at 80', 3' to 6' depth
SAMPLE NUMBER
37989

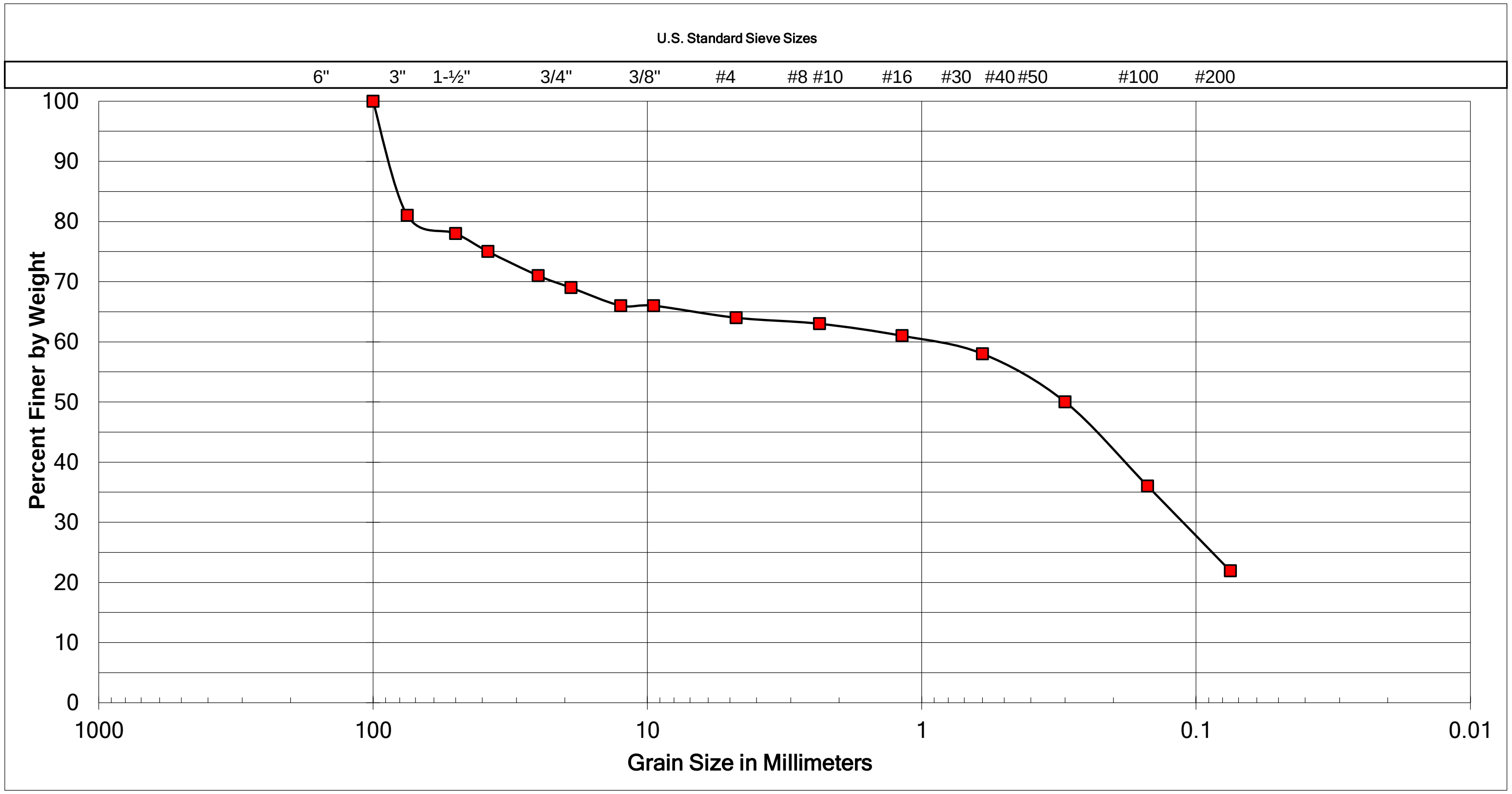
UNIFIED SOIL CLASSIFICATION:	GM
DESCRIPTION	SILTY GRAVEL

ATTERBERG LIMITS	
LIQUID LIMIT	--
PLASTIC LIMIT	--
PLASTICITY INDEX	--

SCST, LLC

Fairmount Avenue Fire Station
San Diego, California

By:	CT	Date:	March, 2019
Job Number:	170446P4	Figure:	II-1



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
FT at various locations, at 0 to 2' depth
SAMPLE NUMBER
37990

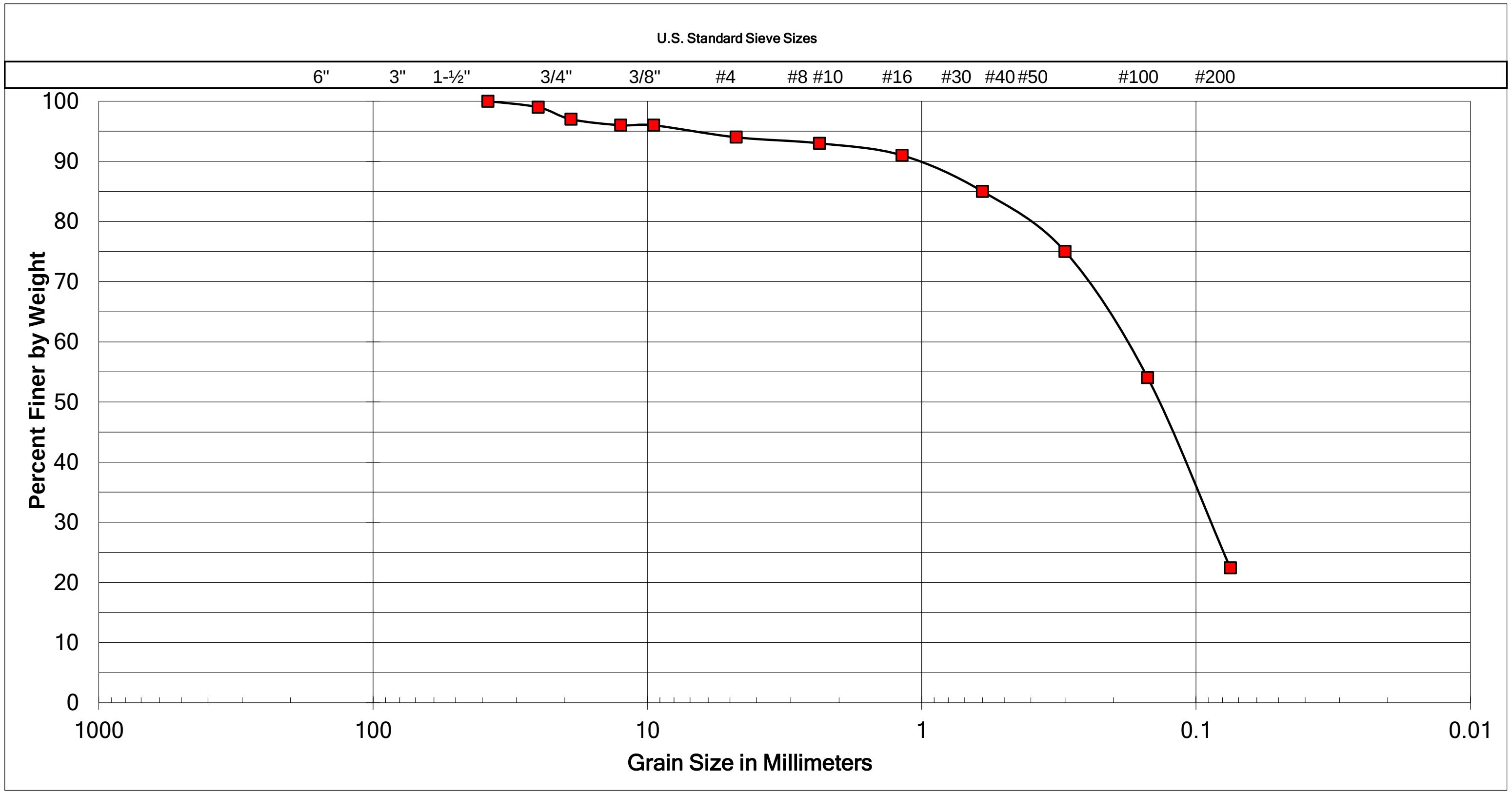
UNIFIED SOIL CLASSIFICATION:	SM
DESCRIPTION	SILTY SAND with GRAVEL

ATTERBERG LIMITS	
LIQUID LIMIT	--
PLASTIC LIMIT	--
PLASTICITY INDEX	--

SCST, LLC

Fairmount Avenue Fire Station
San Diego, California

By:	CT	Date:	March, 2019
Job Number:	170446P4	Figure:	II-2



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
FT at 38', 2' to 4' depth
SAMPLE NUMBER
37991

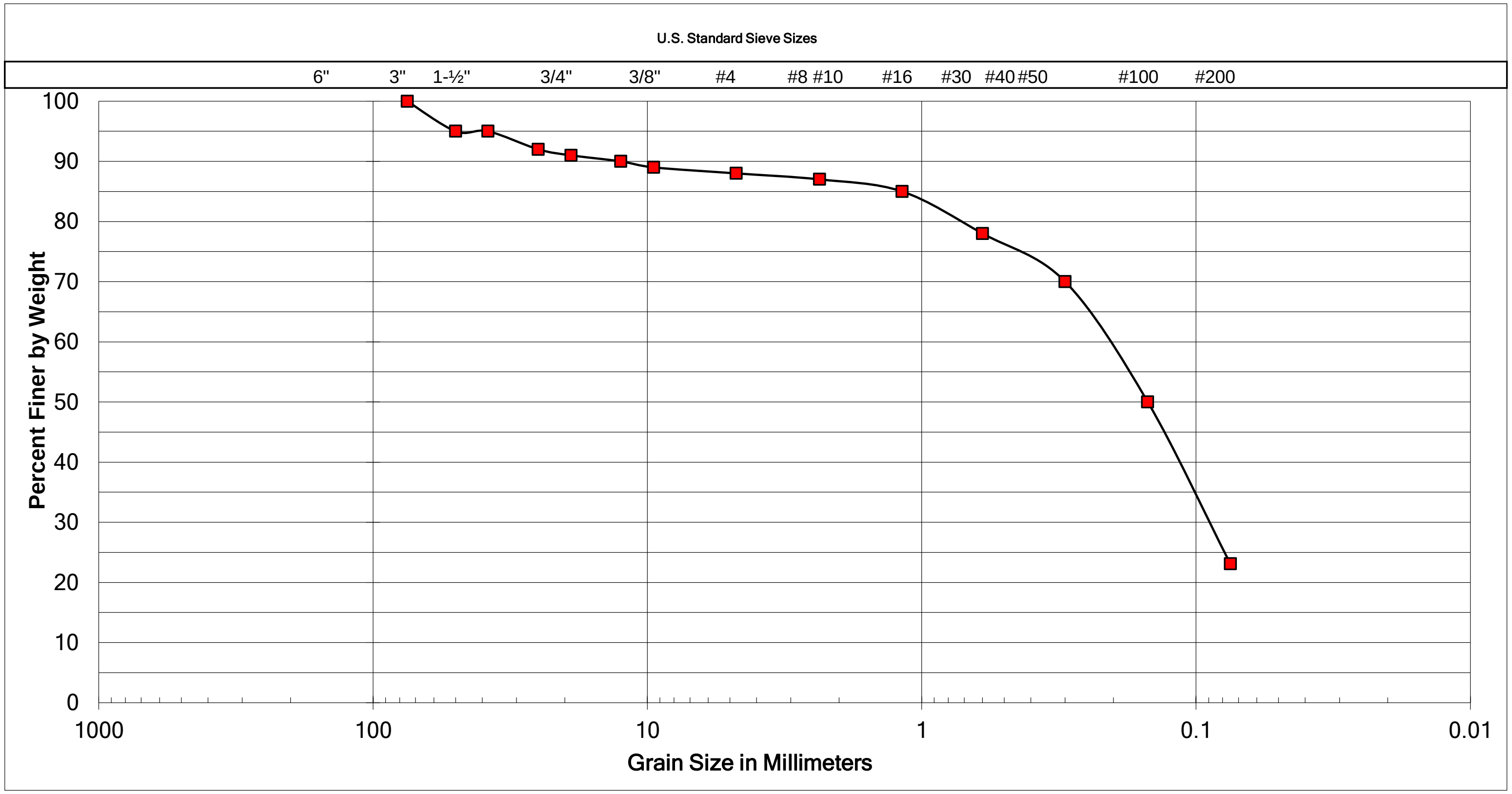
UNIFIED SOIL CLASSIFICATION:	SM
DESCRIPTION	SILTY SAND

ATTERBERG LIMITS	
LIQUID LIMIT	--
PLASTIC LIMIT	--
PLASTICITY INDEX	--

SCST, LLC

Fairmount Avenue Fire Station
San Diego, California

By:	CT	Date:	March, 2019
Job Number:	170446P4	Figure:	II-3



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
FT at 40', 4.5 to 5.5' depth
SAMPLE NUMBER
37992

UNIFIED SOIL CLASSIFICATION:	SM
DESCRIPTION	SILTY SAND

ATTERBERG LIMITS	
LIQUID LIMIT	--
PLASTIC LIMIT	--
PLASTICITY INDEX	--

SCST, LLC

Fairmount Avenue Fire Station
San Diego, California

By:	CT	Date:	March, 2019
Job Number:	170446P4	Figure:	II-4

EXPANSION INDEX

ASTM D2489

SAMPLE	DESCRIPTION	EI
FT at 38', 2' to 4' depth	SILTY SAND	16

Classification of Expansive Soil[1]

EXPANSIVE INDEX	POTENTIAL EXPANSION
1-20	Very Low
21-50	Low
51-90	Medium
91-130	High
Above 130	Very High

1. ASTM - D4829

MAXIMUM DENSITY AND OPTIMUM MOISTURE

ASTM D1557

SAMPLE	DESCRIPTION	MAXIMUM DENSITY (pcf)	OPTIMUM MOISTURE (%)
FT at 38', 2' to 4' depth	SILTY SAND	123.7	10.9

SAND EQUIVALENT

ASTM D2419

SAMPLE	DESCRIPTION	SE VALUE
FT at 38', 2' to 4' depth	SILTY SAND	14
FT at various , 0' to 2' depth	SILTY SAND with GRAVEL	12

ORGANIC MATTER

ASTM D2974

SAMPLE	DESCRIPTION	Organic Matter (%)
TP-2 at 3½ to 5 feet	SILTY SAND with GRAVEL	2.3

RESISTIVITY, pH, SOLUBLE CHLORIDE and SOLUBLE SULFATE

pH & Resistivity (Cal 643, ASTM G51)

Soluble Chlorides (Cal 422)

Soluble Sulfate (Cal 417)

SAMPLE	RESISTIVITY (Ω-cm)	pH	CHLORIDE (%)	SULFATE (%)
FT at 38', 2' to 4' depth	1980	7.31	0.230	0.001

WATER-SOLUBLE SULFATE (SO_4^{2-}) EXPOSURE

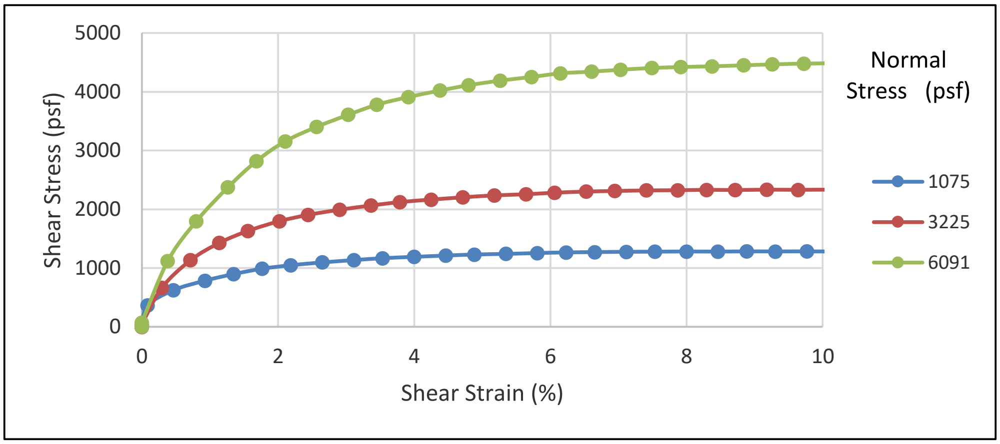
Modified from ACI 318-14 Table 19.3.1.1 and Table 19.3.2.1

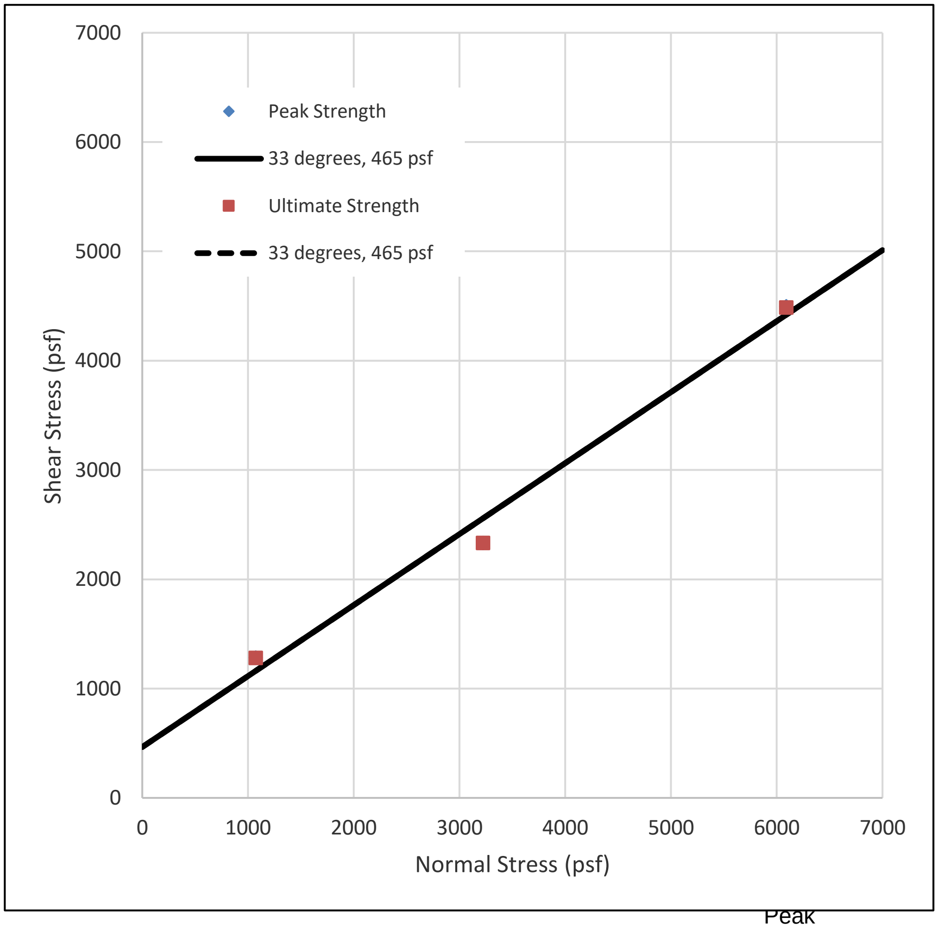
Water-soluble sulfate (SO_4^{2-}) in soil, percent by weight	Exposure Severity	Exposure Class	Cement Type (ASTM C150)	Max. w/cm	Min. f_c' (psi)
$SO_4^{2-} < 0.10$	Not applicable	S0	No type restriction	N/A	2,500
$0.10 \leq SO_4^{2-} < 0.20$	Moderate	S1	II	0.50	4,000
$0.20 \leq SO_4^{2-} < 2.00$	Severe	S2	V	0.45	4,500
$SO_4^{2-} > 2.00$	Very Severe	S3	V plus pozzolan or slag cement	0.45	4,500

SCST, LLC

Fairmount Avenue Fire Station
San Diego, California

By:	DJR	Date:	March, 2019
Job Number:	170446N-1	Figure:	II-5





SAMPLE ID: FT at 38', 2' to 4' depth

Silty Sand

NOTES: Remolded

Strain Rate: 0.003 in/min

Sample was consolidated and drained

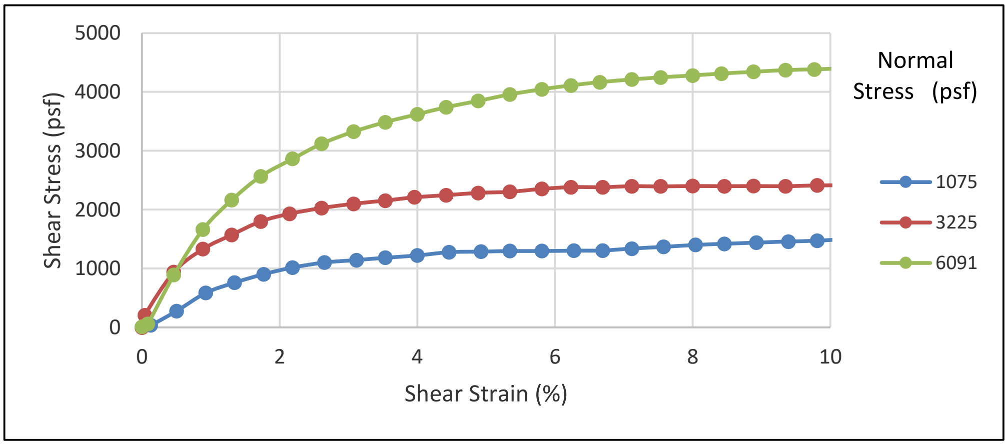
	Peak	Ultimate
Φ	33 °	33 °
c	465 psf	465 psf

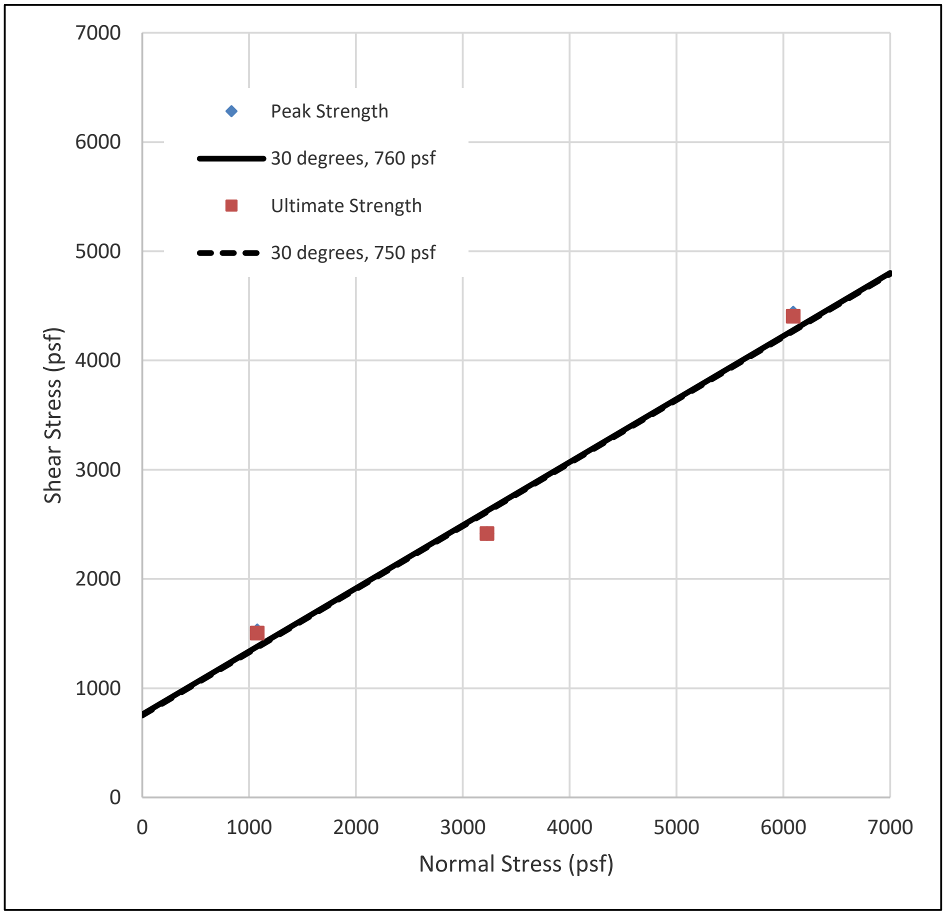
	Initial	Final
γ_d	111.4 pcf	111.4 pcf
w_c	11.2 %	16.5 %
Saturation	60 %	88 %

SCST LLC.

Fairmount Ave Fire Station
San Diego, California

By:	DRB	Date:	March, 2019
Job Number:	170446P4	Figure:	II-6





SAMPLE ID: TP-3 at 6 to 7½ feet

Silty Sandstone, San Diego Formation

NOTES: Remolded
Strain Rate: 0.003 in/min
Sample was consolidated and drained

	Peak	Ultimate
Φ	30 °	30 °
c	760 psf	750 psf

	Initial	Final
γ_d	107.8 pcf	107.8 pcf
w_c	9.3 %	17.5 %
Saturation	45 %	85 %

SCST LLC.

Fairmont Ave Fire Station
San Diego, California

By:	DRB	Date:	March, 2019
Job Number:	170446P4	Figure:	II-7