John R. Byerly
INCORPORATED

PRELIMINARY SOILS INVESTIGATION

DESERT TRAILS PREPARATORY
ACADEMY MIDDLE SCHOOL

ASSESSOR'S PARCEL NO. 3096-361-07

VICTORVILLE, CALIFORNIA

DESERT TRAILS PREPARATORY ACADEMY

GEOTECHNICAL ENGINEERS • TESTING AND INSPECTION
2257 South Lilac Ave., Bloomington, CA 92316-2903
Bloomington (909) 877-1324 Riverside (909) 783-1910 Fax (909) 877-5210

John R. Byerly
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PRELIMINARY SOILS INVESTIGATION

MAY 20, 2019

DESERT TRAILS PREPARATORY ACADEMY MIDDLE SCHOOL
EAST SIDE OF MESA VIEW DRIVE AND NORTH OF FOREST PARK LANE
VICTORVILLE, CALIFORNIA

CLIENT:
DESERT TRAILS PREPARATORY ACADEMY
14350 BELLFLOWER STREET
ADELANTO, CALIFORNIA 92301
ATTENTION: DEBRA TARVER, CEO

RPT. NO.: 5854
FILE NO.: S-14158

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INTRODUCTION

During February through May of 2019, an investigation of the soil conditions underling the proposed middle school site was conducted by this firm. The purpose of our investigation was to evaluate the surface and subsurface conditions at the site with respect to safe and economical foundation types, vertical and lateral bearing values, liquefaction and seismic settlement potential, support of concrete slabs-on-grade, and site preparation. Included in the recommendations are the seismic design parameters as required by the 2016 edition of the California Building Code and the ASCE Standard 7-10. Recommendations are also provided for the design of asphalt concrete and portland cement concrete pavement for vehicle drive and parking areas, and for portland cement concrete pavement to receive only pedestrian traffic. Our preliminary soils investigation, together with our conclusions and recommendations, is discussed in detail in the following report.

This report has been prepared for the exclusive use of the Desert Trails Preparatory Academy and their design consultants for specific application to the project described herein. Should the project be modified, the conclusions and recommendations presented in this report should be reviewed by the geotechnical engineer. Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted engineering principles and practices. This warranty is in lieu of all other warranties, express or implied.

PROJECT DESCRIPTION

For the preparation of this report, we reviewed the project site plan prepared by MAA Architects, Inc. We understand that a new middle school is proposed and will consist of three buildings separated by two breezeways and with a combined footprint area of about 35,440 square feet. We also understand that the buildings will be of concrete tilt-up or concrete block masonry construction incorporating concrete slab-on-grade floors. It is anticipated that the structures will exert moderate to heavy foundation loads on the underlying soils. A parking lot, student pick-up/drop-off drive, fire lane, hardscape, and turf field areas will also be developed. As part of the development, we were informed that infiltration systems are planned in the north-central and easterly portions of the property to dispose of storm water runoff. Based on the site topography, minimal cuts and fills will be required for site development. The site configuration and proposed development are illustrated on Enclosure 1.

SITE CONDITIONS

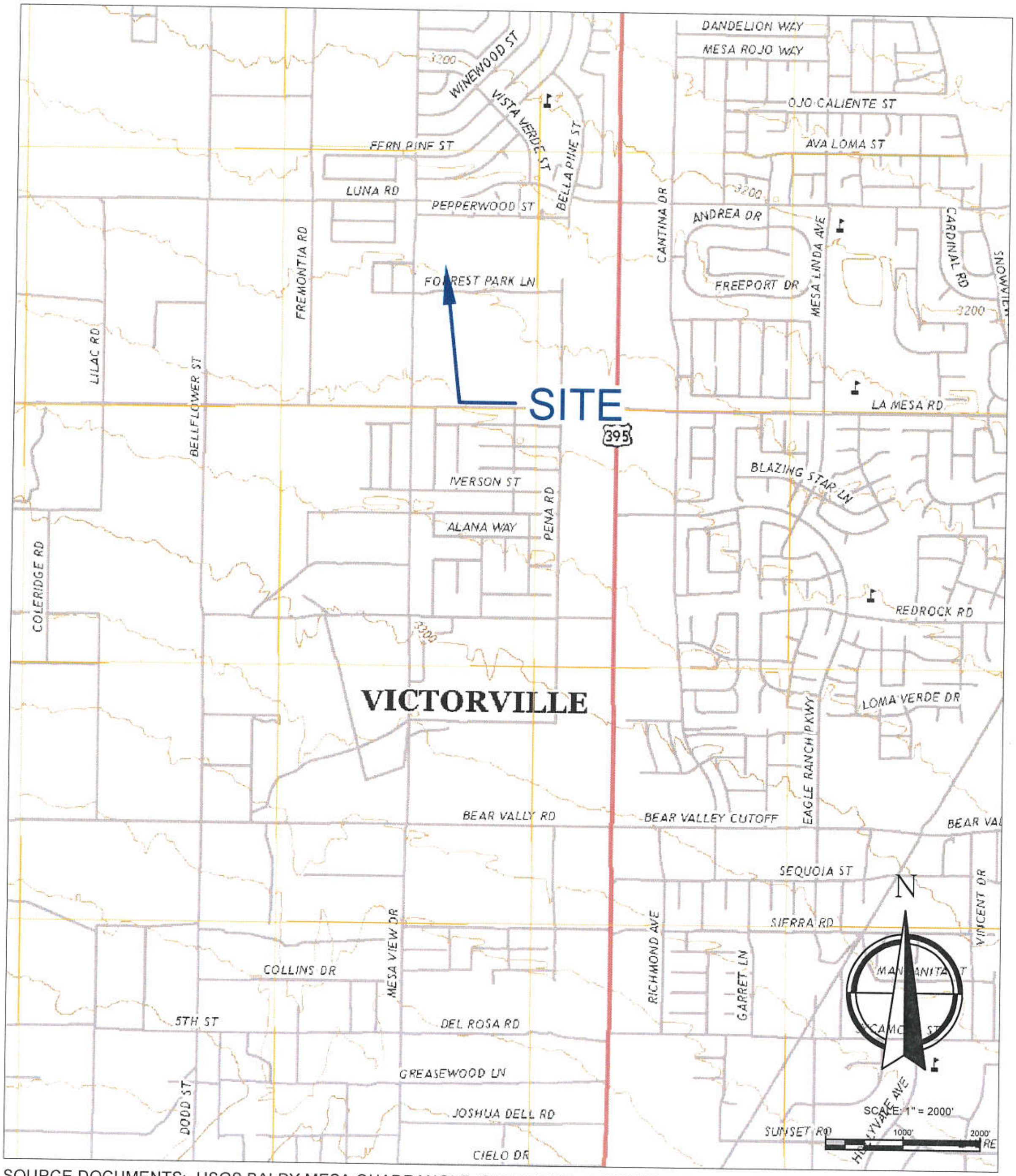
The 4.31-acre site is located on the east side of Mesa View Drive, north of Forest Park Lane in the city of Victorville. An Index Map showing the general vicinity of the site is presented on the following page. The coordinates of the site are latitude 34.4898° N and longitude 117.4071° W utilizing the North American Datum 1983 (NAD 1983). The area proposed for the new middle school is currently vacant. The ground surface throughout the property is covered with a light to moderate growth of weeds and sagebrush. Single-family residences occupy the properties to the south and west across Mesa View Drive. The remaining surrounding properties are vacant. The area topography is generally flat, and the site slopes downward to the northeast at an average gradient of less than 1½ percent.

FIELD AND LABORATORY INVESTIGATION

The soils underling the proposed building areas were explored by means of eight test borings drilled with a four-wheel drive truck-mounted flight-auger to depths of up to 51.5 feet below the existing ground surface. Also, six shallow borings were drilled to a depth of 6 feet in the vicinity of the new parking lot, driveways, fire lane, hardcourt, and ball field areas. The approximate locations of the explorations are indicated on Enclosure 1. The soils encountered were examined and visually classified by one of our field engineers. A summary of the soil classifications appears as Enclosure 2. The exploration logs show subsurface conditions at the dates and locations indicated, and may not be representative of other locations and times. The stratification lines presented on the logs represent the approximate boundaries between soil types, and the transitions may be gradual. A hollow-stem auger with an outside diameter of 8.5 inches was utilized. The inside diameter of the auger was 4.5 inches.

Bulk and relatively undisturbed samples were obtained at selected levels within the explorations and returned to our laboratory for testing and evaluation. The driving energy or blow counts required to advance the sampler at each sample interval were also noted. Relatively undisturbed soil samples were recovered at various intervals in the borings with a California sampler. The California sampler was a 2.9-inch outside diameter, 2.5-inch inside diameter, split-barrel sampler lined with brass tubes. The sampler was 18 inches long. The sampler conformed to the requirements of ASTM D 3550. A 140-pound automatic trip hammer was lifted hydraulically and was dropped 30 inches for each blow. Standard penetration tests were performed as Boring 1 was advanced. The standard

INDEX MAP



SOURCE DOCUMENTS: USGS BALDY MESA QUADRANGLE, CALIFORNIA, 7.5 MINUTE SERIES, 2018

TOWNSHIP AND RANGE: SECTION 28, T5N, R5W

LATITUDE: 34.4898° N

LONGITUDE: 117.4071° W

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penetration test blow counts are shown on the log for Boring 1. Standard penetration testing was performed with a 2.0-inch outside diameter, 1.5-inch inside diameter, split-barrel sampler. The sampler was 18 inches long. The inside diameter of the sampler shoe was 1.4 inches. The sampler was unlined. The sampler conformed to the requirements of ASTM D1586. A 140-pound automatic trip hammer was lifted hydraulically and was dropped 30 inches for each blow. An efficiency value of 1.0 was assumed for the automatic trip hammer.

Included in our laboratory testing were moisture/density determinations on all undisturbed samples. Optimum moisture content/maximum dry density relationships were established for typical soil types so that the relative compaction of the subsoils could be computed. A composite sample of potential subgrade soil was tested for gradation, sand equivalent, and "R" value for pavement design purposes. The moisture/density data are presented on the boring logs, Enclosure 2. Maximum density test data appear on Enclosure 3. Subgrade soil test data are summarized on Enclosure 4. Chemical testing, comprised of pH, soluble sulfate, chloride, redox potential, and resistivity testing, was also performed. The chemical test results are presented in the "Chemical Test Results" section of this report.

SOIL CONDITIONS

Artificial fill was not encountered in our explorations. The upper natural soils encountered in our test borings generally consisted of loose to dense sands and silty sands with varying amounts of gravel. The loose soils encountered in Borings 4, 6, and 12 extended to depths of 2.0 feet, 2.5 feet, and 2.5 feet, respectively. The deeper soils consisted of dense to very dense sands and silty sands with varying amounts of gravel. Based on published geologic reports for this area, dense alluvial soil is considered to extend to a depth of at least 100 feet beneath the site. Neither bedrock nor free ground water was noted at our boring locations. The near-surface soils observed in our test borings are granular and non-plastic, and are considered to have a very low expansion potential in accordance with ASTM D4829.

LIQUEFACTION AND DYNAMIC SETTLEMENT

Liquefaction is a phenomenon that occurs when a soil undergoes a transformation from a solid state to a liquefied condition due to the effects of increased pore-water pressure. Loose saturated soils with particle sizes in the medium sand to silt range are particularly susceptible to liquefaction when subjected to seismic ground shaking. Affected soils lose all strength during liquefaction, and foundation failure can occur.

Free ground water was not encountered at our boring locations. Data from the State of California Department of Water Resources indicate that the water well closest to the site (05N05W21J001S) is approximately 1.1 miles to the northeast. At this location, ground water (W.S. Elevation 2791.9) was at a depth of 348.1 feet below the ground surface (G.S. Elevation 3140) during January of 1957. The ground surface elevation of the new middle school site varies from about 449.1 feet to 455.1 feet (G.S. Elevation 3241 to 3247) above the water surface elevation. We have searched the resources at the Western Municipal Water District. No well data applicable to the subject site were found. Due to the great depth to ground water, we conclude that the potential for seismically induced liquefaction is low.

It is anticipated that major earthquake ground shaking will occur during the lifetime of the proposed development from the seismically active Mojave section of the San Andreas fault located approximately 14.4 miles southwest of the site. This fault would create the most significant earth shaking event. Based on an earthquake magnitude of 7.3, a peak horizontal ground acceleration of 0.500g is assigned to the site. To evaluate the potential for seismically induced settlement of the subsoils, the soils were analyzed for relative density. The most effective measurement of relative density of sands with respect to seismic settlement potential is standard penetration resistance. Standard penetration tests were performed as Boring 1 was advanced to a depth of 51.5 feet. The standard penetration test "N" values are presented on the boring log for Boring 1.

The standard penetration data provided input for the LiquefyPro Version 4.3 program for seismically induced settlement. As recommended in Special Publication 117A (Revised) Release, "Guidelines for Evaluating and Mitigating Seismic Hazards in California, March 2009," a safety factor of 1.3 was used in this analysis. We have assumed that the upper 3 feet of soil will be overexcavated and replaced as engineered fill, and that the bottom of overexcavation would be scarified to a depth of 12 inches and recompacted. The engineered fill was assumed to have an "N" value of 30. The results of this evaluation are shown on Enclosure 6. This analysis reveals a total potential dynamic settlement of 0.59 inch in Boring 1. This maximum value of potential dynamic settlement is quite small and is not considered significant. It is our judgment that neither liquefaction nor seismically induced dry settlement need be a consideration in the design of the new middle school.

CONCLUSIONS

Artificial fill was not encountered in our explorations. It appears that the upper natural soils are non-uniform, varying from loose to dense. To assure uniform and acceptable foundation conditions, we recommend that these upper natural soils be overexcavated and recompacted to a depth of at least 2 feet below the bottom of footings. Subsequent to site preparation, the new middle school buildings may be safely founded on conventional continuous and isolated footings. Recommendations for foundation design and slabs-on-grade are provided below for very low (Expansion Index of 0 to 20) expansion potential. Detailed recommendations are presented below.

RECOMMENDATIONS

FOUNDATION DESIGN

Where the site is prepared as recommended, the proposed middle school buildings may be founded on conventional continuous and pad footings. These footings should be at least 12 inches wide, should be placed at least 18 inches below the lowest final adjacent grade, and should be designed for a maximum safe soil bearing pressure of 2,500 pounds per square foot for dead plus live loads. If the footing embedment is increased to 24 inches below the lowest final adjacent grade, the maximum safe soil bearing pressure can be increased to 3,000 pounds per square foot. These bearing capacity values may be increased by one-third for wind and seismic loading.

Building footings should bear on at least 24 inches of compacted fill. The existing soil should be overexcavated and recompacted to provide a minimum of 24 inches of compacted fill below the footings. Specific grading recommendations are presented in the "Site Preparation" section of this report.

Continuous footings should be reinforced with at least two No. 4 bars, one placed near the top and one near the bottom of the footings. This recommendation for foundation reinforcement is based on geotechnical considerations. Structural design may require additional foundation reinforcement.

SEISMIC DESIGN PARAMETERS

To assist the structural engineer in the selection of seismic coefficients to be incorporated into the design of the structures, we have reviewed the 2016 edition of the California Building Code and the ASCE Standard 7-10. The various coefficients and factors are provided in the following table:

Factor or Coefficient	***Value***
Latitude	34.4898° N
Longitude	117.4071° W
Mapped S_S	1.500g
Mapped S_1	0.600g
F_a	1.000
F_v	1.500
Final S_{MS}	1.500g
Final S_{M1}	0.900g
Final S_{DS}	1.000g
Final S_{D1}	0.600g
PGA	0.500g
T_L	12 seconds
Site Class	D

LATERAL LOADING

For horizontal backfill surface and cantilever wall conditions, we recommend an active fluid pressure of 35 pounds per square foot per foot of depth, exclusive of surcharge loads. For braced walls with horizontal backfill surface conditions, we recommend an at-rest fluid pressure of 60 pounds per square foot per foot of depth, exclusive of surcharge loads. Resistance to lateral loads will be provided by passive earth pressure and basal friction. For footings bearing against compacted fill or dense natural soil, passive earth pressure may be considered to develop at a rate of 350 pounds per square foot per foot of depth. Basal friction may be computed at 0.4 times the normal dead load. The resistance from basal friction and passive earth pressure may be combined directly without reduction. A backdrain system or weep holes should be provided to prevent buildup of hydrostatic pressure behind retaining walls.

SLABS-ON-GRADE

Concrete slab-on-grade design recommendations are listed below. The slab-on-grade recommendations assume underlying utility trench backfills and pad subgrade soils have been densified to a relative compaction of at least 90 percent (ASTM D1557).

1. It is our opinion that the compacted fill soils should provide adequate support for concrete slabs-on-grade without the use of a gravel base. The final pad surface should be rolled to provide a smooth dense surface upon which to place the concrete.

2. The slab-on-grade floors should be at least 4 inches thick – structural considerations may require a thicker slab. Concrete slabs-on-grade supporting significant loads may be designed using a modulus of subgrade reaction of 300 pounds per cubic inch.

3. The concrete slab-on-grade floor should be reinforced with 6"x6"-W2.9/W2.9 welded wire fabric or No. 3 bars at 24 inches on-center each way or equivalent.

4. Slabs to receive moisture-sensitive floor coverings should be underlain with a moisture vapor retardant membrane, such as 10-mil Stego Wrap or equivalent. The moisture vapor retardant membrane should conform to ASTM E 1745-11 (Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs). The moisture vapor retardant membrane should be lapped into the footing excavation to provide full coverage of the subgrade soils. Punctures and/or holes cut for plumbing should be taped to minimize moisture emissions through the membrane. The project superintendent and/or a representative of the geotechnical engineer should inspect the placement of the moisture vapor retardant membrane prior to covering. Installation of the moisture vapor retardant membrane should be performed in accordance with ASTM E 1643-11 (Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs).

5. A 2-inch layer of clean sand (SE>30, no more than 7 percent passing the No. 200 sieve) should be placed over the moisture vapor retardant membrane to promote uniform setting of the concrete. Concrete should be placed on the sand blanket when the sand is damp. Excess moisture should not be allowed to accumulate within the sand blanket prior to

concrete placement. At the time of concrete placement, the moisture content of the sand blanket above the moisture vapor retardant membrane should not exceed 2 percent below the optimum moisture content.

6. In lieu of placing the sand blanket described above and to further minimize future moisture vapor emissions through the slabs-on-grade, the slab concrete may be placed directly on the moisture vapor retardant membrane. Placing concrete directly on the moisture vapor retardant membrane will increase shrinkage and curling forces and make finishing more difficult. To accommodate these concerns, the structural engineer should provide appropriate mix design criteria for concrete placed directly on the moisture vapor retardant membrane.

7. We recommend a maximum water-cement ratio of 0.50 for all building slab concrete. Architectural or structural considerations may require the utilization of a lower water-cement ratio. Where slab concrete is placed directly on the moisture vapor retardant membrane without the presence of an intervening layer of absorptive sand, a lower maximum water-cement ratio may be needed.

8. Preparation of the concrete floor slabs should conform to ASTM F 710-11 (Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring) and the manufacturer's recommendations. Moisture vapor emission tests should be performed to verify acceptable moisture emission rates prior to flooring installation.

SITE PREPARATION

We assume that the site will be prepared in accordance with the California Building Code and the current City of Victorville Grading Ordinance. The recommendations presented below are to establish additional grading criteria. These recommendations should be considered preliminary and are subject to modification or expansion based on a geotechnical review of the project foundation and grading plans.

- All areas to be graded should be stripped of organic matter, man-made obstructions, and other deleterious materials. Any underground utilities encountered should also be removed and relocated or abandoned. All cavities created during site clearing should be cleaned of loose and disturbed soil, shaped to provide access for construction equipment, and backfilled with fill placed and compacted as described below.

- Any existing artificial fill encountered should be removed from the building, pavement, site walls or retaining wall areas, or other hardscape areas.

- Overexcavation

    - Building and any wall areas – The soils below and within 5 feet of the building and any wall areas, should be overexcavated to a depth of 2 feet below the bottom of footings. The soil exposed in the bottom of the overexcavation should be evaluated by the representative of the geotechnical engineer. Soil exhibiting a relative compaction of less than 85 percent should be further overexcavated until undisturbed soil exhibiting a relative compaction of at least 85 percent is encountered. The overexcavation should extend beyond the building area and site and retaining wall footings a horizontal distance at least equal to the depth of overexcavation below the final ground surface or 5 feet, whichever distance is greater. A representative of this firm should observe the bottom of all excavations.

    - Pavement and hardscape areas – The soils below asphalt concrete and portland cement concrete pavement and hardscape areas should be scarified to a minimum depth of 12 inches below existing grade or 12 inches below proposed final grade, whichever is deeper. Final grade is defined as the elevation of the top of the subgrade. The scarified soils should be moistened to near the optimum moisture content and densified to a minimum relative compaction of 90 percent (ASTM D1557).

- Approved subexcavated surfaces and all other surfaces to receive fill should be scarified to a minimum depth of 12 inches, moisture conditioned to near optimum moisture content, and densified to a minimum relative compaction of 90 percent (ASTM D1557).

- The on-site soils should provide adequate quality fill material provided they are free from significant organic matter and other deleterious materials, and are at acceptable moisture contents. Import fill should be inorganic, granular, non-expansive soil free from rocks or lumps greater than 8 inches in maximum dimension, and should exhibit a very low expansion potential (expansion index less than 21), negligible sulfate content (less than 1,000 ppm soluble sulfate by dry weight of soil), and low corrosion potential. Prior to bringing import fill to the site, the contractor should obtain certification to verify that the proposed import meets the State of California Department of Toxic Substance Control (DTSC) environmental standards. Proposed import should be sampled at the source and tested by this firm for expansion index, soluble sulfate content, and corrosion potential.

- All fill should be placed in 8-inch or less lifts; each lift of fill should be moisture conditioned to near optimum moisture content, and densified to a minimum relative compaction of 90 percent (ASTM D1557).

- The surface of the site should be graded to provide positive drainage away from the structures. Drainage should be directed to established swales and then to appropriate drainage structures to minimize the possibility of erosion. Water should not be allowed to pond adjacent to footings.

SHRINKAGE AND SUBSIDENCE

Volume change in going from cut to fill conditions is anticipated where near-surface grading will occur. Assuming the fill will be compacted to an average relative compaction of 93 percent, an average cut-fill shrinkage of 10 percent is estimated. Further volume loss will occur through subsidence during preparation of the natural ground surface. Although the contractor's methods and equipment utilized in preparing the natural ground will have a significant effect on the amount of natural ground subsidence that will occur, our experience indicates as much as 0.10 foot of subsidence in areas prepared to receive fill should be anticipated. These values are exclusive of losses due to stripping or removal of subsurface obstructions.

ASPHALT CONCRETE AND PORTLAND CEMENT CONCRETE PAVEMENT

A representative sample of upper soils at the site has been tested for relevant subgrade properties and exhibits a moderate stability under traffic loading ("R" value of 57). A Traffic Index of 5.0 was assumed for interior parking and driveway areas for conventional vehicular traffic, and a Traffic Index of 6.0 was assumed where heavier truck or bus traffic will be accommodated. Recommendations for portland cement concrete (PCC) for hardscape are also presented below. In conjunction with the test data shown on Enclosure 4, we believe the sections presented on the following tables should provide durable pavement.

Location	**TI**	**"R" Value**	**Thickness (Inches)** **Asphalt Concrete**	 **Aggregate Base**
Pavement areas for conventional passenger cars and light trucks	5.0	57	2.5	4.0
Pavement areas for heavier trucks and buses	6.0	57	3.0	4.0

Location	**TI**	**"R" Value**	**Thickness (Inches) Portland Cement Concrete**
Pavement areas for conventional passenger cars and light trucks	5.0	57	4.5
Pavement areas for heavier trucks	6.0	57	6.5

Location	**Thickness (Inches) Portland Cement Concrete**
Pavement areas for pedestrian traffic	3.5

The foregoing thicknesses for portland cement concrete pavement are for unreinforced concrete placed directly on the compacted subgrade soil. Aggregate base is not geotechnically required for the PCC pavement sections; however, if aggregate base is to be utilized for the PCC pavement, we recommend a minimum of 4 inches of aggregate base placed over the 12 inches of compacted subgrade soil. The design engineer may wish to provide some level of reinforcement to minimize the width of shrinkage cracks.

For hardscape areas to receive only pedestrian traffic, we recommend the PCC pavement be at least 3.5 inches in thickness and be placed directly on the compacted subgrade soil. Prior to the placement of hardscape concrete, we recommend that the final subgrade surface be scarified to a depth of at least 12 inches, moisture conditioned to within 2 percent of the optimum moisture content, and densified to a minimum relative compaction of 90 percent (ASTM D1557). There are no geotechnical conditions indicating the need for reinforcement of the concrete pavement. The design engineer may wish to provide some level of reinforcement to minimize the width of shrinkage cracks.

Portland cement concrete should be proportioned for a maximum slump of 4 inches and to achieve a minimum compressive strength of 3,000 psi at 28 days. If additional workability is desired, a plasticizing or water-reducing admixture should be utilized in lieu of increasing the water content. Control joints for the 3.5-inch-thick pavement should be spaced no more than 10.5 feet on-center each way. The control joints for the 4.5-inch-thick pavement should be spaced no more than 13.5 feet on-center each way. The control joints for the 6.5-inch-thick pavement should be spaced no more than 19.5 feet on-center each way. Control joints should be established either by hand groovers, plastic inserts, or saw-cutting as soon as the concrete can be cut without dislodging aggregate. Cutting the control joints the day after the concrete pour will likely result in uncontrolled shrinkage cracks. Concrete should not be placed in hot and windy weather. Water curing should commence immediately after the final finishing and should continue for at least 7 days.

The above designs are preliminary and for estimating purposes only. We recommend that during the process of rough grading, observation and additional testing of the actual subgrade soils should be performed. Final pavement design sections can then be determined. The foregoing pavement sections assume that utility trench backfill below all proposed pavement areas will be compacted to at least 90 percent relative compaction. Prior to the placement of aggregate base, we recommend that the final subgrade surface be scarified to a depth of at least 12 inches, moisture conditioned to within 2 percent of the optimum moisture content, and compacted to a minimum relative compaction of at least 90 percent (ASTM D1557). Aggregate base should be densified to at least 95 percent relative compaction. Suggested specifications for aggregate base material are presented on Enclosure 5. The preparation of the subgrade and compaction of the aggregate base should be monitored by a representative of the geotechnical engineer.

CHEMICAL TEST RESULTS

The chemical test results from a sample taken from Boring 12 between the ground surface and a depth of 5 feet are shown on the following table:

Analysis	Result	Units
Saturated Resistivity	11400	ohm-cm
Chloride	ND (Not Detected)	ppm
Sulfate	20	ppm
pH	7.7	pH units
Redox Potential	289	mV

The chemical test results from a sample taken from Boring 14 between the ground surface and a depth of 5 feet are shown on the following table:

Analysis	Result	Units
Saturated Resistivity	10600	ohm-cm
Chloride	ND (Not Detected)	ppm
Sulfate	60	ppm
pH	8.1	pH units
Redox Potential	266	mV

The soil tested in Borings 12 and 14 exhibited negligible soluble sulfate content; therefore, sulfate-resistant concrete will not be required for this project. In addition, the results of the corrosivity testing indicate that the soil tested is not detrimentally corrosive to ferrous-metal pipes.

FOUNDATION AND GRADING PLAN REVIEW

The project foundation and grading plans should be reviewed by the geotechnical engineer. Additional recommendations may be required at that time.

CONSTRUCTION OBSERVATIONS

All grading operations, including the preparation of the ground surface, should be observed and compaction tests performed by this firm. No fill should be placed on any prepared surface until that surface has been evaluated by the representative of the geotechnical engineer. All footing excavations should be observed by the representative of the geotechnical engineer prior to placement of forms or reinforcing steel.

The conclusions and recommendations presented in this report are based upon the field and laboratory investigation described herein, and represent our best engineering judgment. Should conditions be encountered in the field that appear different from those described in this report, we should be contacted immediately in order that appropriate recommendations might be prepared.

Respectfully submitted,

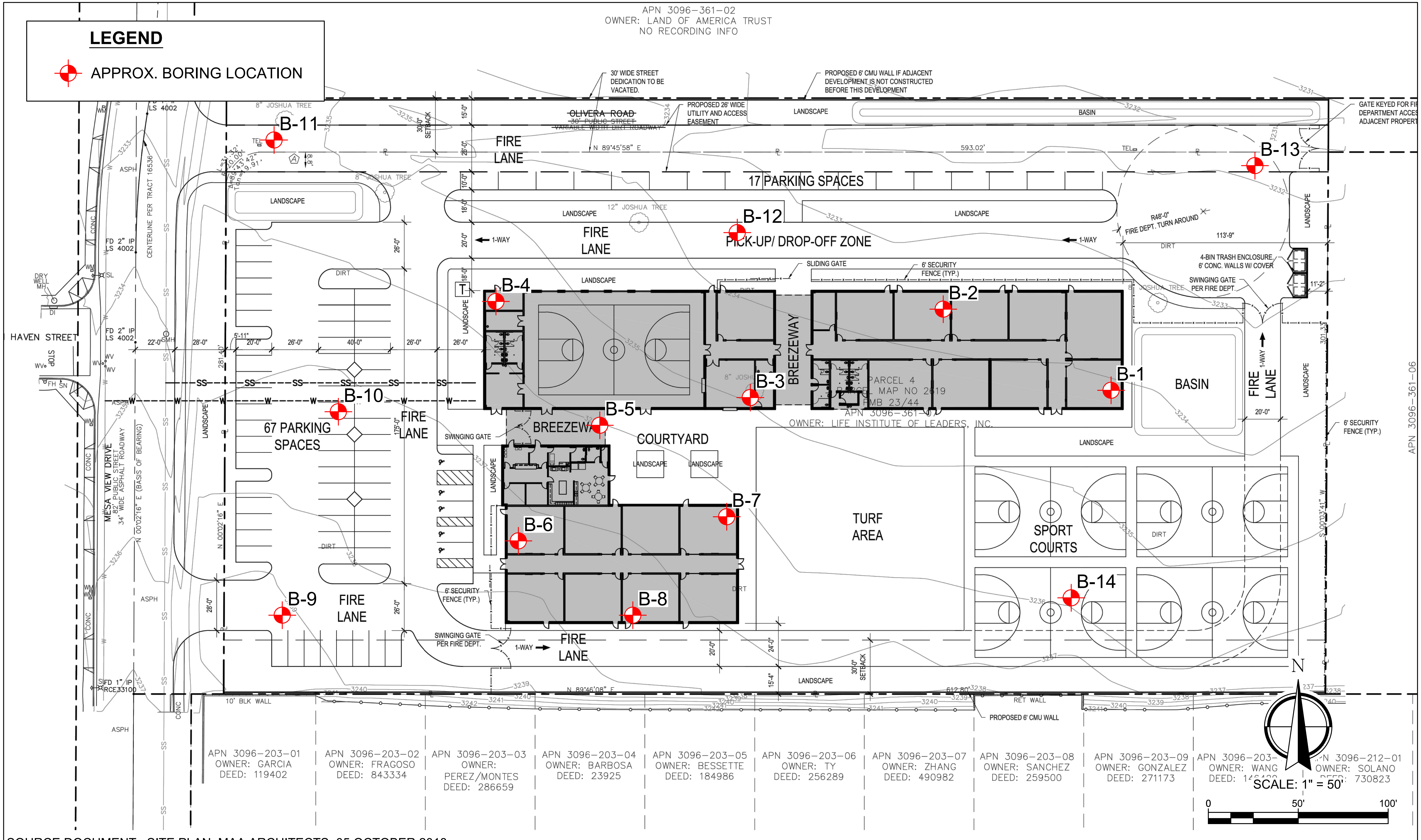
JOHN R. BYERLY, INC.

John R. Byerly, Geotechnical Engineer
President

REGISTERED PROFESSIONAL ENGINEER
JOHN R. BYERLY
No. GE000179
Exp. Date 6-30-19
GEOTECHNICAL
STATE OF CALIFORNIA

JRB:MLL:jet

Enclosures:
(1) Plot Plan
(2) Test Boring Logs
(3) Maximum Density Determinations
(4) Subgrade Soil Tests
(5) Specifications for Aggregate Base
(6) Liquefaction and Dynamic Settlement Analysis



SOURCE DOCUMENT: SITE PLAN, MAA ARCHITECTS, 05 OCTOBER 2018

John R. Byerly INCORPORATED	SOILS INVESTIGATION	DESERT TRAILS PREPARATORY ACADEMY MIDDLE SCHOOL MESA VIEW DRIVE VICTORVILLE, CALIFORNIA	Enclosure 1 Rpt. No.: 5854 File No.: S-14158

Boring 1

Boring Date: 2/20/19
Surface Elevation:
Drilling Method: Four-Wheel Dirve Flight-Auger

Depth	Std. Pen. "N" Value	Blows/Ft.	Dry Density (PCF)	Moisture Content (%)	Rel. Compaction (%)	Water Table		
0		22	114	1.1	87	GWT not encountered	SM	Light gray-brown silty fine to coarse sand, dry and medium denes (ORIGINAL GROUND)
		17	---	---	---		SP	- with gravel at 3.0 feet Light gray-brown fine to coarse sand with gravel, dry and medium dense
	23	23	116	0.7	86			
10	25	27	118	0.9	88		SP	Gray fine to coarse sand with some gravel, dry and medium dense
	26	30	120	0.6	89			
20	49	50/11"	116	2.7	91		SM	Light gray-brown silty fine to medium sand, dry and dense
	56	50/9"	1119	2.4	94		SM	Light brown silty fine to medium sand, dry and dense
30	59	50/9"	128	1.6	95		SP	Light brown fine to coarse sand with silt and some gravel, dry and very dense
	61							
40	69						SM	Light gray-brown silty fine to coarse sand with some gravel, dry and very dense
	73							
50	80							
60								
70								

Total Depth at 51.5 Feet
No Free Ground Water Encountered

LOG OF BORING

John R. Byerly, Inc.

Desert Trails Preparatory Academy
Middle School

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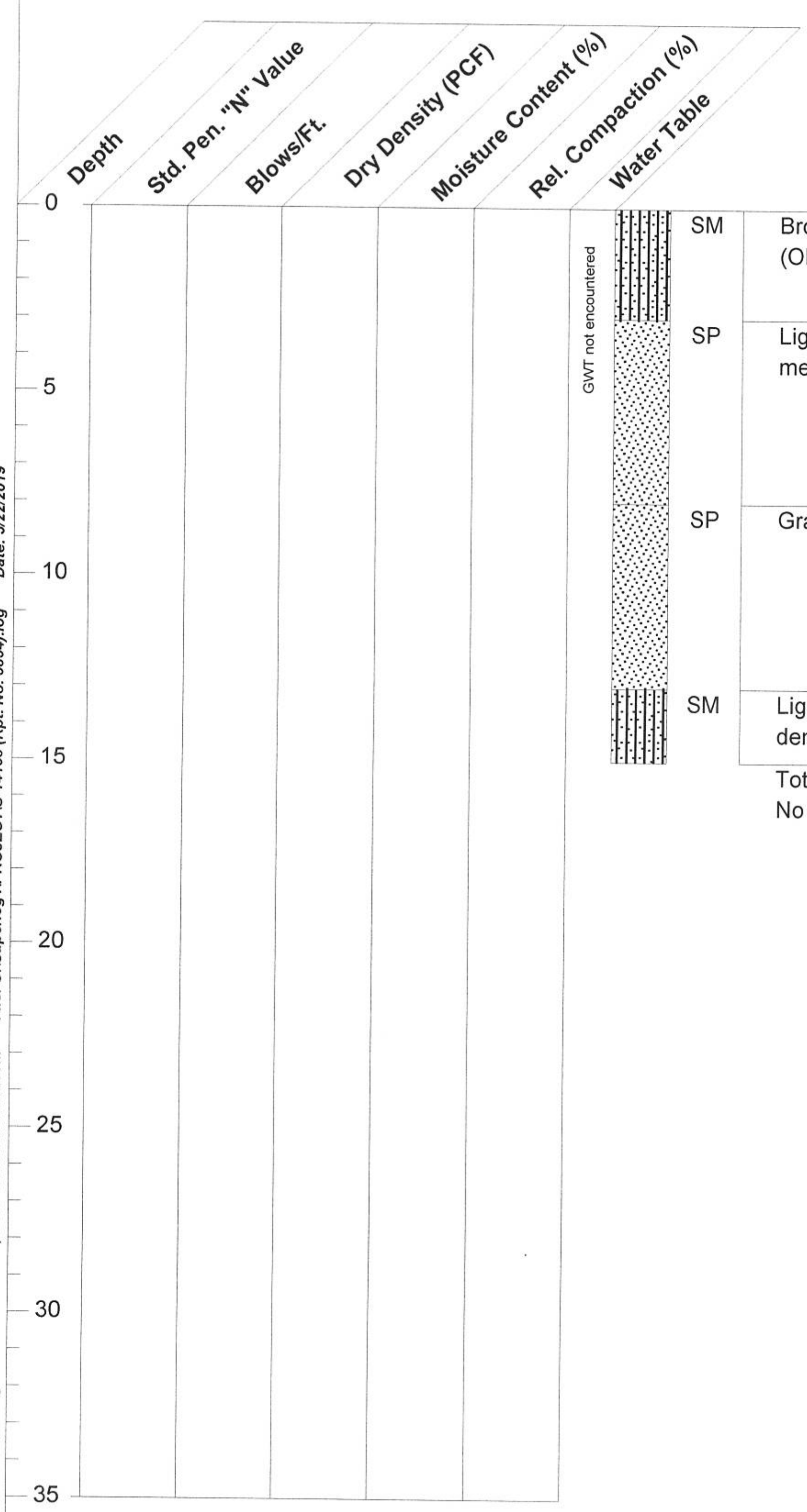
SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog4\PROJECTS-14158 (Rpt. No. 5854).log Date: 5/22/2019

Boring 2

Boring Date: 2/21/19
Surface Elevation:
Drilling Method: Four-Wheel Dirve Flight-Auger



SM	Brown silty fine to medium sand, dry and medium dense (ORIGINAL GROUND)
SP	Light gray-brown fine to coarse sand with gravel, dry and medium dense
SP	Gray fine to coarse sand with gravel, dry and medium dense
SM	Light gray-brown silty fine to coarse sand, dry and medium dense

Total Depth at 15.0 Feet
No Free Ground Water Encountered

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog4\PROJECT\S-14158 (Rpt. No. 5854).log Date: 5/22/2019

LOG OF BORING

John R. Byerly, Inc.

Desert Trails Preparatory Academy
Middle School

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Boring 3

Boring Date: 2/20/19
Surface Elevation:
Drilling Method: Four-Wheel Dirve Flight-Auger

Depth	Std. Pen. "N" Value Blows/Ft.	Dry Density (PCF)	Moisture Content (%)	Rel. Compaction (%)	Water Table		
0					GWT not encountered	SM	Light gray-brown silty fine to coarse sand, dry and medium dense (ORIGINAL GROUND)
	20	112	1.3	86			
	22	---	---	---		SP	Light gray-brown fine to coarse sand with gravel, dry and medium dense
5	18	114	0.5	85			
	40	122	0.8	91			- becoming dense at 7.5 feet
10	40	121	0.6	90			
15	33	117	0.7	87			- becoming medium dense at 15.5 feet
20	50/9"	118	2.4	93		SM	Light brown silty fine to medium sand with some gravel, dry and dense
25	50/10"	124	1.9	92		SP	Light gray fine to coarse sand with gravel, dry and dense
30	50/11"	---	---	---			
							Total Depth at 31.0 Feet No Free Ground Water Encountered
35							

LOG OF BORING

Boring 4

Boring Date: 2/20/19
Surface Elevation:
Drilling Method: Four-Wheel Dirve Flight-Auger

Depth	Std. Pen. "N" Value Blows/Ft.	Dry Density (PCF)	Moisture Content (%)	Rel. Compaction (%)	Water Table		
0							
	10	104	4.0	80	GWT not encountered	SM	Gray-brown silty fine to coarse sand with some gravel, damp and loose (ORIGINAL GROUND)
	17	116	0.8	86		SP	Light gray-brown fine to coarse sand with gravel, dry and medium dense
5	25	118	0.7	88			
	45	124	0.9	92		SM	Light gray-brown silty fine to coarse sand, dry and medium dense
						SP	Light gray fine to coarse sand with gravel, dry and dense
10	25	117	0.6	87			- becoming medium dense at 10.5 feet
15	26	120	1.0	89			
20	30	114	2.3	90		SM	Brown silty fine to medium sand, dry and dense
25	42	122	2.1	91		SP	Gray-brown fine to coarse sand with gravel, dry and dense
30	50/10"	126	2.9	94		SP	Light brown fine to coarse sand, dry and dense
35							

Total Depth at 31.0 Feet
No Free Ground Water Encountered

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog4\PROJECT\S-14158 (Rpt. No. 5854).log Date: 5/22/2019

LOG OF BORING

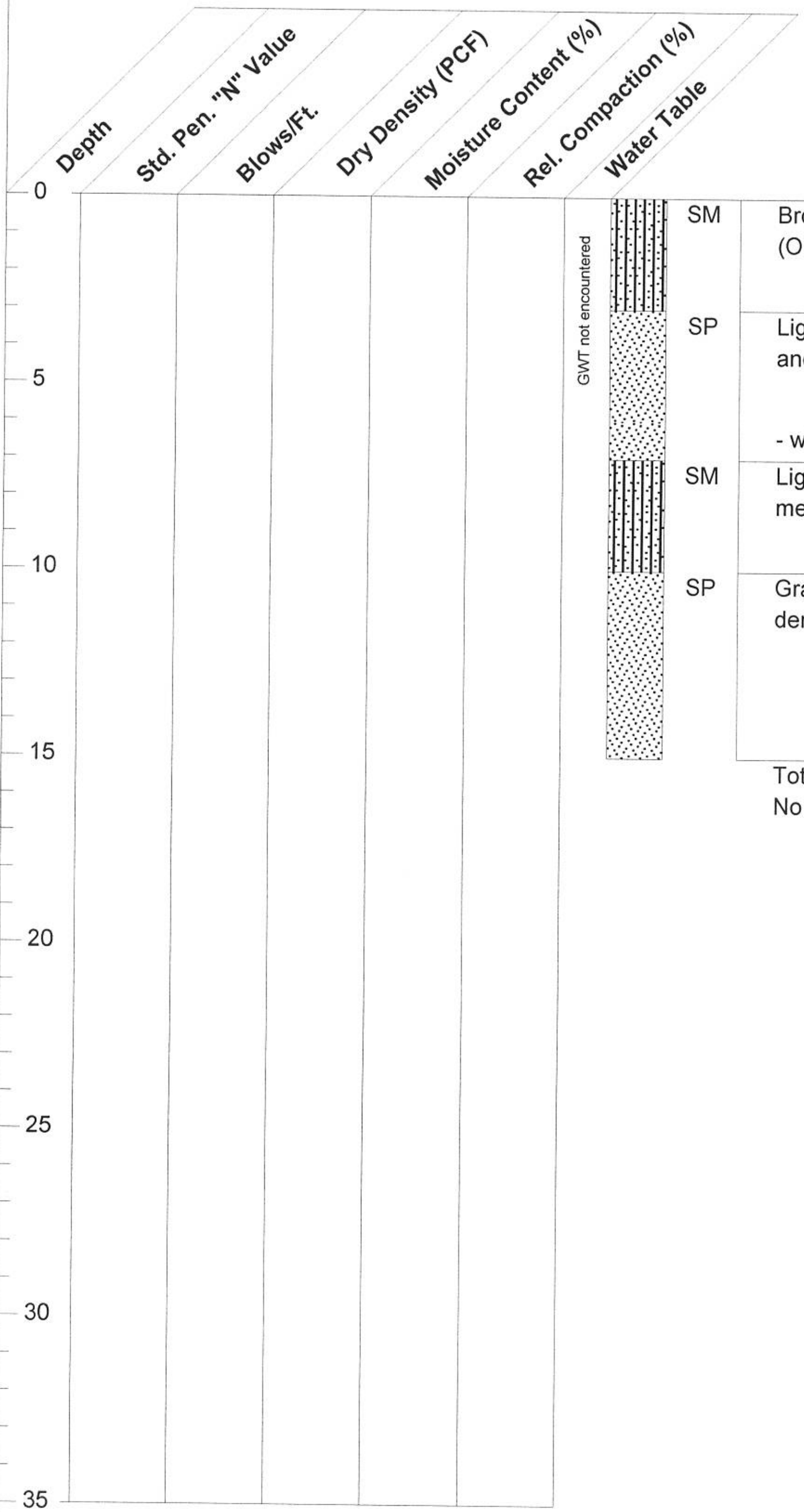
John R. Byerly, Inc.

Desert Trails Preparatory Academy Middle School

Enclosure 2, Page 4
Rpt. No.: 5854
File No.: S-14158

Boring 5

Boring Date: 2/21/19
Surface Elevation:
Drilling Method: Four-Wheel Dirve Flight-Auger



SM — Brown silty fine to coarse sand, dry and medium dense (ORIGINAL GROUND)

SP — Light gray-brown fine to coarse sand with some gravel, dry and medium dense

- with gravel at 6.0 feet

SM — Light gray-brown silty fine to coarse sand with gravel, dry and medium dense

SP — Gray fine to coarse sand with some gravel, dry and medium dense

Total Depth at 15.0 Feet
No Free Ground Water Encountered

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog4\PROJECT\S-14158 (Rpt. No. 5854).log Date: 5/22/2019

LOG OF BORING

John R. Byerly, Inc.

Desert Trails Preparatory Academy
Middle School

Boring 6

Boring Date: 2/20/19
Surface Elevation:
Drilling Method: Four-Wheel Dirve Flight-Auger

Depth	Std. Pen. "N" Value	Blows/Ft.	Dry Density (PCF)	Moisture Content (%)	Rel. Compaction (%)	Water Table
0						GWT not encountered
		11	108	4.2	83	
		17	---	---	---	
5		27	117	0.7	87	
		50	121	2.8	93	
10		31	120	0.6	89	
15		37	122	0.9	91	
20		50/9"	118	2.9	93	
25		50/5"	123	2.4	97	
30		50/11"	124	1.1	92	
35						

SM	Brown silty fine to coarse sand, damp and loose (ORIGINAL GROUND)
SP	Light gray-brown fine to coarse sand, dry and medium dense - with some gravel at 5.0 feet
SM	Light gray-brown silty fine to coarse sand, dry and medium dense
SM	Light gray silty fine to coarse sand with gravel, dry and dense
SP	Gray fine to coarse sand with gravel, dry and medium dense - becoming dense at 15.5 feet
SM	Brown silty fine to medium sand, dry and dense - becoming very dense at 25.5 feet
SP	Light gray fine to coarse sand, dry and dense

Total Depth at 31.0 Feet
No Free Ground Water Encountered

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog4\PROJECT\S-14158 (Rpt. No. 5854).log Date: 5/22/2019

LOG OF BORING

John R. Byerly, Inc.

Desert Trails Preparatory Academy
Middle School

Boring 7

Boring Date: 2/20/19
Surface Elevation:
Drilling Method: Four-Wheel Dirve Flight-Auger

Depth	Std. Pen. "N" Value Blows/Ft.	Dry Density (PCF)	Moisture Content (%)	Rel. Compaction (%)	Water Table		
0					GWT not encountered	SM	Light gray-brown silty fine to medium sand, damp and medium dense (ORIGINAL GROUND)
	15	108	3.2	85			
	22	---	---	---		SP	Light gray-brown fine to coarse sand with some gravel, dry and medium dense
5	15	116	0.6	86			
	22	---	---	---			
10	39	121	0.8	90		SP	Light gray fine to coarse sand with gravel, dry and dense
15	46	124	1.1	92			
20	50/10"	119	2.3	91		SM	Light gray-brown silty fine to coarse sand, dry and dense
25	50/9"	126	1.4	94		SP	Light gray-brown fine to coarse sand with gravel, dry and dense
							Total Depth at 26.0 Feet No Free Ground Water Encountered
30							
35							

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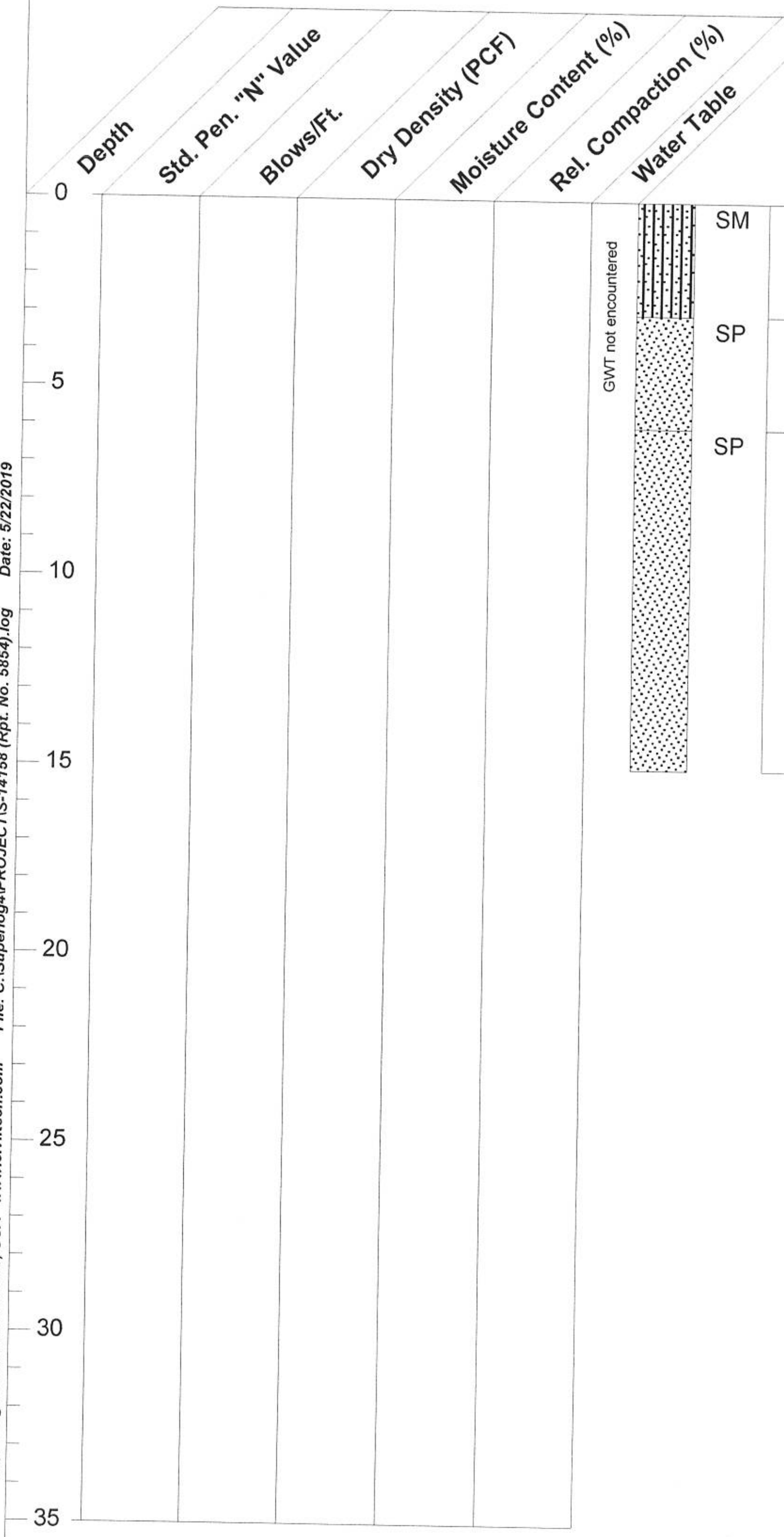
LOG OF BORING

John R. Byerly, Inc.

Desert Trails Preparatory Academy
Middle School

Boring 8

Boring Date: 2/21/19
Surface Elevation:
Drilling Method: Four-Wheel Dirve Flight-Auger



SM – Brown silty fine to medium sand, damp and medium dense (ORIGINAL GROUND)

SP – Light gray-brown fine to coarse sand, dry and medium dense

SP – Gray fine to coarse sand with gravel, dry and medium dense

Total Depth at 15.0 Feet
No Free Ground Water Encountered

LOG OF BORING

John R. Byerly, Inc.

Desert Trails Preparatory Academy
Middle School

Boring 9

Boring Date: 2/20/19
Surface Elevation:
Drilling Method: Four-Wheel Dirve Flight-Auger

Depth	Std. Pen. "N" Value	Blows/Ft.	Dry Density (PCF)	Moisture Content (%)	Rel. Compaction (%)	Water Table		
0		18	108	4.1	85	GWT not encountered	SM	Brown silty fine to medium sand, damp and medium dense (ORIGINAL GROUND)
		30	118	1.0	88		SP	Light gray-brown fine to coarse sand with silt, dry and medium dense
5		18	116	1.1	86		SP	Light gray-brown fine to coarse sand with gravel, dry and medium dense
								Total Depth at 6.0 Feet No Free Ground Water Encountered
10								
15								
20								
25								
30								
35								

LOG OF BORING

Boring 10

Boring Date: 2/21/19
Surface Elevation:
Drilling Method: Four-Wheel Dirve Flight-Auger

Depth	Std. Pen. "N" Value	Blows/Ft.	Dry Density (PCF)	Moisture Content (%)	Rel. Compaction (%)	Water Table
0						GWT not encountered
		15	107	3.4	84	
		21	117	0.8	87	
5		20	116	0.7	86	
10						
15						
20						
25						
30						
35						

SM	Brown silty fine to medium sand, damp and medium dense (ORIGINAL GROUND)
SP	Gray-brown fine to coarse sand, dry and medium dense
SP	Light gray-brown fine to coarse sand with some gravel, dry and medium dense

Total Depth at 6.0 Feet
No Free Ground Water Encountered

LOG OF BORING

John R. Byerly, Inc.

Desert Trails Preparatory Academy
Middle School

Enclosure 2, Page 10
Rpt. No.: 5854
File No.: S-14158

Boring 11

Boring Date: 2/21/19
Surface Elevation:
Drilling Method: Four-Wheel Dirve Flight-Auger

Depth	Std. Pen. "N" Value	Blows/Ft.	Dry Density (PCF)	Moisture Content (%)	Rel. Compaction (%)	Water Table
0						GWT not encountered
		14	108	3.7	85	
		30	116	1.2	89	
5		28	115	1.3	88	
10						
15						
20						
25						
30						
35						

SM	Brown silty fine to medium sand, damp and medium dense (ORIGINAL GROUND)
SM	Brown silty fine to coarse sand, dry and medium dense

Total Depth at 6.0 Feet
No Free Ground Water Encountered

SuperLog CivilTech Software, USA www.civiltech.com File: C:\Superlog4\PROJECTS\S-14158 (Rpt. No. 5854).log Date: 5/22/2019

LOG OF BORING

John R. Byerly, Inc.

Desert Trails Preparatory Academy
Middle School

Enclosure 2, Page 11
Rpt. No.: 5854
File No.: S-14158

Boring 12

Boring Date: 2/21/19
Surface Elevation:
Drilling Method: Four-Wheel Dirve Flight-Auger

Depth	Std. Pen. "N" Value	Blows/Ft.	Dry Density (PCF)	Moisture Content (%)	Rel. Compaction (%)	Water Table
		9	106	3.5	81	GWT not encountered
		22	114	1.3	87	
		18	---	---	---	

0
5
10
15
20
25
30
35

▥	SM	Brown silty fine to coarse sand, damp and loose (ORIGINAL GROUND)
▥	SM	Light gray-brown silty fine to coarse sand, dry and medium dense
░	SP	Light gray fine to coarse sand, dry and medium dense

Total Depth at 6.0 Feet
No Free Ground Water Encountered

LOG OF BORING

Boring 13

Boring Date: 2/21/19
Surface Elevation:
Drilling Method: Four-Wheel Dirve Flight-Auger

Depth	Std. Pen. "N" Value	Blows/Ft.	Dry Density (PCF)	Moisture Content (%)	Rel. Compaction (%)	Water Table
		18	112	2.7	86	GWT not encountered
		25	118	1.1	88	
		23	117	1.5	87	

SM	Brown silty fine to coarse sand, dry and medium dense (ORIGINAL GROUND)
SP	Light gray-brown fine to coarse sand with gravel, dry and medium dense

Total Depth at 6.0 Feet
No Free Ground Water Encountered

LOG OF BORING

John R. Byerly, Inc.

Desert Trails Preparatory Academy
Middle School

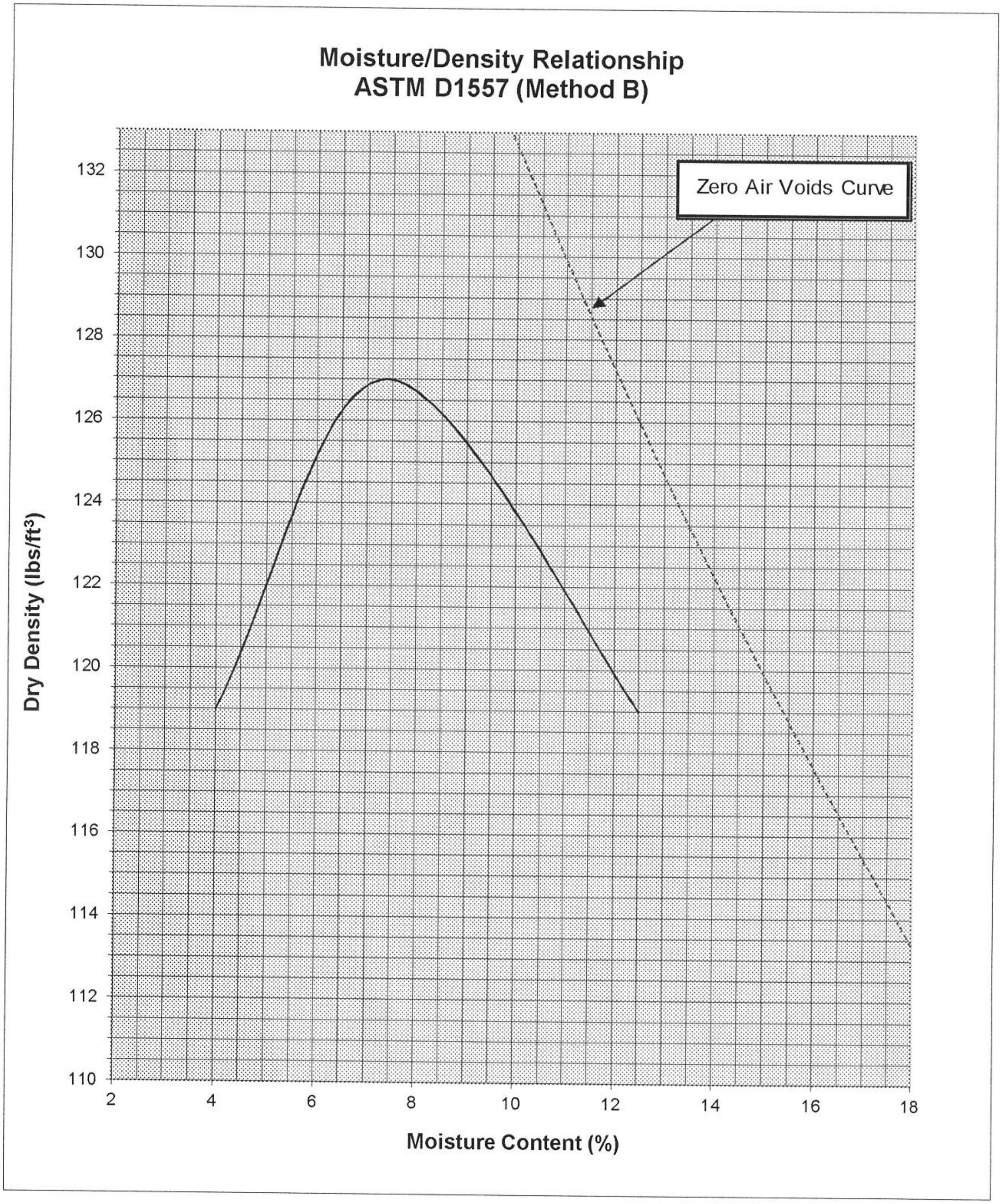
Enclosure 2, Page 13
Rpt. No.: 5854
File No.: S-14158

Boring 14

Boring Date: 2/20/19
Surface Elevation:
Drilling Method: Four-Wheel Dirve Flight-Auger

Depth	Std. Pen. "N" Value	Blows/Ft.	Dry Density (PCF)	Moisture Content (%)	Rel. Compaction (%)	Water Table		
0						GWT not encountered	SM	Light gray-brown silty fine to coarse sand, damp and medium dense (ORIGINAL GROUND)
		15	111	3.6	85			
							SP	Light gray-brown fine to coarse sand with some gravel, dry and medium dense
		15	---	---	---			
5		15	116	1.2	86			
								Total Depth at 6.0 Feet No Free Ground Water Encountered
10								
15								
20								
25								
30								
35								

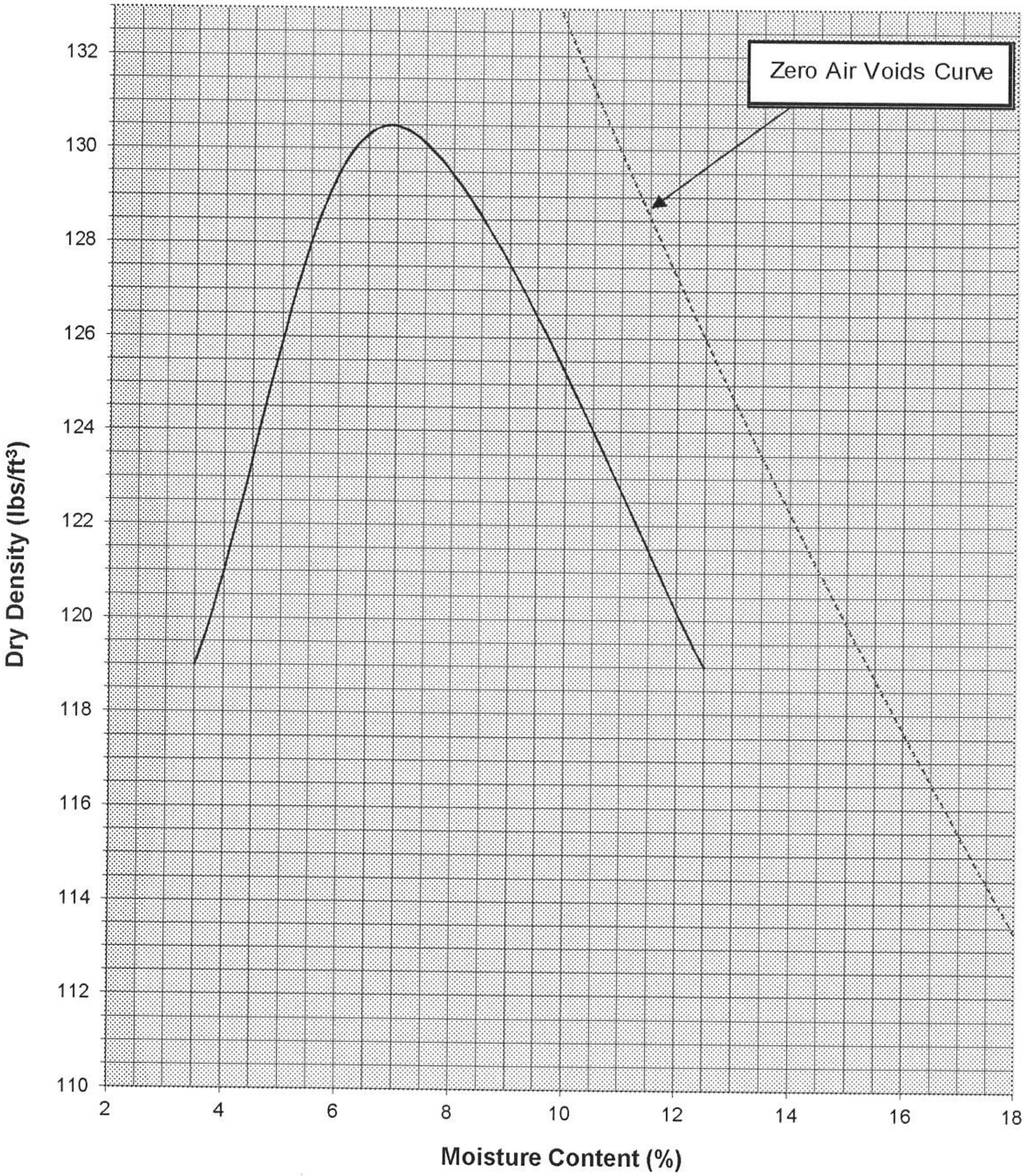
LOG OF BORING



Boring No.	B-3
Depth (ft.)	20.0
Optimum Moisture (%)	7.4
Maximum Dry Density (pcf)	127.0
Soil Classification	Light brown silty fine to medium sand (SM)

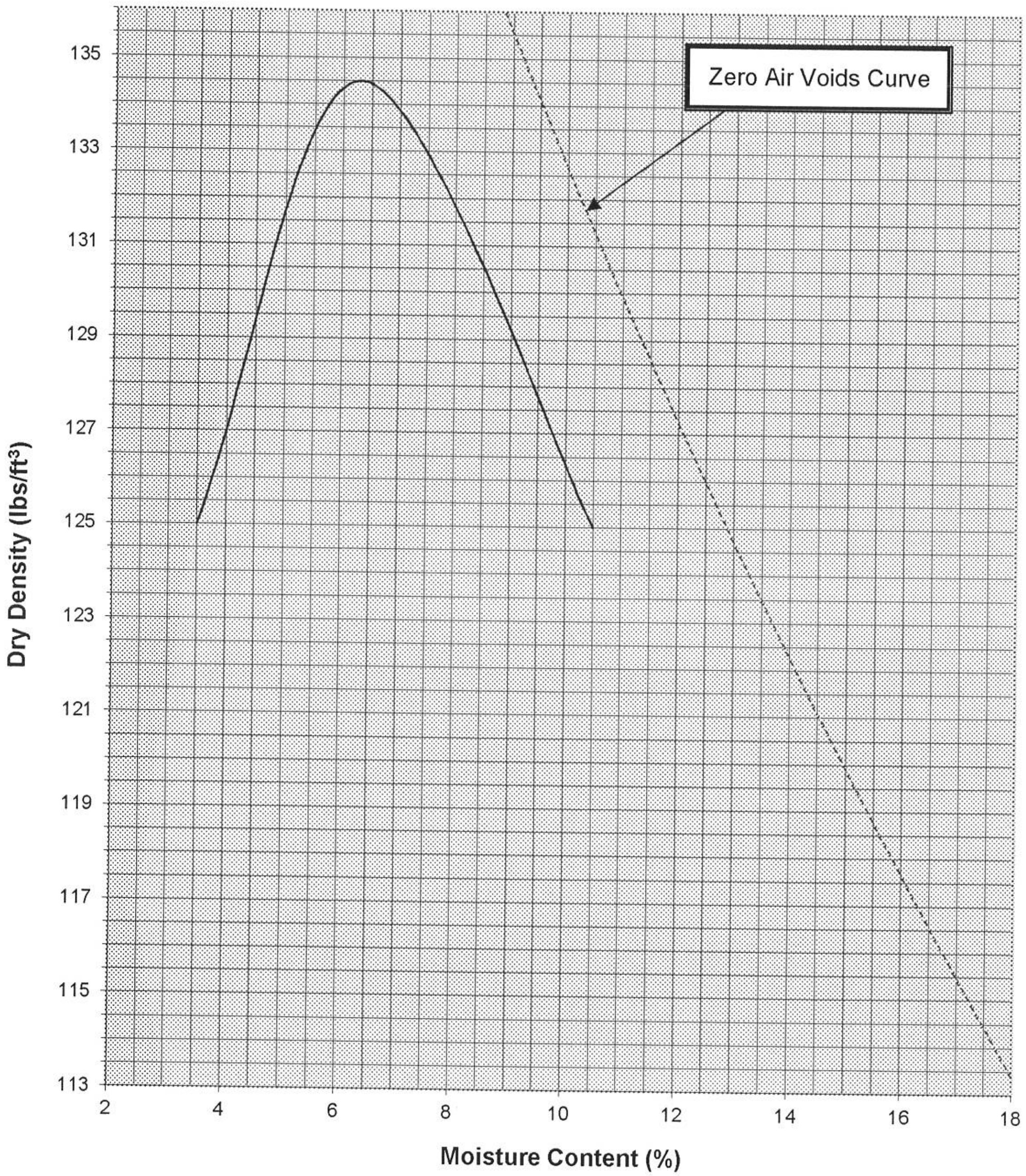
Desert Trails Preparatory Academy Middle School Victorville, California	Enclosure 3, Page 1 Rpt. No.: 5854 File No.: S-14158

Moisture/Density Relationship
ASTM D1557 (Method B)



Boring No.	B-1
Depth (ft.)	2.0
Optimum Moisture (%)	6.9
Maximum Dry Density (pcf)	130.5
Soil Classification	Light gray-brown silty fine to coarse sand (SM)

Moisture/Density Relationship
ASTM D1557 (Method B)



Boring No.	B-3
Depth (ft.)	5.0
Optimum Moisture (%)	6.3
Maximum Dry Density (pcf)	134.5
Soil Classification	Light gray-brown fine to coarse sand with gravel (SP)

Desert Trails Preparatory Academy Middle School
Victorville, California

Enclosure 3, Page 3
Rpt. No.: 5854
File No.: S-14158

RESULTS OF SUBGRADE SOIL TESTS

California Department of Transportation Test Methods 202, 217, & 301
ASTM Designations C136 and D2419

PROJECT: Desert Trails Preparatory Academy Middle School

		Percent Passing Sieve Size:														
Sample No.	**Location**	**3"**	**2½"**	**2"**	**1½"**	**1"**	**3/4"**	**1/2"**	**3/8"**	**No. 4**	**No. 8**	**No. 16**	**No. 30**	**No. 50**	**No. 100**	**No. 200**	**Sand Equiv.**
1	B-9 at 0-5'					100	99	98	97	93	87	72	55	29	26	17	29
2	B-13 at 0-5'					100	99	97	96	91	86	72	52	34	20	12	35

STABILOMETER "R" VALUE

Sample No.		1	
Moisture Content (%)	7.9	8.8	9.6
Dry Density (lbs./cu. ft.)	124.1	123.2	122.3
Exudation Pressure (psi)	474	340	195
Expansion Pressure (psf)	0.00	0.00	0.00
"R" Value	74	61	45
"R" Value at 300 PSI Exudation		57	

Enclosure 4
Rpt. No.: 5854
File No.: S-14158

John R. Byerly
INCORPORATED

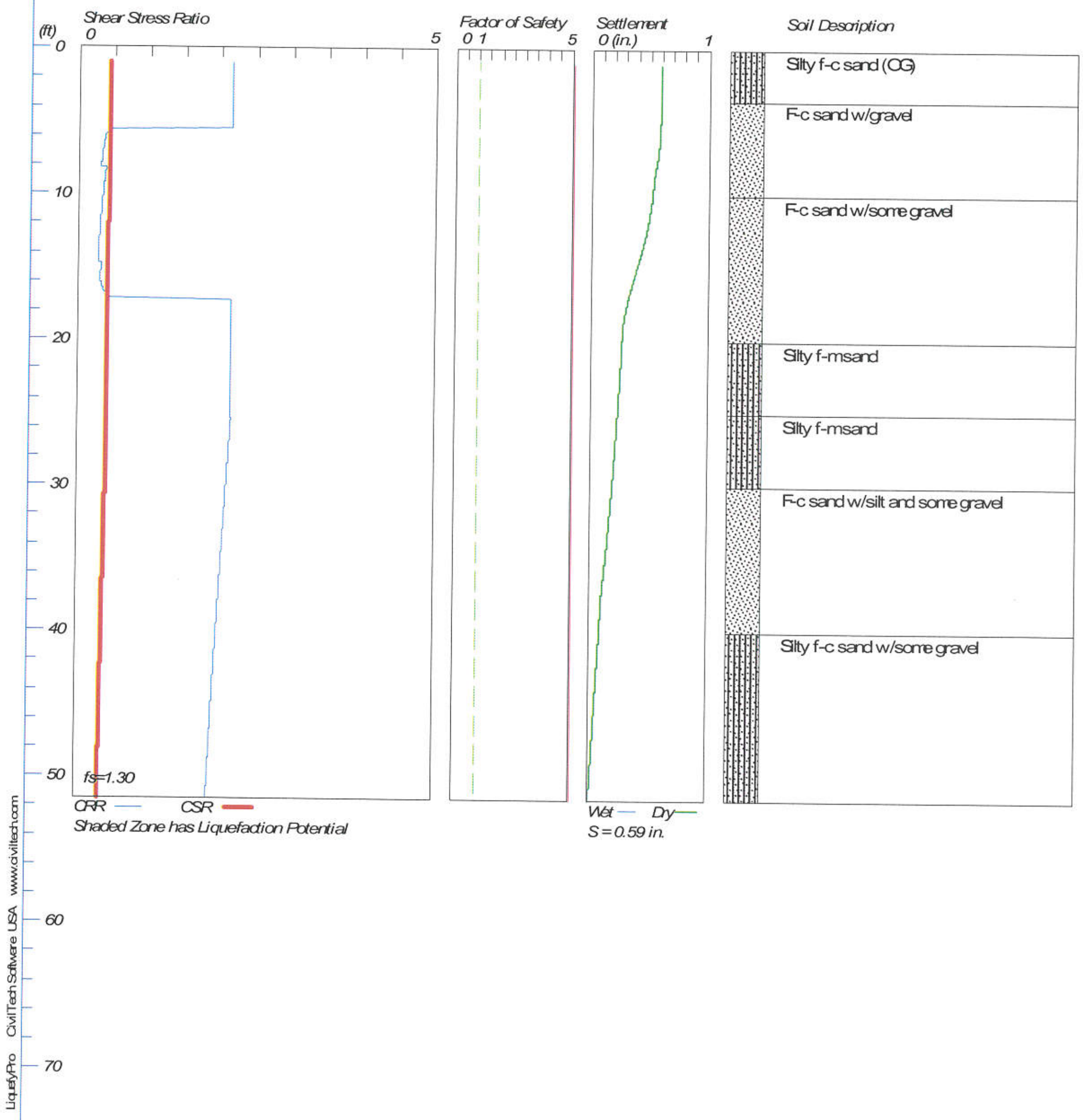
SUGGESTED SPECIFICATIONS FOR CLASS II BASE

Sieve Size	**Percent Finer Than**
1 Inch	100
3/4 Inch	90 - 100
No. 4	35 - 60
No. 30	10 - 30
No. 200	2 - 9
Sand Equivalent (Minimum)	25
"R" Value (minimum) at 300 psi Exudation	78

LIQUEFACTION ANALYSIS

DESERT TRAILS PREPARATORY ACADEMY MIDDLE SCHOOL

Hole No.=B-1   Water Depth=449.1 ft   Surface Elev.=3242 feet above MSL   Magnitude=7.3
Acceleration=0.500g



CivilTech Corporation

S-14158

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                              LIQUEFACTION ANALYSIS CALCULATION SHEET

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                                 (425) 453-6488  Fax (425) 453-5848

*************************************************************************
*******************
        Licensed to John R Byerly, John R. Byerly, Inc. 5/21/2019      4:25:26 PM

        Input File Name: T:\Liquefy4\S-14158.1.liq
        Title:  DESERT TRAILS PREPARATORY ACADEMY MIDDLE SCHOOL
        Subtitle:  S-14158

        Surface Elev.=3242 feet above MSL
        Hole No.=B-1
        Depth of Hole= 51.5 ft
        Water Table during Earthquake= 449.1 ft
        Water Table during In-Situ Testing= 449.1 ft
        Max. Acceleration= 0.5 g
        Earthquake Magnitude= 7.3
        User defined factor of safty (applied to CSR)       User fs=1.3
        fs=user,  Plot one CSR (fs=user)

        Hammer Energy Ratio, Ce=1
        Borehole Diameter, Cb=1
        Sampeling Method, Cs=1
        SPT Fines Correction Method: Stark/Olson et al.*
        Settlement Analysis Method: Ishihara / Yoshimine*
        Fines Correction for Liquefaction: Stark/Olson et al.*
        Fine Correction for Settlement: Post-Liq. Correction *
        Average Input Data: Smooth*
        * Recommended Options

Input Data:
        Depth    SPT      Gamma    Fines
        ft                pcf      %
        ____________________________________
        1.0      30.0     130.0    25.0
        3.0      30.0     130.0    25.0
        6.0      23.0     116.8    1.0
        11.0     25.0     119.1    1.0
        16.0     26.0     120.7    1.0
        21.0     49.0     119.1    30.0
        26.0     56.0     121.9    30.0
        31.0     59.0     130.0    1.0
        36.0     61.0     130.0    1.0
        40.0     69.0     130.0    25.0
        45.0     73.0     130.0    25.0
        50.0     80.0     130.0    25.0
        ____________________________________

Output Results:
        Settlement of saturated sands=0.00 in.
        Settlement of dry sands=0.59 in.
        Total settlement of saturated and dry sands=0.59 in.
        Differential Settlement=0.296 to 0.391 in.
```

```
Depth    CRRm     CSRfs    F.S.    S_sat.   S_dry    S_all
ft                w/fs             in.      in.      in.
___________________________________________________________
1.00     2.14     0.42     5.00    0.00     0.59     0.59
2.00     2.14     0.42     5.00    0.00     0.59     0.59
3.00     2.14     0.42     5.00    0.00     0.59     0.59
4.00     2.14     0.42     5.00    0.00     0.59     0.59
5.00     2.14     0.42     5.00    0.00     0.58     0.58
6.00     0.37     0.42     5.00    0.00     0.58     0.58
7.00     0.33     0.42     5.00    0.00     0.57     0.57
8.00     0.31     0.41     5.00    0.00     0.55     0.55
9.00     0.36     0.41     5.00    0.00     0.53     0.53
10.00    0.33     0.41     5.00    0.00     0.51     0.51
11.00    0.32     0.41     5.00    0.00     0.50     0.50
12.00    0.30     0.41     5.00    0.00     0.48     0.48
13.00    0.29     0.41     5.00    0.00     0.45     0.45
14.00    0.28     0.41     5.00    0.00     0.42     0.42
15.00    0.31     0.41     5.00    0.00     0.38     0.38
16.00    0.30     0.41     5.00    0.00     0.35     0.35
17.00    0.40     0.41     5.00    0.00     0.31     0.31
18.00    2.14     0.40     5.00    0.00     0.29     0.29
19.00    2.14     0.40     5.00    0.00     0.27     0.27
20.00    2.14     0.40     5.00    0.00     0.26     0.26
21.00    2.14     0.40     5.00    0.00     0.26     0.26
22.00    2.14     0.40     5.00    0.00     0.25     0.25
23.00    2.14     0.40     5.00    0.00     0.24     0.24
24.00    2.14     0.40     5.00    0.00     0.24     0.24
25.00    2.14     0.40     5.00    0.00     0.23     0.23
26.00    2.15     0.40     5.00    0.00     0.22     0.22
27.00    2.13     0.40     5.00    0.00     0.21     0.21
28.00    2.12     0.39     5.00    0.00     0.20     0.20
29.00    2.11     0.39     5.00    0.00     0.19     0.19
30.00    2.09     0.39     5.00    0.00     0.18     0.18
31.00    2.08     0.39     5.00    0.00     0.17     0.17
32.00    2.07     0.39     5.00    0.00     0.16     0.16
33.00    2.05     0.38     5.00    0.00     0.15     0.15
34.00    2.04     0.38     5.00    0.00     0.14     0.14
35.00    2.03     0.38     5.00    0.00     0.13     0.13
36.00    2.02     0.37     5.00    0.00     0.12     0.12
37.00    2.00     0.37     5.00    0.00     0.11     0.11
38.00    1.99     0.37     5.00    0.00     0.10     0.10
39.00    1.98     0.36     5.00    0.00     0.09     0.09
40.00    1.97     0.36     5.00    0.00     0.08     0.08
41.00    1.96     0.36     5.00    0.00     0.08     0.08
42.00    1.94     0.35     5.00    0.00     0.07     0.07
43.00    1.93     0.35     5.00    0.00     0.06     0.06
44.00    1.92     0.34     5.00    0.00     0.06     0.06
45.00    1.91     0.34     5.00    0.00     0.05     0.05
46.00    1.90     0.34     5.00    0.00     0.04     0.04
47.00    1.89     0.33     5.00    0.00     0.03     0.03
48.00    1.88     0.33     5.00    0.00     0.03     0.03
49.00    1.87     0.33     5.00    0.00     0.02     0.02
50.00    1.86     0.32     5.00    0.00     0.01     0.01
51.00    1.85     0.32     5.00    0.00     0.00     0.00
___________________________________________________________
* F.S.<1, Liquefaction Potential Zone
(F.S. is limited to 5,  CRR is limited to 2,    CSR is limited to 2)

    Units          Depth = ft, Stress or Pressure = tsf (atm), Unit Weight =
pcf, Settlement = in.

_____________________________________________________________________________
    CRRm           Cyclic resistance ratio from soils
```

```
        CSRfs               Cyclic stress ratio induced by a given earthquake (with user
request factor of safety)
        F.S.                Factor of Safety against liquefaction, F.S.=CRRm/CSRfs
        S_sat               Settlement from saturated sands
        S_dry               Settlement from dry sands
        S_all               Total settlement from saturated and dry sands
        NoLiq               No-Liquefy Soils
```

```
*******************************************************************************************
*******************
                              LIQUEFACTION ANALYSIS CALCULATION SHEET

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*******************************************************************************************
*******************
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        Input File Name: T:\Liquefy4\S-14158.1.liq
        Title:  DESERT TRAILS PREPARATORY ACADEMY MIDDLE SCHOOL
        Subtitle:  S-14158

 Input Data:

        Surface Elev.=3242 feet above MSL
        Hole No.=B-1
        Depth of Hole=51.5 ft
        Water Table during Earthquake= 449.1 ft
        Water Table during In-Situ Testing= 449.1 ft
        Max. Acceleration=0.5 g
        Earthquake Magnitude=7.3
        User defined factor of safty (applied to CSR)       User fs=1.3
        fs=user,  Plot one CSR (fs=user)

        Hammer Energy Ratio, Ce=1
        Borehole Diameter, Cb=1
        Sampeling Method, Cs=1
        SPT Fines Correction Method: Stark/Olson et al.*
        Settlement Analysis Method: Ishihara / Yoshimine*
        Fines Correction for Liquefaction: Stark/Olson et al.*
        Fine Correction for Settlement: Post-Liq. Correction *
        Average Input Data: Smooth*
        * Recommended Options

        Depth    SPT      Gamma    Fines
        ft                pcf      %
        ____________________________________
        1.0      30.0     130.0    25.0
        3.0      30.0     130.0    25.0
        6.0      23.0     116.8    1.0
        11.0     25.0     119.1    1.0
        16.0     26.0     120.7    1.0
        21.0     49.0     119.1    30.0
        26.0     56.0     121.9    30.0
        31.0     59.0     130.0    1.0
        36.0     61.0     130.0    1.0
        40.0     69.0     130.0    25.0
        45.0     73.0     130.0    25.0
        50.0     80.0     130.0    25.0
        ____________________________________

Output Results:            (Interval = 1.00 ft)

        CSR Calculation:
        Depth    gamma    sigma    gamma'   sigma'    rd      CSR      fs       CSRfs
```

```
 ft       pcf       tsf       pcf      tsf                             (user)   w/fs
________________________________________________________________________________________
 1.00     130.0     0.065     130.0    0.065     1.00      0.32      1.3      0.42
 2.00     130.0     0.130     130.0    0.130     1.00      0.32      1.3      0.42
 3.00     130.0     0.195     130.0    0.195     0.99      0.32      1.3      0.42
 4.00     125.6     0.259     125.6    0.259     0.99      0.32      1.3      0.42
 5.00     121.2     0.321     121.2    0.321     0.99      0.32      1.3      0.42
 6.00     116.8     0.380     116.8    0.380     0.99      0.32      1.3      0.42
 7.00     117.3     0.439     117.3    0.439     0.98      0.32      1.3      0.42
 8.00     117.7     0.498     117.7    0.498     0.98      0.32      1.3      0.41
 9.00     118.2     0.556     118.2    0.556     0.98      0.32      1.3      0.41
 10.00    118.6     0.616     118.6    0.616     0.98      0.32      1.3      0.41
 11.00    119.1     0.675     119.1    0.675     0.97      0.32      1.3      0.41
 12.00    119.4     0.735     119.4    0.735     0.97      0.32      1.3      0.41
 13.00    119.7     0.795     119.7    0.795     0.97      0.32      1.3      0.41
 14.00    120.1     0.854     120.1    0.854     0.97      0.31      1.3      0.41
 15.00    120.4     0.915     120.4    0.915     0.97      0.31      1.3      0.41
 16.00    120.7     0.975     120.7    0.975     0.96      0.31      1.3      0.41
 17.00    120.4     1.035     120.4    1.035     0.96      0.31      1.3      0.41
 18.00    120.1     1.095     120.1    1.095     0.96      0.31      1.3      0.40
 19.00    119.7     1.155     119.7    1.155     0.96      0.31      1.3      0.40
 20.00    119.4     1.215     119.4    1.215     0.95      0.31      1.3      0.40
 21.00    119.1     1.275     119.1    1.275     0.95      0.31      1.3      0.40
 22.00    119.7     1.334     119.7    1.334     0.95      0.31      1.3      0.40
 23.00    120.2     1.394     120.2    1.394     0.95      0.31      1.3      0.40
 24.00    120.8     1.455     120.8    1.455     0.94      0.31      1.3      0.40
 25.00    121.3     1.515     121.3    1.515     0.94      0.31      1.3      0.40
 26.00    121.9     1.576     121.9    1.576     0.94      0.31      1.3      0.40
 27.00    123.5     1.637     123.5    1.637     0.94      0.30      1.3      0.40
 28.00    125.1     1.699     125.1    1.699     0.93      0.30      1.3      0.39
 29.00    126.8     1.762     126.8    1.762     0.93      0.30      1.3      0.39
 30.00    128.4     1.826     128.4    1.826     0.93      0.30      1.3      0.39
 31.00    130.0     1.891     130.0    1.891     0.92      0.30      1.3      0.39
 32.00    130.0     1.956     130.0    1.956     0.91      0.30      1.3      0.39
 33.00    130.0     2.021     130.0    2.021     0.91      0.29      1.3      0.38
 34.00    130.0     2.086     130.0    2.086     0.90      0.29      1.3      0.38
 35.00    130.0     2.151     130.0    2.151     0.89      0.29      1.3      0.38
 36.00    130.0     2.216     130.0    2.216     0.88      0.29      1.3      0.37
 37.00    130.0     2.281     130.0    2.281     0.87      0.28      1.3      0.37
 38.00    130.0     2.346     130.0    2.346     0.86      0.28      1.3      0.37
 39.00    130.0     2.411     130.0    2.411     0.86      0.28      1.3      0.36
 40.00    130.0     2.476     130.0    2.476     0.85      0.28      1.3      0.36
 41.00    130.0     2.541     130.0    2.541     0.84      0.27      1.3      0.36
 42.00    130.0     2.606     130.0    2.606     0.83      0.27      1.3      0.35
 43.00    130.0     2.671     130.0    2.671     0.82      0.27      1.3      0.35
 44.00    130.0     2.736     130.0    2.736     0.82      0.27      1.3      0.34
 45.00    130.0     2.801     130.0    2.801     0.81      0.26      1.3      0.34
 46.00    130.0     2.866     130.0    2.866     0.80      0.26      1.3      0.34
 47.00    130.0     2.931     130.0    2.931     0.79      0.26      1.3      0.33
 48.00    130.0     2.996     130.0    2.996     0.78      0.25      1.3      0.33
 49.00    130.0     3.061     130.0    3.061     0.78      0.25      1.3      0.33
 50.00    130.0     3.126     130.0    3.126     0.77      0.25      1.3      0.32
 51.00    130.0     3.191     130.0    3.191     0.76      0.25      1.3      0.32
________________________________________________________________________________________
 CSR is based on water table at 449.1 during earthquake

 CRR Calculation from SPT or BPT data:
 Depth    SPT       Cebs      Cr       sigma'    Cn        (N1)60    Fines    d(N1)60
(N1)60f CRR7.5
 ft                                                                  %

____________________________________________________________________________________________
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         1.00     30.00    1.00     0.75     0.065    1.70      38.25    25.0      4.80
 43.05   2.00
         2.00     30.00    1.00     0.75     0.130    1.70      38.25    25.0      4.80
 43.05   2.00
         3.00     30.00    1.00     0.75     0.195    1.70      38.25    25.0      4.80
 43.05   2.00
         4.00     27.67    1.00     0.75     0.259    1.70      35.28    17.0      2.88
 38.16   2.00
         5.00     25.33    1.00     0.75     0.321    1.70      32.30    9.0       0.96
 33.26   2.00
         6.00     23.00    1.00     0.75     0.380    1.62      27.97    1.0       0.00
 27.97   0.34
         7.00     23.40    1.00     0.75     0.439    1.51      26.49    1.0       0.00
 26.49   0.31
         8.00     23.80    1.00     0.75     0.498    1.42      25.31    1.0       0.00
 25.31   0.29
         9.00     24.20    1.00     0.85     0.556    1.34      27.57    1.0       0.00
 27.57   0.33
         10.00    24.60    1.00     0.85     0.616    1.27      26.65    1.0       0.00
 26.65   0.31
         11.00    25.00    1.00     0.85     0.675    1.22      25.86    1.0       0.00
 25.86   0.30
         12.00    25.20    1.00     0.85     0.735    1.17      24.99    1.0       0.00
 24.99   0.28
         13.00    25.40    1.00     0.85     0.795    1.12      24.22    1.0       0.00
 24.22   0.27
         14.00    25.60    1.00     0.85     0.854    1.08      23.54    1.0       0.00
 23.54   0.26
         15.00    25.80    1.00     0.95     0.915    1.05      25.63    1.0       0.00
 25.63   0.29
         16.00    26.00    1.00     0.95     0.975    1.01      25.02    1.0       0.00
 25.02   0.28
         17.00    30.60    1.00     0.95     1.035    0.98      28.57    6.8       0.43
 29.00   0.38
         18.00    35.20    1.00     0.95     1.095    0.96      31.95    12.6      1.82
 33.78   2.00
         19.00    39.80    1.00     0.95     1.155    0.93      35.18    18.4      3.22
 38.39   2.00
         20.00    44.40    1.00     0.95     1.215    0.91      38.27    24.2      4.61
 42.87   2.00
         21.00    49.00    1.00     0.95     1.275    0.89      41.23    30.0      6.00
 47.23   2.00
         22.00    50.40    1.00     0.95     1.334    0.87      41.45    30.0      6.00
 47.45   2.00
         23.00    51.80    1.00     0.95     1.394    0.85      41.68    30.0      6.00
 47.68   2.00
         24.00    53.20    1.00     0.95     1.455    0.83      41.91    30.0      6.00
 47.91   2.00
         25.00    54.60    1.00     0.95     1.515    0.81      42.14    30.0      6.00
 48.14   2.00
         26.00    56.00    1.00     0.95     1.576    0.80      42.38    30.0      6.00
 48.38   2.00
         27.00    56.60    1.00     0.95     1.637    0.78      42.02    24.2      4.61
 46.63   2.00
         28.00    57.20    1.00     1.00     1.699    0.77      43.88    18.4      3.22
 47.10   2.00
         29.00    57.80    1.00     1.00     1.762    0.75      43.54    12.6      1.82
 45.36   2.00
         30.00    58.40    1.00     1.00     1.826    0.74      43.22    6.8       0.43
 43.65   2.00
         31.00    59.00    1.00     1.00     1.891    0.73      42.91    1.0       0.00
 42.91   2.00
         32.00    59.40    1.00     1.00     1.956    0.72      42.48    1.0       0.00
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42.48    2.00
         33.00    59.80    1.00    1.00    2.021    0.70    42.07    1.0    0.00
42.07    2.00
         34.00    60.20    1.00    1.00    2.086    0.69    41.69    1.0    0.00
41.69    2.00
         35.00    60.60    1.00    1.00    2.151    0.68    41.32    1.0    0.00
41.32    2.00
         36.00    61.00    1.00    1.00    2.216    0.67    40.98    1.0    0.00
40.98    2.00
         37.00    63.00    1.00    1.00    2.281    0.66    41.72    7.0    0.48
42.20    2.00
         38.00    65.00    1.00    1.00    2.346    0.65    42.44    13.0   1.92
44.36    2.00
         39.00    67.00    1.00    1.00    2.411    0.64    43.15    19.0   3.36
46.51    2.00
         40.00    69.00    1.00    1.00    2.476    0.64    43.85    25.0   4.80
48.65    2.00
         41.00    69.80    1.00    1.00    2.541    0.63    43.79    25.0   4.80
48.59    2.00
         42.00    70.60    1.00    1.00    2.606    0.62    43.74    25.0   4.80
48.54    2.00
         43.00    71.40    1.00    1.00    2.671    0.61    43.69    25.0   4.80
48.49    2.00
         44.00    72.20    1.00    1.00    2.736    0.60    43.65    25.0   4.80
48.45    2.00
         45.00    73.00    1.00    1.00    2.801    0.60    43.62    25.0   4.80
48.42    2.00
         46.00    74.40    1.00    1.00    2.866    0.59    43.95    25.0   4.80
48.75    2.00
         47.00    75.80    1.00    1.00    2.931    0.58    44.28    25.0   4.80
49.08    2.00
         48.00    77.20    1.00    1.00    2.996    0.58    44.60    25.0   4.80
49.40    2.00
         49.00    78.60    1.00    1.00    3.061    0.57    44.93    25.0   4.80
49.73    2.00
         50.00    80.00    1.00    1.00    3.126    0.57    45.25    25.0   4.80
50.05    2.00
         51.00    80.00    1.00    1.00    3.191    0.56    44.79    25.0   4.80
49.59    2.00

____________________________________________________________________________________
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         CRR is based on water table at 449.1 during In-Situ Testing

         Factor of Safety,  - Earthquake Magnitude= 7.3:
         Depth    sigC'    CRR7.5   Ksigma   CRRv    MSF     CRRm     CSRfs    F.S.
         ft       tsf      tsf                                        w/fs     CRRm/CSRfs
         ______________________________________________________________________________
         1.00     0.04     2.00     1.00     2.00    1.07    2.14     0.42     5.00
         2.00     0.08     2.00     1.00     2.00    1.07    2.14     0.42     5.00
         3.00     0.13     2.00     1.00     2.00    1.07    2.14     0.42     5.00
         4.00     0.17     2.00     1.00     2.00    1.07    2.14     0.42     5.00
         5.00     0.21     2.00     1.00     2.00    1.07    2.14     0.42     5.00
         6.00     0.25     0.34     1.00     0.34    1.07    0.37     0.42     5.00
         7.00     0.29     0.31     1.00     0.31    1.07    0.33     0.42     5.00
         8.00     0.32     0.29     1.00     0.29    1.07    0.31     0.41     5.00
         9.00     0.36     0.33     1.00     0.33    1.07    0.36     0.41     5.00
         10.00    0.40     0.31     1.00     0.31    1.07    0.33     0.41     5.00
         11.00    0.44     0.30     1.00     0.30    1.07    0.32     0.41     5.00
         12.00    0.48     0.28     1.00     0.28    1.07    0.30     0.41     5.00
         13.00    0.52     0.27     1.00     0.27    1.07    0.29     0.41     5.00
         14.00    0.56     0.26     1.00     0.26    1.07    0.28     0.41     5.00
         15.00    0.59     0.29     1.00     0.29    1.07    0.31     0.41     5.00
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 16.00    0.63    0.28    1.00    0.28    1.07    0.30    0.41    5.00
 17.00    0.67    0.38    1.00    0.38    1.07    0.40    0.41    5.00
 18.00    0.71    2.00    1.00    2.00    1.07    2.14    0.40    5.00
 19.00    0.75    2.00    1.00    2.00    1.07    2.14    0.40    5.00
 20.00    0.79    2.00    1.00    2.00    1.07    2.14    0.40    5.00
 21.00    0.83    2.00    1.00    2.00    1.07    2.14    0.40    5.00
 22.00    0.87    2.00    1.00    2.00    1.07    2.14    0.40    5.00
 23.00    0.91    2.00    1.00    2.00    1.07    2.14    0.40    5.00
 24.00    0.95    2.00    1.00    2.00    1.07    2.14    0.40    5.00
 25.00    0.98    2.00    1.00    2.00    1.07    2.14    0.40    5.00
 26.00    1.02    2.00    1.00    2.00    1.07    2.15    0.40    5.00
 27.00    1.06    2.00    1.00    1.99    1.07    2.13    0.40    5.00
 28.00    1.10    2.00    0.99    1.98    1.07    2.12    0.39    5.00
 29.00    1.15    2.00    0.98    1.97    1.07    2.11    0.39    5.00
 30.00    1.19    2.00    0.98    1.95    1.07    2.09    0.39    5.00
 31.00    1.23    2.00    0.97    1.94    1.07    2.08    0.39    5.00
 32.00    1.27    2.00    0.96    1.93    1.07    2.07    0.39    5.00
 33.00    1.31    2.00    0.96    1.92    1.07    2.05    0.38    5.00
 34.00    1.36    2.00    0.95    1.91    1.07    2.04    0.38    5.00
 35.00    1.40    2.00    0.95    1.89    1.07    2.03    0.38    5.00
 36.00    1.44    2.00    0.94    1.88    1.07    2.02    0.37    5.00
 37.00    1.48    2.00    0.94    1.87    1.07    2.00    0.37    5.00
 38.00    1.52    2.00    0.93    1.86    1.07    1.99    0.37    5.00
 39.00    1.57    2.00    0.92    1.85    1.07    1.98    0.36    5.00
 40.00    1.61    2.00    0.92    1.84    1.07    1.97    0.36    5.00
 41.00    1.65    2.00    0.91    1.83    1.07    1.96    0.36    5.00
 42.00    1.69    2.00    0.91    1.82    1.07    1.94    0.35    5.00
 43.00    1.74    2.00    0.90    1.81    1.07    1.93    0.35    5.00
 44.00    1.78    2.00    0.90    1.79    1.07    1.92    0.34    5.00
 45.00    1.82    2.00    0.89    1.78    1.07    1.91    0.34    5.00
 46.00    1.86    2.00    0.89    1.77    1.07    1.90    0.34    5.00
 47.00    1.90    2.00    0.88    1.76    1.07    1.89    0.33    5.00
 48.00    1.95    2.00    0.88    1.76    1.07    1.88    0.33    5.00
 49.00    1.99    2.00    0.87    1.75    1.07    1.87    0.33    5.00
 50.00    2.03    2.00    0.87    1.74    1.07    1.86    0.32    5.00
 51.00    2.07    2.00    0.86    1.73    1.07    1.85    0.32    5.00
_______________________________________________________________________
* F.S.<1: Liquefaction Potential Zone.  (If above water table: F.S.=5)
(F.S. is limited to 5,  CRR is limited to 2,   CSR is limited to 2)


CPT convert to SPT for Settlement Analysis:
Fines Correction for Settlement Analysis:
Depth   Ic      qc/N60  qc1     (N1)60  Fines   d(N1)60 (N1)60s
ft                      tsf             %
_______________________________________________________________
1.00    -       -       -       38.25   25.0    2.19    40.44
2.00    -       -       -       38.25   25.0    2.19    40.44
3.00    -       -       -       38.25   25.0    2.19    40.44
4.00    -       -       -       35.28   17.0    1.54    36.82
5.00    -       -       -       32.30   9.0     0.84    33.14
6.00    -       -       -       27.97   1.0     0.10    28.07
7.00    -       -       -       26.49   1.0     0.10    26.59
8.00    -       -       -       25.31   1.0     0.10    25.40
9.00    -       -       -       27.57   1.0     0.10    27.67
10.00   -       -       -       26.65   1.0     0.10    26.75
11.00   -       -       -       25.86   1.0     0.10    25.96
12.00   -       -       -       24.99   1.0     0.10    25.09
13.00   -       -       -       24.22   1.0     0.10    24.32
14.00   -       -       -       23.54   1.0     0.10    23.64
15.00   -       -       -       25.63   1.0     0.10    25.73
16.00   -       -       -       25.02   1.0     0.10    25.11
17.00   -       -       -       28.57   6.8     0.64    29.22
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     18.00    -        -        -       31.95    12.6      1.16      33.12
     19.00    -        -        -       35.18    18.4      1.66      36.84
     20.00    -        -        -       38.27    24.2      2.12      40.39
     21.00    -        -        -       41.23    30.0      2.56      43.79
     22.00    -        -        -       41.45    30.0      2.56      44.01
     23.00    -        -        -       41.68    30.0      2.56      44.24
     24.00    -        -        -       41.91    30.0      2.56      44.47
     25.00    -        -        -       42.14    30.0      2.56      44.70
     26.00    -        -        -       42.38    30.0      2.56      44.94
     27.00    -        -        -       42.02    24.2      2.12      44.15
     28.00    -        -        -       43.88    18.4      1.66      45.54
     29.00    -        -        -       43.54    12.6      1.16      44.70
     30.00    -        -        -       43.22    6.8       0.64      43.86
     31.00    -        -        -       42.91    1.0       0.10      43.01
     32.00    -        -        -       42.48    1.0       0.10      42.57
     33.00    -        -        -       42.07    1.0       0.10      42.17
     34.00    -        -        -       41.69    1.0       0.10      41.78
     35.00    -        -        -       41.32    1.0       0.10      41.42
     36.00    -        -        -       40.98    1.0       0.10      41.08
     37.00    -        -        -       41.72    7.0       0.66      42.38
     38.00    -        -        -       42.44    13.0      1.20      43.64
     39.00    -        -        -       43.15    19.0      1.71      44.86
     40.00    -        -        -       43.85    25.0      2.19      46.04
     41.00    -        -        -       43.79    25.0      2.19      45.98
     42.00    -        -        -       43.74    25.0      2.19      45.92
     43.00    -        -        -       43.69    25.0      2.19      45.88
     44.00    -        -        -       43.65    25.0      2.19      45.84
     45.00    -        -        -       43.62    25.0      2.19      45.81
     46.00    -        -        -       43.95    25.0      2.19      46.14
     47.00    -        -        -       44.28    25.0      2.19      46.46
     48.00    -        -        -       44.60    25.0      2.19      46.79
     49.00    -        -        -       44.93    25.0      2.19      47.11
     50.00    -        -        -       45.25    25.0      2.19      47.44
     51.00    -        -        -       44.79    25.0      2.19      46.97
    _______________________________________________________________________


    Settlement of Saturated Sands:
    Settlement Analysis Method: Ishihara / Yoshimine*
    Depth    CSRfs    F.S.    Fines    (N1)60s Dr       ec       dsz      dsv      S
    ft       w/fs             %                %        %        in.      in.      in.

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    Settlement of Saturated Sands=0.000 in.
    dsz is per each segment: dz=0.05 ft
    dsv is per each print interval: dv=1 ft
    S is cumulated settlement at this depth

    Settlement of Dry Sands:
    Depth    sigma'   sigC'    (N1)60s CSRfs    Gmax     g*Ge/Gm  g_eff    ec7.5    Cec
ec  dsz      dsv      S
    ft       tsf      tsf              w/fs     tsf                        %
%   in.      in.      in.

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         51.45    3.22     2.09     46.77    0.32     2328.0   4.4E-4   0.0965   0.0305   1.01
0.0308   3.7E-4   0.000    0.000
         51.00    3.19     2.07     46.97    0.32     2320.8   4.4E-4   0.0963   0.0304   1.01
0.0307   3.7E-4   0.003    0.004
         50.00    3.13     2.03     47.44    0.32     2304.5   4.4E-4   0.0956   0.0302   1.01
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0.0305   3.7E-4   0.007    0.011
         49.00    3.06     1.99     47.11    0.33    2275.3   4.4E-4   0.0961   0.0304   1.01
0.0307   3.7E-4   0.007    0.018
         48.00    3.00     1.95     46.79    0.33    2245.8   4.4E-4   0.0966   0.0305   1.01
0.0308   3.7E-4   0.007    0.026
         47.00    2.93     1.90     46.46    0.33    2216.1   4.4E-4   0.0969   0.0306   1.01
0.0309   3.7E-4   0.007    0.033
         46.00    2.87     1.86     46.14    0.34    2186.3   4.4E-4   0.0972   0.0307   1.01
0.0310   3.7E-4   0.007    0.041
         45.00    2.80     1.82     45.81    0.34    2156.2   4.4E-4   0.0974   0.0308   1.01
0.0311   3.7E-4   0.007    0.048
         44.00    2.74     1.78     45.84    0.34    2131.5   4.4E-4   0.0970   0.0307   1.01
0.0309   3.7E-4   0.007    0.055
         43.00    2.67     1.74     45.88    0.35    2106.6   4.4E-4   0.0965   0.0305   1.01
0.0308   3.7E-4   0.007    0.063
         42.00    2.61     1.69     45.92    0.35    2081.5   4.4E-4   0.0959   0.0303   1.01
0.0306   3.7E-4   0.007    0.070
         41.00    2.54     1.65     45.98    0.36    2056.2   4.4E-4   0.0952   0.0301   1.01
0.0304   3.6E-4   0.007    0.078
         40.00    2.48     1.61     46.04    0.36    2030.6   4.4E-4   0.0945   0.0299   1.01
0.0301   3.6E-4   0.007    0.085
         39.00    2.41     1.57     44.86    0.36    1986.6   4.4E-4   0.0955   0.0302   1.01
0.0304   3.7E-4   0.007    0.092
         38.00    2.35     1.52     43.64    0.37    1941.7   4.4E-4   0.0965   0.0305   1.01
0.0308   3.7E-4   0.007    0.099
         37.00    2.28     1.48     42.38    0.37    1896.0   4.4E-4   0.1500   0.0474   1.01
0.0478   5.7E-4   0.009    0.109
         36.00    2.22     1.44     41.08    0.37    1849.5   4.5E-4   0.1523   0.0482   1.01
0.0486   5.8E-4   0.012    0.120
         35.00    2.15     1.40     41.42    0.38    1827.2   4.4E-4   0.1486   0.0470   1.01
0.0474   5.7E-4   0.012    0.132
         34.00    2.09     1.36     41.78    0.38    1804.6   4.4E-4   0.1447   0.0457   1.01
0.0461   5.5E-4   0.011    0.143
         33.00    2.02     1.31     42.17    0.38    1781.7   4.3E-4   0.1406   0.0445   1.01
0.0448   5.4E-4   0.011    0.154
         32.00    1.96     1.27     42.57    0.39    1758.4   4.3E-4   0.1364   0.0431   1.01
0.0435   5.2E-4   0.011    0.164
         31.00    1.89     1.23     43.01    0.39    1734.8   4.2E-4   0.1321   0.0418   1.01
0.0421   5.1E-4   0.010    0.175
         30.00    1.83     1.19     43.86    0.39    1716.1   4.2E-4   0.1268   0.0401   1.01
0.0404   4.9E-4   0.010    0.185
         29.00    1.76     1.15     44.70    0.39    1696.6   4.1E-4   0.1195   0.0378   1.01
0.0381   4.6E-4   0.009    0.194
         28.00    1.70     1.10     45.54    0.39    1676.3   4.0E-4   0.1128   0.0357   1.01
0.0360   4.3E-4   0.009    0.203
         27.00    1.64     1.06     44.15    0.40    1628.4   4.0E-4   0.1111   0.0351   1.01
0.0354   4.3E-4   0.009    0.212
         26.00    1.58     1.02     44.94    0.40    1607.2   3.9E-4   0.1048   0.0331   1.01
0.0334   4.0E-4   0.008    0.220
         25.00    1.52     0.98     44.70    0.40    1573.1   3.8E-4   0.1008   0.0319   1.01
0.0321   3.9E-4   0.008    0.228
         24.00    1.45     0.95     44.47    0.40    1538.6   3.8E-4   0.0968   0.0306   1.01
0.0309   3.7E-4   0.008    0.235
         23.00    1.39     0.91     44.24    0.40    1503.8   3.7E-4   0.0929   0.0294   1.01
0.0296   3.6E-4   0.007    0.243
         22.00    1.33     0.87     44.01    0.40    1468.6   3.6E-4   0.0889   0.0281   1.01
0.0284   3.4E-4   0.007    0.249
         21.00    1.27     0.83     43.79    0.40    1433.0   3.6E-4   0.0851   0.0269   1.01
0.0271   3.3E-4   0.007    0.256
         20.00    1.21     0.79     40.39    0.40    1361.9   3.6E-4   0.0862   0.0272   1.01
0.0275   3.3E-4   0.007    0.263
         19.00    1.16     0.75     36.84    0.40    1287.9   3.6E-4   0.0878   0.0343   1.01
0.0346   4.1E-4   0.007    0.270
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         18.00    1.10     0.71     33.12   0.40     1210.3   3.7E-4   0.1866   0.0903   1.01
0.0911   1.1E-3   0.019    0.289
         17.00    1.04     0.67     29.22   0.41     1128.6   3.7E-4   0.2003   0.1186   1.01
0.1196   1.4E-3   0.025    0.315
         16.00    0.97     0.63     25.11   0.41     1041.4   3.8E-4   0.2222   0.1624   1.01
0.1638   2.0E-3   0.034    0.348
         15.00    0.91     0.59     25.73   0.41     1016.8   3.7E-4   0.1876   0.1328   1.01
0.1339   1.6E-3   0.035    0.384
         14.00    0.85     0.56     23.64   0.41     955.5    3.7E-4   0.1849   0.1465   1.01
0.1477   1.8E-3   0.037    0.421
         13.00    0.79     0.52     24.32   0.41     930.1    3.5E-4   0.1539   0.1174   1.01
0.1184   1.4E-3   0.032    0.453
         12.00    0.73     0.48     25.09   0.41     903.8    3.3E-4   0.1278   0.0936   1.01
0.0944   1.1E-3   0.025    0.478
         11.00    0.68     0.44     25.96   0.41     876.2    3.2E-4   0.1059   0.0741   1.01
0.0747   9.0E-4   0.020    0.498
         10.00    0.62     0.40     26.75   0.41     845.1    3.0E-4   0.0884   0.0593   1.01
0.0598   7.2E-4   0.016    0.514
         9.00     0.56     0.36     27.67   0.41     812.6    2.8E-4   0.0735   0.0471   1.01
0.0475   5.7E-4   0.013    0.527
         8.00     0.50     0.32     25.40   0.41     746.8    2.8E-4   0.1485   0.1069   1.01
0.1078   1.3E-3   0.019    0.546
         7.00     0.44     0.29     26.59   0.42     712.1    2.6E-4   0.0859   0.0581   1.01
0.0586   7.0E-4   0.019    0.565
         6.00     0.38     0.25     28.07   0.42     675.0    2.3E-4   0.0568   0.0356   1.01
0.0359   4.3E-4   0.011    0.576
         5.00     0.32     0.21     33.14   0.42     655.1    2.0E-4   0.0401   0.0194   1.01
0.0195   2.3E-4   0.006    0.582
         4.00     0.26     0.17     36.82   0.42     609.6    1.8E-4   0.0334   0.0131   1.01
0.0132   1.6E-4   0.004    0.586
         3.00     0.20     0.13     40.44   0.42     545.8    1.5E-4   0.0293   0.0093   1.01
0.0093   1.1E-4   0.003    0.589
         2.00     0.13     0.08     40.44   0.42     445.7    1.2E-4   0.0228   0.0072   1.01
0.0073   8.7E-5   0.002    0.591
         1.00     0.07     0.04     40.44   0.42     315.1    8.7E-5   0.0159   0.0050   1.01
0.0051   6.1E-5   0.002    0.592

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         Settlement of Dry Sands=0.592 in.
         dsz is per each segment: dz=0.05 ft
         dsv is per each print interval: dv=1 ft
         S is cumulated settlement at this depth

         Total Settlement of Saturated and Dry Sands=0.592 in.
         Differential Settlement=0.296 to 0.391 in.

         Units          Depth = ft, Stress or Pressure = tsf (atm), Unit Weight =
pcf, Settlement = in.

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         SPT            Field data from Standard Penetration Test (SPT)
         BPT            Field data from Becker Penetration Test (BPT)
         qc             Field data from Cone Penetration Test (CPT)
         fc             Friction from CPT testing
         Gamma          Total unit weight of soil
         Gamma'         Effective unit weight of soil
         Fines          Fines content [%]
         D50            Mean grain size
         Dr             Relative Density
         sigma          Total vertical stress [tsf]
         sigma'         Effective vertical stress [tsf]
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sigC'	Effective confining pressure [tsf]
rd	Stress reduction coefficient
CSR	Cyclic stress ratio induced by earthquake
fs	User request factor of safety, apply to CSR
w/fs	With user request factor of safety inside
CSRfs	CSR with User request factor of safety
CRR7.5	Cyclic resistance ratio (M=7.5)
Ksigma	Overburden stress correction factor for CRR7.5
CRRv	CRR after overburden stress correction, CRRv=CRR7.5 * Ksigma
MSF	Magnitude scaling factor for CRR (M=7.5)
CRRm	After magnitude scaling correction CRRm=CRRv * MSF
F.S.	Factor of Safety against liquefaction F.S.=CRRm/CSRfs
Cebs	Energy Ratio, Borehole Dia., and Sample Method Corrections
Cr	Rod Length Corrections
Cn	Overburden Pressure Correction
(N1)60	SPT after corrections, (N1)60=SPT * Cr * Cn * Cebs
d(N1)60	Fines correction of SPT
(N1)60f	(N1)60 after fines corrections, (N1)60f=(N1)60 + d(N1)60
Cq	Overburden stress correction factor
qc1	CPT after Overburden stress correction
dqc1	Fines correction of CPT
qc1f	CPT after Fines and Overburden correction, qc1f=qc1 + dqc1
qc1n	CPT after normalization in Robertson's method
Kc	Fine correction factor in Robertson's Method
qc1f	CPT after Fines correction in Robertson's Method
Ic	Soil type index in Suzuki's and Robertson's Methods
(N1)60s	(N1)60 after seattlement fines corrections
ec	Volumetric strain for saturated sands
ds	Settlement in each Segment dz
dz	Segment for calculation, dz=0.050 ft
Gmax	Shear Modulus at low strain
g_eff	gamma_eff, Effective shear Strain
g*Ge/Gm	gamma_eff * G_eff/G_max, Strain-modulus ratio
ec7.5	Volumetric Strain for magnitude=7.5
Cec	Magnitude correction factor for any magnitude
ec	Volumetric strain for dry sands, ec=Cec * ec7.5
NoLiq	No-Liquefy Soils

References:

NCEER Workshop on Evaluation of Liquefaction Resistance of Soils. Youd, T.L., and Idriss, I.M., eds., Technical Report NCEER 97-0022.

SP117. Southern California Earthquake Center. Recommended Procedures for Implementation of DMG Special Publication 117, Guidelines for Analyzing and Mitigating Liquefaction in California. University of Southern California. March 1999.