# ENGINEERING GEOLOGY AND GEOTECHNICAL ENGINEERING REPORT

FOR

PROPOSED MODULAR CLASSROOM BUILDINGS AT
RIO MESA HIGH SCHOOL,
545 CENTRAL AVENUE,
OXNARD AREA, VENTURA COUNTY, CALIFORNIA

PROJECT NO.: 303085-001
APRIL 19, 2019

PREPARED FOR
OXNARD UNION HIGH SCHOOL DISTRICT

BY

**EARTH SYSTEMS PACIFIC**
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April 19, 2019

Project No.: 303085-001
Report No.: 19-4-60

Attention: Joshua Koenig-Brown
Oxnard Union High School District
309 South K Street, Building C
Oxnard, CA 93003

Project: Rio Mesa High School Modular Classroom Buildings
545 Central Avenue
Oxnard Area, Ventura County, California



As authorized, we have performed a geotechnical study for eight proposed modular classroom buildings to be located on the Rio Mesa High School campus in the Oxnard area of Ventura County, California. The accompanying Engineering Geology and Geotechnical Engineering Report presents the results of our subsurface exploration and laboratory testing programs, as well as our conclusions and recommendations pertaining to geotechnical aspects of project design. This report completes the scope of services described within our Proposal No. VEN-19-03-025 dated March 28, 2019, and authorized by you on April 3, 2019.

We have appreciated the opportunity to be of service to you on this project. Please call if you have any questions, or if we can be of further service.

Respectfully submitted,

**EARTH SYSTEMS PACIFIC**

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## INTRODUCTION

This report presents results of an Engineering Geology and Geotechnical Engineering study performed for eight proposed 36-foot by 40-foot modular classrooms to be located near the western parking lot of the Rio Mesa High School at 545 Central Avenue in the Oxnard area of Ventura County, California (see Vicinity Map in Appendix A). The buildings will be prefabricated structures with wood foundations sitting on asphalt pavement.

The site of the proposed classrooms is an asphalt-paved area that includes basketball courts. Grading for the proposed project is expected to only be necessary if calculated liquefaction and/or seismic-induced settlements exceed design tolerances.



## PURPOSE AND SCOPE OF WORK

The purpose of the geotechnical study that led to this report was to analyze the geology and soil conditions of the site with respect to the proposed improvements. These conditions include potential geohazards, surface and subsurface soil types, expansion potential, settlement potential, bearing capacity, and the presence or absence of subsurface water. The scope of work included:

1. Reconnaissance of the site.
2. Reviewing geotechnical data gathered in 2010 during previous geotechnical studies for adjacent solar carports on the campus.
3. Reviewing pertinent regional geologic literature.
4. Analyzing the geotechnical data in accordance with current building codes.
5. Preparing this report.

Contained in this report are:

1. Descriptions and results of field and laboratory tests that were performed for our 2010 geotechnical study for a solar carport project.
2. Discussions pertaining to the local geologic, soil, and groundwater conditions.
3. Conclusions pertaining to geohazards that could affect the site.
4. Conclusions and recommendations pertaining to site grading and structural design.

## GEOLOGY

The site lies within the Ventura Basin, which in turn lies in the western Transverse Ranges. The Ventura Basin and the Transverse Ranges are characterized by ongoing tectonic activity. In the Ventura Basin, Tertiary and Quaternary sediments have been folded and faulted along predominant east-west structural trends. Although there are several faults located within the region, the surface trace of the nearest known fault of significant activity (i.e. the Oak Ridge Fault) is located approximately 0.9 miles north of the subject site. The Oak Ridge Fault is a south-dipping reverse fault, and for the purposes of this report it has been assumed for seismic analyses that the distance to the fault is zero miles.



The project area is not located within any of the "Fault Rupture Hazard Zones" specified by the State of California (C.D.M.G. 1972, Revised 1999). However, the site is located within one of the Liquefaction Hazard Zones designated by the California Geological Survey (2003b).

The campus is underlain by what are likely several hundred feet of alluvial and young shallow marine sediments. Bedrock was not encountered to the maximum depth of exploration in 2010, which was 51.5 feet below the ground surface in Boring B-1.

Strikes of bedding were not measured on-site, but sediments are expected to be oriented nearly parallel to the ground surface.

No faults or landslides were observed to be located on or trending into the subject property during the field study, or during reviews of the referenced geologic literature.

## GEOLOGIC HAZARDS

Geologic hazards that may impact a site include seismic shaking, fault rupture, landsliding, liquefaction and flooding.

A. Seismic Shaking

1. Although the site is not within a State-designated "fault rupture hazard zone", it is located in an active seismic region where large numbers of earthquakes are recorded each year. Historically, major earthquakes (i.e. those with Richter magnitudes greater than 7.0) felt in the vicinity of subject site have originated from faults outside

the area. These include the December 21, 1812 "Santa Barbara Region" earthquake, that was presumably centered in the Santa Barbara Channel, the 1857 Fort Tejon earthquake, the 1872 Owens Valley earthquake, and the 1952 Arvin-Tehachapi earthquake.

2. It is assumed that the 2016 CBC and ASCE 7-10 guidelines will apply for the seismic design parameters. The 2016 CBC includes several seismic design parameters that are influenced by the geographic site location with respect to active and potentially active faults, and with respect to subsurface soil or rock conditions. The seismic design parameters presented herein were determined by the U.S. Seismic Design Maps "risk-targeted" calculator on the USGS website for the jobsite coordinates (34.2551° North Latitude and 119.1460° West Longitude). The calculator adjusts for Soil Site Class D (for stiff soils), and for Occupancy (Risk) Category III (which includes schools). (A listing of the calculated 2016 CBC and ASCE 7-10 Seismic Parameters is presented below and again in Appendix C.)



Because S1 is greater than or equal to 0.75 g and the Seismic Design Category is “E”, a site-specific seismic analysis was performed in addition to the “general procedure”. For the General Analysis, presented in the table below, the Short Period Spectral Response ($S_{DS}$) was found to be 1.867 g, and the 1 Second Spectral Response ($S_{D1}$) was found to be 1.078 g. For the Site-Specific Analysis, the Short Period Spectral Response ($S_{DS}$) was found to be 1.494 g, and the 1 Second Spectral Response ($S_{D1}$) was found to be 1.248 g.

The Fault Parameters table (see Appendix C) lists the significant "active" and "potentially active" faults within an approximate 35-mile radius of the subject site. The distance between the site and the nearest portion of each fault is shown, as well as the respective estimated maximum earthquake magnitudes, and the deterministic mean site peak ground accelerations.

**Summary of Seismic Parameters – 2016 CBC**

| | |
|---|---|
| Site Class (Table 20.3-1 of ASCE 7-10 with 2016 update) | D |
| Occupancy (Risk) Category | III |
| Seismic Design Category | E |

| **Maximum Considered Earthquake (MCE) Ground Motion** | |
|---|---|
| Spectral Response Acceleration, Short Period – $S_s$ | 2.801 g |
| Spectral Response Acceleration at 1 sec. – $S_1$ | 1.078 g |
| Site Coefficient – $F_a$ | 1.00 |
| Site Coefficient – $F_v$ | 1.50 |
| Site-Modified Spectral Response Acceleration, Short Period – $S_{MS}$ | 2.801 g |
| Site-Modified Spectral Response Acceleration at 1 sec. – $S_{M1}$ | 1.618 g |
| **Design Earthquake Ground Motion** | |
| Short Period Spectral Response – $S_{DS}$ | 1.867 g |
| One Second Spectral Response – $S_{D1}$ | 1.078 g |
| Site Modified Peak Ground Acceleration - $PGA_M$ | 1.130 g |
| Note: Values Appropriate for a 2% Probability of Exceedance in 50 Years | |



3. Southern Ventura County has been mapped by the California Division of Mines and Geology to delineate areas of varying predicted seismic response. The "older deltaic deposits" that underlie the subject area are mapped as having a probable maximum intensity of earthquake response of approximately VIII on the Modified Mercalli Scale. Historically, the highest observed intensity of ground response has been VII in the Oxnard and Saticoy areas (C.D.M.G., 1975).

4. The San Andreas is the dominant active fault in California. The fault extends from the Gulf of California to Cape Mendocino in northern California. That portion of the zone extending southward from Parkfield, California is estimated to have been active for the last 12 million years. As much as 190 miles of right lateral displacement has occurred across the zone (Crowell, 1975). This displacement includes offsets on the actual San Andreas Fault and related faults that include the Imperial, Banning, Mission Creek, and San Jacinto faults.

5. Historically, the San Andreas Fault is responsible for two of the three "great" earthquakes experienced in California. ("Great" earthquakes are defined as having Richter magnitudes that are equal to or greater than 8.0.) These are the 1857 Fort Tejon and 1906 San Francisco earthquakes. Each event is credited with approximately 200 miles of surface rupture and horizontal displacements of up to 30 feet. Ground shaking was very intense and damage to man-made structures very wide spread. The 1857 rupture extended along the San Andreas Fault from near

Bakersfield to Cajon Pass and was felt throughout most of California. Horizontal displacements of 10 to 13 feet were observed along the fault in the Palmdale area.

6. Recurrence intervals for major earthquakes in southern California are best documented for the San Andreas Fault. It is estimated that a major earthquake has occurred along the southern portion of the San Andreas Fault every 100 to 200 years (Sieh, 1978). The average recurrence interval is estimated to be 140 years. The last major earthquake on the San Andreas Fault in the southern California area occurred in 1857; therefore, the occurrence of a major event in the same general area is considered likely within the estimated lifetime of any new construction.



7. On December 21, 1812, an estimated 7.0 Richter magnitude event occurred in an area believed to be offshore in the western part of the Santa Barbara Channel. This earthquake caused considerable shaking in the area of the proposed project.

8. On March 26, 1872, the greatest recorded earthquake in the western United States, excluding Alaska, occurred along the Owens Valley Fault near Lone Pine. The earthquake is estimated to have had a Richter magnitude of 8.25, and significantly shook most of California.

9. On July 21, 1952, the Arvin-Tehachapi earthquake occurred on the White Wolf Fault. The earthquake registered 7.7 on the Richter Scale and was felt throughout southern California.

B. <u>Fault Rupture</u>

Surficial displacement along a fault trace is known as fault rupture. Fault rupture typically occurs along previously existing fault traces. As mentioned in the "Structure" section above, no existing fault traces were observed to be crossing the site in any of the referenced documents, including the Ventura County General Plan. As a result, it is the opinion of this firm that the potential for fault rupture on this site is low.

C. <u>Landsliding and Rock Fall</u>

The subject site and surrounding areas are essentially level. Thus, potential hazards due to landsliding and rock fall are nil.

D. Liquefaction, Lateral Spreading, and Seismic-Induced Settlement of Dry Sands

Earthquake-induced vibrations can be the cause of several significant phenomena, including liquefaction in fine sands and silty sands. Liquefaction results in a loss of strength and can cause structures to settle or even overturn if it occurs in the bearing zone. Liquefaction is typically limited to the upper 50 feet of soils underlying a site.

Fine sands and silty sands that are poorly graded and lie below the groundwater table are the soils most susceptible to liquefaction. Soils that have $I_c$ values greater than 2.6, soils with plasticity indices greater than 7, sufficiently dense soils, and/or soils located above the groundwater table are not generally susceptible to liquefaction.



An examination of the conditions existing at the site, in relation to the criteria listed above, indicates the following:

1. Groundwater was not encountered in the upper 51.5 feet when exploration was performed in 2010. However, mapping of historical high groundwater levels by C.G.S. (2003a) indicates groundwater has risen to within about 25 feet of the ground surface.
2. The soil profile consists of non-plastic sands.
3. Standard penetration tests conducted in the borings indicate that soils within the tested depth are in a variably dense state.

Based on the above, cyclic mobility analyses were undertaken to analyze the liquefaction and seismic-induced settlement potentials of the various soil layers. The liquefaction analyses were performed in general accordance with the methods proposed by NCEER (1997). In the analyses, the design earthquake was considered to be a 7.4 moment magnitude event, and a site adjusted peak ground acceleration of 1.130 g was assumed, as per the discussion in the "Seismicity and Seismic Design" section of this report. Soil stratigraphic and engineering data interpreted from Boring B-1 were utilized. Groundwater was assumed to be at a depth of 25 feet in one analysis and at greater than 51.5 feet in the other.

The analysis with the groundwater level at 25 feet indicated that layers totaling about 19 feet in thickness had factors of safety that were less than 1.3, with the shallowest layer at depths between 32.5 and 37.5 feet (see Appendix D for calculations). Those zones with factors of safety less than 1.3 are considered potentially liquefiable (C.G.S., 2008, and SCEC, 1999).

The volumetric strain for the potentially liquefiable zones was estimated using a chart derived by Tokimatsu and Seed (1987) after reducing the $N_160$ values by the calculated "FC Delta" value, then making adjustments for fines content as per Seed (1987) and SCEC (1999). Using this methodology, the volumetric strain was found to be approximately 1.8 inches when groundwater was at 25 feet, although an additional 1.3 inches of seismic-induced settlement of dry sands was also predicted for a total potential settlement of 3.1 inches.



When groundwater was assumed to be at 52 feet, no liquefaction would occur, but the volumetric strain related to seismic-induced settlement of dry sands was estimated to be 2.1 inches.

According to a chart derived by Ishihara (National Academy Press, 1985), no "ground" damage would be expected related to the potentially liquefiable zones identified in the borings because of the 32.5-foot thickness of non-liquefiable soils above the 15-foot thick shallowest potentially liquefiable layer. In addition, the construction of a geogrid-reinforced mat beneath the proposed buildings will mitigate the potential for ground damage at the site. (Examples of ground damage are sand boils and ground cracks.)

Although the analysis predicts that there will be no ground damage, there is a potential for differential areal settlement suggested by the findings. As mentioned previously, the combined liquefaction and seismic-induced settlements could potentially range up to about 3.1 inches depending on groundwater depth. According to SCEC (1999), up to about half of the total settlement could be realized as differential settlement. As a result, differential settlement could range up to about 1.6 inches at the ground surface.

”Free face” lateral spreading does not appear to pose a potential hazard because there are no nearby sloped areas or canyons (Bartlett and Youd, 1995). “Ground slope” lateral spreading, sometimes referred to as “ground oscillation”, can occur when adjusted blow counts ($N_{1(60)}$) measured within potentially liquefiable zones are less than 15. However, all adjusted blow counts are greater than 15. As a result, it appears that the potential for lateral spreading is low.

Based on the above, it is the opinion of this firm that a potential for liquefaction exists at this site.

E. Flooding

Earthquake-induced flooding types include tsunamis, seiches, and reservoir failure. Due to the inland location of the site, hazards from tsunamis and seiches are considered extremely unlikely.



According to the Ventura County General Plan Hazards Appendix (2013), this site, like most of the Oxnard Plain, is within a dam failure inundation zone for Lake Castaic, Pyramid Lake, Lake Piru, and Bouquet Canyon Dam. Proper maintenance of these dams is anticipated, and assuming the maintenance continues as planned, the hazard posed by reservoir failure appears to be low.

The site is located within an area designated by FEMA Flood Map Service Center website as Zone X, which is designated as an “area of minimal flood hazard". As a result, it appears that the hazard posed by storm-induced flooding is low.

## SOIL CONDITIONS

Based on interpretation of nearby points of exploration advanced in 2010, near-surface soils underlying the existing asphalt pavements are likely to be well-graded alluvial slightly silty sands with variable quantities of gravels, and minor interbeds of silty sands. Approximately 4.5 feet of artificial fill was encountered in Boring B-1, but the other soils appeared to be natural. Soils encountered within the anticipated bearing zones are characterized by variable blow counts and in-place densities. Testing indicates that anticipated bearing soils lie in the "very low" expansion range of Table 1809.7 because the expansion index was found to be 0. [A locally adopted version of this classification of soil expansion is included in Appendix B of this report.] It appears that soils can be cut by normal grading and/or drilling equipment, although a large quantity of cobbles and/or boulders may be encountered.

Groundwater was not encountered to a depth of 51.5 feet when borings were advanced in 2010. Historic high groundwater levels have been approximately 25 feet below the ground surface according to C.G.S. (2003a).

During studies conducted in 2010, samples of near-surface soils were tested for pH, resistivity, soluble sulfates, and soluble chlorides. Sulfate contents (11 mg/Kg) were in the "S0" ("negligible") exposure class of Table 19.3.1.1 of ACI 318-14.

Based on criteria established by the County of Los Angeles (2013), measurements of resistivity of near-surface soils (13,500 ohms-cm) indicate that they are "mildly corrosive" to ferrous metal (i.e. cast iron, etc.) pipes.



## GEOTECHNICAL CONCLUSIONS AND RECOMMENDATIONS

As noted above, there is a potential for liquefaction to produce differential settlements in the proposed building areas. Without mitigation, the currently proposed wood foundations may not be structurally capable of withstanding anticipated differential settlements of approximately 1.6 inches. The following remedial recommendations are intended to reduce potential differential settlement to a level where the proposed modular classroom buildings could be supported by wood foundations on asphalt pavement.

To mitigate the anticipated liquefaction-related effects, Earth Systems recommends that a geogrid reinforced mat be constructed beneath the relocatable buildings. The intent of the geogrid reinforced mat is to stiffen underlying soils so that they act as a block that would result in more uniform settlement beneath the structures.

To create the geogrid reinforced mats, native soils beneath the proposed buildings should be excavated a minimum of 5 feet below existing grade. The limits of overexcavation should be extended laterally to a distance of at least 5 feet beyond the outside edges of the foundation element wherever no existing structures are located within 10 feet of the outside edge of the overexcavation zone. If existing structures are within 10 feet of the lateral overexcavation limit, the overexcavation width may be reduced to 3 feet outside the building perimeter in that direction only. The bases of the overexcavation zones should be relatively level.

The bottoms of the remedial excavations should be scarified to a depth of 6 inches, uniformly moisture conditioned to above optimum moisture content; and compacted to achieve a relative compaction of at least 90 percent of the ASTM D 1557 maximum dry density. Following compaction of the bottom, a layer of geogrid should be placed on the prepared subgrade that extends across the entire area of overexcavation and up the sidewalls of the remedial excavation. The reinforcing geogrids should consist of Tensar Tri-Axial TX7, or equivalent as approved by the Geotechnical Engineer. Where more than one geogrid roll is required, the rolls should be overlapped at least 3 feet. A 1-foot layer of one-inch minus aggregate base material should be placed and compacted over the bottom layer of geogrid. The aggregate base material should be uniformly moisture conditioned to at or above optimum moisture content and compacted to achieve a relative compaction of at least 95 percent of the ASTM D 1557 maximum dry density. A second layer of geogrid should be placed over the compacted aggregate base material, and an additional foot of aggregate base material should be placed and compacted on top of the second geogrid layer. The second layer of geogrid rolls should be overlapped by 3 feet where necessary, and extend across the entire excavation; however, it does not need to extend up the sidewalls. Once the second lift of aggregate base material has been placed and compacted, the remedial excavation may then be brought up to finished subgrade elevation using the excavated soil compacted to at least 95 percent of the ASTM D 1557 maximum dry density. Once the fill reaches 6 inches below finished subgrade elevation, the bottom layer of geogrid extending up the sidewall of the remedial excavation should be pulled down onto the compacted surface to create an 8-foot overlap. The remedial excavation may then be brought up to finished subgrade using the excavated soil compacted to at least 95 percent of the ASTM D 1557 maximum dry density. The area may then be paved to match the existing structural paving section.



The modular building manufacturer and installer may choose to increase the number of pipe anchors used to firmly secure the building into the geogrid reinforced mat and stiffen the wood foundation.

## ADDITIONAL SERVICES

This report is based on the assumption that an adequate program of monitoring and testing will be performed by Earth Systems during construction to check compliance with the recommendations given in this report. The recommended tests and observations include, but are not necessarily limited to the following:

1. Review of the building and grading plans during the design phase of the project.
2. Observation and testing during site preparation, grading, placing of engineered fill, and foundation construction.
3. Consultation as required during construction.

**LIMITATIONS AND UNIFORMITY OF CONDITIONS**

The analysis and recommendations submitted in this report are based in part upon the data obtained from the borings and CPT soundings advanced on the site during earlier site studies. The nature and extent of variations between and beyond the borings and soundings may not become evident until construction. If variations then appear evident, it will be necessary to reevaluate the recommendations of this report.



The scope of services did not include any environmental assessment or investigation for the presence or absence of wetlands, hazardous or toxic materials in the soil, surface water, groundwater or air, on, below, or around this site. Any statements in this report or on the soil boring logs regarding odors noted, unusual or suspicious items or conditions observed, are strictly for the information of the client.

Findings of this report are valid as of this date; however, changes in conditions of a property can occur with passage of time whether they be due to natural processes or works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur whether they result from legislation or broadening of knowledge. Accordingly, findings of this report may be invalidated wholly or partially by changes outside the control of this firm. Therefore, this report is subject to review and should not be relied upon after a period of one year.

In the event that any changes in the nature, design, or location of the structure(s) and other improvements are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing.

This report is issued with the understanding that it is the responsibility of the Owner, or of his representative to ensure that the information and recommendations contained herein are called to the attention of the Architect and Engineers for the project and incorporated into the plan and that the necessary steps are taken to see that the Contractor and Subcontractors carry out such recommendations in the field.

As the Geotechnical Engineers for this project, Earth Systems has striven to provide services in accordance with generally accepted geotechnical engineering practices in this community at this time. No warranty or guarantee is expressed or implied. This report was prepared for the exclusive use of the Client for the purposes stated in this document for the referenced project only. No third party may use or rely on this report without express written authorization from Earth Systems for such use or reliance.

It is recommended that Earth Systems be provided the opportunity for a general review of final design and specifications in order that earthwork and foundation recommendations may be properly interpreted and implemented in the design and specifications. If Earth Systems is not accorded the privilege of making this recommended review, it can assume no responsibility for misinterpretation of the recommendations.



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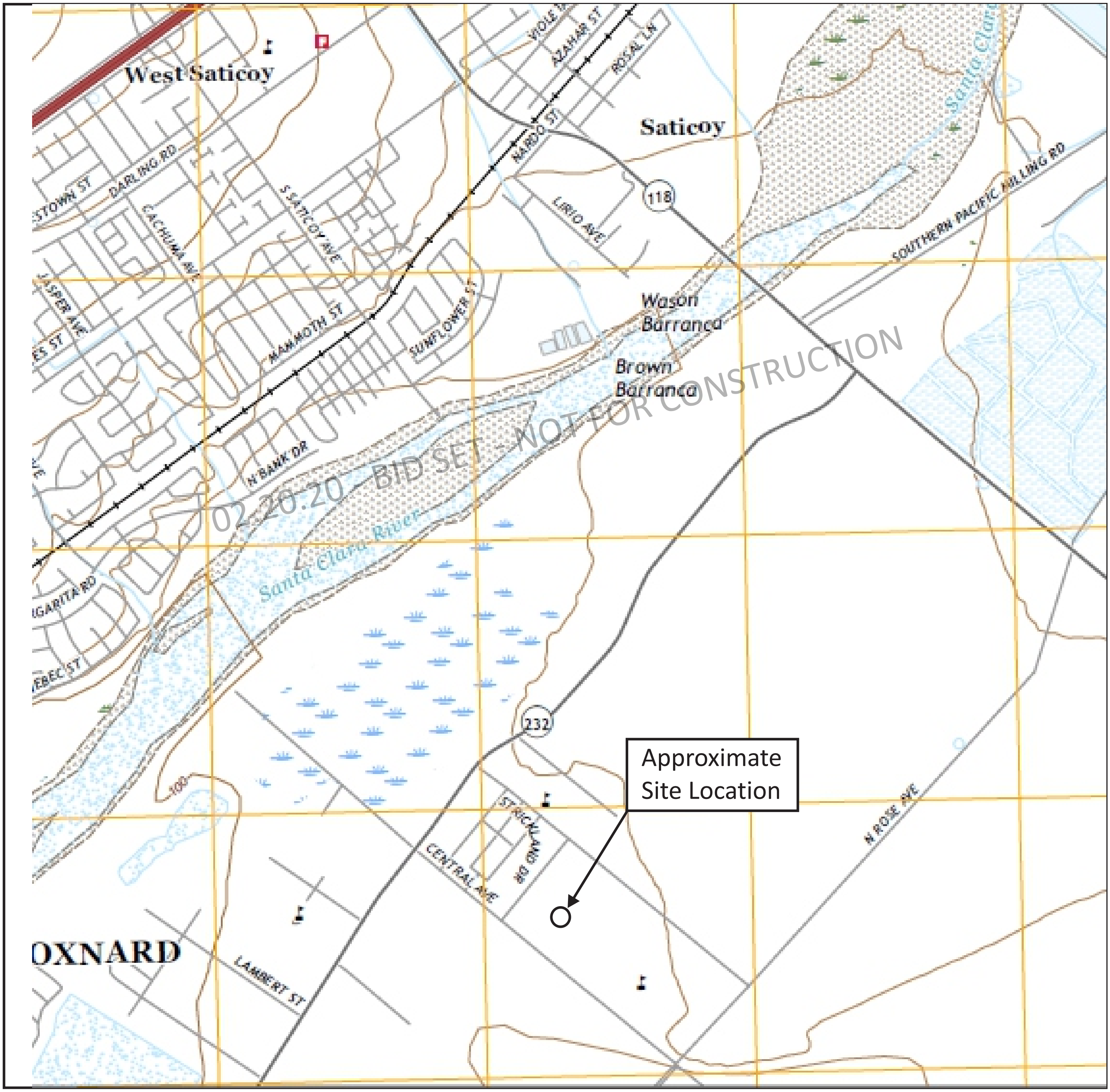
**APPENDIX A**

Vicinity Map
Regional Geologic Map
Seismic Hazard Zones Map
Historical High Groundwater Map
Enlarged Partial Site Plan
Geologic Map
Geologic Cross-Section A – A'
Logs of Exploratory Borings from 2010
Boring Log Symbols
Unified Soil Classification System
CPT-1 Sounding Log and Interpretations from 2010




*Taken from USGS Topo Map, Saticoy Quadrangle, California, 2018.

Approximate Scale: 1" = 2,000’

0 2,000’ 4,000’

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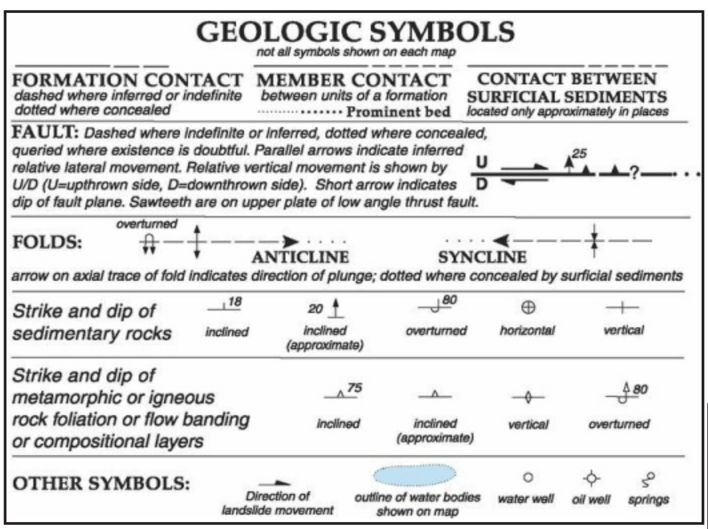
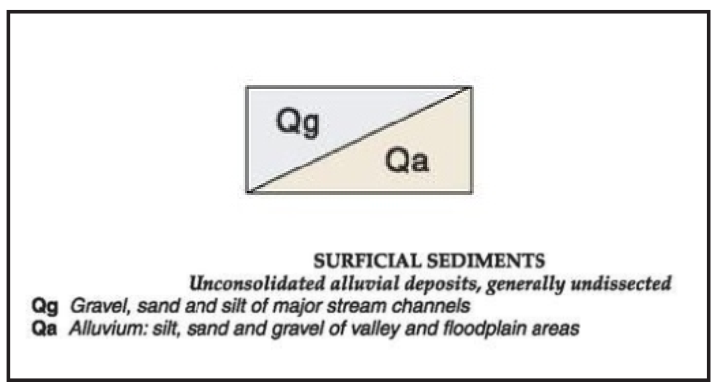
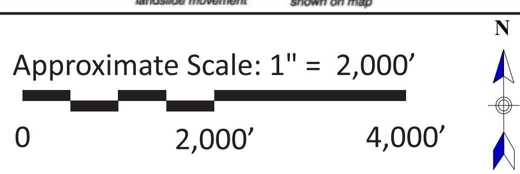
| VICINITY MAP | |
|---|---|
| Rio Mesa H.S. Modular Classrooms<br>Oxnard, California | |
| Earth Systems | |
| April 2019 | 303085-001 |




*Taken from Dibblee, Jr., Geologic Map of The Saticoy Quadrangle, Ventura County, California, 1992 DF-42.




## REGIONAL GEOLOGIC MAP

Rio Mesa H.S. Modular Classrooms
Oxnard, California

**Earth Systems**

| April 2019 | 303085-001 |
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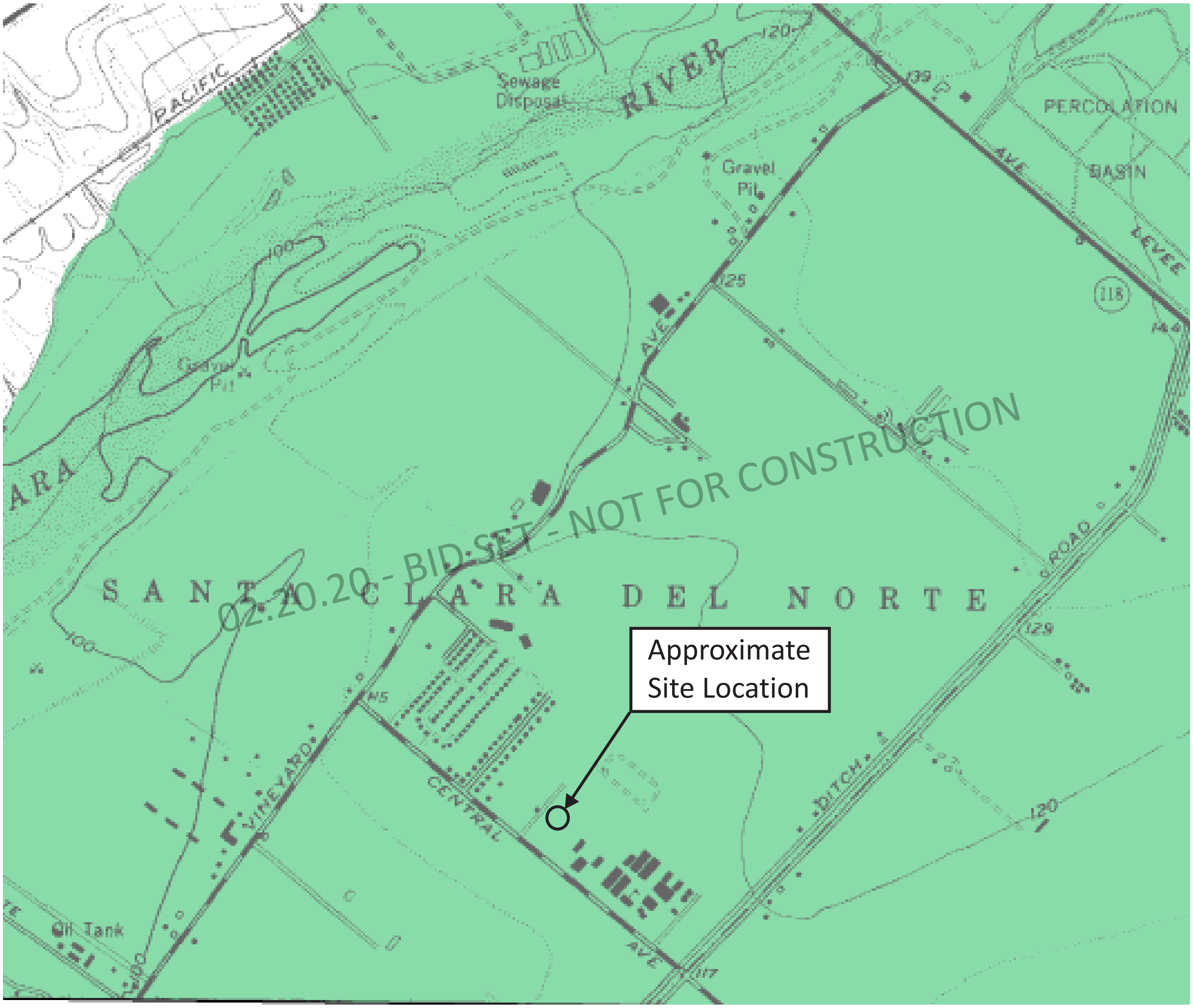



MAP EXPLANATION

Zones of Required Investigation:

Liquefaction

Areas where historical occurrence of liquefaction, or local geological, geotechnical and ground-water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

Earthquake-Induced Landslides

Areas where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

NOTE: Seismic Hazard Zones identified on this map may include developed land where delineated hazards have already been mitigated to city or county standards. Check with your local building/planning department for information regarding the location of such mitigated areas.

Approximate Scale: 1" = 2,000'

0 2,000' 4,000'

STATE OF CALIFORNIA

**SEISMIC HAZARD ZONES**

Delineated in compliance with
Chapter 7.8, Division 2 of the California Public Resources Code
(Seismic Hazards Mapping Act)

**SATICOY QUADRANGLE**

OFFICIAL MAP

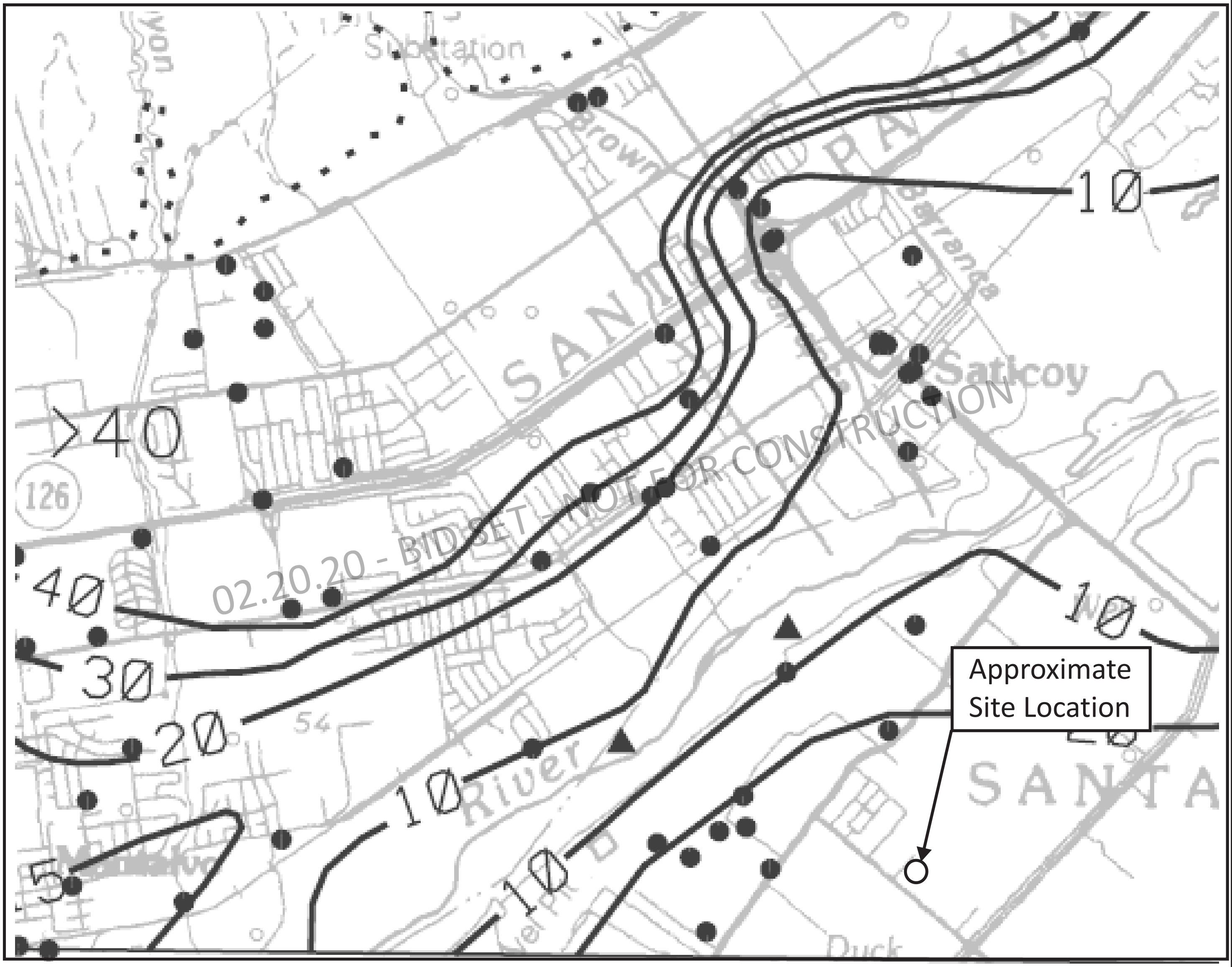
Released: February 14, 2003

**SEISMIC HAZARD ZONES MAP**

Rio Mesa H.S. Modular Classrooms
Oxnard, California

**Earth Systems**

| | |
|---|---|
| April 2019 | 303085-001 |






*Taken from CGS, Seismic Hazard Zone Report For The Saticoy 7.5-Minute Quadrangle, Ventura County, California, 2003.

Alluviated Valley Boundary

Borehole Site

Approximate location of sand boils and lurch cracks observed following the Point Mugu Earthquake of February 21, 1973.

20 Historically shallowest ground–water depth contours (in feet)

>40 Historically shallowest ground–water depth greater than 40 feet over a broad area

Approximate Scale: 1" = 2,000’

0 2,000’ 4,000’

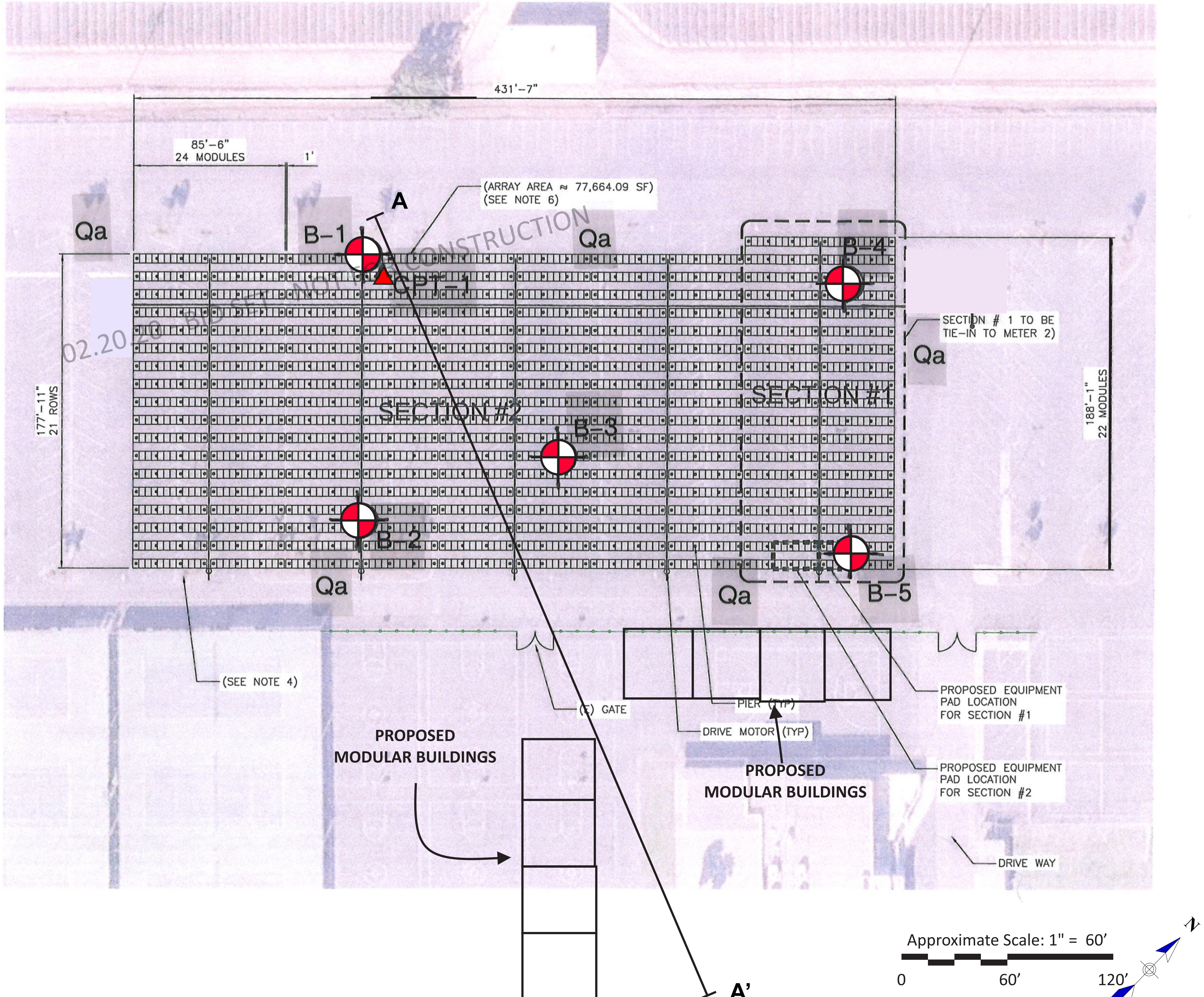
N

## HISTORICAL HIGH GROUNDWATER MAP

Rio Mesa H.S. Modular Classrooms
Oxnard, California

**Earth Systems**

| April 2019 | 303085-001 |
|---|---|

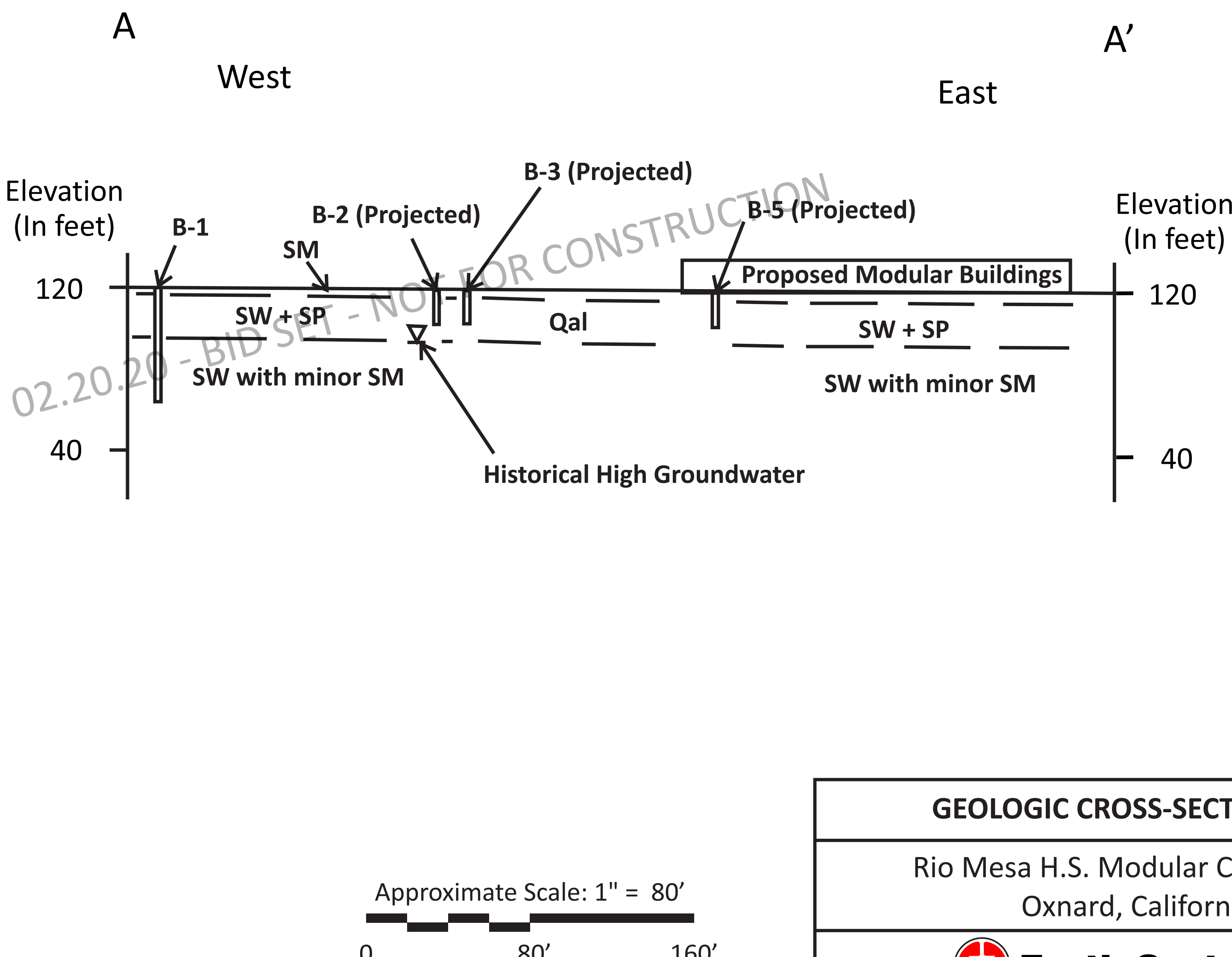



**B-1** Approximate Location of Boring

**CPT-1** Cone Penetration Test Location

**A A'** Location of Cross-Section

| GEOLOGIC MAP | |
|---|---|
| Rio Mesa H.S. Modular Classrooms<br>Oxnard, California | |
| Earth Systems | |
| April 2019 | 303085-001 |






| GEOLOGIC CROSS-SECTION A-A’ | |
|---|---|
| Rio Mesa H.S. Modular Classrooms<br>Oxnard, California | |
| Earth Systems | |
| April 2019 | 303085-001 |

Earth Systems Southern California
1731-A Walter Street, Ventura, California 93003
PHONE: (805) 642-6727 FAX: (805) 642-1325

| | |
|---|---|
| **BORING NO: 1** | DRILLING DATE: October 20, 2010 |
| PROJECT NAME: Rio Mesa H.S. Solar Array | DRILL RIG: Mobile B-61 |
| PROJECT NUMBER: VT-24499-01 | DRILLING METHOD: 6" Hollow Stem |
| BORING LOCATION: Per Plan | LOGGED BY: B. Shofner |

| Vertical Depth | Sample Type: Bulk | Sample Type: SPT | Sample Type: Mod. Calif. | PENETRATION RESISTANCE (BLOWS/6") | SYMBOL | USCS CLASS | UNIT DRY WT. (pcf) | MOISTURE CONTENT (%) | DESCRIPTION OF UNITS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | **PAVEMENT:** 3" asphalt over 3" aggregate base |
| | | | ■ | 7/20/21 | | SM | 109.9 | 5.5 | **ARTIFICIAL FILL:** Silty fine to medium sand with gravels, moist, dense, dark brown |
| | | | ■ | 20/25/43 | | SM | 121.8 | 4.4 | **ARTIFICIAL FILL:** Same as above, but less gravel, dense, brown |
| 5 | | | ■ | 7/12/8 | | SW | 102.0 | 3.4 | **ALLUVIUM:** Slightly silty fine to coarse sand with some gravels, moist, medium dense, pale brown |
| 10 | | | ■ | 4/8/13 | | SP | 101.3 | 5.0 | **ALLUVIUM:** Slightly silty fine to medium sand with trace gravels, moist, medium dense, light brownish gray |
| 15 | | | | | | | | | |
| | | | ■ | 45/22/25 | | SW | 107.5 | 2.6 | **ALLUVIUM:** Fine to coarse sands with gravels, moist, medium dense, light brownish gray |
| 20 | | | | | | | | | |
| 25 | | | ■ | 60/40/50 | | SM | 110.0 | 3.8 | **ALLUVIUM:** Silty fine to medium sand with trace gravels, moist, very dense, light orangish brown |
| 30 | | ■ | | 12/30/35 | | SW | | | **ALLUVIUM:** Fine to coarse sand with gravels, moist, very dense, brown |
| 35 | | ■ | | 12/25/21 | | SW | | | **ALLUVIUM:** Same as above, but slightly silty |

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

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| BORING NO: 1 (Continued) | DRILLING DATE: October 20, 2010 |
|---|---|
| PROJECT NAME: Rio Mesa H.S. Solar Array | DRILL RIG: Mobile B-61 |
| PROJECT NUMBER: VT-24499-01 | DRILLING METHOD: 6" Hollow Stem |
| BORING LOCATION: Per Plan | LOGGED BY: B. Shofner |

| Vertical Depth | Sample Type: Bulk | Sample Type: SPT | Sample Type: Mod. Calif. | PENETRATION RESISTANCE (BLOWS/6") | SYMBOL | USCS CLASS | UNIT DRY WT. (pcf) | MOISTURE CONTENT (%) | DESCRIPTION OF UNITS |
|---|---|---|---|---|---|---|---|---|---|
| 40 | | ■ | | 5/12/21 | | SW | | | **ALLUVIUM:** Slightly silty fine to coarse sand with gravels, moist, dense, light orangish brown |
| 45 | | ■ | | 17/34/25 | | SW | | | **ALLUVIUM:** Slightly silty fine to coarse sand with gravels, moist, very dense, light orangish brown |
| | | | | | | SM | | | **ALLUVIUM:** Silty fine to medium sand, moist, very dense, light orangish brown |
| 50 | | ■ | | 21/33/41 | | SW | | | **ALLUVIUM:** Slightly silty fine to coarse sand with gravels, moist, very dense, light orangish brown |
| 55 | | | | | | | | | **TOTAL DEPTH: 51.5 Feet**<br>**Groundwater Was Not Encountered** |
| 60 | | | | | | | | | |
| 65 | | | | | | | | | |
| 70 | | | | | | | | | |
| 75 | | | | | | | | | |



Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

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| | |
|---|---|
| **BORING NO: 2** | DRILLING DATE: October 20, 2010 |
| PROJECT NAME: Rio Mesa H.S. Solar Array | DRILL RIG: Mobile B-61 |
| PROJECT NUMBER: VT-24499-01 | DRILLING METHOD: 6" Hollow Stem |
| BORING LOCATION: Per Plan | LOGGED BY: B. Shofner |

| Vertical Depth | Sample Type: Bulk | Sample Type: SPT | Sample Type: Mod. Calif. | PENETRATION RESISTANCE (BLOWS/6" | SYMBOL | USCS CLASS | UNIT DRY WT. (pcf) | MOISTURE CONTENT (%) | DESCRIPTION OF UNITS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | **PAVEMENT:** 3" asphalt over 3" aggregate base |
| | | | ■ | 11/16/18 | | SM | 121.2 | 9.4 | **ALLUVIUM:** Silty F-C sand w/ tr. gravels,moist,med. dense,brown |
| | | | | | | SM | | | **ALLUVIUM:** Silty F-M sand, v. moist, med. dense, brown |
| | | | ■ | 10/12/18 | | SM | 108.4 | 5.4 | **ALLUVIUM:** F-C sand w /gravels, moist, med. dense, brown |
| 5 | | | ■ | 11/15/21 | | SW | 109.8 | 2.8 | **ALLUVIUM:** Slightly silty fine to coarse sand with trace gravels, moist, medium dense, light orangish brown |
| 10 | | | ■ | 4/7/13 | | SP | 96.1 | 3.7 | **ALLUVIUM:** Slightly silty fine to medium sand, moist, medium dense, light brownish gray |
| 15 | | ■ | | 17/24/34 | | SW | | | **ALLUVIUM:** Fine to coarse sand with gravels, moist to slightly moist, very dense, gray to light brownish gray |
| 20 | | | | | | | | | **TOTAL DEPTH: 16.5 Feet**<br>**Groundwater Was Not Encountered** |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |



Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

Earth Systems Southern California

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| | |
|---|---|
| **BORING NO: 3** | DRILLING DATE: October 20, 2010 |
| PROJECT NAME: Rio Mesa H.S. Solar Array | DRILL RIG: Mobile B-61 |
| PROJECT NUMBER: VT-24499-01 | DRILLING METHOD: 6" Hollow Stem |
| BORING LOCATION: Per Plan | LOGGED BY: B. Shofner |

| Vertical Depth | Sample Type: Bulk | Sample Type: SPT | Sample Type: Mod. Calif. | PENETRATION RESISTANCE (BLOWS/6") | SYMBOL | USCS CLASS | UNIT DRY WT. (pcf) | MOISTURE CONTENT (%) | DESCRIPTION OF UNITS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | **PAVEMENT:** 3" asphalt over 3" aggregate base |
| | | | | 11/12/21 | | SM | 122.3 | 4.6 | **ALLUVIUM:** Silty fine to medium sand, moist, medium dense, brown |
| | | | | 10/17/21 | | SW | 101.0 | 5.7 | **ALLUVIUM:** Fine to coarse sand with gravels, moist, dense, light orangish brown |
| 5 | | | | 14/22/19 | | | | | |
| | | | | 7/10/14 | | SW | 110.3 | 2.7 | **ALLUVIUM:** Fine to coarse sand with gravels, moist, dense, light orangish brown |
| 10 | | | | 10/13/18 | | SM | 102.3 | 4.1 | **ALLUVIUM:** Slightly silty fine to coarse sand with trace gravels, moist, medium dense, grayish brown |
| 15 | | | | 18/30/38 | | SW | | 2.2 | **ALLUVIUM:** Fine to coarse sand with gravels, moist, dense, grayish brown |
| 20 | | | | | | | | | **TOTAL DEPTH: 16.5 Feet** |
| | | | | | | | | | **Groundwater Was Not Encountered** |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |



Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

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| | |
|---|---|
| **BORING NO: 4** | DRILLING DATE: October 20, 2010 |
| PROJECT NAME: Rio Mesa H.S. Solar Array | DRILL RIG: Mobile B-61 |
| PROJECT NUMBER: VT-24499-01 | DRILLING METHOD: 6" Hollow Stem |
| BORING LOCATION: Per Plan | LOGGED BY: B. Shofner |

| Vertical Depth | Sample Type: Bulk | Sample Type: SPT | Sample Type: Mod. Calif. | PENETRATION RESISTANCE (BLOWS/6") | SYMBOL | USCS CLASS | UNIT DRY WT. (pcf) | MOISTURE CONTENT (%) | DESCRIPTION OF UNITS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | **PAVEMENT:** 3" asphalt over 3" aggregate base |
| | | | | 21/29/32 | | SM | 114.7 | 4.4 | **ALLUVIUM:** Slightly silty fine to coarse sand with trace gravels, moist, dense, brown |
| | | | | 17/19/24 | | SM | 108.2 | 9.0 | **ALLUVIUM:** Same as above, except medium dense |
| 5 | | | | 10/22/20 | | SW | 115.0 | 3.9 | **ALLUVIUM:** Slightly silty fine to coarse sand with gravels, moist, medium dense, light orangish brown |
| 10 | | | | 15/16/19 | | SW | 113.7 | 3.8 | **ALLUVIUM:** Slightly silty fine to coarse sand with gravels, moist, medium dense, light orangish brown |
| 15 | | | | 13/21/22 | | SM | | | **ALLUVIUM:** Slightly silty fine to coarse sand with gravels, moist, medium dense, light orangish brown |
| 20 | | | | | | | | | **TOTAL DEPTH: 16.5 Feet** |
| | | | | | | | | | **Groundwater Was Not Encountered** |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |



Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

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**BORING NO: 5**
PROJECT NAME: Rio Mesa H.S. Solar Array
PROJECT NUMBER: VT-24499-01
BORING LOCATION: Per Plan

DRILLING DATE: October 20, 2010
DRILL RIG: Mobile B-61
DRILLING METHOD: 6" Hollow Stem
LOGGED BY: B. Shofner

| Vertical Depth | Sample Type: Bulk | Sample Type: SPT | Sample Type: Mod. Calif. | PENETRATION RESISTANCE (BLOWS/6") | SYMBOL | USCS CLASS | UNIT DRY WT. (pcf) | MOISTURE CONTENT (%) | DESCRIPTION OF UNITS |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | | | | | | | | **PAVEMENT:** 3" asphalt over 3" aggregate base |
| | | | X | 13/18/24 | | SM | 111.6 | 6.7 | **ALLUVIUM:** Silty fine to medium sand, moist, med. dense, brown w/ basal clean fine to medium sand, moist, med. dense, brown |
| | | | X | 13/21/19 | | SM | 110.5 | 6.6 | **ALLUVIUM:** Very silty fine sand, moist, medium dense, brown |
| 5 | | | X | 9/11/13 | | SM | 108.1 | 7.2 | **ALLUVIUM:** Very silty fine sand, moist, medium dense, brown |
| | | | | | | SW | | | **ALLUVIUM:** Slightly silty fine to coarse sand with trace gravels, moist, medium dense, brown |
| 10 | | | X | 6/11/20 | | SW | 100.8 | 5.0 | **ALLUVIUM:** Fine to coarse sand with gravels, moist, medium dense, light orangish brown |
| 15 | | | X | 23/30/45 | | SW | | 3.1 | **ALLUVIUM:** Fine to coarse sand with gravels, moist, dense, light orangish brown |
| 20 | | | | | | | | | **TOTAL DEPTH: 16.5 Feet** |
| | | | | | | | | | **Groundwater Was Not Encountered** |
| 25 | | | | | | | | | |
| 30 | | | | | | | | | |
| 35 | | | | | | | | | |

Note: The stratification lines shown represent the approximate boundaries between soil and/or rock types and the transitions may be gradual.

# BORING LOG SYMBOLS

Modified California Split Barrel Sampler

Modified California Split Barrel Sampler - No Recovery

Standard Penetration Test (SPT) Sampler

Standard Penetration Test (SPT) Sampler - No Recovery



Perched Water Level

Water Level First Encountered

Water Level After Drilling

Pocket Penetrometer (tsf)

Vane Shear (ksf)

1. The location of borings were approximately determined by pacing and/or siting from visible features. Elevations of borings are approximately determined by interpolating between plan contours. The location and elevation of the borings should be considered.

2. The stratification lines represent the approximate boundary between soil types and the transition may be gradual.

3. Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. This data has been reviewed and interpretations made in the text of this report. However, it must be noted that fluctuations in the level of the groundwater may occur due to variations in rainfall, tides, temperature, and other factors at the time measurements were made.

BORING LOG SYMBOLS

Earth Systems

# UNIFIED SOIL CLASSIFICATION SYSTEM

| *MAJOR DIVISIONS* | | | *GRAPH SYMBOL* | *LETTER SYMBOL* | *TYPICAL DESCRIPTIONS* |
|---|---|---|---|---|---|
| COARSE GRAINED SOILS | GRAVEL AND GRAVELLY SOILS | CLEAN GRAVELS (LITTLE OR NO FINES) | | GW | WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES |
| | | | | GP | POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES |
| | MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE | GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES) | | GM | SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES |
| | | | | GC | CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES |
| | SAND AND SANDY SOILS | CLEAN SAND (LITTLE OR NO FINES) | | SW | WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES |
| | | | | SP | POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES |
| MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE | MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE | SANDS WITH FINES (APPRECIABLE AMOUNTOF FINES) | | SM | SILTY SANDS, SAND-SILT MIXTURES |
| | | | | SC | CLAYEY SANDS, SAND-CLAY MIXTURES |
| FINE GRAINED SOILS | SILTS AND CLAYS | LIQUID LIMIT LESS THAN 50 | | ML | INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS 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 OF LOW PLASTICITY |
| | SILTS AND CLAYS | LIQUID LIMIT GREATER THAN 50 | | MH | INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS |
| | | | | CH | INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS |
| MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE | | | | OH | ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS |
| HIGHLY ORGANIC SOILS | | | | PT | PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENT |



NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

UNIFIED SOIL CLASSIFICATION SYSTEM

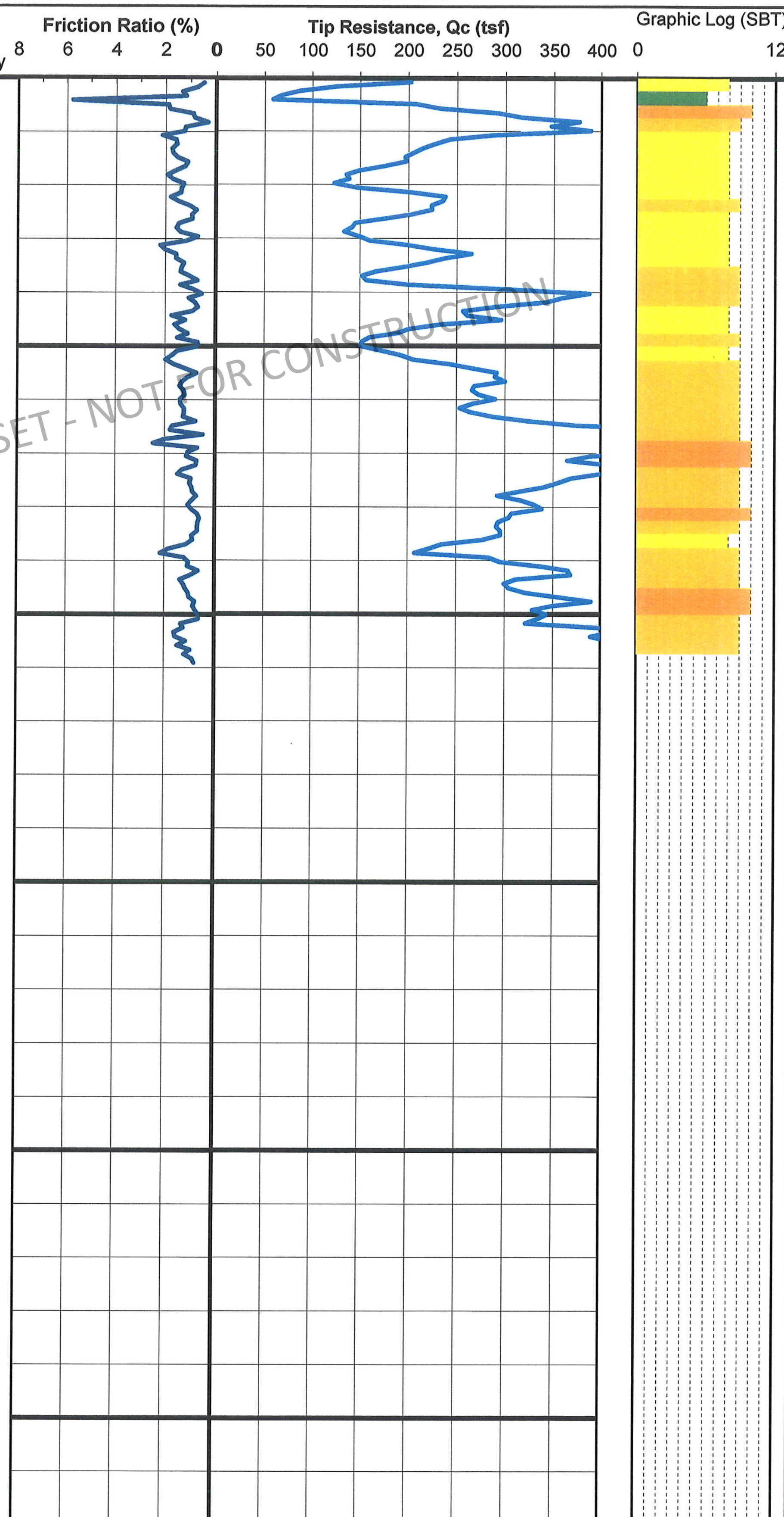
Earth Systems

**Earth Systems**
**Southern California**

| | | | |
|---|---|---|---|
| **CPT No:** | **CPT-1** | **CPT Vendor:** | **Middle Earth Geo Testing, Inc.** |
| **Project Name:** | Rio Mesa HS Solar Array | | Truck Mounted Electric |
| **Project No.:** | VT-24499-01 | | Cone with 30-ton reaction |
| **Location:** | See Site Exploration Plan | **Date:** | 10/18/2010 |

DEPTH (FEET)

| Interpreted Soil Stratigraphy Robertson & Campanella ('89) | Density/Consistency |
|---|---|
| Silty Sand to Sandy Silt | dense |
| Sand | very dense |
| Sand to Silty Sand | very dense |
| Sand to Silty Sand | dense |
| Sand | very dense |
| Sand to Silty Sand | dense |
| Sand to Silty Sand | very dense |
| Sand | very dense |
| Sand | very dense |
| Sand | dense |
| Sand to Silty Sand | very dense |
| Sand | very dense |
| Sand | very dense |
| Sand | very dense |
| Sand | very dense |
| Sand | very dense |
| Sand | very dense |
| Sand | dense |
| Sand | very dense |
| Gravelly Sand to Sand | very dense |
| Sand | very dense |




Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50

End of Sounding @ 22.0 feet

Earth Systems
Southern California

**CONE PENETROMETER INTERPRETATION** (based on Robertson & Campanella, 1989)

**Project: Rio Mesa HS Solar Array** Project No: VT-24499-01 Date: 10/18/10

**CPT SOUNDING: CPT-1** Plot: 1 Density: 1 SPT N Program developed 2003 by Shelton L. Stringer, GE, Earth Systems Southwest

Est. GWT (feet): **55.0** Dr correlation: 0 Baldi Qc/N: 0 Jefferies & Davies Phi Correlation: 4 SPT N

| Base Depth meters | Base Depth feet | Avg Tip Qc, tsf | Avg Friction Ratio, % | Soil Classification | USCS | Density or Consistency | Est. Density (pcf) | Qc to N | SPT N(60) | Total po tsf | p'o tsf | F | n | Cq | Norm. Qc1n | 2.6 Ic | Clean Sand Qc1n | $N_{1(60)}$ | Clean Sand $N_{1(60)}$ | Est. % Fines | Rel. Dens. Dr (%) | Phi (deg.) | Nk: 17 Su (tsf) | OCR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.15 | 0.5 | 93.23 | 1.09 | Sand to Silty Sand | SP/SM | medium dense | 100 | 5.5 | 17 | 0.013 | 0.013 | 1.09 | 0.55 | 1.70 | 149.8 | 1.80 | 166.3 | 29 | 33 | 20 | 94 | 36 | | |
| 0.30 | 1.0 | 166.09 | 3.17 | Sandy Silt to Clayey Silt | ML | very dense | 110 | 5.1 | 33 | 0.039 | 0.039 | 3.17 | 0.61 | 1.70 | 266.9 | 2.01 | 351.6 | 56 | 70 | 30 | 100 | 42 | | |
| 0.46 | 1.5 | 328.20 | 0.69 | Gravelly Sand to Sand | SW | very dense | 110 | 6.5 | 51 | 0.066 | 0.066 | 0.69 | 0.50 | 1.70 | 527.3 | 1.30 | 527.3 | 86 | 105 | 0 | 100 | 46 | | |
| 0.61 | 2.0 | 340.83 | 1.55 | Sand | SP | very dense | 100 | 5.9 | 58 | 0.093 | 0.093 | 1.55 | 0.50 | 1.70 | 547.6 | 1.59 | 547.6 | 98 | 110 | 10 | 100 | 47 | | |
| 0.76 | 2.5 | 228.87 | 1.64 | Sand to Silty Sand | SP/SM | very dense | 100 | 5.7 | 40 | 0.118 | 0.118 | 1.64 | 0.52 | 1.70 | 367.7 | 1.70 | 380.7 | 69 | 76 | 15 | 100 | 44 | | |
| 0.91 | 3.0 | 199.91 | 1.47 | Sand to Silty Sand | SP/SM | very dense | 100 | 5.7 | 35 | 0.143 | 0.143 | 1.47 | 0.51 | 1.70 | 321.2 | 1.69 | 330.8 | 60 | 66 | 15 | 100 | 42 | | |
| 1.07 | 3.5 | 154.00 | 1.59 | Sand to Silty Sand | SP/SM | dense | 100 | 5.5 | 28 | 0.168 | 0.168 | 1.59 | 0.54 | 1.70 | 247.4 | 1.78 | 271.0 | 48 | 54 | 20 | 100 | 40 | | |
| 1.22 | 4.0 | 136.26 | 1.46 | Sand to Silty Sand | SP/SM | dense | 100 | 5.5 | 25 | 0.193 | 0.193 | 1.46 | 0.54 | 1.70 | 218.9 | 1.79 | 240.1 | 42 | 48 | 20 | 100 | 39 | | |
| 1.37 | 4.5 | 225.04 | 1.56 | Sand to Silty Sand | SP/SM | very dense | 100 | 5.7 | 39 | 0.218 | 0.218 | 1.57 | 0.51 | 1.70 | 361.6 | 1.68 | 371.2 | 67 | 74 | 15 | 100 | 44 | | |
| 1.52 | 5.0 | 217.52 | 0.93 | Sand | SP | very dense | 100 | 6.0 | 36 | 0.243 | 0.243 | 0.93 | 0.50 | 1.70 | 349.5 | 1.51 | 349.5 | 61 | 70 | 10 | 100 | 43 | | |
| 1.68 | 5.5 | 149.25 | 1.35 | Sand to Silty Sand | SP/SM | dense | 100 | 5.6 | 27 | 0.268 | 0.268 | 1.35 | 0.53 | 1.70 | 239.8 | 1.74 | 254.7 | 45 | 51 | 15 | 100 | 40 | | |
| 1.83 | 6.0 | 168.66 | 1.36 | Sand to Silty Sand | SP/SM | very dense | 100 | 5.7 | 30 | 0.293 | 0.293 | 1.36 | 0.52 | 1.70 | 271.0 | 1.71 | 282.3 | 51 | 56 | 15 | 100 | 41 | | |
| 1.98 | 6.5 | 243.93 | 1.74 | Sand to Silty Sand | SP/SM | very dense | 100 | 5.7 | 43 | 0.318 | 0.318 | 1.74 | 0.52 | 1.70 | 391.9 | 1.70 | 407.6 | 73 | 82 | 15 | 100 | 44 | | |
| 2.13 | 7.0 | 194.45 | 1.35 | Sand to Silty Sand | SP/SM | very dense | 100 | 5.7 | 34 | 0.343 | 0.343 | 1.35 | 0.51 | 1.70 | 312.4 | 1.67 | 317.0 | 58 | 63 | 15 | 100 | 42 | | |
| 2.29 | 7.5 | 169.16 | 1.06 | Sand | SP | dense | 100 | 5.8 | 29 | 0.368 | 0.368 | 1.07 | 0.50 | 1.70 | 271.3 | 1.62 | 271.3 | 48 | 54 | 10 | 100 | 40 | | |
| 2.44 | 8.0 | 348.32 | 0.84 | Sand | SP | very dense | 100 | 6.3 | 55 | 0.393 | 0.393 | 0.84 | 0.50 | 1.64 | 540.5 | 1.36 | 540.5 | 88 | 108 | 5 | 100 | 46 | | |
| 2.59 | 8.5 | 297.11 | 0.82 | Sand | SP | very dense | 100 | 6.3 | 47 | 0.418 | 0.418 | 0.82 | 0.50 | 1.59 | 447.0 | 1.40 | 447.0 | 73 | 89 | 5 | 100 | 44 | | |
| 2.74 | 9.0 | 263.52 | 1.54 | Sand to Silty Sand | SP/SM | very dense | 100 | 5.7 | 46 | 0.443 | 0.443 | 1.54 | 0.51 | 1.56 | 387.4 | 1.66 | 391.7 | 69 | 78 | 15 | 100 | 44 | | |
| 2.90 | 9.5 | 183.70 | 1.37 | Sand to Silty Sand | SP/SM | dense | 100 | 5.6 | 33 | 0.468 | 0.468 | 1.37 | 0.52 | 1.53 | 266.1 | 1.71 | 278.5 | 48 | 56 | 15 | 100 | 40 | | |
| 3.05 | 10.0 | 158.20 | 0.98 | Sand | SP | dense | 100 | 5.8 | 27 | 0.493 | 0.493 | 0.98 | 0.51 | 1.47 | 220.0 | 1.65 | 221.5 | 39 | 44 | 15 | 100 | 38 | | |
| 3.20 | 10.5 | 212.64 | 1.80 | Sand to Silty Sand | SP/SM | very dense | 100 | 5.5 | 39 | 0.518 | 0.518 | 1.81 | 0.54 | 1.47 | 296.4 | 1.78 | 324.3 | 54 | 65 | 20 | 100 | 41 | | |
| 3.35 | 11.0 | 282.70 | 1.02 | Sand | SP | very dense | 100 | 6.0 | 47 | 0.543 | 0.543 | 1.02 | 0.50 | 1.40 | 373.2 | 1.52 | 373.2 | 64 | 75 | 10 | 100 | 43 | | |
| 3.51 | 11.5 | 278.03 | 1.34 | Sand | SP | very dense | 100 | 5.8 | 48 | 0.568 | 0.568 | 1.34 | 0.50 | 1.37 | 358.8 | 1.63 | 358.8 | 64 | 72 | 15 | 100 | 43 | | |
| 3.66 | 12.0 | 276.67 | 1.34 | Sand | SP | very dense | 100 | 5.8 | 48 | 0.593 | 0.593 | 1.34 | 0.50 | 1.34 | 349.4 | 1.63 | 349.4 | 62 | 70 | 15 | 100 | 43 | | |
| 3.81 | 12.5 | 268.03 | 1.26 | Sand | SP | very dense | 100 | 5.8 | 46 | 0.618 | 0.618 | 1.26 | 0.50 | 1.31 | 331.6 | 1.63 | 331.6 | 59 | 66 | 15 | 100 | 42 | | |
| 3.96 | 13.0 | 405.35 | 1.43 | Sand | SP | very dense | 100 | 5.9 | 69 | 0.643 | 0.643 | 1.43 | 0.50 | 1.28 | 491.6 | 1.58 | 491.6 | 86 | 98 | 10 | 100 | 46 | | |
| 4.11 | 13.5 | 648.75 | 1.64 | Sand | SP | very dense | 100 | 6.0 | 109 | 0.668 | 0.668 | 1.64 | 0.50 | 1.26 | 772.0 | 1.55 | 772.0 | 133 | 154 | 10 | 100 | 50 | | |
| 4.27 | 14.0 | 430.70 | 0.97 | Gravelly Sand to Sand | SW | very dense | 110 | 6.2 | 70 | 0.694 | 0.694 | 0.98 | 0.50 | 1.23 | 502.7 | 1.43 | 502.7 | 84 | 101 | 5 | 100 | 46 | | |
| 4.42 | 14.5 | 423.05 | 0.93 | Gravelly Sand to Sand | SW | very dense | 110 | 6.2 | 68 | 0.721 | 0.721 | 0.93 | 0.50 | 1.21 | 484.3 | 1.43 | 484.3 | 80 | 97 | 5 | 100 | 45 | | |
| 4.57 | 15.0 | 374.54 | 1.15 | Sand | SP | very dense | 100 | 6.0 | 63 | 0.748 | 0.748 | 1.16 | 0.50 | 1.19 | 421.2 | 1.54 | 421.2 | 72 | 84 | 10 | 100 | 44 | | |
| 4.72 | 15.5 | 316.39 | 0.85 | Sand | SP | very dense | 100 | 6.1 | 52 | 0.773 | 0.773 | 0.86 | 0.50 | 1.17 | 350.0 | 1.48 | 350.0 | 59 | 70 | 10 | 100 | 42 | | |
| 4.88 | 16.0 | 322.82 | 0.91 | Sand | SP | very dense | 100 | 6.1 | 53 | 0.798 | 0.798 | 0.91 | 0.50 | 1.15 | 351.4 | 1.50 | 351.4 | 60 | 70 | 10 | 100 | 42 | | |
| 5.03 | 16.5 | 296.03 | 0.66 | Gravelly Sand to Sand | SW | very dense | 110 | 6.2 | 48 | 0.824 | 0.824 | 0.66 | 0.50 | 1.13 | 317.1 | 1.42 | 317.1 | 53 | 63 | 5 | 100 | 41 | | |
| 5.18 | 17.0 | 289.33 | 0.84 | Sand | SP | very dense | 100 | 6.0 | 48 | 0.850 | 0.850 | 0.84 | 0.50 | 1.12 | 305.1 | 1.51 | 305.1 | 52 | 61 | 10 | 100 | 41 | | |
| 5.33 | 17.5 | 221.86 | 1.72 | Sand to Silty Sand | SP/SM | dense | 100 | 5.4 | 41 | 0.875 | 0.875 | 1.72 | 0.56 | 1.11 | 233.1 | 1.83 | 262.6 | 44 | 53 | 20 | 100 | 39 | | |
| 5.49 | 18.0 | 305.02 | 1.13 | Sand | SP | very dense | 100 | 5.9 | 52 | 0.900 | 0.900 | 1.13 | 0.50 | 1.08 | 312.6 | 1.60 | 312.6 | 55 | 63 | 10 | 100 | 41 | | |
| 5.64 | 18.5 | 348.39 | 1.00 | Sand | SP | very dense | 100 | 6.0 | 58 | 0.925 | 0.925 | 1.01 | 0.50 | 1.07 | 352.2 | 1.53 | 352.2 | 60 | 70 | 10 | 100 | 42 | | |
| 5.79 | 19.0 | 307.90 | 1.16 | Sand | SP | very dense | 100 | 5.8 | 53 | 0.950 | 0.950 | 1.16 | 0.50 | 1.06 | 307.1 | 1.62 | 307.1 | 54 | 61 | 10 | 100 | 41 | | |
| 5.94 | 19.5 | 364.68 | 0.89 | Gravelly Sand to Sand | SW | very dense | 110 | 6.1 | 60 | 0.976 | 0.976 | 0.90 | 0.50 | 1.04 | 358.8 | 1.49 | 358.8 | 61 | 72 | 10 | 100 | 42 | | |
| 6.10 | 20.0 | 335.43 | 0.68 | Gravelly Sand to Sand | SW | very dense | 110 | 6.2 | 54 | 1.004 | 1.004 | 0.68 | 0.50 | 1.03 | 325.5 | 1.42 | 325.5 | 54 | 65 | 5 | 100 | 41 | | |
| 6.25 | 20.5 | 377.11 | 1.40 | Sand | SP | very dense | 100 | 5.8 | 65 | 1.030 | 1.030 | 1.40 | 0.50 | 1.01 | 361.3 | 1.64 | 360.7 | 64 | 72 | 15 | 100 | 43 | | |
| 6.40 | 21.0 | 406.07 | 1.40 | Sand | SP | very dense | 100 | 5.8 | 70 | 1.055 | 1.055 | 1.41 | 0.50 | 1.00 | 384.4 | 1.63 | 384.4 | 68 | 77 | 15 | 100 | 44 | | |
| 6.55 | 21.5 | 458.12 | 1.02 | Sand | SP | very dense | 100 | 6.1 | 75 | 1.080 | 1.080 | 1.02 | 0.50 | 0.99 | 428.6 | 1.49 | 428.6 | 72 | 86 | 10 | 100 | 44 | | |

**APPENDIX B**

Tabulated Laboratory Test Results from 2010
Individual Laboratory Test Results from 2010
Table 1809.7

# TABULATED LABORATORY TEST RESULTS

## REMOLDED SAMPLES

| | |
|---|---|
| BORING AND DEPTH | B-3 @ 0-5' |
| USCS | SM |
| MAXIMUM DENSITY (pcf) | 122.0  125.0^ |
| OPTIMUM MOISTURE (%) | 8.5  8.0^ |
| COHESION (psf) | 210*  0** |
| ANGLE OF INTERNAL FRICTION | 36°*  33°** |
| EXPANSION INDEX | 0 |
| pH | 8.2 |
| SOLUBLE CHLORIDES (mg/Kg) | 1.7 |
| RESISTIVITY (OHMs-cm) | 13,500 |
| SOLUBLE SULFATES (mg/Kg) | 11 |
| GRAIN SIZE DISTRIBUTION (%) | |
| GRAVEL | 9.3 |
| SAND | 75.8 |
| SILT | 9.6 |
| CLAY | 5.3 |



## RELATIVELY UNDISTURBED SAMPLES

| | | |
|---|---|---|
| BORING AND DEPTH | B-1 @ 3' | B-3 @ 1' |
| USCS | SM | SM |
| IN-PLACE DENSITY (pcf) | 121.8 | 122.3 |
| IN-PLACE MOISTURE (%) | 4.4 | 4.6 |
| COHESION (psf) | 80*  40** | 170*  0** |
| ANGLE OF INTERNAL FRICTION | 42°*  37°** | 41°*  37°** |

^ = Value Corrected for Oversized Material

* = Peak Strength Parameters

** = Ultimate Strength Parameters

File Number: VT-24499-01 Lab Number: 095652

## MAXIMUM DENSITY / OPTIMUM MOISTURE

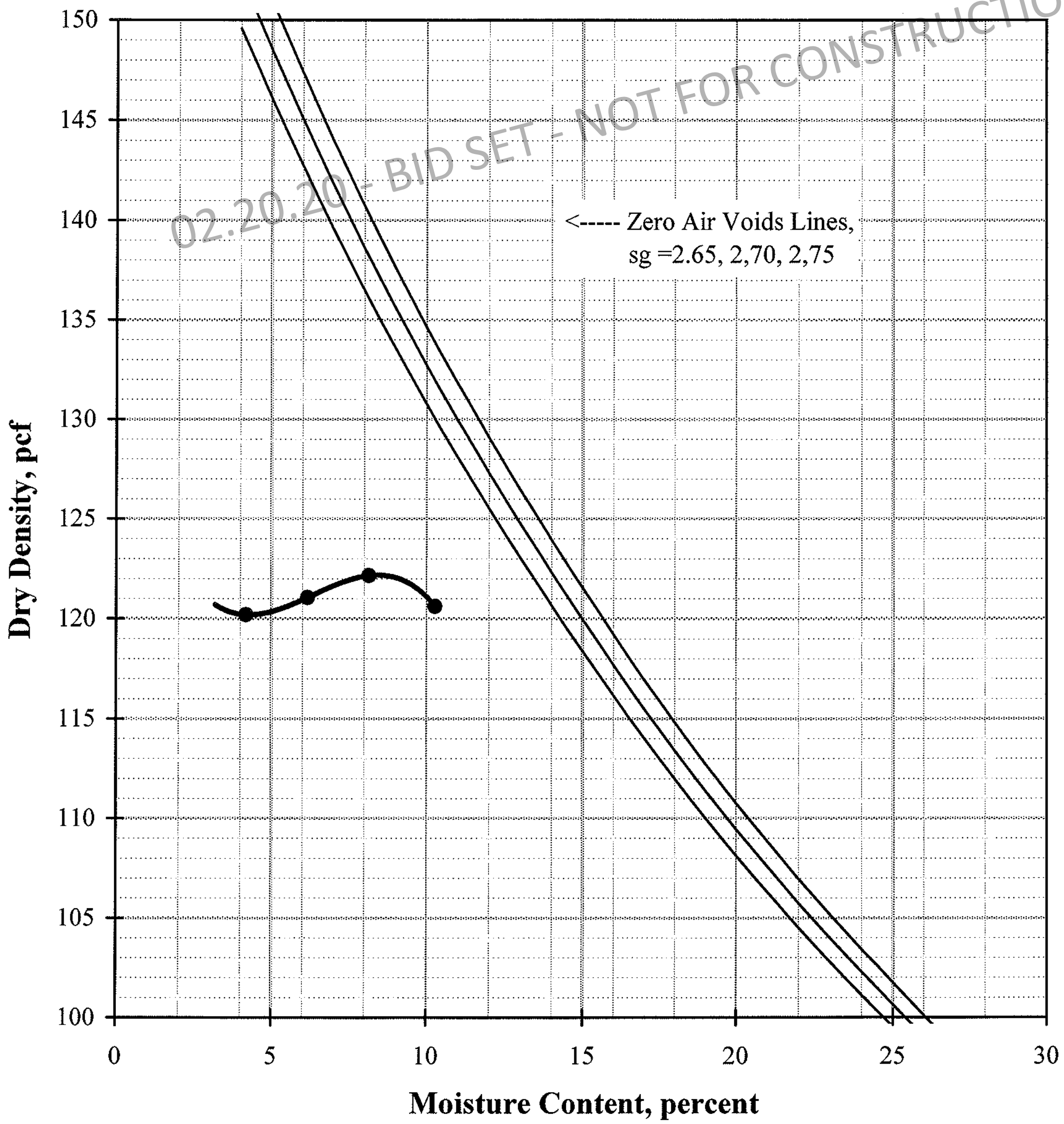
ASTM D 1557-07 (Modified)

Job Name: Rio Mesa High School Solar Array
Sample ID: B 3 @ 0-5'
Location: 0-5'
Description: Brown To Dark Brown Gravelly Silty Sand

Procedure Used: A
Prep. Method: Moist
Rammer Type: Automatic

**Maximum Density:** **122 pcf**
**Optimum Moisture:** **8.5%**

| Sieve Size | % Retained |
|---|---|
| 3/4" | 0.0 |
| 3/8" | 0.0 |
| #4 | 9.3 |



File Number: VT-24499-01 Lab Number: 095652

## MAXIMUM DENSITY / OPTIMUM MOISTURE

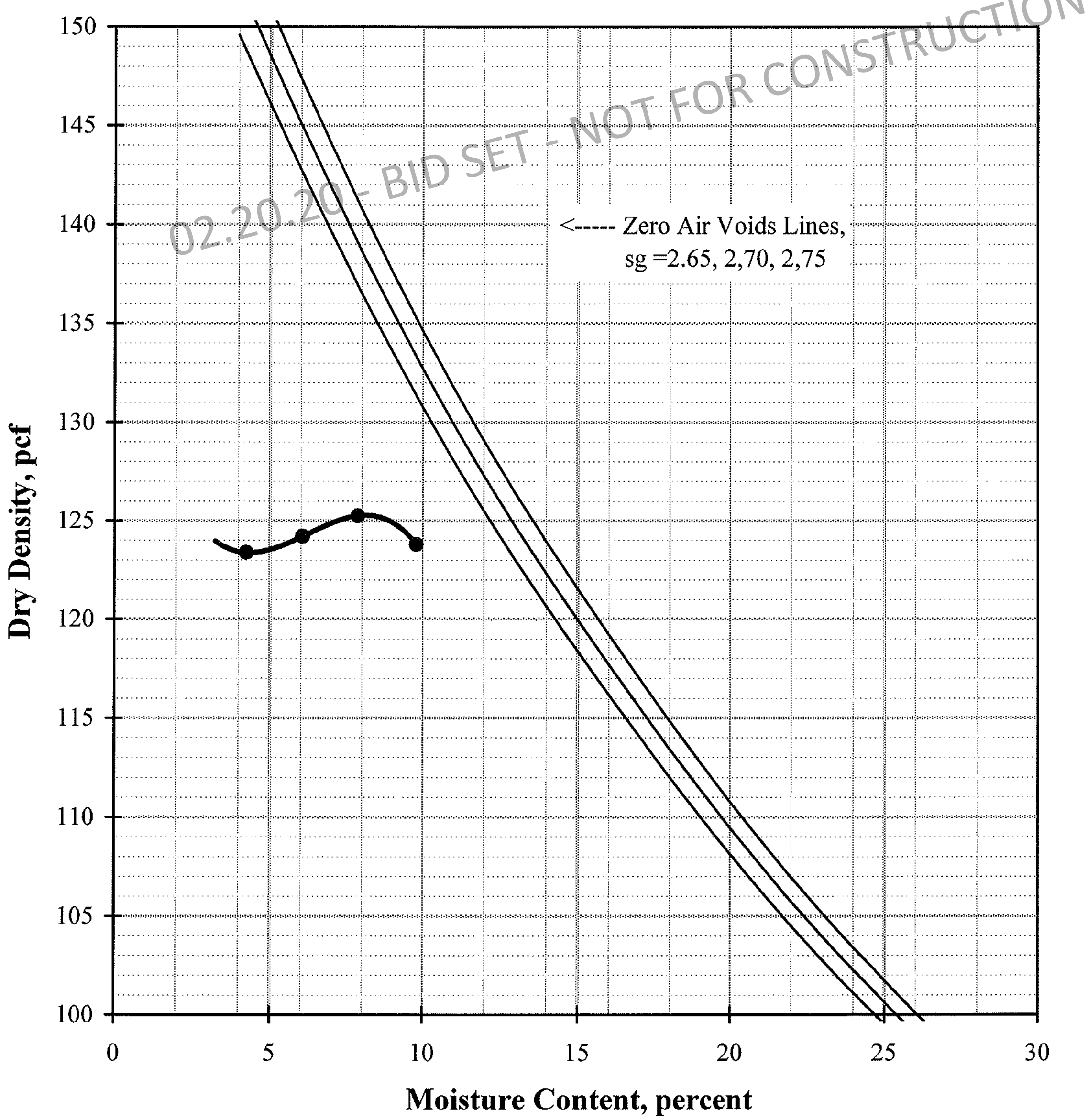
ASTM D 1557-07 (Modified)

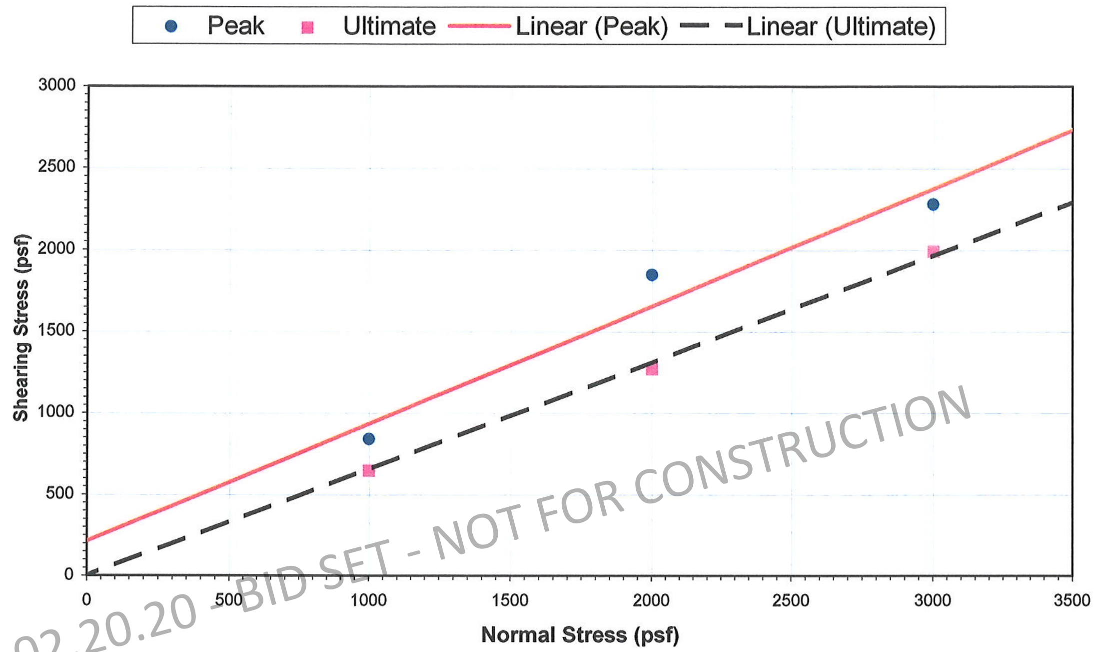
Job Name: Rio Mesa High School Solar Array
Sample ID: B 3 @ 0-5'
Location: 0-5'
Description: Brown To Dark Brown Gravelly Silty Sand

Procedure Used: A
Prep. Method: Moist
Rammer Type: Automatic

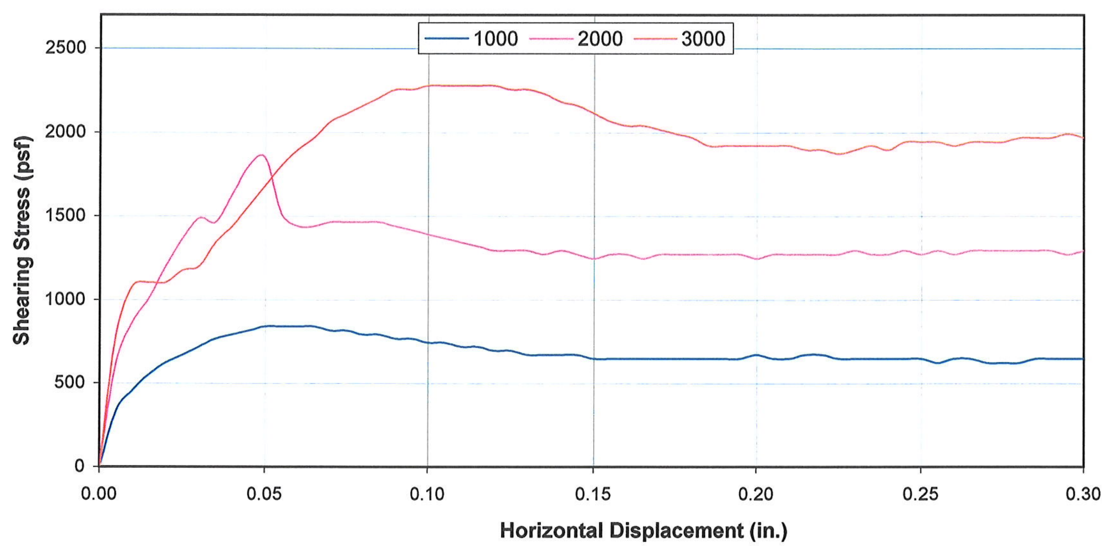
**Maximum Density:** **125 pcf**
**Optimum Moisture:** **8%**
Corrected for Oversize (ASTM D4718)

| Sieve Size | % Retained |
|---|---|
| 3/4" | 0.0 |
| 3/8" | 0.0 |
| #4 | 9.3 |








## DIRECT SHEAR DATA*

Sample Location: B 3 @ 0-5'
Sample Description: Silty Sand
Dry Density (pcf): 109.6
Intial % Moisture: 8.5
Average Degree of Saturation: 81.6
Shear Rate (in/min): 0.0112 in/min

| | | | |
|---|---|---|---|
| Normal stress (psf) | 1000 | 2000 | 3000 |
| Peak stress (psf) | 840 | 1848 | 2280 |
| Ultimate stress (psf) | 648 | 1272 | 1992 |

| | Peak | Ultimate |
|---|---|---|
| ϕ Angle of Friction (degrees): | 36 | 33 |
| c Cohesive Strength (psf): | 210 | 0 |

Test Type: Peak & Ultimate

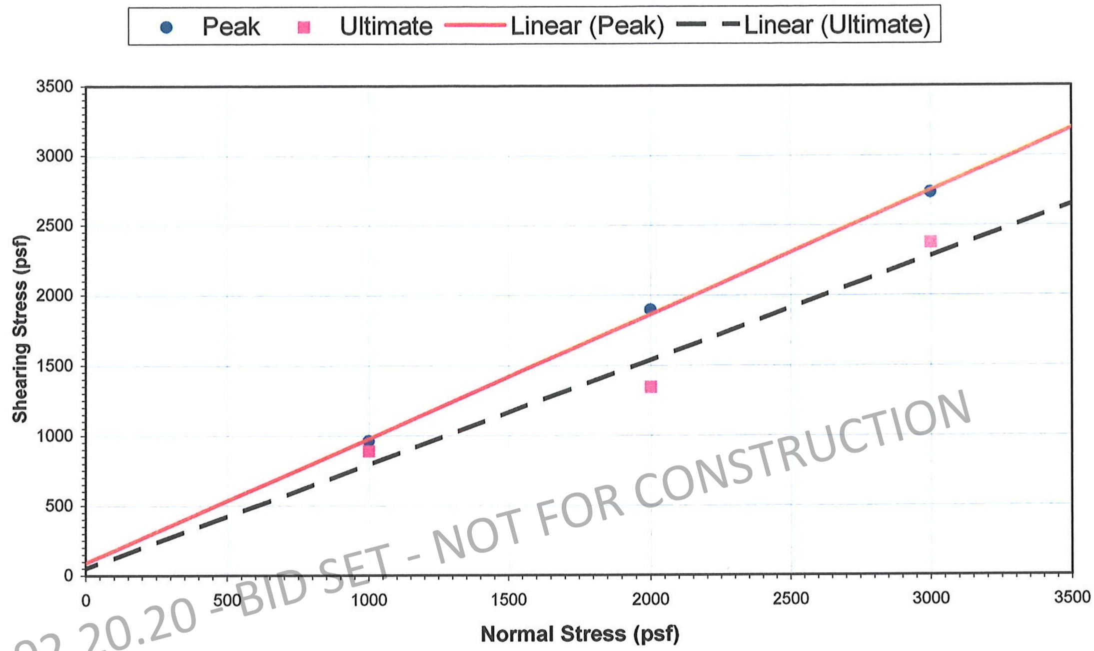
* Test Method: ASTM D-3080

**DIRECT SHEAR TEST**

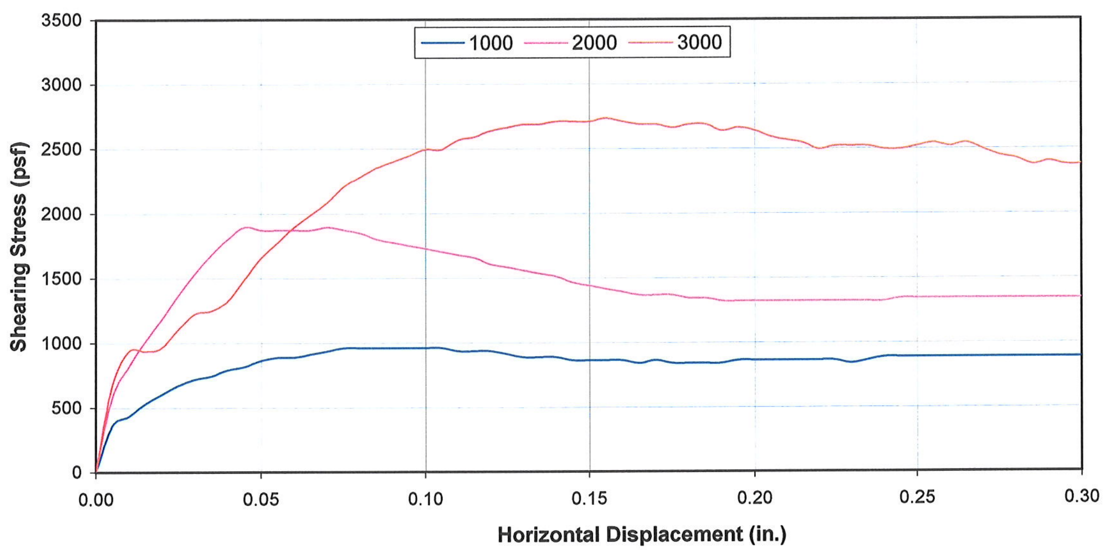
**Rio Mesa High School Solar Array**

Earth Systems
Southern California

11/16/2010 | VT-24499-01






## DIRECT SHEAR DATA*

Sample Location: B 1 @ 3'
Sample Description: Gravelly Sand
Dry Density (pcf): 121.8
Intial % Moisture: 4.4
Average Degree of Saturation: 79.1
Shear Rate (in/min): 0.008 in/min

| | | | |
|---|---|---|---|
| Normal stress (psf) | 1000 | 2000 | 3000 |
| Peak stress (psf) | 960 | 1896 | 2736 |
| Ultimate stress (psf) | 888 | 1344 | 2376 |

| | Peak | Ultimate |
|---|---|---|
| ϕ Angle of Friction (degrees): | 42 | 37 |
| c Cohesive Strength (psf): | 80 | 40 |

Test Type: Peak & Ultimate

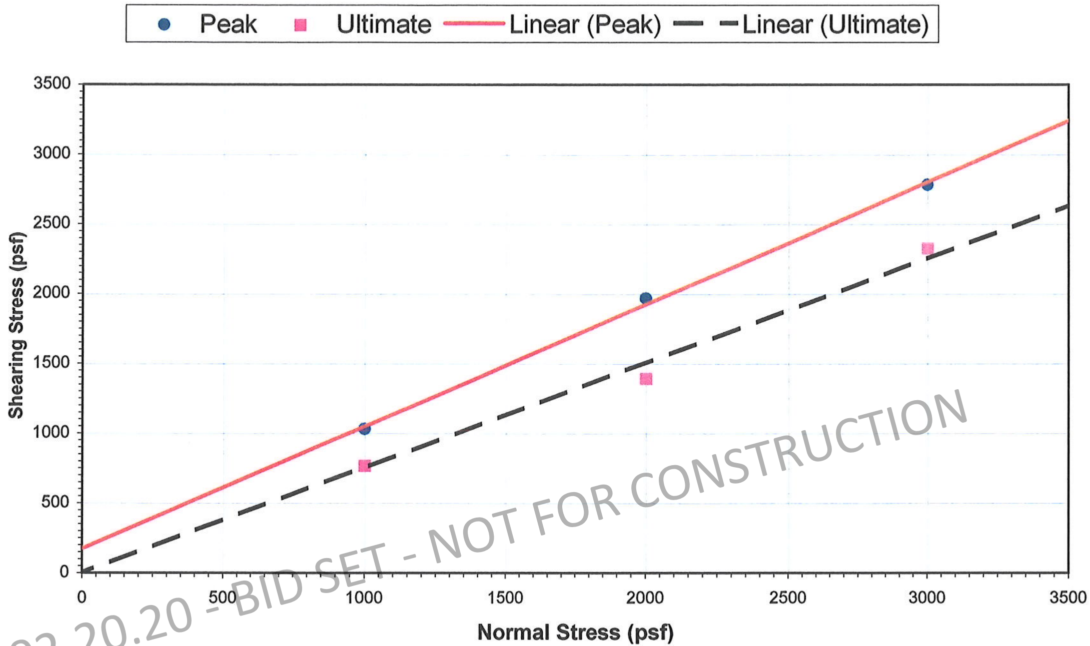
* Test Method: ASTM D-3080

## DIRECT SHEAR TEST

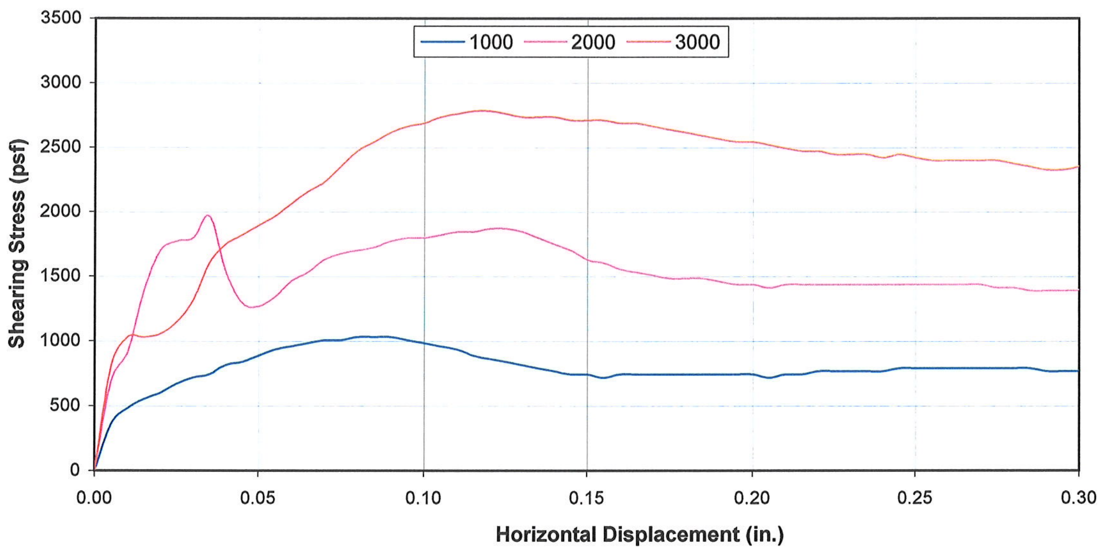
**Rio Mesa High School Solar Array**

Earth Systems
Southern California

11/16/2010 | VT-24499-01






## DIRECT SHEAR DATA*

Sample Location: B 3 @ 1'
Sample Description: Silty Sand
Dry Density (pcf): 122.3
Intial % Moisture: 4.6
Average Degree of Saturation: 76.7
Shear Rate (in/min): 0.0109 in/min

| | | | |
|---|---|---|---|
| Normal stress (psf) | 1000 | 2000 | 3000 |
| Peak stress (psf) | 1032 | 1968 | 2784 |
| Ultimate stress (psf) | 768 | 1392 | 2328 |

| | Peak | Ultimate |
|---|---|---|
| ϕ Angle of Friction (degrees): | 41 | 37 |
| c Cohesive Strength (psf): | 170 | 0 |

Test Type: Peak & Ultimate

* Test Method: ASTM D-3080

**DIRECT SHEAR TEST**

**Rio Mesa High School Solar Array**

Earth Systems
Southern California

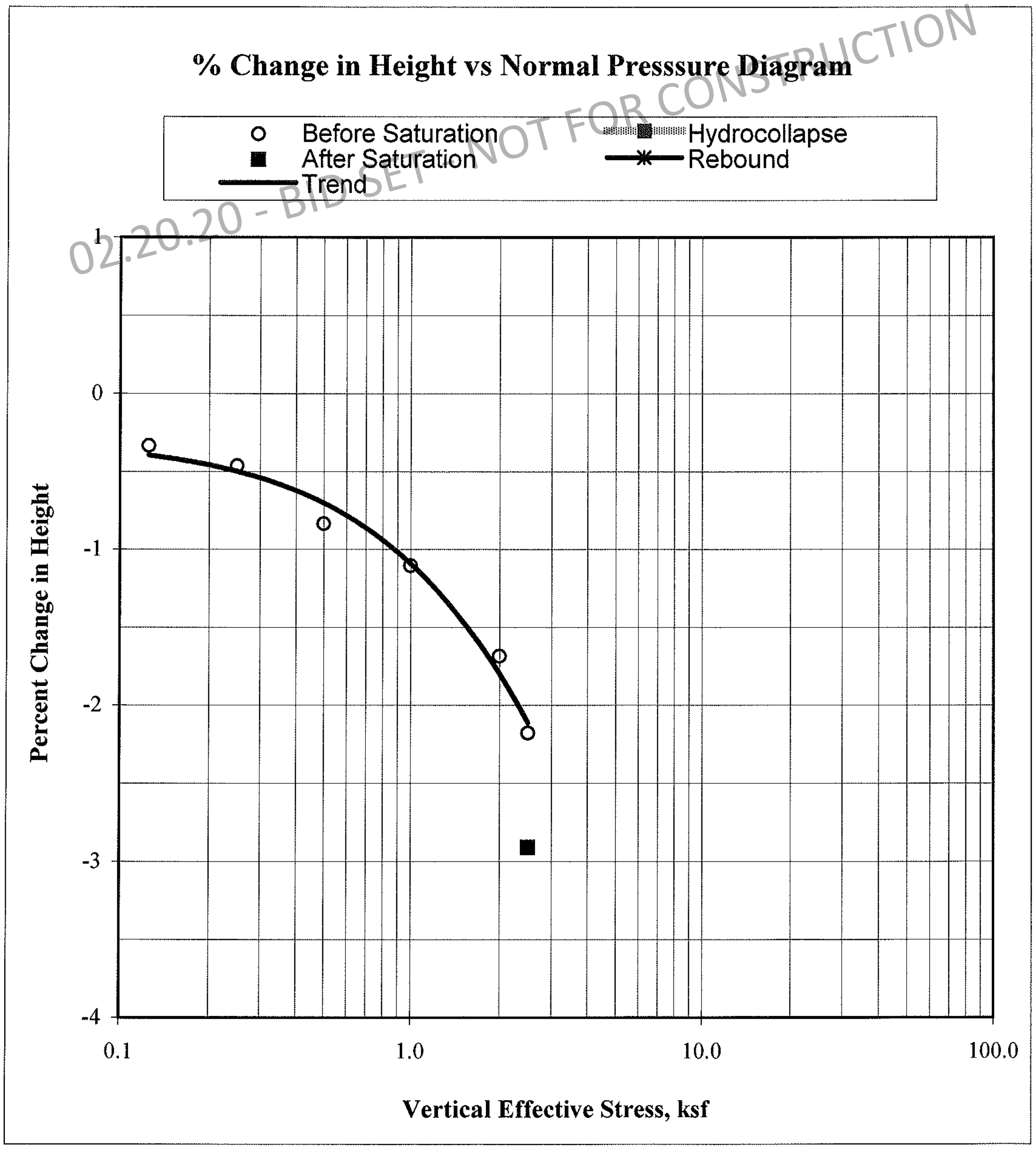
11/16/2010 | VT-24499-01

## CONSOLIDATION TEST

ASTM D 2435-90 & D5333

Rio Mesa High School Solar Array
B 1 @ 25'
GW
Ring Sample

Initial Dry Density: 110.0 pcf
Initial Moisture, %: 3.8%
Specific Gravity: 2.67 (assumed
Initial Void Ratio: 0.515

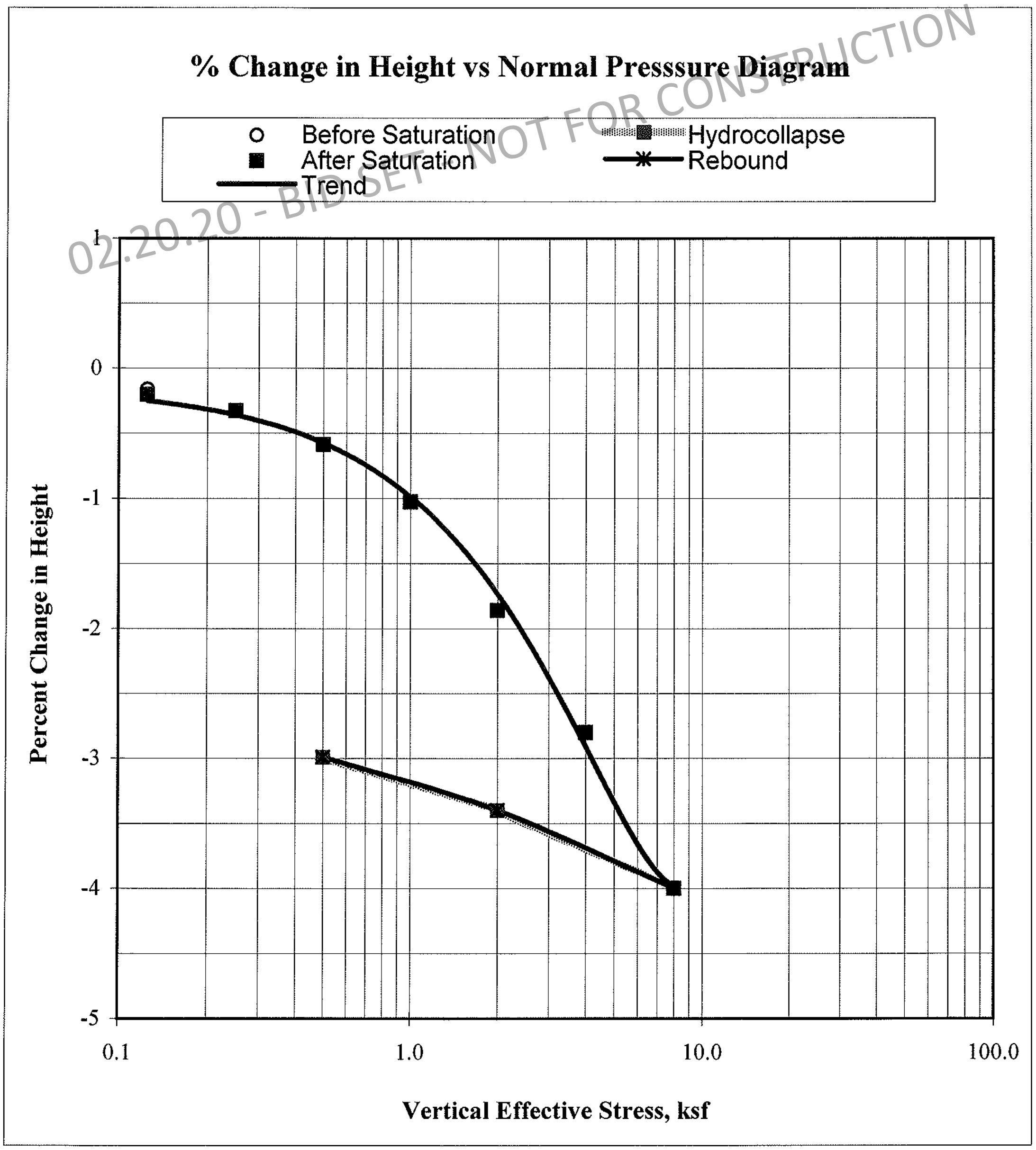


## CONSOLIDATION TEST

ASTM D 2435-90

Rio Mesa High School Solar Array
B 2 @ 3'
SM
Ring Sample

Initial Dry Density: 108.4 pcf
Initial Moisture, %: 5.4%
Specific Gravity: 2.67 (assumed
Initial Void Ratio: 0.537



## CONSOLIDATION TEST

ASTM D 2435-90

Rio Mesa High School Solar Array
B 4 @ 3'
SM
Ring Sample

Initial Dry Density: 108.2 pcf
Initial Moisture, %: 9.0%
Specific Gravity: 2.67 (assumed
Initial Void Ratio: 0.541

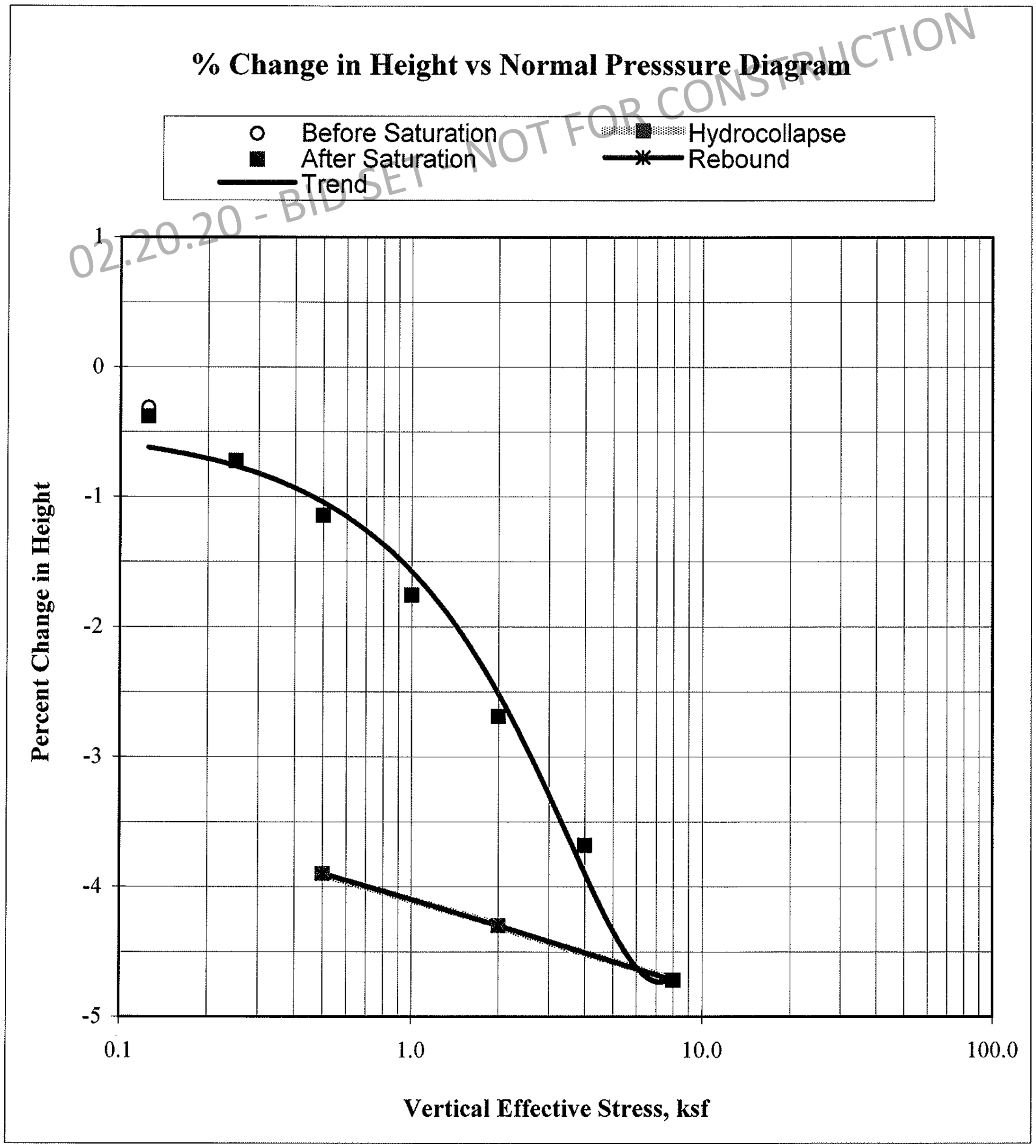


TABLE 1809.7
PRESCRIPTIVE FOOTINGS FOR SUPPORTING WALLS OF LIGHT FRAME CONSTRUCTION*

| WEIGHTED EXPANSION INDEX (13) | FOUNDATION FOR SLAB & RAISED FLOOR SYSTEM (4) (8) | | | | | | | CONCRETE SLABS (8) (12) | | PREMOISTENING OF SOILS UNDER FOOTINGS, PIERS AND SLABS (4) (5) | RESTRICTION ON PIERS UNDER RAISED FLOORS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | NUMBER OF STORIES | STEM THICKNESS | FOOTING WIDTH | FOOTING THICKNESS | ALL PERIMETER FOOTINGS (5) | INTERIOR FOOTINGS FOR SLAB AND RAISED FLOORS (5) | REINFORCEMENT FOR CONTINUOUS FOUNDATIONS (2) (6) | 3-1/2" MINIMUM THICKNESS | | | |
| | | | | | DEPTH BELOW NATURAL SURFACE OF GROUND AND FINISH GRADE | | | REINFORCEMENT (3) | TOTAL THICKNESS OF SAND (10) | | |
| | | (INCHES) | | | | | | | | | |
| 0 - 20 Very Low (non-expansive) | 1<br>2<br>3 | 6<br>8<br>10 | 12<br>15<br>18 | 6<br>6<br>8 | 12<br>18<br>24 | 12<br>18<br>24 | 1-#4 top and bottom | #4 @ 48" o.c. each way, or #3 @ 36" o.c. each way | 2" | Moistening of ground recommended prior to placing concrete | Piers allowed for single floor loads only |
| 21-50 Low | 1<br>2<br>3 | 6<br>8<br>10 | 12<br>15<br>18 | 6<br>6<br>8 | 15<br>18<br>24 | 12<br>18<br>24 | 1-#4 top and bottom | #4 @ 48" o.c. each way, or #3 @ 36" o.c. each way | 4" | 120% of optimum moisture required to a depth of 21" below lowest adjacent grade. Testing required. | Piers allowed for single floor loads only |
| 51-90 Medium | 1<br>2 | 6<br>8 | 12<br>15 | 6<br>6 | 21<br>21 | 12<br>18 | 1-#4 top and bottom | #3 @ 24" o.c. each way | 4" | 130% of optimum moisture required to a depth of 27" below lowest adjacent grade. Testing required | Piers not allowed |
| | 3 | 10 | 18 | 8 | 24 | 24 | #3 bars @ 24" in ext. footing Bend 3' into slab (7) | | | | |
| 91-130 High | 1<br>2 | 6<br>8 | 12<br>15 | 6<br>6 | 27<br>27 | 12<br>18 | 2-#4 Top and Bottom | #3 @ 24" o.c. each way | 4" | 140% of optimum moisture required to a depth of 33" below lowest adjacent grade. Testing required. | Piers not allowed |
| | 3 | 10 | 18 | 8 | 27 | 24 | #3 bars @ 24" in ext. footing Bend 3' into slab (7) | | | | |
| Above 130 Very High | Special design by licensed engineer/architect | | | | | | | | | | |

*Refer to next page for footnotes (1) through (14).

**APPENDIX C**

Site Class Determination Calculations
2016 CBC & ASCE 7-10 Seismic Parameters
US Seismic Design Maps
Spectral Response Values Table
Spectral Response Curves
Fault Parameters

**EARTH SYSTEMS**

| | |
|---|---|
| Job Number: | 303085-001 |
| Job Name: | Rio Mesa HS Modular Classroom |
| Calc Date: | 4/16/2019 |
| CPT/Boring ID: | B-1 |

Use "SPT $N_{60}$" if correlated from CPT.
Use "Raw SPT blow/ft" if from SPT/ModCal.
Input Number Max Limit = 100.

| Depth (ft) | SPT N | Sublayer Thick (ft) | Sublayer Thick/N |
|---|---|---|---|
| 5.0 | 26.0 | 5.0 | 0.192 |
| 7.5 | 13.0 | 2.5 | 0.192 |
| 15.0 | 13.0 | 7.5 | 0.577 |
| 23.5 | 27.0 | 8.5 | 0.315 |
| 27.5 | 33.0 | 4.0 | 0.121 |
| 32.5 | 24.0 | 5.0 | 0.208 |
| 37.5 | 24.0 | 5.0 | 0.208 |
| 42.5 | 17.0 | 5.0 | 0.294 |
| 46.0 | 34.0 | 3.5 | 0.103 |
| 51.5 | 42.0 | 5.5 | 0.131 |
| 100.0 | 42.0 | 48.5 | 1.155 |

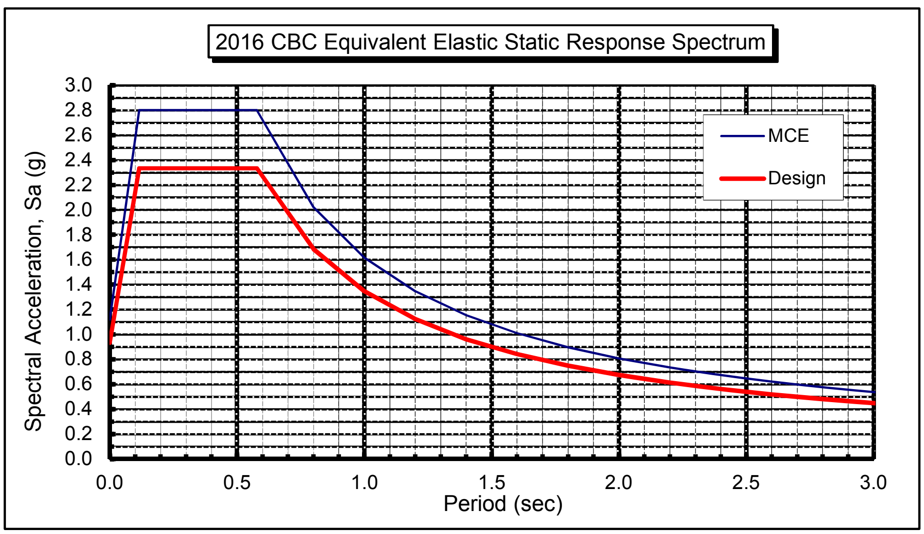
| | | |
|---|---|---|
| Total Thickness of Soil = | 100.00 | ft |
| N-bar Value = | 28.6 | * |
| Site Classification = | Class D | |

*Equation 20.4-2 of ASCE 7-10

**2016 California Building Code (CBC) (ASCE 7-10) Seismic Design Parameters**

| | | | CBC Reference | ASCE 7-10 Reference |
|---|---|---|---|---|
| Seismic Design Category | | **E** | Table 1613.5.6 | Table 11.6-2 |
| Site Class | | **D** | Table 1613.5.2 | Table 20.3-1 |
| Latitude: | | 34.255 N | | |
| Longitude: | | -119.146 W | | |
| Maximum Considered Earthquake (MCE) Ground Motion | | | | |
| Short Period Spectral Reponse | $S_S$ | **2.801 g** | Figure 1613.5 | Figure 22-3 |
| 1 second Spectral Response | $S_1$ | **1.078 g** | Figure 1613.5 | Figure 22.4 |
| Site Coefficient | $F_a$ | 1.00 | Table 1613.5.3(1) | Table 11.4-1 |
| Site Coefficient | $F_v$ | 1.50 | Table 1613.5.3(2) | Table 11-4.2 |
| | $S_{MS}$ | 2.801 g | $= F_a*S_S$ | |
| | $S_{M1}$ | 1.617 g | $= F_v*S_1$ | |
| Design Earthquake Ground Motion | | | | |
| Short Period Spectral Reponse | $S_{DS}$ | **1.867 g** | $= 2/3*S_{MS}$ | |
| 1 second Spectral Response | $S_{D1}$ | **1.078 g** | $= 2/3*S_{M1}$ | |
| | To | 0.12 sec | $= 0.2*S_{D1}/S_{DS}$ | |
| | Ts | 0.58 sec | $= S_{D1}/S_{DS}$ | |
| Seismic Importance Factor | I | 1.25 | Table 1604.5 | Table 11.5-1 |
| | $F_{PGA}$ | 1.00 | | |



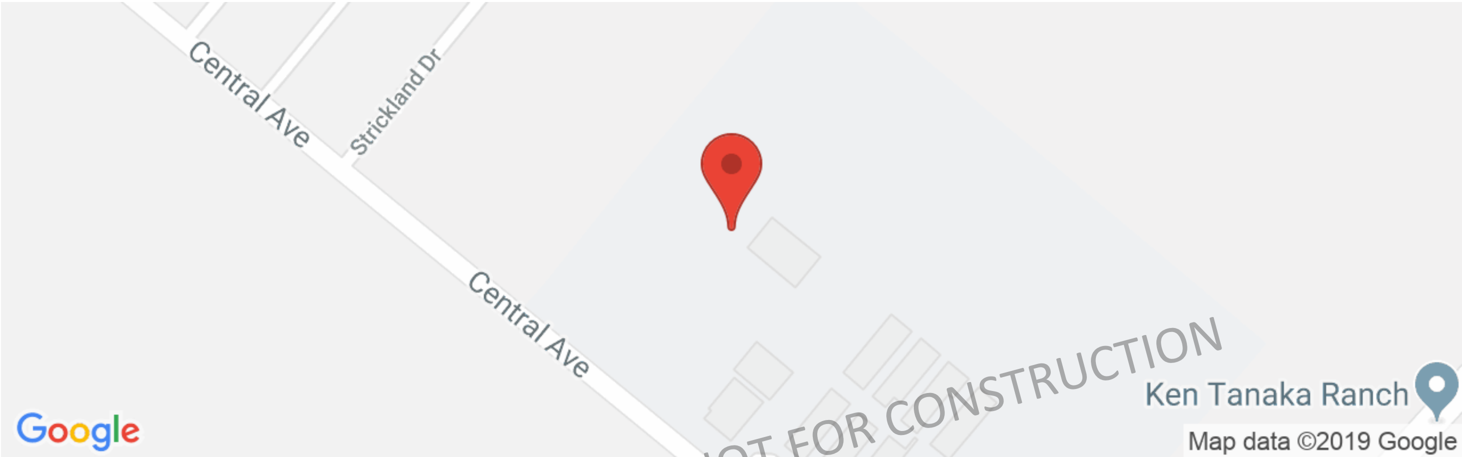



| Period T (sec) | Design Sa (g) |
|---|---|
| 0.00 | 0.934 |
| 0.05 | 1.540 |
| 0.12 | 2.334 |
| 0.58 | 2.334 |
| 0.80 | 1.684 |
| 1.00 | 1.348 |
| 1.20 | 1.123 |
| 1.40 | 0.963 |
| 1.60 | 0.842 |
| 1.80 | 0.749 |
| 2.00 | 0.674 |
| 2.20 | 0.613 |
| 2.40 | 0.561 |
| 2.60 | 0.518 |
| 2.80 | 0.481 |
| 3.00 | 0.449 |

OSHPD

# Rio Mesa High School Modular Classroom

**Latitude, Longitude: 34.2551, -119.1460**



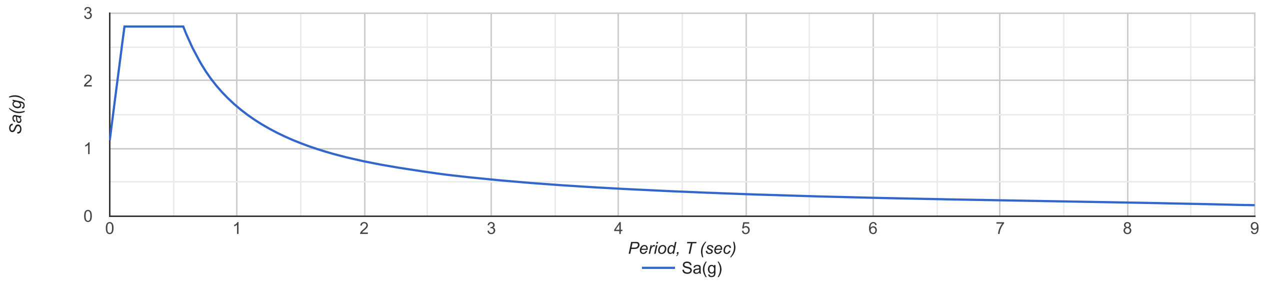



| | |
|---|---|
| **Date** | 4/16/2019, 12:39:37 PM |
| **Design Code Reference Document** | ASCE7-10 |
| **Risk Category** | III |
| **Site Class** | D - Stiff Soil |

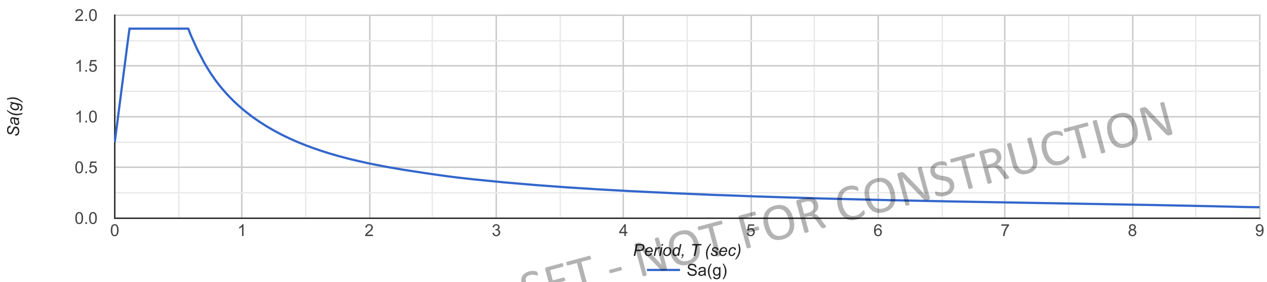
| Type | Value | Description |
|---|---|---|
| $S_S$ | 2.801 | $MCE_R$ ground motion. (for 0.2 second period) |
| $S_1$ | 1.078 | $MCE_R$ ground motion. (for 1.0s period) |
| $S_{MS}$ | 2.801 | Site-modified spectral acceleration value |
| $S_{M1}$ | 1.618 | Site-modified spectral acceleration value |
| $S_{DS}$ | 1.867 | Numeric seismic design value at 0.2 second SA |
| $S_{D1}$ | 1.078 | Numeric seismic design value at 1.0 second SA |

| Type | Value | Description |
|---|---|---|
| SDC | E | Seismic design category |
| $F_a$ | 1 | Site amplification factor at 0.2 second |
| $F_v$ | 1.5 | Site amplification factor at 1.0 second |
| PGA | 1.13 | $MCE_G$ peak ground acceleration |
| $F_{PGA}$ | 1 | Site amplification factor at PGA |
| $PGA_M$ | 1.13 | Site modified peak ground acceleration |
| $T_L$ | 8 | Long-period transition period in seconds |
| SsRT | 2.801 | Probabilistic risk-targeted ground motion. (0.2 second) |
| SsUH | 3.106 | Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration |
| SsD | 3.313 | Factored deterministic acceleration value. (0.2 second) |
| S1RT | 1.078 | Probabilistic risk-targeted ground motion. (1.0 second) |
| S1UH | 1.207 | Factored uniform-hazard (2% probability of exceedance in 50 years) spectral acceleration. |
| S1D | 1.335 | Factored deterministic acceleration value. (1.0 second) |
| PGAd | 1.278 | Factored deterministic acceleration value. (Peak Ground Acceleration) |
| $C_{RS}$ | 0.902 | Mapped value of the risk coefficient at short periods |
| $C_{R1}$ | 0.893 | Mapped value of the risk coefficient at a period of 1 s |

**MCER Response Spectrum**




**Design Response Spectrum**



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**Spectral Response Values Table**

**Probabilistic and Deterministic Response Spectra for MCE compared to Code Spectra**

**for 5% Viscous Damping Ratio**

| Natural Period T (seconds) | GeoMean Probab. 2% in 50 yr MCE Spectrum | Max Rotated Probab. 2% in 50 yr MCEr | Max 84th Percentile Determ. MCE Spectrum | Determ. Lower Limit MCE Spectrum | Determ. MCE Spectrum | **Site Specific MCE Spectrum** | **2013 CBC MCE Spectrum** | Site Specific Design Spectrum | 2013 CBC Design Spectrum |
|---|---|---|---|---|---|---|---|---|---|
| | (1) 2475-yr | (2) 2475-yr | (3) | (4) | (5) max(3,4) | (6) min(2.5) | (7) | (8) 2/3*(6)* | (9) 2/3*(7) |
| **0.00** | 0.948 | 0.941 | 1.047 | 0.600 | 1.047 | **0.941** | **1.121** | 0.627 | 0.747 |
| **0.05** | 1.221 | 1.212 | 1.230 | 0.975 | 1.230 | **1.212** | **1.848** | 0.986 | 1.232 |
| **0.10** | 1.495 | 1.483 | 1.608 | 1.350 | 1.608 | **1.483** | **2.576** | 1.374 | 1.717 |
| **0.15** | 1.704 | 1.691 | 1.914 | 1.500 | 1.914 | **1.691** | **2.801** | 1.494 | 1.867 |
| **0.20** | 1.913 | 1.898 | 2.086 | 1.500 | 2.086 | **1.898** | **2.801** | 1.494 | 1.867 |
| **0.30** | 2.058 | 2.039 | 2.254 | 1.500 | 2.254 | **2.039** | **2.801** | 1.494 | 1.867 |
| **0.40** | 2.053 | 2.124 | 2.330 | 1.500 | 2.330 | **2.124** | **2.801** | 1.494 | 1.867 |
| **0.50** | 2.047 | 2.207 | 2.385 | 1.500 | 2.385 | **2.207** | **2.801** | 1.494 | 1.867 |
| **0.75** | 1.792 | 2.007 | 2.284 | 1.200 | 2.284 | **2.007** | **2.156** | 1.338 | 1.437 |
| **1.00** | 1.537 | 1.784 | 1.981 | 0.900 | 1.981 | **1.784** | **1.617** | 1.190 | 1.078 |
| **1.50** | 1.172 | 1.360 | 1.539 | 0.600 | 1.539 | **1.360** | **1.078** | 0.907 | 0.719 |
| **2.00** | 0.806 | 0.936 | 1.221 | 0.450 | 1.221 | **0.936** | **0.809** | 0.624 | 0.539 |

Crs: 0.902

Cr1: 0.893

* > 80% of (9)

Probabilistic Spectrum from 2008 USGS Ground Motion Mapping Program adjusted for site conditions and maximum rotated component of ground motion using NGA, Column 2 has risk coefficients Cr applied.



Reference: ASCE 7-10, Chapters 21.2, 21.3, 21.4 and 11.4

| Mapped MCE Acceleration Values | | | Site Coefficients | | **Site-Specific Design Acceleration Values** | | |
|---|---|---|---|---|---|---|---|
| PGA | 1.130 | g | $F_{PGA}$ | 1.00 | **$PGA_M$** | **1.130** | **g** |
| Ss | 2.801 | g | $F_a$ | 1.00 | **$S_{DS}$** | **1.494** | **g** |
| $S_1$ | 1.078 | g | $F_v$ | 1.50 | **$S_{D1}$** | **1.248** | **g** |

Spectral Amplification Factor for different viscous damping, D (%):

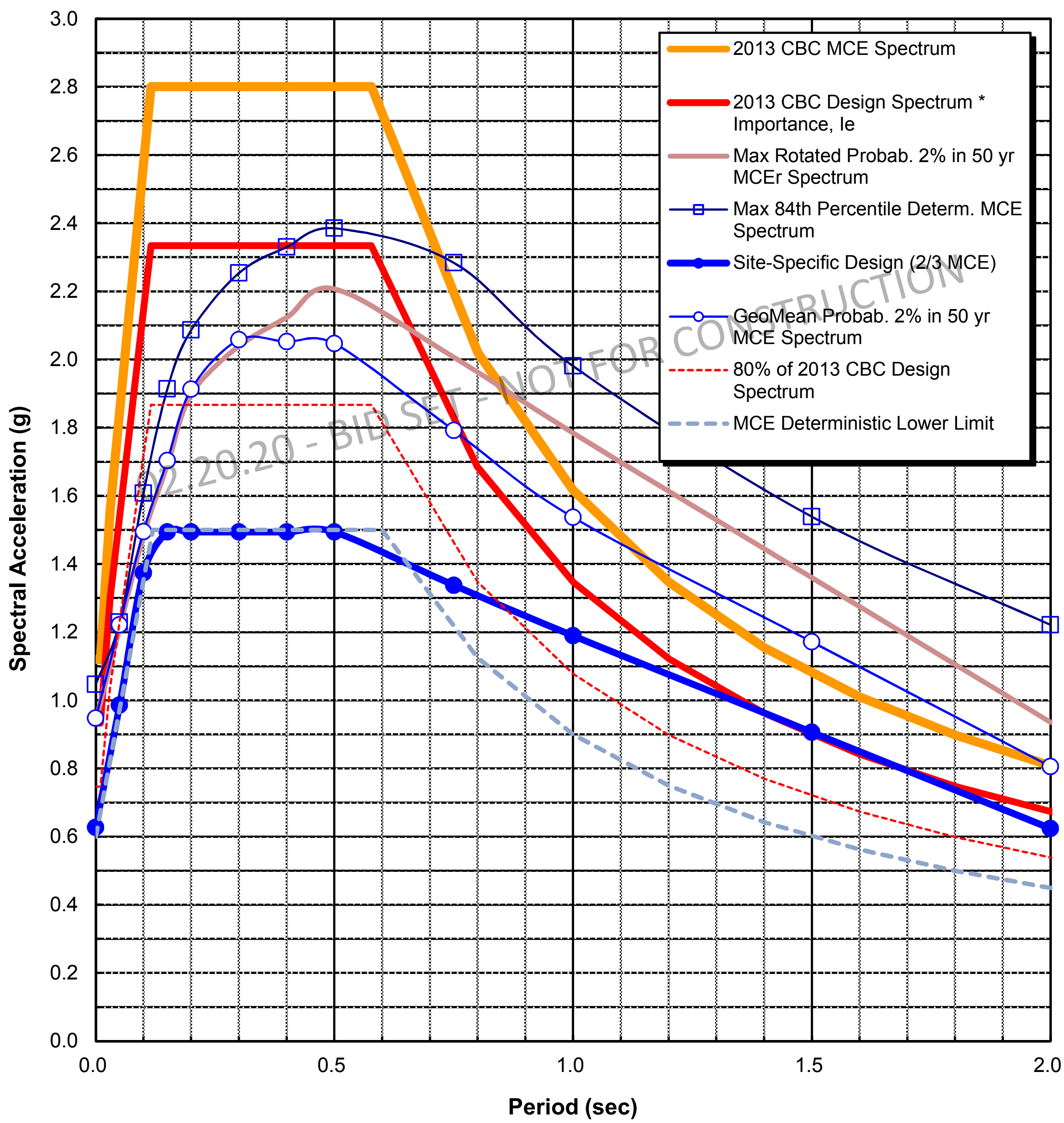
| 0.5% | 2% | 10% | 20% |
|---|---|---|---|
| 1.50 | 1.23 | 0.83 | 0.67 |

1 g = 980.6 cm/sec$^2$ =32.2 ft/sec$^2$

PSV (ft/sec) = 32.2(Sa)T/(2$\pi$)

Key: Probab. = Probabilistic, Determ. = Deterministic, MCE = Maximum Considered Earthquake

# RESPONSE SPECTRA




Based on USGS National Strong Ground Motion Interactive Deaggregation Website using 2008 Parameters

Site Class: D
Latitude: 34.2551
Longitude: -119.146

**Spectral Response Curves**

Rio Mesa High School Modular Classroom
File No.: 303085-001

Earth Systems

**Table 1**
**Fault Parameters**

| **Fault Section Name** | **Distance** (miles) | (km) | Avg Dip Angle (deg.) | Avg Dip Direction (deg.) | Avg Rake (deg.) | Trace Length (km) | Fault Type | **Mean Mag** | Mean Return Interval (years) | Slip Rate (mm/yr) |
|---|---|---|---|---|---|---|---|---|---|---|
| Oak Ridge (Onshore) | 0.0 | 0.0 | 65 | 159 | 90 | 49 | B | **7.4** | | 4 |
| Simi-Santa Rosa | 3.7 | 6.0 | 60 | 346 | 30 | 39 | B | **6.8** | | 1 |
| Ventura-Pitas Point | 4.7 | 7.6 | 64 | 353 | 60 | 44 | B | **6.9** | | 1 |
| Oak Ridge (Offshore) | 7.3 | 11.7 | 32 | 180 | 90 | 38 | B | **6.9** | | 3 |
| Red Mountain | 10.7 | 17.2 | 56 | 2 | 90 | 101 | B | **7.4** | | 2 |
| Sisar | 11.4 | 18.4 | 29 | 168 | na | 20 | B' | **7.0** | | |
| San Cayetano | 12.5 | 20.1 | 42 | 3 | 90 | 42 | B | **7.2** | | 6 |
| Malibu Coast (Extension), alt 1 | 13.2 | 21.2 | 74 | 4 | 30 | 35 | B' | **6.5** | | |
| Malibu Coast (Extension), alt 2 | 13.2 | 21.2 | 74 | 4 | 30 | 35 | B' | **6.9** | | |
| Mission Ridge-Arroyo Parida-Santa Ana | 13.8 | 22.3 | 70 | 176 | 90 | 69 | B | **6.8** | | 0.4 |
| North Channel | 16.5 | 26.6 | 26 | 10 | 90 | 51 | B | **6.7** | | 1 |
| Channel Islands Thrust | 17.2 | 27.7 | 20 | 354 | 90 | 59 | B | **7.3** | | 1.5 |
| Malibu Coast, alt 1 | 18.9 | 30.4 | 75 | 3 | 30 | 38 | B | **6.6** | | 0.3 |
| Malibu Coast, alt 2 | 18.9 | 30.4 | 74 | 3 | 30 | 38 | B | **6.9** | | 0.3 |
| Santa Ynez (East) | 19.1 | 30.8 | 70 | 172 | 0 | 68 | B | **7.2** | | 2 |
| Anacapa-Dume, alt 1 | 19.4 | 31.1 | 45 | 354 | 60 | 51 | B | **7.2** | | 3 |
| Anacapa-Dume, alt 2 | 19.4 | 31.1 | 41 | 352 | 60 | 65 | B | **7.2** | | 3 |
| Channel Islands Western Deep Ramp | 19.7 | 31.7 | 21 | 204 | 90 | 62 | B' | **7.3** | | |
| Pitas Point (Lower)-Montalvo | 19.8 | 31.8 | 16 | 359 | 90 | 30 | B | **7.3** | | 2.5 |
| Santa Cruz Island | 19.9 | 32.0 | 90 | 188 | 30 | 69 | B | **7.1** | | 1 |
| Pine Mtn | 22.2 | 35.8 | 45 | 5 | na | 62 | B' | **7.3** | | |
| Santa Susana, alt 1 | 22.8 | 36.7 | 55 | 9 | 90 | 27 | B | **6.8** | | 5 |
| Santa Susana, alt 2 | 22.8 | 36.8 | 53 | 10 | 90 | 43 | B' | **6.8** | | |
| Shelf (Projection) | 24.1 | 38.7 | 17 | 21 | na | 70 | B' | **7.8** | | |
| Northridge Hills | 25.3 | 40.7 | 31 | 19 | 90 | 25 | B' | **7.0** | | |
| Del Valle | 25.4 | 40.9 | 73 | 195 | 90 | 9 | B' | **6.3** | | |
| Pitas Point (Upper) | 25.4 | 40.9 | 42 | 15 | 90 | 35 | B | **6.8** | | 1 |
| Holser, alt 1 | 25.7 | 41.4 | 58 | 187 | 90 | 20 | B | **6.7** | | 0.4 |
| Holser, alt 2 | 25.7 | 41.4 | 58 | 182 | 90 | 17 | B' | **6.7** | | |
| Northridge | 27.2 | 43.7 | 35 | 201 | 90 | 33 | B | **6.8** | | 1.5 |
| Santa Cruz Catalina Ridge | 27.4 | 44.0 | 90 | 38 | na | 137 | B' | **7.3** | | |
| Santa Monica Bay | 29.4 | 47.4 | 20 | 44 | na | 17 | B' | **7.0** | | |
| San Pedro Basin | 29.5 | 47.4 | 88 | 51 | na | 69 | B' | **7.0** | | |
| Oak Ridge (Offshore), west extension | 30.3 | 48.7 | 67 | 195 | na | 28 | B' | **6.1** | | |
| Big Pine (Central) | 31.1 | 50.0 | 76 | 167 | na | 23 | B' | **6.3** | | |
| Big Pine (West) | 32.5 | 52.3 | 50 | 2 | na | 18 | B' | **6.5** | | |
| Santa Ynez (West) | 32.6 | 52.5 | 70 | 182 | 0 | 63 | B | **6.9** | | 2 |
| San Gabriel | 33.0 | 53.1 | 61 | 39 | 180 | 71 | B | **7.3** | | 1 |
| Big Pine (East) | 33.2 | 53.4 | 73 | 338 | na | 23 | B' | **6.6** | | |
| Compton | 34.5 | 55.6 | 20 | 34 | 90 | 65 | B' | **7.5** | | |

Reference: USGS OFR 2007-1437 (CGS SP 203) Based on Site Coordinates of 34.2551 Latitude, -119.146 Longitude

Mean Magnitude for Type A Faults based on 0.1 weight for unsegmented section, 0.9 weight for segmented model (weighted by probability of each scenario with section listed as given on Table 3 of Appendix G in OFR 2007-1437). Mean magntude is average of Ellworths-B and Hanks & Bakun moment area relationship.

**APPENDIX D**

Liquefaction/Seismic-Induced Settlement Calculations
Liquefaction and Seismic-Induced Settlement Analysis Curves

**LIQUEFY-v 2.3.XLS - A SPREADSHEET FOR EMPIRICAL ANALYSIS OF LIQUEFACTION POTENTIAL AND INDUCED GROUND SUBSIDENCE**

Developed 2006 by Shelton L. Stringer, PE, GE, PG - Earth Systems Southwest

**Project:** Rio Mesa High School Modular Classroom
**Job No:** 303085-001
**Date:** 4/19/2019
**Boring:** B-1 Data Set: 1

**Methods:** **Liquefaction Analysis using 1996 & 1998 NCEER workshop method (Youd & Idriss, editors)**
Journal of Geotechnical and Enviromental Engineering (JGEE), October 2001, Vol 127, No. 10, ASCE
Settlement Analysis from Tokimatsu and Seed (1987), JGEE,Vol 113, No.8, ASCE
Modified by Pradel, JGEE, Vol 124, No. 4, ASCE

**EARTHQUAKE INFORMATION:**

Magnitude: 7.4 7.5
PGA, g: 1.13 1.09
MSF: 1.03
GWT: 52.0 feet
Calc GWT: 25.0 feet
Remediate to: 0.0 feet

**SPT N VALUE CORRECTIONS:**

Energy Correction to N60 ($C_E$): 1.33 Automatic Hammer
Drive Rod Corr. ($C_R$): 1 Default
Rod Length above ground (feet): 3.0
Borehole Dia. Corr. ($C_B$): 1.00
Sampler Liner Correction for SPT?: 1 Yes
Cal Mod/ SPT Ratio: 0.63

**Threshold Acceler., g: 0.25**

**Required SF: 1.30**
**Minimum Calculated SF: 0.22**

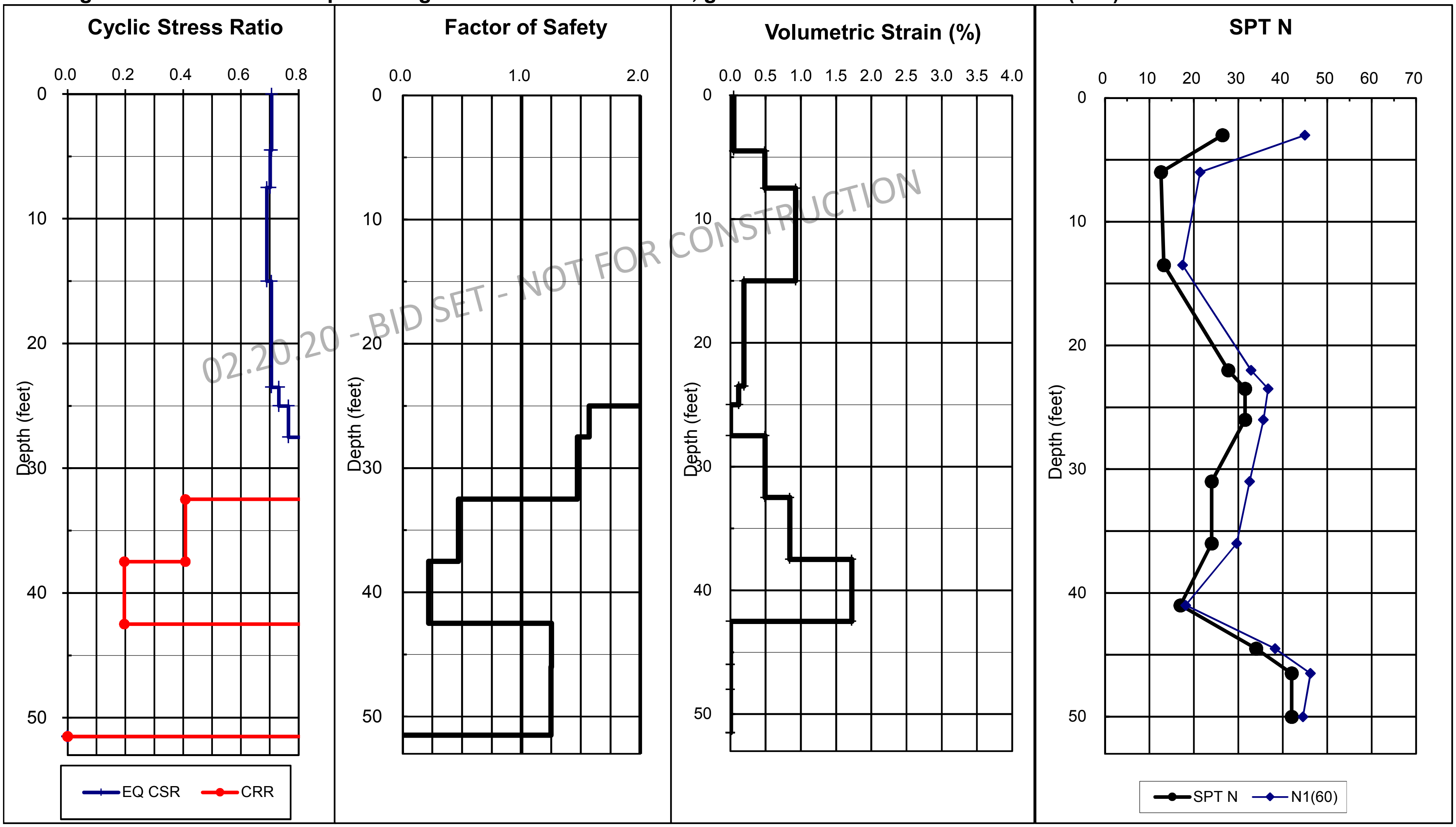
| Total (ft) Liquefied Thickness | Total (in.) Induced Subsidence |
|---|---|
| 19 | 3.1 |

| Base Depth (feet) | Cal Mod N | SPT N | Liquef. Suscept. (0 or 1) | Total Unit Wt. (pcf) | Fines Content (%) | Depth of SPT (feet) | Rod Length (feet) | Tot.Stress at SPT po (tsf) | Eff.Stress at SPT p'o (tsf) | rd | $C_N$ | $C_R$ | $C_S$ | $N_{1(60)}$ | Rel. Dens. Dr (%) | *Trigger FC Adj.* $\Delta N_{1(60)}$ | *Equiv. Sand* $N_{1(60)CS}$ | $K\sigma$ | M = 7.5 Available CRR | M =7.5 Induced CSR* | Liquefac. Safety Factor | *Post FC Adj.* $\Delta N_{1(60)}$ | $N_{1(60)CS}$ | Volumetric *Strain (%)* | Induced Subsidence (in.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | | | | 0 | | | | 0.000 | | | | | | | | | | | | | | | | | |
| 4.5 | 42 | **26** | 1 | 125 | 15 | 3.0 | 6.0 | 0.188 | 0.188 | 0.99 | 1.70 | 0.75 | 1.00 | 45.0 | 80 | 4.7 | 49.6 | 1.00 | 1.200 | 0.706 | **Non-Liq.** | 4.7 | 49.6 | 0.05 | **0.03** |
| 7.5 | 20 | **13** | 1 | 106 | 5 | 6.0 | 9.0 | 0.361 | 0.361 | 0.99 | 1.70 | 0.75 | 1.00 | 21.4 | 55 | 0.0 | 21.4 | 1.00 | 0.233 | 0.701 | **Non-Liq.** | 0.0 | 21.4 | 0.49 | **0.18** |
| 15.0 | 21 | 13 | 1 | 106 | 5 | 13.5 | 16.5 | 0.758 | 0.758 | 0.97 | 1.18 | 0.84 | 1.00 | 17.4 | 50 | 0.0 | 17.4 | 1.00 | 0.188 | 0.690 | **Non-Liq.** | 0.0 | 17.4 | 0.93 | **0.83** |
| 23.5 | 44 | 28 | 1 | 110 | 5 | 22.0 | 25.0 | 1.223 | 1.223 | 0.95 | 0.93 | 0.96 | 1.00 | 32.8 | 68 | 0.0 | 32.8 | 0.96 | 1.200 | 0.705 | **Non-Liq.** | 0.0 | 32.8 | 0.19 | **0.20** |
| 25.0 | 50 | 32 | 1 | 110 | 15 | 23.5 | 26.5 | 1.305 | 1.305 | 0.95 | 0.90 | 0.97 | 1.00 | 36.7 | 72 | 4.3 | 40.9 | 0.92 | 1.200 | 0.731 | **Non-Liq.** | 4.3 | 40.9 | 0.12 | **0.02** |
| 27.5 | 50 | 32 | 1 | 114 | 15 | 26.0 | 29.0 | 1.445 | 1.445 | 0.94 | 0.86 | 0.99 | 1.00 | 35.6 | 71 | 4.2 | 39.9 | 0.89 | 1.200 | 0.764 | **1.57** | 4.2 | 39.9 | 0.00 | **0.00** |
| 32.5 | 0 | 24 | 1 | 115 | 5 | 31.0 | 34.0 | 1.732 | 1.732 | 0.92 | 0.78 | 1.00 | 1.30 | 32.5 | 68 | 0.0 | 32.5 | 0.89 | 1.200 | 0.816 | **1.47** | 0.0 | 32.5 | 0.49 | **0.29** |
| 37.5 | 0 | 24 | 1 | 115 | 5 | 36.0 | 39.0 | 2.019 | 2.019 | 0.88 | 0.72 | 1.00 | 1.28 | 29.6 | 65 | 0.0 | 29.6 | 0.87 | 0.408 | 0.867 | **0.47** | 0.0 | 29.6 | 0.84 | **0.51** |
| 42.5 | 0 | 17 | 1 | 115 | 5 | 41.0 | 44.0 | 2.307 | 2.307 | 0.84 | 0.68 | 1.00 | 1.18 | 18.2 | 51 | 0.0 | 18.2 | 0.85 | 0.196 | 0.896 | **0.22** | 0.0 | 18.2 | 1.72 | **1.03** |
| 46.0 | 0 | 34 | 1 | 115 | 5 | 44.5 | 47.5 | 2.508 | 2.508 | 0.81 | 0.65 | 1.00 | 1.30 | 38.3 | 74 | 0.0 | 38.3 | 0.79 | 1.200 | 0.958 | **1.25** | 0.0 | 38.3 | 0.00 | **0.00** |
| 48.0 | 0 | 42 | 1 | 115 | 5 | 46.5 | 49.5 | 2.623 | 2.623 | 0.79 | 0.64 | 1.00 | 1.30 | 46.2 | 81 | 0.0 | 46.2 | 0.78 | 1.200 | 0.961 | **1.25** | 0.0 | 46.2 | 0.00 | **0.00** |
| 51.5 | 0 | 42 | 1 | 115 | 5 | 50.0 | 53.0 | 2.824 | 2.824 | 0.75 | 0.61 | 1.00 | 1.30 | 44.6 | 80 | 0.0 | 44.6 | 0.77 | 1.200 | 0.961 | **1.25** | 0.0 | 44.6 | 0.00 | **0.00** |

**EARTH SYSTEMS - EVALUATION OF LIQUEFACTION POTENTIAL AND INDUCED SUBSIDENCE**

**Rio Mesa High School Modular Classroom** **Project No: 303085-001** 1996/1998 NCEER Method

**Boring: B-1** **Earthquake Magnitude: 7.4** **PGA, g: 1.13** **Calc GWT (feet): 25**






**Total Thickness of Liquefiable Layers: 19.0 feet** **Estimated Total Ground Subsidence: 3.1 inches**

**LIQUEFY-v 2.3.XLS - A SPREADSHEET FOR EMPIRICAL ANALYSIS OF LIQUEFACTION POTENTIAL AND INDUCED GROUND SUBSIDENCE**

Developed 2006 by Shelton L. Stringer, PE, GE, PG - Earth Systems Southwest

**Project:** Rio Mesa High School Modular Classroom
**Job No:** 303085-001
**Date:** 4/19/2019
**Boring:** B-1 Data Set: 1

**Methods:** **Liquefaction Analysis using 1996 & 1998 NCEER workshop method (Youd & Idriss, editors)**
Journal of Geotechnical and Enviromental Engineering (JGEE), October 2001, Vol 127, No. 10, ASCE
Settlement Analysis from Tokimatsu and Seed (1987), JGEE,Vol 113, No.8, ASCE
Modified by Pradel, JGEE, Vol 124, No. 4, ASCE

**EARTHQUAKE INFORMATION:**

Magnitude: 7.4 7.5
PGA, g: 1.13 1.09
MSF: 1.03
GWT: 52.0 feet
Calc GWT: 52.0 feet
Remediate to: 0.0 feet

**SPT N VALUE CORRECTIONS:**

Energy Correction to N60 ($C_E$): 1.33 Automatic Hammer
Drive Rod Corr. ($C_R$): 1 Default
Rod Length above ground (feet): 3.0
Borehole Dia. Corr. ($C_B$): 1.00
Sampler Liner Correction for SPT?: 1 Yes
Cal Mod/ SPT Ratio: 0.63

**Total (ft) Liquefied Thickness:** 0

**Total (in.) Induced Subsidence:** 2.1

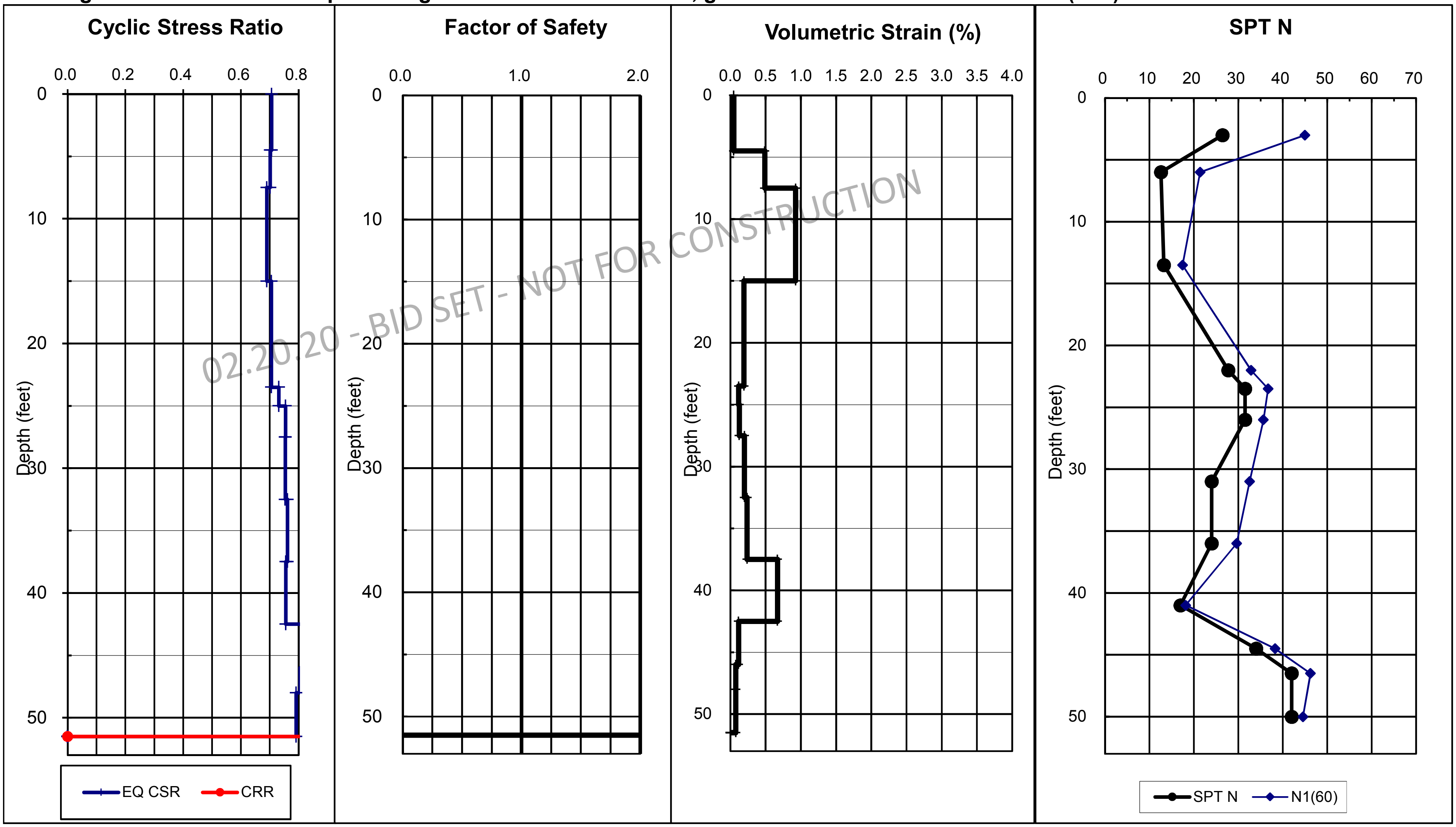
**Threshold Acceler., g:** #N/A
**Required SF:** 1.30
**Minimum Calculated SF:** #N/A

| Base Depth (feet) | Cal Mod N | SPT N | Liquef. Suscept. (0 or 1) | Total Unit Wt. (pcf) | Fines Content (%) | Depth of SPT (feet) | Rod Length (feet) | Tot.Stress at SPT po (tsf) | Eff.Stress at SPT p'o (tsf) | rd | $C_N$ | $C_R$ | $C_S$ | $N_{1(60)}$ | Rel. Dens. Dr (%) | *Trigger FC Adj.* $\Delta N_{1(60)}$ | *Equiv. Sand* $N_{1(60)CS}$ | $K\sigma$ | Mag M = 7.5 Available CRR | M =7.5 Induced CSR* | Liquefac. Safety Factor | *Post FC Adj.* $\Delta N_{1(60)}$ | $N_{1(60)CS}$ | Volumetric *Strain (%)* | Induced Subsidence (in.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.0 | | | | 0 | | | | 0.000 | | | | | | | | | | | | | | | | | |
| 4.5 | 42 | **26** | 1 | 125 | 15 | 3.0 | 6.0 | 0.188 | 0.188 | 0.99 | 1.70 | 0.75 | 1.00 | 45.0 | 80 | 4.7 | 49.6 | 1.00 | 1.400 | 0.706 | **Non-Liq.** | 4.7 | 49.6 | 0.05 | **0.03** |
| 7.5 | 20 | **13** | 1 | 106 | 5 | 6.0 | 9.0 | 0.361 | 0.361 | 0.99 | 1.70 | 0.75 | 1.00 | 21.4 | 55 | 0.0 | 21.4 | 1.00 | 0.233 | 0.701 | **Non-Liq.** | 0.0 | 21.4 | 0.49 | **0.18** |
| 15.0 | 21 | 13 | 1 | 106 | 5 | 13.5 | 16.5 | 0.758 | 0.758 | 0.97 | 1.18 | 0.84 | 1.00 | 17.4 | 50 | 0.0 | 17.4 | 1.00 | 0.188 | 0.690 | **Non-Liq.** | 0.0 | 17.4 | 0.93 | **0.83** |
| 23.5 | 44 | 28 | 1 | 110 | 5 | 22.0 | 25.0 | 1.223 | 1.223 | 0.95 | 0.93 | 0.96 | 1.00 | 32.8 | 68 | 0.0 | 32.8 | 0.96 | 0.453 | 0.705 | **Non-Liq.** | 0.0 | 32.8 | 0.19 | **0.20** |
| 25.0 | 50 | 32 | 1 | 110 | 15 | 23.5 | 26.5 | 1.305 | 1.305 | 0.95 | 0.90 | 0.97 | 1.00 | 36.7 | 72 | 4.3 | 40.9 | 0.92 | 1.400 | 0.731 | **Non-Liq.** | 4.3 | 40.9 | 0.12 | **0.02** |
| 27.5 | 50 | 32 | 1 | 114 | 15 | 26.0 | 29.0 | 1.445 | 1.445 | 0.94 | 0.86 | 0.99 | 1.00 | 35.6 | 71 | 4.2 | 39.9 | 0.88 | 1.400 | 0.754 | **Non-Liq.** | 4.2 | 39.9 | 0.13 | **0.04** |
| 32.5 | 0 | 24 | 1 | 115 | 5 | 31.0 | 34.0 | 1.732 | 1.732 | 0.92 | 0.78 | 1.00 | 1.30 | 32.5 | 68 | 0.0 | 32.5 | 0.86 | 0.438 | 0.753 | **Non-Liq.** | 0.0 | 32.5 | 0.20 | **0.12** |
| 37.5 | 0 | 24 | 1 | 115 | 5 | 36.0 | 39.0 | 2.019 | 2.019 | 0.88 | 0.72 | 1.00 | 1.28 | 29.6 | 65 | 0.0 | 29.6 | 0.82 | 0.408 | 0.761 | **Non-Liq.** | 0.0 | 29.6 | 0.24 | **0.14** |
| 42.5 | 0 | 17 | 1 | 115 | 5 | 41.0 | 44.0 | 2.307 | 2.307 | 0.84 | 0.68 | 1.00 | 1.18 | 18.2 | 51 | 0.0 | 18.2 | 0.79 | 0.196 | 0.755 | **Non-Liq.** | 0.0 | 18.2 | 0.67 | **0.40** |
| 46.0 | 0 | 34 | 1 | 115 | 5 | 44.5 | 47.5 | 2.508 | 2.508 | 0.81 | 0.65 | 1.00 | 1.30 | 38.3 | 74 | 0.0 | 38.3 | 0.71 | 1.400 | 0.811 | **Non-Liq.** | 0.0 | 38.3 | 0.12 | **0.05** |
| 48.0 | 0 | 42 | 1 | 115 | 5 | 46.5 | 49.5 | 2.623 | 2.623 | 0.79 | 0.64 | 1.00 | 1.30 | 46.2 | 81 | 0.0 | 46.2 | 0.70 | 1.400 | 0.805 | **Non-Liq.** | 0.0 | 46.2 | 0.08 | **0.02** |
| 51.5 | 0 | 42 | 1 | 115 | 5 | 50.0 | 53.0 | 2.824 | 2.824 | 0.75 | 0.61 | 1.00 | 1.30 | 44.6 | 80 | 0.0 | 44.6 | 0.68 | 1.400 | 0.791 | **Non-Liq.** | 0.0 | 44.6 | 0.08 | **0.03** |

**EARTH SYSTEMS - EVALUATION OF LIQUEFACTION POTENTIAL AND INDUCED SUBSIDENCE**

**Rio Mesa High School Modular Classroom** **Project No: 303085-001** 1996/1998 NCEER Method

**Boring: B-1** **Earthquake Magnitude: 7.4** **PGA, g: 1.13** **Calc GWT (feet): 52**






**Total Thickness of Liquefiable Layers: 0.0 feet** **Estimated Total Ground Subsidence: 2.1 inches**