Design Considerations

Some materials are more of a concern than others. Toxic and hazardous materials must be prevented from coming in contact with stormwater. Non-toxic or non-hazardous materials do not have to be prevented from stormwater contact. However, these materials may have toxic effects on receiving waters if allowed to be discharged with stormwater in significant quantities. Accumulated material on an impervious surface could result in significant impact on the rivers or streams that receive the runoff.

Material may be stored in a variety of ways including bulk piles, containers, shelving, stacking, and tanks. Stormwater contamination may be prevented by eliminating the possibility of stormwater contact with the material storage areas either through diversion, cover, or capture of the stormwater. Control measures may also include minimizing the storage area. Design requirements for material storage areas are governed by Building and Fire Codes, and by current City or County ordinances and zoning requirements. Control measures are site specific and must meet local agency requirements.

Where proposed project plans include outdoor areas for storage of materials that may contribute pollutants to the stormwater conveyance system, the following structural or treatment BMPS should be considered:

- Materials with the potential to contaminate stormwater should be: (1) placed in an enclosure such as, but not limited to, a cabinet, shed, or similar structure that prevents contact with runoff or spillage to the stormwater conveyance system, or (2) protected by secondary containment structures such as berms, dikes, or curbs.
- The storage area should be paved and sufficiently impervious to contain leaks and spills.
- The storage area should slope towards a dead-end sump to contain spills and direct runoff from downspouts/roofs should be directed away from storage areas.
- The storage area should have a roof or awning that extends beyond the storage area to minimize collection of stormwater within the secondary containment area. A manufactured storage shed may be used for small containers.

Note that the location(s) of installations of where these preventative measures will be employed must be included on the map or plans identifying BMPs.

Additional Information

Stormwater and non-stormwater will accumulate in containment areas and sumps with impervious surfaces. Contaminated accumulated water must be disposed of in accordance with applicable laws and cannot be discharged directly to the storm drain or sanitary sewer system without the appropriate permits.

Other Resources

A Manual for the Standard Urban Stormwater Mitigation Plan (SUSMP), Los Angeles County Department of Public Works, May 2002.

Model Standard Urban Storm Water Mitigation Plan (SUSMP) for San Diego County, Port of San Diego, and Cities in San Diego County, February 14, 2002.

Model Water Quality Management Plan (WQMP) for County of Orange, Orange County Flood Control District, and the Incorporated Cities of Orange County, Draft February 2003.

Ventura Countywide Technical Guidance Manual for Stormwater Quality Control Measures, July 2002.

Attachment F
Geotechnical Report

September 6, 2024
Project No. S168-193

STK ARCHITECTURE, INC.
42095 Zeno Drive, Suite A15
Temecula, California 92590

Attention: Tony Finaldi

Subject: Geotechnical Investigation
Proposed Fire Station 227
NWC Genevieve Street N. and W. 38th Street
San Bernardino, California

Dear Mr. Finaldi:

This report presents the results of the geotechnical investigation for the proposed Fire Station 227. The investigation was conducted in general conformance with our proposal dated March 6, 2024.

This report includes project design and construction recommendations along with the field and laboratory data. The primary geotechnical issues are the potential for strong ground shaking and the presence of variable soil conditions within the building areas that will require removal and recompaction.

We appreciate the opportunity to work with you on this project. Please call if you have any questions or need any other information.

Sincerely,
INLAND FOUNDATION ENGINEERING, INC.

Allen D. Evans, P.E., G.E.
Principal

Christopher Hogan Rangel, PG
Project Geologist
ADE:CHR:sd

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INTRODUCTION

This report presents the results of the geotechnical investigation conducted for the proposed San Bernardino County Fire Station 227. Fire Station 227 will be located on the northwest corner of Genevieve Street N. and W. 38th Street in San Bernardino, California. Our project understanding was based on the discussions with STK Architecture and review of the following plan.

- FS 227 – Conceptual Site Plan, W. 38th Street, San Bernardino, CA, prepared by STK Architecture Inc, dated June 12, 2024

SCOPE OF SERVICE

The purpose of this geotechnical investigation was to provide geotechnical parameters for design and construction of the proposed project. The scope of the geotechnical services included:

- *Evaluation of existing geologic conditions at the site and review of potential geologic and seismic hazards.*
- *Evaluation of the local and regional tectonic setting and historical seismic activity, including a site-specific ground motion analysis.*
- *Reconnaissance of the site and surrounding area to ascertain the presence of unstable or adverse geologic conditions.*
- *Subsurface sampling and laboratory testing.*
- *Analysis of the data collected and the preparation of this report with geotechnical engineering conclusions and recommendations for design and construction.*

Evaluation of hazardous waste was not within the scope of services provided.

PROJECT DESCRIPTION

The Fire Station No. 227 project will consist of the construction of a new single-story structure comprising approximately 9,870 square feet. The station will be constructed on the southerly portion of the existing Arrowhead Elementary School property.

The fire station will include 3 truck bays, sleeping quarters for 8 crew members and will provide storage for 2 Type 1 Engines and a future ladder truck. A storage building and generator / fuel tank pad will be constructed in the northwest site area. Foundations for

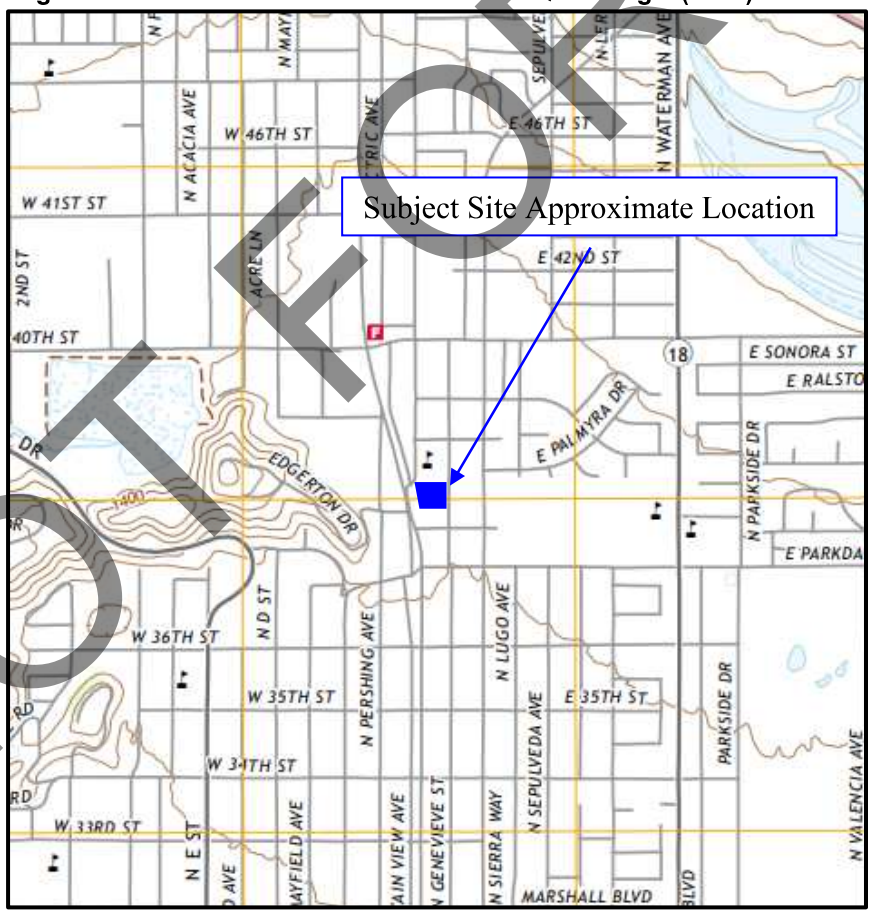
the proposed structures are expected to consist of shallow continuous and isolated concrete spread footings with slab-on-grade floors. Off-site improvements on Genevieve Street and 38th Street will be necessary. Site grading is expected to consist of minor cuts and fills of 2 to 3 feet, exclusive of remedial removals as recommended in this report.

Stormwater infiltration basins are planned in the southern and northwestern portions of the site. The basin depths are expected to be no deeper than five feet below existing surface grades.

SITE DESCRIPTION

The subject site is located on the northwest corner of Genevieve Street N. and W. 38th Street in San Bernardino, California (34.160118˚, -117.286677˚). The site occupies 1.21 acres and is currently covered with a grass field and large trees on the east, west and south sides. Figure 1 below shows the site location.

Figure 1: USGS San Bernardino North 7.5' Quadrangle (2021)



According to Google Earth, elevations at the site range from 1,279 to 1,283 feet above mean sea level (msl). The site slopes generally to the south at an overall rate of approximately 2 percent.

GEOLOGIC HAZARDS EVALUATION

A geologic hazards report for this project was prepared by our subconsultant, Terra Geosciences, and is appended. The engineering geology and seismicity review was performed using the suggested "Checklist for the Review of Geologic/Seismic Reports for California Public Schools, Hospitals and Essential Services Buildings" (California Geologic Survey, Note 48, 2022).

The geologic hazards study indicates that the proposed fire station and associated structures are considered feasible from a geologic standpoint, providing that the conclusions and recommendations presented in the report are considered during planning and construction. No adverse geologic conditions were found within the proposed construction area, with the exception of the potential for strong ground shaking from nearby seismogenic fault sources.

The geologic hazards study included a site-specific ground motion analysis. The mapped spectral acceleration parameters, coefficients, and other related seismic parameters were evaluated using the OSHPD Seismic Design Maps web application (OSHPD, 2020) and the California Building Code criteria (CBC, 2022), with the site-specific ground motion analysis being performed following Section 21 of the ASCE 7-16 Standard (2017). The results of the site-specific analysis are summarized and tabulated in Table 1 below:

Table 1: Seismic Design Parameters

Factor or Coefficient	Value
S_S	2.506g
S_1	1.002g
F_a	1.2g
F_V	1.7g
S_{DS}	1.670g
S_{D1}	1.620g
S_{MS}	2.506g
S_{M1}	2.429g
T_L	8 Seconds
MCE_G PGA	0.95g
Site Class	D

SUBSURFACE CONDITIONS

Subsurface exploration at the site consisted of four (4) exploratory borings to depths ranging from approximately 16.5 to 50.5 feet below existing site grades. The site exploration is described in Appendix A. Boring locations are shown on Figure A-7.

The soil encountered in the borings consisted of quaternary alluvial materials comprised of interlayered silty sand (SM), sand with silt and gravel (SP/SW-SM), and silty clayey sand (SC-SM). Cobbles and boulders were encountered in boring B-01 at a depth of 30.5 feet. The soil encountered was generally fine to very coarse grained, loose to very dense and in a slightly moist to moist state.

Corrosion Potential: Analytical testing indicates the concentration of sulfates is 52 ppm. In accordance with ACI 318, Table 4.2.1, the soil is classified as having a negligible sulfate exposure. The chloride concentration in the tested sample was 30 ppm and indicates that the soil is generally not corrosive with respect to ferrous metal. The soil is alkaline with a pH value of 8.5. The saturated minimum resistivity value of 7,790 ohm-cm indicates the soil may be moderately corrosive to buried ferrous metal. Alternative material such as PVC piping should be considered in the project design. Inland Foundation Engineering, Inc. does not practice corrosion engineering. A qualified corrosion engineer should be consulted for additional guidance.

Hydrocollapse Potential: Consolidation testing indicates that the soil is compressible and normally consolidated. The results show a slight to moderate potential for hydrocollapse when saturated under anticipated foundation and soil overburden loads. Provided that the building pad area is prepared as recommended herein, and appropriate surface drainage is provided in accordance with contemporary design practice, the potential for adverse building settlement due to hydrocollapse is not significant.

Expansive Soil: The site soil is granular, non-plastic, and non-expansive. Design measures to mitigate soil expansion are not necessary.

Groundwater: Groundwater was not encountered within the exploratory borings, which extended to a maximum depth of 50.5 feet below existing ground surface. Based on a review of pertinent groundwater data (referenced in appended geologic hazards report), the depth to the high groundwater mark in the general region is greater than 120 feet.

Liquefaction and Seismically-Induced Settlement: In general, liquefaction is a phenomenon that occurs where there is a loss of strength or stiffness in the soil that can result in the settlement of buildings, ground failure, or other hazards. The main factors contributing to this phenomenon are: 1) cohesionless, granular soil with relatively low density (usually of Holocene age); 2) shallow ground water (generally less than 50 feet);

and 3) moderate to high seismic ground shaking. Based on current and historical groundwater levels of more than 120 feet below ground surface, the potential for soil liquefaction is not significant.

"Dry sand" settlement occurs in loose granular soil as a result of seismic ground shaking. The potential for "dry sand" settlement was evaluated using GeoSuite® software and Pradel's method (1998). The results indicate a potential for seismically-induced "dry sand" settlement of less than 1 inch. The estimated differential seismic settlement is less than ½ inch over 30 feet. A discussion of the seismic settlement analysis, with graphic results, is included in Appendix D.

INFILTRATION TESTING

Infiltration testing was conducted in general accordance with Appendix D of the Technical Guidance Document for Water Quality Management Plans, prepared by CDM Smith for the County of San Bernardino Areawide Stormwater Program (2013). The shallow percolation test method was used per the Riverside County Department of Environmental Health guidelines. Four percolation tests were performed at the locations shown on Figure A-7. The testing procedures are described, and the test data is included in Appendix C of this report.

The test results are shown in Table 2. The corresponding calculated infiltration rate (I_c) ranges from 2.0 inches per hour to 5.7 inches per hour. These values exclude a factor of safety. The appropriate factor of safety should be determined by the design engineer.

Table 2: Infiltration Rate

Percolation Test No.	Percolation Rate (min/in)	Depth Below Ground Surface (in)	Infiltration Rate (I_c) (in/hr)
P-01	1.0	60	5.7
P-02	1.0	48	5.7
P-03	2.5	60	2.0
P-04	1.0	48	5.7

CONCLUSIONS AND RECOMMENDATIONS

The primary geotechnical issue that will require mitigation is the presence of loose compressible near surface soil conditions within the proposed structure areas. The near surface soil is not suitable for supporting foundations in its existing condition and should be over-excavated and recompacted. This and other geotechnical engineering recommendations for project design and construction are presented below.

Foundation Design: The proposed fire station and associated structures can be supported by shallow continuous and isolated spread footings designed with an allowable bearing pressure of 2,000 pounds per square foot (psf). Footings should have a minimum width of 12 inches and bottoms a minimum depth of 12 inches below the lowest adjacent grade. The allowable bearing pressure can be increased by 400 psf for each additional foot of width and by 800 psf for each additional foot of depth, to a maximum allowable bearing pressure of 4,000 psf. The allowable bearing pressure can be further increased by ⅓ for short-term transient wind and seismic loads.

Static settlement of footings designed and constructed as recommended herein is expected to be less than one inch. Differential settlement between footings of similar size and load is expected to be less than one-half inch.

Lateral Resistance: Resistance to lateral loads will be provided by a combination of friction acting at the base of the slab or foundation and passive earth pressure. A coefficient of friction of 0.45 between soil and concrete may be used with dead load forces only. A passive earth pressure of 250 psf/ft may be used for the sides of footings poured against recompacted or dense native material. These values may be increased by ⅓ for short-term transient wind and seismic loads. Passive earth pressure should be ignored within the upper one foot, except where confined as beneath a floor slab, for example.

Lateral Earth Pressure: Retaining walls should be designed for an active earth pressure equivalent to that exerted by a fluid weighing not less than 40 pcf. Any applicable construction or seismic surcharges should be added to this pressure. Retaining wall backfill should have an expansion index of less than 20.

Concrete Slabs-on-Grade: Concrete slabs-on-grade should have a minimum thickness of four inches. During final grading and prior to the placement of concrete, all surfaces to receive concrete slabs-on-grade should be compacted to maintain a minimum compacted fill thickness of 12 inches.

Load bearing slabs should be designed using a modulus of subgrade reaction (k) not exceeding 200 pounds per square inch per inch. This value is based on an applied foundation load area of 1.0 square foot. The k value should be reduced for larger foundation areas according to the following formula:

$k_R = k * ((B+1) / 2B))^2$

where k_R = reduced modulus of subgrade reaction
B = foundation width (feet)

Slabs should be designed and constructed in accordance with the provisions of the American Concrete Institute (ACI). Shrinkage of concrete should be anticipated and will result in cracks in all concrete slabs-on-grade. Shrinkage cracks may be directed to saw-cut "control joints" spaced on the basis of slab thickness and reinforcement.

Control joint spacing in unreinforced concrete at maximum intervals equal to the slab thickness times 24 is recommended.

Slabs to receive moisture-sensitive coverings should be provided with a moisture vapor retarder/barrier designed and constructed according to the American Concrete Institute 302.1 R, Concrete Floor and Slab Construction, which addresses moisture vapor retarder/barrier construction. At a minimum, the vapor retarder/barrier should comply with ASTM EI745 and have a nominal thickness of at least 10 mils. The vapor retarder/barrier should be properly sealed, per the manufacturer's recommendations, and protected from punctures and other damage.

Portland Cement Concrete (PCC) Pavement: All surfaces that will support fire apparatus should be paved with Portland cement concrete (PCC). PCC pavement should consist of 9 inches of PCC over 6 inches of Class 2 aggregate base. The concrete should have a minimum 28-day modulus of rupture of 600 psi. This corresponds to a compressive strength of approximately 4,500 psi.

For all other areas that will utilize PCC pavement the below table can be utilized for design sections. The following Portland cement concrete pavement sections are based on the American Concrete Institute (ACI) Guide for Design and Construction of Concrete Parking Lots and Site Paving (ACI 330-21). The concrete to be utilized for Category A and B areas as well as pedestrian areas should have a minimum 28-day modulus of rupture of 500 psi. This corresponds to a compressive strength of approximately 2,500 psi. The actual pavement subgrade soil should be evaluated during construction to verify that the recommended pavement sections are appropriate.

Table 3: Portland Cement Concrete Pavement

Service	Concrete Thickness (in.)	Aggregate Base (in.)
Car parking and access lanes (Category A)	4.25	4.0
Entrance and truck service lanes (Category B)	5.25	4.0
Pedestrian, non-vehicular hardscape	4.0	0.0

The Class 2 aggregate base should comply with current Caltrans requirements. The aggregate base should be compacted to at least 95 percent relative compaction based on ASTM D1557. The upper 12 inches of pavement subgrade soil, below the aggregate base, should also be compacted to a minimum relative compaction of 95 percent.

The concrete pavement should be constructed with doweled joints and be restrained laterally by concrete curb/gutter or building foundations. The edges of the concrete should be protected from traffic loads by curbs or paved shoulders. If unrestrained pavement edges or non-doweled joints are desired, this firm should be contacted so that revised recommendations can be developed.

Construction joints should be sawcut in the pavement at a maximum spacing of 30 times the thickness of the slab, up to a maximum of 15 feet. Pavement sawcutting should be performed within 12 hours of concrete placement, preferably sooner. Sawcut depths should be equal to approximately ¼ of the slab thickness for conventional saws or one inch when early-entry saws are utilized on slabs nine inches thick or less. Construction joints should not be placed near flow lines. The use of plastic strips for formation of jointing is not recommended. The use of expansion joints is not recommended, except where the pavement will adjoin structures.

Asphalt Concrete Pavement: Recommended asphalt concrete structural pavement sections are shown below in Table 4.

Table 4: Asphalt Concrete Pavement

Service	Asphalt Concrete Thickness (ft.)	Base Course Thickness (ft.)
Light traffic (autos, parking areas, T.I. = 5.0)	0.25	0.35
Heavy traffic (trucks, driveways, T.I. =7.0)	0.30	0.45

Inland Foundation Engineering, Inc. does not practice traffic engineering. The T.I. values used to develop the recommended pavement sections are typical for projects of this type. The project civil engineer or traffic engineer should review the T.I. values used to verify that they are appropriate for this project.

General Site Grading: All grading should be performed per the applicable provisions of the 2022 California Building Code and the following recommendations.

1. **Clearing and Grubbing:** All building and pavement areas and all surfaces to receive compacted fill should be cleared of vegetation, debris, and other unsuitable materials. All such material should be disposed of off-site.

   All undocumented artificial fill and loose native soil within the grading limits should be completely removed. Such material is suitable for use as compacted fill as recommended herein.

2. **Preparation of Surfaces to Receive Compacted Fill:** All surfaces to receive compacted fill should be reviewed by a geologist or engineer from this firm prior

to processing. If roots or other deleterious materials are encountered or if the exposed excavation bottom is loose or unstable, additional over-excavation may be required until satisfactory conditions are encountered. Upon approval, surfaces to receive fill should be scarified to a minimum depth of eight inches, brought to near optimum moisture content, and compacted to a minimum of 90 percent relative compaction.

3. **Placement of Compacted Fill:** Fill materials consisting of on-site soil or approved imported granular soil should be spread in shallow lifts and compacted at near optimum moisture content to a minimum of 90 percent relative compaction, based on ASTM D1557. Fill placed within 10 feet of finish grade should not contain any particles larger than 12 inches (boulders). Boulder-size particles should be disposed of off-site or in designated rock disposal fill areas.

4. **Import Soil:** All proposed import soil should be tested prior to placement on the site to verify that it is not corrosive or expansive. Recommended import soil criteria are shown in the following Table 5.

Table 5: Recommended Import Soil Criteria

Sieve Size	Recommended Criteria
Percent Passing 3-Inch Sieve	100
Percent Passing No. 4 Sieve	85 – 100
Percent Passing No. 200 Sieve	15 – 40
Plasticity Index	Less than 15
Expansion Index (ASTM D4829)	20 or less (very low)
Organic content	Less than 1 percent by weight
Sulfates	< 1,000 ppm
Min. Resistivity	> 10,000 ohm-cm

5. **Preparation of Building Areas:** All proposed building areas should be over-excavated to a depth of at least 8 feet below existing grade or 24 inches below the bottom of the deepest footing, whichever is greater. Building area excavation should extend laterally for at least 5 feet outside of exterior building foundation lines. Following excavation, the exposed soil should be evaluated by this firm to verify it is suitable to receive compacted fill. The removed soil should be placed and compacted as recommended above. Soil within 5 feet of finish grade and within 2 feet of footing and slab bottoms should not contain any particles larger than 3 inches (cobbles).

6. **Preparation of Paving Areas:** During final grading and immediately prior to the placement of aggregate base, all surfaces to receive asphalt concrete or Portland cement concrete paving should be processed to remove all particles larger than 3 inches within 12 inches of subgrade. The upper 12 inches of pavement subgrade should be tested to assure compaction for a depth of at least 12 inches. Compaction within proposed pavement areas should be to a minimum of 95 percent relative compaction for both the subgrade and base course.

7. **Utility Trench Backfill:** Utility trench backfill consisting of the on-site soil types should be placed by mechanical compaction to a minimum of 90 percent relative compaction. This is with the exception of the upper 12 inches under pavement areas where the minimum relative compaction should be 95 percent. Jetting of the native soil is not recommended.

8. **Testing and Observation:** During grading, tests and observations should be performed by a representative of this firm to verify that the grading is performed per the project specifications. Density testing should be performed per the current ASTM D1556 or ASTM D6938 test methods. The minimum acceptable degree of compaction should be 90 percent of the maximum dry density, based on ASTM D1557, except where superseded by more stringent requirements, such as beneath pavement. Where testing indicates insufficient density, additional compactive effort should be applied until retesting indicates satisfactory compaction.

LIMITATIONS

The findings and recommendations presented in this report are based on the soil conditions encountered at the boring locations. Should conditions be encountered during grading that appear to be different than those indicated by this report, this office should be notified.

This report was prepared for STK Architecture, Inc. for their use in the design of the proposed Fire Station No. 227. This report may only be used by STK Architecture, Inc for this purpose. The use of this report by parties or for other purposes is not authorized without written permission by Inland Foundation Engineering, Inc. Inland Foundation Engineering, Inc. will not be liable for any projects connected with the unauthorized use of this report.

The recommendations of this report are considered to be preliminary. The final design parameters may only be determined or confirmed at the completion of site grading on the basis of observations made during the site grading operation. To this extent, this report is not considered to be complete until the completion of both the design process and the site preparation.

The information in this report represents professional opinions that have been developed using that degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical consultants practicing in this or similar localities. No warranty, express or implied, is made.

REFERENCES

American Concrete Institute 318 (2019), Building Code Requirements for Structural Concrete.

American Society of Civil Engineers (ASCE), 2017, Minimum Design Loads and Associated Criteria for Buildings and other Structures, ASCE Standard 7-16, 889pp.

California Building Standards Commission, 2022, California Building Code (CBC), California Code of Regulations, Title 24, Part 2, Volume 2.

County of San Bernardino (2013), Areawide Stormwater Program, Technical Guidance Document for Water Quality Management Plans

Terra Geosciences, Geologic Hazards Report, San Bernardino County Fire Station 227, NWC of 38th Street and Genevieve Avenue, City of San Bernardino, California, Project No. 244073-1, dated July 20, 2024

United States Geologic Survey, San Bernardino North 7.5' Quadrangle (2021)

APPENDIX A –
Site Exploration

APPENDIX A

SITE EXPLORATION

Four exploratory borings were drilled at the approximate locations shown on Figure A-7. The materials encountered during drilling were logged by a staff geologist. Boring logs are included with this report as Figures A-3 through A-6.

Representative undisturbed soil samples were obtained within the borings by driving a modified California split spoon sampler and thin-walled steel penetration sampler. Representative bulk soil samples were also obtained from the excavation cuttings. Samples were placed in moisture sealed containers and transported to our laboratory for further testing and evaluation. Laboratory tests results are discussed and included in Appendix B.

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D2487)

PRIMARY DIVISIONS			GROUP SYMBOLS		SECONDARY DIVISIONS
COARSE GRAINED SOILS – MORE THAN HALF OF MATERIALS IS LARGER THAN #200 SIEVE SIZE	GRAVELS – MORE THAN HALF OF COARSE FRACTION IS LARGER THAN #4 SIEVE	CLEAN GRAVELS (LESS THAN) 5% FINES	GW		WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
			GP		POORLY GRADED GRAVELS OR GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVEL WITH FINES	GM		SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			GC		CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS – MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN #4 SIEVE	CLEAN SANDS (LESS THAN) 5% FINES	SW		WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
			SP		POORLY GRADED SANDS OR GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES	SM		SILTY SANDS, SAND-SILT MIXTURES
			SC		CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS – MORE THAN HALF OF MATERIALS IS SMALLER THAN #200 SIEVE SIZE	SILTS AND CLAYS – LIQUID LIMIT IS LESS THAN 50		ML		INORGANIC SILTS, VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS
			CL		INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL		ORGANIC SILTS AND ORGANIC SILT-CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS – LIQUID LIMIT IS GREATER THAN 50		MH		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDS OR SILTS, ELASTIC SILTS
			CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH		ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
	HIGHLY ORGANIC SOILS		PT		PEAT, MUCK AND OTHER HIGHLY ORGANIC SOILS
TYPICAL FORMATIONAL MATERIALS	SANDSTONES		SS		
	SILTSTONES		SH		
	CLAYSTONES		CS		
	LIMESTONES		LS		
	SHALE		SL		

CONSISTENCY CRITERIA BASES ON FIELD TESTS

RELATIVE DENSITY – COARSE – GRAIN SOIL

RELATIVE DENSITY	SPT * (# BLOWS/FT)	RELATIVE DENSITY (%)
VERY LOOSE	<4	0-15
LOOSE	4-10	15-35
MEDIUM DENSE	10-30	35-65
DENSE	30-50	65-85
VERY DENSE	>50	85-100

CONSISTENCY – FINE-GRAIN SOIL

CONSISTENCY	SPT* (# BLOWS/FT)	TORVANE: UNDRAINED SHEAR STRENGTH (tsf)	POCKET ** PENETROMETER: UNCONFINED COMPRESSIVE STRENGTH (tsf)
Very Soft	<2	<0.13	<0.25
Soft	2-4	0.13-0.25	0.25-0.5
Medium Stiff	4-8	0.25-0.5	0.5-1.0
Stiff	8-15	0.5-1.0	1.0-2.0
Very Stiff	15-30	1.0-2.0	2.0-4.0
Hard	>30	>2.0	>4.0

* NUMBER OF BLOWS OF 140 POUND HAMMER FALLING 30 INCHES TO DRIVE A 2 INCH O.D. (1 3/8 INCH I.D.) SPLIT BARREL SAMPLER (ASTM -1586 STANDARD PENETRATION TEST)

** UNCONFINED COMPRESSIVE STRENGTH IN TONS/SQ.FT. READ FROM POCKET PENETROMETER

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
DRY	Absence of moisture, dusty, dry to the touch
MOIST	Damp but no visible water
WET	Visible free water, usually soil is below water table

CEMENTATION

DESCRIPTION	FIELD TEST
Weakly	Crumbled or breaks with handling or slight finger pressure
Moderately	Crumbles or breaks with considerable finger pressure
Strongly	Will not crumble or break with finger pressure

LOG OF BORING B-01

DRILLING RIG	Mobile B-61	DATE DRILLED	7/11/24	HAMMER TYPE	Auto-Trip
DRILLING METHOD	Rotary Auger			HAMMER WEIGHT	140-lb.
LOGGED BY	FWC			HAMMER DROP	30-inches
GROUND ELEVATION	+/-			BORING DIAMETER	8-inches

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	BULK SAMPLE	DRIVE SAMPLE	SAMPLE TYPE	BLOW COUNTS /6"	MOISTURE (%)	DRY UNIT WT. (pcf)
			This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered and is representative of interpretations made during drilling. Contrasting data derived from laboratory analysis may not be reflected in these representations.						
			GRASS,			AU			
	SM		**SILTY SAND,** with trace gravel, fine to very coarse, very dark grayish-brown (10YR 3/2), moist, medium dense.			SS	9 9	11	112
5	SP-SM		**SAND with SILT and GRAVEL,** fine to very coarse, gray-brown (2.5Y 5/2), slightly moist, medium dense.			AU			
						SS	6 11	6	93
	SM		**SILTY SAND,** with trace gravel, fine to very coarse, very dark grayish-brown (10YR 3/2), moist, medium dense.						
10			**SAND with SILT and GRAVEL,** fine to coarse, grayish-brown (10YR 5/2), slightly moist, medium dense.			SS	8 13	5	113
	SW-SM					AU			
						SS	23 18	2	130
15									
						SS	9 10	12	117
	SC-SM		**SILTY, CLAYEY SAND,** very fine to fine, olive-brown (2.5Y 4/4), moist, medium dense.						
20			**SAND with SILT and GRAVEL,** fine to very coarse, light olive-brown (2.5Y 5/4), slightly moist, medium dense.						
	SW-SM					SS	18 25	5	114
25									
	SM		**SILTY SAND,** with trace gravel, very fine to fine, grayish-brown (2.5Y 5/2), moist, dense.			SPT	33 28	10	
	SW-SM		**SAND with SILT and GRAVEL,** fine to very coarse, gray-brown (2.5Y 5/2), slightly moist, medium dense.						
30						SPT	30 50/3"	2	
			COBBLES and BOULDERS,						
			End of boring at 30.8 feet. No groundwater encountered. Backfilled with native soil.						

IFE Inland Foundation Engineering, Inc.

CLIENT	STK Architecture, Inc.
PROJECT NAME	Fire Station #227
PROJECT LOCATION	NWC Genevieve St. & W. 38th St. San Bernardino, CA
PROJECT NUMBER	S168-193

FIGURE NO. A-3

LOG OF BORING B-02

DRILLING RIG	Mobile B-61	DATE DRILLED	7/11/24	HAMMER TYPE	Auto-Trip
DRILLING METHOD	Rotary Auger			HAMMER WEIGHT	140-lb.
LOGGED BY	FWC			HAMMER DROP	30-inches
GROUND ELEVATION	+/-			BORING DIAMETER	8-inches

SUMMARY OF SUBSURFACE CONDITIONS

This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered and is representative of interpretations made during drilling. Contrasting data derived from laboratory analysis may not be reflected in these representations.

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	BULK SAMPLE	DRIVE SAMPLE	SAMPLE TYPE	BLOW COUNTS /6"	MOISTURE (%)	DRY UNIT WT. (pcf)
0								
5	SM			☒	SS	6 6	5	109
				☒	SS	4 5	9	106
10	SM			☒	SS	8 12	3	109
	SP-SM			☒	SS	6 8	8	110
15				☒	SS	12 14	6	107
				☒	SS	17 24	3	117
20								
	SW-SM			⧓	SPT	13 19	5	
25								
				⧓	SPT	35 50	3	
30	GW							
				⧓	SPT	50	2	
35								
				⧓	SPT	50/5"	3	
40								
				⧓	SPT	31 50	3	
45								
				⧓	SPT	50/5"	7	
50								

GRASS,

SILTY SAND, with trace gravel, fine to medium, dark grayish-brown (10YR 5/2), moist, loose.

SILTY SAND, with trace gravel, fine to medium, light olive-brown (2.5Y 5/2), slightly moist, medium dense.

SAND with SILT, fine to coarse, dark grayish-brown (10YR 4/2), moist, loose to medium dense.

SAND with SILT and GRAVEL, fine to medium, grayish-brown (10YR 5/2), slightly moist, medium dense.

GRAVEL with SAND, fine to coarse, olive-gray (5Y 4/2), moist, dense.

SAND with SILT and GRAVEL, fine to medium, olive-gray (5Y 5/2), slightly moist, dense.

End of boring at 50.5 feet. No groundwater encountered. Backfilled with native soil.

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CLIENT	STK Architecture, Inc.
PROJECT NAME	Fire Station #227
PROJECT LOCATION	NWC Genevieve St. & W. 38th St. San Bernardino, CA
PROJECT NUMBER	S168-193

FIGURE NO. A-4

LOG OF BORING B-03

DRILLING RIG	Mobile B-61	DATE DRILLED	7/11/24	HAMMER TYPE	Auto-Trip
DRILLING METHOD	Rotary Auger			HAMMER WEIGHT	140-lb.
LOGGED BY	FWC			HAMMER DROP	30-inches
GROUND ELEVATION	+/-			BORING DIAMETER	8-inches

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	BULK SAMPLE	DRIVE SAMPLE	SAMPLE TYPE	BLOW COUNTS /6"	MOISTURE (%)	DRY UNIT WT. (pcf)
			This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered and is representative of interpretations made during drilling. Contrasting data derived from laboratory analysis may not be reflected in these representations.						
			GRASS,			AU			
			SILTY SAND, fine to medium, dark grayish-brown (2.5Y 4/2), slightly moist, loose.						
					X	SS	3 6	4	107
	SM								
5					X	SS	3 8	7	111
			- rootlets throughout -						
			SAND with SILT and GRAVEL, fine to coarse, light olive-brown (2.5Y 5/3), slightly moist, medium dense.			AU			
					X	SS	8 11	3	108
10	SP-SM								
					X	SS	12 25	4	116
	SM		**SILTY SAND,** fine to coarse, brown (10YR 4/2), moist, medium dense.						
	SW-SM		**SAND with SILT and GRAVEL,** fine to coarse, light olive-brown (2.5Y 5/3), slightly moist, medium dense.						
15									
	SM		**SILTY SAND with GRAVEL,** fine to medium, light olive-brown (2.5Y 5/3), slightly moist, medium dense.		X	SS	10 14	5	113
			SAND with SILT and GRAVEL, fine to coarse, OLIVE-GRAY (5y 4/2), slightly moist, medium dense.						
	SW-SM								
20					X	SS	21 35	2	131
			End of boring at 21.5 feet. No groundwater encountered. Backfilled with native soil.						

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CLIENT	STK Architecture, Inc.
PROJECT NAME	Fire Station #227
PROJECT LOCATION	NWC Genevieve St. & W. 38th St. San Bernardino, CA
PROJECT NUMBER	S168-193

FIGURE NO. A-5

LOG OF BORING B-04

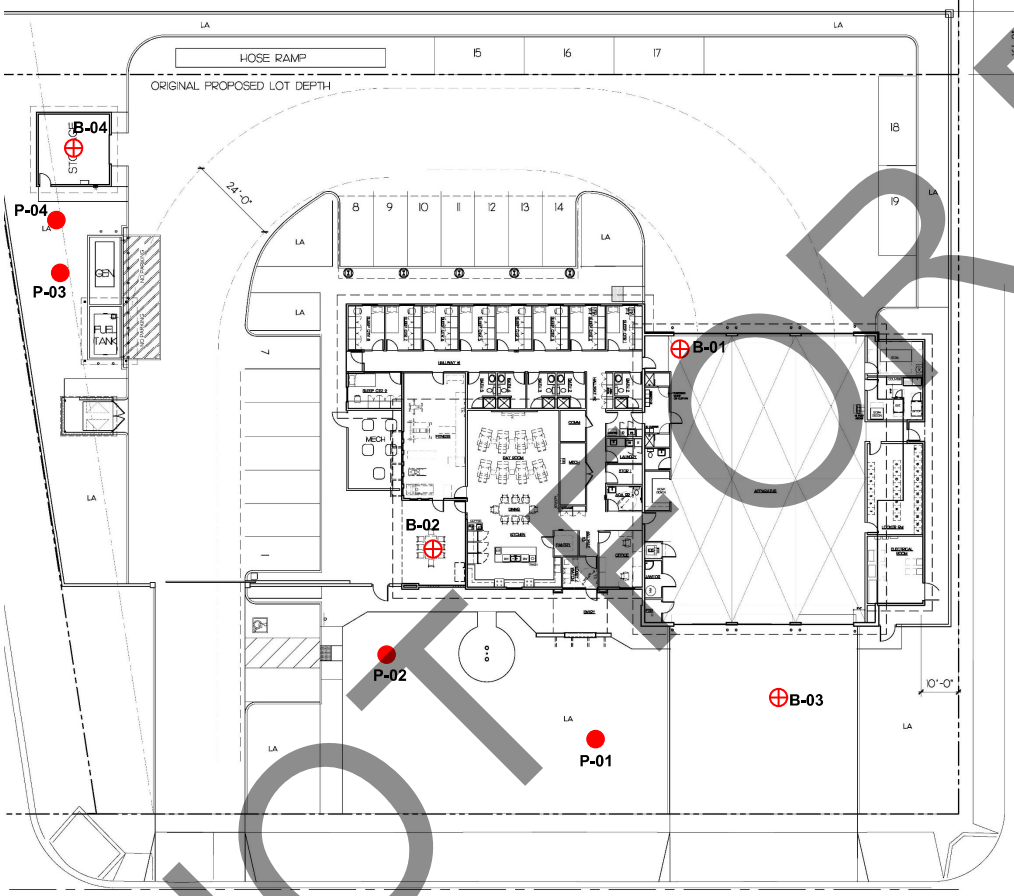
DRILLING RIG	Mobile B-61	DATE DRILLED	7/11/24	HAMMER TYPE	Auto-Trip
DRILLING METHOD	Rotary Auger			HAMMER WEIGHT	140-lb.
LOGGED BY	FWC			HAMMER DROP	30-inches
GROUND ELEVATION	+/-			BORING DIAMETER	8-inches

DEPTH (ft)	U.S.C.S.	GRAPHIC LOG	SUMMARY OF SUBSURFACE CONDITIONS	BULK SAMPLE	DRIVE SAMPLE	SAMPLE TYPE	BLOW COUNTS /6"	MOISTURE (%)	DRY UNIT WT. (pcf)
			This summary applies only at the location of the boring and at the time of drilling. Subsurface conditions may differ at other locations and may change at this location with the passage of time. The data presented is a simplification of actual conditions encountered and is representative of interpretations made during drilling. Contrasting data derived from laboratory analysis may not be reflected in these representations.						
			GRASS,			AU			
	SM		**ARTIFICIAL FILL,** SILTY SAND, with trace gravel, fine to medium, grayish-brown (10YR 5/2), slightly moist, medium dense.						
						SS	16 18	3	110
	SM		**SILTY SAND,** fine to coarse, grayish-brown (10YR 5/2), slightly moist, medium dense.			AU			
5			**SAND with SILT and GRAVEL,** with trace gravel, fine to coarse, light olive-brown 2.5Y 5/4), slightly moist, medium dense.			SS	10 14	3	115
	SW-SM					SS	8 8	6	102
10			**GRAVEL with SAND,** fine to coarse, light olive-brown (2.5Y 5/4), slightly moist, medium dense.						
	GW					SS	11 14	3	115
			SAND with SILT and GRAVEL, with trace gravel, fine to coarse, light olive-brown 2.5Y 5/4), slightly moist, medium dense.						
15	SW-SM					SS	22 31	4	
			End of boring at 16.5 feet. No groundwater encountered. Backfilled with native soil.						

IFE Inland Foundation Engineering, Inc.

CLIENT	STK Architecture, Inc.
PROJECT NAME	Fire Station #227
PROJECT LOCATION	NWC Genevieve St. & W. 38th St. San Bernardino, CA
PROJECT NUMBER	S168-193

FIGURE NO. A-6



SITE PLAN

STK Architecture, Inc.

Proposed Fire Station 227

NWC Genevieve Street N. and W. 38th Street

San Bernardino County, California

LEGEND

Approximate Location of Exploratory Boring - ⊕

Approximate Location of Percolation Test - ●

Base Map: Prepared by STK Architecture, Inc.

N

IFE Inland Foundation Engineering, Inc.
1310 S. Santa Fe Avenue, San Jacinto, CA 92583 | (951) 654-1555

Figure A-7	STK Architecture, Inc. Proposed Fire Station 227 San Bernardino County, California	
	Drawn By: HR	Project No. S168-193
	Not to Scale	Date: August 2024

APPENDIX B –
Laboratory Testing

APPENDIX B

LABORATORY TESTING

Representative soil samples obtained from our borings were delivered to our laboratory. Descriptions of the tests performed are provided below. Results of the testing are appended.

Unit Weight and Moisture Content: Ring samples were weighed and measured to evaluate their unit weight. A small portion of each sample was then tested for moisture content. The testing was performed per ASTM D2937 and D2216. The results of this testing are shown on the boring logs (Figures A-3 through A-6).

Maximum Density-Optimum Moisture: One sample was selected for maximum density testing in accordance with ASTM D1557. The maximum density is compared to the in-situ density of the soil to evaluate the relative compaction of the soil. The results of the testing are shown on Figure B-3.

Sieve Analysis: Ten soil samples were selected for sieve analysis testing in accordance with ASTM D6913. These tests provide information for classifying the soil in accordance with the Unified Classification System. This classification system categorizes the soil into groups having similar engineering characteristics. The results of the testing are shown on Figures B-4 and B-5.

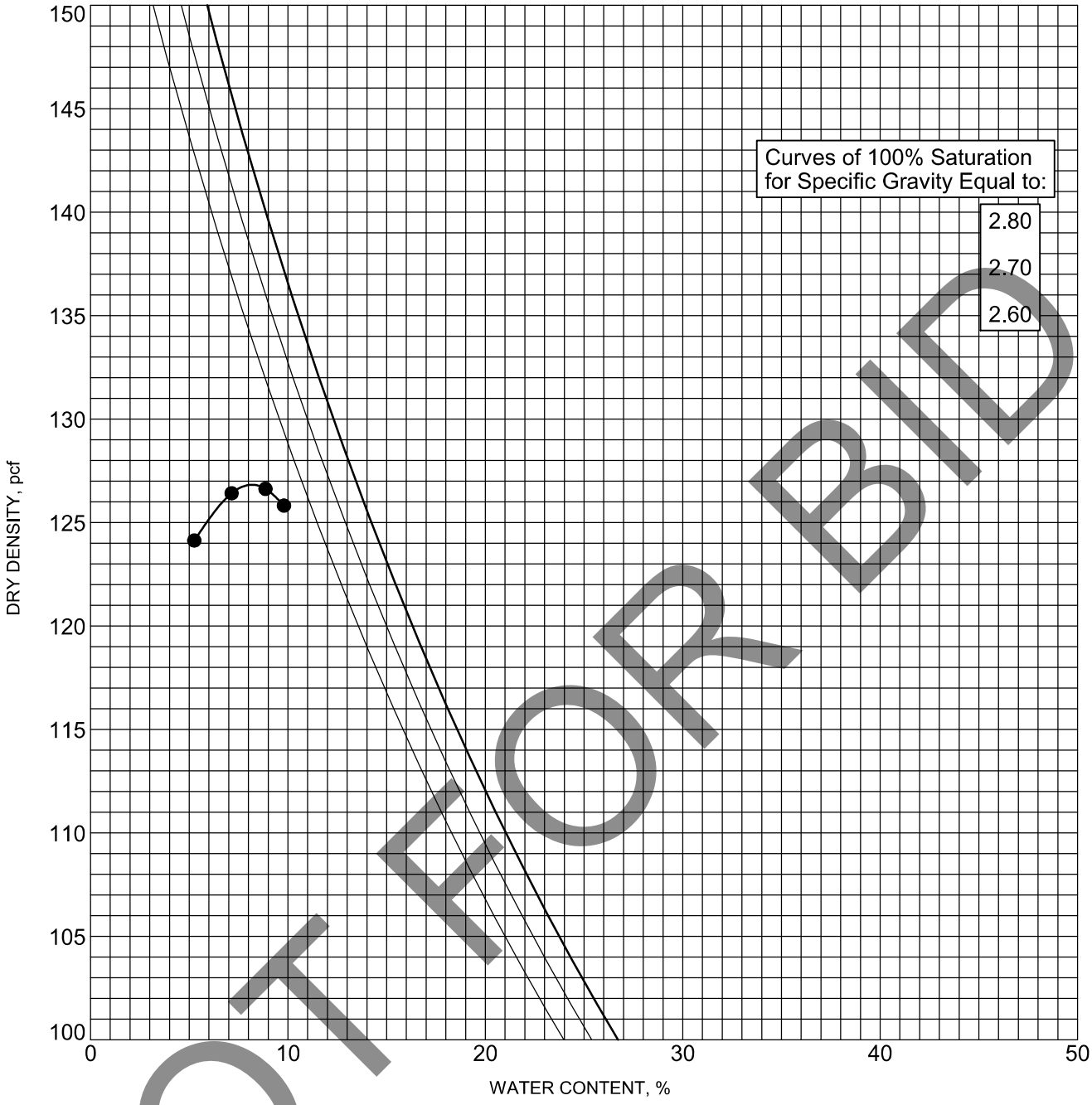
Plastic Index: Two samples were selected for plastic index testing in accordance with ASTM D4318. These tests provide information regarding soil plasticity and are also used for developing classifications for the soil in accordance with the Unified Classification System. The results of the testing are shown on Figures B-4 and B-5.

Consolidation Testing: Two samples were selected for consolidation testing in accordance with ASTM D2435. This test is used to evaluate the magnitude and rate of settlement of a structure or earth fill. The results of this testing are presented graphically on Figure B-6.

Direct Shear Strength: Two samples were selected and transported to AP Engineering and Testing in Pomona, California for direct shear strength testing in accordance with ASTM D3080. This testing measures the shear strength of the soil under various normal pressures and is used to develop parameters for foundation bearing capacity and lateral earth pressure. Test results are shown on Figures B-7 and B-8.

Corrosion Testing: One sample was selected and transported to AP Engineering and Testing in Pomona, California to evaluate the concentration of soluble sulfates and chlorides, pH level, and resistivity of and within the on-site soils. The test results are shown on Figure B-9.

R-value: One sample was selected for R-value and delivered to Terracon in Colton, California for testing in accordance with ASTM D2844. This test measures the potential strength of subgrade, subbase, and base course materials for use in pavements. Test results are shown on Figure No. B-10.



BOREHOLE	DEPTH	Description of Materials	Max DD	Optimum WC
● B-01	0.0	**SILTY SAND with GRAVEL(SM)**	**126.8 PCF**	**8.1 %**

MOISTURE-DENSITY CURVES (ASTM D1557)

INLAND FOUNDATION ENGINEERING, INC.

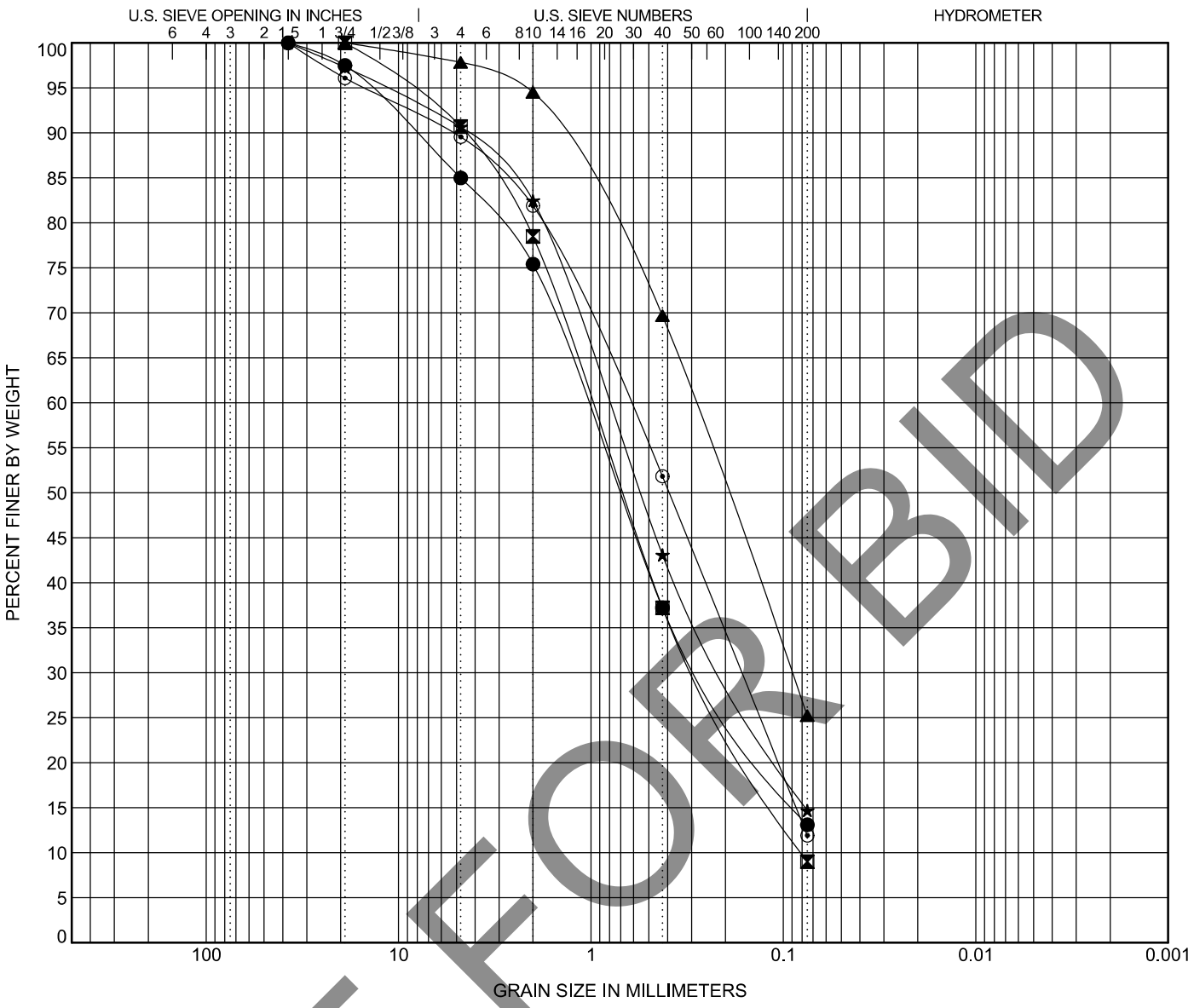
FIGURE NO. B-3

CLIENT STK Architecture, Inc.

PROJECT NAME Fire Station #227

PROJECT NUMBER S168-193

PROJECT LOCATION NWC Genevieve St. & W. 38th St.
San Bernardino, CA



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	SAMPLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	B-01	0.0	SILTY SAND with GRAVEL(SM)	NP	NP	NP		
⊠	B-01	4.5	POORLY GRADED SAND with SILT(SP-SM)	NP	NP	NP	0.93	12.53
▲	B-02	0.3	SILTY SAND(SM)	NP	NP	NP		
★	B-02	8.0	SILTY SAND(SM)	NP	NP	NP		
⊙	B-02	12.5	POORLY GRADED SAND with SILT(SP-SM)	NP	NP	NP	0.61	9.38

	BOREHOLE	DEPTH	D100	D90	D50	D10	%Gravel	%Sand	%Silt	%Clay
●	B-01	0.0	37.5	8.278	0.714		15.0	71.9	13.1	
⊠	B-01	4.5	19	4.517	0.687	0.08	9.3	81.7	9.0	
▲	B-02	0.3	19	1.51	0.197		2.2	72.6	25.2	
★	B-02	8.0	37.5	4.43	0.558		9.3	76.0	14.7	
⊙	B-02	12.5	37.5	5.223	0.393		10.4	77.6	11.9	

GRADATION CURVES (ASTM D6913, ASTM D4318)

INLAND FOUNDATION ENGINEERING, INC.

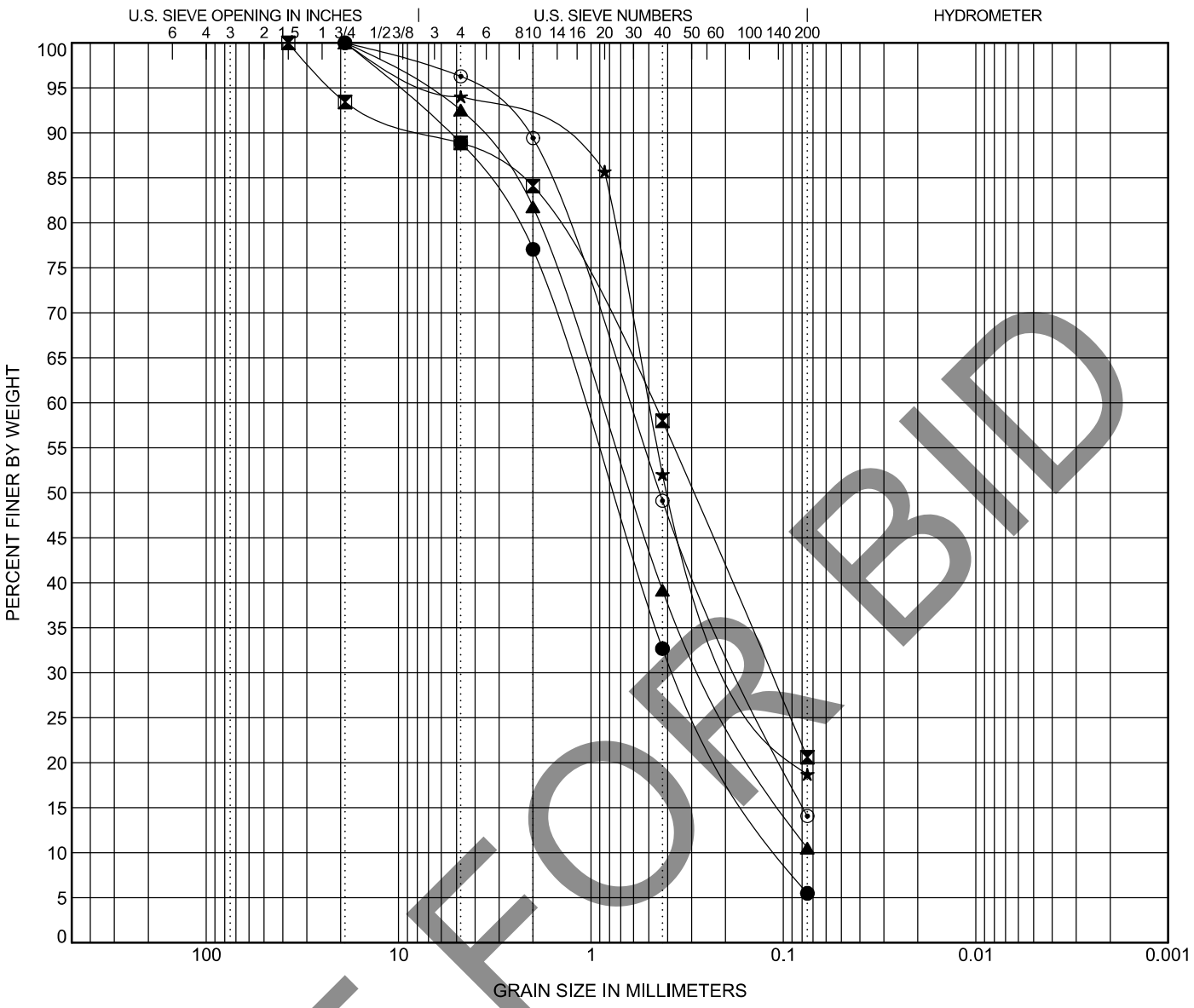
FIGURE NO. B-4

CLIENT STK Architecture, Inc.

PROJECT NAME Fire Station #227

PROJECT NUMBER S168-193

PROJECT LOCATION NWC Genevieve St. & W. 38th St.
San Bernardino, CA



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	SAMPLE	DEPTH	Classification	LL	PL	PI	Cc	Cu
●	B-02	20.5	WELL-GRADED SAND with SILT(SW-SM)	NP	NP	NP	1.16	11.03
⊠	B-03	0.3	SILTY SAND(SM)	NP	NP	NP		
▲	B-03	7.8	POORLY GRADED SAND with SILT(SP-SM)	NP	NP	NP	0.90	12.46
★	B-04	0.3	SILTY SAND(SM)	NP	NP	NP		
⊙	B-04	2.0	SILTY SAND(SM)	NP	NP	NP		

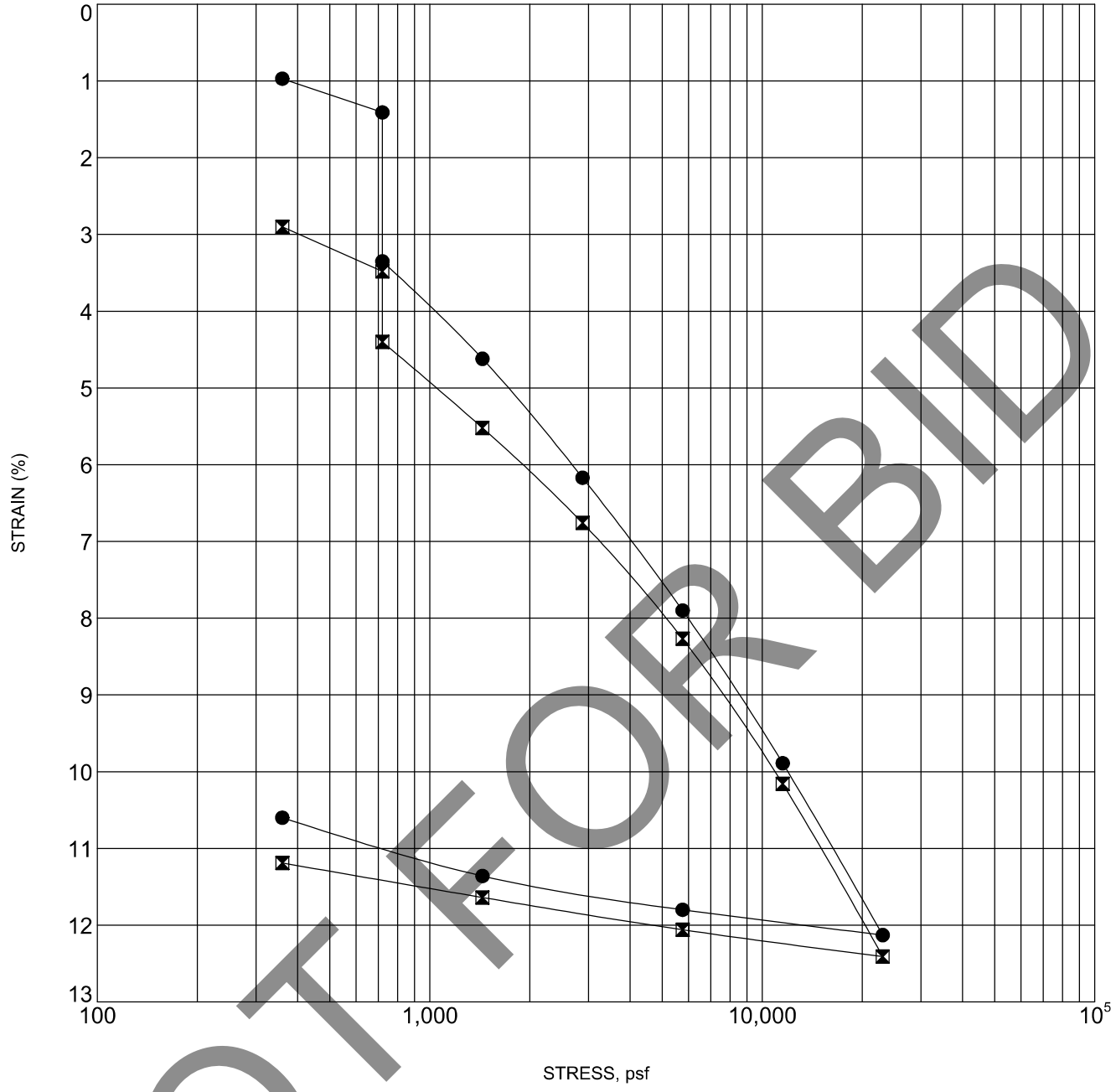
	BOREHOLE	DEPTH	D100	D90	D50	D10	%Gravel	%Sand	%Silt	%Clay
●	B-02	20.5	19	5.451	0.778	0.1	11.1	83.4	5.5	
⊠	B-03	0.3	37.5	6.699	0.293		11.1	68.2	20.6	
▲	B-03	7.8	19	3.874	0.63		7.5	82.0	10.5	
★	B-04	0.3	19	2.069	0.382		6.0	75.3	18.7	
⊙	B-04	2.0	19	2.151	0.44		3.7	82.2	14.1	

GRADATION CURVES (ASTM D6913, ASTM D4318)

INLAND FOUNDATION ENGINEERING, INC.

FIGURE NO. B-5

CLIENT STK Architecture, Inc.
PROJECT NAME Fire Station #227
PROJECT NUMBER S168-193
PROJECT LOCATION NWC Genevieve St. & W. 38th St.
San Bernardino, CA



BOREHOLE	DEPTH	Classification	γ_d	MC%
● B-02	6.5			
⊠ B-03	5.5			

CONSOLIDATION TEST (ASTM D2435)

FIGURE NO. B-6

INLAND FOUNDATION ENGINEERING, INC.

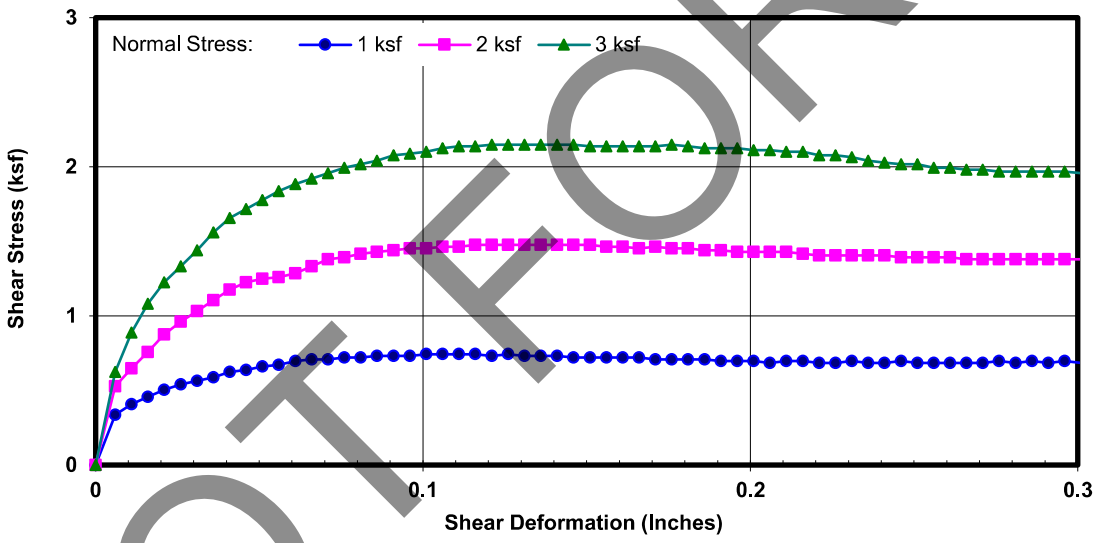
CLIENT STK Architecture, Inc.
PROJECT NAME Fire Station #227
PROJECT NUMBER S168-193
PROJECT LOCATION NWC Genevieve St. & W. 38th St.
San Bernardino, CA

AP Engineering and Testing, Inc.
DBE|MBE|SBE
2607 Pomona Boulevard | Pomona, CA 91768
t. 909.869.6316 | f. 909.869.6318 | www.aplaboratory.com

DIRECT SHEAR TEST RESULTS
ASTM D 3080

Project Name: STK - Fire Station 227 | **Tested By:** ST | **Date:** 08/02/24
Project No.: 5163-193 | **Computed By:** JP | **Date:** 08/07/24
Boring No.: B-02 | **Checked by:** AP | **Date:** 08/07/24
Sample No.: - | **Depth (ft):** 3.5-4.5
Sample Type: Mod. Cal.
Soil Description: Silty Sand
Test Condition: Inundated | **Shear Type:** Regular

Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Initial Moisture Content (%)	Final Moisture Content (%)	Initial Degree Saturation (%)	Final Degree Saturation (%)	Normal Stress (ksf)	Peak Shear Stress (ksf)	Ultimate Shear Stress (ksf)
110.0	106.4	3.4	19.3	16	89	1	0.744	0.684
						2	1.476	1.380
						3	2.148	1.956



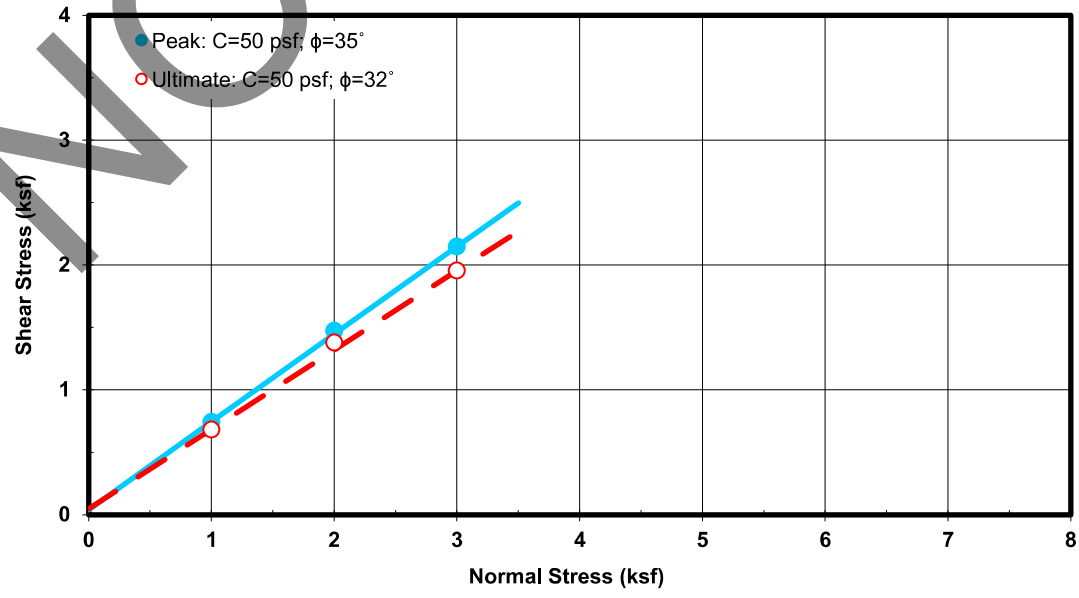


Figure No. B-7

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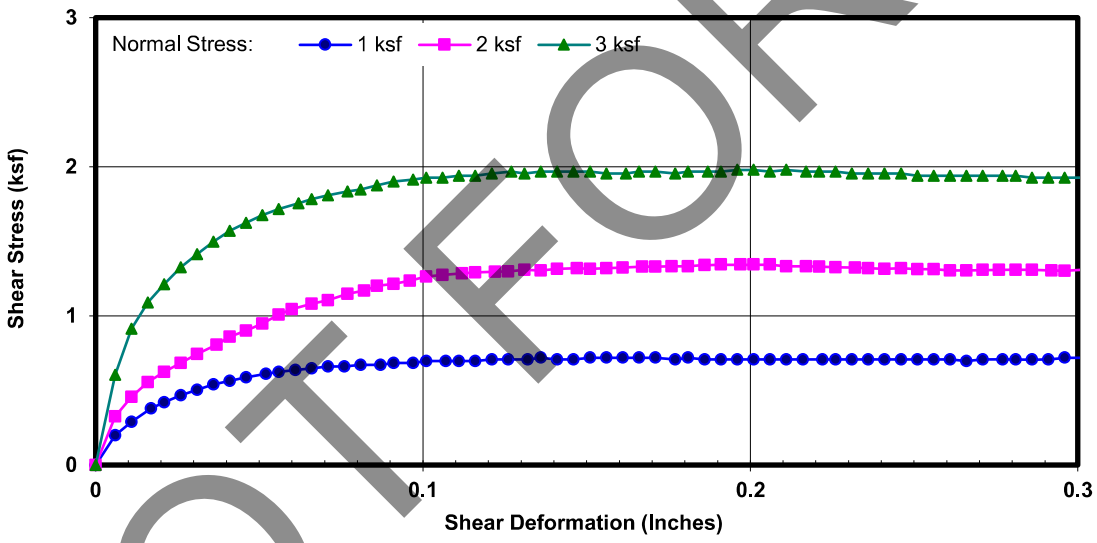
2607 Pomona Boulevard | Pomona, CA 91768
t. 909.869.6316 | f. 909.869.6318 | www.aplaboratory.com

DIRECT SHEAR TEST RESULTS
ASTM D 3080

Project Name: STK - Fire Station 227 | **Tested By:** ST | **Date:** 08/02/24
Project No.: 5163-193 | **Computed By:** JP | **Date:** 08/07/24
Boring No.: B-03 | **Checked by:** AP | **Date:** 08/07/24
Sample No.: - | **Depth (ft):** 2.5-3.5
Sample Type: Mod. Cal.
Soil Description: Silty Sand
Test Condition: Inundated | **Shear Type:** Regular

Wet Unit Weight (pcf)	Dry Unit Weight (pcf)	Initial Moisture Content (%)	Final Moisture Content (%)	Initial Degree Saturation (%)	Final Degree Saturation (%)	Normal Stress (ksf)	Peak Shear Stress (ksf)	Ultimate Shear Stress (ksf)
106.1	102.4	3.6	21.0	15	88	1	0.720	0.720
						2	1.344	1.308
						3	1.980	1.927



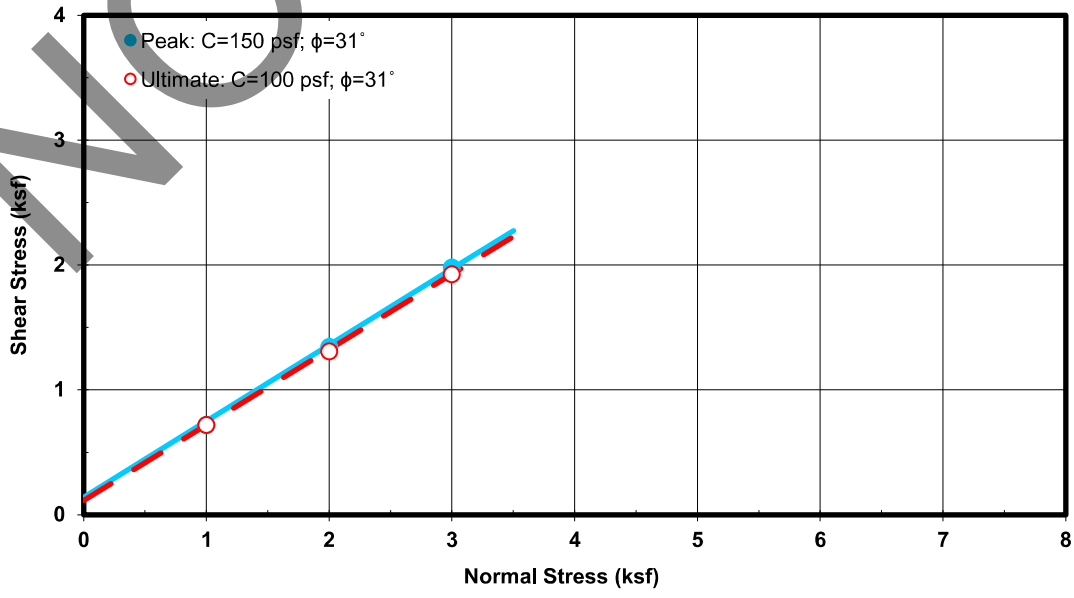


Figure No. B-8

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CORROSION TEST RESULTS

Client Name: Inland Foundation Engineering
Project Name: STK - Fire Station 227
Project No.: 5163-193

AP Job No.: 24-0764
Date: 08/01/24

Boring No.	Sample No.	Depth (feet)	Soil Description	Minimum Resistivity (ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
B-01	-	0-4.5	Silty Sand w/gravel	7,790	8.5	52	30

NOTES:
Resistivity Test and pH: California Test Method 643
Sulfate Content : California Test Method 417
Chloride Content : California Test Method 422
ND = Not Detectable
NA = Not Sufficient Sample
NR = Not Requested