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GEOTECHNICAL INVESTIGATION
BIKE TRAIL IMPROVEMENTS
FAIRVIEW PARK
CITY OF COSTA MESA, CALIFORNIA

PREPARED FOR:

MS. LEAH KABBARA
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PREPARED BY:

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Providing Professional Engineering Services Since 1959

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April 10, 2015

SCST No. 1231043PN
Report No. 1R

Ms. Leah Kabbara
Kabbara Engineering
121 North Harwood Street
Orange, California 92866

Subject: GEOTECHNICAL INVESTIGATION
BIKE TRAIL IMPROVEMENTS
FAIRVIEW PARK
CITY OF COSTA MESA, CALIFORNIA

Dear Ms. Kabbara:

This letter transmits Southern California Soil & Testing, Inc.'s geotechnical report for the subject project. We understand the project will consist of the design and construction of a bike trail and two parking lots. If you have questions concerning this report, please call us at (619) 280-4321.

Respectfully Submitted,
SOUTHERN CALIFORNIA SOIL & TESTING, INC.

Emil Rudolph, GE 2767
Principal Geotechnical Engineer

Andrew K. Neuhaus, CEG 2591
Project Geologist

EL:AKN:vat

(4) Addressee
(1) Addressee via e-mail at leah@kabbara.net

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EXECUTIVE SUMMARY

This report presents the results of the geotechnical investigation performed by Southern California Soil and Testing, Inc. (SCST) for the bike trail improvements at Fairview Park in the City of Costa Mesa, California. We understand the project will consist of widening the existing bike trail and the design and construction of 2 parking lots.

An SCST geologist observed the drilling of 5 exploratory test borings drilled using a truck mounted drill rig equipped with a hollow stem auger. The borings extended to depths of between about 10 feet and 20 feet below existing grade. Selected samples from the borings were tested to evaluate pertinent soil classification and engineering properties to assist in the development of geotechnical conclusions and recommendations.

Materials encountered in the borings consist of artificial fill, young alluvial fan deposits, and old paralic deposits. The fill consists of soft sandy clay with gravel and sandy clay. The alluvial fan deposits consist of stiff to very stiff sandy clay and medium dense clayey sand. The old paralic deposits consist of medium dense clayey sandstone, very stiff to hard sandy claystone and very dense silty sandstone. Groundwater was not encountered in the borings.

The main geotechnical considerations affecting the bike trail are the presence of clayey materials, potentially compressible fill or expansive site soils, and steepened slopes. Portions of the slopes along the planned bike trail have experienced slope creep. Alternatives to reduce the potential for future failures of the proposed path consist of re-grading the slope and/or construction of a retaining wall along the top of the slope, or constructing the path away from the outside slope. We understand the existing bike trail will be widened to about 16 feet in width in order to accommodate sidewalks and shoulders. Granular import material with an expansion index of 20 or less may be necessary as fill below pavements for the bike trail and for use as retaining wall backfill. Furthermore, the planned parking areas are underlain by clayey soils with poor pavement support and infiltration characteristics.

1. INTRODUCTION

1.1 GENERAL

This report presents the results of the geotechnical investigation performed by Southern California Soil and Testing, Inc. (SCST) for the slope repair and bike trail improvements at Fairview Park in the City of Costa Mesa, California. We understand the project will consist of widening the existing bike trail with a new concrete surface and decomposed granite walkway and the design and construction of 2 parking lots. Figure 1 presents a site vicinity map. This report presents recommendations to reduce the potential for distress to the future improvements and pavement section recommendations.

1.2 SCOPE OF WORK

The geotechnical study performed by SCST consisted of a surface reconnaissance, subsurface exploration, subsurface sampling, laboratory testing, engineering analyses, development of design recommendations and the preparation of this report. The results of the field exploration and laboratory test programs were evaluated to develop conclusions and recommendations regarding:

1. Subsurface conditions beneath the site;
2. Site preparation;
3. Slope repair alternatives including:
    - Retaining walls
    - Grading
4. Flexible, rigid, and permeable pavement sections.

2. DATA ACQUISITION

2.1 FIELD EXPLORATION

Five exploratory borings were drilled using a truck mounted drill rig equipped with a hollow stem auger. The borings extended to depths of between about 10 feet and 20 feet below existing site grades. An SCST geologist logged the materials encountered in the borings and collected samples for laboratory testing.

The approximate locations of the borings are shown on Figure 2. The test pit logs are presented in Appendix I. Soils are classified according to the Unified Soil Classification System, which is explained in Appendix I.

3. SITE CONDITIONS

3.1 SURFACE CONDITIONS

The existing bike trail is located along a natural slope within the northern portion of the park. The slope descends to the north at an inclination ranging from about 2:1 (horizontal:vertical) above the bike trail to approximately 1½:1 (H:V) below the trail. A total elevation difference from the top of the

slope to the bottom of the slope is about 65 feet. Vegetation in this area consists of shrubs and grasses.

The 2 planned parking lots will be located in undeveloped areas of the park. One parking lot will be located within the northeast portion of the park, north of an existing parking area and west of Placentia Avenue. The other parking lot will be located within the southwest portion of the park at the northern terminus of Pacific Avenue. The 2 parking lot areas are relatively flat with elevation differences of less than 1 foot over a span of about 100 feet. Vegetation in these areas consists of trees and grasses.

3.2 SUBSURFACE CONDITIONS

Materials encountered in the exploratory borings consist of artificial fill, young alluvial fan deposits, and old paralic deposits. Figure 3 presents a geologic Cross-Section.

Artificial Fill (Qaf): Fill was encountered in borings B-1 and B-2. This material consists of soft sandy clay with gravel and sandy clay. The fill extends to a depth of about 4 feet below existing grade.

Young Alluvial Fan Deposits (Qyf): The young alluvial fan deposits were encountered below the fill in borings B-1 and B-2, at the surface in boring B-3 and below the grass and associated topsoil in boring B-4. This material consists of stiff to very stiff sandy clay and medium dense clayey sand that extends to a depth of about 9 feet in boring B-1, about 16 feet in boring B-2, about 19 feet in boring B-3, and about 4 feet in boring B-4.

Old Paralic Deposits (Qop): Old paralic deposits were encountered below the young alluvial fan deposits in borings B-1, B-2, B-3 and B-4 and at the surface in boring B-5. These deposits are comprised of medium dense clayey sandstone, very stiff to hard sandy claystone and very dense silty sandstone. This material extends to the maximum depth explored of 20 feet in borings B-1, B-2 and B-3 and 10 feet in borings B-4 and B-5.

3.3 GROUNDWATER

Groundwater was not encountered in the borings. The groundwater level is expected to be below a depth that will influence planned construction. However, the groundwater level can be expected to vary depending on local irrigation, rainfall, and runoff.

3.4 SEISMIC DESIGN PARAMETERS

A geologic hazard likely to affect the project is groundshaking as a result of movement along an active fault zone in the vicinity of the subject site. The site coefficients and adjusted maximum considered earthquake spectral response acceleration parameters in accordance with the 2013 California Building Code are presented below:

Site Coordinates: Latitude 33.665°
Longitude -117.941°
Site Class: D
Site Coefficient F_a = 1.0
Site Coefficient F_v = 1.5
Spectral Response Acceleration at Short Periods S_s = 1.635 g
Spectral Response Acceleration at 1-Second Period S_1 = 0.605 g
S_{DS}=2/3* S_{MS}=1.090 g
S_{D1}=2/3* S_{M1}=0.605 g

PGA_M=0.653 g

4. CONCLUSIONS AND RECOMMENDATIONS

The main geotechnical considerations affecting the bike trail are the presence of potentially compressible fill and steepened slopes. Portions of the clayey site soils are potentially expansive. Portions of the slopes along the planned bike trail have experienced slope creep. Alternatives to reduce the potential for distress to the planned improvements consist of re-grading the slope and/or construction of a retaining wall along the top of the slope. We understand the existing bike trail will be widened to about 16 feet in width in order to accommodate sidewalks and shoulders. The planned parking areas are underlain by clayey soils with poor pavement support characteristics.

4.1 GRADING

4.1.1 Site Preparation for Bike Trail

Site preparation should begin with the removal of existing improvements, debris, vegetation and deleterious matter. Potentially compressible material should be excavated in its entirety. Excavations of up to 2 feet should be anticipated. An SCST representative should observe conditions exposed in the bottom of the excavation to determine if additional excavation is required. In areas where the bottom of the excavation exposes alluvium or the existing slope is steeper than 2:1(horizontal:vertical) the backfill should be strengthened with reinforcing grids, such as Tensar TX7, placed at 18 inch vertical intervals approximately 6 feet deep up to within 12 inches of the planned subgrade elevation.

The surface exposed by excavation should be scarified to a depth of 6 inches; moisture conditioned to approximately 2 percentage points above optimum moisture content and compacted to at least 90% relative compaction.

Generally, the excavated soil will be suitable for use as newly compacted fill, if needed. To reduce the potential for distress, the areas within 2 feet of the bottom of the concrete portion of the bike trail should be brought to designed finish grades using onsite or imported granular materials with an expansion index of 20 or less. Fill should be placed in lifts 6 inches or less in

loose thickness, moisture conditioned to approximately 2 percentage points above optimum moisture content and compacted to at least 90% relative compaction. The upper 12 inches of subgrade below planned pavements should be compacted to at least 95% relative compaction.

4.1.2 Site Preparation for Conventional and MSE Walls

The fill should be excavated in its entirety where retaining walls will be founded. Excavations of up to 5 feet should be anticipated. An SCST representative should observe conditions exposed in the bottom of the excavation to determine if additional excavation is required.

The surface exposed at the bottom of the excavations should be scarified to a depth of 6 inches, moisture conditioned to between optimum moisture content and 2 percentage points above optimum moisture content and compacted to at least 90% relative compaction. Optimum moisture content and relative compaction should be based on the ASTM D 1557 laboratory test procedure. All references to optimum moisture content and relative compaction in this report are based on these test methods. In areas where the bottom of the excavation exposes alluvium or the existing slope is steeper than 2:1(horizontal:vertical) the backfill should be strengthened with reinforcing grids, such as Tensar TX7, placed at 18 inch vertical intervals approximately 6 feet deep up to within 12 inches of the planned subgrade elevation.

The excavated soil free of trash, construction debris and organics can be placed as fill. Fill should be placed in lifts 6 inches or less in loose thickness, moisture conditioned to between optimum moisture content and 2 percentage points above optimum moisture content and compacted to 90% relative compaction.

4.1.3 Site Preparation for Parking Lot Areas

Site preparation should begin with the removal of existing improvements, debris, vegetation and deleterious matter. An SCST representative should observe conditions exposed in the bottom of the excavation to determine if additional excavation is required.

The surface exposed by excavation should be scarified to a depth of 12 inches moisture conditioned to approximately 2 percentage points above optimum moisture content and compacted to at least 90% relative compaction.

4.1.4 Site Excavation Characteristics

It is anticipated that excavation can be achieved with conventional earthwork equipment in good working order. However, it should be noted that gravel and cobble zones may be encountered during grading.

4.1.5 Temporary Excavation Slopes

Temporary slopes in fill should not be steeper than 1:1 (horizontal:vertical). Temporary slopes in the old paralic deposits should not be steeper than ½:1 (horizontal:vertical) up to 10 feet in height. The faces of temporary slopes should be inspected daily by the contractor's Competent Person before personnel are allowed to enter the excavation. Any 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. Fill alluvium and old paralic deposits should be classified as Type C soils in accordance with CalOSHA guidelines.

4.1.6 Imported Soil

A portion of the clayey soil excavated at the site is not expected to meet the specifications for Caltrans structure backfill. Therefore, import material is anticipated to be needed for use as wall backfill.

4.1.7 Surface Drainage

Final surface grades should be designed to collect and direct surface water away from the tops of slopes toward appropriate drainage facilities. Drainage patterns established at the time of fine grading should be maintained throughout the life of the proposed improvements. 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.

4.1.8 Grading Plan Review

The grading plans should be submitted to SCST for review to ascertain whether the intent of the recommendations contained in this report have been implemented, and that no revised recommendations are necessary due to changes in the development scheme.

4.2 RETAINING WALL RECOMMENDATIONS

4.2.1 Foundations-Conventional Retaining Wall

Shallow spread footings with bottom levels in young alluvial fan deposits, old paralic deposits or compacted fill can be used to support the planned retaining wall following site preparation recommendations presented in Section 4.1.2 of this report. The footings should extend to a minimum depth of 18 inches below the lowest adjacent elevation. Footings adjacent to slopes should be extended to a depth such that a minimum distance of 7 feet exists between the bottom of the footing and the face of the slope. A minimum width of 18 inches is recommended for continuous footings. A bearing capacity of 2,500 pounds per square foot (psf) can be used. This value can be increased by ⅓ when considering the total of all loads, including wind or seismic forces.

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. A friction factor of 0.30 can be used. Passive pressure for the design of retaining walls can be taken as 250 psf per foot of depth. This pressure can be increased by ⅓ for seismic loading.

4.2.2 Foundation Excavation Observations

It is recommended that all foundation excavations be approved by a SCST representative prior to forming or placing reinforcing steel.

4.2.3 Static Settlement Characteristics

Total wall settlements are estimated to be less than 1 inch. Differential settlements are estimated to be less than ½ inch over a span of 20 feet along the wall. Settlements should occur rapidly, and should be completed shortly after structural loads are applied.

4.3 LATERAL EARTH PRESSURES

4.3.1 Active Pressure

The active soil pressure for the design of unrestrained earth retaining structures with level backfills can be taken as equivalent to the pressure of a fluid weighing 40 pounds per cubic foot (pcf). An equivalent fluid pressure weighing 60 pcf can be used for walls with a 2:1 (horizontal: vertical) sloping backfill. If other surcharge loads are anticipated, SCST should be contacted for the necessary increase in soil pressure. A typical wall backdrain detail is shown on Figure 4.

4.3.2 At-Rest Pressure

The at-rest soil pressure for the design of restrained earth retaining structures with level backfills can be taken as equivalent to the pressure of a fluid weighing 60 pcf. A granular and drained backfill condition has been assumed. If any surcharge loads are anticipated, SCST should be contacted for the necessary increase in soil pressure.

4.3.3 Passive Pressure

Passive pressure for the design of retaining walls can be taken as 250 psf per foot of depth. This pressure can be increased by ⅓ for seismic loading. The coefficient of friction can be taken as 0.30. The upper 12 inches of material in front of foundations should not be included in passive pressure calculations unless the surface is covered with pavement.

4.3.4 Seismic Earth Pressure

The seismic earth pressures can be taken as an inverted triangular distribution with a maximum pressure at the top equal to 24H pounds per square foot (with H being the height of the retained earth in feet). This pressure is in addition to the un-factored static design wall load. The allowable

passive pressure and bearing capacity can be increased by ⅓ in determining the stability of the wall.

4.3.5 Retaining Wall Backfill

Retaining wall backfill should consist of granular materials meeting the criteria for Caltrans Structure Backfill. Wall backfill should be placed in lifts 6 inches or less in loose thickness, moisture conditioned to near optimum moisture content and compacted to 90% relative compaction based on the ASTM D 1557 laboratory test method.

4.4 MECHANICALLY STABILIZED EARTHEN (MSE) WALL

The following soil parameters can be used for the design of MSE walls.

Mechanically Stabilized Earth Wall Design Parameters

	Reinforced Soil	Retained Soil	Foundation Soil
Internal Friction Angle (degrees)	32°	25°	25°
Cohesion (pounds per square foot)	0	0	0
Moist Unit Weight (pounds per cubic foot)	125	125	125

MSE walls are expected to range between about 4 feet and 10 feet in total height. A typical MSE wall section detail is shown on Figure 5.

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.

4.5 PAVEMENT SECTIONS

Laboratory R-value test results are less than 5. Alternatives for flexible and rigid pavement structural sections where new pavements will be required are listed below. Final pavement sections may be based on the results of R-value test performed on the materials present when final subgrade elevations are reached.

Flexible Pavement Recommendations

Traffic Index	Asphalt Concrete (inches)	Aggregate Base[1] (inches)	Full Depth Asphalt Concrete (inches)
5.0 (Parking Stalls)	4	8	7.5
7.0 (Driveways)	4	16	12.5

Note 1: **AB shall conform to Class 2 Aggregate Base in Section 26-1.02 of the Standard Specifications of The State of California Department of Transportation or Crushed Miscellaneous Base in accordance with the Standard Specifications for Public Works and City of Solana Beach Standards.**

Portland Cement Concrete Pavement Sections

Traffic Index	JPCP* (inches)	Aggregate Base* (inches)
5.0	7	6
7.0	8	6

***Jointed Plain Concrete Pavement, Type II/V Cement**

The top 12 inches of subgrade should be scarified, moisture conditioned to near optimum moisture content, and compacted to at least 95% relative compaction. Soft or yielding areas should be removed and replaced with compacted fill. The aggregate base material should be compacted to at least 95% relative compaction. Materials and methods of construction should conform to good engineering practices and the minimum standards of the City of Costa Mesa.

4.5.1 Permeable Pavements

We recommend that the structural pavement section for permeable pavement consist of 7 inches of concrete underlain by 6 inches of crushed gravel. The pavement structural section provided is based on the strength of the subgrade soils. If pervious pavements are used at the site, the design may be controlled by water storage capacity and permeability of the subgrade soils. The onsite subgrade soils may be considered to have low infiltration characteristics. To improve water storage capacity, a thicker gravel base section may be used beneath permeable pavements. The water storage and base thickness requirements should be determined by the project civil engineer.

4.6 BIKE TRAIL PORTLAND CEMENT CONCRETE SECTIONS

Portland cement concrete used in the bike trail construction should have a minimum thickness of 4 inches and should be reinforced with at least No. 3 bars at 18 inches on center each way. Additionally, slabs should be underlain by at least 12 inches of granular fill with very low expansion potential. Alternatively, the section can consist of 6 inches of concrete underlain by 8 inches of compacted processed miscellaneous base. Slabs should be provided with weakened plane joints. Joints should be placed in accordance with the American Concrete Institute (ACI) Guidelines Section

3.13, but should generally be 6 feet on center. Alternative patterns consistent with ACI guidelines also can be used. The landscape architect can be consulted in selecting the final joint patterns.

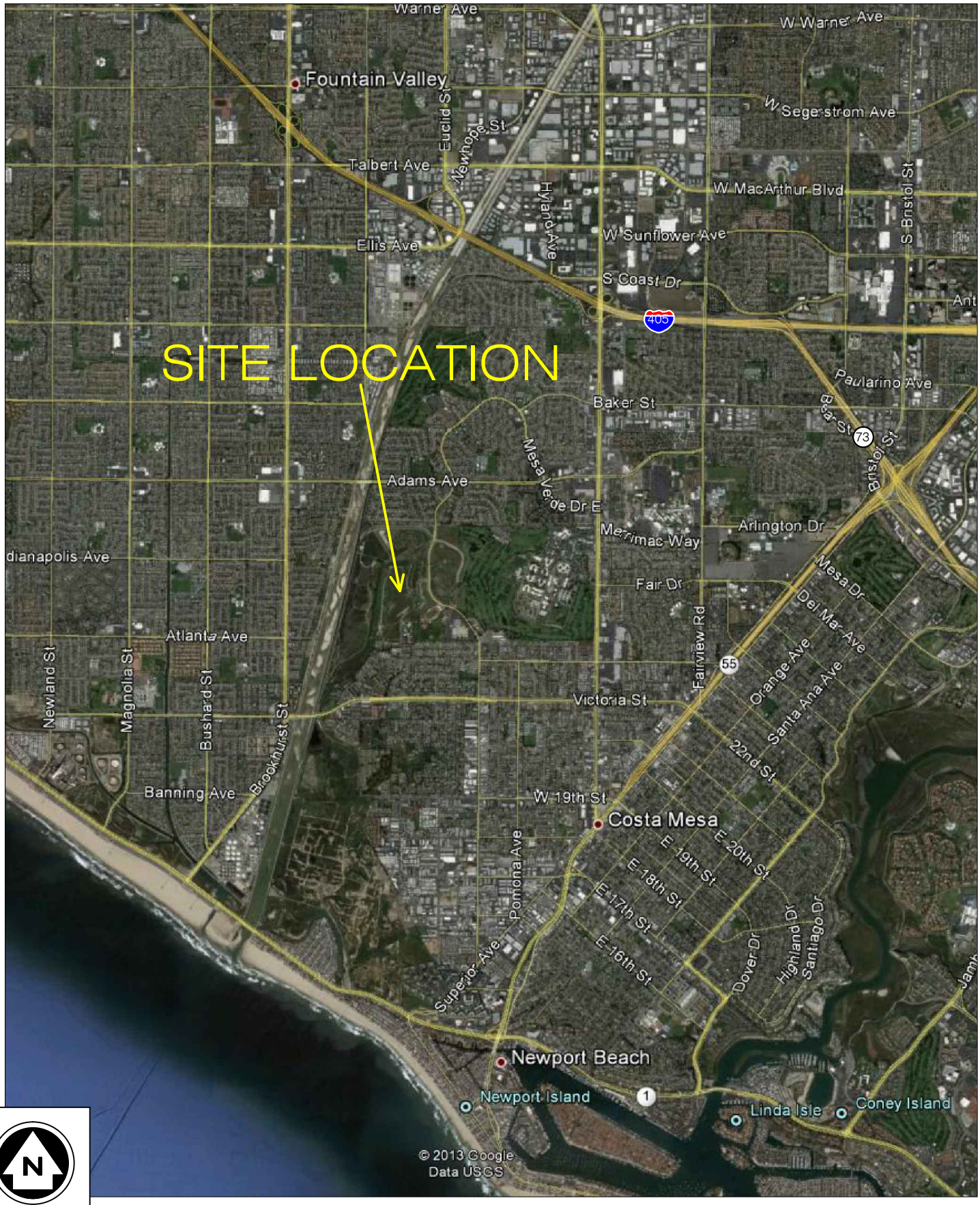
A 1-inch maximum size aggregate mix is recommended for concrete for exterior slabs. A water/cement ratio of less than 0.45 is recommended, in order to decrease the potential for shrinkage cracks. Coarse and fine aggregate in concrete should conform to the "Greenbook" Standard Specifications for Public Works Construction.

Special attention should be paid to the method of curing the concrete to reduce the potential for excessive shrinkage and resultant random cracking. Minor cracks occur normally in concrete slabs and foundations due to shrinkage during curing and redistribution of stresses. Some shrinkage cracks can be expected. These cracks are not necessarily an indication of vertical movements or structural distress.

5. CLOSURE

SCST should be advised of any 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 location, 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 any 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.



SOUTHERN CALIFORNIA SOIL & TESTING, INC.

SITE VICINITY MAP
CITY OF COSTA MESA
BIKE TRAIL IMPROVEMENTS
AT FAIRVIEW PARK

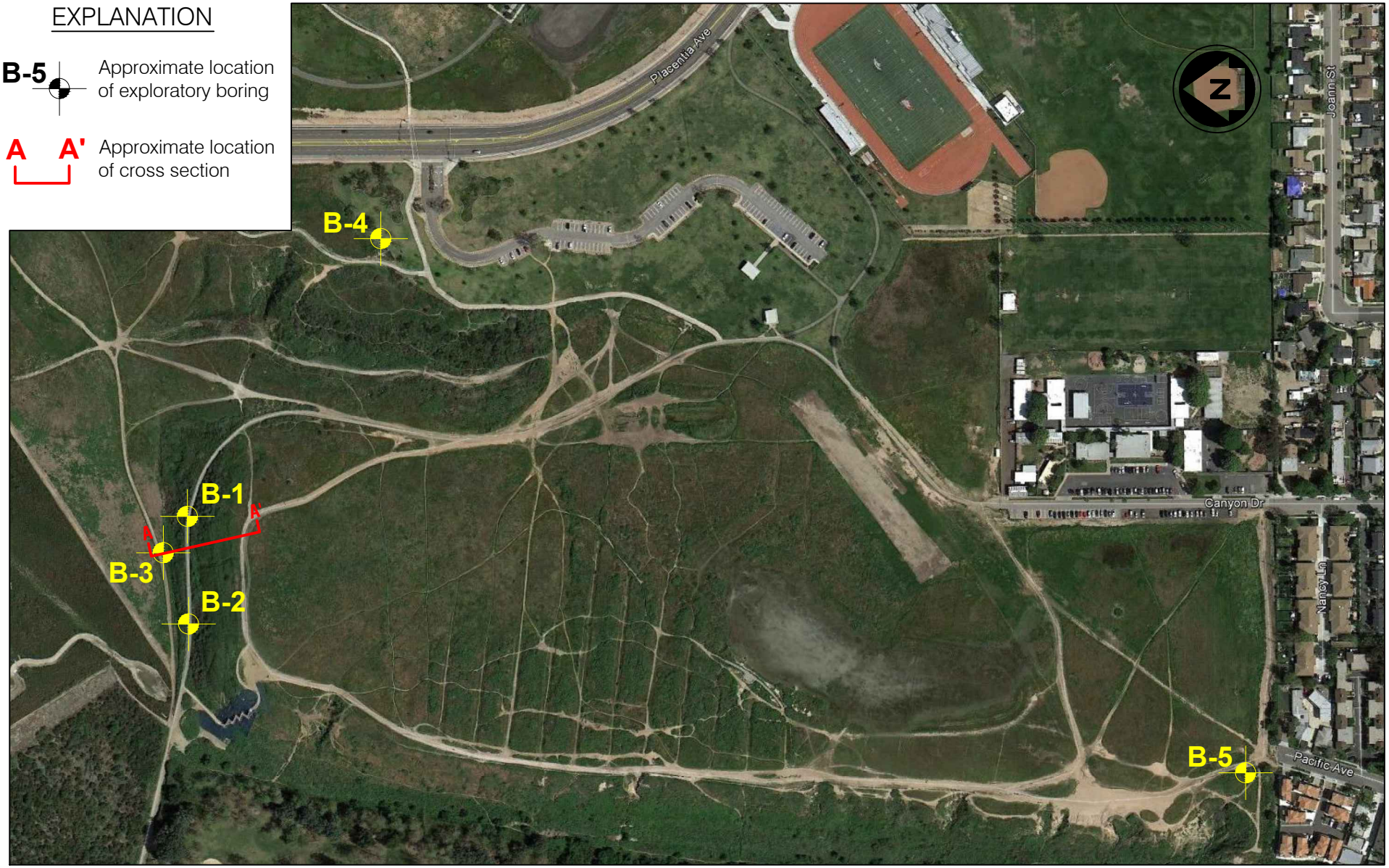
Date:	April, 2015
By:	AKN
Job No.:	1231043PN-1
Scale:	Not To Scale

Figure: 1

EXPLANATION

B-5 — Approximate location of exploratory boring

A A' — Approximate location of cross section

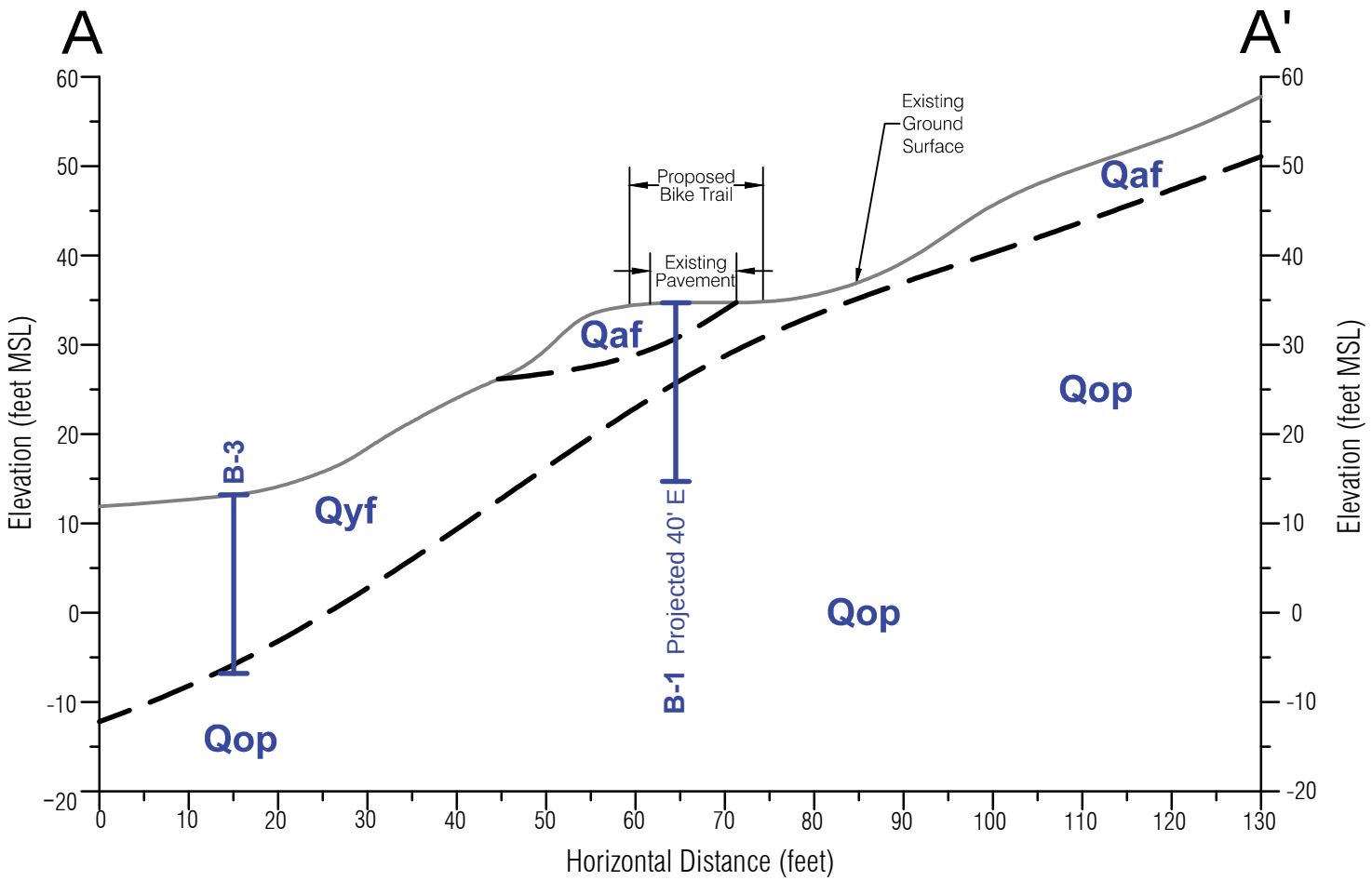


SOUTHERN CALIFORNIA SOIL & TESTING, INC.

SUBSURFACE EXPLORATION MAP
CITY OF COSTA MESA BIKE TRAIL IMPROVEMENTS AT FAIRVIEW PARK

Date:	April, 2015
By:	AKN
Job No.:	1231043PN-1
Scale:	Not To Scale

Figure: 2



SCST LEGEND:

B-3	Approximate Location of Boring	Qyf	Young Aluvial Fan Deposits		Approximate Geologic Contact
Qaf	Artificial Fill	Qop	Old Paralic Deposits		

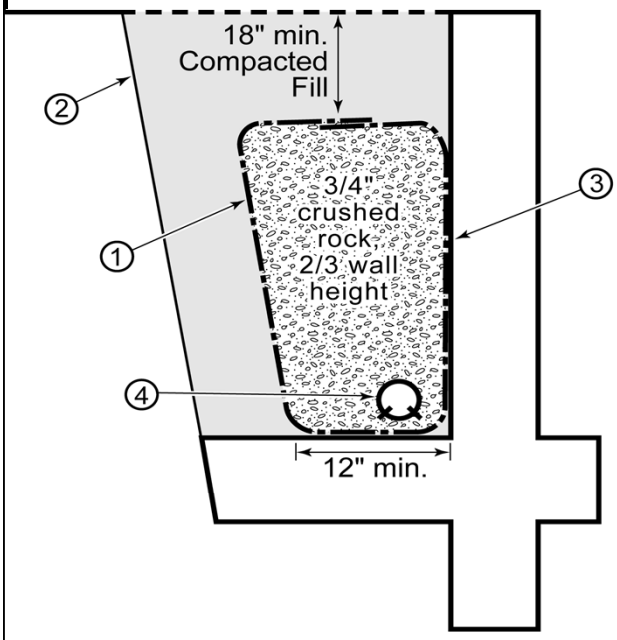
0 20′ 40′
Scale

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

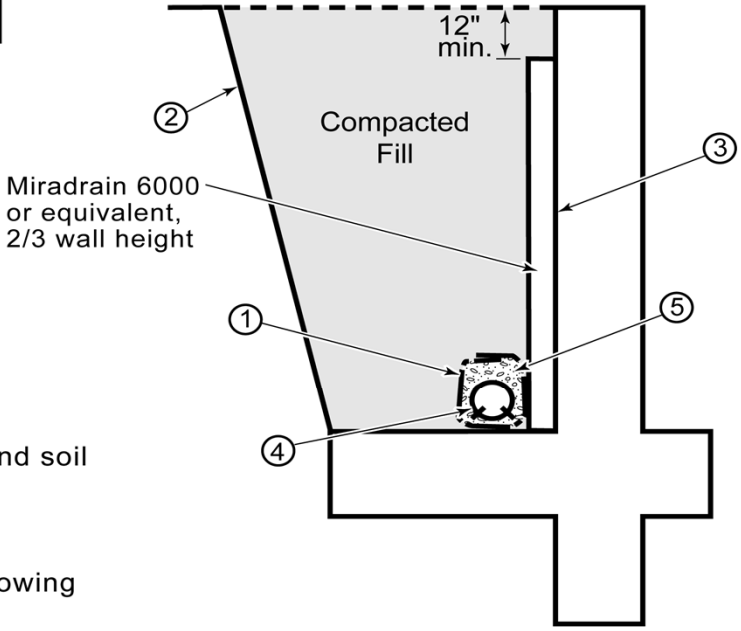
CROSS SECTION A-A'
CITY OF COSTA MESA BIKE TRAIL IMPROVEMENTS AT FAIRVIEW PARK

Date: April, 2015
By: JGA
Job No.: 1231043PN-1

Figure: 3



Typical Retaining Wall Backdrain Detail
Not to Scale



① Filter fabric between rock and soil

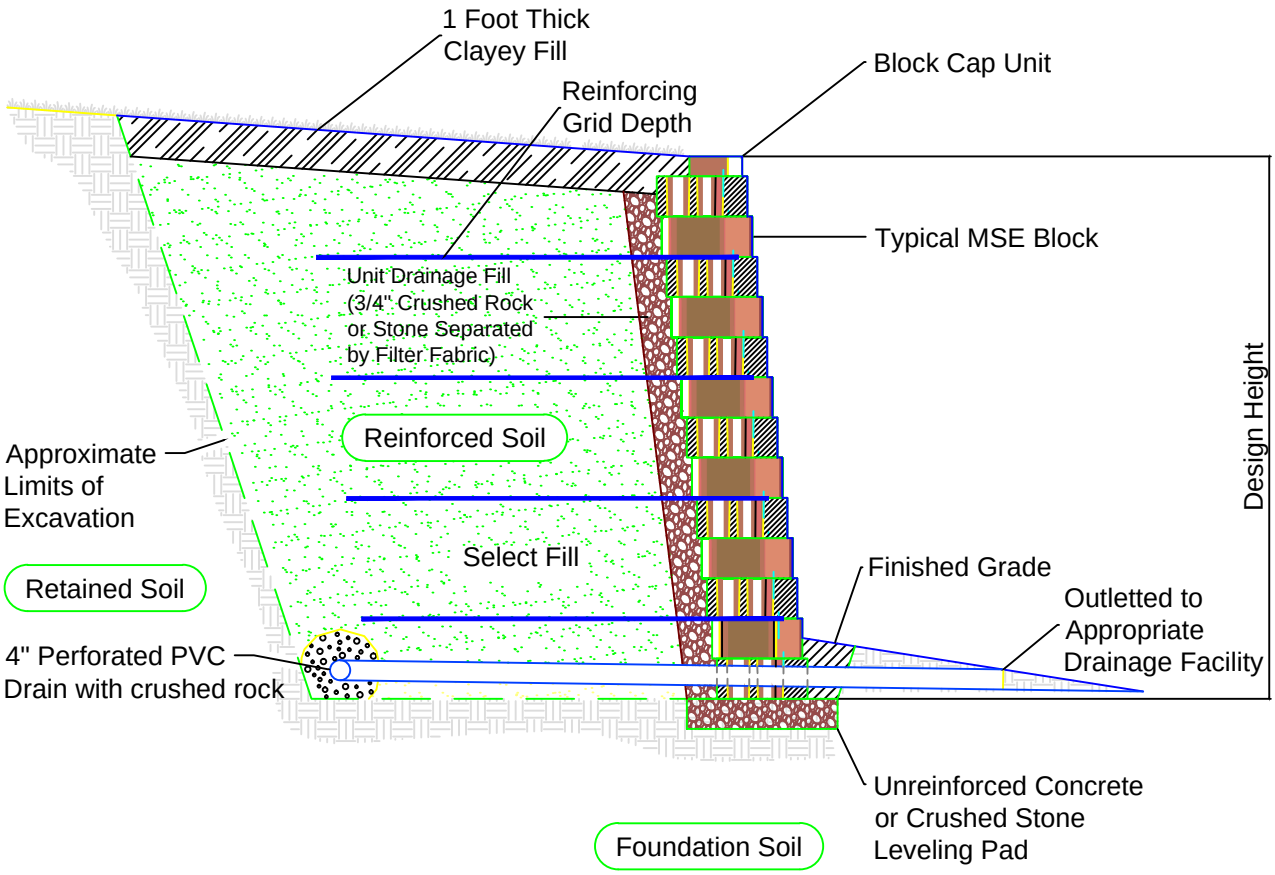
② Backcut

③ Waterproof back of wall following architect's specifications

④ 4" minimum perforated pipe, SDR35 or equivalent, holes down, 1% fall to outlet, encased in 3/4" crushed rock. Provide 3 cubic feet per linear foot crushed rock minimum. Crushed rock to be surrounded by filter fabric (Mirafi 140N or equivalent), with 6" minimum overlap. Provide solid outlet pipe at suitable location.

⑤ 3/4" crushed rock

SOUTHERN CALIFORNIA SOIL & TESTING, INC.	CITY OF COSTA MESA BIKE TRAIL IMPROVEMENTS AT FAIRVIEW PARK		
	By: AKN	Date:	April, 2015
	Job Number: 1231043PN-1	Figure:	4



Typical MSE Wall Section

SOUTHERN CALIFORNIA SOIL & TESTING, INC.	TYPICAL MSE WALL DETAIL CITY OF COSTA MESA BIKE TRAIL IMPROVEMENTS AT FAIRVIEW PARK	Date: April, 2015 By: DAS Job No.: 1231043PN-1 Scale: Not To Scale	Figure: 5

APPENDIX I

FIELD INVESTIGATION

Five exploratory test borings were drilled at the locations indicated on Figure 2. The field work was performed under the observation of our geology personnel, who also logged the borings and obtained samples of the materials encountered. Relatively undisturbed samples were obtained with a 2.5-inch inner diameter sampler driven with a 140-pound weight falling 30 inches. Disturbed samples were obtained from drill cuttings. The number of blows required to drive both types of samplers the final 12 inches of an 18-inch drive are noted on the borings logs as “PENETRATION (blows/ft. of drive).”

Soils are described in accordance with the Unified Soil Classification System illustrated on Figure I-1. The boring logs are presented on Figures I-2 through I-6.

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.
	SANDS WITH FINES (Appreciable amount of 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.

▽ - Water level at time of excavation or as indicated
⊠ - Bulk Sample
AL - Atterberg Limits
CAL - Modified California pentration test sampler
CK - Undisturbed chunk sample
CL - Chloride
CON - Consolidation
COR - Corrosivity Test
- Sulfate
- Chloride
- pH and Resistivity

DS - Direct Shear
EI - Expansion Index
MS - Maximum Size of Particle
MAX - Maximum Density
pH - pH & Resistivity
RC - Relative Compaction
RV - R Value
SA - Sieve Analysis
SC - Sand Cone
SF - Sulfate & Chloride
SPT - Standard penetration test sampler
ST - Shelby Tube
TX - Triaxial Compression
UC - Unconfined Compression

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

CITY OF COSTA MESA BIKE TRAIL IMPROVEMENTS AT FAIRVIEW PARK			
By:	AKN	Date:	April, 2015
Job Number:	1231043PN-1	Figure:	I-1

LOG OF EXPLORATORY BORING NUMBER B-1

Date Excavated:	1/9/2013	Logged by:	AKN
Equipment:	Hollow Stem Auger	Project Manager:	GBF
Surface Elevation (ft):	N/A	Depth to Water (ft):	Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: UNDISTURBED	SAMPLES: BULK	PENETRATION (blows/ ft. of drive)	MOISTURE (%)	DRY UNIT WT. (pcf)	LABORATORY TESTS
0	CL	**2 INCHES OF ASPHALT CONCRETE**						
2		**ARTIFICIAL FILL (Qaf)** - Dark brownish gray, very moist, soft, SANDY CLAY with GRAVEL.		X				AL, SA
4	SC	**YOUNG ALLUVIAL FAN DEPOSITS (Qyf) -** Mottled medium brown and dark gray, moist, medium dense, CLAYEY SAND.	CAL	X	18			DS
8								
10		**OLD PARALIC DEPOSITS (Qop) -** Mottled light yellowish brown and light gray, moist, medium dense, CLAYEY SANDSTONE.	CAL		20			
12		Light brownish gray, moist, stiff, SANDY CLAYSTONE.		X				
14								
16			CAL		33			DS
18		(contact at 19½ feet) Light orange brown, moist, dense to very dense, SILTY SANDSTONE.						
20			CAL		78			

BORING TERMINATED AT 20 FEET.

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

CITY OF COSTA MESA BIKE TRAIL IMPROVEMENTS AT FAIRVIEW PARK

By:	AKN	Date:	April, 2015
Job Number:	1231043PN-1	Figure:	I-2

LOG OF EXPLORATORY BORING NUMBER B-2

Date Excavated:	1/9/2013	Logged by:	AKN
Equipment:	Hollow Stem Auger	Project Manager:	GBF
Surface Elevation (ft):	N/A	Depth to Water (ft):	Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: UNDISTURBED	SAMPLES: BULK	PENETRATION (blows/ ft. of drive)	MOISTURE (%)	DRY UNIT WT. (pcf)	LABORATORY TESTS
0	CL	**2 INCHES OF ASPHALT CONCRETE**						
2		**ARTIFICIAL FILL (Qaf)** - Dark brownish gray, moist to very moist, soft, SANDY CLAY.		X				MAX, DS
4	CL	**YOUNG ALLUVIAL FAN DEPOSITS (Qyf) -** Mottled medium brown and dark gray, moist, stiff, SANDY CLAY.		X				
6			CAL		25			AL, SA
8								
10			CAL		18			
12								
14								
16			CAL		33			
18		**OLD PARALIC DEPOSITS (Qop) -** Mottled light yellowish brown and light gray, moist, medium dense, CLAYEY SANDSTONE.		X				
		Light orange brown, moist, dense, SILTY SANDSTONE.						
20			CAL		40			

BORING TERMINATED AT 20 FEET.

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

CITY OF COSTA MESA BIKE TRAIL IMPROVEMENTS AT FAIRVIEW PARK

By:	AKN	Date:	April, 2015
Job Number:	1231043PN-1	Figure:	I-3

LOG OF EXPLORATORY BORING NUMBER B-3

Date Excavated:	1/9/2013	Logged by:	AKN
Equipment:	Hollow Stem Auger	Project Manager:	GBF
Surface Elevation (ft):	N/A	Depth to Water (ft):	Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: UNDISTURBED	SAMPLES: BULK	PENETRATION (blows/ ft. of drive)	MOISTURE (%)	DRY UNIT WT. (pcf)	LABORATORY TESTS
2	CL	**YOUNG ALLUVIAL FAN DEPOSITS (Qyf) -** Mottled dark gray and light gray, moist, stiff, SANDY CLAY.						SA
4								
6			CAL		33			
8								
10			CAL		41			
12								
14		Becomes mottled dark gray and medium brown below 14 feet.						
16			CAL		28			
18		**OLD PARALIC DEPOSITS (Qop) -** Mottled light yellowish brown and light gray, moist, medium dense, CLAYEY SANDSTONE.						
20			CAL		65			

BORING TERMINATED AT 20 FEET.

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

CITY OF COSTA MESA BIKE TRAIL IMPROVEMENTS AT FAIRVIEW PARK

By:	AKN	Date:	April, 2015
Job Number:	1231043PN-1	Figure:	I-4

LOG OF EXPLORATORY BORING NUMBER B-4

Date Excavated:	1/9/2013	Logged by:	AKN
Equipment:	Hollow Stem Auger	Project Manager:	GBF
Surface Elevation (ft):	N/A	Depth to Water (ft):	Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: UNDISTURBED	SAMPLES: BULK	PENETRATION (blows/ ft. of drive)	MOISTURE (%)	DRY UNIT WT. (pcf)	LABORATORY TESTS
0		**6 INCHES OF SOD AND ASSOCIATED TOPSOIL**						
2	CL	**YOUNG ALLUVIAL FAN DEPOSITS (Qyf) -** Mottled dark gray and light gray, moist to very moist, very stiff, SANDY CLAY.		X				RV
4		**OLD PARALIC DEPOSITS (Qop) -** Mottled light yellowish brown and light gray, moist, medium dense, CLAYEY SANDSTONE.	CAL	X	73			
8		Mottled medium brownish gray and medium orange brown, moist, very dense, SILTY SANDSTONE.		X				
10		**BORING TERMINATED AT 10 FEET.**	CAL		50/6"			
12								
14								
16								
18								
20								

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

CITY OF COSTA MESA BIKE TRAIL IMPROVEMENTS AT FAIRVIEW PARK

By:	AKN	Date:	April, 2015
Job Number:	1231043PN-1	Figure:	I-5

LOG OF EXPLORATORY BORING NUMBER B-5

Date Excavated:	1/9/2013	Logged by:	AKN
Equipment:	Hollow Stem Auger	Project Manager:	GBF
Surface Elevation (ft):	N/A	Depth to Water (ft):	Not Encountered

DEPTH (ft)	USCS	SUMMARY OF SUBSURFACE CONDITIONS	SAMPLES: UNDISTURBED	SAMPLES: BULK	PENETRATION (blows/ ft. of drive)	MOISTURE (%)	DRY UNIT WT. (pcf)	LABORATORY TESTS
2		**OLD PARALIC DEPOSITS (Qop) -** Mottled medium brownish gray and medium brown, moist, very stiff to hard, SANDY CLAYSTONE.						SA
4								
6			CAL		54			
8		Mottled medium brownish gray and medium orange brown, moist, very dense, SILTY SANDSTONE.						
10			CAL		50/6"			
12		**BORING TERMINATED AT 10 FEET.**						
14								
16								
18								
20								

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

CITY OF COSTA MESA BIKE TRAIL INPROVEMENTS AT FAIRVIEW PARK

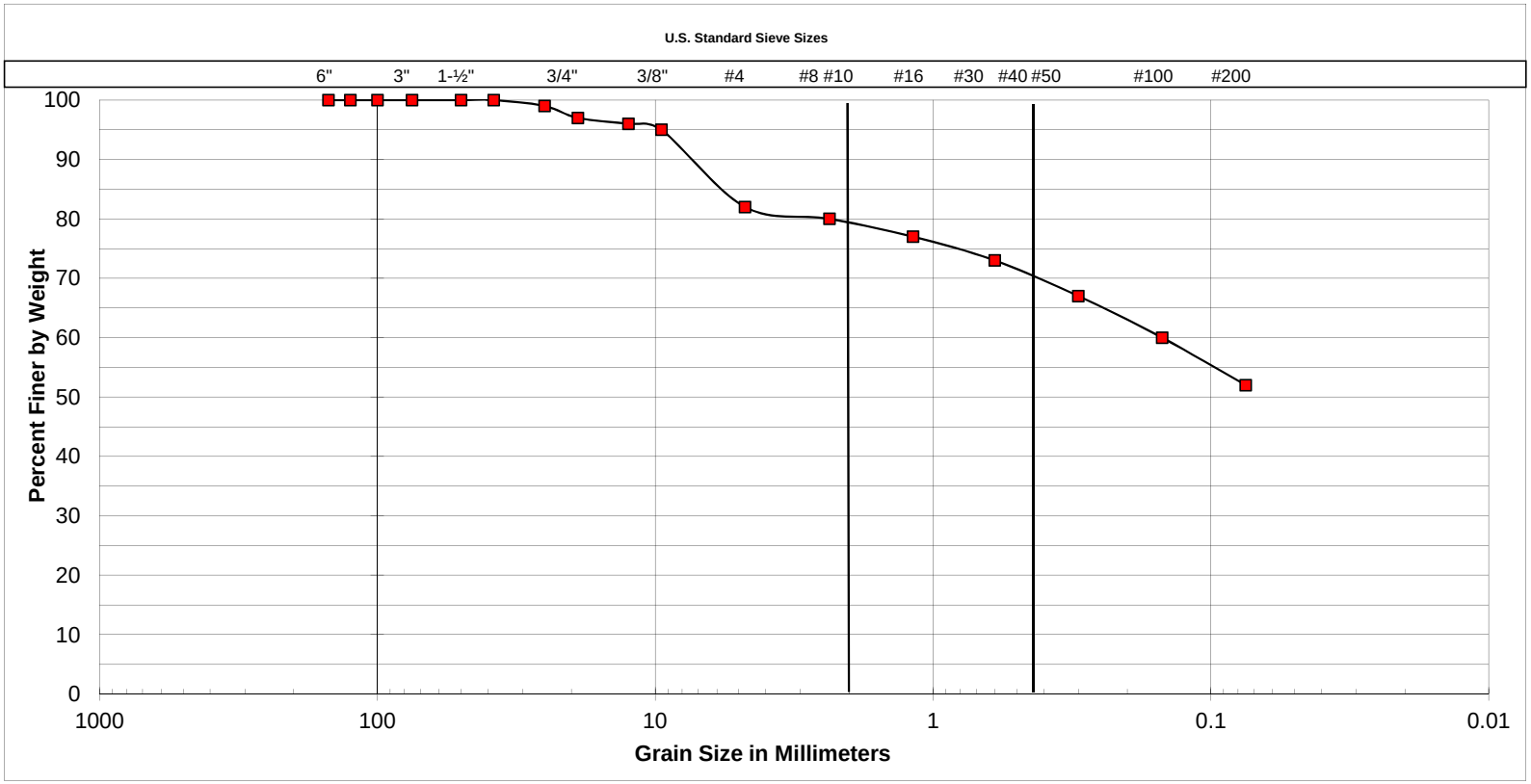
By:	AKN	Date:	April, 2015
Job Number:	1231043PN-1	Figure:	I-6

APPENDIX II

LABORATORY TESTING

The laboratory test program was designed to fit the specific need of this project and was limited to testing on-site materials. A brief description of each type of test is presented below. Results are given on the following pages and on the test pit logs in Appendix I.

- **CLASSIFICATION:** Field classifications were verified in the laboratory by visual examination. The final soil classifications are in accordance with the Unified Soil Classification System.
- **ATTERBERG LIMITS:** The atterberg limits were determined for 2 samples in accordance with ASTM D 4318. The results are presented on Figures II-1 and II-2.
- **GRAIN SIZE DISTRIBUTION:** The grain size distributions were determined for four samples in accordance with ASTM D 422. The results are shown on Figures II-1 through II-4.
- **MAXIMUM DENSITY AND OPTIMUM MOISTURE:** The maximum density and optimum moisture content was determined for one sample in accordance with ASTM D 1557. The results are presented on Figure II-5.
- **RESISTANCE R-VALUE:** One R-value was determined for the subgrade material in accordance with California Test 301. The result is presented on Figure II-5.
- **DIRECT SHEAR:** Three direct shear tests were performed in accordance with ASTM D 3080. The shear stress was applied at a constant rate of strain of approximately 0.003 inch per minute. The results are presented on Figures II-6 through II-8.



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
B-1 at 1 foot to 4 feet

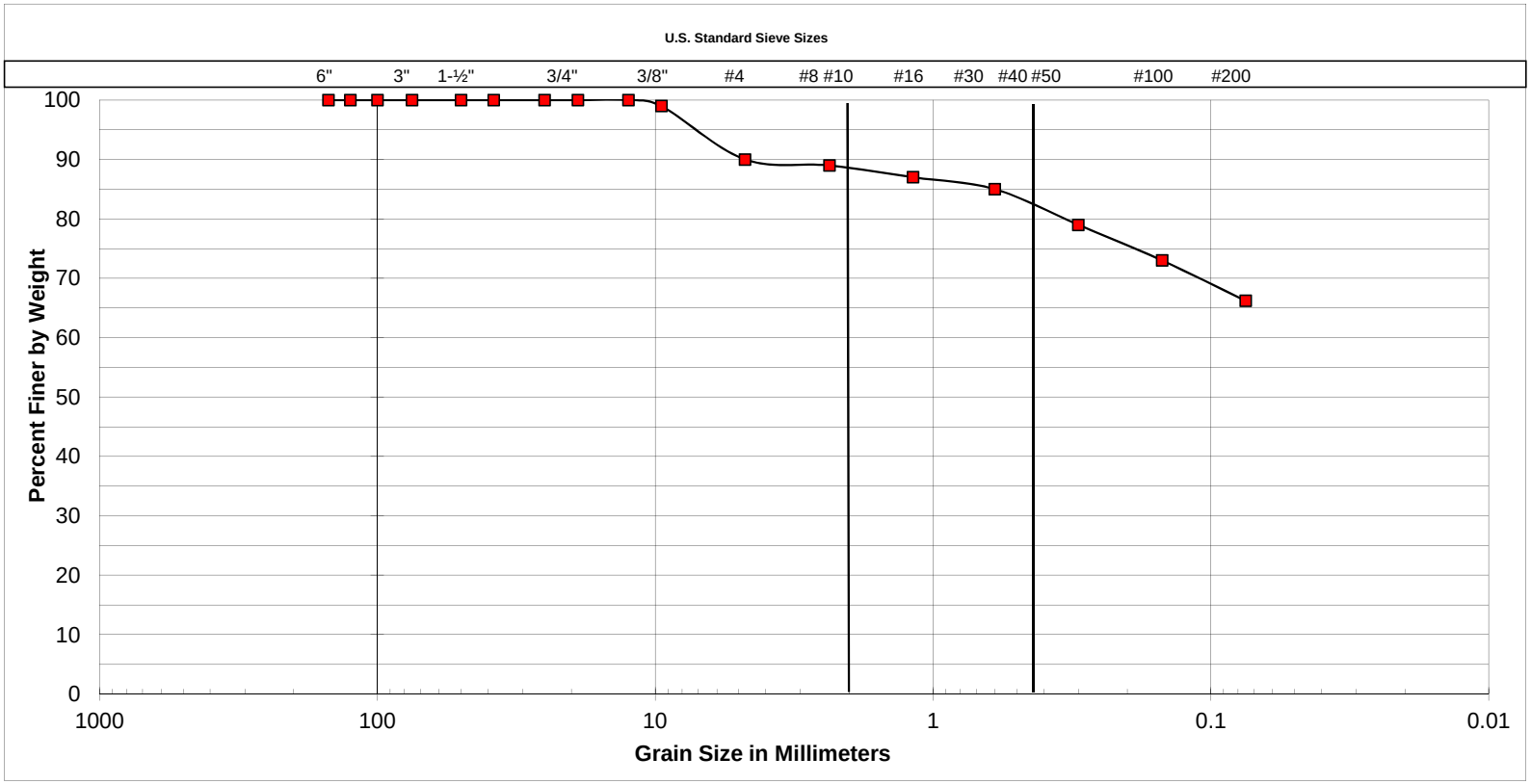
UNIFIED SOIL CLASSIFICATION:	CL
DESCRIPTION	SANDY CLAY with GRAVEL

ATTERBERG LIMITS	
LIQUID LIMIT	34
PLASTIC LIMIT	19
PLASTICITY INDEX	15

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

CITY OF COSTA MESA BIKE TRAIL IMPROVEMENTS AT FAIRVIEW PARK

By:	AKN	Date:	April, 2015
Job Number:	1231043PN-1	Figure:	II-1



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
B-2 at 4 feet to 9 feet

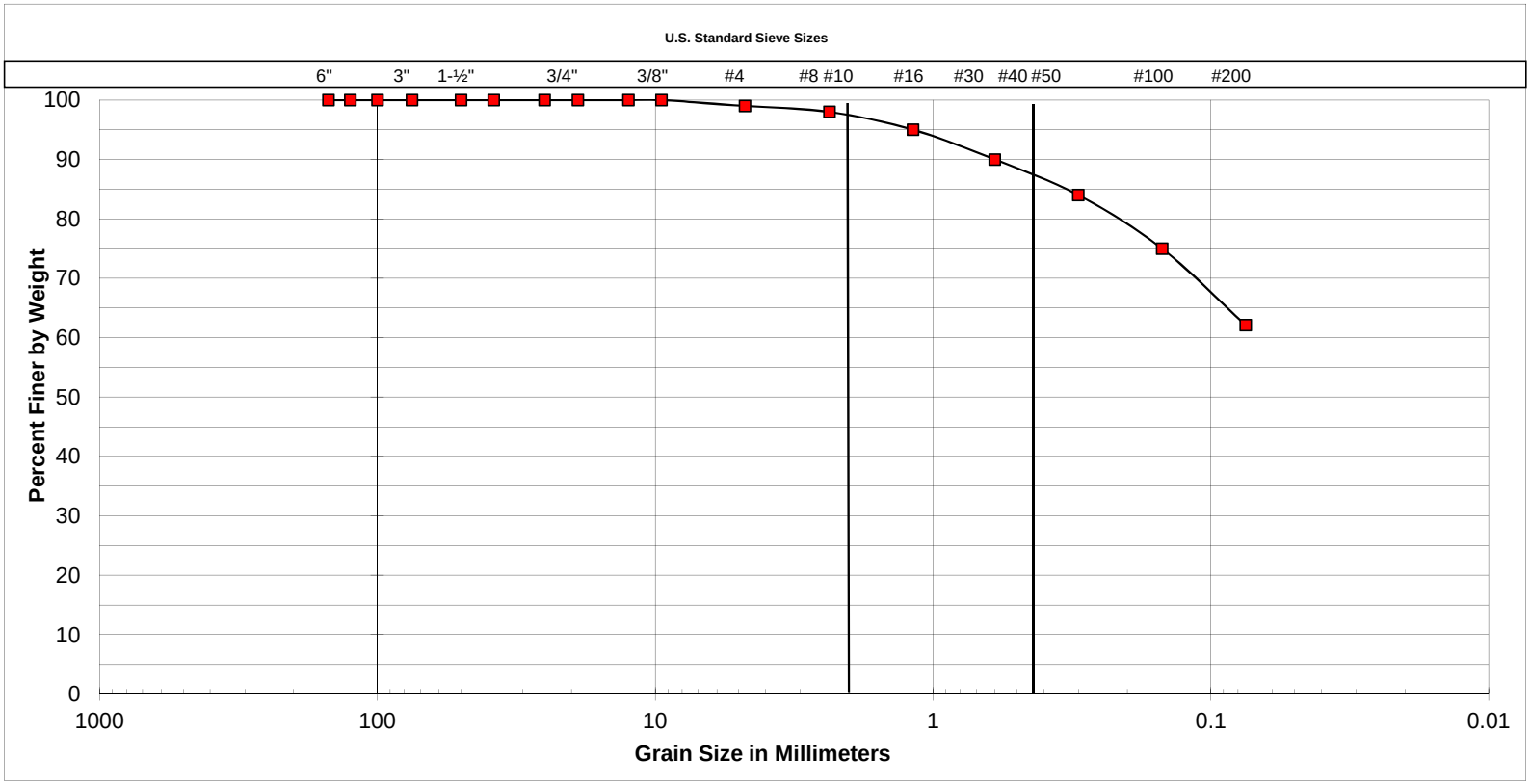
UNIFIED SOIL CLASSIFICATION:	CL
DESCRIPTION	SANDY CLAY

ATTERBERG LIMITS	
LIQUID LIMIT	40
PLASTIC LIMIT	13
PLASTICITY INDEX	27

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

CITY OF COSTA MESA BIKE TRAIL IMPROVEMENTS AT FAIRVIEW PARK

By:	AKN	Date:	April, 2015
Job Number:	1231043PN-1	Figure:	II-2



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
B-3 at 0 foot to 5 feet

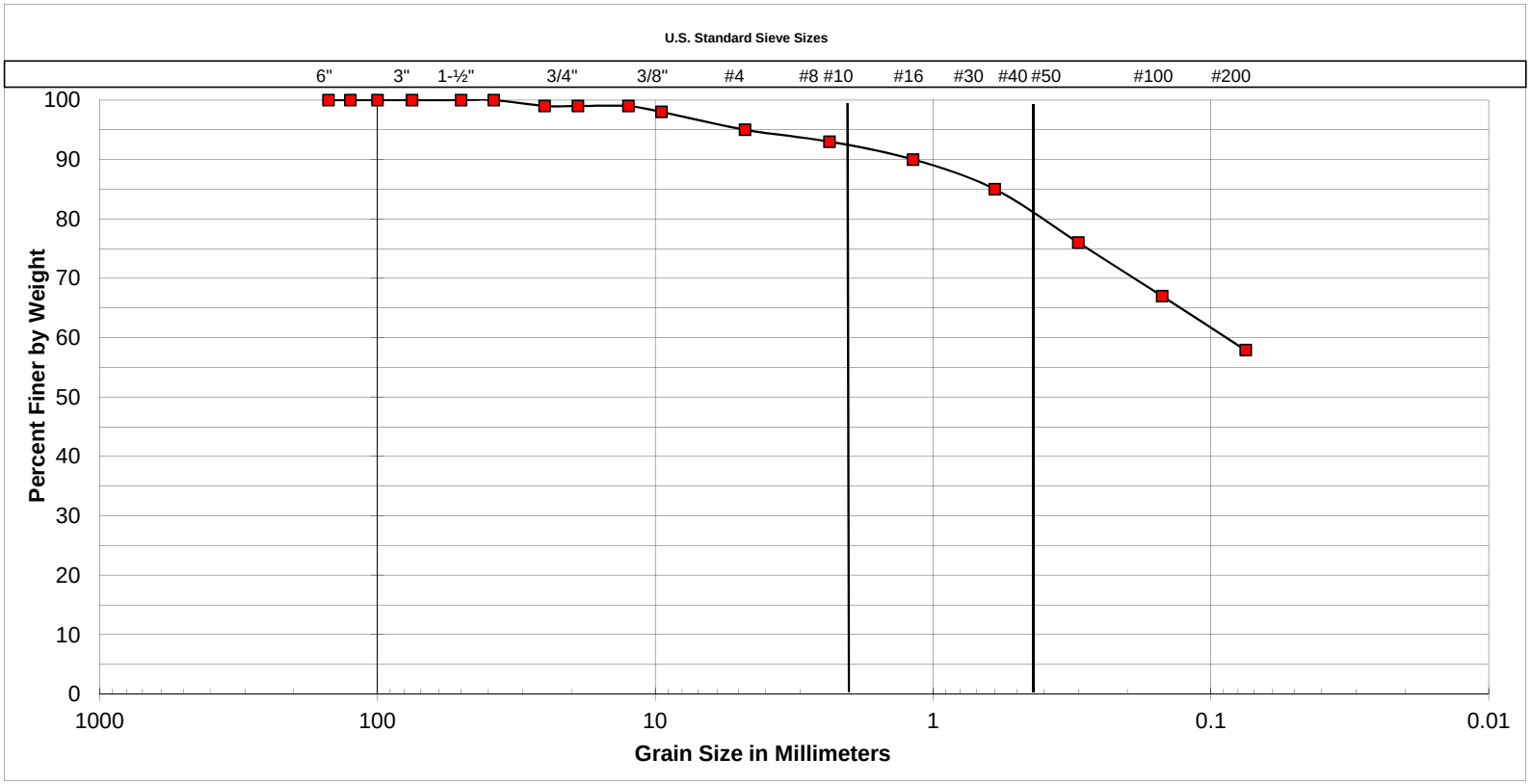
UNIFIED SOIL CLASSIFICATION:	CL
DESCRIPTION	SANDY CLAY

ATTERBERG LIMITS	
LIQUID LIMIT	N/A
PLASTIC LIMIT	N/A
PLASTICITY INDEX	N/A

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

CITY OF COSTA MESA BIKE TRAIL IMPROVEMENTS AT FAIRVIEW PARK

By:	AKN	Date:	April, 2015
Job Number:	1231043PN-1	Figure:	II-3



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

SAMPLE LOCATION
B-5 at 0 foot to 5 feet

UNIFIED SOIL CLASSIFICATION:	CL
DESCRIPTION	SANDY CLAY

ATTERBERG LIMITS	
LIQUID LIMIT	N/A
PLASTIC LIMIT	N/A
PLASTICITY INDEX	N/A

SOUTHERN CALIFORNIA SOIL & TESTING, INC.

CITY OF COSTA MESA BIKE TRAIL IMPROVEMENTS AT FAIRVIEW PARK

By:	AKN	Date:	April, 2015
Job Number:	1231043PN-1	Figure:	II-4

MAXIMUM DENSITY & OPTIMUM MOISTURE CONTENT

METHOD - A

ASTM - D1557

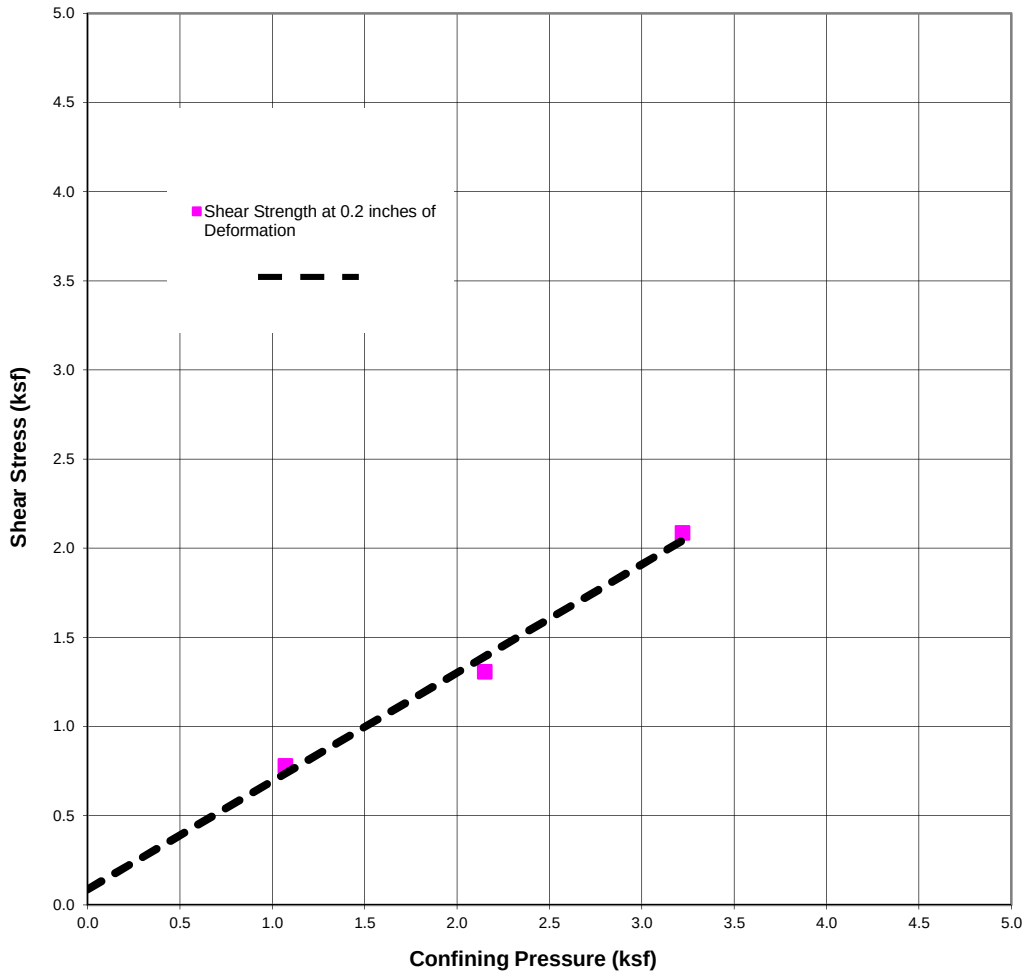
SAMPLE	DESCRIPTION	MAXIMUM DRY DENSITY (pcf)	OPTIMUM MOISTURE (pcf)
B-2 at 1 foot to 4 feet	SANDY CLAY (CL)	121.9	10.5

"R" VALUE

Caltrans Test 301

SAMPLE	"R" VALUE
B-4 at 1 foot to 4 feet	**<5**

Direct Shear Test Results



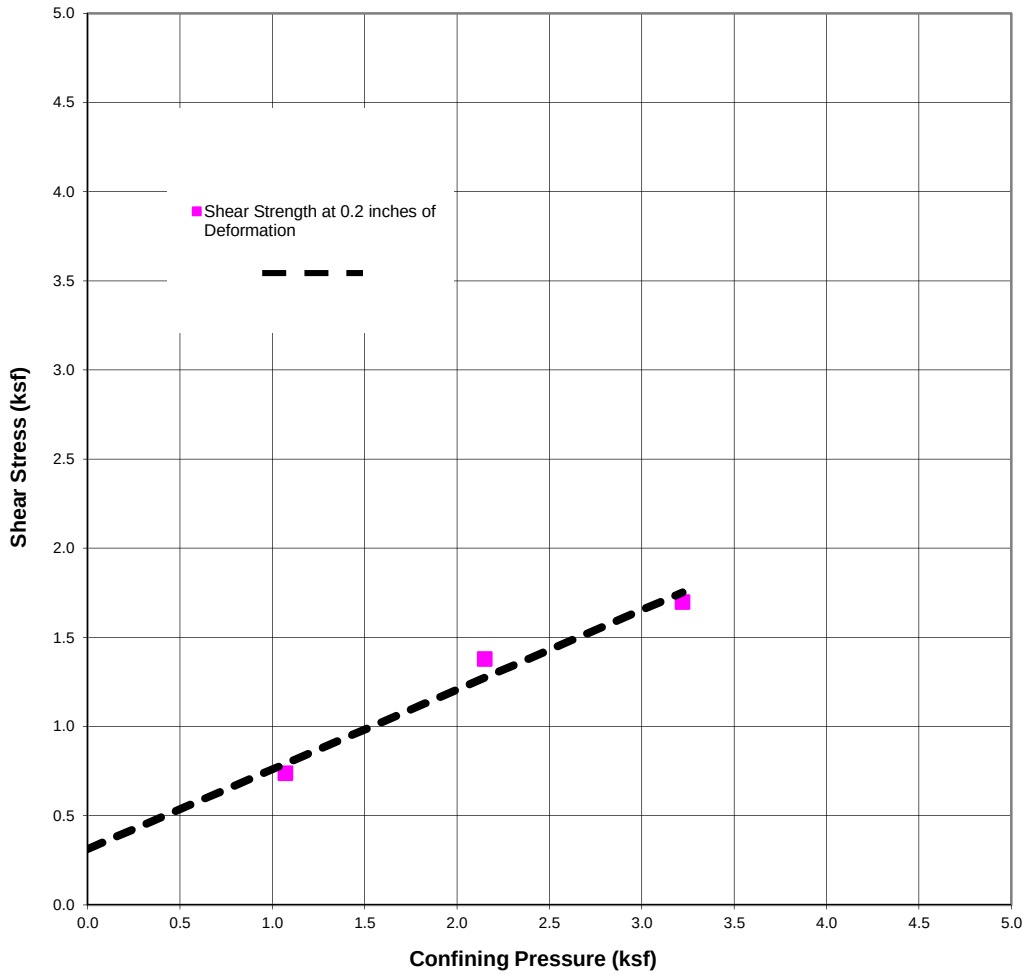
SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
B-1 at 5 feet	CLAYEY SAND (SC)		
Shear Strength at 0.2 inches of Deformation		31	86

SOUTHERN CALIFORNIA SOIL & TESTING

CITY OF COSTA MESA BIKE TRAIL IMPROVEMENTS AT FAIRVIEW PARK

By:	AKN	Date:	April, 2015
Job Number:	1231043PN-1	Figure:	II-6

Direct Shear Test Results



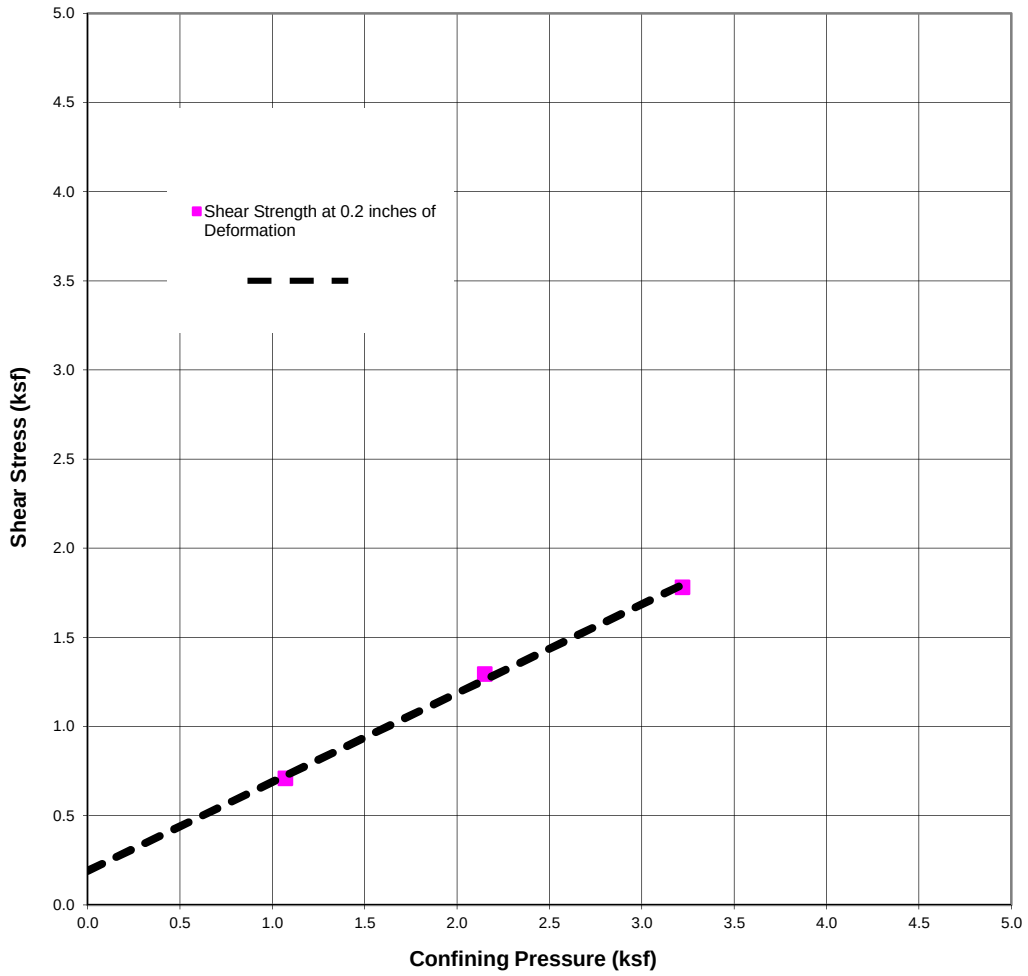
SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
B-1 at 15 feet	SANDY CLAY (CL)		
Shear Strength at 0.2 inches of Deformation		24	312

SOUTHERN CALIFORNIA SOIL & TESTING

CITY OF COSTA MESA BIKE TRAIL IMPROVEMENTS AT FAIRVIEW PARK

By:	AKN	Date:	April, 2015
Job Number:	1231043PN-1	Figure:	II-7

Direct Shear Test Results



SAMPLE	DESCRIPTION	INTERNAL FRICTION ANGLE(DEG.)	COHESION INTERCEPT (PSF)
B-2 at 1 foot 4 feet	SANDY CLAY (CL)		
Shear Strength at 0.2 inches of Deformation	Remolded to 90% Relative Compaction	26	192

SOUTHERN CALIFORNIA SOIL & TESTING

CITY OF COSTA MESA BIKE TRAIL IMPROVEMENTS AT FAIRVIEW PARK

By:	AKN	Date:	April, 2015
Job Number:	1231043PN-1	Figure:	II-8