



Appendix D2

Infiltration Testing



**SOUTHERN
CALIFORNIA
GEOTECHNICAL**
A California Corporation

January 12, 2021

Lake Creek Industrial, LLC
1302 Brittany Cross Road
Santa Ana, California 92705

Attention: Mr. Bob Kubichek

Project No.: **20G248-2**

Subject: **Results of Infiltration Testing**
Proposed Maintenance Building
24016 Orange Avenue
Perris, California

Reference: Geotechnical Investigation, Proposed Maintenance Building, 24016 Orange Avenue, Perris, California, prepared for Lake Creek Industrial, LLC., by Southern California Geotechnical, Inc. (SCG), SCG Project No. 20G248-1, dated January 12, 2021.

Mr. Kubichek:

In accordance with your request, we have conducted infiltration testing at the subject site. We are pleased to present this report summarizing the results of the infiltration testing and our design recommendations.

Scope of Services

The scope of services performed for this project was in general accordance with our Proposal 20P410R, dated December 15, 2020. The scope of services included site reconnaissance, subsurface exploration, field testing, and engineering analysis to determine the infiltration rates of the on-site soils. The infiltration testing was performed in general accordance with the guidelines published in Riverside County – Low Impact Development BMP Design Handbook – Section 2.3 of Appendix A, prepared for the Riverside County Department of Environmental Health (RCDEH), dated December, 2013.

Site and Project Description

The site is located at the northwest corner of Harvill Avenue and Orange Avenue in Perris, California. The site is bounded to the north by vacant land, to the east by Harvill Avenue, to the south by Orange Avenue and to the west by a demolished single-family residence (SFR) and vacant land. The general location of the site is illustrated on the Site Location Map, included as Plate 1 of this report.

The site consists of an irregular-shaped parcel, 8.95± acres in size. The site is developed with one (1) structure, 1,000± ft² in size, located in the central area of the site. The structure is of wood frame and metal panel construction. Remnants of previous structures, including Portland Cement concrete foundations and slabs, are present in the northwestern and southeastern areas of the site. Ground surface cover in the central areas of the site consist of exposed soils. In the

southeastern areas of the site, ground surface cover consists of exposed soils and moderate native grass and weed growth. Several large trees are also present in this area. The north central areas also possess moderate native grass and weed growth. The northern most portion of the site possess ground surface cover of horse manure. The manure appears to have been dumped by owners of SFRs located southwest of the site.

Detailed topographic information was not available at the time of this report. Based on elevations obtained from Google Earth, and visual observations made at the time of the subsurface investigation, the site topography slopes downward to the southeast at a gradient of 2± percent. There is approximately 20± feet of elevation differential between the across the northwest and southeast regions of the site.

Proposed Development

SCG was provided with a preliminary site plan for the proposed development, prepared by Van Dam Engineering. Based on this plan (BK-A0.1), the site will be developed with one (1) maintenance building, 15,000± ft² in size, located in the southeastern area of the site. The building will be surrounded by asphaltic concrete pavements in the parking and driving lanes, Portland cement concrete pavements in the truck parking area, and limited areas of concrete flatwork and landscape planters throughout.

The proposed development will include on-site infiltration to dispose of storm water. Based on the site plan provided by RGA Office of Architectural Design, the infiltration system will consist of an infiltration basin located in the southeastern area of the site. The bottom of the basin will be 10± feet below the existing site grades.

Concurrent Study

SCG concurrently conducted a geotechnical investigation at the subject site referenced above. As part of this investigation, six (6) borings advanced to depths of 15 to 20± feet below the existing site grades. Manure was present at the ground surface in the northern area of the site. The thicknesses of manure lining the ground was about 3± inches. Artificial fill soils were encountered at the ground surface at Boring No. B-6, extending to a depth of 2½± feet below the existing site grades. The artificial fill soils consist of medium dense silty fine sands with little organic content. Native younger alluvium was encountered at the ground surface at Boring Nos. B-1, B-3, B-4, and B-5, extending to depths of 3 to 8½± feet below ground surface. The alluvial soils generally consist of loose to medium dense silty sands, clayey sands and sandy silts. Native older alluvium was encountered at the ground surface at Boring No. B-2, beneath the artificial fill soils at Boring No. B-6, and beneath the younger alluvial soils at all of the remaining boring locations, extending to at least the maximum depth explored of 20± feet below ground surface. The older alluvial soils generally consist of dense to very dense clayey and silty fine to medium sands.

Groundwater

Groundwater was not encountered at any of the boring locations. Based on the lack of any water within the borings, and the moisture contents of the recovered soil samples, the static groundwater table is considered to have existed at a depth in excess of 20± feet below existing site grades, at the time of the subsurface investigation.

Recent water level data was obtained from the California Department of Water Resources Water Data Library website, <http://wdl.water.ca.gov/>. The nearest monitoring well on record is located 1.3± miles southeast of the site. Water level readings within this monitoring well indicate a groundwater level of 62± feet below the ground surface in May 2020

Subsurface Exploration

Scope of Exploration

The subsurface exploration conducted for the infiltration testing consisted of two (2) infiltration trenches, advanced to a depth of 10± feet below the existing site grades using a conventional rubber tire backhoe. The trenches were logged during excavation by a member of our staff. The approximate locations of the infiltration test trenches (identified as Infiltration Test No. I-1 and I-2) are indicated on the Infiltration Test Location Plan, enclosed as Plate 2 of this report.

Geotechnical Conditions

Native Alluvium

Native alluvium was encountered at the ground surface of Infiltration Test No. I-2, extending to the maximum explored depth of 10± feet below existing site grades. The native alluvium consists of dense silty fine to medium sands with trace quantities of coarse sand.

Older Alluvium

Older alluvium was encountered at the ground surface of Infiltration Test No. I-1, extending to the maximum explored depth of 10± feet below existing site grades. The older alluvium consists of very dense fine to medium sands with trace quantities of coarse sands, little silt content, and little porosity.

The Trench Logs, which illustrate the conditions encountered at the infiltration test locations, are included with this report.

Infiltration Testing

We understand that the results of the testing will be used to prepare a preliminary design for the storm water infiltration system that will be used at the subject site. As previously mentioned, the infiltration testing was performed in general accordance with ASTM Test Method D-3385-03, Standard Test Method for Infiltration Rate of Soils in Field Using Double Ring Infiltrometer.

Two stainless steel infiltration rings were used for the infiltration testing. The outer infiltration ring is 2 feet in diameter and 20 inches in height. The inner infiltration ring is 1 foot in diameter and 20 inches in height. At the test locations, the outer ring was driven 3± inches into the soil at the base of each trench. The inner ring was centered inside the outer ring and subsequently driven 3± inches into the soil at the base of the trench. These drive depths were adequate for the existing soil conditions and no water seepage was observed during testing. The rings were driven into the soil using a ten-pound sledge hammer.

Infiltration Testing Procedure

Infiltration testing was performed at two (2) trench locations, I-1 and I-2. The infiltration testing consisted of filling the inner ring and the annular space (the space between the inner and outer rings) with water, approximately 3 to 4 inches above the soil. To prevent the flow of water from one ring to the other, the water level in both the inner ring and the annular space between the rings was maintained at a constant head using float valves. The volume of water that was added to maintain a constant head in the inner ring and the annular space during each time interval was determined and recorded.

The schedule for readings was determined based on the observed soil type at the base of each backhoe-excavated trench. Based on the observed infiltration rate at each test location, the volumetric measurements were made at increments of 2 to 3 minutes. The water volume measurements are presented on the spreadsheets enclosed with this report. The infiltration rates for each of the timed intervals are also tabulated on these spreadsheets.

The infiltration rates for the infiltration tests are calculated in centimeters per hour and then converted to inches per hour. The rates are summarized below:

<u>Infiltration Test No.</u>	<u>Soil Description</u>	<u>Infiltration Rate (inches/hour)</u>
I-1	Light Brown fine to medium Sand, little Silt, trace to little coarse Sand	0.2
I-2	Brown Silty fine to medium Sand, trace coarse Sand	2.2

Laboratory Testing

Grain Size Analysis

The grain size distribution of selected soils from the base of each infiltration test boring has been determined using a range of wire mesh screens. These tests were performed in general accordance with ASTM D-422 and/or ASTM D-1140. The weight of the portion of the sample retained on each screen is recorded and the percentage finer or coarser of the total weight is calculated. The results of these tests are presented on Plates C-1 through C-2 of this report.

Design Recommendations

A total of two (2) infiltration tests were performed at the subject site. As noted above, the calculated infiltration rates at the infiltration test locations range from 0.2 to 2.2 inches per hour.

Based on the infiltration test results, stormwater infiltration is not considered feasible at this site. Soils with high densities and variable silt content were encountered at each infiltration boring location. These soils do not possess favorable characteristics for on-site infiltration.

The design of the proposed storm water infiltration systems should be performed by the project civil engineer, in accordance with the City of Perris and/or County of Riverside guidelines. However, it is recommended that the systems be constructed so as to facilitate removal of silt and clay, or other deleterious materials from any water that may enter the systems. The presence of such materials would decrease the effective infiltration rates. **It is recommended that the project civil engineer apply an appropriate factor of safety. The infiltration rates recommended above are based on the assumption that only clean water will be introduced to the subsurface profile. Any fines, debris, or organic materials could significantly impact the infiltration rates.** It should be noted that the recommended infiltration rates are based on infiltration testing at two (2) discrete locations and the overall infiltration rates of the storm water infiltration systems could vary considerably.

Construction Considerations

The infiltration rates presented in this report are specific to the tested locations and tested depths. Infiltration rates can be significantly reduced if the soils are exposed to excessive disturbance or compaction during construction. Therefore, the subgrade soils within proposed infiltration system areas should not be overexcavated, undercut or compacted in any significant manner. **It is recommended that a note to this effect be added to the project plans and/or specifications.**

Infiltration versus Permeability

Infiltration rates are based on unsaturated flow. As water is introduced into soils by infiltration, the soils become saturated and the wetting front advances from the unsaturated zone to the saturated zone. Once the soils become saturated, infiltration rates become zero, and water can only move through soils by hydraulic conductivity at a rate determined by pressure head and soil permeability. The infiltration rates presented herein were determined in accordance with the ASTM Test Method D-3385-03 standard, and are considered valid for the time and place of the actual test. Changes in soil moisture content will affect these infiltration rates. Infiltration rates should be expected to decrease until the soils become saturated. Soil permeability values will then govern groundwater movement. Permeability values may be on the order of 10 to 20 times less than infiltration rates. The system designer should incorporate adequate factors of safety and allow for overflow design into appropriate traditional storm drain systems, which would transport storm water off-site.

Location of Infiltration Systems

The use of on-site storm water infiltration systems carries a risk of creating adverse geotechnical conditions. Increasing the moisture content of the soil can cause the soil to lose internal shear strength and increase its compressibility, resulting in a change in the designed engineering properties. Overlying structures and pavements in the infiltration areas could potentially be damaged due to saturation of subgrade soils. **The proposed infiltration systems for the site should be located at least 25 feet away from any structures, including retaining walls.** Even with this provision of locating the infiltration systems at least 25 feet from any building, it is possible that infiltrating water into the subsurface soils could have an adverse effect on any proposed or existing structure. It should also be noted that utility trenches which happen to collect storm water can also serve as conduits to transmit storm water toward the structure, depending

on the slope of the utility trench. Therefore, consideration should also be given to the proposed locations of underground utilities which may pass near the proposed infiltration system.

General Comments

This report has been prepared as an instrument of service for use by the client in order to aid in the evaluation of this property and to assist the architects and engineers in the design and preparation of the project plans and specifications. This report may be provided to the contractor(s) and other design consultants to disclose information relative to the project. However, this report is not intended to be utilized as a specification in and of itself, without appropriate interpretation by the project architect, structural engineer, and/or civil engineer. The design of the infiltration system is the responsibility of the civil engineer. The role of the geotechnical engineer is limited to determination of infiltration rate only. By using the design infiltration rates contained herein, the civil engineer agrees to indemnify, defend, and hold harmless the geotechnical engineer for all aspects of the design and performance of the infiltration system. The reproduction and distribution of this report must be authorized by the client and Southern California Geotechnical, Inc. Furthermore, any reliance on this report by an unauthorized third party is at such party's sole risk, and we accept no responsibility for damage or loss which may occur.

The analysis of this site was based on a subsurface profile interpolated from limited discrete soil samples. While the materials encountered in the project area are considered to be representative of the total area, some variations should be expected between boring locations and testing depths. If the conditions encountered during construction vary significantly from those detailed herein, we should be contacted immediately to determine if the conditions alter the recommendations contained herein.

This report has been based on assumed or provided characteristics of the proposed development. It is recommended that the owner, client, architect, structural engineer, and civil engineer carefully review these assumptions to ensure that they are consistent with the characteristics of the proposed development. If discrepancies exist, they should be brought to our attention to verify that they do not affect the conclusions and recommendations contained herein. We also recommend that the project plans and specifications be submitted to our office for review to verify that our recommendations have been correctly interpreted.

The analysis, conclusions, and recommendations contained within this report have been promulgated in accordance with generally accepted professional geotechnical engineering practice. No other warranty is implied or expressed.

Closure

We sincerely appreciate the opportunity to be of service on this project. We look forward to providing additional consulting services during the course of the project. If we may be of further assistance in any manner, please contact our office.

Respectfully Submitted,

SOUTHERN CALIFORNIA GEOTECHNICAL, INC.



Ryan Bremer
Staff Geologist

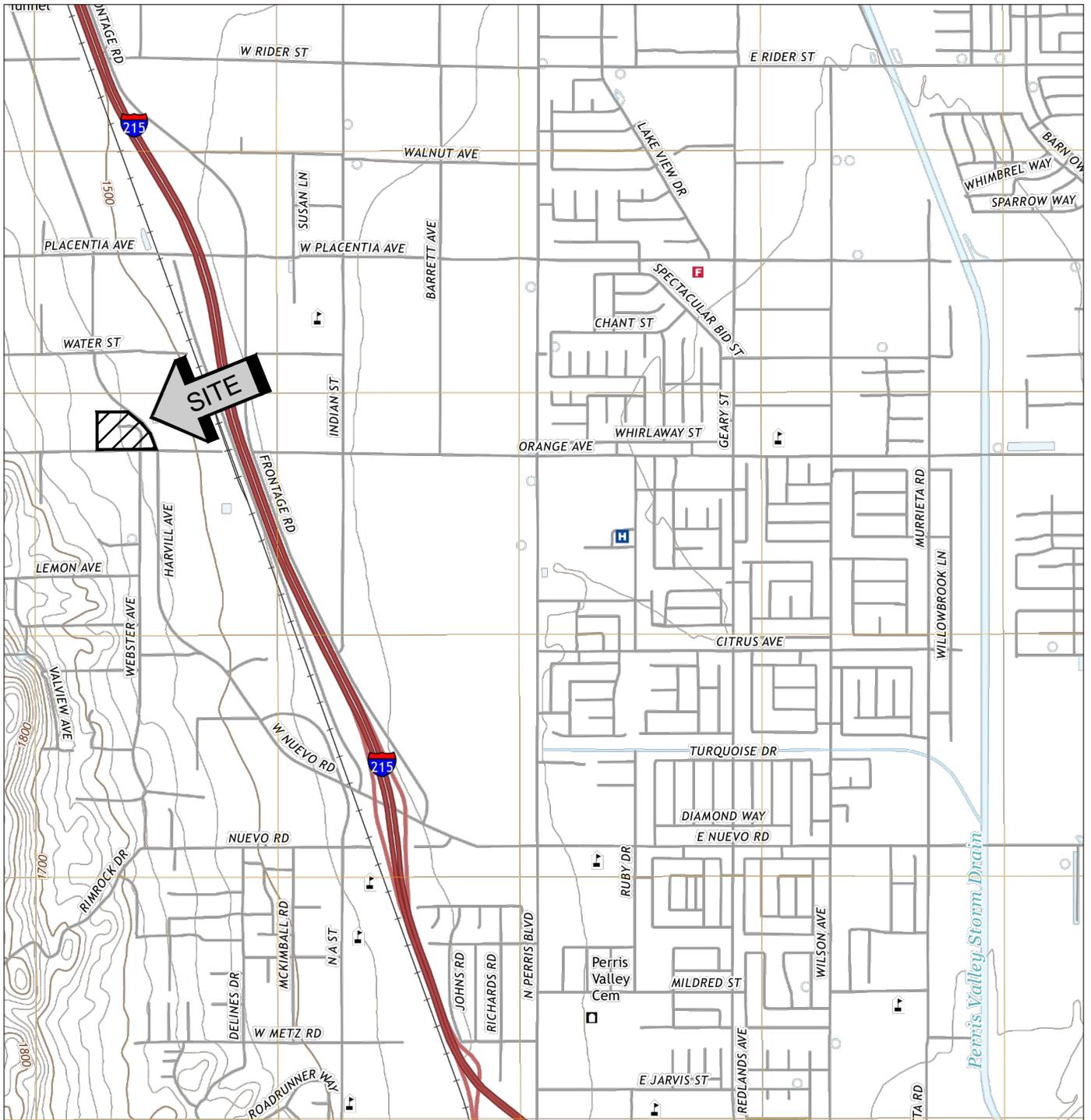


Robert G. Trazo, M.Sc., GE 2655
Principal Engineer



Distribution: (1) Addressee

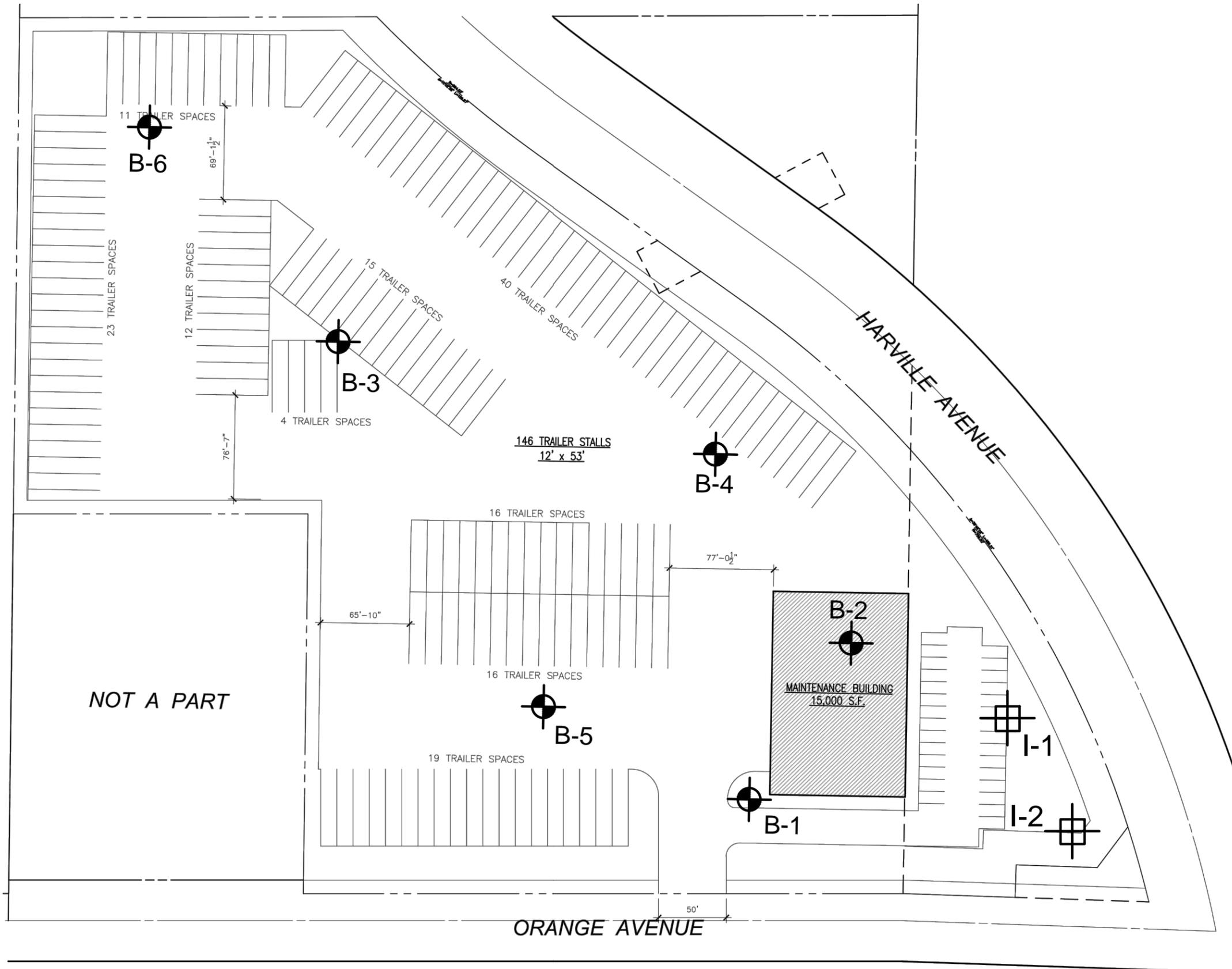
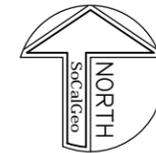
Enclosures: Plate 1 - Site Location Map
Plate 2 - Infiltration Test Location Plan
Trench Log Legend and Logs (4 pages)
Infiltration Test Results Spreadsheets (2 pages)
Grain Size Distribution Graphs (2 pages)



SOURCE: USGS TOPOGRAPHIC MAP OF THE PERRIS QUADRANGLE, RIVERSIDE COUNTY, CALIFORNIA, 2018



SITE LOCATION MAP	
PROPOSED MAINTENANCE BUILDING	
PERRIS, CALIFORNIA	
SCALE: 1" = 2000'	 SOUTHERN CALIFORNIA GEOTECHNICAL
DRAWN: JAH	
CHKD: RGT	
SCG PROJECT 20G248-2	
PLATE 1	



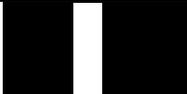
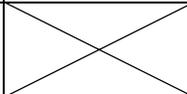
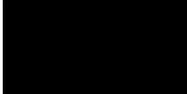
GEOTECHNICAL LEGEND

- APPROXIMATE INFILTRATION TEST LOCATION
- APPROXIMATE BORING LOCATION (SCG PROJECT NO. 20G248-1)

NOTE: PDF BASE LAYER PREPARED BY VAN DAM ENGINEERING.

BORING LOCATION PLAN	
PROPOSED MAINTENANCE BUILDING	
PERRIS, CALIFORNIA	
SCALE: 1" = 25'	
DRAWN: RB	
CHKD: RGT	
SCG PROJECT 20G248-2	
PLATE 2	SOUTHERN CALIFORNIA GEOTECHNICAL

TRENCH LOG LEGEND

SAMPLE TYPE	GRAPHICAL SYMBOL	SAMPLE DESCRIPTION
AUGER		SAMPLE COLLECTED FROM AUGER CUTTINGS, NO FIELD MEASUREMENT OF SOIL STRENGTH. (DISTURBED)
CORE		ROCK CORE SAMPLE: TYPICALLY TAKEN WITH A DIAMOND-TIPPED CORE BARREL. TYPICALLY USED ONLY IN HIGHLY CONSOLIDATED BEDROCK.
GRAB		SOIL SAMPLE TAKEN WITH NO SPECIALIZED EQUIPMENT, SUCH AS FROM A STOCKPILE OR THE GROUND SURFACE. (DISTURBED)
CS		CALIFORNIA SAMPLER: 2-1/2 INCH I.D. SPLIT BARREL SAMPLER, LINED WITH 1-INCH HIGH BRASS RINGS. DRIVEN WITH SPT HAMMER. (RELATIVELY UNDISTURBED)
NSR		NO RECOVERY: THE SAMPLING ATTEMPT DID NOT RESULT IN RECOVERY OF ANY SIGNIFICANT SOIL OR ROCK MATERIAL.
SPT		STANDARD PENETRATION TEST: SAMPLER IS A 1.4 INCH INSIDE DIAMETER SPLIT BARREL, DRIVEN 18 INCHES WITH THE SPT HAMMER. (DISTURBED)
SH		SHELBY TUBE: TAKEN WITH A THIN WALL SAMPLE TUBE, PUSHED INTO THE SOIL AND THEN EXTRACTED. (UNDISTURBED)
VANE		VANE SHEAR TEST: SOIL STRENGTH OBTAINED USING A 4 BLADED SHEAR DEVICE. TYPICALLY USED IN SOFT CLAYS-NO SAMPLE RECOVERED.

COLUMN DESCRIPTIONS

DEPTH:

Distance in feet below the ground surface.

SAMPLE:

Sample Type as depicted above.

BLOW COUNT:

Number of blows required to advance the sampler 12 inches using a 140 lb hammer with a 30-inch drop. 50/3" indicates penetration refusal (>50 blows) at 3 inches. WH indicates that the weight of the hammer was sufficient to push the sampler 6 inches or more.

POCKET PEN.:

Approximate shear strength of a cohesive soil sample as measured by pocket penetrometer.

GRAPHIC LOG:

Graphic Soil Symbol as depicted on the following page.

DRY DENSITY:

Dry density of an undisturbed or relatively undisturbed sample in lbs/ft³.

MOISTURE CONTENT:

Moisture content of a soil sample, expressed as a percentage of the dry weight.

LIQUID LIMIT:

The moisture content above which a soil behaves as a liquid.

PLASTIC LIMIT:

The moisture content above which a soil behaves as a plastic.

PASSING #200 SIEVE:

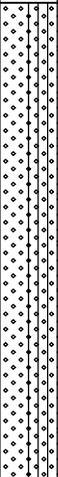
The percentage of the sample finer than the #200 standard sieve.

UNCONFINED SHEAR:

The shear strength of a cohesive soil sample, as measured in the unconfined state.



JOB NO.: 20G248-2	DRILLING DATE: 12/21/20	WATER DEPTH: ---
PROJECT: Proposed Maintenance Building	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: ---
LOCATION: Perris, California	LOGGED BY: Caleb Brackett	READING TAKEN: At Completion

FIELD RESULTS				DESCRIPTION	LABORATORY RESULTS						COMMENTS	
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)		GRAPHIC LOG	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)		ORGANIC CONTENT (%)
5					SURFACE ELEVATION: --- MSL OLDER ALLUVIUM: Light Brown fine to medium Sand, trace to little porosity, little Silt, trace to little coarse Sand, very dense-dry to damp		3					
10					Trench Terminated at 10'							

TBL_20G248-2.GPJ_SOCALGEO.GDT 1/12/21



JOB NO.: 20G248-2	DRILLING DATE: 12/21/20	WATER DEPTH: ---
PROJECT: Proposed Maintenance Building	DRILLING METHOD: Hollow Stem Auger	CAVE DEPTH: ---
LOCATION: Perris, California	LOGGED BY: Caleb Brackett	READING TAKEN: At Completion

FIELD RESULTS				DESCRIPTION	LABORATORY RESULTS						COMMENTS
DEPTH (FEET)	SAMPLE	BLOW COUNT	POCKET PEN. (TSF)		GRAPHIC LOG	DRY DENSITY (PCF)	MOISTURE CONTENT (%)	LIQUID LIMIT	PLASTIC LIMIT	PASSING #200 SIEVE (%)	
				SURFACE ELEVATION: --- MSL							
5					<u>ALLUVIUM</u> : Brown Silty fine to medium Sand, trace coarse Sand, dense-damp						
10						Trench Terminated at 10'		7			

TBL_20G248-2.GPJ_SOCALGEO.GDT 1/12/21

INFILTRATION CALCULATIONS

Project Name	Proposed Maintenance Building
Project Location	Perris, California
Project Number	20G248-2
Engineer	Caleb Brackett

Infiltration Test No I-1

Constants			
	Diameter (ft)	Area (ft ²)	Area (cm ²)
Inner	1	0.79	730
Anlr. Spac	2	2.36	2189

*Note: The infiltration rate was calculated based on current time interval

Test Interval		Time (hr)	Interval Elapsed (min)	Flow Readings				Infiltration Rates			
				Inner Ring (ml)	Ring Flow (cm ³)	Annular Ring (ml)	Space Flow (cm ³)	Inner Ring* (cm/hr)	Annular Space* (cm/hr)	Inner Ring* (in/hr)	Annular Space* (in/hr)
1	Initial	7:49 AM	30	0	650	0	1000	1.78	0.91	0.70	0.36
	Final	8:19 AM	30	650		1000					
2	Initial	8:22 AM	30	0	500	0	1000	1.37	0.91	0.54	0.36
	Final	8:52 AM	63	500		1000					
3	Initial	8:55 AM	30	0	500	0	500	1.37	0.46	0.54	0.18
	Final	9:25 AM	96	500		500					
4	Initial	9:27 AM	30	0	150	0	500	0.41	0.46	0.16	0.18
	Final	9:57 AM	128	150		500					
5	Initial	10:00 AM	30	0	150	0	500	0.41	0.46	0.16	0.18
	Final	10:30 AM	161	150		500					
6	Initial	10:04 AM	30	0	150	0	500	0.41	0.46	0.16	0.18
	Final	10:34 AM	165	150		500					
7	Initial	10:37 AM	30	0	150	0	500	0.41	0.46	0.16	0.18
	Final	11:07 AM	198	150		500					
8	Initial	11:09 AM	30	0	150	0	500	0.41	0.46	0.16	0.18
	Final	11:39 AM	230	150		500					

INFILTRATION CALCULATIONS

Project Name	Proposed Maintenance Building
Project Location	Perris, California
Project Number	20G248-2
Engineer	Caleb Brackett

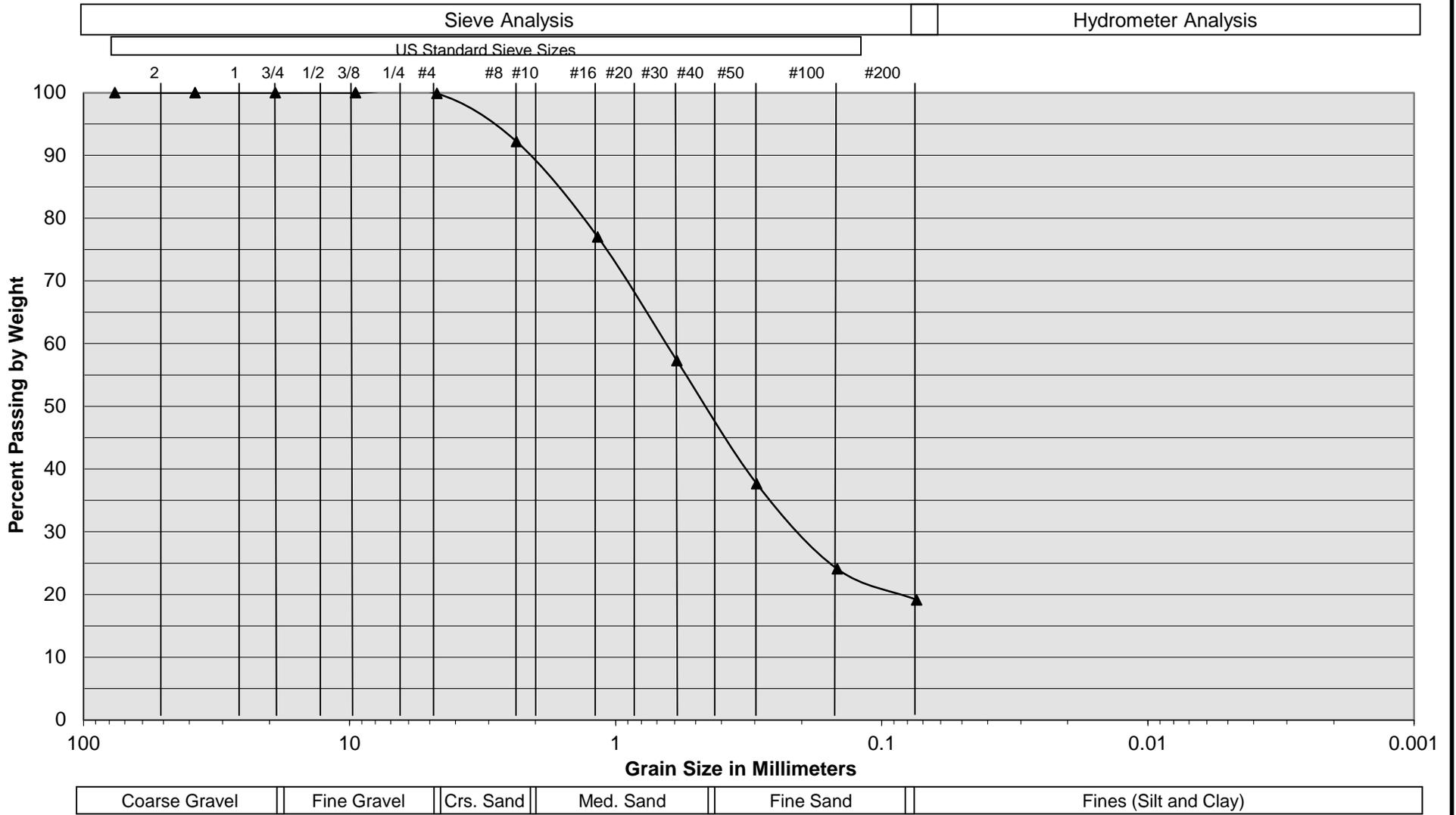
Infiltration Test No I-2

Constants			
	Diameter (ft)	Area (ft ²)	Area (cm ²)
Inner	1	0.79	730
Anlr. Spac	2	2.36	2189

*Note: The infiltration rate was calculated based on current time interval

Test Interval		Time (hr)	Interval Elapsed (min)	Flow Readings				Infiltration Rates				
				Inner Ring (ml)	Ring Flow (cm ³)	Annular Ring (ml)	Space Flow (cm ³)	Inner Ring* (cm/hr)	Annular Space* (cm/hr)	Inner Ring* (in/hr)	Annular Space* (in/hr)	
1	Initial	12:02 PM	15	0		0						
	Final	12:17 PM	15	1600	1600	6800	6800	8.77	12.43	3.45	4.89	
2	Initial	12:20 PM	15	0		0						
	Final	12:35 PM	33	1250	1250	5500	5500	6.85	10.05	2.70	3.96	
3	Initial	12:37 PM	15	0		0						
	Final	12:52 PM	50	1200	1200	5000	5000	6.58	9.14	2.59	3.60	
4	Initial	12:55 PM	15	0		0						
	Final	1:10 PM	68	1100	1100	4700	4700	6.03	8.59	2.37	3.38	
5	Initial	1:12 PM	15	0		0						
	Final	1:27 PM	85	1000	1000	4500	4500	5.48	8.22	2.16	3.24	
6	Initial	1:30 PM	15	0		0						
	Final	1:45 PM	103	1000	1000	4500	4500	5.48	8.22	2.16	3.24	
7	Initial	1:49 PM	15	0		0						
	Final	2:04 PM	122	1000	1000	4400	4400	5.48	8.04	2.16	3.17	
8	Initial	2:05 PM	15	0		0						
	Final	2:20 PM	138	1000	1000	4400	4400	5.48	8.04	2.16	3.17	

Grain Size Distribution



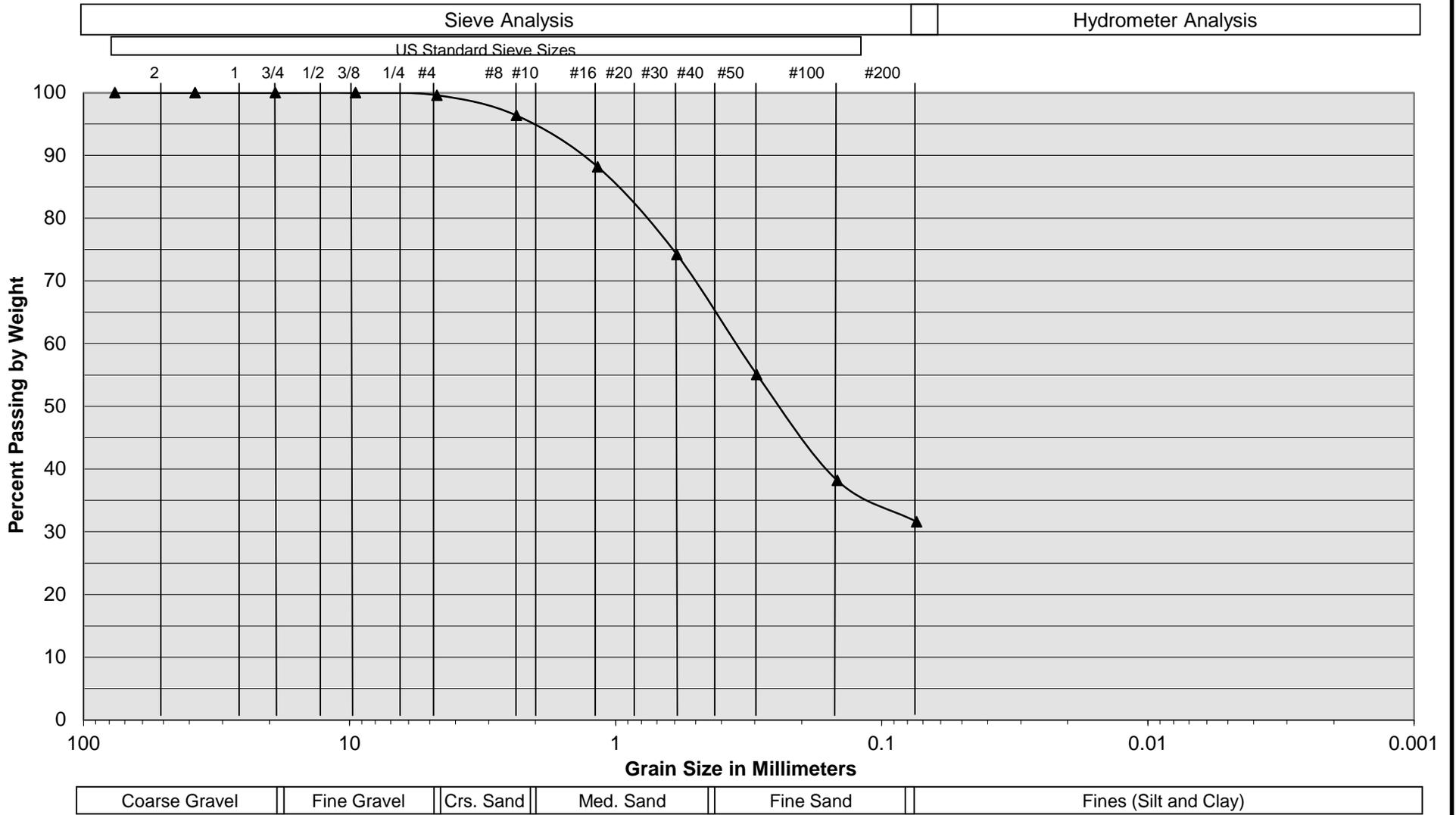
Sample Description	OLDER ALLUVIUM: Light Brown fine to medium Sand, little Silt, trace to little coarse Sand
Soil Classification	I-1 @ 10'

Proposed Maintenance Building
 Perris, California
 Project No. 20G248-2
PLATE C- 1



SOUTHERN CALIFORNIA GEOTECHNICAL
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Grain Size Distribution



Sample Description	ALLUVIUM: Brown Silty fine to medium Sand, trace coarse Sand
Soil Classification	I-2 @ 10'

Proposed Maintenance Building
 Perris, California
 Project No. 20G248-2
PLATE C- 2



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